NEW YORK STATE OF OPPORTUNITY. | NY Power Authority

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President and Chief Executive Officer

August 9, 2019

VIA ELECTRONIC FILING

Secretary Kimberly D. Bose
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

Crescent Hydroelectric Project, FERC Project No. 4678
Vischer Ferry Hydroelectric Project, FERC Project No. 4679
Comments on Scoping Document 1 and the Filing of Supplemental Information

Dear Secretary Bose:

On May 3, 2019, the Power Authority of the State of New York (Power Authority, or NYPA), licensee of the Crescent and Vischer Ferry Hydroelectric Projects, (Projects), FERC Nos. 4678 and 4679, respectively, filed a Pre-Application Document (PAD) and Notices of Intent to seek new licenses for the Projects. On June 10, 2019, the Federal Energy Regulatory Commission (FERC, or Commission) issued Scoping Document 1 (SD1) for the Projects' relicensing, and on July 10-11, 2019, FERC held scoping meetings and Project site visits.

In accordance with the Integrated Licensing Process (ILP) schedule included in Scoping Document 1, the Power Authority hereby provides its comments on SD1. In addition, during the Scoping meetings, Commission staff and others asked clarifying questions about the Crescent and Vischer Ferry Projects and information that was included in the PAD. Enclosed as part of this filing are the Power Authority's responses to questions and additional information requests posed by Commission staff and other stakeholders at the scoping meetings.

Comments on SD1

The Power Authority notes that the ILP Schedule included in Appendix B of SD1 indicates that the first study season will be in 2021 and the second study season in 2022. The first study season will commence in 2020 and the second study season in 2021.

The Recreation and Land Use section of Section 3.2 of SD1 lists the Vischer Ferry Project recreation sites. However, SD1 omits the Power Authority's proposal to maintain the following formal project recreation sites at the Crescent Project: (1) Tailrace Bank Fishing Area and (2) Picnic Area.

Responses to FERC Staff Questions and Requests for Additional Information

Attachment A provides the Power Authority's responses to questions raised during the Project site visits on July 10 and the July 10-11, 2019 scoping meetings.

The Power Authority looks forward to continuing to work with the Commission, resource agencies, Native American nations, local governments, and members of the public on the relicensing of the Crescent and Vischer Ferry Projects. If you have any questions regarding the above, please do not hesitate to contact me. Thank you for your assistance in this matter.

Sincerely,

Robert Daly
Licensing Manager

New York Power Authority
123 Main Street
White Plains, New York 10601
Telephone: (914) 681-6564
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Enclosures:
Attachment A – Response to Scoping Meeting Questions/Information Requests
Attachment B – NYSDEC Flooding Study
Attachment C – Letter Report on Flooding
Attachment D – Location of Fish Deterrent System
Attachment E – Source Documents for Fisheries Section of the PAD
Attachment F – Town of Niskayuna Lock 7 Park Map and Maintenance Agreement

cc: Distribution List (attached)

DISTRIBUTION LIST

ATTACHMENT A

RESPONSE TO SCOPING MEETING QUESTIONS/INFORMATION REQUESTS

Attachment A

Response to Scoping Meeting Questions/Information Requests

At the Crescent and Vischer Ferry Project relicensing scoping meetings held by FERC on July 10-11, 2019, Commission staff and others asked some clarifying questions about information provided in the PAD. The Power Authority's responses to these questions are presented below.

Project Operations

(1) The current licenses for the Projects allow for a 6-inch impoundment fluctuation. Is that 6-inch fluctuation needed for navigation, and, if so, why? How often and under what circumstances is it used?

In March 2001, the Commission amended Article 41 of the Crescent and Vischer Ferry Project licenses to establish that the Projects be operated in a run-of-river mode, where outflows from the Projects are to equal inflows. The order also provided a 6-inch reservoir operating range to compensate for rapid changes in the upstream Barge Canal system which affects Project operations in that, with little to no notice, inflows can increase or decrease in a very short period of time. It should be noted that both Projects are typically operated in a manner which maintains the pond level between 0.1 -0.4 of a foot below the top of the flashboards, or dam crest.

(2) What is the depth of the intakes at the Projects?

For both Projects the inlet elevations of the original units are one foot lower than the inlet elevations of the newer units. At Crescent, the intake elevation for Units 1 & 2 is 162.0' and Units 3 & 4 is 163.0'. At Vischer Ferry, the intake elevation for Units 1 & 2 is at 189.0' and Units 3 & 4 is 190.0'.

(3) Has NYPA conducted any investigations of the potential to decrease upstream flooding at Vischer Ferry? If so, what studies/investigations have been done and what do results show?

The New York State Department of Environmental Conservation (NYSDEC) performed a study in 1979 which determined that the Vischer Ferry Project is not responsible for upstream flooding (Attachment B).

A more recent evaluation of Variable Crest Control Apparatus at Vischer Ferry Dam, performed by Gomez & Sullivan Engineers in 2018, similarly indicates that modifications to the Vischer Ferry Project (regarding the installation of Obermeyer Gates) would have no appreciable impact on upstream flooding (Letter Report, Attachment C).

(4) Has NYPA evaluated the potential for installation of Obermeyer-type inflatable gates in place of flashboards at Crescent or Vischer Ferry? Might such installations be considered as part of relicensing?

The Power Authority has evaluated the possible installation of Obermeyer gates at the Vischer Ferry Project and the concept is undergoing further evaluation. The installation of Obermeyer gates at the Crescent Project has not yet been evaluated but may be when a decision is reached on the Vischer Ferry Project.

(5) How much cooling water is used at each of the Projects?

Both Projects use a maximum of 470 gallons per minute.

Water Quantity/Quality

(6) Why did NYPA provide only 7 years of flow records for developing flow duration curves? FERC would prefer the entire operational record or a minimum of 10 years of data.

In the PAD, the Power Authority included flow data available electronically from the SCADA records (2010-2018). The Power Authority will include flow statistics and flow duration curves for a longer period of record in the draft license application.

(7) Can NYSDEC or NYPA provide more information about the permitted water withdrawals (General Electric, etc.) listed in the PAD? Is water returned to the river?

The Power Authority has reviewed the publicly available information on the NYSDEC website for water withdrawal permits and has confirmed that all the information on water withdrawal use that is readily available on the NYSDEC website is included in Table 4.3-5 of the PAD.

Fish/Aquatics

(8) When is the fish deterrent acoustic system installed and removed each year? Can NYPA provide diagrams of the location of the array systems?

The fish deterrent systems at both the Crescent and Vischer Ferry Projects are installed annually around mid-May, just before the start of the canal navigation season. Both systems are removed at the end of the juvenile blueback herring migration period every year sometime from late October to early December (based on river flows and maintenance barge availability). The locations of the fish deterrent systems at both projects are provided in Attachment D.

(9) Previous studies show that a turbine survival rate of 96% was reported for the Crescent Project. Did those earlier turbine survival studies look at the Francis turbines as well as Kaplans? Were similar turbine survival studies done at Vischer Ferry?

No studies were conducted on passage survival through the Francis turbines at Crescent and no turbine survival studies were conducted at Vischer Ferry, as the unit configuration is the same at both Projects.

(10) Can NYPA provide the source documents that were used to develop the fish/aquatics sections of the PAD, especially the fish community/population data for the Projects' impoundments?

Attachment E includes a list of the source documents that the Power Authority utilized or reviewed in preparing the fisheries section of the PAD.

(11) How much water is passed through the "fish passage" openings in flashboards at the Crescent Project (80 ft opening) and the Vischer Ferry Project (adult and juvenile openings)?

The estimated flow through the 80' flashboard opening for downstream fish passage at the Crescent Project at the normal full pool elevation of the impoundment (185') is 258 cfs. The estimated flow through the flashboard openings provided seasonally for adult and juvenile herring passage at the Vischer Ferry Project at the normal full pool elevation of the impoundment (213.25') is 86.5 cfs each.

(12) What is the status of American eel in the Vischer Ferry Project area of the Mohawk River? What is the migration season for juvenile (silver) and adult eels in the Mohawk and Hudson River drainage areas?

American eel are rarely found in the vicinity of the Projects. For example, NYSDEC conducted six nights of electrofishing in June 2018. The effort consisted of 27 electrofishing runs totaling 8.9 hours and covered much of the reservoir shoreline. The sampling focus was black bass and walleye but resulted in 27 fish species identified and 1,038 fish captured. This effort, however, yielded only one eel (Wells 2018) which we believe was likely an out-migrating silver eel.

Eel migration patterns vary by location and life stage. Upstream migrating juvenile eels (i.e., glass eels, elvers, and yellow eels) generally occur from spring through early fall. Monitoring efforts on tributaries to the Hudson River just downstream of Albany, NY documented upstream movements of glass eels in early April (Bowser et al. 2018). Yellow eels (which would be the life stage more likely to occur in the vicinity of the Projects) are documented to utilize the eel ladders at the Robert Moses Hydroelectric Project on the St. Lawrence River from June through October. Downstream migrating adult (silver) eels generally migrate during the summer and fall.

References

Bowser, C., Mount, S., Ballou, G., and Mabey, A. Hudson River Eel Project 2018; Eels for Experiencing and Learning Science; NYSDEC.

Wells, S. 2018. Bureau of Fisheries Technical Brief #2018040, Crescent Lake (H-240) Black Bass Survey (Survey #: 418011). NYSDEC Region 4 Fisheries, August 31, 2018.

(13) What is the status of alewife on the Mohawk River?

Further research by the Power Authority on the current status of alewife in the Project areas did not yield any significant results. Current data on river herring in the Mohawk River pertains to blueback herring. Alewife are present in the Hudson River both upstream and downstream of Green Island Dam near the confluence of the Mohawk and Hudson Rivers. However, the

Environmental Assessment for the School Street Hydroelectric Project (Project No. 2539) located just downstream of the Crescent Project did not indicate that alewife were present in the Mohawk River in the vicinity of that project. Relatively recent fisheries data in the vicinity of the Crescent and Vischer Ferry Projects, such as the NYSDEC Black Bass survey, also did not document the presence of alewife.

(14) Can NYPA provide more information on freshwater mussels that have been found at the Projects?

The Power Authority has reviewed the data sources and references that it used in the PAD (Table 4.4-3) to identify freshwater mussels that have been found in the Mohawk River and the Erie Canal. None of the sources that were used in developing the PAD provided the exact location of the mussel species that were listed in Table 4.4-3. Thus, based on the information sources we have available, we are unable to provide more specific information regarding which freshwater mussel species have been collected within the boundaries of the Crescent and Vischer Ferry Projects. A review of the New York State Natural Heritage Program data does not show any data of Rare, Threatened or Endangered species of mussels located within the project boundaries.

(15) Does NYPA have any invasive species control programs?

The Power Authority does not have any invasive species control programs specific to the Crescent or Vischer Ferry Projects.

<u>Recreation/Land Use/Shoreline</u>

(16) Who maintains and operates the Niskayuna boat launch at Lock E-7 (Vischer Ferry impoundment)? Is the launch site within the Project boundary?

The non-project Niskayuna boat launch is within the project boundary for the Vischer Ferry Project. It is operated and maintained by the Town of Niskayuna as a result of a permit originally issued in 1977 by the NYS Department of Transportation, the agency at that time responsible for Barge Canal operations. Attachment F provides a map of the Town of Niskayuna's "Lock Seven Park" as well as the original agreement for Niskayuna's development and maintenance of the site.

(17) Where is the Project boundary in relation to the Crescent and Vischer Ferry tailwater fishing areas?

The tailwater fishing areas at the Crescent and Vischer Ferry Projects are each located within their respective Project boundary.

(18) How closely does the Project boundary follow the impoundment shorelines? To what elevation? How many acres of Project lands and waters are within the current Project boundary?

As shown on the Exhibit G maps currently on file with the Commission, the Vischer Ferry Project boundary follows the impoundment shoreline at an elevation of 213.25 Barge Canal Datum (BCD) upstream of the Project dam. Downstream of the dam, the Project boundary follows specific distances measured off of the following structures: 110’ offset from the Powerhouse; 50’ offset from the downstream face of the impoundment structures near the powerhouse and near Lock E-7; 55’ offset from Dam ‘E’; 130’ offset from Dams ‘D’ and ‘F’. There are 1,155 acres within the Vischer Ferry Project boundary, of which 1,050 are the impoundment.

As shown on the Exhibit G maps currently on file with the Commission, the Crescent Project boundary follows the impoundment shoreline at elevation 185 BCD upstream of the structures (dam and powerhouse) on the southerly/westerly side of the river. On the northerly/easterly side of the river the boundary starts at the end of the Vischer Ferry Project boundary and runs one mile along the northerly/easterly side of the old Tow Path, then drops down to the 185 BCD contour to the area of Lock E-6. From there it follows a set distance (50’) off of the Lock impoundment structures to the southerly/westerly side of the Lock, continuing along the lock 50’ from the structure to a point westerly of the Lock entrance. From there it continues westerly along the 185’ BCD contour to the easterly limits of the Vischer Ferry Project boundary. There are 2,151 acres in the Crescent Project boundary, of which 2,000 are the impoundment.

<u>Cultural</u>

(19) The PAD did not include information on the Harmony Mills National Historic Landmark which includes the School Street Project just downstream of Crescent (and visible from Crescent dam/powerhouse).

Harmony Mills National Historic Landmark (NHL) is not adjacent to or within the project boundary for the Crescent Project, nor is Harmony Mills within the New York State Barge Canal NHL. (The Crescent Dam and Powerhouse are contributing elements of the New York State Barge Canal NHL.) We will appropriately address the Harmony Mills NHL in the cultural resources section of the application.

ATTACHMENT B

NYSDEC FLOODING STUDY

wtwy

WATER MANAGEMENT GROUP

April 9, 1979

Mr. Joseph R. Stellato
Director, Waterways Maintenance Subdivision
NYS Department of Transportation
State Office Building Campus
Building 5 - Room 216
Albany, New York

Dear Mr. Stellato:

Enclosed is a report of a hydraulic study of the Mohawk River from Vischers Ferry Dam to a point west of Schenectady.

This report includes water surface profiles for the March 14, 1977 event and the computed 100-year frequency event. Each profile considers the dam with: 1) all waste gates closed, 2) all waste gates open and 3) an assumed major modification involving an 800' X 15' gated weir in the structure. This analysis found that the position of the existing waste gates has no measurable impact on water levels at Schenectady for major flooding events and that major modifications to the dam would not significantly provide flood protection for the City.

If you or members of your staff would like to discuss the findings of this report, please feel free to contact us.

Sincerely,

James F. Kelley
Chief, Water Management Group

Enclosure
cc: C. Carlson, w/enclosure
REW/ea

A SPECIAL STUDY

OF FLUVIAL FLOODING

AT

SCHENECTADY, NEW YORK

BY

THE NEW YORK STATE DEPARTMENT OF
ENVIRONMENTAL CONSERVATION

APRIL 2, 1979

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Purpose

This report is the result of a study agreed to at the July 25, 1978 meeting between representatives from the City of Schenectady and the Department. The study was accomplished by the Department of Environmental Conservation in connection with the flood insurance study of the City of Schenectady for the US Department of Housing and Urban Development.

The purpose of this study is to determine the effect that the Vischers Ferry Dam has on flooding conditions at Schenectady under various river flow conditions and under existing and modified conditions at the dam.

Scope of Study

Develop computed water level elevations for various river flows from Vischers Ferry Dam to a point west of Lock 8, a distance of 10 miles assuming:

1. Closed waste gates in the dam
2. Open Waste gates in the dam
3. Major modification of the dam, assuming an 800' X 15' gated weir in the dam

Discussion:

The Flood Problem at Schenectady

Damages begin to occur in the Stockade Section of Schenectady at river elevation 223.0 feet (USGS). City records indicate that water levels exceeded this elevation 22 times since 1910.

The primary cause of flooding of Schenectady is ice jamming downstream. Recent discussions with the Department of Environmental Conservation and the US Army, Corps of Engineers' Cold Regions Research and Engineering Laboratory (CRREL) resulted in the conclusion that very little can be done to reduce ice jamming in general. Specific questions directed to Mr. Stephen DenHartog (CRREL) concerning the effect of the

Vischers Ferry Dam on ice jam floods are recorded in Addendum #26, authored by the Schenectady County Chamber of Commerce Flood Assessment Task Force. This addendum reports that: "Actually, Vischers Ferry Dam is probably an asset to the region in terms of reducing ice jamming and flooding."

The discussion on ice jam flooding has been adequately addressed. This study will be limited to a discussion of fluvial flooding.

The City of Schenectady is located in the lower reach of the Mohawk River Basin. There are approximately 3300 square miles of drainage area above the City. The various tributaries to the Mohawk respond quite differently to the same storm. As an example, the orographic effect of the Catskill Mountains will produce a substantially greater rainfall and runoff in the Schoharie Creek Basin than will occur in basins on the southern slope of the Adirondacks of the upper Mohawk Basin. In addition, the great snow packs in the foothills of the Adirondack Mountains retard runoff from winter rains, but greatly extend high flow conditions as compared to the southern tributaries. No attempt has been made to hydrologically model the basin in order to predict flooding events at Schenectady. The many variables, not only those noted above, but development of a data collection system, mean daily temperatures, direction of storm movement, rate of storm movement, rain intensity, wind, and secondary cell development, make basin modeling a very expensive tool for predicting flooding events at Schenectady. Such a model has never been developed, therefore, one must rely on observing stream conditions at Prattsville and Burtonsville on Schoharie Creek, and at Little Falls on the Mohawk main stem in order to anticipate flooding at Schenectady.

Vischers Ferry Dam

There is considerable local opinion that this dam, located approximately 7½ miles down river from the Stockade Section, is the root cause of flooding in Schenectady. The dam, combined with Lock 7 and the power facility, comprises a complex 2200 feet in length. The spillway of the dam is 1917.9 feet in length and has an elevation of 210 feet (USGS). The dam is constructed with six waste gates, eight feet wide and 14 feet high. The sill elevation of the gates is at 189 feet (USGS). In addition, there is a single trash gate, eight feet wide and nine feet high, with a sill elevation of 201 feet (USGS).

Several years ago, these gates were damaged when DOT, Waterways Maintenance Subdivision was urged by local interests to operate the gates under ice conditions. As a consequence, the gates were not operable during the March 14, 1977 flood. DOT is planning to rehabilitate these facilities this year. The Flood Assessment Task Force determined that the combined capacity of these gates ranged between 16,000 to 18,000 CFS.

Hydrologic Analysis

Discharges were taken from Camp, Dresser and McKee's flood insurance study for the Town of Niskayuna. The discharge rates were obtained by means of a statistical analysis of the USGS gage at Cohoes, New York, which has a 58-year period of record. No adjustments were made reflecting the difference in drainage areas since this is considered to be negligible. Based on this analysis, frequency of flooding and river flow rates are tabulated in Table I, as follows:

TABLE I

Frequency	Flow Rate CFS
10	87,000
50	140,000
100	160,000
500	200,000

Although the current study shows somewhat higher flow rates for a given frequency of recurrence, it is considered to be compatible with previous studies of the area performed by the US Geological Survey (USGS) and US Army, Corps of Engineers.

Hydraulic Analysis

A computer program developed by the US Army, Corps of Engineers known as HEC-2 was used in the performance of this study. This computerized modeling program uses conservation of energy theorems (Bernoulli's Theorem) and Mannings friction formula to determine the water surface elevation at selected riverine cross-sections. The acceptance of this program is nationwide and its use is required for performing flood insurance studies for the US Department of Housing and Urban Development, and also for any backwater analysis involving the US Army, Corps of Engineers. The specific computer program designation is 723-X6-L202A.

The river cross-sections made by Camp, Dresser and McKee begin below the Vischers Ferry Dam and terminate upstream at the Route 146 Bridge. Program data was obtained from the firm for this portion of the study. C. T. Male Associates, P.E., was engaged by the Department to obtain cross-section geometry for use in the Schenectady Flood Insurance Study. These cross-sections begin at a point near the Schenectady sewage treatment plant and extend upstream to a point west of Lock 8.

Schenectady experienced its greatest fluvial flood of record during March of 1936. A flow rate of 130,000 CFS was recorded at the Cohoes gage. A ratio of drainage areas suggests a 125,000 CFS flow at Schenectady for this event. Unfortunately, there are insufficient or unreliable highway marks to calibrate the computer model for this event.

The March 14, 1977 flood passed an estimated 110,000 CFS at Schenectady and represents a 25-year frequency event. Accurate water levels were determined at the Vischers Ferry Dam, the Route 146 Bridge and the Western Gateway Bridge. This event was used to calibrate the computer model. The computer model matched the observed elevations at the dam and Western Gateway Bridge within 0.05 of a foot.

Existing Conditions - Waste Gates Closed

The calibration of the model from the March 1977 event allows computation of the water elevations for various flood frequencies with a high degree of confidence. Computer runs were made for 10-, 25-, 50-, 100- and 500-year frequencies. This information is listed in Table II.

TABLE II

Elevations (MSL)

Flood Frequency	Western Gateway Bridge Section 63.20	Route 146 Bridge Section 11.00	Vischers Ferry Dam Section 4.20
10	223.66	216.98	214.58
25	226.54	218.61	215.33
50	229.94	220.62	216.26
100	232.04	221.87	216.82
500	236.30	224.33	217.86

Existing Conditions - Waste Gates Open

The program was also run, assuming that the waste gates were open. For modeling purposes, the width of each of the six waste gates was added which, in effect, places a weir 48 feet wide, with a still elevation 189 feet (USGS), in the dam. The result of this run maximizes benefits for the existing condition since entrance losses around the numerous gates were disregarded, resulting in a larger cross-section opening through the dam than actually exists. Table III shows the result of this run.

TABLE III

Elevations (MSL)

Flood Frequency	Western Gateway Bridge Section 63.20	Route 146 Bridge Section 11.00	Vischers Ferry Dam Section 4.20
10	223.45	216.36	213.61
25	226.40	218.12	214.42
50	229.84	220.22	215.41
100	231.95	221.53	215.99
500	236.30	224.05	217.08

It can be observed, by comparing Table II with Table III, there is very little difference in water surface elevations at the Western Gateway Bridge. For example, the exact difference for the March 14, 1977 event is 0.14, which is insignificant for the intended purpose of this study.

Modified Dam with an 800' X 15' Gated Weir Opening

The DOT, Waterways Maintenance Subdivision is planning to rehabilitate the waste gates in Vischers Ferry Dam. The Flood Assessment Task Force and the City of Schenectady requested a study to determine the benefits of increasing the size of these waste gates. In response to this request, an 800-foot-wide gated weir, with a sill elevation of 195 feet (USGS), was assumed to exist in the dam and the program rerun. Table IV illustrates the results of this study.

TABLE IV

Elevations (MSL)

Flood Frequency	Western Gateway Bridge Section 63.20	Route 146 Bridge Section 11.00	Vischers Ferry Dam Section 4.20
10	223.25	214.27	203.10
25	226.28	216.43	204.45
50	229.86	218.86	206.20
100	232.08	220.23	207.28
500	236.30	222.88	209.48

It can be observed that even under a 500-year frequency event, all flow will pass the dam through the weir. This may be compared to a computed 217.86 foot elevation over the dam under existing conditions, with closed waste gates. However, the beneficial effect of such a structural modification is reduced to 0.0 feet downstream from Schenectady. This analysis also shows that the effect of such a modification in the dam would have had only 0.26 foot reduction in flood stage at Schenectady for the March 14, 1977 event.

Summary

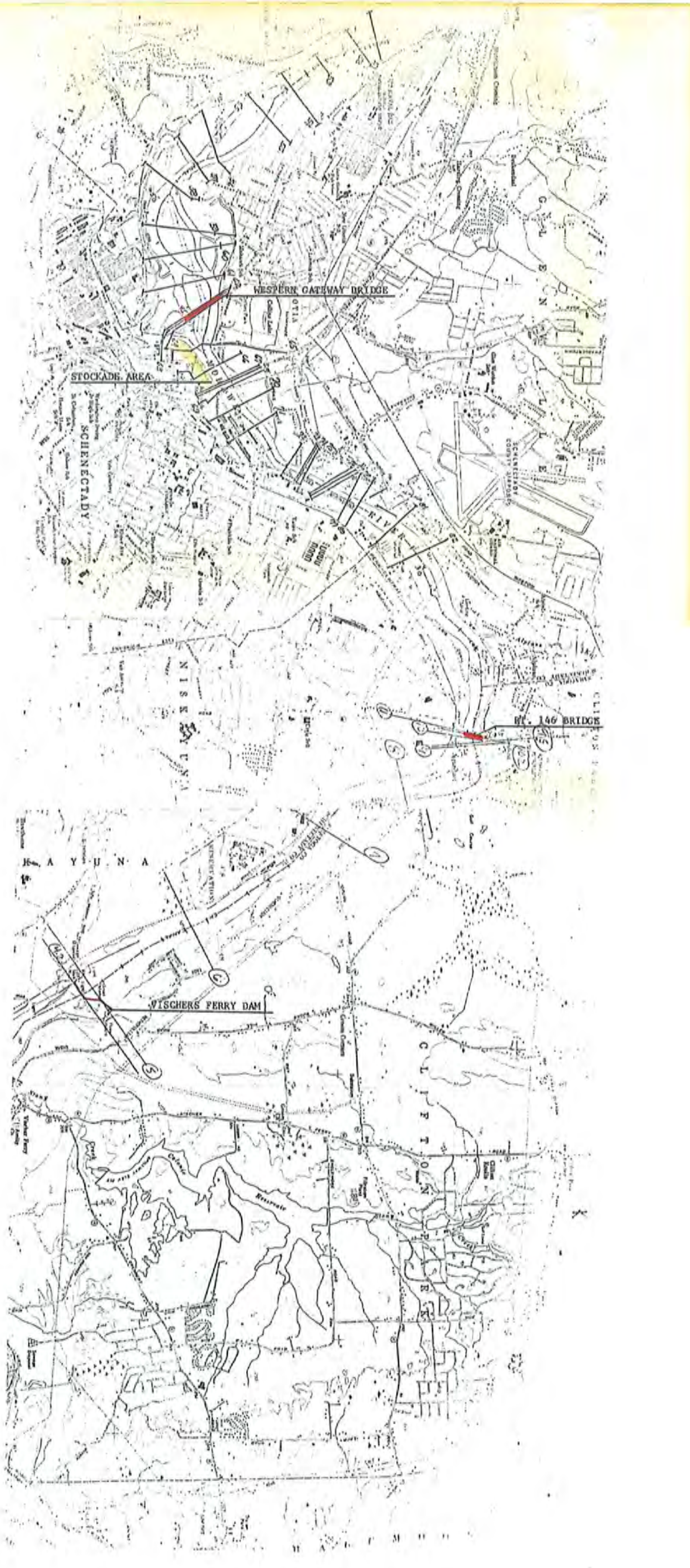
For comparison purposes, Table V summarizes water surface elevations at the Western Gateway Bridge, Section 63.20, for the three conditions discussed in this study.

TABLE V

Elevations (MSL)

Flood Frequency	Waste Gates Closed	Waste Gates Open	800' X 15' Gated Opening
10	223.66	223.45	223.25
25	226.54	226.40	226.28
50	229.94	229.84	229.86
100	232.04	231.95	232.08
500	236.30	236.30	236.30

This confirms the US Army, Corps of Engineers', the NYS Department of Environmental Conservation's and the NYS Department of Transportation, Waterways Maintenance Subdivision's previous statements concerning the effect of Vischers Ferry Dam on flooding conditions in the Stockade Section of Schenectady. The Vischers Ferry Dam has no significant effect on flooding in Schenectady. Simply stated, damages from fluvial flooding are the result of increased development over the years in the Mohawk River flood plain, not the construction or operation of Vischers Ferry Dam.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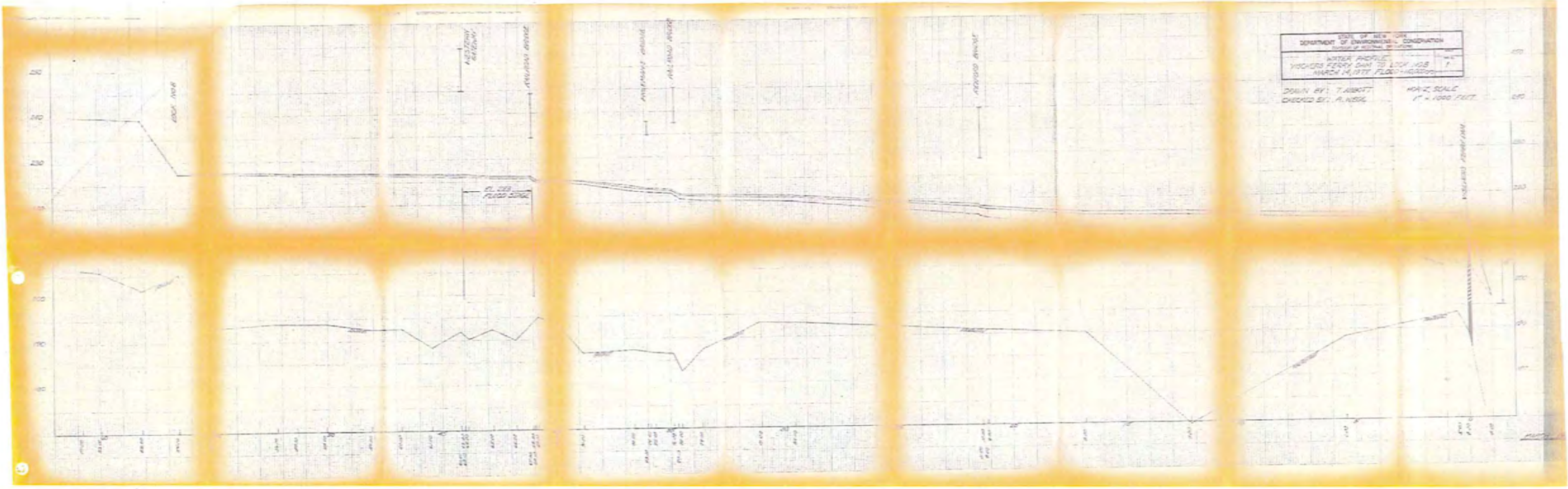
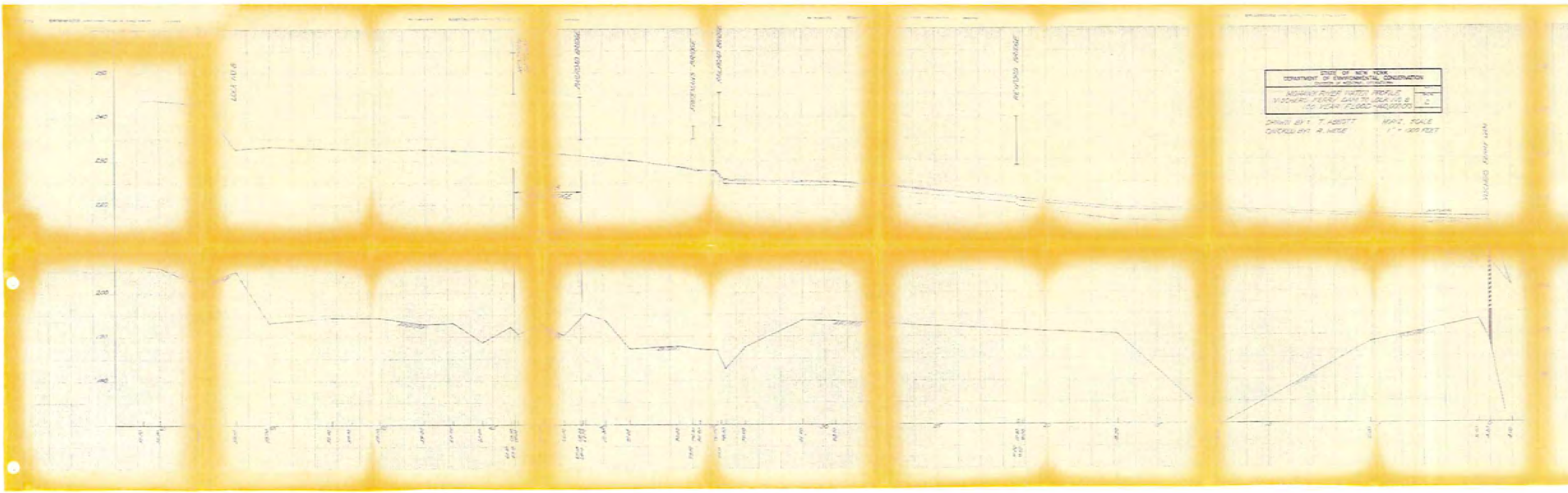
STOCKADE AREA
SCHENECTADY
RT. 146 BRIDGE
VISCHERS FERRY DAM



STATE OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATER PROFILE
VISCHERS FERRY DAM TO LOCK NO.8
MARCH 14, 1977 FLOOD
DRAWN BY: T. ABBOTT
HORIZ. SCALE
1" = 1000 FEET


STATE OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
MOHAWK RIVER WATER PROFILE
VISCHERS FERRY DAM TO LOCK NO. 8
100 YEAR FLOOD
2
DRAWN BY: T. ABBOTT
CHECKED BY: R. WESE
HORIZ. SCALE
1" = 1000 FEET
LOCK NO. 8
RAILROAD BRIDGE
FREEMAN'S BRIDGE
RAILROAD BRIDGE
REXFORD BRIDGE
VISCHERS FERRY DAM

ATTACHMENT C

LETTER REPORT ON FLOODING

GOMEZ AND SULLIVAN ENGINEERS

288 Genesee Street • Utica, NY 13502 • Phone 315-724-4860 • Fax 315-724-4862

April 17, 2018

Mr. Sal Lamsal, P.E.
Acting Director – Civil/Structural Engineering
New York Power Authority
123 Main Street – 12C
White Plains, NY 10601

Re: Evaluation of Variable Crest Control Apparatus at Vischer Ferry Dam

Dear Mr. Lamsal:

Gomez and Sullivan Engineers, DPC (GSE) is pleased to provide the New York Power Authority (NYPA) with this letter report which summarizes our evaluation of the upstream and downstream impacts associated with a simulated modification of the Vischer Ferry Dam representing a variable crest control apparatus.

The purpose of this evaluation is to assess what impact installing a variable crest control apparatus (i.e. crest gates) on one or more of the Vischer Ferry dams may have on the upstream and downstream water levels under high flow events. To assess the potential impacts, seven different modification options were evaluated (including a baseline option representing the existing layout) under four different flow rates, for a total of 28 model scenarios. These scenarios were evaluated using the Mohawk River MIKE11 hydraulic model from the New York State Canal Corporations (NYSCC) Flood Warning and Optimization System (FWOS). The model was run and results were generated for each scenario, and the change in maximum water level was calculated at several locations within the study reach, including the Stockade District and bridges crossing the Mohawk River. The assessment of flooding in the Stockade District is based on ground elevations from LiDAR data.

In general, we found that for a given flow rate, the simulated reductions in the water surface profile at the areas of interest upstream of Vischer Ferry were minor given the degree of simulated modification at the dam. In general, the more extreme the dam is modified (larger and/or taller crest gates are installed) the larger the change in water surface elevation upstream, albeit minor in magnitude. Also, in general, for a given modification option the changes to the water surface profile were inversely related to flow rate (i.e. changes in water level were generally lower at higher flow rates than they were at lower flow rates). Under the 100-year flood, reducing Dams D and F at Vischer Ferry by 6 feet resulted in less than a 2-inch decrease in water level in the Stockade District section of the Mohawk River. Please refer to Table 14 for specific results for the Stockade District.

Because flashboard failure was considered for dams in their existing configuration, reductions in water level at the Vischer Ferry Dam were observed for modification options where the height of the modification (crest gate height) was greater than the height of the existing 2.25-feet flashboards that are in place during the navigation season. Options where the reduction of the spillway crest elevation was less than the height of the flashboards (2.0 feet crest gate vs. 2.25 feet flashboards) showed a slight increase in water level immediately upstream of Vischer Ferry Dam at the two higher modeled flows and a slight decrease in water for the two lower flows. The range of changes in the water level immediately upstream of the Vischer Ferry Dam vary from a maximum increase of only 0.24 feet (Option 5, scenario of 150% of the 100-year flood) to a maximum reduction of 2.44 feet (Option 7, scenario of 50% of the 100-year flood). These changes in water level extended upstream as far as Lock E-09, 15.9 miles upstream of Vischer Ferry where the change is a negligible 0.02 feet (or 0.24 inches).

The vertical datum used for this analysis was the North American Vertical Datum of 1988 (NAVD88), which is the datum used in all the NYSCC's FWOS models. This vertical datum is different from the Barge Canal Datum (BCD), which is the Vischer Ferry project datum and the datum historically used on the New York State Barge Canal. At the Vischer Ferry Dam, elevations in NAVD88 are approximately 1.58 feet lower than those in BCD (i.e. – an elevation in NAVD can be converted to BCD by adding 1.58 feet). References to right and left herein are looking downstream unless otherwise noted.

Project Description

At the Vischer Ferry Dam there are three dams that serve as the primary conveyance structures under high flow conditions and are the subject of this evaluation. These dams are referred to as Dams D, E and F. As shown in Figure 1, Dam D is closest to Lock E-07 on the right bank, Dam E is in the middle and Dam F is closest to the power house on the left bank.

Figure 1: Vischer Ferry Dam Layout

During the navigation season, each of the dams has 2.25-foot-tall flashboards installed on top of the fixed crest to maintain the navigation pool elevation. Table 1 provides the crest length, fixed crest elevation and top of flashboard elevation for each of the dams.

Table 1: Dam Geometry

Dam	Crest Length (feet)	Fixed Crest Elevation (feet, NAVD88)	Top of Flashboard Elevation (feet, NAVD88)
Dam D	735	209.42	211.67
Dam E	682	209.42	211.67
Dam F	502	209.42	211.67

Modification Options

The following modification options for the variable crest control apparatus were evaluated to assess what impacts the modifications may have on the upstream and downstream water levels under high flow events:

- Option 1: Dam D, E, and F in the existing layout (baseline)
- Option 2: Dam D crest reduced by 2.0 feet, with Dam E and F in the existing layout
- Option 3: Dam D crest reduced by 4.0 feet, with Dam E and F in the existing layout
- Option 4: Dam D crest reduced by 6.0 feet, with Dam E and F in the existing layout
- Option 5: Dam D crest reduced by 2.0 feet and Dam F crest reduced by 2.0 feet, with Dam E in the existing layout
- Option 6: Dam D crest reduced by 4.0 feet and Dam F crest reduced by 4.0 feet, with Dam E in the existing layout
- Option 7: Dam D crest reduced by 6.0 feet and Dam F crest reduced by 6.0 feet, with Dam E in the existing layout

The baseline (existing) condition is Option 1, while Options 2 through 7 represent the different modification options evaluated. At each dam, it was assumed that the 2.25-foot-tall flashboards (crest elevation of 211.67 feet), normally used during the navigation season, were in place for the unmodified ("existing layout") condition. The weir length and crest elevation (with the crest gate lowered) for each option are summarized in Table 2.

Table 2: Dam Configuration Options

	Crest Elevation with Gates Lowered (feet NAVD88)		
	Dam D Length = 735 feet	Dam E Length = 682 feet	Dam F Length = 502 feet
Option 1 (baseline)	211.67	211.67	211.67
Option 2	209.67	211.67	211.67
Option 3	207.67	211.67	211.67
Option 4	205.67	211.67	211.67
Option 5	209.67	211.67	209.67
Option 6	207.67	211.67	207.67
Option 7	205.67	211.67	205.67

Each of these options was evaluated under the 10-year, 50% of the 100-year, 100-year, and 150% of the 100-year return interval storm events.

Hydrology

To evaluate potential impacts associated with a simulated modification of the Vischer Ferry Dam under a range of different flow conditions, synthetic inflow hydrographs were developed for four flow conditions (10-year, 50% of the 100-year, 100-year, and 150% of the 100-year return interval storm events). The hydrographs were developed by scaling the Tropical Storm Irene hydrograph from the Cohoes Falls USGS gage (01357500) such that the peak flow rate was equal to the prorated return interval peak flow rate (e.g. 100-year flow) from the Schenectady County Flood Insurance Study (FIS) (effective date: 2014). This is the same methodology that was previously used for the 2011 Inflow Design Flood studies at Crescent and Vischer Ferry. Table 3 shows the peak flow rates in cubic feet per second (cfs) for four return intervals for the Mohawk River at the confluence with the Alplaus Kill (drainage area of 3,306 square miles [sq. mi.], FIS) taken from the Schenectady County FIS. These peak flow rates were prorated by the drainage area of the Mohawk River at the Vischer Ferry Dam (drainage area of 3,385 sq. mi., 2007 Vischer Ferry STID) and were then used to scale the Tropical Storm Irene hydrograph to create the synthetic hydrographs which are shown in Figure 2. These hydrographs were used to establish the inflow boundary to the MIKE11 model upstream of Lock E-09, and were applied to the model after running a steady flow (equal to the initial flow of the hydrograph for each flow event) for 48 hours to stabilize the model.

Table 3: Peak Flow Rates

Storm Event	FIS Peak Flow Rate (cfs) (Drainage Area = 3,306 sq. mi.)	Prorated Peak Flow Rate at Vischer Ferry Dam (cfs) (Drainage Area = 3,385 sq. mi.)
50% of 100-Year	74,800	76,587
10-Year	82,700	84,676
100-Year	149,600	153,175
150% of 100-Year	224,400	229,762

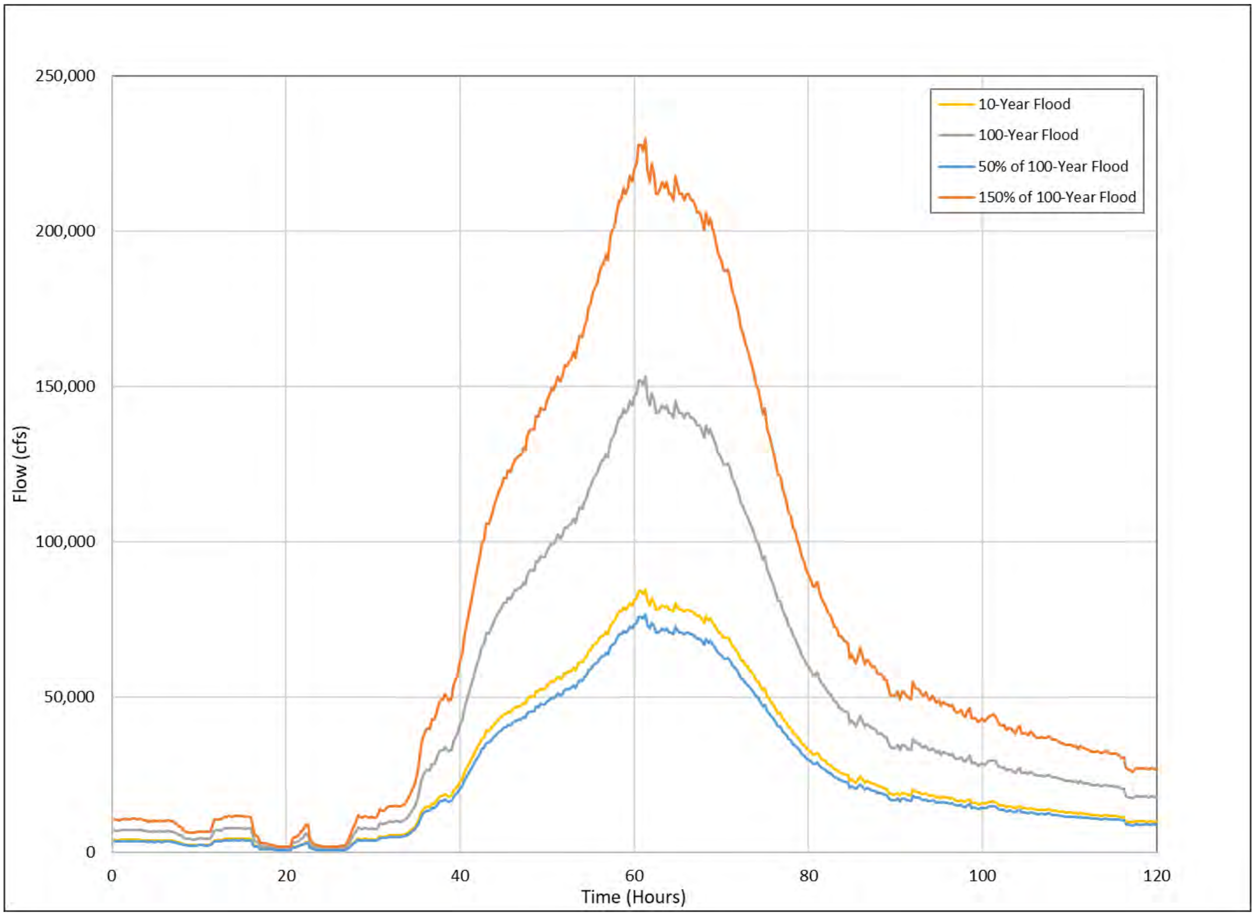


Figure 2: Synthetic Flow Hydrographs Developed for the Mohawk River at Vischer Ferry

Hydraulics

The MIKE11 model for the Mohawk River from the NYSCC's FWOS, which extends from Delta Dam to Cohoes Falls, was truncated upstream of Lock E-09 to simplify the model for this evaluation and to reduce the time required to run each scenario. This location was verified to be sufficiently upstream to capture all the impacts associated with the modification options evaluated for the Vischer Ferry Dam.

To evaluate the upstream and downstream impacts on water level associated with each modification option, an unsteady flow analysis was used. An unsteady flow analysis with the crest gates open at the start of the simulation was used to provide insight into the upstream and downstream impacts without the added complexity of developing rules to control and/or optimize the crest gates. The movable dam gates at Lock E-08 and Lock E-09 were assumed to be completely out of the water for this analysis. The hydraulic analysis assumes free-flowing conditions and does not assess impacts due to ice or debris.

On unmodified dams, the 2.25-foot-tall flashboards installed at the Vischer Ferry Dam during the navigation season were assumed to be in place and to fail when the upstream water surface elevation exceeds the target flashboard failure range. Based on the Crescent and Vischer Ferry Hydroelectric Projects Flashboard

Assessment and Discharge Rating Curve Revisions report (GSE, 2013), the flashboards on each dam have a range of elevations at which failure is expected. These ranges are listed in Table 4.

Table 4: Range of WSEL for Flashboard Failure

Dam	Range of WSEL for Flashboard Failure (ft, NAVD88)
Dam D	El. 213.92± - El. 214.42±
Dam E	El. 214.92± - El. 215.42±
Dam F	El. 214.42± - El. 214.92±

To account for flashboard failure and ensure that the rating curves for the baseline scenarios match the project rating curves, the discharge rating curves from the 2013 GSE report were added to the model as tabulated structures. Separate tabulated structures were created for each spillway (existing condition), the gates and sluice, and for the overbank areas that would be overtopped during significant flood events. This resulted in Vischer Ferry Dam being modeled as a combination of tabulated structures (discharge rating curves) and weirs (for the crest gates). The only exceptions to this are the four baseline scenarios, in which the Vischer Ferry Dam was represented entirely by tabulated structures, as there were no modifications to any of the spillways under these scenarios.

A review of the MIKE11 model from Crescent Dam to Lock E-09 was completed, and cross sections of interest were identified. These cross sections include automobile bridges (Balltown Road, Freemans Bridge Road, and the Western Gateway Bridge), railroad bridges (D&H Railway and Amtrak), and other areas of interest, including the GE Global Research Center and the Stockade District. Table 5 lists the cross sections of interest, for which results (maximum water level, change in water level, etc.) were evaluated and provided. Figure 3 shows the cross sections in the truncated model from Lock E-09 to Crescent Dam. The stationing in Table 5 and Figure 3 is in miles above Crescent Dam.

Table 5: Cross Sections of Interest

Station (miles)	Description
0.0	Crescent Dam - Upstream
1.3	Route 9 Bridge - Upstream
3.7	I-87 Bridge
9.7	Vischer Ferry Dam - Downstream
10.0	Vischer Ferry Dam - Upstream
12.2	GE Global Research Center
14.0	Balltown Road (Rt. 146) Bridge - Upstream
16.5	D&H Railway Bridge - Upstream
16.8	Freemans Bridge Road - Upstream
17.7	Amtrak Bridge
18.1	Stockade Historic District
18.6	Western Gateway Bridge - Upstream
19.9	Isle of the Oneidas
20.8	Lock E-08 - Upstream
22.4	I-890 Bridge
24.1	Pan Am Railway Bridge - Upstream
25.9	Lock E-09 - Upstream

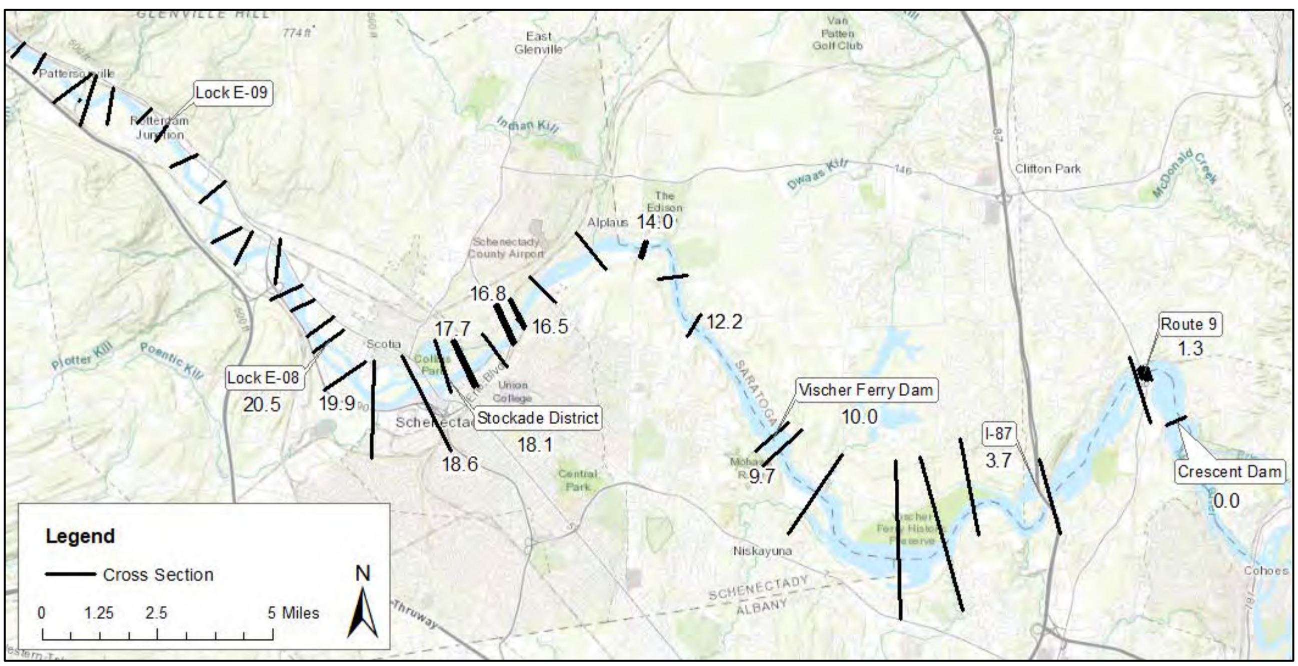


Figure 3: MIKE11 Hydraulic Model Cross Sections

To evaluate each of the dam crest gate modification options, seven MIKE11 network files were created, each representing one of the modification options. For each modification option, the Vischer Ferry Dam was modelled as a combination of rating curves and weirs as described above. The elevation of the Dam D and F weirs varied between network files in accordance with the option they represented. Dam E did not change between options, and was thus always represented by a rating curve. The model was configured and run for each of the 28 scenarios.

Results

For each scenario, the maximum water surface elevation data was extracted from MIKE11. Tables 6 through 9 show the maximum water levels at locations of interest from upstream of Lock E-09 to Crescent Dam. For each of the flow rates evaluated, the maximum reduction in water level upstream of Vischer Ferry occurred under the most extreme modification option (Option 7) in which the crest of Dams D and F were lowered by 6 feet each. The greatest reduction in water level at the Vischer Ferry Dam was associated with the lowest flow rate, equal to 50% of the 100-year flood. At this flow rate, the water level at the Vischer Ferry Dam was reduced by approximately 2.44 feet. The upstream impacts for this flow rate extended upstream to Lock E-09 (15.9 miles), where the water level just upstream of the lock at this flow was reduced by a negligible 0.02 feet (0.24 inches).

The highest flow rate evaluated (equal to 150% of the 100-year flood) yielded a reduction in water level just upstream of Vischer Ferry Dam equal to 2.41 feet under Option 7. Under this scenario, the water levels at the Balltown Road bridge were reduced by only 0.73 feet (less than 9-inches) and all points upstream of that bridge were minimally impacted (maximum reduction of 0.01 feet). These minimal reductions in water level upstream of the Balltown Road bridge are due to the bridge acting as a significant flow control at high flows.

Option 2 and Option 5 showed a slight increase in water level immediately upstream of Vischer Ferry Dam at the two higher modeled flows (100-year and 150% of the 100-year) and a slight decrease in water for the two lower flows (50% of the 100-year and 10-year). The fact that the water level decreased slightly for the two lower flows and increased slightly for two higher flows can be attributed to the fact that a rating curve is being used for the existing conditions (including flashboard failure) and a weir is being used in the model to represent the modified crest. These two methodologies are not completely consistent as the rating curve is based on a variable weir coefficient depending on whether the flashboards are intact or not and the hydraulic model uses a single weir coefficient. Also, under Option 2 and Option 5 the crest is modified (i.e. crest gate open) from the beginning of the simulation whereas the rating curve assumes failure when the water levels rise above the target flashboard failure elevation.

Impacts downstream of the Vischer Ferry Dam were minor (0.02 feet or less) for all options. The lack of impacts downstream of the Vischer Ferry Dam can be largely attributed to the assumption that the gates were completely open for the duration of the analysis and by the fact that the impoundment provides minimal storage compared to the volume of water going through the impoundment. Simulated changes in the maximum upstream water levels did not significantly change the attenuation of the hydrograph as it moved through the impoundment. An unsteady flow analysis that models the variable crest control apparatus such that, for example the navigation pool is maintained by gradually opening the gates, may show more impacts, but those impacts are not expected to be significant under high flow events. The results for each flow rate evaluated, as well as a discussion of the effect on water levels in the Stockade District are discussed in more detail in the following sections.

50% of 100-Year Flood (76,587 cfs)

The maximum simulated water surface elevations for Options 1 (baseline) through 7 for the 50% of the 100-year flood hydrograph are summarized in Table 6. As shown in the table, for the 50% of the 100-year flood, the simulated modification of the Vischer Ferry Dam resulted in minor impacts that extend from Vischer Ferry upstream as far as Lock E-09 for some options. At Vischer Ferry, the maximum water level just upstream of the dam dropped from between 0.03 feet (Option 2) to 2.44 feet (Option 7), and immediately upstream of Lock E-09, the water level decreased by a maximum of only 0.02 feet (0.24-inches) (Option 7).

In the Stockade District, the reduction of the maximum water level from the baseline condition ranged from 0.02 feet for Option 2 to 0.89 feet for Option 7. More importantly, based on a comparison of the simulated water levels and the available LiDAR data, it appears that the river does not leave its banks (top of bank elevation = 221.5 feet) under this flow rate so, none of the modification options impact flooding in the Stockade District under this flow rate.

10-Year Flood (84,676 cfs)

The maximum simulated water surface elevations for Options 1 through 7 for the 10-year flood hydrograph are summarized in Table 7. As shown in the table, for the 10-year flood, reduced flood levels occur from Vischer Ferry upstream as far as Lock E-09. At Vischer Ferry, the maximum water level just upstream of the dam dropped from between 0.02 feet (Option 2) to 2.24 feet (Option 7), and immediately upstream of Lock E-09, the water level decreased by a maximum of only 0.02 feet (0.24-inches) (Option 7).

In the Stockade District, the reduction of the maximum water level, from the baseline condition, ranged from 0.1 feet (1.2-inches) for Option 2 to approximately 0.72 feet (8.6-inches) for Option 7. Under the 10-year flood, none of the options evaluated would reduce the water levels enough to prevent the water from leaving its banks, but they would all result in a slight reduction in the depth of flooding in the Stockade District.

100-Year Flood (153,175 cfs)

The maximum water surface elevations for Options 1 through 7 for the 100-year flood hydrograph are summarized in Table 8. Similar to the results for the other return periods, for the 100-year flood, the most extreme modification option (Option 7) provided the largest reduction in water levels from the baseline condition which ranged from approximately 2.08 feet at Vischer Ferry to only 0.01 feet (0.12-inches) just upstream of Lock E-09. As explained above, under Options 2 and 5 there were small increases to the flood elevations upstream of Vischer Ferry (a maximum of 0.06 feet) for this flow rate.

Under this flow rate, the change in water levels in the Stockade District compared to the baseline ranged from an increase of 0.02 feet for Option 2 to a reduction of only 0.12 feet (1.44 inches) for the most extreme modification option (Option 7). Based on a comparison of the simulated water levels and the available LiDAR data, it appears that the lowest lying buildings and roads would already be flooded by as much as 9.1 feet of water under this flow rate. A reduction in water levels of only 0.12 feet (1.44-inches) would have a de minimis impact relative to the magnitude of flooding that would be occurring.

150% of 100-Year Flood (229,762 cfs)

The maximum water surface elevations for Options 1 through 7 for the 150% of the 100-year flood hydrograph are summarized in Table 9. As shown in the table, the water level impacts for Options 1 through 7 under the 150% of the 100-year flood effectively only extend upstream approximately four miles to Balltown Road. Similar to the results for the other return periods, for this flow rate, Option 7 provided the greatest reduction in water levels from the baseline condition which ranged from approximately 2.41 feet at Vischer Ferry to 0.73 feet at Balltown Road. As explained above, under Options 2 and 5 there were small increases to the flood elevations upstream of Vischer Ferry (a maximum of 0.24 feet) for this flow rate. Upstream of the Balltown Road Bridge, including in the Stockade District, water levels were reduced by only a tenth of a foot or less for all options.

Table 6: Maximum Water Levels for the Scenario of 50% of the 100-Year Flood (Page 1 of 2)

Station	Location	Baseline	Option 2 (Dam D: - 2 ft)		Option 3 (Dam D: - 4 ft)		Option 4 (Dam D: - 6 ft)	
		Max WL (ft, NAVD 88)	Max WL (ft, NAVD 88)	Delta (ft)	Max WL (ft, NAVD 88)	Delta (ft)	Max WL (ft, NAVD 88)	Delta (ft)
0.0	Crescent Dam - Upstream	190.08	190.07	-0.01	190.07	-0.01	190.08	0.00
1.3	Route 9 Bridge - Upstream	190.37	190.36	-0.01	190.36	-0.01	190.37	0.00
3.7	I-87 Bridge	190.59	190.58	-0.01	190.58	-0.01	190.59	0.00
9.7	Vischer Ferry Dam - Downstream	192.23	192.22	-0.01	192.22	-0.02	192.23	0.00
10.0	Vischer Ferry Dam - Upstream	214.75	214.72	-0.03	214.02	-0.73	213.20	-1.55
12.2	GE Global Research Center	215.36	215.33	-0.03	214.71	-0.65	214.02	-1.34
14.0	Balltown Road (Rt. 146) Bridge - Upstream	216.48	216.46	-0.02	215.95	-0.53	215.40	-1.08
16.5	D&H Railway Bridge - Upstream	218.72	218.70	-0.02	218.34	-0.38	218.03	-0.70
16.8	Freemans Bridge Road - Upstream	219.54	219.52	-0.02	219.19	-0.35	218.92	-0.62
17.7	Amtrak Bridge	221.06	221.03	-0.02	220.72	-0.33	220.50	-0.56
18.1	Stockade Historic District	221.21	221.19	-0.02	220.89	-0.32	220.68	-0.53
18.6	Western Gateway Bridge - Upstream	221.46	221.43	-0.02	221.15	-0.31	220.95	-0.51
19.9	Isle of the Oneidas	221.99	221.97	-0.02	221.72	-0.28	221.56	-0.44
20.8	Lock E-08 - Upstream	222.85	222.83	-0.02	222.64	-0.21	222.54	-0.31
22.4	I-890 Bridge	227.08	227.07	-0.01	227.00	-0.08	226.98	-0.10
24.1	Pan Am Railway Bridge - Upstream	232.63	232.63	0.00	232.61	-0.02	232.61	-0.02
25.9	Lock E-09 - Upstream	236.61	236.61	0.00	236.61	-0.01	236.61	-0.01

Table 6: Maximum Water Levels for the Scenario of 50% of the 100-Year Flood (Page 2 of 2)

Station	Location	Baseline	Option 5 (Dam D and Dam F: - 2 ft)		Option 6 (Dam D and Dam F: - 4 ft)		Option 7 (Dam D and Dam F: - 6 ft)	
		Max WL (ft, NAVD 88)	Max WL (ft, NAVD 88)	Delta (ft)	Max WL (ft, NAVD 88)	Delta (ft)	Max WL (ft, NAVD 88)	Delta (ft)
0.0	Crescent Dam - Upstream	190.08	190.06	-0.02	190.08	0.00	190.06	-0.01
1.3	Route 9 Bridge - Upstream	190.37	190.52	0.14	190.37	0.00	190.35	-0.02
3.7	I-87 Bridge	190.59	190.73	0.14	190.59	0.00	190.57	-0.02
9.7	Vischer Ferry Dam - Downstream	192.23	192.32	0.09	192.23	0.00	192.21	-0.02
10.0	Vischer Ferry Dam - Upstream	214.75	214.46	-0.29	213.20	-1.55	212.31	-2.44
12.2	GE Global Research Center	215.36	215.10	-0.26	214.03	-1.33	213.28	-2.08
14.0	Balltown Road (Rt. 146) Bridge - Upstream	216.48	216.24	-0.24	215.42	-1.06	214.83	-1.65
16.5	D&H Railway Bridge - Upstream	218.72	218.54	-0.18	218.03	-0.70	217.62	-1.10
16.8	Freemans Bridge Road - Upstream	219.54	219.37	-0.17	218.92	-0.61	218.55	-0.99
17.7	Amtrak Bridge	221.06	220.89	-0.17	220.50	-0.55	220.14	-0.92
18.1	Stockade Historic District	221.21	221.05	-0.17	220.68	-0.53	220.33	-0.89
18.6	Western Gateway Bridge - Upstream	221.46	221.30	-0.16	220.95	-0.51	220.62	-0.84
19.9	Isle of the Oneidas	221.99	221.84	-0.15	221.56	-0.43	221.25	-0.74
20.8	Lock E-08 - Upstream	222.85	222.73	-0.12	222.54	-0.31	222.31	-0.54
22.4	I-890 Bridge	227.08	227.03	-0.05	226.98	-0.10	226.90	-0.18
24.1	Pan Am Railway Bridge - Upstream	232.63	232.62	-0.01	232.61	-0.02	232.59	-0.04
25.9	Lock E-09 - Upstream	236.61	236.61	0.00	236.60	-0.01	236.60	-0.02

Table 7: Maximum Water Levels for the Scenario of the 10-Year Flood (Page 1 of 2)

		Baseline	Option 2 (Dam D: - 2 ft)		Option 3 (Dam D: - 4 ft)		Option 4 (Dam D: - 6 ft)	
Station	Location	Max WL (ft, NAVD 88)	Max WL (ft, NAVD 88)	Delta (ft)	Max WL (ft, NAVD 88)	Delta (ft)	Max WL (ft, NAVD 88)	Delta (ft)
0.0	Crescent Dam - Upstream	190.55	190.55	0.00	190.54	-0.01	190.56	0.01
1.3	Route 9 Bridge - Upstream	190.88	190.88	0.00	190.87	-0.01	190.89	0.00
3.7	I-87 Bridge	191.13	191.13	0.00	191.12	-0.01	191.13	0.00
9.7	Vischer Ferry Dam - Downstream	192.90	192.90	0.00	192.88	-0.02	192.91	0.01
10.0	Vischer Ferry Dam - Upstream	214.94	214.92	-0.02	214.42	-0.52	213.39	-1.55
12.2	GE Global Research Center	215.65	215.64	-0.02	215.20	-0.45	214.34	-1.31
14.0	Balltown Road (Rt. 146) Bridge - Upstream	216.94	216.93	-0.02	216.58	-0.36	215.90	-1.04
16.5	D&H Railway Bridge - Upstream	219.45	219.44	-0.01	219.18	-0.27	218.78	-0.67
16.8	Freemans Bridge Road - Upstream	220.37	220.36	-0.01	220.12	-0.25	219.78	-0.59
17.7	Amtrak Bridge	222.12	222.10	-0.01	221.88	-0.24	221.59	-0.52
18.1	Stockade Historic District	222.27	222.26	-0.01	222.04	-0.23	221.77	-0.51
18.6	Western Gateway Bridge - Upstream	222.51	222.50	-0.01	222.29	-0.22	222.03	-0.48
19.9	Isle of the Oneidas	223.02	223.01	-0.01	222.82	-0.20	222.60	-0.42
20.8	Lock E-08 - Upstream	223.82	223.81	-0.01	223.65	-0.17	223.51	-0.31
22.4	I-890 Bridge	228.00	228.00	0.00	227.93	-0.07	227.89	-0.10
24.1	Pan Am Railway Bridge - Upstream	233.50	233.50	0.00	233.48	-0.02	233.48	-0.02
25.9	Lock E-09 - Upstream	237.62	237.62	0.00	237.61	-0.01	237.61	-0.01

Table 7: Maximum Water Levels for the Scenario of the 10-Year Flood (Page 2 of 2)

Station	Location	Baseline	Option 5 (Dam D and Dam F: - 2 ft)		Option 6 (Dam D and Dam F: - 4 ft)		Option 7 (Dam D and Dam F: - 6 ft)	
		Max WL (ft, NAVD 88)	Max WL (ft, NAVD 88)	Delta (ft)	Max WL (ft, NAVD 88)	Delta (ft)	Max WL (ft, NAVD 88)	Delta (ft)
0.0	Crescent Dam - Upstream	190.55	190.54	-0.01	190.56	0.01	190.54	-0.01
1.3	Route 9 Bridge - Upstream	190.88	190.87	-0.02	190.89	0.00	190.87	-0.02
3.7	I-87 Bridge	191.13	191.11	-0.02	191.13	0.00	191.11	-0.02
9.7	Vischer Ferry Dam - Downstream	192.90	192.88	-0.02	192.91	0.01	192.88	-0.02
10.0	Vischer Ferry Dam - Upstream	214.94	214.86	-0.08	213.40	-1.54	212.70	-2.24
12.2	GE Global Research Center	215.65	215.58	-0.08	214.35	-1.31	213.78	-1.87
14.0	Balltown Road (Rt. 146) Bridge - Upstream	216.94	216.88	-0.06	215.91	-1.03	215.50	-1.45
16.5	D&H Railway Bridge - Upstream	219.45	219.38	-0.07	218.79	-0.66	218.52	-0.93
16.8	Freemans Bridge Road - Upstream	220.37	220.30	-0.07	219.78	-0.59	219.55	-0.82
17.7	Amtrak Bridge	222.12	222.04	-0.08	221.59	-0.52	221.37	-0.74
18.1	Stockade Historic District	222.27	222.19	-0.08	221.77	-0.50	221.55	-0.72
18.6	Western Gateway Bridge - Upstream	222.51	222.44	-0.07	222.03	-0.48	221.82	-0.69
19.9	Isle of the Oneidas	223.02	222.95	-0.07	222.60	-0.42	222.41	-0.60
20.8	Lock E-08 - Upstream	223.82	223.75	-0.07	223.51	-0.31	223.35	-0.47
22.4	I-890 Bridge	228.00	227.97	-0.03	227.89	-0.10	227.83	-0.17
24.1	Pan Am Railway Bridge - Upstream	233.50	233.49	-0.01	233.48	-0.02	233.46	-0.04
25.9	Lock E-09 - Upstream	237.62	237.61	0.00	237.61	-0.01	237.60	-0.02

Table 8: Maximum Water Levels for the Scenario of the 100-Year Flood (Page 1 of 2)

Station	Location	Baseline	Option 2 (Dam D: - 2 ft)		Option 3 (Dam D: - 4 ft)		Option 4 (Dam D: - 6 ft)	
		Max WL (ft, NAVD 88)	Max WL (ft, NAVD 88)	Delta (ft)	Max WL (ft, NAVD 88)	Delta (ft)	Max WL (ft, NAVD 88)	Delta (ft)
0.0	Crescent Dam - Upstream	194.06	194.06	0.00	194.07	0.01	194.06	0.00
1.3	Route 9 Bridge - Upstream	194.64	194.64	0.00	194.65	0.01	194.64	0.00
3.7	I-87 Bridge	195.12	195.12	0.00	195.13	0.01	195.13	0.00
9.7	Vischer Ferry Dam - Downstream	197.58	197.58	0.00	197.59	0.01	197.59	0.00
10.0	Vischer Ferry Dam - Upstream	216.77	216.80	0.04	216.02	-0.74	215.32	-1.44
12.2	GE Global Research Center	218.33	218.36	0.03	217.80	-0.53	217.33	-1.00
14.0	Balltown Road (Rt. 146) Bridge - Upstream	220.88	220.95	0.07	220.61	-0.27	220.28	-0.60
16.5	D&H Railway Bridge - Upstream	225.34	225.36	0.02	225.25	-0.09	225.22	-0.12
16.8	Freemans Bridge Road - Upstream	227.31	227.33	0.02	227.23	-0.07	227.21	-0.10
17.7	Amtrak Bridge	230.48	230.49	0.01	230.42	-0.06	230.39	-0.09
18.1	Stockade Historic District	230.61	230.62	0.01	230.55	-0.06	230.52	-0.09
18.6	Western Gateway Bridge - Upstream	230.77	230.78	0.01	230.71	-0.06	230.68	-0.09
19.9	Isle of the Oneidas	231.07	231.08	0.01	231.01	-0.06	230.99	-0.08
20.8	Lock E-08 - Upstream	231.83	231.84	0.01	231.77	-0.06	231.75	-0.08
22.4	I-890 Bridge	235.19	235.20	0.01	235.16	-0.04	235.14	-0.05
24.1	Pan Am Railway Bridge - Upstream	239.48	239.48	0.00	239.47	-0.01	239.46	-0.02
25.9	Lock E-09 - Upstream	244.14	244.14	0.00	244.14	0.00	244.13	-0.01

Table 8: Maximum Water Levels for the Scenario of the 100-Year Flood (Page 2 of 2)

Station	Location	Baseline	Option 5 (Dam D and Dam F: - 2 ft)		Option 6 (Dam D and Dam F: - 4 ft)		Option 7 (Dam D and Dam F: - 6 ft)	
		Max WL (ft, NAVD 88)	Max WL (ft, NAVD 88)	Delta (ft)	Max WL (ft, NAVD 88)	Delta (ft)	Max WL (ft, NAVD 88)	Delta (ft)
0.0	Crescent Dam - Upstream	194.06	194.06	0.00	194.07	0.01	194.06	0.00
1.3	Route 9 Bridge - Upstream	194.64	194.64	0.00	194.65	0.01	194.64	-0.01
3.7	I-87 Bridge	195.12	195.12	0.00	195.13	0.01	195.12	-0.01
9.7	Vischer Ferry Dam - Downstream	197.58	197.59	0.00	197.59	0.01	197.58	-0.01
10.0	Vischer Ferry Dam - Upstream	216.77	216.82	0.06	215.52	-1.25	214.68	-2.08
12.2	GE Global Research Center	218.33	218.37	0.04	217.46	-0.87	216.90	-1.43
14.0	Balltown Road (Rt. 146) Bridge - Upstream	220.88	220.94	0.06	220.38	-0.50	219.99	-0.89
16.5	D&H Railway Bridge - Upstream	225.34	225.38	0.04	225.23	-0.11	225.18	-0.16
16.8	Freemans Bridge Road - Upstream	227.31	227.33	0.03	227.21	-0.09	227.17	-0.14
17.7	Amtrak Bridge	230.48	230.50	0.02	230.40	-0.08	230.36	-0.12
18.1	Stockade Historic District	230.61	230.63	0.02	230.53	-0.08	230.49	-0.12
18.6	Western Gateway Bridge - Upstream	230.77	230.78	0.02	230.69	-0.08	230.65	-0.12
19.9	Isle of the Oneidas	231.07	231.08	0.02	230.99	-0.08	230.95	-0.11
20.8	Lock E-08 - Upstream	231.83	231.85	0.02	231.76	-0.08	231.72	-0.11
22.4	I-890 Bridge	235.19	235.20	0.01	235.14	-0.05	235.11	-0.08
24.1	Pan Am Railway Bridge - Upstream	239.48	239.48	0.00	239.47	-0.02	239.45	-0.03
25.9	Lock E-09 - Upstream	244.14	244.14	0.00	244.13	-0.01	244.13	-0.01

Table 9: Maximum Water Levels for the Scenario of 150% of the 100-Year Flood (Page 1 of 2)

Station	Location	Baseline	Option 2 (Dam D: - 2 ft)		Option 3 (Dam D: - 4 ft)		Option 4 (Dam D: - 6 ft)	
		Max WL (ft, NAVD 88)	Max WL (ft, NAVD 88)	Delta (ft)	Max WL (ft, NAVD 88)	Delta (ft)	Max WL (ft, NAVD 88)	Delta (ft)
0.0	Crescent Dam - Upstream	197.14	197.14	0.00	197.14	-0.01	197.14	-0.01
1.3	Route 9 Bridge - Upstream	197.94	197.94	0.00	197.94	0.00	197.94	0.00
3.7	I-87 Bridge	198.65	198.65	0.00	198.65	0.00	198.65	0.00
9.7	Vischer Ferry Dam - Downstream	201.58	201.58	-0.01	201.58	0.00	201.58	0.00
10.0	Vischer Ferry Dam - Upstream	218.88	219.02	0.14	218.26	-0.62	217.46	-1.42
12.2	GE Global Research Center	221.15	221.25	0.10	220.73	-0.42	220.26	-0.89
14.0	Balltown Road (Rt. 146) Bridge - Upstream	224.83	224.96	0.12	224.63	-0.20	224.46	-0.37
16.5	D&H Railway Bridge - Upstream	236.82	236.82	0.00	236.82	-0.01	236.82	-0.01
16.8	Freemans Bridge Road - Upstream	237.40	237.40	0.00	237.39	0.00	237.39	0.00
17.7	Amtrak Bridge	240.85	240.85	0.00	240.85	0.00	240.85	0.00
18.1	Stockade Historic District	240.93	240.93	0.00	240.93	0.00	240.93	0.00
18.6	Western Gateway Bridge - Upstream	241.02	241.02	0.00	241.01	0.00	241.01	0.00
19.9	Isle of the Oneidas	241.15	241.15	0.00	241.15	0.00	241.15	0.00
20.8	Lock E-08 - Upstream	241.86	241.85	0.00	241.85	-0.01	241.85	0.00
22.4	I-890 Bridge	243.40	243.39	0.00	243.39	0.00	243.39	0.00
24.1	Pan Am Railway Bridge - Upstream	245.79	245.79	0.00	245.79	0.00	245.79	0.00
25.9	Lock E-09 - Upstream	249.70	249.70	0.00	249.70	0.00	249.70	0.00

Table 9: Maximum Water Levels for the Scenario of 150% of the 100-Year Flood (Page 2 of 2)

Station	Location	Baseline	Option 5 (Dam D and Dam F: - 2 ft)		Option 6 (Dam D and Dam F: - 4 ft)		Option 7 (Dam D and Dam F: - 6 ft)	
		Max WL (ft, NAVD 88)	Max WL (ft, NAVD 88)	Delta (ft)	Max WL (ft, NAVD 88)	Delta (ft)	Max WL (ft, NAVD 88)	Delta (ft)
0.0	Crescent Dam - Upstream	197.14	197.14	0.00	197.14	-0.01	197.14	-0.01
1.3	Route 9 Bridge - Upstream	197.94	197.94	0.00	197.94	0.00	197.94	0.00
3.7	I-87 Bridge	198.65	198.65	0.00	198.65	0.00	198.64	-0.01
9.7	Vischer Ferry Dam - Downstream	201.58	201.59	0.00	201.58	0.00	201.58	-0.01
10.0	Vischer Ferry Dam - Upstream	218.88	219.12	0.24	217.82	-1.06	216.47	-2.41
12.2	GE Global Research Center	221.15	221.30	0.15	220.47	-0.68	219.74	-1.41
14.0	Balltown Road (Rt. 146) Bridge - Upstream	224.83	224.99	0.15	224.46	-0.37	224.10	-0.73
16.5	D&H Railway Bridge - Upstream	236.82	236.82	0.00	236.82	-0.01	236.81	-0.01
16.8	Freemans Bridge Road - Upstream	237.40	237.40	0.00	237.39	-0.01	237.39	-0.01
17.7	Amtrak Bridge	240.85	240.85	0.00	240.85	-0.01	240.84	-0.01
18.1	Stockade Historic District	240.93	240.93	0.00	240.93	-0.01	240.92	-0.01
18.6	Western Gateway Bridge - Upstream	241.02	241.02	0.00	241.01	-0.01	241.01	-0.01
19.9	Isle of the Oneidas	241.15	241.15	0.00	241.14	-0.01	241.14	-0.01
20.8	Lock E-08 - Upstream	241.86	241.85	0.00	241.85	-0.01	241.85	-0.01
22.4	I-890 Bridge	243.40	243.39	0.00	243.39	-0.01	243.39	-0.01
24.1	Pan Am Railway Bridge - Upstream	245.79	245.79	0.00	245.79	0.00	245.78	-0.01
25.9	Lock E-09 - Upstream	249.70	249.70	0.00	249.69	0.00	249.69	-0.01

Stockade District Impacts

The Stockade Historic District is in the northwest corner of Schenectady on the southern bank of the Mohawk River. The area is prone to flooding and was severely impacted by Tropical Storms Irene and Lee in 2011 and is of interest for this evaluation. A preliminary investigation into the impacts of the crest gate modification of the Vischer Ferry Dam on the depth of flooding in the Stockade District was completed using available LiDAR elevation data and aerial orthophotos. To do this, several low-lying locations in the Stockade District, that would likely be among the first to be flooded during a major storm event, were selected and the ground elevation at these locations was compared to the maximum simulated water level for each scenario. While this is not an evaluation of all potentially impacted locations in the Stockade District, it does provide insight regarding the potential impacts on flooding with the installation a variable crest control apparatus at Vischer Ferry.

The two tables below show an overview of flood impacts in the Stockade District. Table 10 lists the maximum water level at the cross section located adjacent to the Stockade District for each scenario, and Table 11 lists the change in water level from the baseline condition associated with each option for each scenario.

Table 10: Maximum Water Levels in the Stockade District

	Maximum Water Level (feet, NAVD88)			
	50% of 100-Year	10-Year	100-Year	150% of 100-Year
Baseline	221.21	222.27	230.61	240.93
Option 2 (Dam D: - 2 ft)	221.19	222.26	230.62	240.93
Option 3 (Dam D: - 4 ft)	220.89	222.04	230.55	240.93
Option 4 (Dam D: - 6 ft)	220.68	221.77	230.52	240.93
Option 5 (Dam D and Dam F: - 4 ft)	221.05	222.19	230.63	240.93
Option 6 (Dam D and Dam F: - 4 ft)	220.68	221.77	230.53	240.93
Option 7 (Dam D and Dam F: - 6 ft)	220.33	221.55	230.49	240.92

Table 11: Delta from Baseline Condition Elevation in Stockade District

	Maximum Change in Water Level from Baseline (feet)			
	50% of 100-Year*	10-Year	100-Year	150% of 100-Year
Baseline	-	-	-	-
Option 2 (Dam D: - 2 ft)	-0.02	-0.01	0.01	0.00
Option 3 (Dam D: - 4 ft)	-0.32	-0.23	-0.06	0.00
Option 4 (Dam D: - 6 ft)	-0.53	-0.50	-0.09	0.00
Option 5 (Dam D and Dam F: - 4 ft)	-0.16	-0.08	0.02	0.00
Option 6 (Dam D and Dam F: - 4 ft)	-0.53	-0.50	-0.08	0.00
Option 7 (Dam D and Dam F: - 6 ft)	-0.88	-0.72	-0.12	-0.01

*Under all options, including the baseline option, the water level does not leave the river bank

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The best available GIS elevation data was used to estimate the elevations of the locations where the first impacts of rising water may occur in the Stockade District. The LiDAR elevation data used for the evaluation was downloaded from the NYS GIS Clearinghouse. The dataset that covers the Stockade District is the CapitalDistrict2008 collection, which is a 2-meter bare-earth Digital Elevation Model (DEM).

The locations that were selected for comparison were chosen for their proximity to the Mohawk River as seen on aerial imagery and their low elevation on the DEM. A map of these locations is shown in Figure 4, and Table 12 provides the ground elevation of each point from the DEM. Table 10 above shows the maximum water surface elevation for each option at the cross section nearest to the Stockade District for each of the flow rates modeled. Based on the DEM elevation data and simulated water surface elevations, the depth of flooding at each of the locations shown in Figure 4 was calculated for Option 1 and the most extreme case, Option 7. These depths are shown in Table 13.

Figure 4: Points in the Stockade District

Table 12: Points in the Stockade District

Point	Description	DEM Elevation (feet)
1	Building at end of Cucumber Alley	221.50
2	Cul de sac at bottom of Washington Ave	224.70
3	Cul de sac at bottom of Governors Lane	223.10
4	Riverside Park Pavilion	221.50
5	Cul de Sac at bottom of North Street	223.10

Table 13: Approximate Depth of Flooding at Points in the Stockade District

	Approximate Depth of Flooding (feet)							
	50% of 100-Year		10-Year		100-Year		150% of 100-Year	
Point	Baseline	Opt. 7	Baseline	Opt. 7	Baseline	Opt. 7	Baseline	Opt. 7
1	0.00	0.00	0.77	0.05	9.11	8.99	19.43	19.42
2	0.00	0.00	0.00	0.00	5.91	5.79	16.23	16.22
3	0.00	0.00	0.00	0.00	7.51	7.39	17.83	17.82
4	0.00	0.00	0.77	0.05	9.11	8.99	19.43	19.42
5	0.00	0.00	0.00	0.00	7.51	7.39	17.83	17.82

As shown in Table 13 and Table 14, with the installation of crest gates at Vischer Ferry Dam, there is only a 0.72 foot reduction in the depth of flooding that occurs in the Stockade District for the 10-year flood and a minor reduction in the depth of flooding for the 100-year flood under the most extreme modification option (Option 7). Under 50% of the 100-year flood the water surface elevation is below the top of bank (i.e. water is contained in the river), and no significant change to the water surface elevation or the depth of flooding in the Stockade District was found for the 150% of 100-year flood, for any option.

Under the 100-year flood, the lowest lying buildings and roads could be flooded by over 9 feet of water under the baseline condition. A reduction in water levels of a de minimis amount of 0.12 feet (1.44-inches) under the 100-year flood is not going to prevent flooding at the lowest-lying locations.

Conclusion

This report summarizes the evaluation of the upstream and downstream impacts on water levels associated with the installation of a variable crest control apparatus (i.e. crest gates) on one or more of the Vischer Ferry dams during high flow events. The impacts of installing a variable crest control apparatus (i.e. crest gates) were evaluated for seven different dam configurations (including a baseline configuration representing the existing layout) and four different flow rates, for a total of 28 scenarios. The model was run and results were generated for each scenario, and the change in maximum water level was calculated at locations of interest within the study reach, including the Stockade District and bridges crossing the Mohawk River.

The following table (Table 14) provides a summary of results for the change in water surface elevations for the 10-year, 100-year and 150% of the 100-year floods in the Stockade District for the various variable crest control apparatus options.

Table 14: Summary of Results on Water Surface Elevations from the Baseline Condition Elevation in Stockade District

	Maximum Change in Water Level from Baseline (feet)		
	10-Year	100-Year	150% of 100-Year
Baseline - Option 1 - Dam D, E, and F in existing layout	-	-	-
Option 2 - Dam D crest reduced by 2.0 feet, Dam E and F in existing layout	-0.01	0.01	0.00
Option 3 - Dam D crest reduced by 4.0 feet, Dam E and F in existing layout	-0.23	-0.06	0.00
Option 4 - Dam D crest reduced by 6.0 feet, Dam E and F in existing layout	-0.50	-0.09	0.00
Option 5 - Dam D and F crest reduced by 2.0 feet, Dam E in existing layout	-0.08	0.02	0.00
Option 6 - Dam D and F crest reduced by 4.0 feet, Dam E in existing layout	-0.50	-0.08	0.00
Option 7 - Dam D and F crest reduced by 6.0 feet, Dam E in existing layout	-0.72	-0.12	-0.01

The results show that installing crest gates on Dams D and F would have only minor changes to the water surface level in the area of interest upstream of the Vischer Ferry Dam for all flow rates. Installing a 2-foot tall crest gate on Dam D and/or Dam F (Options 2 and 5) yields negligible impacts to the water levels upstream as they have a similar capacity to the existing flashboards. Even under the most extreme modification option (Option 7), there would only be minor changes to the water surface elevation under the 10-year flood and no significant changes to the water surface elevation or the depth of flooding in the Stockade District under the 100-year and 150% of 100-year floods.

The range of changes in the water level immediately upstream of the Vischer Ferry Dam vary from a maximum increase of 0.24 feet to a maximum reduction of 2.44 feet. These changes in water level extended upstream as far as Lock E-09, where the water level dropped a negligible amount of only 0.02 feet (0.24-inches) just upstream of the lock (15.9 miles upstream of Vischer Ferry).

It should be noted that the stability of Dams D and F should be verified if their height is reduced to accommodate the variable crest control apparatus.

An evaluation of the impacts in the Stockade District indicates that a variable crest control apparatus at Vischer Ferry Dam would change the water surface elevation by only about 0.72 feet (8.64-inches) under the 10-year flood and a negligible 0.12 feet (1.44-inches) under the 100-year flood.

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If you require additional information, please do not hesitate to contact Jerry Gomez at 315-724-4860 or Matt Denno at 518-407-0050.

Very Truly Yours,

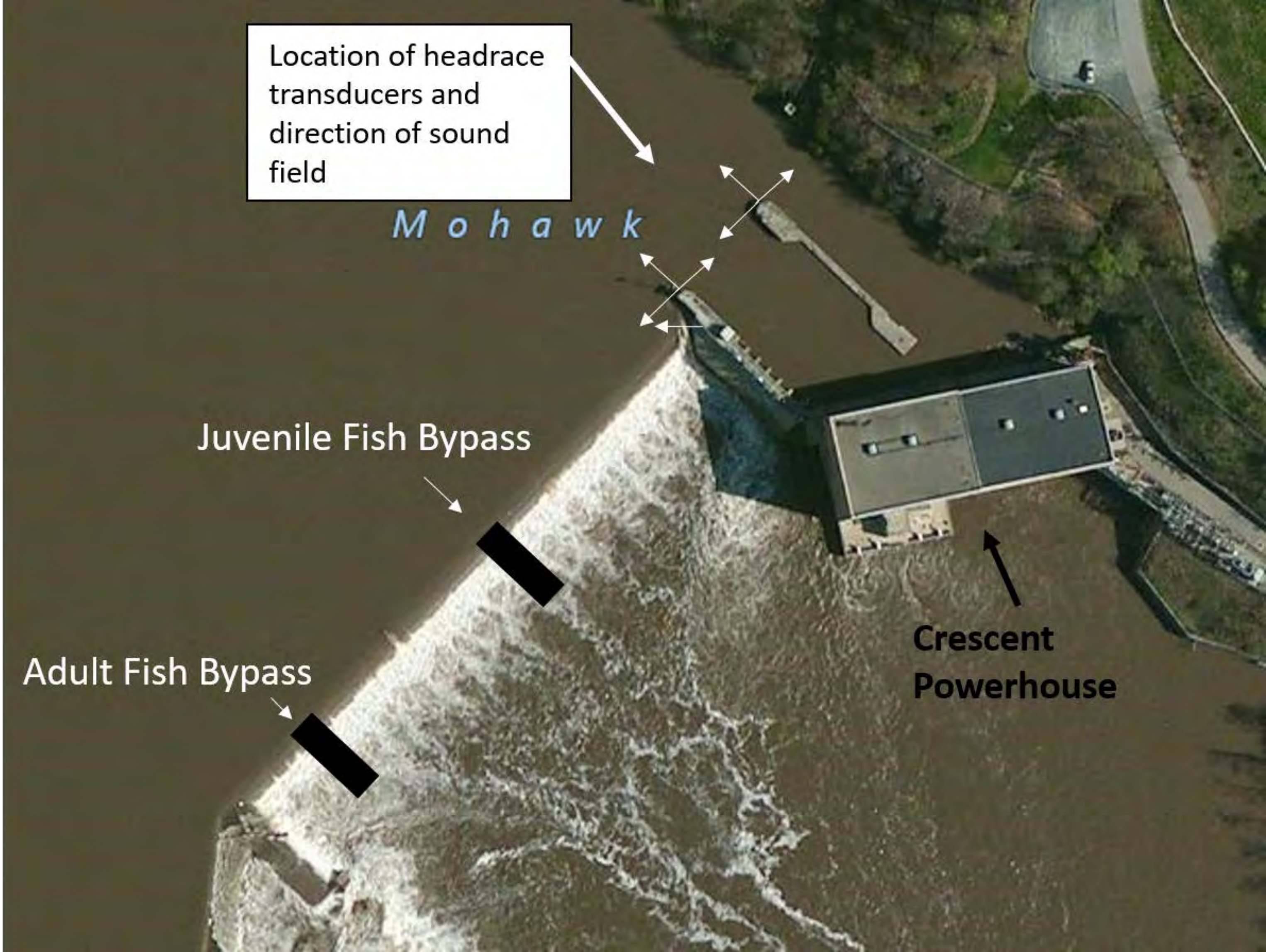
Jerry Gomez, P.E.
Principal

Matthew Denno, P.E.
Project Engineer

ATTACHMENT D

LOCATION OF FISH DETERRENT SYSTEM


N
S
E
W
Shoal
Location of Underwater Structure Housing IPA's and Direction of Sound Field
Main Channel
West Shore
Island
Side Channel
Dam B
Blueback Herring Fish Passage
Dam A
Crescent Powerhouse
Cohoes Crescent Rd
Pintail Pl
Towpath Ln
Canvasback Rdg
Steamboat Lndg
Mallards Lndg N
Flight Rd



Location of headrace transducers and direction of sound field
M o h a w k
Juvenile Fish Bypass
Adult Fish Bypass
Crescent Powerhouse

ATTACHMENT E

SOURCE DOCUMENTS FOR FISHERIES SECTION OF THE PAD

FISHERIES SURVEY

OF

THE CRESCENT LAKE AREA
(Crescent Dam to Lock 7)
OF THE MOHAWK RIVER

by Norman McBride
Senior Aquatic Biologist
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Stamford, New York 12167
March 24, 1980

INTRODUCTION

The Mohawk River is the second longest river in New York State. It originates in the Town of West Turin in Lewis County and flows in an easterly direction for 154 miles before entering the Hudson River at Cohoes. Seventy-five miles of the lower river, totaling 6,872 acres, is in Region 4 making it the region's second largest aquatic resource. The river has a drainage area of approximately 3,460 square miles. The 53-year (1926- 78) average annual flow is 5,753 cfs (U.S. Geological Survey, 1979).

Approximately 79 miles of the Mohawk River is part of the New York State barge canal system and was formerly part of the Erie Canal. The Mohawk River was drastically altered when modernization of the old canal route was completed in 1918 (N.Y.S. Conservation Dept., 1935). Canalization connected the river with previously unconnected waterways in other watersheds. Water levels in the river are regulated by a series of movable dams associated with the lock system. A shipping channel, approximately 200 feet wide and 14 feet deep, is maintained in the river.

Besides serving as a commercial shipping channel, the Mohawk River has three other primary functions:

1. Water supply for drinking water and industrial usage.
2. Sewage disposal site for treated and untreated sanitary and industrial waste water effluent.
3. Recreation area for contact and non-contact activities.

Implementation of the statewide pure waters program has resulted in improved water quality in the Mohawk River and it is continuing to get better. Many municipalities and industries along the river have constructed sewage treatment plants or upgraded old facilities.

Improved water quality has resulted in increased recreation on the river. Increased transportation costs will further accelerate recreational use on the river by local residents and fishing is expected to become a major recreational activity.

The fisheries potential and management needs of the Mohawk River are not clearly recognized at the present time because of a lack of information. A comprehensive fisheries survey has not been done since the 1934 biological survey of the Mohawk-Hudson watershed (N.Y.S. Conservation Department, 1935). Cursory baseline information on the Region 4 portion of the Mohawk was collected during the summers of 1970 and 1971.

Except for the stocking of trout in the Oneida County portion of the Mohawk River, species management programs are non-existant. However, the river has not been ignored from other fisheries related program areas. A water chestnut weed control program was active on the river until 1977. Fish have been collected throughout the river for contaminant analysis. Currently, boat access on the Region 4 portion of the river is being developed.

To determine the fisheries potential and management of the Mohawk River, a comprehensive fisheries survey is needed. Regional time and manpower constraints prohibit such an undertaking for the entire river. Utilizing the lock system to delineate boundaries, the Region 4 Fisheries Unit will survey a section of river each year until the entire Region 4 portion of the river is studied. This is expected to take about eight years. In June 1979, the Fisheries Unit surveyed the Crescent Lake area of the Mohawk River.

Crescent Lake

Although designated a lake, Crescent Lake is basically a flooded stretch of the Mohawk River channel beginning at Crescent Dam and extending upstream 9.5 miles to Lock 7. Crescent Lake covers 1904 acres and is characterized by a sinuous outline and broad shallow covers(Figure 1).

Crescent Dam is a fixed dam 4.2 miles upstream from the confluence of the Mohawk with the Hudson River. At full pool, the lake surface is 184.0' MSL. The lake has a maximum width and depth of 0.6 miles and 37 feet, respectively,and a mean depth of approximately 10 feet. Bottom substrate is approximately 70% sand and silt. Other substrate types includes bedrock, gravel, cobble, muck, and mud. Vegetation is sparse throughout the lake but water chestnut can become dense in localized areas. Emergent marshes consisting primarily of cattail borders a large area of Crescent Lake.

Crescent Lake is expected to become an important recreational fishing area because it has good access and is located in a populated area. The three counties (Albany, Saratoga and Schenectady) bordering Crescent Lake had a 1970 population of 569,400 residents.

METHODS AND MATERIALS

The Crescent Lake survey began by mapping bottom contours (Figure 1). This was accomplished by obtaining a series of bottom profiles with a recording fathometer. Basic water chemistry and temperatures data were collected at two sites (Figure 1).

The fish population was sampled by trap net, gill net, and electro-fishing. Netting sites are shown on Figure 1. Trap nets, of either 1/2 or 3/4 inch bar measure nylon net, were fished for 13 net nights. Standard gill nets were fished for seven net nights. Each net was 150 feet long, five feet deep and contained six 25-foot panels of 1½, 2, 2¼, 2½, 3, and 3½ inch stretch nylon mesh. Electrofishing was conducted for 3.6 hours, of which one hour was for game fish only, with a 220 volt D.C. electrofishing boat (9-11 amps at full wave).

All game fish were individually measured for total length and weighed. Panfish of each species were enumerated, separated into "desirable" and "undesirable" size categories, and weighed collectively. Crappies, yellow perch, bullheads, white perch, and white bass over eight inches and bluegill, pumpkinseed, and rock bass over 6.5 inches are considered desirable by anglers. Rough and forage fish were enumerated and weighed collectively by species. Scale samples were taken from most game fish and a representative sample of each panfish species.

RESULTS

Water Chemistry

Temperature and water chemistry data (Table 1) collected June 13, 1979, indicate that Crescent Lake is homothermous and moderately fertile. Total alkalinity, expressed as calcium carbonate ($CaCO_3$), was 85.5 ppm. The pH ranged from 7.8 - 8.2. The lake was turbid with Secchi disc transparency averaging 2.5 feet. Maximum depth of the lake is 37 feet and dissolved oxygen levels are adequate to support fish life at all depths.

Fish Population

Thirty species of fish were collected during five days of sampling in Crescent Lake (Table 2). Trap net, gill net, and standard electrofishing collections (in which all fish are collected) yielded 2198.4 pounds of fish, of which 115.8, 636.7, and 1,445.9 pounds were gamefish, panfish, and rough and forage fish, respectively (Table 3). The non-game/game fish ratio of fish collected was 18.0/1, by weight. The seasonal influx of the anadromous blueback herring greatly influences the non-game/game fish ratio in Crescent Lake. If the weight of blueback herring were omitted, the ratio would be reduced to 12.6/1. However, the 18.0/1 ratio will be used because the adult blueback herring is present in large numbers for approximately one-half the May to September growing season.

Major game fish species collected included smallmouth bass (117), largemouth bass (56), and walleye (19). In addition, one striped bass, chain pickerel, and northern pike were collected; thus, these species should be considered rare. An occasional brown trout and brook trout are reportedly caught by fishermen.

Panfish are abundant in Crescent Lake. White crappie were the most abundant species collected, followed by brown bullhead, bluegills, black crappie, and white perch. Yellow perch, pumpkinseed, rock bass, and yellow bullhead were collected in fair numbers. Two-thirds (68.9%) of the panfish collected, by number, were of "desirable" size to anglers. Seven white bass were collected which is the first documented occurrence of this species in Region 4.

Fourteen forage and rough fish species comprised two-thirds of the fishes collected, both by weight (65%) and number (62%). Blueback herring are the most abundant species, comprising 80% by number and 51% by weight of the fishes collected in this category. Other major forage and rough fish species collected in Crescent Lake include carp, white sucker, golden shiner, and redhorse sucker. Gizzard shad were not collected in this survey but they are present in the Mohawk River watershed and probably should be considered as rare in Crescent Lake.

DISCUSSION

Water quality has improved significantly in Crescent Lake since the 1934 biological survey. In 1934 dissolved oxygen levels throughout the lake were low at all depths, becoming critical at Crescent Bridge (Route 9) and in the area immediately above the Crescent dams (NYS Conservation Dept., 1935). There are no summertime dissolved oxygen problems today (Table 1). Because Crescent Lake is homothermous, management programs will emphasize warmwater species.

Although the Mohawk River corridor is industrialized, contaminants in the Crescent Lake area are not known to be a problem. In June 1977, largemouth bass, smallmouth bass, and white sucker were collected from Crescent Lake as part of the statewide toxic substances monitoring program. Results are summarized in Table 4. With the exception of mercury and chromium, contaminants such as PCB's, lead, zinc, DDT, and cadmium, are present in concentrations below the federal Food and Drug Administration actionable levels. Mercury levels are borderline and chromium levels are high but neither is expected to pose a health hazard.

The non-game to game fish ratio compares unfavorably with other Region 4 waters (Table 5). A low ratio generally indicates a higher quality fishery. The lowest ratio thus far recorded is 2.7/1 from Alcove Reservoir which supports an abundant and relatively unexploited game fish population (Elliot, 1970). The 57.8/1 ratio was recorded for Blenheim-Gilboa

Reservoir which supports a sparse population of game fish (Sanford, 1976). Despite the moderately high non-game to game fish ratio in Crescent Lake, the ratio is not representative of the overall fishing quality. Bass are abundant and fast growing. Thirty-five percent of all bass collected were legal size (12") or larger. Walleyes provide fair to good fishing opportunity. Finally, almost 69% of the panfish collected, by number, were of "desirable" size to anglers.

Game Fish

Largemouth bass, smallmouth bass, walleye, striped bass, northern pike, and chain pickerel were the six game fish species collected. Age and growth data are summarized in Table 6 for the three most abundant game fish species.

Smallmouth and largemouth bass are the most abundant game fish in Crescent Lake and they appear to be co-dominant. Walleyes are less common than either bass species. Growth rates for bass and walleye are excellent and above average for Region 4 (Table 7). Bass begin attaining legal size (12") during their fourth summer at age 3+ and all bass attain legal size at age 4+. Walleyes attain legal size (15") at age 2+.

Striped bass, chain pickerel, and northern pike are rare so their contribution to the sport fishery is negligible. The abundance of striped bass in Crescent Lake is probably dependent upon their ability to ascend the 2.3 miles and five locks of the New York Barge Canal from the Hudson River. The status of northern pike and chain pickerel has remained unchanged since the 1934 biological survey when their abundance was rated rare (NYS Conservation Dept., 1935).

Panfish

Panfish are abundant in Crescent Lake. Ten species were collected, with white crappies being the most abundant. Age and growth data for panfish are summarized in Table 6. Growth rates for black crappie, white perch, pumpkinseed, and yellow perch are excellent compared to Region 4 averages (Table 7). They attain "desirable" size at age 2+ or 3+. White crappie growth rates are similar to black crappie. Only the bluegill exhibits a less than average growth rate (Table 7).

The collection of white bass represented the first documented occurrence of this species in Region 4. No white bass were collected in the Mohawk River drainage during the 1934 biological survey. (NYS Conservation Dept., 1935). This species probably entered the Mohawk River via the Barge Canal connection with Oneida Lake. A reproducing population is expected to become established; however, the white bass is not likely to become an important component of the sport fishery. White bass prefer clear water rather than turbid or silty conditions, and low turbidity levels may be essential for their survival (Scott and Crossman, 1973). They grow rapidly in Crescent Lake. Age 2+ white bass averaged 11.2 inches (Table 6), and can ultimately exceed 17 inches in total length (Forney, 1963) in New York.

Forage and Rough Fish

Blueback herring are the most common species in Crescent Lake; however, their abundance is seasonal. The blueback herring is an anadromous species, spending most of its life in salt water and returning to fresh waters to spawn in late spring and early summer. Spent fish return to sea soon after spawning. The young hatch within a few days, grow rapidly, and migrate to sea when they are 1.2 - 2.0 inches long (Scott and Crossman, 1973). Seaward migration of juveniles in the Hudson River, and presumably in the Mohawk River, is complete by December (Anon., 1977). The adult blueback's large size, a 30 fish sample averaged 10.9 inches, makes them relatively invulnerable to predation except to the occasional large northern pike, walleye, or bass. The young blueback provides excellent forage and is available throughout the summer which may contribute to the good growth and abundance of piscivorous fish species.

MANAGEMENT NEEDS

The abundant forage base and moderately high non-game fish to game fish ratio indicates that Crescent Lake is capable of supporting another predator species. The tiger muskellunge (muskellunge x northern pike hybrid) would be an excellent choice for introduction into Crescent Lake. According to Weithman (1975) soft rayed species, which are abundant in Crescent Lake, are more vulnerable to esocid predation than spiny rayed species. The tiger muskellunge may reduce abundant rough fish populations and will provide trophy fishing opportunity and angling diversity. Tiger muskellunge in Canadarago Lake (Otsego County, Region 4) attained legal size (30 inches) two years after they were stocked (D. Green, personal communication)[1/]. In Kinderhook Lake (Columbia County, Region 4), tiger muskellunge up to 44 inches long and 24 pounds have been caught by anglers (W. Elliot, personal communication)[2/].

1/ D. Green, Project Leader, Cornell University Field Station, Richfield Springs, N.Y.

2/ W. Elliot, Sr. Aquatic Biologist, NYS Dept. of Environmental Conservation, Stamford, N.Y.

Walleyes are a highly prized game fish in New York. Recent studies show that walleye populations have declined in 34 of 89 waters across the state (Forney, 1977). A 1976 statewide angler survey found that walleyes rank second to trout in popularity and demand among New York anglers (Anon., 1979). In view of their popularity, statewide decline, and relative scarcity in southeastern New York, a better assessment of the walleye population including identification of spawning and nursery areas is needed in Crescent Lake.

Other fish management programs are not necessary at the present time. Crescent Lake supports good bass and panfish populations which do not require special management. Current statewide regulations are adequate to protect and maintain the existing fisheries resource.

MANAGEMENT RECOMMENDATIONS

1. Stock 11,424 six inch tiger muskellunge fingerlings (6 fish/acre x 1,904 acres) annually for three years. Evaluation will take place in the third year to determine future management direction.
2. Assess walleye population including identification of spawning and nursery areas.

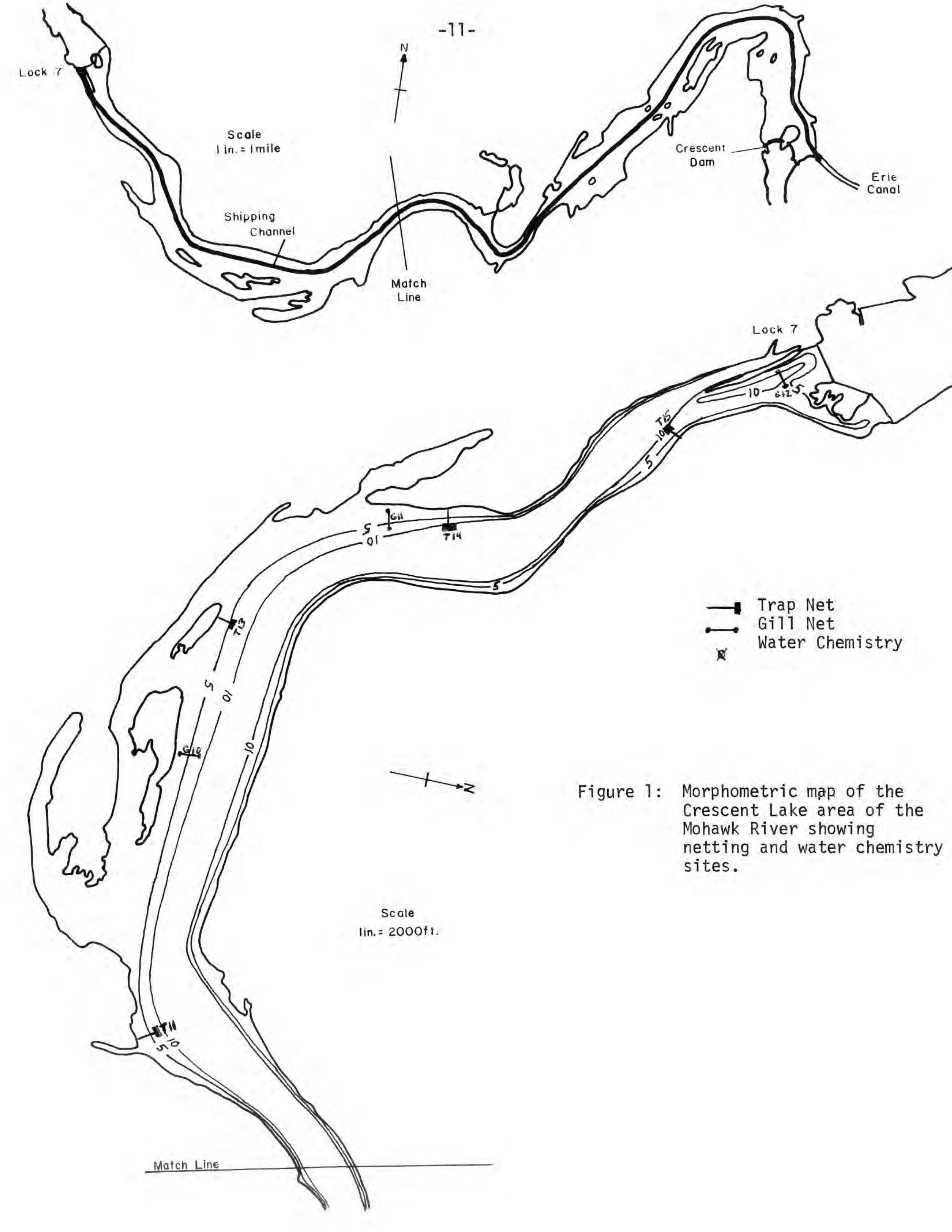

Figure 1: Morphometric map of the Crescent Lake area of the Mohawk River showing netting and water chemistry sites.

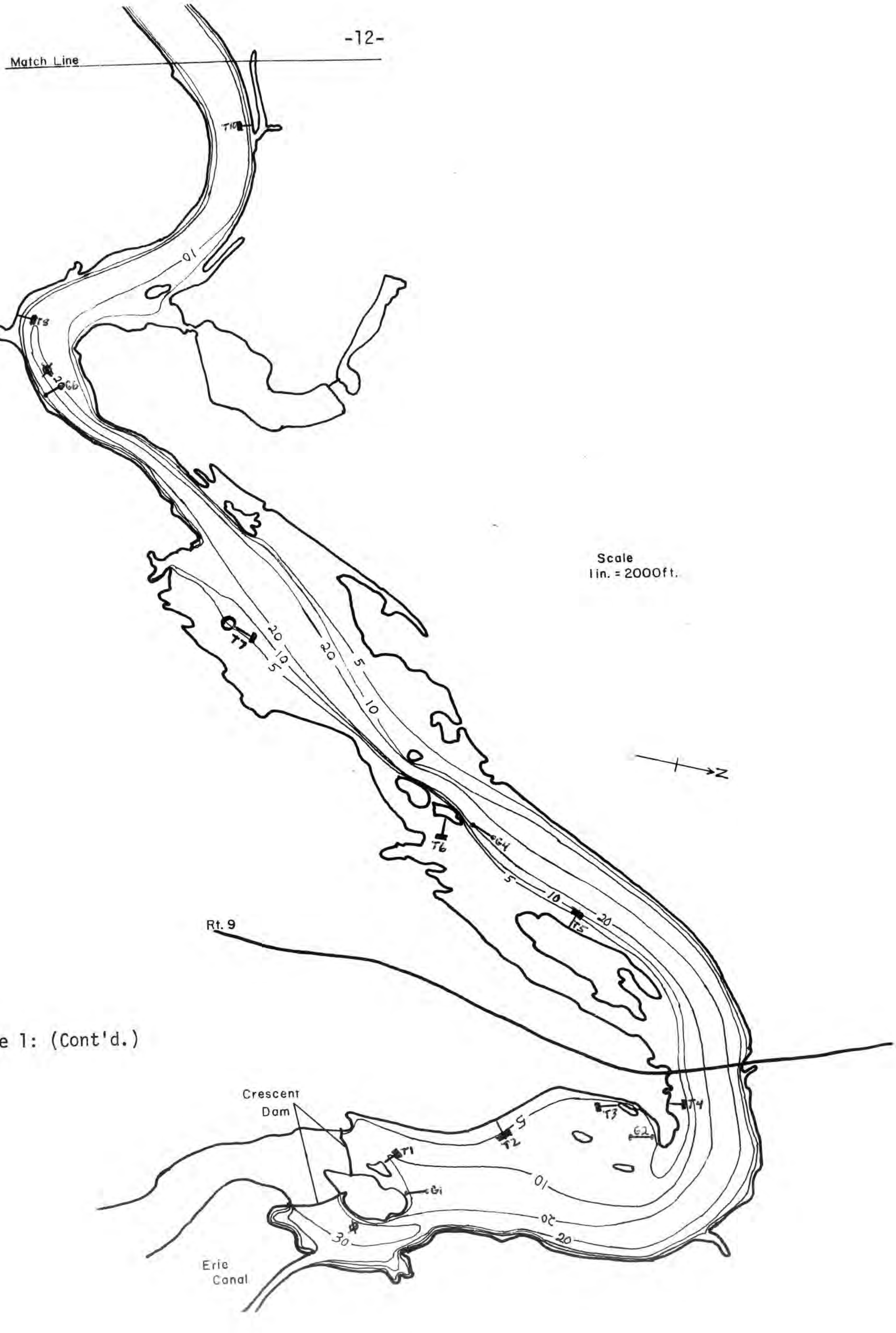

Figure 1: (Cont'd.)

Table 1: Water Chemistry data collected from the Crescent Lake area of the Mohawk River on June 13, 1979

Location	Depth (feet)	Temp. °F Air	Temp. °F Water	Dissolved Oxygen (ppm)	pH	Alkalinity $CaCO_3$ (ppm)
Approximately 1000 feet above dam on north side of river.	0	63°	67°	8.0	7.8	85.5
	10		67°			
	20		66°			
	30		66°			
	33		-	7.0	7.8	85.5
	37B		66°			
Approximately 1000 feet downstream from Trib. 7 adjacent to island.	0	69°	67°	9.0	8.2	85.5
	10		66°			
	20		66°			
	21		-	9.0	8.2	85.5
	22B		66°			

Table 2: Fishes collected in the Crescent Lake area of the Mohawk River during June 11 - 15, 1979

Scientific Name	Common Name	Relative Abundance[1/]
GAMEFISH		
Esox lucius	Northern pike	Rare
Esox niger	Chain pickerel	Rare
Micropterus dolomieui	Smallmouth bass	Common
Micropterus salmoides	Largemouth bass	Common
Morone saxatilus	Striped bass	Rare
Stizostedion vitreum	Walleye	Common
PANFISH		
Ambloplites rupestris	Rock bass	Common
Ictalurus natalis	Yellow bullhead	Common
Ictalurus nebulosus	Brown bullhead	Abundant
Lepomis gibbosus	Pumpkinseed	Common
Lepomis machrochirus	Bluegill	Abundant
Morone americana	White perch	Common
Morone chrysops	White bass	Rare
Perca flavescens	Yellow perch	Common
Pomoxis annularis	White crappie	Abundant
Pomoxis nigromaculatus	Black crappie	Abundant
FORAGE AND ROUGH FISH		
Alosa aestivalis	Blueback herring	Abundant
Anguilla rostrata	American eel	Rare
Carassius auratus	Goldfish	Common
Catostomus commersoni	White sucker	Common

Table 2: (Cont'd.)

Scientific Name	Common Name	Relative Abundance [1/]
FORAGE AND ROUGH FISH (Cont'd.)		
Cyprinus carpio	Carp	Abundant
Hybognathus nuchalis	Silvery minnow	Present [2/]
Moxostoma macrolepidotum	Shorthead redhorse	Common
Notemigonus crysoleucas	Golden shiner	Common
Notropis atherinodes	Emerald shiner	Present [2/]
Notropis hudsonius	Spottail shiner	Present [2/]
Notropis spilopterus	Spotfin shiner	Present [2/]
Percopsis omiscomaycus	Trout - perch	Present [2/]
Pimephales notatus	Bluntnose minnow	Present [2/]
Semotilus corporalis	Fallfish	Present [2/]

1/ Relative abundance is based on standard fish collections and visual observations during game fish only collections.

2/ Sampling techniques utilized were not adequate to determine the abundance of these species.

Table 3: Total number and weight of fishes collected by trap net, boat shocker, and gill net from the Crescent Lake Area of the Mohawk River during June 11-15, 1979[1/]

GAMEFISH

SPECIES	Number	Size Range (in.)	Total Wt(lbs)
Smallmouth bass	63	3.5 - 14.2	31.5
Largemouth bass	48	5.1 - 18.3	51.4
Striped bass	1	9.3	0.2
Northern pike	1	31.0	8.8
Chain pickerel	1	18.6	1.4
Walleye	17	10.2 - 23.2	22.5

PANFISH

	Over 8.0"		Under 8.0"		
	Number	Wt(lbs)	Number	Wt(lbs)	Total Wt(lbs)
White crappie	227	143.2	104	20.6	163.8
Black crappie	150	93.9	93	17.0	110.9
White perch	95	54.1	22	3.6	57.7
Brown bullhead	275	176.4	3	0.6	177.0
Yellow bullhead	15	10.9	2	0.3	11.2
Yellow perch	41	16.6	32	4.0	20.6
White bass	4	3.0	3	0.5	3.5
	Over 6.5"		Under 6.5"		
Bluegill	161	47.7	96	15.9	63.6
Pumpkinseed	14	4.0	79	11.8	15.8
Rock bass	26	10.3	21	2.3	12.6

FORAGE AND ROUGH FISH

	Number	Total Wt(lbs)
Blueback herring	1996	738.0
Carp	225	547.3
Redhorse sucker	44	51.0
White sucker	101	78.8
Goldfish	14	13.6
American eel	2	2.9
Golden shiner	93	13.6
Silvery minnow	2	0.1
Emerald shiner	1	Trace
Fallfish	4	0.3
Trout-perch	1	Trace
Bluntnose minnow	1	Trace
Spottail shiner	3	0.1
Spotfin shiner	11	0.2

1/ Excludes one hour of electrofishing for gamefish only in which 54 smallmouth bass (36.2 lbs.), 8 largemouth bass (6.2 lbs.), and 2 walleye (3.6 lbs.) were collected.

Table 4: Organochlorine and heavy metal analysis results from the statewide toxic substances monitoring program for fish collected in the Crescent Lake area of the Mohawk River in 1977 1/.

Species	Number	Length Range	Weight Range	AVE PCB (ppm)	Ave DDT (ppm)	AVE LEAD (ppm)	AVE MERCURY (ppm)	AVE CADMIUM (ppm)	AVE CHROMIUM (ppm)	AVE ZINC (ppm)	AVE COPPER (ppm)
Largemouth bass	6	10.2 - 12.9"	0.4 - 1.3 lbs.	0.50	0.10	0.98	0.62	0.08	0.17	7.68	0.27
Smallmouth bass	10	10.0 - 11.8"	0.3 - 0.8 lbs.	0.65	0.17	0.56	0.64	0.09	0.20	6.78	0.81
White sucker	19	9.2 - 16.0"	0.3 - 1.4 lbs.	1.04	0.30	0.41	0.31	0.04	0.09	7.05	0.29
FDA Actionable levels				2.00	5.00	1.00	0.50	0.10	0.05	No limit	No limit

1/ NYSDEC. 1978. Monthly Report on Toxic Substances Impacting on Fish and Wildlife. Div. of Fish and Wildlife. Report 12 53 pp.

Table 5: Non game fish/game fish ratio in seven Region 4[1/] reservoirs.

WATER	Location (County)	Non-game fish/ game fish ratio
Crescent Lake	Albany	18.0/1
Watervliet Reservoir	Albany	44.0/1
Schoharie Reservoir	Schoharie	5.4/1
Oneonta Reservoir	Otsego	5.4/1
Alcove Reservior[2/]	Albany	2.7/1
Tomhannock Reservoir	Rensselaer	5.5/1
Blenheim-Gilboa Reservoir	Schoharie	57.8/1

1/ Ratios based on trap and gill net collections and standard electrofishing collections.

2/ Reservoir is closed to fishing.

Table 6: Age and average length (inches) at capture of game and panfish collected in Crescent Lake during June 11-15, 1979 (Figures in parenthesis indicate sample size).

SPECIES	AGE 1+	2+	3+	4+	5+	6+
GAME FISH						
Largemouth bass	6.3 (14)	10.0 (11)	12.0 (14)	13.1 (3)	15.7 (3)	17.0 (2)
Smallmouth bass	5.0 (16)	8.8 (19)	11.0 (23)	12.3 (23)	13.7 (6)	-
Walleye	11.1 (11)	15.5 (3)	17.3 (2)	19.7 (2)	-	23.2 (1)
PANFISH						
Black crappie	5.3 (6)	7.0 (22)	10.5 (9)	11.6 (9)	12.3 (1)	-
Bluegill	2.9 (1)	4.7 (3)	5.9 (6)	6.7 (13)	7.4 (4)	-
Pumpkinseed	-	5.1 (10)	6.3 (11)	7.2 (3)	-	-
Rock bass	3.1 (2)	5.0 (10)	6.6 (4)	7.8 (2)	8.0 (5)	8.0 (2)
White bass	7.2 (2)	11.2 (4)	-	-	-	-
White crappie	4.9 (1)	7.2 (13)	10.3 (14)	11.4 (9)	13.0 (2)	-
White perch	4.7 (4)	7.9 (18)	9.8 (16)	10.7 (10)	12.0 (1)	12.8 (1)
Yellow perch	-	6.6 (20)	8.8 (3)	9.9 (10)	-	-

Table 7: Average growth rate of eight fish species from Region 4 waters compared to growth rates in Crescent Lake (Crescent Lake growth rates in parenthesis).

SPECIES	No. of Waters	Average Total Length (inches) at Capture of Sucessive Age Groups 1+	2+	3+	4+	5+
GAME FISH						
Largemouth bass	17	6.5 (6.3)	9.1 (10.0)	10.7 (12.0)	12.2 (13.1)	13.8 (15.7)
Smallmouth bass	16	5.1 (5.0)	7.6 (8.8)	9.8 (11.0)	11.2 (12.3)	13.3 (13.7)
Walleye	6	9.2 (11.1)	12.6 (15.5)	16.0 (17.3)	18.8 (19.7)	19.0 (-)
PANFISH						
Black crappie	13	6.2 (5.3)	7.9 (7.0)	9.2 (10.5)	9.2 (11.6)	11.3 (12.3)
Bluegill	6	4.8 (2.9)	5.3 (4.7)	6.5 (5.9)	7.2 (6.7)	8.1 (7.4)
Pumpkinseed	17	2.6 (-)	4.5 (5.1)	5.8 (6.3)	6.2 (7.2)	6.5 (-)
White perch	4	4.9 (4.7)	6.9 (7.9)	8.5 (9.8)	9.7 (10.7)	9.4 (12.0)
Yellow perch	24	3.9 (-)	5.8 (6.6)	7.1 (8.8)	8.1 (9.9)	9.2 (-)

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JUVENILE BLUEBACK HERRING (ALOSA AESTIVALIS) SURVIVAL IN POWERHOUSE/TURBINE PASSAGE AND SPILLAGE OVER THE DAM AT THE CRESCENT HYDROELECTRIC PROJECT, NEW YORK

Client Project No. 4024

Prepared for:

New York Power Authority

Prepared by:

RMC Environmental Services, Inc.

RMC
ENVIRONMENTAL
SERVICES

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SUMMARY

As a condition of its Federal Energy Regulatory Commission (FERC) licenses, the New York Power Authority (the Authority) is required to evaluate the impact of the Crescent and Vischer Ferry Projects on the fisheries resources of the Mohawk River. The New York State Department of Environmental Conservation (DEC) and the US Fish and Wildlife Service (FWS) have expressed concern about the Projects' effects on the fall emigration of juvenile blueback herring (Alosa aestivalis). McBride (1985) reported that juvenile herring are the most abundant fish in the lower Mohawk River.

As the herring approach the Projects, there are three migration routes available: spilling over the dam, passing through the power station and its turbines, or passing through the adjacent navigation locks operated by the New York State Department of Transportation. Previous studies have demonstrated that many emigrating juvenile herring pass through the power station. To assess the impact of the Projects on these emigrating herring, the Authority conducted these studies to estimate survival of juvenile blueback herring through the powerhouse/turbine and in spillage over the dam at the Crescent Project.

A total of 125 juvenile blueback herring were tagged and passed through the powerhouse while the turbine was operating at its full rated capacity. An equal number was tagged and released near the exit of the turbine draft tube as controls. Some 110

juveniles were tagged and spilled over the dam and an equal number were tagged and released as controls into the pool below the dam. Test and control fish were introduced individually using a specially designed induction system. For the spillage study, a spillage flow of approximately 40 cfs was created by removal of one flashboard at the crest of the dam.

The recovery rate of juvenile blueback herring at both test sites was high; it exceeded 84%.

The immediate survival ($\leq$1 h) of juvenile blueback herring exposed to the powerhouse/turbine passage was high, 96%. The 48 hour survival rate was also estimated to be 96%.

The immediate survival ($\leq$1 h) of juvenile herring spilled over the crest of the dam was 100%. The 48 hour survival rate was 88.3%.

The high survival rates of juvenile blueback herring exposed to powerhouse/turbine passage at the Crescent Project are similar to those reported in some very recent studies where survival rates were greater than 90%. However, these high survival estimates are in contrast with those reported in earlier published literature. These earlier studies reported immediate survival of clupeids passing through Kaplan and Ossberger turbines ranging from 18 to 50%. The inconsistency between the Crescent study results and these other studies is primarily due to improvements in tagging and recovery techniques. Earlier studies had low recovery rates, high control mortality, and difficulties in separating collection equipment-induced mortality from turbine-induced mortality. The tagging techniques and procedures utilized in the Crescent study avoided these problems to a large extent.

No literature-based data on juvenile clupeid spillway survival were available for direct comparisons with those from the Crescent Project.

In summary, the results of the Authority sponsored studies indicate that (1) the Crescent Hydroelectric Project does not inflict significant mortality on emigrating juvenile blueback herring exiting through this route, and that (2) in spillage over the crest of the dam survival is also very high. The overall survival in spillage and passage through the powerhouse/turbines was similar.

1.0 INTRODUCTION

As a condition of its Federal Energy Regulatory Commission (FERC) licenses, the New York Power Authority (the Authority) is required to evaluate the impact of the Crescent and Vischer Ferry Projects on the fisheries resources of the Mohawk River. The New York State Department of Environmental Conservation (DEC) and the US Fish and Wildlife Service (FWS) have expressed concern about the Projects' effects on the fall emigration of juvenile blueback herring (*Alosa aestivalis*). McBride (1985) reported that juvenile herring are the most abundant fish in the lower Mohawk River.

As the herring approach the Projects, there are three migration routes available: spilling over the dam, passing through the powerhouse and its turbines, or passing through the adjacent navigation locks operated by the New York State Department of Transportation. Previous studies have demonstrated that many emigrating juvenile herring pass through the powerhouse (Chas. T. Main, Inc. 1984; Curtis and Assoc. 1987). To assess the impact of the Projects on these emigrating herring, the Authority conducted these studies to estimate survival of juvenile blueback herring through the powerhouse/turbine and in spillage over the dam at the Crescent Project.

Until recently, accurate estimation of survival of juvenile clupeids passing through powerhouse/turbine was very difficult. Most estimating techniques required the use of nets to recapture the test organisms. Generally, nets cause excessive stress and mortality due to impingement and abrasions against the net mesh when the fish are collected (Gloss et al. 1982). Because of sampling difficulties imposed by turbulent high velocity waters below hydroelectric projects, investigators are constrained in recapturing a high proportion of test organisms without undue stress, injuries or mortalities. Other techniques, such as radio tagging are unsuitable to organisms as small as juvenile herring. For these reasons, conventional methods were judged to be impractical for estimating juvenile clupeid passage survival at the Projects.

RMC Environmental Services, Inc. (RMC) has developed a unique patented tagging technique which allows small and delicate clupeids to be safely recovered after passing through the turbines or over the spillway with negligible collection stresses (RMC 1991a; Heisey et al. 1992; Mathur and Heisey 1992). The Authority contracted with RMC to conduct the studies using this technique.

DEC and FWS commented on and participated with the Authority in designing the study. Representatives from both Agencies, as well as FERC, visited the site and observed the collection of test organisms, the tagging and recovery of fish during the studies.

1.1 Project Description

The Crescent Project is situated on the lower Mohawk River approximately three miles upstream from its confluence with the Hudson River (Figure 1-1). The Crescent Dam, completed in 1912, consists of two independent, concrete gravity overflow sections which link each side of the River to a rock island in the middle of the Mohawk River. The eastern overflow section is 900 ft long and the western section is 536 ft long. The average structural height of the eastern dam is 52 ft and is 32 ft, for the western dam. The approximate vertical drop from the crest of the dam to the pool below is 30 ft for the eastern dam and 12 ft for the western dam. Together, their crests form a spillway 1,436 ft long.

Water impounded by Crescent Dam maintains a relatively constant impoundment level for approximately 10 miles upstream to the Vischer Ferry Dam; the pond has a surface area of approximately 2,000 acres. Flashboards are generally installed each year in May and removed in late November to early December. These flashboards raise the pond elevation approximately 1 ft above the crest of the dam.

The original powerhouse was built in 1925 on the western bank. This was expanded by the Authority in 1990. The original and new powerhouse forms a single enclosed brick and concrete structure approximately 182 ft long and 73 ft wide. The original powerhouse operated with the two vertical Francis units (each 2.8 MW) until 1988. The Francis units are currently being refurbished. Each Francis unit is designed to operate at a head of approximately 27 ft and a discharge of 1,625 cfs.

The expanded portion of the powerhouse contains two vertical Kaplan units each rated at 3.1 MW. Each new Kaplan turbine is designed to operate at a head of approximately 27 ft and a discharge of approximately 1,500 cfs. The Kaplan units have horizontal, adjustable, propeller-shaped blades (runners), and adjustable wicket gates (Figure 1-2). Each unit has five blades with runner blade speed of 144 rpm. Other characteristics of the units are presented in Table 1-1.

Currently river flows in excess of approximately 3000 cfs are spilled over the dam. When refurbishment of the Francis units is completed, the design discharge of the project will be 6,250 cfs. Once completed, river flows in excess of approximately 6,250 cfs will be spilled over the dam or released through the tainter gate.

Table 1-1. Parameters of the Kaplan turbine units at the Crescent Hydroelectric and Vischer Ferry Projects. Data supplied by the New York Power Authority.

Manufacturer	Voith Hydro
Name Plate Horsepower	4200
Number of Blades	5
Rated Head (Ft.)	27
Rated Output (kw)	3100
Approx. Flow at Rated Output (cfs)	1500
RPM	144
Runner diameter - (in.)	108.3
Clearance between Blades - hub (in.)	24.9
- tip (in.)	67.8
Water passage Diameter at runner (in.)	108.3
Blade Tip Speed (fps)	67.9
Plant Sigma	1.39
Efficiency @ most efficient gate setting	94.4%
Intake Velocity @ Trash Rack (fps)	4.1
Maximum Exit Velocity (fps)	5
Axial Flow Velocity @ Runner (fps)	23.6
No. of Wicket Gates	16
Space between Wicket Gates (in.)	27.4
Wicket Gate Opening (Most Efficient Setting)	83%
Distance between Wicket Gate Trailing Edge and Blade Leading Edge (Ft.)	2.0-4.0

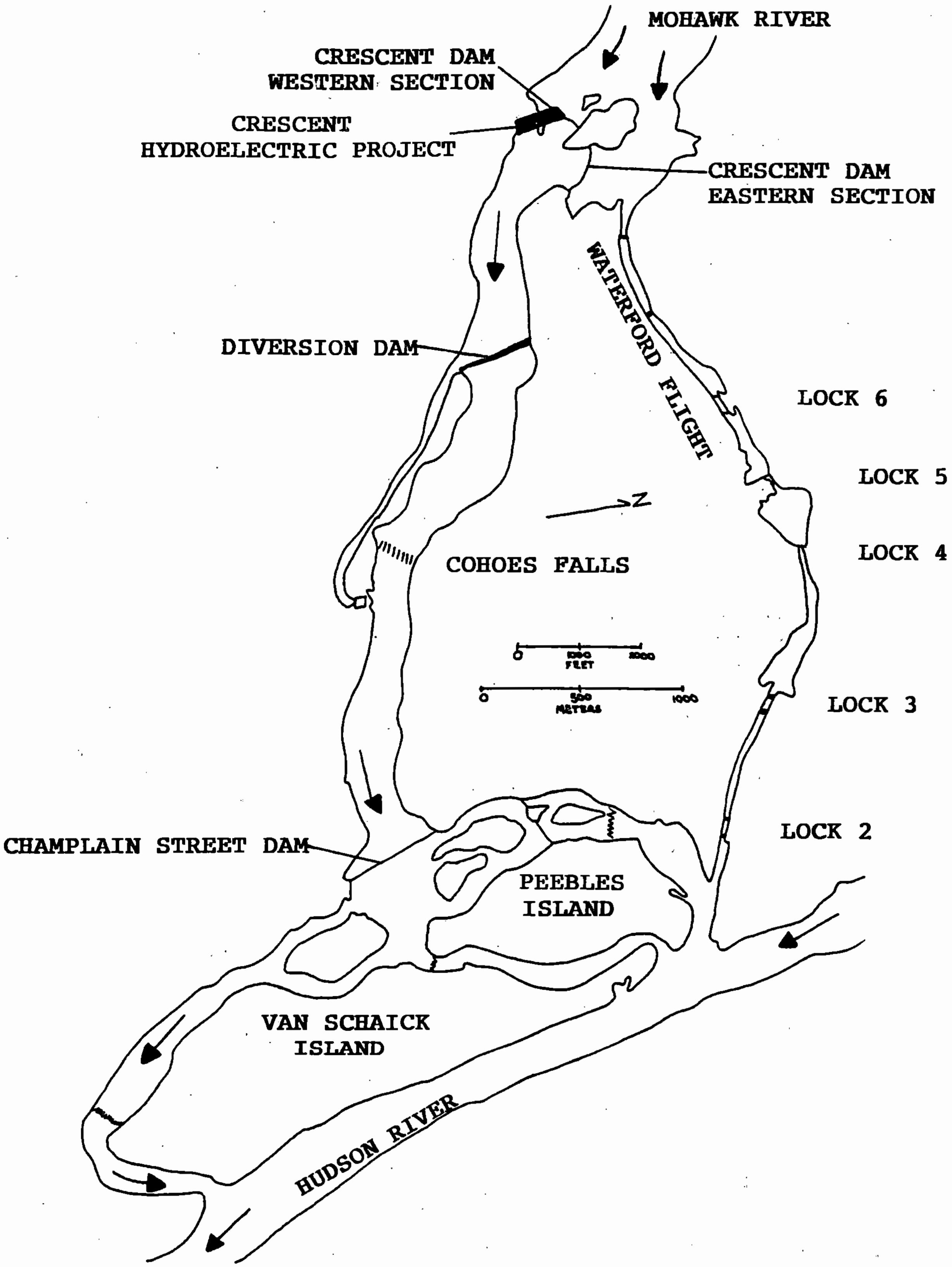


Figure 1-1. Location of the Crescent Hydroelectric Project on the lower Mohawk River.

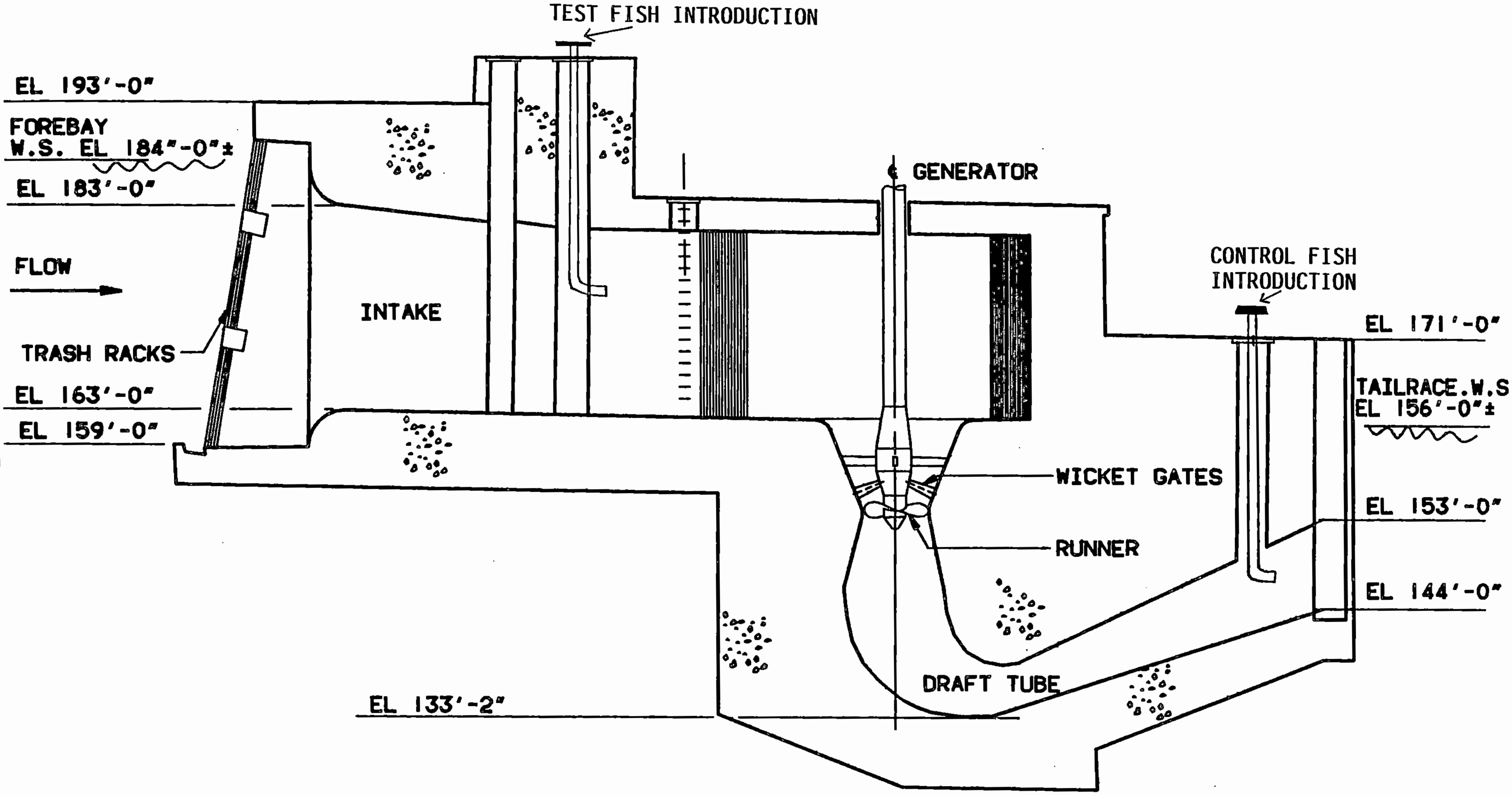


Figure 1-2. General configuration of the Kaplan turbines (Units 3 and 4) at the Crescent Hydroelectric Project and introduction sites for the test and control fish.

2.0 PROCEDURES

2.1 Study Period

The study was conducted from 29 September to 9 October 1991, during the period of emigration of juvenile blueback herring in the Mohawk River. The herring survival study at the Crescent Project utilizing the HI-Z Turb'N tag-recovery technique (U. S. Patent No. 4,970,988) was initiated upon the satisfactory completion of a pretest (RMC 1991b, Appendix I). The pretest was conducted in early September 1991 to demonstrate that: (1) juvenile blueback herring could be located, collected, maintained, and tagged, (2) effects of tagging on juvenile herring were negligible and resulted in survival of ≥80%, and (3) recovery rates of fish released through an operating turbine and over the spillway were ≥80%.

2.2 Collection and Holding of Test Specimens

Juvenile blueback herring were obtained from the forebay of the Crescent Project by a 8 x 8 ft square 0.5 inch mesh lift net. The fish were concentrated into a water-filled bucket positioned in the center of the net. Upon capture by lift net, juveniles were transported in 10 to 15 gallons of approximately 0.5% salt-buffered river water (Chittenden 1971) and released into 660 gallon circular holding pools. These pools were located adjacent to the forebay and were continuously supplied with river water (Figure 2-1). Fish were held for a minimum of 24 hours prior to testing to allow the fish an adjustment period. No significant problems were encountered in holding the specimens on site. Fish were handled with extreme care including water-to-water transfer and held in soft-sided holding pools to minimize abrasions. The turbid Mohawk River water seemed to allow little light to penetrate the pools and may have minimized stress on the fish induced by people working/walking close to the holding pens. Additionally the holding pools were located far from the powerhouse to prevent vibrations from turbines and other equipment stressing the test organisms.

2.3 Water Chemistry

Water temperature and dissolved oxygen (DO) in each pool and the forebay and tailrace of the Crescent Project were recorded twice daily. However, due to a malfunction of the DO meter, DO measurements could not be taken on certain days.

2.4 Tagging

Fish chosen for tagging were concentrated within a net and then individually water brailed from the holding pool and placed into a 5 gallon bucket filled with 0.5% salt buffered river water. The fish (10-15 at a time) were carried to the testing site where they were held in a 20 gallon circular tub prior to tagging.

The tagging-recovery technique involved attaching a small uninflated balloon to each test fish just prior to release. Each balloon was uniquely identified on each day. Just prior to release each uninflated balloon tag was activated by injecting 1 milliliter of water to initiate a chemical reaction. This chemical reaction released a gas in the balloon which caused it to slowly inflate. Shortly after passage through the powerhouse/turbine or over the spillway, the inflated balloon buoyed the test specimen to the surface and allowed it to be collected. Once collected, the balloon/tag was removed from the fish and the fish's condition was determined. The fish was then transported to a holding pen for long-term survival estimates. Fish were released individually, at approximately 5 to 10 minute intervals, to facilitate the collection in the broad tailrace region.

The tags were bright colored pear-shaped latex balloons, with maximum uninflated dimensions of 30 millimeters (1.2 inch) and in length 10 millimeter (0.5 inch) in width, respectively. Upon full inflation, the tags measured 75 millimeter (3 inches) long and 50 millimeter (2 inches) in diameter. Each tag weighed about 1.5 grams. Tags were attached by a single stainless steel pin through the dorsal musculature of the fish below the insertion point of the dorsal fin or in the caudal musculature (Figure 2-2). The pin was inserted with a modified ear-piercing gun and secured by a small plastic disc.

The effects of tagging at two different locations on fish body were examined to determine which site was most suitable for testing. Initially, 20 fish were tagged just below the dorsal fin and an equal number was tagged near the base of the caudal fin. Tagged fish were temporarily retained in a 5 gallon bucket for 2 to 3 minutes and then the tag and pin were removed. The fish were held in floating net pens in the tailrace to determine delayed mortalities at 24 and 48 hours. The delayed effects of the two tag sites were similar; two dorsally tagged fish and two caudally tagged fish were dead at 48 hours. Although the delayed mortality was the same at both sites, fish tagged near the tail had less hemorrhaging and bruising at the tag site. Furthermore, preliminary testing indicated that the tags attached in the caudal region were harder to dislodge from live healthy fish. Nearly equal numbers of fish used in the spillage test were tagged at the base of the dorsal fin or base of the caudal fin; results were similar to those noted above (see Section 3.2). All fish tested for the powerhouse/turbine test were tagged at the base of the caudal fin.

2.5 Introduction of Fish For Powerhouse/Turbine Study

Tagged test fish were introduced individually into the powerhouse water intake above the operating turbine, by an induction apparatus consisting of a small holding basin attached to a 3 inch supply/delivery line (Figure 2-3). The reinforced plastic delivery line was smooth inside, i.e., no ridges from coiled wire supports were present. The length of the hose for release of test and control fish was the same. A gasoline powered trash pump supplied water to the system to ensure that fish were transported quickly from the basin to the intake within a continuous flow of water through the delivery line.

Control fish were tagged and released individually through the induction apparatus near the exit of the draft tube. The experimental purpose of the control fish was to provide a measure of the effects of tagging/handling and induction without the effects of powerhouse/turbine passage (Figure 1-2). The release location for control fish was chosen so that the fish would enter the tailrace at a depth and location similar to the test fish. An equal number of test and control fish was released on each day. Similar sized fish were used for test and control releases.

2.6 Introduction of Fish For Spillage Over The Dam

For the spillage study, juvenile herring were tagged and released utilizing similar techniques and procedures as those for the powerhouse/turbine passage test. A flashboard at the western dam was removed to create an opening (1 x 10 ft) for the spillage study. At full pond elevation approximately 40 cfs passed through this opening and plunged into a spill pool at the base of the dam (Figure 2-1). The test fish were released into the spillage flow immediately above the notch created by removal of a flashboard on the crest of the western dam (Figure 2-1). Control fish were released directly into the pool below the pulled flashboard. The vertical distance from the crest of the dam to the pool was approximately 12 ft.

2.7 Recovery of Fish

Test and control fish were retrieved from the tailrace and pool by personnel in boats. Two boats with two technicians in each boat insured rapid recovery of fish in the tailrace. One boat with two technicians was sufficient for the spill pool. Each fish was carefully removed from the water utilizing a 3-

gallon bucket. This collection procedure maintained water-to-water contact.

Upon recovery, the tag and pin were removed with pliers modified to allow pin removal without harming the specimen. The fish was then transferred to a numbered floating net pen. The powerhouse/turbine study net pens were located in a calm area of the tailrace (Figure 2-1). The holding site was selected where extraneous factors (vandalism, net impingement, etc.) would have minimal influences on assessment of latent survival. Each net pen was circular with a diameter of 5.5 ft, 4 ft deep, and covered on the bottom, sides, and top with 0.25 inch in rigid plastic netting. Fish from the spillage study were held in net pens located in the impoundment above the dam (Figure 2-1).

2.8 Survival/Mortality Classifications

The recovered fish and tags were categorized as follows:

1) Alive -- alive when recovered and remained alive until put into the net pen, usually within 10 minutes of recovery.
2) Dead -- dead when recovered or dead within 10 minutes of recovery.
3) Tag and pin -- balloon and pin only were recovered with no fish attached.
4) Predation -- fish that were directly observed being carried off by gulls or recovered in the stomachs of smallmouth bass.

5) Unknown -- no fish or tag were recovered within 30 minutes after being released.

Test and control fish that were recovered alive were kept in separate net pens. Assessments for long-term survival were made at 24 and 48 hours. Fish were categorized only as alive or dead. The total length (TL) of each fish was measured to the nearest millimeter (mm) at the end of the delayed assessment period or when a fish died.

2.9 Data Analysis

An adequate number of fish was released to recover approximately 100 specimens for assessment of survival for the powerhouse/turbine passage and spillage tests. The number released in each study was dependent upon the number of "unknowns", "tag and pin", and "predation" fish. For the powerhouse/turbine passage study a total of 125 fish in both test and control groups was released. For the spillage over the dam study 110 fish were released in each group.

The short-term ($\leq$1 h), 24 hour and 48 hour survival rates of juvenile blueback herring passing through the powerhouse/turbine or spilled over the dam was estimated using Abbott's formula given in Bliss (1967) and Fleiss (1981):

$$P_e = \frac{P_2 - P_1}{1 - P_1}$$

where P_e = powerhouse/turbine or spillage-related mortality rate adjusted for control

P_1 = fractional mortality of control fish = $\frac{\text{No. dead}}{\text{Total No.}}$

P_2 = fractional mortality of test fish = $\frac{\text{No. dead}}{\text{Total No.}}$

Survival rate was estimated by:

$S = 1 - P_e$

S = survival rate

For these analyses fish that were categorized as "unknown" or "tag and pin" were included with the dead fish. It is not possible to know the eact status of these unknown and tag and pin test organisms. They may have actually survived passage. It is possible that the tags may have been dislodged from the fish without it having been killed or injured; or the fish may have been preyed upon after exiting the turbine. In the case of the unknowns, the fish and tag may have passed through the tailrace area without being observed by the collection crews; the balloon may have malfunctioned; or they too may have preyed upon. Mortality estimates for powerhouse/turbine passed fish determined by the above procedure provides a conservative estimate, since the likelihood of tag and pin being dislodged without direct injury/mortality to the fish is probably higher for fish passing through the turbine than it is for the control. This is due to the more turbulent waters during passage through a turbine.

Fish that were categorized as "predation" were excluded from the analyses because these fish were lost to the experiment with no indication of the treatment/control effects. Predations by smallmouth bass were confirmed when the bass was buoyed to the surface with the test organism and balloon in the bass' mouth or stomach. Predations by gulls were confirmed when a gull was seen with an inflated balloon in its bill. Predation on juvenile clupeids has been observed in other turbine passage studies (RMC 1991a,c).

The confidence intervals on the estimated powerhouse/turbine or spillage mortality (P_e) were calculated using the formula for standard error (SE) given in Fleiss (1981):

$$SE\ of\ P_e = \left(\frac{1}{Q_1}\right) \sqrt{\left(\frac{P_2Q_2}{N_2}\right) + (1-P_e)^2\left(\frac{P_1Q_1}{N_1}\right)}$$

where P_1 = fractional mortality of control fish

P_2 = fractional mortality of powerhouse/turbine or spilled fish

Q_1 = fractional survival of control fish

Q_2 = fractional survival of powerhouse/turbine or spilled fish

N_1 = sample size of control fish

N_2 = sample size of powerhouse/turbine or spilled fish

The significance of differences was statistically determined by the Fisher's exact chi-square 2 x 2 contingency test of independence (Sokal and Rohlf 1981). Data were analyzed using the Statistical Analysis System (SAS Institute, Inc. Version 6.03).

Appendix Tables II-1 and II-2 provide a list of codes and a complete data listing for each fish. Statistical tests are presented in Appendix Tables II-3 through II-9. Summary tables are provided in the main report.

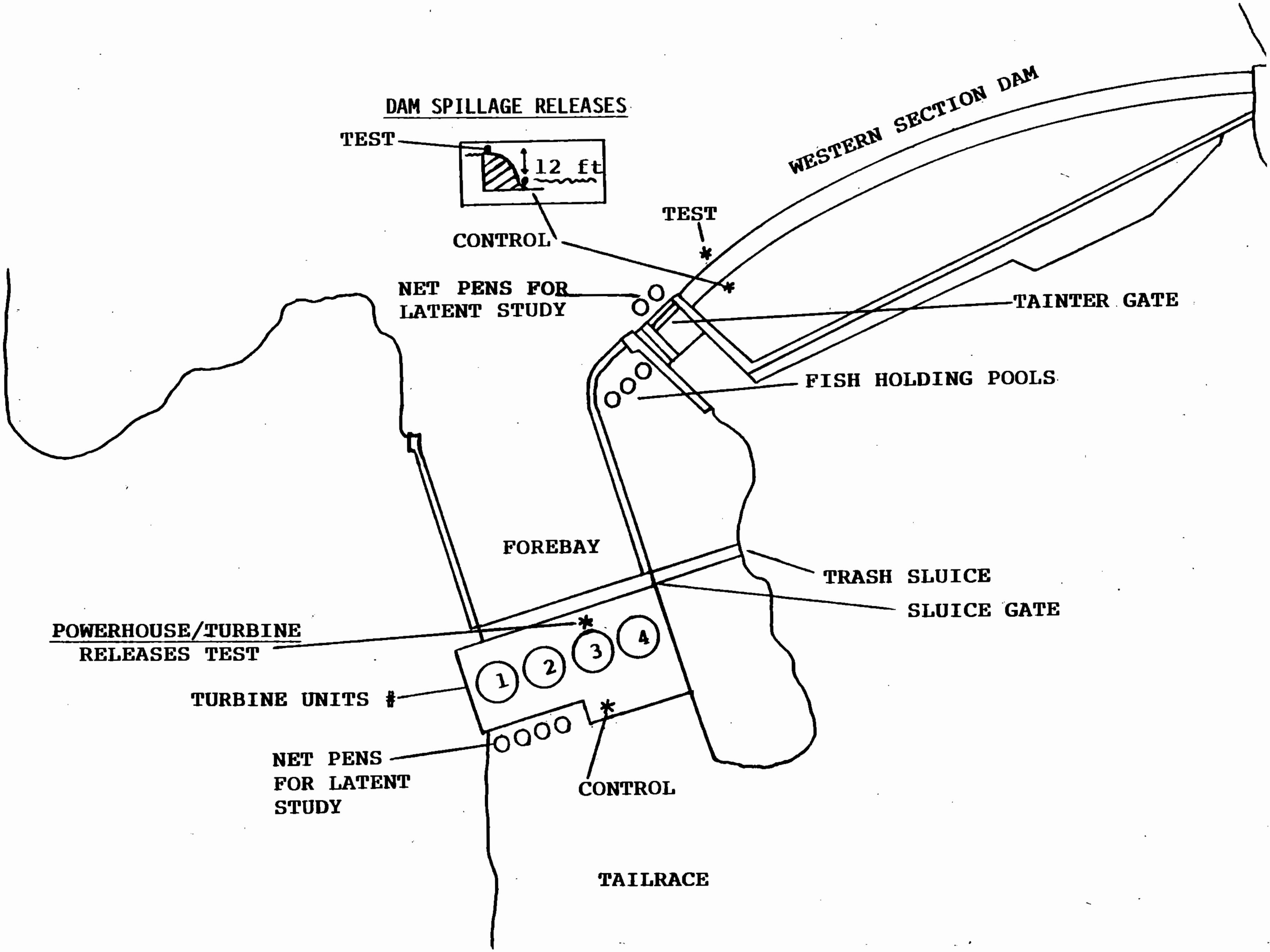
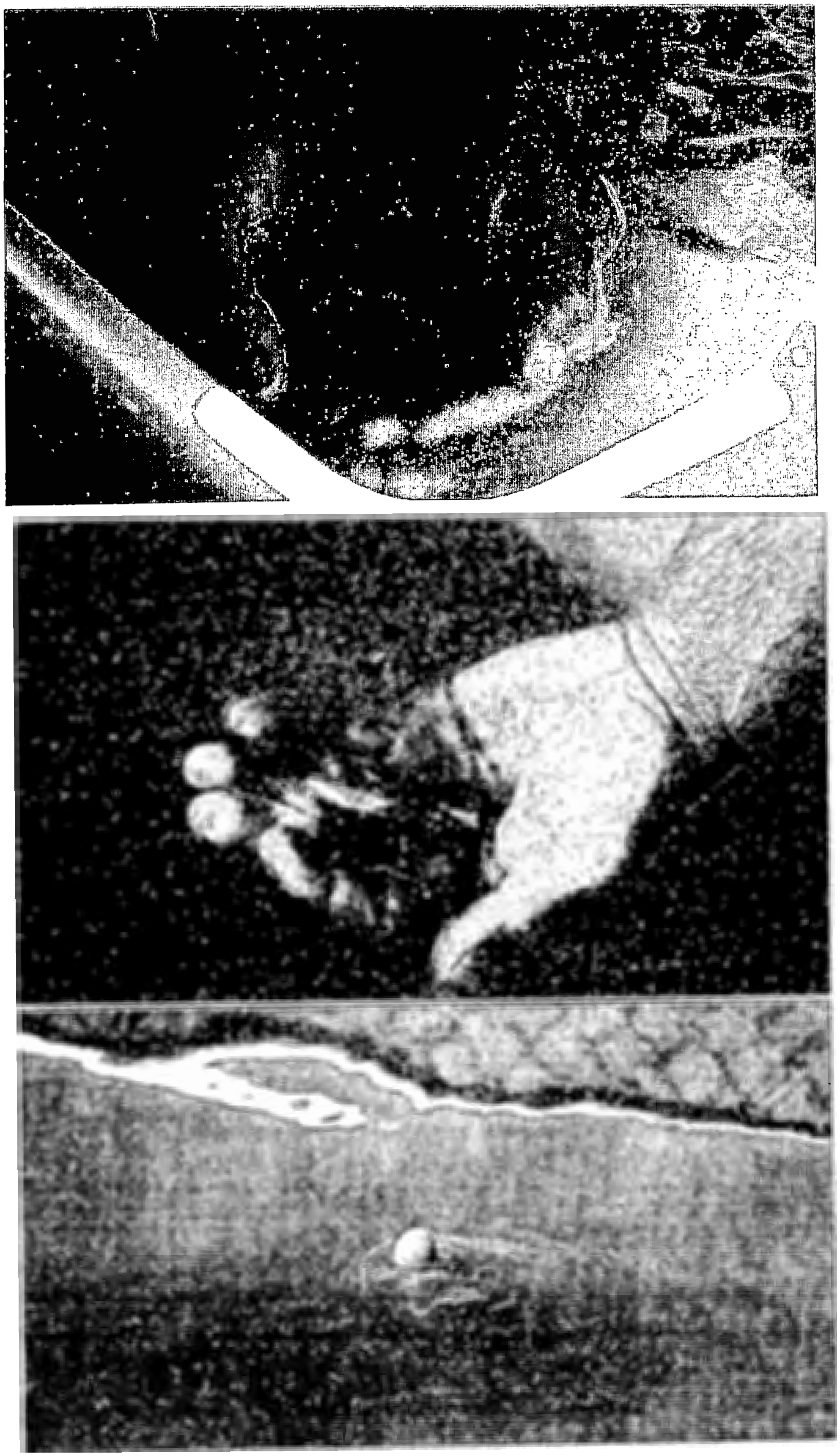


Figure 2-1. Overall schematic of release locations of juvenile blueback herring for the survival study at the Crescent Hydroelectric Project.



DORSAL
(A)

CAUDAL
(B)

INFLATED TAG
(C)

Figure 2-2. Turb'N Tag attachment sites near the dorsal (A) and caudal (B) fin areas, and inflated tag (C) on juvenile blueback herring.

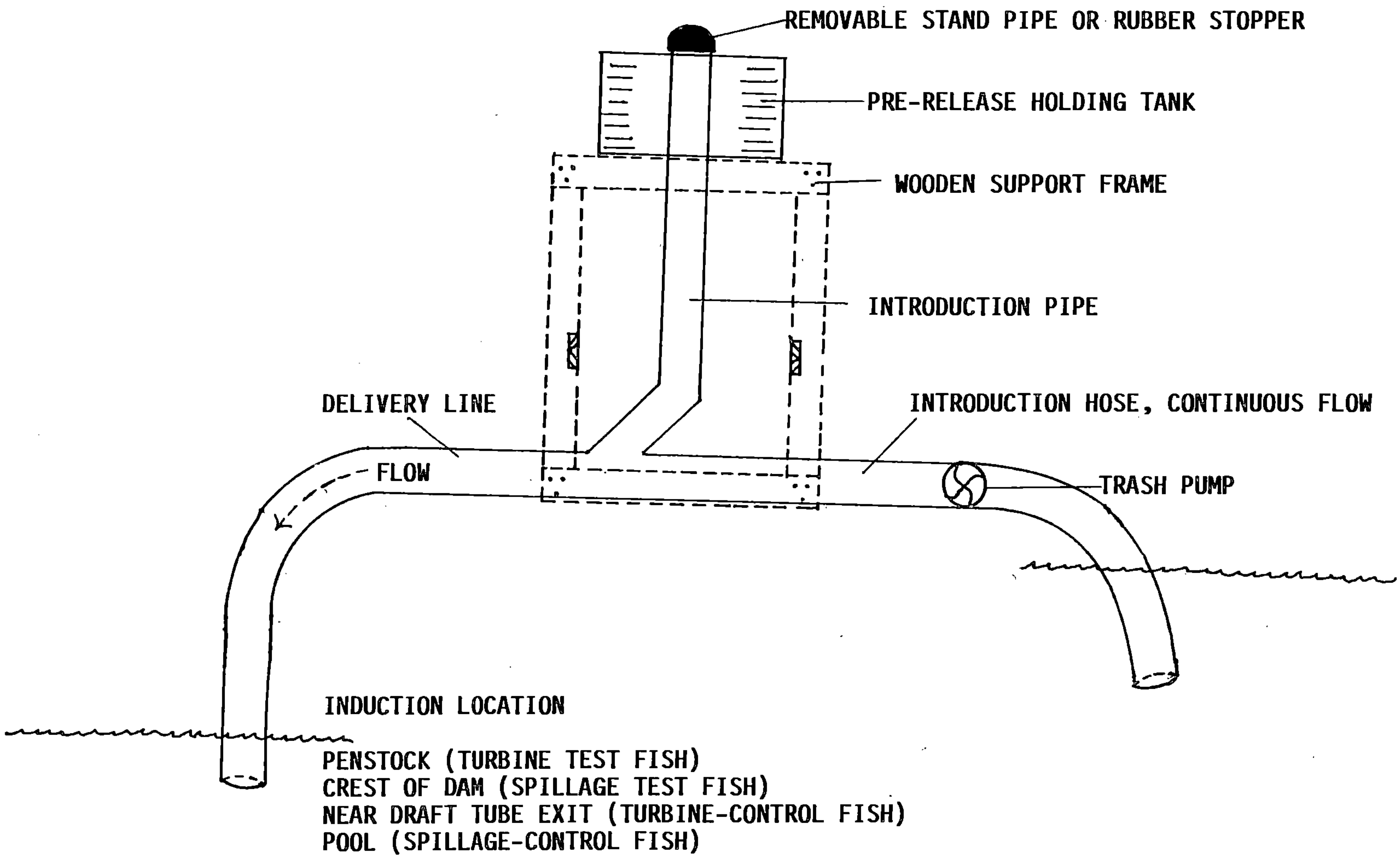


Figure 2-3. Schematic representation of the induction system used for the powerhouse/turbine and spillage survival study of juvenile blueback herring at the Crescent Hydroelectric Project, September-October 1991.

3.0 RESULTS

3.1 Turbine Test

3.1.1 Test Conditions

The survival of juvenile blueback herring exposed to powerhouse/turbine was conducted when river water temperature ranged from 14.4 to 17.5° C (57.9 to 63.5° F) and dissolved oxygen was >7.5 mg/l (Table 3-1). Both remained relatively stable throughout the study period. This range of values met the criteria recommended in the pretest and corresponds to the period of clupeid emigration (Appendix I).

Operating status of the test turbine during the study is given in Table 3-2. Conditions remained relatively constant throughout the study. These operating parameters are optimum in terms of hydraulic and mechanical efficiency at near maximum output, and provide a low likelihood of cavitation. The high blade angles present a relatively low potential for blade contact for organisms passing through the turbines. This turbine operational mode is typical and is the most likely operational mode under normal river flow conditions.

Blueback herring selected for test and control group releases were of similar lengths (Table 3-3). Fish lengths ranged from 77 to 105 millimeter total length; most were 80 to 90 millimeter long.

3.1.2 Specimen Recovery

Of the 125 test and 125 control fish released, 105 test fish and 108 control fish were recovered (Table 3-4). Overall, recovery rate of both test and control fish was similar (84% test and 86% control fish). No statistical differences (P>0.05, Fisher's exact chi-square test) occurred (Appendix Table II-3).

The proportion of inflated tags and pins without fish recovered was also similar for the test and control (10% for test and 9% for control fish) (Table 3-4). It is possible that some of these recoveries resulted from predation or separation/tear-out of tag from the test specimens in the turbulent waters.

Predation by fish and gulls was observed on 3% of test specimens and 2% of control (Table 3-4).

Nothing was recovered or observed for 2% of the test and 3% of the control specimens. The exact status of these fish could not be determined. It is possible that either the tag malfunctioned, inflated at a location outside the surveillance area, was missed by boat crews, or the test specimens were preyed upon.

The average time required to recover both test (5.4 min) and control (7.2 min) fish was short (Table 3-5) Most specimens were recovered in less than 9 minutes.

3.1.3 Short-term Survival ($\leq$1 h)

A total of 125 juvenile blueback herring were tagged and released through the powerhouse/turbine and an additional 125 were tagged and concurrently released as controls (Table 3-4). Between 25 and 35 test and control fish were released on a given day. The short-term survival rate was very high, 96% (Table 3-

4). No significant differences (P>0.05) occurred between the survival of test and control fish (Appendix Table II-4).

3.1.4 Survival Rates at 24 hours and 48 hours

All live test and control fish recovered from the tailrace were placed into net pens for long-term assessment of the effects of powerhouse/turbine passage (Table 3-4). The 24 and 48 hour survival rates were each 100% (Table 3-4). No significant differences (P>0.05) occurred between the survival of control and test fish at 24 hours or 48 hours (Appendix Table II-5).

Because of the slightly greater long-term survival among the test fish relative to the controls, the calculated 24 and 48 hour survival rates adjusted for controls, were greater than 100%. These estimates exceed the immediate survival rates of 96%. Since it is biologically and intuitively impossible for long-term survival to be higher than immediate survival, it is our interpretation that 96% represents a valid estimate of 24 hour and 48 hour survival rates in passage through the Crescent powerhouse/turbines.

Table 3-1. Daily mean water temperature (C) and dissolved oxygen (mg/l) measurements taken in the forebay, tailrace, and holding pools during the powerhouse/turbine and spillage survival of juvenile blueback herring at the Crescent Hydroelectric Project, September-October 1991.

				Fish Holding Pools		
Date	Parameter	Forebay	Tailrace	1	2	3
28 Sep	DO	8.40	8.50	7.80	8.70	8.40
	Temp	16.4	16.4	15.7	16.3	15.9
29 Sep	DO*	-	-	-	-	-
	Temp	16.0	16.0	16.3	16.3	16.3
30 Sep	DO*	-	-	-	-	-
	Temp	14.5	15.3	15.3	15.3	14.8
1 Oct	DO*	-	-	-	-	-
	Temp	14.5	15.0	12.5	14.5	14.0
2 Oct	DO*	-	-	-	-	-
	Temp	15.5	15.5	15.0	15.8	16.3
3 Oct	DO*	-	-	-	-	-
	Temp	16.0	16.0	16.5	16.5	16.8
4 Oct	DO*	-	-	-	-	-
	Temp	16.8	16.5	16.8	16.8	17.3
5 Oct	DO	9.7	9.9	9.6	9.6	9.6
	Temp	16.6	16.6	16.9	16.9	17.9
6 Oct	DO	9.1	9.2	9.3	9.3	-
	Temp	17.0	17.5	17.1	17.3	16.3
7 Oct	DO	8.8	9.0	9.0	8.8	8.1
	Temp	14.4	14.7	13.5	13.8	13.8

* DO meter malfunctioned

Table 3-2. Project operational status during the powerhouse/turbine passage survival study of juvenile blueback herring at the Crescent Hydroelectric Project, October 1991.

Date	Wicket Gate (%)	Blade Angle	Turbine Inlet Level(ft)	Draft Tube Level(ft)	Power Factor (%)	RPM
2 Oct	74.3	32.3	184.2	155.9	1.00	144
3 Oct	75.0	32.5	184.5	156.3	0.997	144
4 Oct	76.4	32.8	183.2	156.4	1.00	144
7 Oct	76.8	35.9	-	156.2	0.998	144

Table 3-3. Length (total) distribution of juvenile blueback herring used for the powerhouse/turbine passage survival study at the Crescent Hydroelectric Project, October 1991.

	Powerhouse/Turbine		
	Control	Test	Total
Length(mm)			
LE 65	-	-	-
70	-	-	-
75	-	-	-
80	12	9	21
85	51	51	102
90	34	36	70
95	8	6	14
100	3	1	4
105	-	2	2
TOTAL	108	105	213
Min Length	77	79	77
Max Length	98	105	105
Mean Length	85.1	85.5	85.5
SD	4.1	4.3	4.2

Table 3-4. Recovery and survival data on test and control juvenile blueback herring released through powerhouse/turbine for the survival study at the Crescent Hydroelectric Project, October 1991.

	Test	Control
No. Released	125	125
No. Recovered Live(≤1 h)	102	108
No. Recovered Dead	3	0
Tag and Pin only	13	11
Predation	4	2
Unknown	3	4
No. alive at 24 h	96	97
No. alive at 48 h	87	87
Est. Survival (≤1 h)	= 96%	
95% CI for immediate survival	88.0 - 100%	
Est. Survival rate at 24 hours =	100% (Established overall survival at 96%)	
95% CI for 24 hour survival rate	87.6 - 100%	
Est. Survival rate at 48 hours =	100% (Established overall at 96%)	
95% CI for 48 hour survival rate	85.5 - 100%	

CI = Confidence interval

Table 3-5. Summary statistics on the recovery times (minutes) of test and control juvenile blueback herring for the survival study at the powerhouse/turbine at the Crescent Hydroelectric Project, October 1991.

	Test	Control
Total number recovered	102	108
Mean	5.4	7.2
Standard error	0.34	0.50
Minimum	1.0	1.0
Maximum	18.0	42.0

3.2 Spillage Test

3.2.1 Test Conditions

The survival of juvenile blueback herring was estimated during spillage at the Crescent Dam (Figure 2-1). Because different tag attachment locations (dorsal and caudal) were utilized, it was important to determine whether tagging site was a source of variation in survival or recovery rates. Consequently, the differences in the recovery and survival rates of the two groups were compared by chi-square test (Appendix Table II-6). No differences either in recovery or survival were noted ($P>0.05$) suggesting that the data can be pooled.

Water temperature ranged from 14.4 to 17.5° C (57.9 to 63.5° F) and dissolved oxygen was >7.5 mg/l (Table 3-1). Both parameters remained relatively stable throughout the test condition.

Length distribution of spilled and control fish was similar (Table 3-6). The total lengths of test and control fish ranged from 74 to 105 millimeter; most were from 80 to 90 millimeter long.

3.2.2 Specimen Recovery

The recovery rates of 110 spilled (test) and 110 control fish were high (Table 3-7). Recovery rates of test and control fish were 93.6% and 90%, respectively. No statistical differences ($P>0.05$) were detected in the overall recovery rates of test and control fish (Appendix Table II-7).

Predation affected the recovery rates of both control and test fish. Control fish suffered a slightly higher rate of predation than test fish (Table 3-7). A 6% predation rate on control fish was confirmed; test fish suffered 3% predation. Three inflated tags and pins without the test fish were recovered, only one inflated tag and pin without the fish was recovered from the control group. The status of only one test and four control fish was unknown. On-site observations suggested that recovery of inflated tags with pins and fish of unknown status were likely victims of predation. Smallmouth bass residing in the pool were responsible for most of the predation. Three smallmouth bass that preyed on tagged fish were recovered when the tags inflated and buoyed them to the surface.

The time to recover fish was short (Table 3-8). It averaged less than 5 minutes for both the test and control fish. Most fish were recovered in less than 4 minutes.

3.2.3 Short-term Survival Rate (≤1 h)

A total of 110 blueback herring were tagged and released over the Crescent Dam and an equal number were tagged and released into the pool below the dam as controls (Table 3-7). Between 20 and 60 fish of each group were released on each day.

The short-term survival rate (≤1 h) of spilled fish was 100% (Table 3-7). No differences (P>0.05) were noted in survival of test and control groups (Appendix Table II-8).

3.2.4 Survival Rates at 24 and 48 hours

All live test and control fish recovered were placed in net pens located above the dam for assessment of long-term effects of spillage (Table 3-7). Survival was high; however, survival decreased between 24 and 48 hours. The 24 hour survival rate was 94.1% and the 48 hour rate was 88.3%. No statistical difference ($P>0.05$) was found between the survival of control and test fish at 24 hours and 48 hours (Appendix Table II-9).

Table 3-6. Length (total) distribution of juvenile blueback herring used for dam spillage survival study at the Crescent Hydroelectric Project, September-October 1991.

	Spillway		
	Control	Test	Total
Length(mm)			
LE 65	-	-	-
70	-	-	-
75	2	-	2
80	14	12	26
85	46	63	109
90	29	20	49
95	6	5	11
100	2	2	4
105	-	1	1
TOTAL	99	103	202
Min Length	74	76	74
Max Length	96	105	105
Mean Length	84.4	84.3	84.3
SD	4.1	4.5	4.3

Table 3-7. Recovery and survival data on test and control juvenile blueback herring spilled over the Crescent Dam for survival study, September-October 1991.

	Test	Control
No. Released	110	110
No. Recovered Live	102	99
No. Recovered Dead	1	0
Tag & Pin Only	3	1
Predation	3	6
Unknown	1	4
No. alive at 24 hours	90	87
No. alive at 48 hours	79	87
Est. Survival rate ($\leq$1 h)	= 100%	
95% CI for immediate survival	94.6 - 100%	
Est. Survival rate at 24 hours	= 94.1%	
95% CI for 24 hours survival rate	84.0 - 100%	
Est. Survival rate at 48 hours	= 88.3%	
95% CI for 48 hour survival rate	75.5 - 100%	

CI = Confidence interval

Table 3-8. Summary statistics on the recovery times (minutes) of test and control juvenile blueback herring for the spillage survival study at the Crescent Dam, September-October 1991.

	Test	Control
Total number recovered	102	99
Mean	4.6	4.9
Standard error	0.24	0.24
Minimum	1.0	1.0
Maximum	12.0	13.0

4.0 DISCUSSION

4.1 Powerhouse/Turbine Passage Survival

Estimates of survival of fish passing through hydroelectric facilities have been very difficult to obtain because of problems associated with handling and collecting the test organisms under the extreme sampling conditions that exist at these facilities. In part, because of this, most previous studies have reported high mortalities. The present study, and recent similar studies, are in direct contrast with those studies. Using a unique tagging-recovery technique, the present study eliminated many of the handling problems and was able to provide more realistic estimates of entrainment survival.

In the present study survival of juvenile blueback herring passing through the powerhouse and Kaplan turbines was estimated to be 96%. These results are similar to those recently reported for clupeids at two other hydro projects with Kaplan turbines (RMC 1991a,c; Heisey et al. 1992). Survival was estimated to be 97% for juvenile American shad immediately following passage at the Safe Harbor Project. This project is located on the Susquehanna River and has Kaplan turbines operating at less than 80 rpm with a net head of approximately 55 ft. Immediate survival for juvenile blueback herring and American shad ranged from 90% to 100% depending on the unit tested and wicket gate openings at the Hadley Falls Project located on the Connecticut River (RMC 1991c). These units have an approximate net head of 45 feet and the Kaplan turbines rotate at approximately 225 rpm.

The results reported in the present study also appear consistent with the survival estimates recently presented by Cada (1990). Although his review of the effects of propellar type turbines primarily focused on ichthyoplankton, it included early juveniles. He stated that mortality attributable to turbine passage would be low, perhaps no more than 5% at a well-designed, well-operated low-head hydroelectric installation with propeller type turbines. Cada suggested that most of the factors that result in mortality can be attributed to direct blade contact, and little mortality is due to injury caused by turbulence, cavitation or pressure changes. The "well-operated" conditions he described were generally met at the Crescent Project, i.e., the turbines were operated near their optimum hydraulic conditions during the test period. Additionally, the turbines turn at a relatively constant slow speed; the clearances between the blades is wide and the project has a relatively low head.

In Cada's (1990) review he provided an equation (attributed to Von Raben 1957) for estimating the probability of an entrained organism being struck by a turbine blade and in turn provide an estimate of entrainment mortality. If applied directly, researchers (Dadswell et al. 1986; Ruggles and Palmeter 1989) have found Van Raben's equation tends to overestimate mortality since blade contact does not always result in mortality. Therefore, they developed a correction factor to derive a mortality estimate. Using the Von Raben's equation with the correction factor for the Crescent operational data during the test period, we estimated mortality to be approximately 4% to 5%, depending upon the size of the organism (60 to 100 mm). This calculated estimate of mortality is virtually the same as the empirically derived estimate in the present study.

Earlier studies on juvenile clupeids have reported substantially lower survivals (conversely higher mortalities) than found in recent studies including the present study. Immediate survival of juvenile clupeids through Kaplan turbines at the Hadley Falls Project was reported to range from 18% to 38% (Kynard et al. 1982). Approximately 95% of the fish in that study were juvenile blueback herring.

Ruggles and Palmeter (1989) reported juvenile alewife (Alosa pseudoharengus) survival of 47%, 46%, and 34% when introduced directly into the turbines at the Tusket River Project (Kaplan), Annapolis Royal (Straflo), and Fourth Lake (tube), respectively. The investigators were unable to explain the apparent low survival of alewife on the basis of turbine design, the turbine operating characteristics, or problems inherent in estimating turbine-induced mortality. However, they believed that survival of juvenile alewife was most likely 86% at each of the projects because the survival of naturally entrained juvenile alewife at the Fourth Lake Project was 86%. Stokesbury and Dadswell (1991) reported a survival of 53% for juvenile clupeids at the Annapolis Royal Project (Straflo).

Generally, the low survival estimates of juvenile clupeids has been explained on the basis of their sensitivity or specific vulnerability to pressure changes (Gloss et al. 1982; Kynard et al. 1982; Stokesbury and Dadswell 1991). However, all these studies utilized nets to recover test and control specimens, and the use of nets for these delicate fish may contribute substantially to these low survival estimates. Test fish are frequently impinged on the nets or abraded against the nets resulting in injuries or mortalities (Gloss et al. 1982; Stokesbury and Dadswell 1991). This generally results in high estimates of mortality for both the test and control fish and makes it difficult to separate sampling mortality from turbine-induced mortality. This problem may be further compounded by low recovery rates of test organisms due to extrusion through the nets, failure to sample the entire turbine flow, predation within nets, or loss of test organisms through holes in damaged nets. Additionally, the high sampling injury and mortality rates also make estimates of long-term survival very difficult (Kynard et al. 1982). These methodological problems have been reported in other entrainment survival studies on juvenile clupeids (Gloss et al. 1982; Stokesbury and Dadswell 1991). Ruggles and Palmeter (1989) concluded that survival of young clupeids in passage through turbines was considerably underestimated in previous investigations, probably resulting from extraneous stresses.

Mortality estimates from netting/mark-recapture studies appear intuitively too high and in conflict with findings on large sized fishes. Since larger fish are more likely to contact turbine blades, mortality of larger fish should exceed that of smaller fish. Bell and Kynard (1985) estimated mortality of post-spawned adult shad (450 - 600 millimeter) in passage through the Hadley Falls Station to be less than 15%. Mortality of Atlantic salmon smolts (210 - 360 millimeter) was estimated to be less than 7% at the Hadley Falls Station (Kynard et al. 1982). This is the same project at which Kynard et al. (1982) reported juvenile clupeid mortality of 62 to 82%. It is interesting to note that the estimated mortality for the post spawned adult American shad and salmon smolts, using radio-tagging technique for both species, is similar to that estimated for the juvenile blueback herring in the present study. Radio telemetry allowed these investigators to know the status (live or dead) of a high proportion of both test species.

The present study avoided many of the problems associated with netting studies and allowed for direct and more accurate estimates of turbine-related effects. Although insertion of the Turb'N Tag does require handling and may result in some injury, our results indicate that it does not cause substantial mortality. The short-term survival of powerhouse/turbine controls was 86.4% in this study; survival of controls for the spillage test was 90%.

The recovery procedures performed well during the present powerhouse/turbine passage study. Over 86% of the fish (test and controls combined) were recovered. This contrasts with some net studies in which recovery rates were sometimes quite low. For example, Kynard et al. (1982) reported average recovery rates for the juvenile clupeids (test fish) less than 6% (2.9 to 5.6%). The reliability of a powerhouse/turbine passage survival estimate is enhanced when investigators can recover a high proportion of fish after turbine passage for direct examination (Burnham et al. 1987).

Some 85.3% of the test fish recaptured alive were alive after 48 hours and a comparable percentage of the controls, 80.6% were alive after 48 hours. The similarity in long-term survival rates of test and control fish suggests that if a fish were captured alive after powerhouse/turbine passage there is a very high probability that it will survive (RMC 1990, 1991a). These delayed mortality data suggest that immediate survival is a good measure of long-term survival (48 hours).

4.2 Spillage Over the Dam

Immediate survival of the juvenile blueback herring that were spilled over the dam was estimated to be 100%. The long-term 48 hour survival rate was 88.3%. During the 48 hour holding period more test fish died than did the controls. This suggests that the test fish may have experienced some additional stress that did not manifest itself immediately.

The survival of juvenile blueback herring spilled over the dam was determined under minimal spillage conditions. This included a spillage of only 40 cfs, only a 12 ft drop, and fish falling into a plunge pool-like environment. Thus, readers are cautioned against using these results for other projects where the net head, spillway configuration, velocities, flow, etc. may not be similar to that at the Crescent Project.

No comparative data exist on survival of clupeids spilled over dams.

It has been hypothesized that spillage should result in higher survival of clupeids than passage through turbines (Taylor and Kynard 1985). The present study suggests that there is little difference in survival between passage through the powerhouse and in spillage over the dam. The overall immediate survival of juvenile blueback herring exposed to the powerhouse/turbine at the Crescent Project was slightly lower than that for herring spilled over the dam, 96% vs. 100% respectively. However, the long-term survival data showed the opposite pattern, higher survival through the Project (96%) than in spillage over the dam (88.3%).

In summary, the present study, and recent similar studies, are in direct contrast with previous studies and their reported high mortalities. Reliable estimates of fish survival, particularly sensitive clupeids, passing through hydroelectric facilities have in the past been very difficult to obtain because of problems associated with handling and collecting the test organisms under the extreme sampling conditions (high velocities, large volumes, and excessive turbulence) that existed at these facilities. These conditions impose significant constraints on the sampling equipment and the ability to collect the test organisms without subjecting them to undue stress, injuries, or mortalities. Earlier entrainment survival studies utilizing nets to recapture the test organisms in the tailrace were unable to avoid these handling and collection induced problems. Many of these studies have reported high mortalities.

Using a unique tagging-recovery technique, the present study eliminated many of the handling problems and was able to provide more realistic estimates of survival of juvenile blueback herring exposed to powerhouse/turbine or spillage over the dam. In general, results from studies using direct tag-recovery technique (e.g. Turb'N Tag, radio-tagging, etc.) indicate that effects of powerhouse/turbine exposure on clupeids are negligible at low head projects with propeller type blades, rotating at slow speeds and large clearances between runner blades.

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APPENDIX I

APPENDIX I

REPORT ON THE PRETEST FOR TURBINE PASSAGE SURVIVAL OF JUVENILE HERRING AT THE CRESCENT HYDROELECTRIC STATION

Prepared For

NEW YORK POWER AUTHORITY

Prepared By

RMC ENVIRONMENTAL SERVICES, INC.

September 1991

REPORT ON THE PRETEST FOR TURBINE PASSAGE SURVIVAL OF JUVENILE HERRING AT THE CRESCENT HYDROELECTRIC STATION

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INTRODUCTION

The New York Power Authority (Authority) funded a phased study to determine survival of juvenile herring exiting the turbines and spillway at the Crescent Hydroelectric Station located on the lower Mohawk River. The scope of work required that the study be progressively phased based on satisfactory completion of each previous phase. The first phase of the study (pretest) was to satisfactorily demonstrate that: (1) RMC could locate, collect, and maintain juvenile herring, (2) effects of tagging will be negligible resulting in survival of ≥80% after tagging, and (3) recovery rates of fish released through an operating turbine and over the spillway will be ≥80%.

The objective of this report is to summarize the results of the Phase I study (pretest) and to demonstrate satisfactory compliance with the three pre-established criteria. The pretest was conducted between 10 and 14 September 1991 at water temperatures of 21.2 to 23.8° C.

Collection and Maintenance of Juvenile Herring

A lift net was used to collect herring from the forebay of the station. It proved effective in collecting large numbers of healthy juvenile herring from the forebay. All 87 herring collected by lift net on 9 September 1991 and held on site in a pool were alive following 72 h of retention. All were in good condition at the end of this period satisfying the first criterion set forth in the study plan. These fish ranged from 61 to 89 mm in total length.

Physical Effects of Turb'N Tag on Juvenile Herring

The second criterion was to carry out handling and Turb'N Tag application procedures that would result in ≥80% survival 48 h after the juvenile herring were tagged. Three different groups of herring were fitted with Turb'N Tags. All fish were collected by lift net. Fish (N=10) in group I were tagged within an hour or two after capture (Table 1). Fish in groups II (N=10) and III (N=20) were tagged approximately 24 and 16 h after collection, respectively. All fish were retained temporarily (5-30 min) in a salt water bath (approximately 0.5%) prior to tagging. Each fish was fitted with a single Turb'N Tag in the dorsal musculature and then placed into a portable pool. Approximately one minute after the activated Turb'N Tag buoyed the fish to the surface, the tag and pin were removed and the fish was returned to the portable pool. Fish from group III were placed into a floating net pen in the forebay.

Group I fish had poor delayed survival (Table 1). Only 10% were alive after 24 h. Fish from group II which were retained 24 h prior to tagging had good survival, 90% were alive 48 h after tagging. The respective survival of group III fish held approximately 16 h prior to tagging and placed into the net pen was 80% and 75% 24 and 48 h after tagging. Twenty untagged fish were also placed into the net pen as a control group for group III. Survival of controls was 95% after 24 and 48 h.

The second criterion in the study plan was met. Turb'N tagged fish retained (16-24 h) prior to tagging had a combined survival rate of 80% (24/30 after 48 h). When survival of the tagged fish (Groups II and III) was adjusted for the survival of controls the estimated survival was 84%.

Group I fish were excluded from the above survival estimates because tagging immediately after capture appears too stressful and resulted in substantial mortality. This procedure will not be used during the subsequent phases of testing.

Water temperatures were near 23° C when most of the fish were tested for determining the effects of tagging. Because delayed survival of tested fish has been shown to be affected by higher water temperatures (RMC 1990), an agreement was reached between RMC and the Authority biologists to postpone the initiation of the full-scale turbine and spillway survival studies until water temperatures approach 18° C. Young herring should respond better to handling and tagging near this temperature and temperature effects should be reduced as a variable in the testing of survival of juvenile herring.

Recovery Rates

The third criterion of the pretest was to demonstrate that test procedures would enable ≥80% recovery of tagged herring passed through an operating turbine and spilled over the dam. Initial recovery tests were conducted at Unit 4 on 13 September 1991, which was operating near full capacity. Six of ten fish passed through this unit were recovered (Table 2). Only Turb'N Tags and pins were recovered from two other fish and nothing was sighted for the remaining two fish.

Two additional fish were released by hand into an eddy area along the east side of Unit 4 discharge. One fish was recovered, only the tag and pin were recovered for the other fish. Anglers were observed catching many smallmouth bass along the east side of the discharge from Unit 4. This area consists of a narrow spit of land, large boulders, and a distinct eddy, which is prime smallmouth bass habitat. It appears that predation may have contributed to the low recovery (60%) of fish passed through this unit.

Because of the low recovery rate (60%) of fish at Unit 4, it was decided to test recovery of fish passed through Unit 3. This unit appeared more favorable because it discharges towards the center of the tailrace and further removed from the prime smallmouth bass habitat. Recovery tests were conducted at Unit 3 on 14 September 1991 while the unit was operating near full capacity. Eight of the ten fish passed through Unit 3 were recovered and all were alive >1 h following capture (Table 2). Based on the Unit 3 testing the third criteria of ≥80% recovery for test fish passed through an operating unit was achieved. Since this portion of the pretest was not designed to test survival beyond one hour, no attempt was made to hold fish for a longer period.

Ten juvenile herring were also released over the spillway on 14 September 1991 to determine if ≥80% recovery rate was attainable with the established testing procedures. Ninety percent (9 of 10) of the fish were recovered and only a Turb'N

Tag and pin were found for the remaining fish (Table 2). Eight of the recovered fish appeared in good condition and the remaining fish had marks in the tail region and showed signs of stress. This fish died within 1 h of capture.

Water Quality Monitoring

Dissolved oxygen (DO) and water temperature (C) were monitored twice daily at the Crescent Hydroelectric Station from 10 through 14 September 1991. Measurements were taken in the morning and afternoon at three locations: the forebay about 10 m in front of the Unit 4 intake, the tailrace off the gallery of Unit 4, and in the primary holding pool for herring. All readings were taken after the DO meter was calibrated.

DO ranged from 5.05 to 8.90 mg/l in the forebay area, 5.60 to 7.75 mg/l in the tailrace, and 6.15 to 8.95 mg/l in the primary holding pool (Table 3). Readings were generally higher in the pool, and showed an increase of 1 to 2 mg/l between morning and afternoon readings. Water temperature ranged from 21.2 to 23.3° C in the forebay, 21.2 to 23.3° C in the tailrace, and 21.0 to 23.8° C in the primary holding pool. As with DO, water temperature varied about 1° C over the course of the day. Variation in measurements between the forebay and tailrace were usually associated with the operation of Unit 4, but are considered inconsequential. The average DO and temperature was 6.83 mg/l and 22.49° C in the forebay vs. 6.76 mg/l and 22.51° C in the tailrace.

Plans For Full-Scale Study

The procedures that provided satisfactory results during the pretest will be implemented during the actual field test at a turbine and the spillway (Phases II and III). Unit 3 will be tested since predation rate appears less here than at Unit 4. Predation in the tailrace and spill pool area will be accounted for by releasing control specimens into these areas near the point where test fish are discharged after passing through a turbine or coming over the dam.

Measurement of DO and water temperature during Phase II (turbine survival) and Phase III (spillway survival) will continue twice daily in the forebay and tailrace of the station.

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TABLE 1

Summary of Turb'N Tag effects on young herring performed as part of the pretest at the Crescent Hydroelectric Station, 10 through 14 September 1991.

Test Lot	Date Tagged	No. Tagged	Holding Time(h) Before Tagging	Survival %	
				24 h	48 h
Group I	10 Sep	10	1-2	10	-
Group II	11 Sep	10	24	100	90
Group III	12 Sep	20	16	80	75
Untagged Controls for Group III	12 Sep	20	16	95	95

TABLE 2

Recovery rates of juvenile herring passed through a turbine or over the spillway as part of the pretest at the Crescent Hydroelectric Station on 13 and 14 September 1991.

Test Location	Date Tagged	No. Tagged	No. Recovered Fish	Tags Only	Unknown	Recovery Rate(%)
Unit 4	13 Sep	10	6	2	2	60
Unit 3	14 Sep	10	8	1	1	80
Spillway	14 Sep	10	9	1	-	90

TABLE 3

Summary of dissolved oxygen and water temperature data recorded at three locations at the Crescent Hydroelectric Station on the Mohawk River, New York, 10 through 14 September 1991.

Location	Date	Dissolved Oxygen(mg/l)		Water Temperature (C)	
		Morning	Afternoon	Morning	Afternoon
Forebay	10 Sep	6.50	7.65	22.5	23.0
	11 Sep	6.40	8.35	23.0	23.3
	12 Sep	5.05	7.25	22.1	23.0
	13 Sep	6.35	6.15	21.5	22.2
	14 Sep	5.70	8.90	21.2	23.1
Tailrace	10 Sep	6.25	7.75	22.5	23.0
	11 Sep	6.30	7.60	23.0	23.3
	12 Sep	5.60	7.60	22.3	23.0
	13 Sep	5.80	7.35	21.8	22.5
	14 Sep	5.75	7.60	21.2	22.5
Pool	10 Sep	6.85	8.00	22.7	23.3
	11 Sep	7.40	8.95	23.0	23.8
	12 Sep	6.70	7.95	22.8	23.3
	13 Sep	6.60	7.55	21.0	23.1
	14 Sep	6.15	*	21.0	*

* = Not available, experiment completed.

APPENDIX II

APPENDIX TABLE II-1

Condition codes assigned to fish and Turb'N Tags upon recovery during a fish passage survival study.

Codes
FISH
A = No visible marks on fish
B = Flesh tear at tagging site(s)
C = Minor scale loss, <25%
D = Major scale loss, >25%
E = Laceration(s); Tear(s)
F = Severed body parts
G = Hemorrhaging, bruised
H = Stressed
I = Spastic movement
J = Very weak, died within 15 minutes
K = Fish failed to enter system
P = Not recovered, predated
Q = Other information
T = Trapped inside tunnel/gate well
V = Stationary radio tag signal, Turb'N Tag(s) recovered, fish not recovered
W = Sighted swimming in tailrace, good condition, not recovered
X = Active radio tag signal, fish not recovered
Y = Turb'N Tag(s) recovered without fish
Z = No Turb'N Tag(s) recovered and/or no radio signal received
TURB'N TAG
A = Fully inflated
B = Partially inflated
C = Pinhole, leaking
D = Burst
E = Not inflated at all
X = Detached from fish

APPENDIX TABLE II-2.

Short-term turbine passage survival data on individual juvenile blueback herring released into turbine No.3 (test fish) or tailrace (control fish) and released into the dam spillage (test fish) or into the spill pool (control fish) at the Crescent Hydro Project, September - October, 1991. Fish were tagged with RMC's HI-Z Turb-N tags.
Description of condition codes are presented in Appendix Table II-1.

Fish No.	TIME				Turb-N Tag Data			Fish Data		
	Tagged	Re-leased	Re-covered	At Large (min.)	No. Tag-ged	No. Re-covered	Condi-tion Codes	Alive/ Dead	Condition Codes	Comments
	28 September 1991 - LOT 29 TEST - SPILLAGE SITE - WATER TEMP 16.7 C									
* 2	13:57	13:58	.	.	1	0		PREYED ON	P	gull predation
3	14:02	14:03	14:08	5	1	1	A	ALIVE	A	
4	14:05	14:06	14:13	7	1	1	A	ALIVE	A	
5	14:08	14:09	14:11	2	1	1	A	ALIVE	A	
6	14:11	14:14	14:23	9	1	1	A	ALIVE	C	
7	14:15	14:17	14:20	3	1	1	A	ALIVE	C	
8	14:18	14:25	14:34	9	1	1	A	ALIVE	A	
* 10	14:39	14:41	14:45	4	1	1	A	ALIVE	A	
11	14:42	14:43	14:50	7	1	1	XA	DEAD	Y	
12	14:44	14:46	14:51	5	1	1	A	ALIVE	A	
13	14:52	14:54	14:59	5	1	1	A	ALIVE	A	
14	14:56	14:57	15:02	5	1	1	A	ALIVE	C	
15	14:59	15:01	15:07	6	1	1	A	ALIVE	A	
16	15:03	15:03	15:05	2	1	1	A	ALIVE	A	
17	15:07	15:09	15:12	3	1	1	A	ALIVE	A	
18	15:10	15:11	15:14	3	1	1	A	ALIVE	A	
19	15:12	15:13	15:17	4	1	1	A	ALIVE	A	
20	15:16	15:17	15:23	6	1	1	A	ALIVE	A	
21	15:22	15:23	15:28	5	1	1	A	ALIVE	A	
22	15:25	15:27	15:35	8	1	1	A	ALIVE	A	

APPENDIX TABLE II-2. Continued.

Fish No.	TIME: Tagged	TIME: Re-leased	TIME: Re-covered	TIME: At Large (min.)	Turb-N Tag Data: No. Tag-ged	Turb-N Tag Data: No. Re-covered	Turb-N Tag Data: Condi-tion Codes	Fish Data: Alive/ Dead	Fish Data: Condition Codes	Fish Data: Comments
28 September 1991 - LOT 30 CONTROL - SPILLAGE SITE - WATER TEMP 16.7 C										
1	15:58	15:59	16:01	2	1	1	A	ALIVE	A	
2	16:00	16:01	16:09	8	1	1	A	ALIVE	A	
3	16:11	16:13	16:14	1	1	1	A	ALIVE	A	
4	16:14	16:15	16:17	2	1	1	A	ALIVE	A	
5	16:16	16:17	16:24	7	1	1	CX	DEAD	Y	
6	16:18	16:19	16:23	4	1	1	A	ALIVE	A	
7	16:20	16:22	16:29	7	1	1	A	ALIVE	A	
8	16:23	16:26	16:30	4	1	1	B	ALIVE	C	
9	16:27	16:30	16:37	7	1	1	XA	PREYED ON	P	fish predation
10	16:32	16:33	16:41	8	1	1	A	ALIVE	A	
11	16:33	16:35	16:40	5	1	1	A	ALIVE	A	
12	16:38	16:39	16:42	3	1	1	B	ALIVE	A	
13	16:42	16:43	16:47	4	1	1	A	ALIVE	C	
14	16:56	16:57	17:04	7	1	1	A	ALIVE	A	
15	16:58	16:59	17:00	1	1	1	B	ALIVE	A	
16	17:00	17:00	17:02	2	1	1	A	ALIVE	A	
17	17:02	17:02	17:06	4	1	1	A	ALIVE	A	
18	17:04	17:05	17:10	5	1	1	A	ALIVE	A	
19	17:06	17:07	17:11	4	1	1	A	ALIVE	A	
20	17:08	17:09	17:14	5	1	1	A	ALIVE	A	
1 October 1991 - LOT 35 TEST - SPILLAGE SITE - WATER TEMP 14.5 C										
1	10:06	10:07	10:12	5	1	1	XA	DEAD	VQ	possible prey

APPENDIX TABLE II-2. Continued.

Fish No.	TIME				Turb-N Tag Data			Fish Data		
	Tagged	Re-leased	Re-covered	At Large (min.)	No. Tag-ged	No. Re-covered	Condi-tion Codes	Alive/ Dead	Condition Codes	Comments
2	10:07	10:08	10:17	9	1	1	A	ALIVE	A	
3	10:09	10:16	10:28	12	1	1	A	ALIVE	A	
4	10:17	10:18	10:24	6	1	1	A	ALIVE	C	
5	10:26	10:28	10:30	2	1	1	A	ALIVE	A	
6	10:30	10:30	10:32	2	1	1	A	ALIVE	A	
7	10:32	10:33	10:35	2	1	1	B	ALIVE	A	
8	10:36	10:38	10:42	4	1	1	B	ALIVE	A	
9	10:41	10:41	10:44	3	1	1	A	ALIVE	A	
10	10:42	10:43	10:46	3	1	1	B	ALIVE	A	
11	10:46	10:47	10:54	7	1	1	B	ALIVE	A	
12	11:04	11:04	11:13	9	1	1	B	ALIVE	A	
13	11:06	11:07	11:15	8	1	1	B	ALIVE	A	
14	11:17	11:18	11:23	5	1	1	B	ALIVE	HC	
15	11:20	11:20	11:26	6	1	1	A	ALIVE	A	
17	11:26	11:27	11:29	2	1	1	B	ALIVE	A	
18	11:29	11:29	11:34	5	1	1	B	ALIVE	A	
19	11:30	11:31	11:33	2	1	1	B	ALIVE	A	
20	11:32	11:33	11:40	7	1	1	A	ALIVE	A	
21	11:36	11:36	11:40	4	1	1	A	ALIVE	A	
22	11:37	11:38	11:42	4	1	1	A	ALIVE	A	
23	11:42	11:43	11:49	6	1	1	B	ALIVE	A	
24	11:44	11:45	11:52	7	1	1	B	ALIVE	A	
25	11:45	11:46	11:56	10	1	1	B	ALIVE	A	
26	11:48	11:49	11:59	10	1	1	B	ALIVE	C	

APPENDIX TABLE II-2. Continued.

Fish No.	TIME				Turb-N Tag Data			Fish Data		
	Tagged	Re-leased	Re-covered	At Large (min.)	No. Tag-ged	No. Re-covered	Condi-tion Codes	Alive/ Dead	Condition Codes	Comments
27	11:56	11:57	11:59	2	1	1	B	ALIVE	A	
28	11:58	11:58	12:07	9	1	1	B	ALIVE	A	
* 30	12:10	12:11	12:12	1	1	1	B	ALIVE	A	
31	12:12	12:12	12:21	9	1	1	A	ALIVE	A	
32	12:18	12:19	12:26	7	1	1	B	ALIVE	A	
	1 October 1991 - LOT 37 CONTROL - SPILLAGE SITE - WATER TEMP 14.5 C									
1	17:02	17:04	17:11	7	1	1	B	ALIVE	A	
2	17:05	17:06	.	.	1	1	XA	PREYED ON	QP	fish predation
3	17:07	17:08	17:14	6	1	1	B	ALIVE	A	
4	17:08	17:09	17:13	4	1	1	B	ALIVE	A	
5	17:14	17:14	17:18	4	1	1	B	ALIVE	A	
6	17:17	17:18	17:20	2	1	1	B	ALIVE	A	
7	17:18	17:19	17:25	6	1	1	B	ALIVE	A	
8	17:21	17:22	17:24	2	1	1	B	ALIVE	A	
9	17:24	17:24	17:37	13	1	1	A	ALIVE	A	
10	17:25	17:26	17:29	3	1	1	B	ALIVE	A	
11	17:27	17:28	17:29	1	1	1	A	ALIVE	A	
12	17:29	17:30	17:41	11	1	1	A	ALIVE	A	
13	17:32	17:33	17:35	2	1	1	B	ALIVE	A	
14	17:34	17:34	17:40	6	1	1	B	ALIVE	A	
15	17:35	17:36	.	.	1	0		UNKN	Z	
16	17:38	17:39	17:46	7	1	1	B	ALIVE	A	
17	17:41	17:41	17:58	17	1	1	A	PREYED ON	PQ	fish predation
18	17:42	17:43	17:50	7	1	1	B	ALIVE	A	

APPENDIX TABLE II-2. Continued.

Fish No.	TIME				Turb-N Tag Data			Fish Data		
	Tagged	Re-leased	Re-covered	At Large (min.)	No. Tag-ged	No. Re-covered	Condi-tion Codes	Alive/ Dead	Condition Codes	Comments
19	17:47	17:49	17:55	6	1	1	B	ALIVE	A	
20	17:51	17:52	17:58	6	1	1	B	ALIVE	A	
21	18:01	18:01	18:04	3	1	1	B	ALIVE	A	
** 22	9:49	9:50	9:56	6	1	1	B	ALIVE	A	
23	9:51	9:52	10:01	9	1	1	B	ALIVE	A	
24	9:52	9:53	10:00	7	1	1	B	ALIVE	A	
25	9:54	9:54	10:06	12	1	1	B	ALIVE	A	
26	9:55	9:56	10:02	6	1	1	B	ALIVE	A	
27	10:03	10:03	10:07	4	1	1	B	ALIVE	A	
28	10:04	10:05	10:15	10	1	1	B	ALIVE	A	
29	10:07	10:08	10:09	1	1	1	B	ALIVE	A	
30	10:09	10:09	10:14	5	1	1	XB	PREYED ON	PQ	fish predation
	2 October 1991 - LOT 38 TEST - TURBINE SITE - WATER TEMP 15.0 C									
1	11:10	11:11	11:16	5	1	1	B	ALIVE	H	
2	11:20	11:20	11:25	5	1	1	XB	DEAD	Y	
3	11:23	11:24	11:27	3	1	1	XB	DEAD	Y	
4	11:34	11:35	11:36	1	1	1	B	ALIVE	A	
5	11:36	11:37	11:42	5	1	1	B	ALIVE	CG	
6	11:42	11:43	11:48	5	1	1	B	ALIVE	A	
7	11:45	11:46	11:48	2	1	1	B	ALIVE	A	
8	11:49	11:50	11:56	6	1	1	A	ALIVE	A	
9	11:51	11:52	11:53	1	1	1	A	ALIVE	A	
10	11:53	11:54	11:59	5	1	1	A	ALIVE	A	
11	11:57	11:57	12:04	7	1	1	XB	PREYED ON	PQ	gull predation

APPENDIX TABLE II-2. Continued.

Fish No.	TIME				Turb-N Tag Data			Fish Data		
	Tagged	Re-leased	Re-covered	At Large (min.)	No. Tag-ged	No. Re-covered	Condi-tion Codes	Alive/ Dead	Condition Codes	Comments
12	11:59	12:00	12:10	10	1	1	A	DEAD	CE	
13	12:03	12:03	12:05	2	1	1	XB	DEAD	Y	
14	12:07	12:07	12:13	6	1	1	A	ALIVE	G	
15	12:10	12:10	12:14	4	1	1	B	ALIVE	C	
16	12:13	12:13	12:25	12	1	1	A	ALIVE	B	
17	12:17	12:18	12:22	4	1	1	A	ALIVE	A	
18	12:21	12:22	12:37	15	1	1	XA	PREYED ON	PQ	gull predation
19	12:43	12:43	12:46	3	1	1	A	ALIVE	A	
20	12:45	12:46	12:47	1	1	1	B	ALIVE	A	
21	12:47	12:48	13:00	12	1	1	A	ALIVE	A	
22	12:49	12:49	12:55	6	1	1	A	ALIVE	A	
23	12:54	12:54	12:58	4	1	1	B	ALIVE	A	
24	12:57	12:58	13:02	4	1	1	A	ALIVE	H	
25	13:02	13:02	13:13	11	1	1	XA	PREYED ON	PQ	gull predation
2 October 1991 - LOT 39 CONTROL - TURBINE SITE - WATER TEMP 15.0 C										
1	14:58	14:58	15:02	4	1	1	XB	DEAD	Y	
2	15:02	15:02	.	.	1	0		UNKN	Z	
3	15:03	15:04	15:11	7	1	1	A	ALIVE	A	
4	15:05	15:06	15:11	5	1	1	B	ALIVE	A	
5	15:14	15:15	15:19	4	1	1	A	ALIVE	A	
6	15:17	15:17	15:22	5	1	1	A	ALIVE	A	
7	15:22	15:23	15:29	6	1	1	A	ALIVE	A	
8	15:24	15:24	15:27	3	1	1	B	ALIVE	A	
9	15:26	15:27	15:34	7	1	1	A	ALIVE	A	

APPENDIX TABLE II-2. Continued.

Fish No.	TIME				Turb-N Tag Data			Fish Data		
	Tagged	Re-leased	Re-covered	At Large (min.)	No. Tag-ged	No. Re-covered	Condi-tion Codes	Alive/ Dead	Condition Codes	Comments
10	15:31	15:31	15:39	8	1	1	B	ALIVE	A	
11	15:33	15:33	15:39	6	1	1	B	ALIVE	A	
12	15:34	15:35	15:55	20	1	1	A	ALIVE	H	
13	15:36	15:36	15:44	8	1	1	B	ALIVE	C	
14	15:50	15:50	15:55	5	1	1	XB	DEAD	Y	
15	15:51	15:52	15:57	5	1	1	A	ALIVE	A	
16	15:57	15:58	16:03	5	1	1	A	ALIVE	A	
17	16:01	16:01	16:05	4	1	1	A	ALIVE	G	
18	16:12	16:13	16:19	6	1	1	A	ALIVE	A	
19	16:14	16:15	16:19	4	1	1	A	ALIVE	A	
20	16:17	16:17	16:21	4	1	1	B	ALIVE	A	
21	16:18	16:19	16:25	6	1	1	B	ALIVE	A	
22	16:21	16:22	16:28	6	1	1	A	ALIVE	C	
23	16:24	16:25	16:29	4	1	1	A	ALIVE	G	
24	16:26	16:26	16:36	10	1	1	A	ALIVE	A	
25	16:30	16:30	16:50	20	1	1	A	ALIVE	A	
	3 October 1991 - LOT 40 CONTROL - TURBINE SITE - WATER TEMP 15.5 C									
1	9:03	9:04	9:13	9	1	1	B	ALIVE	A	
2	9:05	9:06	9:07	1	1	1	B	ALIVE	A	
3	9:07	9:08	9:50	42	1	1	A	ALIVE	A	
4	9:10	9:11	.	.	1	1	XB	DEAD	Y	
5	9:13	9:14	9:19	5	1	1	A	ALIVE	A	
6	9:19	9:22	9:26	4	1	1	A	ALIVE	A	
7	9:23	9:24	9:30	6	1	1	A	ALIVE	A	

APPENDIX TABLE II-2. Continued.

Fish No.	TIME: Tagged	TIME: Re-leased	TIME: Re-covered	TIME: At Large (min.)	Turb-N Tag Data: No. Tag-ged	Turb-N Tag Data: No. Re-covered	Turb-N Tag Data: Condi-tion Codes	Fish Data: Alive/ Dead	Fish Data: Condition Codes	Fish Data: Comments
8	9:26	9:26	9:32	6	1	1	A	ALIVE	A	
9	9:28	9:30	9:36	6	1	1	A	ALIVE	A	
10	9:33	9:34	9:45	11	1	1	A	ALIVE	A	
11	9:36	9:37	9:40	3	1	1	A	ALIVE	A	
12	9:51	9:52	10:01	9	1	1	B	ALIVE	A	
13	9:52	9:53	9:56	3	1	1	B	ALIVE	A	
14	9:54	9:55	10:08	13	1	1	A	ALIVE	G	
15	9:55	9:56	10:02	6	1	1	B	ALIVE	A	
16	9:58	9:58	10:01	3	1	1	B	ALIVE	A	
17	10:01	10:02	10:05	3	1	1	B	ALIVE	A	
18	10:02	10:03	10:12	9	1	1	A	ALIVE	A	
19	10:04	10:05	10:15	10	1	1	XB	DEAD	Y	
20	10:07	10:07	10:13	6	1	1	B	ALIVE	A	
21	10:09	10:09	10:19	10	1	1	XB	DEAD	Y	
22	10:17	10:17	10:20	3	1	1	B	ALIVE	A	
23	10:18	10:18	10:24	6	1	1	B	ALIVE	C	
24	10:20	10:21	.	.	1	0		UNKN	Z	
25	10:23	10:24	10:27	3	1	1	A	ALIVE	A	
26	16:27	16:27	16:34	7	1	1	A	ALIVE	A	
27	16:28	16:29	16:39	10	1	1	A	ALIVE	A	
28	16:30	16:31	16:37	6	1	1	XB	DEAD	YQ	possible prey
29	16:33	16:33	16:35	2	1	1	XA	DEAD	YQ	possible prey
30	16:42	16:42	16:43	1	1	1	A	ALIVE	A	
31	16:43	16:44	.	.	1	0		UNKN	Z	

APPENDIX TABLE II-2. Continued.

Fish No.	TIME				Turb-N Tag Data			Fish Data		
	Tagged	Re-leased	Re-covered	At Large (min.)	No. Tag-ged	No. Re-covered	Condi-tion Codes	Alive/ Dead	Condition Codes	Comments
32	16:46	16:47	16:49	2	1	1	B	ALIVE	A	
33	16:48	16:49	17:26	37	1	1	XA	PREYED ON	P	gull predation
34	16:50	16:51	16:53	2	1	1	B	ALIVE	A	
35	17:05	17:07	17:13	6	1	1	A	ALIVE	A	
	3 October 1991 - LOT 41 TEST - TURBINE SITE - WATER TEMP 15.5 C									
1	11:05	11:06	11:08	2	1	1	A	ALIVE	A	
2	11:11	11:12	11:19	7	1	1	B	ALIVE	A	
3	11:13	11:13	11:16	3	1	1	B	ALIVE	A	
4	11:14	11:15	11:24	9	1	1	B	ALIVE	A	
5	11:17	11:18	11:28	10	1	1	B	ALIVE	A	
6	11:21	11:22	11:26	4	1	1	B	ALIVE	A	
7	11:25	11:26	.	.	1	0		UNKN	Z	
8	11:30	11:31	11:35	4	1	1	B	ALIVE	A	
9	11:33	11:33	11:37	4	1	1	XA	DEAD	Y	
10	11:39	11:40	11:50	10	1	1	B	ALIVE	A	
11	11:44	11:45	11:50	5	1	1	B	ALIVE	A	
12	11:56	11:56	11:58	2	1	1	B	ALIVE	CH	
13	12:13	12:14	12:19	5	1	1	B	ALIVE	A	
14	12:15	12:16	12:21	5	1	1	B	ALIVE	HG	
15	12:18	12:18	12:22	4	1	1	B	ALIVE	A	
16	12:19	12:20	.	.	1	0		UNKN	Z	
17	12:29	12:30	12:36	6	1	1	B	ALIVE	A	
18	12:32	12:33	12:36	3	1	1	A	ALIVE	A	
19	12:34	12:35	12:42	7	1	1	B	ALIVE	A	

APPENDIX TABLE II-2. Continued.

Fish No.	TIME				Turb-N Tag Data			Fish Data		
	Tagged	Re-leased	Re-covered	At Large (min.)	No. Tag-ged	No. Re-covered	Condi-tion Codes	Alive/ Dead	Condition Codes	Comments
20	12:40	12:41	12:44	3	1	1	B	ALIVE	A	
21	12:42	12:43	12:46	3	1	1	B	ALIVE	A	
22	12:43	12:45	12:48	3	1	1	B	ALIVE	A	
23	12:47	12:48	12:57	9	1	1	A	ALIVE	A	
24	12:49	12:50	12:52	2	1	1	B	ALIVE	A	
25	12:50	12:51	12:58	7	1	1	B	ALIVE	A	
26	14:53	14:54	14:59	5	1	1	B	ALIVE	A	
27	14:55	14:56	15:02	6	1	1	A	ALIVE	A	
28	15:29	15:30	15:32	2	1	1	A	ALIVE	A	
29	15:31	15:32	15:36	4	1	1	XA	DEAD	Y	
30	15:34	15:36	15:37	1	1	1	B	ALIVE	A	
31	15:37	15:38	15:40	2	1	1	B	ALIVE	A	
32	15:40	15:41	15:43	2	1	1	B	ALIVE	A	
33	15:44	15:45	15:46	1	1	1	XB	DEAD	Y	
34	15:46	15:48	15:55	7	1	1	B	ALIVE	A	
35	15:56	15:57	16:04	7	1	1	XB	DEAD	Y	
		4 October 1991 - LOT 42 TEST - TURBINE SITE - WATER TEMP 16.5 C								
1	10:53	10:55	10:58	3	1	1	B	ALIVE	A	
2	10:58	10:59	11:04	5	1	1	B	ALIVE	A	
3	11:00	11:01	11:14	13	1	1	A	ALIVE	C	
4	11:04	11:05	11:12	7	1	1	XA	DEAD	Y	
5	11:06	11:08	11:12	4	1	1	B	ALIVE	A	
6	11:15	11:16	11:18	2	1	1	B	ALIVE	C	
7	11:19	11:19	11:22	3	1	1	B	ALIVE	C	

APPENDIX TABLE II-2. Continued.

Fish No.	TIME				Turb-N Tag Data			Fish Data		
	Tagged	Re-leased	Re-covered	At Large (min.)	No. Tag-ged	No. Re-covered	Condi-tion Codes	Alive/ Dead	Condition Codes	Comments
8	11:20	11:21	11:26	5	1	1	B	ALIVE	C	
9	11:34	11:36	11:39	3	1	1	B	ALIVE	C	
10	11:39	11:39	11:48	9	1	1	A	ALIVE	C	
11	11:52	11:53	11:56	3	1	1	XB	DEAD	Y	
12	11:55	11:56	12:00	4	1	1	B	ALIVE	C	
13	11:59	12:00	12:06	6	1	1	B	ALIVE	A	
14	12:04	12:04	12:11	7	1	1	A	ALIVE	A	
15	12:06	12:07	12:12	5	1	1	A	ALIVE	C	
16	12:08	12:09	12:20	11	1	1	B	ALIVE	C	
17	12:10	12:11	12:15	4	1	1	B	ALIVE	A	
18	12:15	12:15	.	.	1	1	XB	DEAD	Y	
19	12:18	12:19	12:25	6	1	1	B	ALIVE	C	
20	12:20	12:22	12:29	7	1	1	B	ALIVE	A	
21	12:29	12:30	12:32	2	1	1	B	ALIVE	C	
22	12:32	12:33	12:38	5	1	1	A	ALIVE	A	
23	12:33	12:35	12:38	3	1	1	A	ALIVE	C	
24	12:42	12:43	12:51	8	1	1	A	ALIVE	A	
25	12:43	12:44	12:47	3	1	1	A	ALIVE	A	
26	12:48	12:48	12:53	5	1	1	A	ALIVE	A	
27	12:50	12:50	12:57	7	1	1	A	ALIVE	A	
28	12:56	12:56	13:03	7	1	1	B	ALIVE	A	
29	12:58	12:59	13:01	2	1	1	A	ALIVE	A	
30	13:01	13:02	13:09	7	1	1	B	ALIVE	A	
31	13:13	13:13	.	.	1	0		PREYED ON	QP	gull predation

APPENDIX TABLE II-2. Continued.

Fish No.	TIME				Turb-N Tag Data			Fish Data		
	Tagged	Re- leased	Re- covered	At Large (min.)	No. Tag- ged	No. Re- covered	Condi- tion Codes	Alive/ Dead	Condition Codes	Comments
32	13:15	13:15	13:20	5	1	1	B	ALIVE	A	
33	13:17	13:18	13:23	5	1	1	A	ALIVE	A	
34	13:19	13:20	13:27	7	1	1	B	ALIVE	A	
35	13:23	13:23	.	.	1	1	XA	DEAD	Y	
4 October 1991 - LOT 43 CONTROL - TURBINE SITE - WATER TEMP 16.0 C										
1	15:04	15:05	15:11	6	1	1	A	ALIVE	A	
2	15:07	15:07	15:09	2	1	1	B	ALIVE	C	
3	15:09	15:10	15:13	3	1	1	B	ALIVE	A	
4	15:11	15:12	15:18	6	1	1	B	ALIVE	A	
6	15:20	15:20	15:24	4	1	1	B	ALIVE	A	
5	15:21	15:22	15:27	5	1	1	A	ALIVE	A	
7	15:23	15:23	15:28	5	1	1	B	ALIVE	A	
8	15:27	15:28	15:34	6	1	1	A	ALIVE	A	
9	15:29	15:30	15:39	9	1	1	B	ALIVE	A	
10	15:31	15:32	15:37	5	1	1	B	ALIVE	A	
11	15:34	15:34	15:55	21	1	1	A	ALIVE	A	
12	15:36	15:37	15:41	4	1	1	A	ALIVE	A	
13	15:40	15:40	15:51	11	1	1	B	ALIVE	A	
14	15:55	15:56	15:59	3	1	1	B	ALIVE	A	
15	15:58	15:58	16:01	3	1	1	B	ALIVE	A	
16	16:00	16:01	16:05	4	1	1	B	ALIVE	A	
17	16:05	16:05	16:07	2	1	1	B	ALIVE	A	
18	16:10	16:11	16:17	6	1	1	B	ALIVE	A	
19	16:12	16:13	16:24	11	1	1	A	ALIVE	A	

APPENDIX TABLE II-2. Continued.

Fish No.	TIME				Turb-N Tag Data			Fish Data		
	Tagged	Re-leased	Re-covered	At Large (min.)	No. Tag-ged	No. Re-covered	Condi-tion Codes	Alive/ Dead	Condition Codes	Comments
20	16:15	16:16	16:29	13	1	1	A	ALIVE	A	
21	16:17	16:18	16:36	18	1	1	A	ALIVE	A	
22	16:22	16:23	.	.	1	0		UNKN	Z	
23	16:44	16:46	16:49	3	1	1	B	ALIVE	A	
24	16:47	16:48	16:57	9	1	1	A	ALIVE	C	
25	16:49	16:50	16:59	9	1	1	A	ALIVE	A	
26	16:51	16:53	16:59	6	1	1	B	ALIVE	C	
27	17:00	17:01	17:11	10	1	1	A	ALIVE	A	
28	17:03	17:03	17:10	7	1	1	A	ALIVE	C	
29	17:04	17:05	17:13	8	1	1	XB	DEAD	Y	
30	17:08	17:08	17:13	5	1	1	A	ALIVE	A	
31	17:09	17:11	17:25	14	1	1	A	ALIVE	C	
33	17:18	17:19	17:26	7	1	1	A	ALIVE	A	
32	17:19	17:20	17:26	6	1	1	A	ALIVE	A	
34	17:32	17:33	17:37	4	1	1	B	ALIVE	C	
35	17:33	17:34	17:38	4	1	1	A	ALIVE	A	
5 October 1991 - LOT 44 CONTROL - SPILLAGE SITE - WATER TEMP 16.5 C										
1	10:26	10:26	10:28	2	1	1	A	ALIVE	A	
2	10:28	10:29	10:35	6	1	1	A	ALIVE	A	
3	10:31	10:31	10:37	6	1	1	A	ALIVE	A	
4	10:33	10:34	10:39	5	1	1	A	ALIVE	A	
5	10:36	10:36	10:43	7	1	1	A	ALIVE	A	
6	10:38	10:39	10:45	6	1	1	B	ALIVE	A	
7	10:41	10:42	.	.	1	0		UNKN	Z	

APPENDIX TABLE II-2. Continued.

Fish No.	TIME				Turb-N Tag Data			Fish Data		
	Tagged	Re-leased	Re-covered	At Large (min.)	No. Tag-ged	No. Re-covered	Condi-tion Codes	Alive/ Dead	Condition Codes	Comments
8	10:45	10:46	10:53	7	1	1	B	ALIVE	A	
9	10:50	10:51	10:58	7	1	1	A	ALIVE	A	
10	10:53	10:53	11:00	7	1	1	A	ALIVE	A	
11	10:55	10:55	11:02	7	1	1	XA	PREYED ON	QP	fish predation
12	11:01	11:01	11:03	2	1	1	B	ALIVE	A	
13	11:06	11:07	11:10	3	1	1	B	ALIVE	A	
14	11:09	11:10	11:14	4	1	1	A	ALIVE	A	
15	11:17	11:17	11:23	6	1	1	A	ALIVE	A	
16	11:18	11:19	11:24	5	1	1	A	ALIVE	A	
17	11:20	11:20	11:25	5	1	1	XA	PREYED ON	QP	fish predation
18	11:22	11:22	11:28	6	1	1	B	ALIVE	A	
19	11:27	11:27	11:29	2	1	1	B	ALIVE	A	
20	11:28	11:28	11:33	5	1	1	B	ALIVE	A	
21	11:34	11:34	11:37	3	1	1	A	ALIVE	A	
22	11:35	11:36	11:40	4	1	1	B	ALIVE	A	
23	11:38	11:38	11:43	5	1	1	A	ALIVE	A	
24	11:40	11:41	11:45	4	1	1	A	ALIVE	A	
25	11:42	11:43	11:45	2	1	1	B	ALIVE	A	
26	11:44	11:44	11:49	5	1	1	B	ALIVE	A	
27	11:46	11:47	11:51	4	1	1	A	ALIVE	A	
28	11:50	11:51	11:55	4	1	1	A	ALIVE	A	
29	11:52	11:52	.	.	1	0		UNKN	Z	
30	11:54	11:54	11:59	5	1	1	B	ALIVE	A	
31	12:01	12:01	12:04	3	1	1	A	ALIVE	A	

APPENDIX TABLE II-2. Continued.

Fish No.	TIME				Turb-N Tag Data			Fish Data		
	Tagged	Re-leased	Re-covered	At Large (min.)	No. Tag-ged	No. Re-covered	Condi-tion Codes	Alive/ Dead	Condition Codes	Comments
32	12:02	12:03	12:04	1	1	1	B	ALIVE	A	
33	12:09	12:10	12:12	2	1	1	B	ALIVE	A	
34	12:11	12:12	12:20	8	1	1	B	ALIVE	A	
35	12:13	12:13	12:18	5	1	1	B	ALIVE	A	
36	12:14	12:15	12:17	2	1	1	B	ALIVE	A	
37	12:16	12:16	12:22	6	1	1	B	ALIVE	A	
38	12:18	12:18	12:21	3	1	1	B	ALIVE	A	
39	12:24	12:25	12:29	4	1	1	A	ALIVE	A	
40	12:26	12:26	12:33	7	1	1	A	ALIVE	A	
41	12:28	12:28	12:32	4	1	1	B	ALIVE	A	
42	12:30	12:30	12:32	2	1	1	B	ALIVE	A	
43	12:31	12:31	12:36	5	1	1	A	ALIVE	A	
44	12:35	12:35	12:44	9	1	1	B	ALIVE	A	
45	12:37	12:37	12:39	2	1	1	B	ALIVE	A	
46	12:41	12:41	12:45	4	1	1	B	ALIVE	A	
47	13:06	13:06	13:09	3	1	1	A	ALIVE	A	
48	13:07	13:07	13:12	5	1	1	B	ALIVE	A	
49	13:08	13:09	13:16	7	1	1	A	ALIVE	A	
50	13:10	13:11	13:16	5	1	1	A	ALIVE	A	
51	13:12	13:13	13:18	5	1	1	A	ALIVE	A	
52	13:14	13:15	13:21	6	1	1	A	ALIVE	A	
53	13:16	13:16	.	.	1	0		UNKN	Z	
54	13:17	13:18	13:23	5	1	1	B	ALIVE	A	
55	13:21	13:21	13:28	7	1	1	B	ALIVE	A	

APPENDIX TABLE II-2. Continued.

Fish No.	TIME				Turb-N Tag Data			Fish Data		
	Tagged	Re-leased	Re-covered	At Large (min.)	No. Tag-ged	No. Re-covered	Condi-tion Codes	Alive/ Dead	Condition Codes	Comments
56	13:22	13:22	13:30	8	1	1	B	ALIVE	A	
57	13:25	13:26	13:29	3	1	1	B	ALIVE	A	
58	13:28	13:28	13:32	4	1	1	A	ALIVE	A	
59	13:29	13:29	13:33	4	1	1	B	ALIVE	A	
60	13:30	13:31	13:34	3	1	1	B	ALIVE	A	
5 October 1991 - LOT 45 TEST - SPILLAGE SITE - WATER TEMP 16.5 C										
1	14:34	14:35	14:41	6	1	1	A	ALIVE	A	
2	14:36	14:36	14:41	5	1	1	A	ALIVE	A	
3	14:39	14:39	14:42	3	1	1	B	ALIVE	A	
4	14:53	14:54	14:57	3	1	1	A	ALIVE	A	
5	14:54	14:54	14:58	4	1	1	A	ALIVE	A	
6	14:56	14:56	15:04	8	1	1	A	ALIVE	A	
7	14:57	14:58	15:02	4	1	1	A	ALIVE	A	
8	15:04	15:05	15:10	5	1	1	A	ALIVE	A	
9	15:06	15:06	15:11	5	1	1	A	ALIVE	A	
10	15:07	15:07	15:14	7	1	1	B	ALIVE	A	
11	15:10	15:11	15:17	6	1	1	B	ALIVE	A	
12	15:15	15:15	15:20	5	1	1	B	ALIVE	A	
13	15:16	15:16	15:18	2	1	1	B	ALIVE	A	
14	15:17	15:18	15:19	1	1	1	B	ALIVE	A	
15	15:32	15:33	15:35	2	1	1	A	ALIVE	A	
16	15:34	15:34	15:40	6	1	1	A	ALIVE	A	
17	15:36	15:36	15:42	6	1	1	A	ALIVE	A	
18	15:37	15:37	15:40	3	1	1	A	ALIVE	A	

APPENDIX TABLE II-2. Continued.

Fish No.	TIME				Turb-N Tag Data			Fish Data		
	Tagged	Re-leased	Re-covered	At Large (min.)	No. Tag-ged	No. Re-covered	Condi-tion Codes	Alive/ Dead	Condition Codes	Comments
19	15:38	15:39	15:40	1	1	1	XA	DEAD	Q	possible prey
20	15:41	15:41	15:43	2	1	1	B	ALIVE	A	
21	15:43	15:44	15:49	5	1	1	A	ALIVE	A	
22	15:46	15:46	15:49	3	1	1	A	ALIVE	A	
23	15:47	15:48	15:51	3	1	1	A	ALIVE	A	
24	15:49	15:49	15:51	2	1	1	A	ALIVE	A	
25	15:50	15:50	15:52	2	1	1	B	ALIVE	A	
26	15:51	15:51	15:56	5	1	1	A	ALIVE	A	
27	15:52	15:52	15:56	4	1	1	B	ALIVE	A	
28	15:53	15:54	15:58	4	1	1	A	ALIVE	A	
29	15:55	15:55	16:00	5	1	1	A	ALIVE	A	
30	16:02	16:02	16:04	2	1	1	A	ALIVE	A	
31	16:02	16:03	16:08	5	1	1	A	ALIVE	A	
32	16:04	16:04	16:10	6	1	1	A	ALIVE	A	
33	16:05	16:05	16:06	1	1	1	A	ALIVE	A	
34	16:06	16:06	16:09	3	1	1	B	ALIVE	A	
35	16:08	16:08	16:11	3	1	1	B	ALIVE	A	
36	16:11	16:11	16:13	2	1	1	A	ALIVE	A	
37	16:12	16:12	16:13	1	1	1	B	ALIVE	A	
38	16:14	16:14	16:16	2	1	1	B	ALIVE	A	
39	16:14	16:15	16:18	3	1	1	B	ALIVE	A	
40	16:17	16:17	16:18	1	1	1	B	ALIVE	A	
41	16:19	16:19	16:20	1	1	1	A	ALIVE	A	
42	16:19	16:20	16:25	5	1	1	A	ALIVE	A	

APPENDIX TABLE II-2. Continued.

Fish No.	TIME				Turb-N Tag Data			Fish Data		
	Tagged	Re-leased	Re-covered	At Large (min.)	No. Tag-ged	No. Re-covered	Condi-tion Codes	Alive/ Dead	Condition Codes	Comments
43	16:20	16:21	16:25	4	1	1	A	ALIVE	A	
44	16:22	16:22	16:27	5	1	1	A	ALIVE	A	
45	16:37	16:37	16:44	7	1	1	A	PREYED ON	P	fish predation
46	16:38	16:38	16:42	4	1	1	B	DEAD	A	
47	16:39	16:39	.	.	1	0		UNKN	Z	
48	16:41	16:41	16:50	9	1	1	A	ALIVE	A	
49	16:42	16:43	16:45	2	1	1	A	ALIVE	A	
50	16:44	16:45	16:52	7	1	1	B	ALIVE	A	
51	16:45	16:46	16:51	5	1	1	B	ALIVE	A	
52	16:47	16:49	16:58	9	1	1	A	PREYED ON	DP	fish predation
53	16:51	16:52	16:56	4	1	1	B	ALIVE	A	
54	16:57	16:58	17:01	3	1	1	A	ALIVE	A	
56	16:59	17:00	17:02	2	1	1	B	ALIVE	A	
55	17:01	17:01	17:08	7	1	1	B	ALIVE	A	
57	17:02	17:02	17:08	6	1	1	A	ALIVE	A	
58	17:04	17:04	17:10	6	1	1	B	ALIVE	A	
59	17:06	17:07	17:10	3	1	1	B	ALIVE	A	
60	17:11	17:12	17:15	3	1	1	B	ALIVE	A	
		7 October 1991 - LOT 46 CONTROL - TURBINE SITE - WATER TEMP 15.0 C								
1	10:31	10:32	10:37	5	1	1	B	ALIVE	A	
2	10:34	10:35	10:40	5	1	1	A	ALIVE	A	
3	10:36	10:37	10:45	8	1	1	A	ALIVE	A	
4	10:44	10:45	10:59	14	1	1	A	ALIVE	A	
5	10:46	10:47	10:51	4	1	1	A	ALIVE	A	

APPENDIX TABLE II-2. Continued.

Fish No.	TIME: Tagged	TIME: Re-leased	TIME: Re-covered	TIME: At Large (min.)	Turb-N Tag Data: No. Tag-ged	Turb-N Tag Data: No. Re-covered	Turb-N Tag Data: Condi-tion Codes	Fish Data: Alive/ Dead	Fish Data: Condition Codes	Fish Data: Comments
6	10:48	10:48	10:53	5	1	1	XA	DEAD	Y	
7	10:50	10:52	11:00	8	1	1	B	ALIVE	A	
8	11:05	11:07	11:15	8	1	1	A	ALIVE	A	
9	11:08	11:09	11:20	11	1	1	B	ALIVE	A	
10	11:10	11:10	11:13	3	1	1	A	ALIVE	A	
11	11:16	11:16	11:24	8	1	1	B	ALIVE	A	
12	11:30	11:31	11:43	12	1	1	A	ALIVE	A	
13	11:31	11:32	11:43	11	1	1	A	ALIVE	A	
14	11:34	11:34	11:43	9	1	1	A	ALIVE	A	
15	11:44	11:46	11:57	11	1	1	A	ALIVE	A	
16	11:48	11:49	12:10	21	1	1	XA	DEAD	YQ	possible prey
17	11:50	11:50	11:57	7	1	1	B	ALIVE	A	
18	11:51	11:52	12:04	12	1	1	A	ALIVE	A	
19	12:07	12:07	12:18	11	1	1	B	ALIVE	A	
20	12:08	12:09	.	.	1	0		PREYED ON	P	gull predation
21	12:12	12:13	12:21	8	1	1	A	ALIVE	A	
22	12:20	12:21	12:26	5	1	1	B	ALIVE	A	
23	12:22	12:22	12:29	7	1	1	A	ALIVE	A	
24	12:26	12:27	12:34	7	1	1	B	ALIVE	C	
25	12:30	12:31	12:37	6	1	1	B	ALIVE	A	
26	12:36	12:37	12:40	3	1	1	B	ALIVE	C	
27	12:38	12:40	12:49	9	1	1	B	ALIVE	A	
28	12:40	12:41	12:52	11	1	1	A	ALIVE	A	
29	12:45	12:45	13:10	25	1	1	XA	DEAD	YQ	possible prey
30	12:51	12:52	12:58	6	1	1	A	ALIVE	A	

APPENDIX TABLE II-2. Continued.

Fish No.	TIME				Turb-N Tag Data			Fish Data		
	Tagged	Re-leased	Re-covered	At Large (min.)	No. Tag-ged	No. Re-covered	Condi-tion Codes	Alive/ Dead	Condition Codes	Comments
7 October 1991 - LOT 47 TEST - TURBINE SITE - WATER TEMP 14.0 C										
1	15:25	15:26	15:28	2	1	1	A	ALIVE	C	
3	15:33	15:33	15:40	7	1	1	A	ALIVE	A	
5	15:46	15:47	15:50	3	1	1	A	ALIVE	A	
6	15:47	15:48	15:49	1	1	1	XB	DEAD	Y	
7	15:51	15:51	16:00	9	1	1	B	DEAD	EJ	
8	15:55	15:56	15:59	3	1	1	B	ALIVE	A	
9	15:56	15:57	16:15	18	1	1	A	ALIVE	CH	
10	16:06	16:06	16:18	12	1	1	A	ALIVE	A	
11	16:07	16:08	16:19	11	1	1	A	ALIVE	A	
12	16:21	16:21	16:24	3	1	1	B	DEAD	Q	
13	16:23	16:23	16:25	2	1	1	B	ALIVE	A	
14	16:24	16:25	16:33	8	1	1	A	ALIVE	A	
15	16:27	16:27	16:30	3	1	1	B	ALIVE	A	
16	16:30	16:30	16:36	6	1	1	A	ALIVE	A	
17	16:32	16:33	16:34	1	1	1	B	ALIVE	C	
18	16:34	16:34	16:42	8	1	1	A	ALIVE	A	
19	16:36	16:36	16:42	6	1	1	A	ALIVE	C	
20	16:37	16:38	16:54	16	1	1	A	ALIVE	CG	
21	16:46	16:46	16:55	9	1	1	B	ALIVE	A	
22	16:47	16:48	16:50	2	1	1	A	ALIVE	A	
23	16:57	16:58	17:05	7	1	1	A	ALIVE	A	
24	17:02	17:03	17:16	13	1	1	A	ALIVE	C	
25	17:05	17:05	17:08	3	1	1	A	ALIVE	C	

APPENDIX TABLE II-2. Continued.

Fish No.	TIME				Turb-N Tag Data			Fish Data		
	Tagged	Re-leased	Re-covered	At Large (min.)	No. Tag-ged	No. Re-covered	Condi-tion Codes	Alive/ Dead	Condition Codes	Comments
26	17:15	17:16	17:25	9	1	1	B	ALIVE	C	
27	17:19	17:19	17:21	2	1	1	B	ALIVE	C	
28	17:21	17:21	17:49	28	1	1	XC	DEAD	Y	
29	17:23	17:23	17:31	8	1	1	A	ALIVE	A	
30	17:28	17:28	.	.	1	0		UNKN	Z	
31	17:43	17:43	17:48	5	1	1	A	ALIVE	A	
32	17:44	17:45	17:59	14	1	1	A	ALIVE	A	

* - Tag failure before fish released, fish number omitted.

** - Testlot completed on the morning of October 2.

APPENDIX TABLE II-3. STATISTICAL COMPARISION OF THE RECOVERY OF TEST AND CONTROL JUVENILE BLUEBACK HERRING RELEASED FOR THE TURBINE SURVIVAL STUDY AT THE CRESCENT HYDRO PROJECT, 1991.

LOCATION=TURBINE

(FISH RECOVERED)

Frequency / Percent / Row Pct / Col Pct	CONTROL	TEST	Total
NO	15 6.15 48.39 12.20	16 6.56 51.61 13.22	31 12.70
YES	108 44.26 50.70 87.80	105 43.03 49.30 86.78	213 87.30
Total	123 50.41	121 49.59	244 100.00

STATISTICS FOR TABLE

Statistic	DF	Value	Prob
Chi-Square	1	0.058	0.809
Likelihood Ratio Chi-Square	1	0.058	0.809
Continuity Adj. Chi-Square	1	0.002	0.961
Mantel-Haenszel Chi-Square	1	0.058	0.810
Fisher's Exact Test (Left)			0.480
(Right)			0.667
(2-Tail)			0.849
Phi Coefficient		-0.015	
Contingency Coefficient		0.015	
Cramer's V		-0.015	

Sample Size = 244

APPENDIX TABLE II-4. STATISTICAL COMPARISION OF SHORT-TERM SURVIVAL OF TEST AND CONTROL JUVENILE BLUEBACK HERRING RELEASED FOR THE TURBINE SURVIVAL STUDY AT THE CRESCENT HYDRO PROJECT, 1991.

LOCATION=TURBINE

Frequency / Percent / Row Pct / Col Pct	CONTROL	TEST	Total
ALIVE	108 44.26 51.43 87.80	102 41.80 48.57 84.30	210 86.07
DEAD/ UNKNOWN	15 6.15 44.12 12.20	19 7.79 55.88 15.70	34 13.93
Total	123 50.41	121 49.59	244 100.00

STATISTICS FOR TABLE

Statistic	DF	Value	Prob
Chi-Square	1	0.626	0.429
Likelihood Ratio Chi-Square	1	0.627	0.429
Continuity Adj. Chi-Square	1	0.367	0.544
Mantel-Haenszel Chi-Square	1	0.623	0.430
Fisher's Exact Test (Left)			0.835
(Right)			0.272
(2-Tail)			0.464
Phi Coefficient		0.051	
Contingency Coefficient		0.051	
Cramer's V		0.051	

Sample Size = 244

APPENDIX TABLE II-5. STATISTICAL COMPARISION OF 24 AND 48 HOUR SURVIVAL OF TEST AND CONTROL JUVENILE BLUEBACK HERRING RELEASED FOR THE TURBINE SURVIVAL STUDY AT THE CRESCENT HYDRO PROJECT, 1991.

LOCATION=TURBINE

24 HR

Frequency / Percent / Row Pct / Col Pct	CONTROL	TEST	Total
ALIVE	97 39.75 50.26 78.86	96 39.34 49.74 79.34	193 79.10
DEAD/ UNKNOWN	26 10.66 50.98 21.14	25 10.25 49.02 20.66	51 20.90
Total	123 50.41	121 49.59	244 100.00

STATISTICS FOR TABLE

Statistic	DF	Value	Prob
Chi-Square	1	0.008	0.927
Likelihood Ratio Chi-Square	1	0.008	0.927
Continuity Adj. Chi-Square	1	0.000	1.000
Mantel-Haenszel Chi-Square	1	0.008	0.927
Fisher's Exact Test (Left)			0.526
(Right)			0.598
(2-Tail)			1.000
Phi Coefficient		-0.006	
Contingency Coefficient		0.006	
Cramer's V		-0.006	

Sample Size = 244

48 HOUR

Frequency / Percent / Row Pct / Col Pct	CONTROL	TEST	Total
ALIVE	87 35.66 50.00 70.73	87 35.66 50.00 71.90	174 71.31
DEAD/ UNKNOWN	36 14.75 51.43 29.27	34 13.93 48.57 28.10	70 28.69
Total	123 50.41	121 49.59	244 100.00

STATISTICS FOR TABLE

Statistic	DF	Value	Prob
Chi-Square	1	0.041	0.840
Likelihood Ratio Chi-Square	1	0.041	0.840
Continuity Adj. Chi-Square	1	0.004	0.952
Mantel-Haenszel Chi-Square	1	0.041	0.840
Fisher's Exact Test (Left)			0.476
(Right)			0.634
(2-Tail)			0.888
Phi Coefficient		-0.013	
Contingency Coefficient		0.013	
Cramer's V		-0.013	

Sample Size = 244

APPENDIX TABLE II-6. EVALUATION OF DIFFERENT TAGGING SITES ON THE SHORT-TERM SURVIVAL OF TEST AND CONTROL JUVENILE BLUEBACK HERRING RELEASED AT THE SPILLWAY AT THE CRESCENT HYDRO PROJECT, 1991.

------------------------------------- CONTROL --

TAGSITE

Frequency / Percent / Row Pct / Col Pct	CAUDAL	DORSAL	Total
ALIVE	55 52.88 55.56 94.83	44 42.31 44.44 95.65	99 95.19
DEAD/ UNKNOWN	3 2.88 60.00 5.17	2 1.92 40.00 4.35	5 4.81
Total	58 55.77	46 44.23	104 100.00

STATISTICS FOR TABLE

Statistic	DF	Value	Prob
Chi-Square	1	0.038	0.845
Likelihood Ratio Chi-Square	1	0.038	0.845
Continuity Adj. Chi-Square	1	0.000	1.000
Mantel-Haenszel Chi-Square	1	0.038	0.846
Fisher's Exact Test (Left)			0.609
(Right)			0.738
(2-Tail)			1.000
Phi Coefficient		-0.019	
Contingency Coefficient		0.019	
Cramer's V		-0.019	

Sample Size = 104

APPENDIX TABLE II-6. EVALUATION OF DIFFERENT TAGGING SITES ON THE SHORT-TERM SURVIVAL OF TEST AND CONTROL JUVENILE BLUEBACK HERRING RELEASED AT THE SPILLWAY AT THE CRESCENT HYDRO PROJECT, 1991.

TEST

TAGSITE

Frequency / Percent / Row Pct / Col Pct	CAUDAL	DORSAL	Total
ALIVE	55 51.40 53.92 94.83	47 43.93 46.08 95.92	102 95.33
DEAD/ UNKNOWN	3 2.80 60.00 5.17	2 1.87 40.00 4.08	5 4.67
Total	58 54.21	49 45.79	107 100.00

STATISTICS FOR TABLE

Statistic	DF	Value	Prob
Chi-Square	1	0.071	0.790
Likelihood Ratio Chi-Square	1	0.072	0.789
Continuity Adj. Chi-Square	1	0.000	1.000
Mantel-Haenszel Chi-Square	1	0.070	0.791
Fisher's Exact Test (Left)			0.580
(Right)			0.761
(2-Tail)			1.000
Phi Coefficient		-0.026	
Contingency Coefficient		0.026	
Cramer's V		-0.026	

Sample Size = 107

APPENDIX TABLE II-7. STATISTICAL COMPARISION OF THE RECOVERY OF TEST AND CONTROL JUVENILE BLUEBACK HERRING RELEASED FOR THE TURBINE SURVIVAL STUDY AT THE CRESCENT HYDRO PROJECT, 1991.

LOCATION=SPILLWAY

(FISH RECOVERED)

Frequency / Percent / Row Pct / Col Pct	CONTROL	TEST	Total
NO	5 2.37 55.56 4.81	4 1.90 44.44 3.74	9 4.27
YES	99 46.92 49.01 95.19	103 48.82 50.99 96.26	202 95.73
Total	104 49.29	107 50.71	211 100.00

STATISTICS FOR TABLE

Statistic	DF	Value	Prob
Chi-Square	1	0.148	0.701
Likelihood Ratio Chi-Square	1	0.148	0.701
Continuity Adj. Chi-Square	1	0.002	0.965
Mantel-Haenszel Chi-Square	1	0.147	0.701
Fisher's Exact Test (Left)			0.765
(Right)			0.482
(2-Tail)			0.746
Phi Coefficient		0.026	
Contingency Coefficient		0.026	
Cramer's V		0.026	

Sample Size = 211

APPENDIX TABLE II-8. STATISTICAL COMPARISION OF SHORT-TERM SURVIVAL OF TEST AND CONTROL JUVENILE BLUEBACK HERRING RELEASED FOR THE TURBINE SURVIVAL STUDY AT THE CRESCENT HYDRO PROJECT, 1991.

LOCATION=SPILLWAY

Frequency / Percent / Row Pct / Col Pct	CONTROL	TEST	Total
ALIVE	99 46.92 49.25 95.19	102 48.34 50.75 95.33	201 95.26
DEAD/ UNKNOWN	5 2.37 50.00 4.81	5 2.37 50.00 4.67	10 4.74
Total	104 49.29	107 50.71	211 100.00

STATISTICS FOR TABLE

Statistic	DF	Value	Prob
Chi-Square	1	0.002	0.963
Likelihood Ratio Chi-Square	1	0.002	0.963
Continuity Adj. Chi-Square	1	0.000	1.000
Mantel-Haenszel Chi-Square	1	0.002	0.963
Fisher's Exact Test (Left)			0.608
(Right)			0.644
(2-Tail)			1.000
Phi Coefficient		-0.003	
Contingency Coefficient		0.003	
Cramer's V		-0.003	

Sample Size = 211

APPENDIX TABLE II-9. STATISTICAL COMPARISION OF 24 AND 48 HOUR SURVIVAL OF TEST AND CONTROL JUVENILE BLUEBACK HERRING RELEASED FOR THE TURBINE SURVIVAL STUDY AT THE CRESCENT HYDRO PROJECT, 1991.

LOCATION=SPILLWAY

24 HOUR

Frequency / Percent / Row Pct / Col Pct	CONTROL	TEST	Total
ALIVE	93 44.08 50.82 89.42	90 42.65 49.18 84.11	183 86.73
DEAD/ UNKNOWN	11 5.21 39.29 10.58	17 8.06 60.71 15.89	28 13.27
Total	104 49.29	107 50.71	211 100.00

STATISTICS FOR TABLE

Statistic	DF	Value	Prob
Chi-Square	1	1.293	0.256
Likelihood Ratio Chi-Square	1	1.302	0.254
Continuity Adj. Chi-Square	1	0.872	0.350
Mantel-Haenszel Chi-Square	1	1.286	0.257
Fisher's Exact Test (Left)			0.910
(Right)			0.175
(2-Tail)			0.312
Phi Coefficient		0.078	
Contingency Coefficient		0.078	
Cramer's V		0.078	

Sample Size = 211

48 HOUR

Frequency / Percent / Row Pct / Col Pct	CONTROL	TEST	Total
ALIVE	87 41.23 52.41 83.65	79 37.44 47.59 73.83	166 78.67
DEAD/ UNKNOWN	17 8.06 37.78 16.35	28 13.27 62.22 26.17	45 21.33
Total	104 49.29	107 50.71	211 100.00

STATISTICS FOR TABLE

Statistic	DF	Value	Prob
Chi-Square	1	3.032	0.082
Likelihood Ratio Chi-Square	1	3.059	0.080
Continuity Adj. Chi-Square	1	2.475	0.116
Mantel-Haenszel Chi-Square	1	3.018	0.082
Fisher's Exact Test (Left)			0.972
(Right)			5.74E-02
(2-Tail)			9.40E-02
Phi Coefficient		0.120	
Contingency Coefficient		0.119	
Cramer's V		0.120	

Sample Size = 211

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JUVENILE BLUEBACK HERRING (*ALOSA AESTIVALIS*) SURVIVAL VIA TURBINE AND SPILLWAY[1]

Dilip Mathur, Paul G. Heisey, Kevin J. McGrath, and Thomas R. Tatham[2]

ABSTRACT: The 48 h survival of emigrating juvenile blueback herring (*Alosa aestivalis*) was estimated at 96 ± 6.7 percent in passage through a Kaplan-type turbine and at 88.3 ± 10.7 percent (90 percent confidence interval) over a spillway (3.7 m high and spillage of 1.2 m^3/s) of a low-head hydro dam (8.3 m). These results suggest that diversion of juvenile alosids over spillways may not be assumed to be a totally benign strategy without obtaining site-specific data. A remarkable similarity in survival rates of fish observed through turbine routes in this study and others suggests that these trends may be common. However, due to a lack of sufficient data, such a conclusion cannot be made for survival over spillways.

(KEY TERMS: hydrobiology; fish survival; spillway; turbines; anadromous fish; fish passage; restoration, dams.)

INTRODUCTION

Juvenile fish migrating seaward down many rivers with hydroelectric dams encounter two primary exit routes: hydro turbines and spillways. There are two inter-related issues associated with passage through either route. One is the determination of the proportion of fish utilizing either route during emigration. The second issue is the estimation of survival associated with passage through these routes. A successful passage (maximum usage and highest survival) through either route is of paramount importance for maintenance, enhancement, or restoration of the returning adult population. Alosids have been targeted for restoration or enhancement in many rivers. Until the 1980s, estimates of survival rates for juvenile alosids following passage through hydro turbines were virtually nonexistent (Taylor and Kynard, 1985; Heisey *et al.*, 1992); available estimates showed high variability and inconsistency (Mathur *et al.*, 1994). No published data existed on alosid survival (immediate or delayed) in passage over a spillway. Perhaps a lack of a suitable tagging or detection technology for juvenile alosids precluded the determination of proportional usage of exit routes.

Because some earlier studies had reported low (<40 percent) turbine passage survival rates, diversion of juvenile alosids over a spillway was recommended to enhance survival (Taylor and Kynard, 1985). Such a recommendation may have substantial economic and biological consequences. Any exit route may inflict some degree of mortality on emigrating fishes, so it is important to obtain reliable estimates of mortality to assess the relative merits of each of the passage routes. It has been difficult to estimate survival of juvenile fishes, particularly emigrating alosids, due in part to difficulty of sampling at spillways. No such published data exist for juvenile blueback herring (Alosa aestivalis) or other alosids.

Our objectives were to (1) estimate immediate (1 h) and delayed (48 h) turbine passage survival of juvenile blueback herring; (2) estimate immediate and delayed survival of juveniles spilled over the crest of the dam; and (3) determine if the survival rate is greater over spillway than through the turbine.

The HI-Z Turb'N tag-recapture method (U.S. Patent No. 4,970,988; Canada Patent No. 2,016,607) effectively estimates immediate effects of turbine passage and thus was chosen for this study. Because this technique had not been used for estimating survival of small-sized alosids in a spillage, an additional

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objective was to evaluate its applicability at spillways. DuBois and Gloss (1993) pointed out the need for improved techniques for small-sized alosids in survival experiments at hydro dams.

STUDY SITE

The Crescent hydro dam is situated on the lower Mohawk River, New York, approximately 5 km upstream from its confluence with the Hudson River. The dam consists of two independent, concrete gravity overflow sections that link each side of the Mohawk River to a rock island (Figure 1). The eastern overflow section is 277 m long, and the western section is 165 m long. The vertical drop from the crest of the dam to the pool below is about 9.2 m for the eastern dam and 3.7 m for the western dam.

The studied turbine is a Kaplan-type turbine (Eicher Associates, 1987) rated at 3.1 MW, designed to optimally operate at a head of approximately 8.3 m. It has five horizontal, adjustable, propeller-shaped runner blades with a speed of 144 revolutions per minute (rpm), and adjustable wicket gates. The clearances between blades at the hub is 0.64 m and at the tip 1.74 m. The turbine operated at or near optimum efficiency during the study with a discharge of about 42.9 m^3/s.

METHODS

Juvenile blueback herring (74-105 mm total length, average 85 mm) were collected from the forebay of the Crescent dam by a 2.5- x 2.5-m-square, 1.3-cm-mesh lift net. The fish were concentrated into a water-filled bucket positioned in the center of the net. Upon capture, fish were transported in 38- to 61-L buckets containing approximately 0.5 percent-NaCl-buffered river water and released into 2,500-L circular holding pools. These pools were supplied with flowing river water. The holding pools were located far from the powerhouse to prevent vibrations from turbines and other equipment from potentially stressing the fish (Figure 1).

Approximately 15 days prior to initiating the full-scale study, the feasibility of handling, tagging, and holding small-sized herring was evaluated by tagging 40 fish with the HI-Z tag (Heisey *et al.,* 1992). After tag inflation, the tags were removed from the fish within four minutes, and these fish were held in pools at 21.2-23.8°C for 48 h; only four (10 percent) of the herring died. This mortality level was within the acceptable range (≤10 percent) proposed by Ruggles *et al.* (1990). Subsequently, the full-scale experiments were completed between September 28-October 7, 1991, at water temperature of 14.4-17.5°C.

For tag-and-release studies, fish were transferred in a 15-L bucket filled with 0.5 percent-NaCl-buffered river water to the testing site where they were held in a 76-L-circular tub continuously supplied with river water. The average size of herring was similar for both the turbine passage experiment (treatment 85.5 ± 4.3 mm, control 85.1 ± 4.1 mm total length) and spillage study (treatment 84.3 ± 4.5 mm, control 84.4 ± 4.1 mm total length); fish were randomly assigned to each group. Equal numbers of treatment (turbine-exposed or spilled) and control (released at the exit of turbine draft tube discharge or in spillway plunge pool) fish were tagged and individually released for the turbine passage (125) and the spillage study (110). Each day, 20-60 fish were released for both treatment and control groups in each experiment. For the turbine passage experiment, we made four paired releases (trials) and three for the spillage study. The total sample sizes were selected to detect pre-specified differences in mortality between treatment and control groups of ≥10 percent at the α=0.05 level with a power of the test (1-β) of 0.80. These calculations assumed recapture rate of ≥90 percent and control survival of ≥90 percent (Heisey *et al.,* 1992).

For the turbine passage experiment, tagged fish were introduced by an induction apparatus (Heisey *et al.,* 1992) into the turbine intake (treatment) or its discharge (control). The induction system consisted of a small holding basin attached to a 10-cm-delivery hose and was supplied with river water to ensure that fish were transported quickly within a continuous flow of water. The release location for controls in the discharge was chosen so that fish would enter the tailrace at a depth and location similar to the turbine-exposed fish.

For the spillage study, identical tagging and induction techniques were used. To create the treatment spill flow of approximately 1.2-m^3/s, a flash-board at the crest of the western dam was removed to open a 0.3- x 1.3-m gap. The spill flow plunged into a pool at the base of the dam (Figure 1). Fish were released immediately above the gap created by removal of the flash-board. Controls were released directly into the plunge pool. The vertical distance from the crest of the dam to the surface of the plunge pool was about 3.7 m; no rock outcrops or obstructions were noted in the plunge pool.

Shortly after release (generally 2-5 min), fish were buoyed to the surface by the inflated balloon and were recaptured in a 23-L bucket by crews in recovery boats. Upon recapture, the tag was removed and each fish was carefully examined for type and extent of physical injuries. Recaptured alive fish were held in

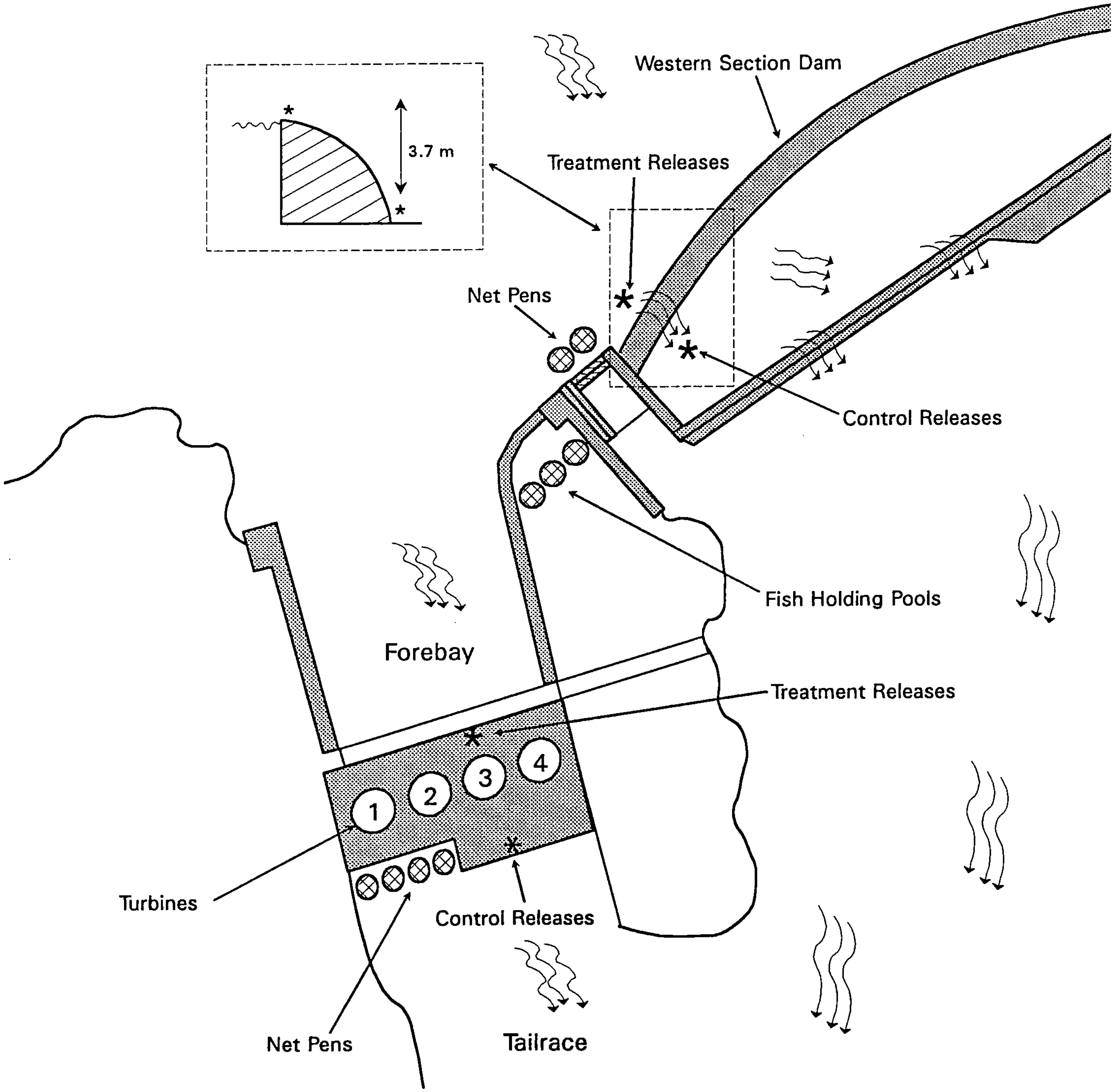

Figure 1. Overall Schematic of Release Locations of Juvenile Blueback Herring for the Turbine and Spillway Passage Survival Experiments at the Crescent Hydroelectric Project.

numbered circular floating covered net pens (1.2-m deep, 1.7-m diameter), either in the tailrace or head pond, for 48 h, similar to the technique described in Heisey *et al.* (1992). To minimize additional handling and transport stress and maintain similarity in handling of fish in the two experiments, recaptured fish were held in an area near the respective experimental sites (Figure 1). For the spillage study, floating net pens were located in the impoundment above the dam; this location was adjacent to the spillage site. Fish for the turbine passage study were held in the tailrace near the power station (Figure 1). Mortalities that occurred over the 48 h were enumerated.

The classification of recaptured and non-recaptured fish followed procedures detailed in Heisey *et al.* (1992). The survival was estimated from the ratio of the conditional survival probabilities of treatment and control fish at 1 h and 48 h (Burnham *et al.* 1987):

$$\hat{S} = \frac{r_t / R_t}{r_c / R_c} \quad (1)$$

$\hat{S}$ = survival after passage through the turbine, r_t = number of alive treatment fish recaptured, R_t = number of alive treatment fish introduced into the turbine, r_c = number of alive control fish recaptured, and R_c = number of alive control fish released. Calculations of point estimates are footnoted in Table 1.

Confidence intervals on the estimated survival (S) were calculated by the maximum-likelihood method for standard error (SE), as given in Burnham *et al.* (1987):

$$var\,\hat{S} = \hat{S}^2\left[\frac{1}{r_t} - \frac{1}{R_t} + \frac{1}{r_c} - \frac{1}{R_c}\right] \quad (2)$$

$$SE(\hat{S}) = \left[var(\hat{S})\right]^{1/2} \quad (3)$$

We included all non-recovered fish (e.g., recovery of inflated tags without fish, and those of unknown status) as mortalities in the analysis. However, we excluded from the analysis fish known to be preyed upon because the treatment and control effects could not be reliably separated and these fish were considered lost to the experiment. Also, we could not ascertain whether the preyed fish were alive, dead, or stunned when eaten. Predation was primarily by smallmouth bass (*Micropterus dolomieui*) and gull (*Larus* sp.). Exclusion of preyed fish provided the following effective release sample sizes for calculation of 1 h and 48 h survival probabilities: 121 treatment and 123 control fish for the turbine passage study; 107 treatment fish and 104 control fish for the spillage experiment (Table 1).

Two explicit assumptions for potential sources of biases in survival estimation using the HI-Z tag-recapture technique were tested: (1) handling, tagging, release, and recapture processes do not differentially affect the survival rates of treatment and control fish, and (2) treatment and control groups are equally susceptible to recapture. Chi-square tests, as described in Burnham *et al.* (1987), were used to detect violations of these assumptions (P=0.05). Additionally, chi-square tests were used to detect homogeneity (P>0.05) in recapture probabilities among trials within each treatment and control

TABLE 1. Numbers of Tagged Fish Released, Captured and Calculated Survival Rates, and 90 Percent Confidence Limits (CI). Upper confidence limits are truncated at 100 percent. Fish eaten by gulls and smallmouth bass are excluded from calculations.

	Treatment Fish For		Control Fish For	
	Turbine	**Spillage**	**Turbine**	**Spillage**
No. Released	125	110	125	110
No. Excluding Predation	121	107	123	104
No. Recaptured Alive	102	102	108	99
No. Recaptured Dead	3	1	0	0
Tags Only	13	3	11	1
Predation	4	3	2	6
Unknown	3	1	4	4
No. Alive at 48 h	87	79	87	87
Calculated 1 h Passage Survival	96%	100%*		
90% CI	89.3-100%	95.5-100%		
Calculated 48 h Passage Survival	100%**	88.3%		
90% CI	87.8-100%	77.6-99%		

*Because of slightly higher survival of treatment than control, calculated survival of 100.1 percent is truncated at 100 percent.
**Survival established at 96±6.7 percent, same as at 1 h (see text).

1 h turbine survival = 102/121 ÷ 108/123 = 0.96 x 100 = 96 percent.
48 h turbine survival = 87/121 ÷ 87/123 = 1.017 = 1.017 x 100 = 101.7 percent.
1 h spillage survival = 102/107 ÷ 99/104 = 1.001 x 100 = 100.1 percent.
48 h spillage survival = 79/107 ÷ 87/104 = 0.883 = 0.883 x 100 = 88.3 percent

group. A one-tailed test (Z-statistic) of the hypothesis that survival probability of spill-passed fish was greater than that of turbine-exposed fish was to be invoked.

RESULTS

Recapture Rates

Recapture probabilities among trials within each group for the turbine passage experiment were homogenous ($P>0.05$), permitting pooling of data from each trial within treatment and controls. Some 105 treatment (86.7 percent) and 108 (87.8 percent) control fish were recaptured (Table 1). These differences were not significant ($P>0.05$), indicating equal susceptibility to recapture. All recaptured alive fish were actively swimming when placed in holding pools for estimating 48 h survival.

Recapture probabilities between trials of treatment and control groups in the spillage study were homogenous ($P>0.05$), permitting pooling of data for each trial within each group. The recapture rates for spill-passed and control fish were 96.3 percent and 95.2 percent, respectively (Table 1). These differences were not significant ($P>0.05$), suggesting acceptance of the assumption of equal susceptibility to recapture. Only 1 of 107 (0.9 percent) spilled fish was recaptured dead; no controls were dead. As in the case of the turbine passage experiment all alive fish appeared in good condition when placed in holding pools.

Survival Rates

The estimated survival rates were high in both experiments (Table 1). The 1 h turbine passage survival was estimated at 96 ± 6.7 percent (90 percent confidence interval). At 48 h, the proportions of alive turbine-exposed and control fish were identical. However, because of the slightly greater survival among the treatment group relative to the controls, the calculated 48 h survival rate was greater than 100 percent. Since the 48 h survival cannot exceed the 1 h survival rate of 96 percent, the overall 48 h survival was established at 96 ± 6.7 percent. Differences in survival of treatment and control groups were not significant ($P>0.05$) at either 1 h or 48 h.

The 1 h survival of spilled fish was estimated at 100 ± 4.5 percent (Table 1). The 48 h survival was calculated to be 88.3 ± 10.7 percent (90 percent confidence interval); a greater loss occurred among the spilled fish relative to the controls. The mortality of fish in both groups over the 48 h period also widened the confidence interval. No significant differences ($P>0.05$) were detected between the survival of spilled treatment and control fish.

We could not invoke the use of Z-statistic because a one-tailed test has no power to detect differences in the opposite direction to those initially hypothesized. Our one-tailed hypothesis that spillage survival probability would be higher than turbine passage survival probability was contrary to observed results.

DISCUSSION

The tag-recapture technique appeared suitable for estimating survival of small-sized alosids in passage through turbine or over the spillway. A major obstacle in obtaining reliable survival estimates of juvenile alosids through any exit route at hydroelectric plants has been the inability of investigators to recapture a high proportion of released fish. Mathur *et al.* (1994) noted that reliability of survival estimates increases when recapture rates generally exceed 70 percent. Over 86 percent of the fish (treatment and control combined, excluding preyed fish) in the turbine passage study and over 95 percent in the spillage experiment were recaptured.

Although recapture probabilities in the spillage study exceeded the initial assumption, they were slightly lower than assumed (>90 percent) in the turbine passage experiment. The slightly lower recapture rates were probably due to tag detachment. The turbulence within the turbine or its discharge may have dislodged the tag from the soft flesh of small sized herrings without killing the fish (Mathur *et al.*, 1996). However, in survival estimation, recoveries of tags only without fish attached were included with mortalities.

The two explicit assumptions made to obtain valid estimates of survival were met. The assumption that handling, tagging, release, and induction do not differentially affect the survival rates of control and treatment fish was supported by no significant differences ($P>0.05$) in survival of recaptured treatment and control fish over the 48 h period. However, the control survival probability during the 48 h holding period was lower (0.81) than assumed (≥ 0.90) in the turbine passage experiment.

The second assumption that the control and treatment fish were equally vulnerable to recapture was supported by no significant differences ($P>0.05$) between recaptures of both groups in the two experiments. The survival estimates, based on the ratio of conditional survival probabilities, may be biased and adjustment for control losses may be difficult to make if large differences in recapture proportions between treatment and controls occur (Ruggles *et al.*, 1990; Mathur *et al.*, 1994). The differences in recapture proportions (alive and dead) among the treatment and control groups in each experiment were consistently small, about 0.01.

In each experiment, both the control and treatment fish were recaptured within minutes (usually 5 min). Thus, release and recapture occurred over an extremely short period, and both groups were exposed to the tailrace conditions over similar periods of time.

Although biological, hydraulic, and intake characteristics differ between sites, evidence is emerging that survival rate of juvenile alosids in passage through Kaplan type turbines at low-head dams (<30 m) is similar (Heisey *et al.*, 1992; Mathur *et al.*, 1994; RMC, 1994a, unpublished). Heisey *et al.* (1992) reported a survival rate of 97 percent for juvenile American shad (*Alosa sapidissima*) in turbine passage at the Safe Harbor Dam (turbine runner speed 77-109 rpm and 5-7 blades) on the Susquehanna River. Survival of juvenile American shad in turbine passage was estimated to range from 97.3-100 percent at the Hadley Falls Station (turbine runner speed 128 rpm and 5 blades) on the Connecticut River (Mathur *et al.*, 1994). RMC (1994a) reported a survival of 94 percent for juvenile American shad in passage through Conowingo Hydroelectric Station (turbine runner blade speed 120 rpm and 6 blades) on the lower Susquehanna River.

Some of the primary factors behind the convergence in the survival rates (≥94 percent) mentioned above are believed to be small number of runner blades (5-7), relatively slow turbine runner blade speeds (<150 rpm), and wide clearances (>1.0 m) between blades relative to fish size (<200 mm). A primary cause of fish mortality appears to be mechanically related (fish striking the blade, collision with structural components, or grinding in the narrow gaps between blade tips and the discharge ring or between blades and hub). Little, if any, mortality may be attributable to other factors such as cavitation or pressure changes (Cada, 1990; Heisey *et al.*, 1992; Mathur *et al.*, 1994, 1996). Only three turbine-exposed fish (2.5 percent) were dead upon recapture in the present study; they had lacerations and bruises indicative of contact with structural components. Large clearance zones within a turbine, such as those reported herein, reduce the probability that fish would encounter areas of excessive cavitation or negative pressures (Ruggles, 1985).

We did not design our study to delineate the causal mechanisms of mortality over the spillway and can only speculate on the possible causes. Some factors that are detrimental to spilled fishes, particularly the sensitive juvenile alosids, are abrasive surfaces, obstructions in the flow path, shear forces or excessive terminal velocity at the end of free fall into the plunge pool, substrate, physiological stress, and shallow depth of plunge pool.

Without arguing the fact that the configuration of each spillway with its associated plunge pool, substrate, hydraulic characteristics, and volume of spillage differs among hydro dams, our findings suggest that spillway passage may not be assumed either benign or significantly superior to the type of turbines reported herein. Our inference is based on a single comparison of 48 h survival rates between one spillage flow and optimum turbine operating efficiency, and thus it is unknown whether similar differences would be observed at other turbine operating efficiencies and spillage volumes at this or other sites. However, the volume of spillage tested, about 2.8 percent of the turbine discharge, represents a typical recommendation of some resource agencies for diverting juvenile fishes over spillways.

It is unknown at present whether 100 percent survival is possible through any exit route. It is logical to expect that any recommended mitigative measure should achieve a level of protection significantly higher than afforded by turbines. Ferguson (1992) reported a 14 percent greater mortality of chinook salmon (*Oncorhynchus tshawytscha*) fingerlings released into the fish bypass system at the Bonneville Dam Second Powerhouse, Columbia River, than those passing through the turbines. Ruggles *et al.* (1990) suggested that if turbine-induced mortality is low (in the range of 5-15 percent), it may not be worthwhile to attempt to exclude fishes from turbine intakes.

Schoeneman *et al.* (1961) reported survival of fingerling and yearling chinook salmon smolts to be 89 percent in passage through a Kaplan turbine at McNary Dam on the Columbia River; the estimated survival over the spillway was 98 percent; smolts plunged from a height of approximately 28 m. The survival rate of Atlantic salmon smolts (*Salmo salar*) passed through ice-log sluices at Bellows Falls (height 18.3 m) and Wilder Dams (height 15.8 m) on the Connecticut River was estimated at 96 percent (Heisey *et al.*, 1993). A recently completed study (RMC, 1994b unpublished) at the Wilder Dam reported a survival rate of 94.3 percent for Atlantic salmon smolts in passage through the Kaplan turbine.

In summary, although survival and proportional usage rates through multiple exit routes at most hydroelectric dams have not been estimated, particularly for alosids, we submit that the strategy of diverting fishes over spillways should be implemented cautiously. Although spillage may be effective in increasing passage rates under certain hydrological conditions its superiority in significantly improving survival has not been demonstrated. The ultimate and logical objective at hydro dams should be to maximize survival of emigrating fish whether the passage route is turbine, spillage, or a bypass system. Whichever strategy is chosen, its success or failure needs to be evaluated.

Similarities, rather than major differences, encourage us to suggest that turbine passage survival rates may be applied to other similar low-head sites where site-specific data are lacking or difficult to obtain in a timely manner. An alternative approach would be to conduct a confirmatory type of investigation to validate this suggestion at an unsampled site. However, a careful application of the survival rates presented herein to other sites with similar turbine characteristics should reduce the costs of hydro dam impact assessment.

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New York Power Authority

March 12, 1999

Honorable David P. Boergers
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

030 033

SUBJECT: Crescent and Vischer Ferry Projects
(FERC # 4678-024 and 4679-027)
Final Report

Dear Secretary Boergers:

In accordance with paragraph (A) of the Federal Energy Regulatory Commission order issued by the Acting Director of the Office of Hydropower Licensing on November 17, 1997, the New York Power Authority (the Authority) is providing the final report on the testing of the acoustic deterrence system at the Vischer Ferry and Crescent Projects.

The results from the tests at the Vischer Ferry Project indicate that high frequency sound, in conjunction with a by-pass located outside of the sound field, will enable more than 90% of the adult and young-of-the-year (YOY) blueback herring to pass the project without going through the turbines. The location of the by-pass for YOY blueback herring should be on Dam F. The location of the by-pass for adult blueback herring should be on Dam E. The construction details for the by-passes will be determined through consulation with agency staff.

The results from the tests at the Crescent Project indicate that high frequency sound, in conjunction with a by-pass located outside of the sound field, will enable more than 90% of the young-of-the-year YOY blueback herring to pass the project without going through the turbines. The high frequency sound field- bypass combination used in the tests was not effective for adult herring. However, the problems caused by physiographic and hydrodynamic features near Dam B and the powerhouse can be overcome by moving the high frequency sound field out to the edge of the main channel and bypassing the fish over the dam across the main river channel (Dam A). The results suggested that a large fraction of both the adult and YOY populations moved down the main channel and this change in the design of the fish protection system should facilitate

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the downstream passage of more fish. The construction details for the by-pass on Dam A will be determined through consulation with agency staff.

If there are any questions concerning the final report, please call me at 914 681 6404.

Sincerely,

Quentin E. Ross, Ph.D.
Senior Environmental Engineer
Environmental Division

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ORIGINAL

Studies to determine the feasibility of using high frequency sound in conjunction with by-passes located outside of the sound field to provide protection for young-of-the-year and adult blueback herring at the Crescent and Vischer Ferry Hydroelectric Projects

By

Quentin E. Ross

New York Power Authority
123 Main Street
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March 12, 1999

Summary

The FERC licenses for the Crescent and Vischer Ferry Hydroelectric Projects required that studies be conducted to determine an effective method for preventing fish from passing through the turbines without hindering their downstream movement or increasing their vulnerability to predation. Because of heavy debris loading and high zebra mussel populations at these two sites on the Mohawk River, the New York Power Authority decided to test the feasibility of using a combination of high frequency sound and by-passes located far from the headraces at these two sites. An added attraction of this combination was that it could be installed quickly if it proved to be effective.

The feasibility studies were conducted at the Vischer Ferry Hydroelectric Project in the fall of 1996 and the spring and summer of 1997. Those at the Crescent Hydroelectric Project were conducted in the fall of 1997 and the spring and summer of 1998. Broad-band (122-128 kHz), high frequency sound was used to generate sound fields projecting outward from the entrances to the headrace canals at these projects. Flashboards were removed from the tops of the dams at the projects to provide by-passes for fish. The by-passes were located where the edges of the sound fields intersected the dams adjacent to the powerhouses. Fish densities were monitored hydroacoustically at the entrances to the headrace canals, near the by-passes, and outside the sound field. During the fall studies, the opening in the flashboards was cut after the sound field had been on for several days, providing before and after comparisons. During the spring/summer studies, the opening was created when the flashboards were put on the dams during the first week in May. The high frequency sound field was turned on and off to determine the response of the fish to the sound field.

The effectiveness of the combination of high frequency sound and remote by-passes was affected by physiographic and hydrodynamic features at the site and the size of the fish involved. At the Vischer Ferry site, the combination proved to be highly effective (more than 90% of the fish used the by-pass) for both adult and young-of-the-year (YOY) blueback herring. At the Crescent site, the combination was highly effective for YOY blueback herring. It wasn't for adult blueback herring. However, adults exhibited a strong preference for deep water and moving the sound field away from the project to the edge of the main river channel should keep them away from the powerhouse. The by-pass will have to be moved to the dam across the main channel.

This study only established the feasibility of this approach at these sites. The details of the bypasses over the dams at each site will have to be developed through consultation with agency staff.

Studies to determine the feasibility of using high frequency sound in conjunction with by-passes located outside of the sound field to provide protectic . for young-of-the-year and adult blueback herring at the Crescent and Vischer Ferry Hydroelectric Projects

Introduction

The target species--The lower Mohawk River supports one of the better smallmouth bass *Micropterus dolomieui* fisheries in New York State and good fisheries for largemouth bass *Micropterus salmoides* and walleye *Stizostedion vitreum* (McBride 1994). Young-of-the-year (YOY) blueback herring *Alosa aestivalis* are the most abundant forage fish in the lower Mohawk River and a major objective of the management plan for the fisheries in the lower Mohawk River is the preservation and maintenance of this forage stock (McBride 1994). Prior to 1825, Cohoes Falls, a natural barrier 24.6 m in height, restricted blueback herring production in the Mohawk River to the 3.1-km section below the falls. Since 1825, the locks and dams constructed as part of the Erie and Barge Canals (completed in 1825 and 1918, respectively) have allowed adult blueback herring to gain access to the river above Cohoes Falls. Blueback herring currently spawn in the upper reaches of the Mohawk River and its tributaries, more than 160 km upstream from Cohoes Falls. Adult blueback herring by-pass Cohoes Falls via the Waterford Flight (Locks 2 through 6) and re-enter the Mohawk River immediately upstream from the Crescent Dam (located 2.4 km upstream from Cohoes Falls).

During their fall migration to the sea, YOY blueback herring from the upper Mohawk River could encounter as many as seven hydroelectric projects, six on the Mohawk River and one on the Hudson River. Three of the six hydroelectric projects on the Mohawk River lie above Cohoes Falls. The Crescent Project is located at Crescent Dam (and the site of Lock 6), 2.4 km upstream from Cohoes Falls. This dam creates an impoundment of 809 hectares. The Vischer Ferry Project is located at the Vischer Ferry Dam (and the site of Lock 7), 16.1 km upstream from the Crescent Dam. The Vischer Ferry Dam creates an impoundment of 425 hectares. The Little Falls Project is located at the Little Falls Dam (and the site of Lock 17), 90.4 km upstream from the Vischer Ferry Dam. There is no impoundment at Little Falls. The first of the three hydroelectric projects located below Cohoes Falls is the School Street Project. This project is located on the southern bank of the river about 0.2 km below the falls. The dam for the School Street Project lies above Cohoes Falls about 1.3 km below Crescent Dam and creates an impoundment of 40 hectares. The School Street Dam diverts the river flow into a head canal (1.3 km in length) that carries it around Cohoes Falls to the School Street Project. The New York State Dam Project is located at the New York State Dam, 1.5 km below Cohoes Falls. There is no impoundment and this dam is the last barrier across the entire flow of the Mohawk River. Below the New York State Dam, the river branches and the Mohawk Paper Mills Project is located at a dam across one of the branches (the Fourth Branch). This project receives 45% of the flow from the New York State Dam Project. The dam for the hydroelectric project on the Hudson River (and the site of Lock 1) is located at Green Island, about 7.5 km downstream from the confluence of the Fourth Branch and the Hudson River.

The National Oceanic and Atmospheric Administration is responsible for the health of the Nation's aquatic ecosystems. The Northeast Region Habitat Conservation Division of the National Marine Fisheries Service (NMFS) seeks to minimize cumulative impacts from the operation of hydroelectric projects within the Hudson River Basin by prescribing fishways under the authority provided to the Secretary of Commerce by Section 18 of the Federal Power Act. Section 18 requires that these fishways utilize available and accepted technologies while providing migratory fish with a readily accessible migration route that possesses adequate attraction and conveyance flows to prevent undue delay, injury, and/or biological stress (USDOC 1998).

The Vischer Ferry and Crescent Projects--The powerhouses at these projects were constructed in 1925 and each originally housed two Francis turbines, powering two 2.8 megawatt (MW) generators. The maximum flow through each of the original powerhouses was 92 m^3/s. Between July 1988 and December 1990, the New York Power Authority doubled the generating capacity at each site by adding two Kaplan turbines, powering two 3.0 MW generators. Currently, the maximum flow through each powerhouse is 177 m^3/s. There are no fish protection systems at either site and the operating licenses issued by the Federal Energy Regulatory Commission (FERC) for the expanded projects require that studies be conducted to determine an effective method for preventing the fish from passing through the turbines without hindering their downstream movement or increasing their vulnerability to predation.

Available and accepted fish passage technologies—The fish passage technology prescribed by NMFS in the Mohawk River at the School Street Hydroelectric Project was an angled louver device installed within the headrace canal in combination with a by-pass and plunge pool at the base of Cohoes Falls (USDOC 1998). The advantage of this technology is that a relatively small area is involved and the intake flows bring the fish directly to the diversion system. However, this technology does not appear to be suitable for the Crescent and Vischer Ferry sites because heavy debris loading occurs at these two sites. Extensive beds of water chestnut *Trapa natans* are present immediately upstream from each of these projects. During the fall when YOY blueback herring move down river, the water chestnut beds break up. The decaying plants float downstream and heavy debris loading occurs on the trash racks at each project. Mechanical cleaning devices are used to remove the debris from the trash racks at these projects. However, they have not yet been developed for angled louvers.

Inclined screen systems are self-cleaning when the approach velocities are high and the prototype for a modular inclined screen that can be rotated and back-washed has been developed (Taft et al. 1997). The flow velocities within the headrace canals at the Crescent and Vischer Ferry Projects are 1.0 m/s or higher (Larsen and White 1986a and 1986b) and are probably adequate for inclined screens. However, the recommended approach velocities at screens used to divert fingerling salmonids range from less than 0.1 m/s to 0.3 m/s (EPRI 1994) and post-diversion survival may be a problem at higher approach velocities, especially for soft, fragile fish like YOY blueback herring. Approach velocities rarely exceeded 0.3 m/s during tests with a reconfigured Ristroph screen at a nuclear generating station on the Hudson River (Fletcher 1990). The short-term (the fish were held for 8 hours after testing) survival of the 277 YOY blueback herring tested in this study was 74%. During the study of a prototype modular inclined screen and by-pass system at the Green Island Project (Taft et al. 1997), YOY blueback herring were held for at least 72 hours after testing and the effects of approach velocities greater than 0.3 m/s on the survival of YOY blueback herring were examined. When the approach velocity was 0.6 m/s, the estimated survival was 86% (n = 95). When the approach velocity was 1.2 m/s, it was 68% (n = 437) and, at 1.8 m/s, it was 22% (n = 605). These results suggest that the approach velocities within the headrace canals at the Crescent and Vischer Ferry Projects may be too high for inclined screens to be effective on YOY blueback herring.

However, there is another factor that makes the use of either louvers or inclined screens in the Mohawk River questionable. Zebra mussels *Dreissena polymorpha* invaded the Mohawk River in 1991 (O'Neill and Dextrase 1994) and significant fluvial transport of veligers began in 1992 (Strayer et al. 1996). Larval settlement occurs whenever flow velocities are 1.5 m/s or less (EPRI 1992) and zebra mussels currently encrust the existing headrace structures at the Crescent and Vischer Ferry Projects. Thus, it is highly likely that they would settle on any diversion screens or louvers installed within the headrace canals at these projects. Zebra mussels will be more difficult to remove from the diversion screens or louvers than plant debris and their presence will accelerate both debris loading and through-screen flow rates. No full-scale tests of diversion screens or louvers have been conducted in a river where zebra mussels are a problem and the actual maintenance requirements for these systems have not been determined.

The alternative to the installation of physical barriers within the headrace is to use electricity, light, or sound to generate a deterrent field that extends outward from the entrance to the headrace and causes fish to turn away or slow their movement toward the powerhouse. However, the guiding principle for designing and locating a deterrent field differs from that for diversion screens or louvers. Screens or louvers are barriers that prevent forward movement and physically deflect fish to a by-pass. Diversion efficiency is a reflection of the fraction of the incoming flow that is screened. Thus, screens and louvers are most efficiently placed within headrace canals, minimizing the cross-sectional area to be screened and maximizing the amount of structural support available for the diversion system. Approach velocities are of concern only as they relate to post-diversion survival. Deterrent fields, on the other hand, involve behavioral responses that are not as effective in the high flow areas (Ploskey et al. 1995). Deterrent fields should be used to deflect the flow of fish toward a powerhouse in an area where the flow velocities are relatively low (less than 0.3 m/s), i.e., outside of the headrace. The deterrent field should also cover an area as large as practicable so that even the smallest fish has sufficient time and the ability to turn and either swim away from the deterrent sound field or along its periphery. Most fish will attempt to continue moving downstream so the most effective location for a by-pass is where the periphery of the deterrent sound field intersects the dam.

Full-scale diversion systems involving strobe lights and high frequency sound have been evaluated at operating power projects (Ross et al 1993; Con Edison 1994, Ploskey et al. 1995; Ross et al 1996; Brown 1997). High frequency sound was determined to be the best technology available for reducing the impingement of alewives *Alosa pseudoharengus* at the James A. FitzPatrick Nuclear Generating Station on Lake Ontario (NYSDEC SPDES Permit #NY0020109: Attachment II: Basis for staff decision: FitzPatrick NGS 316 (b)). For species that exhibit strong responses to both high frequency sound and strobe lights, sound should be used to generate the deterrent sound field because it has a greater range than light (especially in turbid water) and the by-pass can be located further from the powerhouse. High frequency transducers are also much smaller than strobe lights, which means that they can be more easily installed and protected under field conditions. Strobe lights are visible to human eyes; high frequency sounds are not detectable by human ears. Thus, the susceptibility to vandalism (a problem on popular recreational rivers) is probably lower for sound systems than light systems. Fouling may also be less of a problem for sound systems because zebra mussels do not settle on the active surface of a high frequency transducer when it is operated continuously (Ross et al 1996).

The feasibility studies at the Crescent and Vishcher Ferry Hydroelectric Projects— The FERC licenses for these two projects required that studies be conducted to determine an effective method for preventing fish from passing through the turbines without hindering their downstream movement or increasing their vulnerability to predation. The New York Power Authority decided not to employ louver or screen systems in these studies because of the serious questions about their effectiveness, in general, and their effectiveness at these sites, in particular. The Authority felt that the combination of high frequency sound and a by-pass located far from the headrace was more likely to be effective under the conditions existing at these two sites. Furthermore, this combination could be installed quickly if it proved to be effective.

Methods

The study sites—the timing of fish movements and the pathways that are followed at a particular site are strongly influenced by behavioral preferences, bottom contours, and current flows. For example, in Lake Ontario near the JAF power plant, alewives moved offshore into deep water during the day and onshore into shallow water at night. However, the predominant flow of fish during the night was parallel to the shoreline, not onshore, because of the presence of an along-shore current (Ross et al. 1993). In the Mohawk River, blueback herring are not expected to exhibit pronounced onshore-offshore movements like those exhibited by alewives in Lake Ontario. However, they are expected to move upward in the water column at night and down during the day. This behavior in combination with the bottom contours at a site may alter when and how fish approach the powerhouse. They may also alter the effectiveness of a bypass.

The spatial dimensions of a site may also be important because high frequency sound does not physically prevent fish from entering an intake. It slows them down and works best where the current flowing to the powerhouse is low. If the width of the river is small, the current flow to the powerhouse on the opposite side of the river will be high and the fish may be unable to move away from the high frequency sound field. The bottom contours and spatial dimensions at the Crescent and Vischer Ferry sites are described in the following paragraphs.

Vischer Ferry—At Vischer Ferry site, an old spoil area restricts the main channel to the side of the river opposite from the Vischer Ferry powerhouse (Figure 1). Outside of the main channel, for a distance of more than 1800 feet upriver of the dam, the average depth is generally less than 8 feet. The average depth in the channel is about 20 feet. Immediately upstream from the powerhouse, the river is about 1100 feet wide. The Vischer Ferry dam consists of three connecting segments. Dam D is closest to the lock and channel and extends, perpendicular to the lock, 725 feet out into the river. Dam E extends 675 feet upstream at about a 30^0 angle from the end of Dam D and passes across a rock outcrop. Dam F extends 500 feet from the end of Dam E to the powerhouse on the north shore of the river. Below the entrance to the lock the river channel angles toward the intersection of Dams D and E. This section of the channel is about 16 feet deep offshore from the entrance to the lock and about 9 feet deep near the intersection of Dams D and E (Figure 2). From the intersection of Dams D and E to the intersection of Dams E and F, the water depth averages about 8 feet. Near the south end of Dam F, there is a large depression and the water depth increases to about 16 feet (Figure 3). From the lip of this depression to a point about 200 feet from the entrance to the south headrace canal, the water depth averages about 13 feet. From this point, the bottom slopes toward the entrances to the headrace canals, forming a large depression extending approximately 300 feet upstream from the entrances to the headrace canals and increasing in depth from 13 feet at the lip to 29 feet at the entrance to the south headrace canal.

Crescent site—At the Crescent site, the main channel ranges from 25 to 45 feet in depth and passes to the east of a large island located in the middle of the river (Figure 4). The Crescent powerhouse is located on the western bank of the river. Dam B runs from the Crescent powerhouse to the large island, a distance of approximately 600 feet. Dam A extends approximately 850 feet from the opposite side of the large island to the eastern bank of the river. There is a third dam, Dam C, at this site. It is lies immediately below Dam B and holds back enough water to provide sufficient mass at the base of the Dam B to prevent it from overturning during extreme floods.

The main river channel is approximately 35 deep immediately upstream from the entrance to the secondary channel flowing down to the powerhouse. The secondary channel is approximately 2000 feet long and ranges from 100 to 300 feet wide. It is 10-13 feet deep and 300-400 feet wide for the first 1000 feet downstream from the main river channel. Over the next 700 feet, the depth increases to 15-17 feet and the width ranges from 100 to 200 feet. The bottom of the secondary channel is featureless (smooth) until 200-300 feet upstream from Dam B. This area, particularly section lying above Dam B, contains several rocky outcrops that rise nearly to the surface (Figure 5). The bottom contours fall off on the downstream side of these outcrops, creating a depression lying parallel to and 50 feet upstream from the western half of Dam B.

High Frequency Sound Fields—The transducers used to generate the high frequency sound fields were attached to the headrace piers and powered from the powerhouse at both sites. The high frequency signal consisted of broad band (122-128 kHz) pulses (0.5 seconds in duration) generated at 1-second intervals. The general specifications for the sound fields were derived by New York Power Authority (NYPA) biologists from studies involving adult alewives in Lake Ontario (Ross et al. 1993; Ross et al. 1996) and juvenile blueback herring in the Arthur Kill River (Con Edison 1994). The maximum sound pressure level (SPL) was at least 190 dB//uPa at 1 meter from the source. The sound pressure across (surface to bottom and side to side) the entrances to the headrace canals was at least 170 dB//uPa. GEC-Marconi Hazeltine was awarded the contract to design, install, and maintain the sound field systems. After installation, field surveys were conducted at each site to confirm that the design specifications had been met. Each system was monitored remotely by GEC-Marconi Hazeltine staff to ensure that all transducers were operating correctly during each study.

Acoustic Monitoring of Fish Densities—BioSonics, Inc., under a subcontract to GEC-Marconi Hazeltine, installed calibrated transducers (operating at 420 kHz) to monitor fish densities at locations specified by NYPA biologists. In general, the fish densities within the flows along the dams toward the powerhouses and at the entrances to the headrace canals were monitored. The specific transducer locations and the flows that they monitored are described with the results of each individual study. The output from these transducers was collected and monitored remotely by BioSonics, Inc., staff during each study. Cables were routed from each transducer to an echo sounder/multiplexer located in each powerhouse. This computer-controlled echo sounder was programmed to multiplex among all transducers. The echo sounder was operated at 10 pings per second with a pulse length of 0.4ms. A 5-minute sampling interval was used, resulting in 3000 pings of data per sampling interval. These pings were distributed among the transducers. Eight transducers were used during most of the studies and most of the density estimates are based upon 375 pings of data per 5-minute sampling interval.

Schools of blueback herring can be very dense, making it impossible to distinguish and count the fish within the school. Accordingly, echo integration was chosen as the signal processing technique in these studies. This technique does not rely on resolving echoes from individual fish. It measures the total reflected energy from the ensonified volume. The echo sounder was programmed to amplify returning signals with a 20 log R time varied gain. The signal produced by the echo sounder was processed by a Model 221 Echo Signal Processor, a board-level processor located inside a PC. The echo integration technique requires the operator to assign range and time bins for summing up reflected energy. The range bins and the signal processing thresholds associated with each range bin were stored in files. Reflected acoustic energy was averaged over 5-minute intervals within each range bin and written to hard disk files.

Echo integration measures reflected acoustic energy and the average energy estimates are converted to fish density by an echo integrator scaling constant which incorporates system calibration factors, operator-selected data collection parameters, and an estimate of the reflectivity (back-scattering cross section) of an individual fish. When the average reflected acoustic energy is multiplied by the scaling constant, an estimate of density (fish per cubic meter) is obtained. The scaling constant used in this study (7.0 E-6) is accurate for juvenile blueback herring. However, it overestimates adult blueback herring densities by a factor of about 24 and we have indicated this in the tables and figures used in this report. The binary data files produced by the Echo Signal Processor were retrieved from hard disk and read by a FORTRAN program to generate scaled density estimates by range bin for each transducer for each 5-minute sampling interval. The average of the scaled density estimates from the range bins was used as the 5-minute density estimate for a given transducer. The 5-minute density estimates generated within an hour were averaged to produce an estimate of the average fish density by hour for each transducer. The hourly density estimates were used to describe changes in fish densities within a day. The hourly density estimates generated within a 24-hour period were averaged to describe changes in fish densities across days. When it became necessary to partition the effects of within-day differences in fish densities, the 24 hourly density estimates were divided into two 12-hour blocks and hourly density estimates within each block were averaged.

The Fall YOY study at the Vischer Ferry site began on 31 August and ended on 7 November in 1996. The Fall YOY study at the Crescent site began on 8 September and ended on 10 November in 1997. The Spring/Summer adult study at the Vischer Ferry site began on 10 May and ended on 31 July in 1997. The Spring/Summer adult study at the Crescent site began on 12 May and ended on August 1 in 1998, although problems with computer communications terminated the time series of hydroacoustic data from this study on 12 July 1998.

Statistical methods—Because the on/off and by-pass absent/by-pass present treatments were applied to different blocks of days but the day/night difference occurred in every 24-hr period, the basic statistical model for tests of significance was a split-plot design. Kirk (1968) was used to identify the appropriate split-plot model and computational procedures.

The by-pass—the objective of the studies conducted at the Crescent and Vischer Ferry Hydroelectric Projects was to determine if a by-pass, located at the edge of a high frequency sound field, would decrease the number of fish entering the headrace canals at these projects. If the results of these studies indicated that this approach was practicable, the details of the operational systems would be developed through consultation with DEC, FWS, and NMFS staff. In particular, the bypasses used in these studies represent a purely experimental condition and should not be viewed as the proposed method for passing fish over the dams under operational conditions. The bypasses in these feasibility studies were created by removing 10-foot sections from the flashboards on the dams at the projects. To enhance navigation in the Crescent and Vischer Ferry impoundments, flashboards are installed on Dams A, B, D, E, and F. The water level in the Vischer Ferry pool is raised 27 inches; that in the Crescent pool is raised 12 inches. The removal of a 10-foot section (the distance between the posts supporting the flashboards) at the Crescent site creates a by-pass flow of about 40 cubic feet per second (cfs) over the dam. The removal of a 10-foot section at the Vischer Ferry site creates a by-pass flow of about 140 cfs. The navigation season in the New York State Barge Canal System opens during the first week in May and closes during the second half of November. Flashboard installation is usually complete before the end of the second week in May. Flashboard removal is usually complete before the end of November.

Experimental approach—The high frequency sound system was turned on and off repeatedly to evaluate the effect of the high frequency sound field on fish densities in the vicinity of the bypasses and at the entrances to the headrace canals.

The evaluation of the bypasses could not be replicated at an individual site because we could not reinstall flashboards (it was particularly dangerous to approach the by-pass opening at the Vischer Ferry site). However, several fortuitous events provided the solution to this problem for the fall studies. The first of the feasibility studies began in the fall at the Vischer Ferry site so there was no opening in the flashboards from a spring/summer study. Since we did not comprehend how dangerous it was to cut out a 10-foot section of flashboards from a boat at this site, we did so. The first of the feasibility studies at the Crescent site also began in the fall so, again, there was no opening in flashboards from a spring/summer study. Finally, conditions were much less dangerous at the Crescent site and we didn't hesitate to replicate the fall study at Vischer Ferry. Thus, we were able to do "before" and "after" comparisons at both sites during the fall studies and replicate the by-pass effect in that fashion. At the Vischer Ferry site, we turned on the high frequency sound system and left it on for thirteen days. The opening in the flashboards was cut on the fifth day when fish densities were high. At the Crescent site, we turned on the high frequency sound system and left it on for at nine days. The opening in the flashboards was cut on the fourth day.

Good fortune occurred again during the spring/summer studies. At the Crescent site, deep water occurred immediately adjacent to the dam with the by-pass. Fish densities near the by-pass were low and high fish densities were commonly observed at the entrance to the headrace canal. At the Vischer Ferry site, there was no deep water immediately adjacent to the dam with the by-pass. High fish densities were commonly observed near the by-pass and rarely at the powerhouse. At the Crescent site, fish moved into the headrace canal during the day and we suspect that their position in the water column (low during the day) prevented them from detecting the bypass at this site. We used this site to represent the "by-pass absent" condition and the Vischer Ferry site to represent the "by-pass present" condition.

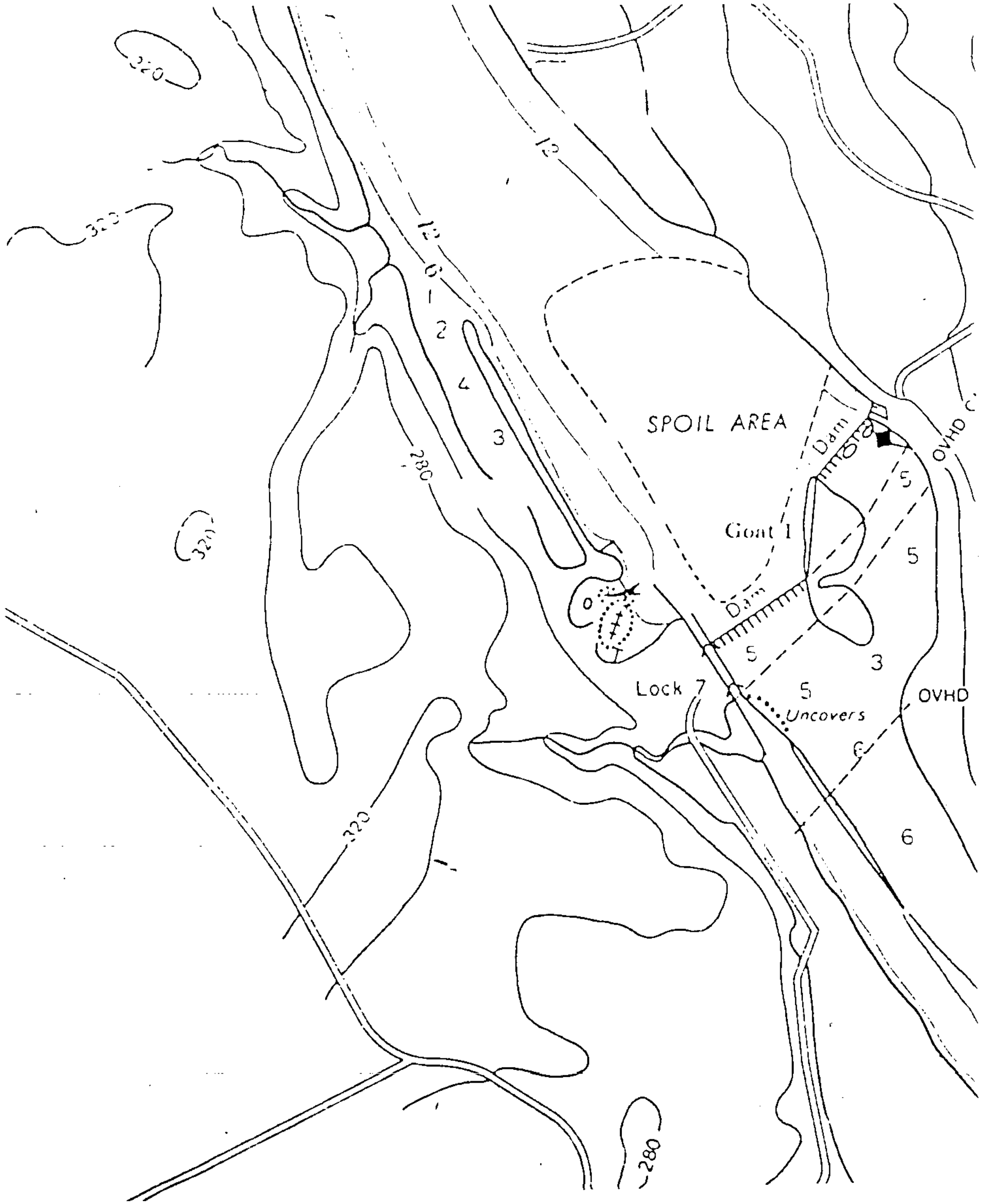


Figure 1. The location of the main channel and spoil area at the Vischer Ferry site.

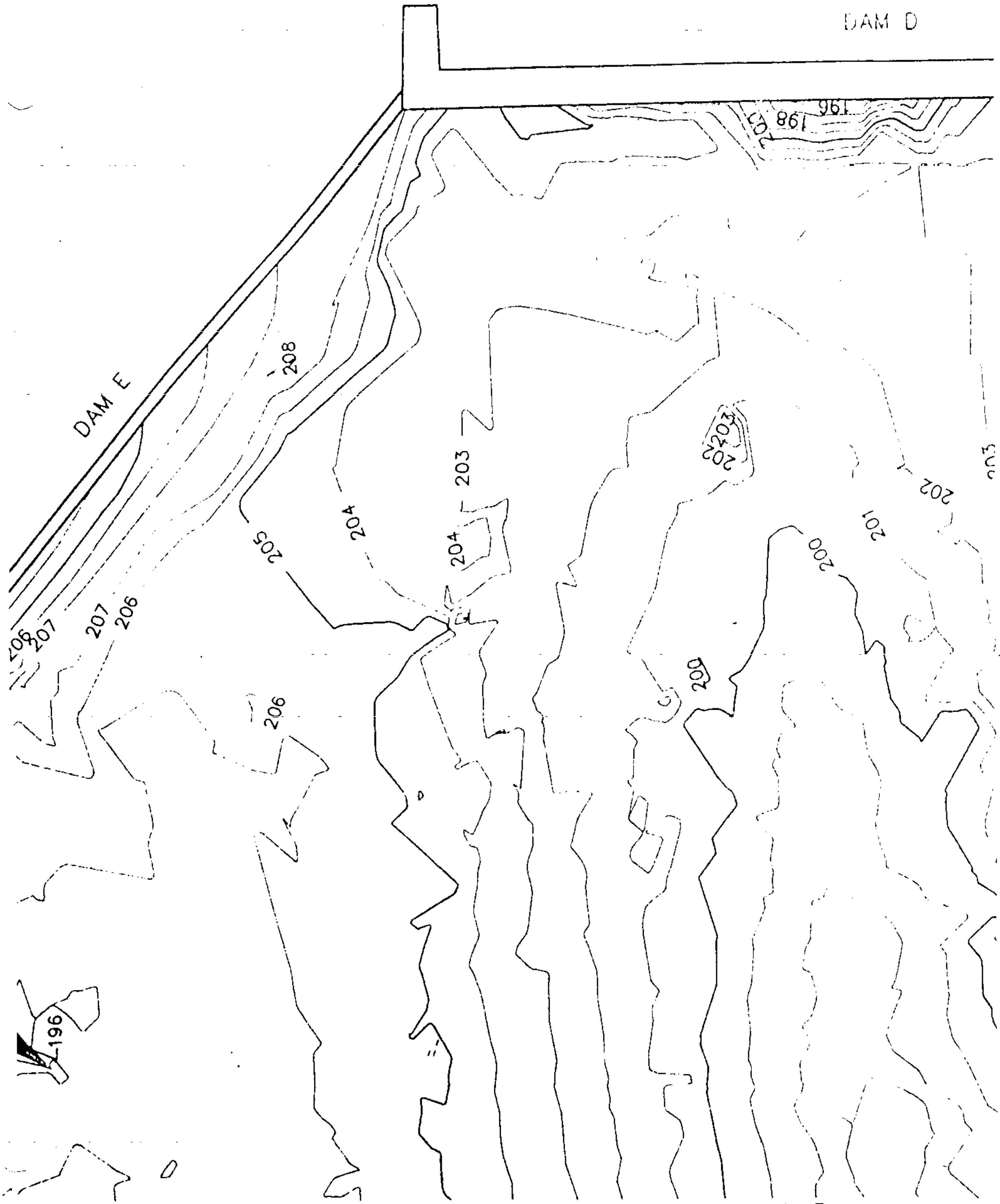


Figure 2. Depth contours in the vicinity of the intersections of Dams D and E at the Vischer Ferry site. Scale: 1 inch = 100 feet. Water surface elevation = 213 feet.

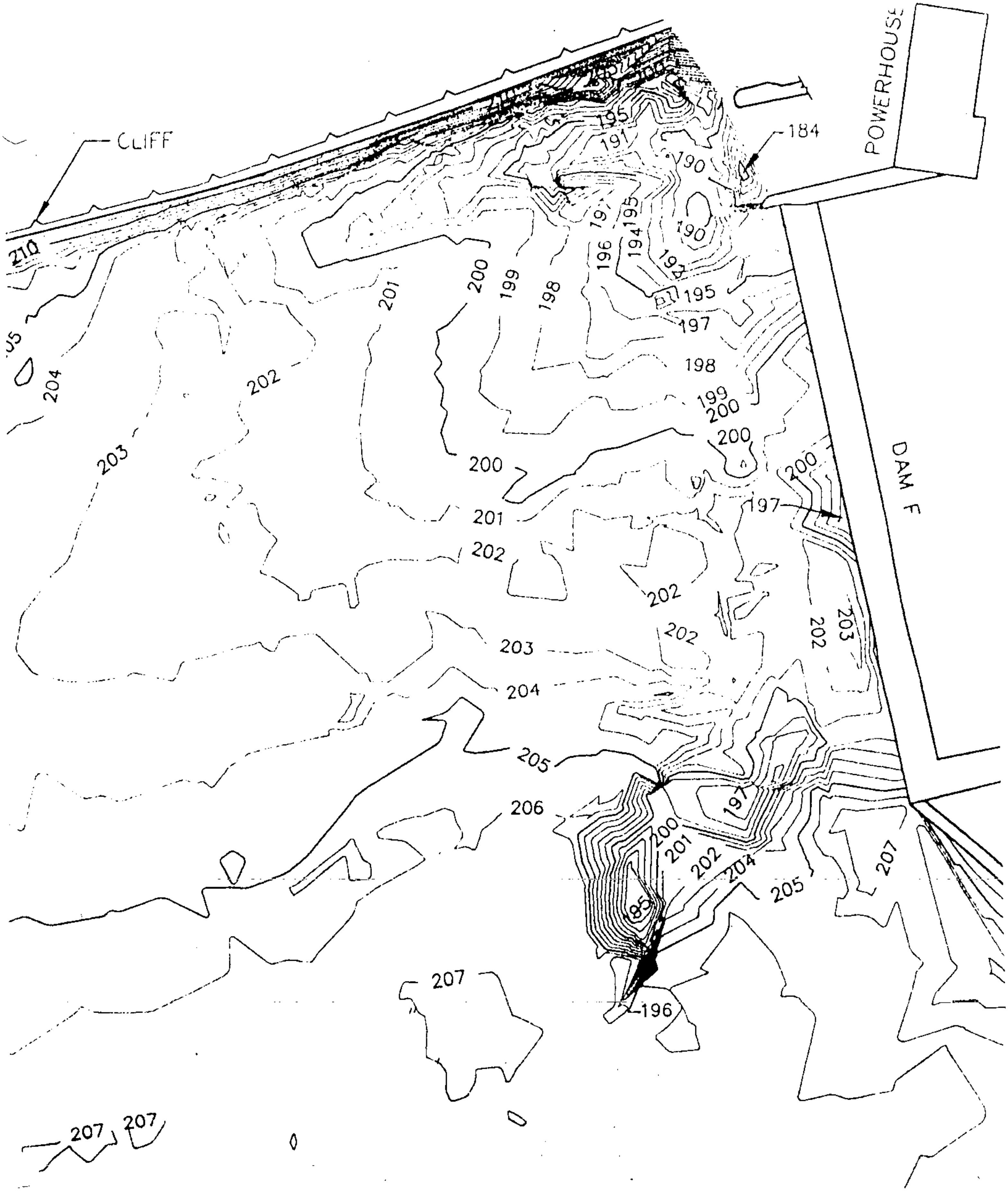


Figure 3. Depth contours in the vicinity of the intersections of Dam F at the Vischer Ferry site. Scale: 1 inch = 100 feet. Water surface elevation = 213 feet.

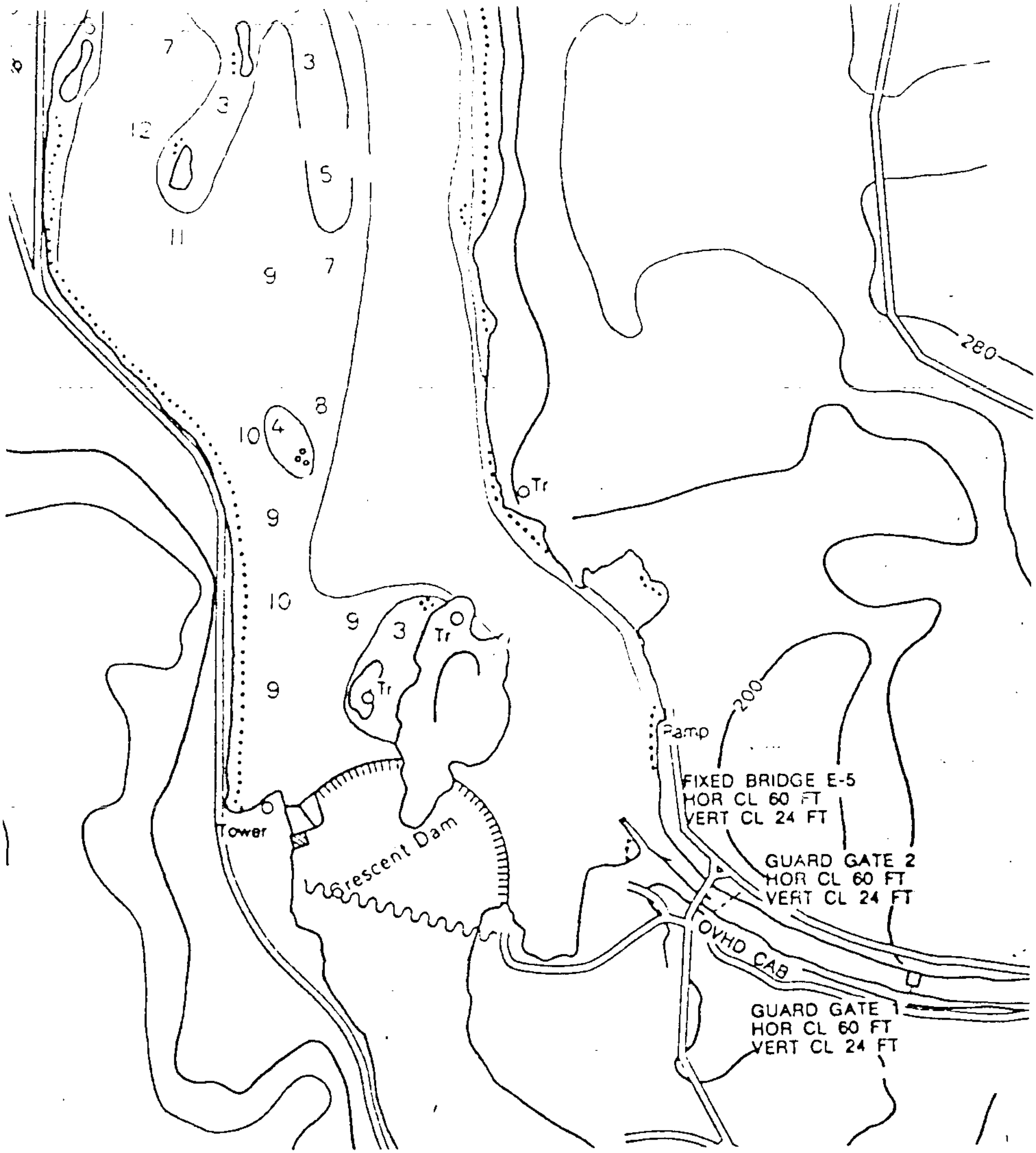


Figure 4. The location of the main channel and secondary channel at the Crescent site.

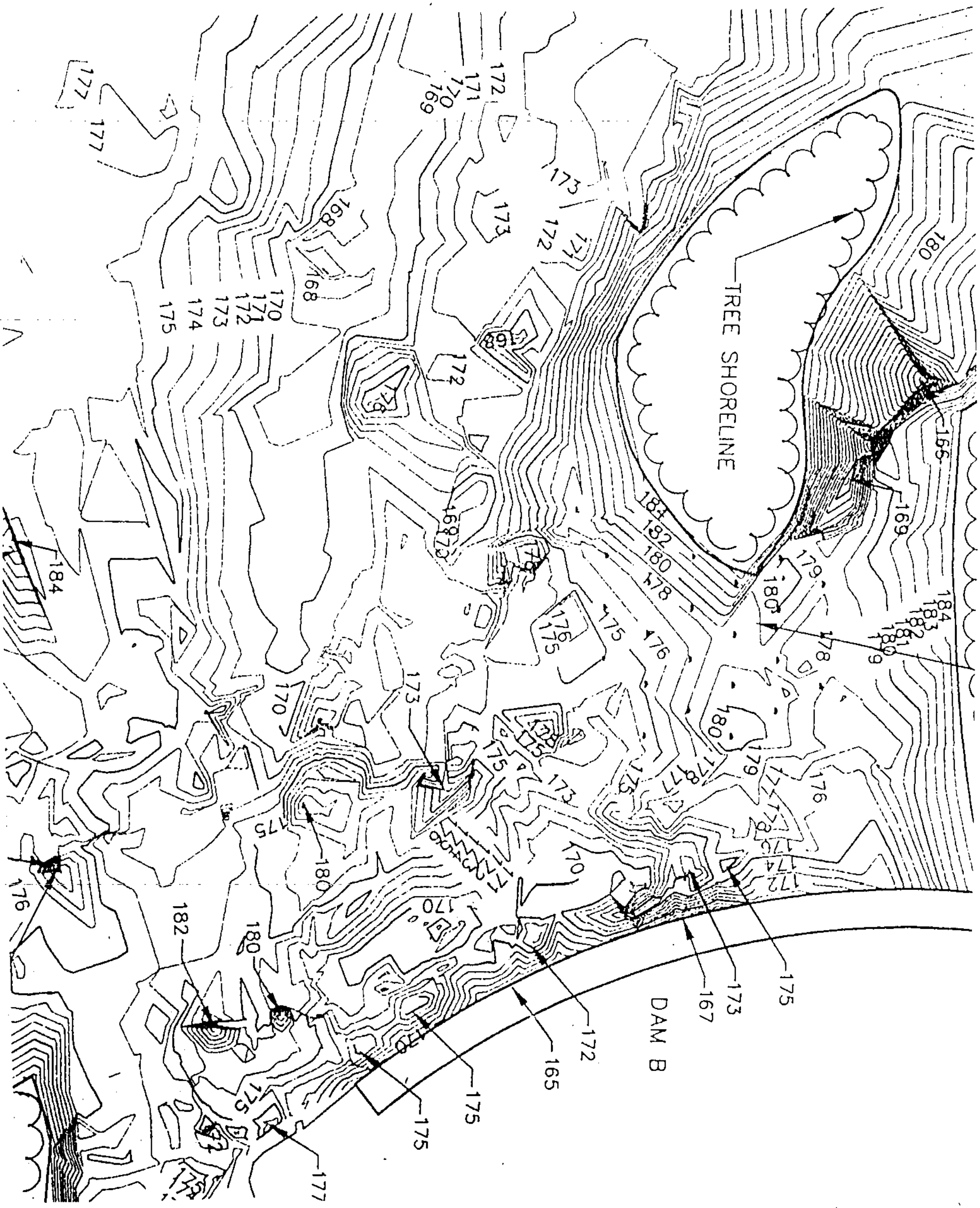


Figure 5. Depth contours in the vicinity of the intersections of Dam B at the Crescent site. Scale: 1 inch = 100 feet. Water surface elevation = 185 feet.

Results

Fall Studies

The Vischer Ferry site

Transducer locations--The locations of the hydroacoustic transducers used during the study conducted at the Vischer Ferry site in the fall of 1996 are depicted in Figure 6.

Transducer 8 monitored fish densities in the flow of water moving toward the powerhouse along the face of the dam, at a location outside of the high frequency sound field (about 300 feet from the entrance to the south headrace canal). The opening in the flashboard, located 225 feet from the entrance to the south headrace canal, was cut in the flashboards on Dam F between 1200 and 1300 hrs on 5 October.

Transducer 7 monitored fish densities in the flow of water moving toward the powerhouse from the channel, in an area about 100 feet upstream from that monitored by transducer 8.

Transducer 6 monitored fish densities in the flow of water moving toward the powerhouse at the periphery of the high frequency sound field, at a location near the opening in the flashboards and about 200 feet from the entrance to the south headrace canal.

Transducer 5 monitored fish densities in the flow of water along the face of the dam between the powerhouse and the opening in the flashboards, in an area within 75 feet of the entrance to the south headrace canal.

Transducer 2 monitored fish densities in the flow of water entering the south headrace canal at a point closest to the dam.

Transducer 4 monitored fish densities in the flow of water entering the south headrace canal at a point farthest from the dam.

Transducer 3 monitored fish densities in the lower half of the water column directly upstream from the midline between the headrace canals.

Transducer 1 monitored fish densities in the flow of water down along the northern shoreline into the north headrace canal.

Fish densities (#/m^3/hr) observed before and after the opening was cut in Dam F—In these comparisons among transducers, the hourly density estimates generated in a 24-hour period were subdivided into two 12-hour periods, 0700 hrs through 1800 hrs and 1900 hrs through 0600 hrs. The averages of the average hourly density estimates within these 12-hr periods for the first ten days of this study are listed in Tables 1 and 2. The average hourly density estimates generated before (0700 hrs through 1200 hrs) and after the opening was cut (1300 hrs throug 1800 hrs) are listed for the day when the opening was cut. The high frequency sound field was turned on at noon on 31 August and it was not turned off until 13 Sept 1500 hrs. The hydroacoustic monitoring system was activated at 1 Sept 1500 hrs.

Table 1 provides the results from the transducers 5, 6, and 7. The highest fish densities observed at the individual transducers occurred during the first night (1900 hrs-0600 hrs) that density data were collected. The highest fish density observed occurred at the edge of the high frequency sound field (transducer 6). Outside the high frequency sound field (transducer 7) fish densities were relatively constant during the day (0700 hrs-1800 hrs) until the opening in the flashboards was cut. Fish densities at transducer 7 appeared to rise and fall on alternate nights until the second night after the opening was cut in the flashboards. At the edge of the high frequency sound field (transducer 6) fish densities appeared to rise and fall on alternate days until the opening was cut in the flashboards. At night, fish densities decreased dramatically between the first and second nights during which data were collected. Then, they increased steadily until the opening was cut in the flashboards. Within the high frequency sound field (transducer 5) fish densities were moderate during the first day of monitoring and very low during the day thereafter. Fish densities at transducer 5 appeared to rise and fall on alternate nights until the opening was cut in the flashboards. Moderate fish densities occurred at transducer 5 on 3 of the 4 nights sampled during this period after the opening was cut in the flashboards. During the day when the opening was cut in the flashboards, fish densities decreased markedly at transducers 6 and 7 when the opening was cut.

Table 2 provides the results from the transducers 2, 4, and 1. The results from transducer 3 are not included in Table 2 because they were always low, ranging from 0.001 to 0.017 during the day (0700-1800 hrs) and from 0.005 to 0.023 after the first night (1900-0600 hrs) that data were collected during this study. The highest average hourly fish densities observed at the individual transducers occurred during the first night. The average hourly density estimate for transducer 3 was 0.084. The highest fish density observed occurred at the entrance to the north headrace along the shoreline (transducer 1). In the main flow into the headrace (transducer 2), fish densities were low during the day except for the first day of monitoring. Fish densities at transducer 2 rose and fell on alternate nights until the second night after the opening was cut in the flashboards. A similar pattern of results was observed at transducer 4. At transducer 1, fish densities were generally low during the day. Nighttime densities were initially high, decreased markedly on the next night, and then declined in a step-wise fashion, remaining relatively constant for two nights and then decreasing, until the second night after the opening was cut in the flashboards. Fish densities were low during the day and cutting the opening in the flashboards had no major effect.

On/Off Comparisons--In these comparisons, the average hourly density estimates generated in a 24-hour period were averaged. The 24-hour period varied between months. The September period occurred from 1500 hrs through 1400 hrs. Fourteen days, seven "on" and seven "off", were available for comparison after the days when wind and high water restricted the ranges on the transducers were eliminated (Table 3). Transducer 8 was installed on October 2 and the range bins and sensitivities for transducers 3, 6, and 7 were adjusted on October 7. The 24-hour period available between October 7 and October 28 occurred from 0800 hrs through 0700 hrs. The 24-hour period available between October 29 and November 8 occurred from 1100 hrs through 1000 hrs. At the end of October, fish densities declined outside of the high frequency sound field and increased dramatically along the north shore of the river (transducer 1). Twenty days, ten "on" and ten "off", were included in the October sample (Table 4) and 8 days, four "on" and four "off" were included in the November sample (Table5). At transducers 8, 7, and 5, the average fish density increased in September and October when the high frequency sound field was on. At transducer 6, there was no change in fish densities. At transducers 2 and 4, the average fish density decreased in September when the high frequency sound field was on. In November, the fish densities at all transducers except transducer 1 were low. The fish densities at transducer 1 initially increased when the high frequency sound field was off (October 31) and remained high for the next three days (November 1-3) when the high frequency sound field was on.

The Crescent site

Transducer locations--The locations of the hydroacoustic transducers used during the study conducted at the Crescent site in the fall of 1997 are depicted in Figure 7.

Transducer 8 monitored fish densities directly in front of the opening in the flashboards.

Transducer 7 monitored fish densities in the flow of water moving toward the Crescent Dam within the far range of the deterrent sound field.

Transducer 6 monitored fish densities in deep water beyond the opening in the flashboards within the far range of the deterrent sound field.

Transducer 5 monitored fish densities in the flow of water moving toward the powerhouse at the western end of the dam.

Transducer 2 monitored fish densities in the western half of the flow entering the headrace canal.

Transducer 4 monitored fish densities in the eastern half of the flow entering the headrace canal.

Transducer 3 monitored fish densities in the eastern half of the headrace, 8 m in front of the trashracks.

Transducer 1 monitored fish densities in the western half of the headrace, 8 m in front of the trashracks.

Fish densities (#/m^3/hr) observed during the first day that the high frequency sound field was on (8 September 1997, 1000 hrs through 1900 hrs)—The high frequency sound field was turned on 8 September at 0900 hrs, three days before the opening was cut in the flashboards on Dam B. The hydroacoustic data from the first hour that the high frequency sound field was on was lost due to computer problems. The average hourly fish densities for the next ten hours are listed in Table 6.

Outside the headrace, fish densities were highest at the western end of Dam B (transducer 5) initially. Over the next three hours (1100 hrs – 1300 hrs), fish densities decreased at the western end of Dam B and increased progressively farther and farther away from the headrace (transducers 8, 6, and 7). At 1500 hrs, fish densities decreased markedly at transducers 6 and 7. Between 1600 hrs and 1900 hrs, fish densities increased progressively from east to west along Dam B (transducer 7 to transducer 5).

Inside the headrace, fish densities were higher in within the eastern half of the headrace canal from 1000 hrs through 1300 hrs. From 1400 hrs through 1500 hrs, they were higher in the western half of the canal. Fish densities were generally low from 1600 hrs through 1700 hrs. At 1800 hrs, fish densities increased in the western half of the canal.

Fish densities (#/m^3/hr) observed before the opening was cut in the flashboards on Dam B—On 11 September 0830 hrs, the opening was cut in the flashboards on Dam B. In the following comparisons among transducers, the average hourly density estimates generated with a 24-hr period were subdivided into two 12-hr periods, 0600 hrs through 1700 hrs and 1800 hrs through 0500 hrs. The averages of the average hourly density estimates within the five 12-hr periods occurring before the opening in the flashboards was cut are listed in Table 7. Unit 4 was the only unit operating at the Crescent Hydroelectric Project during this 60-hr period.

The transducers located outside of the headrace are listed in order from the farthest from the entrance to the headrace canal (transducer 7) to the closest to the entrance (transducer 5). Fish densities were highest at the edge of the high frequency sound field (transducer 8) during the first night after the sound field was turned on. Fish densities were higher at the western end of Dam B (transducer 5) than at the eastern end (transducer 6). During the following two days (0600-1700 hrs) fish densities were highest at the eastern end of the dam and lowest at the western end. During the second night (1800-0500 hrs), fish densities were high all along the dam and as high at the western end as they had been during the first night. During the third night, fish densities were low at all transducers located outside of the headrace.

The transducers located inside the headrace canal are listed east to west away from the trashracks (transducers 4 and 2) and west to east near the trashracks (transducers 1 and 3). Transducer 3 monitored the area closes to the trash sluice and forebay of Unit 4, which was operating during this period. During the first night, fish densities within the headrace were similar in magnitude to those observed at the western end of Dam B, except in the area near the active unit and trash sluice. During the next day, fish densities were still relatively high within the headrace, except near the active unit and trash sluice. The second night, fish densities within the headrace were much higher than those observed at the western end of the dam, especially along the eastern side of the headrace away from the operating unit and trash sluice (transducer 4). The high fish densities carried over into the next day along the eastern side of the headrace. During the third night, fish densities within the headrace were low and similar in magnitude to those observed at the western end of the dam.

The effects of Units 3 and 4 on the distribution of fish within the headrace—The changes in the distribution of fish within the headrace in Tables 6 and 7 suggested that fish might be responding to diel changes in the location of shadows within the headrace canal, i.e., along the eastern wall in the morning and along the western wall in the afternoon, or a shift of the large standing wave, present within the eastern half of the headrace canal when units were operating, away from the eastern wall toward the centerline of the canal when Unit 3 was operating (the units at this site are numbered 1-4 from west to east). The data in Tables 8 and 9 were assembled to answer this question. Only nighttime (1800-0500 hrs) 12-hr averages were used in order to eliminate any shadow effect from the analysis and to restrict the comparison to a period when fish were actively moving into the headrace.

The average densities from transducer 5 were used to identify nights when similar densities of fish were moving towards the entrance to the headrace. When the high frequency sound field was off, there were three comparable nights available for each unit (Table 8). When the high frequency sound field was on, there were five comparable nights available for each unit (Table 9). A visual inspection of the average densities in Tables 8 and 9 indicated that a very strong unit effect was present. When Unit 3 was operating, the average fish densities at transducers 1, 3, and 4 clearly increased. The fish densities at transducer 2 were most similar to those at transducer 5.

The differences among transducers 1, 3, and 4 were tested using a split-plot anova model (nights were nested within units). The unit effect was highly significant in both data sets ($p < 0.01$). The unit x transducer interaction was also significant ($p < 0.05$), which confirms that the unit effect varied across the three transducers.

The effect of cutting the opening in the flashboards—The fish densities at transducer 8 were used as the measure of fish densities near the opening in the flashboards. The fish densities at transducer 5 were used as the measure of fish densities near the entrance to the headrace. The comparisons between these two transducers were restricted to the period from 1800 hrs through 0400 hrs when fish appeared to be actively moving toward the headrace and to the hours within this period when fish densities were high (greater than 1 fish per cubic meter) at transducer 8. During the period before the opening was cut in the flashboards (Sept 8-10) there were 15 paired average hourly density estimates that met these criteria (Table 10). During the period after the opening was cut (Sept 11-16), there were another 15 pairs of average hourly density estimates that met the criteria (Table 10). The effect of cutting the opening in the flashboards on the fish densities at transducer 5 was so great that no statistical test was necessary. The average of the average hourly density estimates went from 5.942 to 0.144 fish per cubic meter per hour. The average of the 15 average hourly density estimates from transducer 8 went from 7.022 to 6.858 fish per cubic meter per hour.

Seasonal changes in abundance—The averages of the average hourly density estimates generated during the 24-hr period from 0600 hrs through 0500 hrs at transducer 8 were used to describe the seasonal changes in fish abundance at the Crescent site from 8 September 1000 hrs through 9 November 0500 hrs (Table 11). Fish densities were high (greater than 1 fish per cubic meter) at the beginning of the study and between September 17 and 18. At the beginning of October, the voltage to the transducers generating the high frequency sound field was lowered from 75 volts to 24 volts, shrinking the sound field back to the entrance to the headrace. High fish densities occurred soon after the voltage was decreased. On October 6, the voltage was increased back to 75 volts and no daily average fish density greater than 1 fish per cubic meter was observed after October 9. In the headrace (transducer 2), there was only a slight increase in fish densities in early October when the voltage was reduced (Table 12).

Average daily river flows during the fall studies in 1996 and 1997—In Table 13, the average daily river flows measured at the United States Geological Survey gauging station at Cohoes, New York, are grouped by days of similar flow during the period from 1 September through 10 November in 1996. In general, river flows were higher during the fall of 1996 than they were during the fall of 1997. The flows during the fall of 1997 were relatively low until late October and even then they were not particularly high until the last two days of the study. The flow on November 10 was 8770 cubic feet per second. The changes in the average hourly fish densities occurring during the period from 10 November 1200 hrs through 2300 hrs at transducer 8 are illustrated in Figure 8. Extremely high fish densities occurred from 1800 hrs through 2000 hrs.

Spring/Summer *Studies*

The Crescent site

Transducer locations--The locations of the hydroacoustic transducers used during the study conducted at the Crescent site in the spring and summer of 1998 are depicted in Figure 9.

Transducer 8 monitored fish densities directly in front of the opening in the flashboards, located approximately 250 feet from the entrance to the headrace canal.

Transducer 7 monitored fish densities in the flow of water moving down the main channel to the Crescent powerhouse approximately 400 feet directly upstream from the entrance to the headrace canal.

Transducer 6 monitored fish densities near the dam approximately 350 feet from the entrance to the headrace canal.

Transducer 5 monitored fish densities in the flow of water moving toward the powerhouse along the western end of the dam, approximately 100 feet from the entrance to the headrace canal.

Transducer 2 monitored fish densities in the upper portion of the water column near the eastern side of the headrace canal.

Transducer 1 monitored fish densities in the lower portion of the water column near the eastern side of the headrace canal.

Transducer 4 monitored fish densities in the lower portion of the water column in the eastern half of the flow entering the headrace canal.

Transducer 3 monitored fish densities in the lower portion of the water column in the center of the flow entering the headrace canal.

Seasonal changes in abundance—The averages of the average hourly density estimates generated during the 24-hr period from 0600 hrs through 0500 hrs were used to describe the seasonal changes in fish abundance at the Crescent site from 12 May 0600 hrs through 13 July 0500 hrs (computer problems terminated the time series on this date). The comparison of the data from the transducers monitoring fish densities within the headrace demonstrated that much higher fish densities were detected by transducers 3 and 4 than by transducers 1 and 2 (Figures 10 and 11). Outside of the headrace, fish densities were low at transducers 6, 7, and 8 until late May. During the period from late May through the middle of June, fish densities increased at transducer 7. During this period, the disparities between transducers 5 and 7 and transducers 6 and 8 (Figure 12) were comparable to those observed between transducers 3 and 4 than by transducers 1 and 2. Fish densities were consistently low at all transducers after June 19. Therefore, the results from transducers 3, 4, 5, and 7 were used to describe the daily changes in abundance during the period from 12 May 0600 hrs through 19 June 0500 hrs.

Fish first appeared at the Crescent site on May 19 near the dam, transducer 5, and moved into the headrace, transducers 3 and 4, on May 20 (Table 14). The next group of fish appeared on May 24 and moved into the headrace on the same day. The biggest group of fish appeared on May 26 and took five days to move by the site.

Fish densities at transducer 7 began to increase at the end of May and were generally high during the first 12 days of June (Table 15). These fish initially moved to the dam, transducer 5. However, they did not enter the headrace. Instead, the fish densities at transducer 5 decreased and those at transducer 7 increased again. Fish densities remained high at transducer 7 for five days and then fish began entering the headrace. Fish densities were high within the headrace for three days.

Hourly changes in abundance—In order to depict when fish appeared and disappeared within a 24-hour period, the average hourly densities from 1000 hrs through 0900 hrs on three days of high abundance during May (May 24, 27, and 28) were averaged by hour across days by transducer for transducers 3, 4, and 5. The averages of the average hourly densities are given in Figure 13. Fish densities started increase at 1100 hrs, peaked between 1300 hrs and 1600 hrs, and reached baseline levels by 2200 hrs.

In June, fish first appeared at transducer 7 on 1 June 2000 hrs and disappeared by 2 June 0400 hrs (Figure 14). Fish appeared at transducer 5 on 2 June 0500 hrs and peaked at 0800 hrs. High fish densities were observed at transducer 5 through 3 June 1100 hrs. Fish densities were low at all transducers from 3 June 1200 hrs through 4 June 1300 hrs. Fish densities increased at transducer 7 during two periods after 1300 hrs during June 4 and June 5, from 1400 hrs through 2100 hrs on June 4 (with peak abundance occurring at 1400 and 1500 hrs) and from 0300 hrs through 0600 hrs on June 5 (Figure 15).

During the next 8 days, fish appeared at transducer 7 after midnight (0000 hrs) and disappeared by 0900 hrs. During four of these days, the high frequency sound system was on (June 5, 6, 9, and 10). During the other four, it was off (June 7, 8, 11, and 12). The average hourly densities from 1000 hrs through 0900 hrs from the "on" and "off" groups were averaged by hour across days and plotted in Figure 16. The arrival of the fish during the "on" days appeared lag about an hour after that of the fish during the "off" days.

On June 9 and 10, fish appeared at transducers 3, 4, and 5. The average hourly densities from 1000 hrs through 0900 hrs were averaged by hour across these two days and plotted in Figure 17. Fish appeared near the dam and in the headrace between 1000 hrs and 1900 hrs, with peak densities occurring at 1700 hrs.

Fish continued to move into the area on June 11 and 12 but much lower densities were observed within the headrace. From June 19 to July 12, the averages of the average hourly fish densities observed during the period from 0600 hrs through 0500 hrs from transducer 7 ranged from 0.002 to 0.097 fish (x 24) per cubic meter.

The Vischer Ferry site

Transducer locations--The locations of the hydroacoustic transducers used during the study conducted at the Vischer Ferry site in the spring and summer of 1997 are depicted in Figure

18.Transducer 8 monitored fish densities in the flow of water moving toward the powerhouse along the face of the dam to the left (channel side) of the opening in the flashboards. This area is outside of the deterrent sound field.

Transducer 7 monitored fish densities in the flow of water moving toward the powerhouse from the channel at the periphery of the deterrent sound field for adult fish.

Transducer 6 monitored fish densities in the flow of water moving toward the powerhouse along the face of the dam to the right (powerhouse side) of the opening in the flashboards. This area is outside of the deterrent sound field

Transducer 5 monitored fish densities in the flow of water along the face of the dam between the powerhouse and the opening in the flashboards, at a location within the deterrent sound field.

Transducer 2 monitored fish densities in the flow of water entering the south headrace canal at a point closest to the dam.

Transducer 4 monitored fish densities in the flow of water entering the south headrace canal at a point farthest from the dam.

Transducer 3 monitored fish densities in the lower half of the water column directly upstream from the midline between the two headrace canals.

Transducer 1 monitored fish densities in the flow of water down along the northern shoreline into the north headrace canal.

Seasonal changes in abundance--The averages of the average hourly density estimates generated during the 24-hr period from 0600 hrs through 0500 hrs were used to describe the seasonal changes in fish abundance at the Vischer Ferry site from 10 May 0600 hrs through 31 July 0500 hrs. Fish densities at transducers 3 and 5 were generally low and the data from these transducers are not included in the following tables. Fish first appeared outside the high frequency sound field on May 24 (Tables 16 and 17). Fish densities remained high at the edge of the sound field (transducer 6) for at least the following 7 days (Table 17) and probably for the following 13 days (Table 18). Although there was a slight increase in fish densities at the entrance to the headrace canals when the high frequency sound field was first turned off, they were generally low in this area during May (Tables 16 and 17). When the high frequency sound field was turned off on June 9, fish densities at the entrances to the headrace canals increased detectably and there was some carry-over into the following "on" period (Table 18).

During the next "off" period, June 15-18, fish densities at the entrances to the headrace canals increased dramatically on June 18 and 19 (Table 18). During the following "on" period, fish densities were high outside the high frequency sound field and low at the entrances to the headrace canals. At the end of June, another group of fish appeared but fish densities at the entrances to the headrace canals did not increase markedly when the high frequency sound field was turned off (Table 19).

The next time that high fish densities occurred at the entrances to the headrace canals was on July 11 when the high frequency sound field was on and fish densities were low at transducers 6 and 8 (Table 20).

After July 11, fish densities remained relatively low at the entrances to the headrace canals (Tables 20 and 21). Fish densities at transducers 6 and 8 increased on five occasions between July 11 and 30 (July 15, 17, 22, 26, and 27) but they were all less than 1 fish (x24) per cubic meter, ranging from 0.253 to 0.931 fish (x24) per cubic meter.

Hourly changes in abundance—The data from transducer 6 was used to describe when fish appeared and disappeared within a 24-hour period. The 24-hour period ran from 0600 hrs through 0500 hrs. The average hourly densities from this period on the first two days that fish appeared in high densities, May 24 and 28, were averaged by hour across days. The averages of the average hourly densities for these two days were compared with the averages generated by averaging across hours for the days sampled in the period from May 29 through June 9, i.e., the period when fish consistently occurred in high densities at transducer 6. The averages for these two periods are plotted in Figure 19. When fish first appeared in May, they moved into the area at the edge of the high frequency sound field between 1800 hrs and midnight (0000 hrs). After May 27, the period of high abundance occurred earlier and peaked late in the afternoon.

On the two days when high fish densities were observed at the entrances to the headrace canals (June 18-19 and July 11-12), the period of high abundance occurred between 2100 hrs and 0700 hrs (Figure 20) at times of high river flow (Figure 21 and Table 22).

The effect of the opening in the flashboards on Dam E—In the Spring/Summer study at the Crescent site, fish at the edge of the sound field (transducer 5) moved into the headrace. Therefore, at the Vischer Ferry site, fish at the edge of the sound field (transducer 6) were expected to move into the headrace canals. Comparisons between the densities at transducers 6 and 8 and the sum of the densities at transducers 1, 2, and 4 for days when the average of the average hourly densities at transducer 6 or 8 was greater than 1 fish (x24) per cubic meter. For transducer 6, the average for the 15 days meeting this criterion (Tables 17, 18, and 19) was 3.833. The average of the sums for transducers 1, 2, and 4 for these days was 0.061. For transducer 8, the average for the 16 days meeting the criterion (Tables 17, 18, and 19) was 4.256. The average of the sums for transducers 1, 2, and 4 for these days was 0.130.

The effect of the high frequency sound field- The fish densities at transducer 2 were used to test the effect of high frequency sound on fish densities near the entrances to the headrace canals. The 24-hour day was divided into day (0600 – 1700 hrs) and night (1800 – 0500 hrs). The average hourly density estimates were averaged over each 12-hour period from May 24 through July 30. These 12-hour averages were then averaged over the days or nights falling within a given "on" or "off" period. The two periods that included June 17-18 and July 10-13 were excluded from this analysis, resulting in 9 "on" periods and 9 "off" periods. Periods are nested within the sound treatment and a split-plot model was used to test the sound effect and the sound x diel interaction. The sound effect was interaction was significant (alpha = 0.05); the interaction was not. The daytime averages for the "on" and "off" treatments were 0.018 and 0.031 fish (x24) per cubic meter. The nighttime averages for the "on" and "off" treatments were 0.014 and 0.059 fish (x24) per cubic meter.

Table 1. *Fall 1996 study at the Vischer Ferry site - -* The averages of the average hourly fish density estimates (#/m³/hr) generated in consecutive 12-hour periods, starting 31 August 0700 hrs and ending 10 September 0600 hrs, from the transducers monitoring fish densities outside the high frequency sound field (transducer 7), near the location of the opening in the flashboards (transducer 6), and near the dam within 75 feet of the entrance to the south headrace canal (transducer 5). The high frequency sound field was present from 31 August 1200 hrs through 10 September 0600 hrs.

TRANSDUCER

	7	**7**	**6**	**6**	**5**	**5**
Date	**07-18 hrs**	**19-06 hrs**	**07-18 hrs**	**19-06 hrs**	**07-18 hrs**	**19-06 hrs**
Aug.31-Sept.1	ND[a]	ND	ND	ND	ND	ND
1-2	ND	3.051	ND	15.798	ND	4.303
2-3	0.259	0.254	0.847	0.344	0.119	0.386
3-4	0.208	0.487	0.599	0.855	0.006	0.605
4-5	0.295	0.189	0.730	1.779	0.004	0.300
5-6[b]	0.212	0.238	0.663	0.139	0.013	1.133
6-7	0.018[c]	0.117	0.037[c]	0.073	0.009[c]	0.325
7-8	0.234	0.088	0.107	0.042	0.006	0.360
8-9	0.052	0.331	0.016	0.006	0.009	0.051
9-10	0.044	0.190	0.025	0.016	0.007	0.252

Sept. 5 0700-1800 hrs	Transducer 7	Transducer 6	Transducer 5
0700-1200 hrs	0.342	1.250	0.011
1300-1800 hrs	0.082	0.077	0.015

a ND = No hydroacoustic data collected

b The opening in the flashboards was cut between 1200 and 1300 hrs on 5 September

c No data were collected during 1600 and 1700 hrs

Table 2: *Fall 1996 study at the Fischer Ferry site* - - The averages of the average hourly fish density estimates (#/m³/hr) generated in consecutive 12-hour periods, starting 31 August 0700 hrs and ending 10 September 0600 hrs, from the transducers monitoring fish densities along the northern shore at the entrance to the north headrace canal (transducer 1), in the southern half of the flow entering the south headrace canal (transducer 2), and in the northern half of the flow entering the south headrace canal (transducer 4). The high frequency sound field was present from 31 August 1200 hrs through 10 September 0600 hrs.

TRANSDUCER

	2	**2**	**4**	**4**	**1**	**1**
Date	**07-18 hrs**	**19-06 hrs**	**07-18 hrs**	**19-06 hrs**	**07-18 hrs**	**19-06 hrs**
Aug.31 – Sept. 1	ND[a]	ND	ND	ND	ND	ND
1-2	ND	1.697	ND	0.243	ND	1.791
2-3	0.308	0.033	0.023	0.009	0.038	0.355
3-4	0.001	0.232	0.001	0.137	0.088	0.342
4-5	0.004	0.094	0.001	0.017	0.008	0.108
5-6[b]	0.005	0.256	0.005	0.069	0.016	0.119
6-7	0.002[c]	0.035	0.005[c]	0.028	0.006[c]	0.066
7-8	0.010	0.030	0.004	0.023	0.025	0.046
8-9	0.035	0.017	0.012	0.009	0.042	0.042
9-10	0.0.32	0.024	0.036	0.010	0.007	0.043

<u>Sept. 5: 0700-1800 hrs</u>

	Transducer 2	Transducer 4	Transducer 1
0700-1200 hrs	0.002	0.002	0.006
1300-1800 hrs	0.009	0.009	0.027

[a] ND = no data collected

[b] The opening in the flashboards was cut between 1200 and 1300 hrs on 5 Sept

[c] No data were collected during 1600 and 1700 hrs

Table 3. *Fall 1996 study at the Vischer Ferry site* - - The averages of the average hourly fish density estimates (#/m³/hr) generated in the 24-hour period from 1500 hrs through 1400 hrs from 7 days when the high frequency sound field was on and from 7 days when the high frequency sound field was off during September. The transducers are listed in order from the southernmost location to the northernmost location.

DATE **TRANSDUCER**

September	7	6	5	2	4	3	1
Field on							
10-11	0.073	0.034	0.066	0.009	0.016	0.005	0.084
11-12	0.099	0.038	0.082	0.062	0.032	0.022	0.046
12-13	0.123	0.070	0.063	0.015	0.008	0.004	0.016
16-17	0.090	0.024	0.061	0.044	0.015	0.007	0.034
17-18	0.063	0.010	0.005	0.017	0.009	0.004	0.027
20-21	0.076	0.010	0.006	0.006	0.010	0.004	0.030
22-23	0.151	0.007	0.003	0.017	0.006	0.005	0.023
Average							
On	**0.096**	**0.028**	**0.041**	**0.024**	**0.014**	**0.007**	**0.037**
Field off							
13-14	0.063	0.033	0.026	0.085	0.029	0.006	0.060
14-15	0.067	0.042	0.076	0.117	0.113	0.017	0.074
15-16	0.058	0.031	0.037	0.263	0.061	0.005	0.125
18-19	0.103	0.014	0.019	0.181	0.046	0.005	0.130
19-20	0.034	0.019	0.012	0.014	0.021	0.002	0.067
23-24	0.018	0.022	0.020	0.051	0.020	0.005	0.053
24-25	0.074	0.011	0.003	0.026	0.026	0.003	ND[a]
Average							
Off	**0.060**	**0.025**	**0.028**	**0.105**	**0.045**	**0.006**	**0.085**

[a]ND = No data available because of noise from wind/waves

Table 4. *Fall 1996 study at the Vischer Ferry site* - - The averages of the average hourly fish density estimates (#/m^3/hr) generated in the 24-hour period from 0800 hrs through 0700 hrs from 10 days when the high frequency sound field was on and from 10 days when the high frequency sound field was off during October. The transducers are listed in order from the southernmost location to the northernmost location.

DATE | **TRANSDUCER**

October	8	7	6	5	2	4	3	1
Field on								
7-8	0.059	0.027	0.003	0.003	0.003	0.008	0.007	0.020
9-10	0.071	0.061	0.063	0.014	0.004	0.003	0.000	0.035
10-11	0.073	0.045	0.026	0.016	0.006	0.006	0.001	ND[a]
15-16	0.026	0.011	0.001	0.015	0.003	0.001	0.003	0.047
16-17	0.054	0.038	0.024	0.093	0.010	0.008	0.002	0.010
17-18	0.040	0.004	0.012	0.025	0.005	0.012	0.000	0.102
25-26	0.110	0.033	0.040	0.044	0.010	0.008	0.002	ND
26-27	0.072	0.008	0.010	0.059	0.005	0.004	0.001	0.114
27-28	0.012	0.013	0.005	0.003	0.002	0.003	0.009	0.088
31 Oct-1 Nov[b]	0.029	0.011	0.062	0.011	0.010	0.015	0.004	ND
Average On	**0.055**	**0.025**	**0.025**	**0.028**	**0.006**	**0.007**	**0.003**	**0.059**
Field off								
5-6	0.026	0.021	0.028	0.020	0.012	0.009	0.010	0.011
6-7	0.012	0.050	0.021	0.014	0.025	0.034	0.004	0.053
11-12	0.015	0.006	0.007	0.008	0.012	0.008	0.001	0.069
12-13	0.010	0.012	0.003	0.003	0.006	0.006	0.002	0.082
13-14	0.004	0.011	0.017	0.001	0.006	0.005	0.002	0.098
19-20	0.014	0.010	0.036	0.003	0.006	0.007	0.001	ND
21-22	0.031	0.008	0.112	0.005	0.002	0.001	0.000	0.013
23-24	0.037	0.014	0.022	0.011	0.005	0.002	0.000	0.096
24-25	0.028	0.006	0.025	0.012	0.008	0.006	0.001	0.084
29-30[b]	0.009	0.016	0.006	0.001	0.005	0.014	0.006	0.104
Average Off	**0.019**	**0.015**	**0.028**	**0.008**	**0.009**	**0.009**	**0.003**	**0.068**

[a]ND = No data available because of noise from wind/waves

[b] - The average number of fish observed per cubic meter per hour over the 24-hour period from 1100 hrs through 1000 hrs

Table 5. *Fall 1996 study at the Vischer Ferry Site* - The averages of the average hourly fish density estimates ($\#/m^3/hr$) generated in the 24-hour period from 1100 hrs through 1000 hrs from 4 days when the high frequency sound field was on and from 4 days when the high frequency sound field was off during November. The transducers are listed in order from the southernmost location to the northernmost location.

DATE **TRANSDUCER**

November	8	7	6	5	2	4	3	1
Field on								
Nov 1-2	0.003	0.001	0.002	0.000	0.001	0.014	0.001	0.753
Nov 2-3	0.005	0.007	0.002	0.005	0.001	0.018	0.002	1.784
Nov 3-4	0.002	0.001	0.000	0.000	0.000	0.010	0.000	0.987
Nov 7-8	0.006	0.002	0.011	0.001	0.005	0.003	0.001	0.028
Average								
On	**0.004**	**0.003**	**0.004**	**0.001**	**0.002**	**0.011**	**0.0001**	**0.888**
Field off								
Oct 30-31	0.067	0.015	0.013	0.009	0.014	0.012	0.002	0.528
Nov 4-5	0.018	0.038	ND[a]	0.006	0.002	0.006	0.002	0.162
Nov 5-6	0.008	0.012	0.005	0.001	0.002	0.002	0.000	0.122
Nov 6-7	0.007	0.003	0.001	0.002	0.009	0.003	0.001	0.026
Average								
Off	**0.025**	**0.017**	**0.006**	**0.004**	**0.007**	**0.006**	**0.001**	**0.209**

[a] ND = No data available because of noise from wind/waves

Table 6. *Fall 1997 study at the Crescent site* - - The average hourly fish densities (#/m^3/hr) by transducer, generated on 8 September from 1000 hrs through 1900 hrs. The high frequency sound field was turned on 8 September 0900 hrs (no data were collected during the first hour of operation).

Transducers located outside the headrace canal:

TRANSDUCER

Hour	5	8	6	7
1000	3.160	0.063	0.280	0.278
1100	0.211	55.146	0.990	1.553
1200	0.103	6.536	8.817	3.174
1300	0.531	2.032	11.089	14.179
1400	0.024	0.943	8.843	5.112
1500	0.064	1.449	0.588	0.296
1600	0.022	0.625	0.557	0.283
1700	0.083	0.695	0.310	1.064
1800	0.305	1.540	0.830	0.524
1900	7.121	8.992	0.497	0.070

Transducers located inside the headrace canal:

TRANSDUCER

Hour	2	1	4	3
1000[a]	0.000	0.084	93.472	5.066
1100[a]	1.082	0.008	63.003	5.813
1200[a]	0.069	0.235	21.696	0.591
1300[ab]	0.099	0.940	2.463	0.180
1400[b]	6.451	2.569	0.000	0.088
1500[b]	1.859	0.084	0.403	0.017
1600[b]	0.472	0.505	0.277	0.112
1700[b]	0.909	0.492	0.296	0.057
1800[b]	0.957	10.362	1.277	0.465
1900[b]	10.463	1.692	5.204	2.433

[a] - Unit 3 in operation; [b] - Unit 4 in operation

Table 7. *Fall 1997 study at the Crescent site* - - The averages of the average hourly fish density estimates (#/m^3/hr) by transducer generated in consecutive 12-hour periods, starting 8 September 1800 hrs and ending 11 September 0500 hrs. The high frequency sound field was present throughout the entire period. Only Unit 4 operated during this period. The opening in the flashboards on Dam B was not cut until 11 September 0930 hrs.

	Sept. 9		**Sept. 10**		**Sept.11**
	1800-0500	**0600-1700**	**1800-0500**	**0600-1700**	**1800-0500**
Transducer					
7	6.207	0.227	4.807	0.111	0.072
6	1.624	6.429	8.025	1.178	0.019
8	17.848	1.965	7.055	0.480	0.026
5	5.881	0.054	4.015	0.012	0.097
4	5.557	2.105	118.027	0.322	0.009
2	5.349	5.311	27.674	12.026	0.069
1	4.179	2.875	8.826	7.422	0.145
3	2.694	0.346	9.278	0.039	0.009

Table 8. *Fall 1997 study at the Crescent site* - - The averages of the average hourly fish density estimates (#/m³/hr) generated in the 12-hour period from 1800 hrs through 0500 hrs from the transducers within the headrace canal (transducers 1-4). The dates selected represent periods when the averages from transducer 5 (used as a control) ranged from 0.102 to 0.278 fish per cubic meter, Unit 3 or 4 was operating, the high frequency sound field was on, and the opening had been cut in the flashboards on Dam B.

TRANSDUCER

	5	**4**	**2**	**1**	**3**
Unit 3					
9/14-15	0.197	0.349	0.111	0.213	0.867
9/15-16	0.136	0.506	0.139	2.413	2.855
9/16-17	0.182	1.306	0.074	0.864	4.840
9/20-21	0.241	1.249	0.091	0.257	2.030
9/23-24	0.102	0.690	0.053	0.319	5.084
Average	**0.172**	**0.820**	**0.234**	**0.813**	**3.099**

Unit 4					
9/11-12	0.238	0.010	0.277	0.542	0.057
9/12-13	0.278	0.039	0.172	0.494	0.398
9/13-14	0.223	0.034	0.108	0.179	0.135
9/19-20	0.259	0.043	0.136	0.360	0.175
9/24-25	0.128	0.008	0.112	0.147	0.035
Average	**0.225**	**0.027**	**0.161**	**0.344**	**0.159**

Table 9. *Fall 1997 study at the Crescent site* - - The averages of the average hourly fish density estimates (#/m³/hr) generated in the 12-hour period from 1800 hrs through 0500 hrs from the transducers within the headrace canal (transducers 1-4). The dates selected represent periods when the averages from transducer 5 (used as a control) ranged from 0.111 to 0.468 fish per cubic meter, Unit 3 or 4 was operating, the high frequency sound field was off, and the opening had been cut in the flashboards on Dam B.

TRANSDUCER

	5	4	2	1	3
Unit 3					
9/17-18	0.468	0.335	0.121	0.416	1.084
9/18-19	0.424	0.133	0.175	0.867	1.301
10/14-15	0.113	0.390	0.088	0.783	1.482
Average	**0.335**	**0.286**	**0.128**	**0.689**	**1.289**

Unit 4					
9/22-23	0.111	0.011	0.065	0.199	0.046
9/25-26	0.165	0.020	0.106	0.287	0.206
9/26-27	0.124	0.044	0.043	0.110	0.167
Average	**0.154**	**0.026**	**0.127**	**0.290**	**0.140**

Table 10. *Fall 1997 study at the Crescent site* - - The paired average hourly fish density estimates (#/m^3/hr) from transducers 8 and 5 before and after the opening was cut on the flashboards. In order to be selected for this comparison, the average hourly fish density at transducer 8 had to be at least 1 fish per cubic meter and the hour had to fall within the period when fish were actively moving (1800 hrs through 0400 hrs).

	Before (Sept. 8-10) Transducer		After (Sept. 11-16) Transducer	
	8	**5**	**8**	**5**
	1.540	0.305	1.945	0.291
	8.992	7.121	2.046	0.192
	9.356	3.274	3.471	0.264
	5.071	14.745	1.792	0.138
	12.004	3.388	5.076	0.034
	5.930	9.801	10.823	0.115
	5.216	11.257	9.186	0.159
	1.211	3.152	7.595	0.072
	1.356	2.569	28.760	0.070
	1.819	1.736	2.402	0.049
	1.274	2.397	1.418	0.034
	5.499	6.661	5.701	0.050
	2.761	1.288	16.290	0.580
	21.820	7.123	4.151	0.006
	16.488	14.320	2.211	0.106
Average	**7.022**	**5.942**	**6.858**	**0.144**

Table 11. *Fall 1997 study at the Crescent site* - - The averages of the average hourly fish density estimates (#/m^3/hr) generated during consecutive 24-hour periods, starting 8 September 0600 hrs and ending 9 November 0500 hrs, from transducer 8. The sign in the Field column denotes whether the high frequency sound field was on (+), off (-), or changed (+/- or -/+) during a 24-hour period. The high frequency sound field was changed at 0900 hrs, except where noted.

Sept.	Field	Average Density	Sept.	Field	Average Density	Oct.	Field	Average Density
8-9	+	13.142	29-30	+/-	0.147	20-21	-	0.147
9-10	+	4.510	30-Oct1	-	0.380	21-22	-/+	0.040
10-11	+	0.253	1-2	-/+[b]	0.144	22-23	+	ND[f]
11-12	+	0.214	2-3	+[c]	0.149	23-24	+	0.184
12-13	+	0.163	3-4	+[d]	0.687	24-25	+/-	0.549
13-14	+	0.195	4-5	+	1.419	25-26	-	0.049
14-15	+	1.102	5-6	+/-	1.368	26-27	-/+[g]	0.192
15-16	+	0.100	6-7	-/+[e]	1.607	27-28	+	0.338
16-17	+	3.091	7-8	+	0.095	28-29	+	0.188
17-18	+/-[a]	1.782	8-9	+	0.100	29-30	+/-	0.048
18-19	-	0.165	9-10	+/-	1.251	30-31	-	0.074
19-20	-/+	0.125	10-11	-	0.711	31-Nov.1	-/+	0.038
20-21	+	0.042	11-12	-/+	0.094	1-2	+	0.077
21-22	+/-	0.109	12-13	+	0.028	2-3	+	0.171
22-23	-	0.409	13-14	+	0.180	3-4	+	0.210
23-24	+	0.069	14-15	+/-	0.456	4-5	+	0.044
24-25	+	0.047	15-16	-	0.144	5-6	+	0.014
25-26	+/-	0.063	16-17	-/+	0.299	6-7	+	0.010
26-27	-	0.041	17-18	+	0.050	7-8	+	0.067
27-28	-/+	0.050	18-19	+	0.007	8-9	+	0.070
28-29	+	0.128	19-20	+/-	0.027			

a Off at 1100 hrs
b On at reduced voltage (24V)
c 0600-2200 hrs (n=17)
d 1100-0500 hrs (n=19)
e On at full voltage (75V)
f ND = No data collected
g On at 0800 hrs

Table 12. *Fall 1997 study at the Crescent site* - - The averages of the average hourly fish density estimates (#/m^3/hr) generated during the nighttime hours (1800-0500 hrs), starting 8 September 0600 hrs and ending 9 November 0500 hrs from transducer 2. The sign in the Field column denotes whether the high frequency sound field was on (+) or off (-) during each 12-hour period.

TRANSDUCER 2

Sept.	HFS	Density	Oct.	HFS	Density	Oct.	HFS	Density
8-9	+	5.349	1-2	+	0.056[b]	24-25	-	0.019
9-10	+	27.674	2-3	+	ND[c]	25-26	-	0.025
10-11	+	0.069	3-4	+	0.114	26-27	+	0.019
11-12	+	0.277[a]	4-5	+	0.321	27-28	+	0.253
12-13	+	0.172	5-6	-	0.411	28-29	+	0.017
13-14	+	0.108	6-7	+	0.025	29-30	-	0.005
14-15	+	0.111	7-8	+	0.019[d]	30-31	-	0.007
15-16	+	0.139	8-9	+	0.058	31-Nov. 1	+	0.008
16-17	+	0.074	9-10	-	0.033	1-2	+	0.079
17-18	-	0.121	10-11	-	0.058[e]	2-3	+	0.019
18-19	-	0.175	11-12	+	0.029	3-4	+	0.012
19-20	+	0.136	12-13	+	0.013	4-5	+	0.009
20-21	+	0.091	13-14	+	0.016	5-6	+	0.008
21-22	-	0.048	14-15	-	0.088	6-7	+	0.013
22-23	-	0.065	15-16	-	0.170	7-8	+	0.011
23-24	+	0.053	16-17	+	0.066	8-9	+	0.040
24-25	+	0.112	17-18	+	0.045			
25-26	+	0.106	18-19	+	0.012			
26-27	-	0.043	19-20	-	0.007			
27-28	+	0.058	20-21	-	0.035			
28-29	+	0.072	21-22	+	0.022			
29-30	-	0.041	22-23	+	ND			
30-Oct.1	-	0.039	23-24	+	0.007			

[a] First opening cut in flashboards
[b] On at reduced voltage (24V)
[c] ND = insufficient data collected (1100-2200 hrs)
[d] On at full voltage (75V)
[e] Second opening cut flashboard

Table 13. *Fall 1996 and 1997 studies* - - Comparison of daily average flows in cubic feet per second (cfs) from the United States Geological Survey (USGS) gauging station located on the Mohawk River at Cohoes, New York, during the Fall 1996 and 1997 studies. The periods in this table were generated by grouping days of similar flows in 1996.

Average Daily Flow (cfs)

Period (Days)	1996	1997
9/1-11(9)	1198	970
9/12-18 (9)	1676	1152
9/19 (10)	2021	887
9/29-10/3 (5)	4856	1232
10/4-8 (5)	2020	1322
10/9-14 (6)	2947	1248
10/15-19 (5)	1986	1044
10/20-25 (6)	5635	1078
10/26-11/3 (9)	4298	1843
11/4-11/8 (5)	2964	3208
11/9-10 (2)	5710	7295

Table 14. *Spring/Summer 1998 study at the Crescent site* - - The averages of the average hourly fish density estimates (#/m^3/hr) x 24 generated during consecutive 24-hour periods, starting 12 May 0600 hrs and ending 1 June 0500 hrs, from transducers 7, 5, 4, and 3 (listed in order of increasing proximity to the entrance to the headrace). The sign in the Field column denotes whether the high frequency sound field was on (+), off (-), or changed (+/- or -/+) during a 24-hour period. The opening in the flashboards on Dam B was present at the start of the study.

TRANSDUCER

Date	Field	7	5	4	3
5/12-13	-	0.008	0.002	0.004	0.003
5/13-14	-	0.004	0.005	0.004	0.008
5/14-15	-/+[a]	0.004	0.082	0.001	0.034
5/15-16	+	0.000	0.129	0.002	0.058
5/16-17	+	0.000	0.063	0.012	0.107
5/17-18	+	0.006	0.013	0.002	0.040
5/18-19	+	0.002	0.081	0.008	0.057
5/19-20	+	0.003	0.328	0.079	0.338
5/20-21	+	0.003	0.615	0.169	1.042
5/21-22	+	0.007	0.019	0.022	0.111
5/22-23	+	0.033	0.032	0.017	0.165
5/13-24	+	0.036	0.106	0.061	0.125
5/24-25	+	0.013	1.321	1.638	5.607
5/25-26	+	0.005	0.078	0.026	0.112
5/26-27[b]	+	0.003	1.057	0.511	1.333
5/27-28[c]	+	0.033	6.551	8.999	9.648
5/28-29	+	0.041	3.041	10.269	14.405
5/29-30	+	0.084	0.114	0.113	0.815
5/30-31	+	0.188	0.054	0.035	2.162
5/31-6/1	+	0.160	0.082	0.042	0.265

a High frequency sound field turned on 15 May 0000 hrs
b Data collected 26 June 0600 hrs to 26 June 1100 hrs
c Data collected 27 June 1300 hrs to 28 June 0500 hrs

Table 15. *Spring/Summer 1998 study at the Crescent site* - - The averages of the average hourly fish density estimates (#/m^3/hr) x 24 generated during consecutive 24-hour periods, starting 1 June 0600 hrs and ending 19 June 0500 hrs, from transducers 7, 5, 4 and 3 (listed in order of increasing proximity to the entrance to the headrace). The sign in the Field column denotes whether the high frequency sound field was on (+), off (-), or changed (+/- or -/+) during a 24-hour period. The high frequency sound field was changed at 0600 hrs. The opening in the flashboards on Dam B was present at the start of the study.

TRANSDUCER

Date	Field	7	5	4	3
6/1-2	+	2.055	0.185	0.048	0.146
6/2-3	+	0.043	4.167	0.009	0.111
6/3-4	-	0.107	1.070	0.067	0.171
6/4-5	-	1.020	0.116	0.075	0.189
6/5-6	+	1.303	0.091	0.013	0.144
6/6-7	+	1.437	0.062	0.008	0.085
6/7-8	-	1.177	0.037	0.013	0.103
6/8-9	-	1.891	0.053	0.009	0.070
6/9-10	+	0.688	10.015	2.864	2.974
6/10-11	+	1.210	2.895	6.406	12.071
6/11-12	-	1.039	0.183	0.063	0.815
6/12-13	-	1.993	0.139	0.039	0.125
6/13-14	+	0.297	0.031	0.009	0.032
6/14-15	+	0.015	0.013	0.007	0.015
6/15-16	-	0.004	0.004	0.001	0.001
6/16/17	-	0.006	0.004	0.002	0.002
6/17-18	+	0.012	0.007	0.001	0.002
6/18-19	+	0.005	0.014	0.001	0.021

Table 16. *Spring/Summer 1997 study at the Vischer Ferry site* - - The averages of the average hourly fish density estimates (#/m^3/hr) x 24 generated during consecutive 24-hour periods, starting 10 May 0600 hrs and ending 24 May 0500 hrs, from transducers 8, 6, 2, 4 and 1. The opening in the flashboards on Dam E was present at the start of the study. Transducers 8 and 6 are located outside of the high frequency sound field near the opening of the flashboards. Transducers 2, 4, and 1 monitor fish densities from south to north (2-south, 4-center, 1-north) across the entrances to the headrace canals. The sign in the Field column denotes whether the high frequency sound field was on (+), off (-), or changed (+/- or -/+) during a 24-hour period.

TRANSDUCER

Date	Field	8	6	2	4	1
5/10-11	-	0.000	0.000	0.002	0.000	0.000
5/11-12	-	0.001	0.005	0.002	0.001	0.004
5/12-13	-	0.000	0.006	0.002	0.001	0.003
5/13-/14	-	0.006	0.008	0.002	0.013	0.002
5/14-15	-/+[a]	0.014	0.019	0.002	0.002	0.000
5/15-16	+	0.003	0.031	0.003	0.002	0.008
5/16-17	+	0.004	0.018	0.003	0.002	0.004
5/17-18	+	0.013	0.027	0.002	0.002	0.006
5/18-19	+	0.002	0.025	0.002	0.002	0.000
5/19-20	+	0.008	0.022	0.002	0.002	0.001
5/20-21	+	0.003	0.019	0.003	0.001	0.023
5/21-22	+	0.005	0.031	0.005	0.004	0.012
5/22-23	+	0.028	0.065	0.004	0.002	0.008
5/23-24	+	0.003	0.014	0.002	0.001	0.013

[a] The high frequency sound field was turned on 15 May 0000 hrs

Table 17. *Spring/Summer 1997 study at the Vischer Ferry site* - - The averages of the average hourly fish density estimates (#/m^3/hr) x 24 generated during consecutive 24-hour periods, starting 24 May 0600 hrs and ending 5 June 0500 hrs, from transducers 8, 6, 2, 4 and 1. The opening in the flashboards on Dam E was present at the start of the study. Transducers 8 and 6 are located outside of the high frequency sound field near the opening in the flashboards. Transducers 2, 4, and 1 monitor fish densities from south to north (2-south, 4-center, 1-north) across the entrances to the headrace canals. The sign in the Field column denotes whether the high frequency sound field was on (+), off (-), or changed (+/- or -/+) during a 24-hour period.

TRANSDUCER

Date	Field	8	6	2	4	1
5/24-25	+	4.506	10.722	0.002	0.002	0.002
5/25-26	+	0.141	0.840	0.002	0.002	0.000
5/26-27	+	0.279	0.574	0.002	0.002	0.000
5/27-28	+	3.133	1.898	0.002	0.002	0.000
5/28-29	+/-[a]	7.024	8.835	0.006	0.016	0.001
5/29-30	-	2.408	5.107	0.041	0.033	0.016
5/30-31	-/+[b]	0.147	1.760	0.010	0.003	0.001
5/31-6/1	+	0.963	7.655	0.002	0.015	0.002
6/1-2	+	0.027	1.270	0.002	0.002	0.000
6/2-3	+/-[c]	0.004	0.779	0.003	0.001	0.000
6/3-4	-	0.859	2.344	0.010	0.004	0.006
6/4-5	-	ND[d]	ND	ND	ND	ND

[a] Sound turned off 28 May 1500 hrs

[b] Sound turned on 30 May 1300 hrs

[c] Sound turned off 2 June 1155 hrs

[d] No data collected

Table 18. *Spring/Summer 1997 study at the Vischer Ferry site* - - The averages of the average hourly fish density estimates (#/m³/hr) x 24 generated during consecutive 24-hour periods, starting 6 June 0600 hrs and ending 23 June 0500 hrs, from transducers 8, 6, 2, 4, and 1. The opening in the flashboards on Dam E was present at the start of the study. Transducers 8 and 6 are located outside of the high frequency sound field near the opening in the flashboards. Transducers 2, 4, and 1 monitor fish densities from south to north (2-south, 4-center, 1-north) across the entrances to the headrace canals. The sign in the Field column denotes whether the high frequency sound field was on (+), off (-), or changed (+/- or -/+) during a 24-hour period.

TRANSDUCER

Date	Field	8	6	2	4	1
6/5-6	-/+[a]	ND[b]	ND	ND	ND	ND
6/6-7	+	1.181	1.659	0.013	0.014	0.008
6/7-8	+	2.013	1.774	0.008	0.008	0.003
6/8-9	+	16.091	4.942	0.011	0.027	0.017
6/9-10	+/-[c]	7.280	3.472	0.043	0.083	0.217
6/10-11	-	0.107	0.043	0.166	0.042	0.049
6/11-12	-	0.040	0.016	0.159	0.099	0.074
6/12-13	-/+[d]	1.324	0.582	0.075	0.047	0.184
6/13-14	+	1.006	0.586	0.113	0.054	0.191
6/14-15	+	0.025	0.016	0.028	0.008	0.031
6/15-16	+/-[e]	ND	ND	ND	ND	ND
6/16-17	-	ND	ND	ND	ND	ND
6/17-18	-	0.248	0.062	0.647	0.224	0.197
6/18-19	-	0.261	0.015	2.459	0.780	0.092
6/19-20	-/+[f]	0.210	0.038	0.310	0.059	0.072
6/20-21	+	1.561	1.459	0.005	0.006	0.008
6/21-22	+	6.797	2.602	0.008	0.041	0.008
6/22-23	+	0.480	0.046	0.008	0.013	0.006

[a] Sound turned on 5 June 1010 hrs
[b] No data collected
[c] Sound turned off 9 June 0920 hrs
[d] Sound turned on 12 June 0910 hrs
[e] Sound turned off 16 June 0912 hrs
[f] Sound turned on 19 June 0902 hrs

Table 19. *Spring/Summer 1997 study at the Vischer Ferry site* - - The averages of the average hourly fish density estimates ($\#/m^3/hr$) x 24 generated during consecutive 24-hour periods, starting 23 June 0600 hrs and ending 7 July 0500 hrs, from transducers 8, 6, 2, 4 and 1. The opening in the flashboards on Dam E was present at the start of the study. Transducers 8 and 6 are located outside of the high frequency sound field near the opening in the flashboards. Transducers 2, 4, and 1 monitor fish densities from south to north (2-south, 4-center, 1-north) across the entrances to the headrace canals. The sign in the Field column denotes whether the high frequency sound field was on (+), off (-), or changed (+/- or -/+) during a 24-hour period.

TRANSDUCER

Date	Field	8	6	2	4	1
6/23-24	+/-[a]	0.026	0.008	0.009	0.011	0.014
6/24-25	-	0.588	0.086	0.058	0.015	0.013
6/25-26	-	0.883	0.486	0.015	0.023	0.008
6/26-27	-/+[b]	0.109	0.004	0.005	0.007	0.007
6/27-28	+	0.104	0.006	0.006	0.015	0.010
6/28-29	+	1.611	0.250	0.005	0.092	0.048
6/29-30	+	ND[c]	ND	ND	ND	ND
6/30-7/1	+/-[d]	8.667	1.995	0.055	0.041	0.116
7/1-2	-	2.316	0.332	0.043	0.030	0.088
7/2-3	-/+[e]	1.208	0.238	0.034	0.052	0.170
7/3-4	+	0.190	0.004	0.007	0.027	0.197
7/4-5	+	ND	ND	ND	ND	ND
7/5-6	+	ND	ND	ND	ND	ND
7/6-7	+	ND	ND	ND	ND	ND

a Sound turned off 23 June 0859 hrs
b Sound turned on 26 June 0905 hrs
c No data collected
d Sound turned off 30 June 0857 hrs
e Sound turned on 2 July 0920 hrs

Table 20. *Spring/Summer 1997 study at the Vischer Ferry site* - - The averages of the average hourly fish density estimates (#/m^3/hr) x 24 generated during consecutive 24-hour periods, starting 17 July 0600 hrs and ending 21 July 0500 hrs, from transducers 8, 6, 2, 4, and 1. The opening in the flashboards on Dam E was present at the start of the study. Transducers 8 and 6 are located outside of the high frequency sound field near the opening in the flashboards. Transducers 2, 4, and 1 monitor fish densities from south to north (2-south, 4-center, 1-north) across the entrances to the headrace canals. The sign in the Field column denotes whether the high frequency sound field was on (+) off (-), or changed (+/- or -/+) during a 24-hour period.

TRANSDUCER

Date	Field	8	6	2	4	1
7/7-8	+/-[a]	ND[b]	ND	ND	ND	ND
7/8-9	-	0.913	0.149	0.113	0.036	0.071
7/9-10	-	0.082	0.005	0.024	0.025	0.016
7/10-11	-/+[c]	0.009	0.009	0.025	0.009	0.026
7/11-12	+	0.121	0.005	1.167	0.126	0.048
7/12-13	+	0.042	0.014	0.035	0.020	0.025
7/13-14	+	0.053	0.003	0.031	0.012	0.018
7/14-15	+/-[d]	0.015	0.003	0.038	0.018	0.018
7/15-16	-	0.931	0.362	0.030	0.026	0.021
7/16-17	-	0.020	0.019	0.015	0.009	0.007
7/17-18	-/+[e]	0.692	0.688	0.008	0.013	0.005
7/18-19	+	ND	ND	ND	ND	ND
7/19-20	+	ND	ND	ND	ND	ND
7/20-21	+	ND	ND	ND	ND	ND

[a] Sound turned off 7 July 0859 hrs
[b] No data collected
[c] Sound turned on 10 July 0912 hrs
[d] Sound turned off 14 July 0910 hrs
[e] Sound turned on 17 July 0900 hrs

Table 21. *Spring/Summer 1997 study at the Vischer Ferry site* - - The averages of the average hourly fish density estimates (#/m^3/hr) x 24 generated during consecutive 24-hour periods, starting 21 July 0600 hrs and ending 31 July 0500 hrs, from transducers 8, 6, 2, 4 and 1. The opening in the flashboards on Dam E was present at the start of the study. Transducers 8 and 6 are located outside of the high frequency sound field near the opening in the flashboards. Transducers 2, 4, and 2 monitor fish densities from south to north (2-south, 4-center, 1-north) across the entrances to the headrace canals. The sign in the Field column denotes whether the high frequency sound field was on (+) off (-), or changed (+/- or -/+) during a 24-hour period.

TRANSDUCER

Date	Field	8	6	2	4	1
7/21-22	+/-[a]	ND[b]	ND	ND	ND	ND
7/22-23	-	0.253	0.051	0.027	0.010	0.013
7/23-24	-	0.042	0.016	0.048	0.020	0.017
7/24-25	-/+[c]	0.016	0.001	0.007	0.018	0.008
7/25-26	+	0.029	0.004	0.014	0.006	0.013
7/26-27	+	0.312	0.260	0.027	0.023	0.012
7/27-28	+	0.362	0.116	0.013	0.011	0.007
7/28-29	+/-[d]	0.002	0.003	0.015	0.007	0.001
7/29-30	-	0.001	0.010	0.015	0.008	0.007
7/30-31	-	0.005	0.012	0.038	0.009	0.010

[a] Sound turned off 21 July 0900 hrs
[b] No data collected
[c] Sound turned on 24 July 0926 hrs
[d] Sound turned off 28 July 0900 hrs

Table 22. *Spring/Summer 1997 study at the Vische Ferry site* - - The daily average flows, averaged over the 24-hour period from 0000 through 2300 hrs, in cubic feet per second (cfs) from the United States Geological Survey (USGS) gauging station located on the Mohawk River at Cohoes, New York, during two periods, June 17-21 and July 9-13, that include the two times when high fish densities were observed at the entrance to the southern headrace at the Vischer Ferry Hydroelectric Project (June 18-19 and July 11-12). The averages of the average hourly fish density estimates (#/m^3/hr) x 24 generated during consecutive 24-hour periods, one starting 17 June 0600 hrs and ending 21 June 0500 hrs and the other starting 9 July 0600 hrs and ending 13 July 0500 hrs, from transducer 2 are provided for comparison. The sign in the Field column denotes whether the high frequency sound field was on (+), off (-), or changed (+/- or -/+) during a 24-hour period.

Date	Field	Average Daily Flow (cfs) (0000-2300 hrs.)	Average Fish Density (0600-0500 hrs.)
6/17		1590	
	-		0.647
6/18		1500	
	-		2.459
6/19		2250	
	-/+		0.310
6/20		1620	
	+		0.005
6/21		1740	
7/9		1140	
	-		0.024
7/10		1680	
	-/+		0.025
7/11		2720	
	+		1.167
7/12		1420	
	+		0.035
7/13		1220	

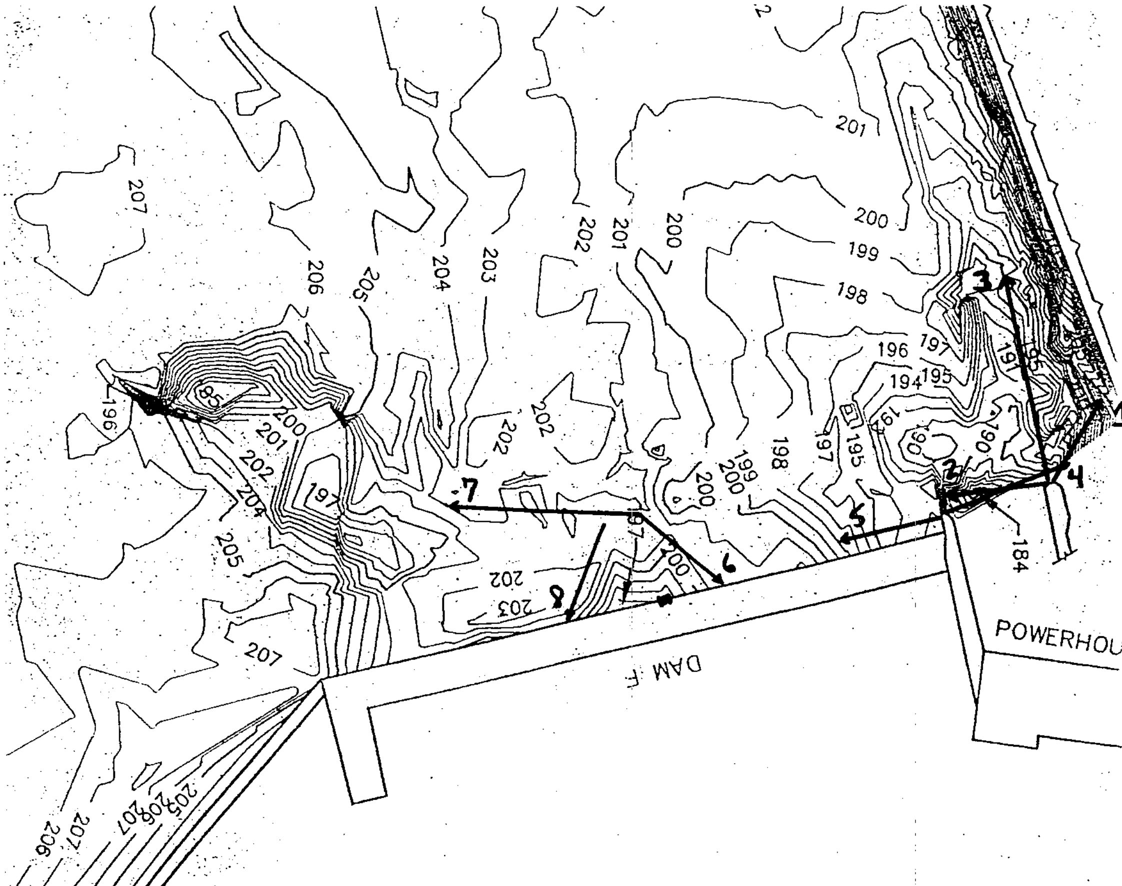


Figure 6. Location, aim, and maximum range of the transducers used in the Fall 1996 study at the Vischer Ferry site.

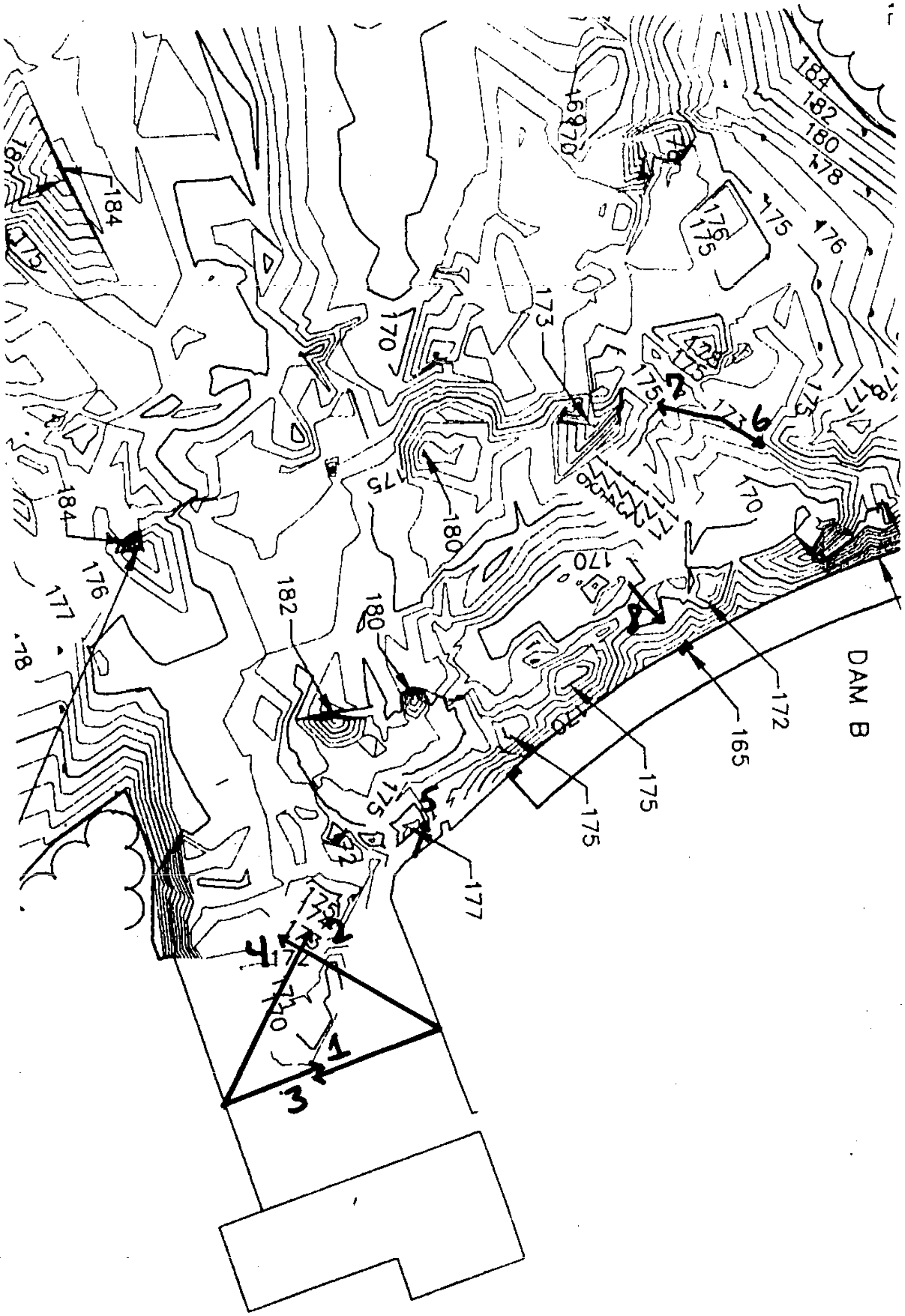
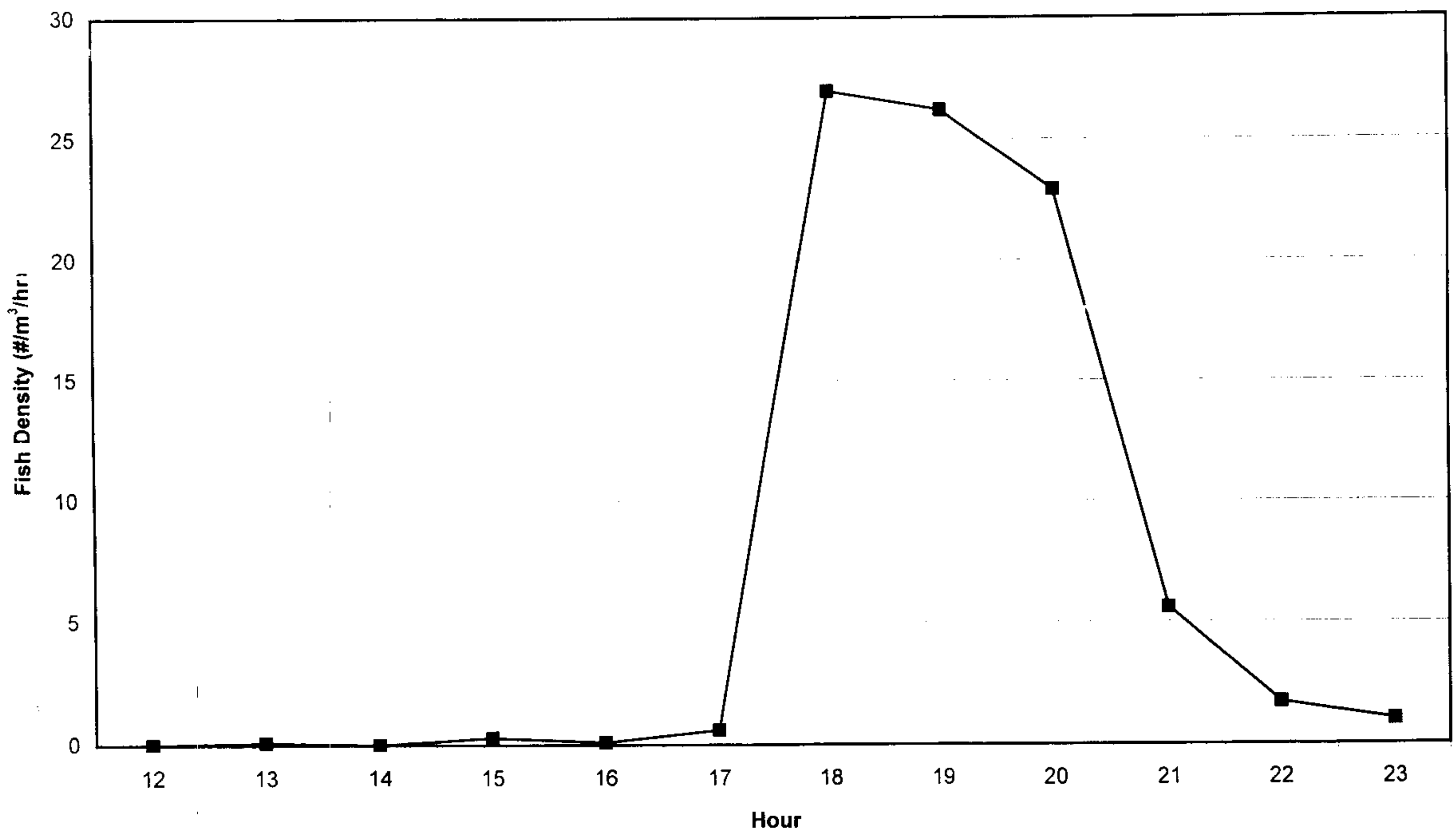


Figure 7. Location, aim, and maximum range of the transducers used in the Fall 1997 study at the Crescent site.

Figure 8. *Fall 1997 Study at the Crescent Project* -- Average hourly fish densities (#/m^3/hr) from transducer 8 for the period from 1200 hrs through 2300 hrs on November 10.



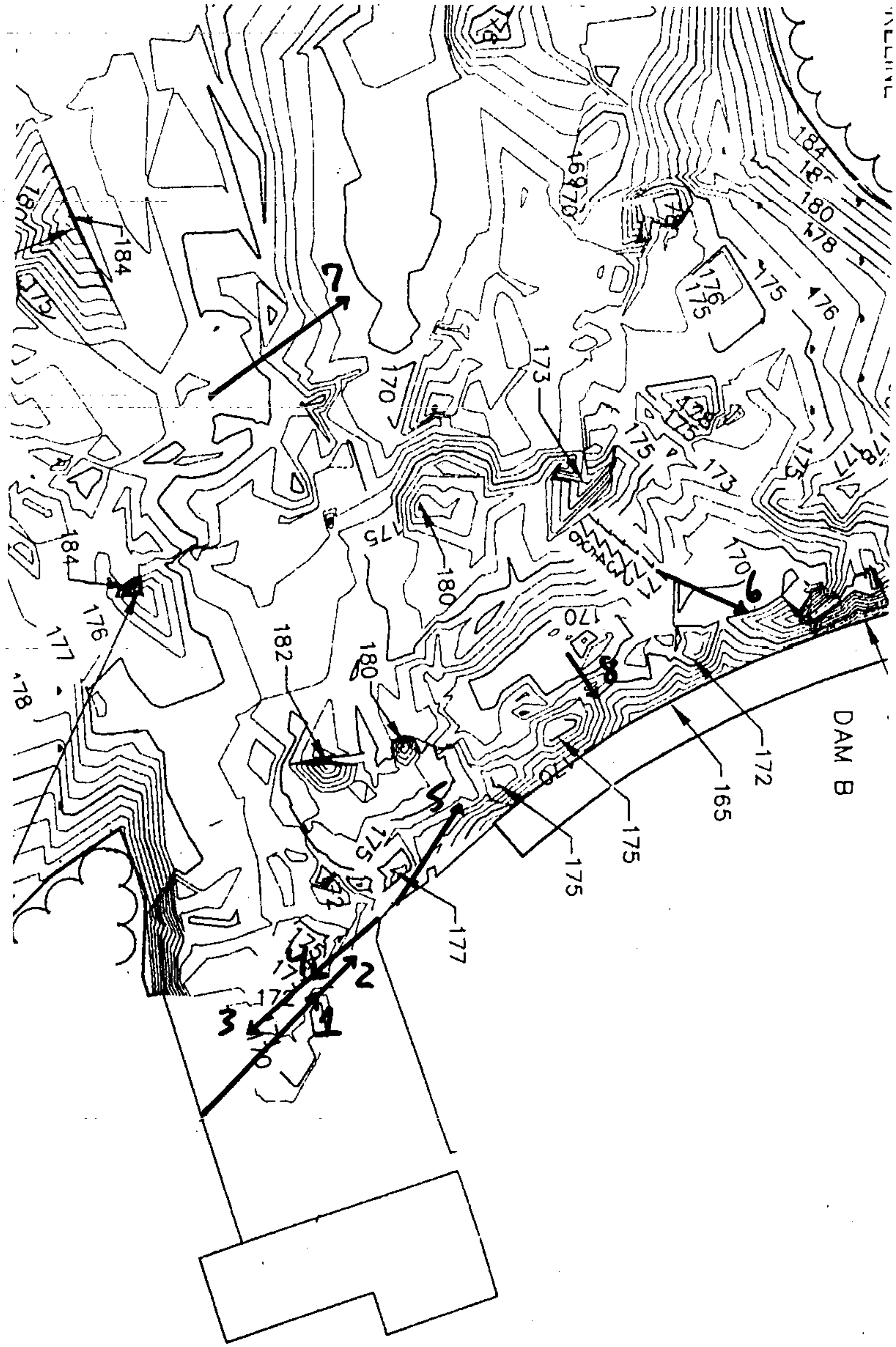


Figure 9. Location, aim, and maximum range of the transducers used in the Spring/Summer 1998 study at the Crescent site.

Figure 10. *Spring/Summer Study at the Crescent Project*-- Average hourly fish densities (#/m³/hour) x 24 by day (0600 hrs through 0500 hrs) from transducers 1, 2, 3, and 4 monitoring fish densities in the headrace (May 18 - June 13, 1998).

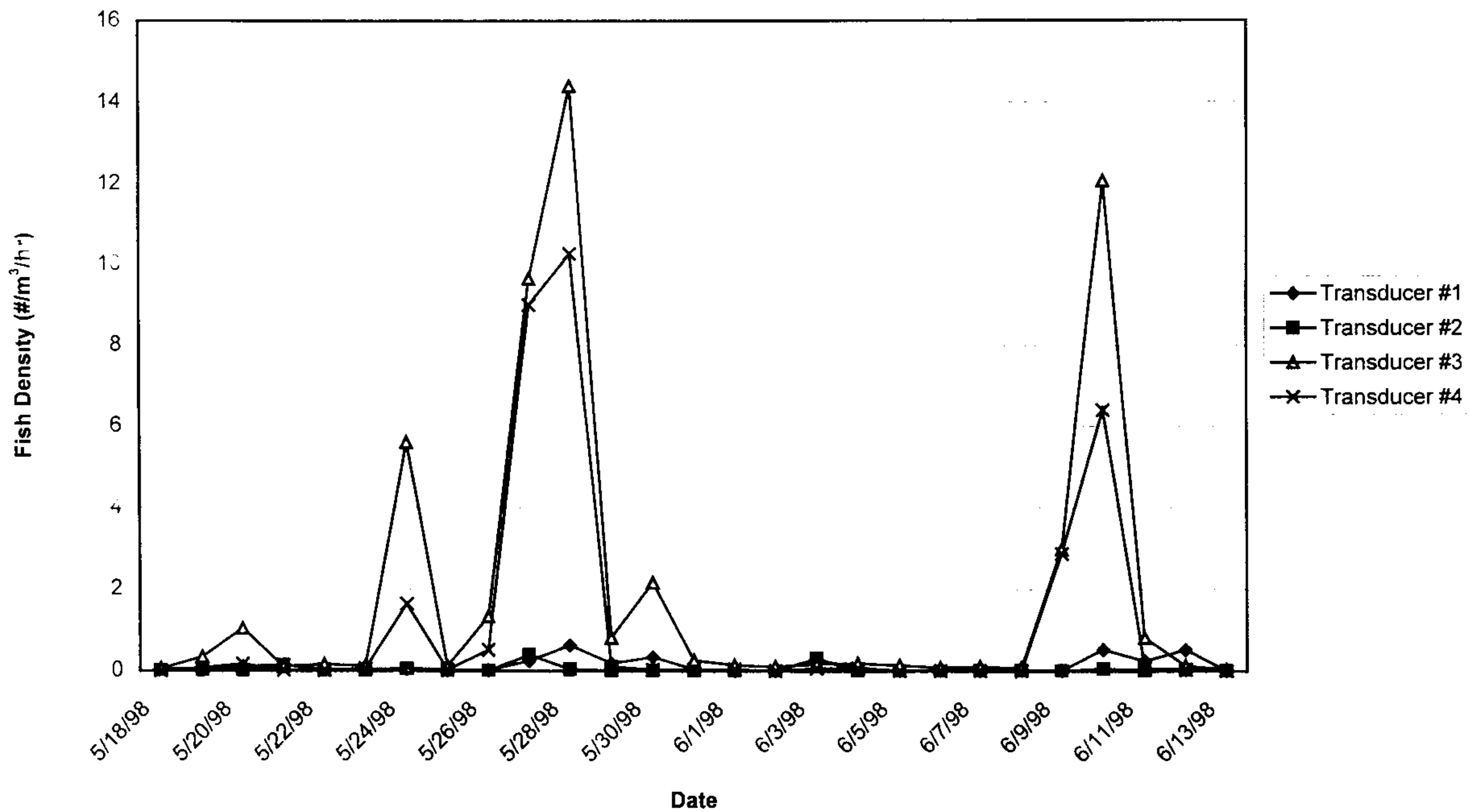


Figure 11. Spring/Summer Study at the Crescent Project -- **average hourly fish densities ($\#/m^3/hr$) x 24 by day (0600 hrs through 0500 hrs) from the transducers 1, 2, 3, and 4 monitoring fish densities in the headrace (June 14 through July 13, 1998).**

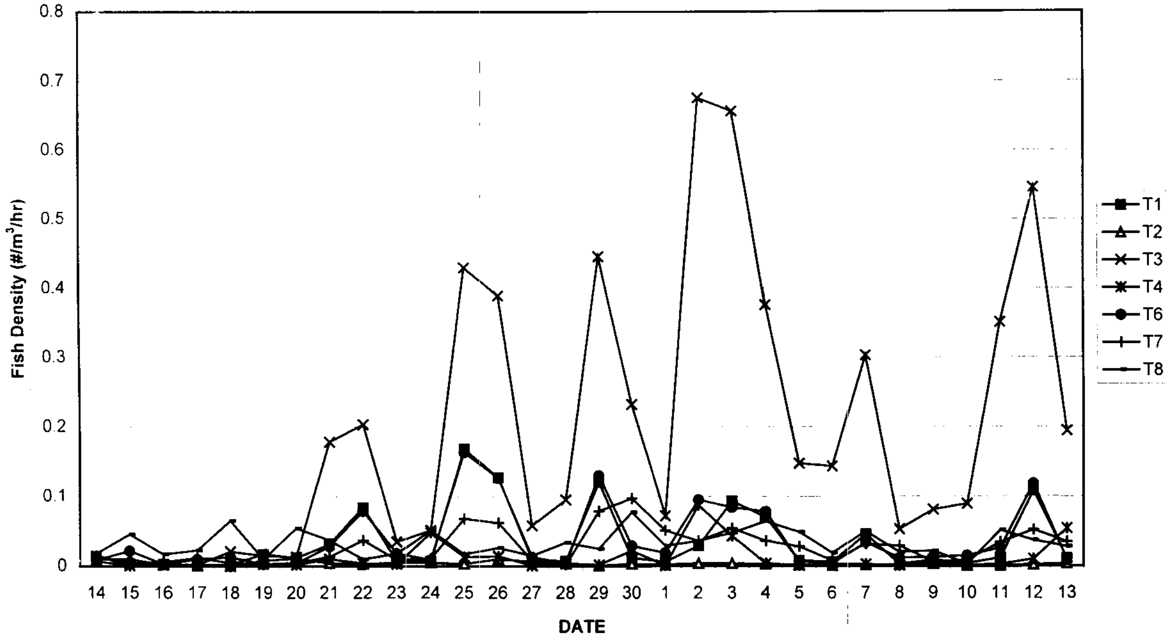


Figure 12. ***Spring/Summer Study at the Crescent Project*** **-- Average hourly fish densities ($3/m^3/hr$) x 24 from transducers 5, 6, 7, and 8, monitoring fish densities outside the headrace (31 May 0600 hrs through 17 June 0500 hrs, 1998).**

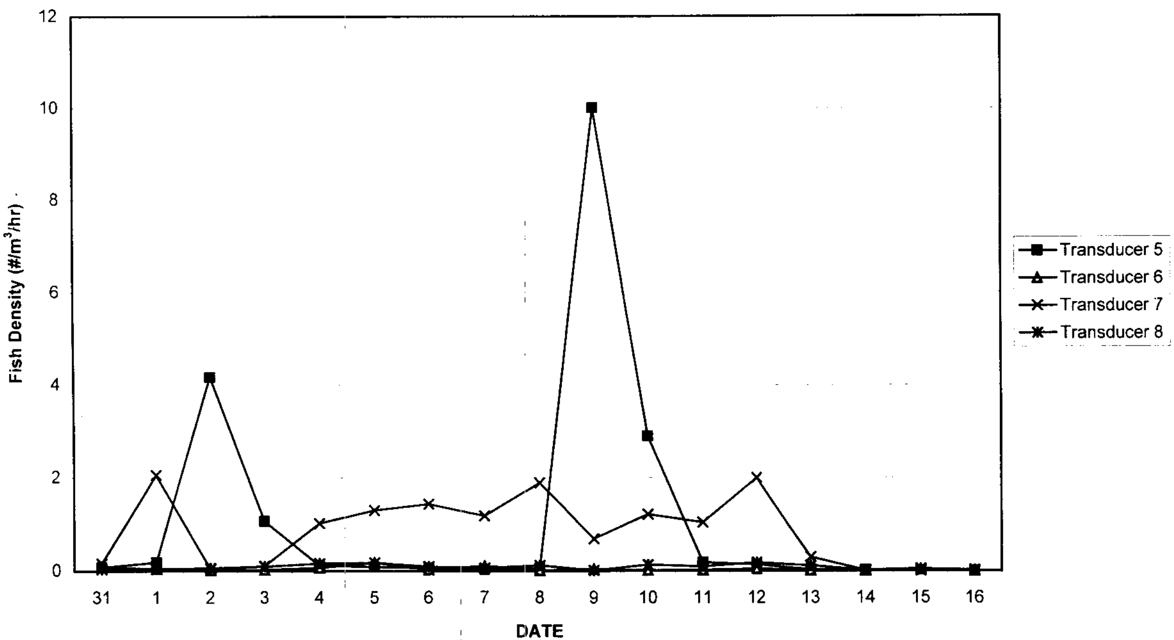


Figure 13. ***Spring/Summer study at the Crescent Project*** **-- average hourly fish densities (#/m^3/hr) x 24 averaged across May 24, 27, 28, 1000 hrs through 0900 hrs, from transducers 3, 4, and 5.**

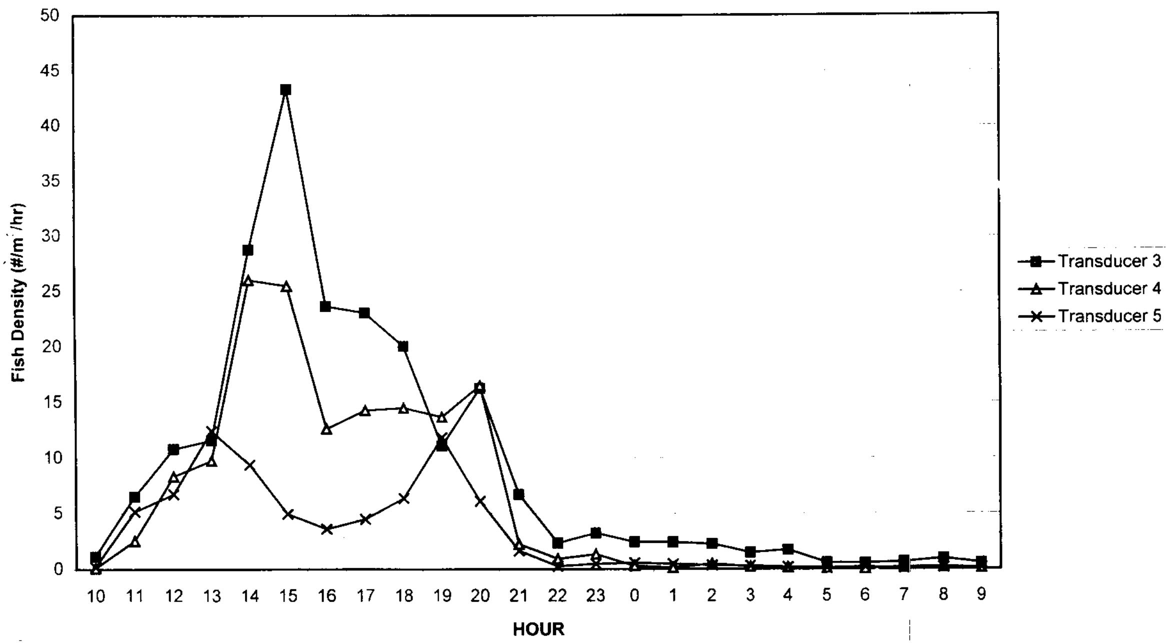


Figure 14. *Spring/Summer at the Crescent Project* -- Average hourly fish densities (#/m^3/hr) x 24 from transducers 5 and 7, 1 June 1400 hrs through 2 June 1400 hrs.

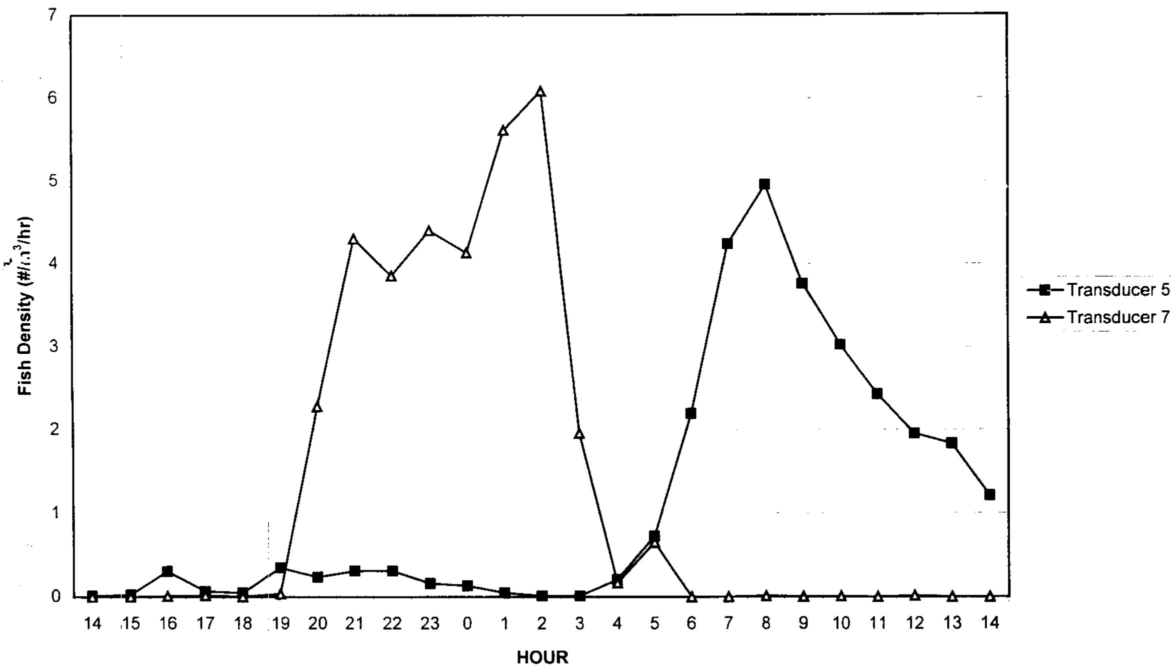


Figure 15. ***Spring/Summer study at the Crescent Project*** **-- average hourly fish densities ($\#/m^3/hr$) x 24 from transducer 7, 4 June 1000 hrs through 5 June 0900 hrs.**

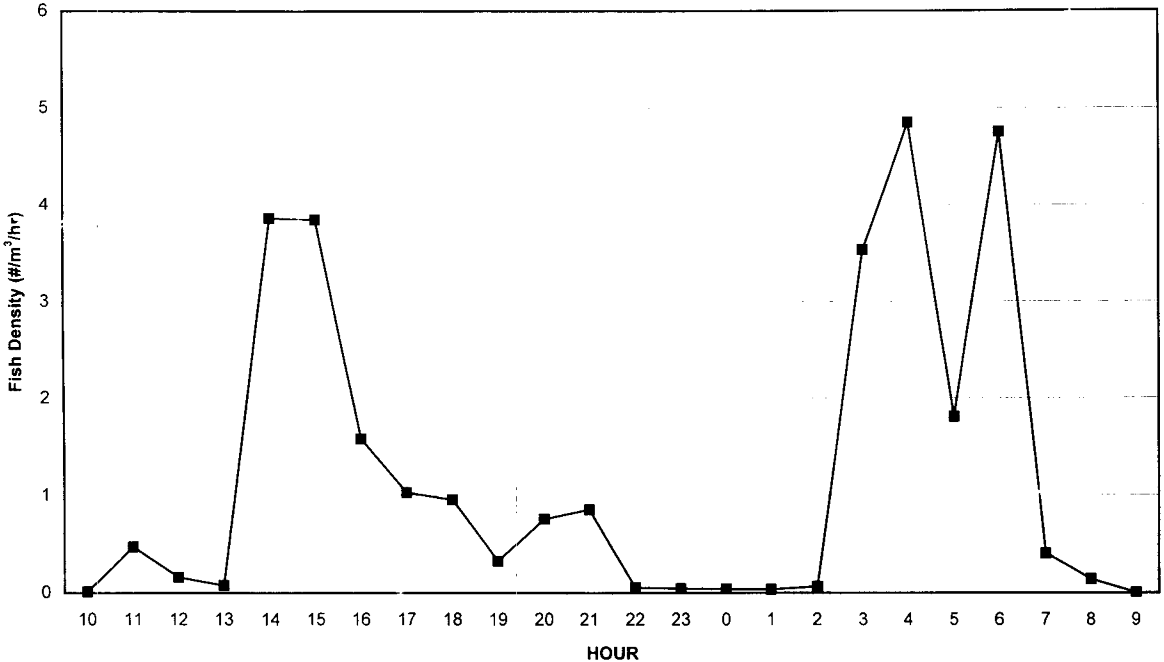


Figure 16. ***Spring/Summer Study at the Crescent Proj.*** **- avg. hrly fish densisteis (#/m^3/hr) x24 from transd. 7 averaged when the sound field was ON (June 7, 8, 11, and 12) and when it was OFF (June 5, 6, 9 and 10), 1000 hrs - 0900 hrs.**

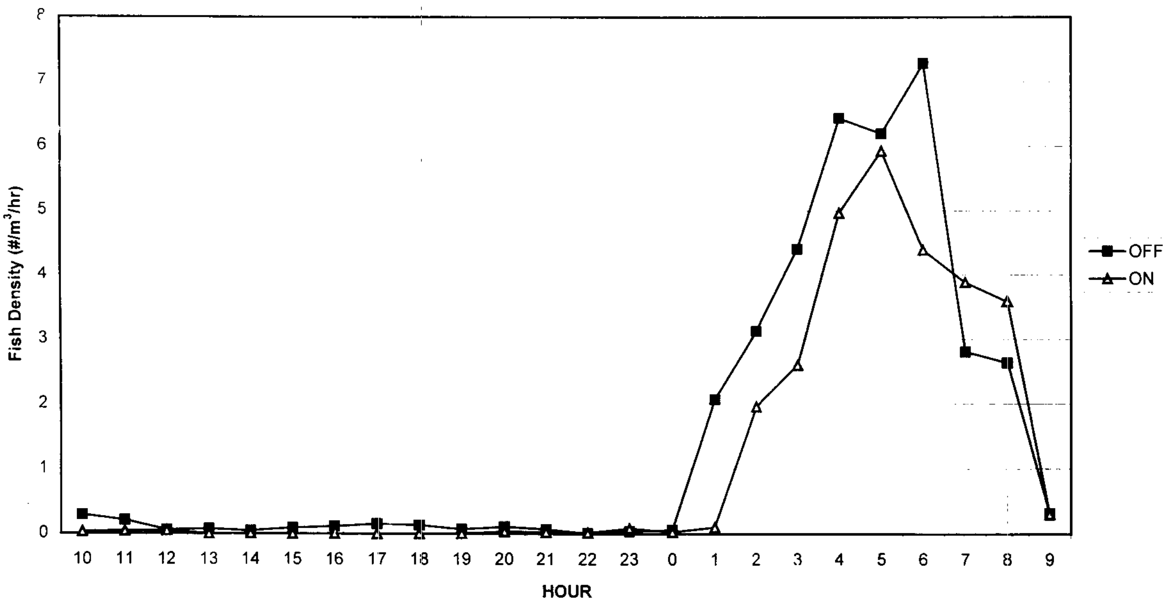
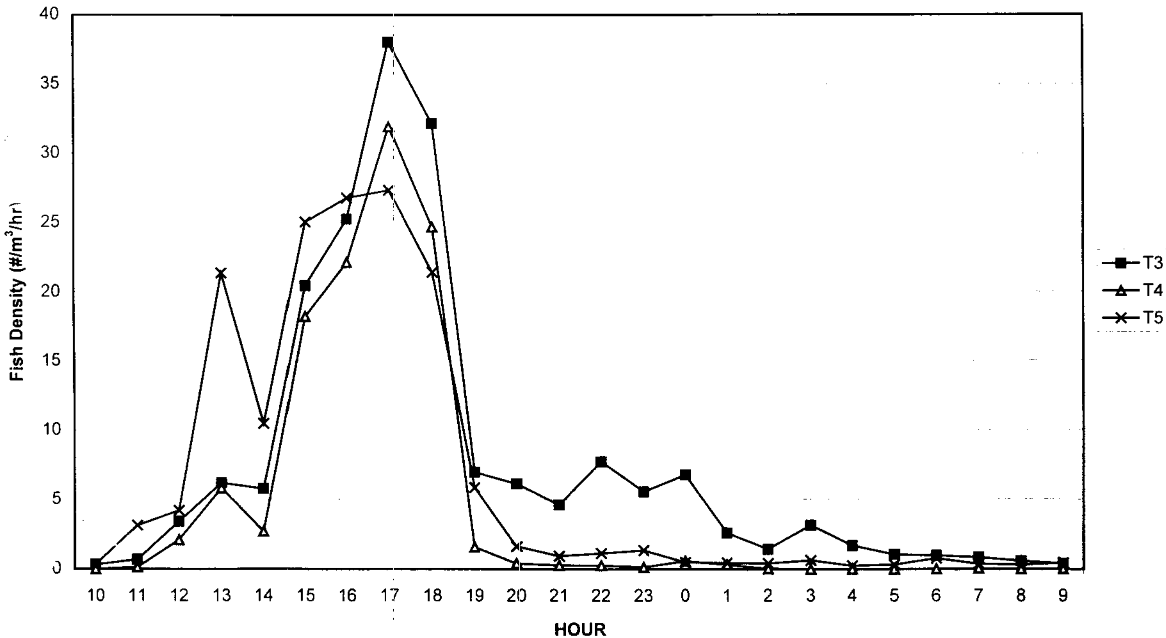


Figure 17. *Spring Summer Study at the Crescent Project* -- average hourly fish densities (#/m^3/hr) x 24 from transducers 3, 4, and 5 averaged across two days (June 9 and 10), 1000 hrs through 0900 hrs.



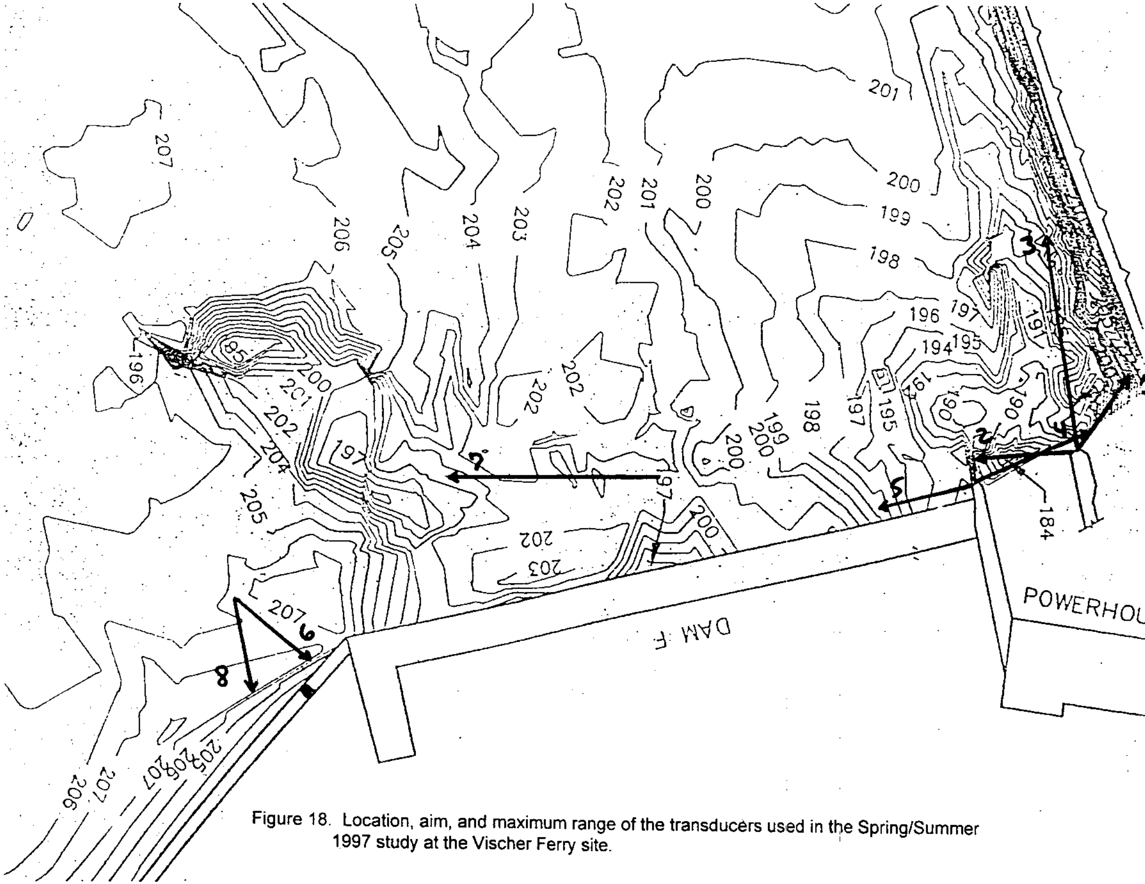


Figure 18. Location, aim, and maximum range of the transducers used in the Spring/Summer 1997 study at the Vischer Ferry site.

Figure 19. *Spring/Sunmer study at the Vischer Ferry Project* -- Average hourly fish densities (#/m/hr) x 24 from transducer 6, averaged across May 24 and May 28 and then across 11 days in the period from May 29 through June 9 (0600 hrs through 0600 hrs).

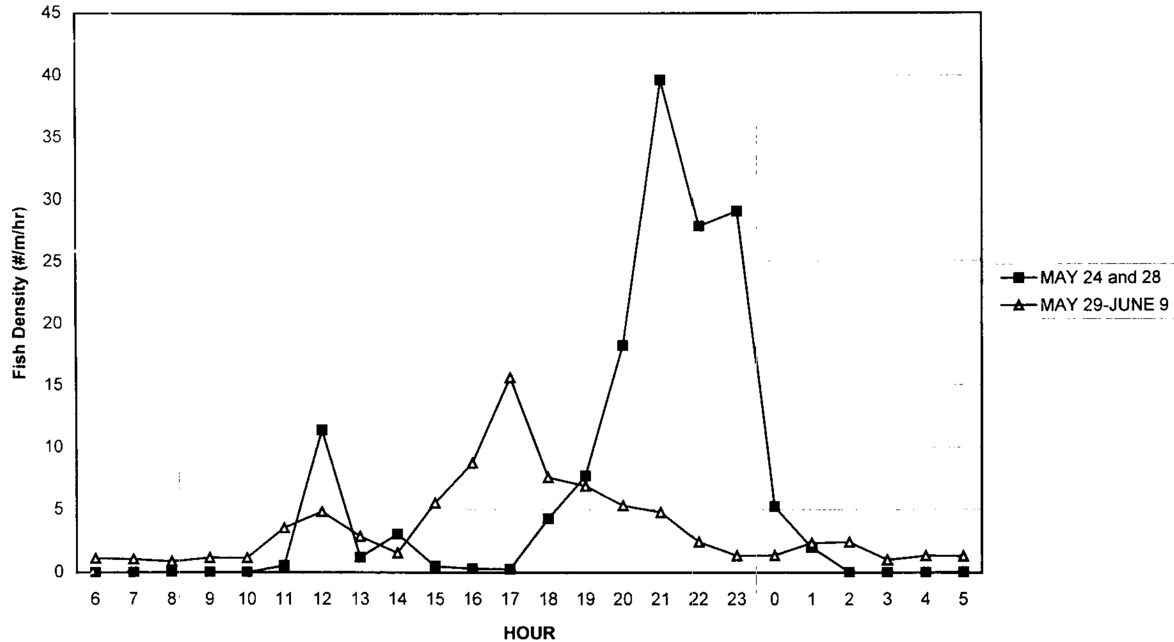


Figure 20. ***Spring/Summer Study at the Vischer Ferry Project*** **-- Average hourly fish densities (#/m³/hr) x 24 from transducer 2, 18 June 0600 hrs. through 19 June 0800 hrs and 11 July 0600 hrs through 12 July 0800 hrs.**

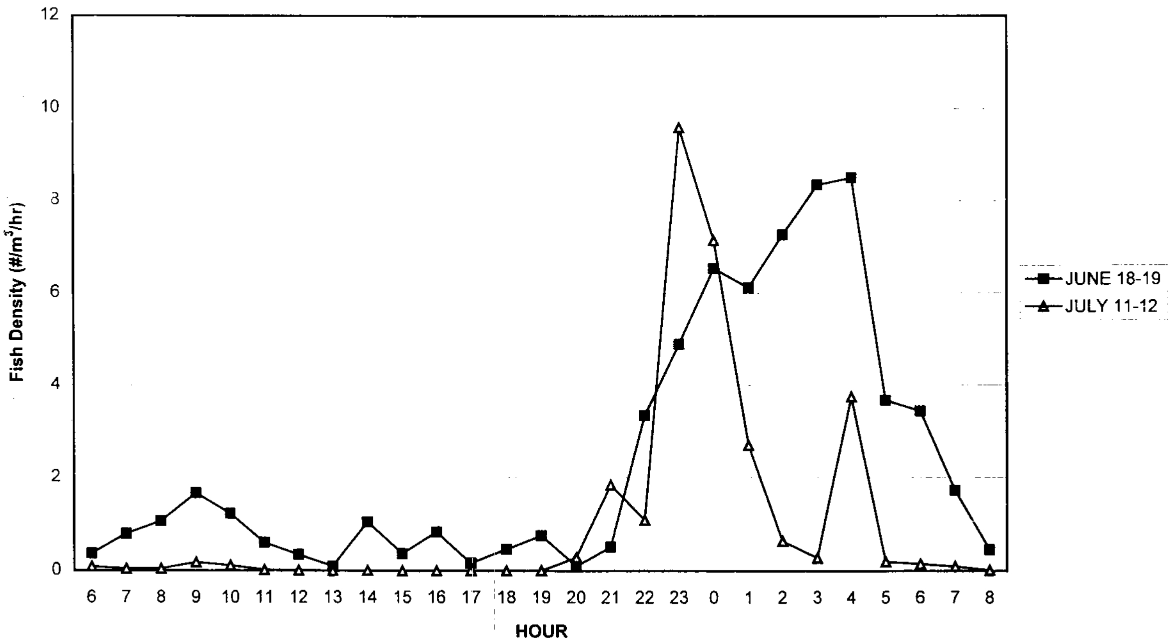
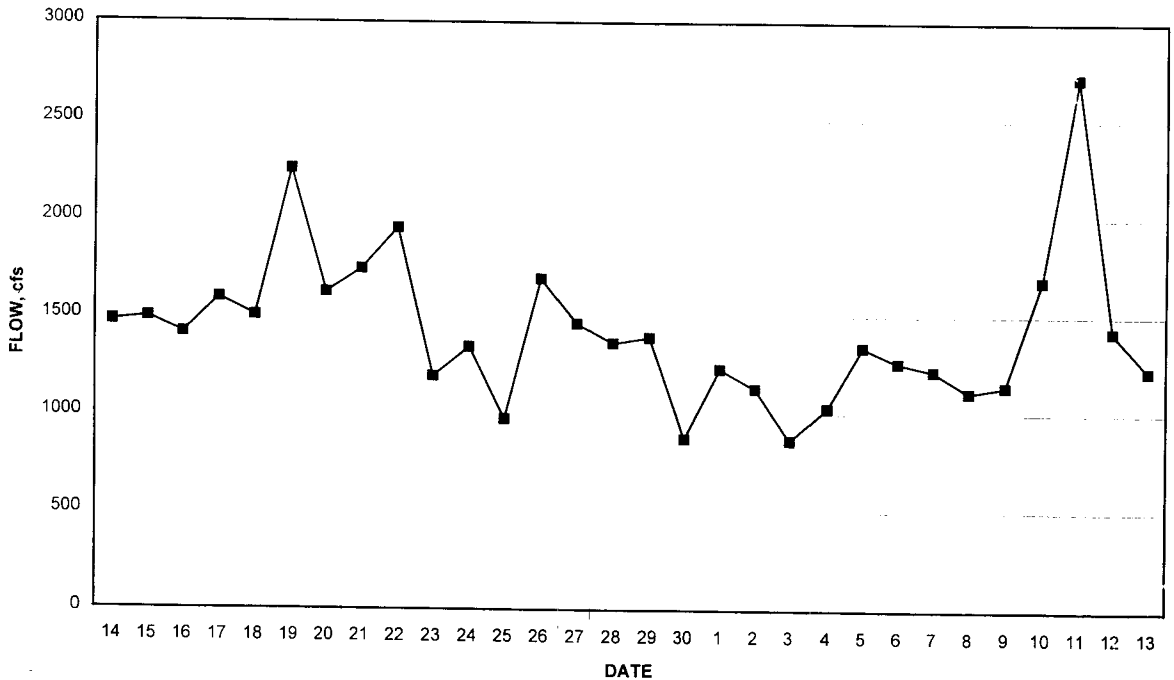


Figure 21. Average daily flows, cubic feet per second (cfs) measured at the USGS Cohoes gauging station on the Mohawk River, NY (June 14 through July 13, 1997)



Discussion

Fall Studies

Movement into the high frequency sound field—The results from both sites confirmed that high frequency sound is not a barrier to the movement of YOY blueback herring. During the period before the openings were cut in the flashboards, fish moved through the high frequency sound field and into the headrace canals (Tables 1, 2, 6, and 7). Initially in each fall study, when fish densities were very high at both sites, fish moved into the headraces during the day. However, after the initial wave of fish passed into the headraces, most fish moved into the high frequency sound field at night, even though fish were present outside of the sound field during the day (Table 1). The movement into the high frequency sound field was higher on alternate nights, suggesting that fish were delaying their downstream movement for 24 hours after encountering the sound field. However, the fact that the alternating pattern of abundance continued for one night after the opening was cut in the flashboards suggests that habituation was involved.

The hourly data from the first day of exposure at the Crescent site demonstrated that fish did move away from the high frequency sound field during the day. Mobile hydroacoustic surveys conducted on September 3 and 4 and October 3 and 4, 1996, at the Vischer Ferry site confirmed tha fish did not move across the shallow spoil area during the day and that they were present in the main channel. At night, fish were observed to move out of the channel and across the spoil are to the powerhouse. The main flow of fish approached the entrance to the south headrace at a 45° angle. Within 100 feet of the south pier nose, most of the fish turned towards the dam and then moved away from the powerhouse along the dam (where the sound pressure levels were lower). This behavior explains why transducer 5 continued to detect fish after the opening was cut in the flashboards. The fish detected at transducer 1 represent fish that turned away from the dam as they approached the south headrace. These fish moved around the sound field to the north shore of the river and then worked their way down along the north shoreline to the north headrace. The data from 5 September 1900 hrs through 6 September 0600 hrs suggest that about 90% of the incoming fish turned toward the dam and 10 % went toward the north shore.

Effect of the opening in the flashboards—The opening in the flashboards at the Vischer Ferry site had an immediate effect on the number of fish stacked up at the edge of the high frequency sound field during the day (Table 1, transducer 6) and on the number of fish passing by transducer 6 at night (Table 1). As mentioned before, it had a delayed effect on the numbers of fish passing into the headrace canals. The densities of fish outside the sound field at transducer 7 are most similar to those entering the south headrace canal (transducer 2). Thus, the most appropriate contrast for estimating the effect of the opening on the densities of fish at the entrance to the headrace is between the ratio of the average fish densities observed at transducer 7 on September 2-3 and 4-5 and transducer 2 on September 3-4 and 5-6 (the "before" ratio) and the ratio of the average fish densities at transducer 7 on September 5-6 and 7-8 and transducer 2 on September 6-7 and 8-9 (the "after" ratio). The formula, [(Before – After)/Before] x 100, was used to determine the effect of the opening in the flashboards. The result was a 91% reduction in the fish densities entering the south headrace. At the Crescent site, the ratios of transducers 5 and 8 were used in the same formula. The result was a 97% reduction in the fish densities at the western end of the dam near the entrance to the headrace.

Effect of high frequency sound on fish densities near the headrace canals—At the Vischer Ferry site, fish densities near the headrace canals were only high enough in September to permit statistical testing. A split-plot model was used (days were nested within the sound treatment). The sound effect was significant (alpha = 0.05) and the reduction in density observed at transducer 2 was 77% (this is the reduction for fish that had not responded to the by-pass). At the Crescent site, the effect of the opening in the flashboards was so strong that "on/off" effects at transducer 5 were not detectable (Tables 8 and 9).

Effect of river flows on seasonal abundance—At the Vischer Ferry site, fish densities were generally quite low after September. At the Crescent site, very high fish densities were observed in November after the sound field had been turned off. River flows were much higher during the Vischer Ferry study and this probably accounts for the difference in the seasonal pattern of abundance. This difference suggests that river flows strongly influence how quickly YOY blueback herring move downstream.

Spring/Summer Studies

Movement into the high frequency sound field—The results from the Crescent site confirmed that high frequency sound is not a barrier to the downstream movement of adult blueback herring. At this site, the presence of deep water near the opening in the flashboards on Dam B, the relatively low flow through the opening, the proximity of the opening to the entrance to the headrace, the proximity of the opening to high sound pressure levels, or some combination of these factors prevented adult blueback herring from responding to the opening in the flashboards. However, the results from the Crescent site established that the densities of fish entering the headrace were comparable to those observed at the edge of the sound field near the west end of Dam B.

At the Vischer Ferry site, adult fish almost never went across the shallow spoil area. However, they did appear at the edge of the sound field during the day. Therefore, they must have moved downstream near the bottom in the channel, encountered the dam, and moved along it toward the powerhouse. At both sites, adult fish were sensitive to the sound of the powerhouse. They didn't move into the headraces when the high frequency sound field was turned off. This was particularly striking at night at the Crescent site. Furthermore, fish only moved down to the Crescent site at night. The difference between the depth of the main channel and the secondary channel down to the powerhouse probably accounts for this phenomenon. During the day, fish move down the main channel. If they stay near the bottom of the main channel, they will pass below the entrance to the secondary channel to the powerhouse and be unaware of the flow down to the powerhouse. However, if they rise upward within the water column at night, they will be at the same depth as the entrance to the secondary channel and respond to the flow down to the powerhouse.

There also appeared to be seasonal differences in the reactivity of the adult fish. The fish that appeared in June appeared to be more responsive to high frequency sound than those that appeared in May. At the Crescent site, the group of fish appearing in May went through the headrace more quickly than the group that appeared in June. At the Vischer Ferry site, the group of fish appearing in May appeared to stack up more at the edge of the sound field than the group that appeared in June. The differences between the May and June fish may be related to where they spawned. Fish in good condition should move downstream faster than fish in poor condition. Thus, fish in good condition should arrive sooner than fish in poor condition. However, if the first group of fish consisted of fish that spawned fairly close to the two sites, this spatial/temporal separation according to condition would not occur because the distance traveled to reach the site was not enough to spread out the fish according to their condition. However, if the fish spawned far upstream from the two sites, the spatial/temporal separation would occur and the most reactive fish would appear first. The last fish to appear at the site would be the least reactive (like those observed on July 11-12).

The high frequency sound field does not appear to delay the downstream movement of adult fish. They reacted to the sound of the powerhouse in the absence of the sound field and apparently delay moving into the headrace canals under normal conditions at the Crescent site. At the Vischer Ferry site, the opening in the flashboard probably accelerated the movement of adult fish past this site.

Effect of the opening in the flashboards—At the Vischer Ferry site, the opening in the flashboards on Dam E was located in shallow water far from the entrances to the headrace canals. The flow velocity toward the powerhouse was low near the opening and the high frequency sound pressure levels were low. The flow through the opening was much higher than that at the Crescent site. High fish densities were observed outside the high frequency sound field in the vicinity of the opening in the flashboards during the period from late May into early July (Tables 17-19). Only 2-3% of the fish moving down into the area near the intersection of Dams E and F appeared to move past the opening in the flashboards. On the two occasions when high fish densities were observed at entrance to the south headrace canal, fish appeared to move directly over the shallow spoil area to the powerhouse, which suggests that this was a very unusual phenomenon. These two occasions were associated with high river flows and may represent spent fish being carried into the intake (especially the July event).

Effect of high frequency sound on fish densities near the headrace canals—In general, high frequency sound reduced the fish densities at transducer 2 by 64%. The effectiveness appeared to be greater (76%) at night than during the day (42%). However, the difference was not statistically significant.

Effect of river flows on seasonal abundance—At both sites, fish first appeared during the last week in May. A second group of fish appeared in early June. In 1998, fish densities were low after June 12. In 1997, high fish densities were observed after mid-June into early July. During the period from May 15 through June 13, river flows were higher in 1997 than those in 1998 (Figure 22). However, during the period from June 14 through June 22, the opposite was true; flows were much higher in 1998 than in 1997 (Figure 23).

Conclusions

Vischer Ferry Site

At the Vischer Ferry site, the use of high frequency sound in conjunction with a by-pass located outside of the sound field appears to be highly feasible for both adult and YOY blueback herring. The location of the by-pass for YOY blueback herring should be on Dam F. The location of the by-pass for adult blueback herring should be on Dam E.

Crescent Site

At the Crescent site, the use of high frequency sound in conjunction with a by-pass located outside of the sound field appears to be highly feasible for YOY blueback herring. However, it is not feasible for adult blueback herring. However, adults did respond strongly to high frequency sound at this site and it appears that the particular physiographic and hydrodynamic features of this site are the problem. The solution is to move the high frequency sound field out to the junction of the main and secondary channels and keep the adult fish in the main channel. The by-pass should be located on Dam A. This arrangement would facilitate the downstream migration of both adult and YOY blueback herring because it will put the by-pass where it is available to the entire population rather than only the fraction moving down the secondary channel.

Figure 22. Average daily flows, cubic feet per second (cfs) measured at the USGS Cohoes gauging station on the Mohawk River, NY (May 15 through June 13, 1997 and 1998).

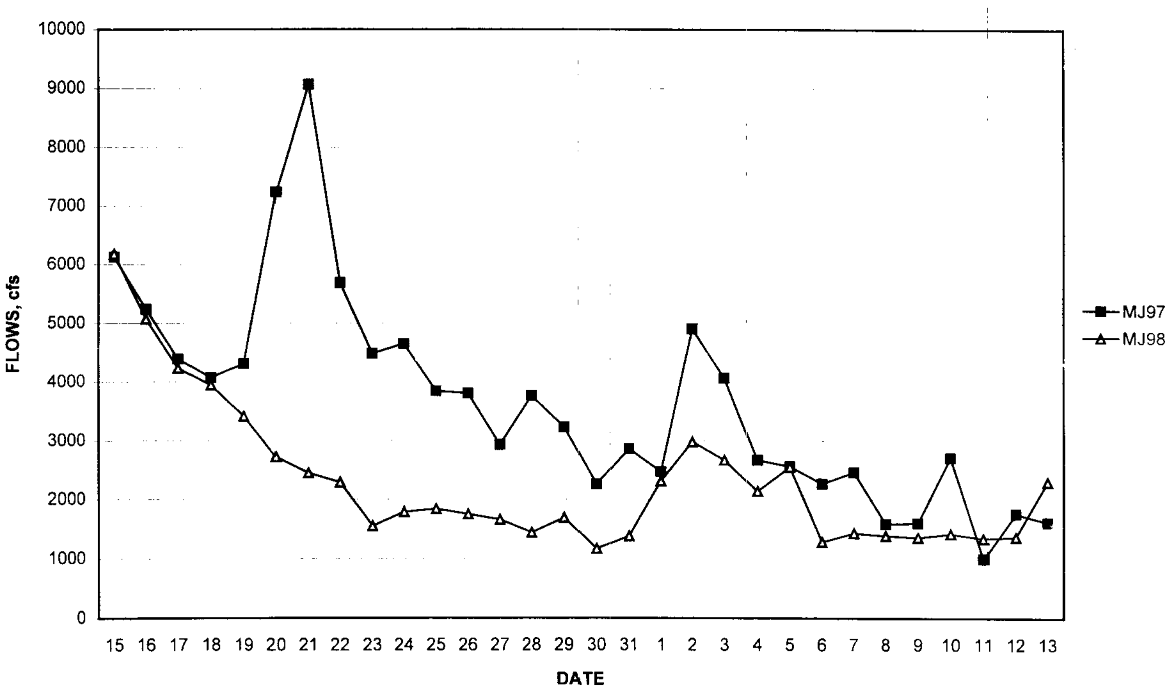
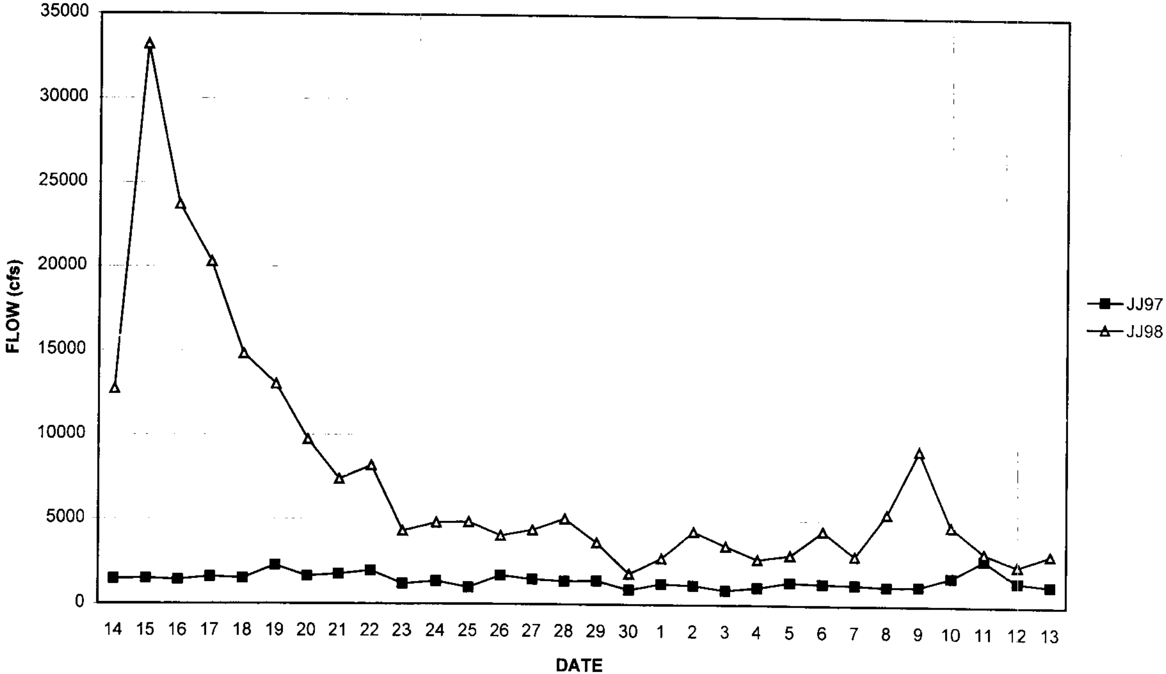


Figure 23. Average daily flows, cubic feet per second (cfs) measured at the USGS Cohoes gauging station on the Mohawk River, NY (June 14 through July 13, 1997 and 1998).



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New York State Department of Environmental Conservation

Division of Fish, Wildlife and Marine Resources

Bureau of Fisheries

Annual Report of Highlights and Accomplishments
for
State Fiscal Year 2001/2002

November 1, 2002

Introduction

The New York State Department of Environmental Conservation, Division of Fish, Wildlife and Marine Resources, Bureau of Fisheries delivers a very diverse program and annually conducts a wide array of activities to accomplish its mission:

Conserve and enhance New York State's abundant and diverse populations of freshwater fishes while providing the public with quality recreational angling opportunities.

This report for state fiscal year 2001/2002 (April 1, 2001 through March 31, 2002) is an effort to highlight many of the findings and accomplishments of activities and efforts carried out by Bureau of Fisheries staff. This report is not inclusive of all Bureau staff activities conducted during 2001/2002. It is a compilation of information that describes activities which were conducted that resulted in significant findings during 2001/2002 or activities from previous years for which results became available during 2001/2002. Information contained in this report was provided by the Regional Fisheries Units, Fish Hatcheries, Great Lakes Fisheries Units, and Central Office staff.

The information is arranged by fishery type (e.g. coldwater stream, warmwater lake) or focus area (e.g. creel and angler surveys, public access) and further by Unit within the Bureau (e.g. Region 1 Fisheries Unit, Adirondack Hatchery, Lake Erie Fisheries Unit) responsible for the accomplishment(s) or findings.

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Warmwater Lakes and Ponds

Region 1

Lake Ronkonkoma Aquatic Plant Survey
With the help of a student from Sachem High School, Region 1 Fisheries staff conducted a semi-quantitative survey of submerged aquatic vegetation in Lake Ronkonkoma. The last comprehensive vegetation survey was completed in 1938. Submerged plants were collected at 61 locations around the lake using a grappling hook attached to a nylon rope. Fifty out of the 61 sites contained some submerged vegetation. However, vegetation was nearly absent in water depths exceeding 10 feet. Five species of submerged plants were collected and several other species were observed during the survey. Western waterweed (*Elodea nuttallii*) was the dominant plant species. Other plants collected during the survey included macroscopic algae of the genus *Nitella* and three different species of pondweeds of the genus *Potamogeton.* Results support anecdotal observations by anglers that the weed beds are beginning to recover in the lake. Continued expansion of this vital habitat should result in better fishing.

Lake Ronkonkoma Walleye Evaluation
Lake Ronkonkoma has been stocked annually with walleye fingerlings since 1994 with the intent of reducing an overabundant white perch population through predation. The goal is to improve fishing and water quality in the lake. Since 1997, equal numbers of pond fingerlings and advanced fingerlings have been stocked in Lake Ronkonkoma as part of a statewide study to compare the performance of the two walleye fingerling types. To evaluate the stocking program, the following activities were completed by Region One staff in 2001: beach seining (August 6th), gillnetting (September 10th), electrofishing (October 29th), and monthly limnological sampling.

The beach seine survey is intended to index the reproduction of game and forage fish in the littoral zone. During the beach seining, largemouth bass were caught at a rate of 9.4 fish per haul and smallmouth bass were caught at a rate of 1 fish per haul. The catch rate for young-of-the-year largemouth bass was the highest on record since the inception of the beach seining program in 1990. Yellow perch were captured at a rate of 31 fish per haul while white perch were caught at a rate of 15 fish per haul. Other species found in the survey include: black crappie, bluegill, pumpkinseed, yellow perch, golden shiner, and banded killifish.

A total of thirty-one walleye were caught during the gillnet survey for an average catch rate of just over five per net. This catch demonstrates that stocked fingerlings have produced a substantial population of mature fish in the lake. The average walleye measured 16 inches and the largest specimen measured 22 inches and weighed 4.4 pounds. Only 20% of the catch originated as advanced fingerlings, indicating substantially better survival of pond fingerlings. White perch dominated the diet of walleye. However this species remains abundant in the lake at this time. The catch rate was 80 perch per net with the fish falling predominantly in the 6 to 8 inch range.

The total catch rate for walleye was 11.9 fish per hour during the electrofishing survey. Seventeen spring-stocked pond fingerlings and 25 fall-stocked advanced fingerlings were caught. However, the growth of the pond fingerlings was clearly superior. On average, advanced fingerlings measured 142 mm while pond fingerlings measured 213 mm. Differences in growth and survival likely hinge on the foraging success of the two types of fingerlings. More than three quarters of the pond fingerling stomachs contained prey items, mainly white perch, while the stomachs of advanced fingerlings rarely contained prey.

In summary, stocked walleye are thriving in Lake Ronkonkoma and actively consuming white perch. However, the catch rates of white perch remain high and the limnological data collected by Region One staff have yet to show an unambiguous shift in trophic structure. Walleye stocking remains the most promising management strategy to restore the balance of the lake, but more time and possibly higher stocking densities may be required to achieve the desired results.

Fort Pond Walleye Evaluation
Fort Pond has been stocked annually with walleye fingerlings since 1997 with the intent of reducing an overabundant white perch population through

predation. The goal is to improve fishing and water quality in the pond. Equal numbers of pond fingerlings and advanced fingerlings have been stocked in Fort Pond as part of a statewide study to compare the performance of two walleye fingerling types. To evaluate the stocking program, gillnetting was completed on September 26th and an electrofishing survey was done during the week of October 29th.

During the gillnet survey a total of 40 walleye were caught for an average catch of 6.7 per net night. This indicates that the stocking program has produced a dense population of mature fish. The average walleye measured 14.7 inches and the largest specimen measured 19.3 inches and weighed 2.25 pounds. All of the walleye caught were unmarked fish indicating that they originated from the pond fingerling stockings. As in Lake Ronkonkoma, walleye were generally plump and their stomach contents were dominated by white perch.

The overall electrofishing catch rate was 8.5 walleye per hour. Nineteen pond fingerlings and 15 advanced fingerlings were caught during the survey. The pond fingerlings averaged 244 mm while the advanced fingerlings averaged 134 mm. About three quarters of the pond fingerlings examined contained prey while the advanced fingerling were almost always empty.

Based on the average gill net catch of 75 perch per net, white perch are still very abundant in Fort Pond. However, the population is dominated by larger size classes than in Lake Ronkonkoma. The mode of the distribution falls at around 8.9 inches as opposed to 6.7 inches in Lake Ronkonkoma. The results of the 2001 surveys suggest a somewhat denser walleye population in Fort Pond than in Lake Ronkonkoma. Moreover, the walleye already seem to be affecting the white perch population.

Region 2

Baisley Pond, Queens

On May 7 the Region 1 and 2 fisheries units completed an electrofishing survey of Baisley Pond. Baisley Pond Park is a NYC Parks Department “catalyst” park. As such, it has been deemed a park of special concern and slated to be revitalized. Over the past 20 years the park had been slowly becoming more and more run-down. Under the new program the city plans on cleaning up the park and restoring all of it original functions, including fishing. To aid in this effort we agreed to survey the pond to get an idea of how to improve its fishery. The pond has a max depth of 9 feet, is spring fed and becomes choked with macrophytes during the summer. Shocking yielded largemouth bass, bluegills, pumpkinseeds, brown bullhead, golden shiners, carp, goldfish, black crappie, and white perch. Of the 450 fish sampled 55 were largemouth bass and 350 were either bluegill or pumpkinseed sunfish. There were very few quality sized fish besides a few largemouth bass that approached four pounds.

Region 3

Walton Lake

Rooted aquatic vegetation, water clarity, and populations of largemouth bass (Micropterus salmoides) and pumpkinseed (Lepomis gibbosus) and bluegill Lepomis macrochirus were monitored for 12 years following introduction of grass carp (Ctenopharyngodon idella) into Walton Lake in Orange County, New York. Areal coverage of submerged aquatic macrophytes, mostly Eurasian milfoil (Myriophyllum spicatum), was 33% of the 120-lake prior to introduction of 400 grass carp (10/vegetated acre) in 1987. The objective of the grass carp stocking program was to reduce submergent aquatic vegetation biomass by 75%. The first stocking resulted in limited control. An additional stocking in 1989 increased estimated grass carp density to 15 to 19/vegetated acre, resulting in a net reduction in macrophyte biomass of approximately 30%. Selective grazing on preferred species increased Eurasian milfoil coverage on established transects by 33% and resulted in a virtual monoculture. Additional stocking increased the estimated grass carp density to 21 to 27/vegetated acre and resulted in complete removal of the remaining milfoil.

Secchi disk readings remained generally in the 9.0 to 11.0 ft, suggesting macrophyte reduction did not result in increased algae blooms. The catch/unit effort (CPUE) during nine night time centrarchid sampling surveys of largemouth bass from 1986 to 2001 ranged from 38.0/h to 89.7/h and generally declined during the study. CPUE of combined Lepomis spp. ranged from 72.0/h to 409.5/h and declined throughout the study. CPUE of largemouth bass >= 12 in averaged 45.4/h (30.1/h to 65.6/h) and declined throughout the study. CPUE of largemouth bass <= 12 in averaged 20.5/h (5.0 to 33.2/h), initially increased, then declined substantially as the submerged aquatic vegetation was eliminated**.** Largemouth bass PSD averaged 78.1 (range 56.7 to 97.1), declined through the mid 1990s, then increased. Bluegill PSD averaged 28.8 (range 4.0 to 43.4) and pumpkinseed averaged 48.7 (range 6.2 to 80.0). Lepomis spp. PSD declined through the 1990s.

A final report entitled "Experiences with Using Grass Carp for Aquatic Vegetation Control in DEC Region 3 with Emphasis on Walton Lake" was completed in November, 2001.

Swinging Bridge Reservoir

This reservoir was an experimental stocking target for walleye with the objective of establishing a self-sustaining population. 20,000 pond fingerlings were stocked annually from 1993 - 1997, with an additional 5,000,000 fry stocked in 1998. In October 2001, two nights of boat electrofishing were conducted, totaling 2.65 hr of "on" time. A total of 208 young-of-year (YOY) walleye were collected, along with nine older walleye. All young-of-year were wild fish.

Six fine mesh midwater gillnets (stretch mesh 3/4 " - 1.5") were set overnight, in November, collecting a total of 201 alewife. These results are in the range of past alewife-targeted netting efforts in this reservoir, indicating that the alewife population abundance was not in a depressed condition at this time.

An ichthyoplankton sample was collected in early May 2002 to try to determine walleye reproductive success this past spring. No larval walleye were collected in the reservoir proper, nor in the major tributary Mongaup River. The odd spring 2002 weather, plus a relative week later deployment of these sampling gears compared to 2001 may have negatively affected the 2002 sampling efficiency for larval walleye.

This documentation of successful walleye recruitment for two years in a row remains both exciting and perplexing, in that it appears the original objective of the experimental walleye stocking program has been met, in spite of an historically abundant alewife population which shouldn't allow for walleye fry survival. Future sampling will continue to document the status of this developing walleye population, while simultaneously attempting to document the dynamics of the alewife/walleye interactions that have allowed for two successful years of walleye recruitment.

Oscawana Lake

A draft report was completed reporting that from 1989 to1997 fingerling and yearling walleye *Stizostedion vitreum* were stocked at 370 acre Oscawana Lake by local residents at rates ranging from 3 to 12 per acre, and averaging 8 per acre. In 1998 the New York State Department of Environmental Conservation, Region 3, Bureau of Fisheries conducted an electrofishing and netting survey to determine the status of the lake's fish populations with special emphasis given to walleye.

Walleye collected during April electrofishing exceeded the statewide 15 inch minimum size limit by age 3 and averaged 16.8, 19.2 and 21.6 inches at ages 3, 4 and 5 respectively. This is considered fast growth. Based upon the ages determined from scale analysis, it appears that all walleye collected originated from 1993-97 plantings of 5 to 8 inch yearling walleye supplied by Phil Goeden, Fisheries, Alexandria, Minnesota. The lack of any walleye older than age 6 suggests that plantings of 2 inch fingerlings from the Empire hatchery in New York made in 1989 and 1990, and 3 to 6 inch fingerlings and or yearlings from the Zetts hatchery in Pennsylvania made in 1991 and 1992, had not survived. Analysis of largemouth bass data collected during May electrofishing indicates a largemouth bass PSD of 69 and a RSDp of 12. For *Lepomis spp.* (Bluegill *Lepomis macrochirus*, pumpkinseed *Lepomis gibbosus* and redbreast sunfish *Lepomis auritus*) the PSD was 49 and the PDSp 8. These structural indices suggest well balanced populations of the lake's principal predator and panfish populations.

Region 4

Kinderhook Lake Alum Treatment

A fishery survey of Kinderhook Lake (Columbia County) was conducted prior to an application of alum by the Kinderhook Lake Association. Kinderhook Lake is a 350 acre warmwater impoundment on the Valatie Kill with limited public access. The sampling plan followed the centrarchid manual with additional samples taken for TSMP analysis. Sampling was conducted over a three night period. Visibility was compromised by an algal bloom. The catch rate for legal size black bass was 20 fish per hour of electrofishing. Many small perch (both white and yellow) were captured or noted. After the alum treatment is finished or stabilizes at a constant yearly rate, a follow-up survey will be planned to evaluate the effects of alum on fish populations.

Canadarago Lake

The biennial netting of 1,900 acre Canadarago Lake in Otsego County was completed in 2001, the 10th netting since 1983. Two, 150 foot long variable mesh (1.5 - 4.0 inches) nets are fished monthly from June through September at random locations throughout the lake for a total of eight net sets. The catch of 18.1 walleye and 83.8 yellow perch per net were the second and fourth highest catches, respectively. The netting data suggests that the walleye and yellow perch population remain at high levels.

Region 6

Oneida Lake Walleye Tagging

Region 6 Fisheries staff assisted Cornell University and Region 7 in an Oneida Lake walleye population study. Regional staff collected and finclipped 1,150 spawning walleye in the Barge Canal and Fish Creek during five days of sampling. Recoveries of marked walleye will help determine the portion of the Oneida Lake walleye population that spawn in the tributaries. This information has not been available in the past and should help in developing walleye management options for Oneida Lake.

Lows Lake Survey Summary

Largemouth bass were illegally introduced into Lows Lake (a remotely located Adirondack Lake located in SE St Lawrence County) in the late 1980's. Since then, bass have become well established. During the early 1990's a very popular sportfishery developed. High catch rates of trophy-sized largemouths have been reported. Recently, however, anglers have noticed some change, having observed a decline in both the in abundance and size quality of lake’s bass population.

June 20 and 21, 2001, Region 6 Fisheries surveyed the Lows Lake fishery. The objective of this survey was to evaluate the status of resident fish populations. In particular, we were interested in quantifying the abundance, and size and age structures of the lake’s largemouth bass population.

Over-all, 2.5 hours of boat electrofishing on-time netted 115 largemouth bass, 11 pumpkinseed, 2 brown bullhead and 1 tessellated darter. The catch of bass was as expected and suggests the population remains relatively abundant. On the other hand, the disparity between the catch of bass and other fish species (115:14) was unexpected. Past surveys (late 1980s via gillnets), before largemouth bass became established, revealed high densities of pumpkinseed, common shiner, creek chubs, brown bullheads and white suckers. Now, based on these (electrofishing) results, non-bass populations appear to be very depressed (or absent). It is unknown weather these declines are the result of the bass instruction, but the evidence is highly suggestive. Regardless, it appears that largemouth bass now substantially out-number their forage supply . If this continues, the quality of the Lows Lake largemouth bass sportfishery can be expected to decline even further.

The age distribution of bass sampled in 2001 suggests the population is recruiting well (almost 50% 1 & 2 year olds) in support of the “over-population” theory. The graph also shows poor survival at older (>4 years) ages, suggesting that angler exploitation or some other mortality factor is having an impact on the population. The length frequency distribution further supports these conclusions. High numbers of bass up to 6 inches represent the high abundance of 1 & 2 year olds, while the apparent decline in abundance of bass over 12 inches in length reflects a sportfishery impact.

Management recommendations:

1. Gillnet survey (a repeat of 1989 effort) to confirm the status of the lake’s non-bass fish species (2002).
2. Repeat the electrofishing survey within the next two years to confirm 2001 results and establish trend
3. Consider special regulations to protect bass population from further declines.

Tooley Pond Survey Summary

Located on one of the newly acquired Champion easement parcels, in St. Lawrence County, Tooley Pond was sampled by night-electrofishing on June 16, 1999 and June 14, 2001. The purpose of the

1999 survey was to obtain baseline data prior to the pond being opened to the public for angling. The 2001 survey purpose was to check the status of the pond's largemouth bass population following two years of public angling under *No-Kill, Artificial Lures Only* Special Regulations.

In general, based on PSD (which ranged above 50 both survey years), Tooley Pond's bass population appears to be stable, and in balance with pumpkinseed, the most abundant non-game fish in pond. The 1999 and 2001 CPUEs for bass greater than or equal too 10 inches in length of 17.4 and 24.1, respectively, indicate the pond's moderate density population remains stable after two years of angling pressure. The 1999 RSD_{15} of 20, suggested a strong potential for quality angling existed prior to the pond being open for public angling. The doubling of the RSD_{15} in 2001 to 40, suggests the bass population size structure may have improved over the past two years, despite any mortality which may be associated with "no-kill" angling.

Recommendations:

- Maintain *No-Kill, Artificial Lures Only* Special Regulations
- Re-Survey in 2002 and 2004 to monitor population abundance and size structure, and re-evaluate the presence of strong/weak year classes and their impact on the fishery.
- Conduct angler survey to quantify effort

Sucker Lake Survey Summary

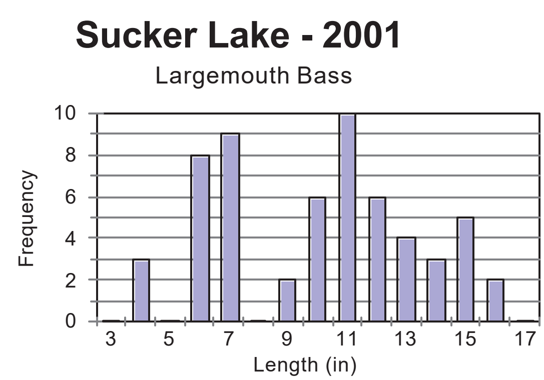
On the evening of June 14, 2001, Region 6 Fisheries surveyed Sucker Lake, located in Town of Fine, St Lawrence County. Three runs, totaling 0.9 hours of on-time (0.62 hours for non-game fish) yielded the following:

Species	Number	Catch Per Hour	Mean Length (in)
Largemouth bass	59	66	9.7
Smallmouth bass	1	1	5.5
Pumpkinseed	29	47	6.4
Rock Bass	2	3	5.5
White sucker	4	6	14.0
Golden shiner	1	2	5.1

High catch rates of largemouth bass and pumpkinseed indicate both species occur at higher than average densities in Sucker Lake. These two species combined appear to comprise the bulk of the lake's fish population. The catch of 31 largemouth bass >= 10 in (34 per hour) further indicates the presence of a high density bass population. PSD and RSD_{15} for largemouth bass, based on this sample, were 45 and 16, respectively. These, in combination with the sample's length frequency distribution (right) which characterizes the population's high proportion of >= 12 in individuals, suggests that Sucker Lake's largemouth bass population is stable and should be providing some quality angling opportunity.

The mean age of the largemouth bass sampled was 3.3 years. Based on mean lengths at age data (below) Sucker Lake bass appear to be growing faster than average for their first 3 years and slower than average thereafter (in comparison to other NYS waters).

Age	Mean Length (in)
1	5.2
2	7.0
3	10.1
4	11.6
5	12.1
6	14.3
7	14.7
8	
9	18.8



Recommendations:

- Maintain current management strategy based on Statewide Angling Regulations.
- Monitor lake's fishery by re-survey in 5 years (2006).

Region 7

Whitney Point Reservoir Sampling

Standard summer sampling was conducted in 2001 which consisted of twelve gillnet sites and four trapnet sites. The gillnet catch rate of walleye (10.5/net) was nearly double the all time catch rate (5.6) observed in 1999. The majority of walleye captured (127) were age 4+ (1997 year-class). Growth of this year-class continues to be slower than normal (average: 16.2 in., range: 13.5 in. - 19.0 in.). Age 4 + walleye in Whitney Point Reservoir generally average 18 inches in length. The strong 1999 year-class of walleye also showed up in the sample and their growth rate appeared to be normal (~14.5 in. average).

Older (mainly age 4+), large white crappie were more abundant than expected. This year-class of crappie was extremely abundant in the 1999 summer netting and continues to be the primary component of the current fishery. The 2000 year-class of white crappie, which appeared very abundant in the fall 2000 electrofishing survey, were not as well represented in the 2001 summer survey as anticipated. A total of 234 age 1+ white crappie were caught which is approximately one-third and one-quarter of the record numbers of age 1+ crappie sampled during the 1991 (609) and 1992 (988) summer surveys, respectively. Although their abundance is low relative to these “record” years we believe their level of abundance still reflects a moderately strong year-class which should support a modest fishery in the future.

Since 1994 night electrofishing in October has been conducted at four standard sites to assess abundance and growth of young-of-year (YOY) and yearling walleye in Whitney Point Reservoir. In 2001 all sites were sampled and a total of 382 YOY were collected. Population estimates of YOY walleye, using Serns (1982) methodology, follow:

1994 - 8,087	1999 - 55,275
1995 - 10,437	2000 - 842
1997 - 106,704	**2001 - 31,141**
1998 - 2,825	

Although not collected, young-of-year yellow perch appeared to be extremely abundant. Young-of-year white crappie abundance appeared to be moderate at best and will not likely provide a large contribution to the future crappie fishery. Interestingly, the fall electrofishing sample of age 4+ walleye had an average length of 17.3 in. (range: 15.8 in.-18.8 in., n=11). Although a small sample size, growth of these walleye after July appears to have been good.

Broome County PL566 Ponds

Two Broome County PL566 Flood Control ponds, *Nanticoke 7A* and *Nanticoke 13* were sampled in mid-July, 2001 to determine the current status of their fish communities. Survey data has not yet been analyzed but it appears that the 1985 stocking of northern pike has created a self sustaining population in Nanticoke 13. Stocked yearling rainbow trout were captured in Nanticoke 7A and quality sized bluegills (6-8 in.) were very abundant.

Oneida Lake Management

Efforts to return the adult walleye population to its long term average included increasing fry stocking to 150 million, stocking 200,000 pond fingerling walleye, stocking 100,000 yearling walleye (March 2002), and instituting restrictive harvest regulations (18" minimum length, 3/ day limit) effective October 1, 2001. In addition, planned attempts to reduce predation impacts of double-crested cormorant include limiting successful nests to 100 annually (done by Cornell) and hazing fall migrants (done by USDA - APHIS). Efforts to limit successful nests did not occur in 2001 and 225 nests were successful, fledging 284 chicks**.** However, hazing was conducted during September as planned, reducing numbers from approximately 1,700 to less than 100 the first week. The numbers of cormorants remained low for the remainder of the month**.** (Fisheries assessment and monitoring of Oneida lake’s fish community and fishery is done by Cornell University under contract to DEC.)

Chittenango Creek Walleye Population Estimate

In a cooperative effort with Cornell University, lower Chittenango Creek, a major tributary to Oneida Lake, was boat electrofished in April 2001 to estimate (through a mark and recapture technique) the size of the creek’s walleye spawning population and its contribution to the overall Oneida Lake walleye population. A total of 403 spawning adult walleye were collected in six days. Each walleye collected was marked with a one half left pectoral fin clip prior to release for future identification. Of the 403 walleye marked and released, 15 were caught more than once during the sampling period (see table below).

Number of walleye collected, marked and released during an April 2001 boat electrofishing survey of lower Chittenango Creek. All first caught walleye were given a one half left pectoral fin clip prior to release.

Collection Date	Water Temp (• F)	Electro-fishing Time (hr)	Number of walleye captured, marked and released	Number of walleye caught more than once	Daily total
4/3/01	36.9	1.19	88	0	88
4/4/01	40.0	0.61	80	4	84
4/5/01	44.2	0.74	86	2	88
4/6/01	45.0	1.27	86	5	91
4/16/01	51.0	0.77	22	2	24
4/19/01	47.0	1.07	41	2	43
Total		**5.65**	**403**	**15**	**418**

Note: Chittenango Creek could not be electrofished between 4/6/01 and 4/16/01 because of flood conditions. Walleye spawning probably peaked during this period.

Marking and releasing walleye during the 2001 spawning run was the first half of the mark and recapture population estimate. Region 7 fisheries will electrofish lower Chittenango Creek during the 2002 walleye spawning run with the primary purpose of collecting (recapturing) walleye that were marked during the 2001 spawning run. The ratio of marked walleye collected in 2002 to the total number of walleye collected in 2002 will be considered roughly equal to the ratio of the 403 marked walleye to the total number of adult walleye in Chittenango Creek during the 2001 marking period.

Cross Lake Walleye Stocking Evaluation

Recent efforts to establish walleye as a major fishery in Cross Lake began in 1996 when 37,000 fingerlings from Chautaugua Hatchery were boat stocked off the northwest shore. A stocking of 6,520 fingerlings from South Otselic Hatchery followed later that year. Since then Cross Lake has been stocked with 69,800, 43,600 and 43,520 walleye fingerlings in 1998, 1999 and 2001, respectively.

Cross Lake walleye stocking has been evaluated by night electrofishing in spring-early summer 1997 and in fall 2000 and 2001. The 1997 evaluation consisted of sampling the entire shoreline with eight 15 minute all fish runs and eight 30 minute gamefish runs. A total of 1,211 fish (23 species) were collected, of which 14 were walleye (2.3 walleye/hr). The 14 walleye collected ranged from 6 to 9 inches in length and averaged 7.9 inches in length. Scale aging revealed all 14 walleye were yearlings probably originating from the 1996 fingerling stocking.

The 2000 evaluation consisted of sampling habitat types with two 15 minute all fish runs and six 30 minute gamefish runs. A total of 253 fish (13 species) were collected, of which six were walleye (1.7 walleye/hr). Scale aging revealed five yearling walleye probably originating from the 1999 fingerling stocking and one 21.9 inch walleye too old to have been stocked in Cross Lake since 1996.

The 2001 evaluation consisted of sampling habitat types with eight 30 minute runs. A total of 251 fish (18 species) were collected, of which six were walleye (1.5 walleye/hr). The six walleye collected ranged from 8.1 to 9.6 inches in length and averaged 8.9 inches in length. Scale aging revealed all six walleye were fingerlings probably originating from the 2001 stocking.

Results of the Cross Lake electrofishing surveys are somewhat encouraging in that walleye probably originating from the fingerling stockings were collected during each survey. However, low walleye catch rates in all three surveys suggest only modest survival. The apparent level of survival is probably an artifact of substantial out-migration to the Seneca River since anglers have also recently reported an increase in the number of walleye caught in the state ditch area of the Seneca River just downstream from Cross Lake.

Region 8

Almond Reservoir

A warmwater fisheries assessment of Almond Reservoir, a flood control project in western Steuben County, was conducted using night boat electrofishing and gill net sets during Summer, 2001. Electrofishing samples were geared toward gamefish and panfish species with the majority of the shoreline sampled. A total of 94 fish were collected with largemouth bass and yellow perch accounting for 64% and 23% respectively. Two gill nets were set with one net in deeper water and the other fishing the entire water column. A total of 168 fish representing 7 species were collected with golden shiners representing 56% of the catch. Based on our sampling, largemouth bass provide the only opportunity to anglers. Growth rate, condition, and size and age distribution indices indicated that the largemouth bass population was in good shape. The forage base consisted primarily of large golden shiners whose young probably provide the majority of forage for bass, crappie, and yellow perch. Black crappie and yellow perch were represented by one or two age classes and provide little angling opportunity. Although the reservoir was suited to sunfish species, only two (both pumpkinseeds) were collected. Predation from largemouth bass, habitat limitations, or other unknown factors are potentially limiting their population and need further investigation.

Conesus Lake Fish Stock Assessment
Standard gang gill netting was conducted on Conesus Lake from September 17-21, 2001. The purpose of the netting is to periodically (approximately 3 year intervals) assess fish stocks, particularly walleye. One hundred nine walleyes were caught in 12 nets. The catch rate of 9.08 walleye/net is similar to 9.8 in 1991, but is down from 33.1 in 1994 and 19.1 in 1997. Preliminary analysis of the data shows that, as suspected, nearly all of the walleye caught are greater than 450 mm. Scale analysis for age has not been completed, but it is believed that these fish are older than 4+ years. This indicates that no natural recruitment to the fishery has occurred since fingerling stocking of walleyes ceased in 1997. Fingerling walleye were stocked in July 2001. The success of these stocked fish will be evaluated by night time electrofishing in late May 2002. A Peterson population estimate is scheduled for Spring 2002.

Conesus Lake Walleye Spawning Success
In cooperation with the Community College of the Finger Lakes (CCFL) and the United States Geological Service (USGS), a CCFL student intern set drift nets in Conesus Inlet from May 2 to 11, 2001. The purpose was to further evaluate the fate of walleye fry spawned in the Inlet. The drift net samples were evaluated by staff at USGS Tunnison Lab in Cortland. Only one sample, upstream most sample collected on May 4 had walleye fry present.

Region 9

Chautauqua Lake Warmwater Surveys
Regional staff assisted Prendergast Hatchery with the tending of the trapnets to monitor the adult muskellunge population. Nets were fished for approximately 21 net nights and produced a catch per net index of 21. This was below the recommended management level of 28 muskellunge per net established by the Chautauqua Lake workgroup. Age-4 to age-6 finclipped muskellunge contributed to 16% of the total catch, showing poor recruitment of these cohorts. These cohorts were stocked at 7.2 (1995), 7.3 (1996) and 6.8 (1997) inches. Twelve percent of the adult muskellunge (>32 inches) had open redspot lesions and the ratio of males to females was 0.3:1.0.

Prey species and age-0 walleye were sampled by a 16 ft. bottom trawl in September and October. The trawl catch indicated an increased abundance of >age-0 pumpkinseed, bluegill and black crappie, while age-0 and adult yellow perch continued to be the most abundant prey species collected by trawl. Age-0 and adult white perch abundance declined from previous trawl surveys. Abundance of age-0 walleye was low, continuing the trend of poor recruitment that has occurred since 1996. Low recruitment has been associated in part to predation by the strong 1993 walleye year class although the possibility of negative associations with white perch cannot be discounted. Low recruitment of walleye is expected to show impacts to the recreational fishery in 2002.

Fisheries staff completed fall electrofishing surveys targeting muskellunge, walleye and black bass. Adult walleye abundance had declined from 2000 and was consistent with data derived from the gill net assessment. Age-0 walleye abundance was low and was similar to data collected by trawl.

Cuba Lake
Late spring electrofishing in 2001 produced catch rates of 76 smallmouth bass, 15 walleye, 7 northern pike and 5 largemouth bass/hour. Rock bass and yellow perch are the dominant panfish, followed by pumpkinseed sunfish. Walleye fry stocking was discontinued in 1999 because of slow walleye growth rates and to evaluate natural reproduction. In

2001, fall electrofishing netted 10 age 0+ walleye/hour and 10 age 1+ walleye/hour. Northern pike, a recent illegal introduction in the early 1990's, continues to expand its population, with 7 consecutive naturally spawned year classes documented.

Silver Lake

Electrofishing shortly after ice-out in 2001 produced a catch rate of 466 adult walleye/hour. State fingerling stocking was discontinued after 1991, state fry stocking was discontinued after 1996 and volunteer fingerling stocking was discontinued after 1994. Minimally, over 40% of the walleye collected in 2001 were naturally reproduced. Late spring electrofishing produced yellow perch catch rates of 760 fish/hour, pumpkinseed 80 fish/hour, bluegill 66 fish/hour and rock bass 85 fish/hour. The yellow perch PSD in 2001 was 42% while the PSD for pumpkinseed was 38% and bluegill 18%. Age 4 yellow perch averaged 200 mm in length, compared to 168 mm at age 4 in 1987 just after the walleye stocking program began. Fall electrofishing netted 35 largemouth bass/hour (8/hour > 15 inches), 10 walleye/hour and 5 northern pike/hour. Only 1 young of year walleye was collected. Fall electrofishing for age 0+ or 1+ walleye in Silver Lake has been unsuccessful over the years, however it is evident from electrofishing the spawning population that reproduction is taking place. Zebra mussels were collected for the first time in Silver Lake in November 2001. (Note: Catch rates for a productive lake like Silver Lake can be misleading. For example, the spring catch rates for walleye and yellow perch can be thought of as netting rates. During electrofishing for spawning walleye perhaps we can physically net half of the walleye we see, while during the spring electrofishing for panfish, it is difficult to even put an efficiency on the yellow perch, but to toss out a number perhaps 5%, meaning over 15,000 yellow perch go by the boat per hour of electrofishing).

Cassadaga Lakes Warmwater Surveys - Assessment of Slot Limit Regulation

To increase growth rates and length distributions of black bass and panfish, a 12-15 inch protected length limit (slot) was imposed for black bass in 1994. Electrofishing in spring, 2001 continued to show an increased abundance of black bass within and exceeding the protected slot with acceptable recruitment of bass below the slot. Analysis of creel survey data indicated that angler catch rates for preferred and quality length bass exceeded levels considered high from selected waters in New York State. The creel survey also indicated that few bass less that 12 in TL were harvested by anglers. Fisheries staff will continue to evaluate this special regulation to complete assessment over two full generations (10 years)..

Central Office - Inland Section

Assessment of Survival of Stocked Walleye Fingerlings

2001 marked the fifth and final year for the Federal Aid to Sportfish Restoration funded study "Factors Affecting Survival of Stocked Walleye in New York Lakes". The 5 year study was designed to complement a previous study on walleye fingerling survival in New York waters. Since 1991, 16 New York waters have been included in this study. Results of this research indicate that although the relative success of the stocking of pond and fall fingerling walleyes has been quite variable, common factors appear to be impacting the survival of both sizes of walleye fingerlings. In most waters, pond-reared fingerling walleyes stocked at approximately 1.5 to 2 inches in size, outperformed the larger 5 inch fall fingerling walleye grown intensively on dry food at the Oneida Fish Hatchery. Pond fingerlings were observed to grow faster and shift to a piscivorous (fish-eating) diet more successfully than fall fingerlings. The major causative factor resulting in the success or failure of a walleye stocking was determined to be predation risk. Abundance of largemouth bass and pike over 15 inches was noted to be the largest factor impacting walleye survival. Walleyes were established in a number of the study waters including Fort Pond and Lake Ronkonkoma on Long Island, where walleyes have not been historically found.

Analysis of fish population trends in Oneida and Canadarago Lakes

Researchers at the Cornell Biological Field Station on Oneida Lake completed their annual assessment of the fish community in Oneida and Canadarago Lakes. The Federal Aid to Sportfish Restoration funded Oneida and Canadarago Lake fishery monitoring projects are the tow longest running warmwater fishery assessment projects in New York State and have provided an excellent insight into the complex dynamics associated with warmwater fish populations in large northern lakes.

Oneida Lake

The Oneida Lake walleye population is currently estimated to be 276,000 age 4 and older fish, which continues to be substantially lower than the long-term average. Large increases in the walleye population are not expected through 2004. The walleye population decline is attributed to increased mortality at two life stages 1) from 9-day-old larvae to their first fall, and 2) between age 1 and 4. Cormorants likely cause the latter. Declining phosphorus loading (since 1987), invasion of zebra mussels (since 1992) and disappearance of the alternative prey species (gizzard shad, since 1993) may all have contributed to the low walleye recruitment since 1992. Evidence of change in the lake is the higher water clarity and lower phytoplankton biomass observed since 1992.

The yellow perch population was estimated at 947,000 age 3 and older fish, which is an increase since the last population estimate was made, but below the long-term average. Zebra mussels have cleared the water but have not affected yellow perch growth rates presumably because zooplankton production has not declined. Increased light levels should also increase foraging efficiency of perch on benthic invertebrates. Abundance of larval walleye (9-day old) was high in 2001, but survival was relatively poor and abundance of YOY walleye in the fall, although higher than in the 1990s, was lower than in previous decades. Abundance of YOY yellow perch continues to be low. Cormorant predation on adult yellow perch is similar to angler catch rates, but cormorants also feed on sub-adults. For adult walleye, anglers are the more important predator. Current management actions include limiting cormorant nesting success and harassment during the fall migration. The walleye minimum size limit was also increased from 15" to 18". These two management actions in concert should result in a slow increase in both populations. Population data from 2001 is consistent with these expectations.

Canadarago Lake

Fall electrofishing indicate good recruitment (catch rates 8 fish/hr) of naturally spawned young-of-the-year (YOY) walleye in Canadarago Lake in 2001. Adult walleye numbers remained high in both electrofishing (28.5 fish/hr) and gill net samples (18.1 fish/net). YOY yellow perch numbers were high in 2001. One 102mm alewife was caught in the end of October. Changes in yellow perch and walleye growth rates over time show strong effects of the increasing walleye population, both through increased growth rates of yellow perch and decreased growth rate of walleye. Interestingly, the growth response in YOY yellow perch was lagged by several years, a dynamics attributed to changes in habitat choice by yellow perch as the risk for predation from walleye increased and before the population level effects of density dependent growth rates went into effect. Secchi disk transparency was lower than the average for the 1990s and the large zooplankton *Daphnia pulicaria* disappeared in July to August, suggesting higher planktivory rates from YOY fish than in previous decades. This correlate well with high catches of YOY yellow perch in 2001, but may also be an effect of a small but increasing population of alewife.

Coldwater Lakes and Ponds

Region 4

Basswood Pond

Basswood Pond is a 15 acre trout pond in Otsego County that is stocked annually with 2,100 rainbow trout fingerlings in the fall and 1,000 brook trout yearlings in the spring. In recent years, the pond has become infested with goldfish and other non-trout species which compete directly with the more desirable species. The results are reduced trout survival and growth rates. The pond was reclaimed September 11, 2001, using rotenone to kill all fish in the pond. An estimated 51 rainbow trout, 11 brook trout, 1 largemouth bass, 12 -15 white sucker, 1,000's of bluntnose minnow, and 100's of goldfish. The treatment is believed to be 100% successful. The pond will be restocked with rainbow trout and brook trout in the spring of 2002.

Region 5

Mohegan Lake Surveyed

Mohegan Lake, in the Town of Long Lake, Hamilton County, was surveyed to assess lake trout and landlocked salmon stocking policies. Mohegan Lake is partially within the Moose River Plains Wild Forest, but is also bordered by private lands once owned by J.P. Morgan. A famous Adirondack great camp, Camp Uncas, still exists on the pond. Gill-nets were set at several depth ranges to catch the full variety of species present. A total of 31 lake trout ranging from 9 to 26 inches were captured, along with yellow perch and white sucker. No landlocked salmon were captured, nor were rainbow smelt which have been caught historically in this lake. Pumpkinseed were observed in the shallows of the lake. Several large lake trout were kept for mercury analysis at the request of the Adirondack Lake Survey and EPA. Lake trout age and growth will be determined from scale samples later this year.

Rock and Little Rock Ponds Reclaimed

Rock and Little Rock Ponds in the Pharaoh Lake Wilderness were reclaimed in mid-November. This was a comparatively large project representing more than 60 acres of restored brook trout habitat. Rock and Little Rock Ponds are in the Town of Ticonderoga and were formerly high quality brook trout waters which had been overwhelmed by non-native yellow perch. The ponds will be restocked with a heritage strain of brook trout in 2002. The treatment was complicated by the reassignment of the state helicopter to fight a forest fire before the project was completed. The pilots were able to fly all materials necessary to finish the project to the pond before they departed. Fisheries staff finished the project by walking in on the final day.

Endangered Round Whitefish Eggs Collected

For the third consecutive year, round whitefish eggs were collected from Lower Cascade Lake, Essex County in an effort to expand the range of this endangered species. One trap net was set for the time period of Nov 19-23, capturing a total of 202 round whitefish. Eggs were take from 51 ripe females and milt from 49 males. Ovarian fluid samples were taken to help establish a disease history for this water. Approximately 25,000 eggs were fertilized and delivered to the Constantia Hatchery for rearing to spring fingerling size. Progeny from this effort will be stocked back into Lower Cascade Lake and to several other candidate waters in Regions 5 and 6 in an effort to safeguard this species listed as “Endangered” in New York State. On the final day of netting, 62 ripe adults were transferred to nearby Upper Cascade Lake. Other species captured during this effort were brook trout, brown trout and white sucker.

Region 7

Jeffrey Pond Post Reclamation Monitoring

Jeffrey Pond, Chenango County, was surveyed as part of the on-going effort to determine if significant growth and survival of brook trout has occurred since the reclamation in 1997. The reclamation was done in conjunction with the dam repair work which required a complete draw-down of the lake.

The pond was boat electrofished during the daylight hours of April 30, 2001 resulting in the capture of just one holdover brook trout. Other species captured were largemouth bass, pumpkinseed, bullhead, and golden shiner. This survey concluded the post-reclamation monitoring effort. The unit’s determination is that management of Jeffrey Pond as a brook trout only fishery is not practical at this time. Either through avoidance of the rotenone treatment and/or illegal restocking a substantial non-trout fish community has reestablished in the pond. Additionally, survival and growth of stocked brook trout was not significant enough to warrant future efforts to control non-trout fishes. Furthermore, informal surveys of anglers using the pond, during our various sampling efforts, revealed a general lack of support for the trout only management effort.

On October 1, 2002 the special regulation prohibiting the use of fish as bait in Jeffrey Pond will be rescinded. Future management efforts at Jeffrey Pond may include the re-stocking of yellow perch and largemouth bass into the pond to try and recreate the thriving pre-reclamation warmwater fishery which had existed.

Tri-County Pond Survey

A biological survey was conducted on Tri-County Pond, Tioga County on June 28, 2001. This pond has been managed with a put-grow-and-take rainbow trout stocking of 200 fish for several decades. A gill-net and trap-net were each fished for one night and water chemistry data was collected. Recent requests by anglers to allow ice fishing and the lack of any recent fisheries data prompted the survey.

Oxygen and temperature levels between depths of 5 and 8 feet were suitable to support trout. Six yearling rainbow trout were captured in the gillnet and all were in good condition. Over 400 black crappie were captured in the trapnet, all between 5 and 6.5 inches in length. All crappie sampled were 4 years old indicating severe stunting has occurred. Several bullhead and golden shiners were also captured.

It is recommended that future management of the trout fishery be on a put-and-take basis due to the likelihood of future reintroduction of unwanted species by anglers. Ice fishing will also be permitted, beginning October, 2002. The introduction of adult largemouth bass is being contemplated in order to reduce the abundance of crappie. This should allow the remaining crappie to grow better but would also negatively impact survival of stocked trout.

Bowman Lake Fish Salvage

In response to the dam outlet failure in mid-June at Bowman Lake, Chenango County, staff attempted a salvage operation to rescue freshly stocked and holdover trout that remained in the emptying lake. Seine hauls were conducted for two days and resulted in the capture of only a dozen rainbow trout. The effort was hampered by a deep (6 feet) hole and large amounts of woody debris and large rocks. Boat electrofishing was not possible. Staff concluded that most of the fish had migrated out of the lake while it was draining. Dam outlet repairs were finally made in late summer but the lake remained nearly dry for most of the year. Bowman Lake is a 34 acre impoundment which is stocked with brook and brown trout and is managed as a put-grow-and-take trout fishery. Sunfish have recently been found in the lake and bullhead are also present.

Warmwater Rivers and Streams

Region 1

Lower Peconic River Survey
The Regional Fisheries Unit, in cooperation with the Bureau of Marine Resources completed a one night electrofishing survey of the lower Peconic River on July 25. The primary purpose of the survey was to look for young alewife to document alewife spawning success in this section of the river. A general assessment of the eel population and freshwater fish community was also conducted. No alewives were observed during the survey, but several hundred eels were observed. The freshwater fish community in this section of the river appears healthy, with good numbers of catchable size yellow perch, sunfish and brown bullhead catfish as well as largemouth bass, chain pickerel and carp.

Region 3

Hudson River Estuary Black Bass Study
The Hudson River Estuary Management Program funded a three year study beginning in 1999 to examine the status of the largemouth and smallmouth bass populations in the Hudson River. The consulting firm of Lawler, Matusky & Skelly Engineers (LMS) was contracted for the study. The last major survey of this type was contracted to Cornell University from 1989-91.
The five primary objectives for the current study are:

1) Estimate the number of black bass greater than 11 inches in the Hudson River Estuary.
2) Locate Smallmouth bass wintering areas.
3) Locate smallmouth bass spawning areas and determine their importance to the fishery.
4) Determine black bass exploitation rate from angling.
5) Determine the effects of repeated catch/ move/release of black bass from tournament fishing.

A brief description of some of the preliminary findings through 2001 follows.

<u>Electrofishing and Tagging</u>
A total of 6,646 largemouth and 1,504 smallmouth bass were jaw tagged between March 1999 and November 2001. Many of the bass (4700 largemouth and 485 smallmouth) were collected during early spring electrofishing of known or suspected wintering areas (Coxsackie Cove, Catskill Creek, Esopus Creek, Rondout Creek, Stockport Creek and Wappinger Creek). The remaining 1,946 largemouth bass and 1,019 smallmouth bass were tagged during tournament monitoring in the summer and fall.

Largemouth bass wintering area abundance estimates in March and April of 1999 and 2000 have remained within the range of previous estimates or increased for Esopus Creek, Rondout Creek and Coxsackie Cove (Table 1). The number of largemouth bass overwintering in Catskill Creek and Wappinger Creek have continued to decline since the mid-1980's. We will look into whether this decline could be an artifact of our sampling design, and if not, we will look into potential reasons for this.

Catch per unit effort of electrofishing varied between 48 and 235 bass/hour for the five sites in 1999 and 2000. This catch per unit effort is similar to or has increased compared to previous studies (Table 2).

Evidence of movement out of and between wintering areas was documented in early April in all years of the study.

<u>Tagging Mortality Study</u>
Three separate studies were conducted to estimate if short term mortality occurred due to the tagging procedure. For two of the studies, a sample of 100 bass were collected via boat electrofishing. In the third study, a 100 fish sample was taken from bass caught during a tournament in September. All 100 fish (25 untagged and 75 tagged) from each study were held in three circular 440-gallon tanks for two days. Only one tagged bass and zero control fish died over the 48 hour periods of these studies. The one tagged bass that died was in poor condition prior to tagging, and may be more indicative of electrofishing or natural mortality than the tagging procedure.

<u>Tournament Monitoring</u>
Black bass tournaments were monitored in the summer and fall of 1999, 2000 and 2001 to gain

recapture information and tag additional bass. Petersen population estimates for the riverwide population of largemouth bass over 11 inches were calculated using this data. The 1999, 2000, and 2001 riverwide estimates for largemouth bass were 22,432, 22,301 and 21,008. This compares to estimates from 1991 of 14,230, 1990 of 14,503, and 1989 of 21,954. Studies by NYS DEC from 1986-1988 estimated the largemouth bass population to be between 30,000 and 37,000 riverwide.

Radio Telemetry

Smallmouth bass movement patterns between overwintering and spring spawning areas were investigated in the Hudson River Estuary between Troy and Kingston. Sixty smallmouth bass were collected by electrofishing from tidal creeks and main-stem shoreline areas during September and October 1999. Radio-transmitters were surgically implanted in these fish. After release, fifty-eight of the fish were subsequently found and tracked through the next year using tracking equipment on foot, boat, and aircraft.

Smallmouth bass overwintered in large tidal creeks as well as deepwater areas of the Hudson River and were generally associated with bridge abutments, rock ledges or protective riprap surrounding navigational light structures. Although most smallmouth bass moved to overwintering areas by mid-January, several individuals continued to exhibit large-scale movements when water temperatures were below 41° F. Smallmouth bass began to move to spring spawning areas during early April. Most smallmouth bass (70%) entered or remained in tidal creeks during the spawning season (late-April through May); including Catskill Creek, Stockport Creek, Hannacroix Creek, Rondout Creek and the Roeliff Jansen Kill. Several fish moved into relatively shallow (<3 feet deep) upstream reaches of the tributaries, beyond previously thought barriers to upstream migration. Smallmouth bass that overwintered in the Hudson River traveled up to 26 miles to spawning areas.

The fish moved between 0.06 mi and 6.08 mi away from release sites. Most fish collected and released within tidal creeks remained within their respective creek throughout the study period. One fish moved into the main-stem of the Hudson River. Fish collected and released along main-stem shoreline areas moved into nearby tidal creeks or to deep-water areas associated with bridge abutments, rock ledges or protective riprap surrounding navigational light structures in the Hudson River. Although most smallmouth bass moved to overwintering areas by mid-January, several individuals continued to exhibit large-scale movements when water temperatures were below 41° F.

Distribution of Information About The Study

An informational poster and pamphlet were designed to inform anglers and the general public about the study. Posters were hung at boat launches and in tackle shops. The pamphlets were distributed to bass clubs and included in tag return response letters. Pamphlets were also carried in the field to help answer questions and aid in continuing with field work without as much time spent explaining what was being done. Final Progress Reports for 1999 and 2000 were completed and reviewed. A Draft Final Report for the study is scheduled for completion in the summer of 2002 with a subsequent Final Report completed in the fall. Summary reports will be periodically updated and sent to tag returners, and used as handouts for presentations and for fishing groups. A PowerPoint presentation was developed and presentations were given to various bass fishing clubs, and at the NYS DEC Bureau of Fisheries Managers Meeting, the Hudson River Estuary Educators Seminar, the Hudson River Estuary Program Managers Meeting, the Annual Meeting of the American Fisheries Society in St. Louis, MO during the Black Bass 2000 Symposium, and the 2001 Northeast Fish and Wildlife Conference held in Saratoga Springs , NY.

Region 4

Mohawk River Study

The third year of a 5-year electro-fishing monitoring program on the Mohawk River was completed. This study is designed to characterize the age and size structure of the smallmouth bass population. The population appears to have become dominated by older and larger fish. This shift in structure may be a product of recruitment failure, as indicated by an absence of young-of-the-year in fall survey work.

Region 8

Chemung River

A survey was conducted to assess current population characteristics of smallmouth bass and walleye and to evaluate the stocking of 14,000 surplus tiger muskellunge fingerlings during the past 2 years. During August and September 2001, fish were collected from 7 sites in the Chemung River using boat mounted and backpack electrofishing gear. Low water conditions limited sampling to areas near boat launches, which were not necessarily quality smallmouth bass and walleye habitat. A total of 30 species of fish were collected. Smallmouth bass (CPUE=17 fish/h) and walleye (CPUE=8 fish/h) were the dominant gamefish collected. Smallmouth bass averaged 150 mm (SD = 79) and ranged in size from 70 - 363 mm. Only 5% of bass collected were legal size (i.e. >305 mm). Relative weights of smallmouth bass >200mm indicated bass were in good condition. Age distribution and growth rates have not been estimated to date. Walleye averaged 214 mm (SD = 93) and ranged in size from 135 - 551 mm. Only 10% walleye collected were legal size (i.e. >356 mm). Although not yet aged, size distribution of the remaining walleye collected indicate they were probably age 1+ and 2+. Because of sampling limitations (i.e. low water conditions), results may not be representative of the smallmouth bass and walleye adult population. However, reports from anglers indicate that while numerous, smallmouth bass generally do not attain large sizes. Whether this is a result of angler mortality or habitat limitation is unknown. Only a few esocids were observed during sampling and none were able to be collected. We could not tell if these fish were tiger muskies or other esocid species. Recent reports indicate that a few tiger muskies are being caught, however further evaluation needs to be completed before recent stockings could be considered a success.

Central Office-Inland Section

St. Lawrence River Esocid Study

Federal Aid to Sportfish Restoration funded efforts to assess and manage Esocids (members of the pike family) in the St. Lawrence River continued in 2001. Researchers at the State University of New York School of Environmental Sciences and Forestry in Syracuse completed the following activities.

<u>Muskellunge Angler Diary Program</u>
Nineteen diaries were distributed to anglers and five participants returned a diary (26% return rate). Each diary recipient was contacted by mail and by phone to encourage participation and diary returns. Anglers fished a total of 1160.5 hours and caught a total of 47 muskellunge (CPUE = 0.04 fish/hour). All of these fish were released. Mean total length of the catch was 42.5 inches. The total length of the muskellunge ranged from 33 to 58.5 inches.

<u>Monitoring of Juvenile Esocids</u>
Based on the 2001 seining effort, age-0 muskellunge abundance was high and northern pike was low. Age-0 muskellunge and northern pike were monitored in eleven bays using a 30' seine during the period July 16 to August 8, 2001. The 30' seine resulted in a total catch of 6 northern pike and 84 muskellunge and 1 grass pickerel. Overall, the CPUE was 0.94 muskellunge per haul compared to 0.06 for northern pike. The grass pickerel was captured at Deer Island. All bays, with the addition of Flynn Bay, were sampled a second time using a 60' seine during the period August 15 to September 1, 2001. The 60' seine resulted in a total catch of 4 age-0 northern pike and 48 age-0 muskellunge. Overall CPUE for the 60' seine was ten-times greater for muskellunge (0.40) than for northern pike (0.04). In addition, two grass pickerel were captured at Deer Island.

<u>Effects of Double-Crested Cormorants on Esocid Populations</u>
A total of 300 otoliths recovered from pellets taken from cormorant colonies in the Lake Ontario-St. Lawrence River region were examined. The estimated mean size of northern pike in the diet of double crested cormorants was 270 mm (10.8 inches). The maximum estimated size was 475 mm (19 inches). The estimated age range of northern pike consumed by double-crested cormorants was 1 to 4 years. A complete report, including estimates of consumption will be completed by Spring 2003.

<u>Northern Pike Spawning Marsh Management</u>
Efforts to evaluate the use and reproductive success of northern pike in managed marshes continued in 2001. Twenty male and 66 female northern pike were caught in traps and transferred over the water control structure at Cranberry Creek during the Spring of 2001. Twenty three YOY pike were captured from the marsh in 2001. These fish ranged in size from 1.6 inches in early June to 3.0 inches in early July.

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Coldwater Streams

Region 1

2002 Carmans River Electrofishing
The Region 1 Fisheries Unit with the assistance of the Bureau of Marine Resources, Bureau of Habitat, Forest Rangers, Region 2 Fisheries Unit, Central Office Fisheries, the Coney Island Aquarium and Trout Unlimited, completed a two day electrofishing survey of the Carmans River in Southaven County Park. This is part of an ongoing brook trout management program in this river. Preliminary results show that the brook trout population is strong, with good natural reproduction. More brook trout over 10 inches were caught in this survey than in previous years and young of the year production was also strong. In addition to monitoring the brook trout population, American eels were collected as part of the Marine Resources Program studying the status of the American eel in New York State.

The electrofishing operation was filmed by a crew from WNBC Channel 4 and reported in the 6:00 News on Tuesday, March 19.

Mud Creek Survey
Mud Creek (LI-PB-T183), East Patchogue, was surveyed on June 26, 2001 in cooperation with the Cold Spring Harbor Fish Hatchery. Mud Creek is considered to be a heritage strain brook trout stream with no records of the creek ever being stocked. Despite duck farms that operated along the creek (1938 Biological Survey), brook trout have managed to survive. During the survey, 45 brook trout were captured, ranging from 2.4 to 10.0 inches. The survey also identified, property that was for sale adjacent to the headwaters of the creek. These parcels along with 32 others for a total of about 130 acres were recommended for open space acquisition in the South Shore Estuary Reserve to protect the headwaters of Mud Creek. The Fisheries Unit completed a short report documenting the fisheries history of the creek and the importance of preserving the headwaters of the Creek. The Regional Fisheries Unit will work with the Regional Real Property Unit and other interested agencies to promote the acquisition process for these properties.

Brook Trout Restoration in Beaver Brook
Beaver Brook is a trout stream located in the Shu Swamp Nature Preserve in Mill Neck, NY (northern Nassau County). At one time, brown trout fry were released into the brook. The brown trout established a self sustaining population. Recent surveys were unable to find any brook trout in the system. Prior to the introduction of brown trout, brook trout had been native in the system. The establishment of brown trout apparently extirpated the native brook trout. The Region One Fisheries Unit with the cooperation of the Cold Spring Harbor Fish Hatchery began a program to restore brook trout to the stream in 2001. Because the steam is located in a wildlife sanctuary which does not allow fishing access, the removal of catchable size brown trout from the system was not an issue. On July 26 and August 2, 2001, Beaver Brook, Mill Neck, was electrofished. All brown trout caught were removed, had an adipose fin clip applied, and released into the tidal raceway at the Cold Spring Harbor Fish Hatchery. Between the two days of electrofishing, 51 young of the year brown trout and 43 yearling or older brown trout were removed. In addition to the electrofishing, 200 yearling and older and 500 young of the year Connetquot River strain brook trout (a Long Island heritage strain brook trout) were stocked into Beaver Brook on August 2, 2001. On October 25, 2001, the brook was electrofished once again in an attempt to collect the remaining young of the year brown trout and to determine if any yearling or older brown trout are running up Beaver Brook from salt water to spawn. Three brown trout were caught, one 10.4 inch fish and two young-of-the-year fish (approximately 4 inches). In addition to the brown trout, 83 brook trout were caught on October 25, including 7 yearlings and 76 young of the year from the August 2 stocking. On February 26, 2002, three thousand Connetquot River strain brook trout fry were stocked into the brook to further help establish a brook trout population. Several holdover brook trout were seen during the stocking. Furthermore, trout fry that might have been brook trout were observed in the book. Electrofishing surveys will be conducted over the next several years to determine if the goals of the project, establishing a naturally reproducing brook trout population and total brown trout removal, were achieved..

Region 4

Beaver Kill Study

Completed the second year of a 5 year study of the Beaver Kill/Willowemoc system, with the goal of restoring its wild trout fisheries by improving management of the entire watershed. Partners include Trout Unlimited, Cornell University, and local communities, with partial funding by the US Fish & Wildlife Service. A second year of angler and stream surveys were completed during the summer of 2001 as were physical inventories of flows, temperatures, and water chemistry. The dry summer of 2001 data will provide and excellent contrast to the wet, cool summer of 2000.

Water temperatures were measured on an hourly basis using thermographs at 72 sites on the Beaver Kill and its tributaries. A comparison of maximum water temperatures observed on the mainstem of the Beaver Kill in 2000 and 2001 shows the difference (10° to 15°F) between a relatively wet summer with moderate temperatures (2000) and a dry summer with warmer temperatures (2001). In 2000, only the lowest several miles of the mainstem had temperatures average above 70°F for a week and nowhere did the temperature average exceed 75°F. In contrast, 2001 had one week where stream temperatures averaged 75°F or more up to river mile (RM) 15, and 70°F up to RM 23. Under these conditions, trout would tend to seek out thermal refuge areas, but the high temperatures demonstrate that tributary and spring fed thermal refuges do not contribute enough cold water in comparison to the stream volume to keep the stream temperatures down.

Temperature comparisons for Willowemoc Creek, the major tributary in the Beaver Kill system, demonstrate the same 10° to 15°F increase from 2000 to 2001 for the summer maximum temperature. In 2000, water temperatures did not exceed a 70°F average anywhere on the Willowemoc. In contrast, 2001 had one week where stream temperatures averaged almost 75°F or more from the mouth upstream to the confluence of the Little Beaverkill (RM 7.1), and exceeded a 70°F average up to RM 9.6.

In contrast to the previous year, water temperatures critical to trout survival were recorded in 2001, so a search for thermal refuges was initiated. TU and other volunteers along with DEC staff working on the Beaver Kill project were enlisted to take note of any concentrations of trout seen on the mainstem of the Beaver Kill or Willowemoc that appeared to identify a possible refuge site. Combining observations made by eight staff members and four volunteers, a total of 16 trout concentration sites were noted over the course of the summer. The most consistent thermal refuge, and the largest with trout numbers approaching 300 fish, appeared off the mouth of Horton Brook at RM 7.0 on the Beaver Kill.

Discharge was measured at 38 sites on the Beaver Kill and its tributaries during three different flow regimes over the course of the summer in 2001. Conditions for flow measurement included summer low stream levels and no recent rains in the watershed. While average stream flows at the USGS station at Cooks Falls for the month of August are 212 cfs, the median summer low flow is about 100 cfs (based on 86 years of record). The average weekly streamflow at the USGS Cooks Falls station for the period beginning at the end of April and continuing to early October illustrate the difference between the wet summer in 2000 and the dry summer in 2001. In 2000, flows were higher than the mean with an average reading for August of 271 cfs. In 2001, we measured flows at our sample sites when the USGS station was reading, on average: 231 cfs, 86.5 cfs and 47 cfs.

Water chemistry tests were conducted at most sample locations where temperatures were monitored, flow measurements were taken, or electrofishing samples were collected . Conductivity ranged from 20 to 60 µS in May, 25 to 150 µS in July, and 25 to 100 in early. pH ranged from 6.5 to 8.0 with an average reading of 7.25.

Trout population abundance and biomass estimates on four Beaver Kill tributaries (Horton Brook, Russell Brook, Spring Brook, and Shin Creek) were conducted for the second year at two locations per stream. Two other tributaries (Trout Brook and Horse Brook) were sampled for the first time. This effort will continue through 2004. Estimates of non-trout abundance and biomass will be determined annually. The 2001 results are pending.

The sampling of all tributaries flowing into the Beaver Kill was completed in 2001. General surveys were completed on 34 tributaries of the upper Beaver Kill. Trout were present in 26 streams and absent in eight streams. Brown trout were collected in 6 streams and brook trout in 26 streams. Brook trout were the dominant trout in 25 streams; brown trout in one. Overall trout biomass in trout-inhabited streams ranged from 2.4 to 169.8 pounds per acre.

Region 5

Batten Kill Electrofishing Survey Completed

A Batten Kill electrofishing survey was finally completed in August 2001. The electrofishing work was postponed in 2000, and on two occasions earlier during Summer 2001 due to high discharges unsafe for electrofishing. During the week of August 6, flows finally decreased to near-normal levels. In blazing heat (air temperatures approaching 95-100• the entire week) and high humidity, fisheries staff conducted electrofishing operations at 7 sites upstream of Route 22. Most of the sites sampled were the same locations sampled in 1999.

New, state-of-the-art stream electrofishing gear built by Principal Fish & Wildlife Technician Les Saltsman and DEC's Bureau of Electronics preformed flawlessly for the entire week.

Brown trout yearling abundance appears to have improved about 800 percent (based on population estimates at one station) since 1999, but is about two-thirds that observed in the mid-1970's. Few two-year-old-size brown trout were collected. Young-of-year brown trout abundance is still excellent. The largest trout collected during the survey was about 18 inches, but a number of large trout were observed in some deeper pools. Brook trout were present in greater numbers than observed in 1999 throughout much of the upper river, possibly the result of high and cool water during 2000 and most of 2001. Samples of all species collected at three sites were submitted to the USFWS pathologists based in Lamar, PA for disease analysis.

Batten Kill Creel Census

Region 5 fisheries staff planned and implemented an eight-month creel census on the Batten Kill to determine fishing pressure and angling quality in 2002. Three creel census agents began conducting angler counts, interviewing anglers to obtain catch information, and key punching data for analysis. In addition, aerial angler counts were initiated and will be conducted periodically throughout the summer. Overall first-year costs are estimated at $90,000.

Stream Trout Stocking Assessment Surveys Conducted

Staff electrofished a number of streams and rivers to assess current stocking policies using Catch Rate Oriented Trout Stocking (CROTS) guidelines. These were the Chubb River and N. Branch Boquet River in Essex County; Negro Brook, Two Bridge Brook and tributary 7 to Two Bridge Brook in Franklin County; Cayadutta Creek, E. Canada Creek and Middle Sprite Creek in Fulton County; the S. Branch W. Canada Creek, N. Branch W. Canada Creek and E. Canada Creek in Hamilton County; and Stony Creek in Warren County.

Schroon River (and tributaries) Landlocked Salmon Fry Stocking Evaluation

The Branch, a major tributary of the Schroon River (Town of North Hudson, Essex County), was sampled at three locations near its headwaters just below Elk Lake to evaluate landlocked salmon fry stocking efforts done for the last two years in that stream section. Despite abnormally low water levels and high water temperatures, good numbers of advanced fingerling and yearling landlocked salmon were caught at all three locations. Wild brook trout were also caught in moderate numbers. The Schroon River at DEC's Sharps Bridge campsite was also electrofished with equally good results in capturing 0+ and 1+ salmon. About 20,000 salmon fry have been stocked annually during this evaluation period. Good survival in the Schroon River suggests this number can be increased, but more work is needed to quantify the amount of suitable habitat available that can be stocked via backpack.

Region 7

Whirling Disease Sampling

Five streams were sampled for whirling disease: Bishop Brook and the West Branch of Onondaga Creek in Onondaga County; Oquaga Creek in Broome County; Cayuga Lake Inlet in Tompkins County, and the Chenango River in Madison County. None tested positive including Bishop Brook which tested positive previously.

Owasco Outlet Catch Rate Oriented Trout Stocking (CROTS) Survey:

An electrofishing survey of Owasco Outlet through the city of Auburn was carried out during July 2001. The primary purpose of this survey was to determine the suitability of this stream for trout stocking to create an urban fishery. Temperature monitoring 1999 -2001 revealed the potential for summer trout survival. Electrofishing was conducted at Canoga Street, Aurelius Street, Venice Street, Garden Street, Mill Street and just downstream from the State Dam. Length of stream electrofished at these locations varied from 207 feet at Aurelis Street to 1,159 feet at Mill Street. The total length of stream electrofished was 3,658 feet. Generally, the electrofishing catch at each location was considered light. A total of 239 fish (19 species) were collected, processed and released. About the same number of fish were observed but not collected. White sucker, longnose dace, cutlips minnow, smallmouth bass and rock bass were fairly common while rainbow trout and walleye were present but rare. Of the six locations surveyed, the area just downstream from the State Dam possessed the highest quality trout habitat. In light of this, a rainbow trout stocking recommendation for the one mile reach between the State Dam and the Mill Street Dam was submitted and will be initiated in spring 2002.

Butternut Creek Catch Rate Oriented Trout Stocking (CROTS) Survey:
Butternut creek, Onondaga County, was surveyed to revise the stocking policy. There was no policy change resulting from applying the CROTS formula.

West Branch Onondaga Creek Catch Rate Oriented Trout Stocking (CROTS) Survey:
West Branch Onondaga Creek, Onondaga County was also surveyed to revise the stocking policy. The policy was deleted since the upper portion of the stream had adequate wild trout abundance to meet New York trout stream management objectives and a beaver colony in the lower portion eliminated trout habitat.

Region 8

Mud Creek
In September 1996, 50 brown trout ranging in size from 75 - 280 mm were transferred from Cohocton River in Livingston County to Mud Creek in Ontario County. Mud Creek was identified during the 1980's as stream that currently did not support trout but had habitat characteristics that could potentially support trout populations. The trout were stocked along an approximately 1.7 mi stream reach. In July 2001, personnel collected fish samples from 4 areas within the original stocked reach using back pack mounted elctrofishing gear. The purpose of the sample was to determine if trout from the original stocking had survived and created self sustaining trout population had developed. A total of 13 brown trout were collected ranging in size from 61 - 384 mm. Age of fish ranged from YOY to Age 4+. Eight of the 13 fish collected were 1+. It appears that brown trout were successfully introduced into Mud Creek. Although relatively few trout were collected, several age classes were represented. No fish from the original stocking were collected.

Oatka Creek Electrofishing Survey
This is the fourth year of a wild brown trout population assessment to evaluate the effects of a No Kill trout fishing regulation. The September 2001 survey represents the first post-regulation change survey. On October 1, 2000 the trout fishing regulations in a special regulations area of the stream was changed from 12 inch minimum size, three trout per day creel limit to no kill. The season remains year round and only artificial lures can be used. Data analysis is still underway, but late season standing crop estimates are quite variable between the three years. Three years of post-regulation change assessments are scheduled.

Catharine Creek Electrofishing
Staff annually sample the adult rainbow trout run from Seneca Lake into Catharine Creek. A one day electrofishing effort captured 156 fish. Scale samples have not been aged so the data has not been analyzed. Sea lamprey wounding did not appear excessive and many large fish, to nearly 10 pounds, were handled. Age analysis of the large rainbow trout will prove very enlightening.

Region 9

Wiscoy Creek
An angler diary program and a late summer electrofishing survey were conducted on the 15 mile section of Wiscoy Creek that is in Wyoming County in 2001. Study objectives included determination of late summer wild brown trout biomass and trout population dynamics associated with a no-kill regulation as well as angler catch rates. The weighted average for late summer wild brown trout biomass was 155 lb/acre. However, biomass averaged over 300 lb/acre in the no-kill section. The density of 1+ and older trout averaged over 1700 fish/mile, but was about 3000 fish/mile in the no-kill

section. The no-kill regulation has increased the number of 1+ and older trout, but has had no effect on increasing the number of large (>16 in (406 mm)) trout. Angler catch rates were 1.2 trout/hour (±0.12 at 95% CI) during the diary program and were higher in the no-kill section by 50%. Even though Wiscoy Creek has a 10 inch (254 mm) minimum size limit (other than the no-kill section), there was a 96% release rate for legal size fish. Anglers caught trout in about the same size proportion as they appeared in the population based on the electrofishing survey.

Mansfield Creek

Water temperatures in Mansfield Creek, a stream supporting substantial populations of wild brown trout (*Salmo trutta*) and wild rainbow trout (*Oncorhynchus mykiss*), were monitored from late June to early September, 2001. We used automated thermometers set to record temperatures 24 hours per day at eight sites on Mansfield Creek itself and two sites on an important tributary, Goodell Creek. The western New York area experienced a severe drought and high air temperatures in the summer of 2001, giving us a chance to see how stream temperatures responded to such extreme weather conditions.

Ideal water temperature regimes for survival and growth of wild trout were found at three of the eight sites on Mansfield Creek and one of two sites on Goodell Creek. The headwater site on Mansfield Creek and two sites below where Mansfield Creek's water emerges from flowing underground for a substantial distance never experienced daily high water temperatures exceeding 70^0F. The upper site on Goodell Creek, where the stream is well shaded, never experienced daily high water temperatures exceeding 70^0F**.** The lower site on this stream, below an open pasture, exceeded 70^0F on 20 days. At the sites where water temperature regimes were higher than ideal for wild trout, a lack of vegetative cover to shade the stream was the major cause. Some of those sites did benefit from enough ground water recharge at night for their overnight low temperatures to drop to 60^0F or lower. There was a statistically significant relationship ($P< 0.05$) found between the number of days where the daily high water temperature exceeded 70^0F and the estimated wild brown and rainbow trout population at the site, based on 1999 electrofishing surveys.

Mansfield Creek has the potential to support a high quality wild trout fishery throughout the upper half of the stream if riparian vegetation cover can be established and maintained. The local chapter of Trout Unlimited and other private groups should be encouraged and supported to work with the agricultural community in the watershed to improve riparian conditions.

Catch Rate Oriented Trout Stocking (CROTS) Surveys:

In the summer of 2001, eight stocked trout streams were surveyed utilizing the CROTS methodology to update their stocking policies. Most of the Region's streams were originally surveyed under CROTS in 1990-1992, meaning that they have not been done in about a decade. We are attempting to resurvey 8-10 stocked streams each season to "catch up". The hope is to get all our stocked streams onto a minimum 10-year rotation of surveys.

The eight streams surveyed were: Chenunda Creek, Hunt Creek, Elton Creek, Forks Creek, Haskell Creek, Chautauqua Creek, Prendergast Creek and E. Branch Cazenovia Creek. Based on the 2001 survey, one stream was removed from the stocking list (Prendergast Creek) due to a high wild brown trout population and another stream (Elton Creek) had a significant section removed from stocking due to a high wild brown and rainbow trout population. Four of the stream's stocking policies remained the same, one increased (Forks Creek), and one (Chautauqua Creek) decreased due to access problems.

Central Office - Inland Section

Beaver Kill Watershed Trout Study

Inland staff continued coordination of Region 3, Region 4, Cornell and Trout Unlimited activities in a second year of determining the status of the Beaver Kill - Willowemoc Creek trout fishery and identifying trout resource limits and potentials. The Beaver Kill Study includes a complete angler use and creel survey, extensive fish population electrofishing surveys, water temperature and flow monitoring and a variety of habitat inventories and projects. Monthly coordination meetings were held with project leaders to plan field collections and review findings. Inland staff provided data entry and data management services for the study and collated a progress report covering year 2000 results.

Coordination with NYSDOT staff continued regarding potential problems and opportunities associated with the pending I-86 highway project. A presentation on the Beaver Kill Study and trout habitat requirements was made at a DOT training workshop in March.

Electrofishing surveys were completed on 57 tributary streams and 13 mainstem reaches. Wild trout populations (mostly brook trout) have been documented in 67 of the 87 Beaver Kill tributaries. Thirty six of the Willowemoc tributaries have been sampled to date with the remainder to be surveyed in 2002. Sampling in the mainstem Beaver Kill and Willowemoc yielded density estimates ranging from 7 to 267 trout per acre. Wild trout densities ranged from 4 to 126 per acre with highest values in the upper Willowemoc.

Water temperatures were again monitored on an hourly basis using recording thermographs at 72 locations. Water temperatures during 2001 were substantially higher than those observed in 2000. Temperatures averaged over 70• F for an entire week in the Beaver Kill all the way upstream to Berry Brook (river mile 23) and in the Willowemoc upstream to the mouth of the Little Beaver Kill. During the relatively cool and wet summer of 2000, weekly average water temperatures never exceeded 70• F except for the lower-most reach of the Beaver Kill. Stream flows in 2001 were below long term average low flows for much of July, August and September. At the lowest flows, Willowemoc Creek contributed 60% of the flow to the Beaver Kill below its confluence at Junction Pool.

Coldwater Fisheries Research Projects

The cooperative Coldwater Fisheries Research and Management project continued with Cornell University. Progress was made toward an initial evaluation of the Trout 4x4 population model and current stocking policies (CROTS). The Trout 4x4 model provides the theoretical basis for the recommended stocking rates listed in the CROTS manual. Activities included rewriting the spreadsheet-based version of the Trout 4x4 model using Visual Basic, with the result being much more user-friendly then the spreadsheet version, and more adaptable for specific purposes in the future. A pilot study in Lewis County that included a creel census, fish population data, and stocking rates was completed with the expectation that the data will be used as part of the Trout 4x4 model evaluation. Cornell has also begun to gather additional, existing fish population data from across the state for use in the model evaluation. As part of Lewis County work, improved statistical methods and computer software were developed for making fish population estimates. These programs have been provided to Bureau of Fisheries staff for evaluation. Finally, GIS-based models to predict stream flows and temperatures from landscape-level data were developed, and a number papers are being prepared for submission to scientific journals reporting on the results.

Two-Story Lakes and Ponds

Region 1

Deep Pond Survey

The Region 1 Fisheries Unit completed a two day gill netting survey of Deep Pond on the Schiff Scout Reservation in Wading River. The primary goal of the survey was to assess the status of the trout that have been stocked in the pond since 1999. Although the pond appears to provide suitable habitat to support trout, anglers have not reported catching any trout. In five net nights of gill netting, no trout were caught. The gill net catches included chain pickerel up to 4.5 pounds, yellow perch up to 2.0 pounds and golden shiner. The Regional Fisheries Unit will complete the survey of the pond in May with electrofishing and hoop nets and then, in consultation with the Boy Scouts, determine what future management priorities should be for the pond.

Region 3

Kensico Reservoir

Since 1987 the New York State Department of Environmental Conservation has been utilizing angler diary information to better understand Kensico Reservoir's trout fishery. Analysis of 2001 angler diary data revealed that the trout fishery has become increasingly dominated by lake trout with this species now contributing 98 % of the cooperating anglers catch vs. 2 % for brown trout. In 2001 natural reproduction appeared to be contributing approximately 45 % of the lake trout present in the reservoir. Although now abundant at sizes up to and slightly above the 21 inch minimum size limit, a relative lack of larger and older lake trout suggests that Kensico Reservoir may have become over stocked with lake trout. Given the increase in lake trout abundance, it is likely that many of the approximately 10,000 nine inch brown trout yearlings stocked annually are now being consumed by lake trout. In an effort to improve growth rates for lake trout and increase the number of larger lake trout (26 inches and larger), as well as improve the survival of brown trout, the annual stocking recommendation for lake trout was reduced from 7,200 yearlings to 3,600 effective in 2000. The diary program will continue to be used to monitor the fishery.

New York City Croton System Reservoirs

In 2001 fish were collected for toxic substance analysis from Boyd Corners, Croton Falls, Cross River, Kensico and New Croton Reservoirs. In 2002 additional fish have been collected at Amawalk, Diverting, Muscoot, Titicus, West Branch and Middle Branch Reservoirs. At each reservoir the goal has been to collect 10 edible/legal sized fish which people prefer to consume. Preferred species include smallmouth bass, walleye, brown trout, lake trout, yellow perch and largemouth bass. Since not all of these species can be collected in each reservoir other edible fish, such as carp, white perch and black crappie, have been collected in some cases. Based on analysis conducted on fish collected during 2001, the New York State Health Department issued a health advisory against eating more than one meal per month of largemouth bass larger than 16 inches and walleye (all sizes) from Boyd Corners Reservoir, and an advisory against eating more than one meal per month of largemouth bass and smallmouth bass larger than 16 inches from Cross River Reservoir. In both cases elevated mercury levels were cited as the reason for the advisories. Additional reservoirs scheduled for collections in 2002 include Bog Brook and East Branch.

Region 4

Otsego Lake Sampling

A multi-year angler cooperator program on the 4,200 acre Otsego Lake began in 2000. The purpose of this study was to monitor the quality of the cold water fishery for lake trout, brown trout, and landlocked Atlantic salmon. For 2000, 31 anglers volunteered to keep diaries with 14 actually returning diaries with fishing trip information. These 14 anglers made 263 fishing trips (includes partners) totaling 1293.6 hours. They caught 310 lake trout, 69 brown trout, and 51 landlocked salmon for an overall salmonid catch rate of 0.33 fish/hour. The lake trout catch rate averaged 0.24 fish/hour and 0.11 legal (• 21 in) fish/h. The catch rate for brown trout and landlocked salmon were 0.05 and 0.04 fish/h, respectively. By statewide standards, the open water fishery for lake trout, brown trout, and landlocked salmon are average.

2001 returns by 21 anglers making 484 trips totaling 2,163.9 hours indicate that fishing success was similar. Ice fishing catch rates were very similar to boat fishing, being 0.20 vs 0.27 fish per hour respectively. Boat anglers in 2001 averaged 0.27 all size and 0.16 legal lake trout per hour compared to 0.24 all size and 0.11 legal lake trout per hour in 2000. Mean length of lake trout caught by boat anglers in 2001 were greater than 2000. The higher catch rate and larger average size for lake trout by boat anglers in 2001 suggests that the previous winter's ice fishery had no appreciable effect on the lake trout population. Results for brown trout were similar. To further protect the largest lake trout, effective October 1, 2002 there will be a creel limit of one (1) Lake Trout 27 inches and larger per day.

In response to the numerous concerns about the impact of the 2000/01 ice fishing harvest of lake trout on Otsego Lake, the lake was netted in mid-September 2001. The net catch of 13.5 lake trout per net was the highest ever recorded and is apparently due to strong 1998 and 1999 year classes of wild and hatchery fish. Twenty two legal sized lake trout were caught in 2001 compared to 17 in 2000.

Greens Lake Surveyed

A survey of Greens Lake (Greene County) was also conducted. Greens Lake is a 43 acre two-story water which is currently stocked with brown and rainbow trout yearlings. For the last several years, kokanee fingerlings have been experimentally stocked. Sampling was conducted in late summer using both boat electrofishing at night and gill nets. The catch rate by boat electrofishing for legal size largemouth bass was 9 fish per hour. One legal pickerel per hour was also sampled. From the gill net sets, alewives were captured for the first time in the lake. One net set on the 20 ft bottom contour caught 7 brown and one rainbow trout. No kokanee of any size were taken, either by electrofishing or gill nets. In combination with the lack of anglers reporting catches of kokanee and the lack of kokanee in our sample, the presence of alewives necessitates a change in the fisheries management plan for the lake. Kokanee were not stocked in 2002 and will not be stocked in the future. Other changes for the lake's management plan are being considered.

NYC Reservoirs

The summer and fall drought throughout the Catskills in combination with large water releases has resulted in significant drawdowns of two of the three NYC reservoirs within the Region. As of mid-November, Cannonsville and Schoharie Reservoir were approximately 8% and 10% of capacity, respectively. While water levels have recovered some in early 2002, the impact on reservoir fish populations remain unknown. Full impacts will have to be evaluated through further sampling later in 2002. The failure of Cannonsville Reservoir to spill or significantly refill by June 1, 2002 may have severe repercussions on the high quality West Branch Delaware River tailwater trout fisheries. Inadequate summer cold water releases may adversely impact wild brown trout populations and could result in fish kills. Low summer flow conditions will negatively impact the fishing tourism industry. Hopefully, this is a scenario that will not occur.

Flooding in the upper Schoharie Creek basin in January 1996 due to the quick thaw of a deep snow pack along with heavy rains, exposed clay lenses and destabilized clay banks along the Batavia Kill, Little West Kill, and the West Kill. These streams continue to be a major source of turbidity to Schoharie Reservoir, Schoharie Creek, and the Mohawk River during high runoff events. Longstanding turbidity problems resulted in a lawsuit by Trout Unlimited alleging unlawful discharges of turbid water from the Schoharie Reservoir into Esopus Creek by the NYC DEP. These claims, initially rejected by the courts, have been upheld in subsequent appeals procedures. The most recent appeal is scheduled to be adjudicated in January 2003. This suit has the potential to significantly change water management on the Schoharie and Esopus systems.

The Schoharie Conservation Council, TU, and other advocacy groups are pressing for releases from Schoharie Reservoir for cold water fishing below the dam. Several Legislators are following these developments closely. With the exception of approximately 1.9 miles between the reservoir and the Blenheim/Gilboa impoundment, cold water releases would not be expected to survive downstream of Blenheim/Gilboa. However, additional releases could benefit a variety of warm water species throughout the lower Schoharie valley. The Department supports this proposal as long as it does not negatively impact the Delaware tailwater fisheries downstream of Cannonsville and Pepacton reservoirs.

Region 5

Lake Champlain Sea Lamprey Control Public Meetings Held

Two public meetings were held to gather input regarding the recently-released Draft Supplemental Environmental Impact Statement (DSEIS) proposing a long-term sea lamprey control program for Lake Champlain. Sixty registered attendees voiced their support for the program and one dissenting opinion was voiced at the first meeting held March 28 at the Willsboro, NY Central School. The second was held at the South Burlington, VT High School, where 80 registered attendees voice mixed opinions. The majority were in favor of the proposed program.

Environmental Impact Statement on Sea Lamprey Control is Available

The document: “A Long-term Program of Sea Lamprey Control in Lake Champlain, Final Supplemental Environmental Impact Statement” was completed and became available to the public. Sea lamprey control is proposed for certain tributaries to Lake Champlain in New York, Vermont, and the Province of Quebec. A variety of control techniques would be employed depending on site specific considerations in each lamprey spawning stream. Substantial biological, recreational and economic benefits are anticipated if the program is undertaken. The several hundred page long impact statement can be obtained from the DEC office in Ray Brook; an electronic version is available at the web site: www.fws.gov/r5lcfwro/lamprey/dseis.html.

The US Fish and Wildlife Service Issues Record of Decision to Begin Long-term Sea Lamprey Control in Lake Chaplain

The US Fish and Wildlife Service issued its record of decision concerning the Final Supplemental Environmental Impact Statement: “A long-term Program of Sea Lamprey Control in Lake Champlain.” The record of decision selected the proposed action (i.e. to conduct an integrated, long-term sea lamprey control program on Lake Champlain). The environmental impact statement (EIS) and the control program represent a major cooperative effort between the US Fish and Wildlife Service, the Vermont Department of Fish and Wildlife, and the New York State Department of Environmental Conservation. The record of decision is the final approval step in the EIS process, but permits from the states of New York and Vermont will be needed for various aspects of the program. Lewis Creek in Vermont and several rivers in New York are expected to be treated during fall 2002.

Lake Champlain Sea Lamprey Control is Challenged

The Vermont Public Interest Research Group, National Audubon Society, and Sylvia Knight filed a lawsuit to stop sea lamprey control in Lake Champlain. The suit alleges that the Final Supplemental Environmental Impact Statement (FSEIS) on sea lamprey control failed to consider several important potential impacts. After reviewing the plaintiffs’ claims, staff involved in developing the FSEIS consider allegations to be invalid. The lawsuit specifies the US Fish and Wildlife Service (USFWS) as the defendant. However, because sea lamprey control is a cooperative program, the NYS Department of Environmental Conservation and the Vermont Department of Fish and Wildlife have petitioned the court successfully to become interveners supporting the USFWS in the case. NYSDEC staff have been involved in legal defense of the program.

Great Sacandaga Lake Surveyed

Great Sacandaga Lake was netted to assess the relative success of the surplus trout and landlocked salmon stockings by DEC, as well as the annual trout stockings conducted by the Great Sacandaga Lake Fisheries Federation. A total of 37 net-nights yielded 40 smallmouth bass, 35 walleye, 2 rainbow trout and 1 brown trout. Numerous other fish species, including rock bass, yellow perch, carp and suckers, were also captured. It appeared the captured trout were from spring 2001 stockings, although scale aging may indicate the fish were holdovers from previous stockings. There is a high quality smallmouth bass fishery in the lake, as many of the captured smallmouth bass were in good condition with lengths up to 18".

Lake George Landlocked Salmon Growth Remains Excellent

Landlocked salmon scales collected from Lake George last fall were aged and the mean length of each age class summarized. The aging reveals that mean length of two-year-olds increased from 16.9" in 1995 to 19.7" in 2000. Mean length of two-year-olds was 19.6" in 2001. Mean length of three-year-olds increased from 19.7" in 1993 to 22.4" in 2001. Steps to improve salmon survival by stocking larger salmon in June and October are underway by the Department.

Tupper Lake Surveyed
Region 5 staff sampled Tupper Lake (R-P109), Franklin County several times in 2001 to assess the landlocked salmon and lake trout stocking policies and to collect fish for DEC and EPA Toxic Substance Monitoring Programs (TSMP).

Initial survey efforts began on April 23, 2001 (ice out on Tupper Lake) and ended on April 27th. Two trapnets were set in Raquette Pond and one was set in Simon Pond to collect pre-spawn northern pike and brown bullhead for toxic substance analysis. On April 27th, a crew boat-electrofished the Raquette River to collect walleyes for TSMP. All fish caught were measured; gamefish species were also weighed and scale-sampled to assess growth rates. All fish except those kept for TSMP were released alive and in good condition. Sampling results were:

Species	No. Caught	Size Range (in.)
Brown Bullhead	176	6.8 - 13.3
Northern Pike	66	15.5 - 39.0
Walleye	27	16.4 - 26.4
Yellow Perch	11	4.8 - 6.8
Pumpkinseed	9	5.0 - 8.5
Rock Bass	5	6.6 - 8.6
Largemouth Bass	2	14.6 - 17.8
Golden Shiner	1	7.1

Tupper Lake, was gill-netted at 14 locations between August 22 - 24th to assess coldwater stocking policies for landlocked Atlantic salmon and lake trout and to capture additional fish for toxic substance monitoring. Juvenile lake trout gill-net gangs (1.5-2.0-2.5 inch meshes, 300 foot total gang length) and gangs of variable mesh Swedish experimental nets were set along deepwater contours for lake trout, or suspended in the thermocline for salmon. Fish caught were:

Species	No. Caught	Size Range (in.)
Lake trout	28	7.5 - 23.9
Cisco	17	8.5 - 15.5
Walleye	5	13.8 - 25.5
Yellow perch	57	5.3 - 9.6
Rainbow smelt	21	3.2 - 8.0
Smallmouth bass	6	13.0 - 17.6
White sucker	2	17.8 - 18.5

Currently, Tupper Lake is stocked annually with 5,700 yearling landlocked salmon and 10,000 yearling lake trout (these fish range from 5-8 inches at stocking).

Eleven of the 28 lake trout caught were unclipped and presumably a result of natural reproductive success.

Landlocked salmon do not appear to be surviving in Tupper Lake, although there is an abundant population of rainbow smelt available as forage.

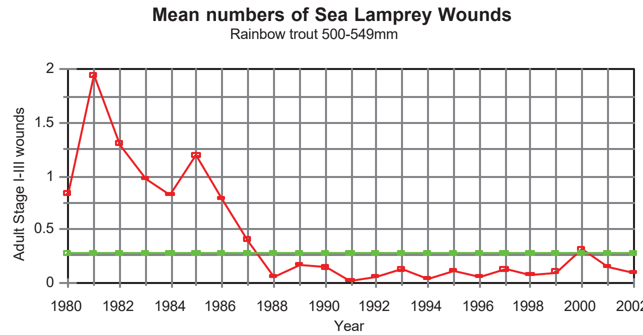
A surprising result of this survey was the number and quality size of cisco captured. Past surveys of Tupper Lake have caught lake whitefish and relatively few cisco. No lake whitefish were netted in 2000, but cisco are an untapped fishery resource in Tupper Lake.

The number of walleye and smallmouth bass caught is not representative of populations available of these species because few gangs were set in suitable, shallow water habitats.

Meacham Lake Surveyed
Meacham Lake, in the Town of Duane, Franklin County, was gill-netted on two nights in late June and early July to assess stocking policies for landlocked Atlantic salmon and two-year-old brown trout. Fish were also collected for toxic substance (TSMP) analysis since there is a health advisory on eating yellow perch from Meacham Lake due to elevated mercury levels. Gill-nets were suspended in the thermocline to focus on catching salmonids. No landlocked salmon were caught; however, 30 splake and 3 brown trout were netted along with rainbow smelt, yellow perch, golden shiner, brown bullhead, white sucker, northern pike and smallmouth bass. The lack of salmon in the Meacham Lake sample is perplexing, the Region has received several anecdotal reports of good salmon fishing during the spring smelt run in Meacham Lake.

Rollins Pond Surveyed
Rollins Pond, in the Town of Santa Clara , Franklin County, was sampled with suspended gill-nets to assess a landlocked Atlantic salmon policy. Rollins Pond is bordered by a popular DEC campground. A single four-pound salmon was captured along with numerous rainbow smelt (the preferred forage species for salmon). A few smallmouth bass were also netted, and anglers fishing the pond reported

catching large northern pike. Survey staff noted that the shoreline stocking point for salmon is along a large, shallow bay. It is likely that recently-stocked salmon are prone to predation from bass and pike here. A switch to air stocking salmon in deeper water should improve survival. Growth of salmon in Rollins Pond appears to be excellent.



Region 7

Owasco Lake Walleye Cooperator Program

In a cooperative effort with DEC, the Owasco Lake Anglers Association (OLAA) has stocked Owasco Lake with pond reared walleye fingerlings since 1996. In 2001 the association produced 33,000 walleye from ponds stocked with fry obtained from the Oneida Fish Hatchery. Most of these fish were from 2 to 3 inches in length when stocked. The OLAA stocked walleye fingerlings in September 2001 that were 3.5 to 7.5 inches in length. Walleye were boat stocked as well as shore stocked at several locations around the lake. Region 7 fisheries staff participated in the walleye harvest and stocking.

Owasco Lake was electrofished at night during fall 2001 to evaluate walleye stocking success. A total of 12 walleye were collected in 4.2 hours of electrofishing, which yielded a catch rate of 2.8 walleye/hour. The 1996, 1997, 1998, 1999 and 2000 fall electrofishing catch rates were 3.6, 2.0, 5.1, 3.8 and 4.2 walleye/hour, respectively. As in each year since 1997, a combination of established sampling sites and new sites were electrofished. Of the 12 walleye collected, 10 were young-of-year (fingerlings) with a length range of 5.8 to 9.0 inches. The other two walleye collected were 20.1 and 19.0 inches in length and scale aged as 5 and 3 years old, respectively.

The Owasco Lake Anglers Association has stocked an average of 34,455 pond fingerling walleye in Owasco Lake each year since 1996. Electrofishing and angler cooperator data indicates a significant walleye population and fishery have been created by these stockings.

Dutch Hollow Brook, entering Owasco Lake at Burtis Point, receives a large spawning run of walleye. Regulations prohibiting fishing and smelt dipping in this stream from the mouth to Route 38A to protect spawning walleye will go into effect October 1, 2004.

Otisco Lake Walleye Evaluation

The lake was surveyed in mid-October, 2001 to determine if we could find any walleye younger than age 3. No hatchery walleye had been stocked in the previous 3 years, thus any fish younger than that age would have been wild fish and would have indicated successful natural reproduction. We were unable to capture any fish in these age classes in this survey as well as in surveys in the previous two years.

There are two possible reasons why walleye are apparently not able to reproduce successfully in Otisco Lake. The first is that alewives are very abundant in the lake and will readily consume young walleye fry. The second is that alewives contain an enzyme in their body that breaks down thiamine. If adult walleye eat enough alewives in their diet the result is a shortage of this vitamin. If the shortage is acute enough, walleye eggs will not produce fry that survive.

The catch rate for adult walleye declined again in the fall of 2001. In 1997 the electrofishing catch rate was 56 fish per hour, whereas in the fall of 2001 it was only 2.8 fish per hour. Anglers enjoyed good fishing for walleye from 1998-2000. The catch of walleye was particularly high in 2000. The combined catch of adult fish during these three years undoubtedly caused a substantial reduction in the catchable population. We believe that stocking is required to maintain a fishery and have submitted a recommendation for pond fingerling stocking.

Cayuga Inlet Fishway Monitoring

Operation of the Cayuga Lake Inlet fishway continued. A total of 340 rainbows and 10,232 white suckers were passed upstream while 121 adult sea lampreys were killed to prevent spawning.
Rainbows were also sent to the Bath hatchery for the production of Finger Lakes Wild (126,000 eggs) and hybrid (30,000 eggs). After spawning the adults

were returned to the Inlet. All rainbows were examined for sea lamprey attacks. The mean number of adult stage I-III wounds on trout in the 500-549 mm length group is 0.09, well below the threshold for treatment (0.27). Sea lamprey control on Cayuga Lake Inlet, the primary spawning and nursery habitat for lampreys, is done primarily by removing adult lampreys from the fishway, preventing access to spawning habitat. In addition, unit staff assisted USGS staff with a research project where rainbow trout migration distances were attempted to be correlated with thiamine levels. Rainbows were collected at the fishway, tagged and some injected with thiamine and released. Collections were made by anglers and electrofishing at various upstream locations.

Region 8

Aquatic Nuisances Species / Finger Lakes Zebra Mussel Monitoring and Ecological Assessment Program (FLZMAP)

The FLZMAP program completed its seventh year of data collection in 2001. This data set may be the longest continuous running data set on the western Finger Lakes. Data indicate that the western Finger Lakes represent all trophic states includingoligotrophic (Canadice, Canandaigua, Seneca), meso-oligotrophic (Hemlock, Keuka), mesotrophic (Conesus), eutrophic (Honeoye).

With the exception of Canandaigua and Conesus Lakes, the 2001 chlorophyll a and Secchi transparencies continued to show an increase in water quality. Canandaigua Lake showed a 22 percent decrease in transparency in 2001 over the 1995-2000 average (6.4m vs 7.8m) and corresponding 67 percent increase in chlorophyll a (2.19 mg/L vs 1.31mg/L). It is thought that this decrease in water quality could be related to a massive zebra mussel die off. Fisheries staff will work with area colleges and Universities during the summer of 2002 to study the situation. Conesus Lake had a slight decrease in transparency in 2001 compared to the 1995-2000 average (2.6m vs 3.0m) and a corresponding slight increase in chlorophyll a. (7.91mg/L vs 7.03mg/L).

Great Lakes

Lake Ontario and tributaries

Region 6

Cormorant Management
The goals of cormorant management in eastern Lake Ontario are:1) restoring the structure and function of the warmwater fish community2) reducing the negative impacts of Double- crested Cormorants on nesting habitats and other colonial waterbird species. 3) improving the quality of smallmouth bass and other fisheries and 4) fostering a greater appreciation for Great Lakes colonial waterbird resources. Management of cormorant colonies in NY has involved egg oiling, nest removal, harassment of migrant cormorants and habitat modification. There has been no lethal control of adults or chicks. Results of egg oiling at Little Galloo Island include: 1) reduced cormorant reproductive success by 95+ % at L. Galloo I. 2) reduced overall fish consumption by 4.8 million fish by LGI colony (19%) and 3) reduced consumption of smallmouth bass by 400,000 fish by LGI colony. Recent declines in the number of nesting cormorant pairs are consistent with oiling effect models.

Thousand Islands
The warmwater fish stock assessment program on the Thousand Islands section of the St. Lawrence River provides standardized indices of abundance for major gamefish and panfish stocks, information on year class strength, and age and growth relationships of these stocks. Information obtained is used to evaluate and, if necessary, modify existing fishing regulations. It also provides baseline information for evaluation of environmental disturbances. Results of 1999 sampling with the greatest management significance include : 1) Northern pike abundance continues to decline, recruitment remains relatively poor (this is probably a habitat effect) and 2) smallmouth bass abundance is still depressed (this is a recruitment issue that may be a result of cold spring water temperatures and cormorant predation).

Eastern Lake Ontario Tributaries
The steelhead fishery in eastern Lake Ontario tributaries is believed to have been in decline for several years. The objectives of this Federal Aid creel survey are to provide estimates of fishing effort, catch & harvest rates and angler residence for the lake-run salmonid fishery in major Jefferson County Lake Ontario tributaries. A pilot study was conducted in spring 1999. Sampling of a full steelhead spawning run fishery began in September - December 1999 and recommenced in March and September 2000.

Steelhead spawning runs begin in late fall and continue into mid spring. Preliminary results (1999-2001): Black River: annual effort 18,228-22,355 angler-hours; annual catch 1042-1282 chinook, 381-979 steelhead. N & S Sandy Creeks: annual effort 30,026-57,071 angler hours; annual catch 1815-5884 chinook, 738-1680 steelhead. Steelhead catch rates in the fall and spring 1999-2001 were well below historical levels on North and South Sandy Creeks and on the Black River. Total fall salmonid fishing effort and total salmonid catch were also low. The majority of anglers on the Black River were local (from Jefferson County). The majority of anglers on North Sandy and South Sandy Creeks were non NYS residents . Anglers from Lewis, St. Lawrence, Oswego and Onondaga counties represented the largest groups of non-local NYS resident anglers. Anglers from Pennsylvania and New Jersey comprised the largest groups of non-resident anglers.

Eastern Basin Chinook Study
The major objectives of this study are to examine the homing, straying and return-to-the-creel of morpholine exposed versus non-exposed chinook and non- exposed cage reared versus direct released (normally stocked) fish. Secondarily we monitor some characteristics of walleye and smallmouth bass populations in the Snowshoe Bay/Association Cut area and the steelhead run in the Black River at Dexter. Generally, indications are that chinooks exposed to morpholine in cages and those that were caged only, return to the creel better than the average chinook stocked in Lake Ontario. Both treatments stray to the Black River at similar rates. This suggests that survival is above average for both caged treatments. Fish released directly into Snowshoe Bay returned to the creel at near average or less than average rates. Although "soft release" effects may contribute to this improved survival, the major advantage of caging may be to release larger fish without sacrificing imprinting on the receiving

water. The greater return of morpholine exposed fish to the Snowshoe Bay area is consistent with the hypothesis that morpholine exposure improved the homing performance of these fish. Data on returns of chinooks exposed to morpholine in hatchery tanks is not yet conclusive but suggests that tank exposure has a lesser effect. In 2000 and 2001 there were poor returns of both experimental and control fish, which may indicate that under current water clarity and cormorant predation levels, Snowshoe Bay is no longer a favorable location for chinook stocking.

Atlantic Salmon in the Black River
Atlantic salmon management in the Black River began in 1990 with a pilot stocking of 7,500 spring yearling Atlantic salmon. These fish were of the Little Clear strain, raised at N.Y.S.D.E.C's Adirondack Hatchery. From 1991 through 1995 some 300,000 yearling (63,000 annually), and 95,000 fingerling (19,000 annually) have been stocked in the Black River by N.Y.S.D.E.C. The U.S. Fish and Wildlife service provided 23,000 experimental Grand Lake strain Atlantic salmon in 1994.

Atlantic salmon harvest in the Black River was not detectable by a direct contact creel survey through 1993. In 1994 an estimated 100 Atlantic's were harvested and in 1995 there was an estimated harvest of 200. In 1996 and 1997 Atlantic salmon harvest remained at the trace level. Fishing effort directed specifically at Atlantic salmon was too low to quantify from 1990 through 1997. By comparison, the chinook salmon fishery, which had not been actively managed in the Black River since the late 1980's, supported a fishery of 4,000 to 11,000 angler-days and harvests of up to 7,000 fish annually.

The potential for Little Clear strain Atlantic salmon to provide a fishery in the Black River is apparently quite limited, although occasional reports of good fishing for Atlantics are received and interest in the fishery persists. The potential for even limited management effort to enhance fishing opportunity appears to be much more promising. As a result, Atlantic salmon management in the Black River has been de-emphasized in order to allow increased management of chinook salmon. From 1996 to the present stocking of Atlantic salmon has been maintained at 25,000 yearlings and 25,000 fingerlings annually.

Chaumont Bay/Black River Bay fish survey and summary of historic records:
Based on samples at 93 shallow-water sites in Chaumont-Black River Bay in 2000-01, changes in the fish community were minor. Even though other deeper water studies have shown differences in the balance among the species, 67 of the 76 species known to this area in the last 30 years are still here. Also in the last 30 years, there have been added another 30 species not previously caught here. Only six species have shown historic losses or reductions, including Atlantic salmon, blue pike and muskellunge. Sportfish catch rates with gill nets and electrofishing were highest for yellow perch, brown bullhead and pumpkinseed.

Region 7

North Sandy Pond Walleye Assessment
A fall electro-fishing survey of North Sandy Pond, an embayment of Lake Ontario in Oswego County, revealed successful natural reproduction of walleye in 2001. The pond was stocked with pond fingerlings from 1996-2000. Catch rate for YOY walleye was 1.98/hour which was higher than the catch rate in a 1997 survey (1.15/hour) when stocking was occurring.

Oswego Net Pen Project
Tag returns from the Oswego net pen steelhead study continue to come in. Paired plantings of pen reared and traditionally stocked fish were done 1998-2000. All of the fish were adipose clipped and lots were uniquely identified with coded wire tags. To date, returns overwhelmingly favor the pen reared fish from all return locations. Overall, 61 of 73 tags in hand are from pen reared fish: 23 of 30 returns from the Oswego River were pen fish, 35 of 39 returns to Salmon River Hatchery were pen fish, and 3 of 4 returns from Lake Ontario were pen fish.

Salmon River Steelhead Stocking Site Study
Another steelhead study in progress is the Salmon River stocking study. Fish were stocked at 4 sites, the smolt release pond at Salmon River Fish Hatchery (SRH) -Beaverdam Brook, the pumphouse at SRH (main stem of the river), the estuary and boat stocked off the mouth of the river 1999-2001. These fish are all finclipped LV or LVAD and the different lots are identified by post-ocular injections of flourescent elastomer. Initial returns of age 3 fish to SRH in the spring of 2000 heavily favored fish

stocked in the smolt release pond. This raised questions about homing bias since the smolt release pond is at the head of the fish ladder in the hatchery. Spring 2001 returns which were from age 3 and age 4 fish, however, were very different favoring fish stocked at the down-river sites (estuary and boat). While returns from the first two years of monitoring offer different and confusing results, we have several more years of returns to monitor. We also learned that we can smolt steelhead in the hatchery, stock them in down river sites, and get good numbers to return to the hatchery. This also suggests that the homing bias suspected in the 2000 returns is not a problem.

Pacific Salmon Biological Monitoring
Fall monitoring of Pacific salmon growth at Salmon River Hatchery revealed reduced growth of chinook and coho salmon in 2001. Weights at age were, however, within the range of those encountered in previous years. While the adult (age 2 and older) alewife population was in the best shape it has been in since the early 1990s, there was a very low abundance of yearling alewives in Lake Ontario in 2001 and that may have been a factor which contributed to the reduced growth seen in the salmon. Future prospects for chinook salmon are positive. Jack (age 1 male) chinooks returning to the hatchery are a good indicator of year class strength. The 2000 year class returned 2,393 jacks to the hatchery in 2001. The only cohorts to have more jacks return to the hatchery were the 1999 (3,196 returns) and the 1996 (2,806 returns).

A creel survey was conducted on the Salmon River for steelhead fishermen during the fall of 2001. This was the 5th year for the survey which has occurred annually since 1997. Anglers fished an estimated 12,500 angler days from the middle of October through the last weekend in November. This was the highest level of effort recorded since the survey began. The catch rate was 0.041 steelhead/angler hour which was intermediate among years sampled. The catch was estimated at 3,660 steelhead and the estimated harvest for the time period sampled was 746. As in previous years, nonresidents comprise about 2/3 of the angler effort.

Oswego Walleye Diary Cooperator Program
A small angler diary program for walleye in the Oswego area of Lake Ontario was conducted for a 4th year in 2001. As in previous years, the average size of walleye caught was very large (27.8"). The catch rate was 0.22 walleye/angler hour. Age frequencies of the catches in 2000 and 2001 revealed that these large fish were coming from several year classes with good numbers of fish as old as age 17 represented in the catch. In 2001, we even had one fish that was 23 years old that was hatched in 1978. The age structures of the catches suggest that, despite the fact that these are very large fish, angler exploitation on the population is light. Because of the lack of small fish in the catch, the real question is where these fish are coming from. One potential source of fish is the Bay of Quinte on the Ontario side of Lake Ontario. Recruitment of fish from there has declined dramatically in the recent years because of colonization of the Bay by zebra mussels and reduction in phosphorus inputs which led to increased water clarity and poor walleye recruitment. The Oswego River system including Oneida Lake is another potential source of fish. In any event, we plan to continue monitoring this fishery and the age structure of the catch.

Region 8

Pen Rearing
The chinook pen rearing partnership between the NYSDEC and various Charter Boat Associations completed its fourth successful year during 2001. Region 8 continued to work with volunteers at four sites. Regional sites included Sodus Bay - 50,000 chinook; Genesee River - 50,000 chinook; Sandy Creek - 25,000 chinook and 5,000 steelhead; and Oak Orchard Creek - 75,000 chinook and 10,000 steelhead. As part of the overall study, fish were clipped and stocked in alternating years between Oak Orchard Creek (1999 and 2001) and the Lower Niagara River (2000 and 2002). A multi-year creel survey was started in 2001 on both Oak Orchard Creek and the Lower Niagara River. The first year of data yielded inconclusive results. Chinook salmon raised at the Salmon River Hatchery and stocked directly into the Lower Niagara River in 2000 returned as age 1 (males) in significantly higher numbers versus Salmon River Hatchery chinook that were pen-reared at the Lower Niagara River or chinook that were raised at the Caledonia Hatchery and stocked directly into the Lower Niagara River. However, returns from Oak Orchard Creek yielded much different results. Chinook salmon raised at the Salmon River Hatchery and stocked directly into Oak Orchard Creek in 1999 returned as age 2 (males and females) in

significantly lower numbers versus Salmon River Hatchery chinook that were pen-reared at Oak Orchard Creek or chinook that were raised at the Caledonia Hatchery and stocked directly into Oak Orchard Creek. There was no significant difference in the number of chinook that strayed from their stocked streams. The creel survey will continued in 2002. Detailed reports on the on pen-rearing aspect and creel survey can be found in the NYSDEC's Bureau of Fisheries Lake Ontario Unit and St. Lawrence River Unit to the Great Lakes Fishery Commission's Lake Ontario Committee - 2001 Annual Report.

Status of Smallmouth Bass in the Central Basin of Lake Ontario

Working in conjunction with the Lake Ontario Fisheries Unit, Region 8 staff performed a gill netting operation in the Central Basin of Lake Ontario, off Pultneyville, just west of Sodus Bay from August 13 to August 15, 2001. Like 2000, the purpose of the netting was two fold: to compare the relative density of smallmouth bass in the Central Basin versus the eastern basin; and, to collect a sample of bass for analysis of various toxins to formulate a baseline before the round goby arrives in the area. It is theorized that the presence of the round goby will provide a more direct pathway for toxins to enter smallmouth bass.

The three most frequently caught species remained the same in 2001 versus 2000 at both sites, with two of the species appearing at both sites (Central Basin - smallmouth bass, rock bass and yellow perch) (Eastern Basin - smallmouth, yellow perch and walleye). Catch-per-unit-effort (CPUE), denoted as fish per lift, from the central basin was dramatically larger for smallmouth (86.3 vs 3.0), yellow perch (23.2 vs 6.4) and rock bass (19.2 vs 1.5). Central Basin smallmouth bass CPUE increased from 2000 to 2001 (78.9 to 86.3 bass per lift). A detailed report can be found in the NYSDEC's Bureau of Fisheries Lake Ontario Unit and St. Lawrence River Unit to the Great Lakes Fishery Commission's Lake Ontario Committee - 2001 Annual Report.

Region 9

Trout and Salmon Pen-Rearing Project

The third year of the Niagara River Anglers Association (NRAA) cooperative pen-rearing project took place in 2001. NRAA volunteer workers took delivery of 75,000 pre-smolt chinook salmon and 10,000 pre-smolt steelhead in late April. They successfully reared and released the fish in late May into the lower Niagara River. The purpose of the pen-rearing project is to improve imprinting and survival of anadromous chinook salmon and steelhead to enhance the sportfishery in the lower Niagara River. A more detailed description of the NRAA lower Niagara River pen project, as well as five other pen projects along the New York portion of the Lake Ontario shoreline, is contained in Wilkinson, Pearsall and Bishop 2002.

2001 Evaluation of Pen-Reared Chinook Salmon in the Lower Niagara River

2001 was the first year for evaluating results of the chinook salmon pen-rearing project on the lower Niagara River. (Fin-clipped chinooks stocked in 2000 were expected to return as jacks (precocious males) in fall 2001.) As part of the evaluation effort, creel survey workers collected over 1100 chinook salmon from the fish cleaning station at Lewiston and shore fishing facilities along the lower Niagara River during September and October. Results indicated that jack (age 1) salmon returns to the lower Niagara River were best for Salmon River Hatchery-direct stocked fish, intermediate for Salmon River Hatchery-pen-reared fish and poorest for Caledonia Hatchery-direct stocked chinooks. Direct-stocked Salmon River Hatchery chinooks were observed at approximately twice the frequency of pen-reared Salmon River Hatchery chinooks, and results were statistically significant (p• 0.01). Interestingly, none of the marked salmon from the lower Niagara River were observed at the Salmon River Hatchery during fall 2001 egg collections, suggesting that straying to Salmon River was very limited. In summary, first year results from the pen project are not yet definitive, and it is still early in the evaluation process. More detail regarding the evaluation portion of the pen project can be found in Bishop, Pearsall and Wilkinson, 2002.

Lake Ontario Unit

Lake Ontario Fishing Boat Census

The Lake Ontario fishing boat census provides trend through time data on angling effort and success, and performance of stocked salmonids. While the census targets the open water salmonid fishery, valuable data on other fish species are also collected. The 2001 angling season marked the seventeenth consecutive year (1985-2001) that the census was conducted. Methodology has changed little over the history the census, with sampling covering boat access channels along 190 miles of New York's Lake Ontario shoreline for the period April 1 to September 30 each year.

Fishing effort has remained relatively constant over the past five years (estimated at 100,038 fishing boat trips in 2001), but is approximately ½ of that observed at its peak in 1990. Anglers targeting trout and salmon accounted for 63,710 fishing boat trips, or 63.7% of the April-September 2001 total. This estimate represents the second lowest trout and salmon effort observed in the history of the census. Anglers targeting smallmouth bass from opening day (June 16) through the end of September accounted for a record-high 31,035 fishing boat trips, or 31% of the April-September 2001 total.

Changes in fishing effort were in part responsible for changes in numbers of fish harvested. Total trout and salmon harvested in April-September 2001 was estimated at 83,241 fish, a 7.3% increase over the record low harvest observed in 2000. Brown trout was the most commonly harvested salmonid in 2001 (25,475 fish), comprising 30.6% of the total, with chinook salmon a close second (25,097), comprising 30.1% of the total. In contrast to trout and salmon, effort targeted at smallmouth bass has generally increased over the years censused, along with harvest. Smallmouth bass harvest in June-September 2001 was estimated at 62,735 fish, a 16.3% decrease compared to 2000. Catch rate among anglers seeking smallmouth bass in 2001 during the open season was 12.3 bass per boat trip, the third highest catch rate among years censused.

Trout and salmon fishing quality, as measured by harvest rates, increased 9.4% from 2000 to 1.3 fish per boat trip, the fourth lowest April-September harvest rate since 1985. Comparisons by species show that April-September 2001 harvest rates were above their respective 1996-2000 April-September averages for brown trout (+3.5%) and coho salmon (+3.1%), and below their respective 1996-2000 April-September averages for coho salmon (-1.5%), chinook salmon (-6.3%), lake trout (-4.1%), rainbow trout (-32.9%) and Atlantic salmon (-23.7%).

Eastern Lake Ontario Warm Water Fisheries Assessment

Assessment of trends in the warm water fish community of the New York waters of Lake Ontario's eastern outlet basin has been conducted annually since 1976 using a standardized gill net sampling program. During this period, the warm water fish community has undergone significant changes, declining from a high of approximately 200-250 fish per net gang in 1976-79, to a record low 15.73 fish per net gang in 2001. The majority of the fish species that were abundant at the start of the assessment program have all experienced significant declines in abundance.

Yellow perch, rock bass, white perch, gizzard shad, and alewife, were all important members of the warm water community in 1976-79, and have all shown a pattern of declining abundance over the 25-year sampling period. Yellow perch and rock bass continue to be important components of the warm water catch (typically the second and third most abundant species), while white perch, gizzard shad, and alewife catches have dropped to very low levels. Catches of northern pike have also shown a significant decline over the sampling period, but were never a major component of the warm water catch in the eastern basin. Other species such as white sucker, channel catfish, brown bullhead, pumpkinseed, freshwater drum, common carp, and silver redhorse, have remained relatively common in the catches, and although average abundance has declined slightly in recent years, long-term trends are not readily apparent. Walleye is the only relatively common species that has shown a long-term increase in abundance, but average catches have also declined for this species since 1993.

Smallmouth bass have always been an important component of the Lake Ontario warm water community , and through 1985 were typically third in abundance behind white perch and yellow perch. By 1988, smallmouth bass emerged as the most commonly captured species in the assessment netting, a position they have since maintained with the exception of 1996, 2000, and 2001 when more yellow perch were collected. Smallmouth bass have shown a cyclic pattern of abundance with two obvious high and low periods. Unfortunately, the last seven years (1995-2001) have been one of the two documented low periods. Smallmouth bass catch decreased in 2001 to a record low 2.99 fish per net gang. A three year moving average catch per net gang, a method often used to help dampen fluctuations due to yearly sample variations, illustrates the current low period to be lower than that experienced in the mid 80's. There is a growing body of data that implicate predation on smallmouth bass by double-crested cormorants as the primary cause for the decline in smallmouth bass abundance in the Eastern Basin of Lake Ontario.

Impacts of Double-crested Cormorant Predation on Smallmouth Bass and Yellow Perch

Diet studies of double-crested cormorants (DCC) from Little Galloo Island in the Eastern Basin of Lake Ontario have been conducted each year since 1992. In 1999 these studies were expanded to include two DCC colonies in the Canadian waters of the Eastern Basin, Pigeon and Snake Islands. In 2001, smallmouth bass and yellow perch predation by DCC's from the three colonies combined totaled 1.07 million and 8.65 million fish, respectively.

Data on smallmouth bass fishing in Lake Ontario collected from the 1985-2001 fishing boat censuses were analyzed in more detail as part of the evaluation of the impacts of DCC predation. From 1985-90, harvest rates were nearly equal to or greater than the lake-wide average harvest rates and averaged 1.16 smallmouth bass harvested/angler hour. From 1991-2001, harvest rates at Henderson Harbor, adjacent to the Little Gallo Island cormorant colony, were all below the lake-wide average. The Henderson Harbor site continues to be the only localized bass fishery that has experienced a decline in harvest rate.

To further assess geographic differences in Lake Ontario smallmouth bass abundance, the Eastern Basin index gill netting program was expanded in 2000 and 2001 to include sites at Pultneyville. These data were compared to those collected at both sites using the same sampling protocol from 1976 to 1979. The study was prompted by claims that the decline in Eastern Basin smallmouth bass abundance is largely attributable to reduced nutrients, colonization by Dreissenid mussels, and angler exploitation. While smallmouth bass habitat is considered less desirable at Pultneyville relative to the Eastern Basin, all of the aforementioned Eastern Basin conditions exist there, however, Pultneyville lacks a concentration of double-crested cormorants. The study demonstrated conclusively that while smallmouth bass and yellow perch were substantially more abundant in the Eastern Basin when compared to Pultneyville during the period 1976-1979, the opposite was true during 2000-2001. Smallmouth bass and yellow perch abundance at Pultneyville increased between the two time periods 438% and 478%, respectively. The same comparison in the Eastern Basin revealed an 86% reduction in both smallmouth bass and yellow perch abundance.

Lake Ontario Forage Fish Abundance

The U.S. Geological Survey and the NYSDEC have cooperatively assessed Lake Ontario prey fishes each year since 1978 through bottom trawling during spring, summer, and fall along twelve transects distributed across the New York shoreline of the lake. In 2001, adult (age-2 and older) alewife abundance increased to its highest level since 1993 due to recruitment of the relatively strong 1998 and 1999 year classes. Catches of age-1 alewife in 2001 suggest that the 2000 year class is one of the smallest observed, and therefore adult abundance is not expected to increase in 2001. Numbers of age-1 and older rainbow smelt were greater than in 2000, however, biomass was barely above the record low observed in 2000. No deepwater sculpins were caught in 2001.

Lake Ontario Lake Trout Restoration

<u>Lake Ontario Juvenile Lake Trout Assessment</u>

Catches of age-2 and age-3 hatchery origin lake trout during trawl and gill net surveys in New York waters declined to an all time low during the period from 1996 to 1998 (1993 to 1996 year classes). Catch of age-2 lake trout rebounded to 1992 levels in 1999, but fell again to a record-low level in 2000 (1998 year-class). Catches of age-2 lake trout in 2001 (1999 year class) rebounded to just below the level observed in 1997. Trends in numbers of age-2 lake trout caught in trawls and age-3 fish caught in gill nets for the 1975 to 1995 year classes suggested that recruitment of hatchery fish to the population was governed by survival during their first year after stocking. Subsequent to the 1995 year class, this relationship has deteriorated, suggesting increased mortality of stocked lake trout during their second year in the Lake.

<u>Lake Ontario Adult Lake Trout Abundance</u>

A total of 767 lake trout were captured in the September gill net survey in 2001. Catch rates for mature lake trout remained remarkably stable from 1986 to 1998. The catch per unit of effort (CPUE) of mature fish, however, declined by 30% between 1998 and 1999. Poor survival of hatchery fish was likely responsible for declining abundance of immature lake trout since 1989 and current declines in adult numbers. The CPUE's for mature lake trout in 2000 and 2001 were similar to 1999, at 31% and 38%, respectively, below the 1986-98 average.

Lake Ontario Sea Lamprey Wounding Rate Index
Overall wounding rates remain much lower than pre-1985 levels, but have been above the planned target level of 2 wounds per 100 fish for four of the last five years. The length of A1 marked fish in 2001 ranged from 605 to 847 mm (mean = 737 mm, n = 17). Numbers of lampreys observed attached to fish caught by boat anglers participating in the boat census also increased markedly in 2001.

Survival of Adult Lake Trout in Lake Ontario
Survival of Seneca strain lake trout has been about 30% to 50 % greater than that of Superior strain for the 1984-1991 year-classes. Lower survival of Superior vs. Seneca strain lake trout was likely due to higher susceptibility to and mortality from sea lampreys. Survival of Lewis Lake strain lake trout in Lake Ontario, calculated for the first time in 2000, was poor (44%) and similar to survival of Superior strain cohorts from stockings in the late 1970's. Assuming constant recruitment, average age of mature females is an auxiliary measure of lake trout survival; as survival improves, a greater number of older females accumulate in the population. Average age of mature female lake trout has been increasing steadily since the mid 1980's. The average age of 9.55 years in 2001 reflects a population comprised of the oldest group of mature females since the rehabilitation program was initiated.

Natural Reproduction of Lake Trout in Lake Ontario
In 2001, a total of 30 naturally produced lake trout (28 to 420 mm total length) were caught with bottom trawls. Survival of naturally produced lake trout to the fingerling stage in summer and fall occurred each year during 1993–2001. Further, survival to older ages has also been apparent. Based on length-frequency, lake trout from all year-classes since 1993 have been observed in catches through 1998. In 1999 and 2000, lake trout from 3 cohorts (age-0 to age-2) were represented in the catch. In 2001, lake trout from four cohorts were collected. This modest level of reproductive success, nine successive year classes produced from the first eight year classes surviving to age-1, is an important early sign of successful natural reproduction and meets the plan objective to demonstrate the feasibility of lake trout rehabilitation in Lake Ontario.

Annual Angler Harvest of Lake Ontario Lake Trout
The estimated annual harvest of lake trout from U.S. waters of Lake Ontario since the slot limit (635 - 762 mm) was re-instated in 1992 has been more than four times lower than previous years when no size limits were in effect. Harvest reached its lowest level in 2000 with an estimated 7,319 lake trout creeled, and increased to 9,866 fish in 2001. Lake trout harvest rate in 2000 (0.113 lake trout per boat trip) was also the lowest recorded, and increased slightly in 2001 (0.155 lake trout per boat trip). The percentage of trophy-size (> 762mm or >30 in) lake trout harvested by anglers, remained near 25% from 1997-2000, and increased to 44% in 2001.

Lake Ontario Commercial Fishery
Commercial fishing activity in the New York waters of Lake Ontario is limited to the embayments and nearshore open waters of the eastern end of the lake. Commercial fishing gear includes gill nets, trap nets, and fyke nets. Commercial harvest is generally targeted at the following species (in decreasing order of abundance): yellow perch (*Perca flavescens*), brown bullhead (*Ameiurus nebulosus*), sunfish (*Lepomis* sp.), white perch (*Morone americana*), rock bass (*Ambloplites rupestris*), and black crappie (*Pomoxis nigromaculatus*). In 2001, six active fishers reported 46,671 pounds of fish caught with an estimated total value of $80,203. The commercial catch was dominated by yellow perch (40,323 pounds, $70,565).

Lake Erie and Tributaries

Lake Erie Unit

Juvenile Warmwater Fish Assessment
This current trawling program is conducted during October at randomly selected stations between the 15- and 30-m depth contours in New York's portion of Lake Erie. Standard tow duration is 10 minutes.

In 2001, abundance measures for 8 of the 12 commonly encountered species increased from the previous 9-year mean catch rate. The most abundant species encountered in this program was YOY rainbow smelt, but several species made large contributions to the 2001 trawl collections, including trout-perch, emerald shiners and round goby. In 2001,YOY white bass catches were an order of magnitude higher than any previous observation. The previous high value for white bass abundance was observed only two years previously, and three of the four highest indices in the white bass time series have been observed in the last three years.

The 2001 mean density estimates for YOY, yearling and adult yellow perch were all above the previous overall 9-year mean density values for these life stages of yellow perch. The YOY index for yellow perch was especially high, ranking close to the other highest values observed in the time series. The mean length of age-0 yellow perch in 2001 was very near the long-term value in the data series. However, age-1 yellow perch in 2001 were 18 mm (0.7 in) longer than average for the last 9 years.

Warmwater Fish Stock Assessment

This annual, autumn gill netting survey has been ongoing since 1981. Four to six 213 m graded mesh nets are set each day, with 40 sites sampled in 2001.

The overall abundance index for walleye in 2001 was below the long-term average abundance since 1981. The age composition of this walleye sample was comprised principally of younger (< age-3) cohorts. This gill net assessment has had a juvenile walleye emphasis since its inception, with age-1 and age-2 walleyes comprising a large fraction of the total walleye sample each year. Yearling walleye catch rates ranked the 2000 year class very weak, relative to the entire time series. Age-2 walleye mean length in 2001 was tied for the largest value observed over the entire 21-year time series at 441 mm (17.4 in). This 2001 walleye sample only comprised 10 age-2 individuals, nevertheless, it continued a trend of increased age-2 length-at-age observed since 1999.

Smallmouth bass catch rates in 2001 remained near the highest levels observed for this 21-year time series. Two age groups (age 2 and age 3) made particularly large contributions to this 2001 sample. Conversely, only two age groups between age 0 and age 19 were not represented in the 2001 sample. Although sub-adult (age-2 and age-3) smallmouth bass age groups dominated the 2001 sample, older, adult cohorts also remained well represented in collections during recent years. The long-term recruitment indices for juvenile, age-2 and age-3, smallmouth bass rank the 1998 year class as large and the 1999 year class as perhaps the largest yet observed in our 21-year time series. These age-2 and age-3 cohorts averaged 272 mm and 344 mm total length, respectively, in this fall 2001 gill net collection. Both age groups were longer than average for the time series. The age-3 bass in 2001 were the longest ever observed in the entire 21-year time series, exceeding previous highs established in 2000 and 1999, respectively. Mean length-at-age of age-3 smallmouth bass has had an increasing trend since 1997.

In the 15- to 30-m stratum, yellow perch maintained markedly higher abundance levels first observed in 2000. This deeper 15- to 30-m stratum has only been sampled since the interagency index fishing protocol was fully implemented in New York, beginning in 1993. Yellow perch are not effectively sampled at the shallower (0 to15 m), long-term gill net sites. Age-3 and age-5 yellow perch were the most abundant age group in the 2001 collections. These age groups, representing the 1998 and 1996 year classes, together comprised 72 percent of the yellow perch sampled in this gill net assessment. Only since 2000 have adult cohorts of yellow perch contributed measurably to this annual sample.

Of the remaining commonly encountered species in this 2001 gill net sample, only channel catfish were caught in higher abundance than the long-term mean catch rate. White sucker catch rates have undergone a gradual, long-term decline and remained near a low ebb in 2001. Three other infrequently encountered benthic fish species in previous years, quillback carp sucker, stonecat, and common carp, were not encountered in 2001. White perch and white bass catch rates declined sharply between the 1980's and 1990's. Freshwater drum were a species of particular concern in 2001 due to observations of extensive fish kills during late summer. This September gill net assessment largely occurred after the observed drum die-offs. The 2001 abundance index for drum was below the long-term (1981-2000) average measured in the shallow stratum (< 15m), but remained slightly above the long-term (1993-2000) average catch rate for the deeper (15-30 m) stratum. Drum catch rates were found to be characteristically higher in the deeper survey stratum every year that both shallow and deep sampling areas have been monitored since 1993.

Walleye Tagging Study

During the 12 years New York has participated in this interagency tagging study, 14,912 walleyes have been tagged in the New York portion of Lake Erie.

During April 2001, 989 walleyes were collected in New York waters and affixed with jaw tags as a continuation of this effort to examine walleye distribution and exploitation rates. Two tagging sites sampled in 2001 were Van Buren Bay and the Lackawanna shoreline. Walleyes tagged for this study were collected by trap nets and boat shocker.

Since the inception of this tagging study, 1,273 tag recoveries originating from the New York tagging effort have been reported by anglers and the Ontario commercial fishery. Seventy-six (76) of these recaptures occurred during 2001.

Over the duration of this 12-year assessment, first-year tag recovery rates ranged between 1.1 and 4.5 percent. We have expanded these observed recovery rates to exploitation rates using a multiplier of 2.46 for non-reporting of recovered tags. The mean exploitation rate for tagged walleye from 1992 to 2001 was estimated as 6.25 percent.

Although these estimates derived from tagging data are bound by broad confidence limits, they remain consistent with other data that are characteristic of a walleye population with low adult mortality.

Lake Trout Assessment

This standard August gill net assessment has been employed to assess lake trout populations for the New York waters of Lake Erie since 1985. Approximately 60 sets of 152 m graded mesh nets are set annually in coldwater habitat.

Total unbiased gill net assessment (all gear types) of the lake trout population residing in New York’s portion of Lake Erie in 2001 sampled 249 individuals, an increase of 115 fish (86%) over the 2000 survey. Longevity continues to increase with 17 year classes, from age 1 to age 17, represented in the sample of 215 known-aged fish. Young fish (ages 2, 3, and 4) were the most abundant cohorts, representing 43% of the total catch. Older fish (age 10+) were also well represented (33%) in the population. Of note was the high ratio of males to females (9:5) found in the older (age 10+) cohorts. Maturity rates were consistent with recent years, where males are 100% mature by age 4 and females by age 5. Mean lengths-at-age and mean weights-at-age of sampled lake trout did not deviate from long-term averages. Long-term averages from three time periods (1986-1990, 1991-1995, 1996-2000) indicate that lake trout growth has been consistent to slightly increasing since sampling began in 1985, with the majority of growth in length in Lake Erie lake trout occurring by age 10, and fish reaching around 800 mm total length and weighing 6,000 g. The largest lake trout sampled measured 953 mm and weighed 10.36 kg (37.5 inches, 22.6 lbs). This was the largest specimen yet recorded from the Lake Erie lake trout gill net survey. Fifty-seven mature females were sampled in New York waters of Lake Erie in 2001. Fifty of these fish contained either fin clips or coded-wire tags and could be assigned ages. These fish ranged from age 4 to 17 and generated a mean age of mature females captured in our sampling of 9.3 years. This marks the fourth consecutive year that mature female lake trout in Lake Erie have met or exceeded the target mean age, established in the Strategic Plan, of at least 7.5 years.

The relative index of abundance for age-5-and-older lake trout rebounded slightly in 2001, but was still low compared to indices of the early and mid-1990's. The 2001 index of 1.18 fish/lift was the second lowest index recorded (lowest in 2000) since the rapid build-up of the adult population due to improved survival, following initial sea lamprey treatments in 1986-1987. The age 1-3 relative abundance index continued to increase in 2001 to the highest level since 1992.

Annual survival was estimated at 0.83 (Z = -0.19) for fish age 3-17, based upon standard assessment catches corrected for stocking. Catch curve estimates of annual survival have met or exceeded the Strategic Plan’s target of >59% since 1993.

One advantage of implanting coded-wire tags (CWT’s) in lake trout before stocking is being able to determine the age and stocking strain when the fish are recaptured. Of the 215 lake trout aged in 2001, six strains were found to comprise the Lake Erie stocks. Finger Lakes (FL) and Superior (SUP) strains were the most prevalent, but are also the most stocked strains. Substantial contributions were also made by Lewis Lake (LL) and Lake Ontario (LO) strains.

More interesting is the contribution of strain by age. Finger Lakes strain lake trout have been stocked in Lake Erie since 1985. With the exception of ages 1, 2, and 15, and ages when not stocked (1993 (age 9) and 1999 (age 3)), lake trout from every year this strain was stocked were present in 2001 catches. The majority of lake trout older than age 11 and all 14, 16, and 17-year-old fish were Finger Lakes strain as well. Superior strain, conversely, have been stocked from 1980-1991 and 1997-2001, but 72 of the 73 returns were from recently stocked fish (ages 1-4). The one older return was from the 1987 (age 15) stocking. The Lewis Lake strain, which is the last of the strains that are currently stocked, has had good returns from fish stocked from 1992-1994 and 1996-2000. No fish, however, were present from the 1987-1988 stockings. Of the remaining strains no longer stocked, good returns are still occurring from both the Lake Ontario strain stocked from 1989-1993 and the Lake Erie strain (1993-1996). A few fish from a Finger Lakes/Superior cross have also survived well.

Analysis of the stomach contents of lake trout and burbot revealed a diet of about 90% fish in both species. Whitefish diets consisted entirely of invertebrates, with quagga and zebra mussels (62%), chironomids (15.2%), and cladocerans (20.3%) making up the bulk of the diet. Of the fish species consumed by lake trout and burbot, 99% and 70% , respectively, were smelt. Round gobies were a significant portion of the diet for burbot (22%), but were absent in lake trout stomachs.

Sea Lamprey Assessment
Observed fresh wounding (A1-A3) on lake trout greater than 532 mm total length was 20.3 wounds per 100 fish in 2001, the second highest rate since 1987. This exceeded the target rate of 5 wounds per 100 fish for the sixth consecutive year. Most (78.6%) of the fresh lake trout wounds (A1-A3) occurred in fish greater than 734 mm. Some fresh wounds did appear in the 533-633 mm and 634-734 mm categories, however. No wounds were found on lake trout from 432-532 mm in length.

Fresh wounds (A1) are considered indicators of the attack rate for the current year at time of sampling (August). The 2001 observed rate of 0.029 wounds per lake trout greater than 532 mm total length was virtually identical to the 2000 rates and still higher than rates for the period 1988-1996. All fresh A1 wounds occurred in lake trout greater than 734 mm.

A4 wounds, which indicate the past year's cumulative attacks, were higher than 2000 rates, but were still lower than the rates observed in 1997-1999. The observed 2001 attack rate was 18.8 wounds per 100 fish for lake trout greater than 532 mm. No A4 wounds were found on lake trout less than 634 mm.

The overall index for sea lamprey nesting in 2001 was 6.0 nests/km, which was down approximately 50% from 1999 and 2000 survey results. The majority of the nests were found in the main branch of Clear Creek, which had a nesting rate of 8.8/km. These results continue the trend in Clear Creek of declining nests since 1997. Only a few nests were found in Canadaway Creek and Delaware Creek. Surprisingly, no lamprey nests were found in North Branch Clear Creek, which had a nesting rate of 16.3 nests/km last year and 53.8 and 47.5 nests/km in 1997 and 1998, respectively. Nest counts in the Lake Erie tributaries are expected to decline after lampricide treatments in both 1999 and 2001 in the Cattaraugus Creek watershed.

Wild Steelhead Assessment
Electrofishing has been used to sample wild steelhead in Cattaraugus Creek tributaries since 1995. In 2001, Chautauqua Creek and Little Chautauqua Creek were also sampled.

1) Spooner Creek (E.23-30)
Ten sampling stations, ranging from 100 to 134m in length, were sampled between September 10 and October 10, 2001, on Spooner Creek. Total area sampled encompassed 0.42 hectares of surface water and over 20% of the stream length (1,182 m). Total available trout habitat from Route 39 upstream to Trevitt Road (5.77 km) was approximately 1.85 hectare of surface area.

Altogether, 3,597 rainbow trout were sampled on Spooner Creek in 2001. The majority (3,117) of the fish were young-of-year (YOY), ranging from 40 to 85mm in length and averaging 62mm. A substantial number of age-1-and-older fish were also sampled, with the largest being 265mm (10.3").

The 2001 YOY density estimate of 8,019 wild fish per hectare and the population estimate of 14,853 (2 sd = $\pm$ 261) were the highest estimates of fish recorded since sampling on this tributary began in 1995. Population estimates of 2,052 fish and densities of 1,108 fish/ha were obtained for age-1-and-older trout.

Mean total length of wild YOY steelhead collected in Spooner creek in 2001 were significantly

(P<0.05) smaller than all previous samples, with the exception of 1995. One of the more interesting aspects of the survey was the difference between the upper half of the stream, which flows through the woods and contains 50-75% tree canopy, and the lower portion, which is non-forested and has virtually no overhead canopy. Water temperatures in the upper portion ranged from 10° to 15° C during the summer, while lower portion water temperatures ranged between 17° and 25° C. Trout densities were corresponding, with upper sampling station populations of 14,645 trout/ha, over 3 times higher than lower sampling stations (4,621 trout/ha).

2) Chautauqua Creek (E.68)
Low numbers of YOY steelhead were found during scouting of Chautauqua Creek on October 4, 2001. The section sampled was just upstream of the village of Westfield. Overall, recruitment potential and spawning habitat was gauged to be low. However, the fact that any fish survived following the drought conditions present during the summer months was promising.

3) Little Chautauqua Creek (E.68-1)
Little Chautauqua Creek was spot-sampled on October 4, 2001 from the mouth up to a natural rock barrier approximately 0.75 km upstream. Recruitment potential was judged to be high, with hundreds of YOY and age 1+ trout found. The habitat was considered excellent with a variety of riffles, pools, logs, gravel, and a full tree canopy. Unfortunately, the natural barrier prevents further passage upstream and limits the potential for significant natural reproduction.

Sport Fishery Assessment
Since 1988, a direct contact sport fishing survey has been conducted to monitor the open water fishery. This standard, annual program extends from May through October along the entire New York portion of Lake Erie.

Overall 2001 open water sport fishing effort in New York waters of Lake Erie was estimated as 438,653 angler-hours. Overall fishing effort estimates during the last 3 years (1999 to 2001) remain very similar and rank as the three lowest annual totals of the 14-year time series. During the 2001 fishing season, walleye angling was the largest component of the boat fishery. Bass angling ranked second in boat fishing effort on New York's portion of Lake Erie. Among the remaining effort, targeted yellow perch effort experienced a sharp increase in 2001.

During 2001, the springtime boat fishing effort (1st Saturday in May to 3rd Saturday in June) was comprised mostly of bass anglers. The recent springtime expansion of bass angling effort now seems to have stabilized between 40,000 and 60,000 angler hours.

The total estimated daytime walleye harvest was 14,669 fish, ranking 2001 as producing the second lowest walleye harvest in the 14-year survey. Walleye fishing effort totals during each of the last 3 years have remained low, relative to the entire 14-year time series. The 2001 walleye effort total of 163,144 angler-hours was the lowest annual estimate observed in the entire time series. In addition, walleye total catch and harvest estimates have remained very similar in 2001, suggesting nearly all the walleyes boated in the sport fishery were creeled. The 2001 walleye sport fishery was centered in offshore waters between Silver Creek and Sturgeon Point, New York; areas west of Dunkirk produced a markedly lower harvest of walleyes. The overall targeted walleye catch rate during the 2001 fishing season was 0.09 per hour, which ranks this walleye fishing season with markedly lower catch rates, relative to most other years in the survey. The average total length of harvested walleyes in 2001 was 612 mm (24.1 inches).

Smallmouth bass harvest was estimated as 9,832 fish, which ranks 2001 with the lowest bass harvest for the entire 14-year survey. The overall 2001 bass fishing effort also declined to the lowest total observed during the period that expanded spring bass fishing opportunities have existed, beginning in 1994. The 2001 smallmouth bass harvest also remained very small, relative to the bass catch by boat anglers. Smallmouth bass remained the most frequently caught species (136,695 fish) by boat anglers by a very wide margin. The 2001 overall catch rate by bass anglers was 0.87 bass per hour, and mean length of harvested smallmouth bass was 404 mm (15.9 inches) in 2001.

Yellow perch emerged as the most harvested species (31,877 fish) in the 2001 sport fishery, and fishing effort extended by yellow perch anglers was the highest observed in the last 9 years. The 2001 yellow perch sport harvest was centered in two relatively localized nearshore areas, one in the vicinity of Dunkirk, and the other area near Silver Creek, New York.. Most other areas produced a markedly lower harvest of yellow perch. The 2001 overall yellow perch catch rate increased to 1.75 perch per hour and was similar to the highest values in the time series observed during the late-1980's. The mean length of harvested yellow perch was 251 mm (9.9 inches) in 2001.

Forage Fish Assessment

A new initiative that began in 1999 as an element of forage assessment, and has since continued as an ongoing program, is an interagency lower food web monitoring program coordinated through the Lake Erie Committee's Forage Task Group. Initial sampling was accomplished, in conjunction with a Cornell-led research project. However, subsequent annual monitoring has become the ongoing responsibility of the Lake Erie Unit, and an annual lakewide summary of this effort appears in the Forage Task Group's annual report to the Lake Erie Committee.

Beginning in 1993, a mid-summer fisheries acoustic survey was implemented to provide a more comprehensive evaluation of the distribution and abundance of rainbow smelt. This initiative was implemented under the auspices of the Lake Erie Committee's Forage Task Group and was led by the New York State Department of Environmental Conservation, with collaboration by the other Lake Erie Committee member agencies and Cornell University's Warmwater Fisheries Unit. This survey has been an ongoing, annual summertime initiative that represents one of eastern Lake Erie's best examples of interagency cooperation in fisheries assessment. Ontario and New York research vessels partner in data collection, and biologists from Ontario, New York and Pennsylvania collaborate in analysis and reporting of data. The 2001 survey found a pattern of pelagic fish abundance similar to previous efforts. This pattern finds pelagic fish densities concentrated near the thermocline, particularly in locations where the thermocline was in close proximity to the bottom. The lowest pelagic fish densities most often occurred centrally over the deepest portion of the eastern basin in surveys. Furthermore, a characteristic alternate year-high and low abundance pattern since 1995 is also apparent in yearling-and-older (YAO) rainbow smelt abundance through our time series. The 2001 collections represented the high phase of the alternate year abundance cycle.

Creel and Angler Surveys

Region 1

Angler Diary Program
Region One continued to coordinate angler diary programs for both warmwater and coldwater gamefish in 2001. Diaries were mailed in March and April; return envelopes were mailed in November.

In 2001, One hundred forty-two anglers volunteered to keep warmwater diaries and ninety-eight anglers volunteered to keep coldwater diaries. Of warmwater diary cooperators, 46% returned diaries at the conclusion of the regular season. Forty four percent of the coldwater diary cooperators returned diaries. Coldwater diary cooperators logged 1,226 hours of fishing on 29 waters. A total of 1,973 fish were caught. Warmwater diary cooperators logged 2,973 hours of fishing on 41 waters. A total of 2,360 fish were caught.

One angler diary report was completed in FY 2001-02. The report, summarizing coldwater diary data submitted between 1998 and 2000, was mailed out to all coldwater diary cooperators. Those cooperators who contributed data to the report received their original diaries enclosed with the report. The 2000 Warmwater Diary Report was begun in FY 2001-02 but remains incomplete at this time. Data from the 2001 diary season has been entered and preliminary analysis completed. Also, several improvements were made to the angler diary cooperator database in FY 2001-02 which should result in more time efficient data handling this year.

Region 2

Prospect Park Lake, Brooklyn
The angler survey was conducted between May 5 and November 4, 2001. The survey was conducted every weekend day as well as three assorted weekdays. Two shifts were established and randomly selected to allow for good coverage of morning and evening anglers (7 a.m.-4 p.m. & 11 a.m.-8 p.m.). During each shift three count runs were made. First, the survey clerk circumnavigated the lake first to get a count of the number of anglers. Second the survey clerk interviewed individual anglers about their knowledge of the regulations and the status of their catch. Julie McPherson and Cheang Taing, our creel clerks, combined to complete 1,357 survey interviews. Besides the catch data we also assessed anglers understanding of the park's special concerns. The following five questions where asked because they are important to the management of the lake:
1) Are you aware that the Parks Department has a No-Kill policy (catch and release fishing only)? 66% answered yes.
2) Are you aware that the Park stocked pickerel in the lake last fall? 47 % answered yes.
3) Are you aware that lead weights are not allowed to be used while fishing in City Parks? 46 % answered yes.
4) Are you aware that the State requires anglers 16 years of age and older to have a fishing license to fish any freshwater body in NY, including Prospect Park Lake? 54% answered yes.
5) Did you know that improperly disposed of fishing line often kills birds? 61% answered yes.

Overall effort during the study was estimated to be 16,963 hours. Peak catch rates were during the months of May and August, with an overall catch rate of 0.26 largemouth bass per hour**.** Preseason bass fishing was very prevalent.

Region 7

Cayuga Lake Angler Diary Program
Sixty - eight angler diary cooperators logged 1,615 trips on Cayuga Lake in 2001 fishing for trout and salmon. They averaged two legal fish per trip and their catch rate was one legal trout or salmon every 2.7 hours which was the best since 1988. Lake trout were the most abundant fish in the catch with 2120 legal size lakers being caught. Brown trout were the next most abundant fish in the catch. A total of 696 legal browns were caught which was much higher than normal. This high catch rate was due in part to the fact that the Cayuga Lake Charter Captains Association stocked 7500 browns in the lake in the spring of 2000. These fish were approximately 12 inches long when stocked, were two years old, and survived well in the lake. Because of the expense we do not normally stock fish this large. Normally the browns we stock average nine inches long. Fishing for landlocked Atlantic salmon was also good. A

total of 276 legal size landlocks were caught. These fish must be at least 18 inches long to be legal on Cayuga whereas they need only be 15 inches in all other finger lakes. However, Cayuga Lake still provides the best fishing for landlocks in New York State. The catch of rainbow trout was somewhat disappointing in 2001. The oil spill in the fall of 1997 basically destroyed that year class. These fish would have been five years old in 2001. At that age the wild rainbows of Cayuga contribute heavily to the fishery. On the up side this year class will have passed through the fishery in another one to two years and the fishery should rebound to normal.

Otisco Lake Angler Diary Program

Ten angler diary cooperators logged 94 trips on Otisco Lake in 2001. The catch rate for walleyes was 0.06 legal fish per hour in 2001 compared with 0.25 in 2000. A catch rate of 0.25 is considered excellent and was the best we had experienced on Otisco Lake since stocking began in 1988, first by Onondaga County and followed by DEC. Mean size of walleyes has been declining over the past several years. The population consisted of more old fish in past years. These fish built up in the population because during those years alewives were so abundant that all walleyes were very well fed and difficult to catch. As the population of walleye built up in the mid to late 1990's, we believe the alewife population declined making the walleyes easier to catch. When this occurred, the larger fish were caught off. With an 18" size limit, many of the male fish, which grow slower had to be returned, while the faster growing females were kept. It is also normal for a fish population to be made up of younger individuals as fishing intensity on that population increases.

Owasco Lake Angler Diary Program

Thirty- four cooperators logged 449 trips and caught 887 legal salmonids in 449 trips for an average of 2.0 fish per trip. Legal salmonids were caught at an average rate of one fish every 1.9 hours. Our coldwater lake cooperators were successful in catching at least one legal salmonid in 82 percent of their trips. This was the best percent success since 1966. Coldwater cooperators caught 722 legal lake trout, 65 legal rainbow trout, 96 legal brown trout and four legal landlocked salmon. Catch rates for these species were 1.6, 0.14, 0.21 and .009 legal fish per trip while harvest rates were 0.54, 0.08, 0.13 and 0.007 legal fish per trip, respectively. Lake trout comprised 81 percent of the legal salmonid catch while rainbows, browns and landlocked salmon were seven, 11, and one percent, respectively.

The twelve warmwater cooperators caught 174 legal smallmouth bass, three legal largemouth bass, 31 legal walleye and six legal northern pike in 177 trips for an average of 1.2 legal warmwater gamefish caught each trip. Only 15 smallmouth bass, 26 walleye and one northern pike were kept by our warmwater cooperators. The Owasco Lake Anglers Association has stocked Owasco Lake with walleye fingerlings annually since 1996. These fish are doing very well in the lake as noted by the annual increase in the warmwater cooperator catch. In 1999 cooperators caught two sub-legal walleye. In 2000 six legal and 18 sub-legal walleye were caught. In 2001 warmwater cooperators caught 31 legal and 53 sub-legal walleye.

Skaneateles Lake Angler Diary Program

Thirty-two coldwater diary cooperators logged 537 trips in 2001 and caught 781 legal salmonids for an average of 1.5 fish per trip. Coldwater lake cooperators were successful in catching at least one legal salmonid in 72 percent of their trips. Legal salmonids were caught at an average rate of one fish every 2.2 hours. Cooperators caught 430 legal lake trout, 299 legal rainbow trout, one legal brown trout and 51 legal landlocked salmon. Catch rates for these species were 0.8, 0.56, 0.002 and 0.09 legal fish per trip while harvest rates were 0.6, 0.45, 0.002 and .08 legal fish per trip, respectively. Lake trout comprised 55 percent of the legal salmonid catch while rainbows and landlocked salmon were 38 and seven percent, respectively. The benefits of a recent increase in landlocked salmon stocking were noted in the substantial increase in the number of salmon caught. Participation in the warmwater section of the Skaneateles Lake angler diary program is light with only five cooperators. They caught and released 36 legal smallmouth bass in 27 trips. An additional four sub-legal smallmouth bass were also caught and released.

Region 8

Trout Angler Opinion Survey

To determine angler opinion of a new regulation (5/2 trout regulation) aimed at distributing the harvest of larger trout among more anglers and for a longer duration throughout the fishing season, a newspaper survey of area anglers was conducted in

May 2000. In addition to the new regulation, opinions were sought on current trout management regulations (i.e. no kill, year round season, artificial lures only) and two site specific regulation proposals. A survey in a local newspaper was chosen in an attempt to generate greater response from anglers than typically would attend a public meeting, but would not require the cost and effort of a more traditional survey. Respondents were able to reply on-line at the newspapers website or clip out a copy of the survey from the newspaper and mail it directly to our office. A total of 271 replies were received, 63% on-line and 34% newspaper and 3% other. About 85% of all respondents fished more than six days during the preceding fishing season. Fifty-three percent of all respondents belong to a fishing club. Approximately 73% of respondents supported the proposed trout regulation with club and non-club members supporting the proposal. For questions concerning current trout regulations and specific stream regulation proposals, generally, the average response of respondents who belonged to a fishing club were significantly different from respondents who did not belong to a fishing club. Except for year-round fishing, respondents belonging to fishing clubs generally supported special regulations more than those that did not. The survey was successful in that response was greater and percentage of club and non-club members was more representative of the general angling public than could be obtained from a typical public meeting. Benefits of the survey included increased awareness of trout management, coverage of area streams, and active participation of constituents in regulation formation. These benefits were directly related to the excellent coverage extended by the local newspaper. However, some control over the survey was lost because of inability to proof the story and the spread of the survey outside of the newspaper.

Oatka Creek Creel Census

A creel survey was conducted on Oatka creek from late March through October, 2001. It was conducted as part of the No Kill trout fishing regulation evaluation. The 2001 creel survey was the post-regulation change census. Preliminary data analysis shows in 2001, like the 2000 census, Oatka creek, which has no closed season, follows the general pattern of high fishing pressure from April to July which tapers off through October. Compared to 2000, fewer of the stocked two year old brown trout were harvested within days of stocking in 2001. The 2001 two year old harvest appeared to be more spread out. Full data analysis has yet to determine whether the No Kill regulation induces more angler effort as predicted.

Early Season Bass

There has been a sincere interest from Bass Angling Sportsmen Society (BASS) clubs located in New York State Department of Environmental Conservation's (NYSDEC's) Region 8 regarding a spring catch-and-release bass season. In response to this interest, a trial catch-and-release bass season regulation was implemented in 2001 on selected waters and evaluated. The goal of a springtime catch-and-release season will be to provide additional bass angling opportunities without negatively impacting the quality of bass fishing during the regular open season. The experimental season runs from the first Saturday in May until the third Saturday in June. The affected waters are Conesus, Hemlock, Canadice, Honeoye, Canandaigua, Keuka, and Seneca Lakes.

Realizing the potential for impacts on the bass populations of these waters and the fact that black bass enter the sport fishery at the age of four or five, the NYSDEC Region 8 Fisheries Management Unit has undertaken an eight year study to determine if spring catch-and-release angling can be permitted without adverse impacts to the black bass resource. Surveys of angler opinions and fishing practices were conducted in 1998, 1999, and 2001, and will be repeated in 2003, 2004 and 2005. Since there are often large natural variations in the year class composition of bass populations, a cornerstone of the NYSDEC study is to survey anglers for their attitudes and perceptions on the quality of the bass fishery and to evaluate changes in levels of angler satisfaction that may result from the experimental catch-and-release season.

The NYSDEC will use four indices to measure angler "acceptance " of the regulation change. Specifically, the proportion of Region 8 anglers having a "Good or Excellent" perception of the bass fishery will remain at 55% or higher; anglers' favorable opinions of the early season catch-and-release fishery will remain at 55% or above; the level of early-season near-shore casting will increase from the 1998-99 average of 1038 boat hours to at least 1194 hours (15% increase) over the 5-year period of 2001-2005; and angler diary catch rate of bass anglers fishing Honeoye Lake in the regular season will be equal to or greater than the 1996-1998 average of 1.05 legal (• 12") bass per hour.

In the first post early season survey conducted in 2001, 69% of surveyed anglers felt that the bass fishery was good to excellent. This is well above the established 55% index level. Seventy three percent of the surveyed anglers were in favor of the early season, again well above the established 55% index level. Anglers targeting bass approve of the season at an 84% level. The level of early season casting was calculated to be 1680 hours. NYSDEC staff set a index level of 1194 near-shore casting hours. Final analysis of catch data is not available at the time of this writing.

Seneca Lake Angler Diary Program

Sixty eight volunteers returned diaries during the 2001 season. On average, it took these anglers 1.2 hours to catch a legal salmonid, which is the best catch rate ever recorded since the diary program was initiated in 1973. This excellent catch rate is a reflection of very hungry lake trout that are more willing to strike an angler's lure due to a declining forage base. To reduce the pressure on the forage base and compensate for the added numbers of wild fish, we lowered lake trout stocking rates by 38% to 20,000 yearlings and 40,000 fingerlings in 1999. We also started fin clipping 100% of the stocked lake trout in an effort to accurately estimate lake trout natural reproduction rates. We will be conducting an extensive gill net survey during the summer of 2002 to further evaluate lake trout and forage populations. Future reductions in lake trout stocking rates may be necessary if growth rates continue to decline and wild fish continue to expand.

The rainbow trout population is completely supported by natural reproduction with both the brown trout and landlocked salmon populations completely supported by stocking, which add diversity to the fishery. The number of these three species caught by anglers continues to be low and may also be showing the strain of a declining forage base. For the near term brown trout will be stocked at the current, annual rate of 21,600 yearlings and 43,000 fingerlings. Landlocked salmon are stocked at a rate of 24,000 yearlings annually.

Keuka Lake Angler Diary Program

Fifty one anglers returned diaries for the 2001 season. For the past eight years Keuka Lake angler diary keepers have experienced an excellent catch rate of approximately 2.0 hours to catch a legal salmonid. These excellent catch rates are the result of a very abundant wild lake trout population with a few landlocked salmon, brown trout and rainbow trout included for diversity. Lake trout continue to exhibit good size in recent diary catches, averaging over 21 inches in length and 3.0 pounds in weight. However, once the effects of zebra mussels are fully realized, we expect growth rates to decline in the near future.

The wild lake trout population in Keuka Lake is increasing, placing an additional burden on the declining forage base. To reduce the pressure on the forage base and compensate for the added numbers of wild fish, we may have to reduce the stocking rates for brown trout and Atlantic landlocked salmon. For the near future we plan on continuing the annual stocking of 22,300 landlocked salmon and 9,400 brown trout yearlings. The rainbow trout population is completely dependent on natural recruitment, which occurs mainly in Cold Brook.

Canandaigua Lake Angler Diary

2001 marked the 29th anniversary of the Angler Diary Program on Canandaigua Lake. On average, anglers fished 1.6 hours to boat one legal salmonid. Lake trout continue to be the driving force behind the coldwater fishery representing about 85% of all salmonids caught. Harvested lake trout averaged 20.8 inches and 3.3 pounds, almost identical to the 10-year average (20.8 inches and 3.4 pounds) during the 1990's. We are planning a survey this summer to evaluate the current condition of the lake trout population and will develop management strategies accordingly. Brown and rainbow trout comprised 8 and 7% of the harvested salmonids. Brown trout populations are maintained by annual yearling stockings while rainbow trout are completely self-sustaining spawning in Naples Creek.

Although recent salmonid catch rates have been excellent, they may be a result of a decreasing forage base, hence a hungrier fish more willing to strike bait or a lure. Reports indicate that the smelt population is greatly reduced and alewives are declining. Recent research has indicated that lake productivity has steadily decreased, while water clarity has steadily increased. Zebra mussels and the fishhook water flea are firmly established in the entire lake and are probably contributing to the decline in productivity. These animals are very efficient filter feeders of plankton and may disrupt the bottom level of the food chain, resulting in fewer and smaller forage fish available for predators (i.e. salmonids) to consume. Decreasing forage abundance could result in poor growth and fish condition of top predators, such as lake trout, and may negatively impact the entire fishery and should be closely monitored.

Region 9

Chautauqua County Small Lakes Creel Survey

An open water (access site/boat) and ice survey was initiated in 1999 at Bear and the Cassadaga lakes to assess the catch, harvest and angler preferences. Anglers were strongly in favor of the slot limit for black bass although the majority were not familiar with the reasons or intent of the regulation. Few bass less than 12 inches were harvested by anglers. Activity by bass anglers has increased measurably in the past two years. Ice angling activity has been light with the majority targeting walleye at Bear Lake. Analysis of data resulting from this survey has been completed with the assistance of Dunkirk Fisheries Station staff and a BOF Type II draft report has been completed and is currently being reviewed by Albany fisheries staff.

Central Office - Inland Section

Beaver Kill Creel Census

Inland staff continued coordination of Region 3, Region 4, Cornell and Trout Unlimited activities in a second year of determining the status of the Beaver Kill - Willowemoc Creek trout fishery. The summer of 2001 experienced a significant drought period which affected trout distributions and fishing use. An estimated 62,316 hrs of angling use occurred in the 15 census reaches during 2001. This was a 20% reduction from year 2000 levels that was attributable to a near complete cessation of fishing activity during the low water and high water temperature period from late July through early September. The overall catch rate for the 2001 season was 0.47 trout/hour with rates for the different study reaches varying from 0.25 to 0.97 trout/hour. Overall, as in 2000, only about 10% of trout caught were kept. However, outside the “no-kill” regulations areas about 1/3 of the anglers who caught trout kept at least one. Total estimated harvest for the watershed was about 3,000 trout.

A large majority of the trout caught systemwide were brown trout (91.5 %) but rainbow trout contributed to the catch (30%) in the lowest reach of the Beaver Kill and brook trout were important in upper Willowemoc Creek (26% of catch). Again in 2001, most Beaver Kill anglers were flyfishers and most were visiting from outside the Delaware and Sullivan County area.

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Habitat Management and Restoration

Region 1

Lake Ronkonkoma Riparian Vegetation Restoration

On Saturday, April 28th, Aquatic Biologist, Fred Henson, directed volunteers from the Long Island Bassmasters and the Lake Ronkonkoma Organization in planting yellow water lilies and wetland trees along a little-used section of the northeast shore of Lake Ronkonkoma. Due to Lake Ronkonkoma's history of development, little near shore vegetation exists today. Over 75 lily tubers, obtained from a nearby pond, were planted in Lake Ronkonkoma. In addition, 100 streamco willows, 100 silky dogwoods, and 25 red maples from the DEC's Saratoga Tree Nursery were installed.

Carmans River Habitat Improvement

On Thursday, May 3rd, members of the Art Flick Chapter of Trout Unlimited in coordination with the Regional Fisheries Unit, planted 25 red maple, 15 buttonbush, and 15 silky dogwoods in two areas along the Carmans River lacking in overhead cover for brook trout. To determine whether deer browsing is a significant problem, some trees were planted in tree tubes and others were planted without protection. TU members will be collecting local seed and sending it to the Saratoga Tree Nursery to be grown out for use in future plantings. The growth and survival of the plants in both of these projects will be monitored over the next several growing seasons.

The Regional Fisheries Unit is also working with the Art Flick Chapter of Trout Unlimited to develop a plan for replacing a failing double wing deflector structure and constructing a bank cover structures. Recent information exchanged with TU members working on Cape Cod streams suggests that bank cover structures would likely benefit the Carmans River. It was agreed that the Art Flick Chapter would provide plans to Fred Henson who would draft a Freshwater Wetlands Permit application.

Hempstead Lake Vegetation Project

Restoring vegetation to Hempstead Lake is a major goal of the Region 1 Freshwater Fisheries Unit. Hempstead Lake had abundant submergent vegetation through the 1960s when a drought caused a massive dieback of the vegetation. Sewering of Nassau County has dropped the average lake level, pulling the shoreline away from the established vegetation. To help re-establish a vegetated shoreline, trees were planted at Hempstead Lake on May 3rd, 2001, in an effort to increase aquatic habitat and riparian cover for fish in the lake. The Region One Fisheries Unit is also concerned with establishing floating vegetation. Water lilies planted in 2000 established two beds approximately 30 feet across during 2001. With this success in mind, fisheries staff took advantage of low water caused by the drought of 2001 to set up eight S-curved fence sections (20 to 30 ft in length) in December, 2001. These sections were placed on the east and west sides of the lake. Areas selected were chosen for the proximity to two peninsulas in the pond to protect the future planting areas from prevailing winds. Past experience from the 2000 water lily planting has shown that planting water lilies under the snow fence was very successful. More water lily planting was planned for the Spring of 2002, but the lowest spring water level in over 10 years prevented the planting. The fence will be left up and planted during the spring of 2003. Soft stem bullrush and cattails were also planted in December, 2002, at various locations along the shoreline where the water's edge would typically occur during normal water conditions. Both the soft stem bullrush and cattail sprouted in 2002. Additionally, in February, 2002, Regional fisheries staff spread seed from approximately 25 cattail heads in the north end of Hempstead Lake. This was a further attempt to take advantage of the low water conditions due to the ongoing drought. Seeds were scattered in areas of mud flats that would be covered by one to two feet of water during a normal spring.

Carll's River Habitat Improvement - On January 19th, Biologists Fred Henson and Gregory Kozlowski joined members of the Long Island and Art Flick Chapters of Trout Unlimited to walk the Carll's River from Park Avenue to Southards Pond. The purpose of the walk was to evaluate the quality of trout habitat provided by that section of stream and identify any opportunities for stream habitat improvement projects. The consensus was that the stream was in pretty good shape and that the biggest problem was litter. A couple of places where deflector structures might be appropriate were identified. Some individuals felt that the stream channel was overgrown with brush. However, the biologists pointed out that coarse woody debris is important as trout habitat. At the conclusion of the meeting the T.U. members discussed plans for a stream corridor litter cleanup day.

Region 4

Beaver Kill Stream Improvement Projects

A stream restoration project designed to reduce flood damage and improve trout habitat in the Beaver Kill watershed was completed this past September. The main focus of this work was Horton Brook, a narrow, flood-prone valley in the Town of Colchester, Delaware County. Some 400 feet of the lower stream channel was reconstructed and the adjacent stream banks were graded back in order to restore some degree of natural stability to this reach. The combination of the redesigned channel and a recent bridge project by the Delaware County DPW is expected to reduce flood damage at the site, and should significantly improve the ecological function of Horton Brook as part of the Beaver Kill system.

Several berms were removed on upper Horton Brook and the main stem of the Beaver Kill. Approximately 500 feet of berms and approximately 1500 cubic yards of fill were removed from the flood plain and stream bank of Horton Brook. A 400 foot berm on the main stem of the Beaver Kill near the mouth of Horse Brook was also breached, opening up an additional three acres of flood plain. Ultimately, this work should help narrow these stream channels leading to improved trout habitat and reduced water temperatures.

Region 5

Flow Monitoring Weir Installed at Whiteface Ski Center

Whiteface Ski Center completed construction of the flow monitoring weir on the West Branch Ausable River. The ski center withdraws water from the river for snow-making, and at critically low river flows the withdrawals could severely impact the aquatic life of the river. Therefore, DEC pursued a requirement for the Ski Center to monitor river flows and discontinue withdrawals during extreme low flow events. The Ski Center awarded a contract for constructing the flow monitoring facilities. The weir provides the ability to accurately and continuously monitor when river flows are low. Water withdrawals for snow-making will be discontinued when river flows decline to critically low levels. DEC and ski center staff will formalize operational, compliance, and record keeping procedures.

Region 6

Whirling Disease

Regional stocking records were reviewed to determine where potentially WD positive rainbow trout were stocked in 1993 and 1994. The stocked waters were reviewed to determine the potential of having transferred WD to wild trout populations, The greatest potential was in tributaries of East Branch of Fish Creek and the upper Black River. Samples of 20 yearling wild brook or brown trout were collected from four tributaries of the East Branch and 3 tributaries of the Black River. All samples were WD negative. An additional sample was collected in the Rome Hatchery Outlet. This body of water was positive in 1994-1996 but has been WD negative since.

Habitat Management and Restoration

Region 6 fisheries staff electrofished the Soft Maple Bypass of the Beaver River in cooperation with Trout Unlimited, the USFWS and Orion Power for their FERC relicensing plan. A viable wild brook trout population was found due to the minimum flow established four years ago. Previous surveys found few, if any trout. This survey revealed a brook trout population of 40 1+ and older trout per acre. They ranged in size from 2 to 9 inches and represented four year classes. Other fish species were also present in higher numbers. Don Meissner of WPBS TV, Watertown, filmed the operation for his national show, Rod and Reel Streamside.

Pond Liming

Two Region 6 Adirondack lakes were treated during 2001-02. These include Clear Pond (AKA Hedgehog Pond) which received 10 tons of Agricultural lime March 5 & 7, and Horn Lake, which received 20 tons of lime on March 19 & 28. Horn Lake is the source water for the Horn Lake strain of Adirondack brook trout. Maintaining this lake's naturally spawning population remains a very high priority. It was last treated with lime in 1994. Lime was transported to both of these waters via NYS Aviation Unit helicopters.

Region 7

Whitney Point Reservoir Habitat Improvement

In cooperation with the Whitney Point Reservoir Fisherman's Association 20 root wad structures were placed along the southeast shoreline of Whitney Point Reservoir, north of Dorchester Park. The structures were placed to provide shelter for fish. Under the direction of Bureau of Fisheries staff, Division of Operations pulled the root-wads into place with a front end loader and the volunteers, under their "adopt-a-resource agreement," secured the structures in place. The structures were secured with 3/8 in. galvanized steel cable and anchored with two or three auger-style anchors typically used to hold mobile homes. All root-wads were situated in four to seven feet of water with a minimum of 18 inches of clearance below the summertime water surface. The cable was donated by a local utility company and the anchors were purchased by the Whitney Point Sportsman's club. The Corps limited the number of root-wads which could be placed this year in order to evaluate whether they would remain in place. If these don't move more root-wads will be placed in the reservoir next year.

Stream Reclassification Surveys

Two Streams, Halfway Brook in Chenango County and Triangle Stream in Broome County were surveyed for the presence of trout. If documented, the data would be presented at a watershed reclassification hearing, when scheduled, to give protection under Article 15 of the Environmental Conservation Law. No trout were found in either stream.

Region 8

Catharine Creek Aquatic Habitat Restoration

Work continued in 2001 on this Clean Water/Clean Air Bond Act funded project. During the late summer and fall of 2001, two log pyramid bed sills were constructed by Camp Monterey inmates supervised by DEC Operations staff. One replacement structure was built in Millport, and one new structure was built on DEC owned land on the main stream just below Millport. Three or four structures per year will continue to be constructed until all of the bed sills proposed in the *Catharine Creek Aquatic Habitat Restoration Plan* are built. Additional monies from the Environmental Protection Fund were awarded to this project in 2000. These funds will be used in 2002 to complete the lower priority sites of the *Plan* that were eliminated when insufficient Bond Act funds were awarded in 1997.

Naples Creek Aquatic Habitat Restoration Project

In July 2000, this project was awarded Clean Water/Clean Air Bond Act funds during the 1999-2000 appropriation cycle. From April 2001 to June 2001, site inspections were conducted, project plans were prepared, permit applications were made, construction plans were discussed, and partnerships with the Ontario County SWCD, and Town and Village of Naples were formed. Construction began on July 30 and ended by permit condition on November 15, 2001. All of the sites proposed for the main stream except one were constructed. Inspections during the winter of 2001 showed that most of the sites are performing as expected. Some minor remedial work will be needed at a few sites. Willow bank stabilization plantings, construction of the last main stream site, the minor remediation, and all of the proposed sites on Grimes creek will occur in the spring and summer of 2002.

Whole Lake Fluridone Treatment DSEIS

According to the Lake Association, recreational use of Waneta and Lamoka Lakes is hampered by the submersed aquatic plant, Eurasian water milfoil. In response to this problem, the Association applied for Aquatic Herbicide and Freshwater Wetlands permits to treat both lakes with the systemic herbicide, fluridone (brand name Sonar). The systemic mode of action of this chemical requires that the whole lake be treated with a low dose (6-12 ppb) over a 60 day period. Under this treatment regime, fluridone apparently targets only milfoil. Because Waneta Lake is the Region's only muskellunge fishery and both lakes have valuable warm water fisheries, Regional staff are concerned that loss of aquatic habitat provided by the vegetation will adversely affect aquatic life in the lakes. Because of these concerns, the permit applications received a positive declaration under the State Environmental Review Act (SEQR), requiring the preparation of a Draft Supplemental Environmental Impact Statement (DSEIS). Considerable staff time was spent reviewing the application, supporting documents, relevant literature, and meeting with the applicants. The DSEIS was submitted January 2, 2002 and our comments were provided to the applicants on March 12, 2002.

Region 9

Wiscoy Creek

Wiscoy Creek is western New York's best wild brown trout stream and has been intensively studied by BOF for over 50 years. Wild brown trout biomass has consistently averaged over 100 lbs/acre (1500 - 2000 age 1+ and older trout) the last 20 years with some areas supporting more than 200 lbs/acre (see Wiscoy Creek report under Coldwater Streams). In 2001, Western New York Trout Unlimited and BOF put together a project to help a large dairy farm minimize impact to Wiscoy Creek. This included constructing a bridge to allow crossing of both livestock and farm machinery, building 300 feet of log cribbing to stabilize a bank that was prone to erosion near farm buildings and manure storage, installing 3800 feet of fence to keep livestock from destroying streambanks and riparian vegetation, constructing an overflow channel to take flood waters away from farm operations, installing angler step-overs across fences where needed for fishermen access, and planting riparian trees and vegetation. The project cost about $50,000 including National TU providing $9000, WNY TU $10,500, local grants administered through the Wyoming County SWCD of $14,436, the landowner $10,690, and USFWS $4500.

Extension, Education and Outreach

Participation in Outdoor Sporting Shows
Bureau staff set up and participated in eight outdoor shows including Springfield, MA, Hartford, CT, Harrisburg, Pa, Cleveland, OH, and Nassau, Suffern, Albany, and Rochester, NY. A primary focus of attending these shows is to inform resident and non-resident anglers about our extensive freshwater resources and angling opportunities.

First Fish Program
DEC continued its *First Fish Program*-- which celebrates the first fish caught by an angler. Aimed at youth, but recognizing all new anglers, the program gives participants an award package that consists of a personalized letter of congratulations from the governor, a personalized certificate with date, location, species and size of fish caught, a first fish sticker, a freshwater fish brochure and a card that can be returned to receive a full color wall poster. The materials feature the "PEANUTS" characters, which are being used with the permission of the late Charles Schulz under an exclusive free contract with United Feature Syndicate, Inc. During the report period the program awarded over 8,000 anglers.

Internet
The Internet continues to explode in popularity and users are constantly requesting additional materials be made available on the web. Because of this, more time and effort is being spent on internet activities, and less on print-based materials. Bureau continued to convert existing Bureau of Fisheries materials into HTML format to go on-line, plus developed additional materials for inclusion on the web. As a result, DEC's website www.dec.state.ny.us continued its rapid growth in both content and public use. The site now contains more than 1,100 pages of fish, wildlife and marine content. Fish, wildlife and marine content remains among the most popular on the site. In addition to updating materials currently on the site, some of the bureau information completed for the web this year includes: fish stocking lists by DEC Region; a list of state boat launching sites; the My First Fish Program; the Angler Achievement Awards Program; popular warmwater fishing waters; and updating of the fishing regulations.

In addition, Bureau staff continued to maintain the FW FISH mailbox on the Department website (www.dec.state.ny.us). FW FISH is one of the more popular mailboxes on the Departments web-site. Over 1,500 e-mails were either directed to the Regions or other programs for answers, or answered directly by Central Office staff. Common e-mail requests included assistance with the interpretation of fishing regulations, spring trout stocking plans and finding appropriate fishing locations for various species throughout the state. The mailbox is also a popular locations for anglers to express opinions on the overall Bureau of Fisheries program, as well as the reporting of violations of the Environmental Conservation Law.

Region 1

Sweet Water Angler
The *Sweet Water Angler* has entered its ninth year of circulation. The circulation goes out to 4,300 addresses with an additional 500 to 1000 copies handed out at various events and though phone inquiries. The circulation is expected to increase dramatically in the next year with the addition of a two page marine section and a 2 page New York City section, making the newsletter relevant to a wider audience. In order to make back issues of the *Sweet Water Angler* more available, all 29 back issues are now available on the web in PDF format for downloading at http://www.dec.state.ny.us/website/reg1/sweetwater2.html. New issues of the Sweet Water Angler will be posted on the internet by March 1, June 1 and September 1 of every year.

Spring Fishing Festival at Belmont Lake State Park
On April 21, 2001, the Region 1 Freshwater Fisheries Unit coordinated the Spring Family Fishing Festival at Belmont Lake State Park. This was the fifth Spring Family Fishing Festival conducted by the NYSDEC at this location. An estimated 2,000 people attended the festival a 50% increase in attendance from the previous year. Bait (provided by NYSOPRHP) was furnished to all who needed it. The Fisheries Unit had 175 fishing rods (donated by Shakespear, NYFTTA and the Art Flick Chapter of Trout Unlimited) available to loan out.

During the course of the day these rods were loaned out to 436 people. Because the day was declared a Free Fishing Day, no fishing license was needed. However, 74 Fishing Licenses were sold at the Festival for a total of $964. Polaroid pictures (donated by the Fishing Line) of people with their catch were taken to give them a memento of the day. Fisheries staff offered to clean and ice the catch for anyone who wanted to keep their catch. During the Festival over 150 trout were cleaned for participants. In addition to giving people the opportunity to fish, four fishing seminars were given through the day on Fly-fishing in ponds, Fly-fishing in streams, Bass fishing light, and Bass fishing basics. Children attending the seminars had a chance to participate in a free raffle at the end of the seminar. Seminar prizes were donated by the DEC and Trout Unlimited. Fly casting and fly tying instruction was also provided during the event. Finally, as a bonus treat for the kids, a moon bounce and face painting were provided by State Parks. Co-sponsors of the festival included NYSOPRHP, The Fishing Line, NYFTTA and Entenmann's. Cooperating organizations included the Long Island Bassmasters, Art Flick Chapter of TU, Long Island Chapter of TU, Freshwater Anglers of Long Island and Long Island Flyrodders. The club organizations really came through to provide the man power necessary to run this event. Overall, the event was considered a big success.

Family Fishing Day Clinic at Hempstead Lake State Park

The Region 1 Freshwater Fisheries Unit hosted its 10th annual Family Fishing Day Clinic at Hempstead Lake State Park on Saturday, August 18th. Over 100 children and adults attended the event, with 65 kids participating in the clinic. The children, ranging in age from 4 to 12 years old, received group and individual instruction on the fundamentals of freshwater fishing, environmental ethics and aquatic ecosystems.

Staff from the Region 1 NYSDEC Fisheries, Law Enforcement and Administration Units and volunteers from The Freshwater Anglers of Long Island conducted a "Round Robin" teaching session with five stations, including Angler Ethics, Fish Identification, Basic Freshwater Fishing Tackle, Aquatic Ecology and Care and Preparation of Your Catch. After the educational presentations, the children had the opportunity to compete in a casting contest. Rod and tackle box prizes were awarded to kids that were able to cast closest to targets placed on the ground 30 feet away. The overall winner was a young girl from the "7 and under" age group that cast within 1 foot of the target!

The Freshwater Fisheries Unit provided rods, tackle and bait so that clinic participants could fish at nearby McDonald Pond. The resident bluegill and pumpkinseed sunfish were very cooperative on this day, and nearly everyone caught fish. There were even several largemouth bass caught. Several kids and adults caught fish for the very first time!

Overall, the clinic was a great success. Numerous parents and kids expressed their appreciation to DEC staff as they were leaving the park. With their bellies full from the freshly prepared catfish and hush puppies and their minds brimming with new ideas for future freshwater fishing trips, many of these people will likely be returning to Hempstead Lake State Park for the next festival in the fall. The Region 1 Freshwater Fisheries Unit certainly hopes so!

Fall Fishing and Children's Festival 2001 - The Regional Fisheries Unit successfully coordinated the Ninth Annual Fall Fishing and Children's Festival at Hempstead Lake State Park on Saturday, October 20. Over 2,100 people attended the festival, a 75% increase in attendance from the previous year. Bait was provided to all who needed it and rods were loaned to 761 people during the day. Eighty per cent of the rods loaned out were to children under 16 years old and 35% were to people who had never fished before. The rods used were donated by Shakespeare, The New York Tackle Trade Association (NYFTTA) and The Art Flick Chapter of Trout Unlimited. DEC Staff stocked South and McDonald Ponds with trout from the Connetquot River State Park hatchery the day before the event and offered a fish cleaning service to anyone wanting to keep their catch. Over 50 trout were cleaned for festival participants during the event. In the Casting for Pumpkins contest children could cast into a pumpkin field and keep the pumpkin they hit. The field was also seeded with prizes donated by The Fishing Line, NYFTTA and the Conservation Officers Association. Next to fishing, this was the most popular activity at the Festival. Boy Scouts from the Theodore Roosevelt Council ran the casting for pumpkins contest. Children could get their picture taken with their catch and keep the photo. The Polaroid film was provided by The

Fishing Line. This event was declared a Regional Free Fishing Day so that fishing licenses were not needed for those attending the event. However, fishing licenses were offered for sale at the event and a total of $374 in licenses were sold. Cosponsors of this event included State Parks, The Fishing Line, NYFTTA and Entenmann's Bakery . Participants included members of Trout Unlimited, the Long Island Bassmasters, The Freshwater Anglers of Long Island, The Long Island Flyrodders, Suffolk Alliance of Sportsmen, the Boy Scouts and other interested sportsmen. In addition to the Region 1 Fisheries Staff, Region 1 License Clerk Jackie Pasquini and Region 2 Natural Resources Supervisor Jim Gilmore assisted with the event.

Deep Pond Cub Scout Fishing Clinic

On June 16 the Regional Fisheries Unit conducted a fishing clinic for the Cub Scouts of the Theodore Roosevelt Council of Boy Scouts of America. The clinic was held at Schiff Scout Reservation in Wading River. About 80 scouts attended. They were given instruction in Fish Identification; Fishing Tackle and Basic Fishing Techniques; Fishing Regulations and Angler Ethics; and Aquatic Ecology. After completing the basic instruction each Cub Scout was provided with a fishing rod and bait and given the opportunity to fish in Deep Pond. Most of the children caught fish and all had an enjoyable and informative day.

Suffolk County Girl Scouts Fishing Clinic

The Regional Fisheries Unit with volunteer assistance from the Long Island Bassmasters and the Suffolk County Seniors Fishing Club conducted a fishing clinic for 30 Brownie and Junior Girl Scouts at Camp Edey in Bayport. The two hour event began with instruction on fish identification, basic fishing tackle and conservation law and ethics. The girls were then provided with bait an fishing rods and given the opportunity to fish in the Camp Pond. After a slow start, the fish began biting and by the end of the clinic nearly every girl had caught a fish, many for the very first time.

Nassau Conservation Days - On May 1st, Fishery Biologist Greg Kozlowski and Technician Tom Hughes participated in the Nassau County Conservation Days at Old Bethpage Village Restoration in Old Bethpage, NY. Approximately 500 5th grade students from several different Long Island schools attended the event. Greg and Tom set up a display and talked about the different methods fishery biologists use to capture fish and the life history and biology of Long Island's native fishes.

Fly Fishing Seminar

On July 13, 2001, a Flyfishing Seminar was held at Caleb Smith State Park from 6:30 to dusk. Dave Sekeres was the guest instructor. Ten participants attended the seminar, the maximum allowed due to space restraints. Participants were instructed in the basics of rol1 casting with some back casting demonstrations also given. Most people caught fish, including brook trout, bluegill, and largemouth bass. All participants left with smiles on their faces and a thank you to the instructor. This was the second of seven fishing seminars coordinated by the Region 1 Freshwater Fisheries Unit for the summer of 2001. The seminars are designed to raise the knowledge level of beginning anglers and to give them the skills to further enjoy their fishing experience.

Seasonal Bass Fishing Seminar Held

On July 18, 2001, the first of a three part bass fishing seminar series titled "A seasonal approach to bass fishing" was held at Belmont Lake State Park. The seminar was co-instructed by bass tournament anglers Chris Zarnitz and Michael Wiltshire. Seventeen people attended the seminar and learned about rods, reels, line, and different lures and how to fish them. Each of the participants was given free handouts from Rattlesnake, a sponsor of the seminar. The remaining two seminars in this series are scheduled to take place at Belmont Lake State Park in August and September.

Cub Scout Pack 363 Fishing Clinic Held

On August 4, 2001, Fisheries Biologist Greg Kozlowski conducted a fishing clinic for Cub Scout Pack 363 at Hempstead Lake State Park. Fifteen cub scouts and seven other children attended the clinic. They learned about the rates that different materials that could end up in water bio-degrade, freshwater fish identification, and basic freshwater fishing tackle and techniques. At the end of the educational session, the scouts were given time to fish. All the scouts caught fish, including pumpkinseed, bluegill and largemouth bass. All fish were released. This clinic has been held for this pack annually since 1996.

Girl Scout Fishing Clinic at Camp Edey

On August 23rd, technicians Lauren Papa and Tom Hughes from the Region 1 Freshwater Fisheries

Unit participated in a fishing clinic for the Girl Scouts at Camp Edey in Sayville on the Sans-Soucci Lakes. The clinic was coordinated by the New York Fishing Tackle Trade Association (NYFTTA) with involvement from the NYSDEC, USFWS, Recreational Fishing Alliance (RFA) and the Long Island Beach Buggy Association (LIBBA). The Region 1 Freshwater Fisheries Unit provided the bait, rods and tackle for the event.

Approximately 200 girls, ranging from 6 to 14 years of age, participated in the clinic. The children and their camp counselors attended the clinic in 45 minute shifts throughout the day as part of the camp's daily session. Each group was given five to ten minutes of instruction by Regional fisheries personnel about fish species present in the pond and the basic use of spincasting outfits. Then, those who wanted to fish were taken down to the pond and those who wanted to practice casting were given one on one instruction by fisheries staff**.** Over all, most of the girls caught fish and had fun. Several even caught their first fish ever**.** One young girl twice hooked into a bass that exceeded 6 lbs.! Her hook was straightened out by the enormous fish on both occasions, however, not before her screams of "I've got one" could be heard from all over the pond.

Long Island Fall Festival at Huntington
On Saturday, October 6th, the Region 1 Freshwater Fisheries Unit participated in the 8th annual Long Island Fall Festival at Huntington. The four day event, sponsored by the Huntington Township Chamber of Commerce, attracts over 250,000 people each year. This was the first year that the Regional Fisheries Unit with the cooperation of the Town of Huntington provided a "Fishing Hole" at Heckscher Park Pond during the Long Island Fall Festival. The program was run by Region One Fisheries staff with volunteer assistance from the Freshwater Anglers of Long Island, the Long Island Bassmasters and Rosa Colomba of Region One Administrative staff. The spincasting fishing outfits, tackle, and literature were provided by the Region One Fisheries Unit, while the bait was provided by the Huntington Chamber of Commerce.

Despite terrible morning rains and high winds, the festival was a success. After the storms cleared, people were eager to fish. By day's end, over 150 rods had been loaned out and many children had caught their "First Fish" ever. Rods and bait were loaned to those children that wished to fish, and one on one casting instruction was given by Regional staff and volunteers. Over all, it was a fun day for all who participated, and people seemed eager to see Region 1 Fisheries Unit back at the festival in 2002.

Children's Fishing Clinic at Peconic River Sportsman's Club At the invitation of the Peconic River Sportsman's Club, Fred Henson conducted a children's fishing clinic at Donahue's Pond on the club property. The program consisted of a lesson on the importance of the aquatic food web to good fishing followed by angling with instruction and supervision by Fred Henson. Live insects and other aquatic organisms were collected from the pond to introduce the children to some of the often overlooked components of the food web. The kids were fascinated by the scary looking bugs, especially when an ornery backswimmer bit Fred on the hand. The concept of the food web was reinforced by playing the "Food Web Game."
While the clinic was a hit with children and parents, overall attendance, at eight children, was too low to justify repeating the event at that venue.

New York National Boat Show
The Region1 Freshwater Fisheries Unit was actively involved in the New York National Boat Show, held at the Jacob Javits Convention Center from January 5-13, 2002. The Fisheries Unit's electrofishing boat was a significant part of the DEC display this year. Region One Fisheries Staff delivered to boat to the Javits Canter in advance of the show and transported it back to Long Island after the show. Region One Fisheries Staff helped man the display on all four weekend days of the show and assisted with the Casting for Bass Contest. Region One Fisheries Staff also assisted Region Two and Central Office Staff with takedown of the display after the show and transported the Fish and Wildlife Display to Long Island for Use at the National Sportsman's and Outdoor Expo in Nassau County.

National Sportsman's and Outdoor Exposition
Region One Fisheries Staff coordinated the setup of the DEC Display at the National Sportsman's and Outdoor Expo held at the Nassau Coliseum from January 17-21, 2002. Fisheries Staff also provided booth coverage for the entire show. In addition to answering numerous questions about fishing and hunting opportunities on Long Island, 55 fishing licenses were sold at the show.

Brentwood Sportsman Show
The Region 1 Fisheries Unit coordinated the DEC attendance at the Long Island Sportsman and Camping Show held at the Suffolk Community College Sports and Convention Center in Brentwood from Friday, March 8, through Sunday, March 10, 2002. While there, over 121 people signed up for the *Sweet Water Angler*. During the show, 104 fishing licenses and 14 senior fishing license were sold. This was the first time that this show was held and it was very well attended. Staff was kept busy throughout the show answering questions and issuing licenses. Regional staff from the following Units participated: Fisheries, Wildlife, Environmental Conservation Officers and Sportsmen Education. Fish and Wildlife Outreach Coordinator Clark Pell, from Central Office, Bureau of Fisheries, and his staff transported the DFWMR Exhibit from Albany to Long Island and back and completed the exhibit set up and take down. They were the only Central Office representatives that participated in the show.

Summary of Extension Efforts
The Regional Fisheries Unit reached the following number of people through their Extension, Education and Outreach efforts:

Fishing Clinics (6):	405
Fishing Festivals (2):	4,100
Fishing Seminars (5):	105
Other Events (5):	850
Sweet Water Angler:	4,300

Region 2

New York National Boat Show, Manhattan
For the fourth straight year the DEC improved its exhibit at the NY National Boat Show. Held January 5-13 at the Javits Center, this year's event was attended by approximately 98,000 people. The exhibit was manned by DEC staff from Fish Wildlife and Marine Resources, Law Enforcement, the Hudson River Estuary Program, Public Affairs and Education and Water and Pollution Prevention. The exhibit included mounts of state-record fish, an electro-fishing boat, a casting pool for the hugely popular Backyard Bass game, a freshwater aquarium full of brook trout, a saltwater aquarium full of striped bass, flounder a sea robin and a blackfish, and an interpretive video describing electro fishing. The *Conservationist* magazine featured button-making, a "picture yourself" photo for the cover of the magazine, a raffle for a free kayak and other giveaways. The Hudson River Estuary program brought down their 6 foot sturgeon mount and video-microscope which allowed people to see live microscopic biota**.** The highlight of the show was Commissioner Crotty's announcement of the "I Fish NY" initiative.

Prospect Park Fishing Clinic, Brooklyn
On June 23 the Region 2 fisheries unit and the Forest Rangers held a fishing clinic in conjunction with the New York City Parks Department and local angling associations at Prospect Park Lake. Despite the torrential downpour, 50 new anglers showed up for the clinic, where they learned about fishing techniques, equipment, fish identification, and fishing regulations. High catch rates kept participants happy and a few even managed to catch largemouth bass. Nearly 100% of those preregistered for the clinic showed up. This was Region 2's first clinic of its type and we learned that volunteers given the responsibility of education need to be given more hands on pre-clinic training, and that a large tent would be a good idea for future clinics.

Gantry Plaza Fishing Clinic, Queens
On October 27, as part of the "I Fish NY" initiative, Region 2 fisheries staff in conjunction with the Bayside Anglers Group, held its first saltwater pier fishing clinic**.** The clinic was designed to give participants an intensive educational experience as well as an opportunity to catch some fish. Each participant went to each of the four educational sections that focused on; fishing tackle and safety, fishing ethics, fishing regulations and advisories, and fish identification. After they completed the education sections we set them up with fishing gear and bait. There was plenty of time to give each participant one-on-one instruction on how to bait a hook, how to cast safely, how to feel a bite and how to set the hook. Species caught included striped bass, cunner and black sea bass. The clinic was attended by 50 local school children and parents. The pier size will probably not allow us to expand the clinic size to more than 70 participants. Gantry Plaza State Park proved to be an excellent location for such a clinic and we hope to make this clinic an annual event.

Getting Started in Fishing Program
As part of the "I Fish NY" initiative, Region 2 fisheries staff have guided our Student Conservation Association (SCA) members in the development of a new classroom based fishing education program called "Getting Started in Fishing". This is a two part program where we go into classrooms in the fall and winter months to teach topics related to fishing, then take these same students on a fishing field trip in the spring.

Our lessons and field trips agree with the New York State Board of Education Standards. The first lesson consists of a basic introduction to fish in which the students learn general fish anatomy. Activities may discuss adaptations that fish have that allow them to survive in water as well as species specific adaptations. They may create their own fish with a variety of different adaptations and discuss what type of habitat that fish could live in. Topics covered in the second lesson may include the food chain, fishing ethics and an introduction to basic fishing gear and skills. They may test their knowledge on our fishing pond poster, in which they can choose a habitat to "fish" in as well as bait and equipment. The activities that we do with each class provide the students with an interactive and thought provoking way of learning about one of New York City's most abundant natural resources.

During the winter of 2000-2001 we made it into 20 different classrooms, teaching students from Kindergarten to Eighth grade**.** This winter we nearly doubled our outreach by getting into 38 classrooms. The program has been well received by local teachers and will continue to grow assuming we can keep a strong SCA presence in Region 2.

Digital Presentation Manual Completed
Regional Fisheries Biologist Greg Kozlowski spent most of the 57th Northeast Fish and Wildlife Conference working in the presentation preparation room and earned the appellation "AV Dude". During the Conference, he had the opportunity to witness many common and uncommon issues regarding digital presentations. Using his experiences with digital presentations, Greg wrote a guidance document titled Digital Presentations Dos and Don'ts. The digital presentations document was created to assist presenters and conference organizers. While the document was created primarily for DEC staff, there have been numerous requests for it from outside the Agency. To date, it has been distributed to Cornell University, College of Environmental Sciences and Forestry, and the NYSDOS. A copy was also provide to the State of Maine, Department of Inland Fisheries and Wildlife, the sponsor of the 58th Northeast Fish and Wildlife Conference. Maine IFW electronically posted the document on its conference web site as a guide to presenters. The web site link is: www.state.me.us/ifw/meetings/nefishwildlifeconf/presenters.htm

Region 4

Indian Kill Fishing Event
Region 4 staff participated in the annual Indian Kill Fishing Open House/Fishing Day (Glenville, Schenectady County) sponsored by the Schenectady County Environmental Advisory Council. Representatives from the Department, Conservation Council, Trout Unlimited and other organizations provided resource information and hands-on fishing experience to some 200 youngsters as they tried to catch some 200 recently stocked Rainbow Trout. Instruction on everything from baiting a hook, to spin casting, to fly casting was provided. Commissioner Crotty was present to kick-off the event and to assist with the program. Prizes were awarded during a noontime ceremony by size of catch and age category. A good time was had by all.

Region 6

Youth Fishing Events and Extension
Exhibits or activities were provided to a number of events which focused on youth fishing/education. These included Fragile Wilderness exhibit at Watertown, a SAREP Fishing Camp for 65 kids, an aquatics exam for the Envirothon in Lewis and Jefferson Counties and Conservation Field Day for Lewis County, a Youth Fishing Clinic at Cranberry Lake Campsite, and a weekend Fishing Camp at Millsite Lake in Jefferson County.

To provide attendees with a better view of 21of NYS's rare fishes (live), staff developed a fish exhibit at NE Fish and Wildlife Conference in April.

Biomonitoring with fish
An index of biotic integrity (IBI) was devised for wadable streams and applied to a previous data set

from the Croton basin. This analysis was then applied to additional fish catches completed in conjunction with biomonitoring by Div. Water in 2001, from Ellicott Creek (Erie Co.) and the Allegheny basin. This allowed comparisons between the Ellicott Creek sites (7) and between recent and historic collections in five larger streams of the Allegheny basin.

Region 7

8th Annual Finger Lakes Fishing Festival

On Saturday, April 28, 2001 Regional Fisheries Unit assisted the Lime Hollow Nature Center in this highly successful event which uses the "Pathways to Fishing" program to introduce young people and their parents to fish and fishing. Over 450 children attended and moved through 10 learning stations where they were instructed on everything from casting and knot tying to fish biology and regulations. After completing the Pathways stations the children got the chance to catch their first trout in a stocked pond.

Falcon Sportsmen Club 49th Annual Children's Fishing Derby

On Sunday, June 10, 2001 Regional Fisheries staff provided a live fish display at this event which was attended by approximately 200 children and their families. A large aquarium was set up and filled with a variety of warm water fish. This allowed for close inspection by the children of many fish species common to central New York. Two large "fish petting tubs" were placed on the ground giving even the youngest angler a chance to make friends with the fishes.

New York State Fair

Region 7 Fisheries staff were represented on all 3 shifts of the fair manning the Division of Fish, Wildlife and Marine Resources booth inside the DEC Aquarium Building. Thousands of hunting and fishing licenses were sold and questions from the public were answered at the booth during this 12 day event from August 23 - September 3, 2001.

Salmon River Hatchery Open House

Regional Fisheries Staff assisted the hatchery in sponsoring this popular event held on National Hunting and Fishing Day September 22, 2001. A table was manned by a Regional Biologist and Technician to answer questions on the management of Lake Ontario and Salmon River Fisheries. Brochures were available on salmon fishing techniques, maps of the river, life history writeups of the Lake Ontario salmonids, stocking information and species identification. Coinciding with the major fall run of pacific salmon this event was attended by over 1000 people.

Conservation Field Days at SUNY Morrisville

On Tuesday, October 9, 2001 the Madison County public school system held this educational event for several hundred 6th grade school children from all over the county. A Regional Fisheries Biologist and Technician provided a live fish display and gave lectures to 8 classes on fish anatomy and identification.

Cayuga County Conservation Field Days

This two day event was held at Emerson Park in Auburn during September 2001. A Regional Fisheries Biologist provided a live fish display and gave lectures on fish ecology and biology to over 300 6th graders who came from school districts all over Cayuga County.

NYC Boat Show

A Region 7 Fisheries Biologist worked at the Division of Fish, Wildlife and Marine Resources booth for 9 days from January 5-13, 2002 held at the Jacob Javitt's Center in New York City. This high-profile event draws over 100,000 people annually an is an excellent opportunity to promote New York's fishing resources to a wide and diverse audience.

Fishing Hotline

Both telephone and Department website versions of the Region 7 Fishing Hotline were updated weekly. The telephone version received 150 - 400 calls per week and was exceeded by the website version.

Region 8

Public Meetings held on Special Trout Fishing Regulations

Two public meetings were held in June to consider public sentiment towards new trout fishing regulations. One was held in Campbell, the other in Caledonia. One proposal being considered was a regulation to be implemented on all Region 8 trout streams, excluding the Great Lakes and Finger Lakes. It would allow five fish of any size to be kept, with no more than 2 greater than 12 inches in length. The purpose of such regulation would be to spread out the harvest of stocked two year old brown trout. This regulation received considerable support from those who attended the meetings. A proposal was drafted and submitted for implementation beginning October 1, 2002. Another regulation that was considered at only the Caledonia meeting was the new no-kill regulation that was instituted on Oatka creek. A controversy erupted because local trout fishermen expressed their concern for the future of Oatka's wild trout fishery since the new regulation went into effect. They were afraid that the wild trout resource would be lost in the areas that were formerly governed by special regulations, and now have liberal harvest regulations. They feared the liberal harvest regulations sent the wrong message about the value of this wild trout resource. The meeting was held to gather more information from anglers on their desires for trout management on the Oatka. We found that Oatka anglers valued wild trout and wanted regulations to reflect this value. New, more protective regulations, were drafted and submitted for implementation beginning October 1, 2002.

Adult Fishing Clinic

The Fisheries Unit, in conjunction with the Region 8 Fish and Wildlife Extension Unit, conducted it's third summer fishing clinic aimed at an adult audience. The event was conducted at the pond located at the Regional headquarters. Approximately 20 adults were given instruction in fish identification, cooking, fishing techniques, casting and regulations. Despite excellent advertisement, the attendance did not seem to justify the effort, although the attendees were very appreciative. Next year's event will target both adults and children in an effort to boost attendance.

Public Information a Major Effort in Region 8

During the year, Region 8 personnel continued to spread the word on the fine fishing in New York State, especially in the western Finger Lakes Region. Production of the Fishing Line, a weekly update on area fishing, has been very popular. It is sent to 66 outlets by mail, fax and email and listed on Region 8's portion of the Department web page. This page on the website receives 2,000 to 3,000 hits a week and ranks in the top five consistently. Information from the Fishing Line is also included in the Region's weekly Hunting and Fishing Radio Reports taped by sixteen western New York radio stations with an estimated 250,000 listeners. The H & F Report is also available on the Region's web page receiving 400 +/- hits a week. News releases are sent to 223 outlets to inform the public of meetings, activities and management information. Four fisheries specific releases were sent during this period.

Participation in public gatherings is an additional means used to disseminate information on area fisheries resources and its management. Two events drawing thousands of people were the Rochester Outdoor Show and the Region's National Hunting and Fishing Day celebration. Staff have also participated in three DEC sponsored, or cosponsored, fishing clinics and have included aquatic resource management in twenty-nine presentations ranging from school groups to adult audiences. In addition fisheries oriented displays are maintained at the Region's Twin Cedars Environmental Area's center.

An additional effort was expended during the Governor's sponsored "Capitol for a Day" program during its session in Batavia. The Fisheries electro-fishing boat provided the back drop for a question and answer format.

Region 9

SAREP Family Fishing Day at Letchworth State Park

The second annual Letchworth State Park SAREP Family Fishing Day event was held on Saturday of Memorial Day weekend. Although attendance was slightly less than the first year of the event, it still exceeded expectations with over 300 children and over 200 adults attending the 6 hour event. Regional BOF had extensive input and participation at the event, which included teaching fishing at the stocked park trout pond, providing presentations on fish ID, and manning a fisheries display.

Internships/Volunteers

Region 9 BOF accepts interns from area high schools as much as possible. In 2001, four interns worked with Fisheries. Their work included office work such as date entry into computers and scale pressing, while field work consisted of electrofishing and netting. Additionally, the Region finds it helpful to use adult volunteers when needed. These come from angler groups such as Trout

Unlimited or are simply interested sportsmen. In 2001, 25 volunteers contributed 53 days of service to the Region. All interns and volunteers are approved through the Regional Director with appropriate paper work being filled out.

Youth Fishing Clinics and Aquatic Education Efforts

The Region continued to conduct educational efforts to introduce young people to sportfishing and spark interest in aquatic ecology. The outreach events are typically conducted in partnership with local sponsors such as conservation organizations or municipalities. A total of four free family fishing clinics were held, as well as the weekly program conducted at the Rushford Environmental Camp. Many other youth group clinics were attended, such as Boy Scout, Cub Scout, LOTSA Youth Clinic and Trout Unlimited clinics.

Western New York Fisheries Resources

The Fisheries resources slide presentation was given at eleven schools in Region 9 and "on the stream" electrofishing demonstrations were given at two schools. Fisheries presentations were also given at DEC's Rushford Environmental Education Camp in 2001. This effort reached over 950 students with the "Fisheries and Aquatic Resources of Western New York" program. The program is only requested at half the schools as was during the 1980's and 1990's.

Central Office - Inland Section

Northeast Fish and Wildlife Conference

Bureau staff were heavily engaged in the planning and delivery of the 57th Annual Northeast Fish and Wildlife Conference held at Saratoga Springs April 22-25, 2001. Inland Fisheries Section personnel played major roles chairing the Program and Arrangements Committees and the Registration Subcommittee. The Conference was very well received and all aspects of the program went smoothly. Over 800 people were registered and attended some 212 professional papers and 9 workshops and special symposia. A substantial contribution was made to the Association of NE Fish and Wildlife Directors for support of future conferences.

Australians check-out NY's fisheries programs.

Central Office staff coordinated and guided Australian government official on a fact-finding tour of New York's fisheries facilities/projects in August of 2001. The State of New South Wales Minister of Fisheries and Mineral Resources and the Agency Director of Fisheries toured the Salmon River hatchery, the Salmon River corridor, the Oneida Hatchery and visited the Cornell Biological Field Station at Shackelton Point. Staff from these facilities provided presentations and tours and all enjoyed interesting discussions about NY and Australian perspectives on and capabilities for recreational fisheries management.

New York National Boat Show

For the third year in a row, the DEC exhibit at the NY National Boat Show was a grand success. The highlight of the 2002 show was Commissioner Crotty's announcement of the new "I Fish NY" sportfishing outreach initiative. Endorsements for the program were also offered by Pat Augustine, executive director of the New York State Sportfishing Federation, Fred Thorner, vice president of the New York City Chapter of Trout Unlimited, and John Mantione, president of the New York Fishing Tackle Trade Association.

This year's exhibit was the largest yet. Along with the full 40' Division of Fish and Wildlife display of state record fish mounts, the exhibit included an 18' electrofishing boat provided by the Region 1 Fisheries Unit; a 180 gallon aquarium with native marine species provided by Normendeau Associates; and a 135 gallon aquarium with large Long Island strain brook trout provided by Connetquot River State Park and Preserve. The exhibit also included a promotional display by the Conservationist magazine, with a sea kayak that was given away to one lucky person; tables full of literature from the Divisions of Fish, Wildlife and Marine Resources; Public Affairs; Water and Pollution Prevention; and a display by the Hudson River Estuary Program with a 6' sturgeon and stereo microscope attached to a video monitor used to show people the diversity of Hudson River micro invertebrates.

Once again the Bureau of Fisheries Cast for Bass Contest was a top draw with kids and families attending the show. Shakespeare Fishing Tackle was the primary sponsor of the event, donating 100 rod and reel combinations and mini-tackle boxes. Backyard Bass and Cabela's were associate sponsors of the event. Ten casting contests were held and over 500 kids got a chance to either cast for the first time or to get some midwinter casting practice. Every participant received a bag full of information that included the “Getting Started” manual designed to educate new anglers. Those that caught a bass received either a Shakespeare rod and reel combo or mini-tackle box, a backyard bass game, a Cabelas’ Tackle Tote or gift certificates, as well as 20 NYSDEC Puzzles, 200 Lil Skipper dolls (the Boat Show mascot), 15 subscriptions to the Conservationist, and 20 passes to the Noah’s Ark playground. The casting contest has provided an excellent means of reaching out to a large group of the general public, many of which are not currently actively involved in the sport of fishing. Whole families walk away feeling excited about the sport of fishing and have a new understanding of and appreciation for the Bureau of Fisheries and NYSDEC in general.

Sportfishing and Aquatic Resource Education Program (SAREP)

During 2001, the New York State Sportfishing and Aquatic Resource Education Program (SAREP) completed 9 instructor trainings involving 156 participants and 7 shorter term trainings involving 150 participants. Overall it is estimated that over 58,500 youth and 18,000 adults were involved with some sort of SAREP related programming in 2001. Instructors logged over 19,000 hours and taught over 1,300 programs.

Bureau staff spent significant time during the period working with SAREP leader Keith Koupal to revise the program to better meet the Bureau need for an introductory angling education program that will work in conjunction with the Division’s new I FISH NY outreach initiative. Plans for SAREP over the next 5 years were developed to work closely with I FISH NY staff to improve the knowledge of fishing and aquatic resources in developed sections of New York, while maintaining support of active instructors throughout New York State. Unfortunately, Keith Koupal has left SAREP to explore new opportunities in fisheries management in Nebraska. Although plans have yet to be finalized, the Bureau of Fisheries has decided not to renew the SAREP contract with Cornell University and will likely incorporate the program directly into the I FISH NY initiative.

Public Access and Use

Public Use Section - Overview
Regional fisheries personnel obtained purchase agreements for 11.358 equivalent miles of public fishing rights (PFR) and six fisherman parking areas (FPA) during the period 4/1/01 - 3/31/02 (Table 1). Three new FPAs serving easement sections were developed. Since the assignment of $1,000,000 in CW/CA Bond funding to PFR purchases in 1997/98, over 28 (28.078) equivalent miles of new easements have been purchased along with 30 new parking area parcels, at a total cost of $912,929. Considering additional "pending" purchases, the original $1,000,000 is now totally committed.

It was estimated by Section staff last year (2001), that only about half of our total PFR holdings are properly posted. This means there are more than 600 equivalent miles of existing PFR that are not properly posted.

Engineering Design/Capital Construction
The Bureau of Engineering Services provided the Public Use Program with 3.0 staff-years of services this year consisting of: two staff years of design services from the "pool" of design engineers, and 1.0 year of design services provided by Deanne Blanke, Parks Engineer. This group provides all design work, permitting assistance, project bidding, contract award and construction oversight for the entire list of currently funded projects (see proceeding).

Access to Lakes, Ponds and Rivers
Regional staff effort devoted to acquiring and developing new fishing access sites remained at a low level. No general fund capital appropriations for new site development were provided in FY 01/02. However, in recent years, several project have been funded via allocations from the Environmental Protection Fund and the CW/CA Bond Act.

The status of all currently funded projects is listed in the following table.

Project	Amount/Source	Status
Hudson River at Luzerne	$400,000 Bond 99/00 $125,000 Bond 00/01	Completed 2001
Upper Chateaugay Lake	$280,000 Bond 99/00 $220,000 Bond 00/01	Under const.
Chazy Lake	$150,000 Capital 85/86 $ 50,000 Bond 00/01	Under const.
Oneida Lake at Godfrey Point	$250,000 EPF 99/00	Completed 2001
Tupper Lake	$400,000 EPF 99/00 $ 60,000 EPF 00/01	Under const.
Delaware River @ Narrowsburg	$200,000 EPF 99/00	In design & permitting
Riverdale/Greystone Stations (Lower Hudson River)	$650,000 EPF 00/	In design & permitting

During the year, two (2) new Fishing Access Site purchases were completed; Hudson R. at Moreau ("West River Rd. Marina") in Region 5, and Chaumont Bay - Lake Ontario ("Golden's Marina") in Region 6. Five additional small sites were secured via Cooperative Agreements, MOU's, etc. Nine new Fishing Access Sites were developed during the year. See Table 2 for details.

Region 1
Lake Ronkonkoma Fishing Access Renovation
The Region One Fisheries Unit coordinated with the Region One Operations Unit to carry out renovations of the Fishing Access Site at Lake Ronkonkoma during the period when the bass and walleye seasons were open. The site had experienced problems with sinking due to improper fill under the entrance road. In order to fix the problem the Regional Operations Unit excavated the driveway removing 150 cubic yards of improper fill and replacing it with clean fill. The Fisheries Unit assisted in getting NYSDOT to help transport the fill off site. The driveway was graded and graveled and the site was opened in time for the opening day of Walleye Season.

Region 3

DEC acquired one angler parking area parcel on the North Branch Callicoon Creek and one on the Beaverkill. Two new angler parking areas were constructed - one on the Willowemoc and one on the West Branch Beerkill.

A cooperative agreement was signed with the Village of New Paltz, Ulster County to develop two new boat access sites - one for cartop boats and one small trailer launch.

The Narrowsburg boat launch on the Delaware river is slated for rehabilitation with a $200,000 allocation from the Environmental Protection Fund and currently in the design/permitting phase.

Region 4

PFR Marking
A concerted effort to update the posting maintenance of Public Fishing Rights (PFR) easements was made in 2001. A seasonal employee was hired and his time devoted mainly to inspecting these easements and placing new signs where older ones were worn or missing. Because of staff shortages and other priorities, a number of locations have not been marked for several years, leading to confusion by landowners and fishermen alike. Under the guidance of Regional access specialist, this seasonal was able to correct and update signs on 103 of the 181 miles of PFR easements in Region 4 -- that's 57% of the Region's total PFR holdings! Twenty-seven staff days of effort were invested and the average re-posting rate was 3.8 miles/day. Many favorable comments have been received so we plan on bringing him on again for 2002 to complete the job.

New PFR
A new Fisherman's Parking Area and PFR easement were obtained on the Poesten Kill and Quacken Kill in Rensselaer County. An agreement has also been signed to purchase an additional 0.13 equivalent miles on the Poesten Kill adjacent to the recently purchased PFR.

Region 5

DOT and DEC Establish a Cooperative Car-top Boat Access Site to Ray Brook Pond
Fisheries staff met with representatives of the Department of Transportation (DOT) concerning public access to Ray Brook Pond, Essex County. Restoration of the Adirondack Railroad closed an informal access site to this stocked pond. DOT was agreeable to restoring public access but was concerned about safety for people crossing the tracks. Agency representatives agreed to pursue alternative access that avoided the railroad at the meeting, and DOT completed construction of the new site. DEC will provide appropriate signs.

Tupper Lake BLS Modernization Process Begins
The Bureau of Fisheries submitted permit applications for the reconstruction of the Tupper Lake Boat Launch Site on Route 30, Town of Altamont. Three permits were required and obtained, including an Adirondack Park Agency wetland permit, a NYS DEC Water Quality Certification, and a U.S. Army Corps of Engineers Permit. By making modifications to the design plan, the project qualified for coverage under the US Army Corps of Engineers nationwide permit. The project proposal included a new ramp and sheet-pile shore protection; paving and modernizing the parking area; installation of floating docks including a separate dock/access area for and handicapped access.

Construction began and a great deal of work has been accomplished toward the reconstruction of the Tupper Lake Boat Launch. The contractor, Delaney Construction of Mayfield, worked steadily since early January and made major strides despite mid-winter conditions. All site dredging was completed. The steel sheetpile shore protection was installed. The new concrete ramp was poured. The stone shore protection was installed along the west shore and the barrier-free handicapped access pier was constructed.

Efforts to Improve Access Continue at Other Sites
The reconstruction of the Hudson River Boat Launch at Lake Luzerne was completed. The facility has been modernized and the construction appears to be top quality. The Department can take pride in this facility.

The reconstruction of the Chazy Lake Boat Launch was completed by late autumn. The reconstruction of the Chateaugay Lake Boat Launch was scheduled to began in September 2001, and is nearly completed as of this writing.

An inspection was done of the Fourth and Seventh Lakes launches in the Town of Inlet, Hamilton County. These sites both had serious problems which were addressed during the low water in fall and early winter 2001-2002. In short, a new concrete ramp was installed at Fourth Lake and a re-cycled steel mat ramp was installed at Seventh Lake.

Region 6

Public Access - Closing papers were signed completing the acquisition of Golden's Marina in the Town of Lyme. Jefferson County. This 13 acre property offers important lake access to the public and a safe harbor area on Lake Ontario.

Completed the acquisition of 0.43 equivalent miles of Public Fishing Rights on Skinner Creek in the town of Ellisburg, Jefferson County. Skinner Creek is a Lake Ontario tributary and supports fishing for wild steelhead and chinook salmon, as well as resident brown trout. The agreement also includes a 600+ foot long footpath from an existing developed fisherman parking area to provide access to the stream.

A FWMA Cooperative Agreement was signed with a landowner on Jacobs Creek. Nearly one mile of this popular Jefferson County trout stream will now be opened to the angling public.
Additional access sites were developed on the recently acquired Sucker Lake and North Sandy Creek. Phase 2 of the modernization of the Godfrey Point Boat Launch site on Oneida Lake was also completed. The parking area was expanded to 56C/T capacity with one handicapped spot and six cars including two handicapped places. The entire parking area and entrance road was paved and paint striped and also incorporated a "made-ready/tie-down" area for staging on the approach loop to the launch ramp. The existing toilet building was removed and replaced with an enclosed Port-a-John facility that is handicapped accessible.

Region 7

NYS DOT Environmental Initiative Projects:
Oneida Lake at Bartell Road and Swamp Road- Working in conjunction with the I-81 bridge resurfacing project, there were two separate handicap accessible sites constructed. The first, in Onondaga County, at Bartell Road, utilized an existing Park and Ride parking lot. This lot is spaced for 39 vehicles, including three spaces reserved for handicap parking. There is a paved wheel chair accessible trail leading from the parking area to the south shore of Oneida Lake. DOT installed a 100 ft. pedestrian bridge to access an island for shoreline fishing opportunities.

The second site is located on the north shore of Oneida Lake in Oswego County and is accessible from Swamp Road. This site has a new, paved parking area for 16 vehicles, including two spaces reserved for handicap parking. A paved wheel chair accessible trail leads to the shoreline and on to a treated wood surfaced fishing pier.

Appalachin Bridge Fisherman Access Site- In conjunction with a new bridge over the Susquehanna River near the hamlet of Appalachin in Toga County, DOT constructed a Fisherman Access Site. This site includes a gravel surfaced parking area that will accommodate 15 car/trailer units, and a concrete launch ramp.

Salmon River- In conjunction with the new NY. Rte. 3 bridge over the Salmon River in Oswego County, the DOT constructed a Fisherman Access Site. This site has parking for nine vehicles, including one space reserved for handicap parking. A handicap accessible trail goes from the paved parking area to a fishing platform. There is also non-handicap accessible shoreline fishing.

All of the above sites include landscaping with shrubs.

Otselic River- In cooperation with DOT, DEC Operations crews constructed an eight car Fisherman Access Site on DOT property, on the Otselic River, Cortland County, Town of Taylor. This site has a gravel surfaced access driveway and parking area.

Public Fishing Rights:
Ninemile Creek, Onondaga County- Through an agreement with Save The County, 1.798 eq.mi. of Public Fishing Rights was purchased. The purchase included a 261 ft. Footpath easement. Also, from another individual, a small Fisherman Parking Area was purchased, fee title, which includes approximately 90 ft. of stream frontage.

Region 8

Public Fishing Rights

Fishing Rights (2.891 eq. mile) were acquired on Cayuta Creek, Schuyler and Chemung Counties and on Johnson Creek, Orleans County. A 2.49 acre Fisherman Parking Area was also acquired on Oak Orchard Creek in Orleans County. Agreements were signed on another 2.991 eq. miles of Public Fishing Rights on Cayuta Creek and the Cohocton River, Steuben County.

Chemung River Trail Partnership

Three new boat launches were developed on the Chemung River trail bringing the total developed sites to six. The 3 new sites are Bottcher's Landing in Big Flats (T), Dunn Field in Elmira and Toll Bridge Park in Ashland (T). Work was also started at a fourth site at the Route 427 crossover in Chemung (T). Two new sites at Grove Street in Elmira and Conhocton Street in Corning are slated to be developed in 2002/03.

Seneca Lake (Severne Point) FAS

Stewardship funding from the Environmental Protection Fund was awarded for Phase 2 development of the Seneca Lake FAS. Parking was expanded from 25 cars/trailers to 43 cars/trailers. Development is now complete at this popular site.

Region 9

Stream Access

Approximately ½ mile of PFR was secured on California Hollow Creek, an excellent trout stream in Allegany County. This stream is stocked with trout annually and experiences heavy angler effort.

Fish Culture

Fish Culture Section

SPDES Permit Modifications

Discharge permits for all 12 of DEC's fish hatcheries were modified in 2001 to provide a consistent set of permit conditions for therapeutic chemical treatments used to control fish diseases or parasites. In cooperation with Division of Water staff, an updated reporting format was developed and implemented so that compliance with limits protective of aquatic fauna (ambient guidance values) could be demonstrated clearly for all treatments and reported on each Discharge Monitoring Report submitted by an individual hatchery. Additional system wide permit modifications standardized the deadlines for submission of Discharge Monitoring Reports to more closely correspond with the time required to receive results of laboratory analyses, and to standardize methods of quantifying the dilution factor of receiving waters.

As part of this overall process, Kathleen Wrotniak, Fish Culturist I at Salmon River Fish Hatchery, developed a Therapeutic Chemical Usage Form and a computer program that allows hatchery personnel to easily model treatment concentrations and dilution flows before actual treatments are conducted. This program provides a valuable tool that quickly shows how much hatchery flow can be treated while maintaining compliance with ambient guidance values.

USFWS Cold Water Fish Culture Course Hosted by DEC

In January 2002, the Cold Water Fish Culture course, coordinated by the USFWS National Conservation Training Center was presented in Syracuse, NY at the request of DEC staff. Because of the favorable location, 20 staff persons from DEC's fish hatcheries were able to attend. Course topics included fish nutrition, fish health management, fish physiology, fish hatchery management, broodstock genetics and culture of various life stages of cold water fish. This course provided valuable information on the most current technology used in cold water fish culture, and provided the opportunity for nearly 30% of DEC's hatchery staff to upgrade their knowledge and skills.

New Fish Stocking Trucks

Thirteen new, large fish stocking trucks were ordered via state contract, with arrival scheduled for May 2002. The cost of the trucks was $642,000, with funding provided by General Fund Capital Appropriations earmarked for Fish Hatchery Equipment. This purchase will allow replacement of all 1983-84 vintage stocking trucks. Stocking tanks, life support systems, and electronic monitoring capability will be installed on the trucks later in 2002 and the trucks will be available for spring stocking in 2003. The NYSDEC fish hatchery system stocks approximately 1 million pounds of fish from 12 fish hatcheries. Hatchery vehicles travel over 400,000 miles annually in fulfilling rearing and stocking program activities.

Adirondack Fish Hatchery

Large-scale feeding of landlocked salmon an ultra-low-phosphorus diet containing phytase to reduce phosphorus discharges at the Adirondack Fish Hatchery (2001).

This study represents a culmination of several pilot tests to develop a diet to markedly reduce the amount of excess dietary phosphorus that is not retained by fish. An ultra-low phosphorus (0.645% P) diet was fed to fingerling landlocked salmon *(Salmo salar)* at the NYS-DEC Adirondack Fish Hatchery at Saranac Lake, New York. The diet contained 10% fish meal, 5% fish hydrolysate, and increased levels of plant proteins and other low-phosphorus ingredients shown to be effective in rearing healthy salmon. Growth, bone ash, survival, feed conversion, and the amounts of waste phosphorus generated in effluents were determined. Modification of fish feed formulas represents one component of the Best Management Practices Plan for reducing phosphorus discharges in the Adirondack Hatchery effluent.

Fingerling landlocked salmon (initial mean weight, 17.4 g/fish) were acclimated in eleven circular tanks (26,050 fish/tank) and fed a standard feed before the test. The test diet was fed for 31 days starting September 14 until October 15, 2001.

The amounts of daily feed fed were calculated to supply 2.0% of body weight daily at the beginning of the experiment and decreased to 1.25% by the end. Mean body weights for fish in each tank were determined at the beginning of each experiment and every 2 weeks thereafter. The amount of waste phosphorus discharged was determined by calculation from the amount of phosphorus fed during the study less the amount retained in fish. The amount of dietary phosphorus fed to fish was determined (for each lot of fish) from analyses of P in feed fed. The amount of phosphorus retained in fish was determined by analyses of P in carcasses at the beginning (0.39%) and the end (0.38%) of the period. The amount of dietary phosphorus discharged as wastes was determined by the difference between the amount of phosphorus fed and the amount retained in the carcass during the study. At the end of the study, staff from the NYS-DEC Fish Health Laboratory in Rome, NY conducted a standard fish health assessment on the fish.

After 31 days of feeding, results showed that the experimental ultra-low-phosphorus (0.645%) diet containing phytase supported typical or normal growth, feed efficiency, survival, bone development and health in fingerling landlocked salmon, while generating the lowest amount of waste phosphorus discharged in water yet achieved at the hatchery. Salmon fed this diet discharged only 28.8% of the phosphorus consumed. That equated to 1.53 or 1.86 grams of phosphorus per kilogram of weight gain or feed fed.

Staff from the NYS-DEC Fish Health Laboratory in Rome (NY) examined 20 fish from the beginning and at end of the test. Diet had no apparent impact on condition factor, hematocrit, leucocrit or plasma protein. There were no observable impacts of feed on the eyes, gills, pseudobranchs, thymus, mesentery fat, spleen, hindgut, kidney, liver, or bile; therefore the fish were apparently in good health.

This large-scale hatchery test showed that an ultra-low-phosphorus (0.645%) diet containing phytase supported normal or excellent growth, feed efficiency, survival, bone development and health in fingerling Atlantic salmon while accomplishing the greatest retention of dietary phosphorus observed at the hatchery. Therefore, the amounts of wasted phosphorus were the lowest yet observed**.**

Bath Fish Hatchery

In 2000-2001 the Bath Hatchery produced 82,000 pounds of trout. This included domestic browns and rainbows, wild Finger Lakes strain rainbows and lakers, and Finger Lakes hybrid rainbows. The wild rainbow eggs were obtained from adults collected at the Cayuga Inlet fish ladder by Region 7 fisheries personnel. The hybrids were created using Cayuga Inlet females and domestic Randolph Hatchery males.

The lake trout egg take was one of the shortest in recent memory. It lasted five days from 10/9 to 10/13/00. Two crews were utilized, one each at Cayuga and Seneca. A total of 147 females were stripped from both lakes. 507,000 eggs were collected.

The heated pole barn shop was completed by the hatchery crew. The electric service line and meter to the residence were replaced. A propane-fired steam boiler furnace was purchased for the residence. It will be installed this coming summer.Upcoming R&I projects include repairing the garage foundation, installing a new service entrance in the residence, and installing an underground electric feeder line to the garage.

Van Hornesville Hatchery

During fiscal year 2001-2002 the Van Hornesville Fish Hatchery produced 33,290 lbs. of domestic rainbow trout using 37,360 lbs of food for a conversion of 1.12. Starting with 315,000 eggs acquired from the Randolph Hatchery in October/November of 1999 the staff at Van Hornesville produced an end result of 250,000 fish that were either transferred to other NYS facilities or stocked. No major losses were experienced due to diseases or human error. The Van Hornesville facility retains an A-1 disease classification and during the past year there was no therapeutic treatment utilized on the fis

Van Hornesville stocked over 165,000 yearling fish, 41,000 lbs., of 5 different coldwater species; brown, brook, rainbow and lake trout and Atlantic salmon. Another 9,400 two year old brown trout, 10,859 lbs., were also stocked. All species stocked other than rainbow trout were obtained from other hatcheries. 8,838,000 fry/fish, 3153 lbs. of three cool water species; walleye pike, muskellunge and tiger muskellunge, were stocked.

Physical projects under construction during the past year include: building a pond cover to exclude avian predators, a new moveable visitor information kiosk has been put into use. and a 15 ft. extension was added to the 30 ft. truck barn to allow winter storage of the new larger stocking truck. A local company, Empire Fiberglass, applied a prototype lining to a deteriorated hatchery raceway to help extend its usefulness.

On March 26, 2002 the Van Hornesville Area experienced a severe ice storm. Power was off for 46 hours. Nearly 100 of the Red Pine trees that border the hatchery were blown down or snapped off. No injuries to personnel, or loss of fish were experienced, but a mess was left which took a crew from Operations Unit several weeks to clean-up.

Two off- site presentations were given to area schools and a trout egg incubation and hatching program was provided for the Owen D. Young 4th grade classroom. A total of 200 eggs were incubated in the classroom, resulting in 100 fingerlings from the program. The kids enjoyed watching mother nature do her thing!

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Annual Report of Fish Species Production by Hatchery
April 1, 2001 - March 31, 2002

	Fry		1" - 4 1/4"		4 1/2" - 5 3/4"		6" - 6 3/4"		7" - 7 3/4"		8" plus		Total	
Species	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**
Brook Trout														
Adirondack			95,049	2,366	23,230	883					14,840	4,795	133,119	8,044
Bath											3,810	1,268	3,810	1,268
Caledonia							400	44					400	44
Catskill											6,790	2,377	6,790	2,377
Chateaugay			35,470	850	7,700	339	2,200	255			37,040	10,526	82,410	11,970
Randolph											12,265	4,497	12,265	4,497
Rome			13,073	163	177,760	6,481					35,270	12,024	226,103	18,668
Salmon River					2,000	63					7,700	1,925	9,700	1,988
Van Hornesville			600	16							2,080	548	2,680	564
Total			**144,192**	**3,395**	**210,690**	**7,766**	**2,600**	**299**			**119,795**	**37,960**	**477,277**	**49,420**
Brown Trout														
Adirondack							650	63			61,170	16,777	61,820	16,840
Bath			95,000	1,874	28,250	1,788			2,600	477	159,810	52,218	285,660	56,357
Caledonia							700	82	21,900	4,018	271,290	105,911	293,890	110,011
Catskill											404,410	144,523	404,410	144,523
Chateaugay					800	57	300	31			126,630	33,209	127,730	33,297
Randolph			160,000	2,566	14,750	1,003	5,200	433			154,200	48,904	334,150	52,906
Rome					31,400	2,133	2,400	226	1,200	164	324,400	90,971	359,400	93,494
Salmon River					134,420	4,201			7,820	1,372	190,490	37,948	332,730	43,521
Van Hornesville					2,800	179					145,290	40,822	148,090	41,001
Total			**255,000**	**4,440**	**212,420**	**9,361**	**9,250**	**835**	**33,520**	**6,031**	**1,837,690**	**571,283**	**2,347,880**	**591,950**
Rainbow Trout														
Adirondack					12,000	706					28,160	8,210	40,160	8,916
Bath			53,000	571			44,000	4,696	28,000	4,445	20,115	6,019	145,115	15,731
Caledonia											67,950	17,844	67,950	17,844
Catskill							2,000	165			44,340	12,538	46,340	12,703
Chateaugay					56,500	4,122	69,000	6128			84,960	25,801	210,460	36,051
Randolph									2,000	292	39,380	14,015	41,380	14,307
Rome											51,330	12,603	51,330	12,603
Salmon River											7,880	1,926	7,880	1,926
Van Hornesville							3,270	314			27,190	8,780	30,460	9,094
Total			**53,000**	**571**	**68,500**	**4,828**	**118,270**	**11,303**	**30,000**	**4,737**	**371,305**	**107,736**	**641,075**	**129,175**

Annual Report of Fish Species Production by Hatchery
April 1, 2001 - March 31, 2002

	Fry		1" - 4 1/4"		4 1/2" - 5 3/4"		6" - 6 3/4"		7" - 7 3/4"		8" plus		Total	
Species	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**
Rt-steelhead														
Chateaugay					20,000	662							20,000	662
Salmon River					563,800	22,482	195,000	14,871					758,800	37,353
Total					**583,800**	**23,144**	**195,000**	**14,871**					**778,800**	**38,015**
Lake Trout														
Adirondack							29,250	2,024	450	36			29,700	2,060
Bath							121,200	6,774			89,500	15,411	210,700	22,185
Caledonia							111,500	7,892	240,000	20,086			351,500	27,978
Catskill							11,100	793					11,100	793
Chateaugay							6,850	496	39,600	3,288			46,450	3,784
Rome							8,350	618	4,150	323			12,500	941
Salmon River							36,000	2,666	112,000	8,746			148,000	11,412
Van Hornesville											5,000	1,000	5,000	1,000
Total							**324,250**	**21,263**	**396,200**	**32,479**	**94,500**	**16,411**	**814,950**	**70,153**
Splake														
Adirondack									3,540	578			3,540	578
Chateaugay									300	49	5,600	1,902	5,900	1,951
Rome									3,500	588	5,200	1,090	8,700	1,678
Total									**7,340**	**1,215**	**10,800**	**2,992**	**18,140**	**4,207**
Landlocked Salmon														
Adirondack			594,500	572	81,000	2,594			193,380	22877	500	3,605	869,380	29,648
Bath									52,000	6,011			52,000	6,011
Catskill									3,000	349			3,000	349
Chateaugay							41,220	4,087	37,930	4,734			79,150	8,821
Rome									1,950	227			1950	227
Salmon River							49,600	3,900					49,600	3,900
Van Hornesville									4,200	525			4,200	525
Total			**594,500**	**572**	**81,000**	**2,594**	**90,820**	**7,987**	**292,460**	**34,723**	**500**	**3,605**	**1,059,280**	**49,481**
Coho														
Salmon River					155,000	6,145			101,000	11,663			256,000	17,808
Total					**155,000**	**6,145**			**101,000**	**11,663**			**256,000**	**17,808**

Annual Report of Fish Species Production by Hatchery
April 1, 2001 - March 31, 2002

	Fry		1" - 4 1/4"		4 1/2" - 5 3/4"		6" - 6 3/4"		7" - 7 3/4"		8" plus		Total	
Species	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**
Chinook														
Caledonia			126,610	1,096									126,610	1,096
Salmon River			1,502,800	16,286									1,502,800	16,286
Total			**1,629,410**	**17,382**									**1,629,410**	**17,382**
Kokanee														
Adirondack			160,000	706									160,000	706
Catskill			4,800	23									4,800	23
Rome			21,820	122									21,820	122
Van Hornesville			15,200	39									15,200	39
Total			**201,820**	**890**									**201,820**	**890**
Total Number Trout & Salmon			**2,877,922**	**27,250**	**1,311,410**	**53,838**	**740,190**	**56,558**	**860,520**	**90,848**	**2,434,590**	**739,987**	**8,224,632**	**968,481**
Walleye														
Adirondack					32,930	1,220							32,930	1,220
Bath	9,970,000	133											9,970,000	133
Caledonia			36,340	63									36,340	63
Catskill			10,000	21	9,000	391							19,000	412
Chateaugay	2,284,000	30	10,000	27	9,100	297							2,303,100	354
Chautauqua			235,500	187									235,500	187
Oneida	169,753,000	2,261			103,000	4,478							169,856,000	6,739
Randolph			5,500	11	5,500	204							11,000	215
Rome	5,200,000	69	6,120	13									5,206,120	82
Salmon River	6,650,000	89	16,500	27	16,500	611							6,683,000	727
Van Hornesville	8,678,000	116	14,500	30	3,600	133							8,696,100	279
Total	**202,535,000**	**2,698**	**334,460**	**379**	**179,630**	**7,334**							**203,049,090**	**10,411**
Muskellunge														
Bath											5,800	446	5,800	446
Chautauqua	362,000	13	198,000	24	12,700	146					21,900	1,931	594,600	2,114
Total	**362,000**	**13**	**198,000**	**24**	**12,700**	**146**					**27,700**	**2,377**	**600,400**	**2,560**
Tiger Muskellunge														
Bath											12,030	1,835	12,030	1,835
Caledonia											9,500	1,384	9,500	1,384
Catskill											9,450	1,383	9,450	1,383
Chateaugay											1,900	271	1,900	271

Annual Report of Fish Species Production by Hatchery
April 1, 2001 - March 31, 2002

	Fry		1" - 4 1/4"		4 1/2" - 5 3/4"		6" - 6 3/4"		7" - 7 3/4"		8" plus		Total	
Species	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**
Tiger Muskellunge (cont.)														
Randolph											1,500	214	1,500	214
Rome											21,950	3,098	21,950	3,098
Salmon River											10,440	1,358	10,440	1,358
So. Otselic											3,000	461	3,000	461
Van Hornesville											20,150	2,868	20,150	2,868
Total											**89,920**	**12,872**	**89,920**	**12,872**
Paddle Fish														
Randolph	1,878	498											1,878	498
Total	**1,878**	**498**											**1,878**	**498**
Panfish														
Chautauqua											3,000	600	3,000	600
Total											**3,000**	**600**	**3,000**	**600**
Total Number Warmwater Fish	**202,898,878**	**3,209**	**532,460**	**403**	**192,330**	**7,480**					**120,620**	**15,849**	**203,744,288**	**26,941**

Hatchery Fish Production Annual Summary by Species
April 1, 2001 - March 31, 2002

	Fry		1"- 4 1/4"		4 1/2" - 5 3/4"		6" - 6 3/4"		7" - 7 3/4		8" plus		Total	
Species	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**	**Number**	**Weight**
Cold Water														
Brook Trout			144,192	3,395	210,690	7,766	2,600	299			119,795	37,960	477,277	49,420
Brown Trout			255,000	4,440	212,420	9,361	9,250	835	33,520	6,031	1,837,690	571,283	2,347,880	591,950
Rainbow Trout			53,000	571	68,500	4,828	118,270	11,303	30,000	4,737	371,305	107,736	641,075	129,175
Rt-steelhead					583,800	23,144	195,000	14,871					778,800	38,015
Lake Trout							324,250	21,263	396,200	32,479	94,500	16,411	814,950	70,153
Splake									7,340	1,215	10,800	2,992	18,140	4,207
Landlocked Salmon			594,500	572	81,000	2,594	90,820	7,987	292,460	34,723	500	3,605	1,059,280	49,481
Coho					155,000	6,145			101,000	11,663			256,000	17,808
Chinook			1,629,410	17,382									1,629,410	17,382
Kokanee			201,820	890									201,820	890
Total Number Trout & Salmon			**2,877,922**	**27,250**	**1,311,410**	**53,838**	**740,190**	**56,558**	**860,520**	**90,848**	**2,434,590**	**739,987**	**8,224,632**	**968,481**
Warm Water														
Walleye	202,535,000	2,698	334,460	379	179,630	7,334							203,049,090	10,411
Muskellunge	362,000	13	198,000	24	12,700	146					27,700	2,377	600,400	2,560
Tiger Muskellunge											89,920	12,872	89,920	12,872
Paddle Fish	1,878	498											1,878	498
Pan Fish											3,000	600	3,000	600
Total Nuimber Warmwater Fish	**202,898,878**	**3,209**	**532,460**	**403**	**192,330**	**7,480**					**120,620**	**15,849**	**203,744,288**	**26,941**
Grand Total of Trout & Warmwater Fish	**202,898,878**	**3,209**	**3,410,382**	**27,653**	**1,503,740**	**61,318**	**740,190**	**56,558**	**860,520**	**90,848**	**2,555,210**	**755,836**	**211,968,920**	**995,422**

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Endangered, Threatened, and Special Concern Species

Region 1

Otis Pike Pond Reclamation
The Regional Fisheries Unit coordinated the reclamation of a small pond on the Otis Pike Preserve. This pond is a authenticated breeding pond for the tiger salamander (*Ambystoma tigrinum*), a New York State endangered species. The Region 1 Natural Resources Unit was advised on September 18, 2000 that mosquitofish (*Gambusia sp.*) and golden shiner (*Notemigonus crysoleucas*) had become established in the pond. Mosquitofish are known to be predators on amphibians and the inability of tiger salamanders to spawn successfully in waters with established fish populations is well documented. To allow the tiger salamanders to breed in this pond in 2001, The Regional Fisheries Unit coordinated with the Wildlife Unit, Habitat Unit, Pesticides Unit and Environmental Permits to secure emergency authorization to have the pond treated with rotenone in October, when the tiger salamanders were not in the pond.

Licensed Pesticide Applicators were contacted and the lowest bid was submitted by L.I.F.E. Inc. of Stormville NY. The treatment was completed on October 19 under the supervision of the Regional Fisheries and Pesticides Units. A follow up inspection on the morning of October 20 revealed a good kill of golden shiner, mosquitofish and brown bullhead (*Ameiurus nebulosus*). Unfortunately a follow up inspection the following week revealed that there were still mosquitofish and brown bullhead alive in the pond. Arrangements were made for a second treatment of the pond, but a cold snap the day before the planned second treatment dropped the water temperature too low for the treatment to be effective. Consequently, reclamation efforts were abandoned and plans were initiated to complete reclamation of the pond in the summer of 2001.

Region 9

Paddlefish Restoration
2001 was the fourth consecutive year that paddlefish were released into Kinzua Reservoir (1998 - 46, 1999 - 535, 2000 - 135, 2001 - 1,878). The paddlefish measured 6.4 inches (eye to fork of tail) and appeared to be in good condition when released. A coded wire tag was inserted into the paddle of all paddlefish before release. As of March, 2002 nine reports of paddlefish either stranded or caught angling have been received. Stocking and tag recovery information was forwarded to MICRA.

Statewide

Recovery activities for Endangered/Threatened fish species
Restoration efforts for paddlefish, round whitefish and lake sturgeon resulted in stocking of 4,400 whitefish (spring fingerlings to three Adirondack waters) and 1,900 paddlefish (four times the usual allotment to Allegheny Res.). Lake sturgeon eggs suffered complete mortality after two weeks of development. The round whitefish recovery plan was updated with the cooperative efforts of Regions 5 and 6. Progress toward lake sturgeon restoration, 1995-2001 was summarized in a manuscript to be in the proceedings of a July 2001 conference in Wisconsin.

Surveys conducted at 163 sites provided catches and updates on several rare species including bluebreast darter, mountain brook lamprey, bigeye chub and eastern sand darter. Apparent declines by the swallowtail shiner in the north central part of Susquehanna basin were studied in association with their apparent replacement by mimic shiners (new to the basin). Summary reports are available on fishes in the upper Niagara R., Allegheny basin and in northern rivers extending from the Poultney to the Black Rivers. Extensive editorial review was offered to a series of reports, which were part of an effort classifying 21 fish species as AAt Risk@ for the Northeast US.

Urban and Suburban Fisheries

Region 1

Training to Park Police

Fisheries staff assisted Division of Law Enforcement staff in conducting ECL enforcement training for New York State Parks Police and for Suffolk County Parks Police. The purpose of the training was to familiarize parks police with portions of the ECL that they are likely to have opportunity to enforce in the course of their usual duties. Fisheries staff gave a 45 minute presentation on the identification of freshwater fish species common to Long Island and the angling regulations pertaining to these species. The presentation also included a brief overview of the responsibilities of the Bureau of Fisheries and a case study of a fisheries management problem. The case study was included to give the officers a basic understanding of why fishing regulations are imposed, how they are developed, and how their biological impact is evaluated by biologists. A total of four training sessions were given, two for Suffolk County Park Police and two for New York State Park Police.

Central Office - Inland Section

I FISH NY

Substantial progress was made in the planning of the Division of Fish, Wildlife and Marine Resources's new **I FISH NY** outreach initiative. A steering committee comprised of Division staff from Regions 1,2,3 and Central Office, as well as representatives from the Division of Public Affairs and Education and Law Enforcement was organized and met on a monthly basis to develop a strategy for implementing the initiative. The program was kicked off at a Press Conference at the 2002 New York National Boat Show, where Commissioner Crotty officially announced the initiative. In addition to the completion of the strategic plan, initial plans for year 1 of I FISH NY, include the development of promotional and informational materials, as well as the gathering of baseline information on the knowledge of residents of the focus area on fishing and aquatic resources which will be used to measure the future success of the program.

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Administration

Region 1

Database Management

During fiscal year 2000/2001, the Regional Fisheries Unit made a big push to update the fisheries database and catch up on the backlog of surveys that were outstanding. One hundred fifty four surveys were sent up to the Biosurvey Unit representing new surveys and old style Data Verification Reports (DVR) dating back to 1992. Many of DVRs were of surveys that had been lost from the database at some time and had to be re-entered into the database. Of the 154 surveys sent up, 58 were returned to the Regional Fisheries Unit by March 31, 2001. Fifteen of those surveys had their DVRs reviewed and were sent back to the Biosurvey Unit for processing. Twenty-two surveys were returned to the Region as finalized.

Region 3

Triploid Grass Carp Stocking Permits

Region 3 issued a total of 293 permits (149 reissues) to stock triploid grass carp (TGC) in 2001. From 1991 through 2000 a total of 2,646 TGC permits have been issued in the Region. About one third of these were reissued permits for waters that already had permits to stock these fish in previous years. Also during this period, 96 of these permit applications required additional review following the SEQRA process given that the ponds were over 5 acres in size or had permanently flowing outlets. We estimate that over 1,900 different water bodies in Region 3 have received permits to stock TGC since 1991.

Region 4

Presentation Given

Staff attended the “Managing River Flows for Biodiversity” conference at Colorado State University and gave a presentation on the Beaver Kill Willowemoc watershed study. Co-presenters included Jock Conyingham of Trout Unlimited, Wayne Reynolds, Commissioner of the Delaware County Department of Public Works, Joel Robinson of the NYS Department of Transportation, and Piotr Parasiewicz of Cornell University. The conference, dealing with man’s impact on and use of riverine ecosystems, was attended by more than 300 people representing many states as well as Canada, Mexico, and Australia.

FMIS Team Participation

Staff participated with the Department’s Financial Management Information System Team, one of the Goal 1 “Action Teams.” This team is charged with assessing fiscal processes in the agency and to recommend improvements in these systems. During this past year the team has gathered requirements from both Central Office Units as well as selected Regions, summarized and prioritized these requirements, and developed a “Request for Proposal” which was then sent to selected vendors having appropriate software. Two vendors presented product demonstrations to the team in October and their submissions are currently being studied with an eye toward making a vendor selection in early 2002. The modern accounting system selected will ultimately replace the fragmented accounting and project tracking systems now in use.

Hoosic River Chemical Spill

On June 28, 2001 a chemical spill by the Oak Mitsui Corporation, entered the Hoosic River (Rensselaer Co.) and significantly impacted aquatic life for approximately seven miles from Hoosic Falls to Buskirk. The Fisheries Unit conducted extensive surveys of the impacted reach and developed estimates of the extent of the kill. The estimates run into millions. These data have been continually refined as the case proceeds. It is expected that Unit involvement will continue for at least the next year.

Water Quality and Stream Protection Violations

Region 4 Habitat and Fisheries Unit Biologists typically review in excess of 300 projects involving activities in and around streams and other protected water bodies within the nine-county area comprising Region 4. In addition, there are a number of violations which must be documented and referred during any given year. The retirement of a critical Habitat Biologist has seriously impacted the Fisheries Unit as well as the remaining Habitat person. Until that position is filled, several of our traditional fish management activities will have to be curtailed. Examples of recent violations include stream bank disturbances on Cherry Valley Creek

(Otsego County), construction-related disturbances on Spring Brook (Delaware County), stream bank and bridge construction disturbances on Catskill Creek (Albany County), improper culvert placement on Honest Brook (Delaware County), improper construction activities on Indian Creek (Columbia County), Article 17 water quality violations in Delaware County from logging activities and illegal pond construction in a course of a stream.

Habitat staff is assisting in the development of Stream Corridor Management Plans on the West Branch of the Delaware River (above Cannonsville Reservoir), and on the Stony Clove and Broadstreet Hollow which flow from Greene into Ulster County. County Soil and Water Conservation Districts are the lead agencies working in cooperation with landowners, businesses, conservation groups, the NYC DEP, as well as DEC staff. All plans will be based on the principles of fluvial geomorphology and each stream will have one or more demonstration projects constructed to address unstable, eroding stream segments.

Habitat and Fisheries staff are working with NYC DEP, County Soil and Water Conservation Districts, and the USGS to select and/or develop a methodology to evaluate in-stream fish habitat. The procedures developed will be used in streams throughout the NYC watershed area.

Region 5

Larry Strait Leaves State Service

Fisheries Manager Larry Strait left state service April 2001 to pursue other interests. A strong dedication to Adirondack brook trout and Lake Champlain landlocked salmon management marked his career.

Burt Morehouse Retires

Principal Fish & Wildlife Technician Burt Morehouse retired effective May 24, 2001, after 37 years with the Bureau of Fisheries. He will be missed, as will his knowledge and expertise.

Region 7

Database Management

The backlog of surveys has been eliminated. A total of 115 surveys were sent into the Biosurvey Unit during the past year and a total of 225 DVR's were received, reviewed and returned for final update into the Statewide Data Base.

Unit Management Planning

Staff supplied fisheries resource data and management information for three Division of Lands and Forests Unit Management Plans (UMP): Rogers Center UMP - Chenango County, Tioga UMP - Tioga County, and Five Streams UMP, Chenango County.

Permits and Licenses

The following number of permits and licenses were issued by the Fisheries Unit:
Bait Licenses - 75; Farm Fish Pond Licenses - 194; Triploid Crass Carp Permits - 216; Permits to stock or remove fish - 25; Piranha Permits - 6.

Region 8

Triploid Grass Carp Permits

The number of triploid grass carp permits for FY 2001 increased from the previous two years and approached the all time high in 1998. The Region issued 404 permits in FY 2002 compared to 337 in FY 2000, 372 in FY 1999 and 410 in FY 1998. Most were for individually owned ponds less than one acre in surface area. No permit fee is charged and the administration involved with this relatively new program is substantial.

Farm Fish Pond Licenses

The Region issued 195 farm pond licenses in FY 2001. Again, there is no fee for this five year license.

Bait Licenses

With the elimination of sporting license sales in the Region, the Fisheries Key Board Specialist adopted an additional duty of issuing bait licenses. She issued 91 bait licenses and handled $1,039 in license fees.

Region 9

Triploid Grass Carp Permits

The number of grass carp permits issued this year was almost 500, which has held true for three years. It would seem that this may be the threshold for grass carp permits.

Inland Fisheries

Regulatory Endevors
Inland staff continued to fine-tune proposed NYCRR amendments to provide for the sale of hatchery reared black bass in New York fish markets and resturants. Proposals originally submitted in 1995 were updated and then revised to accomodate suggestions from legal office and law enforcement staff. The latest proposal was forwarded for legal and executive office approval on March 11, 2002. Inland staff also contributed substantially to the review and finalization of the numerous sport fishing regulation change proposals submitted by Regional units for the October 2002 license year. During this fiscal year, Central Office staff coordinated review of 78 Scientific Collector License Applications.

Federal Aid Coordination
The Section prepared applications for the Bureau's Research and Management Grant (F-48-R) and its Aquatic Education Grant (F-50-E). Staff also compiled performance reports for these grants which encompass 15 studies and 62 jobs. The Bureau's grant guidelines handbook was updated and Section Heads within central office assumed responsibility for administrative as well programmatic oversight of studies under their respective section.

Progress on the Statewide Fisheries Survey Database
Substantial progress was made in restructuring the Fisheries Database into an efficient set of ACCESS tables along with updated and improved field forms and data entry screens. Biosurvey Unit staff continued to process and enter data from backlogged, “found” and new (2001) surveys into the database. As of March 31, 2002 some 500 surveys had been entered and verified to the database.

Statewide Fish Stocking Policies Book
The computerized “Stocking Policies Book” was converted to an interactive, more user friendly ACCESS database. The new structure allows for more direct and efficient interaction with Regional offices and fish culture units on annual adjustments and preparation of annual stocking target numbers. It also provides for easy reference to stocking policies for individual waters and quick summaries of policies by locations and species. The new stocking book database provides a number of convenient searches and reports that allows the rapid retrieval of summary information from the 2366 records currently contained in the database. During 2001-2002, 178 policies were modified, 87 were deleted and 66 were added to the book. Production plans for 2002 for all sizes and strains included: 1,923,749 brown trout, 1,600,000 chinook salmon, 245,000 coho salmon, 327,700 kokanee, 726,330 landlocked salmon, 1,132,300 lake trout, 409,935 muskellunge, 464,789 rainbow trout, 815,700 steelhead, 81,040 splake, 473,824 brook trout, 85,010 tiger muskellunge and 182,428,800 walleye. As with any new program, some gliches were uncovered, but for the most part the new electronic book worked extremely well and was well received by the Regions during its trial run.

Division Work Plan
The Inland Fisheries Section provided a significant amount of staff time in support the Division’s computerized work plan. Activities included reprogramming portions of the user interface, database management, extracting T&A code reports from the Department’s T&A system, and serving on the Division’s program plan workgroup.

Sport Fishing Regulation Changes
Initiated the biennial changes to sport fishing regulations. Approximately 130 changes to regulations were proposed to become effective October 1, 2002. Among the significant changes proposed were the following:

- Reduction of the daily creel limit for walleye on Lake Erie has from 5 to 4 fish per day.
- Changed in the daily creel limit for trout been to 5 fish of any size including not more than 2 longer than 12" for Broome, Chemung, Chenango, Cortland, Genesee, Livingston, Madison, Monroe, Onondaga, Ontario, Orleans, Oswego, Schuyler, Seneca, Steuben, Tioga, Tompkins, Wayne and Yates Counties. An additional five brook trout under 8 inches may be included in the daily creel limit in counties where these regulations have previously been in effect.
- Increase in the minimum size limit for muskellunge in Lake Erie, the Upper and Lower Niagara River, Lake Ontario, and the St. Lawrence River.
- Reduction of the daily creel limit for trout and salmon in the lower Niagara River to 3 fish per day in any combination.

- Reduction of the daily creel limit for yellow perch and sunfish in St. Lawrence County from "any number" to 50 of each per day.

Proposed changes to regulations were posted on the DEC web site and the public was afforded opportunity to comment. This proved to be a popular format for dissemination of information on proposed changes to sport fishing regulations.

Angler Achievement Awards Program

A total of 182 entries to the New York State Angler Achievement Awards program were received during calendar year 2001; Two New York State Records, 51 Annual Awards and 129 Catch and Release Awards. The dominance of catch and release awards is a continuing trend. Notably, a single entry for an Annual Award was received for each of four popular game fish; landlocked salmon, largemouth bass, muskellunge and tiger muskellunge. Twenty-one Catch and Release Awards were issued for largemouth bass, 8 for muskellunge and 5 for tiger muskellunge. Smallmouth bass continued to dominate the Catch and Release Award category with 43 awards issued.

Two New York State Records were advanced during 2001; a 5 lb. 14 oz. brook trout from Clear Pond, Franklin County and a 3 lb. 13 oz.

Bureau of Fisheries
2001-2002 Staffing

CENTRAL OFFICE

Administration

Stang, Douglas	Biologist 4 (Aquatic)
Pell, Clark	Biologist 2 (Wildlife)
Brandt, Robert	Biologist 2 (Aquatic)
Stegemann, Eileen	Sr. Engineering Research Editor
Smollin, Mary	Secretary 1

Great Lakes Fisheries

Lange, Robert	Biologist 3 (Aquatic)

Public Use and Extension

Gann, Michael	Biologist 3 (Aquatic)

Inland Fisheries

Festa, Patrick	Biologist 3 (Aquatic)
Woltmann, Ed	Biologist 2 (Aquatic)
Daley, James	Biologist 2 (Aquatic) - started 8/16
Hurst, Steve	Biologist 1 (Aquatic)
Linda Richmond	Program Aid
James Andersen	Clerk I
Tanashelia McGill	Clerk 1 (Seasonal)

Fish Culture Section

Hulbert, Philip	Fish Culturist VI
Buell, Henry	Fish Culturist V
Sarrge, Beverly	Secretary 1

REGION 1

Guthrie, Charles	Biologist 2 (Aquatic)
Kozlowski, Gregory	Biologist 1 (Aquatic)
Henson, Fred	Biologist 1 (Aquatic)
Hughes, Tom	F&W Tech 2
Papa, Lauren	Laborer (Seasonal)

REGION 2

Van Maaren, Chris	Biologist 1 (Aquatic)

REGION 3

Elliot, Wayne	Biologist 2 (Aquatic)
Pierce, Ron	Biologist 1 (Aquatic)
Angyal, Bob	Biologist 1 (Aquatic)
Surprenant, Leslie	Biologist 1 (Aquatic)
Flaherty, Mike	Biologist 1 (Aquatic)
VanPut, Ed	Fish and Wildlife Technician 3
Falk, Art	Fish and Wildlife Technician 3
Wysocki, Linda	Fish and Wildlife Technician 2
McNamara, Tim	Fish and Wildlife Technician 1 (Seasonal)
Moore, Denise	Fish and Wildlife Technician 1 (Seasonal)
Motluck, Lisa KC	Fish and Wildlife Technician 1 (Seasonal)

REGION 4

Slingerland, Donald	Biologist 2 (Aquatic)
McBride, Norm	Biologist 1 (Aquatic)
Zielinski, Dan	Biologist 1 (Aquatic)
Sicluna, Joe	Biologist 1 (Aquatic)
Cornwell, Dave	Fish and Wildlife Technician 2
Linhart, Fred	Fish and Wildlife Technician 3
Martel, Al	Fish and Wildlife Technician 3
Collins, Kandy	Keyboard Specialist 2
Ryan, Bruce	Fish and Wildlife Technician 1 (Seasonal)
Strassenburg, Jeff	Fish and Wildlife Technician 1 (Seasonal)
Krutz, John	Fish and Wildlife Technician 1 (Seasonal)
Kenney, Jim	Laborer/ FWMA Patrolman (Seasonal)

REGION 5

Nashett, Lawrence	Biologist 2 (Aquatic)
Miller, William	Biologist 1 (Aquatic)
Durfey, Lance	Biologist 1 (Aquatic)
Preall, Richard	Biologist 1 (Aquatic)
Schoch, William	Biologist 1 (Aquatic)
Demong, Leo	Biologist 1 (Aquatic)
Brown, Raymond	Fish and Wildlife Technician 3
Sausville, Jennifer	Fish and Wildlife Technician 2
Shanahan, Thomas	Fish and Wildlife Technician 1
Beatty, Jeannine	Secretary 1
Nettles, David	Fishery Biologist (USFWS)
Morehouse, Burton	Fish and Wildlife Technician 3
Saltsman, Leslie	Fish and Wildlife Technician 3
Inglee, Jeffrey	Laborer (Seasonal)
Stephenson, Bethany	Fish and Wildlife Technician 1 (Seasonal)
Fellion, Melissa	Fish and Wildlife Technician 1 (Seasonal)
Duensing, Sara	Fish and Wildlife Technician 1 Seasonal)

REGION 6

McCullough, Russ	Biologist 1 (Aquatic)
Gordon, William	Biologist 1 (Aquatic)
Flack, Frank	Biologist 1 (Aquatic)
Carlson, Douglas	Biologist 1 (Aquatic)
Hasse, Jack	Biologist 1 (Aquatic)

Klindt, Roger	Biologist 1 (Aquatic)
Adams, Richard	Fish and Wildlife Technician 3
Town, Blanche	Fish and Wildlife Technician 2
Colesante, Mark	Fish and Wildlife Technician 1 (Seasonal)
Gordon, David	Fish and Wildlife Technician 1 (Seasonal)
Hart, Jessica	Fish and Wildlife Technician 1 (Seasonal)
Covey, Julia	Fish and Wildlife Technician 1 (Seasonal)
Edmonds, Brian	Fish and Wildlife Technician 1 (Seasonal)
Farmer, Richard	Laborer (Seasonal)
Gordon, Aaron	Laborer (Seasonal)
Helmetsie, Robert	Laborer (Seasonal)
Hopkins, Lucas	Laborer (Seasonal)

REGION 7

Les Wedge	Biologist 2 (Aquatic)
Dan Bishop	Biologist 1 (Aquatic)
Tom Chiotti	Biologist 1 (Aquatic)
Dave Lemon	Biologist 1 (Aquatic)
Jeff Robins	Biologist 1 (Aquatic)
Russ Davall	F&W Technician 3
Jeff Eller	F&W Technician 2
Paul Moore	F&W Technician 2
Bob Rathman	F&W Technician 2
Janet Hines	Secretary 1
Shawn Fox	Seas. F&W Technician
Peter Moles	Seas. F&W Technician
Jim Ryan	Seas. F&W Technician

REGION 8

Abraham, Bill	Biologist 2 (Aquatic)
Kosowski, David	Biologist 1 (Aquatic)
Pearsall, Web	Biologist 1 (Aquatic)
Sanderson, Matt	Biologist 1 (Aquatic)
Hammers, Brad	Biologist 1 (Aquatic)
Angold, Fred	Fish and Wildlife Technician 3
Olsowsky, David	Fish and Wildlife Technician 2
Verna, Marvin	Fish and Wildlife Technician 2
Richardson, Denise	Fish and Wildlife Technician 2
Burdett, Anna	Keyboard Specialist 1
Deres, Bob	Fish and Wildlife Technician 1 (Seasonal)
Engman, Angel	Fish and Wildlife Technician 1 (Seasonal)
Barge, Sarah	Fish and Wildlife Technician 1 (Seasonal)
DeLong, Martin	Fish and Wildlife Technician 1 (Seasonal)
Mulhall, Daniel	Fish and Wildlife Technician 1 (Seasonal)
Krutz, John	Fish and Wildlife Technician 1 (Seasonal)
Miller, Steve	Fish and Wildlife Technician 1 (Seasonal)

REGION 9

Mooradian, Steve	Biologist 2 (Aquatic)
McKeown, Paul	Biologist 1 (Aquatic)
Evans, Joe	Biologist 1 (Aquatic)
Wilkinson, Mike	Biologist 1 (Aquatic)
Cornett, Scott	Biologist 1 (Aquatic)
Rende, Emilio	Fish and Wildlife Technician 2
Spinelli, Jim	Fish and Wildlife Technician 1 (Seasonal)
Preston, Ron	Fish and Wildlife Technician 1 (Seasonal)
Telecky, Jason	Fish and Wildlife Technician 1 (Seasonal)
Adams, Connie	Fish and Wildlife Technician 1 (Seasonal)

LAKE ERIE UNIT

Culligan, William	Biologist 2
Einhouse, Donald	Biologist 1
Markham, James	Biologist 1
Zeller, Douglas	Fisheries Research Vessel Captain
Zimar, Richard	Fish and Wildlife Technician 2
Beckwith, Brian	Fish and Wildlife Technician 2
Szwejbka, MariEllen	Secretary 1
McCarthy, Patrick	Fish and Wildlife Technician (Seasonal)
Smith, Brandon	Fish and Wildlife Technician (Seasonal)
Sek, Daniel	Fish and Wildlife Technician (Seasonal)

LAKE ONTARIO UNIT

LaPan, Steven	Biologist 2 (Aquatic)
Eckert, Thomas	Biologist 1 (Aquatic)
Lantry, Brian	Biologist 1 (Aquatic) - resigned 11/2001
Muise, Eric	Fisheries Research Vessel Captain - deceased 12/31/2001
Massia, Gaylor	Maintenance Assistant
Grant, Beverly	Secretary 1
Holland, Douglas	Fish and Wildlife Technician 1 (Seasonal)
Holland, Derek	Fish and Wildlife Technician 1 (Seasonal)
Turner, Kristen	Fish and Wildlife Technician 1 (Seasonal)
Bennett, Todd	Fish and Wildlife Technician 1 (Seasonal)
Edmonds, Brian	Fish and Wildlife Technician 1

	(Seasonal)
Gordon, David	Fish and Wildlife Technician 1 (Seasonal)
Hart, Jessica	Fish and Wildlife Technician 1 (Seasonal)
Covey, Julie	Laborer (Seasonal)
Hinckley, M. Ellen	Laborer (Seasonal)
Black, Kate	Green Thumb Staff
Haller, Ralph	Green Thumb Staff

ADIRONDACK HATCHERY

Grant, Edward	Fish Culturist 2
Miller, Douglas	Fish Culturist 1
Wallace, Michael	Fish and Wildlife Technician 1
Aldinger, Fritz	Fish and Wildlife Technician 1
Klubek, Kenneth	Fish and Wildlife Technician 1

BATH HATCHERY

Osika, Kenneth	Fish Culturist 2
Sweet, Robert	Fish Culturist 1
Klesa, Rodney	Fish and Wildlife Technician 1
Raab, Kelly	Fish and Wildlife Technician 1
Schirmer, Jason	Fish and Wildlife Technician 1

CALEDONIA HATCHERY

Mack, Alan	Fish Culturist 3
Stein, Robert	Fish Culturist 1
Zenzen, Stephen	Fish and Wildlife Technician 1
Kelley, Charles	Fish Culturist 1
Hubbard, Bruce	Fish Culturist 1
Krause, Mark	Fish Culturist 2
Hayden, Kevin	Fish and Wildlife Technician 1
Ward, Brian	Fish and Wildlife Technician 1

CATSKILL HATCHERY

Covert, Scott	Fish Culturist 3
Anstey, Timothy A.	Fish and Wildlife Technician 1
Judson, James L	Fish and Wildlife Technician 1
Anderson, John	Fish Culturist 2
Gennarino, Joseph	Fish and Wildlife Technician 1

CHATEAUGAY HATCHERY

Brue, Peter	Fish Culturist 2
Armstrong, David	Fish Culturist 1
Griffin, Joseph	Fish and Wildlife Technician 1
Jackson, Matthew	Fish and Wildlife Technician 1
Ventiquattro, Thomas	Fish Culturist 1

CHAUTAUQUA HATCHERY

King, Larry	Fish Culturist 2
DeFries, Eric	Fish Culturist 1
Rambuski, James	Fish and Wildlife Technician 1
Gruber, Bradley	Fish and Wildlife Technician 1

ONEIDA HATCHERY

Babenzien, Mark	Fish Culturist 3
Colesante, Richard	Biologist 1 (Aquatic)
Rathje, Carl	Fish Culturist 2
Evans, Bill	Fish Culturist 1
Dixon, Michael	Fish Culturist 1

RANDOLPH HATCHERY

Mellon, Jon	Fish Culturist 2
Kriger, Richard L.	Fish Culturist 1
Hohmann, Barry	Fish and Wildlife Technician 1
Baginski, Kenneth	Fish and Wildlife Technician 1
Borner, Richard	Fish Culturist 1
Hulings, Raymond	Maintenance Assistant

ROME HATCHERY

Lewthwaite, Robert	Fish Culturist 3
Woodworth, William	Fish Culturist 1
Wanner, Scott	Fish Culturist 1
Talbot, Clifford	Fish Culturist 2
Smith, Robert	Laborer - retired 8/2001
Benn, Eugene	Fish and Wildlife Technician 1
Matt, Kimberly	Keyboard Specialist.
Batur, Mark	Fish and Wildlife Technician 1
Erway, David	Fish and Wildlife Technician 1
Goulette, Gerard	Fish and Wildlife Technician 1
Grabowski, Steven	Fish and Wildlife Technician 1
Nessel, Robert	Maintenance Supervisor

FISH DISEASE CONTROL CENTER

Schachte, Dr. John	Pathologist 2 (Aquatic)
Petrie, Christopher	Fish and Wildlife Technician 2
Jalbert/Kohler	Keyboard Specialist

SALMON RIVER HATCHERY

Dolan, Stephen	Fish Culturist 2
Greulich, Andreas	Fish Culturist 3
Wrotniak, Kathleen	Fish Culturist 1
Domachowske,David	Fish and Wildlife Technician 1
Gosier, Corbin	Fish and Wildlife Technician 1
Hurd, Karen	Keyboard Specialist
Everard, James .	Fish and Wildlife Technician 1
LaShomb, Ronald	Fish Culturist I
Nelson, Robert	Fish and Wildlife Technician 1

SOUTH OTSELIC HATCHERY

Emerson, Pat	Fish Culturist 2
Kielbasinski, Thomas	Fish Culturist 1
Domachowske, David	Fish and Wildlife Technician 1
Schara, William	Fish and Wildlife Technician 1

VAN HORNESVILLE HATCHERY

Kroon, Larry	Fish Culturist 2
DuBois, Craig	Fish Culturist 1
Everard, James F	Fish and Wildlife Technician 1

Final Report on Fish Protection Studies at the Crescent Hydroelectric Project

By

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February 21, 2002

Introduction

The fish protection system proposed for the Crescent Hydroelectric Project effectively bypassed juvenile blueback herring during the fall but was not effective for adult blueback herring in May and June (Ross 1999). The objectives of this report are to review the results from the adult studies conducted at the Crescent and Vischer Ferry Hydroelectric Projects, discuss why adult blueback herring did not respond to the bypass at the Crescent Project in May and June, and develop an alternative approach for the Crescent site during this period.

Methods

The high-frequency transducers used to generate the deterrent sound fields employed during the fish protection studies conducted at the Crescent and Vischer Ferry Hydroelectric Projects were mounted on the headrace piers. The high-frequency signal consisted of broad-band (122-128 kHz) pulses, 0.5 seconds in duration and generated at 1-second intervals. The maximum sound pressure level was at least 190 dB//uPa at 1 meter from the source. The sound pressure across (surface to bottom and side to side) the entrances to the headrace canals was at least 170 dB//uPa.

Calibrated, hydroacoustic transducers, operating at 420 kHz, were used to monitor fish densities. Each transducer was connected to an echo sounder/multiplexer located in the powerhouse. The computer-controlled echo sounder was programmed to multiplex among all transducers. The echo sounder was operated at 10 pings per second with a pulse length of 0.4ms. A 5-minute sampling interval was used, resulting in 3000 pings of data per sampling interval. These pings were distributed among the transducers. Eight transducers were used during most of the studies and most of the density estimates are based upon 375 pings of data per 5-minute sampling interval.

Schools of blueback herring can be very dense, making it impossible to distinguish and count individual fish within a school. Therefore, echo integration was chosen as the signal processing method in the fish protection studies at the Crescent and Vischer Ferry Hydroelectric Projects. This method does not require the resolution of echoes from individual fish. It measures the acoustic energy reflected back from the out-going signal. Echo integration requires the assignment of range and time bins for summing up reflected energy. In the studies at the Crescent and Vischer Ferry Projects, the reflected energy was averaged over 5-minute intervals. The average energy estimates were converted to fish density by an echo integrator scaling constant which incorporates system calibration factors, operator-selected data collection parameters, and an estimate of the reflectivity (back-scattering cross section) of an individual fish. When the average reflected acoustic energy is multiplied by the scaling constant, an estimate of fish density (number per cubic meter) is obtained. The scaling constant used in these studies (7.0E-6) is accurate for juvenile blueback herring. It overestimates adult densities by a factor of 24, as indicated in the tables used in this review. The binary data files produced by the Echo Signal Processor were retrieved from hard disk and read by a FORTRAN program to generate scaled density estimates by range bin for each transducer for each 5-minute sampling interval. The average of the scaled density estimates from the range bins was used as the 5-minute density estimate for a given transducer. The 5-minute density estimates generated within an hour were averaged to produce an estimate of the average fish density by hour for each transducer. The hourly density estimates were used to describe changes in fish densities with a day. The hourly density estimates generated within a 24-hour period were averaged to describe changes in fish densities across days. When it became necessary to partition the effects of within-day differences in fish densities, the 24, hourly density estimates were divided into two 12-hour blocks and the hourly density estimates within each block were averaged.

The bypasses used at each site were created by removing 10-foot sections from the flashboards on the dams. Flashboards are installed on the dams at the Crescent and Vischer Ferry Projects to enhance navigation in the Crescent and Vischer Ferry impoundments. The water level in the Vischer Ferry pool is raised 27 inches; that in the Crescent pool is raised 12 inches. The removal of a 10-foot section, the distance between the posts supporting the flashboards, creates a bypass flow of about 40 cubic feet per second (cfs) at the Crescent site and about 140 cfs at the Vischer Ferry site. The navigation season in the New York State Barge Canal System begins during the first week in May and closes during the second half of November. The flashboards are installed in early May and removed before the end of November.

Results from the Adult Study at the Vischer Ferry Hydroelectric Project

In the vicinity of the Vischer Ferry Project, the main channel runs along the south side of the Mohawk River (Figure 1). The Vischer Ferry powerhouse is located on the opposite shore, about 1200 feet away from the main channel and about 1700 feet from the entrance to Lock 7. An old spoil disposal area lies immediately above the dam and the average depth outside of the channel is generally less than 8 feet for more than 1800 feet upstream. The Vischer Ferry dam consists of three connecting segments. Dam D is closest to Lock 7 and the channel and extends, perpendicularly to the lock, 725 feet out into the river. Dam E extends 675 feet upstream at about a 30° angle from the end of Dam D and passes across the upper end of a rocky island in the river. Dam F extends 500 feet from the end of Dam E to the south pier of the south headrace canal at the Vischer Ferry powerhouse. The bypass for adult blueback herring was located on Dam E, near the intersection of Dams E and F, about 550 feet from the entrance to the south headrace canal.

The data from days when fish densities were high near the bypass and low near the entrance to the south headrace canal are summarized in Table 1. Transducers 6 and 8 monitored fish densities near the bypass (Figure 2). Transducer 2 monitored fish densities at the entrance to the south headrace canal. A high-density day was defined as a day when at least one of the daytime (0600 hrs through 1700 hrs) and nighttime (1800 hrs through 0500 hrs) averages of the hourly estimates of fish density for Transducers 6 and 8 was greater than 0.900. There were 26 high-density days. They occurred during the period from May 24 through July 18.

The data from days when fish densities were low near the bypass and high near the entrance to the south headrace canal are summarized in Table 2. A high-density day was defined as a day when at least one of the daytime (0600 hrs through 1700 hrs) and nighttime (1800 hrs through 0500 hrs) averages of the hourly estimates of fish density for Transducer 2 was greater than 0.900. There were 3 high-density days. Fish densities were high near the entrance to the south headrace canal on two days in June when the high-frequency sound field was turned off. Fish densities were higher of the second of these two days and the increase in fish densities may be related to the increase in river flows that occurred during the second day. The appearance of fish near the entrance to the south headrace canal when the high-frequency sound field was turned off was not considered to reflect a failure of the fish protection system. The third high-density episode occurred when the high-frequency sound field was present and was considered to represent a failure of the fish protection system.

The estimate of the effectiveness of the fish protection system for adult blueback herring was generated from the ratio of the number of days when fish densities were high near the bypass and low near the entrance to the south headrace canal to the total number of days when fish densities were high. The two days when the high-frequency sound field was turned off and fish densities were high near the entrance to the south headrace canal were excluded from this calculation and the effectiveness was estimated to be 96%, i.e., (26/27) x 100.

Results from the Adult Study at the Crescent Hydroelectric Project

In the vicinity of the Crescent Hydroelectric Project, an island lies in the middle of the Mohawk River (Figure 3). The Crescent powerhouse is located on the western bank of the river. A dam, Dam B, runs from the Crescent powerhouse to the island, a distance of approximately 600 feet.

A second dam, Dam A, extends approximately 850 feet from the opposite side of the island to the eastern bank of the river. There is also a third dam, Dam C, at this site. It lies immediately below Dam B and holds back enough water to provide sufficient mass at the base of Dam B to prevent it from overturning during extreme floods.

The main river channel is approximately 35 feet deep immediately upstream from the entrance to the secondary channel flowing down to the Crescent powerhouse. The secondary channel is approximately 2000 feet long and ranges from 100 to 300 feet wide. It is 10 to 13 feet deep and 300 to 400 feet wide for the first 1000 feet downstream from the main river channel. Over the next 700 feet, the depth increases to 15 to 17 feet and the width ranges from 100 to 200 feet. The bottom of the secondary channel is smooth until 200 to 300 feet upstream from Dam B. This area, particularly, the section lying above Dam B, contains several rocky outcrops that rise nearly to the surface (Figure 4). The water depth increases downstream from these outcrops, creating a depression lying parallel to and 50 feet upstream from the western half of Dam B.

The data from days when fish densities were high near Dam B and fish entered the headrace at the Crescent Project are summarized in Table 3. Transducer 5 monitored fish densities in front of the tainter gate and near the western end of Dam B (Figure 4). Transducer 4 monitored fish densities at the entrance to the headrace canal. Two high-density episodes were observed. The first began on May 24 and ended on May 28. The second began on June 9 and ended on June 10. During each of these episodes, fish moved down to Dam B around mid-day (1100 hrs) and began moving into the headrace canal. Fish were present in the vicinity of Dam B for at least 7 hours. In spite of the similarity of the behavior of the fish when they began moving into the headrace, there was a significant difference between the two episodes. In late May, the fish moved directly down to Dam B and began moving into the headrace. In June, the fish first appeared at Transducer 7 (Table 4), which monitored fish densities in the middle of the secondary channel approximately 350 feet upstream from Dam B (Figure 4). They appeared in the evening and remained in the vicinity of Transducer 7 until early morning, when they moved down to Dam B. They remained near Dam B for 30 hours. At mid-day, they disappeared but did not enter the headrace. High fish densities were observed at Transducer 7 during the afternoon on the following day. High fish densities were again observed at Transducer 7 that night, during the period from 0300 hrs through 0600 hrs. This particular behavior was repeated during the next four nights before the fish moved down to Dam B and entered the headrace during the day on June 9 (Table 5). On the night of June 9, the fish appeared at Transducer 7 around dawn (0500 hrs), remained there until mid-morning (0900 hrs), and then moved down to Dam B and into the headrace. These observations suggested that a large school of adult blueback herring remained in the general vicinity of the Crescent site for eight days before it began to move into the headrace. It also should be noted that after being exposed to high-frequency sound at the beginning of June, these fish moved in and out of the secondary channel whether the high-frequency sound field was on or off (Tables 4 and 5).

A second school of fish moved down into the secondary channel after the first school moved into the headrace on June 9 and 10. The time periods when high fish densities were observed at Transducer 7 during the period from June 11 through June 13 were similar to those observed during the period from June 5 through June 8 (Table 5). Fish appeared at Transducer 7 after midnight but did not move down to Dam B or enter the headrace during the following day. This school was not observed to move down to Dam B or enter the headrace. High river flows appear to be responsible.

The average of the daily average flows, measured as cubic feet per second (cfs), in the Mohawk River at the gauging station maintained by the United States Geological Survey in Cohoes, N.Y., was 19,617 cfs during the period from June 14 through 19 (Table 6) and the daily average flows ranged from 20,300 cfs to 33,200 cfs during the period from June 15 through 17. No high fish densities were observed at Transducers 4 and 5 during the high-flow period and there was no suggestion that fish moved into the headrace. Fish were not detected at Transducer 7 when they moved directly to Dam B in June. During the high-flow period, the flow over the Dam B would draw fish directly to it and out of the range of Transducer 7. These fish would not be detected by Transducer 5 because it only monitors the area near the western end of Dam B and most of the fish would pass over Dam B out of the range of this transducer. However, both dams were spilling during the high-flow events and the fish could have also gone down the main channel and over Dam A.

Two high-density episodes occurred in July when the high-frequency sound field was turned off (Table 7). These fish went directly to Dam B and were not detected at Transducer 7. They appeared at Transducers 4 and 5 during the middle of the afternoon (1400 hrs). However, the fish densities at Transducer 4 were much lower than those at Transducer 5. During the high-density episodes involving movement into the headrace in May and June, the average fish density at Transducer 4 was 1.557 times higher than the average fish density at Transducer 5 (Table 3). In July, the average fish density at Transducer 4 was 0.186 that at Transducer 5. The high-frequency sound field was turned off during the high-density episodes in July. It was on during the high-density episodes in May and June and may have been driving fish into the intake.

However, fish moved in and out of the secondary channel when the high-frequency sound field was off during June and the difference in behavior could be related to a difference in the physical condition of the fish. In Lake Ontario, the response of adult alewives to high-frequency sound was affected by post-spawning condition (Ross et al. 1996) and a similar phenomenon could be responsible for the differences observed across May, June, and July in the Mohawk River. For example, the difference between the responses in May and June could be the result of two major spawning areas, located some distance apart. Fish from the closer spawning area would arrive at the Crescent Project first and they would have had less time to recover from spawning than those arriving later from the more distant spawning area. Thus, the fish arriving first would be in poorer condition and less reactive to the fish protection system than those arriving from the more distant spawning area. The high flows, like those observed in June, would flush fish in poor condition downstream and any adult blueback herring remaining in the Mohawk River after a flood event should be in relatively good condition and quite responsive to both high-frequency sound and bypass flows.

If the ratio of Transducers 4 and 5 from the high-density episodes in May and June reflects the relationship between these two transducers when adult blueback herring were not responsive to the fish protection system and if the ratio in July reflects the relationship when they were, the fish protection system at the Crescent Project was 88% effective when the fish were responsive, i.e., $[(1.557 - 0.186)/1.557] \times 100 = 88\%$.

Discussion

The combination of high-frequency sound and bypasses over the dam was effective at the Vischer Ferry site. Adult blueback herring stopped moving toward the powerhouse near the end of Dam F, about 500 feet from the entrance to the south headrace canal. Fish densities were high for almost the entire period from May 24 through June 4 and the fish densities observed at Transducer 6 were higher than those at Transducer 8 (Table 8). During the remainder of June and through July 18, there were only 2 high-density episodes that lasted 3 to 4 days and seven that were 1 to 2 days in length. During this period, the fish densities observed at Transducer 8 were higher than those at Transducer 6 (Table 8). The differences between the two transducers may have been due to higher flows through the powerhouse. The average of the average daily flows reported at the United States Geological Survey gauging station on the Mohawk River at Cohoes, N.Y., during the period from May 24 through June 4 was 3,411 cubic feet per second (cfs). The average of the daily flows during the high-density episodes observed after June 4 was 1,560 cfs. Higher flows could also be responsible for the extended period of high fish densities observed between May 24 and June 5, i.e., high flows moved a lot of fish down to the Vischer Ferry dam. However, another aspect of their behavior is even more interesting. Except for one occasion (Table 2), most of the fish did not move closer to the powerhouse when the high frequency sound field was turned off for 2 to 3 days (Table 8). This result indicates that either the fish were reacting to something other than high-frequency sound or they developed an aversion to all sounds in the vicinity of Dam F when they encountered the high-frequency sound field. A similar response was observed during June in the Crescent study.

Juvenile blueback herring moved farther into the high-frequency sound field at the Vischer Ferry site than the adult herring did. During the day, juvenile herring stopped moving toward the powerhouse about 225 feet from the entrance to the south headrace canal. At night, they approached to within 100 feet of the south headrace canal before turning and moving away along Dam F. Juvenile blueback herring also moved downstream more quickly than the adults, generally within 24 hours when the bypass was present (Ross 1999).

The difference between the reactive distances for adult and juvenile blueback herring and the presence of the island in the middle of the river at the Crescent site are responsible for the mixed results at this site. The deep-water area lying immediately upstream from Dam B extends about 400 feet from the entrance to the headrace. The secondary channel leading to the Crescent powerhouse is more than 300 feet wide at a point 300 feet upstream from Dam B. Thus, juvenile herring were able to approach Dam B during both day and night. However, these distances are not great enough for adult herring and they cannot reach Dam B without exceeding their threshold tolerance for high-frequency sound. The results from the Crescent study suggest that adult herring habituated to high-frequency sound more quickly in May than they did in June. There no suggestion of habituation to high-frequency sound in July. Adult herring were able to approach Dams D and E and the bypass at the Vischer Ferry site without exceeding their threshold tolerance for high-frequency sound and there was no suggestion of habituation to high-frequency sound during the study at this site. Adult blueback herring did not appear to use the bypass at the Crescent site when they were near Dam B in May and June, which suggests that these fish stayed near the bottom where they are unable to detect the flow through the bypass.

The high-frequency sound field at the Crescent site could be moved so that it covers the entrance to the secondary channel leading to the powerhouse (BAE SYSTEMS 2001; BioSonics, Inc. 2001). This might divert adult and juvenile blueback herring down the main channel past the island to Dam A. However, adult fish approached the end of Dam F almost every day during the period from May 24 through June 9 at the Vischer Ferry site in 1997 and they repeatedly moved in and out of the high-frequency sound field in the secondary channel between June 1 and June 9 at the Crescent site in 1998. Powerhouse flows appear to attract these fish strongly. Consequently, adult blueback herring might not move downstream away from the entrance to the secondary channel if the high-frequency sound field were moved at the Crescent site. Or, if they did, there is no assurance that they would remain downstream from the secondary channel. There are no strong flows in the main channel or near Dam A to attract them and the repeated movement into the secondary channel suggests that they swim back and forth between the main and secondary channels.

Because of the uncertainty about keeping adult herring away from the flows into the secondary channel, it is probably better to leave the high-frequency transducers in the same locations that were used during the juvenile feasibility study at the Crescent site and turn down the sound pressure levels so that the high-frequency sound field is restricted to the immediate vicinity of the entrance to the headrace canal. This would allow adult blueback herring to move down to Dam B without being exposed to sound levels like those that occurred in the feasibility study and they may behave like the adult herring did in July. To compensate for the fact that adult herring may be in poorer physical condition and moving closer to the bottom in May and June, all flows into the headrace could be shut off when fish appear near Dam B in these months. The increased flow over the dam should draw the fish away from the bottom and into the upper portion of the water column where they should be more likely to detect the flow through the bypass. A bypass over Dam A might further reduce fish densities near Dam B by attracting any adult fish near Dam A and keeping them from moving back upstream. A bypass on Dam A would also be important for juvenile fish in the fall because they do not swim about as actively as adult fish and dense aggregations were observed near Dam A during the fall feasibility study at the Crescent site.

Recommendations

The following recommendations should result in an effective fish protection system at the Crescent site:

1) Install the high-frequency transducers in the configuration used in the feasibility study conducted during the fall of 1997.

2) Install bypasses on Dams A, B, and C.

3) From May 15 through August 15, reduce the sound pressure levels so that the sound pressure at the entrance to the headrace is between 156 and 160 dB//uPa.

4) Monitor fish densities with two hydroacoustic transducers that correspond to Transducers 4 and 5 used in the feasibility study conducted during the spring and summer of 1998.

5) Turn off all flows into the headrace canal when an hourly estimate of fish density at Transducer 5 exceeds 3.000 fish per cubic meter (x 24) between 1100 hrs and 1600 hrs.

6) Turn on the flows into the headrace canal when the hourly estimate of fish density at Transducer 4 falls below 0.200 fish per cubic meter (x 24).

7) From August 16 through November 10, maintain the sound pressure level at the entrance to the headrace at 170 dB//uPa and remove the hydroacoustic transducers.

The fifth and sixth items in this list were generated from the hourly estimates of fish density at Transducers 4 and 5 during the high density episodes identified in Tables 3 and 7. These hourly estimates are listed in Tables 9 through 12.

References

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BioSonics, Inc. 2001. Hydroacoustic observations of juvenile blueback herring in the Mohawk River, upstream from the Crescent Dam. BioSonics, Inc., 4027 Leary Way NW, Seattle, WA 98107.

Ross, Q.E. 1999. Studies to determine the feasibility of using high frequency sound in conjunction with by-passes located outside of the sound field to provide protection for young-of-the-year and adult blueback herring at the Crescent and Vischer Ferry Hydroelectric Projects. New York Power Authority, 123 Main Street, White Plains, NY 10601.

Table 1. Averages of the hourly estimates of fish density ((#/m^3) x 24) generated for successive 24-hr periods (0600 hrs through 0500 hrs) from 0600 hrs May 10 through 0500 hrs July 31 during the feasibility study at the Vischer Ferry Project in 1997. Transducer 8 monitored fish densities near Dam E, approximately 80 ft from the south end of Dam F. Transducer 6 monitored fish densities near Dam E, approximately 25 ft from the south end of Dam F. Transducer 2 monitored fish densities at the entrance to the south headrace canal.

	Transducer		
Period	**8**	**6**	**2**
May 10-23	0.006	0.021	0.003
May 24-July 18 (26 days)*	2.834	2.415	0.025
July 19-31	0.113	0.052	0.023

*Average of the daily averages for 26, high-density days, i.e. 24-hr periods when at least one of the daytime (0600 hrs-1700 hrs) and nighttime (1800 hrs-0500 hrs) averages of the hourly estimates of fish density for transducers 6 and 8 was greater than 0.900.

Table 2. Averages of the hourly estimates of fish density (($\#/m^3$) x 24) for the only days (0600 hrs through 0500 hrs) during the feasibility study at the Vischer Ferry Project in 1997 when at least one of the daytime (0600 hrs through 1700 hrs) and nighttime (1800 hrs through 0500 hrs) averages of the hourly estimates of fish density for Transducer 2 was greater than 0.900. Transducer 8 monitored fish densities near Dam E, approximately 80 ft from the south end of Dam F. Transducer 6 monitored fish densities near Dam E, approximately 25 ft from the south end of Dam F. Transducer 2 monitored fish densities at the entrance to the south headrace canal.

	Transducer		
Period	**8**	**6**	**2**
June 17-18 (HF Sound Off)	0.248	0.062	0.647
June 18-19 (HF Sound Off)[a]	0.261	0.015	2.459
July 11-12 (HF Sound On)[b]	0.121	0.005	1.167

[a] The average daily flow at the USGS gauging station at Cohoes, NY, on the Mohawk River increased from 1500 cubic feet per second (cfs) on June 18 to 2250 cfs on June 19.

[b] The average daily flow at the USGS gauging station at Cohoes, NY, on the Mohawk River increased from 1680 cubic feet per second (cfs) on July 11 to 2720 cfs on July 12.

Table 3. Periods when the hourly estimates of fish density (($\#/m^3$) x 24) were high (greater than 0.900) at the entrance to the headrace canal during the feasibility study at the Crescent Project in 1998. Transducer 5 monitored fish densities in front of the tainter gate and near the western end of Dam B. Transducer 4 monitored fish densities at the entrance to the headrace canal.

Date	Transducer	Period	Average of the Hourly Density Estimates (($\#/m^3$)x24m)	HF Sound Field (+=on; -=off)
May 24	5	1100-1800 hrs	3.555	(+)
	4	1100-1600 hrs	6.219	(+)
May 27	5	1300*-2100 hrs	11.667	(+)
	4	1300*-2200 hrs	14.953	(+)
May 28	5	1100-1900 hrs	7.861	(+)
	4	1100-2000 hrs	24.009	(+)
June 9	5	1100-2300 hrs	18.305	(+)
	4	1300-1900 hrs	9.522	(+)
June 10	5	1100-1800 hrs	7.593	(+)
	4	1200-1800 hrs	21.544	(+)

*No data were collected prior to 1300 hrs on this date.

Table 4. Periods when the hourly estimates of fish density ((#/m^3) x 24) were high (greater than 0.900) during the feasibility study at the Crescent Project in 1998 and fish approached Dam B, but did not enter the headrace canal. Transducer 7 monitored fish densities in the channel approximately 350 feet upstream from Dam B. Transducer 5 monitored fish densities in front of the tainter gate and near the western end of Dam B.

Date	Transducer	Period	Average of the hourly density estimates ((#/m^3)x24)	HF Sound Field (+=on; -=off)
June 1-2	7	2100-0400 hrs	4.087	(+)
June 2-3	5	0600-0500 hrs	4.166	(+)
June 3	5	0600-1100 hrs	4.045	(-)
June 4	7	1400-1800 hrs	2.256	(-)
June 5	7	0300-0600 hrs	3.737	(-)

Table 5. Periods when the hourly estimates of fish density ((#/m^3) x 24) were high (greater than 0.900) during the feasibility study at the Crescent Project in 1998 and fish entered the side channel leading to the powerhouse at night, but did not enter the headrace canal during the following day. Transducer 7 monitored fish densities in the channel approximately 350 feet upstream from Dam B.

Date	Transducer	Period	Average of the Hourly Density Estimates ((#/m^3)x24)	HF Sound Field (+=on; -=off)
June 5	7	0300-0600 hrs	3.737	(-)
June 6	7	0200-0800 hrs	6.646	(+)
June 7	7	0300-0800 hrs	4.137	(+)
June 8	7	0200-0800 hrs	4.504	(-)
June 9	7	0100-0600 hrs	6.819	(-)
June 10	7	0500-0900 hrs	1.967	(+)
June 11	7	0200-0600 hrs	5.395	(+)
June 12	7	0200-0900 hrs	3.824	(-)
June 13	7	0100-0600 hrs	6.196	(-)

Table 6. Averages of the average daily flows (cubic feet per second) measured at the USGS gauging station on the Mohawk River at Cohoes, N.Y., and the averages of the averages of the hourly estimates of fish densities ((#/m^3) x 24) generated by Transducer 7 during the feasibility study at the Crescent Project in 1998. Transducer 7 monitored fish densities in the channel approximately 350 feet upstream from Dam B.

Dates	Average daily flow	Average fish density
May 25-29	1,676	0.019[a]
June 5-8	1,662	4.756[a]
June 9-10	1,390	4.393[b]
June 11-13	1,670	5.138[b]
June 14-19	19,617	0.056[a]

[a] No high density periods occurred. The average fish density reported is the average of the 24-hr averages (0600 hrs through 0500 hrs) for these dates.

[b] Average of the averages for periods when the hourly estimates of fish density were high (greater than 0.900).

Table 7. Averages of the hourly estimates of fish density ((#/m^3) x 24) during two high density episodes* in July at the Crescent Project in 1998. The high frequency sound field was turned off on these dates. Transducer 5 monitored fish densities in front of the tainter gate and near the western end of Dam B. Transducer 4 monitored fish densities at the entrance to the headrace canal.

Date	Transducer 5	Transducer 4
July 2 (1400-1900 hrs)	2.079	0.334
July 14 (1400-1900 hrs)	3.047	0.623

Table 8. Averages of the hourly estimates of fish density (($\#/m^3$) x 24) for high-density days* when the high-frequency sound field was present (On) and absent (Off) during the feasibility study at the Vischer Ferry Project in 1997. Transducer 8 monitored fish densities near Dam E, approximately 80 ft from the south end of Dam F. Transducer 6 monitored fish densities near Dam E, approximately 25 ft from the south end of Dam F. Transducer 2 monitored fish densities at the entrance to the south headrace canal.

	Transducer		
	8	**6**	**2**
May 24 - June 5			
HF Sound Field On (n = 6)	1.486	4.024	0.003
HF Sound Field Off (n = 4)	2.574	4.266	0.015
June 6 - July 18			
HF Sound Field On (n = 10)	3.348	1.478	0.028
HF Sound Field Off (n = 6)	3.498	1.133	0.050

*Average of the daily averages for 24-hr periods when at least one of the daytime (0600 hrs through 1700 hrs) and nighttime (1800 hrs through 0500 hrs) averages of the hourly estimates of fish density for transducers 6 and 8 was greater than 0.900.

Table 9. The hourly averages for the fish density estimates [(#/m^3) x 24] from Transducers 4 (T4) and 5 (T5) at the Crescent site in 1998: 1000 hrs May 24 through 0900 hrs May 25

	May 24-25	
Hour	T5	T4
1000	0.252	0.034
1100	3.039	2.091
1200	4.621	4.767
1300	3.625	1.603
1400	6.005	9.495
1500	7.006	17.338
1600	1.166	2.021
1700	1.96	0.678
1800	1.02	0.413
1900	0.591	0.112
2000	0.817	0.029
2100	0.111	0.12
2200	0.261	0.034
2300	0.447	0.171
0	0.218	0.169
100	0.035	0
200	0.083	0.1
300	0.055	0
400	0.017	0.001
500	0.071	0.004
600	0.095	0
700	0.023	0
800	0.011	0.001
900	0.005	0

Table 10. The hourly averages for the fish density estimates [(#/m^3) x 24] from Transducers 4 (T4) and 5 (T5) at the Crescent site in 1998: 1000 hrs May 27 through 0900 hrs May 29

	May 27-28		May 28-29	
Hour	T5	T4	T5	T4
1000	M	M	0.116	0.141
1100	M	M	7.295	3.01
1200	M	M	8.774	11.873
1300	6.135	1.665	27.46	25.932
1400	16.579	15.341	5.483	53.27
1500	1.538	5.041	6.291	54.131
1600	1.182	14.431	8.508	21.351
1700	8.763	15.618	2.746	26.511
1800	15.542	12.497	2.489	30.521
1900	33.133	28.356	1.705	12.504
2000	17.445	48.433	0.036	0.991
2100	4.685	6.133	0.148	0.475
2200	0.407	2.013	0.136	0.77
2300	0.826	0.771	0.155	3.049
0	1.4	0.265	0.055	0.447
100	1.28	0.229	0.031	0.104
200	0.896	1.146	0.06	0.177
300	0.779	0.548	0.026	0.08
400	0.479	0.304	0.031	0.147
500	0.294	0.19	0.004	0.084
600	0.411	0.1	0	0.038
700	0.199	0.489	0	0.015
800	0.414	0.146	0.004	0.509
900	0.41	0.163	0.004	0.106

Table 11. The hourly averages for the fish density estimates [(#/m^3) x 24] from Transducers 4 (T4) and 5 (T5) at the Crescent site in 1998: 1000 hrs June 9 through 0900 hrs June 11

	June 9-10		June 10-11	
Hour	T5	T4	T5	T4
1000	0.166	0	0.485	0.007
1100	3.041	0.126	3.236	0.136
1200	6.047	0.346	2.366	3.855
1300	32.583	5.102	10.154	6.516
1400	15.201	0.29	5.752	5.101
1500	47.16	8.822	2.94	27.581
1600	41.031	9.747	12.536	34.488
1700	38.98	13.054	15.714	50.797
1800	34.782	26.907	8.046	22.467
1900	11.276	2.733	0.422	0.416
2000	2.859	0.64	0.378	0.164
2100	1.524	0.392	0.333	0.144
2200	1.628	0.256	0.629	0.252
2300	1.856	0.101	0.809	0.169
0	0.498	0.056	0.458	1.081
100	0.581	0.153	0.305	0.476
200	0.331	0.002	0.469	0.036
300	0.299	0.005	0.932	0.009
400	0.168	0.002	0.298	0.021
500	0.187	0.005	0.466	0.003
600	1.317	0.018	0.225	0.006
700	0.334	0.003	0.406	0.088
800	0.349	0.003	0.274	0.008
900	0.749	0.011	0.105	0.02

Table 12. The hourly averages for the fish density estimates [(#/m^3) x 24] from Transducers 4 (T4) and 5 (T5) at the Crescent site in 1998: 1000 hrs July 2 through 0900 hrs July 3 and 1000 hrs July 14 through 0900 hrs July 15

	July 2-3		July 14-15	
Hour	T5	T4	T5	T4
1000	0.285	0.001	0.51	0
1100	0.662	0.004	0.606	0.179
1200	0.576	0.021	1.666	0.418
1300	0.483	0.008	0.251	0.096
1400	1.298	0.034	1.472	0.582
1500	1.918	0.054	3.413	0.273
1600	1.177	0.059	2.293	0.322
1700	1.202	0.41	6.881	1.789
1800	4.097	1.269	9.294	0.282
1900	2.78	0.181	3.542	0.332
2000	0.724	0.022	1.232	0.67
2100	0.52	0.004	1.368	1.127
2200	0.35	0.001	0.924	0.236
2300	0.138	0.001	0.578	0.433
0	0.102	0	0.588	1.173
100	0.023	0	0.853	0.716
200	0.063	0.014	1.059	0.228
300	0.31	0	0.609	1.477
400	0.099	0.001	1.198	0.785
500	0.074	0.001	0.218	0
600	0.067	0.017	0.174	0.001
700	0.145	0.002	0.053	0.007
800	0.128	0.001	0.067	0.004
900	0.145	0	0.387	0

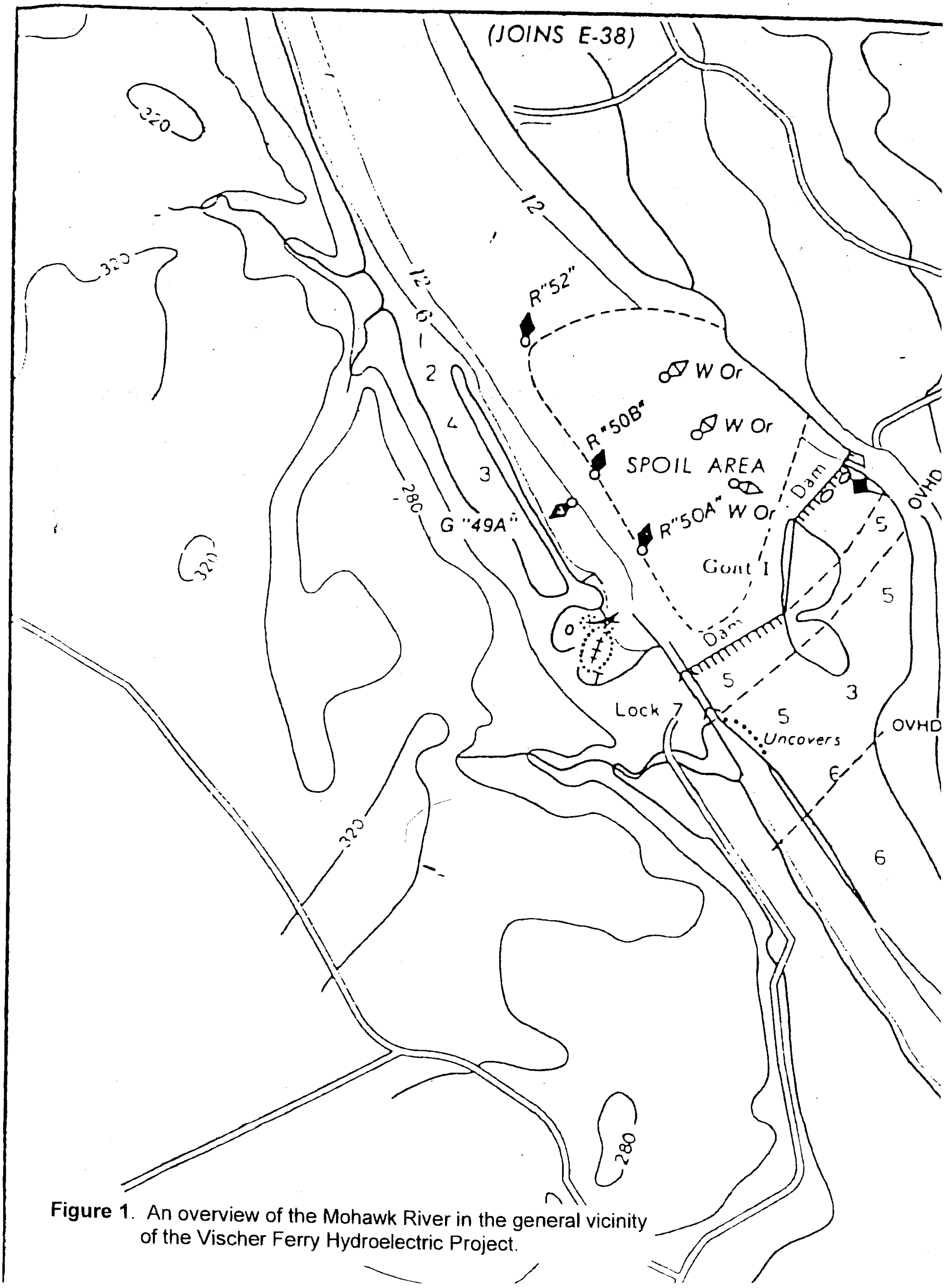

Figure 1. An overview of the Mohawk River in the general vicinity of the Vischer Ferry Hydroelectric Project.

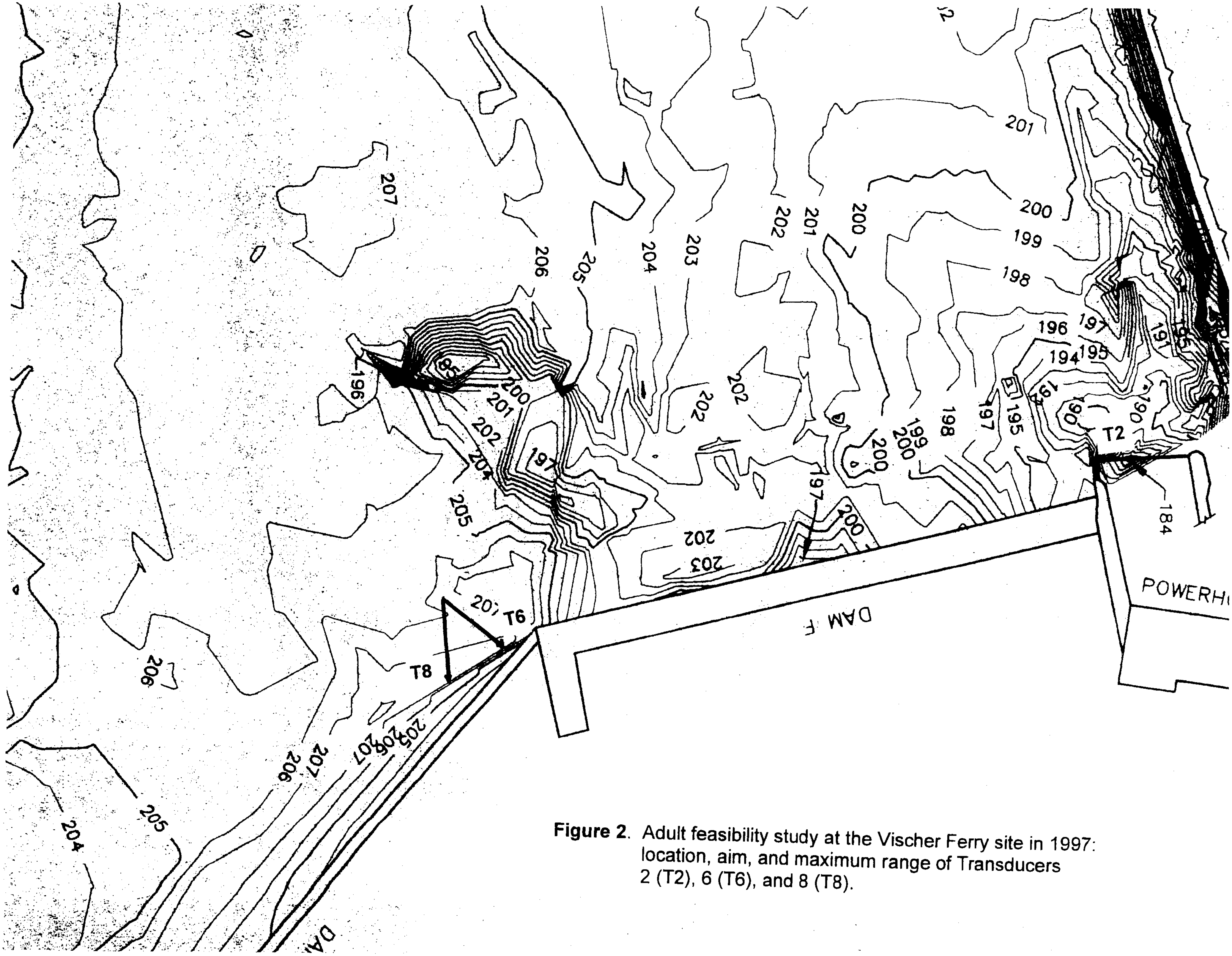

Figure 2. Adult feasibility study at the Vischer Ferry site in 1997: location, aim, and maximum range of Transducers 2 (T2), 6 (T6), and 8 (T8).

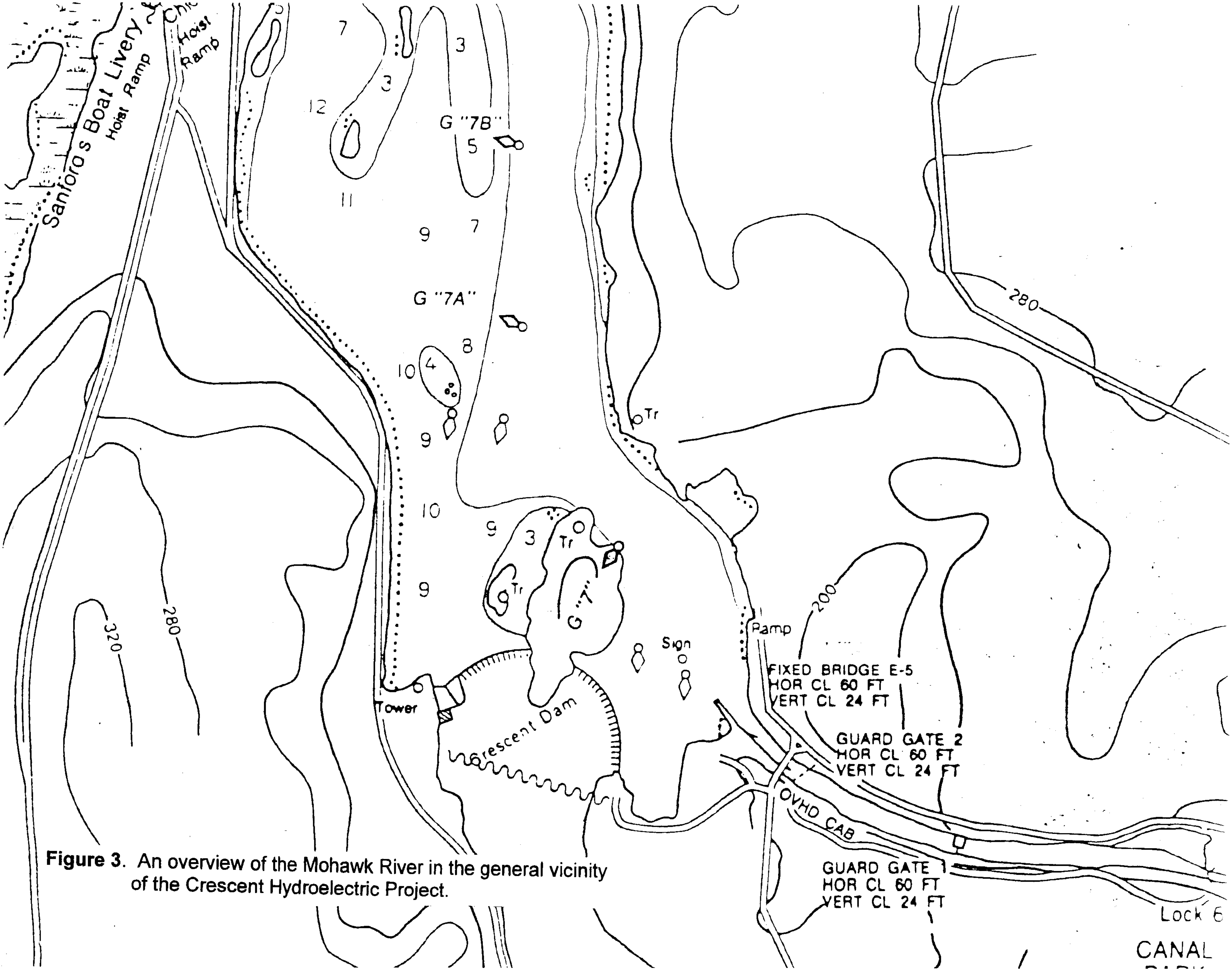

Figure 3. An overview of the Mohawk River in the general vicinity of the Crescent Hydroelectric Project.

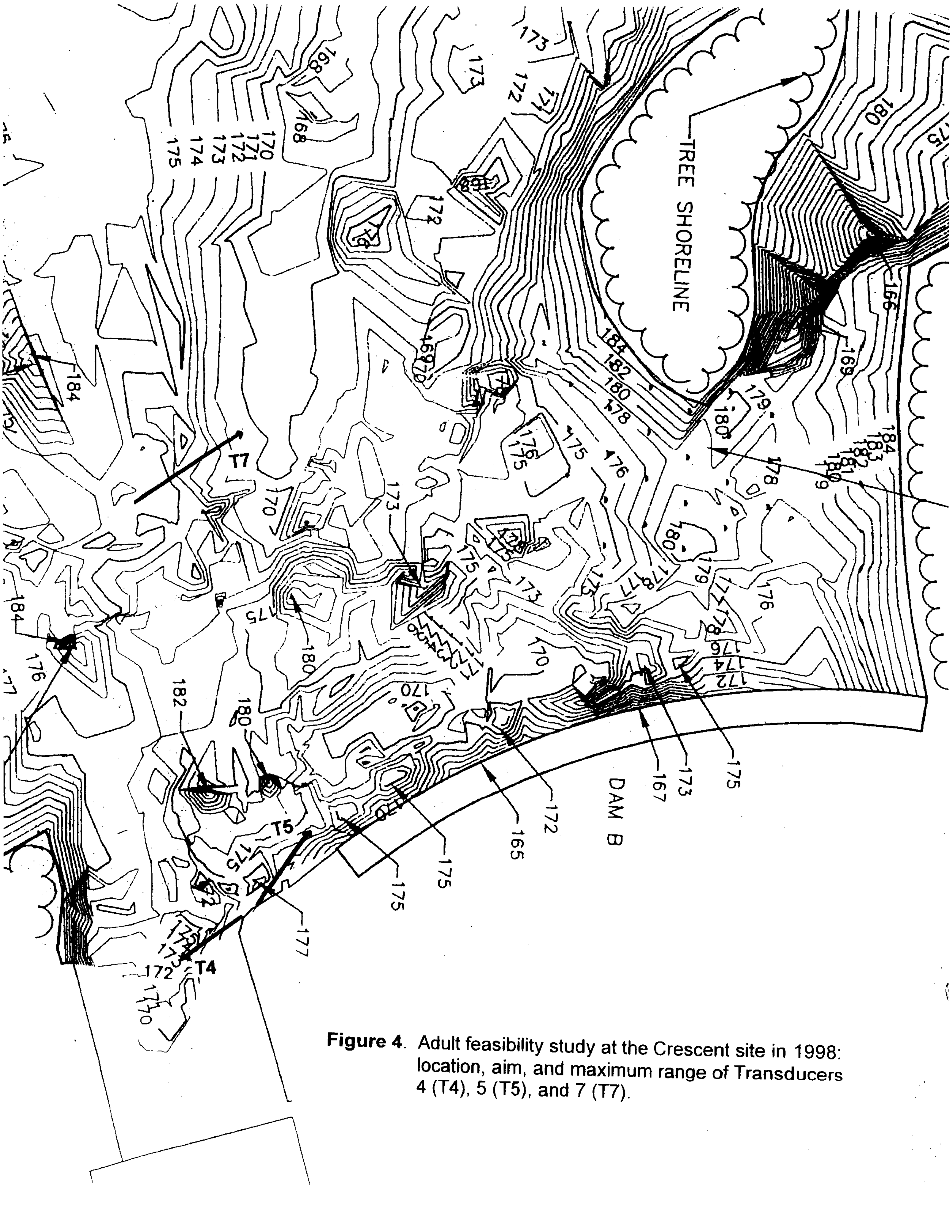

Figure 4. Adult feasibility study at the Crescent site in 1998: location, aim, and maximum range of Transducers 4 (T4), 5 (T5), and 7 (T7).

Status of River Herring Stocks in Large Rivers

Chapter · January 2003

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Status of River Herring Stocks in Large Rivers

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Abstract.—We examined long-term data sets from large rivers in the northern, central, and southern parts of the ranges of anadromous river herring (alewife *Alosa pseudoharengus* and blueback herring *A. aestivalis*) to assess the current status of these species and for evidence of fishery-induced effects on their demographic characteristics. Both species show signs of overexploitation in all rivers examined, such as reductions in mean age, decreases in percentage of returning spawners, and decreases in abundance. These two species should be managed separately since exploitation within a given river is often biased toward one or the other and there are enough differences in their biology so that a single management option will affect them differently. These species are not distinguished in commercial catches, which hinders understanding of their exploitation.

Introduction

River herring is a term applied to two species of small *Alosa*, alewife *A. pseudoharengus* and blueback herring *A. aestivalis*, found on the East Coast of North America. The alewife is found from the coast of Labrador and Newfoundland south to southern Georgia, whereas the range of blueback herring extends from New Brunswick south to the St. Johns River, northern Florida. Adult fish are readily distinguishable, but the species are rarely differentiated in commercial catch reports. Both species have anadromous and landlocked forms, but landlocking occurs much less frequently in blueback herring. Some river herring populations have modified this basic anadromous life history (Walton 1983), and recent otolith microchemistry data suggest that migratory patterns of these species may be more complex than the term "anadromous" implies (Limburg 1998; Limburg et al. 2001).

These species share spawning streams in the area where their distributions overlap, but spawning is often segregated spatially or temporally (Mullen et al. 1986). Alewife is typically more abundant than blueback herring in the northern part of their ranges. Blueback herring is more abundant by one or perhaps two orders of magnitude along the middle and southern parts of their ranges. Much of the biology of these two species (Table 1) has been documented. Many life history characteristics of river herring show geographic clines (Mullen et al. 1986). Most life history data have been collected from their spawning runs, with little data available from the marine phase of the life cycle.

Richkus and DiNardo (1984) described general trends of declining catches of river herring beginning in the 1960s. Rulifson (1994) summarized the status of many river herring runs from responses to a questionnaire. Most alewife runs were declining and most blueback herring runs were undocumented. About a quarter of the blueback herring runs that were documented were declining, and the rest were stable at a low population size. This paper assesses the current status of these species using several long-term data sets from stocks that represent much of the range of the species. We examined available data sets for signs of overexploitation such as a truncated age distribution, reduction in proportion of repeat spawners, change in relative species composition, or a decline in recruitment, adult abundance, or landings.

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Table 1.—Life history summary of river herring from the East Coast of North America. Data from Rulifson et al. (1982), Loesch (1987), Klauda et al. (1991), and Jessop (1993, 2003, this volume).

Life history trait	Alewife	Blueback herring
Spawning temperature (°C)	5–15	10–15
Age of spawning stock	3–6	3–6
Maximum age	12	13
Fecundity (10^3 eggs/female)	70–467	50–400
Percent repeat spawners	15–80	5–90

Methods

Most of the data presented in this paper are taken from published accounts, and the reader should examine the original papers for methodology. We performed analyses on long-term data sets for river herring in the Connecticut, Hudson, and Delaware rivers.

Estimates of adult blueback herring numbers, supplied to us by S. Gephard (Connecticut Department of Environmental Protection, personal communication), are made annually at the fish lift on the Holyoke Dam, Connecticut River. We plotted the numbers reported uncritically although estimation procedures have changed over the period of the data set.

Young-of-the-year (YOY) indices are obtained in essentially the same way in the Delaware, Hudson, and Connecticut rivers. Young of the year are collected by large beach seines, identified, and counted. An abundance index, a geometric or arithmetic mean of numbers collected over the time when the juveniles are present in the estuary and vulnerable to the gear from a standard set of beaches, is then calculated. For example, YOY indices for the Hudson River were calculated from biweekly beach seine hauls from mid-June through early November. Sampling was done in the upper portions of the estuary (88–225 km north of the southern tip of Manhattan) during the day at about 28 sites. Gear used was a 30.5-m by 3.1-m beach seine with 0.64-cm mesh. The indices are annual geometric means of the number of fish per seine haul. Young-of-the-year indices were supplied by R. Allen (New Jersey Department of Environmental Protection, personal communication), K. Hattala (New York Department of Environmental Conservation, personal communication), and Gephard (personal communication). We arbitrarily chose to plot the indices from 1985 through the most recent year available, and we did a linear regression on the indices over time.

In the Hudson River, additional indices of YOY alewife and blueback herring abundance are available from an annual monitoring program done by the Hudson River Utilities (Klauda et al. 1988). The total number of YOY alewife and blueback herring collected in late summer to early fall in the Hudson River Utilities' beach seine survey was plotted for each year data were available. A linear regression was fit to these data.

Case Histories

Commercial landings of river herring generally show declines over the past 2–3 decades. Within the Maritime Provinces of Canada, there were large annual variations in landings and differences among regions in their temporal trends (Figure 1; DFO 2001). Peak catches (all regions combined) occurred in the early and late 1970s and 1980 and again in the late 1980s. In the Bay of Fundy and southern Gulf of St. Lawrence in eastern Canada, recent catches are below the 1960–2000 means, with the greatest recent decline in the southern Gulf of St. Lawrence. Recent catches in two of the three most productive Canadian rivers for river herring, the Saint John and Margaree rivers, are also below their long-term (1950–2000) means of 2,284 metric tons and 779 metric tons, respectively (Figure 2). The continued low catches in the Margaree River after 1996 reflect the introduction of a restrictive management plan for stock recovery. Catches have increased slightly in the Miramichi River, generally fluctuating around a long-term mean of 1,939 metric tons.

The American landings averaged approximately 25,000 metric tons for 1950–1969 but declined to the current level of 1,000 metric tons (Figure 3). This overall decline occurred in each reporting state, although patterns of decline differ among states. Virginia and North Carolina accounted for the majority of landings (43% and 29%, respectively) since 1970.

Landings data do not distinguish between alewife and blueback herring. Both species are probably present but in different proportions in different areas of the Atlantic coast. River herring in North Carolina are used for bait and for human consumption, typically as fillets that are processed and salted or roe that is consumed fresh or canned (River Herring Development Team 2000). In New Jersey, river herring landings are categorized as bait (Allen et al. 2000). Currently, in the Hudson River, river herring are used as bait (live or dead) for striped bass *Morone saxatilis*, and smoked herring is available for human consumption during the spring run. We know of no published literature

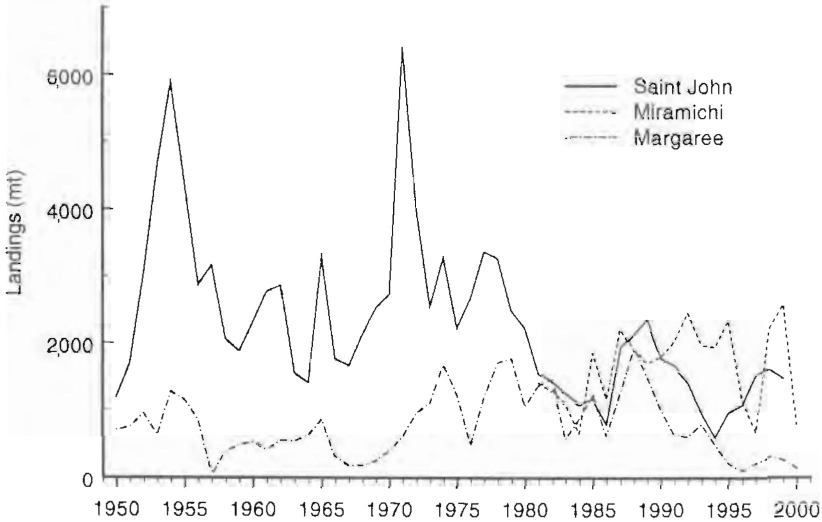

Figure 1.—Landings of river herring from the most productive rivers in the Maritime Provinces, Canada, 1950–2000. Both species are present in the catch, but alewife is more abundant, particularly in the Margaree River. The 1950–2000 mean landings were 2,284 metric tons (mt) for the Saint John River, 1,939 metric tons for the Miramichi River, and 779 metric tons for the Margaree River.

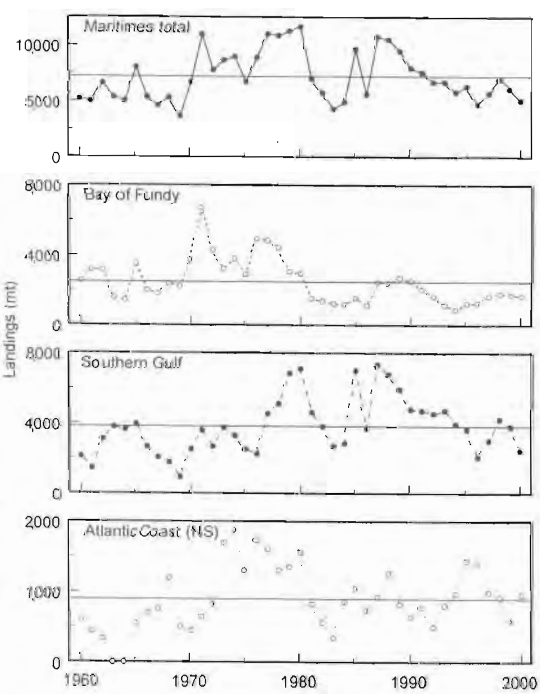

Figure 2.—Landings of river herring from the commercial catch by geographic region in the Canadian Maritime Provinces, 1960–2000. The 1960–2000 mean landings were 7,177 metric tons (mt) for the Maritime Provinces, 2,473 metric tons for the Bay of Fundy, 897 metric tons for the Atlantic coast, and 3,808 metric tons for the southern Gulf of St. Lawrence.

suggesting that the decline we see in landings was due to lack of market demand nor have we seen literature discussing how markets have varied over time.

We also lack data on the variation in fishing effort over the years. One interpretation of the landings is that both species are declining, but other interpretations are also possible. Within the general trend of declining catch, specific rivers or regions may show a stable or increasing trend in catch. Smaller rivers that are lightly fished or unfished may have stable stocks, but their status is generally unknown.

Case History: Saint John River

The Saint John River, New Brunswick, is a large, drowned river valley with a tidal influence extending about 120 km inland. It supports one of the two largest fisheries for alewife and blueback herring in Atlantic Canada. Annual commercial landings have declined markedly since 1971 (6,418 metric tons) and have been below the 1950–2000 mean of 2,284 metric tons since 1980, with the exception of 1989 (Figure 1). There appears to be a 17–18-year cycle of relatively high catches in 1954, 1971, and 1989. A substantial run of river herring to the Mactaquac Dam, Saint John River, about 148 km upstream of the river mouth, has developed since the dam's completion in 1968 (Jessop 1990, 2001a, 2003, this volume). The Mactaquac Dam fishery is

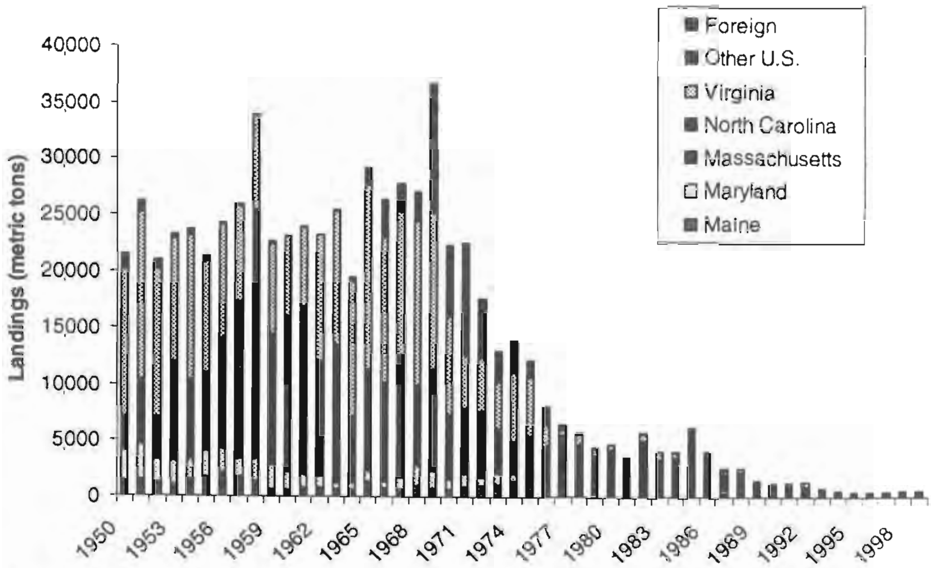

Figure 3.—Landings of river herring from the commercial catch on the East Coast of the United States, 1950–2000. Data are from the National Marine Fisheries Service (2002).

presently managed to provide a target spawning stock of 800,000 alewives and 200,000 blueback herring. Those spawning stock levels have been estimated to provide an acceptable level of recruitment, given the capacity of the fishway, the costs of escapement trucking, and the requirement to minimize interaction with the early run of Atlantic salmon *Salmo salar*. Fish in excess of this escapement target are harvested. This fishery has contributed about 21% (range = 5–41%) of the total harvest from the river. Biological and tagging evidence support the existence of geographic subpopulations of alewife and blueback herring within the major tributary lakes and rivers downstream of the Mataquac Dam and in Mactaquac Lake (Messieh 1977; Jessop et al. 1983; Jessop 1990, 1994). Consequently, the run of river herring to the Mactaquac Dam has been managed independently of the downstream fishery.

No specific management action has been taken to regulate the fishery in the lower tributaries of the Saint John River other than the 1982 moves to fix the number of licenses (a single trap-net license may permit use of a variable number of nets) and close the fishery earlier (mid- to late June rather than June 30) by moving closure progressively upriver as Atlantic salmon enter the lower river. One consequence of earlier closure of the fishery is greater fishing pressure on alewife and less on the later-running blueback herring. In response to the decline in catches since 1971, trap-net fishers, who typically take over 90% of the catch in the lower river, have reduced the number of nets set from 100 or more in the early 1980s to 40–60 in recent years. The unused gear capacity remains available for utilization should stock abundance and market demand increase sufficiently to warrant it.

Mean sample lengths and weights of alewife and blueback herring from the fishery in Washademoak Lake (about 75 km north of the mouth of the Saint John River) have varied over time, rising slightly between the early 1970s and mid-1980s, then declining in the late 1990s (Figure 4; Jessop 2001b). Most alewife in the fishery (about 70–80%) are ages 4 and 5, as are most blueback herring (65–75%), but the annual percentages at each age may vary widely. The mean age of alewife and blueback herring has declined, with fewer alewife older than age 6 (Figure 5) and fewer blueback herring older than age 7. The proportion of repeat spawning alewife declined to 0.1–0.4 during the 1990s from 0.4–0.7 in the 1970s and 1980s (Figure 6). Blueback herring age composition data were not similarly examined because of the small sample sizes in recent years due to early closure of the fishery. Similar trends in length, weight, and age composition were also observed in alewife and blueback herring data from the Oromocto River and French–Indian Lakes, tributaries to the Saint John River (Jessop 2001b).

The persistence of catches well below the long-term mean and declines in the abundance of older

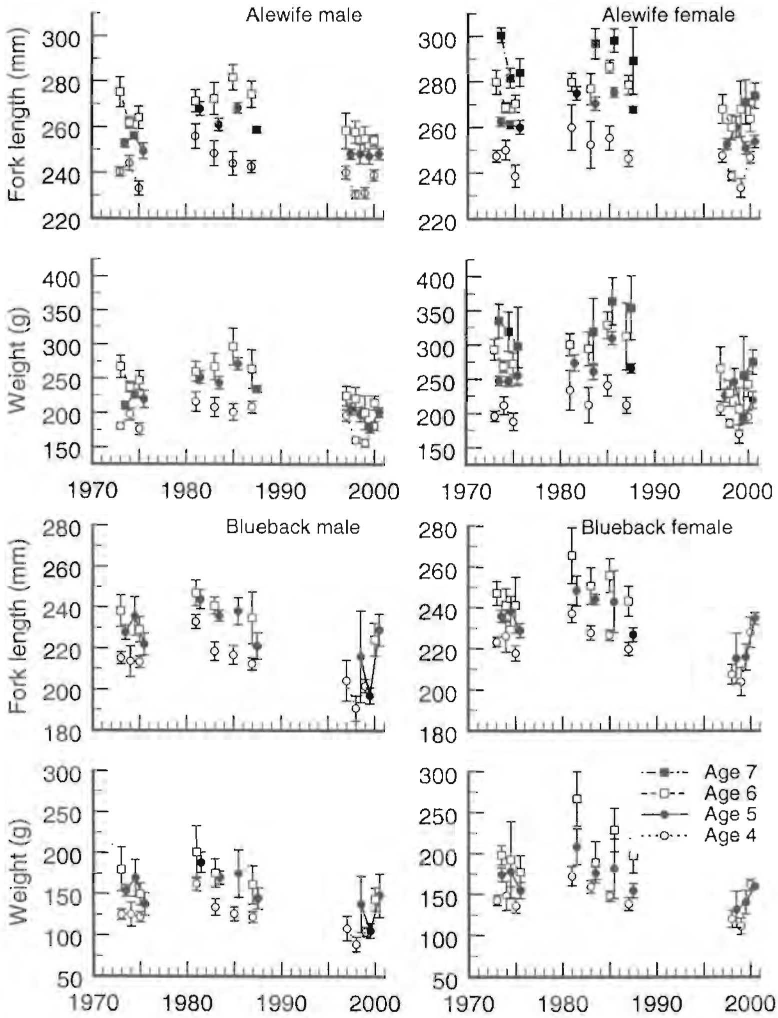

Figure 4.—Annual mean sample lengths and weights by age of male and female alewife and blueback herring from Washademoak Lake, lower Saint John River, 1973–2000. Annual sample sizes for all ages combined averaged about 130 fish (range = 70–260 fish) for each sex.

age-groups and in the proportion of repeat spawners suggest heavy fishing pressure. The effects of long-term exploitation on the size and age composition of alewife and blueback herring observed in the lower tributaries were similar to those observed at the Mactaquac Dam (Jessop 2003). The stock of river herring migrating to the Mactaquac Dam has periodically been highly exploited because it is not managed for maximum sustained yield but by a fixed escapement policy. Annual spawning stock abundances are unknown for the various major tributaries of the lower Saint John River. The prognosis is for catches in the lower Saint John River to remain below the long-term mean unless instream fishing pressure is reduced (DFO 2001). Annual marine catches of river herring exceeded 2,000–10,000 metric tons during the 1960s and 1970s (Jessop 1986), but regulatory changes following the 1977 establishment by Canada of the 370 km (200 mi) coastal management limit have since reduced catches to about 100 metric tons since the mid-1990s (Department of Fisheries and Oceans, Policy and Economics Branch, unpublished data).

Case History: Hudson River and Neighboring Drainages

The Delaware, Hudson, and Connecticut rivers are large, drowned river valleys in the northeastern

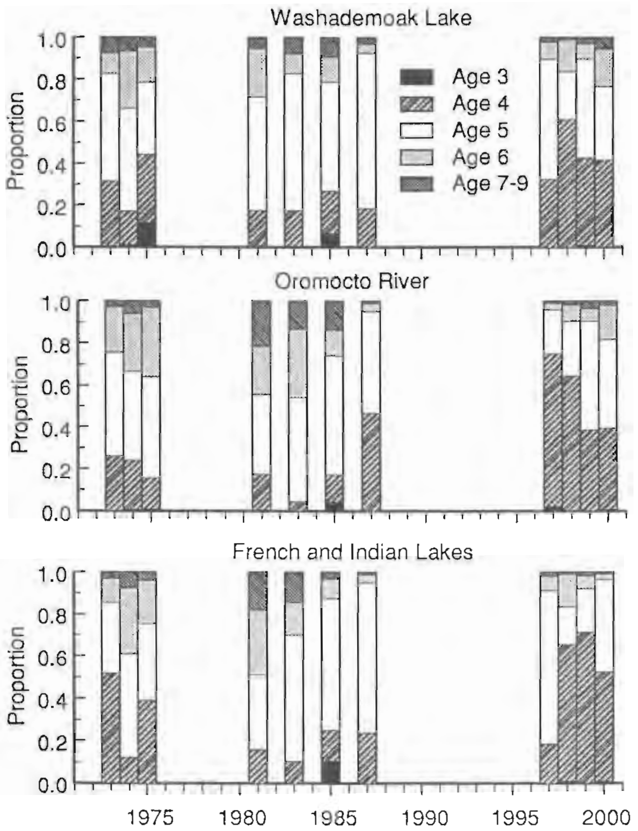

Figure 5.—Annual age composition of alewife from several tributaries of the lower Saint John River, 1973–2000. Annual sample sizes ranged from 122 to 491 fish (median = 249 fish).

United States. All three rivers have tidal influence well inland (up to 243 km in the Hudson River), and much of that distance is freshwater. Each also has numerous upland tributaries that have spawning runs of river herring.

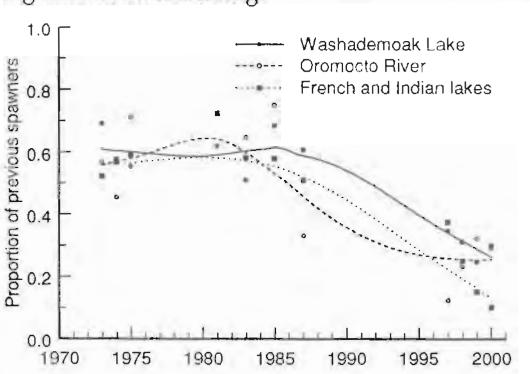

Figure 6.—Proportion of previously spawning alewife from several tributaries of the lower Saint John River, 1973–2000. The trend lines are LOESS-smoothed (span = 0.7).

Long-term data sets from these drainages are counts or indices of YOY abundance as a by-product of monitoring programs to assess stocks of striped bass or American shad *A. sapidissima*. The only long-term data set for adults, annual estimates of blueback herring lifted over the Holyoke Dam on the Connecticut River (Figure 7), shows a sharp decline since the early 1990s, having dropped 98% in the last 10 years (Anonymous 2002). An adult population assessment is underway in the Hudson River.

Indices of blueback herring YOY abundance are available for all three rivers (Figure 7), and all show negative slopes for fitted regression lines since 1985. The only slope significantly different from zero is in the Connecticut River data set which correlates with the adult data (Figure 7). A regression on numbers of blueback herring YOY collected in the Hudson River Utilities' monitoring program does show a significant decline since the late 1980s (Figure 8).

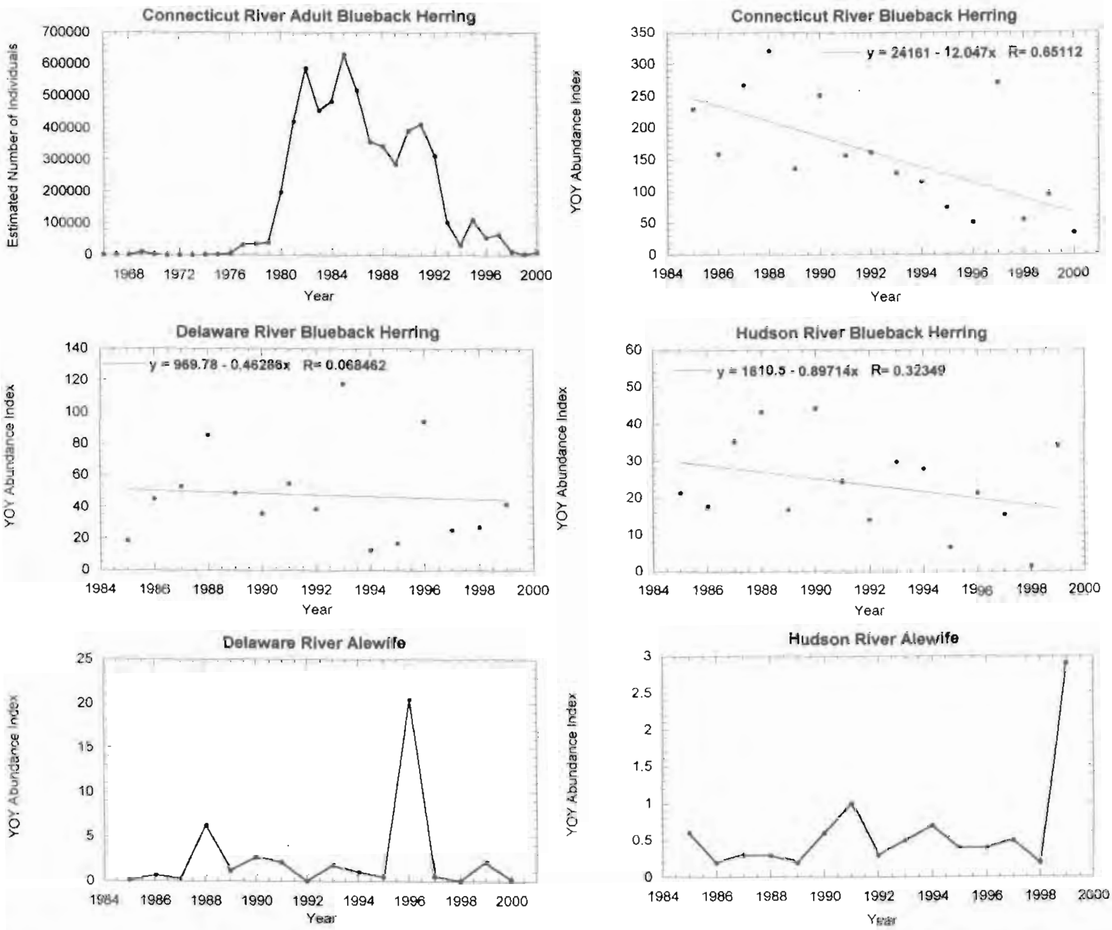

Figure 7.—(Top left) Estimates of total numbers of blueback herring lifted over Holyoke Dam, Connecticut River, 1966–2000. (Top right) Regressions of young-of-the-year (YOY) abundance indices for blueback herring from the Connecticut River, 1965–2000 ($P = 0.04$), (middle left) the Delaware River ($P = 0.17$), and (middle right) the Hudson River, 1965–1999 ($P = 0.46$). (Lower left) Young-of-the-year abundance indices for alewife in the Delaware, 1965–2000, and (lower right) Hudson rivers.

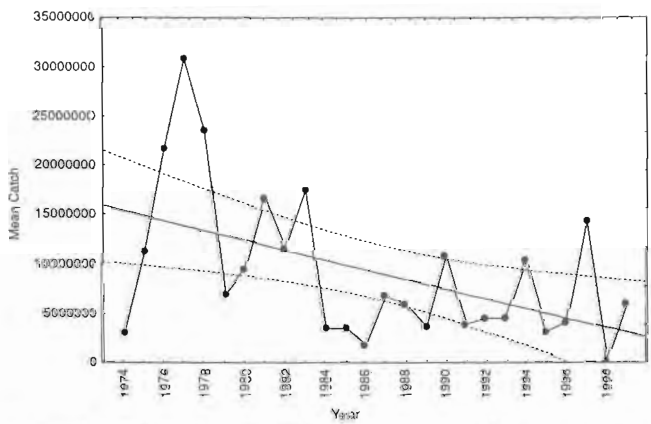

Figure 8.—Regression of young-of-the-year mean catch in beach seines for blueback herring from the Hudson River, New York, 1974–1999. Data are extracted from annual monitoring reports funded by the Hudson River Utilities.

Alewife YOY abundance indices are not available from the Connecticut River. The long-term records from the Hudson and Delaware rivers appear to be similar (Spearman $R = 0.54$; $P = 0.015$) and show no increasing or decreasing trends (Figure 7). However, the numbers collected in the Hudson River Utilities' surveys show a significant decline in the Hudson River (Figure 9).

For most of their life cycle, alewife in the Hudson estuary occur in close proximity to tidal water and therefore are potentially vulnerable to seining gear. Blueback herring have a more complex life history in the Hudson estuary, and abundance indices may not reflect this. Beginning in May, very large numbers of blueback herring adults move through the locks on the federal dam at Troy, New York, and subsequently through locks into the Barge Canal and the Mohawk River, New York. Adults appear near Rome, New York (160 km from the tidal Hudson River), in July. Spawning occurs in the Mohawk River, and some individuals collected there do not appear to be anadromous (Limburg et al. 2001).

Case History: Albemarle Sound

River herring in Albemarle Sound provide a good case history for examining hypotheses for the decline in river herring abundance observed in the southeastern United States. Albemarle Sound accounts for the vast majority of North Carolina river herring landings, and juvenile abundance indices are available for both alewife and blueback herring since 1972 (River Herring Development Team 2000). Also, estimates of population size are available for blueback herring in the Chowan River tributary, supporting the primary river herring fishery within the Albemarle Sound Basin, North Carolina (Carmichael 1999).

Carmichael (1999) reported that the Chowan River blueback herring spawning stock has declined markedly since 1972 (Figure 10). Periods of increasing spawning stock biomass (SSB) occurred in the mid-1970s and mid-1980s due to strong year-classes, but the overall trend has been downward since the early 1970s. Recruitment has been at record-low levels in recent years (Figure 10), a pattern that is consistent with Albemarle Sound survey data for juveniles. Poor year-classes have occurred consistently at SSB levels below about 2,000 metric tons, whereas both strong and weak year-classes have been observed at higher SSB levels (Figure 10). For 1998, SSB is estimated to be 600 metric tons (Carmichael 1999).

The hypothesis that striped bass predation is responsible for declining river herring stocks can be examined in part by comparing the timing of declines in blueback herring abundance to increases in abundance of striped bass. Hassler et al. (1981) and Hassler and Maraveyias (1988) used tag returns to estimate the size of the striped bass spawning run in the Roanoke River for the period 1956–1987. Estimates of 1982–2000 striped bass abundance for the Albemarle–Roanoke population (Carmichael 2000) and Atlantic migratory population (ASMFC

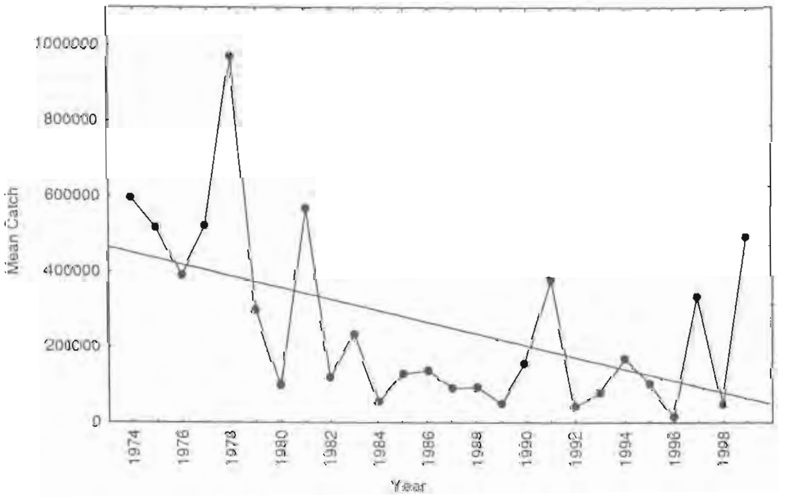

Figure 9.—Regressions of young-of-the-year mean catch ($P < 0.008$) in beach seines from alewife from the Hudson River, New York, 1974–1999. Data are extracted from annual monitoring reports funded by the Hudson River Utilities.

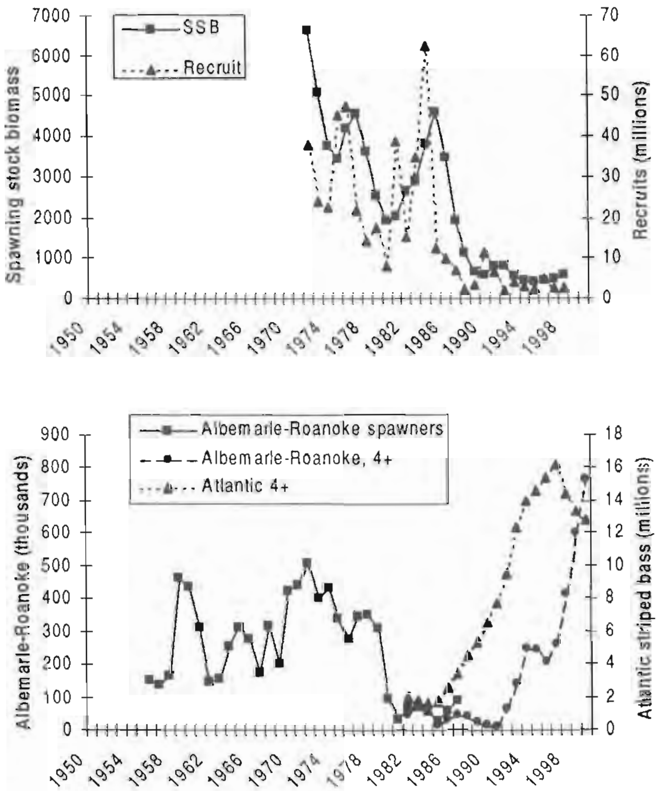

Figure 10.—Estimated spawning stock biomass (SSB; metric tons) and number of age-3 recruits for the Chowan River, North Carolina, blueback herring stock, 1972–1999 (upper panel; Carmichael 1999) and population size for the Albemarle–Roanoke and coastal Atlantic striped bass stocks, 1956–2000 (lower panel; Hassler et al. 1981; Hassler and Maraveyias 1988; ASMFC 2000; Carmichael 2000).

2000) were obtained by virtual population analysis. Based on those assessment results, it appears that the decline in Chowan River blueback herring abundance occurred just prior to the dramatic increases in the Albemarle–Roanoke and coastal Atlantic striped bass stocks (Figure 10).

Discussion

The examples used indicate a general decline in the combined population size for both species throughout their ranges, most likely due to human exploitation. Evidence of overexploitation for individual stocks included reductions in the proportion of previous spawners and declines in spawning stock size and recruitment. These results were observed in fisheries for which landings have been sampled to determine species and age composition. Unfortunately, sampling of river herring landings has not been a management priority for most U.S. states, so determining the extent to which overexploitation contributed to the decline of each species would require considerably more information than is now available. A reasonable starting point for improved management of the major river herring fisheries would be to obtain separate landings records and biological samples for the two species. Data on the movements and distribution of various stocks of both species in the ocean are also unavailable (but see Neves 1981 and Stone and Jessop 1992). Ultimately, the ideal situation would be to obtain information on the size of spawning runs within each river system. Run size is currently known or estimated for only a few stocks that are either counted when moving through fish passage facilities or estimated through stock assessment methods.

The observed declines in abundance of adult alewife and blueback herring could be due to increased natural mortality. For example, Savoy and

Crecco (1995) suggested that the decline in American shad and river herring in the Connecticut River was due to predation by striped bass. As of 2002, recreational and commercial harvest of river herring has been banned in Connecticut, and striped bass predation was cited as the probable cause of the recent decline in numbers (Anonymous 2002). The role of varying marine environmental conditions on river herring survival is unknown but is likely significant and likely to vary temporally and geographically along the Atlantic coast.

For the Chowan River blueback herring population in North Carolina, the low current abundance appears to have been caused by overfishing rather than striped bass predation. The estimated average fishing mortality rate for 1972–1994 was 1.01, which was equivalent to an exploitation rate of 52% and appeared not to be sustainable (Carmichael 1999). The dramatic increases in striped bass abundance may make restoration more difficult, but they occurred after the decline in blueback herring SSB. The decline in blueback herring SSB was underway during the 1970s when recruitment was variable but relatively high. This suggests that low SSB caused recruitment failure rather than the reverse. Past declines in abundance of North Carolina and Virginia river herring stocks have been partly attributed to offshore fishing by foreign fleets (Loesch et al. 1981). However, offshore catches have been relatively low since 1973 (Loesch et al. 1981; ASMFC 1988, 1999; Harris and Rulifson 1989) and are not considered to be the primary cause of the continued low abundance of Chowan River blueback herring (Carmichael 1999).

Alewife and blueback herring are generally assumed to have a high degree of homing to their natal rivers (Thunberg 1971; Messieh 1977), as do American shad (Dodson and Leggett 1973; Melvin et al. 1986; and numerous papers on genetic diversity for shad and, to a lesser degree, river herring). This assumption has not been thoroughly tested, but there is general evidence that it is valid. In any case, the assumption forms the basis for the management of anadromous fish stocks such as river herring. The presence of subpopulations in the Saint John River (Jessop 1994) denotes a high degree of faithfulness among returning adults within the drainage as well as faithfulness in both species returning to the Saint John River per se. Construction of fish ladders in small coastal streams often results in rapid and noticeable increases in the numbers of adults returning to these streams (Rounsefell and Stringer 1943).

Faithful return of adults to a given stream and the observable response of river herring to management activities suggests that most of the exploitation of these species occurs within the coastal drainages. We believe that most commercial catch statistics are reporting in-river catches and that truly marine harvest is minimal since restrictions on foreign vessels were imposed in the early 1980s. The accuracy of catch statistics has often been questioned, but they are probably reliable in detecting long-term trends.

We selected case studies spanning the geographic range of these species in order to document their overall status. The case studies presented here are based on data most familiar to us. Data available for other large drainages on the Atlantic coast were not included because they were similar in many ways to those presented. We are biased in presenting information from large river systems only. Many small drainages support river herring runs, particularly in the northeastern United States and Atlantic Canada, and in some cases, those runs have been increasing in recent times. We did not solicit these data, which are often less available and complete than for larger rivers, and we question whether stable or increasing runs in these small drainages would have a measurable effect on the abundance of the species.

In general, alewife and blueback herring have very similar life history characteristics, but the timing of spawning is an important difference. For example, early closure of the fishery in the Saint John River put more pressure on the earlier-spawning alewife than on blueback herring. In the Albemarle Sound river herring fishery (River Herring Development Team 2000), management by quota will likely increase fishing pressure on alewife relative to blueback herring. A similar situation may exist in the Hudson River, where harvest for bait for striped bass (live and dead) seems to be a substantial part of the exploitation of that run (but has not yet been quantified). Striped bass angling there coincides with the alewife run but precedes the majority of the blueback herring run. Because the two species of river herring are exploited differently throughout their ranges, they should be managed differently. Managing river herring as a single entity could, depending on the circumstances, be detrimental to one species or the other.

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FEASIBILITY ASSESSMENT OF METHODOLOGIES TO CONDUCT AN ADULT BLUEBACK HERRING MARK AND RECAPTURE STUDY AT THE CRESCENT HYDROELECTRIC PROJECT

DECEMBER 2005

Feasibility Assessment of Methodologies to Conduct an Adult Blueback Herring Mark and Recapture Study at the Crescent Hydroelectric Project

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APPENDIX

1.0 INTRODUCTION

This report was produced by Normandeau Associates, Inc. (NAI) at the request of the New York Power Authority (NYPA) and in response to an order issued on February 15, 2005, (see attached Appendix) by the Federal Energy Regulatory Commission (FERC) to NYPA concerning protection for adult blueback herring at the Crescent Hydroelectric Project (FERC No. 4678-037). Paragraph (E) of the FERC order requires that NYPA consult with the resource agencies and design a mark and recapture study to determine the effectiveness of the fish protection system at this hydroelectric project for adult blueback herring. The order also requires NYPA to increase the flows through the fish bypasses at the Crescent site from 30 cfs to 125 cfs. A draft of the study plan and a schedule for its implementation is to be submitted to staff from the United States Fish and Wildlife Service (USFWS), the New York Department of Environmental Conservation (NYDEC), and National Marine Fisheries Service (NMFS) for comment by December 15, 2005. Following agency review, NYPA is required to file the study plan, the comments on the study plan, and the implementation schedule with FERC by January 15, 2006.

On June 30, 2005, NYPA participated in a conference call with USFWS personnel to discuss the objectives of the mark and recapture study at the Crescent Project. USFWS staff requested that the study determine the fraction of fish passing through each of three downstream exits at the Crescent site, the powerhouse and two fish bypasses. NAI has extensive experience collecting and tagging adult blueback herring on the Mohawk and Hudson Rivers and NYPA contracted with NAI to evaluate the applicability of mark and recapture methods for estimating the passage fractions at the Crescent site. The objectives of this feasibility study are to identify the unique features of the Crescent Project, including its fish protection system, and to assess the applicability of various tagging and recapture methods, including radio telemetry, video, netting studies or other methods to estimate the percentage of fish using each of the downstream passage routes.

2.0 METHODS

2.1 PROJECT DESCRIPTION

The Crescent Hydroelectric Project is located on the Mohawk River, 1.5 miles upstream from Cohoes, NY, in Albany County. The dam at the Crescent site consists of two curved sections separated by a large, mid-river rock island, which extends upstream about 800 ft from the dam. The impoundment is about 2,000 acres in size (Figure 2-1). The western section of dam (Dam B) is 537 ft long and runs from the west side of the island to the headrace of the powerhouse. Dam B is located on top of a rock outcrop and has a maximum height of 30 ft. The Crescent powerhouse is located on the western bank of the river and contains two Kaplan and two Francis turbines, each with a hydraulic capacity of approximately 1,500 cubic feet per sec (cfs). The eastern section of the dam (Dam A) is 907 ft long and runs from the east side of the island to the eastern bank of the river. It has a maximum height of 50 ft. The upper end of the Waterford Flight, a series of 5 locks (Locks 2 through 6) enabling boats to bypass the 80-ft high Cohoes Falls, is located about 800 ft upstream from Dam A on the eastern bank of the river. There is a third dam (Dam C) located below Dam B that protects the base of Dam B from erosion as water flows down over the rock outcrop into the pool below the Crescent powerhouse. Dam C has a maximum elevation of 8 ft.

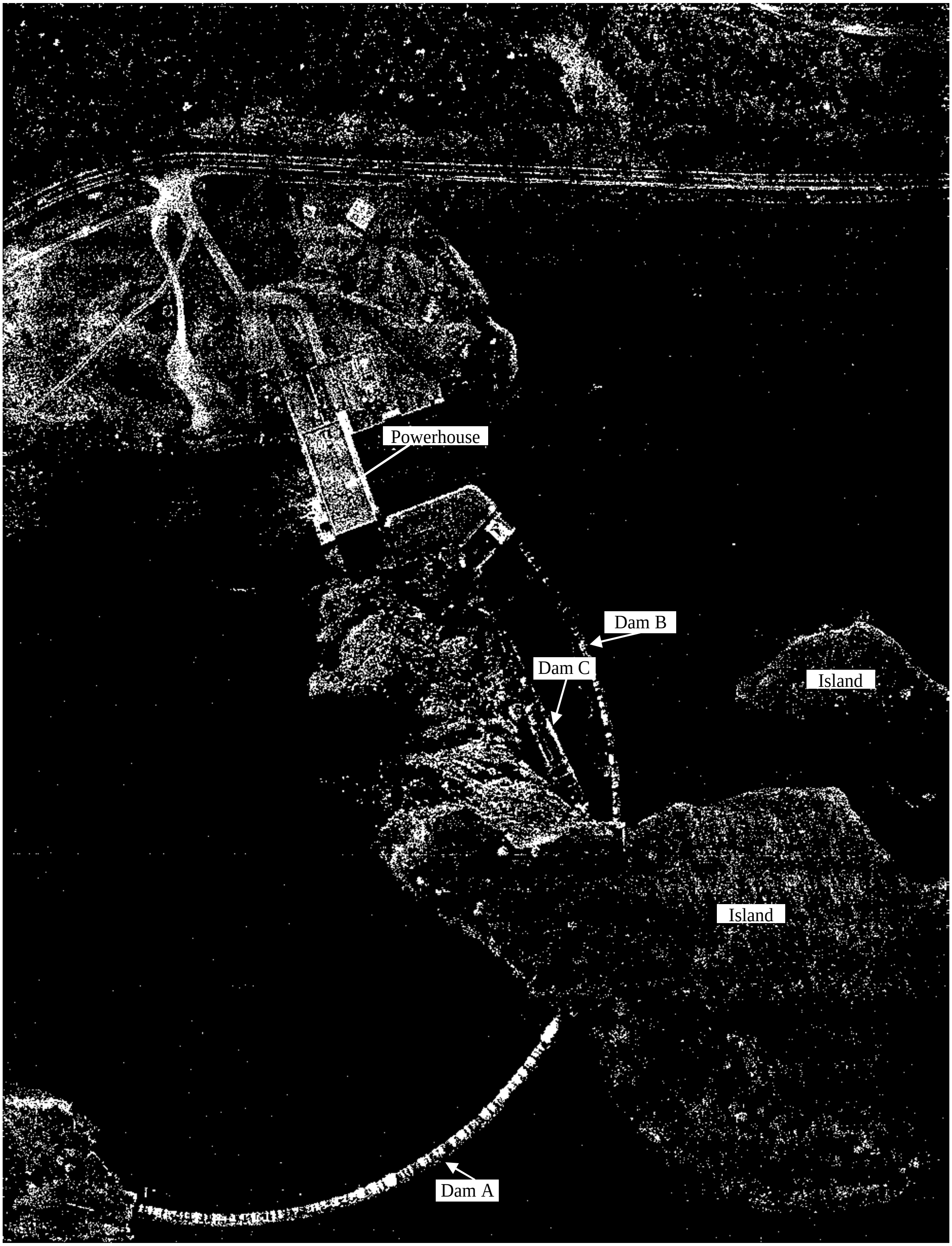

Figure 2-1. Overview of the Crescent Hydroelectric Project.

At the Crescent site, the main channel passes to the east of the mid-river island. It ranges from 700 to 900 ft in width and from 25 to 45 feet in depth. The channel on the western side of the island leading to the powerhouse is approximately 2000 feet long. It is 10 to 13 ft deep and 300 to 400 ft wide for the first 1000 feet downstream from the main channel. Over the next 700 ft, the depth increases to 15 to 17 ft and the width ranges from 100 to 200 ft. The bottom of the channel is featureless (smooth) throughout this 1700-ft section. The remaining section contains several rock outcrops that rise nearly to the surface and the bottom contours fall off on the downstream side of these outcrops, creating a depression lying parallel to and 50 ft upstream from the western half of Dam B. The island prevents adult blueback herring from moving directly from Dam B to Dam A; they have to swim upstream to the head of the island and then swim downstream to Dam A.

2.2 CURRENT FISH PROTECTION SYSTEM AT THE CRESCENT HYDROELECTRIC PROJECT

During the navigation season (the period from the first week in May through the middle of November), flashboards, 12 inches high, are placed on top of Dams A and B. The bypasses for post-spawning blueback herring are created by removing 40-ft sections of flashboards on Dams A and B. The 40-ft section on Dam A begins approximately 600 ft from the eastern shoreline. The 40-ft section on Dam B begins about 180 ft from the western end of the dam. There are no flashboards on Dam C and a 40-ft section, 12 inches deep, will be cut out of Dam C to form the fish bypass. The other component of the fish protection system at the Crescent site is a high frequency sound field projected outward from the entrance to the headrace at the Crescent Project. This high frequency sound field causes adult blueback herring to move out of the channel leading to the powerhouse and back into the main channel, where they move down to Dam A.

The effectiveness of a high frequency sound field on adult herring depends upon the condition of the fish. Fish in poor condition are little affected by the deterrent sound field and move through it. Fish in good condition react strongly to the deterrent sound field and move away from it (Ross et al. 1996). Studies conducted at the Crescent Project in 1997 and 2002 suggest that the post-spawning blueback herring moving downstream during late May and early June were not in good condition; they moved through the sound field into the headrace within 24 hours (Ross 1999, 2003). However, more than 90% of the post-spawning fish moved past the Crescent Project after mid-June and appeared to be in good condition, i.e., they turned away from the deterrent sound field and did not enter the headrace.

2.3 CONSIDERATIONS FOR DESIGNING MARK AND RECAPTURE STUDIES

The study objective is the most important consideration when designing a mark and recapture study and choosing the type of method and mark that will be used. At the Crescent Project, the objective is to determine the passage routes taken by post-spawning blueback herring as they move downstream past the project. Resource agencies requested that NYPA design a mark and recapture study to estimate the percentage of blueback herring that pass downstream through several potential exit routes, including:

1. the headrace (fish committed to passing through the powerhouse)
2. downstream bypass on Dam A
3. downstream bypass on Dam B

In going through the process of selecting a marking method for this study, consideration was given to the length of time the mark or tag needs to remain on the fish, the number of fish that need to be marked, the life history of the blueback herring during the spring spawning run, the methods proposed to capture and mark the fish (and recapture them after marking) and methods that could be used to minimize stress due to capture, handling and marking. Other considerations included the skill required to mark the fish with each type of tag and whether this population of blueback herring is considered "closed" (immigration and/or emigration is negligible) or open, which means individuals can immigrate into and out of the study area.

2.4 Mark and Recapture Assumptions for Open Populations

The population of migrating blueback herring in the Mohawk River is considered "open" because new, untagged recruits can continually enter the Crescent impoundment during the spring passage season and they, along with tagged fish can also leave the project area and continue migrating upstream. Assumptions about the tagged fish in an "open" population that must be satisfied to estimate the proportion of blueback herring using the two downstream fish bypasses and the headrace canal (passage through the powerhouse) include:

1. tagged fish do not experience different survival than untagged fish
2. the sample is representative of the target species
3. tag loss is minimal or known
4. tagged fish have an equal probability of recapture as untagged fish
5. tagged fish are randomly distributed amongst untagged fish

Adult blueback herring migrate up the Hudson River in the spring and move into the Mohawk River in early May. Some of these fish spawn in the lower Mohawk River below Cohoes Falls (approximately 2 miles upstream from the Hudson River) but the majority move upstream through the Waterford Flight, a series of five locks that enables boats to move upstream past the falls. Adult blueback herring moving upstream through the locks enter the Crescent headpond through Lock 6, located on the eastern side of the river. Some of the fish continue to migrate up the Mohawk River for miles and spawn in tributaries emptying into the Mohawk River. Once the fish have spawned in May (peak spawning is usually the third week in May), the spent adults drop back downstream and pass the project to return to the ocean. Since the fish can be in the river for up to 3 months, the tag or mark selected will have to last a minimum of 12 weeks if the fish are tagged early in the run.

2.5 Conventional Tags/Marks

Although there are numerous types of tags and marks available, only those that could be applied to the fish with the least possible stress were considered. Tags that required surgery (implants) or those that take too much time/effort to apply and would stress the fish too much were rejected. Some of the tags/marks that were not considered were cold branding, internal anchor tags, opercle tags and various disk tags. Other tags such as magnetic coded wire tags (CWT) that are detected with a metal detector were also rejected because of potential tag loss if not inserted properly and errors associated with false detections.

The conventional tags/marks that were considered are presented below. When these types of tags are used, it is necessary to use nets to recapture the tagged fish as they emigrate past the project.

Mutilation – this type of mark includes fin clipping or punching holes in fins.

Immersion Dyes – dyes such as acridine orange or bismark brown y are mixed in tanks of water and fish are placed in the dye bath for a specified time until the dye colors the soft tissue.

T-Bar Type Anchor Tags – this is the standard vinyl T-bar tag that can be applied with a tag gun applicator

Visible Implant (VI tag) – injected under living transparent tissue, usually around the eye socket

2.6 PHYSICAL CAPTURE TECHNIQUES USING NETS

If conventional tags or marks are selected to conduct the study at Crescent, the only viable option to recapture tagged fish as they pass downstream through either the powerhouse or one of the two downstream bypasses is the use of nets. For those fish passing through the powerhouse, two types of netting techniques have been used at other hydroelectric facilities and include tailrace netting which is conducted downstream of the powerhouse and intake netting which is conducted upstream.

Tailrace Netting – this method involves using either full discharge nets designed to sample the entire flow through the turbine(s) or partial discharge nets that are made to sample a portion of the turbine flow.

Intake Netting – intake nets are deployed in front of the turbine intakes to sample fish committed to turbine passage and are usually an array of smaller nets attached to a larger framework. Intake nets generally are constructed with a fyke installed near the end of the net to prevent fish from escaping.

Bypass Netting – bypass nets are usually deployed downstream of the bypass plunge pool, if practical, so the energy from the spill can dissipate and not destroy the net. Nets are usually modified commercial trawl nets that must be attached to frames anchored to the bypass substrate.

2.7 RADIO TELEMETRY, ACOUSTIC (ULTRA-SONIC) TELEMETRY AND PIT TAG TECHNOLOGY

Radio Telemetry

The use of radio telemetry to determine both upstream and downstream passage routes of fishes at hydro power sites has been accepted throughout the country as a viable methodology. Over the past decade digital radio tags have been developed that reduce the incidence of false signals that frequently occurred when pulsed radio tags were used in past studies. This technology has typically been applied to anadromous fish species, such as salmon, river herring and American shad.

Radio telemetry monitoring systems used in fish movement evaluations at hydroelectric facilities have three major components: transmitter(s) or tags, receiver/data logger(s), and antenna system, which can be either an aerial or underwater antennae system. The design of monitoring systems utilizing this methodology is dependent on study objectives. Receiving stations can be portable for manual tracking or placed at fixed locations to continuously monitor tagged fish movement. Fixed station systems are more commonly used for downstream evaluations, allowing investigators to continually and concurrently monitor all available passage routes (i.e, turbines, bypasses, spillage areas).

Radio telemetry systems usually operate from 27-300 MHz , although most fish studies utilize the 30-50 MHz or 150-220 MHz radio band. The higher of the two bands can be utilized when water conductivity is relatively low and shallow water depths (<30 ft) are being monitored. Additionally, this frequency band is considered the best for use in the vicinity of electrical generating stations. Electrical signals emitted from hydroelectric generators and transmission lines tend to produce radio interference at lower frequencies.

The attachment location of radio transmitters depends on the morphology, size, behavior of the species, and the objectives of the study. The basic methods used for attachment are external (Knight 1975; Royer et al. 1988), oral insertion into the fish's stomach (Bell and Kynard 1985; Stier and Kynard 1986; Giorgi et al. 1988; Stuehrenberg et al. 1990; Olson et al. 1990; Hanson and Royer 1991), or surgical implantation, particularly for larger fishes (Winter 1983).

Ultra-Sonic Telemetry

A technology similar to radio telemetry is ultrasonic telemetry. Ultrasonic systems utilize sound in the 20-300 KHz frequency range. Ultrasonic telemetry is frequently used in studies conducted in deep water or salt water and requires the use of a hydrophone suspended in the water column to receive signals. Ultra-sonic telemetry has been successfully used in studies of sturgeon and salmon that migrate between salt (or brackish) and fresh water habitats because this method can be used to track fish in both fresh and salt water, whereas radio telemetry will only work in freshwater environments. However, the frequency range of ultrasonic telemetry is typically not suitable for use in turbulent water near hydroelectric stations because entrained air bubbles readily attenuate signals. It would be difficult to get the hydrophones to work in the tailrace due to entrained air and therefore not a good method to determine if tagged herring passed through the turbines. Also, windy days that create choppy surface conditions can impact the hydrophone and receivers ability to record the tag because range is much reduced under these conditions due to background noise.

Fixed station acoustic telemetry is another form of ultra-sonic telemetry that has been used to determine the movements of fish passing downstream of hydroelectric stations. This technology has typically been applied to anadromous fish species, such as salmon smolts and sturgeon.

Acoustic tag systems are comprised of a scientific quality receiver, an array of hydrophones, and acoustic tags (sound transmitters) implanted in the target organisms. Tags are designed to emit unique coded signals on one frequency. Use of this system allows real time fish locations to be recorded in three dimensional plots fish over a period of days and weeks allowing continual and concurrent monitoring of all available passage routes (i.e., turbines, bypasses, spillage areas).

Several types of data can be obtained using this methodology including movement and behavior within the monitoring area and the proportion of tagged fish using various passage routes. This information can then be comparatively analyzed with information on station operation and meteorological conditions.

Generally, hydrophones (a minimum of three) are strategically placed within the forebay and detect signals simultaneously from acoustically tagged fish that enter into the desired or pre-determined monitoring zone. The signals are then recorded by the receiving station and analyzed by triangulation based on detection time and plotted based on the distance from each of the receiving hydrophones. The recorded tracks are accurate to within less than one meter in any direction.

Passive Integrated Transponder (PIT) Tag

The PIT tag and its associated detection monitoring system have provided researchers the tools necessary to statistically apportion fish survival probabilities for an entire river, within a specific reservoir/river reach, or through specific passage routes (turbine, spill, bypass facility). The PIT tag consists of an integrated microchip bonded to an antenna coil with about 1,200 wraps of specially coated copper wire. The electronic components of the tag are encapsulated in a glass tube 12 mm long x 2 mm in diameter. Each tag is coded at the factory with one of 34x109 ten digit unique alphanumeric codes and has an indefinite life expectancy (Prentice et al. 1990a). The tag can be automatically detected and decoded in situ, eliminating the need to kill fish during data retrieval.

The PIT tag is implanted by a special injector system in the body cavity of anesthetized fish posterior to the pyloric caeca in the pelvic girdle area. Tag presence and code are verified after tagging with a detector-decoding system prior to fish release. The detector system can be portable if a small number of fish are being tagged and interrogated, or it can be interfaced with a computer system when large numbers of fish are tagged or interrogated. The tag is energized by a 400-kHz external signal that enables it to transmit a unique 40 to 50-KHz signal to interrogating (search) equipment. When a code is detected, it is immediately processed, displayed, and optionally stored on a computer. The system is designed to interrogate, decode, and process tag code information at rates in excess of one tag per second, with peak rates of 10 codes/second for a maximum duration of one second.

After PIT tagged fish are released, their subsequent fate in passage through any release route is monitored at downstream locations equipped with PIT tag monitoring systems. Tagged fish that bypass a hydroelectric dam are interrogated by monitoring systems and the data are recorded. The detection range of these monitoring systems is a radius of about 18 cm; however, efforts are underway to increase the detection range (Prentice et al. 1990b). An expanded detection system would allow interrogation of tagged fish over a much larger area such as fishway entrances. Data from expanded interrogation areas could provide overall survival estimates (from the time of release of tagged juveniles to the time of returning adults). These monitoring systems have been integrated with fish bypass facilities on some large hydroelectric dams on the Columbia and Snake Rivers. However, there are no similar monitoring systems in operation elsewhere.

The tag was specially developed for monitoring movement patterns, travel time, and survival of emigrating juvenile salmonids in the Columbia River Basin. It has also been used in a limited way with other species, particularly by hatchery managers, for long-term individual fish identification (Jenkins and Smith 1990). The smallest fish equipped with a PIT tag was a 50 mm striped bass tagged under hatchery controlled conditions (Jenkins and Smith 1990).

2.8 CAMERAS AND VIDEO TECHNIQUES

The use of underwater cameras (or in air cameras) and video taping equipment can be a useful tool to monitor fish utilization of various passage routes at hydroelectric facilities under certain conditions. The method is most effective when a small volume of water needs to be monitored, such as a downstream fish bypass, entrances and exits to fishways or at view windows installed in fish ladders and fish lifts (Normandeau 2002; 2003a; 2003b). However, the method has serious shortcomings when attempts are made to monitor larger volumes of water, such as large bypasses and turbine flows. Camera range is severely reduced when visibility is poor and there are also problems with trying to video at night. Infra red lights with compatible cameras have been used with some success, but the range of the camera with this light source is only around 1 or 2 ft (Normandeau 2003b). Using background lighting with low light cameras has had some success, but some researchers contend the lights can keep fish from using the bypass at night. There is also a problem identifying the fish at night with infra red lights because many times just a bright flash is recorded and the fish cannot be identified to species.

Cameras are usually coupled to both a video cassette tape recorder and a monitor via shielded coaxial cable. Continuous recording in real time can be accomplished by an unattended system, but cassette tape replacement is required at least daily even if time lapse recording is used. Newer digital cameras and DVD recording systems can run unattended for days, but large hard drives are required to store the digital images. After the recording is complete, each tape or DVD must be reviewed by playback, and the fish recorded tabulated and compiled. Both tapes and DVD can be played back at greater than real time speed to expedite review and data compilation. However, the individual fish recorded are only visible for at most a few seconds and identifying the fish to species can be difficult. Also, schooling fish such as river herring can pass downstream in groups and in many cases, the individuals closest to the camera block out the fish beside them.

The limiting physical variables for underwater videography are water clarity and available light. Valuable data can be missed if water turbidity increases during the study. Water clarity will also be the prime factor in the determination of whether a given passage route can be monitored by videography. Filming at night has serious range limitations and even with the use of infra red light the cameras have a range of only 1 or 2 ft and some of the fish recorded at this distance cannot be identified to species.

2.9 DUAL-FREQUENCY IDENTIFICATION SONAR (DIDSON) ACOUSTIC CAMERA

The use of an acoustic camera for fish passage research at hydropower dams is a rapidly developing technology that shows great promise. The "Dual-Frequency Identification Sonar" (DIDSON) is a high-definition imaging sonar that can obtain near video quality images for the identification of objects underwater (Tiffan et al. 2004). It was originally developed for the U.S. Navy by the University of Washington's Applied Physics Laboratory. The DIDSON helps bridge the gap between existing fisheries assessment sonar and optical camera systems, because fish within 12 m of the acoustic camera are clear enough that the fish can be observed swimming in zero visibility water where optical cameras would not work.

The DIDSON uses an acoustic lens and has two available frequency modes, a low frequency mode of 1.0 MHz and a high frequency mode of 1.8 MHz. The differences between the low and high frequency modes are in range and resolution. The high frequency 1.8 MHz mode has a beamwidth (two-way) of 0.3º horizontal by 12º vertical and has 96 beams over a 29º field-of-view. The low frequency mode has a beamwidth of 0.4º horizontal by 12º vertical and has 48 beams. The high frequency mode provides high resolution and fast frame rate, which provides target visualization in real time. In the high frequency mode, the 0.3º beamwidths are best for smaller fish targets and it ensures that fish intercept multiple beams if they are within the 12 m range. The high frequency mode appears to be the most useful for fisheries work because it provides high-resolution images (7 frames per second) that define the outline, shape and even fins of some of the target fish (see www.soundmetrics.com for examples of this new technology).

2.10 HYDROACOUSTICS

Hydroacoustic technology is being used extensively at hydropower sites in the Pacific Northwest to monitor fish (usually salmon smolts) as they approach and pass the dams. Although the concept behind hydroacoustics is relatively easy to understand, the equipment, technology, theory, and procedures necessary for scientific applications are sophisticated. Simply stated, hydroacoustics involves:

- the generation of an electrical signal by an echo sounder;
- the conversion of the electrical pulse into an acoustic pulse by a transducer;
- the interaction of the acoustic pulse and a target resulting in a reflection (an echo) of the acoustic pulse back to the transducer;
- the conversion of the echo into an electric signal (or voltage return) by the transducer;
- the processing of the voltage return to determine, for example, target range, target strength, and direction of movement. In some cases (depending on study objectives), these data are then computer processed to weight for position (range and angle off axis) in the conically shaped acoustic beam and extrapolated to account for spatial and temporal subsampling (BioSonics 1989).

There are essentially two general levels of sophistication in hydroacoustic equipment and application. Commercial grade equipment is used primarily in the commercial fishing industry as an aid to harvesting fish. The objectives include location of fish (primarily large schools) and the evaluation of relative biomass or size of the fish school. Commercial grade equipment has also been used in fisheries science applications. This use may be appropriate in cases where the study objective is the determination of presence/absence or gross estimates of biomass. Commercial grade equipment is not appropriate when study objectives include a more quantitative evaluation (BioSonics 1989).

Scientific grade equipment is used primarily in fisheries science and management applications. This equipment is substantially more sophisticated and generally more expensive than commercial grade equipment. Only three companies in the world manufacture scientific grade hydroacoustic equipment. Those companies are: BioSonics, Inc. and Hydroacoustic Technology, Inc. (HTI) located in Seattle, WA; and Simrad located in Norway.

Hydroacoustic equipment can be deployed as stationary (fixed location) or mobile units. A fixed-location application is the most applicable hydroacoustic methodology to estimate rates of entrainment, spill efficiency, and by-pass efficiency at hydroelectric projects. Stationary transducers are deployed in or near intake structures, spill gates, or structural by-pass entrances so that the hydroacoustic system monitors a sub-sample of the water flow passing through or over that structure.

A critical piece of equipment for a fixed-location study is the multiplexer. The multiplexer facilitates interrogation of multiple transducers (one at a time) by a single echo sounder. The interrogation sequence and time interval is programmed into the multiplexer unit by the operator (BioSonics 1989).

This flexibility allows customization of the sampling regimen depending on study objectives. "Fast multiplexing" capability can permit multiple transducers to be sampled virtually simultaneously.

Other required components of a fixed-location system include an echo sounder, one or more transducers, and display or recording equipment for target data. Display unit possibilities include a paper chart recorder, oscilloscope, and computer monitor. Recording equipment possibilities include computers and digital tape recorders. Generally, the more components included in a system the more flexible, useful, complicated, and expensive the system becomes.

Hydroacoustic Techniques

Three general hydroacoustic techniques have been employed for fish evaluations at hydropower dams: single-beam, dual-beam, and split-beam. Each technique requires successively more sophisticated transducers, echo sounders, and data processing techniques. Experts continue to debate the pros and cons for each technique, but most agree that the split-beam technique is preferred at most large hydro sites. The primary advantages of the split-beam technique over dual-beam include an improved signal-to-noise ratio (very important in acoustically noisy environments such as at hydropower dams), and the availability of absolute target location in the beam (in three dimensions) (Ehrenberg 1983, 1984; Johnston 1993; Johnston et al. 1993, 1994). Traynor and Ehrenberg (1990) and other researchers have confirmed that split-beam techniques provide less variable target strength estimates than either the dual-beam technique or single-beam deconvolution technique.

3.0 RESULTS

3.1 ATTRIBUTES OF THE BLUEBACK HERRING SPAWNING RUN IN THE MOHAWK RIVER

Determining the number of marked blueback herring that pass the Crescent site through either the powerhouse or the two downstream bypasses presents some difficult problems. In theory, the best way to conduct a mark and recapture study at this site would be to capture and tag the herring as they gather in large schools upstream of the dam after spawning. Collecting and tagging the blueback herring at this time would ensure that none of the marked fish would migrate upstream out of the study area and all tagged fish would pass the site and be available for capture, basically a “closed” population. However, there are concerns about capturing and tagging the spent herring because the fish are already stressed due to the long migration. The effects of capture, handling and tagging may cause significant mortalities depending on the condition of individual fish. Water temperatures rise rapidly at this time of year, further stressing the fish. The fish could be tagged during their upstream migration, when they are in the best condition and water temperatures are cooler. However, the problem with this method is that most of the fish entering the Crescent headpond via the lock and dam system continue upstream to spawn in the upper Mohawk and many may never return back downstream to become available for recapture. If conventional tags or marks are used, it would be impossible to know how many tagged fish return to the dam after spawning and are available for recapture.

Other troublesome problems with mark and recapture studies involving river herring is attempting to hold marked (and unmarked) control fish in tanks or net pens to determine handling and tagging mortalities and tag retention rates. Basically, the fish held in the tanks will always have greater stress than those that have been tagged and quickly returned to the water to continue their upstream migration. It is our experience that blueback herring held in tanks and pens during the spawning migration are difficult to keep alive for even a month. Normandeau crews set up holding tanks at the Crescent Project during the 1999-2001 river herring stock assessment study to determine tag retention rates for the T-bar tags being used in the study. Both marked and control (unmarked) fish mortality in the tanks was similar and it was thought that the tanks themselves may have been contributing to the mortalities. Much of this is due to the stress these fish experience at going from total freedom to a confined space, especially when the fish have the strong desire to migrate upstream. Some of the stress can be attributed to the gradually increasing water temperatures in the tanks as temperatures rise and also due to fungus and other diseases that frequently occur when these fish are kept in confinement for any length of time. In the wild, the fish can seek out deeper, cooler water when temperatures increase in the late spring and early summer and avoid the higher water temperatures. Some of these problems that occur in holding tanks can be overcome by providing a constant current in the tanks to keep the fish swimming, use of round tanks which seems to increase survival of confined river herring and by shading the tanks.

3.2 CAPTURING BLUEBACK HERRING IN THE MOHAWK

Normandeau biologists captured and tagged thousands of blueback herring in the lower Mohawk River from 1999 through 2001 (report in prep, Rick Simmons, Normandeau Associates, personal communication). The field crews used multiple gear types to capture the herring (cast nets, gill nets, scap nets, beach seines etc) in an effort to find the best capture method/gear with the least bias. During the study, our crews discovered that the blueback herring can be captured quickly and with a minimal amount of stress using fishing rods and jigging with Sabiki rigs (small mylar flies) within the Erie Canal locks. The blueback herring strike the flies readily, and they can be quickly placed in a small tank for processing. It is our experience that the fish must be captured and tagged in less than one minute (30 seconds is ideal) to keep stress to a minimum. Any tag or mark that takes too much time, requires surgery, or requires that the fish be anesthetized to be marked was not considered. In radio telemetry studies using adult shad, we discovered that fish that are released back into the current after capture and tagging do the best. Also, if they can be released back into a school of wild fish, they experience even less stress and mortality. Schooling fish like the clupeids get very stressed when separated from the school. Getting a tagged fish back in with wild fish allows it to stay with the school and keeps its potential stress to a minimum.

3.3 CONVENTIONAL TAG METHODS

Conventional tags or marks that were considered for marking adult blueback herring included fin clipping, immersion dyes, Floy type T-bar tags and Visible implant (VI) tags. Although there are numerous types of tags and marks available, only those that could be applied with the least amount of stress were considered. Any tag that required surgery (implants) or those that take too much time to apply and would unduly stress the fish were rejected. Tags that were not considered due to the problems listed above included cold branding, internal anchor tags and various disk tags. Other tags that require special training to apply, such as magnetic coded wire tags were also rejected because of potential tag loss if not inserted properly and errors associated with false detections (Mattson et al 1990).

Of the four conventional tags/marks that were considered, immersion dyes were quickly eliminated because the dye mark would fade after 2 weeks. If the fish are tagged early in the run as they enter the Mohawk River system, the mark would need to last 10 to 12 weeks and if they are tagged as spent adults, the mark needs to last 4 to 8 weeks, depending on the date the fish are tagged. Visible implant tags were also rejected because the fish must be restrained by a special device to ensure proper tag placement (or anaesthetized) and this takes too much time. The pros and cons of the other two tags/marks are presented below.

Fin Clipping

Pros:

- Many fish can be marked quickly for low cost
- Stress to the fish is moderate if experienced crew clips the fins
- Mark is easily identifiable upon recapture (fin will not grow back during study period)

Cons:

- Control fish will have to be held for length of study to document tagging and handling mortality and herring are very difficult fish to keep alive in confined tanks
- Individual fish and the date they were tagged cannot be identified
- Since tagged fish have to be captured and handled to apply the mark, they will experience more stress than untagged fish

Floy T-Bar Tag

Pros:

- Many fish can be marked quickly with an individual tag number for low cost
- Stress to the fish is moderate for a trained technician
- Mark is easily identified upon recapture
- Tag “gun” used to insert tags is quick and efficient

Cons:

- If tag is not inserted properly, tag may fall out during the study
- If tag not inserted in correct spot, fish could experience delayed mortality
- Control fish have to be held for length of study to document tag/handling mortality and tag retention and these fish are very difficult to keep alive in confined tanks

Either fin clipping or Floy T bar tags would allow numerous herring to be tagged and released with a minimum of stress. However, the use of either mark will require a net study to recapture the tagged fish as they return downstream and pass the site. The pros and cons of the various netting methods are presented below

Full Discharge Tailrace Netting

Pros:

- Properly designed full discharge nets provide accurate data on type and number of fish passing via the turbine.

Cons:

- Sampling with full discharge nets is labor intensive, a potential safety hazard for workers due to high flows, and requires expert boatmen to retrieve samples or gain access to floating work platforms.
- Full discharge nets are expensive and often require major repairs or replacement because of the effects of abrasion or high flows, particularly at large hydro facilities. These activities can become cost prohibitive.
- Deployment of large full discharge nets can be obtrusive to hydro station operation by requiring the use of powerhouse gantry cranes, the shutdown of turbines being sampled, and commitment of hydro station personnel.
- High debris loading coincident with high flows may preclude sampling during times of suspected high entrainment and therefore the potential exists for marked fish to escape recapture and bias the results.
- During high flows fish can avoid capture in any of the three locations (turbines and the two bypasses) by passing the site undetected via a spill.
- Spent blueback herring and other resident fish entrained in the net will experience high mortalities

Partial Discharge Tailrace Netting

Pros:

- Less expensive to construct and deploy than full discharge netting. The least expensive of all netting techniques used to evaluate entrainment.
- Usually the only tailrace netting technique feasible at large (3,000 to 5,000 cfs discharge) hydro-stations/units if cost is the most important consideration.

Cons:

- Tagged fish can pass through the turbines and escape capture undetected because the entire water flow is not being sampled.
- Sampling is labor intensive requiring a minimum of two to three people
- Collection of samples requires expert boatmen. There are safety concerns due to a high potential for entanglement in mooring anchors and lines, as well as in the netting devices themselves.
- High debris loads coincident with high flows may preclude sampling during times of suspected high entrainment.
- Most of the spent herring (and other fish species) captured will experience mortality.

Intake Netting

Pros:

- Properly designed intake nets provide accurate data on species composition and relative abundance of entrained populations.
- Intake netting systems are frequently used successfully to study entrainment at hydro stations with unit discharges >16,000 cfs.
- Intake netting does not require the use of boats and expert boatmen thereby eliminating the potential for serious boating accidents.

- Deployment and retrieval of intake netting systems is generally less equipment intensive than tailrace netting systems. Intake nets do not require an intricate system of mooring lines, anchors, and floating work platforms.

Cons:

- Intake netting sub-samples the flow so some tagged fish could pass through the turbine without being detected, biasing the results
- Fish in good shape can swim back out of the net due to their ability to swim (burst speed) in 8 ft/sec flows.
- Deployment of intake netting systems are labor intensive and usually obtrusive to hydro station operation by requiring the use of headwork gantry cranes, shutdown of turbines being sampled, and commitment of hydro station personnel.
- Mortality due to impingement in intake nets is usually high
- Failure of intake net system frameworks or nets could result in costly turbine damage. This is particularly true in river systems that carry high debris loads.
- Frequent use of headwork gantry cranes poses safety problems that require special consideration.

Bypass Netting

Pros:

- Properly designed and installed bypass net can effectively filter 100% of the bypass flow and therefore capture most of the spent herring exiting the bypass.

Cons:

- Installation of a bypass net at Dam A will be very difficult because of the location of the bypass (in the middle of the dam) and the difficulty for crews to install and fish the net – very dangerous
- Bypass nets will fail eventually because the flows cannot be shut off to remove trash, debris and logs that will end up in the net
- Most of the fish captured (wild and tagged) will perish in the net
- Installation of a bypass net to monitor fish passing via Dam B bypass is less difficult than Dam A, because a bypass net could be set up on the Dam C bypass due to exposed bedrock (Dam C is at the base of Dam B).
- Bypass nets would have to be fished simultaneously with turbine nets – very labor intensive
- Safety concerns are high at both bypass net locations because expert boatmen are needed to fish nets
- A spill during the study will bias the results because tagged and wild fish can pass the project undetected. Also, a spill can wipe out the bypass nets and endanger the crews working the nets below the dam if it occurs unexpectedly.

Basically, full turbine netting (all units) and bypass netting will be needed around-the-clock to satisfy the five tagging assumptions discussed below. Partial turbine netting (sub-sampling) will allow some tagged fish to escape and numerous net efficiency tests will be required to determine what percent of entrained fish get captured.

As mentioned in Section 2.4, at least five assumptions must be satisfied to estimate the proportion of marked blueback herring using the two downstream bypasses and the powerhouse. The first assumption is that tagged fish do not experience different survival than untagged fish. This assumption will be hard to prove, because of the difficulty in keeping marked control fish in tanks or net pens. It is our experience in holding marked blueback herring in tanks along the Mohawk River for T-bar tag retention studies that both marked and unmarked control fish slowly perished at the same rate, which indicated that the holding facility was inducing a greater stress and causing higher mortalities than the tagging and handling did. Fish at large in the river will always have less stress than those kept in confinement, further biasing the results. The second assumption that the sample is representative of the target species may be hard to prove, and will depend on the capture method. If the rod and reel method is used, then we must prove that the capture gear (rod and reel) is unbiased toward sex or size of herring captured, so a representative sample of the population can be taken. The third assumption, tag loss is minimal or known is not a problem with fin clips because the fins will not grow back during the 1 to 3 months needed for this study (time depends on whether we capture and tag green fish or spent fish). The use of T-bar tags and the potential for their loss may be harder to prove since it's difficult to keep the control fish alive in tanks for the studies duration. The fourth assumption, that tagged fish have an equal probability of recapture as untagged fish may be a big problem. The problem will be that when the tagged herring continue their migration up the Mohawk River to spawn, we will not know the number of marked fish that will return and be available for recapture. Some fish will perish on the spawning run due to the energy expended during the long migration. Without knowing the number of tagged fish that are available for recapture on the downstream run, the study will be biased. The final assumption that tagged fish are randomly distributed among the wild fish would be easy to prove with full tailrace and bypass netting, as long as some marked fish are captured with the wild fish.

Another big problem with large scale netting studies occurs during high flow events. If one occurs, we cannot meet our assumptions because many fish (marked and wild) can pass over the spillway and avoid recapture without our knowing how many escaped (see pro and cons for net studies above). High flows also cause high debris loading, which can damage or clog the nets.

3.4 RADIO TELEMETRY, ACOUSTIC (ULTRA-SONIC) TELEMETRY AND PIT TAG TECHNOLOGY

The pros and cons of using radio telemetry are presented below.

Pros:

- Trained fish biologists can radio tag the herring very quickly (oral insertion into the stomach) with minimal stress and low mortality.
- Fish that move in to or out of the study area can be manually tracked or located with strategically placed fixed location telemetry receivers/data loggers.
- Fixed location telemetry receivers/data loggers with proper set-up can effectively monitor the potential exit routes (one fixed location receiver/antenna array for each exit).
- Movements/reactions of spent radio tagged herring as they approach the high frequency deterrent system can be documented with manual tracking and fixed location telemetry receivers.

- System is far less labor intensive than netting studies and is non-destructive to fish populations.
- If radio tagged fish choose to exit via the Erie Canal Locks, a system could be set up to monitor this potential exit route.
- Stationary telemetry units can also be set up to record radio tagged fish that pass over the spillways during high flow events, therefore high flows and debris loading are non issues and all potential exit routes can be monitored around-the-clock

Cons:

- Radio tags are expensive ($230/ea) and if we tag the green fish as they enter the river we cannot be sure how many tagged individuals will return to Crescent after they finish spawning.
- Need to prove the assumption that radio tagged fish are mixing normally with untagged fish
- Some radio tagged fish may get past the site undetected if two or more tagged fish approach a telemetry station at the same time (tag collision can occur and the receiver may only record the strongest tag)

The use of radio telemetry to determine downstream passage routes at hydro sites has been accepted nationwide by most agencies. For a study at Crescent, radio tags offer a unique advantage compared to conventional tags and nets in that we will know the number of tagged fish that return to the site and pass downstream. Other benefits include downstream passage coverage of the projects spillways during high flows (not possible with nets) and the method is non-destructive, i.e. no fish would be killed as would occur during a large scale netting study.

One of the mark and recapture assumptions for open fish populations that must be satisfied to properly determine downstream passage routes are that radio tagged fish do not experience different mortality than untagged fish. This can be difficult to prove, given the problems holding river herring in tanks. However, it is our experience that if the fish is not unduly stressed by the capture method and radio tag is quickly placed into the stomach via the mouth, that the majority of fish will survive and this is easily proved by manual tracking. The second assumption that the sample is representative of the target species will have to be proved and it depends on whether the capture gear selected is biased in any way. The third assumption that tag loss is minimal or known is easy to prove with telemetry, because the radio tagged fish that do not return to the site will be a known number. The fourth assumption, tagged fish have an equal probability of recapture is a problem because we will only be able to monitor the radio tagged fish and not the wild fish as they pass the project. The fifth assumption that tagged fish are randomly mixing with wild fish will require additional field effort to prove. If the radio tagged fish are amongst the wild fish prior to moving downstream past the project, then a mobile sonar survey in the vicinity of the radio tagged fish will quickly determine if the radio tagged fish is mixed with a school of the wild fish. If agencies are concerned that the fish schools located with the mobile sonar gear may not be herring, we can capture a representative sample to verify the fish species present.

The pros and cons of using acoustic telemetry at Crescent hydro site are presented below.

Pros:

- Tags can be quickly inserted into the fishes stomach with minimal stress

- Data collection and retrieval is not labor intensive. Data retrieval can be conducted by one or two individuals downloading receivers daily either on site or through modem links.
- Current state-of-the-art acoustic receiving systems allow remote, continuous data collection with minimal or no impact to station operations during deployment and monitoring.
- Modern acoustic telemetry techniques can monitor a large number (up to 400) of individuals per test group, thereby providing a large sample size for statistical evaluation.
- Fixed location receiver equipment poses few safety risks for personnel collecting data from receivers.

Cons:

- Large scale acoustic telemetry studies designed to provide ample, statistically sound sample sizes are inherently expensive.
- Confirmation of downstream passage in the tailrace or through the slots may not be easily obtained since hydrophones will not function properly in environments that have substantial amounts of entrained air.

The use of acoustic tags and the pros and cons are very similar to those presented for radio telemetry, including meeting the five assumptions. However, radio telemetry is a better method for Crescent site because the aerial antennae can cover a much larger range than the underwater hydrophones. We cannot effectively cover fish that may spill over the dam and therefore could have fish pass undetected. Also, we cannot set up hydrophones in the tailrace or downstream of the bypasses to confirm passage, as can be done with radio telemetry and large aerial antenna. For these reasons, we do not recommend acoustic telemetry for this study.

We did not consider PIT tag technology for this study for several reasons. The first is that the fish need to be anesthetized to insert the tag and any tag method that requires this much effort was rejected. Also, the fish passing through the turbines need to be recaptured with nets and a PIT tag detector has to be used to see if the fish is tagged (see section on net studies).

3.5 CAMERAS AND VIDEO TECHNIQUES

The use of underwater and in air cameras to monitor fish passage at hydro sites is well documented and they are an effective tool in certain situations. The cameras work well for small bypasses (50 cfs or less) during daylight hours, but have difficulty covering the same opening at night. The pros and cons of using cameras are presented below.

Pros:

- Good for qualitative studies if covering small areas within the cameras range, capability
- Underwater cameras could be used to positively ID river herring exiting the bypasses, but would only work during daylight hours.

Cons:

- Cannot be used to conduct a mark and recapture study – only qualitative data can be collected, therefore the mark/recap assumptions cannot be met.

- Cameras will not work well in the forebay – range limited to about 6 ft in a river situation, and this is if the water is clear during the day. Will not work at night beyond 2 ft if infra red lights are used
- Multiple cameras will be needed to completely cover the two wide bypasses (40 ft wide) during the day but they will not work well at night.
- Costs very high to run cable and power out to bypasses (hundreds of feet) and cameras can be damaged due to debris that pass through bypasses
- Spill may wipe out gear and fish will pass undetected
- Labor intensive to review tapes

3.6 DUAL-FREQUENCY IDENTIFICATION SONAR (DIDSON), OR SONAR CAMERA

This new technology holds great promise for monitoring fish bypasses, small spillways and for recording fish migrations in shallow rivers. The sonar camera can work with no light and in very turbid water, conditions that render underwater video cameras useless. The pros and cons for this technology are presented below. Go to www.soundmetrics.com to see some examples of fish imaged with this new technology.

Pros:

- Works well in low light or turbid conditions where underwater cameras have limited range (less than 1 m)
- If the fish being imaged are within 12 m of the 1.8 MHz sonar camera, body shapes may be used to identify the fish to genus or species
- This technology is best for qualitative studies, where fish could be imaged passing through a bypass or for specific fish such as eels that have unique body shape

Cons:

- Can only cover (and in many cases sub-sample) small bypass openings due to narrow beam width and because the fish need to be within 12m of the unit before their shapes can be imaged.
- Very expensive units (75k each, without cables, computer or hard drives included) and at Crescent, they will not be able to fully cover the turbine intakes or discharge
- Needs large amount of hard drive storage space (at least $8k to $10k to purchase hard drives for each unit)
- Does not yet have algorithms developed that could be used to count fish so the image files have to be reviewed like video tapes. It can be speeded up just like video to quickly get through “no fish periods”, but would still require a lot of labor to review images over a 3 month period.
- Works best in quiet water – bubbles, etc. reduce the unit’s ability to get good images so the fish can be identified.
- At Crescent, it would be very expensive to run the sonar cables across the dam face for hundreds of feet (special order for this distance) and also the units mounted on the dam or flashboards could be lost or damaged during a spill
- Agencies may still require ground truthing – i.e. we may still have to physically capture the fish exiting the bypasses to prove they are river herring.

- This technology cannot be used to do a mark and recapture study because we cannot satisfy the mark and recapture assumptions (see Section 2.4) and the DIDSON cannot identify a marked/tagged fish.

3.7 HYDROACOUSTIC TECHNIQUES

Use of hydroacoutics at hydro sites is common place in some parts of the country, especially at the larger hydro sites on the west coast because of the difficulty in sampling big water with traditional methods such as nets. The equipment works very well for identifying schools of fish and calculating their densities, usually number per cubic meter of water. The technology is sophisticated and requires extensive training to operate properly, therefore only a few vendors sell the high end equipment.

Pros:

- The use of hydroacoustic equipment does not affect fish behavior;
- There is no mortality of monitored fish;
- Cost effectiveness.
- Good for locating schools of fish and recording their movements in the vicinity of the transducer arrays

Cons:

- Does not provide species composition information, therefore ground truthing (nets etc) may be necessary
- Cannot conduct a mark/recapture study with this technology
- May not work well if entrained air or severe turbulence is present around bypass openings

3.8 SUMMARY OF MARK AND RECAPTURE METHODOLOGIES

In reviewing the various methods available to conduct a mark and recapture study at the Crescent site to determine downstream passage routes of blueback herring, it became evident that the traditional method of using nets and conventional tags would be technically difficult and may not achieve the study objective. The technical problems associated with setting up and using nets to fish the powerhouse flow and two large downstream bypasses are great and this method would cause significant mortalities to the fish captured (see Section 3.3). Additionally, the study results would probably be biased because it would be difficult to prove some of the mark and recapture assumptions for open populations that must be satisfied to estimate the downstream exit routes used by emigrating blueback herring.

Some of the other methodologies reviewed such as camera/video techniques and sonar cameras (DIDSON) can provide qualitative data on fish passage, but these techniques cannot be used to conduct a mark and recapture study at a hydro site as large as Crescent. Most of the problems with traditional cameras stem from their limited range (around 6 ft during daytime) which significantly worsens at night even with the use of infra red light (1 to 2 ft range). The DIDSON sonar camera is not limited by available light or turbidity, but it has limitations, including problems covering a large volume of water due to the narrow beam (all the exit routes at Crescent would have to be sub-sampled) and fish have to be close (within 12 m) to identify them to species. The use of scientific grade hydroacoustic gear can provide quantitative data on the densities of fish moving past hydro sites but this technology cannot be used to conduct a mark/recapture study and it also cannot be used to identify the fish species.

Of all the mark/recapture methodologies reviewed in this report, radio telemetry has the best chance of success at determining downstream passage routes at the Crescent Project. However, this method also has some significant problems that need to be addressed. Technically, the biggest problem is when and where to capture and radio tag the adult blueback herring. If the fish are captured and tagged early in the run prior to spawning, we have no idea how many will survive and return back downstream to pass the project – if few return to pass the project the study will be inconclusive and costly. Tagging the fish early would also require the use of a larger radio tag so its battery life will last for more than 2 months. This would require attaching the radio tag externally via surgery to the fish's dorsal region and surgery is something we would like to avoid. If we attempt to capture and radio tag spent herring, then we would be able to use a smaller radio tag (1 month battery life) that can be quickly inserted into the fish's stomach with minimal stress. Also, the spent fish would not have the desire to migrate upstream after tagging as would green individuals and therefore most of the radio tagged fish that survive capture and tagging would be available for downstream passage. If the spent fish can be successfully captured with a minimal amount of stress and radio tagged upstream of the project, then a larger percentage of the radio tagged fish will be available for downstream passage compared to a study plan that relies on radio tagging the fish prior to spawning.

4.0 DISCUSSION

In determining the best technical method available to conduct a mark/recapture study of emigrating blueback herring at the Crescent Project, Normandeau wanted to ensure that the study could be designed and conducted using the existing high frequency sound deterrent system. The sound deterrent system is set up to deter herring from entering the headrace canal and passing through the powerhouse. We also recommend the use of hydroacoustic techniques to monitor fish that approach the headrace leading to the powerhouse to determine when emigrating bluebacks are attempting to pass downstream on the west side of the island and if they are repelled by the sound deterrent system.

4.1 PROPOSED MARK/RECAPTURE STUDY PLAN FOR CRESCENT

Normandeau recommends the use of a combination of radio telemetry and hydroacoustic monitoring techniques to determine downstream passage routes of spent blueback herring. The high frequency sound deterrent system should be operated during the study.

Because of the potential problems associated with capturing and tagging spent blueback herring, we recommend that the study be conducted over at least two migration seasons. During the first year, a pilot study would be conducted using a reduced number of radio tagged fish to determine if it is feasible to capture and radio tag spent blueback herring upstream of the project. Normandeau recommends radio tagging up to 60 spent herring between late May and June and monitoring their movements as they pass the project. Test fish should be captured and tagged from several different locations in an effort to determine the best time during the season and best location to capture fish in decent condition to ensure a good return of radio tagged fish to the project. If the pilot study demonstrates that spent blueback herring can be captured and radio tagged successfully without incurring high mortalities, then a larger group of fish can be captured and radio tagged during the second year.

The three proposed capture locations are 1) the upper headpond area upstream of the largest island, 2) the Erie Canal area in the vicinity of Lock 6 (fish entering the headpond) and 3) the tailrace of the Vischers Ferry Hydroelectric Project, located approximately 6 miles upstream of Crescent. Normandeau recommends that at least 20 blueback herring be captured and radio tagged at each location, unless better locations are discovered during the pilot study. Spent fish should be captured and radio tagged in the headpond at least several hundred meters upstream of the Island. Release at this upstream location should give the radio tagged fish time to recover from the immediate effects of handling and tagging, such as an immediate “drop down effect” that happens with some radio tagged alosids.

Up to 20 additional herring should be captured and tagged from the Erie Canal prior to their entering the Crescent headpond (vicinity of Lock 6). Fish tagged in this location may still be green (have not spawned yet), therefore we recommend waiting until the run is at least half over before tagging fish from this site. Normandeau biologists speculate that the later it is in the run, the shorter the upstream migration distance will be and that fish entering the headpond at least halfway through the season may not migrate that far upstream. If this theory is correct, fish that are radio tagged later in the run should have a greater chance to successfully return and pass the site.

The third capture site is located approximately 8 miles upstream in the tailwater area of the Vischers Ferry Hydro site. It is our experience that many adult blueback herring in the NE region spawn in the tailraces of hydro plants because of higher water velocities (they prefer to spawn in higher velocity water than both alewife and American shad). Capturing and radio tagging up to 20 blueback herring as they congregate and spawn below Vischers Ferry should ensure that these fish will not attempt to migrate further upstream to spawn (via the Erie Canal) and instead will soon drop back downstream to pass at Crescent. Radio tagging the fish from several locations will give insight into the best location to capture and tag the fish to ensure a sizable number will survive and pass Crescent Project.

Normandeau also recommends the use of mobile hydroacoustic gear to locate schools of spent herring as they congregate upstream of the project and to determine if some of the radio tagged fish are congregating with the wild fish. Radio tagged fish should be manually tracked upstream of the headpond and if the mobile hydroacoustic gear also records a school of fish in the immediate vicinity of the radio tagged fish, fish from the school should be captured with cast nets, rod and reel or gill nets to verify the species being recorded by the hydroacoustic sonar. If wild fish are captured, it will help satisfy the assumption that radio tagged fish are behaving and mixing normally with wild fish. Also, if one or more of the radio tagged fish approach the powerhouse along with a school of wild fish in an attempt to pass downstream and they are deterred by the high frequency sound system, this will confirm that our capture and tagging method does not affect the condition of the tagged fish.

Prior to radio tagging any adult river herring during the pilot study, stationary telemetry receivers/data loggers should be set-up to monitor passage of radio tagged herring through powerhouse and each of the two downstream fish bypasses (one bypass is on Dam A and the other is located on Dam B, nearest the powerhouse). A fourth telemetry unit should be set up to monitor Lock 6 in case any radio tagged fish attempt to pass downstream via this location and a fifth unit should be used for manual tracking. For the pilot study, Normandeau recommends not attempting to monitor the entire length of the dams' spillways, given that in most years there are few high flow events in June. Blueback herring should be radio tagged with transmitters small enough that they can be manually inserted into the stomach.

Data collected during the pilot study will be used to plan a larger telemetry effort in spring of the following year. The primary goals of the pilot study will be 1) determine if spent blueback herring can be captured and radio tagged with minimal mortality, 2) find the best location and time during the run to capture and tag the spent herring, 3) determine if the radio tagged fish mix with the schools of wild fish and, 4) use the mobile and fixed hydroacoustic gear and manual tracking of radio tagged fish to verify if the high frequency sound deterrent system repels fish from the intake areas.

If the pilot study demonstrates that spent blueback herring can be captured and radio tagged without high mortalities and a large percentage of these fish pass the Crescent site, then a larger test group (up to 100 individuals) could be tagged and released in the following year to gather additional data on the downstream passage routes.

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APPENDIX

UNITED STATES OF AMERICA 110 FERC ¶62,141
FEDERAL ENERGY REGULATORY COMMISSION

New York Power Authority Project No. 4678-037

ORDER MODIFYING AND APPROVING FISH PROTECTION RECOMMENDATIONS UNDER AUGUST 14, 2002 ORDER

(Issued February 15, 2005)

The New York Power Authority (licensee) filed, on April 1, 2003, a report and recommendations for its fish deterrence testing and downstream fish passage at the Crescent Hydroelectric Project, as required by the August 14, 2002 order.[1] The license supplemented its report and recommendations with additional filings on May 12, June 10, and October 22, 2003. The Crescent Hydroelectric Project is located on the Mohawk River in Schenectady, Saratoga, and Albany Counties, New York.

BACKGROUND

The Crescent Project consists of a dam in two curved sections separated by a mid-river rock island, with an impoundment about 2,000 acres in area. The mid-river island extends upriver roughly 800 feet from the dam and prevents fish from moving freely across the width of the river in the vicinity of the project. The main river channel with an approximate depth of 35 feet flows to the east of the mid-river island. The side channel flowing to the west of the island, where the powerhouse is located, has a depth of about 13 feet. A navigational lock, a part of the Erie Canal lock system, is accessible from the main river channel.

Blueback herring are the target species for downstream passage at the project. Adults moving downstream after spawning, preferring the deeper habitat, would be expected to stay in the main channel of the river.[2] Juveniles migrating out as young-of-year (YOY), prefer the shallower habitat, and generally move into the side channel. The adults move upstream to spawn in the Mohawk River, reaching the area upstream from the Crescent Project dam, via the canal system and its locks.

A 10-foot-wide notch formed by an opening in the dam's one-foot-high flashboards[3] on the east side of the island (Dam A) offers a downstream passage path for blueback herring in the main river channel.[4] A second notch formed in the same manner on the west side of the island (Dam B) provides a path for juvenile fish to move downstream past the dam. Additionally, a notch cut in the top of a buttressing dam (Dam C)[5] at the foot of Dam B provides passage from the pool it forms

[1] Order Accepting Final Report on Year 2001 System Testing, Requiring Additional Testing, and Approving Fish Bypasses Design Drawings, 100 FERC ¶ 62,122.

[2] Jenkins, R. E., and N. M. Burkehead, 1993. Freshwater Fishes of Virginia. American Fisheries Society, Bethesda Maryland.

[3] Flashboards are installed seasonally from May through mid-November to raise the river level for navigational purposes. The notch opening in the flashboards on Dam A was initiated during the spring 2002 flashboard installation.

[4] This passage is at the surface, although the deeper-habitat-preferring adults tend to this main channel.

[5] This third dam sits just below dam B, providing added structural stability for Dam B by impounding water to approximately 4.5 feet deep against the downstream toe of Dam B.

below Dam B to the river. The powerhouse, located at the west end of Dam B adjacent to the west river bank, contains two Kaplan turbines and two Francis turbines. Each of the four turbines has a hydraulic capacity of about 1,500 cubic feet per second.

In July 1992, the licensee filed recommendations for the protection of blueback herring pursuant to article 40 of its license.[6] The licensee proposed to allow out-migrating herring to pass through the Kaplan turbines, because tests indicated 96 percent of juvenile blueback herring passing through the turbines would survive. A January 9, 1995 Commission order[7] directed the licensee to file for approval plans to study the effects of the project on outmigrating adult blueback herring, of gull predation on herring passing through the turbines, and of minimum flow releases.

In March 1996, the licensee reached agreement with the U.S. Fish and Wildlife Service (FWS), New York State Department of Environmental Conservation (DEC), and National Marine Fisheries Service (NMFS), to study fish diversion systems. The licensee was to install and test high-frequency sound generators intended to divert blueback herring from the project's intake to downstream passage over the dam. A Commission Order Granting Extension of Time issued November 17, 1997 indicated that successful operation of the acoustic deterrence system to deter fish from entering the headrace might negate the need for future studies of turbine mortality, gull predation, and minimum flow.

The Commission's March 16, 2001 order[8] approved the licensee's proposed schedule for installing and testing fish bypass systems deemed acceptable in lieu of the turbine mortality, gull predation, and minimum flow studies required by the January 1995 order. Paragraph (C) of the March 2001 order required the licensee to file for Commission approval, functional design drawings for a fish bypass system, and a final report on the 2001 testing of its acoustic deterrence system, including resource agency comments on the final report and fish bypass design drawings.

The August 14, 2002 Commission Order Accepting Final Report on Year 2001 System Testing, Requiring Additional Testing, and Approving Fish Bypasses Design Drawings required the licensee to file for Commission approval test results for the 2002 acoustic deterrence system testing, and recommendations for further testing, including resource agencies' comments on the recommendations. The Commission reserved the right to require changes to project structures and operations or to require further testing based on its review of the report and recommendations.

LICENSEE'S REPORT AND RECOMMENDATIONS

The licensee's report filed with the Commission April 1, 2003 summarized its data and presented its interpretation of the data for the 2002 acoustic deterrence system testing of high frequency sound to divert out-migrating adult and juvenile blueback herring from the turbine intakes to the fishways providing passage over the project dam. The licensee monitored fish densities hydroacoustically near the dam adjacent to the powerhouse and at the entrance to the headrace. It used hourly estimates of

[6] Order Issuing License (Major), June 26, 1984, 27 FERC ¶ 61,466. Article 40 required the licensee to evaluate the effects of project operations on fishery resources of the Mohawk River, and to recommend measures for the protection and enhancement of fisheries resources in project waters.

[7] Order Approving and Modifying a Proposal for Protection and Enhancement of Fishery Resources and Denying Article 36 Amendment Request, 70 FERC ¶ 62,010.

[8] Order Modifying and Approving Schedule for Installation of Fish Passage, 94 FERC ¶ 62,122.

fish density, and arrived at numerical abundance estimates inferred from its hydroacoustic data. According to the licensee, the acoustic deterrence system is generally successful in diverting YOY fish. In the first study at the site, adult blueback herring in the side channel upstream from Dam B were less responsive to the sound deterrent in late May and early June. These fish moved through the sound field to the headrace within 24 hours. The licensee conjectured that this reduced the likelihood that they would find the fishway.

With hydroacoustic monitoring in the side channel just upstream from Dam B adjacent to the powerhouse, and at the entrance to the headrace, adult fish were detected near Dam B. The fish then disappeared from the areas monitored by the two transducers. The licensee noted that past monitoring at a site upstream from the two dam-area transducers showed fish disappearing from the monitoring area near the dam and reappearing in the upstream monitoring area. Based on this past monitoring, the licensee surmised fish, detected near Dam B that subsequently vanished from the monitored area, swam back upstream and, presumably, around the island into the main channel to pass the project at Dam A. The licensee asserted that the high frequency sound deterrent in the side channel (successful in diverting YOY herring), and the fishway on Dam A, allowed 86 percent of adult herring detected in the side channel to bypass the project after mid-June. The licensee derived its estimates of percentage of adults passing from hourly hydroacoustic density data collected in the side channel.

The license stated that during periods of high river flows with spill at the dam, adult herring successfully bypassed the turbine intakes with the spill flow. It stated that during non-spill periods adult blueback herring milled about, moving into and out of the channel leading to the powerhouse, for over a week. It speculated that the repeated movement of the adult herring in and out of the channel leading to the powerhouse should increase the likelihood that the fish would find the main channel fishway on Dam A. Again, the licensee derived its estimates of percentage of adults passing from hourly hydroacoustic density data collected in the side channel

During late May 2002, all generating units were shut down to evaluate this mode of fish protection at the project. With the generating units off line and the acoustic deterrent at the headrace entrance, the licensee estimated that 84 percent of adult blueback herring detected in the side channel used the fishway on Dam A, based on hourly hydroacoustic density data collected in the side channel.

The licensee concluded that a permanent main channel fishway with the smooth concrete finish would improve adult downstream passage and should be installed on Dam A. In addition, the licensee recommended ceasing generation for two 4-day periods each year to allow adult blueback herring to pass the project with spill flows. For this purpose, the licensee recommended shutdowns of all generating units from 11:00 AM to 3:00 PM from May 26 through 29 and June 9 through 12 of each year. However, the licensee stated that it could not implement adaptive project shut-downs, initiated and ended by fish density estimates, because planned outages require a minimum of three hours notice, and a 24-hour notice preferred in the deregulated New York market.

The licensee also recommended continued use of the configuration of high-frequency sound generators used during a fall 1997 study and during the 2002 study at the site,[9] along with installation

[9] The licensee stated that this deterrent sound field configuration (used in 1997 and 2002) did not extend as far upstream in the west channel as the one tested the intervening years. The licensee provided a diagram illustrating the transducer locations.

of fish passage notches on all three dams. An October 22, 2003 filing indicated that the licensee has installed a smooth concrete finish at the Dam B fish passage notch and cut a notch into the crest of Dam C to provide a fishway in that location. It stated its intention to install a smooth concrete finish on the fish passage notch on Dam A.

RESOURCE AGENCY CONSULTATION

In a letter to the licensee, filed with the Commission on May 12, 2003, the FWS provided comments on the licensee's report and recommendations for passage of blueback herring at the Crescent Project, taking issue with the assumptions and assertions of the report and recommendations. The FWS was not convinced that the sound deterrent system coupled with the fish passage notches in the flashboards is effective for passing blueback herring at the project. It stated that the licensee's use of deterrent mechanisms does not provide sufficient guidance to downstream migrants.

The FWS expresses its continued concern that the licensee lacked sufficient transducer coverage to detect the presence of fish approaching the project. It found unconvincing the licensee's argument that disappearance of fish from the areas monitored by hydroacoustic detectors indicated successful fish passage. The FWS observed that the licensee's collected data did not document that any fish used the fish passage. The FWS noted the licensee failed to provide video footage recording the actual movement of fish through the fish bypass structures, as had been agreed upon. Video documentation would have provided evidence of fish locating and using the fish passage notches. The FWS observed that, because the licensee collected no definitive data documenting successful fish passage, any estimates of the percentage of fish passing are meaningless.

The FWS took issue with the licensee's unsubstantiated claims about the spawning and passage dates for blueback herring in the Mohawk River. It noted that episodes of fish abundance are highly variable and cannot be predicted. Further, it observed that there is no data supporting the conclusion that the use of project shutdowns with spillage over the dam improved downstream fish passage. It expressed its concern that whenever there is flow through the generating units, adult blueback herring would be attracted to the powerhouse flow and entrained. It recommended the use of a mark and recapture study as a dependable way to quantify the number of fish passing. It further noted radio-tagging of adult blueback herring as an accepted method for tracking fish movements.

The FWS concluded that it was not possible to determine from the information provided by the licensee whether the fish passage notch on Dam A in the main river channel passed fish downstream. The licensee collected no data documenting the presence of herring in the main river channel or using the fish passage notch on Dam A.

Based on its review of the licensee's report and recommendations, the FWS outlined three specific concerns, as follows. 1) Spillage over the dam may be rough and result in descaling and injury to fish. Depth of spillage must be sufficient so that flow separation does not occur. 2) Discharge into the stilling basin located below the dam would concentrate fish, subjecting them to undue predation and delay. Modifications of the spilling basin located below the dam would be necessary to avoid this situation. 3) For the licensee to use shutdown as a fish protection measure, the licensee would have to possess the operational capabilities to accomplish a project shutdown as a rapid response to detection of approaching blueback herring. This would require adequate monitoring to detect the presence of herring, in addition to the ability to rapidly take the project off-line.

The FWS recommended that an adequate downstream discharge and conveyance of out-migrating blueback herring through an appropriately located downstream bypass system be discussed. It further recommended perforated-plate overlay trashracks for this project, similar to those utilized seasonally at a nearby project,[10] to exclude blueback herring from the project intake. The FWS recommended that, for the Crescent Project with its turbine capacity, and with an effective guidance system, the minimum bypass flow should be 125 cubic feet per second (cfs). Without an effective guidance system, the bypass flow and its effectiveness should be evaluated up to a flow of 313 cfs. The bypass should lead to a plunge pool with a depth equal to, or greater than, one-quarter of the differential head at the site.

The DEC and NMFS did not comment on the report.

On June 10, 2003, the licensee filed a response to the FWS comments, taking issue with comments and recommendations the FWS provided.

DISCUSSION AND CONCLUSIONS

The licensee's filed report is inconclusive. The licensee's report provided no concrete information demonstrating successful downstream passage of blueback herring at the Crescent Project. The licensee's methods (hydroacoustic monitoring) and results did not document downstream passage use. Therefore, the basis is lacking to make specific recommendations regarding safe downstream passage of blueback herring.

The licensee stated that the primary objective of the hydroacoustic study was to evaluate the effectiveness of a fishway on Dam A in the main channel, despite the fact that it conducted no monitoring in the main river channel or near Dam A with its fish passage notch.[11] The licensee monitored, only with hydroacoustic monitoring, near the powerhouse in the shallow side channel to the west of the island. The licensee derived its estimates of percentage of adults passing from hourly hydroacoustic density data collected in the side channel. However, it provided no documentation of how it related hydroacoustic data to actual numbers of fish present, or how it derived its estimates of percentage of adults passing from hourly hydroacoustic density data collected in the side channel. The FWS noted the lack of evidence of fish passage use and success that video documentation could have provided.

The licensee proposed to shut down the project for two 4-day periods to improve the downstream passage success for adult blueback herring. The FWS stated that for shutdown to be successful as a fish protection measure, the licensee would have to possess the ability to detect the presence of

[10] The FWS stated that perforated-plate overlays were shown to work at a nearby upstream site, the Little Falls Project (FERC No. 3509). These are plates mounted on frames and deployed in front of the existing trashrack by use of a chain hoist for seasonal installation. A plate with ½-inch perforations extending to 20-foot depth excludes YOY herring from the intake, while allowing easy cleaning and debris removal. A similar design, employing a plate with larger one-and-5/8-inch perforations and extending to 40-foot depth, excludes adult herring. The plates are coated with a coal tar epoxy to discourage zebra mussel attachment. This fish protection device was approved for use at the Little Falls Project by the Commission Order Approving Fish Passage Design Drawings and Requiring a Fish Bypass Effectiveness Study, issued April 13, 1995, 71 FERC ¶ 62,026. The Little Falls licensee performed a study demonstrating effectiveness of the overlays and recommended continued seasonal use. The Commission Order Approving Recommendations with Respect to Fish Bypass Facility, issued December 11, 1997, (81 FERC ¶ 62,187) approved the recommendation to continue use of the trashrack overlays at the Little Falls Project.

[11] The licensee stated that the fishway on Dam A passes adult fish. The fishway located on Dam B about 225 feet from the entrance to the headrace targets juvenile fish.

herring and to rapidly take the project off-line in response to the presence of herring. The licensee stated that it lacks the ability to quickly shut down the project, due to electrical market restrictions. Fish abundance is highly variable and cannot be predicted. No evidence exists that the licensee's shut down proposal would improve downstream blueback herring passage at the project. Therefore, the licensee should not implement its proposed shutdown schedule.

The FWS recommended perforated-plate overlay trashracks for this project, similar to those used at the nearby Little Falls Project. The perforated-plate overlays at the Little Falls Project are mounted on frames and deployed in front of the existing trashrack by use of a chain hoist for seasonal installation. A plate with ½-inch perforations extending to 20-foot depth excludes YOY herring from the intake, while allowing easy cleaning and debris removal. A similar design, employing a plate with one-and-5/8-inch perforations and extending to 40-foot depth, excludes adult herring. The Commission approved the recommendation to continue seasonal use of the trashrack overlays at the Little Falls Project,[12] following a study demonstrating effectiveness of the overlays.

Commission staff analysis indicates that the FWS-recommended seasonal installation of perforated plate overlays is not appropriate for the Crescent Project. No two hydropower projects are identical, and although the targeted fish population, and the turbine type (Kaplan), at the Little Falls and Crescent Projects have similarities, other essential characteristics differ. The trashrack overlay plates are appropriate to the Little Falls Project, because its intake has a unusually large cross-sectional area for the volume of water it passes. With a large intake area, average intake velocity is low, at less than 0.9 feet per second (fps), before the addition of the overlay plates.[13] Addition of the perforated plate overlays reduce the available open area, reducing flow volume available for generation, and increasing flow velocities through the openings in the overlay. Because the Little Falls Project has a large intake area with low intake velocities, the project can still efficiently operate with the flow-reducing perforated plate overlays in place, provided the licensee is conscientious about keeping the overlays debris-free.

The Crescent Project has a smaller intake area and larger hydraulic capacity, resulting in a much higher average intake velocity of 4.1 fps, as a starting point.[14] Addition of perforated plates would reduce the available flow cross-sectional area, and so reduce the intake volume below the project's current hydraulic capacity, and increase already high intake flow velocities through the plate perforations. A certain consequence of installing of perforated plate overlays would be reduced turbine efficiency and reduced generation. Higher velocities could and would be expected to result in injury, impingement, and mortality of fish, as well as increasing the risk of trashrack failure. For these reasons staff finds the FWS recommendation for installation of perforated plate overlays to be inappropriate for this project.

The FWS fish passage guidelines recommend two to five percent of turbine capacity be provided as fish passage attraction flow. Based on the Crescent Project's turbine capacity of 6250 cfs, and with an effective guidance system in place, the FWS recommended a minimum fish bypass flow of 125 cfs

[12] Order Approving Recommendations with Respect to Fish Bypass Facility, issued December 11, 1997, (81 FERC ¶ 62,187).

[13] The maximum hydraulic capacity of the Little Falls Project is 2250 cfs, with an intake area of 2560 square feet. This gives an average intake velocity of 0.878 fps.

[14] The maximum hydraulic capacity of the Crescent Project is 6250 cfs, with an intake area of 1512 square feet. This gives an average intake velocity of 4.133 fps.

(two percent of turbine capacity). It stated that without an effective guidance system, up to 313 cfs (five percent of turbine capacity) might be required to effectively pass fish.

The licensee's existing fish passage notches consist of a 10-foot gap in the one-foot-high flashboards. Application of the weir equation[15] estimates flow through each of the existing notches with the water at the top of the flashboards to be 30 cfs.

To provide the minimum recommended flow of 125 cfs through its fish passage notches, the licensee would have to significantly enlarge the fish passage notches in the flashboards from the present size of 10 feet wide by one foot deep. This could be achieved by cutting a 1.6-foot-deep notch in the top of the dam crest aligned with the absent flashboard, for a total fish passage notch depth of 2.6 feet from the top of the flashboards. The 125 cfs notch flow could also be achieved by leaving a 4-flashboard opening of 40 feet, with little or no notching of the dam crest. As manipulation of the numbers in the weir equation will suggest, various combinations of increased width and/or depth of the notch[16] could provide the 125 cfs flow volume.

The licensee should design a fish passage notch to achieve a flow of 125 cfs through the notch with the project headpond at a normal operating elevation. The licensee should perform the weir flow calculation with a "C" value representing as accurately as possible the proposed shape for broad crest weir to be used for the fish passage notch. It should propose a fish passage notch design to provide a flow of no less than 125 cfs though the fish passage notches on Dam A and on Dam B. The licensee should continue to open and/or maintain the 125 cfs flow through the modified fish passage notch on the same schedule that it currently uses.

The licensee should plan to provide this minimum fish passage attraction flow at the Dam A fish passage notch, and also at the Dam B notch, because the large island intervening in the middle of the dam prevents effective use of the fish passage notch on one dam section by fish that have entered the other channel approaching the other dam section. With a 125 cfs flow release from Dams A and B, the total fish passage release would be 250 cfs or 4 four percent of turbine capacity. This is within the commonly accepted FWS guidelines of two to five percent of turbine capacity for fish passage attraction flows.

The licensee's October 22, 2003 filing did not specify the size of the notch it cut in the crest of Dam C, to provide fish passage to fish passing through the Dam B notch into the Dam C pool (impounded against the foot of Dam B) and into the river below. The licensee should assure that the notch in the crest of Dam C also passes flows of 125 cfs over a smooth surface for the protection of fish migrating downstream. The licensee's proposed design for fish passage notches should include a proposal to enlarge the notch in the crest of Dam C, to provide a 125 cfs fish passage flow from the Dam C pool to the river below.

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[15] $Q=CLH^{3/2}$. This equation assumes a rectangular weir opening, with Q = flow volume in cfs passing through notch, C = 3, chosen as a ballpark estimate for the coefficient adjusting for the weir shape, L = width of the opening in feet, and H = head (water height) in feet of the head pond above the bottom of the weir opening.

[16] For example, to achieve the 125 cfs flow, the licensee could leave an opening of two flashboards, or 20 feet, and cut a 0.6-foot-deep notch in the top of the dam crest aligned with the two absent flashboards, for a total notch depth of 1.6 feet from the top of the flashboards. An opening four flashboard sections wide, that is 40 feet wide, would require little or no notch in the dam crest.

Article 36 requires a minimum flow of 100 cfs, or inflow if less, to be released below the project dam at all times.[17] During generation or spill flow, the minimum flow is met by those flows. When there is no spill and no generation, the minimum flow is released from a low-level release gate adjacent to the powerhouse. The Commission Order Amending Article 41[18] required the licensee to operate the project in a run-of-river mode and allowed the licensee to operate its turbines as long as inflows are greater than 300 cfs.[19] Subsequent to the current order, at any time when the downstream fish passage facilities are operating in the absence of other flow releases, the minimum flow could be assumed to be provided as a part of the required fish passage attraction flow of 250 cfs total.

The licensee should consult with the resource agencies in preparation of its proposed design of the fish passage notches to pass a 125 cfs flow. The design proposal should include the "C" value and weir equation calculations used to arrive at its proposed notch dimensions, functional design drawings of the enlarged notches, and a proposed schedule for opening/ operating the downstream fish passage facilities on a schedule similar to the existing seasonal schedule. The licensee should include, in its proposed design modifications of the fish passage facilities, a downstream fish passage operating schedule, and any proposed stilling basin modifications to avoid predation and delay. . The licensee should, by April 30, 2005, provide the draft plan to FWS, the DEC, and the NMFS, for their comments and recommendations. The licensee should allow at least 30 days for the agencies to comment on the proposed plan. The licensee should file, by May 30, 2005, for Commission approval, functional design drawings of the fish passage notches and any proposed stilling basin modifications, including the resource agencies' comments on the proposed designs. The Commission should reserve the right to require changes to proposed fish passage facility designs and operations.

A letter from the licensee, filed October 22, 2003, informed the Commission's New York Regional Office that it had completed installation of a smooth finish on the notch section of the Dam B, and cut a notch in the crest of Dam C, to improve the juvenile passage facilities in the side channel. The smooth finish to be installed on the Dam A notch, to improve adult passage success, was not completed due to adverse weather conditions. The smooth finish would be expected to reduce injury to passing fish, thus improving the success of downstream blueback herring passage at the project. However, this work is premature until the licensee has modified the fish passage notches to provide a minimum of 125 cfs flow with the project headpond at a normal operating elevation. The licensee should delay this work until the enlarged fish passage notches have been designed. Provisions for the smooth finish on the notches on Dams A, B and C should be incorporated into plans for modifying the notches to pass 125 cfs, included in the construction of the enlarged notches.

Under Paragraphs 12.4, 12.11, and 12.40 of the Commission's regulations, at least 60 days before starting construction on the modifications of the fish passage facilities, the licensee must submit one copy to the Division of Dam Safety and Inspections – New York Regional Engineer and two copies to the Commission (one of these shall be a courtesy copy to the Director, Division of Dam Safety and Inspections), of final contract plans and specifications, and a quality control program for the work. The Commission may require changes to the plans and specifications to assure the work is completed

[17] Order Issuing License (Major), June 26, 1984, 27 FERC ¶ 61,466.

[18] November 17, 2000, 93 FERC ¶ 62,127.

[19] This is the minimum hydraulic capacity of the turbines.

in a safe and environmentally sound manner. Construction may not commence until authorized by the Regional Engineer.

The high frequency sound deterrent, combined with a flow of 125 cfs through each of the fish passage notches (one on each dam section), should provide adequate fish protection to blueback herring migrating downstream past the project. Following the licensee's modification of the fish passage notches, and modification of the associated stilling basin(s), if needed, the licensee must verify the effectiveness of these fish protection and passage methods, by conducting a study to document the numbers of fish successfully using the facilities. The effectiveness of these methods of fish protection and passage should be subject to verification by studies before final Commission approval of the facilities as adequate and permanent.

The licensee must conduct a mark and recapture study empirically and quantitatively documenting the effectiveness of the high frequency sound as a deterrent discouraging fish from entering the project's intake, and documenting the effectiveness of a flow of 125 cfs through each of the fish passage notches: the Dam A notch to provide passage in the main river channel and the Dam B and C notches to provide passage in the side channel. The study plan should include measures to adequately and empirically assess differences between passage success of YOY and of adult blueback herring, and passage success at Dams A and B. A radio-tagging or balloon tagging study might be supplemented by video documentation fish successfully using the downstream fish passage facilities. The licensee should consult with the resource agencies regarding the design of the mark and recapture study to demonstrate the effectiveness of fish passage and protection measures. The licensee should provide to the resource agencies for their comments by December 15, 2005, a draft study plan and implementation schedule for the effectiveness study, along with a schedule for reporting the results. The licensee should allow at least 30 days for the agencies to comment on the proposed plan. The licensee should incorporate into the final plan the comments and recommendations from the resource agencies. The licensee should file, by January 15, 2006, for Commission approval, the fish passage study plan, including documentation of the agencies comments, and a schedule for reporting the study results and recommendations for any needed measures to improve fish protection at the project. If the licensee does not adopt an agency recommendation, the licensee should explain citing project-specific reasons why the recommendation is not adopted. Following completion of the testing and monitoring, the licensee should file with the Commission a report of the testing and monitoring results and, for Commission approval, its recommendations for fish protection at the project based on the results. The Commission should reserve the right to require changes to project structures and operations or to require further monitoring and testing based on its review of the report and recommendations.

The licensee's recommendations, with the modifications discussed above, should offer improved fish protection measures to blueback herring moving downstream past the Crescent Project. The licensee's recommendations with the discussed modifications should be approved.

<u>The Director Orders:</u>

(A) The licensee's recommendations for fish protection and passage at the Crescent Hydroelectric Project, filed with the Commission on April 1, 2003 and supplemented on May 12, June 10, and October 22, 2003, as modified by paragraphs (B) through (F), are approved.

(B) Because no evidence exists that the licensee's shut down proposal would improve downstream blueback herring passage at the project, the licensee shall not implement its proposed shutdown schedule.

(C) The licensee shall consult with the resource agencies in preparation of its proposed design of fish passage notches to achieve a flow of 125 cfs through the notch with the project headpond at a normal operating elevation. The licensee shall perform the weir flow calculation with a "C" value representing as accurately as possible the proposed shape for broad crest weir to be used for the fish passage notch design. The licensee shall propose a fish passage notch design to provide a flow of no less than 125 cfs though the fish passage notches on Dam A and on Dam B, at normal operating headpond elevations. The licensee shall include provisions to enlarge the notch in the crest of Dam C, to provide a 125 cfs fish passage flow from the Dam C pool (impounded against the foot of Dam B) to the river below. The licensee shall also include, in its proposed design modifications of the fish passage facilities, a downstream fish passage operating schedule, any proposed stilling basin modifications to avoid predation and delay, and a construction schedule in its draft plan. The licensee shall, by April 30, 2005, provide the draft plan to the U.S. Fish and Wildlife Service (FWS), New York State -Department of Environmental Conservation (DEC), and National Marine Fisheries Service (NMFS), for their comment. The licensee shall file, by May 30, 2005, for Commission approval, functional design drawings of the modified fish passage notches, any proposed stilling basin modifications, and a schedule for their construction, including the resource agencies comments and recommendations on the plan. The licensee's filing shall include documentation of the resource agency consultation, and an implementation schedule for the notch modifications and any proposed stilling basin modifications. The licensee must allow at least 30 days for the agencies to comment on the proposed design and schedules. The licensee shall incorporate into the final design plan the comments and recommendations from the resource agencies. If the licensee does not adopt an agency recommendation, the licensee must explain why the recommendation is not adopted, citing project-specific reasons. The Commission reserves the right to require changes to proposed fish passage facility designs and operations.

(D) Pursuant to Paragraphs 12.4, 12.11, and 12.40 of the Commission's regulations, at least 60 days prior to the planned initiation of construction of the modifications of the fish passage facilities, the licensee shall submit one copy to the Division of Dam Safety and Inspections – New York Regional Engineer and two copies to the Commission (one of these shall be a courtesy copy to the Director, Division of Dam Safety and Inspections), of final contract plans and specifications, and a quality control inspection program. The Commission may require changes to the plans and specifications to assure the work is completed in a safe and environmentally sound manner. Authorization to start construction will be given by the Regional Engineer after all preconstruction requirements are satisfied.

(E) The licensee shall conduct a mark and recapture study documenting the effectiveness of the downstream passage facilities. The study plan shall include methods to and procedures to adequately and empirically assess differences between passage success of YOY and of adult blueback herring, and passage success at Dams A and B. The licensee shall consult with the resource agencies regarding the design of the mark and recapture study to demonstrate the effectiveness of fish passage and protection measures. The licensee shall provide to the resource agencies, by December 15, 2005, for their comments, a draft study plan and implementation schedule for the effectiveness study, along with a schedule for reporting the results. The licensee shall allow at least 30 days for the agencies to comment on the proposed plan. The licensee shall incorporate into the final plan the comments and recommendations from the resource agencies. The licensee shall file, by January 15, 2006, for Commission approval, the fish passage effectiveness study plan, including the agencies' comments and recommendations. If the licensee does not adopt an agency recommendation, the licensee must explain why the recommendation is not adopted, citing project-specific reasons. Following completion of the testing and monitoring, the licensee shall file with the Commission a report of the testing and monitoring results and, for Commission approval, its recommendations for fish protection at the project based on the results. The Commission reserves the right to require changes to project structures and operations or to require further monitoring and testing based on its review of the report and recommendations.

(F) Unless otherwise directed in this order, the licensee shall file an original and eight copies of any filing required by this order with:

The Secretary
Federal Energy Regulatory Commission
Mailbox Code: PJ 12.3
888 First Street N.E.
Washington, D.C. 20426

In addition, the licensee shall serve copies of these filings on any entity specified in this order to be consulted on matters related to these filings. Proof of service on these entities shall accompany the filings with the Commission.

(G) This order constitutes final agency action. Requests for rehearing by the Commission may be filed within 30 days of the date of issuance of this order, pursuant to 18 CFR ' 385.713.

George H. Taylor
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Site Survey of Crescent Dam

In preparation for the 2007 pilot Blueback Herring migration study

Prepared for:

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December 18, 2006

Purpose

On Wednesday, November 19th, 2006, we visited the Crescent Dam to:

1. determine if there exists significant interference on any frequencies likely to be used for tracking

2. visually inspect the facility to determine the optimum methods and locations for installing receiving systems.

Figure 1 shows the proposed locations for the receiving equipment to be used in the pilot study.

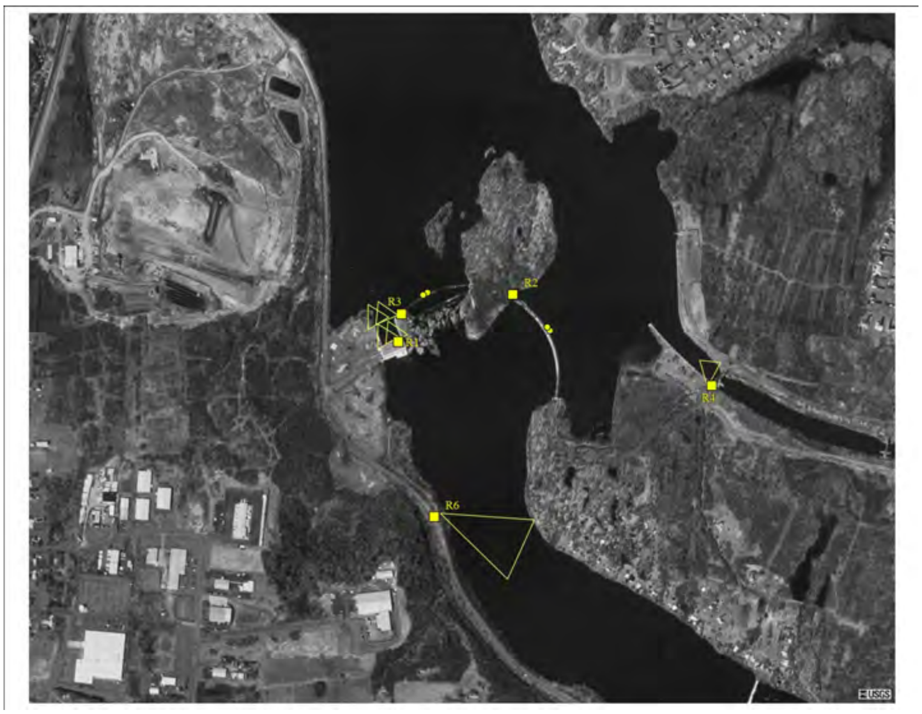

Figure 1: Equipment Locations

Equipment

Spectrum Analyzer	Make: Agilent Model: E4404B Serial Number: US41191276
Receiver	Make: Communications Specialists Inc. Model: R1000 Serial Number: 05940

Antenna	Make: Grant Systems Engineering Model: ANT-YAG-4
Digital Camera	Make: Panasonic Model: DMC-LC33 Serial Number: UA34102532

Method

Two locations were selected to measure the background interference levels. These location were located on opposite sides of the river (as shown in Figure 2) to ensure potential sources of interference were not shielded from the analysis. We chose to sweep between frequencies of 149.000MHz and 151.000MHz since these ranges include two common bands used for fisheries telemetry and crystals are more readily available for these frequencies.

The spectrum analyzer was connected to a 4 element yagi antenna and placed in peak hold mode. The antenna was moved around slowly in all directions in an attempt to capture any transient signal. The test was repeated at least three times.

Spectrum analyzers are not quite as sensitive as narrow band receivers so a receiver was also used to search for interference, particularly close to frequencies identified on the spectrum analyzer.

Finally, we inspected and photographed the area around the locations where receivers and antennas are to be mounted to assist with installation planning.

Figure 2: Interference Analysis Locations

Results

Location 1 Interference Analysis

At Location 1, scanning with the spectrum analyzer revealed a quiet spectrum with only one significant carrier observed at exactly 150.000MHz and a possible broad band signal close to 151MHz. The spectrum observed is shown in Figure 3.

Subsequent listening with the narrow band receiver confirmed the lack of interference except at 150.000MHz and 150.985MHz.

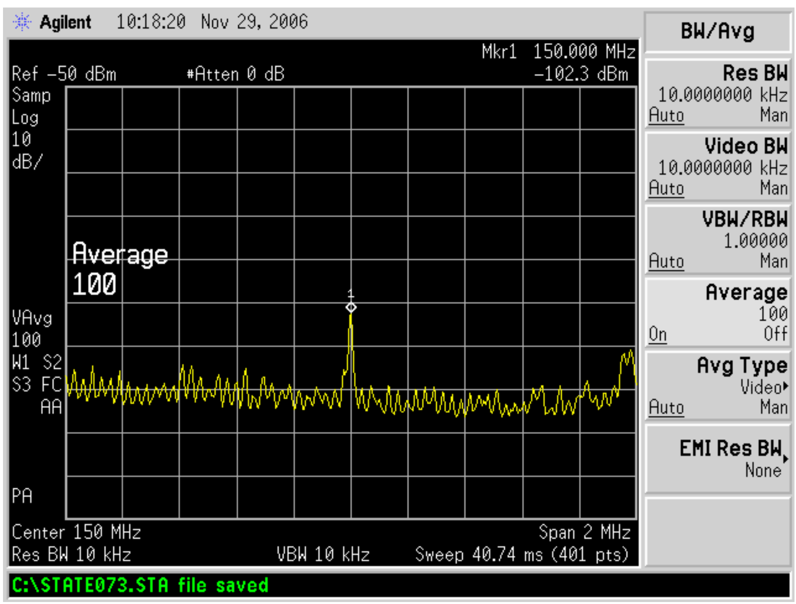

Figure 3: Sweep at Location 1

Location 2 Interference Analysis

At Location 2, a similar sweep showing little interference was observed. This trace was almost exactly the same as the one observed at Location 1 as shown in Figure 4.

Subsequent analysis with the narrow band receiver revealed no additional signals.

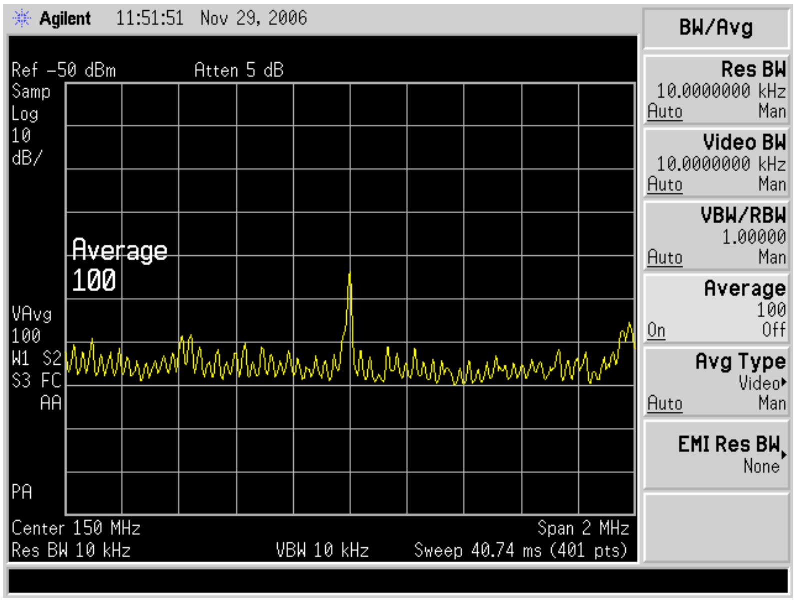

Figure 4: Sweep at Location 2

Powerhouse Headrace

Figure 5 through Figure 7 show the area around the headrace which reveal that fencing exists on both sides of the headrace. This fencing could be used for mounting yagi antennas. Figure 8 shows the location where a 120VAC outlet is available to power receivers R1 and R3.

Figure 5: Power House

Figure 6: Headrace

Figure 7:Headrace

Figure 8: Power at Headrace

Dam B

Figure 9 shows a view from the west side of dam B. The flashboard has been removed in one location, but it is difficult to see in the photograph. Figure 10 shows a close-up of the flashboard and j-hook installation. The j-hooks and the j-hook holes could potentially be used to mount antennas but more information on the hole depth and j-hook size must be obtained from NYPA.

Figure 9: Dam B

Figure 10: Flash Boards

Dam A

Figure 11 shows Dam A with flashboards installed looking northwest. It is exactly the same as Dam B, so the j-hook holes are, again, the most plausible means of attaching antennas.

There are no sources of power for the receiver at Dam A (R2).

Figure 11: Dam A

Canal

Figure 12 and Figure 13 show the canal entrance. The roadway bridge does not move, so it is possible to mount antennas on the railing as long as they do not obstruct the boats. There are also posts on either side that can be used.

The operator's house is available for the equipment and the antenna wires can be run out through holes in the window sill.

Figure 12: Canal Entrance

Figure 13: Canal Entrance

A complete set of pictures can be downloaded from:

http://www.grantsystems.com/clients/Kleinschmidt/2007/Crescent/

Conclusions

1. Only frequencies 150.000MHz and 150.985MHz need to be avoided. Any other frequencies in the 149 or 150 MHz bands are available assuming no new transmitters are installed in the area.

2. Headrace yagi antennas can be mounted on fencing.

3. AC is available for receivers R1 and R3.

4. Dam A and Dam B underwater antennas must be designed to utilize the flashboards to support cables and the j-hook holes to support the antennas. It will require some design work to determine the best way to do this in light of the potentially harsh treatment.

5. The canal antennas can be mounted on the bridge or poles to the side of the canal.

6. The canal receiver can be placed in the operators house and receive 120V power at that location.

Recommendations

1. Obtain further information and possibly drawings from the NYPA on the j-hook holes and their dimensions.

2. Utilize the above information to design the final installation.

3. Check FCC tables to verify availability of frequencies.

New York State
Department of Environmental Conservation
Division of Fish, Wildlife and Marine Resources

Bureau of Fisheries

Annual Report
Highlights and Accomplishments
2006/2007

Introduction

The New York State Department of Environmental Conservation, Division of Fish, Wildlife and Marine Resources, Bureau of Fisheries delivers a diverse program and annually conducts a wide array of activities to accomplish its mission:

Conserve and enhance New York State's abundant and diverse populations of freshwater fishes while providing the public with quality recreational angling opportunities.

During the New York State Fiscal Year 2006/2007 (April 1, 2006 - March 31, 2007), the Bureau of Fisheries logged a total of 45,175 staff days of effort which was valued at more than $8.3 million. Most of this effort was provided by permanent personnel (36,269 staff days), but 8,906 staff days were provided by temporary personnel.

The Bureau of Fisheries staff efforts are categorized under five Division of Fish, Wildlife and Marine Resources program goals:

Ecosystem Protection - *Protect, Enhance and Restore New York's Fish, Wildlife and Marine Resources and the Ecosystems That Support Them (17% of staff effort)*

Fish, Wildlife and Marine Resources Extension - *Help Provide New York Residents and Visitors with the Knowledge to Appreciate Fish, Wildlife, and Marine Resources and Their Habitats (5% of staff effort)*

Recreation, Use and Allocation - *Provide a Wide Array of Opportunities to Enjoy Fish, Wildlife and Marine Resources (60% of staff effort)*

Protection of Human Health, Safety and Welfare - *Minimize Fish, Wildlife and Marine Resource-related Negative Impacts on Natural Resources; and Human Health, Safety and Land Use. (< 1% of staff effort)*

Organizational Effectiveness - *Foster and Maintain an Organization That Effectively Achieves Our Mission. (17% of staff effort).*

For 2006/2007, Bureau of Fisheries activities were organized under 13 objectives which generally describe the intended outcomes from our efforts (e.g. satisfied anglers; restored, self-sustaining fish populations; healthy hatchery fish; additional public fishing access; improved aquatic habitats; confidence in the Bureau of Fisheries staff abilities). The objective which accounted for the greatest amount of staff effort was:

By 2007, 75% of surveyed anglers will indicate that they are satisfied (and 30% will indicate they are highly satisfied) with the numbers and sizes of fish they catch from New York's inland and Great Lakes waters.

with more than 56% of total staff effort followed by:

Maintain self-sustaining populations of 165 species of freshwater and anadromous fishes in New York waters.

with approximately 6% of total staff effort (Table 1).

The information contained in this report is not a listing of all activities that the Bureau of Fisheries staff engaged in. This report is a summary of information, provided by Bureau staff, that they deemed to be most significant and representative of their efforts. The information is organized along broad resource (e.g. warmwater lakes and ponds, coldwater streams) or programmatic (e.g. creel surveys, fish culture) lines and is further organized by administrative unit (e.g. Region, Central Office, Great Lakes Unit, Hatchery). This report highlights the findings, accomplishments and significant efforts of the Bureau of Fisheries during State fiscal year 2006-07 for the study, protection, enhancement, restoration, and sound management of New York's fisheries resources.

Table 1. Distribution of Bureau of Fisheries staff effort among twenty Bureau of Fisheries programmatic objectives for the State fiscal year 2006/2007.

Bureau of Fisheries Objective	Total Staff Days	Percent of Staff Days	Total Staff Costs
By 2007, based on a sample of concerned "user groups"and the opinions of Bureau staff, the percentage of responses indicated a high degree of satisfaction with the Bureau of Fisheries efforts to restore fish populations and protect aquatic habitats will exceed 60%	1,850	4.1%	$442,747
Restore five additional self-sustaining populations of New York State listed-threatened or endangered fishes by 2007.	406	0.99%	$83,888
Maintain self-sustaining populations of 165 species of freshwater and anadromous fishes in New York waters	2,498	5.5%	$451,527
Provide 30 additional fisheries supported entirely by self-sustaining populations of wild fishes in publicly accessible New York waters by 2007.	19	<0.1%	$4,073
By 2007, 90% of Bureau of Fisheries staff is satisfied that the Bureau of Fisheries is conducting the most effective and efficient program it can.	618	1.4%	$184,246
By 2007, an effective and inclusive angler education techniques/programs will be established that will provide a conduit for New Yorker's of all ages to gain the necessary knowledge to become an effective and ethical angler.	410	0.9%	$69,255
By 2007, based on a sample of anglers and constituents, and opinions of all Bureau staff, the percentage of responses expressing a high degree of satisfaction with the quality of information provided by the Bureau of Fisheries will exceed 75%.	993	2.2%	$196,398
By 2007, 75% of surveyed anglers will indicate that they are satisfied (and 30% will indicate they are highly satisfied) with the numbers and sizes of fish they catch from New York's inland and Great Lakes waters.	25,072	55.5%	$4,379,978
The average health and physical condition of all fishes cultured at each DEC hatchery will meet or exceed measurable quality standards established by the Bureau annually.	1,578	3.5%	$286,837
Acquire ten miles of Public Fishing Rights (PFR) easements annually and maintain PFR network for optimal angler use and enjoyment.	450	1.0%	$94,443
Acquire new waterway access parcels as opportunities and funding permit. Complete development of three Boating Access Sites annually, while maintaining the waterway access network for optimal angler use and enjoyment.	310	0.7%	$72,613
By 2007, 90% of Bureau of Fisheries staff is satisfied that they have sufficient knowledge, skills and training to effectively accomplish their work duties and the objectives of the Bureau.	1,377	3.0%	$304,947
By 2010 based on a sample of anglers and opinions of all Bureau staff the percentage of responses expressing a high degree of confidence in the professionalism and ability of Bureau of Fisheries staff to manage the State's fisheries will exceed 80%.	131	0.3%	$32,148
All other Division objectives	9,464	20.9%	$1,796,826
Bureau of Fisheries Totals	**45,175**	**100%**	**$8,399,926**

Note: The distribution of effort by Bureau of Fisheries staff is provided as an overview of the number of staff days that were expended to delivery a quality statewide fisheries program; however the focus of this report is to describe the results of the Bureau of Fisheries 45,000-plus days of effort during fiscal year 2006/2007.

Common Abbreviations, Acronyms and Units of Measurement Used

CPUE	*catch per unit of effort* - such as the number of fish caught per hour or fish caught per net
YOY	*young of year* - typically, a fish that is captured by sampling in the same year it was hatched
PSD	*proportional stock density* - describes the portion of a fish population or sample that exceeds a size threshold. For example, the PSD for largemouth bass is the proportion of 12 inch and larger bass in the sample of largemouth bass that were stock size (8 inches and larger).
RSD 15	*relative stock density greater than 15 inches* - describes the proportion of fish larger than 15 inches in a population or sample of all fish exceeding a size threshold. For example, the RSD 15 for largemouth bass is the proportion of 15 inch and larger bass in a the sample of all largemouth bass that were stock size (8 inches and larger)
RM	*river mile* - denotes the distance upstream from the river mouth
mm	*millimeter* - a metric system unit of length, 100 mm = 3.94 inches
kg	*kilogram* - a metric system unit of weight, 1 kg = 2.2 pounds
km	*kilometer* - a metric system unit of length, 1 km = 0.62 miles or 3,281 feet
ha	*hectare* - a metric system unit of area, 1 hectare = 2.47 acres
m	*meter* - a metric system unit of length, 1 meter = 3.28 feet
ppm	*part per million* - describes the density of a substance in another solid, liquid or gas (typically water, air)
ppb	*parts per billion* - describes the density of a substance in another solid, liquid or gas (typically water, air)
CROTS	*Catch-Rate-Oriented-Trout-Stocking* - the model used to develop stocking rates for trout streams that takes into account: biological measures of the stream and stream carrying capacity, trout natural reproduction, hold-over of previously stocked trout, classification of the type of trout fishery managed for, measured or assumed angler effort and targeting an angler catch rate of 0.5 trout/ hour

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Warmwater Lakes and Ponds

Central Office- Inland Section

Ecology and Management of the Fish Communities in Oneida and Canadarago Lakes

Researchers at the Cornell Biological Field Station at Oneida Lake completed their annual assessment of the fish communities in Oneida and Canadarago Lakes. Funded by a Federal Aid to Sportfish Restoration grant, these monitoring projects are the longest running warmwater fishery assessments in New York State and continue to provide valuable insight on the complex dynamics associated with warmwater fish populations in large northern lakes.

Oneida Lake – Study of the walleye population in Oneida Lake continues to be a primary focus. Future recruitment of walleye to the adult stock at age 4 was predicted from the CPUE of age 1 walleye taken in trawls. Alternative predictors of population size using gill net catches were also investigated. The age 4 and older walleye population was estimated to be between 450,000 and 570,000 depending on the choice of predictive index. The population is now more than double what it was in 1999 (220,000 adult walleye). Trawl and gill net indices produced very different estimates of future population abundance: the trawl index estimated a decline to less than 250,000 by 2009 and a gill net index estimated a stable population of 500,000 through 2008, which is close to the long-term average. The divergent predictions from the two indices and the predicted decline when using the traditional trawl index are causes for concern. Also, captures of 2006 young of year (YOY) walleye were low and this year class is not expected to contribute much to the adult population in 2010. To further evaluate walleye population size, a mark-recapture study was initiated and will be completed in the fall of 2007.

Retrieving a gill net from Oneida Lake

The yellow perch population was estimated at around 1.1 million age 3 and older fish using catches in gill nets, which maintains an increasing trend since 1997. The population is expected to decline in the next two years but should remain around 1 million fish. Zebra mussels have cleared the water but have not decreased young yellow perch growth rates, presumably because zooplankton production has not declined. Increased light levels should also increase foraging efficiency of perch on benthic invertebrates and light is correlated with growth of young perch. Abundance of YOY yellow perch continues to be lower than in the 1970s and 1980s, but faster growth and the presence of YOY gizzard shad has increased survival through their first winter.

An assessment of food web interactions indicated that predation of young yellow perch by walleye accounted for 38% of their observed mortality. Walleye diet studies conducted in 1971-1977, 1992-1994, 1996, and 2003 showed the proportion of age-0 yellow perch mortality accounted for by walleye predation was significantly lower in recent years (49%) compared to the 1970's (91%). These results suggest an increased importance of other predators in determining yellow perch early mortality.

The cormorant management strategy continued in 2006 and the number of birds on the lake was consistently less than 300. Cormorant predation on young walleye and yellow perch was thought to be minimal in 2006 and survival rates of fish from age 1 to maturity should have increased. Non-linear estimation techniques (AD-model builder) were used to show that walleye mortality between age 1 and 3 was higher prior to cormorant hazing efforts. This analysis supported earlier conclusions of increased mortality of sub-adult walleye during cormorant years. Assessment of yellow perch is more uncertain and the effect of cormorant management more difficult to detect.

A review of available information on the fish and fishery in Oneida Lake was summarized in an ecosystem model of the lake and its fishery using EcoPath/EcoSim. The simulations indicate that both cormorants and increased mortality during the first year of life contributed to the decline in walleye. As part of this effort, the fish sampling procedures and database for Oneida Lake was summarized.

Higher water clarity, due to filter feeding by zebra mussels, has resulted in changes in the distribution and species composition of aquatic macrophytes. These changes are resulting in expansion of nearshore fish habitat, and thus a sampling program, using fyke nets and seines, is being developed to monitor affected fish communities. Fyke net samples consistently collected nearshore species such as pumpkinseed, rock bass, and YOY black basses that are not always captured in historical sampling. Higher total catches and diversity in catches was observed in later summer sampling. Consistent trends towards higher total catches, diversity and catches of centrarchids were observed in perpendicular net sets as compared to parallel sets. Wings did not affect catches. YOY bass were captured more often in smaller mesh nets, likely due to failure of bass to recruit into the larger mesh before sampling was completed. Dense vegetation resulted in difficulties in seining all sites. These results indicate that the nearshore sampling program will likely be most effective if efforts are concentrated on fyke nets and sampling is conducted late in the growing season.

Study results were presented at several meetings and a symposium on Oneida Lake, in association with the 50 year celebration of the Cornell Biological Field Station. A presentation was also made at the Annual Meeting of the American Fisheries Society in Lake Placid, NY. Publications in 2006/07 include analyses of: 1) ecosystem changes in Oneida Lake (Zhu et al. 2006); 2) over winter mortality of yellow and white perch (Fitzgerald et al. 2006); and 3) the effect of party size and trip length on angler catch rate (VanDeValk et al. 2007). Papers in press include analyses of: 1) burbot population changes in Oneida Lake (Jackson et al.); 2) the contribution of yearling stocking to the 2001 walleye year class (VanDeValk et al.); and 4) the effect of dreissenids on macrophytes (Zhu et al.). The Oneida Lake Profile (Mills et al. 2006) and a detailed account of the Oneida Lake fish research walleye stock assessment and population projections for Oneida Lake 2006-2009 (VanDeValk et al. 2007) were also completed.

Oneida Lake walleye

Canadarago Lake – Fish populations and other lake characteristics were monitored to measure trends and determine potential effects of an increasing alewife population. Walleye natural recruitment was low in 2006. Fry sampling yielded no walleye fry and 1,853 yellow perch fry in 60 samples. Similar results were found in 2005, and suggest year class failures of walleye but not yellow perch. Fall electrofishing indicated similar trends; only 2 YOY walleye (1.8/h) were caught in 2005 and none in 2006 (first time in 16 years), and large numbers of young perch were caught both years. While this cannot be solely attributed to alewife predation because yellow perch larvae were abundant, it is possible that alewife predation is more intense on the earlier hatching walleye larvae because fewer larvae are present in the lake at that time. Adult walleye electrofishing catch was 33.6/h, above the long-term average. Electrofishing catch of adult yellow perch set a new record high of 950/h, which follows the 2005 record YOY catch of 904/h. YOY perch catch in 2006 remained very high at 762/h. Gillnet catch of walleye in 2006 remained about average (15.6/net), while the yellow perch catch tripled from 2004, due mainly to high recruitment of young fish from large YOY classes the past several years. Alewife catch in the standard gillnet was the highest yet recorded (6.0/net).

Catch of alewife in small mesh gillnets has increased each year since they were introduced. Six nets set for 4.25 hours caught 180 alewife (7.1/net/h), nearly a 3-fold increase from 2005. While the alewife catch continues to increase, it is still lower than many established alewife lakes. Large adult alewife (over 250 mm) were present and in very good condition, creating the potential for large recruitment again in 2007. Length of YOY alewife has decreased almost 30 mm since 2004, and dry/wet weight ratio of YOY and age-1 alewife has also decreased, suggesting the alewife population is becoming denser. Acoustic surveys indicated alewife was 30-50 times more abundant in 2006 than in previous years.

Zooplankton densities did not indicate large changes from past years. Average size and biomass have decreased somewhat in recent years, but are still within the long term ranges. Larger decreases are expected, given the abundance of YOY perch and alewife. Water clarity reached an all time high of 8.4 m in May 2005, and then decreased to 4.1 m in 2006, about equal to the long term average. Secchi disk trends are probably a result of the competing effects of zebra mussel filtering and increased zooplankton predation.

An overwinter temperature recorder was moored in this lake for the 4th year and revealed winter temperatures that almost never go below 1°C, and usually remain at about 2°C all winter. Winter temperatures were higher than in Oneida Lake (which averages about 0.5°C) but lower than in Cayuta Lake (usually around 3.5°C). This suggests alewife will do better in Canadarago Lake than in Oneida Lake.

Oneida Lake Creel Survey

Researchers at the Cornell Biological Field Station at Oneida Lake conducted work on this creel survey. A Federal Aid to Sportfish Restoration grant funded the project. A total of 820 roving interviews were conducted during 53 days throughout the 2006 open water season. Total effort was estimated to be 333,100 angler-h (16.1 angler-h/ha) and was the highest of the recent years measured. Anglers caught 78,600 walleye, 59,800 black bass, and 106,000 yellow perch. Of those fish, 54,200 walleye (69%), 3,000 black bass (5%), and 52,400 yellow perch (49%) were harvested. Anglers reported an additional catch of 53,700 fish comprised of 10 other species.

The mean angler catch rate of walleye for all trips (0.22 walleye/angler-h) was the second lowest since 2002. The 2006 targeted catch rate (0.31 walleye/angler-h) is a more refined estimate that takes into account only those anglers actively seeking walleye, and is similar to reported rates from other North American lakes. Walleye catch rates declined dramatically in late summer, probably due to the growth of YOY gizzard shad to lengths selected by walleye. The 2006 targeted harvest rate of walleye (0.21 fish/angler-h) was the highest for all survey years since 1997. In October 2000, regulation changes increased the minimum size limit from 381 mm (15 in) to 457 mm (18 in), and reduced the bag limit from 5 fish/day to 3 fish/day. As a result, anglers targeting walleye harvested 18% of their catch in 2002 and 2003, and 23% in 2004. Beginning October 1, 2004, the minimum legal harvest length for walleye was returned to 15 inches but the 3 fish daily bag limit was retained. Anglers harvested 75% of their walleye catch during the 2005 open-water season, and 69% in 2006. Anglers released only 3% of all legal walleye caught in 2005 and 5% in 2006. The high harvest rate combined with high effort resulted in 12% of the adult population being removed during the 2006 open water season alone. The targeted catch rate for smallmouth bass was 0.69 fish/angler-h and compared favorably to other lakes with smallmouth fisheries sampled in New York State from 1977-78. Yellow perch angling (targeted catch rate 2.99 fish/angler-h) was the highest in recent years. Most of the directed yellow perch angling typically occurs in the fall. Angler catch rates exceed 1.0 perch/angler-h in September and October and have been as high as 5 yellow perch/angler-h.

Walleye as a Management Tool for Alewife in Cayuta Lake

Researchers at the Cornell Biological Field Station at Oneida Lake conducted work on this study. A Federal Aid to Sportfish Restoration grant funded the project. The goal of this project is to build a walleye population that can have a measurable impact on the current alewife population, and to study the effect of compensatory responses of the alewife population to increased predation rates. Trap netting during the spawning run caught 694 walleye in 60 net nights. Walleye were marked with a 1/2LP fin clip. By-catch was large, and included 2,446 crappie, 1,550 bluegill, 1,112 yellow perch, 909 bullhead, and 1,584 other fish. Approximately ½ of the walleye captured in nets were from the 2006 stocking, with the remaining fish from the 1992-1996 stocking (age-10+ to 15+). Many large fish were present, up to 722 mm (28.4 in). The walleye diet continued to be nearly 100% alewife. Subsequent electrofishing captured 175 walleye, 138 of which were adults (>300 mm), with 47 marked fish. The resulting population estimate was 2,038 walleye > 300 mm. 2006 was the last year of a five year stocking schedule, therefore peak walleye biomass should occur in 2008 or 2009.

Three gillnets captured 787 alewife in 2 hours (131/net/h). Growth and dry to wet weight ratio of alewife was low. Acoustic surveys indicated that alewife have decreased for 4 straight years, from over 8,000/ha in 2002 to 2,001/ha in 2006, suggesting predation may be reducing the population. However, the population is still higher than in many other alewife waters.

A total of 27 diary cooperators were enlisted, but only 5 returned diaries. In 359 hours of fishing effort, only 9 walleye were caught, 7 of which were less than 381 mm (15”). Angler catch rate was 0.03/h, with less than 0.006 legal walleye caught per hour. Secchi depth and zooplankton remained low, with no major changes from past years. Winter water temperatures averaged 3-4 C, higher than Canadarago or Oneida lakes.

Effects of Winter Temperature on Fish in Oneida Lake

Researchers at the Cornell Biological Field Station (CBFS) at Oneida Lake conducted work on this study. A Federal Aid to Sportfish Restoration grant funded the project. This study was designed to 1) measure the degree and timing of winter mortality in three important invasive species: white perch, gizzard shad, and alewife; and 2) to predict future changes in fish community structure based on lake gradients and potential climate change. During the winter of 2006/07, controlled studies on the survival of gizzard shad were conducted in the cold rooms of the CBFS’s experimental facility. Shad were collected from Oneida Lake throughout the summer, fall and winter to compliment the cold room experiments and assess overwinter survival in the lake. Predator (primarily walleye) diet samples were collected through the winter. Mortality of shad was highest in the coldest temperature-treatments (1.5 and 2.5ºC). Lake surveys indicated high survival of the 2005 gizzard shad year class through the 2005-06 and 2006-07 winters. Sampling through the winter and spring (2007) showed that YOY shad survived through mid February within marinas, but were not present in walleye diets, gill nets, or electrofishing surveys in late winter or spring. Temperature profiles from locations throughout Oneida Lake indicated marinas as key temperature refuges and large congregations of YOY shad were observed in those areas through the fall and early winter. However, these refuges became anoxic in late winter due to consistent ice cover. Catches of shad in under-the-ice gill nets set in marinas ceased concurrently with the drop in dissolved oxygen. In years with short periods of ice cover, anoxia may not develop (observed in 2005/06). The relationship between ice cover and anoxia may explain the high overwinter mortality of YOY shad in most years as well as the survival of some shad during warm winters with short ice cover. An ice cover model predicted shorter periods of ice cover by 2050, which suggests that over-winter survival of YOY gizzard shad will become increasingly common resulting in adult shad becoming a dominant species in Oneida Lake. This has implications for food web interactions in the lake. Further research on the over winter survival of white perch and alewife will be evaluated based on the gizzard shad results.

Cornell Biological Field Station- Shackleton Point

Region 1

Hempstead Lake Seine Survey

In the summer of 2002, Hempstead Lake completely dried up due to the extreme temperatures and lack of precipitation. The lake was only dry for a month before heavy rains brought it back to nearly full pool. The Fisheries Unit restocked the lake in 2003 with black crappie, yellow perch, bluegill, pumpkinseed, banded killifish, golden shiner, chain pickerel, brown bullhead. Largemouth bass were stocked in 2004. On August 17th, Fisheries Manager Charles Guthrie, Fisheries Biologist Heidi O’Riordan and Seasonal Technician Joe Pries seined Hempstead Lake to assess the reproductive success of this relatively new fish population. Noteworthy observations include an increase in young of the year black crappie, pumpkinseed, largemouth bass and common carp (Table 2). The occurrence of carp is problematic, it was illegally introduced into the lake by an unknown source since the last survey. Prior to 2002, the fish community in Hempstead Lake was dominated by carp and a significant targeted fishery existed. The loss of the fish community provided an excellent opportunity to restore a balanced fish community. This will be much more difficult given this illegal introduction of the non-native common carp.

Historically Hempstead Lake supported very little submersed aquatic vegetation. In 2005, substantial amounts of submersed aquatic vegetation were observed in nearly every seine haul, raising hopes that healthy vegetation beds would develop. Unfortunately, this year very little aquatic vegetation was observed.

Table 2. Species found in Hempstead Lake.

SPECIES	2005	2006
Golden Shiner	39	0
Brown Bullhead	1	13
Banded Killifish	82	18
Pumpkinseed	13	50
Bluegill	84	10
Largemouth Bass	18	48
Black Crappie	14	68
Yellow Perch	123	142
Common Carp	0	37
Chain Pickerel	7	6
Mummichog	0	6

Walleye Stocking
Region 1 Fisheries staff continued the annual Lake Ronkonkoma Walleye Stocking Program by releasing 10,000 walleye fingerlings on June 27, 2006. Ranging in length from 32 to 60 mm with an average length of 38 mm, these juvenile walleye were reared at the DEC's South Otselic Fish Hatchery and transported to Long Island by Catskill Hatchery staff. The Walleye Stocking Program was initiated in 1994 with the goal of controlling the overabundant white perch population in Lake Ronkonkoma. In addition the walleye stocking program has created an exciting new sportfishing opportunity for Long Island anglers.

Lake Ronkonkoma Water Chemistry and Seine Survey
On August 23, 2006, Fisheries Manager Charles Guthrie, Fisheries Biologist Heidi O'Riordan, Technician Joe Pries and Cobleskill intern Joe Albanese conducted a water quality and seine survey on Lake Ronkonkoma. The annual seine survey is to determine young of the year bass production and monitor the forage base. A 100' seine was utilized on only 3 of the usual 7 sites due to the fact that the water level in the Lake is 3 ft higher than normal. We collected and measured 8 largemouth bass, 46 banded killifish, 15 white perch, 11 yellow perch, 3 bluegill sunfish, 1 pumpkinseed sunfish, and one smallmouth bass.

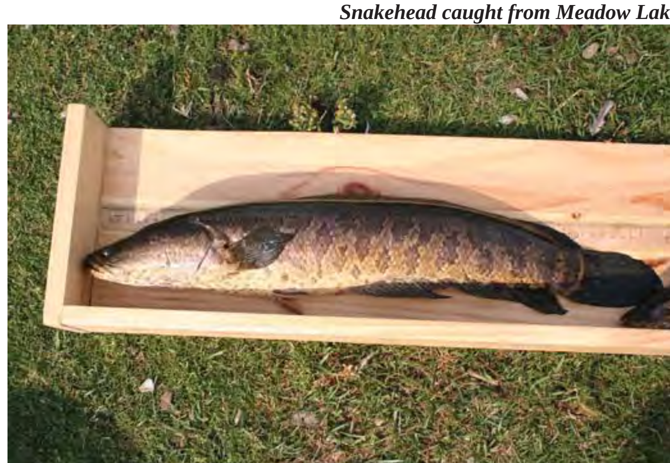
As part of the water quality survey, a zooplankton sample, temperature/dissolved oxygen/conductivity profile and water sample collections for chlorophyll testing were conducted. The temperature ranged from 26.9ºC at the surface to 9.2ºC near the bottom (50'). The dissolved oxygen levels dropped from 5.7 mg/l to 0.1 mg/l at approximately 10 ft where the thermocline occurs which is typical for mid-summer. The chlorophyll samples were analyzed by Suffolk County Health Department and the zooplankton sample was sent to the Cornell Biological Field Station at Shackleton Point.

Lake Ronkonkoma Seine Survey

Region 2

Meadow Lake, Willow Lake, Queens, NY
Northern Snakehead surveys continued in these two large public freshwater lakes. Nine mature adults, all greater than ten inches, were recovered during this time period. Staff continue to investigate control methods which would not adversely impact the existing fish population or public access. The two lakes are within a major New York City park that hosts a variety of recreational activities.

Snakehead caught from Meadow Lake



Region 4

Canadarago Lake Gill Netting
The biennial netting of the 2,000 acre Canadarago Lake in Otsego County was completed in 2006, the 13th netting since 1983. Two, 150 foot long variable mesh (1.5-4.0 in) gill nets were fished overnight each month from June through September at random locations throughout the lake for a total of eight net sites. The objective of this study is to monitor the abundance of walleye and yellow perch. The catch of walleye and yellow perch averaged 15.6 and 96.0 fish per net, respectively. Although the catch of walleye was down 28% from the record catch of 21.6 fish per net in 2003, walleye abundance remains high with an excellent fishery

reported in 2006. Yellow perch abundance was up about three fold from the catch of 33.9 perch per net recorded in 2004 which was the second lowest catch recorded to date. The increased yellow perch abundance has resulted in a greatly improved ice fishery during the winter of 2006-07 and should result in even better fishing during the next two to three winters.

During the 2006 netting effort, a record 48 alewife were collected compared to none in 2004 and six in 2003. Alewife were first documented in 1999 when two fish were collected. Although the alewife population is growing, abundance remains very low. Alewife abundance is being monitored every fall by Cornell University fisheries scientists. Although the latest sampling efforts indicate that alewife abundance remains sparse, their growing abundance has the potential to affect the lakes ecology and fishery.

Kinderhook Lake
A survey was conducted as part of an evaluation of the treatment of Kinderhook Lake with alum to control algae blooms. The lake association has been treating the lake with alum every summer since 2001. A pretreatment survey was conducted prior to the first use of alum in 2001, for the purpose of establishing a base line.

Smallmouth bass numbers were up with 29 fish (stock size or better) per hour collected by electrofishing. That compares favorably with 12 fish per hour in 2001. The PSD was 49% and RSD was 25%, which represents a decline from 2001 and indicates that all of the increase seen was due to fish in between the stock size and the preferred size. Still, this does represent great potential for improvement in the smallmouth bass fishery in future seasons.

Largemouth bass numbers were very similar between the two surveys at about 15 fish per hour. The PSD was 89% and the RSD was 62%. These values were slightly higher than in 2001 which had a PSD of 84% and an RSD of 44%.

Other species noted include yellow perch with the numbers collected down, but the size structure improved somewhat. PSD for yellow perch improved from 2% in 2001 to 15% in 2006. Pumpkinseed numbers collected were up in 2006 and PSD increased from 62% to 76%. Bluegill numbers were down and the PSD increased from 87% to 92%. Black crappie numbers were also down, with PSD increasing from 4% to 60%. White perch numbers were down from 600 in 2001 to 500 in 2006. The PSD for white perch increased from 30% to 37%.

These results seem to indicate only moderate changes in the fish community population structure in Kinderhook Lake during the 5 year period that alum was added to the lake. Most of the changes should constitute an improvement for the recreational angler.

In conjunction with this survey, fish were collected as part of the Department's Toxic Substance Monitoring Program to supply fish for contaminant analysis. There is currently a fish health advisory for eating American eel taken from Kinderhook Lake. The collection included 10 American Eel, 12 White Perch, 13 Yellow Perch; 1 Largemouth bass and 10 Smallmouth Bass. No American eel were seen in the 2001 survey.

Region 5

Progress towards three new, north-country walleye fisheries, but an existing walleye fishery is in severe decline.
2006 marked the 5th year of walleye fingerling stocking in Harris Lake. State campground personnel on the lake indicate the stocking has been successful in establishing a walleye fishery. A fisheries survey to assess the relative success of the walleye stocking will likely be scheduled for 2009. The planned survey should be able to confirm that a successful fishery was created and assess whether the walleye are successfully reproducing in Harris Lake.

A survey of Fern Lake, located in south-central Clinton County, was undertaken to assess the success of a five-year experimental walleye stocking program which was initiated in 2002. The survey replicated a 2001 survey which was conducted prior to the experimental stocking. The survey documented survival of walleye in Fern Lake. Gill netting captured two individuals and anglers captured several on the day of the survey. Night electrofishing along the shoreline showed a decline in the largemouth bass population and a shift towards smallmouth bass. No new species were documented and no black crappie, a fish once common in Fern Lake, were captured. The data will be examined and a decision will be made regarding continued stocking of walleye.

Kiwassa Lake in Franklin County has reportedly provided catches of walleye in recent years. In contrast, the once popular fishery for cisco, has apparently declined. The lake was surveyed to assess the apparent changes and determine potential management actions. Six gillnet gangs were set in late July at depths ranging from 5 to 35 feet and water temperatures ranging from 49 to 76 Fahrenheit. A strong thermocline was present from 15-20 feet. Dissolved oxygen levels were low from 35 feet to the maximum depth of 46 feet. No salmonids or cisco were caught. However, three adult walleye ranging from 19-21 inches were netted. Nice-size smallmouth bass, northern pike, yellow perch and brown bullhead were also caught along with numbers of rock bass and pumpkinseed. Kiwassa Lake has a good warmwater community. Walleye in this lake are migrants from stocking efforts made in Lower Saranac Lake. Although there is low dissolved oxygen in the deepest part of the lake, there is a large volume of water from 15-30 feet which would support trout. Age/growth analysis will be done this winter and final stocking decisions will be made. Kiwassa Lake looks like a good stocking candidate for walleye and/or rainbow trout.

A netting survey was conducted on Lake Pleasant near the village of Speculator in Hamilton County to assess its walleye population status. This 1,475 acre lake has had a self-sustaining walleye population since the species was introduced in the 1920s. However, since the emergence of an abundant rainbow smelt population circa 2000, angling success for walleye has decreased greatly. For instance, no walleye have been entered in the annual ice fishing derby for the last three years. Gillnet gangs with meshes ranging from 1.25 to 4.0 inches were set at 10 sites around the lake. Water chemistry sampling found a sharp thermocline at 10-15 feet and that dissolved oxygen levels were good throughout the water column (maximum depth found was 73 feet). Netting done at sites with habitat types ranging from large cobble to sand and along drop-offs near weed beds failed to capture any young walleye. Ultimately, 10 large adult walleye ranging from 20-26 inches in length were caught in 20-25 ft of water. These walleye were eating young-of-year smelt. Smallmouth bass were abundant; nearly 100 were caught. Many of the smallmouth bass were infected with parasitic tapeworms. Other species captured were brown trout, rainbow trout, chain pickerel, yellow perch, fallfish, brown bullhead, rock bass, pumpkinseed, and white sucker. While on the lake, staff investigated a fish kill occurring along the beaches on the eastern (windward) side of the lake. About 20 dead fish were found, but no fish showed sign of VHS. It appears that natural reproduction of walleye is now greatly diminished in the lake due to the presence of rainbow smelt which can prey on emerging walleye fry.

Black crappie established in the Saranac River watershed; may cause declines in walleye.

Staff documented two cases of black crappie being illegally introduced into ponds within the Saranac River watershed. These introductions may damage popular walleye fisheries in connected water bodies. Angler reports indicated that crappie were present in Moody Pond in the Village of Saranac Lake. An electrofishing survey confirmed that multiple year classes of crappie were present, indicating that the crappie are successfully reproducing. Similarly, an angler reported catching crappie in East Pine Pond located near the St. Regis Canoe Area in Franklin County. Netting in East Pine Pond also found multiple year classes of crappie.

Crappie from East Pine and Moody Ponds are expected to move downstream, and infest important walleye waters. East Pine Pond drains into Floodwood Pond which in turn eventually drains to Upper Saranac Lake and other Saranac chain waters. Moody Pond drains into the Saranac River. Black crappie are known to be serious predators on young fish, especially walleye fry. Through intensive stocking efforts over many years, walleye have been successfully established by the Department in Franklin Falls Flow and Union Falls Flow - waters located downstream on the Saranac River. The Department has also been trying to establish walleye in Lower Saranac Lake. If black crappie spread to the downstream walleye lakes, it is feared that walleye reproduction will be greatly reduced and the populations may crash. This pattern has been observed in Region 6 waters such as Black Lake and may be why walleye have declined in the South Bay area of Lake Champlain.

Black crappie are a popular panfish species with many anglers. However, would-be spreaders of this species need to be aware that crappie are not native to the Adirondacks and their introduction could jeopardize valuable gamefish species. Most Adirondack lakes lack the productivity to support a wide array of fish species. Any introduction of a new species into a lake or system of lakes has to be done with caution and is only legal by stocking permit issued by DEC Fisheries.

Region 6

Grass Lake, St. Lawrence County

Grass Lake is located in northern New York on the border of Jefferson and St. Lawrence Counties. A centrarchid survey was performed to address concerns raised by Lake Association members concerning the bass fishery and future management.

This lake is composed of two distinct basins. The western arm is narrow and shallow (<10 ft), whereas the eastern basin is bowl shaped with waters >50 ft in depth. In general a warmwater fish assemblage dominates this water body. Fish collected include: largemouth bass, smallmouth bass, northern pike, pumpkinseed, bluegill, yellow perch, brown bullhead and black crappie (Table 3.)

Walleye and tiger muskellunge have been actively managed since 1955 and 1996 respectively. Walleye were stocked as fry from 1955-1996 (300,000 to 1.6 million/year). Walleye fingerlings, both spring and fall, were stocked from 1997-2001 as part of a Cornell University research program. Tiger musky have been stocked from 1996-present as fall fingerlings at a rate of 640/year. No walleye or tiger musky were collected or observed in this electrofishing effort.

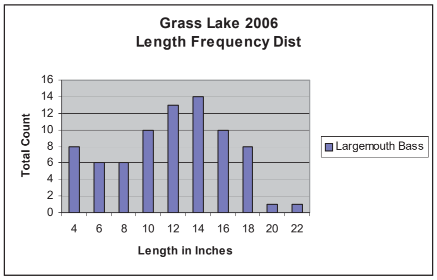
Both largemouth and smallmouth bass inhabit Grass Lake. Largemouth bass were the predominant species encountered due to the extensive littoral zone available, and their vulnerability to electroshocking. Catch per unit effort (CPUE) was 58 and 6.7 fish per hour for largemouth and smallmouth respectively. PSD for largemouth and smallmouth was 59.7 and 50.0 respectively. The RSD15 for largemouth was 22.8, indicating a high proportion of preferred size fish >15 inches available to anglers. It should be noted that the smallmouth sample size was extremely small (N=10) and any conclusions based on PSD alone may be erroneous.

Black bass in Grass Lake are currently managed by statewide regulations. Although public access is available, it is unlikely that angling exploitation has any significant effect on the population. Size classes of fish collected in this survey indicate adequate recruitment for self sustaining populations with little management needed at this time.

Table 3. Total catch by species in Grass Lake. Includes 0.75 hours each of gamefish and all-fish collections.

Common Name	Number of Fish
Black Crappie	4
Bluegill	276
Bluntnose Minnow	1
Brown Bullhead	12
Golden Shiner	4
Largemouth Bass	62
Northern Pike	2
Pumpkinseed	63
Smallmouth Bass	10
Yellow Perch	57

Figure 1. Length frequency distribution for largemouth bass captured in Grass Lake.



Johnny Smith Pond Survey (Oneida County)
Johnny Smith Pond located on state land in northern Oneida County, is a man made pond that had numerous stunted bass when last surveyed in the late 1970s. The 2006 survey showed the largemouth bass were 6 - 20 in, with the average being 14 in. A strong forage base of golden shiner now exists along with a pumpkinseed population averaging 6 in. Bullheads which were uncommon in the previous survey are now common and average 12 in.

Region 7

Whitney Point Reservoir October 2006 Sampling
With the exception of 1996, annual night electrofishing surveys in October have been conducted since 1994 at four standard sites along the reservoir's shoreline. The purpose of these surveys is to assess abundance and growth of young-of-year (YOY) and yearling walleye in Whitney Point Reservoir. In 2006, no YOY walleye were collected in the fall effort. This indicates that few juvenile walleye were produced and/or survived in 2006. The following are population estimates of YOY walleye for all the years surveyed to date:

1994- 8,087	1998- 2,825	2001- 31,141	2004- 37,307
1995- 10,437	1999- 55,275	2002- 1,110	2005- 41,667
1997- 106,704	2000- 842	2003- 70,958	**2006- 0**

Although the 2006 year class was a failure, the strong 2005 year class of walleye was very abundant during the survey. A total of 261 yearling walleye were captured which provided a population estimate of 17,549 yearling walleye using Serns' (1983) methodology. This represents an overall survival of 42% from the previous year's (2005) estimated number of YOY. Growth of yearling walleye was highly variable with sizes ranging from 7.7 to 13.8 in. The 2005 year class showed a similarly wide range of sizes as YOY (4.3 to 10.4 in). Compared to earlier years, the average size of young walleye in the reservoir has generally been smaller and range of sizes greater. Older walleye (age 2 and above) were also collected during the survey with the largest measuring just under 24 in and nearly 4.5 lb. Overall, walleye fishing at Whitney Point Reservoir should remain very good for a number of years.

Yearling (2005 year class) white crappie were very abundant during the survey. The large number of yearlings caught suggests that reproduction/survival of crappie in 2005 was excellent. If this is the case it is the first strong yearclass produced in the reservoir since 2000. The averaged length of the yearlings was approximately 6.5 in. If they continue to grow at their current rate many individuals will reach the legal minimum length of 9 in during the fall of 2007.

Oneida Lake Management
Regional and Central Office Fisheries staff met with Cornell Fisheries Scientists to review survey work conducted in 2006 (assessment and monitoring of the Oneida Lake fishery is done by Cornell University under contract with DEC). The 2002 and 2003 yearclasses of walleye were smaller than originally predicted, and they, along with the 2004 year class, are expected to add relatively few fish to the adult population in the coming years. The overall adult walleye population is expected to decline back to the levels observed in the late 1990's. Depending on the amount of angler harvest, the adult walleye population, which reached 470,000 in 2005, is predicted to decline to between 270,000 and 360,000 adults by 2009. Angler catch and harvest of walleye are strongly related to forage fish abundance (i.e., juvenile perch, gizzard shad, and adult emerald shiners). Walleye are hard to catch when forage fish are abundant and when scarce they are easy to catch.

Predictions for the yellow perch population levels indicate that the adult population will continue to remain at near historic low levels (approximately one million fish) through 2008. The long term adult perch population abundance has averaged over 2 million fish and has been as high as six million in 1980.

Oneida Lake lake sturgeon

Other findings reported by Cornell include: white perch production continues to be strong in recent years and adults are now nearly as abundant as yellow perch; catches of smallmouth bass young and adults have increased dramatically since the mid-1980s; growth of stocked lake sturgeon continues to be exceptional with several fish weighing over 45 lb having been captured; estimated cormorant predation on yellow perch and walleye is believed to have been minimal due to the intensive cormorant control program which was implemented by USDA-APHIS Wildlife Services as per the population goals established for cormorants by NYSDEC; daytime angler effort for walleye was the highest measured in recent years and the catch rate for walleye (0.31 walleye/angler hour) still fell within the range considered "good" by New York State standards. An estimated 54,200 walleye, 3,000 black bass, and 54,400 yellow perch were harvested during the 2006 open water season.

Otisco Lake Walleye Assessment
Fall night electrofishing was conducted along the Otisco Lake shoreline to determine the relative success of the 2006 stocking of 45,000 pond fingerling walleye. A total of 171 YOY and 16 yearling (2005 stocking) walleye were captured along with several adults. The number of YOY walleye captured is the highest we have seen to date. All of the walleye captured were caught south of the causeway which is also where all stocked walleye have been planted since stocking resumed in 2002.

Relatively little survey work has been conducted south of the causeway in the past so direct comparisons between this catch rate and catch rates of YOY in the 1990s is not appropriate. Shoreline electrofishing north of the causeway has never been very productive even while the population was obviously building during the 1990s. Regardless, the high number of YOY walleye observed during this survey indicates survival of stocked fish was excellent in 2006. Using Serns' 1982 formula for estimating numbers of YOY walleye provides a population estimate of 5,895 in the south end of the lake below the causeway. If accurate, this estimate represents a 13.1% survival rate. The 16 yearlings captured provided a population estimate of 456 yearlings south of the causeway using Serns' 1983 formula. Both population estimates are probably low because we do not know how many have already moved through the causeway into the main lake.

Black bass and tiger musky were also collected during the survey. A total of 77 largemouth bass and 131 smallmouth bass were captured. Most of the smallmouth bass were young fish less than 9 inches long while the majority (47) of the largemouth bass were mature fish between 12 and 22 inches in length. Five tiger musky between 21 and 39 inches were also captured during the survey. Based on our survey work and angler reports, it appears that survival of stocked tiger musky has improved in recent years.

Otisco Lake Water Chestnut Control
In August 2006, Region 7 fisheries staff became aware of the first known occurrence of water chestnut in Otisco Lake. A large, dense bed covering at least a quarter acre was observed along the northeast shoreline in a protected cove. A complete survey of the entire lake shore was immediately conducted but no other plants were found. A decision was made attempt to eradicate this localized population by hand pulling the plants. Hand pulling of water chestnut is a proven control/eradication technique because plants do not overwinter but instead rely solely on seeds for propagation.

The intention of this effort was to try to eliminate this bed and minimize the chances of water chestnut colonizing other areas in the lake. With the cooperation and assistance of the adjacent landowner all of the weeds were pulled in just over a week. Because they were discovered so late in the season many mature seeds broke off the plants during the removal operation. Therefore we expect a significant bed of plants to develop in 2007. However, the fisheries unit anticipates that the plants will be eliminated over the course of several years simply by hand pulling the plants in future years before they have a chance to set seed. Continued lake-wide monitoring for satellite populations will be done for the foreseeable future since dormant seeds can remain viable for 10 years or longer.

Water chestnut eradication from Otisco Lake

Tully Lake Fishery Assessment
Spring night electrofishing was conducted along the Tully Lake shoreline to assess survival of walleye fingerlings stocked by the Tully Lake Association over the past 5 years and to assess the fish community.

Only one walleye was captured during the survey indicating low survival of stocked walleye fingerlings. The catch rate of predators (largemouth bass and chain pickerel) was very high, likely explaining the poor survival of walleye. The condition of most largemouth bass was fair, but there appeared to be a higher proportion of thin fish. Large chain pickerel were abundant but many of them were thinner than average as well. Panfish (bluegill, pumpkinseed, and yellow perch) numbers were high and there seems to be good numbers of quality-sized fish.

Overall, Tully Lake is a very fertile lake which supports higher than average fish population densities. Populations of predator and prey are in "balance" but lower than average weights and slightly slow growth rates of most species could indicate populations are too dense. Management recommendations based on this survey are: discontinue walleye stocking because high predator numbers precludes walleye survival; retain existing angling regulations.

Region 8

Conesus Lake Cooperative Walleye Culture
Conesus Lake was stocked on June 29, 2006 with about fifteen thousand (15,000) 2.5 inch fingerling walleyes, as part of the Finger Lakes Community College (FLCC) Cooperative walleye rearing program. FLCC's Mueller Conservation Field Station, with the help of many volunteers from the Conesus and Honeoye Lake Associations, FLCC interns, students, alumni and faculty, DEC Caledonia Hatchery personnel, and Region 8 Fisheries Management personnel are partners in the program.

Hemlock Lake Surveyed for Young Walleyes
Hemlock Lake was stocked with walleye fingerlings by a local sportsman club under a stocking permit issued by the Department. Documented stocking occurred in various intermittent years in the mid to late 1990s. Stocking was last reported in 1997. Numbers of walleye fingerlings stocked varied from year to year but rarely exceeded 2,000. Evaluation of the success of these stockings

occurred via spring trap net surveys in 1998 and 2005. Twenty and 54 adult walleyes were caught in four net nights during those surveys, respectively. Evaluation of natural reproduction has not been attempted. Since fingerling stocking has not occurred within the last several years, any age 1+, 2+, or 3+ walleyes captured during late spring electrofishing would indicate natural reproduction. On the nights of June 7 and 15, 2006, Region 8 Fisheries staff electrofished along the shoreline of Hemlock Lake for a total of 3.5 hours. Both steeply-sloped, gravel, cobble, and boulder, and less steeply-sloped vegetated habitats were sampled. No young or adult walleyes were captured or observed. Other fish species observed, but not captured, include: largemouth and smallmouth bass, chain pickerel, rock bass, pumpkinseed and bluegill sunfish, black crappie, yellow perch, alewife, golden shiner, white sucker, carp, brown bullhead, and four rainbow trout about 130 mm total length. The modest fingerling walleye stocking to date appears to have resulted in an exploitable population. Despite the previous spring trap net and angler-reported catches of adult walleyes, the results of this survey indicates that the density of adult walleyes as a result of these fingerling stockings appears to be low. The survey also indicates that no natural reproduction has occurred.

Waneta and Lamoka Lakes Fish Communities Evaluated
General surveys were conducted beginning in April 2003, using the standard centrarchid sampling protocol to assess the fish community during year after (Waneta) and prior to (Lamoka) fluridone treatment. In the spring and fall surveys, State University of New York (SUNY) Brockport (Dr. James Haynes and students) assisted DEC staff with fish collection using their new Smith Root electrofishing boat concurrently with ours. Two DEC crew worked on the SUNY Brockport boat and two SUNY Brockport crew worked on the DEC boat. This provided an excellent teaching and learning exercise for both DEC and SUNY staff. Waneta and Lamoka Lakes were surveyed one night each in the spring and fall. Sixteen species of fish were captured in Waneta Lake in the spring and 18 species were captured in the fall. Fifteen species were captured in Lamoka Lake in both the spring and fall. All samples in both lakes were dominated by bluegill and pumpkinseed sunfish, and in Lamoka, yellow perch. Several quality size muskellunge, largemouth and smallmouth bass were also recorded.

Data analysis was performed by SUNY and DEC staff and a final report was prepared by Dr. Haynes. DEC biologist Matt Sanderson presented the results of the surveys at the 136th annual meeting of the American Fisheries Society held in Lake Placid, NY and as an invited speaker at the annual meeting of the North East Aquatic Plant Management Society in West Dover, VT. The following is the abstract of the presentations:

Fisheries surveys in Waneta and Lamoka Lakes from 2003 to 2006 were conducted to assess potential changes in the fish community of Waneta Lake after an April 2003 whole-lake treatment with the herbicide fluridone. A variety of standard fishery statistics were used to compare and evaluate potential differences in the status of fish populations between lakes, years, and seasons. Very few significant differences were detected. Abundance of chain pickerel and yellow perch was higher in Lamoka, and smallmouth bass abundance was higher in Waneta. Pumpkinseed, bluegill and yellow perch were longer and heavier in Waneta than in Lamoka Lake, largemouth bass were longer and heavier in Lamoka than in Waneta Lake. However, there were no significant interaction effects among lakes and years suggesting that something unusual happened in 2003 in Waneta Lake. Longer and heavier pumpkinseed and bluegill in 2003 may suggest that the fluridone treatment had a short-term effect on reproduction and recruitment, but because their ages did not differ among years this hypothesis is weak. Smallmouth bass in Waneta Lake were longer, heavier and older in 2003 than in 2004 and 2005; therefore, reproduction or recruitment may have been impaired as a result of the fluridone treatment in 2003. Although it was not detected clearly by the statistical analyses of catch per unit effort, the number of yellow perch caught in October 2004 and May 2005 declined sharply in Waneta Lake and rose exponentially in Lamoka Lake. This may have occurred due to loss of aquatic macrophyte habitat after the fluridone treatment that lead to increased natural mortality or poor year classes in Waneta but not Lamoka Lake. Overall, the four years of data examined do not appear to show that the fluridone treatment of Waneta Lake adversely affected the fish community. If loss of cover for juvenile fish or loss of food and cover for invertebrate prey of juvenile fish exists in Waneta Lake, it has yet to manifest itself in a detectable way.

Viral Hemorrhagic Septicemia (VHS) found in Conesus Lake
Conesus Lake became the first non-Great Lake water to have VHS. The discovery came after samples were collected from a reported August fish kill involving walleye. Samples were sent to Cornell University where VHS was found to be present in the fish.

Region 9

Allen Lake
Allen Lake is a 58 acre artificial impoundment located in north central Allegany County. It has a maximum depth of 19 ft and an average depth of 8 ft. It was built on private property in 1958 on the headwaters of an unnamed tributary to the Genesee River. New York State purchased the lake in 1963 along with 700 upland acres and added it to state forest land now totaling 2,421 acres.

The Allen Lake drainage area is only 0.3 mi^2. The land use of the drainage area is state forest. The lake as well as the surrounding state forest is a high use area. There is an unimproved hand boat launch ramp, an accessible T-dock for fishing, a 25 car parking lot and a seasonal use sanitary facility. The lake is restricted to the use of non-gasoline powered boats. Although boats and canoes are common on the lake, the majority of the fishing takes place from the 1,600 ft earthen dike. Allen Lake has a population of largemouth bass, assorted panfish but mainly brown bullhead, sunfish and yellow perch, and is stocked annually with 5,600 yearling brook trout and 350 two year old brown trout.

Largemouth bass were introduced in 1996 to provide a predator to control the abundant, stunted panfish population. The introduction was successful with year classes produced from 1996 through 2002. By October 2002, the daytime electrofishing catch for bass was 117/hr (age 1+ and older). An electrofishing survey in late May 2006, however, found a catch rate of 5 bass/hr. Although not documented by DEC, a major fish kill was reported by the public in early April 2003, presumably due to classic winter kill. The largemouth bass population has not yet recovered from this event.

Panfish collected during the 2006 survey showed average to slower than average growth rates. Besides Allen Lake being low in fertility, the loss of a majority of the largemouth bass population, which acted as a control on panfish numbers, has caused growth rates of panfish to decrease. When the largemouth population was increasing, panfish growth rates were improving. Since the winter kill die-off of many largemouth bass in 2003, panfish numbers have increased while growth has decreased. Zooplankton indices have been negatively impacted since the largemouth bass winter kill also. The average size and density of zooplankton has decreased since 2002.

Species diversity continues to change in Allen Lake. Yellow perch were not collected in a 1995 survey, a few were collected in a 2002 survey, and by 2006 they were the most commonly collected panfish. Green sunfish, which were common in 1995, now appear to be extirpated, as none were collected in 2006. Pumpkinseed, which were very abundant in 2002, decreased dramatically in numbers in 2006, while brown bullhead increased greatly between 2002 and 2006.

Chautauqua Lake

Regional staff assisted Prendergast Hatchery with the tending of trap nets to monitor the adult muskellunge population. Nets were fished for 14 net nights and produced a catch per net index of 29, which is slightly above the management goal of 28 fish per net (Figure 2). The total catch of 236 adult muskellunge, included 32 fish over 40 inches. Two pathologists for Cornell University spent a day collecting tissue and blood samples to try and determine the cause for the red spot disease. They concluded that is was a common fish bacteria.

A larval fish survey was established to evaluate natural reproduction of walleye. The last known walleye fry survey was from 1970, that survey had identified 18 stations with two tows per station. It was decided to use the historic sites and repeat the survey for three years. The equipment was borrowed from Lake Erie Unit and 108 tows were completed with help from Prendergast Hatchery staff. The larval fish samples were processed by SUNY Fredonia Biology department staff and students, no walleye fry were found in the 2006 samples.

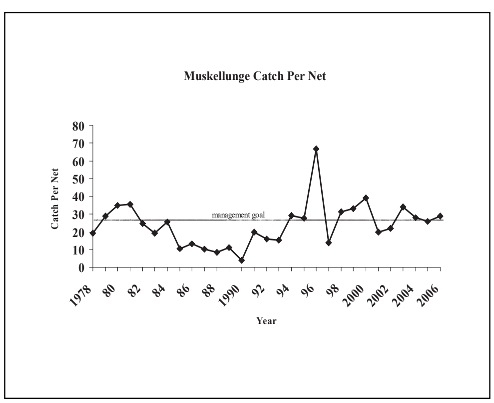
After a three-year hiatus, trawling was conducted at 13 sites to estimate forage abundance and species composition in the lake. A standard 16 ft bottom trawl was towed for five minutes at each site twice a month for two months. The catch was sorted by species, then separated into young of the year or older groups. The groups were then sub-sampled and measured and scales were taken if needed for age determination. Yellow perch dominated the catch, followed by white perch, pumpkinseed and bluegill. White and black crappie catches remained low. Walleye numbers were still low totaling only 47, which averages less than one fish per tow.

Fisheries staff completed fall electrofishing surveys at 15 standardized sites. The primary targets were muskellunge, walleye and black bass. Fish were collected and delivered to Cornell for VHS testing. At this time Chautauqua Lake remains VHS free. Largemouth bass numbers were down from 2004 fall electrofishing. Some of this can be contributed to very high turbidity at the time of sampling. Walleye numbers doubled to 8 fish per hour, up from 4 fish per hour, but still low compared to 1998s 40 fish per hour.

Cassadaga Lakes

The muskellunge work group suggested trap netting other muskie lakes in a effort to increase the sex ratio during egg take operation at Pendergast Hatchery. For years it has been difficult to obtain a good number of males at the time when females become ripe. Hatchery staff set two trap nets in Cassadaga Lake and one each in Upper and Lower lakes. Regional staff helped tend the nets. The trap nets were fished for 14 net nights with 100 total muskellunge caught, the largest being a 40 inch male. With a high male to female ratio, brood muskellunge from Cassadaga Lake were used as part of the overall egg take for 2006.

Figure 2. Trap Net Catch of Muskellunge in Chautauqua Lake 1978-2006



Coldwater Lakes and Ponds

Central Office- Coldwater Fisheries Unit

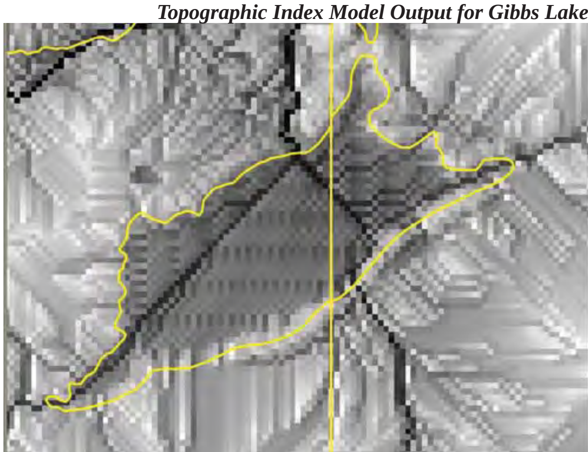
Brook Trout Genetics

The Bureau of Fisheries has participated in a collaborative effort with Tim King of the USGS on a brook trout mitochondrial DNA study with the primary objective of determining if individual broodstocks of heritage strain brook trout have diverged significantly from their original sources. As part of this effort over 400 tissue samples were submitted for analysis, including six heritage populations, three broodstock waters, two hatchery strains, and several unstocked waters of questionable lineage. The final report has not been completed, but initial results indicate that broodstock populations have diverged very little from their original sources. This finding confirms that we have been successful in perpetuating the genetic integrity of these strains.

Identification of Cold Water Inputs to Brook Trout Ponds

As part of the Coldwater Federal Aid Project DEC is working with Cornell researchers to develop, evaluate, and implement a procedure that will predict groundwater seepage sites in nearshore locations and tributaries for Adirondack lakes. These cold water inputs are critical for trout spawning and for trout refuge areas during the summer. Using commonly available GIS layers, a prediction model for lakeshore and tributary groundwater seepage has been build using a Topographic Index approach. The model has been calibrated with field-collected data for a set of study lakes, and is now being applied to lakes and ponds of interest to DEC for management purposes. It is hoped that this information may help identify good candidates for brook trout restoration and could help guide management for selected ponds.

Topographic Index Model Output for Gibbs Lake



Region 1

Spring Trout Stocking

Starting at the end of March and throughout the month of April the Freshwater Fisheries Unit spent several days assisting DEC Fish Culture Staff in stocking 29 Nassau and Suffolk water bodies with trout. Suffolk County waters received 3,350 yearling and 3,750 two year old brown trout and 12,100 yearling rainbow trout. Nassau County waters received 420 yearling and 1,250 two year old brown trout and 3,050 yearling rainbow trout. The yearlings average nine inches and the two year olds averaged 13.5 inches with some as large as 16 inches.

There was no shortage of volunteers this spring which included angling club members, staff from other NYSDEC Units and several Environmental Conservation Officers. The ECOs were able to scope out the stocking locations, check licenses and inform the public of the fishing regulations. Members of Long Island and Art Flick Chapters of Trout Unlimited were on hand throughout and took the time to scatter stock sections of the Carlls and Carmans Rivers.

Although many of the waters on Long Island are open to trout fishing year round with a few exceptions, (special regulations apply for Swan Lake, Carmans River in Southaven County Park, Connetquot River in Connetquot River State Park and Nissequogue River in Caleb Smith State Park) many Long Island trout fishermen still consider April 1st opening day. You can imagine the excitement the sight of a stocking truck brings to not only fishermen but residents along the water bodies and the neighborhood children. Anyone who approaches the stocking crew is encouraged to grab a bucketful and take part in the process. The Fisheries Unit will be stocking again in the fall, volunteers are always welcome.

Long Island Fall Trout Stocking

On October 19th and 20th and November 9th Region 1 Fisheries Staff met Catskill Hatchery staff to stock many of Long Island's rivers, ponds and lakes. Members of Trout Unlimited often assist with the stocking and this fall was no different. The members follow the stocking trucks to each location and bucket by bucket make sure that each fish arrives at it's destination in a quick and safe manner. They even take the time and effort to scatter stock a few hundred trout in Carlls River. Over 8,000 brown trout were stocked in18 water bodies in Nassau and Suffolk Counties.

Region 5

Brook trout protection and restoration in the Adirondacks

The intent of this program is to restore native brook trout to Adirondack waters that have been compromised by acidification or the introduction of nonnative fishes. Related activities included public education efforts, reliming two ponds, and researching the status of acidified waters and of non-native fishes. Pond reclamations, to eliminate non-native fishes from individual waters, were not done in 2006-07.

Research on the status of water chemistry and introduced fish

The introduction of competing and predacious fish, as well as pond acidification, are the primary causes of the decline of brook trout in Adirondack lakes and ponds. Continued introductions of fish are causing further declines in brook trout. In contrast, we know that some ponds are becoming less acidic, which can provide outstanding opportunities to restore brook trout. Researching the status of such changes is essential to identify restoration opportunities.

Brook Trout Lake, Deep Lake and Falls Pond in the West Canada

Lakes Wilderness are three waters that have become less acidic in recent years. Brook Trout Lake's water chemistry is now suitable to support fish, and Horn Lake strain brook trout were stocked in 2005 and 2006. Followup research by RPI and the State Museum confirms that the stocked trout are surviving and growing. Deep Lake and Falls Pond have water chemistries on the threshold of being suitable for trout survival. Both were checked in 2005 and again in 2006. In 2005, Deep Lake had a pH of 5.1 and ANC (acid neutralizing capacity) of 2.8, but in 2006, the pH was 4.9 with an ANC of -5.2. Thus, water chemistry conditions were slightly worse in 2006. The survey crew found a natural barrier to upstream fish movement on the outlet immediately below the lake. Dissolved oxygen values were good throughout the water column. Falls Pond had a pH of 4.9 and an ANC of -1.4 in 2005. The 2006 sampling found the same pH with ANC slightly improved to 1.2. A good natural barrier was found about 0.1 miles down the outlet from the lake. The dissolved oxygen was good down to its maximum depth of 22 ft.

Both Deep Lake and Falls Pond have levels of acidification that are marginal for trout survival. Since there are natural barriers on their outlets, there is little risk of nonnative fish species establishing in these waters. Consideration will be given to stocking these lakes with a heritage strain of brook trout - most likely Horn Lake strain. Stocking may not take place in 2007 due to a limited supply of Horn Lake fingerlings.

Reclaimed ponds surveyed

Several recently reclaimed ponds received biological surveys to assess the current status of their fisheries. Certain of the ponds have again become compromised by competitive fish species and brook trout populations will no doubt suffer. This underscores the need for the reclamation program to regain momentum.

Bumps Pond, located in the Lake George Wild Forest, was treated with rotenone in 1994. Central mudminnows were found shortly after the reclamation, but golden shiner and brown bullhead, two difficult to eliminate species, were successfully removed. When last surveyed in 2000, Bumps Pond continued to provide a quality brook trout fishery with central mudminnow being the only other fish species present. Surveyed again in May of 2006, Bumps Pond continues to support only brook trout and mudminnow. The brook trout population is dependent upon stocking.

Mountain Pond and Dry Lake are two inter-connected waters in the Saint Regis Canoe Area that were reclaimed in 1991. Brown bullhead was the only species that was not eliminated during the reclamation. Surveys in 2006 reaffirmed that Mountain Pond and Dry Lake contain only brown bullhead and brook trout. As is sometimes the case, the proportion of naturally spawned fish has increased over time. The catch of brook trout in Mountain Pond consisted of 8 wild trout and two stocked .

Nellie and Bessie Ponds were treated in 1990. Located in the St. Regis Canoe Area, these two ponds quickly developed self-sustaining populations of Horn Lake strain brook trout. Several species were successfully eliminated during the reclamation and only one unidentified minnow species was collected in a 1996 netting effort. Sadly, an August 2006 netting survey showed that creek chub, brown bullhead and golden shiners have all now become established in Nellie and Bessie Ponds. Extensive beaver activity on the outlet may have allowed competitive species to surmount the blasted rock barrier. The remote nature of the ponds precludes frequent attention to the barrier situation. All three competitive fish species were still at relatively low levels, suggesting that the introductions were recent. Brook trout were still abundant and naturally spawned.

Howard Pond, located in the Hammond Pond Wild Forest was treated with rotenone in 1992. Golden shiners survived the treatment but several other competitive species were eliminated. Redbelly dace were established intentionally following reclamation for study purposes. This 2006 survey documented the reestablishment of brown bullhead, a competitive species that had been absent since the reclamation. The brown bullhead population was at a low level, but is expected to expand at the expense of the stocked brook trout population.

Whey Pond was reclaimed in 1989 and was one of the first waters reclaimed during the "modern era" of the brook trout restoration and enhancement program. The pond was treated at 0.75 parts per million (ppm) of rotenone, rather than the 1.0 ppm that we have since found to be essential to successfully eliminate tolerant species, particularly brown bullhead and golden shiner. Golden shiner and brown bullhead did survive the treatment, but highly competitive yellow perch were eliminated. Whey Pond is a good example of the tremendous competitive force exerted by yellow perch. Prior to the reclamation, trout were virtually absent from the pond. Following elimination of yellow perch the pond is producing quality trout fishing despite the continued presence of golden shiner and brown bullhead. Whey Pond is productive and relatively large with good conditions for salmonids. In most trout ponds, golden shiner and brown bullhead populations will severely impact brook trout populations and stymie reproduction. The recent survey captured nearly 60 brook and rainbow trout. Naturally spawned Windfall strain brook trout dominated the catch.

Little Charley Pond in Hamilton County had been privately owned and is believed to support the Little Tupper strain of brook trout. The Nature Conservancy recently acquired the pond and is supportive of efforts to preserve the Little Tupper strain. Fisheries staff surveyed Little Charley Pond to determine its potential as a broodstock water and for a reclamation. Little Charley Pond has a good natural barrier on its outlet which should prevent largemouth bass that are now destroying the brook trout population in Little Tupper Lake from reaching Little Charley Pond. However, large wetlands on the inlet and outlet of Little Charley Pond make a reclamation difficult. Only five brook trout were netted in Little Charley Pond. Tissue samples were taken for genetic comparison to known Little Tupper strain brook trout. The netting also revealed a large population of nonnative rainbow smelt - some nearly nine inches long. Other species caught were pumpkinseed, white sucker and creek chub. Rainbow smelt are known predators on brook trout fry. The presence of this species in Little Charley Pond does not bode well for the native brook trout. Little Charley Pond is not open to the public for angling. The Nature Conservancy and DEC have not set a date for transferring this water to state ownership.

Holmes Lake and Bone Pond limed

Holmes Lake, located in Fulton County was limed on March 13-14, 2007. Holmes Lake is a productive brook trout lake which requires periodic liming to counteract the negative impacts associated with acid precipitation. The lake received 20 tons of pulverized agricultural limestone which was applied to the ice-covered pond via helicopter. The limestone will slowly mix with the lake water when the ice melts during the spring thaw. The liming of Holmes Lake is considered to be exceptionally valuable because it sustains an important fishery in an area of the state where the impacts from acid rain are severe. Few remote lakes in Fulton County support brook trout fisheries. Holmes Lake is in the Shaker Mountain Wild Forest and the liming of Holmes Lake was determined by the Adirondack Park Agency to be a non-jurisdictional action.

Bone Pond, located in the Saranac Lakes Wild Forest and the Saint Regis Canoe Area, was also limed in early 2007. Bone Pond is a 10-acre pond that requires periodic treatment with pulverized agricultural limestone to maintain water quality suitable for trout. Bone Pond was last treated with lime in February of 1994, thus the prior treatment was successful in providing suitable water quality for trout for more than 12 years. This is considered an excellent retention time for this type of application. The Adirondack Park Agency was consulted prior to treatment, with the project considered non-jurisdictional.

For the pond limings, Bureau of Fisheries personnel were assisted by New York State Forest Rangers, who provided communications. The New York State Police provided aviation support. Staff from the Division of Operations provided technical assistance, including trucking the limestone and preparing an operation zone. The Bureau of Fisheries thanks all that were involved.

Helicopter releasing lime on Bone Pond

Heritage brook trout egg takes successful

Restoring native strains of brook trout, known as Heritage strains, is a part of the brook trout restoration effort. Working with the native strains requires special egg collections from the wild. Late October is prime brook trout spawning time in the Adirondacks. Fisheries staff members T. Shanahan and J. Gnann trapnetted Mountain Pond, Town of Brighton in Franklin County, on October 25-26, 2006 and found the Windfall strain brook trout present there in peak spawning condition. Approximately 18,600 eggs were gathered from 25 pairs of trout. The egg take exceeds regional stocking needs based on past egg to fry survival rates. Windfall strain brook trout are found in nine other Adirondack waters.

Chris Van Maaren and Rich Preall organized a cooperative venture in netting Fishbrook Pond in Washington County for Horn Lake strain brook trout eggs also on October 25-26. As in Mountain Pond, the trout were at peak ripeness. Chris, Leo Demong, Matt Presher and Emily Zollweg took eggs from 26 pairs with a yield of 17,000 eggs. Horn Lake strain brook trout are present in 10 other Adirondack waters.

Egg take from Horn Lake strain brook trout

Public outreach on fish introductions and the use of fish as bait

Introductions of competing and predacious fishes are a major threat to brook trout (and round whitefish) in Adirondack Ponds. Unfortunately many such introductions are the result of humans transporting live fish. To reduce the frequency of such introductions, efforts were increased to educate the public about the dangers of moving fish. Displays were developed for use at county fairs, watershed field days and similar events. Related information was added to the Department web pages. A press release helped generate numerous articles in Adirondack area newspapers, as well as coverage in other media. Also, staff made a point of discussing the issue when attending county federations and other public meetings.

Region 6

Horn Lake Egg Take Attempt

In an effort to reseed our easily accessible brood waters with natal Horn Lake strain brook trout, Region 6 BOF conducted two egg take attempts at Horn Lake. On November 7, Fisheries staff were flown into Horn Lake with a State Police helicopter to set trap nets. The nets produced 23 brook trout of which all the males caught were ripe but only one of the females was releasing eggs. Two weeks later, Fisheries staff returned on a State Police helicopter, and used gill nets to catch fish and again found the females less than willing to release their eggs. Twelve fish were caught in 1.5 hours of quick set gill netting, all of which were females (odd sex ratio). One of these 12 was spent, one was ripe (image below), and 10 were not ready. Horn Lake has historically been a difficult place to collect eggs with the fish not being ripe often until ice cover. Research is needed to uncover the cause of this late spawning that is specific to Horn Lake, as Horn Lake strain brookies that have been transplanted into other waters don't spawn as late. As an example, an egg take of Horn Lake strain brookies was conducted on Fishbrook Pond in Region 5 successfully on October 27 of this year. Our other waters that serve as brood waters for these egg takes have also historically produced ripe fish much earlier than the third week in November.

Genetic testing using microsatellite techniques conducted last year, revealed that our most commonly used brood water for Horn Lake strain brook trout had fish with less complex genetic profiles than do the fish in Horn Lake. The preservation of the unique heritage strain genetics is one of the primary goals of our heritage brook trout program and has motivated us to do this egg take in Horn Lake.

Horn Lake strain brook trout

Five Ponds Wilderness Area Brook Trout Sampling
Salmon Lake, Witch Hopple Pond, Beaverdam Pond and Negro Lake are part of a drainage of ponds that flow south into Stillwater Reservoir, in northern Herkimer County. all of which have non-stocked wild brook trout populations. Besides the outlet from Salmon Lake, none of these waters have suitable stream spawning access. This leads one to suspect sufficient groundwater for in-lake spawning. However, none of these waters have high silicon levels that would suggest abundant groundwater. It appears there would need to be a good deal of groundwater to support the number of brook trout that we found in these waters that also hold large populations of yellow perch. The alternate hypothesis is that these fish are swimming up the outlets from the stocked Stillwater Reservoir. Tissue samples were taken from all trout to help us understand the source of these fish. Current micro-satellite genetic analysis will allow us to determine if these fish are the Temiscamie-hybrids stocked in Stillwater vs. wild fish that may have a more historic hatchery source.

Search to Confirm Region 6 Heritage Strain Brook Trout Existence
Two of the regions least abundant strains where targeted in netting efforts during the month of May. Windfall Pond and Stink Lake were both sampled in an effort to collect tissue samples to confirm that these brook trout populations are indeed free from any stocking influences and can be viewed as "Heritage". Due to the low numbers of brook trout in each of these waters, sampling techniques where made with an eye on keeping fish alive. In Windfall Pond we set a trap net and in Stink Lake we monitored Swedish gill nets on 45 minute sets. Despite having caught a brook trout in Windfall last year, this trap netting effort did not yield any brookies. This speaks to the low density of fish in this water and should not be viewed as verification that the population has been extirpated. In Stink Lake we were excited to catch our first brook trout since the late 1980s. This population could be at great risk as our pH reading on the surface that day read 5.05. Additional water samples will be taken in June to confirm the water quality in Stink Lake.

Jordon River Survey
This was the first attempt at surveying a water thought to possibly have a stream population of heritage strain brook trout. Current special regulations list it as catch & release, artificials only. Attempts to conduct shocking were limited due to poor gear performance in this low conductivity medium-size stream. Shocking efficiency was likely very low with the conductivity and the dark water color that made netting difficult. Gill nets were also set in the slower water. Additional tissue samples need to be collected to get a sufficient sample for genetic analysis.

No changes to the special regulation are requested at this point until genetic analysis is complete. Recommendations in the Unit Management Plan for this area will be to not increase angling pressure by providing additional access. The limited catch included a YOY brook trout and 2 decent-size stream brook trout. Fishing reports suggest that the trout population is fair but not exceptional, despite low pressure. Habitat and low productivity are the likely cause of this. Much of the river is slow and meandering and may have high summer water temperatures.

Region 8

Seneca Lake Deepwater Electrofishing Sea Lamprey Ammocoete Assessment
Larval sea lamprey populations were assessed on Dresden and Watkins Glen deltas and Catharine Creek canal during May and June 2006 using a deepwater shocking boat and equipment on loan from Region 5. Although this technique is best used to define areas of high densities, rough population estimates were determined for each delta and a 2.5 mile portion of the canal. Only one ammocoete was collected in the Watkins Glen delta indicating a very low density. This delta will not require treatment. However, the Dresden Delta population was estimated at about 10,000 ammocoetes with the highest density near the vicinity of the mouth of Keuka Outlet. Estimated ammocoete kill in Keuka Outlet was less than 500 in 2004, therefore it appears that most of the production occurs in the delta, which has not been treated since 1986. Two areas in Catharine Creek canal, immediately downstream of L' Hommideau Creek and at the mouth of Glen Creek also had high densities of ammocoetes estimated at about 2,500. Based on this information, along with monitoring of wounding rates of trout and salmon during trout derbies and lake and tributary surveys, bayluscide treatments will be scheduled for 2008 provided appropriate permits can be attained. Additionally, data will be used in the preparation of federal documents to amend the Sportfish Restoration Grant and allow the expenditure of federal monies for sea lamprey control activities in Seneca and Cayuga Lakes.

Canandaigua Lake Lake Trout Survey
Canandaigua Lake was surveyed this past summer using gill nets placed in various locations throughout the lake. A total of six assessments have been conducted since 1978, the most recent being 2002. Although all data have not been analyzed, preliminary observations can be made. A total of 141 lake trout were collected

with the largest being approximately ten pounds. Catch-per-unit-effort was 6.1 lake trout/net night, the lowest of all the assessments, but only slightly lower than in 2002. Fish appeared to be in fair to good condition. Approximately fifty percent of all stomachs analyzed were empty. Of those that contained food items, smaller lake trout were consuming mysis, or freshwater shrimp, and larger fish were feeding on alewives and smelt.

Beginning with the spring yearling stocking in 2003, all lake trout stocked into Canandaigua Lake were fin-clipped to estimate natural recruitment to the fishery. Additionally, no lake trout from the 2005 year class were stocked into Canandaigua Lake. Preliminary observations based on fin-clip returns indicate that natural recruitment remains low. In addition, based on size, there did not appear to be any lake trout from the 2005 year class, the year in which stocking did not occur, further indicating low natural recruitment. More definitive estimates of natural recruitment rates will be determined once all fish scales have been aged.

Evidence of a slight rebound in the rainbow smelt population was documented as CPUE increased to 2 smelt/net night, the highest level since 1985. In addition to the increased catch, anglers reported a small spring run of smelt in Naples Creek this year, the first in several years. Alewife catch remained low. Base on these preliminary findings, it appears that current stocking rates and regulations should be maintained.

Western Finger Lakes Nuisance Aquatic Species Report

From 1995-2004, in response to the Nonindigenous Aquatic Species Comprehensive Management Plan, Region 8 Fisheries Management personnel conducted an intensive monitoring program including physical (temperature and dissolved oxygen profiles, total phosphorus, chlorophyll a, pH, calcium, and conductivity) and biological community (zooplankton, phytoplankton, and limited fisheries surveys) sampling in all of the Finger Lakes within the region to assess potential ecological effects related to Dreissena infestations. The Finger Lakes included Canadice, Canandaigua, Conesus, Hemlock, Honeoye, Keuka, and Seneca Lakes. In addition to these lakes, other important waterbodies were sampled and included Cayuta, Lamoka, and Waneta Lakes. Zebra mussels were first discovered in Seneca Lake in 1991 and have since colonized every Finger Lake except Canadice Lake. More recently, quagga mussels have also been found in Seneca Lake. To date only Canadice and Waneta Lakes have not been colonized by Dreissenids.

Environmental conditions in most of the study lakes provided moderate to high potential for Dreissenid colonization. Subsequently, once Dreissenids invaded these waters, populations appeared to have expanded and have become firmly established. The lone exception is Canadice Lake which has the lowest recorded calcium levels of the ten study lakes and to date has not had any documented Dreissenid infestation. Oxygen levels in most of the warmwater lakes and a few of the deeper coldwater lakes appear to be the most limiting factor in the spread of Dreissenid populations.

Overall, it appears that Dreissenids have had a more apparent impact on the deeper, less fertile coldwater lakes as opposed to the relatively shallow, more fertile warmwater lakes. In general, the biovolume of phytoplankton in deep coldwater lakes was dominated by diatoms, while blue-green algae generally was the most abundant phytoplankton group in the shallow warmwater lakes. Zooplankton size was typically larger in lakes with established Dreissenid populations and may be a result of the filtering of smaller size zooplankton from the water column by Dreissenids. However, other factors such as fish community structure may also be impacting zooplankton size. Total biomass of zooplankton, like phytoplankton biovolume, was lowest in the deeper coldwater lakes and highest in the two most shallow warmwater lakes, Honeoye and Waneta. Generally, there appeared to be a decline in zooplankton biomass after 1998 in Seneca, Keuka, and Canandaigua Lakes. These declines along with relatively poor primary production in these lakes could potentially impact forage fishes.

Impacts to fisheries resources as a direct result of Dreissenid colonization are difficult to assess due to highly variable population parameters that are naturally inherent in fishery populations. Based on these assessments it appears that forage abundance in the deep, coldwater lakes has been declining since the introduction of Dreissenids. Rainbow smelt, in particular, have all but disappeared in lakes where they were once a primary forage fish. Alewife, another primary forage species, has also declined but not as extensively as smelt populations. The decline in these forage species has generally resulted in slower growth and poorer condition of lake trout, the primary predator and most easily sampled predator fish in these deep coldwater Finger Lakes. However, it is important to note that other biotic or abiotic factors may be causing these changes. Impacts to fish species in the warmwater lakes have been less evident and may be a result of the high productivity associated with these systems.

Warmwater Rivers and Streams

Central Office- Inland Section

St. Lawrence River Studies

Researchers at the State University of New York, School of Environmental Sciences and Forestry completed their annual assessment of muskellunge, northern pike, and walleye populations and habitats in the St. Lawrence River. A Federal Aid to Sportfish Restoration grant funded this assessment.

Muskellunge Management and Monitoring

Abundance and Health - Spawning adult muskellunge were monitored in ten known spawning bays. Thirteen muskellunge were captured for a catch rate of 0.04 fish/night in 2006 compared to a catch of 43 muskellunge at a rate of 0.12 fish/night in 2003. The low catch observed in 2006 is of concern because of its potential relation to increased mortality associated with recent VHS outbreaks. Significant muskellunge mortality was also observed in 2005, but VHS was not confirmed as the causative agent. In 2005, 23 dead muskellunge were processed from the St. Lawrence River from 6 June to 22 July. Nine of these fish were females with eggs (mean TL = 1245 mm, SD= 125), and twelve were males (mean TL = 1104 mm, SD= 94). In 2006, 12 dead muskellunge were processed from 16 May to 25 July. Sex was unidentified on four individuals and the remaining eight were large females with eggs (mean TL = 1329 mm, SD= 82). In both 2005 and 2006, all dead female muskellunge (N=17) had ovaries full with eggs, suggesting spawning stress may have been a factor in mortality. Interestingly, no males were confirmed among dead muskellunge in 2006.

The annual YOY muskellunge index was completed for the tenth consecutive year of standardized sampling. A total of 90 seine hauls in 11 bays were completed during each sampling period. During the fine mesh series in July, 63 YOY muskellunge (CPUE = 0.700) and only 1 YOY northern pike (CPUE = 0.011) were captured. The large-mesh seining series in August resulted in a catch of 34 YOY muskellunge (CPUE = 0.378) and 7 YOY northern pike (CPUE = 0.078). Catch rates for both series were slightly below the long-term average (July CPUE = 0.944, SD=0.224; August CPUE = 0.609, 0.218). Data on habitat use was collected and will be used in the development of probability based predictive models.

Spawning and Nursery Habitat Assessment - Two locations were sampled to determine spawning habitat use: French Bay and Carrier Bay, Clayton, NY. French Bay has sandy substrates and abundant fine-leaved submersed vegetation that appeared suitable for muskellunge nursery, but no YOY muskellunge were observed at this location. Carrier Bay, a known nursery area that had not been surveyed since the 1980s, produced five YOY muskellunge in six seining hauls. Delaney Bay and Long Point Marsh (primarily sampled for YOY northern pike) also each produced YOY muskellunge in 2006.

Muskellunge Angler Diary Program - The number of muskellunge caught (N = 22) and the overall muskellunge catch rate in the 2006 Muskellunge Angler Diary Program (CPUE = 0.015 fish/hour) were the lowest on record (the program started in 1997). However, the average length of muskellunge caught (46.2 inches-TL) was similar to the high average lengths observed during 2002-2004. The low catch rate and few muskellunge caught during 2006 are of concern given the 2005 and 2006 large-scale mortality events.

Northern Pike Management and Monitoring

Abundance and Health – Efforts to evaluate northern pike use of, and reproductive success in, managed marshes continued in 2006. Hoopnets were set to intercept upstream migrating northern pike at six tributary locations including two managed spawning marshes (Carpenters Branch and Butterfield Marsh). A total of 146 northern pike were captured in 149 net-nights, a CPUE of 0.98 fish/night, down from 3.5 per net-night in 2005. All fish captured at entrances to the spawning marshes were transferred into the marsh. Sex ratios were female dominated during the spawning run. One left ventral fin-clipped adult northern pike was captured in Cranberry extension suggesting it originated from YOY production in Cranberry Marsh. Trends of age 0 northern pike in the 30 ft and 60 ft seining surveys continue to show very low abundance in coastal bays. Despite the overall low CPUE, the two seining series seem to trend in a similar pattern (with exception of 1997) suggesting they accurately reflect YOY abundance at the sites.

Cobb Shoal seining

Nursery Habitat Assessment - Three large Grindstone Island bays were sampled in August by seining to identify critical northern pike YOY habitats in the upper St. Lawrence River. This sampling also provided a comparison of pike YOY catches from the longer term seining for the 11 smaller bays used to index YOY muskellunge. Seine hauls at Delaney Bay (N=10) resulted in a catch of three YOY pike; catches were also low in this site in 2005. Total catch of YOY in Long Point Marsh was lower in 2006 (1 YOY/ 8 hauls versus 13 YOY/ 6 hauls) relative to 2005. Flynn Bay, which historically provided a high YOY pike catch resulted in no YOY in ten hauls. A single YOY muskellunge was caught in both the Delaney and Long Point samples.

Spawning Marsh Production and Habitat Quality - The Carpenter's Branch site was monitored for emigrating YOY northern pike using spillway traps. A total of 1,139 YOY northern pike were captured; 331 were given fin-clips (29.1%) and trap mortality was

474 fish (41.6%). The remaining fish were below the 70 mm cut-off for fin-clipping. The estimated mean length of the emigrant pike was 84 mm. Water level data was collected continuously at all sites including reference locations. Vegetation monitoring was completed at elevation specific plots along transects using a point-quadrat method.

Northern Pike Fisheries Management Plan - A northern pike symposium was held at the 2006 American Fisheries Society Annual Meeting in Lake Placid, NY. Sessions on management, biology, and ecology of pike received considerable focus from worldwide experts. Much information was shared among participants that will be useful to understanding the species and its management in the St. Lawrence River. A series of publications to be available in Hydrobiologia are now through the review process, including one paper related to this study.

Walleye Management and Monitoring
Genetic Assessment - Walleye genetics samples taken in 2004 and 2005 were given to Dr. Chris Wilson of The Ontario Ministry of Natural Resources (OMNR) and Trent University in a collaborative effort for DNA extraction and micro-satellite DNA laboratory analyses. The DNA was extracted in spring 2007 and data from PCR amplifications relative to genetic markers will be available soon to analyze genetic divergence among geographic locations.

Spawning and Nursery Habitat Identification - Egg traps were used to collect walleye eggs in Kent's (Mud) Creek and Mud Bay, a tributary with a known spawning compliment in eastern Lake Ontario. Approximately 5,900 eggs were collected in Kent's Creek over the course of the sampling effort of which more than half (N=3135) were walleye eggs. The remaining eggs were white sucker (N=2306) and unidentified (N=499). Walleye eggs were detected in 21 of the 28 traps monitored. The 26 traps located in Mud Bay did not yield any walleye eggs. These data will be used in development of a habitat suitability model for walleye within the Kent's Creek/Mud Bay tributary system.

In order to document successful walleye hatching, drift nets were set in Kent's Creek. However, because of frequent and unpredictable flow reversals in the creek, drift net operation, which relies on unidirectional flow, was unsuccessful. Temperature loggers were deployed in Kent's Creek, Brandy Brook, Mullet Creek, Barrett's Creek and the Black River, and recorded data from early April through the beginning of June. In July 2006 spatial habitat surveys were conducted on portions of four streams (Kent's Creek, Brandy Brook, Barrett's Creek, Mullet Creek) using GPS and GIS base layers were constructed for future habitat suitability analyses.

Population Evaluation - The Cape Vincent hatchery stocked an estimated 122,000 fingerling walleye into seven sites in eastern Lake Ontario and the St. Lawrence River in 2006: Cape Vincent (17,358 fish); Chaumont Bay (23,380 fish); Stony Creek (28,429 fish); Fishers Landing (10,000 fish); Mud Bay (24,000 fish); French Creek (7,562 fish), Swan Bay (11,330 fish). None of the fish released were mass marked. In order to evaluate the success of the 2006 fingerling stocking, stocking sites where there was believed to be little or no natural production, French Bay (French Creek) and Fisher's Landing (Mullet Creek), were electrofished in October for age 0 walleye. No age 0 walleye were captured at either site. Areas suspected to have natural production (Mud Bay) were not sampled because there was no way to separate unmarked hatchery reared fish from naturally produced fish.

Fish passage structure on French Creek

Region 2

Bronx River, Bronx, NY

Approximately 400 alewife were released to the Bronx River through the efforts of the NYC Parks Department, Lehman College (CUNY), Wildlife Conservation Society and the Connecticut Department of Environmental Protection. This was the second release to the Bronx River of this multi-year effort to re-establish alewife. The event was observed by 50+ visitors and the local news media. Students from Lehman College will monitor the river to observe survival of the released fish. Regional staff are assisting in this on-going effort. In addition, local property owners, are undertaking activities adjacent to the river designed to improve riparian habitat.

Region 6

Northern Pike Cooperative Rearing Project, St. Lawrence Co.
The Chippewa Bay Fish & Game Club has been involved in a cooperative northern pike rearing project with NYS DEC Region 6 since 2001. The 5 year experimental program was intended to produce northern pike fry, from local broodstock, for stocking into waters within Chippewa Bay. NYS DEC captured broodstock and fertilized eggs while the sportsman group provided a rearing facility. This is the final year of the project.

A total of 6 quarts (~475,000 eggs) were collected over the April sampling period. Hatching success was poor with total production of swim-up fry between 20,300-21,200. Fry were stocked at both Oak and Rabbit Island at a rate of 9,500 and 11,000 respectively. Seining was done at the end of July in both stocked embayments, and control sites, to evaluate stocking success. The seining technique used has been developed over approximately 20 years of esocid work on the St. Lawrence River.

No YOY northern pike were collected in either stocked or control embayments in 2006. It has been difficult to detect any increase in number of YOY pike in stocked sites throughout this project. In several cases it may be a result of stocking fry too early due to problems in the hatchery system (fungus, temperature, etc.). Capture of YOY pike tended to reflect background year class development, regardless of fry stocking.

While this seining effort focused on northern pike, densities of other esocids are also noted for community comparison. Muskellunge YOY have been previously collected in the area but were lacking in 2006. Adult muskellunge are a low density top predator in the St. Lawrence River. Disease outbreaks in 2005-06 from VHS removed a significant number of adult fish and will likely have an impact on future recruitment of this species.

Grass pickerel have become very common in the Thousand Islands region and are typically the highest density esocid in our seining efforts. Information from the early to mid 1980's (SUNY ESF) rarely reported this species. Possible changes in the river related to long term habitat and environmental changes may have created conditions favoring this species over other esocids. In 2006 there seemed to be a noticeable decline in the total number of grass pickerel, YOY to adult, as compared to the previous four years of seining.

Region 7

Susquehanna River American Shad Stocking and Restoration Update

Bureau of Fisheries staff in Cortland and Albany represent New York State on the Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC) which includes natural resource agencies from Pennsylvania and Maryland as well as the U.S. Fish and Wildlife Service, National Marine Fisheries Service, and the Susquehanna River Basin Commission. The aim of the cooperative is to restore self sustaining populations of anadromous (shad and herring) fish species throughout the watershed.

As part of the restoration effort regional fisheries staff again assisted with the stocking of American shad fry in the Susquehanna River. On June 20, 2006 approximately 230,350 fry were picked up at the Pennsylvania Fish and Boat Commission's VanDyke Fish Hatchery and stocked in the river at Apalachin and Binghamton. This was the fourth year of a five year experimental American shad stocking program in the New York portion of the Susquehanna River drainage. Because of record high river flows just days after the stocking no effort was made by staff to collect juvenile shad in the early fall.

In recent years, results of the ongoing restoration effort have not been promising. After two decades of increasing numbers of American shad at Conowingo Dam, the first of four hydroelectric dams on the lower river, runs have declined over the past few years. In 2006, only 60,800 American shad were passed which is the lowest total since 1998. Declining numbers of American shad have been reported by natural resource agencies up and down the Atlantic coast indicating it is not a problem confined to the Susquehanna River. Increased shad harvest in the open ocean fisheries is the suspected reason for the coast-wide decline in American shad populations. Increased numbers of hickory shad, a close relative of the American shad, at Conowingo and along most of the Atlantic coast provide evidence for this theory. Unlike American shad which venture farther out to sea, hickory shad generally tend to stay close to the coast and thus are not vulnerable to the open ocean fishery.

Egg collections for the American shad restoration effort were down in 2006 which resulted in a reduced number of shad fry for stocking. Future egg collections are in jeopardy due to declining numbers in the Hudson River which has historically accounted for 50 - 75% of the total fry production.

Proposed Dam on the Susquehanna River

Staff attended public and agency meetings and provided numerous written comment in opposition of a proposed inflatable dam on the Susquehanna River in Wilkes-Barre. The proposed dam would create a seasonal recreational pool for boaters in the Wilkes-Barre area. Agencies opposed to the structure include the Pennsylvania Fish and Boat Commission, Pennsylvania Department of Natural Resources, and the U.S. Fish and Wildlife Service. The primary concerns of the agencies and other private groups include impacts to water quality and concerns over inadequate fish passage for river resident and anadromous fish species. The overwhelming opposition of both the environmental agencies and the general public may well result in the denial of a permit to construct the dam, but a final decision has not yet been made.

Susquehanna River June 2006 Flood Response and Post Flood Assessment

Flooding in June 2006 reached record levels and was classified as a 200 year to 500 year event in many areas of the drainage in New York. Several members of the Region 7 Fisheries staff assisted with the flood control efforts mounted by the DEC flood control unit and area municipalities. Hundreds of millions of dollars in damages were averted as a direct result of the flood control devices that are maintained and applied by DEC staff. Not all residents were so lucky and humans and wildlife both paid a toll. However, post flood visual surveys along the Susquehanna River corridor in Broome and Tioga County revealed no signs of mass fish mortalities. Although water quality was certainly compromised during the flood it appeared that most of the river's fish were able to make it through okay.

Region 9

Buffalo Harbor and Upper Niagara River Muskellunge

Muskellunge fishing quality in both the Buffalo Harbor and the Upper Niagara River has declined significantly in recent years. Angler cooperator catch rates in the Buffalo Harbor declined approximately 80% from a very robust 0.10 muskellunge per hour in the mid 1990s to 0.02 muskellunge per hour in the mid 2000's. The decline in the Buffalo Harbor was also associated with diminished opportunities to catch trophy 50+ inch muskellunge, which was a popular characteristic of the fishery. Similarly, angler co-operator catch rates declined approximately 50% during the same period in the Upper Niagara River. The reasons for the decline are not known, but are believed to be due to environmental changes in Lake Erie, primarily related to declines in aquatic productivity.

In Fall 2006, Region 9 Fish Unit conducted electrofishing surveys of YOY muskellunge nursery habitats to compare abundance with that observed during the early 1990's. In the Buffalo Harbor, there was no clear trend in young muskellunge abundance; however, young muskellunge have never been abundant in shallow, weedy habitats in the Buffalo Harbor during our surveys. In the Upper Niagara River there was a 78% reduction in YOY muskellunge at sites sampled in 1992 and 2006. There was a 61% reduction at sites from 1993 to 2006. This information suggests that production of young muskellunge may be substantially reduced, especially in the Upper Niagara River.

Other interesting results of the muskellunge survey were that YOY largemouth bass abundance was very high, adult rudd abundance increased and overall abundance of young fish in nursery areas was reduced. At two sites where muskellunge were abundant in the early 1990s, habitat conditions had changed making them less favorable for young muskellunge. The YOY results were snapshot results , not based on annual updates, therefore the surveys will be continued in Fall 2007.

During 2007, researchers from SUNY Environmental Science and Forestry will be working in the Buffalo Harbor and Niagara River to help better understand the dynamics of this changing muskellunge resource.

Young-of-the-year muskellunge

Niagara River tiger muskellunge

Coldwater Streams

Region 1

Infectious Pancreatic Necrosis (IPN) found in Connetquot River State Park Hatchery

As part of the Department's response to VHS, Bureau of Fisheries staff collected fish from the Connetquot River State Park Hatchery in December 2006. The fish were tested for VHS and a suite of other fish diseases including IPN. In the sample from the Connetquot River State Park Hatchery, 38% of the brown trout, 38% of the brook trout, and 20% of the rainbow trout tested were positive for IPN. These tests were confirmed by an independent laboratory. This is a very high level of infection. IPN is a serious disease that primarily effects trout and salmon in hatchery, pen rearing or other high density environments. It can cause high mortality within affected populations. There is no human health risk for IPN. The Emergency Regulation, Part 188 of Title 6 of NYCRR regarding fish health inspections in place at the time of sampling stated that fish testing positive for IPN could not be stocked into the waters of the State of New York. Because of the presence of IPN in the fish in the Connetquot River State Park Hatchery, the stocking permit for the hatchery was revoked.

The Connetquot River State Park Hatchery is a run of the river hatchery, meaning that the river flows directly through the hatchery. This makes disinfection of the hatchery very difficult because infected fish in the river can reinfect hatchery stock. Most of the current brood stock for the hatchery resides in the river and will no longer be able to be used for hatchery production.

Bureau Fish Pathologist Andy Noyes, Propagation Section Head Phil Hulbert and Regional Fisheries Manager Chart Guthrie met with Regional State Parks staff to discuss the status of the Connetquot River State Park Hatchery on March 5, 2007. At that time revised regulations were about to be released that would allow the stocking of IPN positive fish with a permit from the DEC until January 1, 2009. At the meeting, DEC and State Park staff agreed that State Park staff would only stock Connetquot Hatchery fish below the hatchery so that potentially infected fish could not reinfect the hatchery. They also agreed to destroy all brook trout and brown trout eggs and fry taken in the fall of 2006. Rainbow trout were allowed to remain because these eggs came from a clean source. A new water source for the Hatch House that comes from a pond without trout in it would also be developed. The DEC agreed to supply brown trout to replace the ones destroyed and suggested that State Parks contact Cold Spring Harbor Hatchery to replace the brook trout destroyed. The DEC also agreed to collect and remove fish from immediately above the hatchery to keep these fish from reinfecting the hatchery and to assist State Parks with collections of fish from the river to determine the extent of the infection in the river.

Upon promulgation of the new emergency regulations the DEC issued a revised Stocking Permit to the Connetquot Hatchery allowing the stocking of fish from the hatchery only below the hatchery in the Connetquot River.

The Department stands ready to assist State Parks in any way that it can to further define the extent of the disease in the river, assist in the sterilization of the hatchery, repopulating the brood stock, and stock some waters formerly stocked by the Connetquot River State Park Hatchery.

Mill River, Oyster Bay

The Regional Fisheries Unit with the assistance of Cold Spring Harbor Fish Hatchery and Friends of the Bay conducted an electrofishing survey of Mill River in Oyster Bay. Historically the river supported naturally reproducing trout above the Mill Pond. However, no trout have been collected from this section of the river since the 1984 and none were collected in this survey. There is also a small tributary that enters the tidal section of the river via a culvert that continues to support trout. Two native brook trout were collected in the tidal section of the river and three were collected from a 100 foot section of the stream above the culvert.

Native brook trout caught from Mill River

Region 7

Limestone Creek Electrofishing Survey

This survey was conducted in cooperation with the Iroquois Chapter of Trout Unlimited (TU) to create a baseline data set prior to their planned implementation of habitat improvement work on Limestone Creek. TU intends to narrow the channel and create better holding water for trout at several areas within the Village of Manlius. When TU completes the habitat improvement project the sites will be resurveyed in subsequent years to determine whether the trout population has responded to changed stream habitat.

Stream Reclassification Surveys

In recent years Region 7 Fisheries staff have documented numerous "unprotected" streams where wild trout populations exist and this work continued during the summer of 2006. The long term goal of this effort is to have the water quality designations of these streams upgraded to afford them protection under Article 15 of the Environmental Conservation Law. In the interim, staff developed a Geographic Information System (GIS) theme which shows the sections of streams that are candidates for upgrade. This theme was provided to Region 7 Division of Environmental Permits staff who are now using it when reviewing permit applications or handling information requests.

Region 8

Annual Finger Lakes Spring Rainbow Trout Spawning Run Surveys

Spring rainbow trout sampling occurred on four major Finger Lake tributaries: Springwater Creek (Hemlock Lake), Naples Creek (Canandaigua Lake), Cold Brook (Keuka Lake), and Catharine Creek (Seneca Lake) (Table 4). Two of the four surveys (i.e. Naples Creek and Cold Brook) are planned to coincide within one week of the April 1 trout season opener. Dates for these surveys are announced to the public in order to allow anglers the opportunity to observe and assess the current status of the trout run in anticipation of the trout opener. The Naples Creek "event" typically draws a crowd of 300-500 people. Results of the surveys are presented in the following table.

Table 4. Results of rainbow trout electrofishing surveys from Finger Lakes tributaries, Spring 2007.

Stream	Total Number	Max length (inches)	Max weight (pounds)
Springwater Creek	2	24.3	6.3
Naples Creek	79	26.2	7.6
Cold Brook	3	20.5	3.2
Catharine Creek	196	29.1	10.8

Except for Catharine Creek, numbers collected were similar to last year. In order to increase the number of fish handled, Catharine Creek was sampled for two days. General observation indicate that fish were in good condition and generally larger in size. Numerous fish were encountered in Catharine and Naples Creeks. Based on continued cold weather and a late thaw and fish condition, it appeared that sampling occurred during the early portion of the spring spawning run. Only three rainbow trout were collected in Cold Brook and continues a decreasing trend in recent years. Stream conditions (i.e. blockages and poorly defined stream channel) in the lower portion of the creek may be impacting spawning runs and will be evaluated this spring.

Catharine Creek Rainbow Trout Production Survey

A total of 10 sites were sampled during the week of August 21, 2006 to evaluate rainbow trout production in Catharine Creek. The creek was last surveyed in 1997 following extensive flooding and stream clearing work. Since that time stream habitat restoration including bank stabilization, pool diggers, and channel shaping has occurred. Preliminary results suggest a significant decrease in the production of rainbow trout young-of-year in 2006 compared to other years. Standing crop of young-of-year and age 1+ rainbow trout averaged 735/ac and 60/ac. For comparison, the next most recent survey in 1997 yielded a standing crop of young-of-year and age 1+ trout of 3,503/ac and 181/ac. Reasons for the decrease are unclear at this time and may warrant further investigation. However, 1997 was one of highest standing crops reported in all of the surveys during the 1960s and 1970s. Potentially, the warm winter that occurred in 2006 and the lack of any significant rainfall during the peak spawning period may have resulted in a smaller than normal spring run of adults and therefore limited production of young-of-year trout.

Oatka Creek Electrofishing Survey Report Completed

The report for this long term project was completed and submitted for Bureau review. The abstract is:

Oatka Creek is a high quality western New York trout stream. One section of the stream is managed for wild, naturally produced brown trout with restrictive harvest regulations. The trout fishing regulations in a portion of the wild area were changed from a high size and low creel limit to a no kill regulation on October 1, 2000. Baseline biological surveys were conducted in early fall 1998, 1999, and 2000. Post-regulation change surveys were conducted in fall 2001, 2002, and 2003. The surveys were designed to determine the success or failure of the no kill regulation in achieving the objective of increasing the number of wild brown trout that are greater than 14 inches. Electrofishing stations were set up at five experimental sites within the no-kill area and two control sites outside the no kill area. Brown trout cpue, length and age frequencies, mean adult standing crop, number of adult brown trout per mile by age group, number of brown trout greater than 14 inches (356 mm) per mile, and adult brown trout mean length at age were estimated for each station. Adult brown trout post-season standing crop estimates varied considerably between sites and years at both the experimental and control stations. The no kill regulation did not have any affect on wild brown trout biomass. Age 1 and 2 brown trout showed considerable and similar annual variability at both the experimental and control sites. Generally, the density of one and two year old brown trout remained stable at the experimental and control sites after the imposition of the no-kill regulation. Age 3 brown trout declined in the study areas after the imposition of the no-kill regulation. Age 4 trout showed a slight, yet significant increase (Student's two sample t, P=0.022) in density at the experimental sites and did not appear to show any changes in density at the control sites following the imposition of the no-kill regulation. Brown trout greater than 14 inches in total length increased significantly (Student's two sample t, P=0.053) in density at the experimental sites and declined in density at the control sites following the imposition of the no-kill regulation. Despite the wide variability in brown trout density in both pounds per acre and numbers per mile, growth appears to have been stable at both the experimental and control sites.

Region 9

CROTS

It has been over 15 years since the Bureau instituted the updated trout stream stocking policy called CROTS (Catch Rate Oriented Trout Stocking). Region 9 has made a concerted effort to resurvey stocked trout streams for the second time using CROTS methodology. The primary objective was to determine if the streams could support a recreational trout fishery and if stocking was necessary to achieve this objective.

Small wild trout streams

In 2006, seven small unstocked streams in Cattaraugus County were sampled to check for the presence of reported or already known wild trout populations. In these streams, five wild brook trout populations were found and two wild brown trout populations were found. Of these streams, four had never been sampled before.

Wiscoy Creek

Wiscoy Creek in Wyoming and Allegany Counties was surveyed in August 2006 at nine sites. A tenth site was scheduled to be surveyed, however; high flows did not allow sampling at that site. Wiscoy Creek is considered to be Region 9's premier wild brown trout fishery and the stream has been sampled extensively since the 1940s. The stream has not been stocked with trout since the early 1970s. Sampling was last done in 2001, when electrofishing and an angler diary program occurred. Six of the nine sites done this year were in the same locations as those sampled in 2001.

Wiscoy Creek

In this year's sampling, a total of 1,293 yearling and older wild brown trout were captured, yielding an estimated population of 1,406 yearling and older trout. First run capture efficiencies ranged from 54% to 90% and were directly related to stream flow and depth of sampling site. The estimated density of yearling and older wild brown trout averaged 1632 fish/mi and ranged from 1254 fish/mi to 2602 fish/mi. The biomass of yearling and older wild brown trout averaged 128 lbs/ac and ranged from 73 lbs/ac to 266 lbs/ac depending on location. Legal size brown trout (>10 in) comprised 27% of the late summer population, with a density of about 446 trout/mi in 2006. Brown trout >12 in made up 6% of the population while trout >14 in represented 1% of the population in 2006. Late summer yearling wild brown trout averaged 6.8 in, while two year old wild brown trout averaged 9.8 in. These are considered good growth rates for brown trout in New York State. The North Branch and Trout Brook also both supported substantial wild brown trout populations. Fifty six angler diarists reported catching 1,381 brown trout, yielding an average catch rate of 1.34 fish/hr, which is very consistent with those found in 2001 and 1997. Water temperatures were found to get well into the mid-to upper 70s on many occasions at most sites in June, July and August 2006, without apparently having substantial negative impacts on the wild brown trout population.

Wiscoy Creek brown trout

Wiscoy Creek continues to provide anglers with the opportunity to fish over one of the most dense populations of wild brown trout in New York State. The stream is not known for producing large trout due to the high number of fish overall, however a 19 inch fish was captured in this years survey. Anglers have abundant access to this 22 mile long stream with 12.5 miles of public fishing easements, 11 angler footpaths and three angler parking areas. Other areas are open by landowner permission.

Spring Brook

On July 17th, 2006, staff sampled the brook trout population in Spring Brook, located in the Village of Springville, Erie County. This stream had not been sampled since 1992. The stream is unique in Region 9. Wild brook trout are the only salmonid occupying the stream and it is the largest, high fertility stream brook trout are found exclusively in. The stream averages 14 ft in width, with a flow at the time of sampling of 8-10 cfs. In the 1992 survey, there were an estimated 26 lbs/acre of yearling and older wild brook trout (257/mile) in the stream. In this year's survey, we found an estimated 18 lbs/acre of yearling and older wild brook trout (199/mile). The largest brook trout collected was 10.6 inches, however seven of the 31 adult brook trout captured were greater than nine inches. Because of its fertility, this stream has the potential to produce more larger brook trout than most others where they are found in the region. This stream should be able to produce many more brook trout than our surveys have found and there are several limiting factors that need to be addressed. The first limiting factor is water temperature. In the afternoon of the survey, with air temperatures in the low 90s F, we recorded water temperatures at our lower and upper sampling sites of 72°F and 74°F. We recorded temperatures at two bridges above our upper sampling site and found temperatures of 74° at those sites also. High water temperatures are likely due to loss of shade where the stream runs through a golf course, a dairy farm and also due to several large beaver ponds on the upper stream. The second limiting factor is siltation, likely due to beaver activity and poor land use practices throughout the watershed. The wild brook trout population in Spring Brook is a unique resource in Erie County and Region 9 that needs further monitoring, rehabilitation and protection.

Twenty Mile Creek

On July 19, 2006 Region 9 Staff, assisted by the Lake Erie Fisheries Unit, sampled the trout population in Twenty Mile Creek, located near Ripley in western Chautauqua County. The survey was done to evaluate the trout stocking policy in the stream and to evaluate steelhead reproduction known to occur here from fish running from Lake Erie. Based on a survey done in 1991, Twenty Mile Creek is recommended to be stocked in mid-April with 1,100 yearling brown trout over 3 miles from County Route 9 upstream to County Route 6. The stream between these two roads runs through an inaccessible gorge, thus all trout are stocked at these two sites. The lower sampling site was located about 5 miles above the state line (the lower several miles are in Pennsylvania). This lower 5 miles flows through a largely inaccessible gorge with at least two rock formations that may at times act as barriers to steelhead migration. From a regulatory standpoint, Great Lakes tributary regulations apply up to the first barrier (considered to be near Gage Gulf (T-3)), with inland regulations applying in the stocked section.

Two sites were electrofished in this survey. Site one was located 550 feet below the County Route 9 bridge. Three yearling and one hold-over two year old stocked brown trout were captured at this 557 foot site. We also captured 180 YOY rainbow trout, 18 yearling and two year old rainbow trout and eight other species of fish. The average stream width at this site was 33 feet and the flow was 4.2 cfs. At 10:30 am with 77°F air temperature the water at site one was 70°F. At site two, located on the upstream side of County Route 6, we collected two hatchery yearling brown trout and a wild yearling rainbow trout. Eight other fish species were captured at this site. Just below our site there was a large culvert pool that was too deep to shock, but likely held a number of stocked brown trout and perhaps some yearling or older rainbow trout. The average width at site 2 was 18 ft. At 1:00 pm with 79°F air temperature, the water at site two was 73°F.

Considering that all 1,100 yearling brown trout are stocked at the two sites we electrofished, it does not appear there is significant survival of the stocked trout into the summer on this stream. Whether this is due to high fishing pressure or to high water temperatures is not clear. On opening day in 2002, the author conducted a drive-by survey of angler use in Chautauqua County. At mid-morning six cars were counted at the County Route 9 bridge, with none seen at the County Route 6 bridge. The stream was not stocked until later in April. It is likely that those anglers were there to fish for steelhead, not stocked brown trout. No survey was conducted of the use after stocking.

The wild trout population in this stream is very poorly understood. Based on the age structure of the rainbow trout found in our survey, it is highly likely that the trout in this stream are the migratory steelhead form, not the resident rainbow trout form. At site one 180 YOY were captured, with only 15 yearling and three two year old rainbow trout captured. No three year old (spawning age) trout were captured. Based on findings in streams with resident rainbow trout, there should be significantly more age two and three trout captured in a stream capable of producing the number of YOY we found. We estimated our efficiency on capturing YOY at 25%, however based on the cobble substrate and the abundance of smaller minnows, the efficiency may have actually been lower. At 25% efficiency, the 180 YOY captured expands to an estimated 6,857/mile. If this site is representative of extensive areas of this creek, the potential for the stream to be producing steelhead smolts is impressive. In the 1991 survey at County Route 9, 45 YOY rainbow trout were captured in 600 ft. The estimated efficiency for them in that survey was 60%, thus an estimated 658/mile of YOY rainbow trout were present that year. If a similar efficiency of 25% was applied to the 1991 catch, there would have been an estimated 1,579 YOY per mile.

It seems fairly clear, that at least in most years, significant numbers of steelhead are able to pass what is regulated as the upstream barrier to fish. It is also likely there is a largely (but not completely) impassible barrier to steelhead in the gorge between County Routes 9 and 6. Only the single yearling rainbow trout was captured at the upper site in this year's survey and only one yearling and two young-of-year rainbow trout were captured in the 1991 survey. Another possibility for the lack of rainbow trout at the upper site is that spawning habitat or water temperatures are limiting. The gorge section between the two county roads needs to be walked to determined if there is a likely barrier in that section.

Why the rock formations above Gage Gulf were ever chosen as the "barrier impassible to fish" is uncertain. In 1966, biologist Carl Widmer reported that rainbow trout from Lake Erie were able to make it upstream as far as County Route 9 and that catches of wild 6-7 inch rainbow trout were common in the spring at that site. A 1951 survey at County Route 9 listed young rainbow trout as abundant and recommended that the stream from the state line to T-17 be managed as NSA (natural spawning adequate) for rainbow trout that migrated upstream from Lake Erie. This was likely before New York or Pennsylvania were stocking steelhead into Lake Erie, but these were likely the wild steelhead form of rainbow trout. Consideration should be given to managing the entire stream, or at least the stream up to whatever barrier may be between County Routes 9 and 6 under Great Lakes tributary regulations. If this is done, the stocking policy should be eliminated or reduced to include only the area one half mile above and below County Route 6.

Vandermark Creek

Vandermark Creek is located in south central Allegany County and is tributary to the Genesee River. The stream averages 15-20 ft in width, has a bottom of cobble and gravel with some silt, and has an average summer flow of about 1-3 cfs. The watershed is mostly a mixture of abandoned farmland and small woodlots, with 2,384 ac of state forest in the headwaters. A 5 mile section is stocked with 1,200 yearling brown trout annually (240 per mi). There are no Public Fishing Rights on Vandermark Creek, however the upper 1.5 miles of the stocked section are on the state forest land.

An electrofishing survey at 4 different sites in August 2006 found that about 25 stocked yearling brown trout per mile remained from the original spring stocking. No holdover brown trout from previous years' stockings were collected. Additionally, we found a number of yearling brook trout that did not come from state hatchery fish. Perhaps they escaped from a nearby farm pond or someone may have purchased some fish to stock in the stream. Yearling brook trout were stocked in the nearby Genesee River and perhaps someone caught the fish there and moved them to Vandermark Creek. There was no permit issued for anyone from the public to stock fish into Vandermark Creek and we need to do a better job of educating the public regarding why fish should not be moved from one water to another or stocked without a permit from the DEC, especially with the recent discovery of VHS disease.

The upper half of Vandermark Creek also has a small, native brook trout population. Most of these fish are found in waters on the state forest land and the adult population averages 50-100 fish per mi. After this survey, management will remain the same and Vandermark Creek will annually receive 1,200 yearling brown trout.

Stony Lonesome Hollow

Stony Lonesome Hollow is a tributary to Honeoye Creek and is located in the town of Alma in south central Allegany County. The stream has a cobble, gravel substrate with some larger boulders, an average width of about 8 ft and a normal summer flow of about 1 cfs, although when surveyed in July of 2006 after recent rains the flow was estimated at 4 cfs. The watershed is mostly forested, with logging, oil and gas extraction, and recreation being the main land use activities. During the July survey, it was estimated that there were about 450 adult native brook trout per mile of stream. This compares to an estimated 475 adult fish per mi during a 1999 survey. Both YOY brook trout and brown trout were collected during the 2006 survey, although no adult wild brown trout were seen. In the 1999 survey, the adult wild brown trout population was estimated at about 50 fish per mi. There are no Public Fishing Rights on Stony Lonesome Hollow and most of the stream is posted. Anglers will have to get landowner permission to fish this small, scenic wild brook trout stream.

Orebed Creek

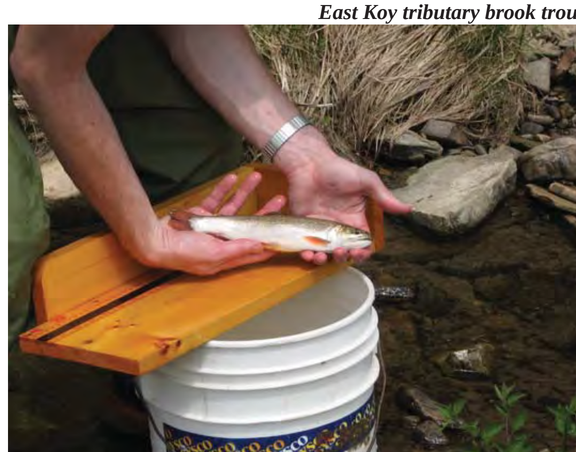
Orebed Creek, tributary to Marsh Creek and ultimately the Genesee River, is located in the town of Willing in south central Allegany County. The stream has a cobble, gravel bottom with some boulders, averages about 8 feet in width and has a summer flow of about 0.5 cfs. The watershed is mixed forest, however there are impacts to the stream from oil and gas production as well as logging. An electrofishing survey was done in June 2006 to monitor the native brook trout population. In late June, it was estimated that there were about 790 adult brook trout per mi of stream. A 1999 survey estimated the brook trout population at 800 fish per mile while a 1992 survey estimated the population at 350 trout per mi. The largest brook trout collected in 2006 was 10 in. The flow was high during the 2006 survey, estimated at 10 cfs and influenced by recent rains. Few YOY brook trout were collected but this was likely due to decrease efficiency because of high flow as well as being early in the summer and the young being of small size. There are no Public Fishing Rights on Orebed Creek and most of the stream is posted. Anglers will have to ask landowner permission to fish this small, scenic native brook trout stream.

Redwater Creek

Redwater Creek, tributary to Marsh Creek and ultimately the Genesee River, is located in the town of Alma in south central Allegany County. The stream has a cobble, gravel substrate with boulders and bedrock in the upper part, and boulders and silt in the lower section. The stream has an average width of 6-8 ft and an average flow of 1 cfs. During an electrofishing survey in July 2006, the stream had a width of 12 ft and a flow of 10 cfs due to recent, heavy rains. The watershed is mostly forested. Logging, oil and gas extraction, and recreation are the main land uses. In July 2006, the wild brook trout population was estimated at 300 adults per mi of stream. There has been a dramatic increase in the wild brook trout in the past 20 years. The brook trout were virtually extirpated in the late 1980s due to illegal brine discharges from oil and gas operations. Upon compliance with DEC regulations, the population returned to a level of about 75 adult fish per mi in a 1999 survey, and now to about 300 per mi.

Unnamed tributary 2 of Redwater Creek was also surveyed in July 2006. It was estimated that there were about 365 adult wild brook trout per mi of stream which was almost the same as an estimated population of 360 adult fish per mi during a survey in 1999. There are no Public Fishing Rights on either Redwater Creek or tributary 2 and most of the streams are posted. Anglers will have to get landowner permission fo fish these small, productive wild brook trout streams.

East Koy tributary brook trout



Two-Story Lakes and Ponds

Region 4

Otsego Lake

Otsego Lake is a 4,226 ac natural lake in Otsego County that is the source of the Susquehanna River. The lake is primarily known for its coldwater fishery, primarily wild and stocked lake trout. The lake is also stocked with brown trout and landlocked Atlantic salmon. In September 2006, five 450 ft long gill net gangs were set overnight at standardized sites to monitor lake trout abundance. This was the 21st such netting since 1969.

The 2006 netting effort resulted in the capture of 104 lake trout ranging in size from 7.3 to 31.9 in with 27 lake trout legal (≥21 in) size. Of the 104 lake trout collected, 78 were wild fish and 26 were fin clipped hatchery fish. The catch of 20.8 lake trout and 5.4 legal lake trout per net were both record catches which suggests that the current lake trout population is at a record high. It is not known if the current high population is sustainable or the result of increasing lake trout abundance that began around 1992.

The current high population can probably be attributed in part to the unauthorized introduction of alewives into the lake sometime in the late 1980s. Alewife were first collected in 1988 and were abundant by 1991. In the pre-alewife period (1969-86), the catch of lake trout ranged from 3.0 to 7.7 fish per net compared to 9.2 to 20.8 fish per net since 1992. The pre-and post- alewife catch rate averaged 4.9 and 12.9 lake trout per net, respectively. The quality of the lake trout population has also improved over the last 40 years. From 1969 through 1986, the catch of lake trout 21 in and larger ranged from 0.1 to 0.9 fish per net compared to the 1.8 to 5.4 fish per net since 1992. This represents an eight fold increase from the average of 0.4 legal fish during the pre-alewife period compared to 3.2 legal fish per net in the post alewife period.

Although the unauthorized introduction of alewife has benefitted the lake trout population, the cisco and lake whitefish populations have declined to very low levels. The on-going fingerling walleye stocking program in the lake will not result in a self sustaining fishery because of alewife predation on the newly hatchery walleye which remain suspended in the water column for six to eight weeks before swimming to the bottom. During this pelagic phase, the entire year class of walleye can be eliminated because of the intense predation by alewife.

Region 5

Lake Champlain Lake Trout and Salmon Restoration

Work on Lake Champlain continued to be dominated by efforts to reestablish landlocked Atlantic salmon and lake trout by controlling the very abundant fish parasite, sea lamprey. These management activities are conducted in partnership with the Vermont Department of Fish and Wildlife, and the U.S. Fish and Wildlife Service.

Increased Federal role sought for sea lamprey control in Lake Champlain

The Lake Champlain Fish and Wildlife Management Cooperative held a Policy Committee meeting and a public meeting on April 11, 2007 to review the status and future of Lake Champlain sea lamprey control. The Cooperative includes the New York State Department of Environmental Conservation, the Vermont Department of Fish and Wildlife and the United States Fish and Wildlife Service. Staff from the Great Lakes Fisheries Commission also attended the meetings, and provided valuable expertise from the Great Lakes lamprey control program. The current control effort in Lake Champlain is not achieving the desired level of benefits for salmonids and other fishes. Lamprey attack rates remain very high on lake trout and salmon. Also, returns of salmon to spawning rivers are poor. Based on the meetings, the Cooperative will pursue shifting certain aspects of the program from the states to the Fish and Wildlife Service. Doing so would be consistent with how lamprey control is conducted in the Great Lakes. However, additional Federal funding will be required prior to switching to the Great Lakes model. The public meeting improved many people's understanding of this complex program. More than 100 stakeholders, plus agency staff, Congressional staff, and press attended the public meeting. Many attendees made statements, and a great diversity of concerns and interests were raised. Also, the attendees asked many questions of the two states, the Fish and Wildlife Service, and the Great Lakes Fisheries Commission.

Sea lamprey abundances and impacts remain high in Lake Champlain

Sea lamprey continue to have severe impacts on their preferred food source, lake trout and landlocked Atlantic salmon. One measure of lamprey impacts is the number of wounds per 100 salmon and lake trout; those wounding rates were very high during 2006 (Table 5). Certain lamprey producing tributaries are presently not being treated, and control needs to be expanded to those tributaries if the lake-wide objectives are to be achieved. One such tributary is the Pike/Morpion system in Quebec. The US Fish & Wildlife Service is working on a lamprey barrier to help control production in that system. Vermont and New York are progressing towards treating the Poultney River (see discussion below). Other tributaries in Vermont remain a problem with a need for permits to conduct treatments.

Table 5. Wounding rates on Lake Champlain lake trout and salmon

Species	Number of lamprey wounds per 100 fish						
	Objective	Pre-control	Eight-year control	2003	2004	2005	2006
Lake trout	25	55	38	90	62	94	98
Landlocked salmon	15	51	22	86	45	54	71

Several treatments conducted to control sea lamprey

Sea lamprey control treatments were completed on Putnam Creek, the Salmon River, Little Ausable River and Ausable River in New York, as well as Lewis Creek in Vermont during the fall of 2006. Post-treatment sampling revealed that all treatments except the Ausable River were successful in reducing sea lamprey number by 95% or better. On the Ausable River, the treatment achieved only an 86% reduction in larval sea lamprey numbers. An estimated 648,500 sea lamprey larvae were in the Ausable River prior to the fall treatment, and about 89,000 survived the treatment. The vast majority of these sea lamprey (about 80,000) were in the south fork of the Ausable River. Because of the high density of sea lamprey in the south fork, a spring treatment was conducted on that fork. Biologist Lance Durfey, obtained the necessary permit modifications and approvals, and the South Fork was treated with TFM on May 31, 2007 .

The Poultney River, on the border of New York and Vermont is a major sea lamprey producer that has not been treated since 1996. Sampling of the Poultney River in 2006 revealed that the river has an estimated population of 158,000 sea lamprey larvae. Treatment of the Poultney River was postponed for five years following initiation of the long-term sea lamprey control program in 2002. The five-year delay was to allow for the exploration of viable control alternatives to lampricides, and to see if sea lamprey wounding rate objectives for lake trout, landlocked salmon and walleye could be achieved without treatments on the Poultney River. Unfortunately, wounding rates are the highest since sea lamprey control began in 1990, and are far above the established target rates. Nor have viable treatment alternatives to lampricides been developed. However, we have been able to conduct extensive toxicity testing on the non-target organisms of special concern in the Poultney, and results indicate that by using a slightly lower target TFM concentration relative to most other river systems, we can conduct an effective treatment without endangering even the most sensitive non-target organisms tested. Expectations are to treat the Poultney in the fall of 2007. In preparation for that treatment both New York and Vermont are pursuing required permits in each state.

Landlocked salmon with lamprey wound

Toxicity testing

Lampricide toxicity testing, essential for obtaining necessary treatment permits, was completed on two species in 2006. Cylindrical papershell mussels were tested and found to be very resistant to TFM, with a NOEC (No Observed Effect Concentration) of 2.6 times the MLC (sea lamprey minimum lethal concentration). Similarly, when eastern sand darters were tested, they were found to be relatively resistant to the TFM/Niclosamide mixture, with an NOEC of 1.6 times the MLC.

Lake trout abundant, salmon scarce in Lake George

Fisheries staff Emily Zollweg, Matt Presher, Jennie Sausville and Dan DeSorcy set trap nets at Hague, Indian Brook, and Shelving Rock Brook to evaluate landlocked salmon in Lake George. Among the hundreds of lake trout and dozens of largemouth bass caught, there were ten salmon. Nine of the salmon were mature and healthy fish. Five of the ten were advanced yearlings stocked in the fall rather than in the spring. The lake trout continue to be numerous and healthy, and some very nice largemouth and smallmouth bass were caught as well.

A Lake George landlocked salmon

Annual egg take for Adirondack strain lake trout

Each year Fish Culture Staff and Region 5 Bureau of Fisheries personnel join forces to collect lake trout eggs from Raquette Lake in Hamilton County. These eggs are reared at the Chateaugay Fish Hatchery and the resulting lake trout are used to stock Adirondack waters. The 2006 Raquette Lake operation went especially well. With a more normal fall weather pattern than it has experienced in recent years, the fish spawned "on time" and 210,000 lake trout eggs were collected in one week's effort. The crew leader was Dave Armstrong from Chateaugay Hatchery. He was assisted by Brian Ward and Bruce Hubbard from Caledonia Fish Hatchery and Lauren Watson from VanHornesville Fish Hatchery. Regional staff consisted of Aquatic Biologists Leo Demong and Matt Presher, as well as seasonal Fish and Wildlife Technician Jacob Gnann. The nets were set on October 11, 2006 and the run peaked on October 18, 2006 when more than 60,000 eggs were collected. B. Hubbard was the chief egg taker. His proficiency was reflected in the exceptional egg quality. The initial pick off was 7% compared to an average initial mortality of 12 - 14%. The low mortality rate is notable because this year the eggs were allowed to water harden in a disinfectant solution, in an effort to minimize the possibility of vertical transmission of VHS, a fish disease of concern. It appears that this process was not detrimental to early egg survival.

Sagamore Lake Surveyed

Sagamore Lake (166 ac) is in the Town of Long Lake in Hamilton County. Most of Sagamore Lake borders on the Blue Ridge Wilderness and the recently-approved Unit Management Plan for that area called for updating the status of the fish community. Sagamore Lake was last surveyed in 1986. It has naturally sustained brook trout and lake trout populations. The 2006 survey included five gillnets set for salmonids and suckers, plus four smaller minnow nets and minnow traps. Lake trout, white sucker and longnose sucker were abundant in the gillnets. However, the lake trout were small - ranging from 11-17 in. The brook trout population seems reduced from historical levels. Moderate numbers of yellow perch, brown bullhead and pumpkinseed were caught along with a single smallmouth bass and single lake whitefish. All of the species caught in 2006 have been noted in past surveys - no new fish species were noted. Sagamore Lake has a maximum depth of 70 ft and excellent dissolved oxygen levels at all depths. Staff noted beaver activity and deadfalls may be blocking access for brook trout to the lake's main tributary. Scale aging will be conducted this winter to assess growth rates for the salmonids. Consideration will be given to reducing the size limit for lake trout and beginning a stocking program for brook trout. Sagamore Lake has roadside access, but motor use is banned.

Upper Saranac Lake Surveyed
Upper Saranac Lake in Franklin County (4,775 ac) is stocked annually with lake trout, rainbow trout and brown trout and also supports a good warmwater fish community. Lake trout are the most commonly sought coldwater species. Little has been heard in recent years from anglers about rainbow and brown trout fishing. Fisheries staff set suspended gillnets at 15 sites around the lake. The nets were set in the thermocline and sampled strictly from 20-35 ft. Nearly every site yielded rainbow smelt - a good indication they were fished at the appropriate depths and temperature. No rainbow trout or brown trout were caught. But surprisingly, five landlocked salmon averaging around 16 in. in length were netted along with some nice-sized lake trout. The salmon are probably migrants from lakes further up the watershed such as Lake Clear, Fish Creek Ponds, or Follensby Clear Pond. Rainbow and brown trout stocking were terminated based on the survey results. Upper Saranac Lake was stocked with landlocked salmon prior to the rainbow and brown stocking. That policy was ended due to outmigration of the salmon and poor growth rates.

Fawn Lake lake trout surveyed
Fawn Lake (290 ac) in the Town of Lake Pleasant, Hamilton County, has a self-sustaining lake trout population that has been maintained by restrictive special regulations. Fawn Lake is surrounded by state land and can be accessed only by foot. However, it is a popular fishery, especially late in the ice fishing season. Reports of large numbers of anglers this winter and diminished catch rates for lake trout prompted a netting effort. Three juvenile gill gangs were set in the preferred temperature range of lake trout. A good catch rate of 10 lake trout per gang was found (30 trout total). However, only three lake trout were above the 18 in minimum size limit for Fawn Lake. Additional analyses will determine whether over harvest is accountable for the low number of legal lake trout or if the slow growth rates observed in the past are still occurring. If over harvest is occurring, additional restrictive regulations may be proposed to maintain this native lake trout population.

White perch illegally introduced in Great Sacandaga Lake
The presence of white perch in Great Sacandaga Lake was confirmed when a Department employee identified a white perch caught by his son while fishing in the vicinity of Scout Island. White perch are originally an east coast estuarine species that can adapt to freshwater. White perch have invaded Lake Champlain, the Great Lakes, and many mid-western waters. It is not a native fish species in Great Sacandaga Lake. Their potential impact on the lake's resident fish population is not known. Their establishment into Great Sacandaga Lake may also open up new sections of the Hudson River (and tributaries) above Corinth for this invasive species. It is not known how white perch were introduced into Great Sacandaga Lake; however, it is possible they were either intentionally stocked or accidentally introduced with discarded baitfish.

Region 6

Portaferry Lake Survey
This was a routine survey of a two-story (coldwater/warmwater) lake. Also evaluated was the success of the brown trout stocking and the continued existence of smelt. Nets were ganged together in order to get small mesh into the depths in an effort to find the smelt but none were caught. Lake trout and smallmouth bass populations were healthy with a decent size structure for the bass. Only one brown trout was caught, though it was a decent size. The temp/DO profile revealed good conditions for this two-story fishery to persist. Brown trout are likely not competing well for food as they do not have a strong pelagic forage base and would compete with bass and lake trout for the shallow and deep benthic forage. The stocking policy is going to be changed back to rainbow trout. This lake was previously stocked with rainbow trout and was switched to brown trout when the hatchery system was dealing with whirling disease.

Currently, public access has been provided by an FWMA agreement with the Boy Scouts of America. The camp has been closed and the property is going to be sold. The DEC is looking to acquire an easement on this property to continue to allow public access.

Sylvia Lake, St. Lawrence County
Sylvia Lake is a deep (~140 ft) oligotrophic lake in central St. Lawrence County. The lake is a two-story fishery with the primary sport fishery consisting of rainbow and lake trout. The last extensive survey of this water was in 1993.

Littoral zone habitat is lacking in Sylvia Lake due to its morphometry. Inlet and outlet areas are primarily soft bottomed with little submerged vegetation in low densities. Curly leaf pondweed, a recent invader to the lake, was encountered in a few dense mats.

Centrarchids, in particular rock bass, were the predominate fish captured in this survey. Both largemouth and smallmouth bass were collected with smallmouth dominating the catch. Habitat availability would tend to favor smallmouth as deep rock/rubble areas are located throughout the lake.

Both rainbow and lake trout were encountered in this survey. Rainbow trout are stocked annually (~3000 fish @ 9 in) whereas lake trout are self propagating. All rainbows captured appeared to be recently stocked, as most fish were from 8-10 in. in length. All lake trout encountered were relatively small with the longest fish at 22 in.

Of special interest with regards to forage is the noticeable lack of Cyprinids (minnows) in the lake. There are no historical records of minnows of any species inhabiting this water. Banded killifish were reported in 1993, but none were encountered during seining efforts. Stomach analysis of trout yielded both small centrarchids and terrestrial insects (surface feeding). A strong thermocline had set up in the lake at the time of survey. Implication that forage is limiting for Salmonids seeking suitable forage, maybe forced out of their preferred thermal range.

Rainbow smelt were stocked prior to 1930 and were last reported in 1955. One lake trout stomach had a partially digested fish which may have been a smelt. It is possible that smelt still exist in the lake at levels that are not detectable with our current sampling methodology. Slimy sculpin were reported in 1993, however none were encountered during this effort.

Freshwater jellyfish were reported in 2004. This single species of freshwater jellyfish has a global distribution. While not uncommon in New York, there documentation is sporadic and their life history is not well known.

Monitoring for aquatic invasive species should be undertaken periodically as this water appears to be vulnerable to vegetative introductions.

Region 7

Cayuga Lake Inlet Fishway Monitoring

Operation of the Cayuga Inlet fishway continued in spring 2007. A total of 141 rainbow trout, 2,983 white suckers and 1,665 adult sea lampreys were captured at the fishway. All of the white suckers were passed upstream and all the adult lampreys were killed to prevent them from reaching their spawning grounds. Thirty-four male rainbows and 41 female rainbows were held at the fishway for the production of Finger Lakes wild strain (97,000 eggs) and "hybrid" strain (36,000 eggs) rainbows. After spawning, 36 of the spawned rainbows were sacrificed for fish health inspection. The other spawned rainbows were passed upstream. No diseases were found in the rainbows inspected. All trout captured at the fishway were examined for the presence of wounds from sea lamprey attacks. No stage I-III lamprey wounds (very recent to fairly recent) were found on the four rainbow trout in our index group (500-549 mm length) and only five stage I-III lamprey wounds were found on all 141 rainbows captured. The fishway was also operated during fall 2006 to pass early run rainbows and to collect landlocked salmon for studies on thiamine deficiency at the USGS Tunison Fish Laboratory.

2006 Cayuga Inlet Deepwater Sea Lamprey Ammocoete Electrofishing Survey

On July 19, 2006, Region 7 and 8 Fisheries staff carried out a deepwater electrofishing survey of lower Cayuga Inlet below the fishway using the Department's deepwater electrofishing boat on loan from Region 5 Fisheries in Ray Brook. This deepwater electrofishing boat is a pontoon boat equipped with an electrofishing unit and pump specifically designed to shock larval lampreys (ammocoetes) out of the bottom mud where they live and pump them to the surface in water as deep as 30 ft.

Three locations consisting of good sea lamprey ammocoete habitat were sampled including a location just below the fishway where ammocoetes were collected in the past using a chemical irritant (Bayer 73). No lamprey ammocoetes were collected at any of the sampling locations. This was a fair indication that lower Cayuga Inlet was not infested with larval sea lampreys and the absence of ammocoetes at the location that was once infested was a fair indication of the success of the region's lamprey control efforts (lampricide treatments and trapping at the fishway).

2006 Cayuga Lake Tributary Sea Lamprey Nest Counts

Since 1979, sea lamprey spawning activity in Cayuga Lake tributaries has been monitored by counting the number of sea lamprey spawning nests found in index sections of Cayuga Inlet, Sixmile Creek, Cascadilla Creek, Fall Creek, Salmon Creek and Yawgers Creek. The nest count information is used to follow long term changes in spawning activity and to determine whether adult lampreys from Cayuga Lake escaped over the Cayuga Inlet fishway barrier and spawned upstream.

During the 2006 nest count surveys, 18 nests were found in Cascadilla Creek and four nests were found in Sixmile Creek. No sea lamprey spawning nests were found in Fall Creek, Salmon Creek, Yawgers Creek or Cayuga Inlet. Results of these surveys suggested sea lamprey spawning activity was very low in 2006. Similar results were noted in other recent Cayuga Lake tributary nest count surveys.

It was very fortunate that no sea lamprey spawning nests were found above the fishway in Cayuga Inlet since this stream has the potential of producing far more sea lampreys than any other Cayuga Lake tributary. The presence of sea lamprey spawning nests in Cayuga Inlet above the fishway is an early indication that escapement and spawning have occurred and lampricide treatment to kill the resulting juvenile sea lampreys may be required.

Many years of Sixmile Creek nest count data combined with Cayuga Inlet fishway and ammocoete electrofishing data suggests sea lamprey spawning in Sixmile Creek (a tributary to Cayuga Inlet entering about one mile downstream from the fishway) is influenced by the presence of sea lamprey ammocoetes upstream in Cayuga Inlet. Pheromone attractant releases from ammocoetes in Cayuga Inlet draw many spawning adult lampreys past Sixmile Creek upstream into the fishway trap. In years when there are very few or no ammocoetes in Cayuga Inlet (e.g., post lampricide treatments) spawning adult lampreys are more inclined to enter Sixmile Creek.

Bowman Lake Fish Trap and Transfer

After several requests by Bowman Lake State Park staff, a decision was made to abandon the "trout only" management philosophy which has been employed at the lake since the 1960s. This philosophy was intended to allow for optimum trout growth and survival and Bowman Lake had been "reclaimed" several times in the past to eliminate undesirable fish. However no reclamation efforts had been made in a number of years and bullhead and "sunfish" had reportedly become established and stunted. Park staff felt that the introduction of other warmwater species such as bass would provide park patrons a better chance to catch a decent-sized fish during the summer months when trout are hard to catch. Subsequently, members of the Chenango County Sportsman's Federation consulted and agreed to the proposal to abandon the "trout only" management and allow the stocking of warmwater fish into the lake provided trout stocking continue on a "put-and-take" basis.

In July 2006 fish were salvaged from a Broome County owned flood control pond along Airport Road which was scheduled to be drained and dredged. The primary target was largemouth bass but other species were also moved. We anticipate that bass will help control the stunted populations of sunfish and bullhead at the park. The numbers and types of fish salvaged from the pond and stocked into Bowman Lake was as follows: 38 largemouth bass (3 - 16 in), 213 pumpkinseed sunfish (2 - 5 ½ in), 66 black crappie (3 - 15 in), 116 bluegill sunfish (2 - 6 in), 26 brown bullhead (8 - 13 in). Although the number of bass was lower than desired, natural reproduction should allow them to rapidly expand their numbers in the next few years.

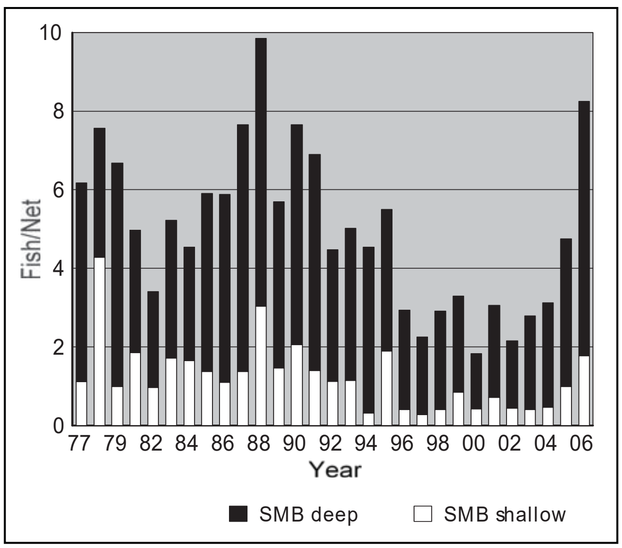
Great Lakes

Region 6

Thousand Islands

Staff completed assessment gill netting in the St. Lawrence River between Clayton and Morristown. The warmwater fish stock assessment program on the Thousand Islands section of the St. Lawrence River provides standardized indices of abundance for major gamefish and panfish stocks, information on year class strength, and age and growth relationships of these stocks. Information obtained is used to evaluate and, if necessary, modify existing fishing regulations. It also provides baseline information for evaluation of environmental disturbances. Results of 2006 sampling with the greatest management significance include: 1) Northern pike abundance continues to decline, recruitment remains relatively poor (this is probably a habitat effect) and 2) smallmouth bass abundance has been depressed but is improving (this was likely a recruitment issue that may have resulted from cold water temperatures during the spring and cormorant predation).

Figure 3. Smallmouth bass abundance in St. Lawrence River



Lake-Run Salmonids

Regional fish and wildlife staff have monitored the Black River chinook salmon run at the Dexter Fishway since 1993. Over 900 migrating salmon were examined in 2006. Monitoring of the fishway is used as a low cost, fishery independent, method of monitoring the returns of lake-run salmonids, primarily chinook salmon, steelhead, and brown trout to the Black River. With the advent of brown trout management in the lower Black River, the fishway may also serve to evaluate the presence of these fish in the river. This year the chinook salmon run was above average by the end of October. Through mid November, the steelhead run (N=32) although not near its expected seasonal peak appeared to be somewhat stronger than in recent years. The brown trout sample (25) was above average. The Black River is not stocked with coho salmon but 47, a record high number, were handled this year.

Lake St. Lawrence, St. Lawrence Co.

This survey is regionally known as the Lake St. Lawrence warmwater assessment (LSLWWA). It is an annual gillnet survey intended to provide a population index for warmwater fish species in the Lake St. Lawrence portion of the St. Lawrence River. Begun in 1983, this survey was at one time shared by NYSDEC and Ontario Ministry of Natural Resources (OMNR). This was the 23rd year of the assessment.

Thirty two experimental gillnets, stratified by depth, are deployed at standard sites in both US and Canadian waters. Biological information taken from fish includes total length, weight, sex and maturity. Scale samples are taken from centrarchids and percids while cleithra bones were removed from esocids for age determination. Small species, such as minnows and darters, are not typically sampled due to gear constraints.

A total of 18 species were collected in 2006. The total CPUE (fish/net-night) was 13.78, lower than the long term average of 16.98. Total CPUE is in large part driven by the yellow perch catch. Year class strength and predation by double crested cormorants are the principle variables which affect yellow perch numbers in Lake St. Lawrence. Yellow perch have been in decline in Lake St. Lawrence since 1988. The 2006 CUE (3.78) was down slightly from 2005 (4.44) but remains relatively stable.

Smallmouth bass CPUE (1.63) declined below the long term average of 2.38 f/n-n. This was the first significant decline in the CPUE since 1997. Juvenile bass are typically collected in low numbers, making it difficult to assess year class strength. Increased growth rates of smallmouth bass in the last five years is likely linked to round goby expansion in the area.

Walleye CPUE (1.91) was the second highest recorded for this assessment. The 2003 and 2004 year classes, which dominated last years catch, appear to remain strong. The population index tends to fluctuate on pulses of immature fish from several net sites near the Hoople Creek (Canada) nursery area. A spawning bed enhancement project for Brandy Brook (New York), scheduled for 2007, will hopefully boost recruitment further in Lake St. Lawrence.

Of interest was a single brown trout (TL=556 mm) collected in this assessment. Other salmonids collected in the past include, rainbow trout and lake trout. Pacific salmon have also been observed on fall spawning runs in Brandy Brook, a tributary to Lake St. Lawrence. While it is possible that these fish could be residents, they are likely migrants from Lake Ontario.

A full report, including age and growth related topics, is incorporated in the Great Lakes Fishery Commission's Lake Ontario Committee Report, 2006.

St. Lawrence River Cormorants

As part of the collaboration between Region 6 Fish and Wildlife and the Ontario Ministry of Natural Resources on the issue of double-crested cormorants in the St Lawrence River, four Public Open House Sessions were conducted in mid-August to give local citizens an opportunity to discuss cormorant and fisheries information and local issues with agency experts. Two sessions were held in Ontario, Canada and two were in St Lawrence County, New York, all in communities along the river. Total attendance was 82, not including members of the press or young children. Cornwall attracted 11, Massena had 3 citizens and 3 press attend, Brockville had 13 public, and Ogdensburg was the most well attended with 55 participants.

Fifteen to 17 key individuals involved in cormorant and St Lawrence River fisheries issues were present at each of the sessions, which ran from 4 pm until 8 pm. DEC and OMNR Fish & Wildlife and Law Enforcement, along with representatives of USGS and USDA Wildlife Services attended each meeting. Most had developed posters which represented the many parts of the cormorant/fisheries issues. These were displayed around the room and gave the public a lot of information to digest and which to ask questions from.

The public who came to the open houses appreciated speaking directly to staff who are involved with the issue and being able to ask questions of agency people on the opposite side of the St Lawrence River. People whose thinking stands on opposite sides of the cormorant management divide came out to the sessions and many interested citizens came simply looking for more information and to see what all the fuss was about and to form their own decisions. The staff took advantage of the extra opportunity to collaborate on cormorant, fisheries and related work topics during the times when public were not in the room and viewed this as an added bonus.

Region 7

Lake Ontario Tributary Creel Survey

A creel survey was conducted on all of the major tributaries to Lake Ontario in New York from September through April in 2005-06 and 2006-07. This is the first comprehensive survey of the New York tributaries since the 1984 Great Lakes Angler Survey. Twenty nine tributaries from Fourmile Creek in Niagara County to the Black River in Jefferson County were surveyed to estimate angler effort, catch and harvest of lake-run trout and salmon species.

Total estimated effort for all the tributaries combined for years 2005-06 and 2006-07 was 1,025,994 and 933,029 angler-hours, respectively. This translated to 226,934 (05-06) and 258,306 (06-07) angler trips. The Salmon River in Oswego County accounted for 605,772 (59% of total) and 595,267 (64% of total) of the angler-hours in 05-06 and 06-07, respectively. The number of angler trips on the Salmon River was 99,850 (44% of total) in the first year and 87,539 (34% of total) in the second. Combined estimates from the four highest use tributaries: Salmon River, Oak Orchard and Eighteenmile creeks, and the Oswego River, accounted for 81% of the angler-hours in the first year and 82% in the second. The high use tributaries accounted for 69% of the 05-06 anglers trips and 65% in 06-07. These "high use" tributaries generally drew anglers from greater geographic distances. Non-New York State residents accounted for 60% of the anglers on the Salmon River in both years and from 33% to 49% of the anglers on the other "high use" tributaries. Tributaries with lower levels of use generally had lower levels of non-resident anglers.

Table 6 provides the catch and harvest estimates for the two years. Chinook salmon were the most abundant species in the catch and harvest for both years. Note the increase and change in distribution of the catch for the coho salmon from 05-06 to 06-07. Coho were far more abundant and more widely distributed in 06-07. Conversely, steelhead and brown trout were markedly less abundant in 06-07, particularly in Eighteenmile Creek (Niagara County) for both species and for brown trout in the Oswego River.

Table 6. Salmonid Harvest & Catch Estimates for Lake Ontario Tributaries

		05-06		06-07	
Species	Tributary	catch	harvest	catch	harvest
Chinook salmon	Salmon River	89,488	25,998	96,088	33,530
	other tribs combined	68,581	22,861	55,161	22,809
	total	158,029	48,859	151,249	56,339
Coho salmon	Salmon River	5,659	2,177	14,513	3,002
	other tribs combined	255	177	3,651	1,855
	total	5,914	2,354	18,164	4,857
Steelhead	Salmon River	20,705	2,713	21,489	3,869
	Eighteenmile Creek	28,603	1,046	1,448	186
	other tribs combined	37,605	2,496	28,723	5,160
	total	86,913	6,255	55,715	9,215
Brown trout	Salmon River	9,804	1,177	3,238	613
	Eighteenmile Creek	22,435	1,696	3,411	825
	Oswego River	11,681	430	738	358
	other tribs combined	22,755	3,778	15,260	2,289
	total	66,675	7,081	22,647	4,085

Pacific Salmon Biological Monitoring

Fall monitoring of Pacific salmon at the Salmon River Hatchery revealed improved growth of chinook salmon compared with recent years. Age 2 and age 3 remained about 1.0 and 1.5 lbs below their long term averages, respectively. Condition of chinook (weight relative to length) also rebounded in 2006 from the record low we observed in 2005. The weight of a 36 in chinook rose from 14.8 lbs in 2005 to 16.1 lbs in 2006. The improvement in growth was attributable to the abundance of yearling alewives in 2006.

Salmon River Wild Young-of-Year Chinook Salmon Seining

A cooperative index seining program with USGS conducted to assess natural reproduction of chinook salmon in the Salmon River suggests that 2006 produced the strongest year class of chinook since the surveys began in 2001. Four sights were surveyed weekly during May and June. For the peak three week period of the survey, the average catch per seine haul was 334 YOY chinook. The average catch per haul was higher for all weeks in 2006 than the corresponding long-term average. Fall flows in the Salmon River appear to drive the success of chinook natural reproduction the following spring. Larger year classes are generally produced in years with high fall flows.

Salmon River Bond Act Project

The first phase of the Salmon River Bond act project was completed during the summer of 2006. This phase of the project involved constructing a large bed sill and rock vane structure across a diversion channel which was causing the main stem of the river to bypass the Salmon River Hatchery. Also constructed was a bank-full bench and rock vane to address an eroding bank which was endangering a highway located at the top of the embankment. Plans are to construct another bank full bench and vane structure to protect another eroding bank above the hatchery in 2007.

Salmon River bed sill

Region 8

Sodus Bay Fish Stock Assessment
Standard gang gillnetting was conducted on Sodus Bay from September 25-29, 2006. The purpose of the netting is to periodically assess fish stocks, particularly walleye. A previous survey was conducted in 1990. In 2006, 30 walleyes were caught in 8 nets, for a catch rate of 3.75 walleyes per net. The recent fingerling walleye stockings appear to have been successful in maintaining the walleye population. Other preliminary results include: 17 species (5 gamefish, 6 panfish, and 6 other species) of fish were caught. Panfish species yellow perch, white perch, bluegill sunfish, pumpkinseed sunfish, rock bass, and brown bullhead made up the majority of the catch. Thirteen northern pike were caught.

Sodus Bay Surveyed for Endangered, Threatened Species
Region 8 staff assisted the Bureau's "Lesser known fishes" expert, Doug Carlson in surveying Sodus Bay on April 19 and May 24, 2006 for the threatened pugnose shiner. Plans for large-scale aquatic vegetation management in the bay prompted the surveys because aquatic vegetation is a preferred habitat of this species. Several were caught in the Second Creek area. A highly unusual catch of an American shad was also made.

Lake Ontario Near Shore "Warmwater" Fish Community Sampled
On August 28, 2006, staff set two Lake Ontario warmwater standard gang gillnets in Lake Ontario near Pultneyville, NY. During the late 1990s and early 2000s this area was known for its world-class smallmouth bass fishing. Fishing quality, as measured by the number of angler complaints and the Lake Ontario boat creel census, has been declining since about 2003. The survey was done as an initial attempt to assess the recent decline in smallmouth bass fishing quality in this section of the lake. This area was surveyed in 2001 and 2002. Unfortunately, the lake experienced an upwelling the night before the survey, which displaced the normally warm near shore water with colder offshore water. Only 13 smallmouth bass were caught. Additional warm water species caught were 15 yellow perch and 1 rock bass. Fourteen lake trout (all with AD clips and coded wire tags (CWT's), and 7 brown trout were also caught. Due to the cold near shore water, no further nets were set. The survey will be resumed in 2007.

2006 Lake Ontario Salmonid Pen Rearing
In 1998, concerns over post-stocking survival and imprinting of steelhead and chinook salmon to stocking sites led to the formation of several cooperative sportsmen's groups interested in pen rearing. Western basin concerns included the apparent lack of imprinting and subsequent impaired homing of chinook salmon and steelhead to the stocking streams. After the successful completion of pen-rearing projects at Oswego Harbor and Oak Orchard Creek in 1998, a number of other sportsmen's groups expressed interest in pen-rearing. New sites were added in 1999, including the Lower Niagara River, Sandy Creek, Genesee River and Sodus Bay. In 2006, a steelhead pen-rearing project was initiated at Wilson Harbor and only steelhead were raised at the Lower Niagara and Sandy Creek pen-rearing projects. All sites have been active each year since inception, except for Sandy Creek which was inactive in 2004 and 2005. This report summarizes 2006 Region 8 pen-rearing activities and results.

All sites used similar pen materials, design and netting as described for the 1998 Oak Orchard Creek Project. Standard operating procedures for stocking, maintaining, feeding, and releasing penned salmon were developed and refined by the Department. Observed mortalities for all projects were based on the number of dead fish collected from the pens during captivity and from the bottom of the pens after release. Mortality does not include fish lost to cannibalism or from predators that may have gained access to pens.

<u>Sodus Bay</u>
On April 12, 2006 52,600 chinook salmon were placed into two pens near First Creek at Sodus Bay. Chinooks were piped to the pens directly from the hatchery truck. Feeding was performed five times per day, and pens were cleaned weekly during the rearing period. Water temperature was monitored with a digital recording device starting on April 12, 2006. Dissolved oxygen was measured on May 1, 2006 with a YSI Model 55 meter. On May 6, after 25 days of rearing, the pens were towed into the open lake. The fish were released in approximately 25 ft of water lakeward, and east of, Sodus Bay Channel. Pens were inverted to release the fish.

Chinook grew from 120 fish per lb to 89 fish per lb (mean weight of two samples, one from each pen) after 25 days. The mean total length of a 20 fish sample of the released chinook was 87 mm (3.4 in). Water temperatures measured by the recording thermometer ranged from 48-62°F. During release, the Bay temperature was 52°F and the lake temperature was 47°F. On May 1, 2006 DO at the pen site was measured at 9.8 mg/L.

<u>Genesee River</u>
The Genesee Charter Association, in conjunction with Irondequoit Bay Fish and Game Club and Greater Rochester Sportfishery Association, used six pens located at Shumway Marina in the Genesee River for raising steelhead and chinook. Ten thousand steelhead were placed into two pens on April 11. Chinook salmon (85,250) were placed in four pens also on April 11. The pens were gravity-loaded by piping the steelhead and salmon from the hatchery truck. Feeding was performed five times per day, and pens were cleaned weekly. Water temperature was monitored with a digital recorder starting on 11 April. Dissolved oxygen was measured

on April 28 with a YSI Model 55 meter. Steelhead and chinook salmon were released on April 29 and May 3, respectively, by inverting the pens on site. Chinook salmon were released four days after the steelhead to reduce potential predation by steelhead upon recently-stocked chinook salmon.

Steelhead were released on April 29 and weighed 13 fish per lb (mean weight of two samples, one from each pen), versus a delivery weight of 16 fish per lb. The mean total length of a 20 fish sample of the released steelhead was 164 mm (6.5 in). Chinook released from pens on May 5 weighed 86 fish per lb (mean weight of four samples, one from each pen), versus a delivery weight of 110 fish per lb. The mean total length of a 40 fish sample of the released chinook was 86 mm (3.4 in). Water temperatures measured by the recording thermometer ranged from 48-60°F during the period that both species were in pens. The temperature of the Genesee River at the time of steelhead release was 56°F. On April 28, DO at the pen site was measured at 10.4 mg/L.

<u>Sandy Creek</u>

The Sandy Creek project was a community group effort. Volunteers included SUNY Brockport students, Boy Scouts, high school groups, charter captains, and community members. On April 14, 7,300 steelhead were placed into two pens in the Sandy Creek Marina basin. The steelhead were piped to the pens directly from the hatchery truck. The pens were then towed from the basin to the creek immediately adjacent to the marina, and tied to a private residence dock. The pens were oriented with the pens' long axis parallel to water flow. Feeding was performed six times per day, and pens were cleaned once a day during the rearing period. Water temperature was monitored with a digital recording device starting on April 14. Dissolved oxygen was measured on April 24 and 28 with a YSI Model 55 meter. On April 29, after 16 days of rearing, the pens were inverted to release the fish at the pen site.

Steelhead were delivered at 16 per lb. They were held in the pens for 16 days and released on April 29. The average of two samples (one from each pen) was 12.3 fish per pound. The average of twenty steelhead was 166.8 mm (6.6 in). Water temperatures measured by the recording thermometer ranged from 49-63°F, well within the guidelines and due to the cool spring, cooler than this site had been in the past. The temperature of the creek at the time of steelhead release was 56°F. On April 28, DO at the pen site was measured at 8.0 mg/L.

<u>Oak Orchard Creek</u>

The Oak Orchard Business Association sponsored this pen project. On April 10, 14,000 steelhead were delivered to Lake Breeze Marina and placed into three pens. On the same date, 85,250 chinook salmon were placed into four pens at the same location. A PVC extension pipe was used to transfer steelhead and chinook into pens located farthest from the shore. Trout and salmon were fed four times daily, and pens were cleaned every two days. Water temperature was monitored with a digital recording device starting on April 10. Dissolved oxygen was measured on April 24 with a YSI Model 55 meter. The steelhead and salmon were released after 17 days on April 26 by towing the pens to the river mouth at Point Breeze.

Steelhead were held in pens from April 10 to April 26, a total of 17 days. Two samples of steelhead, one from each pen, weighed 11.3 fish per lb and were 161 mm (6.3 in) total length when released. Chinook salmon were also held for 17 days and released, weighing 86 fish per lb (mean of 4 samples, one from each pen). Mean total length of a forty fish sample was 84.5 mm (3.3 in). Water temperatures measured by the recording thermometer ranged from 49-64°F during the period that both species were in pens. The temperature of the Oak Orchard River release site at the time of release was 55°F. On April 24, DO at the pen site was measured at 8.2 mg/L.

Lake wide, eight sites pen-reared a total of 84,800 steelhead (Washington and Skamania strains), comprising 13.1% of NYSDEC's Lake Ontario rainbow trout/steelhead stocking allotment in 2006. Observed mortalities at the five steelhead rearing sites ranged from 0.068 to 0.5% . Overall, steelhead mortality in 2006 was low in comparison with previous years. Five pen-rearing sites raised a total of 313,100 chinook salmon, representing 18% of Department's 2006 chinook salmon stocking allotment. At the five sites where chinook were penned, mortality estimates ranged from 0.074 to 0.19%. Water temperatures during the pen-rearing period generally benefitted from cool weather during late April and early May. The water temperature criterion (65°F) established for pen projects, was not exceeded at any pen rearing site.

Steelhead target weights (12-15 fish per lb) were reached at all of the eight pen sites. Chinook target weights (90 fish per lb) were achieved at all five of the pen sites, as well. It is likely that a large percentage of the penned fish imprinted to water at their respective pen sites, since a large majority of fish reached target weights.

The ninth year of pen-rearing steelhead and chinook salmon along the New York shoreline of Lake Ontario was very successful due to relatively low fish mortality at most sites, a relatively high percentage of fish being imprinted, and the goodwill generated through growing partnerships in the projects.

Round Gobies and smallmouth bass Test Positive for VHS

In May 2006, staff received numerous calls regarding a large die-off of round gobies and slow moving bass covered with red sores along the Lake Ontario shoreline. Gobies were collected from just west of Sandy Creek and smallmouth bass from Sodus Bay. The fish were transported by Regional staff to Cornell's veterinary lab. Both the gobies and bass tested positive for VHS.

Region 9

Trout and Salmon Pen-rearing Projects

Region 9 Great Lakes waters are home to five pen-rearing projects designed to improve survival and imprinting of stocked trout and salmon. Three of the projects are located in Niagara County on Lake Ontario and the other two are on Lake Erie. The projects are organized and conducted by volunteer groups responsible for identifying suitable sites, obtaining and deploying pens, feeding fish, cleaning pens, documenting pen activities and safely releasing fish. DEC staff from Region 9 and Great Lakes Section staff assist in developing policy and providing technical assistance for the pen projects.

Table 7. Region 9 Pen Projects in Spring 2006

Location	Species	Number	Days Held	Size
(#fish/lb.)				
Dunkirk Harbor	Steelhead			
Buffalo River	Steelhead	10,000	20	18.8
Lower Niagara River	Steelhead	20,000	22	12.0
Wilson Harbor	Steelhead	5,000	22	11.7
Olcott Harbor	Steelhead	3,500	17	11.4
Olcott Harbot	Chinook salmon	50,000	21	58.8

The volunteer groups have been very successful operating these projects. Growth of penned fish has generally been excellent and mortalities have been very low. The limited assessment studies performed on Lake Ontario pen projects, particularly for steelhead, indicate that penning can significantly increase survival of stocked steelhead. There is a need to evaluate steelhead pen effectiveness in Lake Erie, however there are substantial limitations to performing these assessments for the existing Lake Erie pen sites.

More detailed information on Lake Ontario pen projects is contained in the 2006 Annual Report Bureau of Fisheries Lake Ontario Unit and St. Lawrence River Unit to the Great Lakes Fishery Commission's Lake Ontario Committee, March 2007.

Steelhead pen

<u>Lake Erie and Tributaries</u>

Lake Erie Unit

Autumn Trawl Survey
The trawling program is conducted during October at randomly selected stations between the 50- and 100-ft depth contours in New York's portion of Lake Erie. Standard tow duration is 10 minutes.

In 2006, the most abundant species encountered in the program was emerald shiner. Other species that made large contributions to the trawl collections included round goby, rainbow smelt and troutperch.

The 2006 mean density estimates for age 0, age 1, and adult (age 2 and older) yellow perch were all higher than the previous 14 year mean density estimates for these life stages of yellow perch. The 2006 index for age 1 yellow perch was particularly notable as the highest measured in this trawl series. Juvenile yellow perch growth rates have remained stable over the past several years.

The October trawling program continues to portray an improved status of the yellow perch population relative to a long period of low abundance through the 1990s. These results also closely mirror findings from neighboring jurisdictions and support the view that yellow perch abundance has generally rebounded and perhaps stabilized from the 1990s low ebb. An especially high age 1 yellow perch index in 2006 suggests favorable abundance of adult yellow perch (age 2+) will continue for the near future.

Warmwater Fish Stock Assessment
The standard gill net assessment is the largest and longest standing survey performed by New York's Lake Erie Unit. The annual autumn gill netting survey has been underway since 1981. Four to six, 700 foot, graded mesh nets are set daily, with 40 sites sampled in 2006.

The overall abundance index for walleye in 2006 was well above the long-term average abundance since 1981. The age composition of walleye was composed primarily of age 3 individuals representing the exceptional 2003 year class. Also, the once dominant 1984 year class of walleye is still scarcely detectable at age 22 in the 2006 samples. The gill net assessment has had a juvenile walleye emphasis since its inception, with age 1 and age 2 walleye comprising a large fraction of the overall walleye sample each year. Yearling walleye catch rates in 2006 ranked the 2005 year class as above average, and the seventh largest in the 26 year time series. Age 1 and age 2 walleye were very near long term average sizes for this September netting program.

Overall walleye abundance in 2006 was above average for the time series for the third consecutive year, principally due to the presence of the dominant age 3, 2003 year class. An age 1 cohort also contributed measurably to the 2006 walleye sample. The formerly immense 1984 walleye year class, which dominated gill net samples for more than a decade, still comprises a tiny, but detectable fraction of the annual collections as age 22 individuals. Additional contributions to New York's adult walleye resource are known to occur from summer immigration from western basin Lake Erie walleye spawning stocks. This annual movement remains poorly understood and is an additional factor creating difficulty for forecasting annual walleye abundance and fishing quality. We believe improving our understanding of contributions to New York's summer walleye sport fishery by migratory walleye stocks is a very high information need for effective walleye management. NYS DEC's Lake Erie Unit has been supporting research initiatives to address this important question.

Smallmouth bass catch rates in 2006 were well above the average value for this 26 year time series. Age 1, age 4, and age 7 individuals made large contributions to this 2006 sample that included 16 age groups from age 0 to age 16. The long-term recruitment indices for age 2 and age 3 smallmouth bass rank the 2003 year class as near average in the time series. Early indications from the same juvenile recruitment index suggest the 2004 year class is below average in abundance as age 2 individuals. Also, particularly notable in the 2006 collections was the large sample of YOY and yearling (age 1) bass which typically are not vulnerable to our gillnets. Age 2 and age 3 smallmouth bass cohorts averaged 11.4 in and 13.6 in total length, respectively. Both age groups were approximately an inch longer than the average for the entire time series and both remained near the longest ever observed in the 26 year time series.

Smallmouth bass abundance remains above the long term average. Standard sub-adult recruitment measures describe moderate to poor recruitment for the 2003 (age 3) and 2002 (age 2) year classes, respectively. However, unusually large catches of YOY and age 1 smallmouth bass in 2006 indicate improved smallmouth bass recruitment will occur in the foreseeable future. This recent recruitment history is receiving close scrutiny as it coincides with the emergence of high densities of round gobies in New York's portion of Lake Erie. There has been concern among fishery scientists that the presence of round goby could represent a new recruitment bottleneck for smallmouth bass. The Lake Erie Unit maintains a robust long-term data series for smallmouth bass, and over time, is in a position to critically examine whether a new round goby recruitment bottleneck has occurred. A publication by Einhouse et al. (2002) relates recruitment patterns of smallmouth bass in New York's portion of Lake Erie to mean summer water temperature. This research predicted poor smallmouth bass recruitment would accompany the cool summer water temperatures Lake Erie experienced in the year 2000 and 2004. Our subsequent gillnet recruitment indices for those year classes validated predictions based on water temperature. Similarly, this recruitment-temperature relationship predicts much better bass recruitment should be expected from 2005 and 2006 year classes, because we experienced much warmer summer water temperatures these years.These smallmouth bass recruitment measures assembled over several years should allow us to gather insights about round goby effects, with the backdrop of our long term recruitment history and new found knowledge of a principal factor controlling bass recruitment.

Elevated smallmouth bass growth rates coincided with the emergence of round gobies as an abundant new prey source in eastern Lake Erie. Both smallmouth bass growth rates and round goby abundance increased sharply after 1999. This increased smallmouth bass growth has also resulted in a new uncertainty for our annual smallmouth bass abundance. The more recent abundance and recruitment indices from gillnets have the potential to produce biased results because sub-adult smallmouth bass are significantly larger than in the past, and gill nets are a very size selective sampling gear. We have not critically examined whether changes in growth may have influenced age-specific catch rates. However, conducting such a critical analysis for these data is an important need to maintain a credible index to assess smallmouth bass recruitment and abundance.

In deeper areas, yellow perch continued to be encountered at generally higher levels of abundance that were first observed beginning in year 2000. Deeper areas have only been sampled since the interagency index gillnet protocol was fully implemented in New York, starting in 1993. Yellow perch are not effectively sampled at the shallower (0 to 50 ft), long-term gillnet sites. Age 1, age 3 and age 5 yellow perch were the most abundant age groups in the 2006 collections and individuals greater than age 7 remained scarce. Only since 2000 have adult cohorts of yellow perch contributed measurably to this annual sample.

The status of the yellow perch population has improved considerably in recent years. Independent gillnet and bottom trawling programs continue to corroborate observations of neighboring jurisdictions that abundance of adult yellow perch has increased in eastern Lake Erie.

Abundance trends for some other commonly encountered species have recently received closer scrutiny due to extensive fish kills observed especially during 2001 and 2002. The species composition of those fish kills consisted largely of freshwater drum, and to a lesser extent, a wide variety of generally benthic species, including rock bass, stonecats, and smallmouth bass. Despite these extensive fish kills, we could not detect population level declines for freshwater drum in our gillnet index. During 2005 we also observed an extensive summertime mortality of channel catfish but were unable to obtain suitable fresh samples for examination by pathologists. Subsequent gillnet indices found channel catfish catches sharply dropped from 2004 to 2006, following progressive increases in abundance between 1999 and 2003. Recently VHS has emerged in the Great Lakes as a serious pathogen of fish. In light of these continuing perturbations, long-term monitoring of the fish community through our warmwater gillnet program has considerable added value for assessing population-level impacts by an array of new stressors to the Great Lakes.

Gillnetting on Lake Erie

Walleye Tagging Study

During the 17 years New York has participated in this interagency tagging study, 20,079 walleye have been tagged in New York's portion of Lake Erie. During April and May 2006, 1,498 walleye were collected in New York waters and affixed with jaw tags as a continuation of this effort to examine walleye distribution and exploitation rates. The two tagging sites sampled in 2006 were Van Buren Bay and Cattaraugus Creek. Walleye were collected by electrofishing and trap nets. Through most of the years of this study, trap nets contributed a larger portion of the annual sample for this tagging effort.

Since the inception of this tagging study, 1,660 tag recoveries originating from the New York tagging effort have been reported by anglers and the Ontario commercial fishery. Eighty-seven (87) of these recaptures occurred during 2006.

This series of walleye tag recovery data has been annually examined using a model that estimates mean survival and recovery rates for the tagged population. From 1992 to 2005, several potential arithmetic mean survival rates for tagged walleye were derived from the Brownie model. Differing survival estimates were obtained by employing various assumptions concerning survival and recovery patterns, and all point estimates for the annual survival rate exceeded 70 percent. Over the duration of this assessment, maximum likelihood tag recovery rates ranged between 1.4 and 5.1 percent. We have expanded these observed recovery rates to exploitation rates using a multiplier of 2.82 for non-reporting of recovered tags. This current, non-reporting expansion factor was developed from a 2000 reward tag study in the New York waters of Lake Erie and is adjusted annually with each year's new tag recoveries. As such, the mean exploitation rate for tagged walleye from 1992 to 2006 was estimated as 7.74 percent.

Jaw tag on walleye

Beginning in 2005, the ongoing walleye jaw tagging study was expanded to incorporate a PIT (Passive Integrative Responder) tagging component. The walleye PIT tagging study is a 3-year inter-agency research initiative to independently develop estimates of exploitation and survival without a reliance on voluntary tag returns from fisheries. A secondary objective of this PIT tag initiative is to evaluate tag loss. In the absence of voluntary returns by fishers, the PIT tagging study requires a supplemental effort by agency personnel to examine large numbers of walleye encountered at fish cleaning stations and creel survey locations. During 2006, New York PIT-tagged 1,492 walleye, examined 1,017 angler-caught walleye for the presence of PIT tags, and detected 4 tags. A summary of the inter-agency PIT tag study will be prepared as a separate report upon the conclusion of this investigation. New York will participate in PIT-tagging at least one more year (2007), but the examination of walleye for PIT tag recoveries is expected to extend many years.

Lake Trout Assessment

This standard August gill net assessment has been employed to assess lake trout populations in the New York waters of Lake Erie since 1986. Approximately 60 sets of 500 ft, graded mesh nets are set annually in coldwater habitat.

The total gill net catch of lake trout in New York's portion of Lake Erie in 2006 was 353 individuals in 60 lifts. Eighteen age classes, from age 2 to 22, were represented in the sample of 331 known-aged fish. Similar to the past five years, young lake trout ages 2 - 5 were the most abundant cohorts, representing the majority (80%) of the total catch. No age 1 lake trout were sampled in the New York waters of Lake Erie; yearlings (Slate Island strain) were stocked in Spring 2006 in Ontario waters of the Eastern Basin for the first time. Cohorts older than age 7 remain in low abundance. Three age 21 and two age 22 lake trout were sampled, which were the oldest lake trout ever caught in the survey. Both of these successful cohorts were the first stockings to benefit from sea lamprey treatments.

Lake Trout Growth

Mean lengths-at-age and mean weights-at-age of sampled "Lean strain" lake trout were consistent with averages from the previous 10 years (1996-2005) up to age 8. Low sample sizes contributed to variation in mean length and weights in the older age groups. Mean length and weight of Klondike strain lake trout was slightly lower compared to Lean strain lake trout at ages 2 and 3. The largest lake trout sampled was a 21 year old fish that measured 39.4 in and weighed 25.3 lbs. This was the largest lake trout ever sampled in this program.

Lake Trout Maturity

Maturity rates remained consistent with past years where males are nearly 100% mature by age 4 and females by age 5. Ninety-six mature females were sampled in New York waters of Lake Erie in 2006. These fish ranged from age 4 to 22, but only 17 were older than age 6 and 65 (68%) were age 5. Mean age of mature females was 6.32 years. This is the fourth consecutive year that the mean age of mature females fell below the target of 7.5 established in the Strategic Plan (Lake Trout Task Group 1985) and continues to reflect the absence of older age-classes in the Lake Erie lake trout population.

Abundance of Coldwater Species

The relative abundance of lake trout caught in standard size meshes of 1.5 - 6.0 in has been on a general increase since its time-series low in 2000. Overall abundance continued to increase in 2006 to 5.3 lake trout/lift, an increase over the previous years estimated CPUE (4.0 fish/lift) and well above the time series average of 3.83 fish/lift. The increase was mainly due to excellent survival of age 2 Klondike strain lake trout. Burbot abundance increased slightly in 2006 following a sharp decline in 2005. Overall burbot abundance was estimated at 3.4 burbot/lift, still well-above the time-series average of 2.09 fish/lift, but well below the peak abundance of 4.7 fish/lift in 2004. Whitefish catches continue to be highly variable in this survey, both between years and within years. The abundance of whitefish declined sharply in 2006 to 0.75 whitefish/lift, the lowest abundance estimate since 1996 and an 85% decline from the 2005 estimate of 5.1 fish/lift. Abundance estimates fell below the time series average of 2.16 fish/lift for the first time in three years. Other salmonids caught during the survey include 20 brown trout and one steelhead.

The relative abundance of lake trout by age of the 2006 standard gill net assessment catch illustrates the higher abundance of the younger cohorts between the ages of 2 and 5 and the relatively lower and more sporadic abundance of age 8 and older age-classes. Klondike strain lake trout comprise all of the age 2 and 65% of the age 3 age-classes. Younger age-classes have dominated the catches since 2002 while lake trout moving into the age 7-9 age groups have seemingly disappeared. The abundance of older lake trout (age 10+) has declined from over 30% of the total abundance in 2001 to only 3.3% in both 2005 and 2006.

The index of abundance for age-5-and-older lake trout more than doubled from last year, increasing from 1.03 fish/lift in 2005 to 2.42 fish/lift in 2006. This increase was mainly due to the recruitment of the abundant 2002 stocking to age 5. Adult abundances are above the time-series average of 1.60 fish/lift and at their highest levels since 1997, but still remain well below the peak abundances observed in the early and mid-1990's. Despite the increase in overall adult recruitment, the relative abundance of age 7-and-older lake trout shows a steady decline over the past decade. Further analysis shows that declines in adult stocks aged 5+ are due to declines in age 7+ fish; lake trout age 5 and 6 show a variable recruitment pattern with no apparent trend.

The CPUE of mature females >4500g (10lbs) in Lake Erie is 0.5 in 2006, well below the target of 1.0. In fact, the CPUE of females >4500g (10lbs) has been below target for the entire time-series with the exception of 1997. Overall trends in abundance of females >4500g (10lbs) generally follows trends in total female abundance through 2003, but there appears to be a separation thereafter with females >4500g (10lbs.) showing further decline than overall female abundance.

Lake Trout Recruitment

The age 1-3 relative abundance index for lake trout increased for the first time in the last four years to 1.97 fish/lift. The increase was mainly due to the higher-than-expected survival and recruitment of age 2 and 3 Klondike strain lake trout. Age 1 lake trout were absent from catches in New York waters. The age 2 recruitment index, which is an abundance index of survival to age 2 standardized for the number of stocked yearlings, increased to 1.85 in 2006, its highest value in the time-series. This was due to the excellent recruitment of age 2 Klondike strain lake trout stocked at relatively low stocking densities (54,200 yearlings). Klondike strain lake trout also exhibited substantially higher recruitment in 2005 compared to Finger Lakes strain lake trout.

Lake Trout Survival

Cohort analysis estimates of annual survival (S) were calculated for lake trout by strain and year class using a 3-year running average of CPUE with ages 4 through 10. A running average was used due to the high year-to-year variability in catches. Mean overall adult survival estimates were highest for the Lake Ontario (LO) strain (0.81) and lowest for the Lewis Lakes (LL) strain (0.59). Survival rates for the Lake Erie (LE) strain were also high (0.79), but this was based upon two year classes with relatively poor returns. The Finger Lakes (FL) and Superior (SUP) strains, the most commonly stocked lake trout strains in Lake Erie, had overall mean survival estimates of 0.76 and 0.71, respectively. Survival estimates prior to 1986 are low due to the effects of a large sea lamprey population. Survival of the 1987 –1991 year classes were comparably higher as the sea lamprey population declined and the number of adult lake trout increased, decreasing the affect of host density. Survival estimates during this period (1987-91) were highest for the FL strain (0.83) and lowest for the SUP strain (0.79). The LO strain, a cross between SUP and FL strains, was intermediate at 0.81. Survival estimates declined again beginning with the 1992 year class as the lamprey population increased. Mean overall survival estimates for all strains were above the Stategic Plan's target goal of 60% or higher except for the LL strain. However, three out of five survival estimates prior to lamprey control (1983-85) were below the target goal, indicating the importance of lamprey control on the adult lake trout population.

More recent estimates of survival indicate declines well below target levels. Survival estimates of the 1997-1999 year-classes of SUP strain lake trout using catch curves from ages 5-8 or 4-7 ranges from 0.33-0.42. Survival estimates from the 1997 FL strain also declined to 0.62. Both of these survival estimates are well below the ranges that were observed for these strains during the period of high-lamprey control.

Lake Trout Strains

Similar to the last five years, six different lake trout strains were found in the 333 fish caught with hatchery-implanted coded-wire tags (CWT's) or fin-clips. Finger Lakes (FL) and Superior (SUP) strain lake trout have been the most numerous strains in Lake Erie due to their stocking prevalence, but Klondike (KL) strain lake trout, despite being stocked in low numbers for only two years, increased substantially in 2006 returns and now comprise a significant portion of the population. Lewis Lake (LL), Lake Ontario (LO), and Lake Erie (LE) strains remain minor contributions to the Lake Erie stock. The FL strain was the most prevalent strain in Lake Erie catches in 2006 due to its consistent stocking over the past 20 years. Lake trout were caught from each year of stocking through age 13, and then at some of its older stockings (ages 16, 21, 22). The Superior strain continues to be the most prevalent strain in the younger cohorts. However, it is absent from stockings at older ages. Returns at ages 5-7 are artificially high due to the size-at-stocking paired planting study which resulted in a 2x return rate for the larger-sized SUP strain fish. Overall, there were poor returns from all strains over age 7.

Diet of Lake Trout and Burbot

Analysis of the stomach contents of lake trout and burbot revealed diets almost exclusively comprised of fish. However, the composition of the prey continues to evolve with the emergence of invasive species and an ever changing lake ecosystem. Rainbow smelt, the longtime main prey item for lake trout, declined significantly in lake trout diets in 2006, while round gobies increased. The frequency of occurrence of round goby and smelt was equal in lean strain lake trout stomachs (53%) while round gobies were twice as common in Klondike strain fish (68% vs. 32%). This represents a major change for lean strain lake trout as smelt have comprised over 88% of their diet since 1999. Gobies tend to be more prevalent in Klondike strain lake trout, possibly due to their orientation closer to the bottom compared to lean lake trout strains. Other fish species comprised minor portions of both lean and Klondike strain lake trout diets.

Burbot diets remain more diverse than lake trout diets with nine different fish and invertebrate species identified in stomach samples. Round gobies were once again the most prevalent prey item, occurring in 63% of the stomach samples while smelt declined to 19%, the lowest frequency since gobies arrived. Yellow perch comprised a measurable portion of the burbot diet, most likely due to their high abundance in the lake. All other fish and invertebrate species were occasional occurrences in the burbot diets.

Paired Plantings of Lake Trout

Evaluation of five consecutive years of paired plantings of yearling lake trout to compare survival and growth rates of large versus small stocking size was continued in 2006. The plantings began in 2000. In general, the results of the first three years of stocking using SUP strain fish have favored the larger stocked fish at a ratio of 2:1, and this has remained fairly consistent up to age 7. Returns of the 2000 stocking (1999 year-class) have dwindled dramatically from age 4 through age 7, presumably due to lamprey mortality, and survival estimates for this once abundant year-class were low (S=0.367; ages 4-7; r2 = 0.9993). Results of the last two years of the paired plantings (2003, 2004 stockings) using FL strain fish remain inconclusive due to poor returns from either of these stockings. Overall smaller stocking sizes, especially in 2004, or differences in sampling variability or fish behavior may be responsible for the poor return rates. However, excellent returns from Klondike strain lake trout stocked at similar sizes and at less densities than FL strain fish (31.6K vs. 40K) in 2004 indicate that behavior differences in strain, or poor post-stocking survival is most likely contributing to poor returns of FL strain lake trout, not small stocking size. There were no significant differences in growth between any of the paired stockings. Growth differences observed at earlier ages has diminished at older ages.

While some aspects of the Lake Erie lake trout population are promising, such as recruitment of young lake trout post-stocking, the status of the adult population is at a critical stage. Several indices show that recruitment to the older ages (7+), which are the prime spawners, is poor. The increase seen in the age 5+ index in 2006 was due to the recruitment of the 2002 stocking to age 5, and these fish comprised over 2/3 of the index. Trends in recruitment to age 7+ reveals declining abundance despite increased lake trout abundance at ages 5 and 6, indicating that lake trout mortality is high within these age-classes. Survival estimates for lake trout cohorts from the late 1990's confirm this with survival rates ranging from 0.33-0.42, about half of the rates found earlier in the decade and well below the target rates of 0.60 stated in the Lake Trout Management Plan. The CPUE of adult females >4500g remains well below the target and may indicate why naturally produced fish have not been observed yet in Lake Erie.

Assessment of Klondike Strain Lake Trout

Initial returns of the Klondike strain lake trout indicate excellent post-stocking survival. Returns of 31,600 yearlings stocked in 2004 were over four times higher at age 3 than a paired stocking of 80,000 Finger Lakes strain lean lake trout when adjusted for stocking rates. Stocking-adjusted return rates of the 2005 stocking (54,200 yearlings) at age 2 were the highest in the time-series.

Growth of this strain appears to be slightly slower than for Lean strains at ages 2 and 3, but not to a significant degree. Mean lengths are around one inch smaller at age and mean weights about 20% less. Maturity rates at ages 2 and 3 are similar to Lean lake trout strains. More data will be needed to determine if these fish do have different growth rates, especially after maturity.

Slower growth may be beneficial if it deters predation by sea lampreys. Studies show that larger lake trout are the main targets for sea lamprey. Wounding rates on different size-classes confirm this in Lake Erie with the majority of the fresh wounds occurring on lake trout larger than 25". If Klondike strain lake trout mature earlier and exhibit slower growth, this could be an advantage over Lean strain lake trout for avoiding excessive mortality from lamprey attacks.

Analysis of stomach contents of both Lean and Klondike strain lake trout reveals a higher percentage of round gobies in the diets of Klondikes, and may indicate that Klondikes are more bottom-oriented than Lean lake trout strains which tend to prey more heavily on smelt. If Klondikes are indeed a more bottom-oriented strain, this could lead to higher catch rate returns due to their increased susceptibility to bottom-set sampling gear. It may also make them more prone to lamprey attacks when they reach vulnerable sizes. Future surveys will continue to monitor the progress of these fish, and compare their growth, maturity, and wounding rates to the currently stocked Lean lake trout strains.

Sea Lamprey Assessment

Sea lamprey invaded Lake Erie and the Upper Great Lakes in the 1920's with the opening of the Well and Canal connecting Lakes Erie and Ontario. Although not completely responsible for the demise of the lake trout population in Lake Erie, they undoubtably played an integral part in the eventual failure of the original stocks. Populations of lampreys were left untreated in Lake Erie until the Strategic Plan for Lake Trout Restoration in Eastern Lake Erie document was formulated in 1985 and pointed to the lack of lamprey treatment as a bottleneck in the establishment of a lake trout population. The Sea Lamprey Management Plan for Lake Erie followed with a set of goals to achieve lamprey control. Since 1986, the Great Lakes Fisheries Commission has conducted regular treatments of key Lake Erie tributaries to control lamprey populations and the damage they inflict on the Lake's coldwater fishery resources.

The fresh A1-A3 wounding rate on lake trout greater than 21 inches total length was 16.0 wounds per 100 fish in 2006. This was slightly lower than 2005 (17.0 wounds/100 fish) but still over three times higher than the target rate of 5 wounds per 100 fish. Wounding rates have remained well above target for 10 of the last

11 years following more relaxed lamprey control measures in the mid- 1990's. Lampreys continue to target larger fish with lake trout >29 inches receiving the highest percentage of fresh wounds, followed by fish in the 25-29 inch range. There were no wounds found on lake trout less than 21 inches.

Fresh A1 wounds are considered indicators of the attack rate for the current year at the time of sampling (August). A1 wounding in 2006 was 0.024 wounds per adult lake trout greater than 21 inches, which was lower than 2005 (0.03) but still above the series average of 0.021 wounds/fish. A1 wounding rates have remained at or above average for nine of the last ten years, but the rate has remained stable since 2000. All of the A1 attacks occurred on lake trout >25 inches in length.

The past year's cumulative attacks are indicated by A4 wounds. The 2006 A4 wounding rate increased for the fourth consecutive year to 70.4 wounds per 100 fish for lake trout greater than 21 inches. This is the highest A4 wounding rate in the time series, including the pre-treatment years, and 3.7 times the series average of 19.2 wounds/100 fish. Similar to past surveys, the majority of the A4 wounds were found on fish greater than 25 inches in total length. Twenty-nine of the 45 lake trout sampled >29 inches in length (64.4%) possessed A4 lamprey wounds, and many of these fish had multiple wounds.

Sea lamprey nest count surveys occurred on 20-21 June, 2006. Nest count sampling was later than usual due to colder-than-normal water temperatures. The overall index for sea lamprey nesting increased slightly to 24.6 nests/mile in 2006. This nesting rate was above the series average of 15.4 nests/mile and the highest rate recorded in the last eight years. The highest nest counts were once again found in the main branch of Clear Creek (33.0 nests/mile), a tributary to Cattaraugus Creek. This is the highest nesting rate on this stream since 1998. Sea lamprey nesting rates also increased in both Delaware and Canadaway Creeks, but declined in North Branch Clear Creek.

Sea lamprey abundance continues to be high in Lake Erie despite regular control measures in the major tributaries. Fresh wounding rates (A1-A3) remained well above target levels, A1 wounds remained above average and at levels similar to the past six years, A4 wounding rates increased to unprecedented heights, and lamprey nesting counts increased. In addition, anglers are reporting high numbers of wounds on other lake fishes, especially steelhead.

Population projections using the Lake Erie Lake Trout Simulation Model indicate that lamprey control is one of the major influences on the lake trout population in Lake Erie, and that adult lake trout populations cannot reach levels needed for successful rehabilitation efforts without good lamprey control. Unfortunately, adult lake trout, especially the larger fish over 29 inches, continue to decline rapidly within the lake trout population, presumably due to high lamprey mortality. Almost 1/3 of the lake trout >29 inches exhibited recent lamprey attacks, and the average number of A4 wounds per fish was greater than one. Estimates from recently stocked SUP strain year-classes indicate that survival is only half of what it was when lamprey wounding rates were below target levels. Mortality estimates extrapolated from wounding rates suggest 34% of the adult population died from lamprey attacks in 2005 with the majority of those losses occurring in the larger adults. Other estimates of sea lamprey induced mortality rates based on fresh wounding observed in 2006 were estimated at 0.15 for lake trout over 25 inches. In order to proceed with successful lake trout rehabilitation, consistent measures need to be taken to reduce mortality and increase survival of the adult lake trout population and attain levels where successful natural reproduction is possible.

Sport Fishery Assessment

Since 1988, a direct contact sport fishing survey has been conducted to monitor boat fishing activity. This has been a standard, annual program that extended from May through October along the entire New York portion of Lake Erie. From 1993 to 1997 this survey was augmented by a spring creel survey of the nighttime walleye fishery, and those results were reported annually in earlier editions of this report. This nighttime survey component was suspended from 1998 to 2005, and then resumed in 2006 to update the status of this fishery. This spring, nighttime walleye fishery survey is now scheduled to proceed at regular 3-year intervals.

Overall 2006 open water sport fishing effort in New York waters of Lake Erie was estimated as 277,779 angler-hours. Peak fishing activity occurred during June and the most frequently used site was the Cattaraugus Creek Harbor. The 2006 fishing effort estimate was the lowest annual total of the 19-year time series. During the 2006 fishing season, walleye angling was the largest component of the boat fishery with 49 percent of the overall angling effort. Smallmouth bass angling ranked second in boat fishing effort with 26 percent of the total. Among the remaining effort, anglers fishing for yellow perch ranked 3rd with 17 percent of the overall effort, and anglers fishing for "anything" accounted for 6 percent of the total in 2006. The remaining 2 percent of the fishing effort total was distributed mostly among trout specialists, and Ecosid specialists returning to the Buffalo Small Boat Harbor.

A notable decline in boat fishing effort, first observed in 1999, briefly stabilized in 2003 and 2004, but dropped further thereafter. Lake Erie's recent decline in fishing effort remains consistent with broad trends observed in other waters and is likely attributable to factors independent of fishing quality. Likely contributors to declines in fishing effort beginning in 2005 were coincident sharp increases in fuel prices, and in 2006, especially inclement weather during late summer and autumn.

The total estimated daytime walleye harvest was 37,157 fish, ranking the 2006 walleye harvest about 48% above the average for the previous 10 years, and the seventh largest in the 19-year survey series. The 2006 walleye fishing effort accompanying this walleye harvest was approximately the same as measured in 2005, and 40% greater than the low ebb for walleye fishing effort measured in 2004. Despite increased walleye fishing activity relative to the 2004 low ebb, 2005 and 2006 targeted walleye fishing effort remained among the lowest measured in this 19-year data series.

The 2006 walleye sport fishery occurred mostly between Barcelona Harbor and Silver Creek, New York. The overall targeted walleye catch rate during the 2006 fishing season was 0.28 fish per hour, which was identical to the 2005 measure and highest observed in the 19-year data series. The average total length of harvested walleye in 2006 was 21.8 in or roughly 2 in below the average (24.1 in) observed for the previous 10 years.

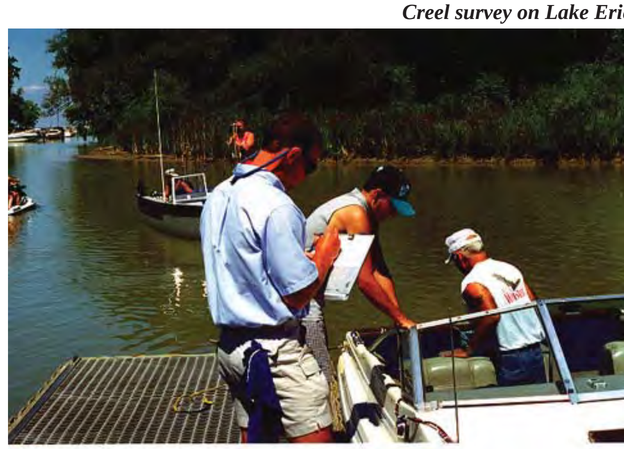
In 2006 daytime walleye fishing was excellent. August was the peak month for walleye harvest and catch rates, but the excellent walleye fishing quality extended from June through August. Age 3 walleye, from the dominant 2003 year class, accounted for 39 percent of the overall walleye harvest. The age 5, 2001 year class, was the second most abundant age group, and cohorts age 10-and-older together accounted for 23 percent of the 2006 walleye harvest.

The 2006 survey year also provided an opportunity to assess a smaller, infrequently monitored walleye fishery that briefly emerges in evening hours as the walleye season opens each spring. This nighttime survey found 7 percent of overall walleye fishing effort and 10 percent of the harvest occurred at night in 2006. In addition, nighttime walleye fishing quality (fish/hour) was superior to companion daytime measures. Both the daytime and night walleye catch rates describe superb fishing quality for eastern Lake Erie. Nighttime walleye fishing effort and harvest totals are only a minor contributor to the total walleye fishing effort and harvest in a year. However, a relatively small cadre of nighttime walleye anglers experience better fishing quality than their daytime counterparts. As a minor contributor to a very important sport fishery continued periodic surveys (every 3rd year) of the nighttime fishery seems to be an appropriate frequency for ongoing assessment.

Smallmouth bass harvest was estimated as 4,623 fish, which ranks 2006 with the lowest annual bass harvest for the 19-year survey. Overall 2006 bass fishing effort was approximately 50 % below the mean for the previous 10 years and declined 29 % from 2005. The 2006 smallmouth bass harvest also remained very small, relative to the bass catch by boat anglers. Smallmouth bass were the second most frequently caught species (61,969 fish) by boat anglers. The largest component of the smallmouth bass catch and harvest was by anglers encountered at Buffalo's Small Boat Harbor. The 2006 overall catch rate by bass anglers was 0.80 bass per hour, and mean length of harvested smallmouth bass was 16.9 in. in 2006. The 2006 targeted catch rate remained 17 % below the long term average value.

Overall fishing quality experienced by bass anglers has been reasonably similar among recent years, as measured by angler catch rates and average size of harvested smallmouth bass. These measures characterize Lake Erie's bass angling as an excellent quality fishing experience. Conversely, in recent years smallmouth bass harvest totals have plummeted to the lowest observed in the time series. Part of the reason for these conflicting measures of bass fishing quality and bass harvest is found in the characteristics of Lake Erie's boat angling community. Through recent years there has been a notable trend of increasing catch-and-release fishing preferences by bass angling specialists. In addition, much of the smallmouth bass harvest from Lake Erie's sport fishery includes anglers who do not describe themselves as targeting black bass and, nevertheless, account for most of the smallmouth bass harvest. The contribution to the annual smallmouth bass harvest by anglers targeting other species, or no particular species, sometimes is as much as 70 percent of the total smallmouth bass harvest in any given year. As such, smallmouth harvest estimates for the entire sport fishery do not necessarily mirror targeted catch or harvest rates by bass specialists who mostly do not choose to harvest black bass. Since 2001, catch rates by smallmouth bass anglers have diverged from overall harvest totals for Lake Erie. Harvest rates may have been further depressed by the common knowledge of botulism induced fish kills, which undoubtedly reduced motivation to harvest smallmouth bass among some anglers. Also, the recent emergence of excellent quality yellow perch and walleye fishing may represent a more palatable alternative for anglers interested in consuming their day's catch. Independent indicators of the smallmouth bass population suggest the adult bass population remained abundant in 2006, despite the measured low angler harvest.

Creel survey on Lake Erie



The yellow perch harvest (65,706 fish) in the 2006 sport fishery was the fifth highest observed in the 19-year survey. The 2006 yellow perch sport harvest was centered in the vicinity of Silver Creek, New York. All other areas produced a markedly lower harvest of yellow perch. The 2006 overall yellow perch catch rate was 1.46 perch per hour and remained similar to the highest values observed in the time series. The mean length of harvested yellow perch was 11.0 in. in 2006.

Round gobies remained a frequently encountered nuisance species for anglers in 2006. Lake trout was the most caught (880 fish) salmonid species, but only a small fraction of them (207 fish) were harvested. Rainbow trout and brown trout were the other salmonid species detected during the 2006 creel survey. In all, 20 species were reported caught, representing an estimated total catch of 244,928 individual fish from the 2006 angler survey. Smallmouth bass, yellow perch and walleye comprised approximately 73 percent of the total 2006 catch. These same three species accounted for 98 percent of the 2006 harvest.

Beginning in 2001, a significant yellow perch fishery emerged and has continued through 2006. The recent improvement in yellow perch fishing quality was consistent with other independent indicators that suggest the status of the yellow perch population has improved from very low levels measured during the mid-1990s.

Forage Trawl Survey
Annual bottom trawling to characterize the forage fish community in Lake Erie has been underway since 1992. This survey has an additional objective of assessing the status of yellow perch. New York's annual forage fish abundance measures are also merged with broader lake wide assessments of forage fish populations and reported with the inter-agency Forage Task Group.

Each year, the principal functional group among forage fishes in the New York waters of Lake Erie are soft-rayed fishes. Until 2001, this soft-rayed group encountered by nearshore bottom trawling has been annually dominated by rainbow smelt. In the past, an alternate year cycle of expanded yearling smelt abundance has been a conspicuous, predictable characteristic of annual forage abundance. In the absence of an abundant yearling cohort of smelt, YOY smelt had typically remained as the most abundant forage fish component. Beginning in 2001 several other species also began to make significant contributions to this soft-rayed segment of the forage fish community, including emerald shiners, trout-perch and round gobies. From 2000 through 2003, yearling-and-older (YAO) smelt abundance remained at low abundance, ending their predictable alternate-year abundance cycle. During 2004 YAO smelt briefly re-emerged as the most abundant forage fish component in this trawling survey then subsided to lower abundance in 2005 and 2006. Round goby emerged in the late 1990's as a new species among this soft-rayed forage fish group and their abundance peaked during 2004. The 2006 abundance index for round goby remains as the second highest observed in the trawling series. Beginning in 2001, emerald shiners also became a predictable annual contributor to forage biomass and abundance. In 2006, emerald shiners became the most abundant species encountered in this trawl survey and were also measured at their highest abundance in the 15 year history of this survey. Overall forage fish abundance and diversity in 2006 remained at high levels relative to the entire time series.

Bottom trawling suggests that autumn forage fish densities in the New York waters of Lake Erie during 2006 were high relative to the history (1992-2006) of this program. In past years, large annual fluctuations in forage fish abundance observed in both acoustic and bottom trawl assessments have been attributed to an alternate-year cycle in rainbow smelt abundance. In 2004 high densities of yearling smelt briefly emerged following four years of relatively low abundance then subsided in 2005. Overall forage fish abundance as measured by the trawl survey remained high in 2006. The largest contributor to the 2006 forage fish index in both numbers and biomass was emerald shiners. This 2006 survey was also the first occasion in 15 years of assessment that a native fish species was the most abundant component of the forage fish community.

<u>Lake Ontario and Tributaries</u>

Lake Ontario Unit

Lake Ontario Fishing Boat Census
The Lake Ontario fishing boat census provides trend through time data on angling effort and success, and performance of stocked salmonids. While the census targets the open water salmonid fishery, valuable data on other fish species are also collected. The 2006 angling season marked the 22nd consecutive year (1985-2006) that the census was conducted. Methodology has changed little over the history of the census, with sampling covering boat access channels along 190 miles of New York's Lake Ontario shoreline for the period April 1 to September 30 each year.

Trout and salmon fishing quality in 2006, as measured by catch rate (number of fish caught per fishing boat trip) among boats fishing for trout and salmon (2.53 fish per boat trip) was excellent. The 2006 estimate was 12.6% lower than in 2005, and 1.2% lower than the previous 5-year (2001-05) average. The April-September 2006 chinook salmon catch rate (1.21 fish per boat trip) declined from the 2005 record high (1.74 fish per boat trip), however was still the fourth highest on record. Catch rates were above their respective previous 5-year averages for coho salmon (+106.0%) and rainbow trout (+32.2%). Catch rates for brown trout, lake trout and Atlantic salmon were below their respective previous 5-year averages.

Despite excellent fishing quality in 2006, particularly for chinook salmon, total fishing effort declined to the lowest level (66,906 fishing boat trips) in the 22-year census history and was 23.4% below the 2001-2005 average. Trout and salmon fishing effort in 2006 was the second lowest estimate among the years censused and 12.5% below the previous 5-year average. Anglers targeting trout and salmon accounted for 49,223 fishing boat trips, or 73.6% of the April - September 2006 total. Fishing boat trips targeting smallmouth bass during the open season declined to 13,586 (+/- 22.9%) in 2006, 48.2% below the 2001-2005 average and the second lowest estimate among years censused.

Total trout and salmon harvest in April-September 2006 was estimated at 78,166 fish. Chinook salmon was the most commonly harvested salmonid in 2006 (39,439 fish), comprising 50.5% of the total. The 2006 chinook harvest rate was the third highest observed among the 22 years censused, and increased 15.9% compared to the previous 5-year average, and increased 51.9% compared to the longer term (1985-2005) average harvest rate. Brown trout harvest in 2006 was estimated at 15,642, comprising 20.0% of the total harvest. This estimate was a record low harvest estimate among all years censused and represented a 24.8% decrease compared to the previous 5-year average. Rainbow trout was the third most commonly harvested species, with an estimate of 10,750 fish. This represents a 42.3% increase over 2005, and a 7.2% increase compared to the previous 5-year average. Coho salmon harvest in 2006 was estimated at 9,370 fish, representing 12.0% of the total salmonine harvest in 2006 and a 106.0% increase compared to the 2001-2005 average. Lake trout harvest in 2006 declined to a fourth consecutive record low 2,964 fish. In 2006, no Atlantic salmon were observed among the 2,239 fishing boat interviews. The declines in harvest rates for brown trout and lake trout may be attributable, in part, to the excellent Chinook salmon catch rates over the last two years and the excellent coho fishing in 2006.

Smallmouth bass was the most commonly harvested species in the census from 1995-2003; however, Chinook salmon harvest increased dramatically from 2004 through 2006 while smallmouth bass harvest declined, indicating a possible shift in angler preference. The 2006 smallmouth bass harvest (17,759 +/-61.3%) was the lowest seasonal harvest among the years censused and a 62.8% decrease relative to the previous 5-year average.

Lake Ontario Prey Fish Abundance

The USGS and the NYSDEC have cooperatively assessed Lake Ontario prey fishes annually since 1978 using bottom trawls during spring, summer, and fall along twelve transects distributed across the New York shoreline of the lake. Alewife and rainbow smelt are the dominant prey species for Lake Ontario salmonids. NYSDEC also conducts a summer hydroacoustic survey of prey fish populations cooperatively with the Ontario Ministry of Natural Resources.

In 2006, the abundance index for adult alewife (age 2 and older) was the lowest on record, 71% lower than in 2005 and 94% lower than the peak in the 1980s. The numerical abundance index for age 1 alewife in 2006, however, was 5 fold higher than that of spring 2005, approximately double the long-term mean. In 2007, we expect strong recruitment of age 2 fish from the large 2005 year class to increase the adult alewife abundance index to 2002-2004 levels.

The exotic round goby continued its expansion along New York waters of Lake Ontario. The numerical abundance index for round goby in 2006 was similar to that in 2005, but the weight index continued to increase, perhaps indicating a leveling-off of the population with a higher number of older, larger fish.

Trawl net full of alewives

Lake Ontario preyfish trawling assessments are incorporating several methods to improve accuracy, including hydroacoustic evaluation of areas between trawl transects, and informed allocation of sampling effort. Results showed no spatial differences in fish abundance estimated by acoustic sampling compared to bottom trawling, and acoustic sampling did not identify any potentially large sources of error in allocation of trawling effort, i.e., trawling effort was allocated to depths at which fish were mostly present.

The 2006 hydroacoustic survey consisted of five cross-lake transects and an Eastern Basin transect. The hydroacoustic estimate of age-1 and older alewife abundance (1.03 billion fish) rebounded from the record-low level observed in 2005, probably as a result of the strong 2005 alewife year class. The 2006 acoustic estimate for alewife abundance was equal to the number observed in 2000, when the strong 1998 and 1999 year classes began recruiting to the yearling and older alewife population. The 2006 hydroacoustic estimate of smelt was 126 million fish. The smelt population declined by 42% from 2005, and was the 3rd lowest on record from the acoustic survey. Abundance and biomass were 38% and 49%, respectively, below the long term averages.

In October 2006, we continued use of the tickler chain modification to resume the slimy sculpin index survey. Catches of slimy sculpins in 2006 were lower than in 2005 for all depths. During 2006 sampling, we also caught 16 deepwater sculpin [52 - 108 mm (2.0 - 4.3 in)], continuing the 2005 trend of increased catches of this species, once thought to be extirpated from Lake Ontario.

Eastern Lake Ontario Warm Water Fisheries Assessment

Assessment of trends in the warm water fish community of the New York waters of Lake Ontario's eastern outlet basin has been conducted annually since 1976 using a standardized gillnet sampling program. Since 1976, the warm water fish community has undergone significant changes, declining from a high catch-per-unit-effort (CPUE) of approximately 200-250 fish per overnight gill net set in 1976-79 to a record low 14.9 fish in 1995. Most fish species have experienced significant declines in abundance, however, the decline in warmwater fish abundance is primarily attributed to declines in white perch, yellow perch, gizzard shad, alewife and rock bass abundance. Since 1995, mean stratified CPUE for total warmwater fish catch has varied without trend, averaging 22.7. The species dominating the catches have changed over time, changing from a community dominated by white perch, yellow perch and gizzard shad to one dominated by smallmouth bass and yellow perch by 1990.

In 2006, total mean CPUE was 28.2 fish, comparable to the 2005 estimate, and 30.0% and 37.2% higher than the previous 5-year and 10-year averages, respectively. The smallmouth bass CPUE trend has varied over time and reached record to near record lows during 2000-2004 (mean CPUE=4.2). The decline in smallmouth bass at that time was primarily attributable to double-crested cormorant predation. Smallmouth bass CPUE increased substantially in 2005 (CPUE=11.3) and remained near that level in 2006 (CPUE=10.6). The 2006 smallmouth bass CPUE was 148.6% higher than the previous 5-year average. Concurrent with increased CPUE, growth of smallmouth bass has increased in recent years and condition was at record high levels for all length increments examined in 2006. The recent increase in smallmouth bass CPUE may be due to several factors including recruitment of a strong year class, improved catchability, and reduced predation by double-crested cormorants. Yellow perch abundance in 2006 was 11% higher than the previous 5-year average. Walleye abundance in 2006 was comparable to the previous 5- and 10-year averages. Lake sturgeon, a threatened species in New York State, have been collected in ten of the last twelve years. Round gobies first appeared in the Eastern Basin assessment in 2005 and, in 2006, appeared in greater frequency in both gillnets (N=5) and in smallmouth bass stomachs (20.3% of non-empty stomachs).

Setting gillnet on Lake Ontario

Impacts of Double-crested Cormorant Predation on Smallmouth Bass and Yellow Perch

For the eighth consecutive year, Region 6 Wildlife staff continued double-crested cormorant population control at Little Galloo Island through oiling of eggs with food grade vegetable oil and culling of adults birds. Nest destruction and culling of adult birds were utilized to discourage nesting on Bass and Gull Islands. A total of 170 cormorants were culled by shooting at Bass Island, and 620 at Little Galloo Island. Target levels of fish consumption by cormorants, as measured by the Weseloh and Casselman feeding day model, were very nearly reached in 2006.

Diet studies of cormorants from Little Galloo Island in the Eastern Basin of Lake Ontario have been conducted each year since 1992. In 1999 these studies were expanded to include two cormorant colonies in the Canadian waters of the Eastern Basin of Lake Ontario, Pigeon and Snake Islands, as well as three colonies in the Canadian waters of the upper St. Lawrence River (Griswold, McNair and Strachan Islands).

Egg-oiling reduced cormorant chick production by approximately 97% on Little Galloo Island in 2006, thereby reducing fish consumption by 90,000 smallmouth bass and 338,000 yellow perch. Since 1999, the cormorant egg oiling program on Little Galloo Island has reduced fish consumption by chicks at the colony by 45.2 million fish, including approximately 8.3 million yellow perch and 2.2 million smallmouth bass. Smallmouth bass abundance in the Eastern Basin as measured in index gillnets increased in 2005 and 2006, possibly indicating a population response to reduced cormorant predation. The 2006 smallmouth bass harvest rate in the Eastern Basin increased to the highest level since 1989, lending additional evidence of an increase in smallmouth bass abundance. Estimated total fish consumption by cormorants from the Little Galloo Island colony in 2006 was 10.1 million fish, including 6.9 million round goby, 1.01 million alewife, 0.96 million yellow perch, 0.34 million rock bass, 0.31 million pumpkinseed and 0.14 million smallmouth bass.

Estimated total fish consumption by cormorants from three upper St. Lawrence River colonies (Ontario waters) in 2006 (7.32 million fish) was the highest observed over the last six years. Average annual fish consumption by cormorants from Griswold, McNair, and Strachan Islands since 1999 is 6.16 million fish. Total combined consumption in 2006 included 1.7 million yellow perch, 2.6 million round gobies, 0.47 million rock bass, 0.4 million pumpkinseeds, and 0.06 million smallmouth bass. Since 1999, Double-crested cormorants from these colonies have consumed an estimated 49.28 million fish including 23.18 million yellow perch, 8.12 million rock bass, 4.91 million cyprinids, 4.12 million pumpkinseed, 0.49 million smallmouth bass, and 0.31 million esocids(pike, pickeral and muskellunge).

Lake Ontario Unit staff are continuing efforts to promote a coordinated binational, regional approach to cormorant research, monitoring, and management.

Lake Ontario Lake Trout Restoration

The USGS and the NYSDEC cooperatively assess juvenile and adult lake trout in Lake Ontario. The mid-summer bottom trawl survey targeting age 2 lake trout has been conducted annually since 1979. A September gillnetting survey targeting adult lake trout has been conducted annually since 1983. The total yearling lake trout stocking target (U.S. and Canada) for lake Ontario is currently 1 million fish annually.

<u>Lake Ontario Juvenile Lake Trout Assessment</u>

First year survival of stocked lake trout was relatively high for the 1979-1982 year classes but then declined by about 32%, and fluctuated without trend for the 1983-1989 year classes. First year survival began declining in the early 1990s and has remained low for more than a decade. In 2006, the total catch of one age 2 lake trout was the lowest recorded and the survival index was 99% below the average for the 1983-1989 year classes. In four out of the last six years the survival index (for the 1997, 1999, 2000, and 2002 year classes) was about 3.5 times higher than the lows seen for the 1994–1996 year classes. Although this modest increase in the survival index was encouraging, it has not persisted and nearly all of the age 2 fish caught in those years were from sites near the western end of the lake suggesting that yearling survival in western Lake Ontario is higher than in eastern Lake Ontario.

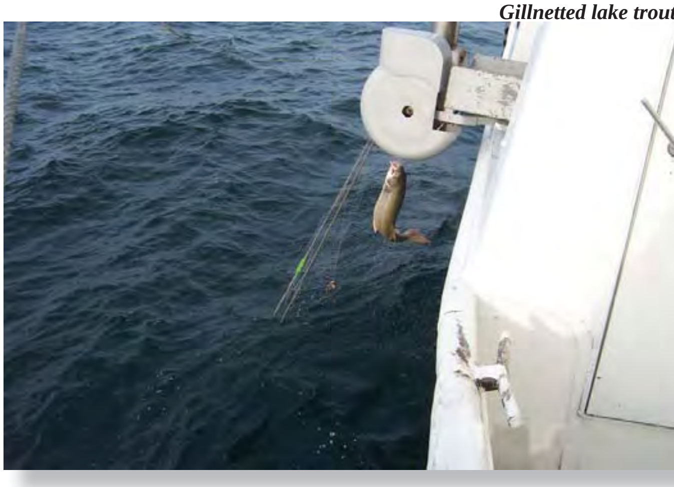
<u>Lake Ontario Adult Lake Trout Abundance</u>

A total of 505 adult lake trout were captured in the September 2006 gill net survey. Catch rates for mature lake trout remained remarkably stable from 1986 to 1998. The catch-per-unit-effort (CPUE) of mature fish, however, declined by 31% between 1998 and 1999. Declines in adult numbers after 1998 were likely due to poor survival of hatchery fish in their first year post-stocking and lower numbers of fish stocked since the early 1990s. After the 1998-1999 decline, the CPUE for mature lake trout remained relatively stable during 1999-2004 (mean 11.0), but then declined by 54% in 2005. The 2006 CPUE (7.3) for adult fish rebounded somewhat to a level 58% below the 1986-1998 mean and 33% below the 1999-2004 mean.

<u>Lake Ontario Sea Lamprey Wounding Rate Index</u>

Sea lamprey wounding rates on lake trout remain much lower than pre-1985 levels, but have been above the planned target level of 2.0 A1 wounds per 100 fish for seven of the last ten years. Wounding rate in 2006 was 2.9 A1 wounds per 100 fish. Numbers of lampreys observed attached to lake trout caught by boat anglers participating in the boat census was 22.0% higher than the 2001-2005 average, but was 36.3% lower than the 2005 record high.

Gillnetted lake trout



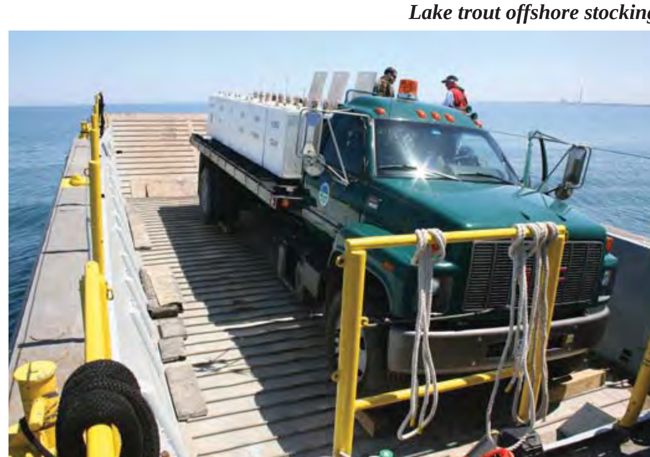
Survival of Adult Lake Trout in Lake Ontario
Survival of Seneca strain lake trout has been about 20-45% greater than that of Superior strain for the 1984-1995 year-classes. Lower survival of Superior strain lake trout was likely due to higher susceptibility to and mortality from sea lampreys. Survival of both the Lewis and Jenny Lake strains was similar to the Superior strain suggesting that they are highly vulnerable to sea lamprey predation. In recent years, survival of the remaining Ontario strain fish (Seneca X Superior strain) approached that of the Seneca strain. Use of coded wire tags was only limited for the 1996-2002 year classes, therefore, adult survival values for the 1996-1998 year classes could not be estimated for the untagged Seneca strain fish which made up 69-89% of those stockings. Tagging all lake trout stocked into New York waters of Lake Ontario resumed in 2004 (2003 year class).

Natural Reproduction of Lake Trout in Lake Ontario
In 2006, seven naturally produced age 2 (6) and age 3 (1) lake trout (7.6 to 12.9 in total length) were caught with bottom trawls. Survival of naturally produced lake trout to the fingerling stage in summer and fall occurred each year during 1993–2004. Further, survival to older ages has been apparent, demonstrating the feasibility of lake trout rehabilitation in Lake Ontario. The distribution of catches of wild fish suggests that lake trout are reproducing throughout New York waters. No wild yearling lake trout were caught in 2005 or 2006, and there is no evidence of a naturally produced year class in 2005.

Annual Angler Harvest of Lake Trout from Lake Ontario
The estimated annual harvest of lake trout from U.S. waters of Lake Ontario declined over four-fold since the slot limit (25 to 30 in) was re-instated in 1992 compared to years without size limits. The slot limit was imposed to protect adult fish during the age period of peak spawning potential. In 2006, lake trout harvest (2,964), catch (8,656), and harvest rate were the lowest on record, but total trout and salmon angling effort was also the second lowest observed since the creel survey began in 1985. The percentage of lake trout harvested by anglers that were of trophy size (>30 inches) declined to 22.5%, down from the record value observed in 2003 (48.5%). The relatively low catch and harvest rates for lake trout may be due, in part, to both a shift in angler preference to take advantage of excellent chinook salmon fishing, and recent declines in adult population.

Lake Trout Stocking Study
A study evaluating the effect of location (onshore vs. offshore) and timing (May vs. June) of stocking on the survival of lake trout is being conducted at Olcott and Sodus, New York. Catches of age 2 through age 7 lake trout from Olcott indicate offshore stocking improved survival compared to shore stocking in May or shore stocking in June by a 1.9 : 1.0 : 1.1 margin. In addition, lake trout stocked at Olcott yielded catches 5.8-fold higher than those stocked at Sodus. Sodus catches showed a trend similar to that observed at Olcott with offshore stocking improving survival over May and June shore stockings by a margin of 2.3 : 1.4 : 1.1. The 2-fold greater returns for offshore stocking over both shore stockings indicates that predation on shore stocked fish has likely contributed to the declines in first year survival of stocked lake trout observed since 1991. Both the trawl survey (< age 2 lake trout) and the adult gill net survey indicate that survival and recruitment of stocked lake trout is greater for fish released west of Rochester compared with those released east of Rochester.

Lake trout offshore stocking



Eastern Basin Lake Whitefish Spawning Study
The USGS and Lake Ontario Unit staff are cooperating in an ongoing assessment of the reproductive habits of lake whitefish and lake herring in the U.S. waters of the Eastern Basin of Lake Ontario. In 2006, a study investigating the disease status and genetic makeup of spawning lake herring and whitefish was conducted. Lake Ontario Unit staff collected 19 lake whitefish and 37 lake herring from Chaumont Bay in November 2006. All fish were determined to be disease-free by NYSDEC Rome Laboratory, and genetic analyses were conducted by USGS Wellsboro for comparison to Coregonines from other Great Lakes. Genetic analyses revealed that lake herring from Lake Erie are most likely a distinct remnant stock most closely related to Lake Huron stocks. Fish from Lake Ontario are more genetically divergent and have higher genetic diversity than Coregonines collected from other lakes. DEC will use this and other information in developing a deep-water Coregonine restoration plan for Lake Ontario in 2007.

Chinook Salmon Energy Content Study
Chinook salmon are Lake Ontario's dominant, large predator

and highly regarded sport fish. The Lake Ontario Unit initiated a project in 2003 to monitor the energy content of chinook salmon in the lake. Energy content is a strong indicator of chinook nutritional status, which is dependent upon their ability to capture prey items with sufficient nutritional value. A low energy content would suggest that either there are few prey available, or that the prey they are consuming are widely dispersed and/or low in energy content. The Lake Ontario study is based on, and in conjunction with, studies being done on the upper Great Lakes coordinated by researchers at Michigan State University. It has been found that the traditional method of measuring a fish's condition by using the relationship between its length and weight may not be appropriate for use with chinooks. As with many pelagic or open-water fish species, chinook maintain their body form to keep an efficient hydrodynamic profile for prolonged swimming. They achieve this by taking on more water in their tissues to replace unavailable fat. Therefore a fish which is low in energy content (body fat) may appear and weigh normal, while in fact they are actually retaining more water. A salmon with water content greater than 78 percent indicates nutritional stress.

During the summer of 2006, tissue samples from approximately 120 chinook salmon were obtained from fish cleaning stations at Olcott ("western" sample) and Oswego ("eastern" sample). The fish were measured, weighed and had a small section of muscle removed from their backs, from which the water content was determined. Average water content of Chinook salmon from eastern (72.1%) and western (72.9%) ports was not statistically different. Average water content declined as fish aged. Mean water content of age-1 fish (75.8%) was significantly different from older ages. No salmon in 2006 had water content greater than the 78% threshold that would indicate nutritional stress. Average water content of salmon was lower in 2006 compared to 2003 and 2004 indicating an improved nutritional condition of salmon in Lake Ontario. This study will supplement the ongoing long-term prey fish assessment information that the DEC currently uses to help make management decisions regarding the balance between predator and prey in Lake Ontario.

Walleye Rearing and Stocking - Eastern Lake Ontario/St. Lawrence River

Lake Ontario Unit and Region 6 Fisheries staff, in collaboration with the Village of Cape Vincent and the Lake Ontario Fisheries Coalition, reared and stocked over 122,000 summer fingerling walleye in 2006. Walleye brood stock were collected from Mud Bay in Eastern Lake Ontario. Walleye were stocked at three Lake Ontario and four St. Lawrence River sites, and averaged 1.7 in. in length at time of stocking.

Walleye hatching jars

Region 6

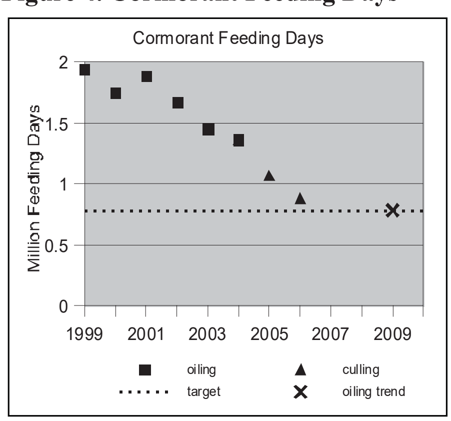
Enhanced Survival of Stocked Salmonids

Fisheries and Operations staff, along with fish culture staff and a contract vessel operator stocked 48,000 domestic brown trout into Lake Ontario off Stony Point, Jefferson County. Fish were stocked off-shore by landing craft in order to minimize losses due to bird and fish predation. Brown trout are stocked to support a fishery.

Cormorant Management

The goals of cormorant management in eastern Lake Ontario are: 1) restoring the structure and function of the warmwater fish community 2) reducing the negative impacts of Double-crested Cormorants on nesting habitats and other colonial waterbird species. 3) improving the quality of smallmouth bass and other fisheries and 4) fostering a greater appreciation for Great Lakes colonial waterbird resources. Management of cormorant colonies in NY has involved egg oiling, nest removal, harassment of migrant cormorants and habitat modification. Lethal control of adults has been applied for several years. Results of cormorant management at Little Galloo Island include: 1) reduced cormorant reproductive success by 95+% 2) reduced overall fish consumption, especially yellow perch 3) reduced consumption of smallmouth bass. In recent years much of the cormorant predation has focused on round goby.

Figure 4. Cormorant Feeding Days



Creel and Angler Surveys

Central Office- Biological Survey Unit

2007 New York Statewide Angler Survey
In order to manage New York's fisheries in ways that maximize human benefits, comprehensive information is needed periodically on the fishing patterns, preferences, and attitudes of anglers as well as the economic benefits of New York's fisheries. Such information is most efficiently obtained from a statewide mail survey of anglers. The Bureau has not conducted a study of this type since 1996. Numerous changes in regulations, stocking, and fish populations over the past decade warrant that a new survey be developed and deployed to garner information for effective management.

In 2006 a seven person team developed the angler survey. The primary goal was to develop a survey that would be less lengthy than those of the past and which would yield a higher response rate amongst surveyed anglers. In the end the team developed a total of 16 questions to gather key information and to evaluate progress toward meeting Bureau management objectives. The Bureau also entered into a contractual agreement with professionals from the Human Dimensions Resource Unit of Cornell University to refine the questionnaire, define the sampling pool, implement the survey and aid in the analysis of collected data.

Roughly 54,000 anglers will be randomly selected from the Department's automated licensing system (DECALS) to receive surveys. Unlike previous surveys that asked anglers to remember fishing experiences for an entire year, the 2007 survey will be conducted in three phases to minimize the time horizon for recollection and hopefully reduce the amount of bias associated with long-term recall. The phase one mailing to 17,000 anglers will take place in June of 2007. Subsequent mailings will take place in the fall and winter of 2007. A final report on the results of the survey will be available in the spring of 2009.

Region 1

Suffolk County Trout Stocked Waters Creel Census
The Region 1 Fisheries Unit initiated a Creel Census of eight trout stocked waters in Suffolk County in the fall of 2006. The program objectives for this two year survey are:

1. Determine angler use, speciestargeted, catch composition, catch rates and harvest rates from trout stocked ponds in Suffolk County.

2. Determine angler use and harvest from fall stocked waters in the fall and winter.

3. Determine angler attitudes and satisfaction levels with fishing quality and fish management policies in trout stocked ponds in Suffolk County.

4. Determine compliance with the current fishing regulations. Provide education on the purpose and need for those regulations.

5. Determine numbers of Canada geese and double crested cormorants utilizing survey waters.

Project results for the reporting period:

- From October 7, 2006 to March 31, 2007, 1,777 count surveys were completed and 124 anglers interviewed. Count surveys were performed each visit at each lake and include counts of Canada geese, double crested cormorants, and anglers by shore, wading, boat, and ice. Figure 1 shows the average number anglers counted by angling type observed for each lake/pond and river. Randall Pond was the only freshwater where an ice angler was observed and interviewed.
- From October 8, 2006 to March 31, 2007, the NYSDEC Region 1 Fisheries Unit interviewed 124 anglers. Of the interviewed anglers, 71.2% (N=118) were at least satisfied with the sizes of fish caught, and 64.4% (N=118) were at least satisfied with the numbers of fish caught.
- The proposed trout regulation states "The current trout season for this water body is year-round with a catch limit of 3 trout per day of any size (except Nissequogue River - 3 trout per day, minimum length 12 in). The Department is considering creating a period of catch and release only for trout fishing immediately after stocking for X amount of time (in weeks)." Seventy-nine percent (N=82) of the interviewed anglers are in support of this change. Seventy-four percent of those in agreement with this proposal would like to see the catch and release fishing for 4 weeks.
- Table 8 shows CPUE's, HPUE's, and total amount of angling hours when trout were targeted for each of the surveyed lakes through April 17, 2007. As the table shows, Upper Yaphank Lake had the highest amount of angling hours exerted by anglers, Sayville Mill Pond had the highest average CPUE, and West Lake was the only lake where trout were harvested.

Table 8. Trout fishing effort by lake. Data collected are preliminary at this time. Sample size (n) represents total amount of anglers interviewed at the corresponding lakes

Lake Name	Total fishing effort (hrs)	Average CPUE (trout/hour)	Average HPUE (trout/hour)	Sample size (n)
Canaan Lake	2.1	0	0	1
Swan Lake	2.8	1.2	0	3
Sayville Mill Pond	9.8	5	0	4
Randall Pond	13	1.2	0	14
Kahlers Pond	31.1	0.1	0	7
Nissequogue River	51.5	0.04	0	26
Lower Yaphank Lake	60.9	0.1	0	15
West Lake	129.1	0.5	0.6	17
Upper Yaphank Lake	144.1	0.3	0	44

Region 4

Delaware Tailwaters Angler Diary Program
The West Branch Delaware River (West Branch) downstream of Cannonsville Reservoir, the East Branch Delaware River (East Branch) downstream of Pepacton Reservoir, and the Delaware River from Hancock to Callicoon comprise the upper Delaware Tailwaters, a unique fisheries resource in New York. Coldwater releases from Cannonsville and Pepacton Reservoirs have resulted

in popular, high quality trout fisheries totaling 75 miles. A multi-year angler diary program was established in 2002 to monitor the fishery throughout the Delaware Tailwaters. The objective of this study is to monitor trout catch rates, species composition, and size distribution for the West Branch, East Branch, and Delaware River.

During the 2006 trout season, 41 angler cooperators made 788 trips throughout the Delaware Tailwaters totaling 1,988 hours. Cooperators caught 78 hatchery brown trout, 942 wild brown trout, 136 rainbow trout, 9 brook trout, and 1 tiger trout for an overall Delaware Tailwaters catch rate of 0.61 trout per hour. This was down from the 0.83, 0.84 and 0.70 trout per hour recorded in 2003, 2004, and 2005, respectively.

West Branch cooperators made 450 trips totaling 1,101 hours and they caught 710 trout of which 482 were legal size (≥12 in). Brown trout comprised 93% of the catch. The riverwide catch rate averaged 0.65 trout per hour and 0.44 legal trout per hour. Approximately 22% and 8% of all trout caught were 18 inches plus and 20 inches plus, respectively. The West Branch is not stocked.

East Branch cooperators made 229 trips totaling 452 hours and they caught 318 trout of which 170 were legal size (≥12 in). The riverwide catch rate averaged 0.70 trout per hour and 0.38 legal trout per hour. In the upper East Branch (upstream of the Beaver Kill), anglers averaged 0.78 trout per hour compared to the 0.49 trout per hour in the lower East Branch (downstream of the Beaver Kill). Approximately 11% and 4% of all trout caught were 18 inches plus and 20 in plus, respectively. Brown trout comprised 89% of the total catch of which 24% were hatchery brown trout. The upper East Branch is stocked with approximately 1,500 yearling and 800 two year old brown trout annually.

Delaware River cooperators made 109 trips totaling 344 hours and they caught 138 trout of which 99 were legal size (≥14 in). The riverwide catch rate averaged 0.40 trout per hour and 0.29 legal trout per hour. Approximately 22% and 5% of the trout caught were 18 in plus and 20 in plus, respectively. The Delaware River is not stocked and brown trout comprised 54% of the trout catch.

Canadarago Lake Angler Diary Program

An angler diary program was established in 2004 on the 2,000 acre natural lake in Otsego County to assess the quality of the walleye and bass fishery. Eleven cooperators made 180 trips totaling 715 hours during the 2006 open water season. They caught 424 walleye, 27 largemouth bass, 22 smallmouth bass, 18 chain pickerel, and 1 tiger musky for an overall catch rate of 0.69 game fish per hour. In 2004 and 2005, cooperators averaged 0.33 and 0.42 game fish per hour.

Angler targeting walleye averaged 0.67 fish and 0.36 legal (≥ 15 in) fish per hour in 2006 compared to 0.41 fish and 0.30 legal walleye per hour in 2005. Sixty five percent of the 221 legal size walleye caught were creeled for a creel rate of 0.23 fish per hour. Walleye ranged from 7 to 24 in with an average length of 14.9 in and creeled walleye averaged 17.4 in. The high catch rate of walleye demonstrates that Canadarago Lake supports an excellent walleye fishery and this fishery should remain good to excellent in the coming years.

Targeted effort for bass was too low in 2006 to provide meaningful catch statistics. In 2004 and 2005, bass anglers averaged 0.33 and 0.70 bass per hour. The 2004 and 2005 effort indicated that the bass fishery has changed dramatically since similar studies were conducted from 1976 through 1980 and again in 1988 and 1989. During the 1976-80 study, the largemouth bass catch rate averaged 0.03 fish per hour (range was 0.02 to 0.05 fish/hour) and 0.55 smallmouth bass per hour (range was 0.39 to 0.65 fish/hour). In 1988 and 1989, the smallmouth bass catch rate was 0.44 and 0.20 fish per hour compared to less than 0.05 fish per hour for largemouth bass. Bass anglers in the 2004-05 study averaged 0.29 and 0.57 largemouth bass per hour and 0.04 and 0.13 smallmouth bass per hour, respectively. The reason for the shift from a bass fishery dominated by smallmouth bass, to one now dominated by largemouth bass is uncertain.

Schoharie Reservoir Diary Program

An angler diary program was established in 2004 on this 1,150 ac New York City water supply impoundment to assess the quality of the walleye fishery. Twelve cooperators made 60 trips totaling 223 hours during the 2006 open water fishing season. The low fishing effort recorded in 2006 was due to the extensive and extended drawdowns that were required to make emergency repairs to the dam. The intent was to maintain the water level at 60 feet below the crest of the dam from early spring into the fall which meant that the reservoir would have been at 20% capacity.

Despite the drawdowns, shore anglers targeting walleye averaged 0.35 fish per hour and 0.28 legal (≥15 in) fish per hour. The creel rate was 0.27 walleye per hour. The size of walleye caught by shore anglers ranged from 12 to 25 in with an average size of 16.5 in and 11% of the walleye were 20 in and larger. Boat anglers targeting walleye averaged 0.40 fish per hour and 0.36 legal fish per hour. The creel rate by boat anglers was 0.29 walleye per hour. The size of walleye caught by boat anglers ranged from 13 to 26 inches with an average size of 17.8 in and 18% of the walleye were 20 in and larger. Schoharie Reservoir supports a good to excellent walleye fishery.

The impact of the 2006 drawdowns on the Schoharie Reservoir walleye fishery is not known. There were no reports of any fish kills. The rainy summer and lack of any prolonged hot weather probably helped in minimizing any negative impacts. The 2007 cooperator study should help in better accessing the 2006 drawdown impacts.

Pepacton Reservoir Angler Diary Program

An angler diary program was established in 2004 on this 5,700 ac New York City water supply impoundment to assess the quality of the brown trout fishery. Shore angler cooperators made 125 trips totaling 565 hours and they caught 65 brown trout and six brook trout for an average catch of 0.13 fish hour and 0.06 legal (≥15 in) fish per hour. In 2004 and 2005, shore anglers averaged 0.20 fish per hour both years with 0.17 legal fish per hour caught in 2004 and 0.12 legal fish per hour caught in 2005. In 2006, the average size trout caught averaged 14.9 inches. Shore anglers creeled 0.03 trout per hour averaging 16.8 inches.

Boat angler cooperators made 598 trips totaling 2,677 hours and they caught 791 brown trout and 2 rainbow trout for an average catch of 0.30 fish per hour and 0.23 legal fish per hour. The catch of 0.30 trout per hour in 2006 was almost identical to the 0.29 and 0.28 trout per hour recorded in 2004 and 2005, respectively. Brown trout 21 in and larger numbered 131 fish for an average catch of 0.05 large trout per hour. Boat anglers creeled 210 brown trout averaging 20.2 in for a creel rate of 0.08 trout per hour. The average brown trout caught averaged 17.0 inches with 78% of the brown trout caught legal size.

Pepacton Reservoir is stocked with approximately 10,000 yearling brown trout annually. Shore and boat anglers caught 335 adipose fin clipped brown trout ranging in size from 7 to 25 in. Fin clipped fish from the 2004-06 stocking represented 39% of the total brown trout catch. Hatchery holdovers from the 2004 and 2005 stockings represented 34% of the 646 legal size brown trout caught in 2006.

Cannonsville Reservoir

An angler diary program was established in 2004 on this 4,800 ac New York City water supply impoundment to assess the quality of the brown trout fishery. Shore angler cooperators made 31 trips in 2006 totaling 84 hours and caught 6 brown trout, of which four were of legal size for an average catch of 0.07 trout/h and 0.05 legal trout/h. In 2005, shore anglers averaged 0.17 trout per hour. Boat angler cooperators made 157 trips totaling 565 hours and they caught 82 brown trout for an average catch of 0.15 fish per hour and 0.13 legal (≥12 in) fish per hour. The 2006 catch rates for all size and legal brown trout were much lower than the 0.25 fish per hour and 0.19 legal fish per hour in 2005. Ninety-one percent of the brown trout caught were legal size, 27% were 21 in and larger; and 11% were 25 in or larger. Creeled brown trout averaged 18.5 in.

An experimental stocking program of approximately 5,000 brown trout yearlings annually began in 2005. All stocked fish were fin clipped. In 2006, 21 hatchery brown trout from 10 to 18 inches were caught and comprised 24% of the total brown trout catch. Nineteen of these 21 fish were holdovers from the 2005 stocking. The presence of holdover hatchery fish in the 2006 catch suggests that the adverse conditions present in 2005 still provided sufficiently favorable habitat for these hatchery fish to survive even though Cannonsville Reservoir was drawn down 59 ft to 26% capacity by October 10.

Schoharie Creek Angler Diary Program

A five year angler diary program was started in 2004 to assess the walleye fishery in the 48 mi reach of Schoharie Creek from lower Blenheim-Gilboa dam downstream to the Mohawk River. Unfortunately all cooperator effort was limited to the upper 32 mi which lies almost entirely within Schoharie County. Since only five cooperators participated in the 2006 program, targeted effort was too small to provide meaningful catch statistics so all effort and catch data were combined. In 2006, all cooperators combined averaged 0.13 walleye per hour compared to 0.11 and 0.08 walleye per hour in 2004 and 2005, respectively. In general, open water non-targeted catch rates of 0.05 to 0.10 walleye per hour is considered fair fishing, 0.10 to 0.25 fish per hour as good to very good and anything over 0.25 fish per hour as excellent walleye fishing. By these standards, Schoharie Creek provides fair to good walleye fishing. The average walleye caught measured 18.8 in.

Although the focus of this study was on walleye, the smallmouth bass catch rates were also of interest. Shore, boat, and all anglers combined averaged 0.88, 2.07, and 1.07 smallmouth bass per hour, respectively. The 237 smallmouth bass caught ranged from 5 to 20 inches and 56% were 12 in and larger, compared to 37% and 55% in 2004 and 2005, respectively.

The abundance of 12 in and larger smallmouth bass in 2004, 2005, and 2006 suggests that the premise for the no size limit on bass upstream of Esperance and a 10 in size limit downstream of Esperance is no longer valid. Implementation of the statewide 12 in size limit would be appropriate for all of Schoharie Creek downstream of lower Blenheim-Gilboa Dam. This regulation change will be discussed with the three county sportsmen federations following completion of this study in 2008.

Region 7

Otisco Lake Angler Diary Program

Angler participation in the Otisco Lake diary program increased substantially in 2006. Sixteen cooperators recorded effort from 316 trips and caught 477 legal gamefish. They were successful in catching at least one gamefish in 69% of their outings. Walleye fishing was very good with cooperators catching a total of 160 legal fish. Legal length gamefish caught by cooperators also included 99 smallmouth bass, 175 largemouth bass, 35 brown trout and eight tiger muskellunge. Of the legal gamefish caught, anglers harvested only 107 walleye, 14 smallmouth bass, 6 largemouth bass, and 16 brown trout.

2006 Cayuga Lake Angler Diary Program

Sixty-one coldwater cooperators caught 1,684 legal salmonids in 1,013 trips for an average of 1.7 fish per trip. Legal salmonids were caught at an average rate of 3.0 hours per fish. Coldwater lake cooperators were successful in catching at least one legal salmonid in 74 percent of their trips. Cayuga Lake coldwater cooperators caught 1,543 legal lake trout, 35 legal rainbow trout, 58 legal brown trout and 48 legal landlocked salmon. Catch rates for these species were 1.52, 0.03, 0.06 and 0.05 legal fish per trip while harvest rates were 0.71, 0.02, 0.03 and 0.03 legal fish per trip, respectively. Lake trout comprised 92 percent of the legal salmonid catch while rainbow trout, brown trout and landlocked salmon were two, three and three percent, respectively.

Fourteen Cayuga Lake warmwater cooperators caught 88 legal smallmouth bass, 59 legal largemouth bass, 19 legal northern pike and eight legal chain pickerel in 133 trips for an average of 1.3 legal warmwater gamefish per trip. A total of 30 smallmouth bass, 16 largemouth bass and one northern pike were kept by warmwater cooperators. The largest smallmouth bass, largemouth bass, northern pike and chain pickerel caught were 19.0, 18.5, 40.0 and 18.0 inches, respectively. The north end of the lake produced all the pickerel while the south end produced all the northern pike and most of the smallmouth bass and largemouth bass.

2006 Owasco Lake Angler Diary Program
Thirty-six Owasco Lake coldwater cooperators caught 815 legal salmonids in 314 trips for an average of 2.6 legal fish per trip. Legal salmonids were caught at an average rate of 1.8 hours per fish. Coldwater lake cooperators were successful in catching at least one legal salmonid in 82 percent of their trips. Owasco Lake coldwater cooperators caught 777 legal lake trout, 31 legal rainbow trout, six legal brown trout and one legal landlocked salmon. Catch rates for these species were 2.47, 0.09, 0.02 and 0.003 legal fish per trip while harvest rates were 0.58, 0.04, 0.01 and 0.00 legal fish per trip, respectively. Lake trout comprised 95 percent of the legal salmonid catch while rainbow trout and brown trout were four and one percent, respectively.

Twelve Owasco Lake warmwater cooperators caught 33 legal walleye, 48 legal smallmouth bass, 21 legal largemouth bass and seven legal northern pike in 108 trips for an average of 1.0 legal fish per trip. A total of 29 walleye, 17 smallmouth bass and one largemouth bass were kept by our cooperators. The largest walleye, smallmouth bass, largemouth bass and northern pike caught were 26.5, 21.0, 18.3 and 32.5 inches, respectively. Burtis Point and the north end produced most of the walleye, smallmouth bass and largemouth bass while the south end produced most of the northern pike.

2006 Skaneateles Lake Angler Diary Program
Thirty-six Skaneateles Lake coldwater cooperators caught 686 legal salmonids in 519 trips for an average of 1.3 fish per trip. Coldwater cooperators were successful in catching at least one legal salmonid in 66 percent of their trips. Legal salmonids were caught at an average rate of 2.9 hours per fish. Skaneateles Lake coldwater cooperators caught 321 legal lake trout, 276 legal rainbow trout, one legal brown trout and 88 legal landlocked salmon. Catch rates for these species were 0.62, 0.53, 0.002 and 0.17 legal fish per trip while harvest rates were 0.30, 0.31, 0.00 and 0.11 legal fish per trip, respectively. Lake trout comprised 47 percent of the legal salmonid catch while rainbow trout and landlocked salmon were 40 and 13 percent, respectively. The benefits of increased salmon stocking were noted in the 2006 lake catch. An additional 64 sub-legal salmon were caught and released which suggested good salmon fishing would likely continue in 2007.

Three Skaneateles Lake warmwater cooperators caught 80 legal smallmouth bass in 28 trips for an average of 2.8 legal fish per trip. Sixty-two of these fish were harvested by our cooperators. The harvested smallmouth bass averaged 14.8 in and the largest was an impressive 20.0 in.

To achieve uniformity with the other Finger Lakes and to be consistent with the increased abundance of 12 in and larger bass, the minimum legal length of Skaneateles Lake smallmouth bass and largemouth bass was increased from 10 in to 12 in on October 1, 2006.

Region 8

Conesus Lake Angler Diaries
Fishing effort by angler diary cooperators in 2006 was the lowest of the six years the Conesus Lake diary program has been in existence. The lowest number of days fished and angler trips were recorded in 2005-2006. It took diary-keeping anglers 1.78 hours to catch one legal game fish. This catch rate is a result of an abundant largemouth bass population. For anglers targeting largemouth bass, the catch rate was 0.79 legal bass/hour, which is better than the statewide average of 0.26 legal bass/hour. Largemouth bass dominated the catch with 81% of the total game species caught. The largemouth bass catch was composed of 98% legal sized (>12 in) fish. Of the legal largemouth bass caught, all but one were released. Although the majority of the bass were less than 15 in, anglers did catch some memorable fish with 26 largemouths greater than 18 in caught. Smallmouth bass comprised 10% of the total game fish catch, all were legal size, and all were released. Nine (24%) of the smallmouths caught were larger than 18 in. Northern pike made up a smaller portion of the total game fish catch than last year (6% down from 21%). Eighty four percent were legal size, with creeled fish averaging 27.3 inches. Diary keepers caught two northerns greater than 36 in. Tiger muskies made up only 1.0% of the game fish catch, with 5 of them caught and released by diary anglers. The tigers caught averaged 24.5 in. in length. Walleye made up only 2% of the total game fish catch with fish averaging 22.7 in. in the creel. All walleye caught were legal size. These numbers are similar to previous years. Anglers specifically targeting walleye caught 0.11 walleye per hour- less than the best catch rate of 2003-2004, but similar to other years. This is about half of the New York State objective of 0.2 walleye per hour, or one legal walleye for every five hours of fishing. Only 72 panfish were caught by diary keepers. All were caught by anglers who were after any game fish, or not specifically targeting any species of fish. Most were caught by bass fishermen. Catch rates for panfish species (i.e. perch, bluegill, pumpkinseed, and rock bass) were good, even though they were not targeted by those anglers. Most of the panfish catch was represented by rock bass (86%), black crappie (8%) and bluegill sunfish (69%). No yellow perch were reported.

Honeoye Lake Angler Diary 2006
This was the 18th consecutive year for the Honeoye Lake Angler Diary program. Four hundred forty two fishing trips were recorded, the lowest number ever. Anglers averaged only 0.95 hours to catch one legal gamefish. This is the best catch rate observed since this angler diary program began. Largemouth bass represented 93% of all gamefish caught. Anglers specifically targeting bass caught 1.83 legal bass/hour, a slightly higher catch rate than last year. The average length of harvested largemouth bass was 14.4 in. Several trophy-sized largemouth bass were caught with six fish over 20 in. in length reported. Honeoye Lake is providing great bass fishing opportunities in Region 8.

This year 167 walleye were reported, slightly more than last year. Anglers specifically targeting walleye caught 0.16 walleye/hour, slightly lower than the catch rate objective for New York waters. Catch of larger walleye decreased from the previous year with 14% of walleye with recorded lengths greater than 20 in. One walleye greater than 27 in was reported. This was the first time a fish this large has been reported since at least 2000. More walleye smaller than the legal 15 in were reported this year, with almost half of all reported walleye sub-legal. These sub-legal walleye should be contributing to the fishery in the coming years. Approximately 20% of all walleye were caught through the ice, down slightly from last year. Honeoye Lake is providing anglers with walleye catch rates comparable to other New York waters.

Oatka Creek Creel Survey Report Completed
The report for this Federal Aid funded survey was completed and submitted for Bureau review. The abstract is:

Oatka Creek is a high quality western New York trout stream. Fisheries resources in certain areas within the stream are managed by stocking hatchery raised yearling and two-year-old brown trout. Another section of the stream is managed for wild, naturally produced brown trout with restrictive harvest regulations. The trout fishing regulations in a portion of the wild area were changed from a high size and low creel limit to a no kill regulation on October 1, 2000. The trout fishing regulation in the stocked area was changed on October 1, 2002 from a no size and liberal creel limit to a regulation that limits the number of large trout that can be harvested (5 per day any size with no more than 2 larger than 12 in, known as the "5/2" regulation). Creel censuses were conducted prior to (2000), immediately after (2001) and three years after (2004), the regulation changes. The 2000 and 2001 surveys found that immediately after implementing a no kill regulation, total angler effort, total catch, and total harvest over both survey areas (wild and stocked) increased proportionally similar among management types and months. Catch rates remained the same between the two years among management types and months and harvest rates in the stocked areas were the same. As expected, harvest rates in the wild area immediately dropped from a low rate to nearly zero, but the near zero harvest rate unexpectedly did not persist in 2004. In 2004, effort in the wild area was slightly higher than 2000. It is not likely that the no kill regulation alone induced higher fishing pressure in the wild area, since effort was higher in both the stocked and wild areas in 2001 compared to both 2000 and 2004. Favorable air temperature and stream flow conditions were probably the reason why higher angler effort occurred in 2001, immediately after the no kill regulation change, because both 2000 and 2004 had unfavorable weather and stream flow conditions. The 2000 and 2001 surveys also determined that under the right weather and flow conditions, anglers targeting the larger stocked two-year-old brown trout were very successful at catching and creeling these fish immediately after they were stocked. Stocked area effort, catch, and harvest in 2004 were the lowest of the three survey years. The 2004 catch and harvest of large (>12"TL) brown trout from the stocked area were also the lowest of the three years surveyed. In 2004, the wild area catch and catch rates of large brown trout were the same as 2000 and 2001. The no kill regulation did not increase the density of anglers, the catch rate of, or the number of anglers catching, large brown trout in the wild area. The "5/2" regulation may have caused reduced angler effort, catch, and harvest rates of large brown trout, but does not appear to have appreciably spread the harvest of large brown trout among more anglers over a longer period of time in the stocked area.

Canadice Lake Angler Diary Program 2006
This was the first year that the Canadice Lake Angler Diary cooperator program was conducted since 1994. Eleven cooperators reported 73 trips. Anglers targeting any salmonid averaged 2.8 hours to catch one legal salmonid. This catch rate is higher than any of the previous angler diary catch rates from 1980 through 1994 for Canadice Lake. Lake trout represented 87.3% of all trout caught. A total of 110 lake trout were caught and only 44 were harvested. A total of 16 brown trout were caught and only two were harvested. No rainbow trout were reported in 2006. Canadice's trout population is maintained by annual stockings of 2,100 yearling lake trout, 2,500 yearling brown trout, and 2,500 yearling rainbow trout. Significant natural recruitment of lake trout has been found in the past.

Canandaigua Lake Angler Diary Program 2006
This was the 34th year of the Canandaigua Lake diary cooperator program. A total of 599 legal-sized lake trout were caught in 2006. It took 1.6 hours to catch one legal sized trout. The same as last year. For comparison, diary cooperators on Keuka and Seneca Lakes average 1.3 and 1.7 hours, respectively to catch one legal trout. Lake trout continue to be the driving force behind the coldwater fishery representing 91% of all trout caught. Anglers specifically targeting lake trout took only 1.1 hours to catch a legal lake trout, up slightly from last year when it took only 1.0 hours. Length and weight of lake trout averaged 21.4 in and 3.6 lbs, very similar to the 30-year average. June, July, and August provided 52% of the lake trout catch. Rainbow trout, Canandaigua Lake's only completely wild salmonid species, averaged 20.3 in and 3.5 lbs in the 2006 catch, slightly higher than recent years. The rainbow trout population is supported entirely by natural reproduction with Naples Creek being the main nursery stream. These trout typically spend two growing seasons in high quality tributaries before migrating downstream to Canandaigua Lake.

Hemlock Lake Angler Diary Program 2006
This was the first year that the Hemlock Lake Angler Diary cooperator program was conducted since 1994. Seventeen cooperators reported 172 trips. Anglers targeting any salmonid averaged 12.4 hours to catch one legal salmonid. This catch rate is similar to those reported in the past from Hemlock Lake angler diaries. Lake trout represented 44.1% of all trout and salmon caught. A total of 45 lake trout were caught and only four were harvested. A total of 36 brown trout were caught and only 14 were harvested. Rainbow trout and landlocked salmon diversified angler catches. Some large fish were reported from Hemlock Lake in 2006. The four harvested lake trout averaged over 8 pounds. Hemlocks's trout and salmon population is maintained by annual stockings of 3,200 yearling lake trout, 6,600 fingerling lake trout, 5,000 yearling brown trout, and 4,100 fingerling landlocked salmon. The Regional Management Unit is currently evaluating the extent of rainbow trout natural reproduction in Springwater Creek and its contribution to the fishery.

Warmwater gamefish were included in 2006. Anglers averaged 4.4 hours to catch a legal gamefish. A total of 89 smallmouth bass were caught and only four were harvested. A total of 4 largemouth bass were caught and none harvested. Twenty-four walleye were caught and 20 were harvested. Anglers who were specifically targeting walleye averaged 14.4 hours to catch a legal walleye.

Keuka Lake Angler Diary Program 2006
Initiated in 1968, Keuka Lake is the longest running angler diary program in Region 8. A total of 1,096 legal sized lake trout were caught in 2006. Catch rate of legal sized trout was very similar to recent years with anglers taking only 1.3 hours to boat a legal salmonid. For comparison, diary cooperators on Canandaigua and Seneca Lakes' average 1.6 and 1.7 hours, respectively to catch one legal trout. Lake trout continue to be the driving force behind the coldwater fishery representing 98% of all trout caught. Anglers specifically targeting lake trout took only 1.4 hours to catch a legal lake trout, slightly higher than recent years but still an excellent catch rate. The lake trout population in Keuka Lake is sustained entirely by naturally reproduced fish. Other trout and salmonids contributed very little to the overall fishery, although they continue to provide some diversity to anglers' catches. The rainbow trout population is completely dependent on natural recruitment, which occurs mainly in Cold Brook. Surveys have shown that Cold Brook supports an abundant population of young rainbow trout. However, as these young rainbow trout migrate to the lake, they are preyed upon heavily by the abundant lake trout population and other salmonine species. Bond Act monies have been allocated for work on Cold Brook to improve the stream habitat via rock rip-rap, willow plantings and construction of pool diggers. Work began this year and should be completed in 2007. In addition to the Bond Act project, preliminary work is being conducted to evaluate the causes and potential solutions to problematic conditions of the stream channel near the Mercury Aircraft plant upstream of Hammondsport.

Seneca Lake Angler Diary Program 2006
A total of 1,677 legal sized lake trout were caught in 2006. Of these, 769 or 46% were harvested. Catch rate of legal sized trout was very similar to recent years with anglers taking 1.7 hours to boat a legal salmonid. For comparison, diary cooperators on Canandaigua and Keuka Lakes average 1.6 and 1.3 hours, respectively to catch one legal trout. Lake trout continue to be the driving force behind Seneca's coldwater fishery representing 90% of all trout caught. Anglers specifically targeting lake trout took only 1.2 hours to catch a legal lake trout. Length and weight of lake trout kept averaged 21.8 in and 3.5 lbs and was slightly higher than recent years. Estimates from recent surveys indicate the natural recruitment rate accounts for approximately 60-70% of the fish that have been surveyed. Continued increases in natural recruitment may allow for a decrease in lake trout stocking in future years. Other trout and salmonids contributed little to the overall fishery, although they continue to provide diversity to anglers' catches. Anglers caught a total of 98 Atlantic salmon, harvesting approximately 61% of legal fish caught. The rainbow trout harvest was the highest in recent years. The rainbow trout population is completely dependent on natural recruitment, which occurs mainly in Catherine Creek.

Creel survey being conducted

Habitat Management, Protection and Restoration

Region 1

Peconic River Invasive Species Control

The Region 1 Fisheries Unit worked with the Peconic Estuary Program (PEP), The Nature Conservancy, the Freshwater Anglers of Long Island, and the Peconic Lake Estates Civic Organization to develop a plan for removal of *Ludwigia peploides*, also known as floating primrose willow, from the Peconic River. This plant, a South American native, was discovered in Peconic Lake, the largest impoundment on the Peconic River, in 2003. By the summer of 2005, the plant had overrun much of the lake's native vegetation and spread downstream to the head of the tidewater. The PEP with the assistance of the Regional Fisheries Unit applied for and received a grant for this project through the DEC's Aquatic Invasive Eradication Grant Program.

Ludwigia removal

The original plan called for two days of manual removal of the invader each year for three years, In 2006 the scheduled manual removal days were June 10 and August 19. On June 10, a total of 61 DEC staff and volunteers descended upon the water removing enough of the invasive species to fill a 20 cubic yard dumpster. On August 19, Fisheries staff and volunteers, about 50 individuals, pitched in to remove nearly 40 cubic yards of Ludwigia from about 55% of the infested shoreline of Peconic Lake.

Although several large patches were not removed during the two days of removal, most of the small patches around the lake were, including several near the spillway. This removal helped to prevent the further spreading of Ludwigia downstream.

The good news is that the areas that were cleared in June had not grown back in August. Based upon the removal results in Peconic Lake, extra removal days were scheduled for 2007. The August removal was moved into July to get the removal completed before the plants go to seed and to get in ahead of the massive biomass increase during the heat of the summer.

Regional Fisheries Unit staff also assisted with an additional manual removal operation of Ludwigia downstream from Peconic Lake. This operation was coordinated by the Peconic River Fish Restoration Commission with help from the Town of Riverhead and concentrated on Grangable Park, immediately above the tidewater and the spillway at Upper Mills Pond in between Peconic Lake and Grangable Park. This effort resulted in the removal of about 5 cubic yards of the plant from these areas.

Region 5

Sediments released from a dam on the Chateaugay River impact excellent trout habitat

On about September 5, 2006, a drain gate at the Chasm Hydro dam on the Chateaugay River in Franklin County was opened, allegedly causing the release of large quantities of sand and silt downstream. The Chateaugay River in this area was a very high-quality trout stream. Law enforcement, Water Quality and Fisheries staff investigated the complaint. Staff observed the impoundment behind the dam had been drained to perform repairs to the dam. A plume of sediment extends for more than three miles downstream. The sediment consists of a light brown fine, silty sand and a black organic muck. Pools were filled with sediment, and sediment covered the rocks and adjacent banks. Estimates indicate that about 4,000 cubic yards of sediment had been discharged, significantly damaging the river's ecosystem. Clean-up efforts by suction dredging were authorized by the Department on three pools in the river where about 50% of the sediment had accumulated. An estimated 200+ cubic yards of sediment were removed from the river before high flows from heavy rains in late October scoured most of the remaining sediment and carried it downstream toward the Canadian border. The Chasm Hydro Partnership has been served with an official Notice of Complaint from the Department and an adjudicatory hearing is anticipated.

Program initiated to reduce impacts of road culverts on stream biota

If installed improperly, road culverts can have significant negative impacts on stream fishes. Culverts can become barriers to natural movements of fish, blocking access to critical spawning, summer, or winter habitats. Also, undersized culverts are likely to wash out during large storm events. Such washouts damage stream habitat and pose risks to people using the road. To improve road culvert design and installation, an Interagency Culvert Workgroup was formed, including representatives from the Department of Transportation, the US Fish & Wildlife Service, Army Corps of Engineers, DEC, and Adirondack Park Agency. The intention is to formulate guidelines on sizing, installation methods, and natural resource protection. The guidelines would be used by government agencies and landowners involved with installing culverts

Many tons of mining overburden enter the Hudson River

A slope failure at the Glens Falls Lehigh Cement Company sent rock, clay, soil and vegetation into the Hudson River downstream of the City of Glens Falls. Department staff and the US Army Corps of Engineers conducted inspections and held numerous meetings with representatives from the facility. An estimated 30,000 cubic yards of waste slumped off a large, overburdened stockpile area for the cement mine. Negotiations are leading towards a settlement that will include removing the material from the river, and stabilizing upland material.

Region 6

Grass Carp

Otter Lake in Oneida County was stocked with triploid grass carp after several years of environmental studies and review, as well as repair of the dam necessary to keep the fish in the lake. As part of the permit, the lake will be monitored for 5 years to document changes. Many lake residents believe the fish have reduced the plant population already.

Post stocking inspections and interviews of landowners of ponds stocked with grass carp in Herkimer and Oneida Counties at the maximum allowable rate of 15 fish per acre has shown that aquatic vegetation has been drastically reduced in most cases. Fish stocked at 10 fish per acre are providing more desirable results. Most of the applicants want the aquatic weeds controlled not eliminated.

Environmental Protection

The extensive flood damage in Herkimer and Oneida Counties in late June required an emergency response of Fisheries staff to review the nearly 50 expedited permits authorized by the DEC. Staff also spent many hours assisting landowners who suffered flood damage but ultimately did not take any corrective action for various reasons. Major damage was done on East Canada Creek, Fulmer Creek, Moyer Creek, and Steele Creek. Staff also manned a booth at the emergency coordination center established by FEMA and New York State for several days.

Windpower

Staff reviewed a Draft Environmental Impact Statement for the proposed St. Lawrence Windfarm. This proposed 96-turbine facility would be located in the Towns of Cape Vincent and Lyme. The Project also would result in the construction of approximately 29 mi of gravel access roads, 44 mi of underground interconnect cables, an electrical substation, and an operations and maintenance building.

Staff also reviewed a Draft Generic Environmental Impact Statement for the proposed Horse Creek Windfarm. The proposed 62-turbine windfarm would be located in the Towns of Clayton and Orleans. The Project also would result in the construction of approximately 16 miles of gravel access roads, 28 miles of underground interconnect cables, an electrical substation, and an operations and maintenance building.

French Creek Wildlife Management Area

A cooperative project between Region 6 DEC, the USFWS, and SUNY ESF to restore wetland habitat for both fish and wildlife is currently underway. This project will utilize passive restoration techniques rather than the construction of an active flow-control device that would impede the connectivity of the French Creek System to the St. Lawrence River.

Region 7

Ninemile Creek Habitat Improvement Project

Work was completed on a habitat improvement project which began in 2005 and utilized over $40,000 of Environmental Damages money that was derived from a major pollution violation which had occurred in Ninemile Creek. The project was a cooperative effort that utilized staff and/or equipment from the NYS Department of Transportation, Village of Marcellus Public Works, Town of Marcellus Public Works, U.S. Fish and Wildlife Service, and Region 7 Fisheries staff. Overall, nearly 3,400 ft of stream was renovated to address issues which included bank erosion, bridge scour, exposed water lines, and poor fish habitat. “Natural Stream Design” techniques were utilized throughout the work area and nearly $20,000 in extra heavy stone was used to make numerous cross vanes, j- hooks, rock vanes, and boulder clusters. Most of the rock work was completed in August 2005 but nearly $8,000 worth of willows were planted under contract with SUNY ESF in the spring 2006.

Ninemile Creek Restoration

Willow Planting

Region 7 staff distributed 9,000 willows, raised at the New York State Nursery, to various organizations for planting on trout streams throughout the Region.

Region 8

Cold Brook Aquatic Habitat Restoration Project

In October 2002, this project was awarded Clean Water Clean Air Bond Act funds during the 2001-2002 appropriation cycle. In October 2006, construction began on the downstream-most sites. Improvements include stream bank stabilization via rock rip-rap, willow plantings and construction of pool diggers and fish passage enhancement. The majority of the project sites will be constructed in the summer of 2007. In addition to the Bond Act project, preliminary work is being conducted to evaluate the causes and potential solutions to problematic conditions of the stream channel near the Mercury Aircraft plant upstream of Hammondsport.

Region 9

Wiscoy Creek Stream Restoration

Repairs were completed to a stream bank restoration project on Wiscoy Creek in Wyoming County, partially funded by Habitat/Access Stamp monies. Tree revetments and a tapered flood plain had been utilized to fix a badly eroding length of stream bank in August 2005. Severe flooding in the fall and winter since the project was completed caused damage to the revetments and flood plain. On April 10-11, staff, along with Trout Unlimited volunteers and the Wyoming County SWCD, anchored the tree revetments and installed angular rock to prevent further problems at the site. The undercut tree revetments are providing excellent trout habitat while the rock is protecting the toe of the stream bank from erosion. Willow live posts were installed behind the rock and the entire flood plain was also planted with shrubs and trees in late April.

Wiscoy Creek Restoration

Habitat Management, Protection and Restoration

Staff completed settlement negotiations with the New York Power Authority (NYPA) on the Federal Energy Regulatory Commission re-licensing of the Niagara Power Project, one of the largest hydro power facilities in North America. The operation of the facility causes water fluctuations in the upper Niagara River that impact-fish and wildlife species and habitat. The settlement consists of constructing 8 Habitat Improvement Projects (HIPs) estimated in 2007 dollars to cost 12 million dollars, an enhancement and restoration fund of 1 million dollars per year, land acquisition fund of 1 million dollars and improvements at 3 public access sites.

Staff worked with DOT on a number of projects:

- A wetland mitigation area built in the 1980s for wetland losses caused by the construction of I-86 was restored and enhanced. The project in this 40 ac site included reestablishing the hydrology in the wetland ponds, deepening a fishing pond, placing fish attraction structures, a 100 ft plastic wood fishing platform with accessible ramp, 2 osprey nest platforms and a blacktop walking path.

- A hands-on workshop on stream stabilization and restoration was presented. The workshop introduced nearly 60 DOT, county and local township highway staff to bank stabilization, bio engineering, re-directive methods to restore/create fish habitat, control erosion and thalweg management. The week long workshop stabilized 350 ft of stream and protected an equal length of highway in Allegany county.

- A stream restoration and enhancement mitigation project on a trout stream in Cattaraugus county was designed. The work on the 2,500 ft reach of stream is required for impacts associated with the first phase of the Rt. 219 expansion project. The project involves raising the streambed to reconnect it with its floodplain and preventing an adjacent wetland from draining, creating a more balanced riffle/pool spacing, buffer areas, vernal pools, and bank erosion protection. Project completion is scheduled for the summer of 2007.

Staff worked with the local county Soil and Water Conservation District to obtain Great Lakes and Fish America grants for stream bank restoration, habitat enhancements, thalweg management for flooding and ice jams, and fishing access improvements along a 750 foot reach of Chautauqua Creek, a trout protected tributary of Lake Erie. The project included bank stabilization, bio-engineering, thalweg management using bendway weirs, hydraulic cover stones and holding/resting pools for migrating steelhead and brown trout and a stoned walking path.

Staff participated in a culvert workgroup involving representatives from DOT, Army Corps of Engineers, Adirondack Park Agency and US Fish and Wildlife staff. The goal of the workgroup is to develop a standard protocol for culvert installation that will not impede movement of both aquatic and terrestrial species,while meeting the needs of transportation safety.

Extension, Education and Outreach

Central Office- Public Use & Outreach Section

Free Fishing Days/National Boating and Fishing Week

Each year up to 4 Free Fishing Events can be designated by the Department of Environmental Conservation in each DEC region. These events not only provide an opportunity to experience fishing without the need to purchase a fishing license, but also provide a mechanism for beginning anglers to learn basic fishing techniques. Fifteen free fishing events were held throughout the state in 2006. Several other events were held on June 23 and 24, New York's free fishing weekend.

Table 9. 2006 Free Fishing Events

Region/County	Date	Location
Region 1	April 1, 2006	Belmont Lake State Park
	August 12, 2006	Hempstead Lake State Park
	October 21, 2006	Hempstead Lake State Park
Region 2	April 22, 2006	Crotona Park
	October 7, 2006	Crotona Park
Region 6	May 13, 2006	Wilson Hill Causeway & Boat Launch
	May 20, 2006	Remington Pond
	June 3, 2006	Sauqouit Creek, Washington Mills Athletic Park
	July 15, 2006	Cranberry Lake & Oswegatchie River (Cranberry Lake Campground)
Region 7	April 29, 2006	Tunison Laboratory- Gracie Road, Cortland
	May 13, 2006	Mill Run Park, Whorrall Pavilion- Mill Street, Manlius
	June 11, 2006	Falcon Sportsmen Club- Turnpike Road, Auburn
	September 23, 2006	Nathanial Cole Park- 1674 Colesville Road, Harpursville
Region 8	May 18, 2006	Powder Mill Park- Powderhorn Lodge
Region 9	June 3, 2006	Hyde Park Lake, Niagara Falls
	June 3, 2006	Letchworth State Park
	June 10, 2006	Tift Farm
	June 17, 2006	Forness Park, Olean

Brochures and Publications

Two new brochures have been added to the Bureau of Fisheries inventory. "Career Opportunities in the Division of Fish, Wildlife & Marine Resources" was updated from a previous version. The full-color trifold brochure contains information for individuals interested in pursuing a career in natural resources. Also produced was a "Fishes of NY" tip-strip. Requested by Doug Carlson, this strip was designed to inform people of sources of information on the various fishes of New York State. The strip contains a "quiz" where people can match up questions about a fish species with the associated image of that species. The intention is get people to visit the two main web addresses that house information on the fishes of NYS - the DEC Freshwater Fisheries web page and Cornell's Inland Fishes of NY web page.

The Angler Achievement Awards brochure was updated and reprinted in March 2007. The one color trifold brochure contains information on the program, along with rules and an entry form.

Angler Achievement Awards

The Angler Achievement Award program, which recognizes anglers catching trophy fish in New York waters, continues to be a very popular outreach effort. Awards and/or recognition is provided to anglers catching popular New York fish species that exceed minimum qualifying criteria. In total, 177 entries were received during FY 2006-2007. Sixty-six percent of the entries received were Catch and Release entries. One new State Record was established during the period: a 4 lb. 15 oz. brook trout caught by Jesse Yousey in the Five Ponds Wilderness Area in Herkimer County. A summary of the award winners for the past 6 years, along with applications and entry information, can be found at: http://www.dec.ny.gov/outdoor/7980.html

58" muskellunge caught from the St. Lawrence River

**136th Annual Meeting of the American Fisheries Society-
A Resounding Success**

After 4 years of planning, the 136th Meeting of the American Fisheries Society was successfully completed during the period September 10-14, 2006. Attendance exceeded all expectations with approximately 2,000 attendees finding their way to Lake Placid. This makes the 136th Annual Meeting the largest ever held in the lower 48 and second largest in AFS history. This is particularly significant considering the relative inaccessibility of this location in comparison to past big city AFS meeting locations. All aspects of the meeting, including technical sessions and social events went extremely smoothly thanks to careful planning and oversight by the conference organizing committee and over 70 volunteers. In total over 1,100 oral presentations and 200 poster presentations were made over the course of the meeting. At times, as many as 16 sessions were conducted concurrently at the Lake Placid Olympic Center and Crowne Plaza. Social arrangements included a Welcome Social held on the Lake Placid Speed Skating Oval, a Trade Show Social held on the Olympic Center's 1980 Rink and an off-site Fishtoberfest held at the Lake Placid Show Grounds. Fishtoberfest attendees were treated first to an aerial skiing show at the ski jumps, before being treated to an authentic German Oktoberfest complete with band. The evening came to a close with a fireworks exhibition sponsored by the Lake Placid Convention and Visitors Bureau.

Session rink with Adirondack campground theme

Feedback from meeting attendees has been very favorable, with most enjoying the small village/rural atmosphere provided in Lake Placid. One of the most telling comments was from a member of the San Francisco (AFS 2007) organizing committee who commented: "How are we going to top this? All we have to offer is San Francisco!" AFS 2006 was an example of the outstanding things that can occur through collaboration and the organizing committee would like to thank all of the volunteers, as well as the Division of Operations and Law Enforcement who assisted us with this successful endeavor.

Trade Show Social

VHS Extension Efforts

The outbreak of Viral Hemorrhagic Septicemia (VHS) in New York during 2006 and the subsequent emergency regulations necessitated an outreach effort to inform anglers and interested parties about the disease. A double sided tri-fold brochure titled "Keep Fishing Great! Use Certified Bait!" was produced in March, 2007. The brochure contained background information on VHS establishing credibility that VHS was a threat, new bait fish regulations and Q&A on the regulations. Six hundred thousand of the brochures were produced and sent out to fishing license agents for distribution. Additionally, the brochure was made available to bait fish sellers to hand out to their customers. Also, the information from the brochure was placed into the Revised 2006-2008 New York State Freshwater Fishing Regulations Guide.

Gregory Kozlowski produced several articles for the print media to increase awareness of VHS and other diseases effecting fish. An two page article titled "How the New Fish Health Regulations Affect Angling on the Hudson River" was written for the April 2007 issue of Boating on the Hudson & Beyond magazine. An article titled "New York State's Response to VHS" was written for Aquatic Invasives magazine for a Spring 2007 release. The article focused on the decision making process of the DEC through March 2007.

Nine informational meetings on VHS were held during early January, 2007. Meeting locations were held throughout the state, including Buffalo, Waterloo, Chenango Bridge, Watertown, Mexico, Plattsburgh, Albany, Yonkers - Lower Hudson Valley and New Paltz. The meetings covered the history of VHS, steps the DEC was taking to halt the spread of VHS, and the emergency regulations restricting the use of bait fish and the transport of fish in New York.

Emergency regulations were put into effect to halt the spread of VHS. The regulations affect a variety of groups that obtain licenses from the Department. In late November 2007, letters explaining the new regulations were sent to bait fish collectors and sellers, commercial fishermen, licensed fish hatcheries, fishing preserves and triploid grass carp importers and sellers. The release of a revised set of emergency regulations necessitated that a second letter be sent to bait fish collectors and sellers on March 29, 2007. A copy of "Keep Fishing Great! Use Certified Bait!" accompanied these letters.

Several web pages were placed on the DEC website during December 2006, informing visitors of the potential problems associated with VHS and other diseases. The web pages were updated as necessary.

Region 9 Website Pages

During 2006, Region 9 fisheries staff developed extensive content on a variety of topics, including trout fishing opportunities, lake and pond information, fishing warmwater rivers information, and fish survey information. This information along with pictures was given to Central Office for development into web pages. Site visitors have expressed satisfaction with the new content.

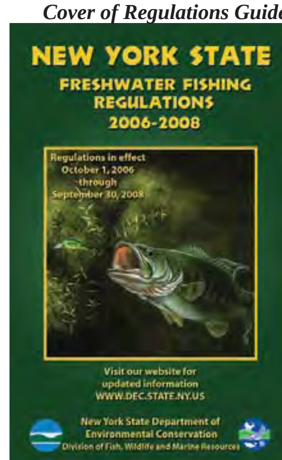
Website Re-design

The Department redesigned it's website into a web-content management system. The new system will allow for better control over the website, will prevent broken links, can set dates for when pages are active on the website. One of the decisions during the re-design was that content was going to be organized by topic and geographic area, not by region. For example, Regions 8 and 9 would be combined into "Western New York." Approximately 480 web pages associated with the Bureau of Fisheries had to be re-coded and all the links, pictures and table re-done. The work was in the process of being completed at the close of the fiscal year.

New York State Freshwater Fishing Regulations Guide 2006 - 2008

The New York State Freshwater Fishing Regulations Guide was updated to include over 100 regulation changes from the 2004-2006 guide. A phone list of all the Environmental Conservation Officers was included in the guide, resulting in the loss of some previously included information.

Cover of Regulations Guide



Region 1

I FISH NY Fishing Promotion and Education Efforts

Spring Fishing Festival

The Region 1 Fisheries Management Unit kicked off the 2006 fishing season with their annual Spring Fishing Festival at Belmont Lake State Park on April 1. Over 2,400 people came out to enjoy a free day of fishing provided by the New York State Department of Environmental Conservation and New York State Office of Parks and Recreation. Many volunteers from organizations such as Freshwater Anglers of Long Island, Long Island BassMasters, Long Island Fly Rodders, and Suffolk County Seniors Fishing Club, were on hand to fill bait cups, detangle fishing rods, teach casting methods, clean fish, and hand out rods. Volunteers lent out over 500 rods to eager participants—each of the Fisheries Unit's 222 rods was loaned out at least twice! Other scheduled events included fishing seminars by David Kennedy and Mark Malenovsky; and fly casting demonstrations by Art Flick and the Long Island Chapters of Trout Unlimited.

In addition, the event featured various children's activities such as a magic bouncy slide and temporary tattoos. The Festival also saw its first casting contest, organized by the Knights of Columbus. Throughout the day, children under 16 years of age could win fishing rods, tackle boxes, t-shirts, or hats donated by Orvis, radio stations WBLI 106.1 and WBAB 102.3, New York Fishing Tackle and Trade Association, NYSDEC, and Westbury Sports Authority.

In preparation for the event, DEC personnel along with Trout Unlimited volunteers stocked Belmont Lake with over 1,000 fish from the Catskill Fish Hatchery. Six hundred, nine inch rainbow trout and 420 brown trout averaging 13.5 in. in length were released in the lake on the afternoon of March 30. Some of the brown trout exceeded 16 in. in length. New York State Parks also released 1,000 brook trout from the Connetquot River Fish Hatchery the day before the event.

I FISH NY Fishing Festival

In-Class Education

In an effort to implement a classroom program, staff partnered with the Board of Cooperative Educational Services (BOCES) in both Nassau and Suffolk Counties. BOCES offers fishing field trips aboard various party boats to elementary and high school students. Staff visit schools prior to their fishing trip; introducing fisheries related topics and helping prepare students for their upcoming trip. Aboard the fishing boat, staff heads a fish dissection station; discussing proper fish handling and safety procedures. Throughout the fiscal year, the I FISH NY Program reached 1,536 students; 7 Nassau County schools, 9 Suffolk County schools, and 1 Bronx County school. Prior to the partnership, less than 60 students were seen each school year.

Three new lesson plans were created with implementation set for the Spring/Summer 2007; Fish Anatomy and Adaptations, Food Web, and Aquatic Ecology/Classification. During the Fish Anatomy and Adaptations lesson plan, students are introduced to the external anatomy features of a fish through local fish identification. Students then role play to become scientists in the future, creating their own fish designed to live and survive on a pre-created planet. Students learn that form influences function, and how this information can help them when fishing. To understand relationships that exist in an ecosystem, students become organisms within an aquatic environment during the Food Web lesson plan. Visual linkages help students to recognize their role in a food web as well possible bait selections while fishing. The Aquatic Ecology/Classification lesson plan gives students a chance to become scientists, identifying and classifying various pond invertebrates. Students are then presented with the larger organisms within the ecosystem, the vertebrates. In each of the lesson plans, students are introduced to local fish species and proper fish handling techniques.

In-class Fisheries education

Out-of-Class: Public Education

The I FISH NY Program offered seven free public fishing events, clinics and festivals, reaching a total of 4,002 residents. For the first time in the program, staff partnered with NYS Parks and Recreation to offer two saltwater clinics at Captree State Park and Jones Beach State Park. Over 70 people attended each event; it was agreed to make these annual events. Freshwater events included: Spring Family Fishing Festival at Belmont Lake State Park in April, Free Fishing Day at Lake Ronkonkoma County Park in June, Family Fishing Clinic at Hempstead Lake State Park in August, and Fall Family Fishing Festival at Hempstead Lake State Park in October. The Spring Family Fishing Festival at Belmont Lake State Park saw its largest numbers to date, 2,400 participants! Unfortunately due to bad weather, Free Fishing Day at Lake Ronkonkoma was cancelled.

Through a raffle, staff were able to gather some information from participants and begin to evaluate the program. Over 50% of our participants are between the ages of 0-10; less than 10% between the ages of 11-15; less than 1% between the ages of 16-30; and about 30% were adults, over the age of 30. Residents from both Nassau and Suffolk Counties attended events, as well as some Kings, Queens, and New York County residents. Moreover, about 30% of program participants are first time anglers, and about 22% of participants were attending more than one event, both fresh and saltwater.

Out-of-Class: Youth Groups
The I FISH NY program expanded its youth group fishing schedule through partnerships with BOCES, Girl Scouts of America, and the Nassau County Office of the Physically Challenged; over 794 students were reached.

Two new summer camps were added to the program schedule: Nassau and Western Suffolk BOCES. Nassau County offers a three week marine biology camp for high school students at Caumsett State Park. Staff visited the camp two days, one education day and one fishing day. Education day included fish identification, fish dissection, casting practice, rules and regulations, and fishing techniques with lures. During the fishing day, campers were able to try their hand at using artificial baits and surfcasting on the North Shore. For four weeks, Western Suffolk BOCES partners with various upstate BOCES to offer students the opportunity to experience New York's marine environment. Students are awarded a one week free marine biology summer camp on Long Island through an essay contest. The program introduced "upstaters" to surfcasting/pier fishing for two hours each week during the four weeks.

In addition to the summer camp fishing program with the Girl Scouts at Camp Edey in Sayville, the I FISH NY Program offered a new environment for the girls to experience fishing—at night! On alternating Wednesdays staff either visits the Camp for the day, offering several different education stations followed by open fishing, reaching between 100-200 girls each session; or spends the evening fishing, which is open to scouts and individuals with their parents.

The Nassau County Office of the Physically Challenged, in conjunction with the I FISH NY Program, offered a freshwater fishing day for Cerebral Palsy students at Roosevelt County Park in Roosevelt. Over 60 students came out and fished for the day, ages ranged from 5 to 30. The event was made annual and will be held each May.

Literature, Website, and Media Relations
In the spring of 2006, staff launched the I FISH NY Newsletter. A tri-annual publication, the Newsletter has over 100 mail and over 40 e-mail recipients. The Newsletter includes a feature story, local hot spots in New York City and on Long Island, seafood health and safety information, fishing tips and techniques, and lists upcoming events.

I FISH NY's website (www.ifishnewyork.org) was unveiled in 2005, with major revisions in 2006. New York Sea Grant is currently overhauling the website, with a projected release date of Fall 2007. New additions include a teacher's page with lesson plans, photo gallery, and student artwork.

In cooperation with the Division of Public Affairs and Education, a revised media list was compiled and a new press release format was designed. Since the restructure, I FISH NY-LI has been featured in Newsday, Suffolk Life, The Fisherman Magazine, and on local radio stations.

Table 10. Participants reached through I FISH NY Program for the 2006-2007 Fiscal Year

Outreach Effort	Number Reached
In-Class Education	1,536
Out-of-Class: Public Education	4,002
Out-of-Class: Youth Groups	794
Newsletter Recipients	140
Total Reached	**6,472**

Nassau Coliseum National Sportfishing, Hunting & Outdoor Expo
Region 1 Fisheries Unit coordinated the DEC presence at the 14th Annual Sportfishing, Hunting and Outdoor Expo held in the Nassau Veterans Memorial Coliseum in Uniondale, NY from January 19-21, 2007. Department staff from Freshwater Fisheries, Sportsmen Education, Environmental Education, Environmental Conservation Officers, and Marine Fisheries all participated in the event. There were 18,000 attendees at the Expo over the three day event. The show brought various Bureaus within the DEC together, and the team created many action plans to implement. Questions were asked by the public and answers were given by the DEC team based upon each type of question. The majority of questions were in relation to the Artificial Reef Program, NYC Reservoir fishing, fluke regulations, the upcoming I FISH NY Program season, trout stocking activities, and the possibility of a saltwater license being required to fish the marine district of New York State. The center of attention at the expo appeared to be the Bureau of Fisheries electrofishing research vessel which was built by the DEC Bureau of Electronics, animal pelts, and fish mounts. Many fishing hot spots were shared amongst the Department employees and sportsmen. The team also recruited 27 volunteers for the Freshwater Angler Diary Program. Overall, the Expo was a huge success as the Department drew the majority of the attendees to further inform the public on current issues and events.

Region 2

I FISH NY Fishing Promotion and Education Efforts

During 2006-07, 2,492 constituents were reached through in-class programs, youth group outreach, fishing clinics, and newsletter, as part of the DEC's I FISH NY Program.

In-Class Education
I FISH NY classroom programs reached 1,439 students, taking over 1,200 of them fishing. The program was limited to 3rd graders and above (previously the program accepted all grade levels).

Over 200 more students were involved than the previous year. The 16 participating schools represented all five of NYC's boroughs. Staff made two classroom visits before taking classes fishing where they learned fishing techniques, local fish species, and fishing regulations.

This year we focused on producing 500 Go Fish! card decks, which augmented our existing fish anatomy lesson. With permission from Florida Fish and Wildlife Conservation Commission to use artwork, I FISH NY Program staff conceived of and designed the cards. The game is an adaptation of the classic children's game, but features New York State fish, grouping the fish by family. Through playing the game, the students learn about fish identification, classification, and local diversity. Using these cards, we also created another lesson "Mystery Fish," where students pretend they are teams of scientists who discover a new fish. From their newly acquired observational skills and understanding of traits families have in common, they discuss, debate, and then justify the correct family for their "mystery fish."

In order to evaluate the program's efficacy, this spring 921 evaluation forms were distributed to teachers to administer to their students. The evaluations asked students to describe how to fish (angling skills) and how to conserve fish (stewardship principles). Twenty-six percent of the forms were returned and will be used to adjust the lessons for the next school year.

Out-of-Class: Youth groups
Staff taught 253 children outside of the formal classroom setting. Working with DEC's Division of Public Affairs and Education staff from Region 2, we participated as one module of their After School Conservation Club. When unable to fish, students practiced angling skills indoors, catching mock fish and then assessing whether these fish followed marine regulations. Additionally, we worked with summer schools, community groups, and the Virtual Y.

Out-of-Class: Public Education
The I FISH NY Program reached 660 people by offering several public fishing clinics and distributing literature at organized public events. We fished with 160 people at our public clinics and distributed consumption advisories, fishing regulations and demonstrated fishing techniques. For the first time, we sent a representative to the Hong Kong Dragon Boat Festival, which takes place in Meadow Lake in Queens, NY, the only water body in New York State where invasive snakehead fish have been discovered. Our representative distributed 500 copies of literature in both English and Chinese at an event that was attended by 30,000 people.

Staff joined the DEC's exhibit booth at the NY Boat Show, attended by over 63,000 people. Staff displayed dioramas of fresh and saltwater fish of NYS, the program's Go Fish! cards and an interactive fishing knot tying display.

Professional Development
Staff taught 30 future teachers in the Student Conservation Association how to use sport fishing to teach natural history and fish identification.

Literature, Website, and Media Relations
Staff produced two issues of the I FISH NYnewsletter (see Region 1 Outreach section). The NYC office was responsible for editing, writing health articles, art directing, and generating graphics.

Program staff revised the I FISH NY website (see Region 1 Outreach section). In June 2005 to June 2006 there were 5,779 visits to the website. During the same period the following year, there were 16,059 visits, a 278% increase in viewings.

I FISH NY was featured in several publications: Coastlines (New York Sea Grant publication), Empire State Magazine, as well as numerous online newsletters. In addition, illustrations by staff were featured in The Conservationist magazine, Nearshore Saltwater Sportfish of New York (NYS DEC brochure), and the Go Fish! cards.

Table 11. Participants reached through I FISH NY Program for the 2006-2007 Fiscal Year

Outreach Effort	Number Reached
In-Class Education	1,439
Out-of-Class: Youth	253
Out-of-Class: Public Programs	660
Newsletter Recipients	140
Total Reached	**2492**

Region 5

Bureau of Fisheries continues a tradition of leadership in the profession of aquatic sciences:
The 136th Annual Meeting of the American Fisheries Society was held in Lake Placid September 10-14, 2006. The meeting drew fisheries and aquatic scientists from more than 30 countries, with an attendance of approximately 2,000 people. DEC fisheries programs were highlighted at this premier gathering of fisheries professionals. Presentations included Bill Schoch, Regional Fisheries Manager for Region 5, talking about the DEC's brook trout restoration program in the Adirondacks. That presentation was part of a day-long symposium titled "Brook Trout: Conservation Challenges at Multiple Scales." Dan Bishop, Regional Fisheries Manager for Region 7, talked about steelhead trout management in a similar symposium on steelhead. Several aspects of the Lake Champlain sea lamprey control program (a cooperative program between NYSDEC, the US Fish and Wildlife Service, and the Vermont Fish and Wildlife Department) were presented by agency and university staff at a sea lamprey symposium. Each of those three symposiums, as well as the numerous other symposiums, were attended by some of the top professionals in the respective areas of expertise. As such, they were exceptional opportunities to interact with the profession's best. In addition to the scientific and technical aspects of the meeting, the Department received high accolades from the attendees for hosting and organizing this logistically daunting event. Dozens of Department staff contributed their time to running what all agreed was an outstanding meeting.

Region 6

Conservation Education Days
Staff participated in 3 of the region's 5 counties' conservation education days. Fisheries and fishing messages are taught to 6th graders at all of the events. The hands on lessons are taught in an outdoor setting and repeated 12 to 17 times throughout the day. St. Lawrence County held their event at the Indian Creek Nature Center on Upper and Lower Lakes where approximately 600 students where taught how to cast and were given an interactive presentation on the local aquatic food web. Four members of the regional fisheries staff participated in Jefferson County Environmental Awareness Days at Westcott Beach State Park, coordinated by Cornell Cooperative Extension. Over 1,100 sixth graders were presented with information regarding Lake Ontario fish communities and environment. Hands on activities with live and preserved fish generated considerable interest and enthusiasm.

Envirothons
Region 6 staff prepared and delivered Envirothon questions for the Aquatics section for Lewis, Jefferson, Herkimer, Otsego, Montgomery, and Fulton Counties. Lewis and Jefferson Counties had their own individual events, whereas Herkimer, Otsego, Montgomery and Fulton Counties combined their schools to hold one event. Each Envirothon has test sections in Aquatics, Forestry, Soils, Wildlife and a unique Current Issue section each year. Teams of up to five students work together to answer questions in all 5 sections to compete to win their county and get a chance to go to the state championship. The 2006 state championships were held in Oswego and a team from Tioga County won.

Camp Wabasso
Staff from the Region 6 Bureau of Fisheries conducted an outreach event at the 4H Camp Wabasso on Millsite Lake. Approximately 50 campers were taught the basics of fish collection methodology, fish identification and fish fileting. Gillnets and a seine produced numerous bass, bluegill, pumpkinseed, pike, bullhead and various minnow species, for the campers to work with. The presentation is part on an on-going effort to introduce those attending Camp Wabasso to the aquatic fauna in their back yard.

Education session at Camp Wabasso

Lewis County Fishing Camp
Fishing was great in northern New York State for more than 60 people at the eleventh annual Youth Sportfishing Camp held June 16 -18, 2006, at Beaver Camp on Beaver Lake in the Town of Watson, Lewis County. This weekend event was organized by Joe Hulbert at the North Country Sportfishing Camp, a feature attraction also supported and sponsored by Teen Anglers, the Department of Environmental Conservation and Walmart's All American Fishing Derby. Its goal was to have a fun-filled and educational weekend of fishing.

The sportfishing camp gives youth ages 8 - 16 a better understanding and appreciation for sportfishing, conservation and angler's ethics. During skill-sessions, campers learned about making lures and spinners, fly fishing, fly-tying, fish identification and conservation and outdoor skills like hiking. They shared in the joys of fishing and canoeing while practicing sportsmanship and stewardship of our renewable natural resources.

Campers caught chain pickerel, bullheads, sunfish a few yellow perch. They also saw many large bullheads that were caught in DEC trap nets. Participants came from several nearby counties to take part in this year's event. The young anglers included both boys and girls and many repeat campers. "Fish cleaning started by mid-afternoon and was followed by a fish bake where everyone enjoyed the fillets of bullhead and sunfish," noted Joe Hulbert, organizer of the camp.

Cranberry Lake Fishing Derby
Staff from the Region 6 Bureau of Fisheries conducted an outreach event at the DEC campground at Cranberry Lake. Approximately 20 kids were given use of fishing gear to compete in a derby to win prizes provided by a local sporting goods store. Prior to the derby, anglers were given instruction in proper use of the tackle and fish handling techniques. Nearly all the participants caught fish and won some sort of prize.

Region 7

Fishing Events/Clinics
Fisheries staff conducted a number of education and outreach events throughout the region. A family fishing day clinic held on June 3, 2006 at Carpenters Brook Fish Hatchery drew in more than 100 kids and adults. Staff assisted the Iroquois Chapter of Trout Unlimited on May 13, 2006 for a family fishing day clinic at Mill Run Park on Limestone Creek. Other events include a kids fishing derby at Chenango Valley State Park on September 23, the 13th Annual Finger Lakes Fishing Festival on April 29, a kids fishing derby held by the Falcon Sportsmen Club on June 11, a Conservation Field Day at SUNY Morrisville on May 25 and Onondaga County Family Sportsmen's Days on September 23 and 24. Fish identification, regulations and ethics, tackle basics, fish anatomy were just some of the topics covered at the events. A large aquarium was set up at most of the events for a more hands-on experience.

Fishing Outreach

New York State Fair
Several Region 7 Fisheries personnel worked at the annual New York State Fair helping staff the Division of Fish, Wildlife and Marine Resources booth inside the DEC Aquarium Building. Thou-

sands of hunting and fishing licenses were sold using the DECALS automated licensing system which operated with very little down time. Questions from the public were answered during the license sales process. This was a 12 day event which ran from August 24 through September 4, 2006.

New York National Boat Show
Held at the Jacob Javits Center in New York City, a Region 7 Fisheries Biologist helped staff the Division of Fish, Wildlife and Marine Resources booth from December 30, 2006 through January 2, 2007. This high profile event draws over 100,000 people annually and is an excellent opportunity to promote New York's fishing resources to a wide and diverse audience.

Fishing Hotline
Both telephone and Department Website versions of the Region 7 Fishing Hotline were updated on a weekly basis. The telephone version received 150 - 400 calls per week and the Website version continues to be one of the top 10 most frequently visited pages on the DEC website.

A proud angler with her catch

Region 8

Over 100 students get hands-on fisheries experience
Fisheries staff teamed up with the non-profit Delta Labs for the fifth consecutive year to bring hands-on learning to area high school biology students. In the fall of 2006, close to 100 students observed a DEC staff electrofishing demonstration. This allowed students to see the different type of fish collected by this method. Students collected biological data from the fish, including learning how to age fish, along with basic limnological data from the canal. This year's events were well received by students, teachers and staff.

Region 9

Participation in Outdoor Sporting Shows
Fisheries staff participated in the Hamburg Outdoor Show, the Erie County Fair and the Niagara Falls Fish and Wildlife Festival.

Youth Fishing Clinics and Aquatic Education Efforts
Regional Fisheries staff conducted educational efforts to introduce young people to sportfishing and spark interest in aquatic ecology. The outreach events were typically conducted in partnership with local sponsors such as sportsmens federations and local government entities. A total of three free family fishing clinics were held (Hyde Park Lake-City of Niagara Falls, Tifft Nature Preserve-Buffalo Museum of Science, Chestnut Ridge Park-Erie County Parks Dept.) in Erie and Niagara Counties in 2004/2005.

Young Fishing Clinics
In 2006, Regional Fisheries staff continued to conduct educational efforts to introduce young people to sportfishing and spark interest in aquatic ecology. The outreach events were typically conducted in partnership with local sponsors such as sportsmen's federations and government entities. Two free family fishing clinics were held at Chestnut Ridge County Park and Tifft Nature Preserve (Buffalo Museum of Science) in Erie County.

In Fall 2006, staff participated for the first time in two outreach events: the Wildlife Festival at the New York Power Authority Vista Facility in Niagara County and the Fall Festival at the NYS DEC Reinstein Woods Facility in Erie County. Both events attracted large crowds and were considered worthwhile events for continued participation next year.

Young angler displaying her catch

Public Access and Use

Central Office- Public Use & Outreach Section

2006-07 Public Fishing Rights and Waterway Access Progress
Acquisition of fishing easements to valuable stream fisheries in New York State remains a high priority with the Bureau of Fisheries. Although various staff changes within the Public Use Section had an impact on progress during the period, a number of purchases were completed and many others are currently in the process of being completed. Completed acquisitions include a 2.3 mi section of the Delaware River in Region 4 and 1.1 eq mi on Mansfield Creek in Region 9. PFR purchases currently in the process of finalization include: .18 eq mi on Esopus Creek, .14 eq mi on the Pine Kill, .03 eq mi on the Neversink and .012 eq mi on the Willowemoc in Region 3; .37 eq mi on the West Branch Delaware in Region 4; .51 eq mi on the Ausable River in Region 5; .284 eq mi on the Cohocton River, .22 eq mi on Cayuta Creek and .05 eq mi on Mansfield Creek in Region 8; .076 eq mi. on Elm Creek in Region 9. Acquisitions are also underway on Butternut Creek in Region 7 and West Branch Fish Creek in Region 6.

The highlight of the waterway access program in 2006-2007 was the purchase of a $2 million Conservation Easement to ensure that the Narowal Marina in the Hamlet of Bolton Landing on Lake George remains a public access point on Lake George. Narowal Marina is one of the busiest access points on Lake George, both for anglers and campers on the Lake George islands. The Conservation Easement provides for the continued operation of the site as a marina, but prohibits any additional commercial or residential development of the site. Had the State of New York not made this purchase, it his highly likely that this parcel would have fell into private hands and all public access to the lake from this site would have been lost.

2006-07 Boat Launch Rehabilitation Projects
No major boat launch modernization projects were completed during the period. Disabled access improvements continued in Region 5 with work completed at Cossayuna Lake, Northville, Saratoga County and West Lake boat launches. Significant effort was also put towards design drawings for funded boat launch projects in the City of Plattsburgh (Lake Champlain) and Town of Moreau (Hudson River). Major rehabilitation projects completed during 2005-2006 on Schroon Lake, Ticonderoga (Lake Champlain), Long Lake, Narrowsburg (Delaware River) and the Mohawk River (Amsterdam and Nelliston) have all held up well through their first year of use.

Mohawk River site

In response to increasing concerns about the spread of nuisance invasive species, the Bureau of Fisheries has also begun the installation of Nuisance Invasive Species Disposal Stations at select boat launches. These stations provide both information and a dedicated location for disposal of aquatic plants or other invasive species found clinging to boating and fishing equipment. Additional stations will be installed as needed at DEC sites throughout the state.

Nuisance Invasive Species Disposal Station

Clean Vessel Assistance Program (CVAP)
Bureau of Fisheries administration of the Clean Vessel Assistance Program (CVAP) continued in 2006-2007. CVAP funds the construction and maintenance of septic pumpouts and dumpstations, as well as information and education programs associated with it. A new contract with the New York State Environmental Facilities Corporation was finalized which allows EFC to continue to run the CVAP program for an additional 3 year period. During the past year, 39 projects were funded for $592,309. To date, CVAP had funded 359 projects totaling approximately $4.193 million. A new operation and maintenance grant program was initiated in 2006 with 24 applicants receiving awards of $26,682. Four information and education projects were completed over the past year. CVAP staff also attended the New York National Boat Show, the Quality Communities Canal Conference and the Clean Marina/Green Marina event in New York City. CVAP advertising was placed in the Captains Guide, Canal Times, Seaway Trail, Long Island Boating World and Soundings magazines.

Region 5

Work continues to make Bureau of Fisheries facilities accessible to Americans with disabilities
In the ongoing effort to make DEC facilities accessible, work progressed at several Bureau of Fisheries access facilities. At the Second Pond Boat Launch (provides access to Lower Saranac Lake) the toilet building has been made accessible, an accessible walkway from the parking lot to the dock was constructed, and reserved accessible parking has been designated. Similar improve-

ments were completed at the Upper Saranac Lake Boat Launch. Improvements at Lake Colby include an accessible port-a-john, an accessible pathway to the water, and reserved parking.

Progress continued towards an accessible fishing pier on South Bay of Lake Champlain. The Town of Dresden, Washington County, local sportsmen, and the Department are combining efforts to rebuild the South Bay Fishing Pier and to make it universally accessible with 19 parking spaces, benches, rod holders, and a roofed area at the end of the pier. Construction was expected to occur during the summer of 2007, but delays resulted when the initial round of bidding yielded unexpectedly expensive cost estimates. The cost issue is close to being resolved, and construction may yet begin during 2007. This will be a very important project for the community, providing a fishing opportunity for people of all abilities.

Repairs and modernization completed on several boat launch sites

Schroon Lake Village Boat Launch: The Department and the Town of Schroon Lake partnered to improve the Town Boat Launch, located in the hamlet of Schroon Lake. The Department provided funding to demolish the old concrete ramp, which was in poor condition, and replace it last year with a modern structure installed at an optimum pitch. The Town of Schroon Lake has now installed modern floating docks along the new ramp. These attractive, wood-decked docks will provide for a quality launch and retrieval experience. The Bureau of Fisheries appreciated the efforts of the Town of Schroon to provide boating access to Schroon Lake.

Newly modified Schroon Lake Boat Launch

Ticonderoga Boat Launch overflow parking now open to the public: The Ticonderoga State Boat Launch, which provides valuable boating access to Lake Champlain at Fort Ticonderoga, was modernized during 2004-2005, making it a premier boat launching site in northern New York. However, an overflow parking area to accommodate parking on busy weekends and during fishing tournaments was completed only recently. This parking area was surfaced with a modern stabilization material called "grass pave," which allowed the site to remain vegetated while still providing a durable surface during wet and rainy periods. It was desirable to retain a natural surface rather than pavement for two reasons. The overflow parking area was of concern from an archeological perspective; therefore, it was best to leave it undisturbed. Also, retaining the area as grass was an environmentally sound way to lessen storm water runoff. The overflow parking area was closed to the public for an extended period, due to technical difficulties with the grass pave installation. Those problems were solved and the area is now open and ready for business. The Bureau of Fisheries is particularly grateful to Fort Ticonderoga Director Nick Westbrook for his support of this project.

Ticonderoga Boat Launch (Lake Champlain)

A Cooperative Effort with the Town of Caroga restores a flood-damaged boat launch: The West Lake Boat Launch, which is the only public boat launch serving Canada Lake, West Lake and Green Lake (Fulton County) was made inoperable by flood events. The concrete boat ramp and the adjacent area were completely filled with sand and gravel from a washed out road bed. Bureau of Fisheries staff obtained approvals to conduct an emergency excavation of the site from the Adirondack Park Agency, the US Army Corps of Engineers, and DEC Water Quality and Permits offices. Then Leo Demong of Fisheries and Rudy Peters from the Division of Operations joined forces with the Town of Caroga Highway Department to remove the material from the boat launch. Department staff installed a silt screen fence and floating oil boom around the work site, while the Town of Caroga crew excavated the material. Many cubic yards of deposited material were removed from the launch ramp and immediate area. The Bureau of Fisheries would like to thank the Town of Caroga for their willingness to join forces to solve this dilemma.

Upper Saranac Lake Boat Launch repaired: Ice damage and contractor misuse had made the bulkhead and dock structure unusable at the Upper Saranac Lake Boat Launch in Franklin County. Just prior to the boating season, the dock had to be closed to public traffic. The operations crew of Don Durkee, Ross Robert and Ed Hoyt came to the rescue and did an exceptional job of repairing the structure. They also extended the dock several feet to allow docked boats to avoid underwater debris. The Bureau of Fisheries is very grateful to Operations staff for getting this work accomplished in a timely fashion. Thanks to those mentioned above and Conservation Operations Supervisor Greg White.

Region 6

FWMA Agreement with Town of Webb
An agreement was reached to allow fishing access for Wheeler Pond, Clear Pond, Gibbs Lake, Independence Lake, Round Pond, Little Safford Lake and the North Branch of Moose River from April 1 - Sept 15. These waters are located just north of the village of Old Forge and are easy to reach from the network of snowmobile trails on the property. Both Gibbs and Independence have wild brook trout populations and the DEC is looking to reclaim both Clear and Wheeler to allow brook trout populations to be re-established. Round Pond does not offer much of a fishery and Little Safford has a fishery for both largemouth yellow perch. In exchange for formalizing fishing access to these waters the Bureau of Fisheries will actively manage them to provide the best fishing possible.

Region 7

Lake Access
Jamesville Reservoir - Through a permit with the Canal Corp, staff constructed a parking area and developed a shoreline fishing access site at the Jamesville Reservoir dam, Onondaga County, Town of LaFayette.

Salmon River Reservoir - Constructed a Fisherman Access Site (FAS) at Redfield Island, Oswego County, Town of Redfield.. The site includes a concrete ramp, parking for 30 car and trailer units, and an ADA accessible fishing pier.

Oneida Lake - Extended a Fish & Wildlife Management Act (FWMA) Agreement between the State and the new owner of Lewis Point (south shore), thus ensuring shoreline and ice fishing access at this extremely popular location. The previous owner had always allowed ice fisherman to use the site but with the change in ownership this access had been threatened.

River Access
Seneca River - Purchased an aluminum skid dock for the Port Byron boat launch site on Rt. 38, Cayuga County, Town of Mentz.

Oneida River - Purchased an aluminum skid dock for the Bonstead Road boat launch site, Onondaga County, Town of Clay.

Public Fishing Rights
Cayuga Inlet- Purchased 0.33 eq mi of PFR and a 530ft footpath in Tompkins County, Town of Newfield.

Owasco Inlet - Purchased 0.17 eq mi of PFR and a Fisherman Parking Area in Cayuga County, Town of Moravia.

Butternut Creek - Purchased a Fisherman Parking Area to enable off-road parking along US Rte. 20 in Onondaga County, Town of LaFayette.

Region 8

Enhancement of the existing East Bay Fishing Access Site on the barrier bar
A new road will enable car top launching directly into the bay instead of a long carry.

Region 9

Stream Access
Public fishing easements were acquired on 4 streams (Elton Creek, Mansfield Creek, Ischua Creek and 18 Mile Creek), totaling 1.703 miles and easements were signed, but not completed on 6 other streams (18 Mile Creek, Wiscoy Creek and N. Branch, Ischua Creek, Mansfield Creek and Canadaway Creek), totaling 1.01 mi. With the help of Town and County DPW's, fisherman parking areas were developed on Chautauqua Creek and Cattaraugus Creek. Fisherman access sites were developed at Tonawanda Creek and Birch Run Ponds.

Elton Creek PFR segment

PFR maps and website
Updates were made to the twenty one brochures which show Public Fishing Areas on all 28 streams in Region 9 with Public Fishing Rights. The color brochures are printed in the Regional office as needed. In addition, all the brochures were available on the Bureau website in PDF format. Updates will be made to the brochures yearly as new PFR is acquired and regulation and management changes occur.

Fish Culture

Central Office- Fish Culture Section

Hatchery Infrastructure Needs

A report summarizing the current status of DEC's Fish Hatchery System infrastructure repair needs was completed in winter 2003 and implementation of some of the identified repair needs continued in 2006. Major projects that were completed included replacement of the South Otselic Hatchery water supply pipeline and pond inlet structures, and replacement of the broodstock holding ponds at Rome Laboratory. The South Otselic project was paid for using funds from a Capital appropriation and was constructed via contract. Most of the Rome Lab broodstock replacement work was done by Fish Culture Section staff under the expert direction of Bill Hajdasz from Rome Hatchery. The Rome Lab was funded using EPF Stewardship and Capital funds. Exploratory work for additional shallow infiltration wells at Salmon River Hatchery resulted in "finding" one successful well, which will be connected to existing piping and electrical service in the future. In 2006 a total of $5,000,000 was appropriated for hatchery repairs in the state budget. A portion of those funds will be used to secure the full time dedicated service of a design engineer in the Division of Operations, which will speed up the process of getting large projects designed and built. The first projects that will be addressed by this new capability will be raceway enclosures for the east pond series at Rome Hatchery and the design of a new office/early rearing building at Rome Hatchery.

Trout in the Classroom Project Guidelines

Guidelines were developed to standardize the procedures used by sponsoring organizations to obtain eggs for these classroom projects and the subsequent stocking of fish into receiving waters. DEC is the largest source of eggs to these projects, typically providing about 150-200 eggs for each classroom project. Due to the rising popularity of these projects across the state, the sudden and troubling appearance of VHS in portions of New York in 2006, and the adoption of emergency regulations to limit the spread of VHS and other fish pathogens into or throughout the state, standard procedures needed to be developed and communicated to project participants. These procedures and their underlying rationale were presented and discussed with approximately 60 participants, primarily school teachers, at a workshop in March 2007. Attendees included the Superintendent of Fish culture and Catskill Hatchery Manager Scott Covert, who gave a tour of the hatchery later in the day. In addition to the need to obtain certified disease free eggs and obtain stocking permits before any fish are released, workshop attendees were instructed to keep the focus of these projects on the educational experience rather than view them as small scale stocking programs for a particular species or strain of fish. DEC currently supplies eggs to about 200 projects statewide.

Coolwater Workshop

Tom Kielbasinski from South Otselic Hatchery, Carl Rathje from Oneida Hatchery, and Phil Hulbert from Central Office attended a coolwater species workshop in New Jersey. Tom presented a paper discussing the pond fingerling walleye rearing program at South Otselic, and included some preliminary results evaluating different pond fertilization regimes and variation in age of fry placed into the ponds. Discussions with colleagues from other states, particularly Iowa, provided valuable opportunities to compare respective rearing programs and techniques for intensively reared walleye. Based on those discussions, alternate starter diets and rearing techniques will be evaluated at Oneida Hatchery later in 2006. The workshop also provided the opportunity to explore alternate sources of tiger muskellunge for DEC's program. For many years Pennsylvania Fish and Boat Commission staff provided tiger muskellunge gratis to New York but their source waters were close to Lake Erie, which was identified as a VHS positive water in 2006. To lessen the chance of inadvertently importing VHS positive eggs or fry, tentative arrangements were made to receive tiger muskellunge from New Jersey, which has some captive muskellunge and northern pike brood fish at one of their hatcheries. The tiger muskellunge would be reared at DEC's South Otselic Hatchery as normally occurs.

Bath Fish Hatchery

IPN (Infectious Pancreatic Necrosis) was discovered at the Allegheny National Fish Hatchery in September of 2005. The entire hatchery was depopulated and sterilized. This was done to prevent the spread of this virus to other waters. Allegheny normally supplies 620,000 yearling lake trout for stocking in Lakes Erie and Ontario.

The Bath Hatchery raises 215,700 Finger Lakes strain lake trout yearly for stocking in the Finger Lakes and Lake Champlain. Of this number 94,500 are stocked as spring yearlings. It was decided that for the spring of 2006 we would forego stocking the Finger Lakes and instead raise these fish for stocking in Lake Ontario. Lake Champlain would still receive its normal allotment of 25,000.

The number of lakers stocked in the fall of 2005 was reduced and 15,000 fish were sent to the Pittsford National Fish Hatchery to raise and stock in Lake Champlain. After doing this, 117,820 lakers remained for the spring 2006 stocking in Lake Ontario. All of these fish required a Coded Wire Tag (CWT) and adipose clip for identification. The equipment needed to do this was at the Allegheny Hatchery. The assistant manager of Allegheny, Dave Blick, coordinated moving the equipment and supplying the manpower to accomplish this task. From April 3 to April 12, 2006 the tagging operation was carried out at the Bath Hatchery. On May 8 and May 9, 2006 all the fish were stocked by landing craft at Olcott. Olcott was chosen because past records indicated that stocking survival was very good at this site. This project could not have been accomplished without excellent cooperation from the Allegheny crew especially Dave Blick and the manager Tracy Copeland.

Allegheny will not be able to raise lake trout until they finish a rehabilitation of their facility. In the meantime the National Fish Hatcheries at Pittsford and White River in Vermont will raise the fish. New York State has already supplied eyed lake trout eggs from Cayuga Lake in 2005 and 2006 to keep the program going.

The Bath Hatchery clips a large number of lake trout and wild rainbow trout each year. The clipping shed that is used for this is in bad shape. During the winter of 2006-2007 a clipping trailer was built to replace the old shed. The new trailer is a hut built on top of a boat trailer that was supplied by the Region 8 Operations Unit. The new trailer has two pumps that supply water to a holding tank inside as well as a trough that pushes the fish out of the trailer after they are clipped. The trailer was used by seasonal laborers this past spring to clip 88,000 lake trout and 30,000 wild rainbows.

Catskill Fish Hatchery

Catskill Hatchery not only met but also exceeded annual production requirements. Nearly 22K surplus summer Brown Trout fingerlings (4 in) and 15K (9 in) Brown Trout yearlings were distributed to other hatcheries & regions throughout NYS. Spring 2007 was one of the most challenging spring stocking seasons ever. Weather and a major truck breakdown raised havoc. However through cooperation between hatcheries, quality and caring hatchery staff, and direction and decision making from Central Office Fish Culture & Operations staff, we were able to accomplish our mission on time.

Due to a quality caring staff and some newly tested water supply manipulation Catskill was able to save over $15K in electric cost by turning off production wells (not to mention wear and tear on expensive equipment) for 2+ months during the early rearing cycle (parts of January, Febuary, March). The wells had always been used because they are +/- 4 degrees warmer than the spring water. From now forth (unless there is an emergency) they will be used during the incubation stage and the intial feeding stage. Once the YOY fish are feeding properly they will be switched over to gravity flow spring water and the wells will be turned off. Studies at the hatchery have shown that eggs and intial fry have better survival rates on well water. Once feeding the difference was insignificant. The difference in size from 7/1/06 (all well water) to 7/1/07 was .02 in. Being fully staffed, having a properly trained and quality staff makes all the difference.

October 2006 was the tenth year of the Trout-in the-Classroom (TIC) program. Catskill Hatchery has provided quality eggs for the program since it's inseption, which started with 8 schools and has since grown to over 125 with more schools coming in every year. On average each school gets 100 eyed brown trout eggs from Catskill. TIC is used in all studies science, math, music, english and art. Other oranizations are also involved. Along with the Fish Culture Unit TU, NYC DEP and DEC Fisheries Management staff are also main sponsors.

In spring 2007 Supt. of Fish Culture Phil Hulbert met 40+ TIC participants at the Catskill Flyfishing Center. Supt. Hulbert outlined the newly adopted regulations of transferreing eggs/fish from water to water. DEC will now be the sole provider of the eggs for the program. TIC has their own web site www.troutintheclassroom.org. TU hired Rochelle Gandour as the coordinator.

Chateaugay Fish Hatchery

Chateaugay Fish Hatchery produced 99,000 lbs. of trout in the 2006-2007 operating year. Rainbow trout, brown trout, Temiscamie hybrid brook trout, domestic brook trout, Raquette Lake strain lake trout, and splake comprised the species reared at Chateaugay. A total of 377,000fish weighing 74,000 lbs. were stocked by Chateaugay and an additional 668,000 fish with a total weight of 52,000 lbs.were transferred to and from other facilities.

A total of 210,000 lake trout eggs were taken from lake trout netted at Raquettte Lake and sent to Chateaugay to be hatched. In addition 208,000 Temiscamie hybrid brook trout, 450,000 rainbow trout, 130,000 domestic brook trout, and 27,000 splake eggs were transferred to Chateaugay from other facilities.

Chateaugay Hatchery staff participated in the preparation and presentation of the American Fisheries Society meeting in Lake Placid in the fall of 2006. All hatchery staff co-ordinated various activities both at the hatchery and at the Lake Placid Convention to help make the meeting a success.

Preparation began for the construction and installation of a 10 kilowatt alternative energy windmill demonstration project. A full Environmental Quality Review, Full Environmental Assessment Form was completed for the project and preconstruction layout work was completed. The wind turbine is due to be constructed in the summer of 2007.

Two Fish and Wildlife Technicians were hired to replace two items that were vacated by two technicians transferring to Chautauqua and Adirondack Fish Hatcheries. Training of the new technicians began in the operation of fish transport and forklift vehicles. Training will continue throughout 2007-2008.

Chautauqua Fish Hatchery

The staff of Chautauqua Fish Hatchery began exploring ways to run their Muskellunge and Walleye production programs on one water source (well) in the spring of 2007. Due to potential threats of VHS virus being introduced into our second source of water (Chautauqua Lake), in addition to it already being contaminated with Zebra Mussels, it was deemed wise to develop a plan to operate on well water only.

The main use of Chautauqua Lake water at the hatchery is our extensive pond culture program of both walleye and muskie. This involves filling 12 one-acre ponds once in the spring for walleye, and six ponds in late July for muskie. Ponds are set up for use of lake water only.

The facility's two wells are located relatively close to the pond complex. By using the two-inch blow-off assembly on each well, and purchasing two-inch plastic pipe, we were able to fill all twelve ponds with well water for this spring's walleye program.

The other use of lake water is from mid-June until the beginning of August and is for the intensive muskie culture program. By eliminating lake water, muskie culture could continue with heated well water. Heated well water is presently used from egg incubation until lake water reaches 65°F and then lake water is supplemented for the well water. In the well water only scenario, the well water would have to be heated to 65°F until August 1st, when muskie fingerlings are normally ponded.

The hatchery's natural gas fired cultural boiler heats the well water. We found that the boiler can only produce 80 gallons per minute of 65°F heated well water. This proved to be a limiting factor in implementation of a well water only intensive program. If a more efficient cultural boiler that can heat 350 gallons per minute could be utilized, the well water only intensive muskie program would be feasible.

Oneida Fish Hatchery

In April 2007, NYS Oneida Hatchery netted 23,291 adult walleyes, collecting 321 million walleye eggs from Oneida Lake. Over 210 million walleye fry were stocked throughout New York and 78,000 five inch fall fingerlings were stocked into ten New York waters in the fall 2006.

Retrieving walleyes from trap net

The hatchery produced 4,000 round whitefish two inch fingerlings which were stocked into Little Green Pond (1,000), Rock Lake (1,300), and Bug Lake (1,700) (Region 5) in May 2006.

The hatchery produced 367 paddlefish(15 inches), which were tagged and stocked into Conewango Creek (Chautauqua County) in August 2006.

In January 2007, Carl Rathje (Assistant Manager) attended the national coolwater workshop at the Hackettstown Fish Hatchery, NJ. After listening to new positive research involving new transition diets and darkened environments for walleye production in Iowa, the Oneida hatchery will conduct several experiments during the 2007 season. These include comparing Inve Epac diet to standard New York diets, and rearing walleyes in darkened tank environments with submerged lighting versus traditional overhead lighted tanks during 28 day diet transition period. Results will be reviewed at the end of 2007.

Rome Fish Hatchery

Rome Hatchery produced 178,000 lbs of Brown and Brook trout from April 1, 2006 - March 31, 2007. Feed usage was 209,000 lbs for a conversion of 1.17 and a cost of .50/lb.

In the Spring of 2006 over 200 waters were stocked by Rome Hatchery. Over 650,000 Brown trout and another 125,000 Rainbow and Brook trout were stocked by Rome or transferred to other State Hatcheries to be stocked throughout NYS. Air stocking occurred in the Spring with 32 ponds being stocked, including the Upper Hudson River.

In the Fall of 2006 Rome Hatchery stocked over 190 different waters of which 170 were stocked by pantoon plane or helicopter. These waters are stocked with Temiscamie Hybrid Brook trout along with some Little Tupper and Horn Lake strain brook trout.

A new living stream display was constructed this past Winter. This will help us to continue to provide a service to different County Fairs and sportsmen groups by having two units ready.

The design phase of a pavilion style pond cover along with preliminary designs for a new hatchery building were started in the Fall of 2006. The pond covers are be started in the Fall of 2007.

Living stream exhibit

After 21 years of service our truck mounted pellet feeder is being replaced by a new one. Delivery is expected Summer of 2007.

Paving is also to be completed from remainder of Lab pond project along with finishing of outside raceway fiberglassing.

Rome is currently fully staffed with 11 employees. They are Hatchery Mgr., Asst. Mgr., two Fish Culturist II's, two Fish Culturist I's, Maintenance Supervisor, Secretary, and a Seasonal Laborer.

Salmon River Fish Hatchery

The Salmon River Fish Hatchery raised about 165,000 lbs of fish in 2006-07. Our normal average is about 130,000 lbs.

With the occurrence of VHS in Lake Ontario and policy changes, chinook salmon production was increased to 1.75 million fish and the winter brown trout fingerling program was cut.

The spring steelhead egg take was a success with 1.85 million Washington strain eggs and 149,000 Skamania strain eggs. Once again, the total requirement of Washington eggs were taken from marked adults.

Through manipulation of the available well water supply, about 333,000 chinook fingerlings, and 100,000 steelhead yearlings were provided to sportsmens pen rearing groups on the Great Lakes by mid April. This was 2-3 weeks earlier than normal. Also started was additional water recirculation on some of the coho's inside with the in-house construction of a filter system. About 100 gpm water is passed through a sand filter and an ultraviolet filter. The intent is to maximize the use of well water.

The fall salmon egg take was successful. About 3.5 million chinook eggs and 1.8 million coho eggs were taken. This was the first year for our new egg disinfection program to prevent the spread of VHS into our facility. With only a few alterations in the routine, that went well.

A lot was accomplished this year, being almost fully staffed for most of the year with a young, mostly inexperienced crew.

Removing eggs from a Chinook salmon

Fish Disease Control Unit

Fish Pathogen Inspection Program
The FDCU has conducted annual fish pathogen inspections of DEC fish hatcheries since the early 1980's. In November 2006, our program expanded to include privately-owned fish hatcheries possessing licenses to culture bass and trout, in accordance with new regulations enacted to minimize the introduction fish diseases into New York. For 2006-7, we inspected 9070 fish from over 90 locations. Results from the DEC hatchery inspections were consistent with previous inspections and revealed nothing new. Aeromonas salmonicida, the cause of bacterial furunculosis in trout and salmon, was isolated from wild, adult coho salmon at the Salmon River State Fish Hatchery. Preventive measures are currently in place to minimize the transmission of this disease to fish in the main culture facility nearby. From private hatchery inspections, two prominent disease pathogens were isolated from two hatcheries. Infectious pancreatic necrosis virus (IPNv) was isolated from a trout hatchery and an extensive plan was developed to remediate the hatchery program. From another hatchery, Yersinia ruckeri, the cause of enteric red mouth (ERM), was isolated from one yellow perch. Because Y. ruckeri is treatable, extensive remediation plans were not necessary. The overall health of fish in our state hatchery system is excellent and we are working with private aquaculturists to improve their fish health issues.

Routine Clinical Disease Investigations
In 2006, the most common diseases in the state hatchery system were columnaris, bacterial gill disease, Ichthyopthiriasis ("Ich"), and saprolegniasis. All of these diseases are widely found throughout the world and are effectively treated with a variety of methods. The DEC currently cooperates in a program with the U.S. Fish and Wildlife Service and Cornell University to use Chloramine T to treat bacterial gill disease and Oxytetracycline to treat a variety of bacterial diseases.

Research projects
The presence of viral hemorrhagic septicemia (VHS) in wild fish in the Great Lakes has lead to management changes intended to minimize disease introduction into our hatcheries. Although VHS has not spread to any of our 12 state hatcheries to date, the threat of VHS entering our hatchery system is very real and research intended to address protecting our hatcheries from VHS and other newly-emergent diseases is underway. We recently determined that iodophor (betadine) disinfection has no effect on walleye or muskellunge egg survival when used immediately after fertilization. We will next address whether iodophor compounds will effectively destroy VHS when used as an egg disinfectant. If so, iodophor egg disinfection will be a useful tool to help protect our hatchery stocks.

The FDCU is also collaborating with Dr. Cliff Starliper from the USGS National Fish Disease Laboratory (Leetown, WV) to develop an improved method for detecting a persistent pathogen in our state hatchery system, Flavobacterium branchiophilum, the bacterium that causes bacterial coldwater disease in salmonids (BCWD). BCWD plagues trout hatcheries around the country and clinical diagnosis has been ineffective because current diagnostic methods are very slow. We are currently trying to develop an improved bacterial growth medium that allows rapid identification of BCWD so that fish may be treated more promptly.

Report Date 8/21/2007

ANNUAL STOCKING REPORT - BY SPECIES

January 1, 2006 - December 31, 2006

	LESS THAN 1"		1" - 4.24"		4.25" - 5.74"		5.75" - 6.74"		6.75" - 7.74"		7.75" Plus		TOTAL	
SPECIES	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT
Cold Water														
Brook Trout	3,850	0	63,835	1,813	314,890	12,561	10,670	862	16,910	2,819	179,610	64,403	589,765	82,458
Brown Trout					45,710	3,390	22,550	2,169	53,840	8,722	1,764,545	560,280	1,886,645	574,561
Rainbow Trout			132,800	2,120			55,200	5,102	3,000	526	380,775	103,554	571,775	111,302
Steelhead					563,200	29,574	269,690	23,585	20,000	2,667			852,890	55,826
Lake Trout							157,590	9,224	70,940	5,903	156,680	24,833	385,210	39,960
Splake											16,010	4,147	16,010	4,147
Landlocked Salmon	5,890	320	95,200	42	19,400	753	172,330	17,459	85,270	10,395	19,450	6,366	397,540	35,335
Coho					155,000	10,534	109,900	9,158					264,900	19,692
Chinook			1,826,900	20,786									1,826,900	20,786
Cold Water Total	**9,740**	**320**	**2,118,735**	**24,761**	**1,098,200**	**56,812**	**797,930**	**67,559**	**249,960**	**31,032**	**2,517,070**	**763,583**	**6,791,635**	**944,067**
Warm Water														
Walleye	09,988,000	2,785	482,900	371	77,785	2,821							210,548,685	5,977
Muskellunge	543,000	21	21,700	4							22,700	2,419	587,400	2,444
Tiger Muskellunge					49,000	1,314					109,560	13,000	158,560	14,314
Panfish											2,500	500	2,500	500
Paddlefish											367	122	367	122
Warm Water Total	**210,531,000**	**2,806**	**504,600**	**375**	**126,785**	**4,135**					**135,127**	**16,041**	**211,297,512**	**23,357**
Grand Total	**210,540,740**	**3,126**	**2,623,335**	**25,136**	**1,224,985**	**60,947**	**797,930**	**67,559**	**249,960**	**31,032**	**2,652,197**	**779,624**	**218,089,147**	**967,424**

Report Date 3/29/2007

COLD WATER ANNUAL STOCKING REPORT - BY HATCHERIES

APRIL 1, 2006 - MARCH 31, 2007

	LESS THAN 1"		1" - 4.24"		4.25" - 5.74"		5.75" - 6.74"		6.75" - 7.74"		7.75" Plus		TOTAL	
SPECIES	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT
Brook Trout														
Adirondack	3,850	0	30,590	923	86,380	3,306					20,500	6,005	141,320	10,234
Bath											4,205	1,583	4,205	1,583
Caledonia											400	78	400	78
Catskill											7,070	2,021	7,070	2,021
Chateaugay			4,375	122	29,490	1,552	10,670	862	13,210	2,184	33,880	9,969	91,625	14,689
Oneida											750	375	750	375
Randolph											42,595	17,870	42,595	17,870
Rome			28,870	768	199,020	7,703			3,000	508	62,210	24,194	293,100	33,173
Salmon River									700	127	4,000	950	4,700	1,077
Van Hornesville											4,000	1,358	4,000	1,358
TOTALS	**3,850**	**0**	**63,835**	**1,813**	**314,890**	**12,561**	**10,670**	**862**	**16,910**	**2,819**	**179,610**	**64,403**	**589,765**	**82,458**

Brown Trout														
Adirondack							650	65			71,640	18,959	72,290	19,024
Bath					43,000	3,209					119,140	37,295	162,140	40,504
Caledonia									30,410	4,943	276,850	110,365	307,260	115,308
Catskill											390,690	144,357	390,690	144,357
Chateaugay							1,100	124			138,460	32,811	139,560	32,935
Oneida											200	1,111	200	1,111
Randolph											175,495	66,070	175,495	66,070
Rome					2,710	181	18,000	1,648			308,150	77,476	328,860	79,305
Salmon River									23,430	3,779	139,310	29,768	162,740	33,547
Van Hornesville							2,800	332			144,610	42,068	147,410	42,400
TOTALS					**45,710**	**3,390**	**22,550**	**2,169**	**53,840**	**8,722**	**1,764,545**	**560,280**	**1,886,645**	**574,561**

COLD WATER ANNUAL STOCKING REPORT - BY HATCHERIES

APRIL 1, 2006 - MARCH 31, 2007

	LESS THAN 1"		1" - 4.24"		4.25" - 5.74"		5.75" - 6.74"		6.75" - 7.74"		7.75" Plus		TOTAL	
SPECIES	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT
Rainbow Trout														
Adirondack											41,600	9,604	41,600	9,604
Bath			78,800	952			40,000	3,704			40,700	10,423	159,500	15,079
Caledonia											45,000	12,343	45,000	12,343
Catskill							2,000	208			42,980	12,783	44,980	12,991
Chateaugay			1,500	36							62,690	19,243	64,190	19,279
Randolph											10,815	6,134	10,815	6,134
Rome			8,000	128							72,440	17,340	80,440	17,468
Salmon River							1,200	119			11,850	2,466	13,050	2,585
Van Hornesville			44,500	1,004			12,000	1,071	3,000	526	52,700	13,218	112,200	15,819
TOTALS			**132,800**	**2,120**			**55,200**	**5,102**	**3,000**	**526**	**380,775**	**103,554**	**571,775**	**111,302**
Steelhead														
Chateaugay					20,000	952							20,000	952
Salmon River					543,200	28,622	269,690	23,585	20,000	2,667			832,890	54,874
TOTALS					**563,200**	**29,574**	**269,690**	**23,585**	**20,000**	**2,667**			**852,890**	**55,826**
Lake Trout														
Adirondack							28,580	2,056	4,020	339			32,600	2,395
Bath							121,200	6,666			127,820	21,228	249,020	27,894
Catskill									9,240	776			9,240	776
Chateaugay							7,260	462	47,290	3,920	28,860	3,605	83,410	7,987
Rome							550	40	10,390	868			10,940	908
TOTALS							**157,590**	**9,224**	**70,940**	**5,903**	**156,680**	**24,833**	**385,210**	**39,960**
Splake														
Adirondack											3,410	853	3,410	853
Chateaugay											11,310	3,038	11,310	3,038
Rome											1,290	256	1,290	256
TOTALS											**16,010**	**4,147**	**16,010**	**4,147**

COLD WATER ANNUAL STOCKING REPORT - BY HATCHERIES

APRIL 1, 2006 - MARCH 31, 2007

	LESS THAN 1"		1" - 4.24"		4.25" - 5.74"		5.75" - 6.74"		6.75" - 7.74"		7.75" Plus		TOTAL	
SPECIES	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT
Landlocked Salmon														
Adirondack	5,890	320	95,200	42	19,400	753	129,610	13,041	80,950	9,760	390	1,032	331,440	24,948
Bath							37,440	3,879					37,440	3,879
Catskill									4,320	635			4,320	635
Chateaugay											19,060	5,334	19,060	5,334
Van Hornesville							5,280	539					5,280	539
TOTALS	**5,890**	**320**	**95,200**	**42**	**19,400**	**753**	**172,330**	**17,459**	**85,270**	**10,395**	**19,450**	**6,366**	**397,540**	**35,335**
Coho														
Salmon River					155,000	10,534	109,900	9,158					264,900	19,692
TOTALS					**155,000**	**10,534**	**109,900**	**9,158**					**264,900**	**19,692**
Chinook														
Caledonia			414,000	3,237									414,000	3,237
Salmon River			1,412,900	17,549									1,412,900	17,549
TOTALS			**1,826,900**	**20,786**									**1,826,900**	**20,786**
Total Trout and Salmon	**9,740**	**320**	**2,118,735**	**24,761**	**1,098,200**	**56,812**	**797,930**	**67,559**	**249,960**	**31,032**	**2,517,070**	**763,583**	**6,791,635**	**944,067**

Report Date 3/29/2007

WARM WATER ANNUAL STOCKING REPORT - BY HATCHERIES

APRIL 1, 2006 - MARCH 31, 2007

	LESS THAN 1"		1" - 4.24"		4.25" - 5.74"		5.75" - 6.74"		6.75" - 7.74"		7.75" Plus		TOTAL	
SPECIES	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT
Walleye														
Bath	1,312,000	17											1,312,000	17
Caledonia	8,780,000	116											8,780,000	116
Chateaugay	2,284,000	30											2,284,000	30
Chautauqua	267,000	3	289,500	181									556,500	184
Oneida	177,487,000	2,366			77,785	2,821							177,564,785	5,187
Rome	5,200,000	69											5,200,000	69
Salmon River	5,950,000	68											5,950,000	68
South Otselic			193,400	190									193,400	190
Van Hornesville	8,708,000	116											8,708,000	116
TOTALS	**209,988,000**	**2,785**	**482,900**	**371**	**77,785**	**2,821**							**210,548,685**	**5,977**
Muskellunge														
Chaut/Bath											4,800	459	4,800	459
Chaut/Chat	79,000	3											79,000	3
Chautauqua	464,000	18	21,700	4							17,900	1,960	503,600	1,982
TOTALS	**543,000**	**21**	**21,700**	**4**							**22,700**	**2,419**	**587,400**	**2,444**
Tiger Muskellunge														
South Otselic					49,000	1,314					109,560	13,000	158,560	14,314
TOTALS					**49,000**	**1,314**					**109,560**	**13,000**	**158,560**	**14,314**
Panfish														
Chautauqua											2,500	500	2,500	500
TOTALS											**2,500**	**500**	**2,500**	**500**
Paddlefish														
Oneida											367	122	367	122
TOTALS											**367**	**122**	**367**	**122**
Total Warm Water Fish	**210,531,000**	**2,806**	**504,600**	**375**	**126,785**	**4,135**					**135,127**	**16,041**	**211,297,512**	**23,357**

Report Date 3/29/2007

ANNUAL STOCKING REPORT - BY SPECIES

APRIL 1, 2006 - MARCH 31, 2007

	LESS THAN 1"		1" - 4.24"		4.25" - 5.74"		5.75" - 6.74"		6.75" - 7.74"		7.75" Plus		TOTAL	
SPECIES	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT
Cold Water														
Brook Trout	3,850	0	63,835	1,813	314,890	12,561	10,670	862	16,910	2,819	179,610	64,403	589,765	82,458
Brown Trout					45,710	3,390	22,550	2,169	53,840	8,722	1,764,545	560,280	1,886,645	574,561
Rainbow Trout			132,800	2,120			55,200	5,102	3,000	526	380,775	103,554	571,775	111,302
Steelhead					563,200	29,574	269,690	23,585	20,000	2,667			852,890	55,826
Lake Trout							157,590	9,224	70,940	5,903	156,680	24,833	385,210	39,960
Splake											16,010	4,147	16,010	4,147
Landlocked Salmon	5,890	320	95,200	42	19,400	753	172,330	17,459	85,270	10,395	19,450	6,366	397,540	35,335
Coho					155,000	10,534	109,900	9,158					264,900	19,692
Chinook			1,826,900	20,786									1,826,900	20,786
Cold Water Total	**9,740**	**320**	**2,118,735**	**24,761**	**1,098,200**	**56,812**	**797,930**	**67,559**	**249,960**	**31,032**	**2,517,070**	**763,583**	**6,791,635**	**944,067**
Warm Water														
Walleye	:09,988,000	2,785	482,900	371	77,785	2,821							210,548,685	5,977
Muskellunge	543,000	21	21,700	4							22,700	2,419	587,400	2,444
Tiger Muskellunge					49,000	1,314					109,560	13,000	158,560	14,314
Panfish											2,500	500	2,500	500
Paddlefish											367	122	367	122
Warm Water Total	**210,531,000**	**2,806**	**504,600**	**375**	**126,785**	**4,135**					**135,127**	**16,041**	**211,297,512**	**23,357**
Grand Total	**210,540,740**	**3,126**	**2,623,335**	**25,136**	**1,224,985**	**60,947**	**797,930**	**67,559**	**249,960**	**31,032**	**2,652,197**	**779,624**	**218,089,147**	**967,424**

Species of Greatest Conservation Need

Central Office- State Wildlife Grants Program

State Wildlife Grants Program and the Comprehensive Wildlife Conservation Strategy
Bureau of Fisheries Central Office staff member Lisa Holst continues to manage the Division-wide State Wildlife Grants Program (SWG). DEC was notified in May of 2006 that its Comprehensive Wildlife Conservation Strategy (CWCS) was accepted by US Fish and Wildlife Service. This acceptance ensures that NY will remain eligible for SWG funds for 10 years.

The program has grown over the past year with the hiring of 10 new Biologist 1 positions. Nine of these biologists are assigned to manage the 11 watersheds delineated in the CWCS. Their role is coordination of the program with local partners and DEC staff in each watershed, and to create individual work plans based on recommendations in the CWCS for each watershed. Two of these biologists are supervised by Regional Fisheries Managers. The 10th Biologist 1 is based in the Central Office in Albany and is responsible for managing data related to SWG species and the data generated by SWG funded projects.

The SWG program used its Federal Fiscal Year 2005 funding to create a $2.94 million grants program for our partners to help implement the recommendations in the CWCS. The program issued its first Request for Applications in January of 2007, and received 93 applications that collectively requested over $12 million in grant funds. Project awards are expected in summer 2007.

The SWG program identifies over 530 fish and wildlife Species of Greatest Conservation Need. The CWCS includes recommendations for 40 species of freshwater fish and several diadromous species that range inland from coastal waters. Several projects related to freshwater fish have been funded by the program. Some highlights from these projects follow.

<u>Adirondack Round Whitefish Investigation</u>
Field work was concluded in spring 2006 and the final report was delivered in February 2007. The report includes an assessment of the status of round whitefish throughout its range in NY, a habitat model identifying the most important biological variables in their distribution and identification of the probable factors in their decline. It also proposes a draft recovery strategy and a prioritized list of Adirondack lakes that would be the best candidates for restoration of the species through re introduction.

<u>Longear Sunfish</u>
This project was completed and the final report was delivered in spring of 2007. The report describes the population characteristics of longear sunfish and their current status in NY. Field work conducted in 2005 involved intensive sampling of 124 sites in 13 waters throughout the former range of the fish in NY. Longear sunfish were found only in a single 2.3 mile stretch of Tonawanda Creek. A management plan was presented along with habitat indicators intended to predict the suitability of other waters for longear sunfish. This has resulted in experimental hatchery rearing and restoration of longear sunfish into additional waters of the State. Also in 2006-07 longear sunfish are being cultured in ponds and were stocked in a tributary of Oak Orchard Creek and of Buffalo River. A second brood stock was acquired from Moira River of Ontario and a third from Tonawanda Creek. Propagation efforts were summarized by Reynolds in an article in American Currents (2007).

Longear sunfish

<u>Rare Fish of Oswayo Creek and the Upper Allegheny River</u>
The project objective is to determine the status and distribution of rare fish in the Allegheny watershed. Sampling of over 70 locations in 2006-2007 extended the known range in NY of bluebreast darter and Ohio lamprey. Two other species of interest in this watershed, gilt darter and gravel chub were not caught despite diligent efforts. This project, expected to be completed in 2008, will also gather data on the habitat requirements and other factors that may be limiting the populations of these fish. These findings will support restoration and management efforts by the Bureau.

<u>American Eel, Inland</u>
The objectives of this project include compiling the current and historic eel population data in each of the State's major drainage basins, summarizing commercial catch reports, analyzing population trends and identifying limiting factors contributing to their widespread decline. Previous population assessments indicate alarming declines in numbers of eels in the Lake Ontario – St. Lawrence River population. Work began in June 2006 and numerous distribution maps and draft analyses have been developed. The project is expected to continue through March 2008 and to coordinate with a complementary project assessing juvenile eels returning to the marine waters of the state from their spawning range in the Sargasso Sea. Final products from this project will include a statewide management plan for eels.

Glass eels (juvenile stage)

Region 1

Banded Sunfish Surveys

Regional Fisheries Unit staff members Chart Guthrie, Heidi O'Riordan, David Kennedy; Cobleskill Intern Joe Albanese and Larry Cowden from Environmental Permits began surveys for the banded sunfish in the Peconic River system. The banded sunfish is listed as a threatened species in New York State. Prior to initiating survey work, the Bureau of Fisheries Statewide Database was searched for all historic records of banded sunfish collections and they were mapped on ArcGIS. In addition all surveys where banded sunfish were sought but not collected were noted and mapped. Possible locations for banded sunfish populations that had not been surveyed were also noted and land ownership was determined with the assistance of Heather Amster from Real Property. Preliminary field surveys consisted of comparisons of gear effectiveness between dip nets and a small seine in waters where banded sunfish were known to exist. The two techniques were both effective in catching banded sunfish, but the effectiveness varied depending upon the type of habitat sampled. In three days of surveys banded sunfish populations were reconfirmed in five waters, their absence was confirmed in two waters, and a population was documented in one water that had not been previously surveyed. In addition a NYS Endangered Species, the tiger salamander was documented in a ninth water.

Banded sunfish

Region 5

Restoration of the endangered round whitefish

Historically round whitefish were found in about 70 Adirondack lakes and ponds. Their distribution has declined dramatically and they are currently listed as endangered in New York. Recent efforts to restore round whitefish include: annual egg take, hatchery production and stocking; pond reclamations to eliminate introduced fishes and to establish a broodstock pond; and survey and planning efforts by Cornell University scientists.

Little Green Pond, reclaimed in 2003, received a third stocking of round whitefish. Also, Rock Pond, located in the Pharaoh Lake Wilderness received a second stocking of round whitefish. About 1,300 round whitefish fry were carried by backpack into Rock Pond. The fry averaged 1.5 in when stocked.

Expectations are that Little Green Pond will become New York's primary brood stock water for round whitefish. The pond was netted in the fall of 2006 in a first attempt to obtain round whitefish eggs from this waterbody. Oneida style trap nets fished for 20 net nights. All three year classes of whitefish were netted. Growth rates were excellent with age 0 fish averaged 6.7 in, age 1 averaged 11 in, and age 2 whitefish averaged 13 in. A total of 94 round whitefish were caught, 66 of which were the large, age 2 fish. Most of the fish were immature: only one ripe female and few ripe males were captured. The relative lack of mature round whitefish is not surprising - the oldest round whitefish in the pond were age 2, yet the parental stock of round whitefish in the Cascade Lakes do not mature until age 3. Due to the lack of adult brood stock fish in Little Green Pond, no stocking occurred in 2006-2007.

Apparently this population will spawn very late in the fall. Nets were set periodically starting in mid-November. No ripe fish were handled until November 30. The net catch picked up markedly in early December, suggesting timing of the real run. Unfortunately rainbow smelt were also captured in the netting. This species was thought to have been eliminated from the pond during the reclamation (and that is still believed to be the case). Smelt spawn in the Little Green outlet each spring and the barrier dam which prevents their entry from Little Green is located immediately adjacent to the pond. Heavy human, pet and wildlife traffic in this area creates a difficult situation in our attempts to keep smelt out of Little Green Pond.

Region 9

Fertilizing whitefish eggs

Paddlefish Restoration

First initiated in 1998, New York's effort to restore paddlefish entered its ninth year in 2006. Paddlefish reared at Oneida Hathchery were released into Allegheny Reservoir (1998 - 46, 1999 - 535, 2000 - 135, 2001 - 1,878, 2002-762 , 2003-778, 2004-803, 2005-1433). Starting in 2006 the Conewango Creek was a new release site with 367 fish stocked. Minute coded wire tags were inserted into the paddles of all paddlefish before release for subsequent identification of stocking site origin and date. Four reports of paddlefish either observed swimming, stranded or caught angling were received in 2005 and six in 2006 with the largest paddlfish reported at approximately 45 in. Stocking and tag recovery information was forwarded to Mississippi Interstate Cooperative Resource Association (MICRA).

Paddlefish

Rare, Threatened and Endangered Fish Program

The discovery of VHS in New York State waters forced a halt in the lake sturgeon hatchery rearing program during 2006-2007. DEC staff hope to fine alternate hatchery facilities or brood stock sources to allow this effort to continue in the future.

This was the fifth year of surveys of lesser-known fishes referred to as watershed updates to fill-in knowledge typically not included in Regional surveys. The watershed summaries have tables showing which major waters have which species, and there are species annotations. For the Black watershed and Mohawk watershed, we sampled at 132 locations in 2006 and summarized catches for 75 and 88 species respectively. These reports will later be combined with the previous ones, for the eight watersheds to the south and west, to develop an article for the NYS Museum Circulars. The first one will be called “Fish survey updates for watersheds of central, western and southern New York”. The Ontario watershed and Erie watershed fish survey updates were also completed with samples from 1999-2007 and will later be melded into that same overview report. Field sampling and data reports were completed with the assistance of Eric Reynolds in the summer, fall and winter.

Exceptional catches from miscellaneous surveys in 2006 (at 157 sites) and early 2007 included: Iowa darters from Mendon Ponds, black bullhead repeat-records from the only two streams where they are known (in ditches of Iroquois Nat. Wildl. Refuge and in Mud Creek next to the Champlain Canal), repeat records of summer suckers in the three lakes where they are known (Squaw Lake in 2006 and L. Moose and Elk lakes in 2007), pugnose shiner and American shad in Sodus Bay, and longear sunfish in Tonawanda Creek at Millersport. The number of surveys and sites in each region in 2006 are listed at the end of this report.

Some of these samples were part of biomonitoring work (at 4 sites at Quacken Kill) that will help in the development of an IBI. This was done in conjunction with RIBS work on macroinvertebrates by Bob Bode’s group, where we now have 120 sites with calculated values for cross referencing the indices or two taxonomic groups. A preliminary examination of the metrics used in the watershed updates was accomplished by borrowing data from Dr. K. Murray (USGS, Troy) and seeing how her IBI values at reference sites compared to values using my 12, more generalized metrics. Further analysis is possible using chemistry and macroinvertebrate ratings for those USGS sites. Our work on an IBI for Lake Ontario bays and tributary mouths from 1996-2000 was finally advanced to a publication that was printed (in a book edited by Simon and Stewart) in December 2006.

NY Biological Survey fish data from 1927-28 were entered into the Fisheries database because of omissions in the electronic records. Unfortunately, the catches in the first 5 years, 1926-30 were not recorded on field sheets as completely as from 1931-39, and only catches of sportfish have been available in electronic files for 1926-30. The catch records by Greeley et al. for Oswego and Erie watersheds (1927-28) were reconstructed from records at the State Museum and the Catalogue stored at CU. All these have been entered for Erie (267 sites) and about 2/3rds are entered for Oswego (214 sites). The remainder for Oswego will be completed in winter 07-08. The catch records are still not a complete listing of all kinds and numbers that were likely caught, but they at least represent most of the species.

Administration

Statewide

Emergency Regulations Enacted to Limit the Spread of Viral Hemorrhagic Septicemia (VHS)
Starting in the Fall of 2006, the Bureau of Fisheries conducted a year long and continuing statewide effort to help prevent the spread of the Viral Hemorrhagic Septicemia (VHS) to additional waters in the state. VHS was first confirmed in freshwater fish in New York waters in May 2006 in Lake Ontario and the St. Lawrence River, since spreading to a few inland waters. There is no known cure for VHS and the virus is nearly always fatal to fishing coming down with the disease. With it's ability to spread, the virus poses serious potential impacts to fisheries, recreation, and the economy of New York (note that VHS is a fish pathogen and does not pose any threat to public health).

Emergency regulations were first put in place in November of 2006 and a final permanent rule making was filed in June of 2007. The new regulations place limits on the possession, sale, transfer, taking and release of certain bait fish and on other live fish species to be placed in New York waters. While the rule making is complex due to the all of the considerations that needed to be taken into account, the major focus was limiting the use of bait fish (both personal and commercial use) to the same body of water; allowing for the commercial sale of bait fish for use in other waters (other than the same water body from which collected) if they have been certified as being free of certain fish pathogens; and requiring that all live fish, destined for release into the waters of the state be inspected and free of certain fish pathogens. Information pertaining to the outreach efforts on VHS, including to anglers, commercial bait fish operators and private hatcheries, is included elsewhere in this report.

Central Office- Biological Survey Unit

Survey Processing
There were 743 fisheries surveys sent to the Biological Survey Unit (BSU) for inclusion into the Fisheries Survey Database in 2006 compared to 316 sent in 2005. These surveys represent a broad array of data collection events used to determine present day and long-term trends in fish presence, abundance, water chemistry and habitat. Of particular significance in 2006 is the addition of vast amounts of historic fisheries data collected from the Finger Lakes in Region 7.

Regional staff also submitted 550 survey abstracts. A survey abstract briefly describes the where, what and how's of a survey effort. Many of these abstracts relate current survey results to previous sampling endeavors and serve as an excellent means for historical perspective on a given resource. Through the abstracts the Bureau is laying down "written tracks" and the value of these documents will increase as data become more historic in nature.

Historic Database
Currently the Bureau has electronic records and a functional database for almost all inland survey work from 1988 to present. "Historic" fisheries survey data (1924 – 1988) is in electronic medium but not in a usable format. The BSU has analyzed the historic data and determined that much of it can be integrated into the existing Modern Fisheries Database. Integration will yield one comprehensive survey database and add 57,000 surveys covering 100,000 site locations. Data will be limited to Site Location, Summary Fish, Water Chemistry and Comments. An algorithm to create survey numbers has been developed and all survey and site location data has been reformatted for integration. The BSU hopes to have the first draft of the new Statewide Fisheries Database completed by the end of August 2007.

Database Conversion
The database has almost doubled in size since 2000 and our current software is becoming overburdened. The BSU is working with DIS to convert the DB from Access to Oracle. Once in Oracle the DB, which is currently distributed via CD will be delivered over the agency network. Once this is accomplished the BSU will begin a pilot program for data entry in the field via handheld data collectors. Process on this initiative has been slow. The BSU is waiting for DIS to upgrade Oracle to 10G and provide workspace on the server.

Fisheries GIS
After three years of hard work the BSU has finally completed the digital tagging of over 80,000 water bodies in the National Hydrography Dataset (NHD) with unique identifiers. The creation of this tagged water layer will serve as the first stepping stone toward the development of a GIS based Fisheries Information Management System which will include the integration of other BOF database and hopefully some new ones such as a fisheries management database. The Bureau envisions a GIS that will provide a means for one stop shopping for all fisheries related information. Via a point and click map interface users will be able to view survey data, stocking information access points, etc. Development of an in-house application will begin in 2007. The Bureau hopes to provide the public with a similar tool via the website in the future.

Central Office- Coldwater Unit

Eastern Brook Trout Joint Venture
In recognition of the need to address regional and range-wide threats to brook trout, DEC joined a group of public and private entities formed the Eastern Brook Trout Joint Venture in 2004. The goals of the Joint Venture are to halt the decline of brook trout and restore fishable populations. The Joint Venture includes Fish and Wildlife agencies from 17 states, USGS, USFS, USFWS, NPS, Trout Unlimited, The Nature Conservancy, the Izaak Walton League, and academic institutions.

Joint Venture scientists, in cooperation with state agency biologists, assessed each of more than 11,400 subwatersheds for brook trout population status and threats across its eastern range. For New York State, it was found that only 5% of watersheds that historically contained brook trout in streams and rivers remain intact, primarily in portions of the Adirondacks and Tug Hill plateau.

Western and south central New York suffered the greatest losses of brook trout. Data gaps remain in the central part of the state from Albany to Syracuse. While many lakes and ponds contain brook trout, losses have been substantial due to competition with non-native fish and acid rain.

In 2006, states prepared individual Conservation Strategy documents designed to meet the challenges identified in the range-wide assessment. New York's Conservation Strategy identified 19 goals and 39 strategies. State strategies were combined to produce a range-wide Eastern Brook Trout Conservation Strategy, which includes five overarching range-wide objectives to be completed by 2025, with smaller regional goals to be completed by 2012. Success will be measured against the baseline status and threats assessment completed in 2005.

One of the range-wide goals is to determine the status of brook trout in watersheds where recent, quantitative data is lacking. We have begun that effort in Region 4 under the Coldwater Federal Aid project, and Trout Unlimited has submitted a SWG proposal to undertake a similar effort in Regions 5 and 6.

Region 5

Emily Zollweg was inducted as President of the New York Chapter of the American Fisheries Society on February 8, 2007. The American Fisheries Society is the professional organization for fisheries scientists. As such, it brings together fisheries experts from state agencies, universities, Federal agencies, and private business. Congratulations to Emily for receiving this honor, and thanks for her extra effort on behalf of our fisheries resources.

Region 7

Permits and Licenses

The following number of permits and licenses were issued by the Fisheries Unit:

Bait Licenses - 63; Farm Fish Pond Licenses - 142; Triploid Grass Carp Permits - 231; Permits to stock or remove fish - 31; Piranha Permits - 1.

Region 8

Triploid Grass Carp Permits

Region 8 issued 334 permits in FY 2006-07. There appears to be a slight trend downward in the number of permits issued since the high of 429 in 2003-2004.

Farm Fish Pond Licenses

The Region issued 154 farm fish pond licenses in FY 2006-07. The numbers of permit issued appears to be stable. There is no fee for these licenses.

Stocking Permits

The Region issued 11 stocking permits during FY 2006-07. There is no fee associated with this permit.

Bait Licenses

The Fisheries Keyboard Specialist has the responsibility of issuing bait licenses. Eighty five (85) licenses were issued with seven hundred forty three dollars ($743.00) collected in FY 2006-07.

Piranha Permits

The Region did not issue any piranha permits in FY 2006-07.

Region 9

Large Waters Fisheries Research Boat

Region 9 staff received their 22 ft aluminum research boat (the "Cecil Heacox") from American Metalcraft Corporation of Clayton, New York. The boat, representing the first large water boat built specifically for fisheries work in Region 9, will be used on Chautauqua Lake, the Niagara River and as a backup boat to the Lake Erie Unit.

New Region 9 Research Boat

Triploid Grass Carp, Farm Pond and Stocking Permits

Once again new permits and renewals continued to increase. We issued 570 Triploid Grass Carp Permits in 2006. That is the most we have ever issued in a single year.

In 2006, 3 new Fish Stocking Permits were issued in Region 9.

In 2006, 72 Farm Fish Pond Permits were issued, which is about the regional average. Below is the number issued by county:

Allegany- 8
Cattaraugus- 18
Chautauqua- 15
Erie- 23
Niagara- 3
Wyoming- 5

Bureau of Fisheries Staffing

CENTRAL OFFICE

Administration

Stang, Douglas	Biologist 4 (Aquatic)

Public Use and Extension

Woltmann, Ed	Biologist 3 (Aquatic)
Kozlowski, Greg	Biologist 2 (Aquatic)
Meschino, Joelle	Environmental Educator Asst.

Inland Fisheries

Keeler, Shaun	Biologist 3 (Aquatic)
Daley, James	Biologist 2 (Aquatic)
Hurst, Steve	Biologist 2 (Aquatic)
Loukmas, Jeff	Biologist 2 (Aquatic)
Holst, Lisa	Biologist 2 (Aquatic)
Herzog, Carl	Biologist 1 (Ecology)
McKelvey, Amy	Env. Program Specialist 1
Richmond, Linda	Agency Program Aide
Andersen, James	Clerk 1
Michasiow, Casey	Fish & Wildlife Technician 1 (seasonal)

Fish Culture

Hulbert, Phil	Fish Culturist VI
Buell, Henry	Fish Culturist V
LaBoissiere, Mary	Secretary 1

REGION 1

Guthrie, Charles	Biologist 2 (Aquatic)
O'Riordan, Heidi	Biologist 1 (Aquatic)
Latremore, Erik	Fish & Wildlife Technician 2
Kennedy, David	Fish & Wildlife Technician 2 (resigned 6/28/07)
Pries, Joseph	Fish & Wildlife Technician 1 (seasonal)
Felice, Tom	Seasonal Laborer (½ time)
Fradua, Jon	Fish & Wildlife Technician 1 (seasonal)
Nichol, Malynda	Recreational Fisheries Specialist *Sea Grant*
Albanese, Joe	Cobleskill Intern (5/15/06-8/15/06)

REGION 2

Pane, Joseph	Biologist 3 (Aquatic)
Cohen, Melissa	Biologist 1 (Aquatic)
Lee, Nim	Recreational Fisheries Specialist *Sea Grant*
Bruner, Sarah	Environmental Educator Asst.

REGION 3

Elliot, Wayne	Biologist 2 (Aquatic) (retired 4/06)
Flaherty, Mike	Biologist 1 (Aquatic) (promoted to Biologist 2- 6/06)
Pierce, Ron	Biologist 1 (Aquatic)
Angyal, Bob	Biologist 1 (Aquatic)
Surprenant, Leslie	Biologist 1 (Aquatic) (transferred 2/07)
Wilson, Larry	Biologist 1 (Aquatic)
Falk, Art	Fish & Wildlife Technician 3 (retired 5/06)
Wysocki, Linda	Fish & Wildlife Technician 2 (promoted to Tech 3- 8/06)
McNamara, Tim	Fish & Wildlife Technician 1 (Seasonal)
Zerkle, Tony	Fish & Wildlife Technician 1 (Seasonal)

REGION 4

Lorence, Steve	Biologist 2 (Aquatic)
McBride, Norm	Biologist 1 (Aquatic)
Zielinski, Dan	Biologist 1 (Aquatic)
Cornwell, Dave	Fish & Wildlife Technician 2
Linhart, Fred	Fish & Wildlife Technician 3
Collins, Kandy	Keyboard Specialist 2

REGION 5

William Schoch	Regional Fisheries Manager
Leo Demong	Biologist I (Aquatic)
Lance Durfey	Biologist I (Aquatic)
Richard Preall	Biologist I (Aquatic)
Matthew Presher	Biologist I (Aquatic)
Emily Zollweg	Biologist I (Aquatic)
Jennifer Sausville	Fish & Wildlife Technician 3
David Armstrong	Fish & Wildlife Technician 2
Bethany Stephenson	Environmental Educator Assistant (Seasonal)
Nathan Favreau	Fish & Wildlife Technician 1 (Seasonal)
Sara Duensing	Fish & Wildlife Technician 1 (Seasonal)
David LaRusso	Fish & Wildlife Technician 1 (Seasonal)

REGION 6

Flack, Frank	Biologist 2 (Aquatic)
McCullough, Russ	Biologist 1 (Aquatic)
Klindt, Rodger	Biologist 1 (Aquatic)
Hasse, Jack	Biologist 1 (Aquatic)
Carlson, Doug	Biologist 1 (Aquatic)
VanMaaren, Chris	Biologist 1 (Aquatic)
McDonald, Dick	Biologist 1 (Aquatic)
Adams, Dick	Fish & Wildlife Technician 3
Hart, Jessica	Fish & Wildlife Technician 1 (Seasonal)
Hart, Silas	Fish & Wildlife Technician 1 (Seasonal)
Niewieroski, Greg	Seasonal Laborer
Rice, Travis	Seasonal Laborer
Ambrose, Jake	Fish & Wildlife Technician 1 (Seasonal)

Reynolds, Eric	Cobleskill Intern
Gordon, Aaron	Fish & Wildlife Technician 1 (Seasonal)
Alexander, Amanda	Fish & Wildlife Technician 1 (Seasonal)
Bailey, Melissa	Fish & Wildlife Technician 1 (Seasonal)

REGION 7

Bishop, Dan	Biologist 2 (Aquatic)
Lemon, Dave	Biologist 1 (Aquatic)
Robins, Jeff	Biologist 1 (Aquatic)
Davall, Russ	Fish & Wildlife Technician 3
Everard, Jim	Biologist 1 (Aquatic)
Hines, Janet	Secretary 1 (retired 12/15/06)
Fox, Shawn	Fish & Wildlife Technician 1 (seasonal- 4/1/06-9/29/06)
Richardson, Denise	Fish & Wildlife Technician 1 (seasonal- 9/16/07-2/7/07)

REGION 8

Pearsall, Webster	Biologist 2 (Aquatic)
Sanderson, Matt	Biologist 1 (Aquatic)
Hammers, Brad	Biologist 1 (Aquatic)
Austerman, Peter	Biologist 1 (Aquatic)
Mahar, Amy	Biologist 1 (Ecology)
Angold, Fred	Fish & Wildlife Technician 3
Olsowsky, David	Fish & Wildlife Technician 2
Verna, Marvin	Fish & Wildlife Technician 2 (transferred to Wildlife)
Burdett, Anna	Keyboard Specialist
Deres, Bob	Fish & Wildlife Technician 1 (seasonal)

REGION 9

McKeown, Paul	Biologist 2 (Aquatic)
Evans, Joe	Biologist 1 (Aquatic)
Wilkinson, Mike	Biologist 1 (Aquatic)
Cornett, Scott	Biologist 1 (Aquatic)
Galati, Joseph	Biologist 1 (Aquatic)
Zanett, James	Fish & Wildlife Technician 3
Clancy, Mike	Biologist 1 (Aquatic)
Holevinski, Robin	Biologist 1 (Ecology)
Sztukowski, Jon	Fish & Wildlife Technician 1 (seasonal)
Anderson, Chris	Fish & Wildlife Technician 1 (seasonal)

LAKE ERIE UNIT

Culligan, William	Biologist 3 (Aquatic)
Einhouse, Don	Biologist 1 (Aquatic)
Markham, Jim	Biologist 1 (Aquatic)
Zeller, Doug	Fisheries Research Vessel Captain
Zimar, Richard	Fish & Wildlife Technician 2
Beckwith, Brian	Fish & Wildlife Technician 2
Szwejbka, MariEllen	Secretary 1
Dusablon, Mark	Fish & Wildlife Technician 1 (seasonal)
Haley, Adam	Fish & Wildlife Technician 1 (seasonal)
Landahl, Brian	Fish & Wildlife Technician 1 (seasonal)

LAKE ONTARIO UNIT

LaPan, Steve	Biologist 2 (Aquatic)
Lantry, Jana	Biologist 1 (Aquatic)
Connerton, Michael	Biologist 1 (Aquatic)
Fairbanks, Alan	Fisheries Research Vessel Captain
Massia, Gaylor	Maintenance Assistant
Eckert, Thomas	Fish & Wildlife Technician 1 (Seasonal)
King, M. Ellen	Environmental Educator Asst.
Grant, Beverly	Secretary 1

ADIRONDACK FISH HATCHERY

Grant, Edward	Fish Culturist 3
Wallace, Michael	Fish Culturist 2
Aldinger, Fritz	Fish Culturist 1
Klubek, Ken	Fish Culturist 1
Jackson, Matt	Fish Culturist 1
Delisle, Jon	Seasonal Laborer

BATH FISH HATCHERY

Osika, Kenneth	Fish Culturist 3
Sweet, Robert	Fish Culturist 2
Klesa, Rodney	Fish Culturist 1
Raab, Kelly	Fish Culturist 1
Todd, Michael	Fish Culturist 1

CALEDONIA FISH HATCHERY

Mack, Alan	Fish Culturist 4
Krause, Mark	Fish Culturist 3
Hubbard, Bruce	Fish Culturist 2
Stein, Robert	Fish Culturist 2
Hayden, Kevin	Fish Culturist 2
Zenzen, Steve	Fish Culturist 1
Ward, Brian	Fish Culturist 1
Schirmer, Jason	Fish Culturist 1

CATSKILL FISH HATCHERY

Covert, Scott	Fish Culturist 4
Anderson, John	Fish Culturist 3
Gennarino, Joe	Fish Culturist 2
Anstey, Tim	Fish Culturist 1
Judson, Jim	Fish Culturist 1
Speziale, Mike	Fish Culturist 1
Sherwood, Steve	Fish Culturist 1

CHATEAUGAY FISH HATCHERY

Brue, Peter	Fish Culturist 3
Ventiquattro, Thomas	Fish Culturist 2
McCarthy, Neil	Fish Culturist 1
Goodale, Zachary	Fish Culturist 1

CHAUTAUQUA FISH HATCHERY

King, Larry	Fish Culturist 3
DeFries, Eric	Fish Culturist 2
Gruber, Bradley	Fish Culturist 1
Preston, Ron	Fish Culturist 1

ONEIDA FISH HATCHERY

Babenzien, Mark	Fish Culturist 4
Rathje, Carl	Fish Culturist 3
Dixon, Michael	Fish Culturist 2
Evans, William	Fish Culturist 2

RANDOLPH FISH HATCHERY

Mellon, Jonathan	Fish Culturist 3
Borner, Richard	Fish Culturist 2
Rambuski, James	Fish Culturist 2
Hohmann, Barry	Fish Culturist 1
Robb, Steve	Fish Culturist 1
Hulings, Raymond	Maintenance Assistant

ROME FISH HATCHERY

Lewthwaite, Robert	Fish Culturist 4
Wanner, Scott	Fish Culturist 3
Woodworth, William	Fish Culturist 2
Grabowski, Steven	Fish Culturist 1
Draper, John	Fish Culturist 1
Stercho, Jonathan	Fish Culturist 1 (Trainee)
Gray, John	Fish Culturist 1 (Trainee)
Matt, Kimberly	Keyboard Specialist 1
Hajdasz, William	Maintenance Supervisor

ROME FISH DISEASE CONTROL UNIT

Noyes, Andrew	Pathologist 2 (Aquatic)
Henson, Fred	Biologist 1 (Ecology)
Batur, Mark	Fish Culturist 1

SALMON RIVER FISH HATCHERY

Greulich, Andy	Fish Culturist 3
Dolan, Steve	Fish Culturist 3
Nelson, Bob	Fish Culturist 2
Domachowske, Andy	Fish Culturist 2
Edmonds, Brian	Fish Culturist 1
Boyer, Brian	Fish Culturist 1 (Trainee 2)
Zoladz, Justin	Fish Culturist 1 (Trainee 1)
Tabolt, Casey	Fish Culturist 1 (Trainee 1)
Hurd, Karen	Keyboard Specialist 1

SOUTH OTSELIC HATCHERY

Emerson, Patrick	Fish Culturist 2
Kielbasinski, Thomas	Fish Culturist 1
Ryan, Bruce	Fish Culturist 1

VAN HORNESVILLE FISH HATCHERY

Kroon, Larry	Fish Culturist 3
DuBois, Craig	Fish Culturist 2
Watson, Larry	Fish Culturist 1

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[Article]

Anthropogenic Impacts on American Eel Demographics in Hudson River Tributaries, New York

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Abstract.—Populations of American eel *Anguilla rostrata* along the eastern coast of North America have declined drastically for largely unknown reasons. We examined the population dynamics of American eels in six tributaries of the Hudson River, New York, to quantify their distribution and the impacts of anthropogenic stressors. With up to 155 American eels per 100 m^2, tributary densities are greater than those within the main stem of the Hudson River and are among the highest reported anywhere. The predominance of small American eels (<200 mm) and wide range of ages (from young-of-year glass eels to 24-year-old yellow eels) suggest that tributaries are an important nursery area for immature American eels. However, upstream of natural and artificial barriers, American eel densities were reduced by at least a factor of 10 and condition, as measured by mass, was significantly lower. Significantly lower American eel condition was also found with increasing riparian urbanization. Density-dependent growth limitations below barriers are suggested by increased growth rates above the first tributary barrier. We suggest that (1) tributaries are important habitat for the conservation of American eels and (2) mitigation of anthropogenic stressors is vital for complete utilization of available habitat and conservation of the species.

Complexities in the management of anadromous and catadromous fisheries over marine fisheries involve the use of multiple ecosystems—freshwater streams and lakes, estuaries, coastal marine waters, and the open ocean—to complete species' life cycles. Noted declines in many anadromous species found on the Atlantic Coast include river herrings *Alosa* spp., striped bass *Morone saxatilis* (but now recovered), and sturgeons *Acipenser* spp. (Kahn and Buerger 1994; Smith and Clugston 1997; Limburg et al. 2003; Schmidt et al. 2003). These declines have been linked to overfishing, the fragmentation or limitation of habitat caused by dams, and pollution as a result of urbanization. Recent concerns regarding the health of anguillid fishes in general, and the American eel *Anguilla rostrata* in particular, have been raised as well (e.g., ASMFC 2000, 2006; ICES 2004); specific concerns center on a lack of understanding of the basic biology of American eels and reliable estimates of stock abundance and distribution (ASMFC 2006). In watersheds of Europe, where habitat for the European eel *Anguilla anguilla* has been reduced by at least 33% (Feunteun 2002), combinations of reduced recruitment, nonsustainable commercial catch of immigrating glass eels and emigrating silvering eels, pollution, and climate change have led to a precipitous decline in European eel stocks, perhaps beyond safe biological limits (ICES 2004). The American eel, the subject of our study, is in general decline along the eastern coast of North America (Castonguay et al. 1994; Richkus and Whalen 1999; Haro et al. 2000). Commercial landings of American eels in New York State, averaging 61.2 metric tons from 1950 to 2003, have fallen to less than 0.2 metric tons/year from a high of 209 metric tons in 1980 (NMFS 2005), and recent glass eel recruitment to Hudson River tributaries showed declines from 10.6 to

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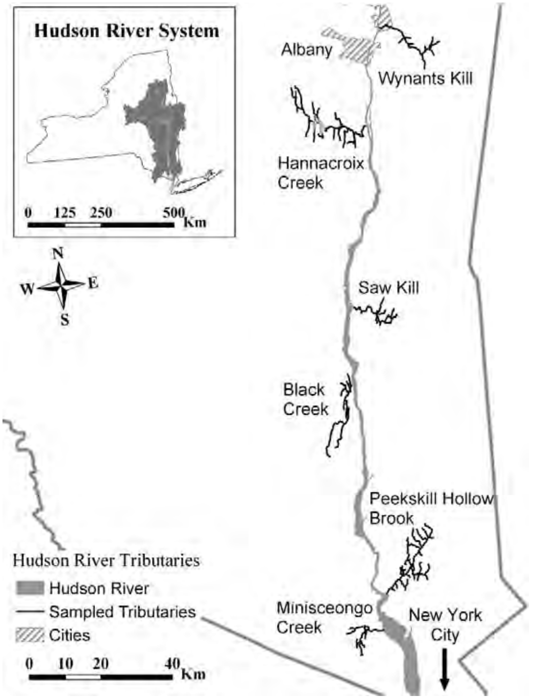

FIGURE 1.—Map of the Hudson River estuary showing the six tributaries in which American eels were studied.

3.3 eels/d from 2003 to 2005 before increasing in 2006 (R. E. Schmidt, Bard College at Simon's Rock, unpublished data).

Barriers may impede the progress of American eels into upstream habitats. Up to 84% of riverine habitat in the U.S. eastern seaboard and Lake Ontario drainages are upstream of dams (Busch et al. 1998). Eels are thought to be able to migrate past barriers only when they are smaller than 250 mm (Jellyman 1977; Legault 1988; Haro and Krueger 1991) by creeping up vertical walls or using areas of low flow. Barriers may also restrict movement between habitats (Cairns et al. 2004). However, most studies of barrier impacts to upstream migration have been conducted on large river systems (McGrath et al. 2003; Verdon and Desrochers 2003); little work has been performed within smaller tributaries.

Additional anthropogenic effects from urbanization may also impact American eels. In general, urbanization and introduced pollutants may affect fish condition and distribution in a watershed (Limburg and Schmidt 1990; Wang et al. 1997; Wolter et al. 2000; Coghlan and Ringler 2005). Urbanization may also alter aquatic invertebrate communities (Lenat and Crawford 1994; Moore and Palmer 2005), which American eels depend on as macroinvertebrate predators. Given the mounting evidence of the effects of land use change, tributary urbanization may be a second contributing factor in American eel decline in continental watersheds.

While broad geographic studies have shown latitudinal gradients in American eel growth and age at maturity (Helfman et al. 1987; Jessop 1987; Morrison and Secor 2003), questions remain about differences among stock densities, age, length, and growth within the longitudinal gradients of smaller streams. Conditions within small streams may exert controls on the growth of the American eel (Oliveira and McCleave 2000). However, there is little documentation of American eels in small tributaries connected to larger freshwater systems. While studies of American eel stocks and production within the Hudson River estuary main stem have estimated American eel densities (0.03–0.24 eels/100 m^2) and freshwater growth (34 mm/year; Morrison and Secor 2003, 2004), no estimates have been produced in tributaries draining into the Hudson River estuary. We argue that these areas are important habitat for yellow-phase American eels, and may contribute a portion of the estuary stock disproportionately important in relation to their area.

Non-fisheries-related anthropogenic impacts on American eels in Hudson River tributaries can be examined within the watershed because of polychlorinated biphenyl contamination of the main stem and the resultant closure of commercial fisheries since 1976. This reduced fishing mortality to negligible levels and allowed us to examine population demographics in the absence of this often dominant factor. Small tributaries of the Hudson River estuary provide opportunities to examine the impact of anthropogenic stressors, to gauge the relative importance of this habitat in relation to the main stem, and to assess their importance in conservation strategies. Specifically, we address the following questions: (1) Does American eel relative abundance vary longitudinally in tributaries, particularly with respect to barriers? (2) How does condition vary along an urbanization gradient or with increasing barrier intensity? (3) Are age and growth rates affected by barriers? (4) Are stock attributes (density, age, growth, and condition) different in tributaries than within the main stem of the Hudson River?

Study Site

The Hudson River estuary is located in eastern New York State (Figure 1). Over 100 tributaries empty into the Hudson River below the first barrier on the main stem, the federal dam at Troy, New York (river kilometer [rkm] 252; rkm 0 = The Battery, Manhattan Island, New York.). Thus, immigrating American eels have unimpeded access to the estuary and into the mouths of sample tributaries. Six tributaries of the

TABLE 1.—Watershed characteristics for censused Hudson River tributaries at which yellow-phase American eels were collected, 2003–2004.

Tributary	Watershed area (km^2)	Distance from Hudson River mouth (km)	Stream length (km)	Eel penetration (km)[a]	Number of barriers	Distance to first barrier (m)	First barrier height (m)	% Artificial barrier[b]	Average barrier height (m)
Wynants Kill	85.47	232.5	25.95	5.0	7	20	1.70	43	3.51
Hannacroix Creek	166.24	204.4	37.81	31.0	4	1,985	3.50	40	4.39
Saw Kill	66.29	153.8	22.62	11.0	7	255	1.34	43	3.27
Black Creek	87.77	132.4	29.55	27.5	9	2,620	4.40	22	2.47
Peekskill Hollow Brook	135.51	69.2	28.11	23.5	4	3,825	3.74	100	1.81
Minisceongo Creek	47.90	58.0	18.86	9.0	6	1,900	0.75	100	2.51

[a] Approximate distance upstream at which no American eels were collected, taken as an index of the degree to which eels penetrate and occupy a particular tributary.

[b] Barriers were separated into two classes: (1) natural waterfalls and (2) artificial (man-made) barriers, such as mill pond dams.

Hudson River estuary were selected for sampling (Table 1): Wynants Kill, Hannacroix Creek, Saw Kill, Black Creek, Peekskill Hollow Brook, and Minisceongo Creek. Streams predominantly were wadable from source to sink, and sampling was carried out in water less than 1 m in depth. Streams with large numbers of barriers were paired with streams having relatively few barriers along a north–south gradient from Troy to West Haverstraw, New York (rkm 58). Within each tributary, six to seven stream segments averaging 45 m in length (range, 21.0 m–80.0 m) were selected at approximately even intervals from the mouth (most with similar substrate composition) to sample American eels. Location and selection of sampling sites were adjusted to maximize the inclusion of barriers and allow easy access (i.e., bridge access or permission from landowners). Sampling areas averaged 381 m^2 and ranged from 87.5 m^2 to 1,065.3 m^2, depending upon stream width.

Methods

Sample and data collection.—Sampling sites were isolated with 5-mm-diameter nylon-mesh block nets and electrofished with a variable-voltage backpack shocker (Smith-Root) from June to August 2003 and 2004 to collect yellow-phase American eels. Reduction sampling (Kohler and Hubert 1999), three to five passes depending upon catch, was performed at each site. Eels were sedated with clove oil, counted, measured for total length (TL) and weight, and any obvious swellings, lesions, and ulcers were noted. Of 1,938 eels captured, a size-stratified random subsample, at each sampling site, of 232 eels was then collected. The number of eels collected for analysis at each sampling site was dependent on the total number of eels collected at the given sampling site and ranged from 1 (if only 1 eel was collected at that site) to 16 (if numerous eels were available). Selected eels were euthanized, placed on ice, and frozen for later dissection in the laboratory.

Sampling sites and all known barriers from the tributary's confluence with the Hudson River upstream to the point at which no American eels were collected were inventoried with a Garmin III Plus Global Positioning System device (WGS84). Barriers, either natural waterfalls or man-made structures (mill dams or water control structures) of at least 0.5 m in height were catalogued by type (natural or man-made) and measured for height.

In the laboratory, American eels were defrosted and rinsed of excess mucus, and their lengths and weights were remeasured. A subsample of 180 eels was then compared, which determined that freezing significantly reduced eel length and weight by 1.2% and 1.9%, respectively ($P < 0.01$). All lengths, unless otherwise noted, are based on field measurements.

Otoliths were used to determine age structure in each tributary system. This procedure has been validated for American eels (Oliveira 1996). Methods for preparing and aging otoliths followed established methods (Secor et al. 1991; Graynoth 1999). Paired sagittal otoliths were removed from the eel, cleaned of excess material with a 10% bleach solution, and stored dry until later embedding in epoxy resin. Left and right otoliths were then randomly selected and thin sections were made in the transverse plane with twin-mounted diamond blades on an Isomet diamond saw. The section was then fixed to a slide with Crystalbond, ground to the core, and polished. Otoliths were etched and stained with 2% EDTA (buffered to a pH of approximately 8) and 5% toluidine blue stain to produce thick, blue rings denoting annual growth. The glass eel transition mark (Michaud et al. 1988) was assumed to equal age 1 for all Hudson River eels (Mattes 1989; Morrison and Secor 2003). Age was determined by counting annual rings along multiple axes, at least one count being made along the left and right edge of the sulcal groove and one count being made along the long axis of the otolith (Figure 2). Age estimations were made on at least three separate occasions for each eel. Differences in age

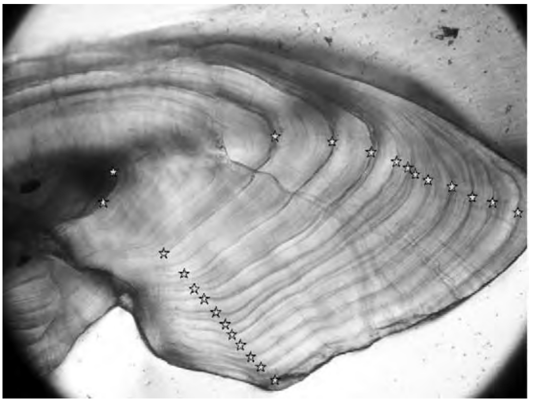

FIGURE 2.—Otolith from a yellow-phase American eel collected from the mouth of Saw Kill in 2003–2004. The stars designate annuli along two of the three transects (the right edge of the sulcal groove and the long axis) that were measured to estimate eel age. The third transect, the left edge of the sulcal groove, is off the image to the left. This 309-mm American eel was 12 years old.

estimates between readers were discussed; if no solution was reached, the otolith was discounted from examination (four otoliths or 2% of all the otoliths read).

Gonads and connective tissue were removed from 102 American eels ranging from 205 mm to 710 mm TL, which were soaked in 3% formalin for 48 h and stored in 70% ethanol before sexing. Gonads were classified (male versus female) following the squash method (Guerrero and Shelton 1974). For each eel, a small section of tissue was placed on a glass slide with a drop of acetocarmine stain. After 1 min, the tissues were pressed with a cover glass and examined at 10× magnification with an image-capture system. Gonads were classified according to the descriptions of Beullens et al. (1997). Reference images of diagnostic structures were captured. Male gonads were typified by spermatogonium *b* cells, while females were identified by presence of oocytes (Colombo and Grandi 1996).

Data analysis.—Estimates for standing stock at sampling sites were made with a binomial depletion model (BDM), a new Bayesian approach especially useful when population densities are low and that allows for the calculation of confidence intervals (Royle and Dorazio 2006; P. Sullivan, Cornell University, unpublished data). Two-factor analysis of variance (ANOVA) was used to test for differences in American eel density (as determined by the BDM), where tributaries and barriers were one series of treatments and barriers and distance upstream were another series of treatments.

We pooled American eels from all sampling sites to perform a stepwise linear regression to determine significant relationships between estimated eel abundances and the following tributary sampling site characteristics: (1) the number of barriers between a sampling site and the confluence of the tributary with the Hudson River (barriers); (2) the cumulative barrier height (m) that must be surmounted to access each habitat sampled; (3) the distance of the sampling site from the mouth of the tributary; (4) the number of barriers per kilometer between a sampling site and the tributary's confluence with the main stem; (5) the proportion of channel urbanization at the sampling site; (6) the proportion of riparian urbanization at the sampling site; (7) the cumulative proportion of riparian urbanization upstream of the sampling location; (8) the proportion of subcatchment urbanization (as determined by ArcMap; ESRI 2004) for the sampling site; and (9) the proportion of urbanization within the entire watershed above the sampling site. Urbanization was determined through a GAP Analysis of land cover types for the six tributary watersheds using ArcMap geographical information systems (GIS) software (ESRI 2004).

An eel condition index was created through linear regression of log-transformed American eel TLs and observed weights ($\log_e[\text{weight}] = 3.317 \cdot \log_e[\text{length}] - 15.084$; $r^2 = 0.99$), which met the assumptions of normality better than other condition factors, such as Fulton's condition factor (*K*; Murphy and Willis 1996). Standardized residuals were calculated for each eel (Sokal and Rohlf 1995:174–175); thus, an eel with a value of +1 is one SD heavier than the average. Eels were then grouped to compare the effects of stream, urbanization, barrier influence, and a north–south gradient on eel condition index through ANOVA.

We clustered sampling sites into groups by (1) stream, (2) distance upstream from the confluence of the tributary with the Hudson River, (3) barrier, and (4) cumulative barrier height to test for differences between American eel lengths at age as determined from laboratory measurements of eel TLs through analysis of covariance (ANCOVA). All lengths and ages were $\log_e$ transformed to increase normality. The effect of barriers on eel condition and length at age was tested with a barrier intensity index (BII) that was defined as follows:

$$\text{BII} = \left(\frac{\text{number of barriers}}{\text{distance upstream}}\right) \times (\text{cumulative barrier height})^2,$$

where distance upstream is in kilometers and barrier height is in meters. This index would test the hypothesis that energy requirements and additional stresses incurred during passage around a barrier would have negative consequences on eel condition and growth. We chose to use a square term for cumulative barrier height to represent the nonlinear effect of this parameter as an energy cost to the eel.

Mean growth rates were estimated by dividing American eel TL (laboratory measurements) by the estimated age, assuming linear growth (Graynoth 1999; Morrison and Secor 2003), and were tested with ANOVA between eel size-class and barrier. Although Morrison and Secor (2003) accounted for oceanic growth before entry into the estuary by subtracting 1 year and 76.6 mm from length at age, we chose to use an oceanic growth of 66 mm, given that we collected numerous partially pigmented elvers that were less than 76.6 mm. Estimation of mean growth rates was therefore limited to estuary growth, tributary growth, or both.

For comparative purposes, we also computed von Bertalanffy growth parameters for all American eels, pooling across tributaries and sex. We did not have sufficient numbers of males and females to compute these parameters individually. The von Bertalanffy model for growth in length is

$$L_t = L_\infty\{1 - \exp[-K(t - t_0)]\},$$

where L_t is length (mm) at age t, L_∞ is asymptotic length, K is the annual growth rate, and t_0 is an integration constant. We solved the parameters with a Levenberg–Marquardt nonlinear estimation algorithm (StatSoft 2003).

All statistical analyses were performed with the software STATISTICA (StatSoft 2003). An α level of 0.05 was used as a critical value to determine statistical significance.

Results

Thirty-one of 40 sampling sites had American eels, which ranged in TL from 50 to 850 mm (mean = 185 mm; median = 152 mm). The 232 eels (12% of all collected) that were analyzed in the laboratory ranged from 58 mm to 710 mm TL (mean = 259 mm; median = 236 mm). Of all eels captured, we collected 82.3% below the first barrier and 94.3% below the second barrier.

Within each stream, highest American eel densities were found near the mouth and below the first barrier; densities dropped dramatically beyond each barrier. Where eels were found, their densities varied greatly; the highest densities (155.1 eels/100 m^2) occurred near the mouth of Hannacroix Creek and the lowest densities (0.2 eels/100 m^2) occurred at the third sampling site of Wynants Kill. This site was located approximately 0.9 km upstream from the confluence with the Hudson River and had four barriers that totaled 15.6 m in height between the sampling site and the Hudson River main stem (Table 2). Biomass varied from 0.3 g/100 m^2 (Wynants Kill; third site) to 2,363 g/100 m^2 (near the mouth of Hannacroix Creek).

Although fewer American eels were caught in the Wynants Kill and Black Creek tributaries, ANOVA tests showed that there was no significant difference (df = 5, P = 0.81) observed among whole-stream eel densities. Neither a north–south gradient nor a within-stream distance gradient were significant (north–south gradient: df = 2, P = 0.81; within-stream gradient: df = 10, P = 0.30). However, the impact of barriers was significant (df = 8, $P < 0.01$), as sampling sites beyond the first barrier in a stream had significantly lower eel densities. Densities at sampling sites above the first barrier, separated by up to eight barriers, were not significantly different from one another (df = 2, P = 0.12). Two-factor ANOVA of four tributaries (Hannacroix Creek, Saw Kill, Minisceongo Creek, and Peekskill Hollow Brook) showed no interaction between stream and barrier (df = 6, P = 0.16).

Length frequencies for all of the American eels collected showed a preponderance of eels less than 150 mm, which dominated sites near the mouths of streams (Figure 3). Length frequencies of eels collected above the second barrier were more normally distributed, ranging from 79 mm to 850 mm. Eels had significantly longer TLs as distance upstream increased as well as beyond barriers ($P < 0.01$; Figure 4). Thus, as we sampled upstream, there was a general trend of fewer but larger eels and a decrease in overall eel biomass.

Stepwise linear regression produced a best fit estimate for American eel abundance at a given sampling location as

$$\log_e(\text{density}) = 25.166 - 2.730 \cdot \log_e(\text{barriers}) - 0.165 \cdot \text{distance} + 1.359 \cdot \text{SC\_URB}$$

($r^2 = 0.63$, $P < 0.001$), where "barriers" is the number of barriers between the sampling site and the confluence of the tributary and the Hudson River, "distance" is the distance of the sample site from the mouth of the tributary (<0.5, 0.5–1.0, 1.0–2.0, 2.0–3.0, 3.0–5.0, 5.0–10.0, 10.0–15.0, 15.0–20.0, or >20.0 km), and SC_URB is the urbanization of the subcatchment sampling site determined by GAP Analysis in ArcMap (ESRI 2004).

American eel condition significantly decreased as urbanization of the riparian zone increased (ANOVA: df = 3, $P < 0.01$; Figure 5a). Similarly, as the BII increased, eel condition significantly decreased (ANOVA: df = 3, $P < 0.01$; Figure 5b). Eels that passed fewer than 0.5 barriers/km had significantly better condition than eels that had to pass more than 0.5 barriers/km.

TABLE 2.—Mean density and biomass of yellow-phase American eels sampled in tributaries of the Hudson River, 2003–2004.

Tributary	Site	Eels caught	Barriers[a]	Distance upstream (m)[b]	Total length (mm) (SD)	Binomial estimated density (eels/100 m^2)	Binomial estimated density > 300 mm (eels/100 m^2)	Estimated biomass (g/100 m^2)[c]
Wynants Kill	1	68	1	385	136.7 (74.5)	80.75	1.83	757.4
	2	36	2	710	258.6 (123.7)	9.95	3.36	505.3
	3	1	4	935	121.0	0.17	0	0.3
	4	6	6	1,170	470.7 (224.3)	1.07	0.89	314.3
	5	1	7	3,585	562.0	0.65	0.65	177.7
	6	0	7	4,885		0	0	0
	7	0	7	7,090		0	0	0
Hannacroix Creek	1	387	0	740	168.6 (83.0)	155.06	5.46	2363.1
	2	134	0	1,960	168.1 (84.8)	26.36	1.86	412.6
	3	20	1	4,000	310.5 (196.3)	1.43	0.56	167.7
	4	9	3	13,720	352.3 (142.6)	4.11	2.74	436.9
	5	13	3	17,910	363.6 (189.8)	4.60	2.50	688.4
	6	0	5	31,330		0	0	0
Saw Kill	1	369	0	225	166.1 (73.7)	142.07	5.65	1782.9
	2	23	1	335	287.0 (117.9)	10.09	3.86	581.0
	3	0	2	485		0	0	0
	4	6	5	1,230	545.3 (137.1)	1.70	1.36	572.1
	5	4	6	5,720	446.5 (288.7)	0.63	0.30	190.9
	6	0	7	11,030		0	0	0
Black Creek	1	53	0	350	174.6 (84.0)	11.57	0.78	242.3
	2	87	0	1,190	236.2 (69.0)	22.00	3.72	677.3
	3	5	4	3,230	513.0 (93.8)	0.73	0.73	176.7
	4	2	4	3,330	363.0 (326.7)	0.61	0.30	133.4
	5	5	9	11,160	492.0 (121.5)	1.93	1.61	471.3
	6	1	9	16,650		0.28	0.28	N/A
	7	0	9	27,325		0	0	0
Peekskill Hollow Brook	1	302	0	3,685	168.2 (77.0)	61.97	4.16	774.7
	2	16	1	4,315	366.6 (126.6)	4.90	3.67	523.4
	3	43	1	7,690	134.4 (69.6)	21.56	0.86	189.9
	4	1	2	9,350	569.0	0.26	0.26	83.9
	5	3	2	11,900	449.3 (143.7)	0.79	0.79	181.6
	6	2	2	17,030	692.6 (35.9)	0.39	0.39	286.4
	7	0	4	23,560		0	0	0
Minisceongo Creek	1	78	0	725	161.4 (104.9)	25.78	1.73	684.6
	2	180	0	1,875	140.9 (87.4)	42.19	2.91	544.2
	3	62	1	2,350	245.6 (86.7)	23.02	4.57	840.2
	4	17	2	3,245	356.1 (154.8)	4.88	3.73	596.1
	5	0	4	5,750		0	0	0
	6	3	4	5,805	287 (223.0)	0.91	0.29	86.8
	7	0	5	8,940		0	0	0

[a] Number of barriers between the mouth of the tributary and the sampling site.
[b] Distance upstream of the sampling site from the confluence of the tributary with the main stem of the Hudson River.
[c] Biomass estimated from binomial depletion population estimates.

The 102 American eels larger than 200 mm that were sampled for sex determination consisted of 22 males, 70 females, and 10 undifferentiated eels. Females averaged 451.9 mm (range, 194–710 mm) and had a mean age of 12.9 years (range, 4–24 years); males were smaller (mean length, 290.3 mm; range, 206–360 mm) and, on average, younger (mean, 9.1 years; range, 3–16 years). In all sampled tributaries, the female : male ratio was 3.2:1, although below the first barrier of each tributary female : male distributions were more even at 1.1 females for every male. Above the first barrier, females dominated with an 8.8:1 female : male ratio. Of female eels, 76% were found above the first barrier in sampled tributaries, while 73% of identified males were below the first barrier and only 27% were above.

Estimated American eel ages were not significantly different among streams (Kruskal–Wallace rank test: $n = 226$, $df = 5$, $P = 0.29$). When pooled, tributary stocks had mean ages of 6.4, 6.6, 9.0, 8.2, 6.8, and 6.9 years along the north–south gradient of Wynants Kill, Hannacroix Creek, Saw Kill, Black Creek, Peekskill Hollow Brook, and Minisceongo Creek, respectively. The youngest eels collected were partially pigmented

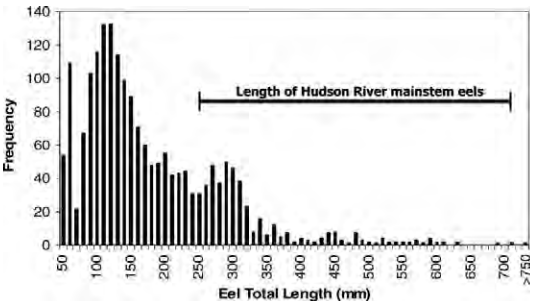

FIGURE 3.—Length-frequency distribution for yellow-phase American eels collected in the Hudson River estuary and six tributaries during 2003–2004. The horizontal bar denotes the size range of American eels collected in the Hudson River main stem during 1997–1999 (Morrison and Secor 2003). The skew of the size distribution toward smaller sizes suggests that tributaries are important nursery zones.

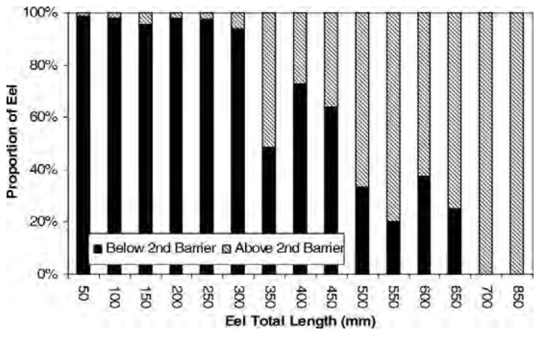

FIGURE 4.—Proportions of American eel size-classes found above and below the second barrier of censused Hudson River tributaries, 2003–2004. For example, of the 355 eels that were 50–99 mm in total length, 350 (98.6%) were found below the second barrier and only 5 (1.4%) beyond that barrier.

glass eels and recently transformed elvers in their first year of freshwater residency. The oldest eel, 24 years, was found at the first sampling site of Minisceongo Creek with a TL of 692 mm (note that one silver eel collected in Saw Kill, but not sacrificed, was over 850 mm and presumably of similar age or older). The oldest eels were distributed among streams and between sites above and below the first barrier of a tributary. There was a significant relationship between $\log_e$(TL) and $\log_e$(age) (Figure 6; $r^2 = 0.86$; $P < 0.01$). Individual tributary length-at-age plots were more variable, but still significant (r^2 range, 0.83–0.92; $P < 0.01$ for all tributaries). Grouping eels using the BII, we developed a length-at-age regression that showed significant differences in length at age among all three BII classes (0, 0.1–100, and >100;$r^2 = 0.90, 0.85, 0.76$; $P < 0.01$; Figure 7).

The growth rates for tributary American eels ranged from 13 to 114 mm/year (mean, 35 mm; median, 30 mm); pooled within-tributary growth rates were higher in the northern and southern streams than in the central streams (Table 3). Analysis of variance showed that the eels within Wynants Kill (all of which were collected above the first barrier) and Peekskill Hollow Brook experienced significantly higher growth than those in other streams (df = 5, $P < 0.01$). Wynants Kill was the only tributary studied where all sampling sites were above at least one barrier. A two-factor ANOVA of growth rate that used five streams (Hannacroix Creek, Saw Kill, Black Creek, Peekskill Hollow Brook, and Minisceongo Creek) and sampling sites either above or below barriers as factors showed no significant difference in growth among streams and no interaction between streams and barriers (growth: df = 4, $P = 0.06$; stream and barrier interaction: df = 4, $P = 0.87$). However, whether an eel was located above or below the first tributary barrier significantly affected growth rates (df = 1, $P < 0.01$), eel growth being higher beyond the first barrier (39.3 mm/year) than below the first barrier (30.5 mm/year). There were no significant differences among eel growth rates between the first and ninth barriers (df = 6, $P = 0.68$). Factorial ANOVA that tested eel growth by sex, barriers, and the interaction between sex and barriers showed that even though females exhibited slightly higher average growth (35.3 mm/year) than males (32.9 mm/year), the difference was not significant (df = 1, $P = 0.27$). By sex, there was a significant difference between eel growth above or below the first tributary barrier (df = 1, $P < 0.01$), both male and female growth being higher beyond the first barrier in a tributary. Tukey honestly significant difference post hoc tests showed female eel growth below the first barrier was significantly different than female eel growth above the first barrier ($P < 0.01$) and male eel growth above the first barrier ($P = 0.03$).

Pooling all six tributaries, growth rates decreased with increasing age from age 2 (1 year oceanic stage and 1 year in freshwater; 56.7 mm/year) to ages 21–24 (25.2 mm/year) in a nonlinear fashion. The von Bertalanffy growth equation had an overall r^2-value of 0.874 ($N = 223$). Asymptotic length (L_∞) was 929.1 ± 210.1 mm (mean ± SE), growth rate K was 0.0404 ± 0.014 mm/year, and t_0 was −1.431 ± 0.48; all parameters were highly significant ($P < 0.01$). Although similar data for American eels are sparse, Jessop et al. (2004) reported similar rates (862.8 mm, 0.04 mm/year, and −0.658 for L_∞, K, and t_0, respectively) in female Nova Scotia American eels.

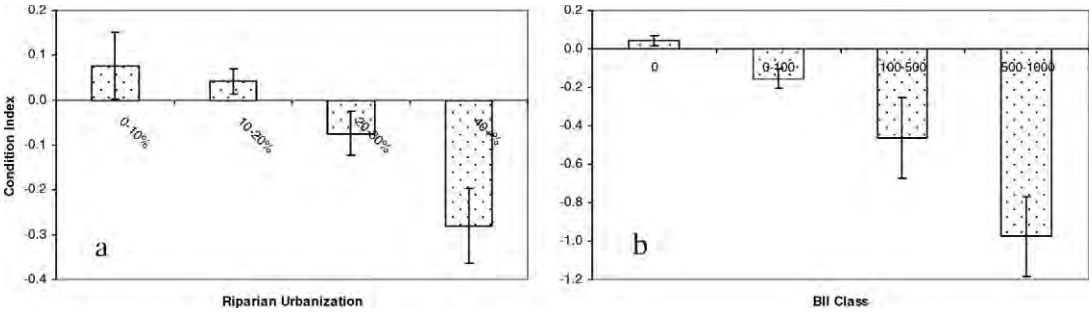

FIGURE 5.—Panel **(a)** shows the condition of yellow-phase American eels based on the mean standardized residuals of wet weight relative to the degree of riparian urbanization in Hudson River tributaries, 2003–2004. No eels were collected from sites with 30–40% urbanization. Panel **(b)** shows eel condition relative to barrier intensity. The barrier intensity index (BII) reflects the compounding effects of both the number of barriers per kilometer and cumulative dam height. In both panels, negative values denote eels of lower than expected condition; error bars are SEs.

Discussion

In the moderately urbanized Hudson River estuary watershed, American eel demographic characteristics responded strongly to barriers (over half of which were artificial) and secondarily to local-scale urbanization in tributary subcatchments. Eel densities were highest below barriers, while age, growth (TL), and female : male sex ratios increased above barriers. Because the American eel is a top predator in Hudson River tributaries, upstream reduction of eel densities may increase the ecosystem's vulnerability to future human disturbances and further upset the natural food web there (e.g., Savoy and Crecco 2004).

Dams are among the most pervasive hydrological alterations of watersheds, and their environmental effects have been widely documented (e.g., McCully 1996; Humborg et al. 1997; Vörösmarty et al. 1997). The ecological consequences of stream fragmentation by dams include loss of biodiversity (Dudgeon 2000), alterations of productivity and nutrient fluxes (Humborg et al. 1997; Dauta et al. 1999) and, in particular, the dramatic impacts on diadromous fish species (confer Freeman et al. 2003). Although American eels do not contribute marine-derived nutrients to streams like many salmonids (i.e., Schindler et al. 2003) and some shads *Alosa* spp. (Garman and Macko 1998), they convey freshwater-derived production to the sea as they return to spawn (Laffaille et al. 2000). In our study, the increased segmentation of streams caused by dams appears to limit penetration of the Hudson River

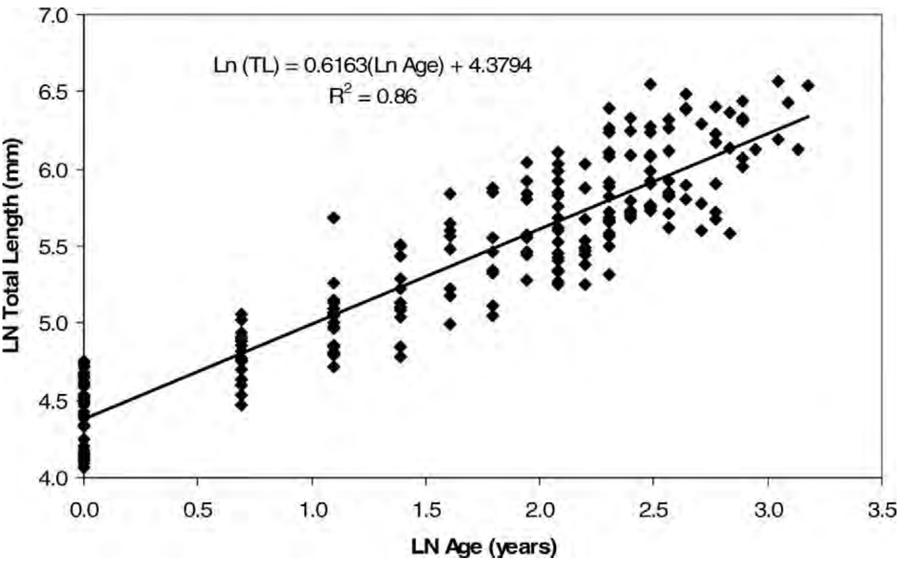

FIGURE 6.—Length of Hudson River tributary American eels versus age, 2003–2004. All values are $\log_e$ transformed (LN).

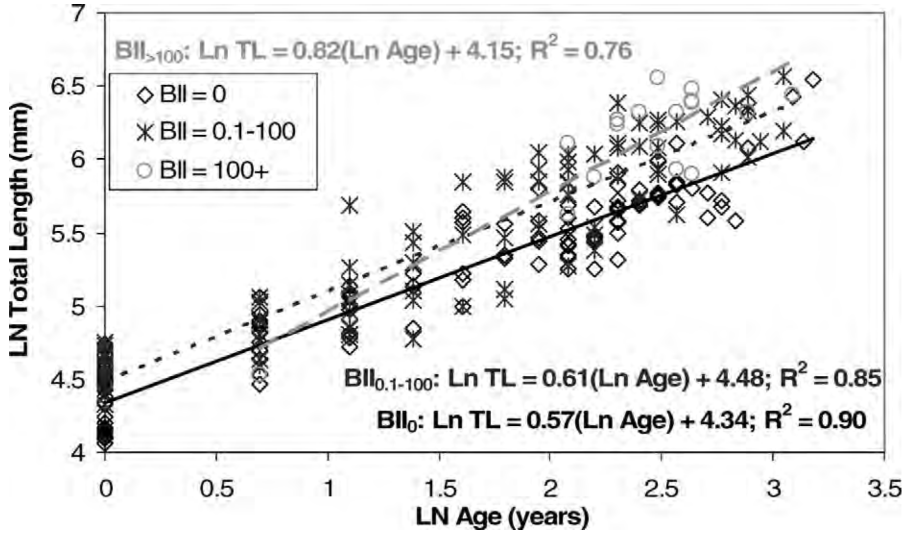

FIGURE 7.—Length of Hudson River tributary American eels versus age by degree of barrier intensity (BII; see Figure 5 for details), 2003–2004. All values are $\log_e$ transformed. Eel growth is significantly lower below barriers ($P < 0.01$), suggesting that growth is density dependent (LN = $\log_e$ transformed).

watershed by eels. There are at least 797 large dams (generally >3 m in height) in the watershed and an unknown, but suspected, high number of smaller dams (Swaney et al. 2006). The highest dam densities are in the downriver reaches of tributaries.

Nevertheless, with up to 155 American eels/100 m^2 in the tributaries, eels were the most numerous fish within the Hudson River tributaries that we censused. Eels have been found to dominate both in distribution and numerically (Bozeman et al. 1985; Ford and Mercer 1986; Jacobs et al. 2004), and their dominance can drive ecosystem processes through structuring of the aquatic community (confer Eklöv and Hamrin 1989; Brabrand and Faafeng 1993; Dörner and Benndorf 2003). Eel densities are higher in unimpeded sections of Hudson River tributaries than has been previously reported in the literature (Table 4). Eel densities may be artificially increased within 0.5 km of a barrier owing to a congestion of eels blocked from upstream migration. While this may be responsible for densities found at the first Saw Kill sampling site and in Peekskill Hollow Brook (where the second site, located just above the first barrier, had a lower abundance estimate than the third site, located directly below the second barrier), habitat in these tributary reaches are conducive to high eel densities. Cobble and gravel substrates found at the third Peekskill Hollow Brook site, where smaller eels made up a greater proportion of the catch, offer extensive habitat not present at the second sampling site, which was composed of larger cobbles, boulders, and sand. Barrier proximity cannot explain high densities at the first Hannacroix Creek site since the first tributary barrier is more than 1.2 km upstream. The high densities, which are biased toward smaller size-classes near the mouths of tributaries, suggest that these areas are important to early eel life stages. The interstitial spaces, shallow water depth, and large invertebrate prey pool make these areas important to declining eel populations. Increased study of the contribution of

TABLE 3.—Pooled growth rates of Hudson River tributary American eels, 2003–2004.

Tributary	Barrier number	Distance to first barrier (m)	Number of eels aged	Average growth (mm/year)[a]	SD	SE
Wynants Kill	7	20	17	45.4 z	21.42	5.20
Hannacroix Creek	4	1,985	31	34.2 y	16.04	2.88
Saw Kill	7	255	24	29.2 y	11.15	2.28
Black Creek	9	2,620	33	32.3 y	16.24	2.83
Peekskill Hollow Brook	4	3,825	27	42.8 z	18.63	3.59
Minisceongo Creek	6	1,900	39	33.9 y	13.90	2.23

[a] Values with different letters are significantly different (single-factor ANOVA; $P < 0.05$).

TABLE 4.—Yellow-phase American eel density estimates from previous studies.

Location	Authors	Gear type	Density (eels/100 m^2)	Size range (mm)
Lake Champlain, Vermont	LaBar and Facey (1983)	Electrofishing	2.32–6.36	N/A
Georgia tidal creek	Bozeman et al. (1985)	Eel pots	1.82–2.32	200–800
Massachusetts tidal creek	Ford and Mercer (1986)	Minnow trap	8.46–9.28	150–630
Rhode Island freshwater river	Oliveira (1997)	Electrofishing	4.50–32.30	>160
Four freshwater Maine rivers	Oliveira and McCleave (2000)	Electrofishing	1.80–35.40	>100
Hudson River shoals, New York	Morrison and Secor (2003)	Eel pots	0.03–0.24	280–700
Hudson River tributaries	This study	Electrofishing	0.28–155.06	60–850

tributary habitats versus main-stem habitat is warranted to quantify the relative importance of these different zones as juvenile rearing areas.

Full utilization of tributary habitat was limited, however, by the number of barriers that inhibit American eel distribution. The first barriers encountered dramatically reduced eel densities and disrupted migration into suitable upstream eel habitat. Historical records have shown sustained commercial eel catches hundreds of kilometers inland in Onondaga and Oneida lakes (Beauchamp 1908; Adams and Hankinson 1928) before damming obstructed immigration and emigration routes. Competition at the mouth may be reduced and eel condition may be increased if more eels were allowed farther upstream in tributaries (i.e., passes beyond the barrier should be established). Barriers may not have played an important role in eel distribution in the Annaquatucket River, Rhode Island (Oliveira 1997), because of the presence of fish passage structures on downstream barriers. Gephard and McMenemy (2004) also noted the importance of fish passage structures in reducing the impact of barriers to eel movement. It is important to note that not all barrier passage systems will be equally functional for migrating eels. Primarily, barrier passage structures designed in the U.S. are developed for fast-swimming fishes (i.e., *Alosa* spp. and salmonids; Lenhart 2003). Eels, with a different swimming style and slower speed, may have difficulty using these structures and may benefit from differing barrier passage designs (Knights and White 1998; Stuart and Mallen-Cooper 1999; Tesch 2003).

Barriers were the dominant factor in predicting American eel abundances in our regression model. The relationship of upstream distance to eel density has been well documented in American eel (Smogor et al. 1995; Krueger and Oliveira 1999; Oliveira and McCleave 2000). Barriers were determined to be of minor influence, secondary to distance upstream, in determining American eel distribution in the Potomac River drainage (Goodwin and Angermeier 2003). In tributaries of the Hudson River watershed, barrier impacts probably play a greater role in eel distribution, given the large number of barriers found within relatively short distances in study tributaries (e.g., there were seven barriers within the first 1.5 km of Wynants Kill). The first barrier in five of six tributaries was within 2.5 km of the tributary mouth, and two of the six streams had barriers less than 0.5 km from the mouth.

Barriers may also negatively affect American eel condition by disrupting eel behavior. Eels have been found to migrate between habitat types (Morrison and Secor 2003; Daverat et al. 2006), and it has been suggested that barriers hamper normal eel movements between habitats (Cairns et al. 2004). Svedäng and Wickström (1997) suggested that eels with low fat content (lower condition) temporarily arrest maturation during their initial spawning phase to feed and increase body mass (fat content) sufficient to reach spawning grounds. Morrison et al. (2003) noted that eels that had migrated from fresh to brackish water exhibited increased growth. Eels historically may have moved upstream to reduce competition and increase TL, moving downstream at later stages to increase fat content necessary to successfully reach the Sargasso spawning grounds. Placement of barriers in these tributaries may negatively affect this life history trait.

High densities below the first barrier caused by interruptions to upstream migration might increase competition, reduce food availability, and thus negatively affect growth rate (Graynoth and Taylor 2000, 2004; Beentjes and Jellyman 2003). Food supply may also play an important role if barriers alter aquatic invertebrate prey densities (Cortes et al. 1998).

Urbanization of tributary watersheds poses a second potential stressor. While there is an apparent positive effect of subcatchment urbanization on American eel distribution, this may be an artifact of sampling. Areas of high eel density, which are near the confluence of tributaries with the Hudson River, are also sites of historic human development. Historically a major commercial conduit, many towns developed along the Hudson River are causing unequal development within the watershed (i.e., near the main stem in areas of naturally high eel density). Therefore, higher eel densities may coincide with urbanization but may not be directly linked to urban densities. Further research is needed to determine potential direct or indirect effects of urbanization on eel density and eel distribution, as negative effects of urbanization have been found in other watersheds (Limburg and Schmidt 1990; Wang et al. 1997; Coghlan and Ringler 2005; Limburg et al. 2005). Changes in the riparian zone may affect shading, allochthonous inputs, hydrology, and water chemistry by altering stream geomorphology, water quality, and invertebrate prey densities (Growns et al. 1998; Wolter et al. 2000; Paul and Meyer 2001). Changes in riparian zone land use have been found to alter macroinvertebrate composition (Lenat and Crawford 1994; Moore and Palmer 2005), which may modify prey densities and reduce eel condition. Influences of urbanization may be unequal, however. Changes in stream flow that create larger interstitial spaces may increase eel density if the eel can survive sublethal increases in eutrophication or pollution caused by urbanization.

However, there may be a threshold at which American eel density and condition are negatively affected by extensive urbanization of the tributary watershed. Within the Wynants Kill watershed, GAP Analysis showed approximately 70% urbanization of the subcatchment, and we noted high stream and streambank degradation and potential sources of pollution (litter and chemicals). Eels were only found within the lowest 5 km of the tributary and were of dramatically lower condition. Higher parasite loads of *Eustrongylides* and *Anguillicola crassus* were found in the highly urbanized sites of Wynants Kill and Minisceongo Creek (Machut 2006). Given the declining population estimates for eels, a greater understanding of the impacts of riparian zones on eel condition and on small-stream ecology is generally needed. Management policies to protect riparian zones from development are warranted.

While barriers and human-dominated land uses shift tributary American eel demographics, comparisons between the sampling streams and the Hudson River main stem suggest that tributaries are still an important component of yellow-phase eel habitat. Comparisons with the main stem must take into account the greater range of eel sizes collected during this study. Direct comparisons of main-stem and tributary stocks are possible via size-corrected density estimates. Hudson River density estimates (Morrison and Secor 2004) assumed unbiased capture of eels larger than 300 mm; therefore, eel abundance estimates between main-stem and tributary stocks can be made if only eels greater than 300 mm TL are compared (Table 2). It is evident that the densities found in the distant upper reaches of the tributaries are comparable to Hudson River abundance estimates and are on average two orders of magnitude higher near the mouths of the tributaries. Given this, tributary abundances seem to be an important component of watershed populations, given their highly suitable additional habitat range and protection from predation. Eel predators in larger estuary waters (Buckel and Conover 1997; Griffin and Margraf 2003; Walter and Austin 2003) are rarely found in tributaries. Tributary eels can be an important component of the silver-phase spawning runs from the Hudson River. With increased access to upstream habitat, tributaries may play a significant role in providing refuge and enhanced yellow-phase growth opportunities to threatened eel stocks. Morrison and Secor (2004) noted that eel abundances in the Hudson River were lower than the commercial catches in both the Delaware and Chesapeake Bay estuaries and suggested that this was caused by the lower carrying capacity for the Hudson River. Enhancing tributary habitat may increase the carrying capacity of the entire watershed.

The mean lifetime growth rates for pooled Hudson River tributary American eels larger than 300 mm (as calculated through otolith aging) are comparable with growth estimates developed for the freshwater Hudson River main stem (Morrison and Secor 2003). While growth above barriers within tributaries is greater than that found in the freshwater sections of the Hudson River, it is still lower than the estimated brackish-water growth rates in the Hudson River main stem (Morrison and Secor 2003). The growth rates above barriers are also greater than those reported in Maine rivers and a Rhode Island stream (Oliveira 1997; Oliveira and McCleave 2000), but are lower than found in southern systems (Helfman et al. 1984). This suggests that tributary eel stocks can be a significant source of eel production for the entire Hudson River estuary.

Increased length at age above barriers may also be coupled with sexual differences in growth rate (Poole and Reynolds 1996; Oliveira and McCleave 2000). Oliveira (1997) also found American eels having TLs greater than 400 mm (presumed females) in a Rhode Island river grew significantly faster than eels less than 400 mm (presumed males or undifferentiated). In our study tributaries, female eels did not grow at rates different from those of males, but they exhibited increased growth above barriers. The results from the two-factor ANOVA test (growth by sex and barrier) suggest that density-dependent factors play a more important role than sex in growth. Both eel sexes had higher growth rates beyond the first barrier than below the first barrier, where densities were increased by a factor of ten. This suggests that density-dependent factors (such as food availability) exert the greatest control over growth rate.

Reducing barrier impacts, such as within Wynants Kill, where there are a number of dams with questionable function, could further increase American eel use of Hudson River tributaries. Reductions in barriers or increased ease of passage would also reduce the impact of barriers on eels currently residing in the tributaries, potentially increasing eel condition and growth below barriers. Female eel size is positively correlated with increased fecundity (Barbin and McCleave 1997); therefore, increasing eel condition in tributaries may help to stabilize decreasing American eel populations and increase recruitment. Additionally, increased tributary access throughout the species' range may provide refuges from exploitation in other basins. Although reducing barrier impact through eel ladders or removal of dams with minimal value will not return the affected tributaries to their prior state (Scheffer and Carpenter 2003), increased passage of eels would reduce current anthropogenic impacts. Given the apparent drastic decline in eel abundances from certain portions of their historic range, increasing available habitat for eels and minimizing human disturbances upon tributaries, in general, is a worthy and attainable goal.

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EFFECT OF AN ULTRASONIC SYSTEM ON ADULT BLUEBACK HERRING AT THE CRESCENT HYDROELECTRIC PROJECT: DATA REPORT

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Executive Summary

Adult blueback herring *Alosa aestivalis* migrate into the Mohawk River during the spring to spawn; after spawning, they migrate out of the river. The Federal Energy Regulatory Commission (FERC) ordered the installation of an ultrasonic system at the Crescent Hydroelectric Project (Crescent) to reduce the number of blueback herring passing through the turbines during their downriver migration. Ultrasound has been shown to elicit avoidance reactions from river herring (blueback herring and alewives *Alosa pseudoharengus*). FERC also ordered that the effectiveness of the ultrasonic system at Crescent be assessed.

At Crescent, the Mohawk River is impounded by two dams that are separated by an island. The main channel lies along the east side of the island and leads to Dam A and the Waterford Flight. A secondary channel lies along the west side of the island and conveys water to the Crescent powerhouse and Dam B. Ultrasound is sound projected across the entrance of the secondary channel and is intended to steer juvenile blueback herring past the secondary channel and down the main channel.

To assess the effectiveness of the ultrasonic field, a radio tag was gastrically implanted in 102 adult blueback herring. The tagged fish were released about two miles upriver of Crescent between May 31 and June 5, 2009. Their location in the river after release was determined by mobile tracking, done for about 3 – 4 hours almost daily and mostly downriver of the release location, through July 9. Additionally, the number of tagged blueback herring that passed downriver of the ultrasonic field was monitored continuously through July 9 at fixed monitoring stations in the main and secondary channels, the entrance to the Waterford Flight, an opening in the flashboards atop Dam A, and downriver of Crescent and the dams.

Of the 102 blueback herring released with a radio tag, 34 were detected at the fixed monitoring stations. Of those, 32 (94.1%) were first detected in the main channel, when the proportion of daily river flow through the secondary channel ranged from 0.552 – 0.902 of the total flow through both channels. When the proportion of daily flow through the secondary channel was 0.902, 11 of 12 blueback herring (91.7%) were first detected in the main channel.

Eight of nine blueback herring detected at fixed monitoring stations downriver of the Crescent dams were last detected upriver of the dams in the main channel; half of those passed through the opening in the flashboards atop Dam A and the other four passed over the Dam A flashboards, when water overtopped them. Eight blueback herring detected at the fixed monitoring stations were last detected at the entrance to the Waterford Flight.

Three of the 34 blueback herring (8.8%) detected at the fixed monitoring stations, moved from the main channel to the secondary channel; 1 of the 34 moved from the secondary channel to the main channel. Overall, 29 of the 34 blueback herring (85.0%) detected at the fixed monitoring stations were never detected in the secondary channel.

Of the 102 blueback herring released with a radio tag, 38 were detected by mobile tracking; 24 below the release location, including 14 detected downriver of the ultrasonic field. Of the 14, 13 (92.9%) were first detected in the main channel when the proportion of daily flow through the secondary channel ranged from 0.595 – 0.913 of the total flow through both channels. When the proportion of daily flow through the secondary channel ranged from 0.902 – 0.913, 6 of 7 (85.7%) were first detected in the main channel.

Introduction

Blueback herring (*Alosa aestivalis*) is an anadromous species. During the spring, adult blueback herring migrate up the Hudson River and into the Mohawk River, where they spawn (Figure 1). After spawning, adult blueback herring migrate out of the Mohawk River. Several months later, juvenile blueback herring also migrate out of the Mohawk River.

Adult blueback herring migrate into, and up, the Mohawk River through a series of locks, which form the 340-mile long Erie Canal section of the New York State Canal System. The Waterford Flight (locks 2-6) extends from the mouth of the Mohawk River around Cohoes Falls, a 75-foot high waterfall, to just upriver of Dam A at the Crescent Hydroelectric Project (Crescent) (Figure 2). Adult and juvenile blueback herring can migrate downriver past Crescent through the Waterford Flight, over Crescent Dams A and B, or through the Crescent powerhouse (Figure 3). The Federal Energy Regulatory Commission (FERC), in consultation with the U. S. Fish and Wildlife Service (FWS) and the New York State Department of Environmental Conservation (DEC), directed the New York Power Authority (NYPA) to install a system that would reduce entrainment of blueback herring through the Crescent powerhouse. In the summer of 2008, NYPA installed and began testing an ultrasonic system near the entrance to the secondary channel, which conveys water to the Crescent powerhouse.

Based on the results of a pilot hydroacoustics study conducted during June 2007, a full-scale study using mobile and fixed-location telemetry was considered feasible. The study was conducted in 2009 to assess: 1) how well the ultrasonic system guided adult blueback herring past the secondary channel as they migrate downriver and 2) whether adult blueback herring continue passing downriver through an opening in the flashboards atop Dam A, over Dams A or B or through the Waterford Flight.

Methods

The 2009 study used fixed-location and mobile telemetry. The fixed-location telemetry was conducted daily at eight sites, which included the secondary channel and the main channel downriver of the ultrasonic system, the entrance to Lock 6 of the Canal, and the Mohawk River below Crescent (Figure 4) from May 29 – July 9. Mobile telemetry was conducted between the release site for tagged fish and Crescent daily except on June 3, 5, 7, 14, 20, and 21. On June 3, mobile telemetry was conducted between Crescent and the Vischer Ferry Hydroelectric Project, which is located about 10 miles upriver of Crescent (Figure 5). Mobile telemetry was conducted for about 3 - 4 hours per day except on June 3 when it was conducted for more than five hours.

Radio Transmitters

Pisces radio transmitters, manufactured by Grant Systems Engineering, Inc. (GSEI) were used during fixed-location and mobile telemetry. Each radio transmitter emitted a signal at a frequency between 149.360 and 149.460 MHz (at intervals of 20 KHz), with a unique code within that frequency. This allowed individual fish to be identified. The frequencies were chosen, based on a survey of ambient radio frequencies in the study area conducted on May 26 and 27, 2009. The survey was conducted prior to activating and selecting tag codes in an effort to assure that the most unique codes in each frequency would be programmed into the radio transmitters for the full-scale study. Each radio transmitter weighed 2 grams, was 20 mm long and 7 mm in diameter (not including the 200 mm long, flexible wire antenna), produced one pulse every 2 seconds, and had a battery expected to last at least 45 days.

A radio transmitter was implanted by first placing it in the oral cavity with the long axis in line with the esophagus and the antenna extending from the mouth. It was then gently pushed down the esophagus to the stomach with a hollow plastic tube, slightly smaller in diameter than the radio transmitter. Each blueback herring was immobilized during the process of implanting a radio transmitter by placing it in the crotch of a folded piece of wet foam so that only the head was exposed. When the radio transmitter was implanted, the flexible wire antenna extended from the mouth and trailed along the outside of the fish.

Radio Receivers

Orion radio receivers, developed and manufactured by GSEI, were used for fixed-location telemetry. The Orion is a DSP, broadband radio receiver that can simultaneously monitor all channels in use at the same, eliminating reception time lost while switching between channels greatly improving detection efficiency, particularly in zones where passage may be rapid. When a signal is received, the validity of the signal is verified and logged, or rejected. Weather permitting, data were generally downloaded daily from the fixed-location radio receivers between May 29 and July 3 and 6 and 9 July. Severe thunderstorms prevented data from being downloaded on 27 June and the field crew was given off on 4 and 5 July.

Radio receivers at all of the fixed-location sites except for Dam A were coupled to a 4-element Yagi antenna. A Yagi antenna, also known as a beam antenna, is a directional antenna system consisting of a dipole array and coupled elements. The radio receivers were powered by a 12-volt deep cycle marine battery. At Monitoring Sites 1, 3 and 6 the battery was connected to a 1.5 AMP trickle charger that was connected to a 120 volt AC electric outlet. At Site 1 the trickle charger was plugged into an outlet at Crescent, at the entrance to Lock 6 the battery charger was plugged into an outlet at the lock operator’s station, and at Site 6 power was obtained from a private residence. Monitoring Sites 2, 4, 5, 7, and 8 were solar powered; at Dam A, the battery was charged by an 80-watt solar panel and the remaining four sites were charged by an array of solar panels that produced 45 watts of power.

Site No. 1 was located on the west shore of the River at the powerhouse to detect tagged blueback herring shad that passed downstream of the project (Figure 4). The antenna was configured to provide full-river width coverage including the tailwater downstream of the powerhouse.

Site No. 2 was located on the east shore of the river downstream of Dam A (Figure 4). The receiver at Monitoring Site No. 2 was used was also configured to provide full-river width coverage downstream of Dams A and B and the tailwater downstream of the powerhouse.

Site No. 3 was located at the entrance to Lock 6 of the Waterford Flight (Figure 4). This receiver was configured to cover the full width of the Canal and detect blueback herring as they approached and/or passed downstream.

Site No. 4 was configured to detect herring at the notch in Dam A (Figure 4). The radio receiver at site Dam A was coupled to three dipole antennas. Each antenna was mounted on a 1-foot piece of 8-inch tubular steel suspended 8 feet below the crest of Dam A. Each antenna was connected to an amplifier mounted in a 12-inch watertight NEMA box that was secured to the back of the flashboard adjacent to the opening of the bypass. The antennas were combined and powered by a single coaxial cable housed inside a garden hose that ran behind the flashboards and was connected to a receiver located on the abutment of Dam A. This resulted in a detection zone that covered the entire 80-foot opening in the flashboards and extended about 25 feet upstream of Dam A.

Sites No. 5 and 6 were located in the main channel on the east and west shore of the river approximately 150 yards upstream of Dam A, respectively (Figure 4). Both receivers were configured to provide full-width coverage of the main channel and were located downstream of the entrance of the secondary channel and the sound deterrent system.

Sites No. 7 and 8 were located in the secondary channel, downstream of the sound deterrent system (Figure 4). These two receivers monitored the cross section of the secondary channel leading to the powerhouse and Dam B. Receiver 7 monitored the primary channel leading to the powerhouse and Receiver 8 monitored the narrow channel located between two islands leading to the powerhouse and Dam B.

Each site and its corresponding detection zone, the area in which transmitters were detectable by the receiver, was triangular in shape. Detection zones at each site were calibrated by checking the noise-floor levels associated with each location and by deploying a radio transmitter from either the shore or a boat and adjusting the gain settings for each antenna. Sites 1, 2 and 3 were checked by deploying a tag 10 and 20 feet from the shore opposite the antenna. The detection zones at Sites 4, 5, 6, 7 and 8 were also calibrated and checked by deploying a tag from a boat 10 and 20 feet from the shore opposite the antenna. At Sites 1, 2, 3, 5, 6, 7 and 8 gain settings were adjusted to establish a detection zone that spanned the depth and width of the river as depicted in Figure 4. As previously mentioned, the detection zone at Site 4 covered the entire opening in the flashboards and extended 25 ft upstream to a depth of 8 feet. Detection zones in Figure 4 are conceptual and intended to provide a generalized view of the actual detection range as the actual range could vary depending on numerous factors including water depth, depth of transmitter in water column, variable background noise, and atmospheric conditions.

Mobile tracking of radio tagged blueback herring was conducted from a boat using a Lotek 400_SRX radio receiver that was coupled to a 4-element Yagi antenna. The receiver identified the pulse trains (codes) of the radio tags used in the study within the specified set of frequencies by sequentially scanning and subsequently displaying valid codes on receiver's display. The Yagi antenna could be freely rotated 360 degrees to facilitate tracking.

Mobile telemetry was used to help determine if blueback herring migrated downriver or upriver after release and if a tag remained in the same location across days. If a tag remained in the same location across days, we assumed that it was regurgitated or the blueback herring which carried it, died and settled to the bottom of the river.

Collection, tagging, and release of adult blueback herring

About 400 adult blueback herring were collected by electrofishng in the Mohawk River below Lock 2 of the Waterford Flight on May 27 and May 28. The blueback herring collected below Lock 2 were transported in 100-gallon circular tanks to Crescent. At Crescent, the blueback herring were transferred to two 8-foot diameter, circular tanks that held about 800 gallons of water. Water in the 800-gallon tanks was circulated continuously from the Mohawk River at a rate of about 10 gallons per minute which kept dissolved oxygen and water temperature in the tanks at levels similar to those in the Mohawk River. A net was placed over each holding tank to prevent fish from escaping and/or being eaten by avian (gulls) predators. The nets also aided in blocking direct sunlight on the holding tanks.

One hundred and two blueback herring were radio tagged in three lots. Throughout the tagging process, care was taken to minimize time spent handling and tagging blueback herring in an effort to minimize stress. A three-person crew captured, tagged and released blueback into a third 800-gallon circular tank that was used to hold the tagged fish. The entire tagging process normally took less than one minute. Two members of the crew including a biologist, captured blueback herring for tagging using hand held nets from the two holding talks. Only fish that swam normally and had no visible lesions, disease or physical abnormalities were tagged. Blueback herring were then gently placed and restrained in the crotch of a folded piece of foam used to immobilize the specimen for tagging. A radio tag was orally inserted into the blueback's stomach by means of a cannula, guiding it gently through the esophagus. On May 28 and 31, a radio transmitter was gastrically implanted in each of 35, adult blueback herring held at Crescent. On June 4, an additional 32 blueback herring were radio tagged. Tagged fish were held overnight (a minimum of 12-hours) prior to release the following morning. The day after each group of fish was tagged, its radio tagged fish were transported about two miles upriver -- ½ mile upriver of Route 9, and released (Figure 6). Seven tagged blueback herring died before they were released and were replaced; one was from the first release, 4 from the second release and two from the third release. Tagged fish that died were replaced a minimum of two hours prior to being released into the river. Blueback herring were released on May 29, June 1 and 5. On May 28 one group was released at about 11:50 hours and the other was released at 12:20 hours. On June 1, blueback herring were released at10:45 hours and 11:30 hours. On June 5, herring were released at 10:25 hours and 11:00 hours. Mobile tracking began soon after blueback herring were released.

Data Processing

Records of frequencies and codes detected by the radio receivers were transferred to a laptop computer daily. Data from the eight monitoring sites was identified by collection date in an EXCEL workbook that contained a worksheet for each site. Data from each monitoring site was sorted by date, frequency and code using EXCEL 2007 and the files were saved into a data set. These files were then filtered to remove ambient noise signals, non-existent codes and data predating the time of release. After the files were sorted and filtered they were visually examined to assess the likelihood that a fish with a radio transmitter was detected. Generally, a record was considered a valid detection if the time between records was two seconds, which matched the pulse rate of the radio transmitters.

Data were stored in the Orion receivers as either a single event or a period of multiple events. Single events or events occurring greater than 15 minutes apart were typically recorded as discrete events. Data stored for each event included: date, time, antenna number, site, frequency, code, power (dBm), and noise floor (dBm) which resulted in thousands of records during the study. Tagged blueback herring not detected by the fixed monitors likely moved upstream and never moved downstream before sampling ended.

Water Flow Data

Water flow through the Crescent turbines and water elevation in the Mohawk River at Crescent were monitored by NYPA. The data were used to calculate water flow through the main channel (over Dam A and through the opening in the flashboards atop Dam A) and through secondary channel (over Dam B, through the tainter gate, debris sluice, and the Crescent turbines). The volume of water flowing through the Waterford Flight daily was calculated by the New York State Canal Corporation, based on the number of lockages that occurred, and added to the main channel flow calculated by NYPA. The Canal Corporation does not monitor leakage through the Waterford Flight.

Results Summary

Water Flow Data

The proportion of water flowing through the secondary channel daily during the period when tagged fish were detected varied from 0.552 to 0.942 (Table 10). Unusually low flow through the Crescent turbines occurred during some daylight hours between 31 May and 6 June occurred in response to request from emergency personnel who were for a drowning victim downriver of Crescent.

Radio Telemetry Data

Of the 102 tagged herring released, a total of 55 were detected. Thirty-four were detected at fixed monitoring locations; 17 of these fish were only detected at fixed monitoring stations Table 2). Thirty-eight were detected while mobile tracking; 21 tagged herring were only detected while mobile tracking. Seventeen tagged herring were detected by both fixed and mobile tracking

Fixed Data Summary

Thirty-four tagged herring were detected at fixed monitoring stations between 29 May and 13 June (Table 3). Eighteen from the first release made on May 29. Eleven from the second release made on 29 May. Five from the third release made on 4 June.

Of the 34 fish detected at fixed monitoring stations, 32 were initially detected in the main channel upstream of Dam A at sites 5 and/or 6. (Table 4).

Seventeen tagged fish moved downstream of the project (Table 5). A total of 8 tagged herring were detected passing downstream via Dam A; three tagged herring (360-102,400-132, 420-81) passed via the notch in Dam A and five (420-140, 460-134, 380-139, 420-117, 440-109) spilled over Dam A. Eight tagged fish moved downstream of the project via the Canal (440-107, 400-121, 360-141, 440-136, 360-139, 460-132, 420-109, 440-103). One fish (440-134) passed downstream via the power station or was spilled over Dam B.

Movement of tagged herring between the main channel and secondary channel was limited in 2009. Two fish (360-108, 400-125) were initially detected in the secondary channel downstream of the sound deterrent system (Table 6). Over the course of the study, five tagged herring (360-108, 380-114, 420-114, 440-134, 400-125) were detected at fixed monitoring stations in the secondary channel downstream of the sound deterrent system.

Fish # 360-108 – Initial detection at Receiver 8 on 30 May at 16:20:09; last detection at Receiver 8 on May at 19:38:56. This fish moved over to the main channel later that night where it was detected at Receiver 5 and 6 between 20:15:41 and 20:21:54.

Fish # 380-114 – First detected in the main channel at Receiver 6 on 30 May at 11:00:56. This fish left the main channel at 16:12:59 and was subsequently detected in the secondary channel at Receiver 7 on 30 May at 16:20:09. It left the secondary channel at 19:22:40 on 31 May and was again detected at Receiver 6 in the main channel on 31 May at 22:21:50.

Fish # 420-114 – First detected in the main channel on 29 May. Detected in the main channel again on 30 May. Left the main channel and subsequently detected in secondary channel at Receiver 8 on 30 May between 20:40:55 and 20:43:25 on 30 May. Moved back to Main channel later that night; the last detection occurred at Receiver 5.at 23:00:55 on 30 May.

Fish # 440-134 – Only fish determined to have passed downstream of the project through the secondary channel. Prior to passing downstream, this fish was detected at Receiver 8 on 7 June at 00:07:51. As this fish was detected downstream of the project at Receiver 2 on 7 June at 12:00:42 it was presumed to have either passed downstream through the power station or spilled over Dam B.

Fish # 400-125 – Initial detection**,** and only detection of this fish occurred at Receiver 8 on 10 June between 12:15:56 and 17:17:08

Eight tagged fish were detected at monitoring site 4, the 80-ft. wide notch in Dam A (Table 7). Three of the eight tagged herring(360-102, 400-132, and 420-081) detected passed downstream via the notch.

Table 8 provides a summary by date, time, and location where blueback herring with a radio tag were detected by fixed-location telemetry during the full-scale telemetry study. Table 9 provides a summary of radio tagged blueback herring detected by date and location with fixed-location telemetry during the full-scale study

Table 10 provides a summary by date of the total kilowatts produced by the Crescent powerstation, average pond elevation, flow (river flow, Waterford Flight flow and weir flow, Dam A spillage & weir plus Waterford Flight flows), the proportion of flow (Dam A spillage & weir plus Waterford Flight flows Vs flow spilled at Dam B & passed by the turbines and gates), and the number of lockages at Lock 6 during the full-scale telemetry study conducted at the Crescent Hydroelectric project in 2009.

Mobile Tracking Summary

Mobile tracking systematically covered the area between the Route 9 bridge and the Crescent Hydroelectric station including the entrance to the Erie Canal, the main channel above Dam A and the secondary channel downstream of the sound deterrent system leading to the powerhouse and/or Dam B. On 29 May, 15 and 25 June the area checked while mobile tracking was expanded upstream and included the section of river between the Rte 9 bridge and the release location. On 3 June, mobile tracking was conducted throughout the river between the Crescent and Vischer Ferry projects.

Mobile tracking was conducted on 33 days between 29 May and 9 July. A total of 38 tagged herring were detected while mobile tracking; 15 from the 1st release, 11 from the 2nd and 12 from the 3rd release (Table 11).

Of the 38 tagged herring located while mobile tracking (Table 12 and Figures 6 - 33):

The majority of fish (32) were initially detected upstream of the entrance to the secondary channel. Seven fish (360-108, 420-114, 440,103, 400-129, 400-132, 420-142, 440-070; fish 440-070 was detected twice in this area) were detected downstream of the release location and above the Rte 9 bridge. Twenty-four fish (360-117,360-69,360-79, 380-114, 380-67, 400-125,400-129,400-132,400-136, 400-140, 400-69, 400-91, 420-70, 420-84, 440-105, 440-117, 440-109,440-144, 440-95, 440-134, 440-75, 440-70, 460-101, 460-69) were detected between the Rte 9 bridge and the entrance to the secondary channel. Fish detected between the Rte 9 bridge and the entrance to the secondary channel were mostly found along the outer portion of the oxbow near the Rte 9 bridge and along the east shore, just downriver of the oxbow.

Nine fish (380-120, 400-121, 420-114, 440-105, 440-107, 380-114, 400-121, 400-125 and 420-138) were detected in the main channel above Dam A and downstream of the secondary channel. Fish 380-120 was detected once each day in this area on 30 and 31 May. Fish 400-121 was detected three times on 1 June and Fish 380-114 was detected twice on 1 June above Dam A. Eight of these fish were also detected at fixed monitoring locations (Receiver 5 and 6) in the main channel. The only fish detected in the main channel downstream of the secondary channel and not detected at fixed monitoring stations was fish 420-138. It was located slightly upstream of Receiver 6 on 4 June.

On 3 June, mobile tracking was conducted between the release site and Vischer Ferry (Figure 11). Nine fish were detected. Five fish were located upstream of the release site; three fish (360-135, 360-136, and 360-102) were detected in the river several miles upstream of the release site but downstream of the Rte 87 bridge. The remaining two fish (360-134 and 400-134) were located upstream of the Rte 87 bridge. Three fish (400-129, 400-132, and 400-129) were located in close proximity to the release site.

Just two fish (380-114 and 420-83) were located downstream of the sound deterrent system while mobile tracking.

> **Fish 380-114** was detected off the small island in the secondary channel downstream of the deterrent system on 31 May. This fish was initially detect in the main channel below the Rte 9 bridge on 30 May and last detected on 1 June in the main channel above Dam A. This fish was one of five fish detected at fixed monitoring stations downstream of the deterrent system

> **Fish 420-83** was initially detected off the upper tip of the small island in the secondary channel downstream of the deterrent system on 6 June. On 8 and 9

June this fish moved slightly further upstream of its initial location off the small island. Between 10 June and 7 July the fish remained at the same location indicating that it had likely died and/or regurgitated its tag. On 9 July, this tag while still detectable, could no longer be coded and it was presumed the battery no longer had sufficient battery strength to permit the receiver to code this tag.

Fish 420-083 was not one of the five fish detected at the fixed monitoring stations (Receivers 7 and 8) located downstream of the sound deterrent system.

Seven of 11 fish that migrated downstream of the project were detected while mobile tracking (360-102, 400-121, 400-132, 440-103, 440-107, 440-109, 440-134).

Combining fixed and mobile data, 6 of 36 tagged herring (360-108, 380-114, 420-114, 440-134, 400-125, 420-83) that were presumably subject to the ultrasonic field were detected in the secondary channel downstream of the sound system. Of the 36 tagged fish presumably subject to the sound deterrent system, 34 were detected at fixed monitoring stations. The other two fish (420-83 and 420-138) were detected while mobile tracking.

ATTACHMENT A

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Table 1. Summary of when blueback herring were radio tagged and released in the Mohawk River two miles upstream of Crescent in 2009.

35 Herring tagged May 28 @ 20:00 hrs	**35 Herring Tagged May 31 @ 18:05 hrs**	**32 Herring Tagged June 4 @ 18:00 hrs**
360 - 102, 104, 108, 117, 121, 126	360 - 134, 135, 136, 139, 140*, 141	360 - 69, 70, 79, 95, 113
380 - 112, 114, 118, 120, 122, 124	380 - 134, 135, 136, 138, 139, 141	380 - 65, 66, 67, 91, 93
400 - 113, 121, 123, 125 127, 129	400 - 132, 134, 136, 138, 140, 142,	400 - 69, 70*, 91
420 - 101, 103, 105, 109, 114, 117*	420 - 134, 136, 138**, 140, 142, 144	420 - 70, 80, 81, 83, 84, 85, 94, 132
440 - 103, 105, 107, 109, 113, 117,	440 - 134, 136, 140, 142***, 144	440 - 69, 70, 71, 75**, 95
460 - 101, 103, 105, 107, 109	460 - 132, 134****, 136, 140, 142, 144	460 - 67, 69, 70, 71, 81, 84
* mortality retagged 5/29/09 @ 08:20	* mortality retagged 6/01/09 @ 07:19	* mortality retagged 6/05/09 @ 10:30
	** mortality retagged 6/01/09 @ 07:22	** mortality retagged 6/05/09 @ 10:35
	*** mortality retagged 6/01/09 @ 10:54	
	**** mortality retagged 6/01/09 @ 10:54	
Release on May 29 @ 11:49 hrs	**Release on May 29 @ 12:19 hrs**	**tagged herring detected**
360 - 102, 108, 117, 121	360 - 104, 126	102, 108
380 - 118, 122, 124	380 - 112, 114, 120	114, 120, 122
400 - 113, 127	400 - 121, 123, 125, 129	121, 123, 125
420 - 103, 105	420 - 101, 109, 114, 117	101, 109, 114, 117
440 - 109, 117	440 - 103, 105, 107, 113	103, 105, 107, 109, 113
460 - 105, 107	460 - 101, 103, 109	101
Release on June 1 @ 10:45 hrs	**Release on June 1 @ 11:30 hrs**	**tagged herring detected**
360 - 134, 136, 140, 141	360 - 135, 139	139, 141
380 - 134, 135, 136, 138, 139, 141	380 -	136, 138, 139
400 - 136, 142	400 - 132, 134, 138, 140	132
420 - 134, 142, 144	420 - 136, 138, 140	140, 142
440 - 134, 136	440 - 140, 142, 144	134, 136
460 - 136, 140, 142	460 - 132, 134, 144	132, 134
Release on June 5 @ 10:25 hrs	**Release on June 5 @ 11:00 hrs**	**tagged herring detected**
360 - 70, 79	360 - 69, 95, 113	79, 113
380 - 65, 93	380 - 66, 67, 91	
400 - 91	400 - 69, 70	
420 - 70, 80, 83, 84, 85	420 - 81, 94, 132	81
440 - 69, 70, 71	440 - 75, 95	
460 - 67, 71, 81	460 - 70, 69, 84	67, 69
102 herring tagged and released		**35 Tagged herring detected**

Table 2. Summary radio tagged blueback herring detected during the full-scale study using mobile and fixed-location telemetry at the Crescent Hydroelectric Project in 2009.

Frequency	149.360	149.380	149.400	149.420	149.440	149.460	
Fish No.	**69**	**67**	**69**	**70**	**70**	67	
	79	114	**91**	81	**75**	69	
	102	120	121	**83**	**95**	101	
	108	122	123	**84**	103	132	
	113	136	125	101	105	134	
	117	139	**129**	109	107		
	134		132	114	109		
	135		**134**	117	113		
	136		**136**	**138**	**117**		
	139		**140**	140	134		
	141			142	136		
					144		
# Fish Detected Fixed Monitoring only	**3**	**3**	**1**	**5**	**2**	**3**	**17**
# Fish Detected Mobile Monitoring only	**5**	**1**	**6**	**4**	**5**	**0**	**21**
# Fish Detected by Both - Fixed and Mobile Monitoring	**3**	**2**	**3**	**2**	**5**	**2**	**17**
Total # Fish Detected	**11**	**6**	**10**	**11**	**13**	**5**	**55**

Fixed monitoring	**Blue Highlight**
Mobile tracking	**Bold**
Both - Fixed and Mobile	**Yellow Highlight**

Table 3. Summary by release group of radio tagged blueback herring detected during the full-scale study using fixed-location telemetry at the Crescent Hydroelectric Project in 2009.

Frequency	149.360	149.380	149.400	149.420	149.440	149.460	
Release Group 1	102	114	121	101	103	101	
	108	120	123	109	105		
		122	125	114	107		
				117	109		
					113		
Release Group 2	139	136	132	140	134	132	
	141	139		142	136	134	
Release Group 3	79			81		67	
	113					69	
# Fish Detected Fixed Monitoring only	**6**	**5**	**4**	**7**	**7**	**5**	**34**

Table 4. The location where blueback herring with a radio tag, released in the Mohawk River two miles upriver of Crescent Hydroelectric Project were first detected by fixed location telemetry.

	Fish #		Monitoring Location	Date	Time	River Flow (cfs)	Dam A Flow (cfs)	Dam B Powerhouse Flow (cfs)	Dam A Water Elv. (ft)
1	380	122	Main Channel (Rec 5)	5/29/09	17:49:27	6,241	312	5,929	185.1
2	420	101	Main Channel (Rec 6)	5/29/09	16:02:50	6,372	510	5,862	185.2
3	420	114	Main Channel (Rec 6)	5/29/09	17:50:33	6,241	312	5,929	185.1
4	440	105	Main Channel (Rec 6)	5/29/09	16:28:59	6,372	510	5,862	185.2
5	460	101	Main Channel (Rec 6)	5/29/09	16:16:36	6,372	510	5,862	185.2
6	360	108	Powerhouse (Rec 8)	5/30/09	16:20:09	6,479	518	5,961	185.2
7	380	114	Main Channel (Rec 6)	5/30/09	11:00:56	6,625	729	5,896	185.3
8	380	120	Main Channel (Rec 6)	5/30/09	10:26:33	6,628	729	5,899	185.3
9	400	121	Main Channel (Rec 6)	5/30/09	5:03:18	6,584	724	5,860	185.3
10	420	117	Main Channel (Rec 6)	5/30/09	10:42:02	6,628	729	5,899	185.3
11	440	107	Main Channel (Rec 6)	5/30/09	10:02:50	6,628	729	5,899	185.3
12	440	113	Main Channel (Rec 5)	5/30/09	12:09:51	6,583	724	5,861	185.3
13	360	141	Main Channel (Rec 6)	6/1/09	20:05:09	2,933	704	2,229	185.3
14	460	134	Main Channel (Rec 6)	6/1/09	23:29:08	3,080	338	2,741	185.1
15	360	139	Main Channel (Rec 6)	6/2/09	0:04:01	3,140	251	2,889	185.0
16	380	139	Main Channel (Rec 5)	6/2/09	12:59:10	1,669	1,152	517	185.5
17	420	109	Main Channel (Rec 6)	6/2/09	0:04:16	3,140	251	2,889	185.0
18	420	140	Main Channel (Rec 6)	6/2/09	4:00:13	3,180	191	2,989	184.8
19	440	136	Main Channel (Rec 6)	6/2/09	6:12:05	2,861	172	2,689	184.8
20	460	132	Main Channel (Rec 6)	6/2/09	5:21:42	3,174	190	2,984	184.8
21	380	136	Main Channel (Rec 5)	6/3/09	7:19:31	2,902	174	2,728	184.8
22	440	109	Main Channel (Rec 6)	6/3/09	22:49:48	4,310	216	4,094	184.9
23	400	123	Main Channel (Rec 6)	6/4/09	16:27:00	1,669	1,152	517	185.5
24	400	132	Main Channel (Rec 5)	6/4/09	5:38:42	2,702	243	2,459	185.0
25	360	102	Main Channel (Rec 6)	6/5/09	1:41:16	3,994	240	3,754	184.9
26	360	113	Main Channel (Rec 6)	6/5/09	15:36:46	2,592	233	2,359	185.0
27	420	81	Main Channel (Rec 6)	6/5/09	16:18:34	982	157	825	184.8
28	460	67	Main Channel (Rec 6)	6/5/09	13:40:35	1,657	199	1,458	184.9
29	460	69	Main Channel (Rec 6)	6/5/09	20:04:39	290	125	165	184.9
30	360	79	Main Channel (Rec 5)	6/6/09	13:02:13	879	176	703	184.9
31	440	134	Main Channel (Rec 5)	6/6/09	9:47:16	838	201	637	185.0
32	420	142	Main Channel (Rec 6)	6/7/09	10:02:37	1,228	184	1,044	184.9
33	400	125	Powerhouse (Rec 8)	6/10/09	12:15:56	740	148	592	184.8
34	440	103	Main Channel (Rec 5)	6/12/09	2:11:04	1,415	198	1,217	184.9

Table 5. The monitoring location where radio tagged blueback herring were detected at when or after passing downstream of the Crescent Hydroelectric Project in 2009.

Fish #		Downriver Path	Last Detection Upriver			First Detection Downriver			Flow (cfs)			Water Elev. (ft)
			Date	Receiver	Time	Date	Receiver	Time	River	Dam A	Dam B Powerhouse	Dam A
440	107	Canal	30-May	3	18:16:17				6,390	511	5,879	185.2
400	121	Canal	1-Jun	3	15:58:02				1,412	861	551	185.4
420	140	Dam A (Flashboards)	2-Jun	5	19:41:12	2-Jun	1	20:45:29	6,713	1,947	4,766	185.7
360	141	Canal	2-Jun	3	8:09:55				2,098	210	1,888	184.9
440	136	Canal	2-Jun	3	10:10:02				425	331	94	185.2
360	139	Canal	2-Jun	3	12:27:23				1,669	1,152	517	185.5
460	132	Canal	2-Jun	3	12:29:03				1,669	1,152	517	185.5
420	109	Canal	2-Jun	3	18:09:55				5,462	3,550	1,912	186.1
460	134	Dam A (Flashboards)	2-Jun	5	13:31:57	2-Jun	2	14:27:00	4,040	2,666	1,374	185.9
380	139	Dam A (Flashboards)	2-Jun	6	23:13:05	3-Jun	1	5:13:23	2,827	198	2,629	184.9
420	117	Dam A (Flashboards)	3-Jun	6	8:34:38	3-Jun	1	11:10:09	1,195	837	358	185.4
360	102	Dam A (Opening)	5-Jun	4	7:43:35	5-Jun	2	8:12:20	1,641	230	1,411	184.9
400	132	Dam A (Opening)	5-Jun	4	8:12:17	5-Jun	2	8:52:07	1,194	215	979	184.9
420	81	Dam A (Opening)	5-Jun	5	20:32:07	6-Jun	2	7:04:06	291	125	166	184.9
440	109	Dam A (Flashboards)	4-Jun	3	14:00:12	6-Jun	2	11:14:43	920	202	718	185.0
440	134	Powerhouse/Dam B	7-Jun	8	0:07:51	7-Jun	2	12:00:42	666	186	480	185.0
440	103	Canal	13-Jun	3	9:15:23				5,066	203	4,863	184.9

Table 6. Summary of radio tagged blueback herring detected in the secondary or Powerhouse Channel at the Crescent Hydroelectric Project in 2009.

Fish #		Monitoring Location	Date	Time	River Flow (cfs)	Dam A Flow (cfs)	Dam B Powerhouse Flow (cfs)	Dam A Water Elev. (ft)
360	108	Rec 8	30-May	16:20:09 - 16:20:37	6,479	518	5,961	185.2
				16:21:11 - 19:38:56	6,479 - 6,354	518 - 508	5,961 - 5,846	185.2
380	114	Rec 7	30-May	20:38:18 - 20:38:20	6,261	509	5,752	185.2
		Rec 8	30-May	20:49:42 - 20:52:50	6,261	509	5,752	185.2
380	114	Rec 8	31-May	6:04:54 - 6:12:48	6,071	364	5,707	185.1
				9:06:52 - 9:37:14	6,042	242	5,800	185.0
				9:38:08 - 19:22:40	6,048 - 4,754	242 - 190	5,806 - 4,564	185.0 - 184.8
				21:33:09 - 21:23:55	780	569	211	185.3
420	114	Rec 8	31-May	20:40:55 - 20:43:25	1,732	468	1,264	185.2
440	134	Rec 8	6-Jun to 7-Jun	23:59:01 - 00:07:51	621 - 666	186	435 - 480	185.0
400	125	Rec 8	10-Jun	12:15:56 - 12:17:08	740	148	592	184.8

Table 7. Summary of radio tagged blueback herring detected in the main channel at DAM A (REC 4) of the Crescent Hydroelectric project in 2009.

Fish #		Monitoring Location	Date	Time Start/Stop	River Flow (cfs)	Dam A Flow (cfs)	Dam B Powerhouse Flow (cfs)	Dam A Water Elev. (ft)
420	101	Dam A	30-May	0:42:29 - 0:43:25	6,296	504	5,792	185.2
				4:47:22 - 4:57:58	6,573	723	5,850	185.3
				5:17:11 - 5:56:37	6,584	724	5,860	185.3
				6:01:57 - 6:09:45	6,601	726	5,875	185.3
440	105	Dam A	30-May	6:25:56 - 6:27:44	6,601	726	5,875	185.1
360	102	Dam A	5-Jun	4:38:01 - 4:39:07	2,102	231	1,871	185.0
				5:26:46 - 5:27:34	2,077	312	1,765	185.1
				5:56:00 - 6:00:01	2,077 - 1,662	312 - 233	1,765 - 1,429	185.1 - 185.0
				7:21:54 - **7:43:35**	1,641	230	1,411	184.9
360	113	Dam A	5-Jun	16:59:45 - 17:25:19	982 - 290	157 - 136	825 - 154	184.8 - 185.0
400	132	Dam A	5-Jun	8:10:11 - **8:12:17**	1,194	215	979	184.9
420	81	Dam A	5-Jun	21:25:11 - **21:25:33**	291	125	166	184.9
440	134	Dam A	6-Jun	10:14:57 - 11:14:28	1,070 - 920	182 - 202	888 - 718	184.9 - 185.0
440	103	Dam A	12-Jun	5:27:45 - 5:44:09	1,416	227	1,189	185.0
				6:04:30 - 6:04:56	1,610	225	1,385	185.0
				7:13:58 - 7:14:02	2,295	230	2,065	185.0
				8:13:41 - 8:17:25	2,748	247	2,501	185.0
				8:24:11 - 8:51:15	2,748	247	2,501	185.0

NOTE: Bold is time herring passed downstream of project.

Table 8. Date, time, and location where blueback herring with a radio tag were detected by fixed-location telemetry during a pilot telemetry study for the Crescent Hydroelectric Project (see Figure 1 for locations).

Fish #		Monitoring Location	Date	Time Start / Stop
360	**79**	Receiver 5	6-Jun	13:02:13 - 13:27:48
		Receiver 6		14:10:02 - 14:10:38
		Receiver 6	7-Jun	10:07:14 - 10:09:02
		Receiver 5		14:10:02 - 14:10:38
		Receiver 6		14:20:48 - 14:20:56
360	**102**	Receiver 6	5-Jun	1:41:16 - 3:00:04
		Receiver 5		2:09:49 - 2:27:07
		Receiver 5		2:48:12 - 4:23:10
		Receiver 6		3:57:39 - 4:26:54
		Receiver 4		4:38:01 - 4:39:07
		Receiver 4		5:26:46 - 5:27:34
		Receiver 5		5:38:40 - 5:43:10
		Receiver 6		5:40:30 - 5:42:58
		Receiver 4		5:56:00 - 6:00:01
		Receiver 5		6:18:16 - 6:20:32
		Receiver 6		6:20:24 - 6:28:27
		Receiver 5		7:02:27 - 7:11:42
		Receiver 4		7:21:54 - 7:43:35
		Receiver 2		8:12:20 -8:19:20
		Receiver 2		9:47:08 -9:50:48
		Receiver 2		10:30:17 - 10:30:19
		Receiver 2		11:04:46 - 11:04:48
		Receiver 2		19:04:46 - 23:36:34
		Receiver 1		20:19:35 - 20:19:37
		Receiver 1		23:04:32 - 23:04:34
		Receiver 1		23:06:52 - 23:33:05
		Receiver 1	6-Jun	4:55:32 - 5:00:28
		Receiver 1		6:37:32 - 6:55:38
		Receiver 1		7:33:49 - 7:34:11
360	**113**	Receiver 6	5-Jun	15:36:46 - 16:36:28
		Receiver 5		15:38:39 - 15:39:11
		Receiver 5		15:59:15 - 16:00:51
		Receiver 5		18:39:55 - 18:43:07
		Receiver 6		18:44:54 - 18:54:41
		Receiver 5		19:22:08 - 19:50:54

Fish #		Monitoring Location	Date	Time Start / Stop
		Receiver 6		19:23:05 - 19:46:32
		Receiver 6		19:55:42 - 21:38:38
		Receiver 5		20:21:01 - 20:38:39
		Receiver 5		21:09:10 - 21:20:56
		Receiver 4		16:59:45 -17:25:19
360	**108**	Receiver 8	30-May	16:20:09 - 16:20:37
		Receiver 8		16:21:11 -19:38:56
		Receiver 6		20:15:41 - 20:16:31
		Receiver 5		20:19:18 -20:21:54
360	**139**	Receiver 6	2-Jun	0:04:01 - 0:07:19
		Receiver 3		0:35:25 - 1:46:02
		Receiver 5		5:21:47 - 5:32:38
		Receiver 6		5:24:26 - 5:26:26
		Receiver 3		8:38:41 - 10:28:53
		Receiver 3		10:53:49 -12:27:23
360	**141**	Receiver 6	1-Jun	20:05:09 - 20:08:33
		Receiver 5		20:08:08 - 20:49:17
		Receiver 6		20:27:15 - 20:37:43
		Receiver 5	2-Jun	5:28:26 - 5:52:37
		Receiver 6		5:26:49 - 5:44:21
		Receiver 3		6:29:29 - 6:53:41
		Receiver 5		7:08:06 - 7:10:06
		Receiver 6		7:08:23 - 7:12:21
		Receiver 3		7:31:58 - 8:09:55
380	**114**	Receiver 6	30-May	11:00:56 - 11:01:14
		Receiver 6		11:18:23 - 11:19:09
		Receiver 6		13:30:56 - 13:30:58
		Receiver 5		16:08:13 - 16:12:59
		Receiver 7		20:38:18 - 20:38:20
		Receiver 8		20:49:42 - 20:52:50
		Receiver 8	31-May	6:04:54 - 6:12:48
		Receiver 8		9:06:52 - 9:37:14
		Receiver 8		9:38:08 - 19:22:40
		Receiver 8		21:33:09 - 21:23:55
		Receiver 6		22:21:50 - 22:27:54
		Receiver 5		23:58:15 - 23:59:33

Fish #		Monitoring Location	Date	Time Start / Stop
380	**120**	Receiver 6	30-May	10:26:33 - 10:49:12
		Receiver 5		10:29:08 - 10:41:13
		Receiver 6		11:52:43 - 11:54:07
		Receiver 5		11:52:54 - 11:59:24
		Receiver 5		12:30:49 -12:42:31
		Receiver 6		12:43:12 - 12:43:16
		Receiver 6		13:25:51 - 13:28:05
		Receiver 5		13:28:00 - 13:30:18
		Receiver 5		15:28:49 - 15:31:01
		Receiver 5		16:20:18 - 17:12:59
		Receiver 6		16:58:01 - 17:00:02
		Receiver 5		18:31:53 - 18:31:59
		Receiver 5		20:18:01 - 20:20:53
		Receiver 3	30 - 31 May	20:43:31 - 6:17:27
		Receiver 5	31-May	7:48:18 - 7:49:52
		Receiver 5		8:20:34 - 8:23:00
		Receiver 5		8:58:41 - 9:22:56
		Receiver 6		9:03:24 - 9:17:49
		Receiver 5		9:29:28 - 9:52:38
		Receiver 6		9:40:41 - 9:43:57
		Receiver 6		10:00:33 - 10:02:17
		Receiver 5		10:31:01 - 1032:49
		Receiver 5		13:18:59 - 13:31:51
		Receiver 6		13:21:32 - 13:32:00
		Receiver 5		15:29:08 - 15:33:00
		Receiver 6		15:31:54 - 16:31:58
		Receiver 5		16:18:27 - 16:33:01
		Receiver 5		17:58:57 - 18:29:40
		Receiver 6		18:00:54 - 18:35:54
		Receiver 6		20:30:53 - 20:41:31
		Receiver 5		20:30:58 - 20:42:36
		Receiver 5		23:51:16 - 23:51:46
		Receiver 6		23:51:25 - 23:51:35
380	**122**	Receiver 5	29-May	17:49:27 - 17:51:51
		Receiver 6		17: 49:51 - 17:51:49
		Receiver 5		18:22:28 - 18:22:58
380	**136**	Receiver 5	3-Jun	7:19:31 - 7:19:59
		Receiver 5		19:38:21 - 19:42:33
		Receiver 5		20:01:24 - 20:01:48
		Receiver 6		20:04:16 - 20:15:14

Fish #		Monitoring Location	Date	Time Start / Stop
380	**139**	Receiver 5	2-Jun	12:59:10 - 13:02:56
		Receiver 5		13:59:11 - 14:22:58
		Receiver 6		14:23:26 - 14:23:28
		Receiver 6		16:36:27 - 16:31:29
		Receiver 5		19:39:03 - 19:41:0
		Receiver 6		19:39:11 - 19:57:55
		Receiver 5		20:31:40 - 20:43:06
		Receiver 6		20:32:34 - 20:43:46
		Receiver 5		22:58:45 - 23:13:05
		Receiver 5	3-Jun	0:18:55 - 0:23:07
		Receiver 5		0:59:15 - 0:59:53
		Receiver 6		1:04:56 - 1:14:40
		Receiver 6		2:22:14 - 4:37:32
		Receiver 5		1:00:45 - 1:13:06
		Receiver 5		2:12:03 - 3:03:06
		Receiver 5		3:31:21 - 4:38:24
		Receiver 1		5:13:23 - 7:10:38
		Receiver 2		5:19:47 - 7:16:09
		Receiver 2		15:51:01 - 15:51:11
		Receiver 2		16:13:13 - 16:16:19
400	**121**	Receiver 6	30-May	5:03:18 - 5:11:55
		Receiver 5		5:10:43 - 5:11:25
		Receiver 5		5:19:20 - 5:19:22
		Receiver 5		6:11:37: -6:11:39
		Receiver 6		6:18:28 6:19:52
		Receiver 5		6:19:21 - 6:19:23
		Receiver 5		7:59:09 - 7:59:13
		Receiver 5		16:48:10 - 16:48:14
		Receiver 5		18:21:32 - 18:42:57
		Receiver 6		18:24:13 - 18:26:07
		Receiver 5	31-May	12:08:35 - 12:22:59
		Receiver 6		12:19:58 - 12:20:16
		Receiver 6		12:44:59 - 14:05:22
		Receiver 5		13:09:26 - 14:11:36
		Receiver 5		14:49:00 - 15:32:59
		Receiver 6		14:51:39 - 14:51:41
		Receiver 6		15:04:25 - 15:04:41
		Receiver 6		15:15:10 - 15:55:05
		Receiver 6		16:06:39 - 16:06:41
		Receiver 6		17:48:01 - 18:23:46

Fish #		Monitoring Location	Date	Time Start / Stop
		Receiver 5		18:01:44 - 18:22:59
		Receiver 5		19:58:17 - 20:08:21
		Receiver 6		20:57:33 - 21:06:07
		Receiver 5		20:58:04 - 21:02:58
		Receiver 3	1-Jun	15:42:28 - 15:58:02
400	**123**	Receiver 6	4-Jun	16:27:00 - 16:27:02
		Receiver 5		16:27:00 - 17:00:09
		Receiver 6		16:51:57 - 16:51:59
400	**125**	Receiver 8	10-Jun	12:15:56-12:17:08
400	**132**	Receiver 5	4-Jun	5:38:42 - 5:42:06
		Receiver 6		5:40:32 - 5:42:50
		Receiver 3		10:53:23 - 10:59:13
		Receiver 2	5-6 Jun	12:39:51 - 6:39:04
		Receiver 1	5-6 Jun	15:41:03 -6:14:11
		Receiver 1	6-7 Jun	6:16:39 - 7:43:19
		Receiver 2	6-7 Jun	6:39:42 - 9:08:44
		Receiver 1	7-8 Jun	7:43:03 - 8:23:52
		Receiver 2	7-8 Jun	8:03:11 - 9:08:44
		Receiver 1	8-Jun	8:46:20 - 10:43:39
		Receiver 2		9:14:44 - 19:37:20
		Receiver 2	9-Jun	1:30:54 - 1:58:49
420	**81**	Receiver 6	5-Jun	16:18:34 - 16:49:32
		Receiver 5		16:50:09 - 16:51:09
		Receiver 5		17:38:20 - 17:52:34
		Receiver 5		18:01:42 - 18:40:49
		Receiver 5		18:58:35 - 20:32:07
		Receiver 4		21:25:11 - 21:25:33
		Receiver 1	6-Jun	7:04:06 - 8:21:25
		Receiver 2		9:17:44 - 9:48:43
		Receiver 2		10:47:56 - 10:47:58
		Receiver 2		14:59:01 - 15:11:59
420	**101**	Receiver 6	29-May	16:02:50 - 16:17:02
		Receiver 5		23:52:40 - 23:52:42
		Receiver 5		23:58:02 - 23:50:21
		Receiver 6	29 - 30 May	23:22:29 - 0:00:12
		Receiver 4	30-May	0:42:29 - 0:43:25
		Receiver 5		2:12:20 -2:12:42

Fish #		Monitoring Location	Date	Time Start / Stop
		Receiver 5		2:18:40 - 2:19:56
		Receiver 4		4:47:22 - 4:57:58
		Receiver 4		5:17:11 - 5:56:37
		Receiver 4		6:01:57 - 6:09:45
		Receiver 5		6:20:34 - 6:22:46
		Receiver 5		6:38:22 - 6:59:44
		Receiver 6		6:23:33 - 6:38:33
		Receiver 6		6:43:57 - 6:51:05
		Receiver 6		10:05:50 - 10:09:12
420	**109**	Receiver 6	2-Jun	0:04:16 - 0:06:56
		Receiver 6		4:27:56 - 5:04:37
		Receiver 5		4:08:25 - 4:53:02
		Receiver 5		5:29:39 - 5:32:57
		Receiver 5		6:28:36 - 6:31:48
		Receiver 5		7:42:16 - 8:00:18
		Receiver 3		9:39:46 - 10:07:14
		Receiver 3		15:55:16 -18:00:45
420	**114**	Receiver 5	29-May	17:50:33 - 17:50:35
		Receiver 5		20:02:44 - 20:00:50
		Receiver 6		23:58:02 - 0:00:56
		Receiver 6	30-May	14:19:39 - 14:19:01
		Receiver 6		14:23:28 - 14:32:22
		Receiver 5		14:32:19 - 14:42:22
		Receiver 5		15:58:05 - 16:12:59
		Receiver 8		20:40:55 - 20:43:25
		Receiver 5		23:00:49 - 23:00:55
420	**117**	Receiver 5	30-May	8:30:14 - 8:32:26
		Receiver 6		8:31:29 - 8:34:38
		Receiver 6		10:42:02 - 10:42:10
		Receiver 1		11:10:09 - 11:20:09
		Receiver 2		11:21:19 - 11:37:30
420	**140**	Receiver 6	2-Jun	4:00:13 - 4:12:59
		Receiver 5		4:01:15 - 4:12:49
		Receiver 5		5:28:16 - 5:33:04
		Receiver 6		5:32:46 - 5:32:58
		Receiver 5		6:01:24 - 6:51:05
		Receiver 5		7:49:13 - 7:49:15
		Receiver 5		7:49:40 - 7:50:06

Fish #		Monitoring Location	Date	Time Start / Stop
		Receiver 6		6:16:11 - 6:46:52
		Receiver 5		9:02:43 - 9:12:31
		Receiver 6		9:06:52 - 9:09:12
		Receiver 3		12:41:19 -13:10:25
		Receiver 5		14:58:07 - 15:03:05
		Receiver 5		15:28:11 - 15:28:13
		Receiver 5		16:38:07 - 16:52:21
		Receiver 6		16:39:47 - 16:39:49
		Receiver 6		16:44:23 - 16-54:51
		Receiver 5		17:51:26 - 17:58:22
		Receiver 5		19:38:08 - 19:41:12
		Receiver 6		19:38:14 - 19:43:58
		Receiver 1		20:45:29 - 20:58:07
		Receiver 2		21:38:02 - 21:39:46
420	**142**	Receiver 6	7-Jun	10:02:37 - 10:02:39
		Receiver 5		10:29:08 - 10:29:56
		Receiver 6		13:50:31 - 13:51:57
		Receiver 5		13:51:38 - 14:03:12
		Receiver 6		14:32:36 - 14:39:20
440	**103**	Receiver 5	13-Jun	2:11:04 - 2:11:08
		Receiver 5		2:12:16 - 2:12:18
		Receiver 5		3:29:29 - 3:53:23
		Receiver 6		3:30:05 - 3:30:11
		Receiver 5		4:50:31 - 4:52:55
		Receiver 6		4:52:01 - 4:52:13
		Receiver 4		5:27:45 - 5:44:09
		Receiver 4		6:04:30 - 6:04:56
		Receiver 5		6:32:42 - 6:32:56
		Receiver 4		7:13:58 - 7:14:02
		Receiver 4		8:13:41 - 8:17:25
		Receiver 4		8:24:11 - 8:51:15
		Receiver 3		9:05:13 - 9:15:23
440	**105**	Receiver 6	29-May	16:28:59 - 16:35:58
		Receiver 5		16:30:28 - 16:32:00
		Receiver 5		16:38:24 - 16:38:30
		Receiver 5		17:28:48 - 17:51:12
		Receiver 6		17:42:35 - 17:42:41
		Receiver 6		18:18:01 - 18:25:39
		Receiver 5		18:20:19 - 18:23:47

Fish #		Monitoring Location	Date	Time Start / Stop
		Receiver 5		18:48:35 - 18:49:15
		Receiver 5		19:59:05 - 20:22:53
		Receiver 6		20:02:12 - 20:19:38
		Receiver 5	30-May	5:18:55 - 5:18:57
		Receiver 5		5:49:42 - 5:49:46
		Receiver 5		5:51:16 - 6:01:54
		Receiver 5		6:08:04 - 6:12:00
		Receiver 4		6:25 56 - 6:27:44
		Receiver 5		6:40:11 - 6:42:59
		Receiver 6		6:48:08 - 7:56:08
		Receiver 5		7:01:53 - 7:42:54
		Receiver 5		8:08:01 - 8:08:53
		Receiver 5		8:28:31 - 8:42;58
		Receiver 6		8:49:05 - 8:58:17
		Receiver 5		8:58:50 - 9:18:14
		Receiver 6		9:13:07 - 9:13:13
		Receiver 5		10:08:02 - 11:12;55
		Receiver 5		12:28:03 - 12:30:59
		Receiver 6		12:33:02 - 12:42:10
		Receiver 6		18:18:01 - 18:25:39
		Receiver 5		18:21:12 - 18:28:48
440	**107**	Receiver 6	30-May	10:02:50 - 10:11:19
		Receiver 5		10:03:40 - 10:05:35
		Receiver 3		13:58:21 - 14:15:01
		Receiver 3		15:28:00 - 18:39:47
		Receiver 3		16:11:10 - 17:23:03
		Receiver 3		18:13:45 - 18:16:17
440	**109**	Receiver 6	3-Jun	22:49:48 -23:07:38
		Receiver 5		22:51:18 - 22:59:46
		Receiver 6	4-Jun	8:47:03 - 8:52:03
		Receiver 3		9:27:46 - 9:29:48
		Receiver 3		9:30:18 - 9:33:06
		Receiver 3		9:34:48 - 9:37:26
		Receiver 3		14:00:04 - 14:00:12
		Receiver 1	6-Jun	11:38:51 - 14:59:01
		Receiver 2		11:14:43 - 14:02:24
440	**113**	Receiver 6	30-May	10:02:50 - 10:11:19
		Receiver 5		10:03:40 - 10:05:35
		Receiver 5		12:09:51 - 12:12:57

Fish #		Monitoring Location	Date	Time Start / Stop
		Receiver 5		13:08:17 - 13:10:13
		Receiver 5		13:29:50 - 13:31:38
		Receiver 6		13:30:34 - 13:31:38
		Receiver 5		13:51:15 - 13:51:43
		Receiver 5		14:02;51 - 14;02:53
		Receiver 5		17:30:44 -17:33:00
440	**134**	Receiver 5	6-Jun	9:47:16 - 9:48:10
		Receiver 6		9:54:20 - 9:54:44
		Receiver 4		10:14:57 - 11:14:28
		Receiver 5		13:01:31 - 13:22:13
		Receiver 5		14:00:22 - 14:00:24
		Receiver 8	6 -7 Jun	23:59:01 - 0:07:51
		Receiver 2	7-Jun	12:00:42 - 12:00:58
		Receiver 2		12:01:14 - 12:03:28
		Receiver 2		13:03:15 - 13:06:35
		Receiver 2		14:09:43 - 14:09:47
		Receiver 2		15:11:44 - 15:20:18
		Receiver 2		16:25:09 - 16:50:44
		Receiver 2		17:27:14 - 17:28:37
		Receiver 1		18:13:50 - 20:34:53
		Receiver 2		19:52:11 - 20:02:20
		Receiver 2	8-Jun	5:07:11 - 5:07:15
440	**136**	Receiver 6	2-Jun	6:12:05 - 6:20:57
		Receiver 5		6:18:22 - 6:23:04
		Receiver 3		8:28:01 - 10:10:02
460	**67**	Receiver 6	5-Jun	13:40:35 - 13:46:35
		Receiver 5		13:41:17 - 13:42:57
		Receiver 6		15:06:20 - 15:24:46
		Receiver 5		15:22:10 - 15:22:12
		Receiver 5		16:49:18 - 16:49:20
		Receiver 5		16:51:58 - 16:52:10
		Receiver 5		19:29:16 - 21:02:55
		Receiver 6		19:35:20 - 19:59:25
		Receiver 6		20:18:41 - 21:31:26
460	**69**	Receiver 6	5-Jun	20:04:39 - 20:10:43
		Receiver 5		20:52:27 - 20:58:33
460	**101**	Receiver 6	29-May	16:16:36 -16:17:02
		Receiver 5		16:30:09 - 16:30:13

Fish #		Monitoring Location	Date	Time Start / Stop
460	**132**	Receiver 5	2-Jun	5:21:42 - 5:33:02
		Receiver 6		5:22:40 - 5:23:22
		Receiver 6		5:47:40 - 5:49:39
		Receiver 5		6:49:47 - 6:52:53
		Receiver 3		7:32:05 - 8:49:08
		Receiver 5		9:01:05 - 9:29:15
		Receiver 6		9:05:01 - 9:15:07
		Receiver 5		10:22:26 - 10:22:32
		Receiver 3		12:12:35 - 12:29:03
460	**134**	Receiver 6	1-Jun	23:29:08 - 23:29:16
		Receiver 5		23:31:14 - 23:31:52
		Receiver 5	2-Jun	2:18:42 - 2:33:04
		Receiver 6		2:25:30 - 2:33:48
		Receiver 5		2:42:16 - 2:42:26
		Receiver 5		2:58:22 - 2:59:16
		Receiver 5		3:12:34 - 3:13:00
		Receiver 6		3:12:51 - 3:12:55
		Receiver 5		4:22:26 - 4:22:28
		Receiver 6		8:14:35 - 8:30:17
		Receiver 5		8:29:10 - 8:41:14
		Receiver 5		11:11:55 - 11:13:05
		Receiver 5		13:11:31 - 13:31:57
		Receiver 6		13:18:31 - 13:28:39
		Receiver 2		14:27:00 - 15:38:03
		Receiver 1		14:39:46 - 14:45:54

Table 9. Summary of radio tagged blueback herring detected by date and location with fixed-location telemetry during the full-scale study conducted at the Crescent Hydroelectric Project in 2009.

Date	Fish #		Receiver 1	Receiver 2	Receiver 3	Receiver 4	Receiver 5	Receiver 6	Receiver 7	Receiver 8
29-May			No Fish	No Fish	ND	No Fish			No Fish	No Fish
29-May	380	122					17:49:27 - 17:51:51	17: 49:51 - 17:51:49		
29-May	380	122					18:22:28 - 18:22:58			
29-May	420	101					23:52:40 - 23:52:42	16:02:50 - 16:17:02		
5/29 to 5/30	420	101					23:58:02 - 23:50:21	23:22:29 - 0:00:12		
5/29 to 5/30	420	114					23:58:02 - 0:00:56	17:50:33 - 17:50:35		
5/29 to 5/30	420	114						20:00:12 - 20:00:50		
5/29 to 5/30	440	105					16:30:28 - 16:32:00	16:28:59 - 16:35:58		
5/29 to 5/30	440	105					16:38:24 - 16:38:30	17:42:35 - 17:42:41		
5/29 to 5/30	440	105					17:28:48 - 17:51:12	20:02:12 - 20:19:38		
5/29 to 5/30	440	105					18:48:35 - 18:49:15			
5/29 to 5/30	440	105					19:59:05 - 20:22:53			
5/29 to 5/30	460	101					16:30:09 - 16:30:13	16:16:36 -16:17:02		
30-May			No Fish	No Fish	No Fish					
30-May	360	108					20:19:18 -20:21:54	20:15:41 - 20:16:31		16:20:09 - 16:20:37
30-May	360	108								16:21:11 -19:38:56
30-May	380	114					11:18:23 - 11:19:09	11:00:56 - 11:01:14	20:38:18 - 20:38:20	20:49:42 - 20:52:50
30-May	380	114					13:30:56 - 13:30:58			
30-May	380	114					16:08:13 - 16:12:59			
30-May	380	120					10:29:08 - 10:41:13	10:26:33 - 10:49:12		
30-May	380	120					11:52:54 - 11:59:24	11:52:43 - 11:54:07		
30-May	380	120					12:30:49 -12:42:31	12:43:12 - 12:43:16		
30-May	380	120					13:28:00 - 13:30:18	13:25:51 - 13:28:05		
30-May	380	120					15:28:49 - 15:31:01	16:58:01 - 17:00:02		
30-May	380	120					16:20:18 - 17:12:59			
30-May	380	120					18:31:53 - 18:31:59			
30-May	380	120					20:18:01 - 20:20:53			
30-May	400	121					5:10:43 - 5:11:25	5:03:18 - 5:11:55		
30-May	400	121					5:19:20 - 5:19:22	6:18:28 6:19:52		
30-May	400	121					6:11:37: -6:11:39	18:24:13 - 18:26:07		
30-May	400	121					6:19:21 - 6:19:23			
30-May	400	121					7:59:09 - 7:59:13			
30-May	400	121					16:48:10 - 16:48:14			
30-May	400	121					18:21:32 - 18:42:57			

Date	Fish #		Receiver 1	Receiver 2	Receiver 3	Receiver 4	Receiver 5	Receiver 6	Receiver 7	Receiver 8
30-May	420	101				0:42:29 - 0:43:25	2:12:20 -2:12:42	6:23:33 - 6:38:33		
30-May	420	101				4:47:22 - 4:57:58	2:18:40 - 2:19:56	6:43:57 - 6:51:05		
30-May	420	101				5:17:11 - 5:56:37	6:20:34 - 6:22:46	10:05:50 - 10:09:12		
30-May	420	101				6:01:57 - 6:09:45	6:38:22 - 6:59:44			
30-May	420	114					14:19:39 - 14:19:01	14:23:28 - 14:32:22		
30-May	420	114					14:32:19 - 14:42:22			
30-May	420	114					15:58:05 - 16:12:59			
30-May	420	114					23:00:49 - 23:00:55			
30-May	420	117						10:42:02 - 10:42:10		
30-May	440	105				6:25 56 - 6:27:44	5:18:55 - 5:18:57	6:48:08 - 7:56:08		
30-May	440	105					5:49:42 - 5:49:46	8:49:05 - 8:58:17		
30-May	440	105					5:51:16 - 6:01:54	9:13:07 - 9:13:13		
30-May	440	105					6:08:04 - 6:12:00	12:33:02 - 12:42:10		
30-May	440	105					6:40:11 - 6:42:59			
30-May	440	105					7:01:53 - 7:42:54			
30-May	440	105					8:08:01 - 8:08:53			
30-May	440	105					8:28:31 - 8:42;58			
30-May	440	105					8:58:50 - 9:18:14			
30-May	440	105					10:08:02 - 11:12:55			
30-May	440	105					12:28:03 - 12:30:59			
30-May	440	107			15:28:00 - 15:39:47		10:03:40 - 10:05:35	10:02:50 - 10:11:19		
30-May	440	107			16:11:10 - 17:23:03					
30-May	440	107			18:13:45 - 18:16:17					
30-May	440	107								
30-May	440	113					12:09:51 - 12:12:57	13:30:34 - 13:31:38		
30-May	440	113					13:08:17 - 13:10:13			
30-May	440	113					13:29:50 - 13:31:38			
30-May	440	113					13:51:15 - 13:51:43			
30-May	440	113					14:02:51 - 14:02:53			
30-May	440	113					17:30:44 -17:33:00			
5/30 to 5/31	380	120			20:43:31 - 6:17:27					
31-May			No Fish			No Fish			No Fish	
31-May	380	114					23:58:15 - 23:59:33	22:21:50 - 22:27:54		6:04:54 - 6:12:48
31-May	380	114								9:06:52 - 9:37:14
31-May	380	114								9:38:08 - 19:22:40
31-May	380	114								21:33:09 - 21:23:55
31-May	380	120					7:48:18 - 7:49:52	9:03:24 - 9:17:49		
31-May	380	120					8:20:34 - 8:23:00	9:40:41 - 9:43:57		

Date	Fish #		Receiver 1	Receiver 2	Receiver 3	Receiver 4	Receiver 5	Receiver 6	Receiver 7	Receiver 8
31-May	380	120					8:58:41 - 9:22:56	10:00:33 - 10:02:17		
31-May	380	120					9:29:28 - 9:52:38	13:21:32 - 13:32:00		
31-May	380	120					10:31:01 - 1032:49	15:31:54 - 16:31:58		
31-May	380	120					13:18:59 - 13:31:51	18:00:54 - 18:35:54		
31-May	380	120					15:29:08 - 15:33:00	20:30:53 - 20:41:31		
31-May	380	120					16:18:27 - 16:33:01	23:51:25 - 23:51:35		
31-May	380	120					17:58:57 - 18:29:40			
31-May	380	120					20:30:58 - 20:42:36			
31-May	380	120					23:51:16 - 23:51:46			
31-May	400	121					12:08:35 - 12:22:59	12:19:58 - 12:20:16		
31-May	400	121					13:09:26 - 14:11:36	12:44:59 - 14:05:22		
31-May	400	121					14:49:00 - 15:32:59	14:51:39 - 14:51:41		
31-May	400	121					18:01:44 - 18:22:59	15:04:25 - 15:04:41		
31-May	400	121					19:58:17 - 20:08:21	15:15:10 - 15:55:05		
31-May	400	121					20:58:04 - 21:02:58	16:06:39 - 16:06:41		
31-May	400	121						17:48:01 - 18:23:46		
31-May	400	121						20:57:33 - 21:06:07		
31-May	420	114								20:40:55 - 20:43:25
31-May	440	105					18:21:12 - 18:28:48	18:18:01 - 18:25:39		
1-Jun			No Fish	No Fish		No Fish			No Fish	No Fish
1-Jun	360	141					20:08:08 - 20:49:17	20:05:09 - 20:08:33		
1-Jun	360	141						20:27:15 - 20:37:43		
1-Jun	380	114			14:10:14 - 14:30:20					
1-Jun	400	121			15:42:28 - 15:58:02					
1-Jun	460	134					23:31:14 - 23:31:52	23:29:08 - 23:29:016		
2-Jun									No Fish	No Fish
2-Jun	360	139			0:35:25 - 1:46:02		0:05:07 - 0:06:49	0:04:01 - 0:07:19		
2-Jun	360	139			8:38:41 - 10:28:53		5:21:47 - 5:32:38	5:24:26 - 5:26:26		
2-Jun	360	139			10:53:49 -12:27:23					
2-Jun	360	141			6:29:29 - 6:53:41		5:28:26 - 5:52:37	526:49 - 5:44:21		
2-Jun	360	141			7:31:58 - 8:09:55		7:08:06 - 7:10:06	7:08:23 - 7:12:21		
2-Jun	380	139					12:59:10 - 13:02:56	14:23:26 - 14:23:28		
2-Jun	380	139					13:59:11 - 14:22:58	16:36:27 - 16:31:29		
2-Jun	380	139					19:39:03 - 19:41:0	19:39:11 - 19:57:55		
2-Jun	380	139					20:31:40 - 20:43:06	20:32:34 - 20:43:46		
2-Jun	380	139					22:58:45 - 23:13:05			
2-Jun	420	109			9:39:46 - 10:07:14		4:08:25 - 4:53:02	0:04:16 - 0:06:56		
2-Jun	420	109			15:55:16 -18:00:45		5:29:39 - 5:32:57	4:27:56 - 5:04:37		

Date	Fish #		Receiver 1	Receiver 2	Receiver 3	Receiver 4	Receiver 5	Receiver 6	Receiver 7	Receiver 8
2-Jun	420	109					6:28:36 - 6:31:48			
2-Jun	420	109					7:42:16 - 8:00:18			
2-Jun	420	140	20:45:29 - 20:58:07	21:38:02 - 21:39:46	12:41:19 -13:10:25		4:01:15 - 4:12:49	4:00:13 - 4:12:59		
2-Jun	420	140					5:28:16 - 5:33:04	5:32:46 - 5:32:58		
2-Jun	420	140					6:01:24 - 6:51:05	6:16:11 - 6:46:52		
2-Jun	420	140					7:49:40 - 7:50:06	9:06:52 - 9:09:12		
2-Jun	420	140					7:49:13 - 7:49:15	16:39:47 - 16:39:49		
2-Jun	420	140					9:02:43 - 9:12:31	16:44:23 - 16:54:51		
2-Jun	420	140					14:58:07 - 15:03:05	19:38:14 - 19:43:58		
2-Jun	420	140					15:28:11 - 15:28:13			
2-Jun	420	140					16:38:07 - 16:52:21			
2-Jun	420	140					17:51:26 - 17:58:22			
2-Jun	420	140					19:38:08 - 19:41:12			
2-Jun	440	136			8:28:01 - 10:10:02		6:18:22 - 6:23:04	6:12:05 - 6:20:57		
2-Jun	460	132			7:32:05 - 8:49:08		5:21:42 - 5:33:02	5:22:40 - 5:23:22		
2-Jun	460	132			12:12:35 - 12:29:03		6:49:47 - 6:52:53	5:47:40 - 5:49:39		
2-Jun	460	132					9:01:05 - 9:29:15	9:05:01 - 9:15:07		
2-Jun	460	132					10:22:26 - 10:22:32			
2-Jun	460	134	14:39:46 - 14:45:54	14:27:00 - 15:38:03			2:18:42 - 2:33:04	2:25:30 - 2:33:48		
2-Jun	460	134					2:42:16 - 2:42:26	3:12:51 - 3:12:55		
2-Jun	460	134					2:58:22 - 2:59:16	8:14:35 - 8:30:17		
2-Jun	460	134					3:12:34 - 3:13:00	13:18:31 - 13:28:39		
2-Jun	460	134					4:22:26 - 4:22:28			
2-Jun	460	134					8:29:10 - 8:41:14			
2-Jun	460	134					9:52:16 - 9:53:04			
2-Jun	460	134					11:11:55 - 11:13:05			
2-Jun	460	134					13:11:31 - 13:31:57			
3-Jun					ND	ND			No Fish	No Fish
3-Jun	380	136					7:19:31 - 7:19:59	20:04:16 - 20:15:14		
3-Jun	380	136					19:38:21 - 19:42:33			
3-Jun	380	136					20:01:24 - 20:01:48			
3-Jun	380	139	5:13:23 - 7:10:38	5:19:47 - 7:16:09			0:18:55 - 0:23:07	1:04:56 - 1:14:40		
3-Jun	380	139		15:51:01 - 15:51:11			0:59:15 - 0:59:53	2:22:14 - 4:37:32		
3-Jun	380	139		16:13:13 - 16:16:19			1:00:45 - 1:13:06			
3-Jun	380	139					2:12:03 - 3:03:06			
3-Jun	380	139					3:31:21 - 4:38:24			
3-Jun	420	117	11:10:09 - 11:20:09	11:21:19 - 11:37:30			8:30:14 - 8:32:26	8:31:29 - 8:34:38		
3-Jun	440	109					22:51:18 - 22:59:46	22:49:48 -23:07:38		

Date	Fish #		Receiver 1	Receiver 2	Receiver 3	Receiver 4	Receiver 5	Receiver 6	Receiver 7	Receiver 8
4-Jun									No Fish	No Fish
4-Jun	400	123					16:51:57 - 16:51:59	16:27:00 - 16:27:02		
4-Jun	400	123					16:27:00 - 17:00:09			
4-Jun	400	132			10:53:23 - 10:59:13		5:38:42 - 5:42:06	5:40:32 - 5:42:50		
4-Jun	440	109			9:27:46 - 9:29:48			8:47:03 - 8:52:03		
4-Jun	440	109			9:30:18 - 9:33:06					
4-Jun	440	109			9:34:48 - 9:37:26					
4-Jun	440	109			14:00:04 - 14:00:12					
5-Jun										No Fish
5-Jun	360	102	20:19:35 - 20:19:37	8:12:20 -8:19:20		4:38:01 - 4:39:07	2:09:49 - 2:27:07	1:41:16 - 3:00:04		
5-Jun	360	102	23:04:32 - 23:04:34	9:47:08 -9:50:48		5:26:46 - 5:27:34	2:48:12 - 4:23:10	3:57:39 - 4:26:54		
5-Jun	360	102	23:06:52 - 23:33:05	10:30:17 - 10:30:19		5:56:00 - 6:00:01	5:38:40 - 5:43:10	5:40:30 - 5:42:58		
5-Jun	360	102		11:04:46 - 11:04:48		7:21:54 - 7:43:35	6:18:16 - 6:20:32	6:20:24 - 6:28:27		
5-Jun	360	102		19:04:46 - 23:36:34			7:02:27 - 7:11:42			
5-Jun	360	113				16:59:45 -17:25:19	15:38:39 - 15:39:11	15:36:46 - 16:36:28		
5-Jun	360	113					15:59:15 - 16:00:51	18:44:54 - 18:54:41		
5-Jun	360	113					18:39:55 - 18:43:07	19:23:05 - 19:46:32		
5-Jun	360	113					19:22:08 - 19:50:54	19:55:42 - 21:38:38		
5-Jun	360	113					20:21:01 - 20:38:39			
5-Jun	360	113					21:09:10 - 21:20:56			
5-Jun	400	132	8:52:30 - 8:52:36	8:52:07 - 8:52:19		8:10:11 - 8:12:17				
5-Jun	400	132	12:41:00 - 12:41:04							
5-Jun	420	81				21:25:11 - 21:25:33	16:50:09 - 16:51:09	16:18:34 - 16:49:32		
5-Jun	420	81					17:38:20 - 17:52:34			
5-Jun	420	81					18:01:42 - 18:40:49			
5-Jun	420	81					18:58:35 - 20:32:07			
5-Jun	460	67					13:41:17 - 13:42:57	13:40:35 - 13:46:35		
5-Jun	460	67					15:22:10 - 15:22:12	15:06:20 - 15:24:46		
5-Jun	460	67					16:49:18 - 16:49:20	19:35:20 - 19:59:25		
5-Jun	460	67					16:51:58 - 16:52:10	20:18:41 - 21:31:26		
5-Jun	460	67					19:29:16 - 21:02:55			
5-Jun	460	69					20:52:27 - 20:58:33	20:04:39 - 20:10:43		
6/5 to 6/6	400	132	15:41:03 -6:14:11	12:39:51 - 6:39:04						
6-Jun	360	79					13:02:13 - 13:27:48	14:10:02 - 14:10:38		
6-Jun	360	102	4:55:32 - 5:00:28							
6-Jun	360	102	6:37:32 - 6:55:38							
6-Jun	360	102	7:33:49 - 7:34:11							
6-Jun	420	81	0:07:25 - 7:29:51	7:04:06 - 8:21:25						

Date	Fish #		Receiver 1	Receiver 2	Receiver 3	Receiver 4	Receiver 5	Receiver 6	Receiver 7	Receiver 8
6-Jun	420	81		9:17:44 - 9:48:43						
6-Jun	420	81		10:47:56 - 10:47:58						
6-Jun	420	81		14:59:01 - 15:11:59						
6-Jun	440	109	11:38:51 - 14:59:01	11:14:43 - 14:02:24						
6-Jun	440	134				10:14:57 - 11:14:28	9:47:16 - 9:48:10	9:54:20 - 9:54:44		
6-Jun	440	134					13:01:31 - 13:22:13			
6-Jun	440	134					14:00:22 - 14:00:24			
6/6 to 6/7	440	134								23:59:01 - 0:07:51
6/6 to 6/7	400	132	6:16:39 - 7:43:19	6:39:42 - 9:08:44						
7-Jun									No Fish	No Fish
7-Jun	360	79					14:10:02 - 14:10:38	10:07:14 - 10:09:02		
7-Jun	360	79						14:20:48 - 14:20:56		
7-Jun	420	142					10:29:08 - 10:29:56	10:02:37 - 10:02:39		
7-Jun	420	142					13:51:38 - 14:03:12	13:50:31 - 13:51:57		
7-Jun	420	142						14:32:36 - 14:39:20		
7-Jun	440	134	18:13:50 - 20:34:53	12:00:42 - 12:00:58						
7-Jun	440	134		12:01:14 - 12:03:28						
7-Jun	440	134		13:03:15 - 13:06:35						
7-Jun	440	134		14:09:43 - 14:09:47						
7-Jun	440	134		15:11:44 - 15:20:18						
7-Jun	440	134		16:25:09 - 16:50:44						
7-Jun	440	134		17:27:14 - 17:28:37						
7-Jun	440	134		19:52:11 - 20:02:20						
6/7 to 6/8	400	132	7:43:03 - 8:23:52	8:03:11 - 9:08:44						
8-Jun							No Fish	No Fish	No Fish	No Fish
8-Jun	400	132	8:46:20 - 10:43:39	9:14:44 - 19:37:20						
8-Jun	440	134		5:07:11 - 5:07:15						
9-Jun					No Fish		No Fish	No Fish	No Fish	No Fish
9-Jun	400	132		1:30:54 - 1:58:49						
10-Jun										
10-Jun			No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	
10-Jun	400	125								12:15:56-12:17:08
11-Jun										
11-Jun			No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish
12-Jun										
12-Jun			No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish
13-Jun										
13-Jun	440	103	No Fish	No Fish	9:05:13 - 9:15:23	5:27:45 - 5:44:09	2:11:04 - 2:11:08	3:30:05 - 3:30:11	No Fish	No Fish

Date	Fish #		Receiver 1	Receiver 2	Receiver 3	Receiver 4	Receiver 5	Receiver 6	Receiver 7	Receiver 8
13-Jun	440	103				6:04:30 - 6:04:56	2:12:16 - 2:12:18	4:52:01 - 4:52:13		
13-Jun	440	103				7:13:58 - 7:14:02	3:29:29 - 3:53:23			
13-Jun	440	103				8:13:41 - 8:17:25	4:50:31 - 4:52:55			
13-Jun	440	103				8:24:11 - 8:51:15	6:32:42 - 6:32:56			
14-Jun			No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish
15-Jun			No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish
16-Jun			No Fish	No Fish	No Fish	No Fish	No Fish	ND	No Fish	ND
18-Jun			No Fish	No Fish	ND	No Fish	No Fish	No Fish	No Fish	No Fish
19-Jun			No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish
20-Jun			No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish
21-Jun			No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish
22-Jun			No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish
23-Jun			No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish
24-Jun			No Fish	No Fish	No Fish	ND	No Fish	No Fish	No Fish	No Fish
26-Jun			No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish
28-Jun			No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish
29-Jun			No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish
30-Jun			No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish
Jun-31			No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish
1-Jul			No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish
2-Jul			No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish
3-Jul			No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish
6-Jul			No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish
7-Jul			No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish
8-Jul			No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish
9-Jul			No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish	No Fish

Table 10. Summary by date of the total kilowatts, average pond elevation, flow (river flow, Waterford Flight flow, Dam A spillage and weir flow, Dam A spillage & weir plus Waterford Flight flows), the proportion of flow (Dam A spillage & weir plus Waterford Flight flows Vs flow spilled at Dam B & passed by the turbines and gates) and the number of daily lockages at Lock 6 during the full-scale telemetry study conducted at the Crescent Hydroelectric Project in 2009.

			Flow (CFS)					Proportion of flow		# of Daily Lockages
Date	*Total (kw)*	*Average PONDELEV*	*River*	*Waterford Flight*	*Calc river flow + Waterford Flight*	*Dam A spillage + weir*	*Dam A spillage + weir + Waterford Flight*	*Dam A spillage & weir + Waterford Flight*	Dam B + turbines + gates	Erie Canal Lock 6
29-May	11,995	185.2	6,183	45	6,228	563	608	0.098	0.902	5
30-May	12,494	185.1	6,467	45	6,512	604	649	0.100	0.900	5
31-May	10,519	185.2	5,176	54	5,231	401	455	0.087	0.913	6
1-Jun	4,879	185.0	3,028	117	3,146	664	781	0.248	0.752	13
2-Jun	3,997	184.9	3,773	63	3,836	1,313	1,376	0.359	0.641	7
3-Jun	4,874	184.9	3,086	63	3,149	756	819	0.260	0.740	7
4-Jun	2,324	184.9	2,176	81	2,257	833	914	0.405	0.595	9
5-Jun	3,195	184.8	1,408	54	1,462	248	302	0.206	0.794	6
6-Jun	1,229	185.0	630	90	720	232	323	0.448	0.552	10
7-Jun	4,074	184.8	2,013	81	2,094	211	292	0.140	0.860	9
8-Jun	1,506	184.8	796	117	914	211	328	0.359	0.641	13
9-Jun	4,911	184.9	2,413	63	2,476	216	279	0.113	0.887	7
10-Jun	3,415	184.8	1,557	72	1,629	220	292	0.179	0.821	8
11-Jun	2,253	184.8	1,194	90	1,284	212	303	0.236	0.764	10
12-Jun	5,635	184.9	2,895	99	2,994	242	341	0.114	0.886	11

13-Jun	9,610	185.0	4,624	99	4,723	234	333	0.071	0.929	11
14-Jun	9,608	185.1	4,610	63	4,673	270	333	0.071	0.929	7
15-Jun	8,456	184.9	4,191	126	4,318	232	358	0.083	0.917	14
16-Jun	7,598	184.9	3,568	63	3,631	222	285	0.078	0.922	7
17-Jun	5,001	184.7	2,331	54	2,385	222	276	0.116	0.884	6
18-Jun	8,030	186.1	4,570	45	4,616	613	658	0.142	0.858	5
19-Jun	12,321	186.6	14,847	108	14,955	3,945	4,053	0.271	0.729	12
20-Jun	12,162	186.0	12,930	54	12,984	4,839	4,893	0.377	0.623	6
21-Jun	11,978	186.3	9,408	54	9,462	2,737	2,792	0.295	0.705	6
22-Jun	12,226	185.4	11,778	72	11,850	4,108	4,180	0.353	0.647	8
23-Jun	11,806	184.9	6,305	54	6,360	708	762	0.120	0.880	6
24-Jun	10,054	184.8	4,706	72	4,778	239	311	0.065	0.935	8
25-Jun	7,177	184.9	3,605	81	3,687	247	328	0.089	0.911	9
26-Jun	8,364	184.8	3,979	72	4,052	241	313	0.077	0.923	8
27-Jun	8,757	184.9	4,261	54	4,315	242	296	0.069	0.931	6
28-Jun	10,741	184.9	5,189	90	5,279	215	305	0.058	0.942	10
29-Jun	8,150	184.9	3,909	45	3,955	223	268	0.068	0.932	5
30-Jun	6,776	185.4	3,530	54	3,584	434	488	0.136	0.864	6
1-Jul	10,824	185.1	5,539	81	5,620	550	631	0.112	0.888	9
2-Jul	11,410	185.2	5,624	63	5,687	403	466	0.082	0.918	7
3-Jul	11,640	185.5	6,488	108	6,596	941	1,049	0.159	0.841	12
4-Jul	11,303	184.9	5,740	108	5,848	550	659	0.113	0.887	12
5-Jul	7,538	184.9	3,568	126	3,694	221	348	0.094	0.906	14
6-Jul	6,800	184.9	3,183	90	3,273	232	322	0.099	0.901	10
7-Jul	5,067	184.9	2,349	45	2,394	214	260	0.108	0.892	5
8-Jul	8,342	185.0	4,059	108	4,168	265	373	0.089	0.911	12
9-Jul	7,145	184.9	3,306	72	3,378	224	297	0.088	0.912	8

Table 11. Summary of radio tagged blueback herring detected during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project in 2009.

Frequency	149.360	149.380	149.400	149.420	149.440	149.460	
Release Group 1	102	114	121	114	103	101	
	108	120	125		105		
	117		129		107		
					109		
					117		
Release Group 2	134		132	138	134		
	135		134	142	144		
	136		136				
			140				
Release Group 3	69	67	69	70	70	69	
	79		91	83	75		
				84	95		
Number of Fish	8	3	9	6	10	2	**38**

Table 12. Summary by date, waypoint and time when radio tagged blueback herring detected during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project in 2009.

Date	Frequency	Code	Waypoint	Time	Notes & Comments
5/29/09					release site to dam; 1330 to 1600 hrs
5/29/09				1500	Nothing at Dam A /canal
5/29/09				1530	no fish below deterrent System
5/29/09	149.440	105	3	1420	
5/29/09	149.460	101	3	1420	
5/29/09	149.420	114		1353	
5/29/09	149.360	108		1430	
5/29/09	149.440	103		1341	
5/29/09	149.420	114		1415	
5/30/09					checked RTE 9 to dam; 1100 to 1500 hrs
5/30/09				1120	No fish below deterrent system
5/30/09				1346	No fish below deterrent system
5/30/09	149.420	114	4	1119	
5/30/09	149.380	120	5	1144	
5/30/09	149.440	105		1300	
5/30/09	149.440	107		1330	
5/30/09	149.400	121		1338	
5/31/09					checked RTE 9 to dam; 1030 to 1430 hrs
5/31/09	149.380	114	5	1040	no fish below deterrent system
5/31/09	149.380	120	6	1140 & 1245	
5/31/09	149.440	117	7	1217	
5/31/09	149.360	117	8	1236	
6/1/09					checked RTE 9 to dam; 1130 to 1600
6/1/09				1222	no fish below deterrent system
6/1/09	149.440	117	9	1249	
6/1/09	149.440	109	10	1311	
6/1/09	149.400	125	11	1350	
6/1/09	149.400	121	12	1350	
6/1/09	149.400	121	113	1409	
6/1/09	149.380	114		1150	
6/1/09	149.400	121		1155	
6/1/09	149.380	114		1357	

Date	Frequency	Code	Waypoint	Time	Notes & Comments
6/2/09					checked Rte 9 to Dam; 1230 to 1600
6/2/09				1545	No fish below deterrent system
6/2/09				1515	No fish Dam A & canal
6/2/09	149.400	140		1303	
6/2/09	149.400	129		1306	
6/2/09	149.400	136		1325	
6/2/09	149.440	117		1335	
6/2/09	149.400	125	13	1346	
6/2/09	149.440	144		1351	
6/2/09	149.420	142	14	1411	
6/2/09	149.400	132	15	1452	
6/2/09	149.440	144	10	1418	
6/3/09					checked Vischer Ferry 1015 to 1045 - no detections powerhouse, dam wall and lock; mobile tracking 1000 to 1530 hrs
6/3/09	149.360	134	17	1100	
6/3/09	149.400	134	26	1215	
6/3/09	149.360	135	29	1242	
6/3/09	149.360	102		1307	
6/3/09	149.360	136	32	1313	
6/3/09	149.400	129	36	1331	
6/3/09	149.420	142	37	1336	
6/3/09	149.420	132	38	1338	
6/4/09					checked Rte 9 to Dam 1150 to 1500
6/4/09	149.400	136	39	1349	
6/4/09	149.420	138	40	1425	
6/4/09	149.440	117	41	1453	
6/4/09				1252	No fish below deterrent system
6/5/09					checked Rte 9 to Dam 1150 to 1500 1100 to 1330
6/5/09					No fish dam B , Police Helicopter caused lots of interference, hard to track. No fish detected
6/6/09					checked Rte 9 to Dam 1100 to 1500
6/6/09	149.360	69	42	744	
6/6/09	149.380	67	43	801	
6/6/09	149.420	83	45	826	
6/6/09	149.460	69	53	942	
6/6/09	149.400	91	46	844	
6/6/09	149.400	136	47	847	
6/6/09	149.400	69	48	855	

Date	Frequency	Code	Waypoint	Time	Notes & Comments
6/6/09	149.420	70	49	902	
6/6/09	149.420	84	50	905	
6/6/09	149.440	134	51	923	
6/6/09	149.440	95	52	927	
6/7/09					No mobile tracking - day off
6/8/09					checked Rte 9 to Dam; 1100 to 1500
6/8/09	149.420	83	55	1101	
6/8/09	149.360	69	56	1619	
6/8/09	149.360	79	57	1622	
6/8/09	149.400	69	58	1705	
6/8/09	149.420	83	60	1734	
6/8/09	149.420	70	61	1744	
6/9/09					Tracked upstream at Vischer Ferry; no fish at Dam, lock or powerhouse; mobile tracking 1200 - 1600
6/9/09	149.400	69	58	1500	
6/9/09	149.420	83	63	1540	
6/10/09					checked Rte 9 to Dam; 900 to 1230
6/10/09	149.420	83	64	935	
6/10/09	149.420	70		1015	
6/10/09	149.400	91	65	1036	
6/10/09	149.400	69		1039	
6/10/09	149.360	79	66	1047	
6/10/09	149.360	69		1050	
6/11/09					checked Rte 9 to Dam; 0930 to 1230
6/11/09	149.400	69	56	1044	
6/11/09	149.400	91	47	1040	
6/11/09	149.360	79	66	1049	
6/11/09	149.440	70	70	1143	
6/11/09	149.420	83	69	959	
6/12/09					checked Release location to Dam; 0900 to 1100
6/12/09	149.420	83	73	924	
6/12/09	149.400	69	74	1014	
6/13/09					No Mobile tracking
6/14/09					No Mobile tracking

Date	Frequency	Code	Waypoint	Time	Notes & Comments
6/15/09					checked Rte 9 to Dam; 1000 to 1500
6/15/09	149.440	70	75	1212	
6/15/09	149.400	91	77	1230	
6/15/09	149.400	69	56	1236	
6/15/09	149.440	75	78	1346	
6/16/09					checked Rte 9 to Dam; 0900 to 1300
6/16/09	149.420	83	79	912	
6/16/09	149.440	75	80	935	
6/16/09	149.400	91	81	1020	
6/17/09					checked Rte 9 to Dam; 0900 to 1300
6/17/09	149.420	83	85	1115	
6/17/09	149.440	75		1058	
6/17/09	149.400	91	82	1000	
6/18/09					checked Rte 9 to Dam; 0700 to 1200
6/18/09	149.420	83	85	1005	
6/19/09					Checked Rte 87 to dam; 1300 to 1630
6/19/09	149.420	83	85	1430	
6/19/09	149.440	75		1415	
6/20/09					checked Rte 9 to Dam 1000 to 1400; no fish located
6/21/09					checked Rte 9 to Dam 1230 to 1530; no fish located
6/22/09					checked Rte 9 to Dam; 1000 to 1300
6/22/09	149.420	83	85	1030	
6/23/09					
6/23/09	149.420	83	85	1006	checked Rte 9 to Dam; 0935 to 1230
6/24/09					Checked Rte 9 to dam 1000 to 1500
6/24/09	149.420	83	85	1430	
6/24/09	149.440	70	39	1330	
6/25/09					checked release location to Dam; 1000 to 1300
6/25/09	149.440	70	107	1233	
6/25/09	149.420	83	85	1050	

Date	Frequency	Code	Waypoint	Time	Notes & Comments
6/26/09					checked Rte 9 to Dam; 0930 to 1230
6/26/09	149.420	83	85	1015	
6/27/09					No Mobile tracking
6/28/09					No Mobile tracking
6/29/09					checked Rte 9 to Dam 1000 to 1200, forced off river by Thunderstorm
6/29/09	149.420	83	85	1032	
6/30/09					checked Rte 9 to Dam; 0930 to 1300
6/30/09	149.420	83	85	1013	
7/1/09					checked Rte 9 to Dam; 0930 to 1200
7/1/09	149.420	83	85	959	
7/2/09					checked Rte 9 to Dam; 1000 to 1330
7/2/09	149.420	83	85	1224	
7/3/09					No Mobile tracking
7/4/09					No Mobile tracking
7/5/09					No Mobile tracking
7/6/09					checked Rte 9 to Dam; 1100 to 1300
7/6/09	149.420	83	85	1215	
7/7/09					checked Rte 9 to Dam; 1300 to 1600
7/7/09	149.420	83	85	1215	
7/8/09					no mobile tracking due to weather (Thunderstorms)
7/9/09					checked Rte 9 to Dam 930 to 1200 NOTE: 149.420 code 83 not audible (gain at 88)

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Figure 3. Location of Dam A, Dam B, and the powerhouse of the Crescent Hydroelectric Project and Lock 6 of the Waterford Flight.

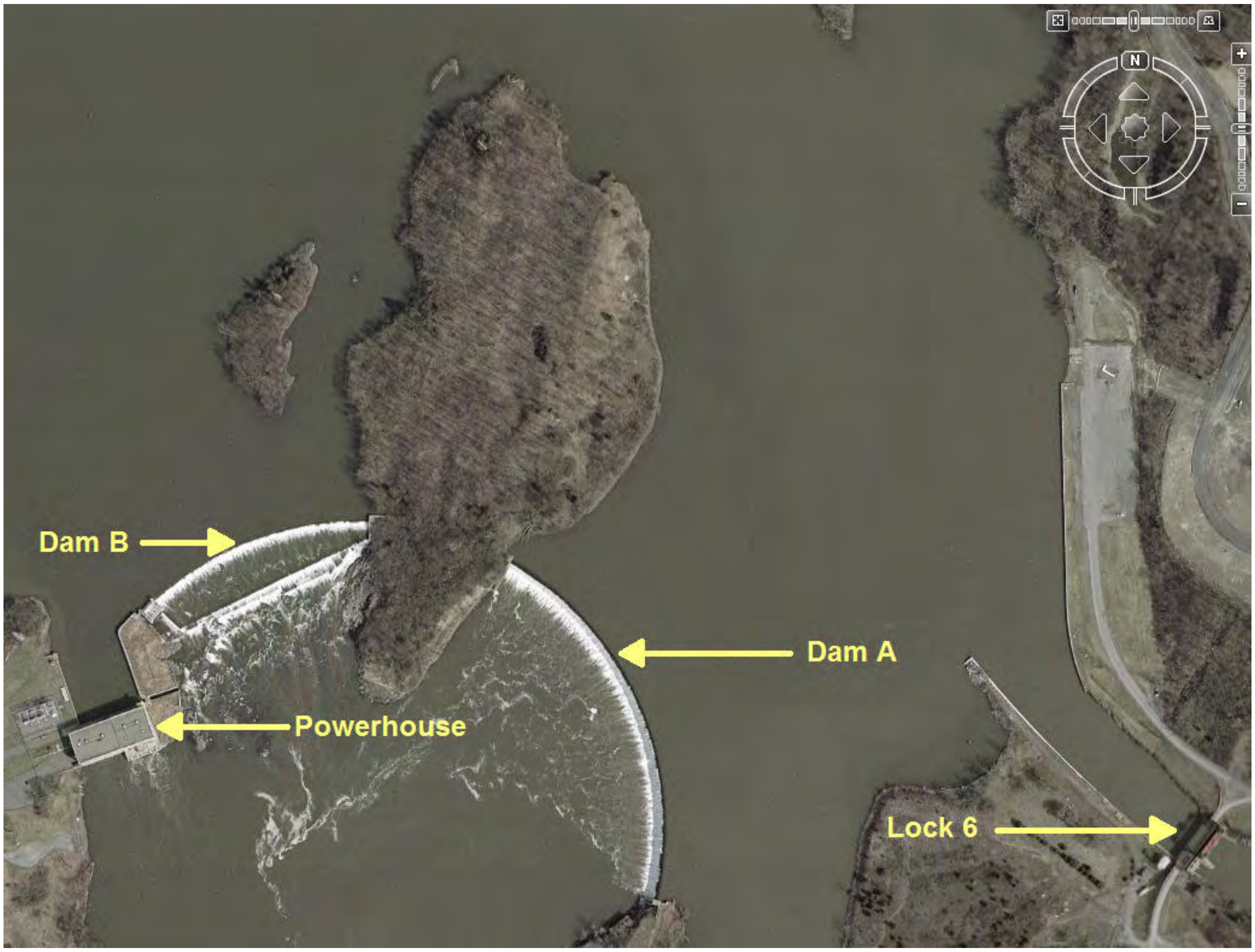


Figure 4. Eight fixed-location telemetry sites used during the full-scale study at the Crescent Hydroelectric Project in 2009.

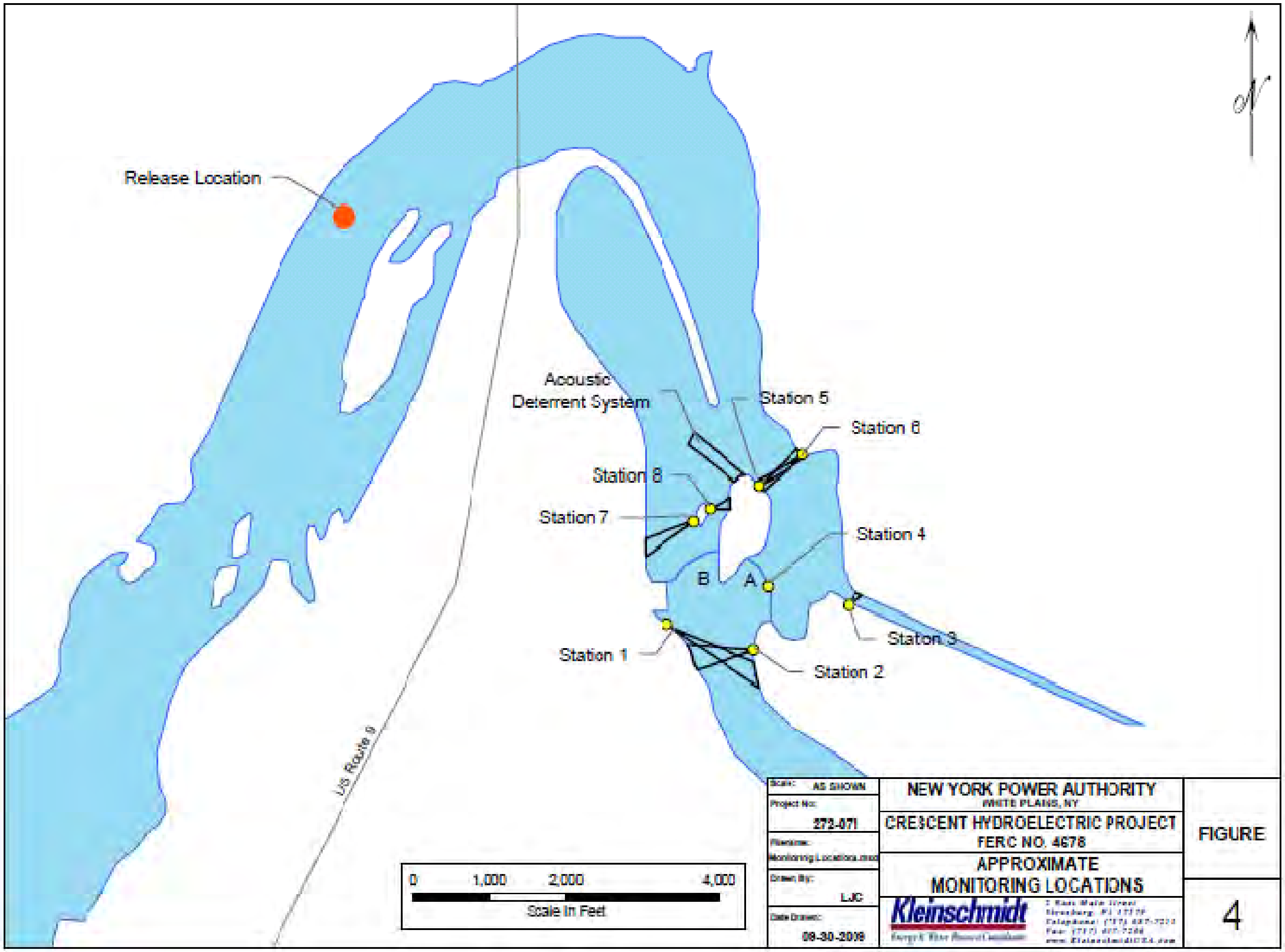


Figure 5. Location between the Crescent Hydroelectric Project and the Vischer Ferry Hydroelectric Project where mobile telemetry was done during the 2009 full-scale study.

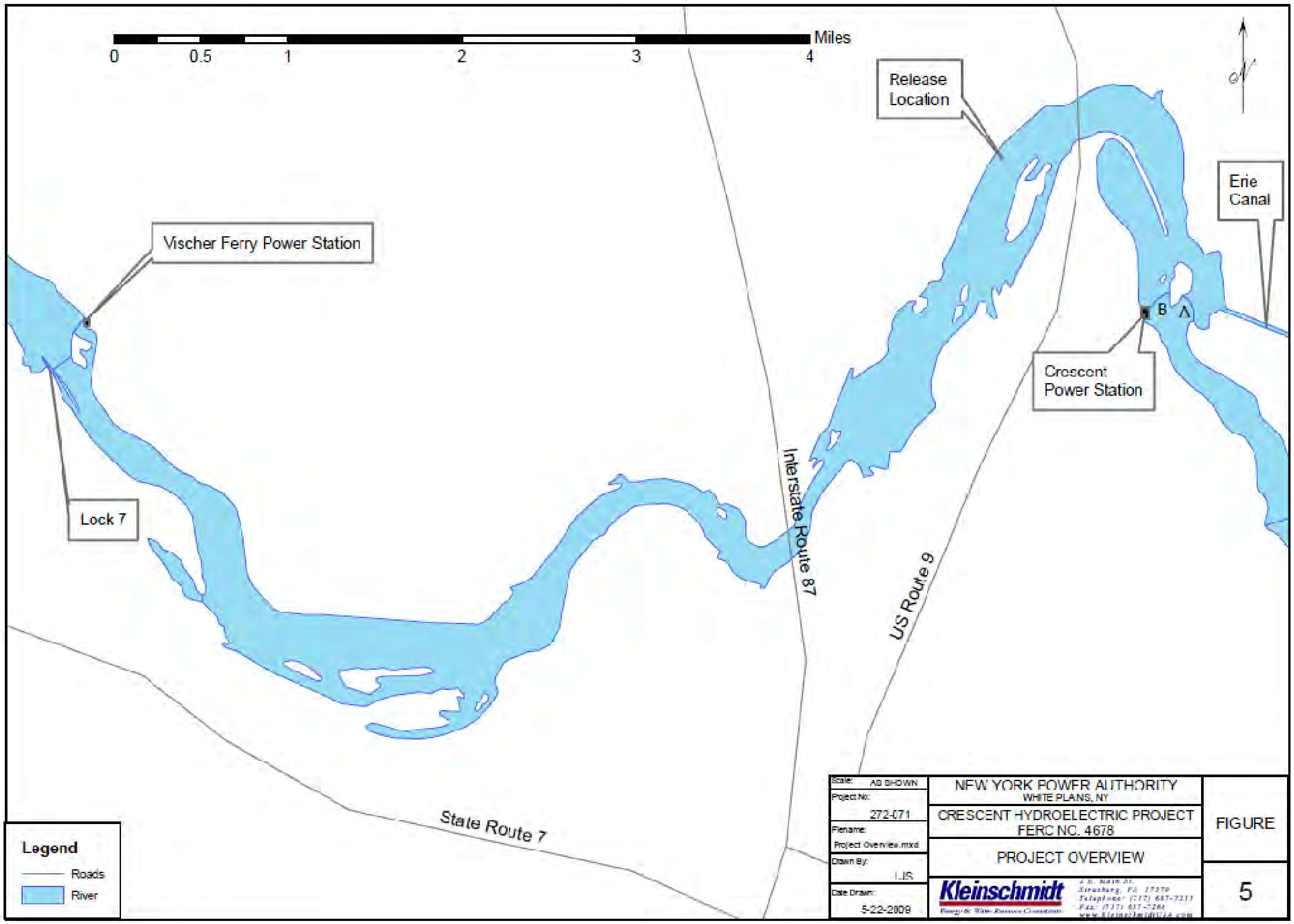


Figure 6. **Location where radio tagged blueback herring were detected on May 29, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.**

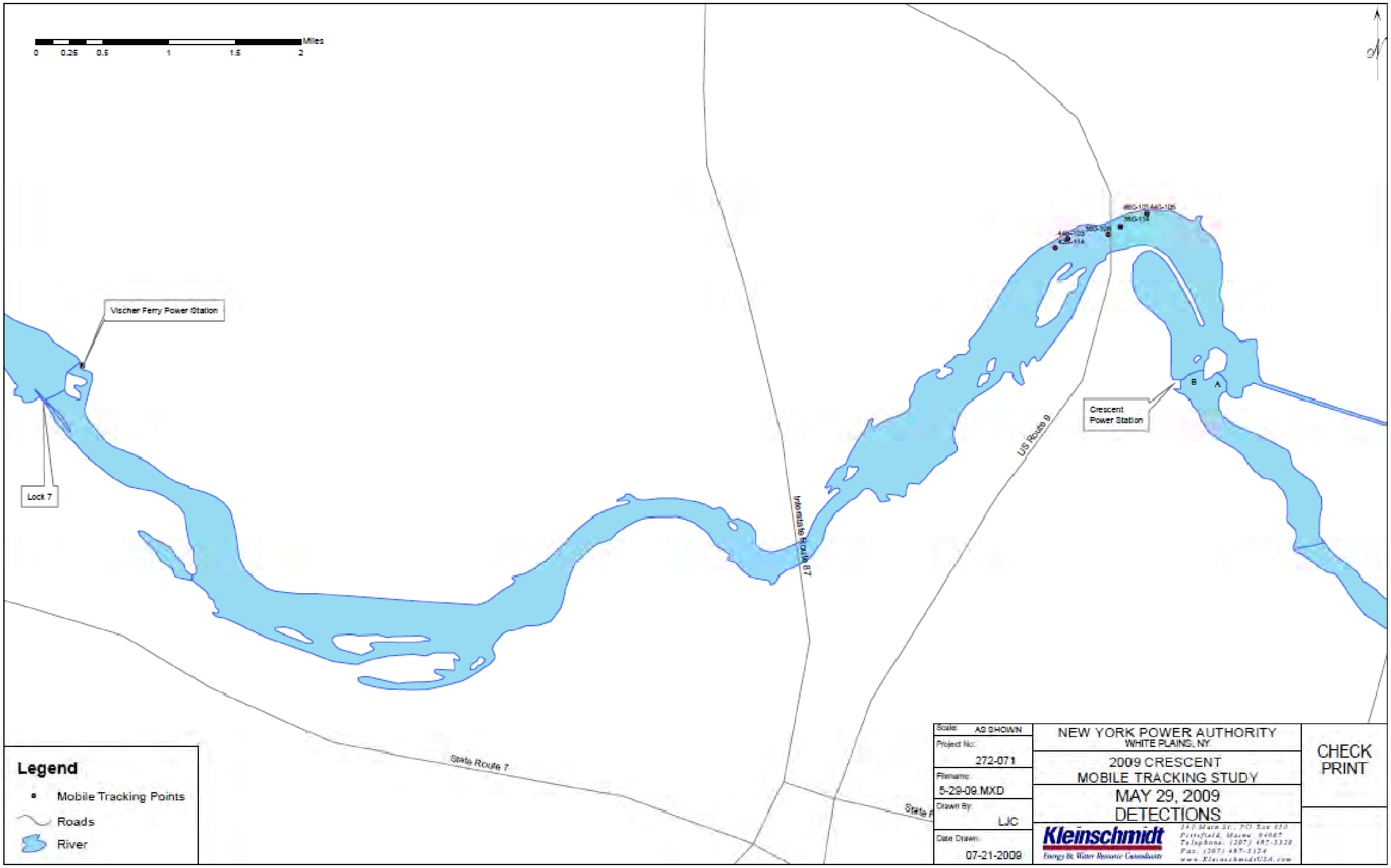


Figure 7. Location where radio tagged blueback herring were detected on May 30, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.

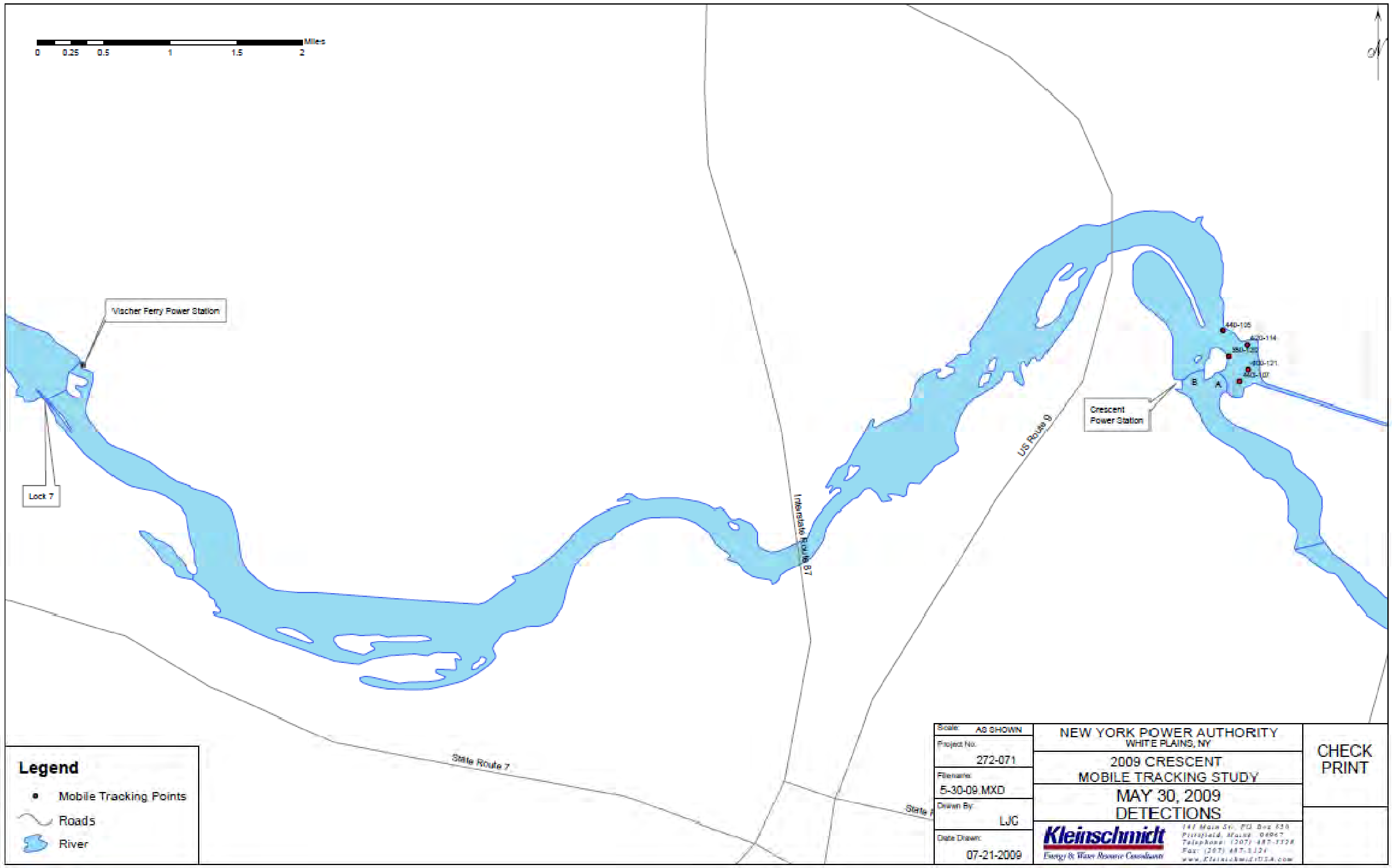


Figure 8. Location where radio tagged blueback herring were detected on May 31, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.

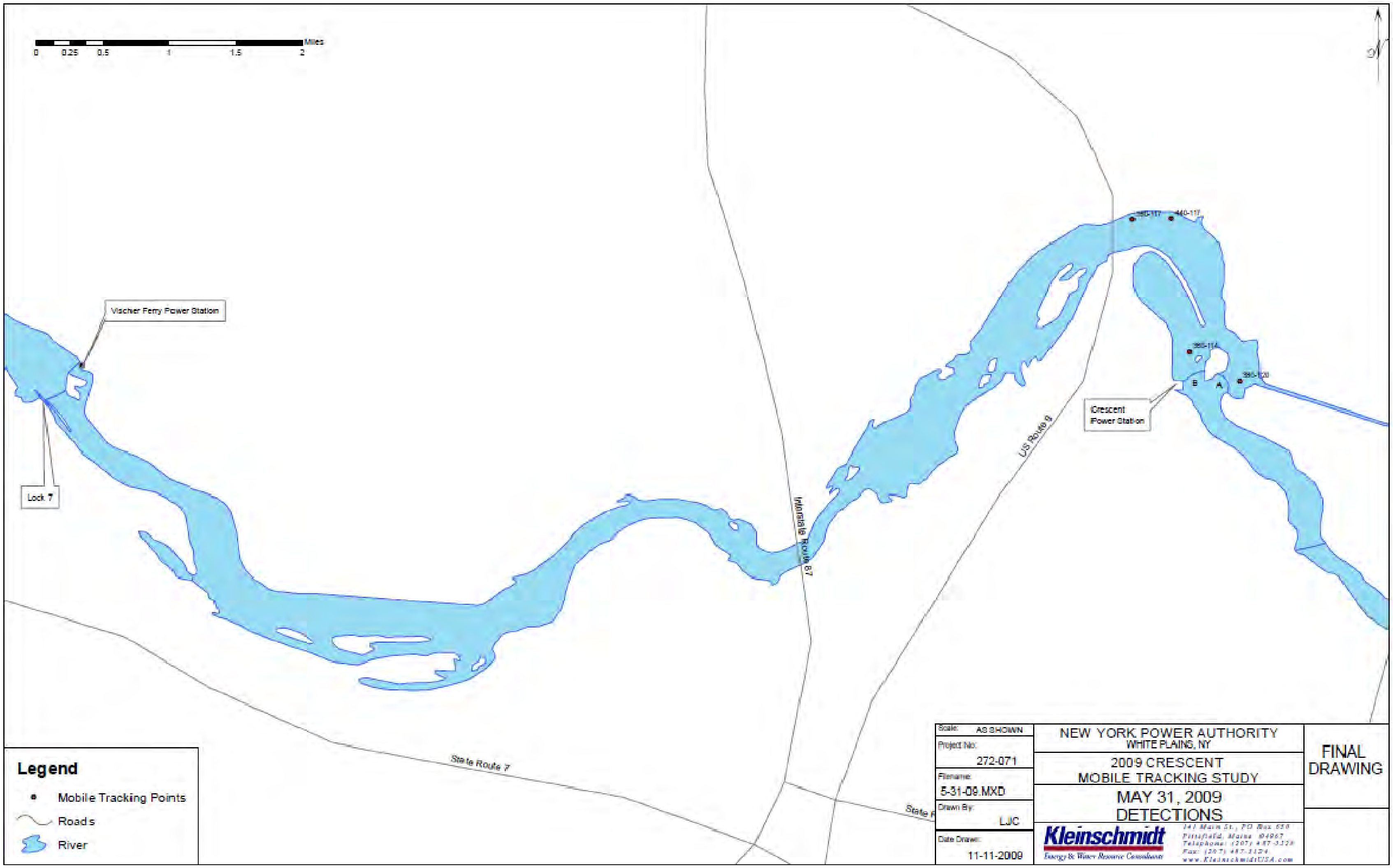


Figure 9. Location where radio tagged blueback herring were detected on June 1, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.

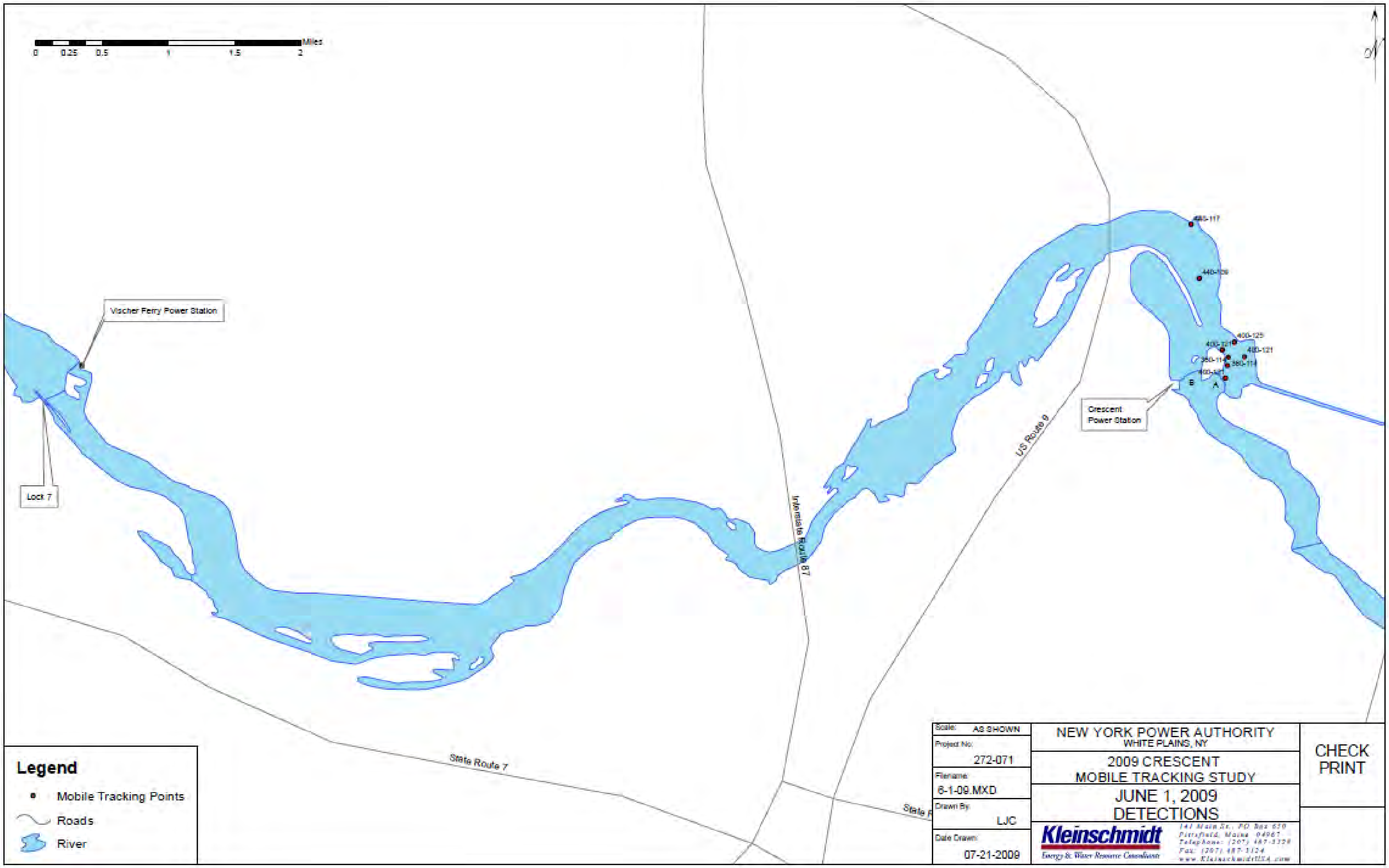


Figure 10. Location where radio tagged blueback herring were detected on June 2, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.

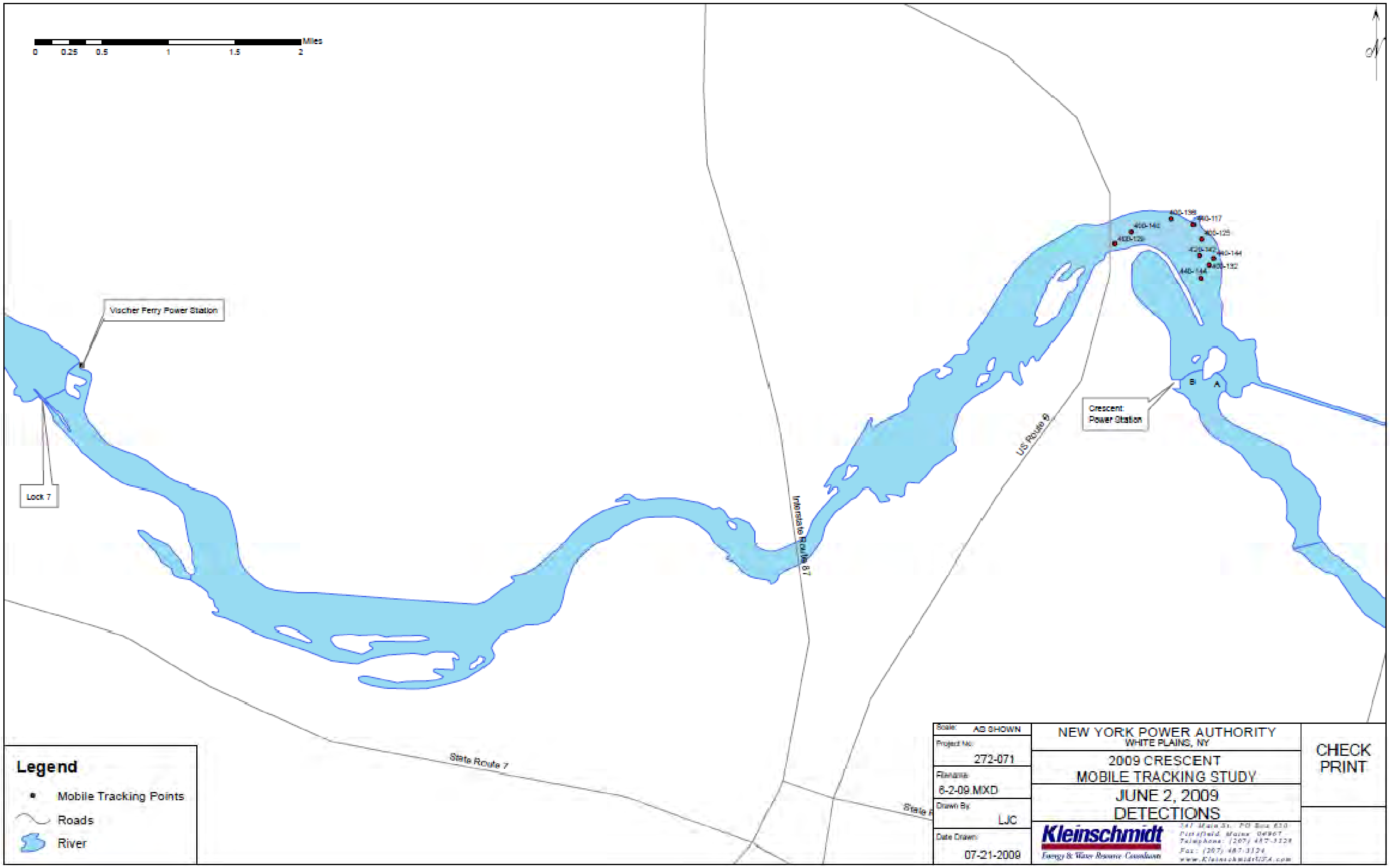


Figure 11. Location where radio tagged blueback herring were detected on June 3, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.

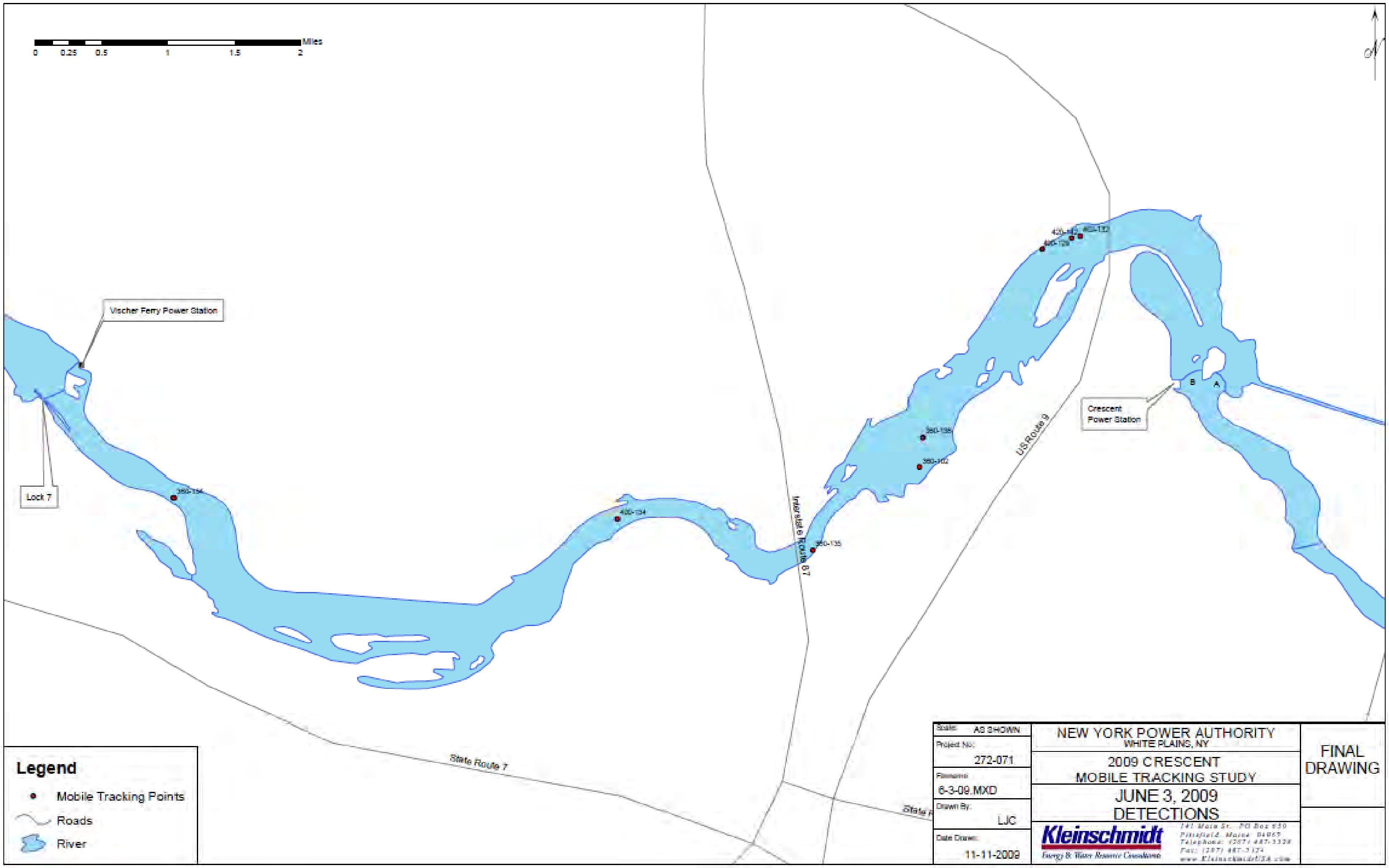
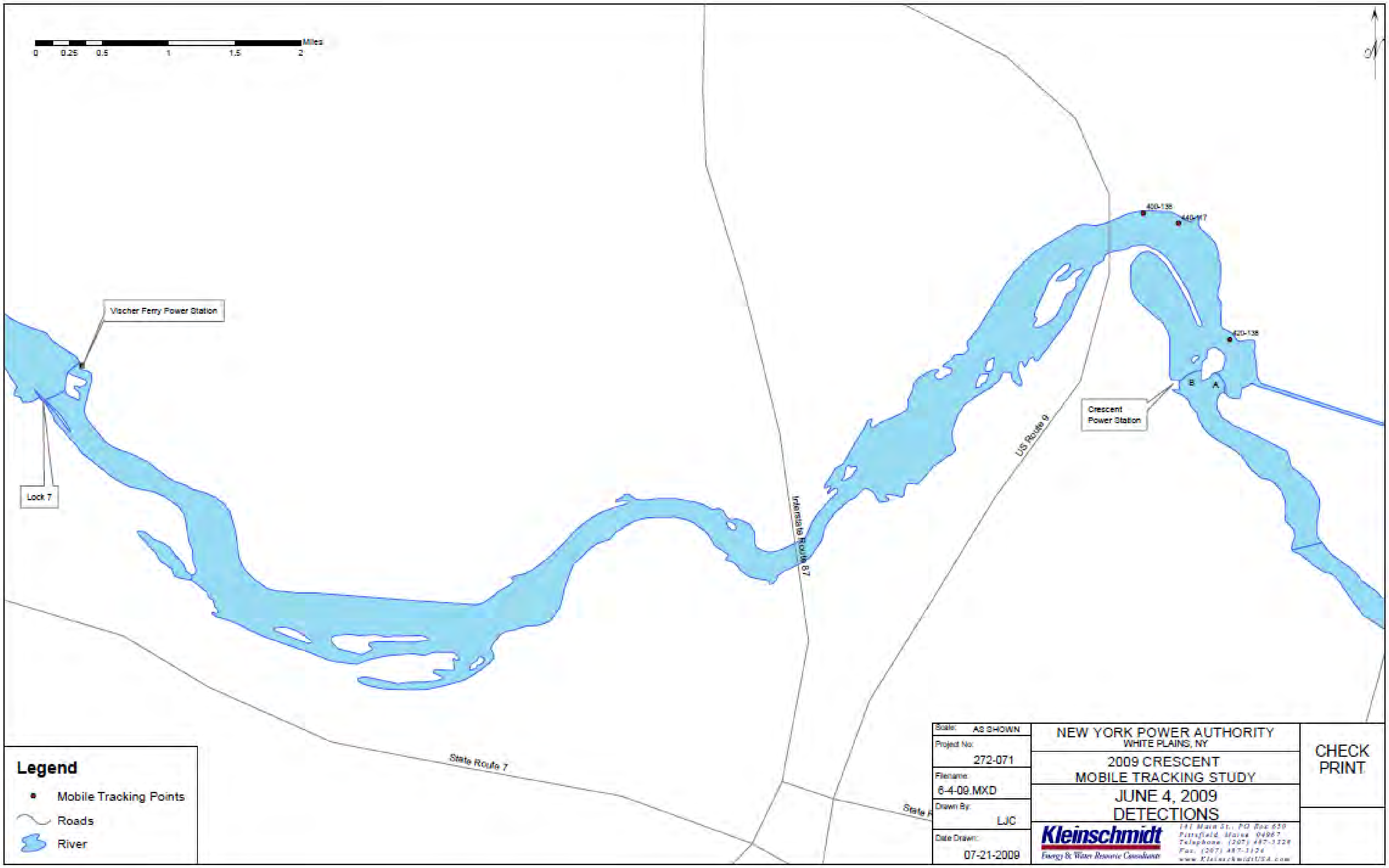


Figure 12. Location where radio tagged blueback herring were detected on June 4, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.



12/9/09

Figure 13. Location where radio tagged blueback herring were detected on June 6, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.

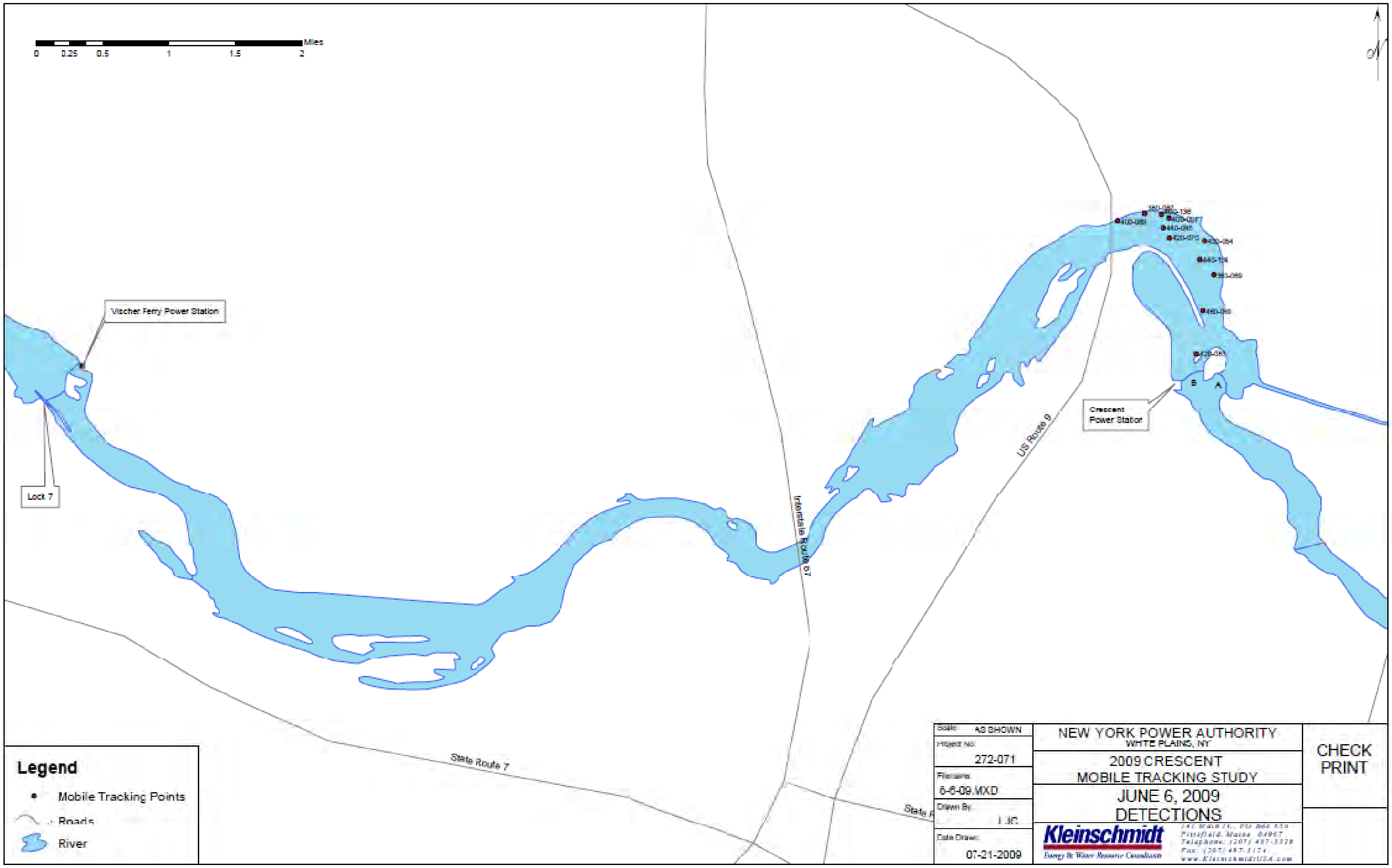


Figure 14. Location where radio tagged blueback herring were detected on June 8, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.

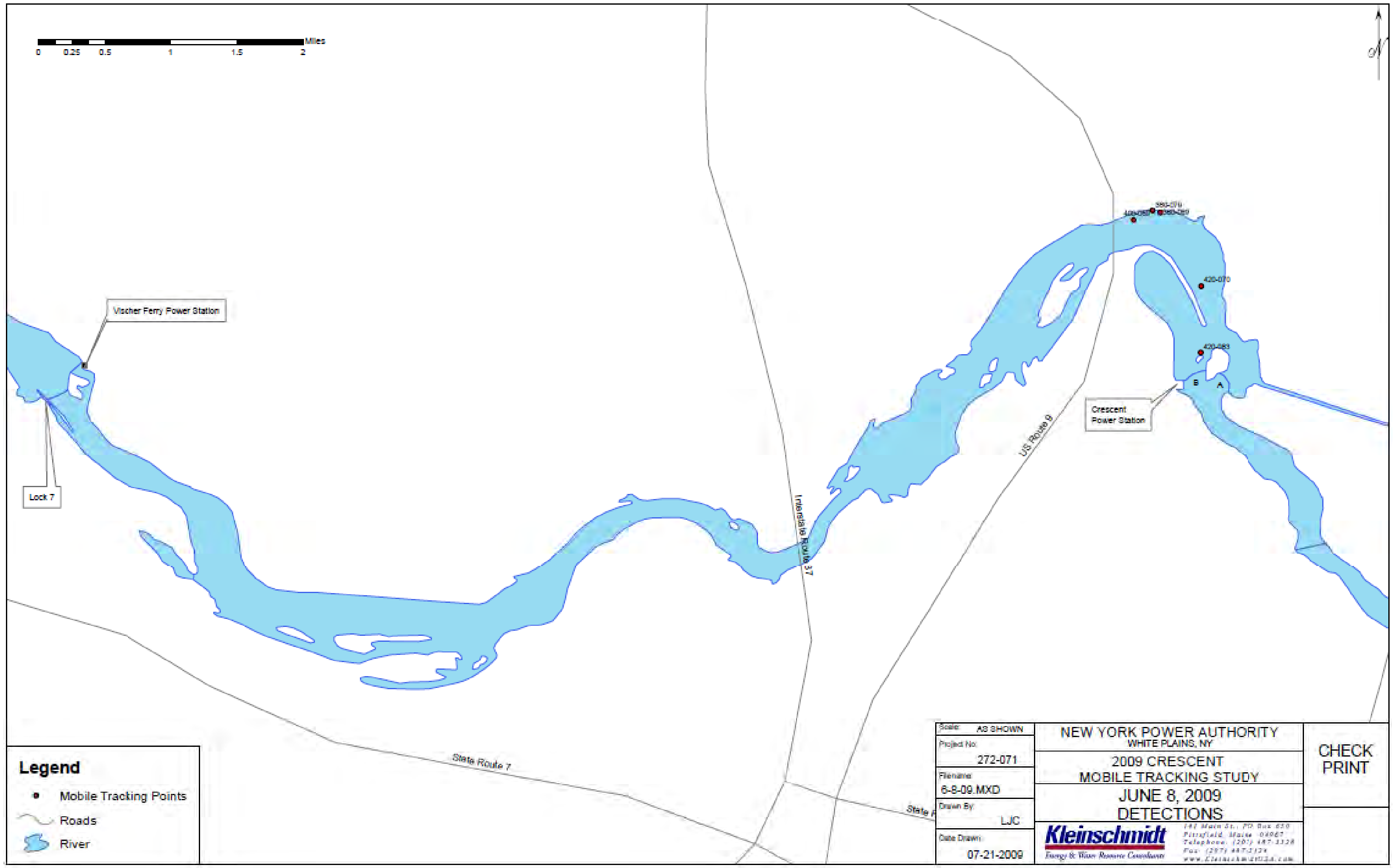


Figure 15. Location where radio tagged blueback herring were detected on June 9, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.

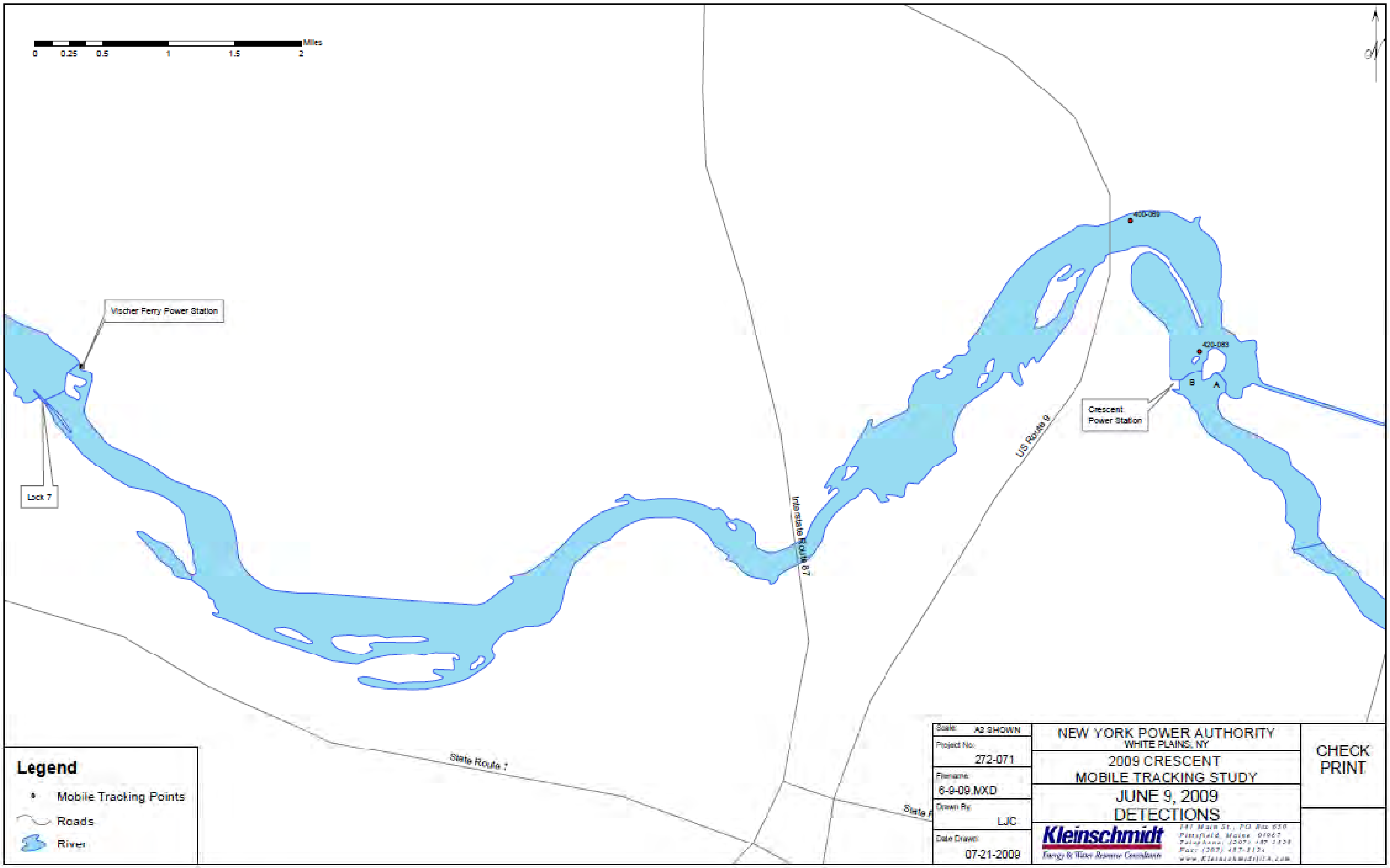


Figure 16. Location where radio tagged blueback herring were detected on June 10, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.

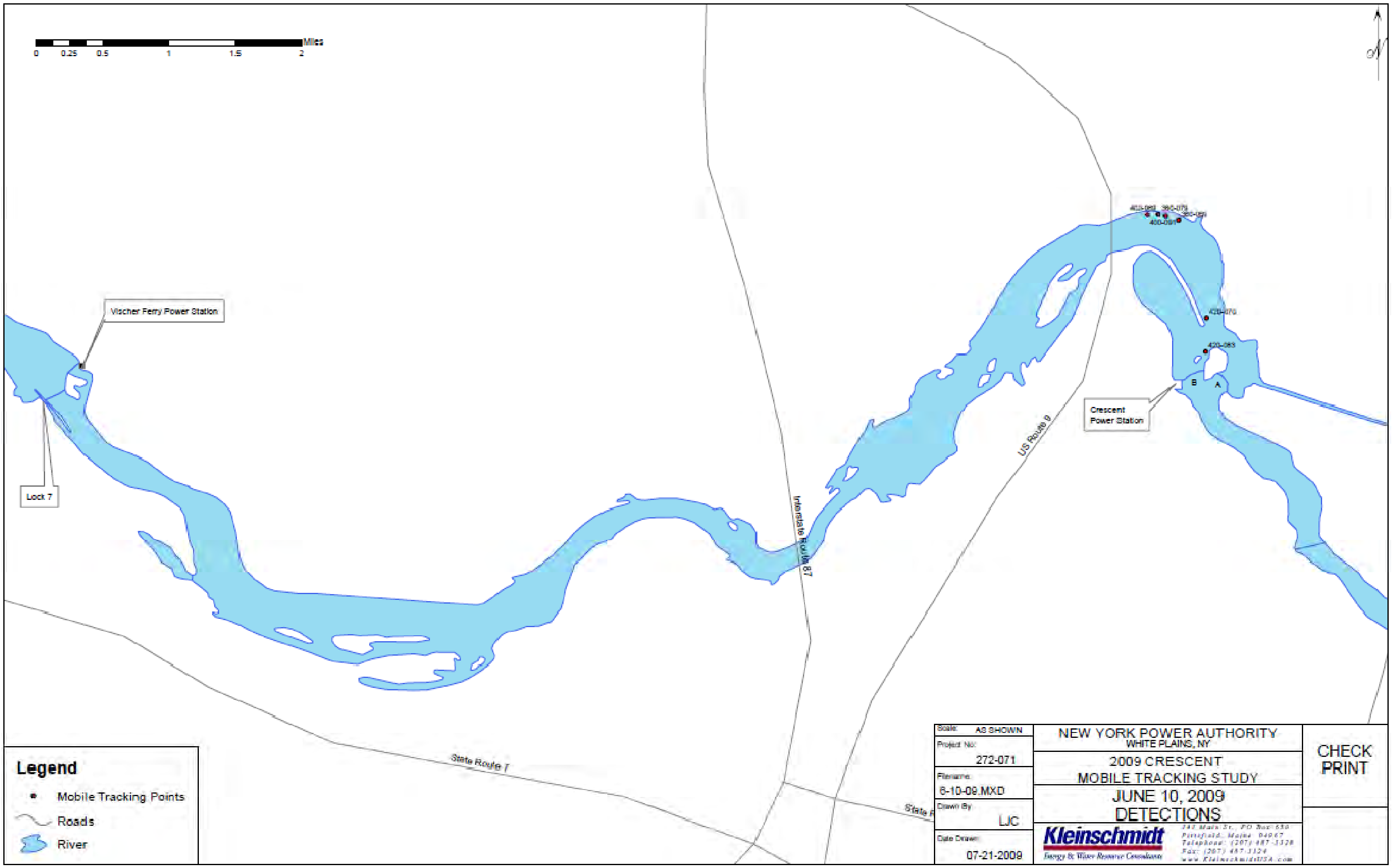


Figure 17. Location where radio tagged blueback herring were detected on June 11, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.

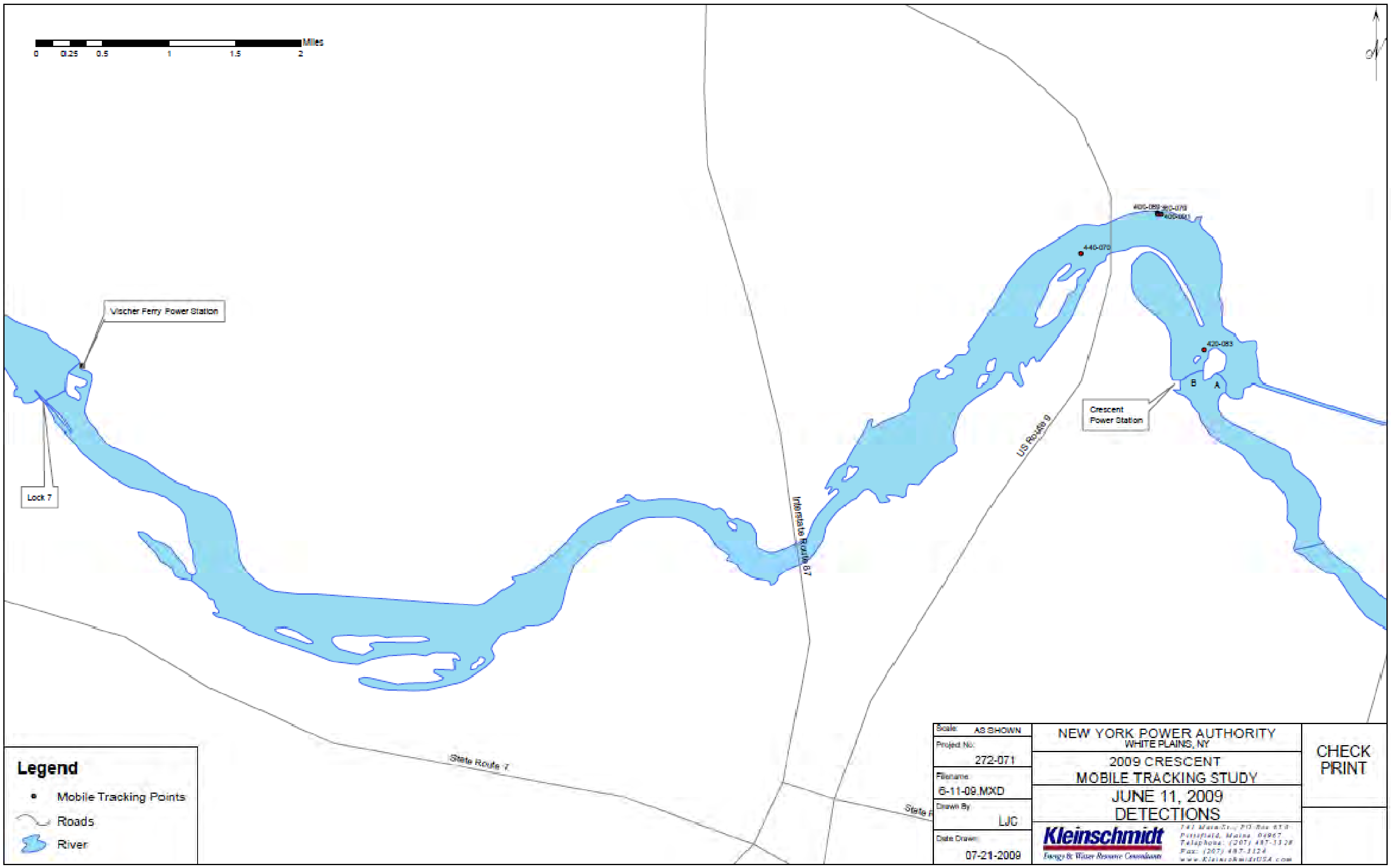


Figure 18. Location where radio tagged blueback herring were detected on June 12, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.

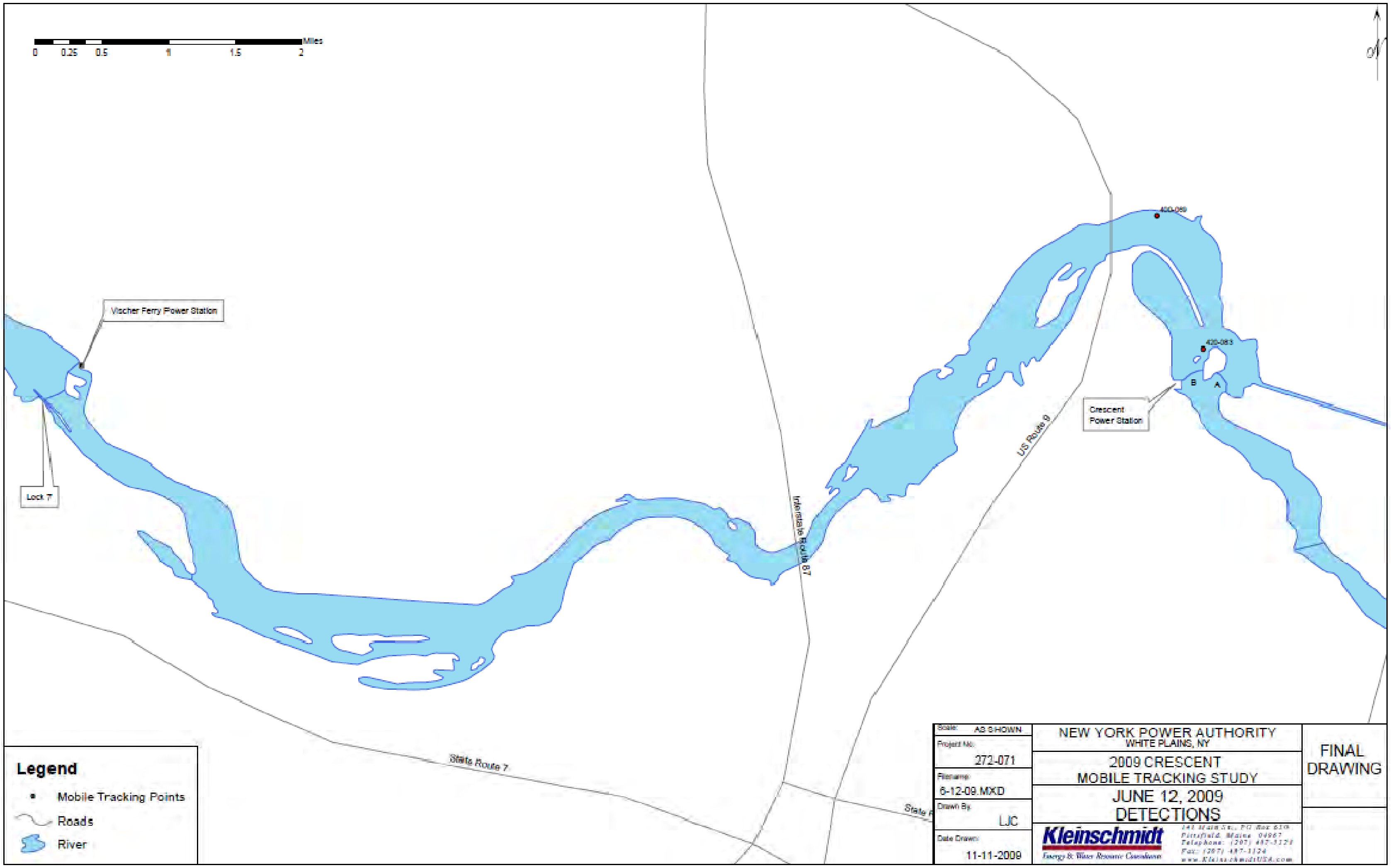


Figure 19. Location where radio tagged blueback herring were detected on June 15, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.

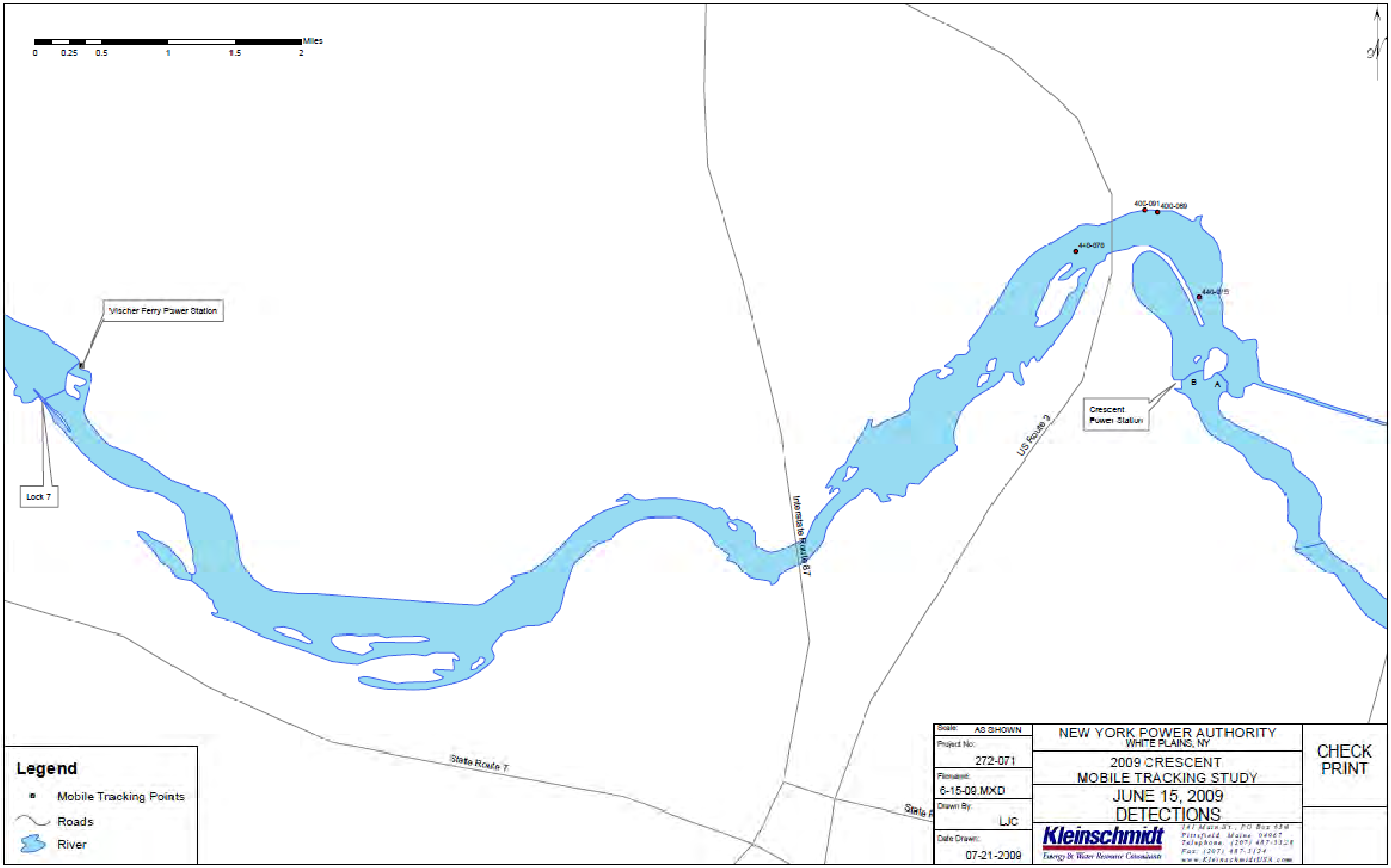


Figure 20. Location where radio tagged blueback herring were detected on June 16, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.

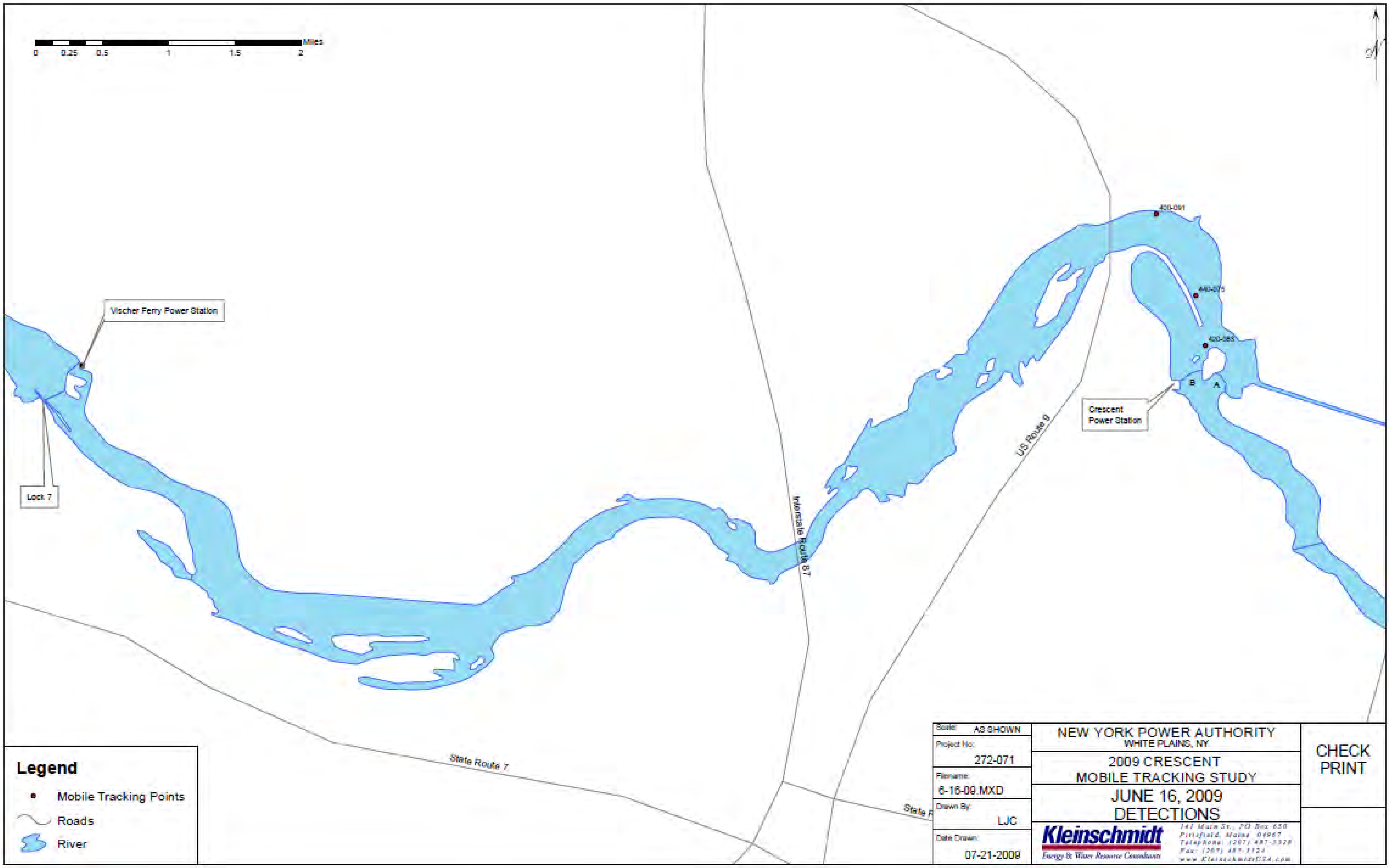


Figure 21. Location where radio tagged blueback herring were detected on June 17, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.

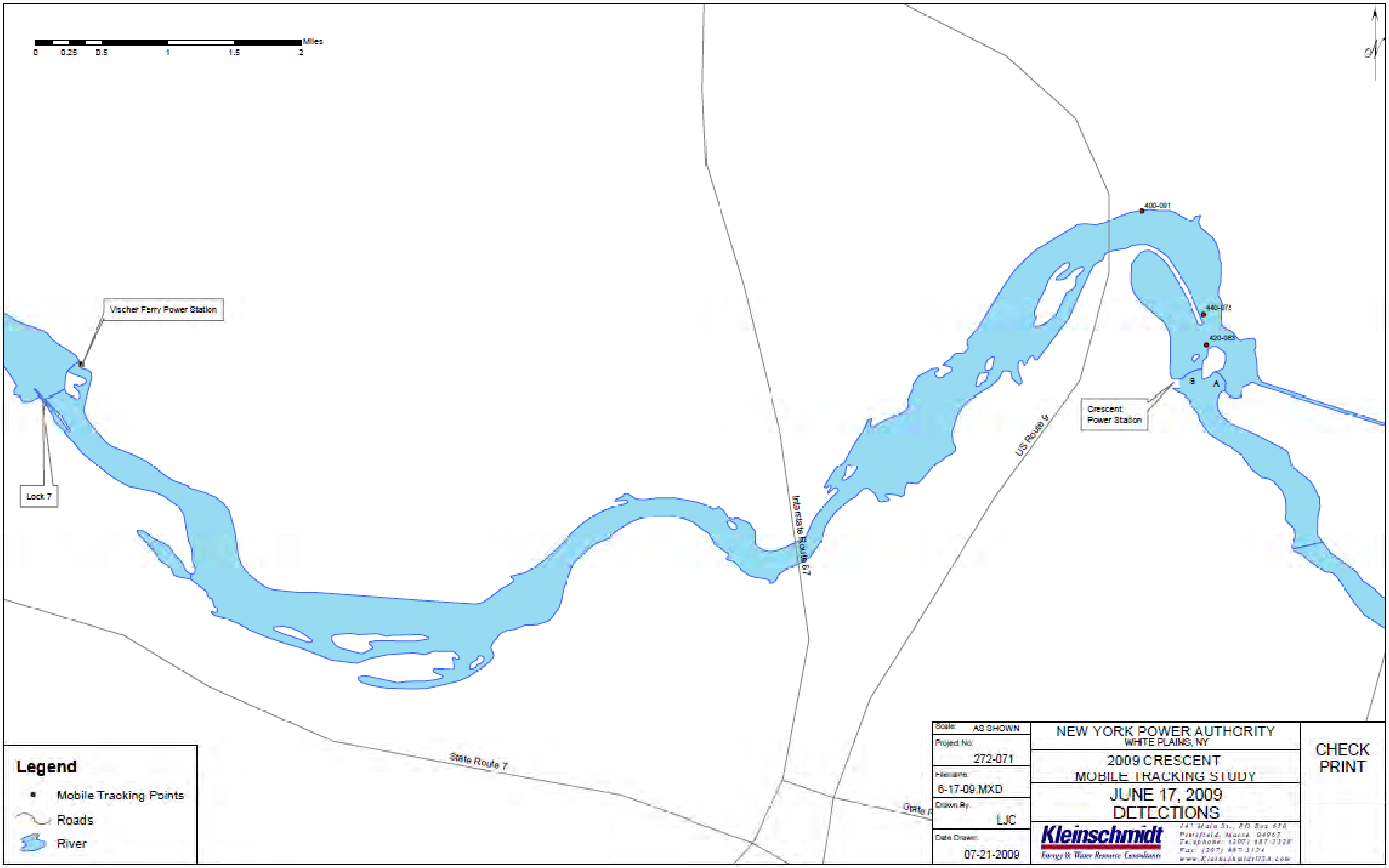


Figure 22. Location where radio tagged blueback herring were detected on June 18, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.

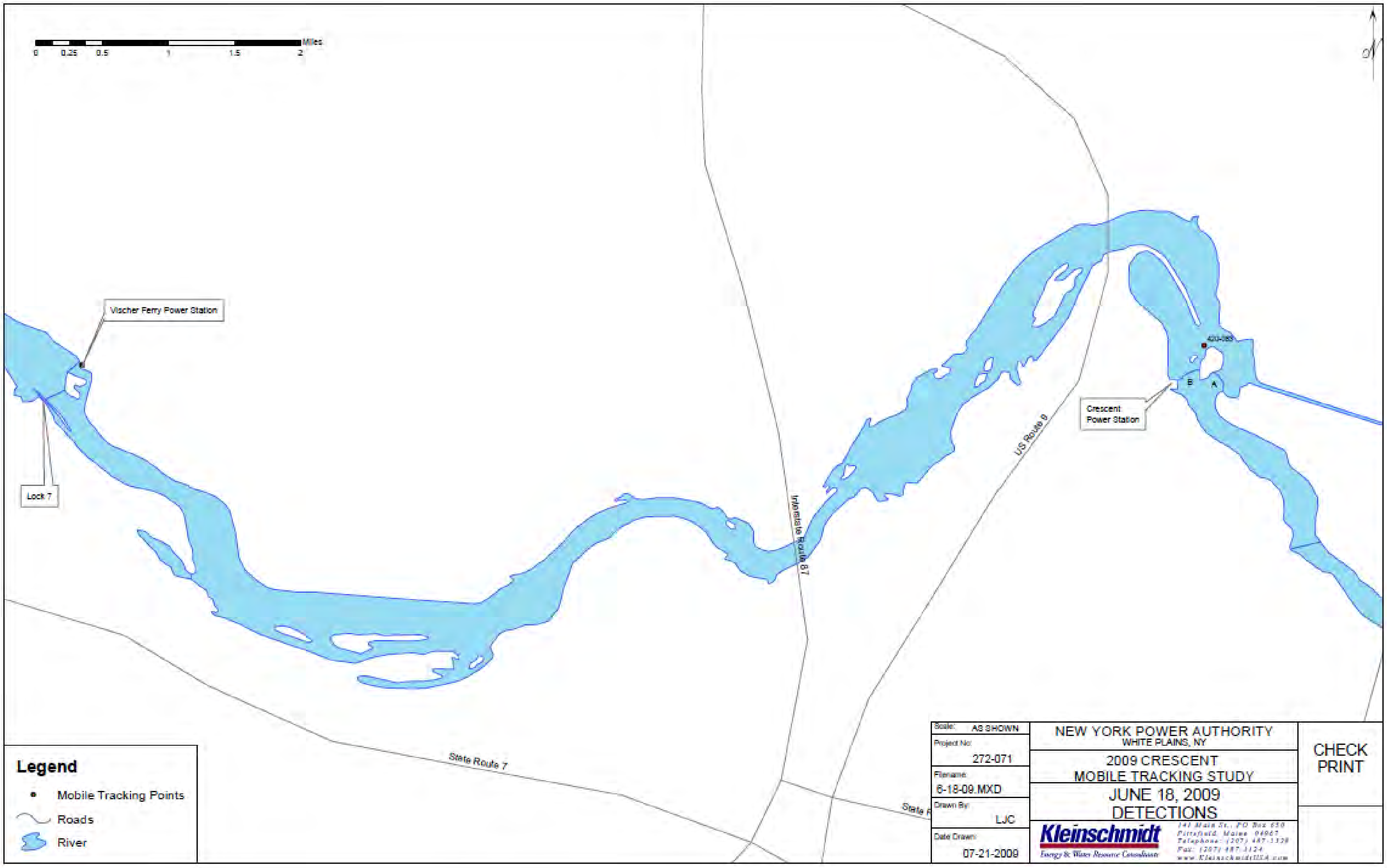


Figure 23. Location where radio tagged blueback herring were detected on June 19, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.

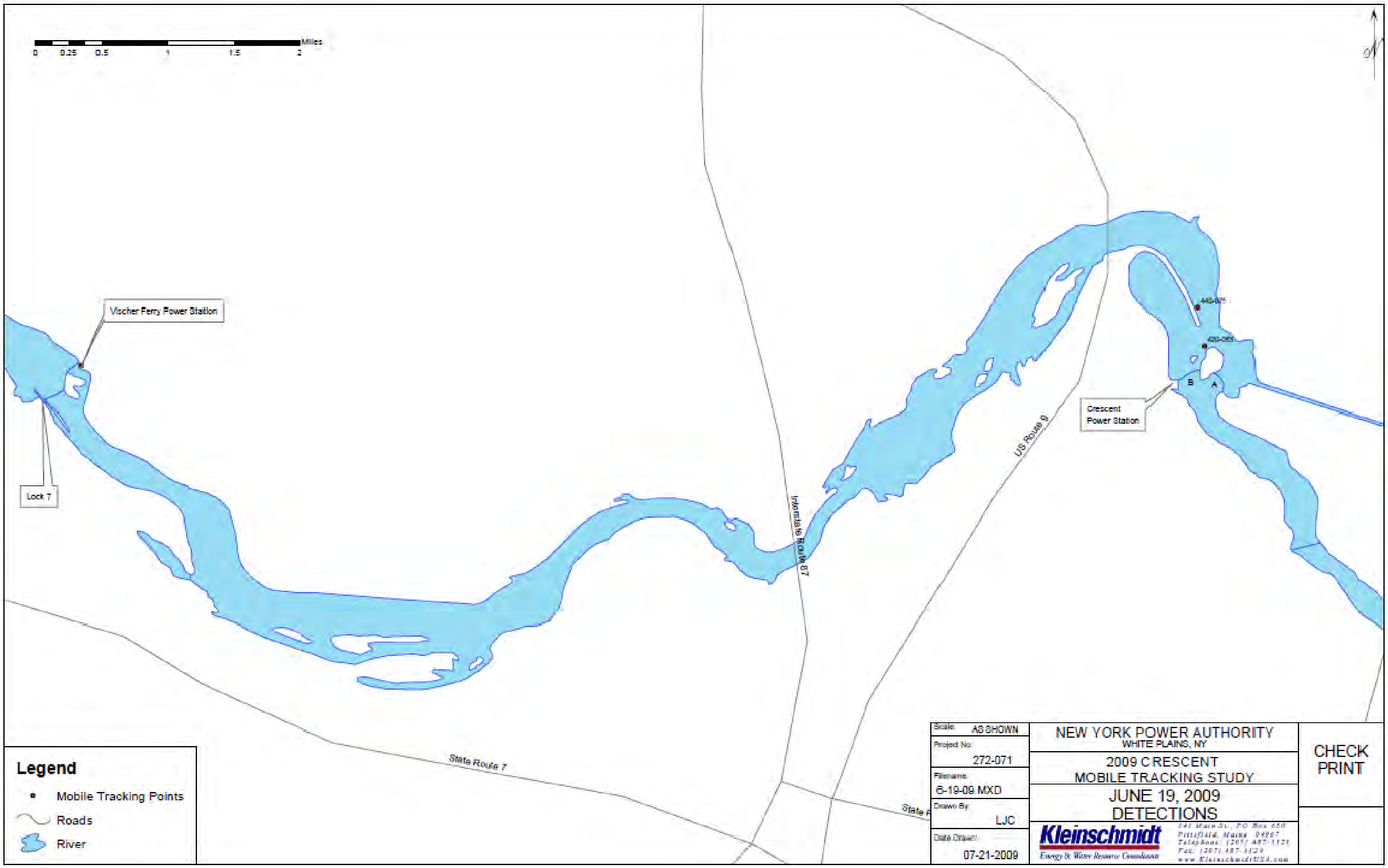


Figure 24. Location where radio tagged blueback herring were detected on June 22, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.

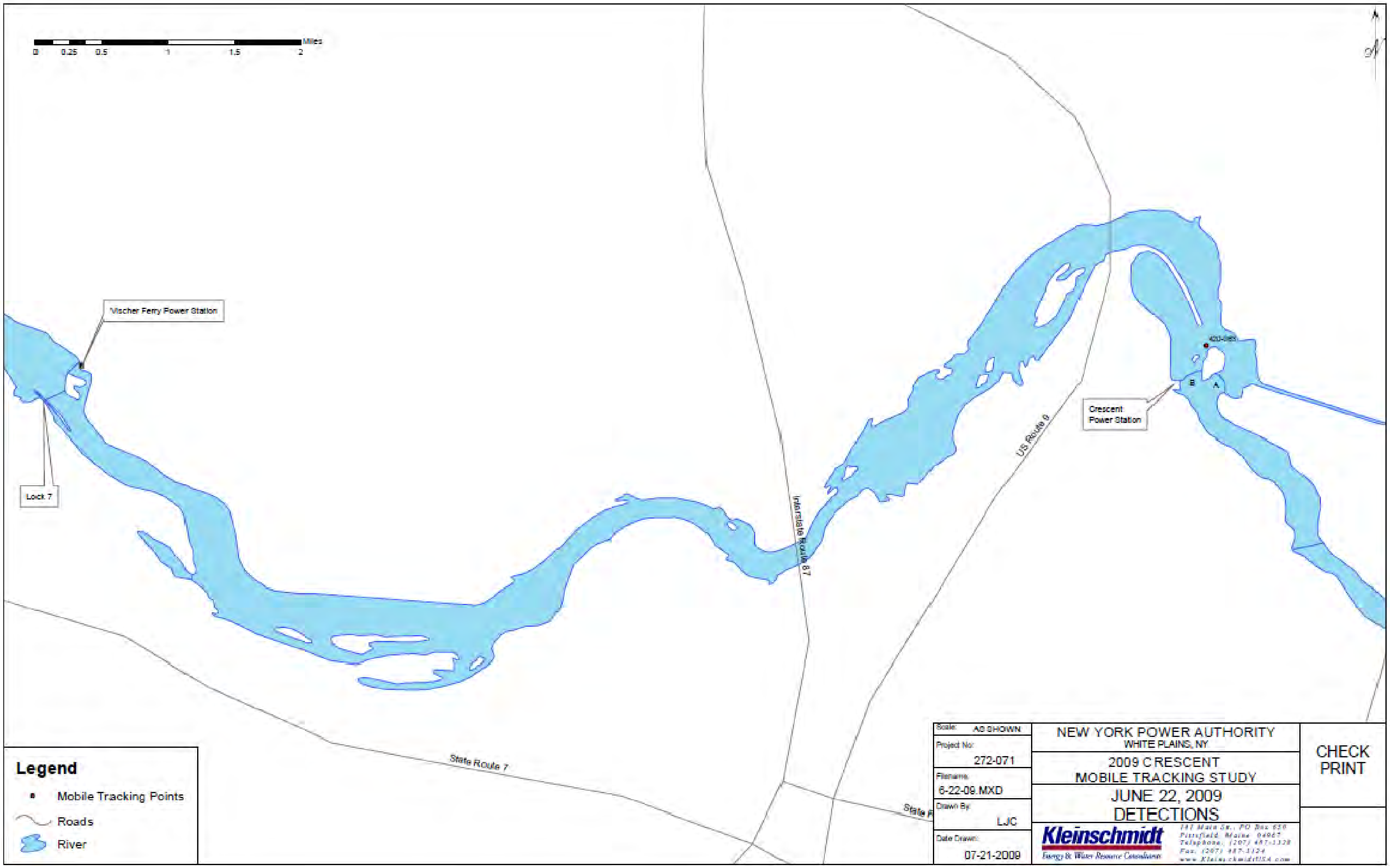


Figure 25. Location where radio tagged blueback herring were detected on June 23, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.

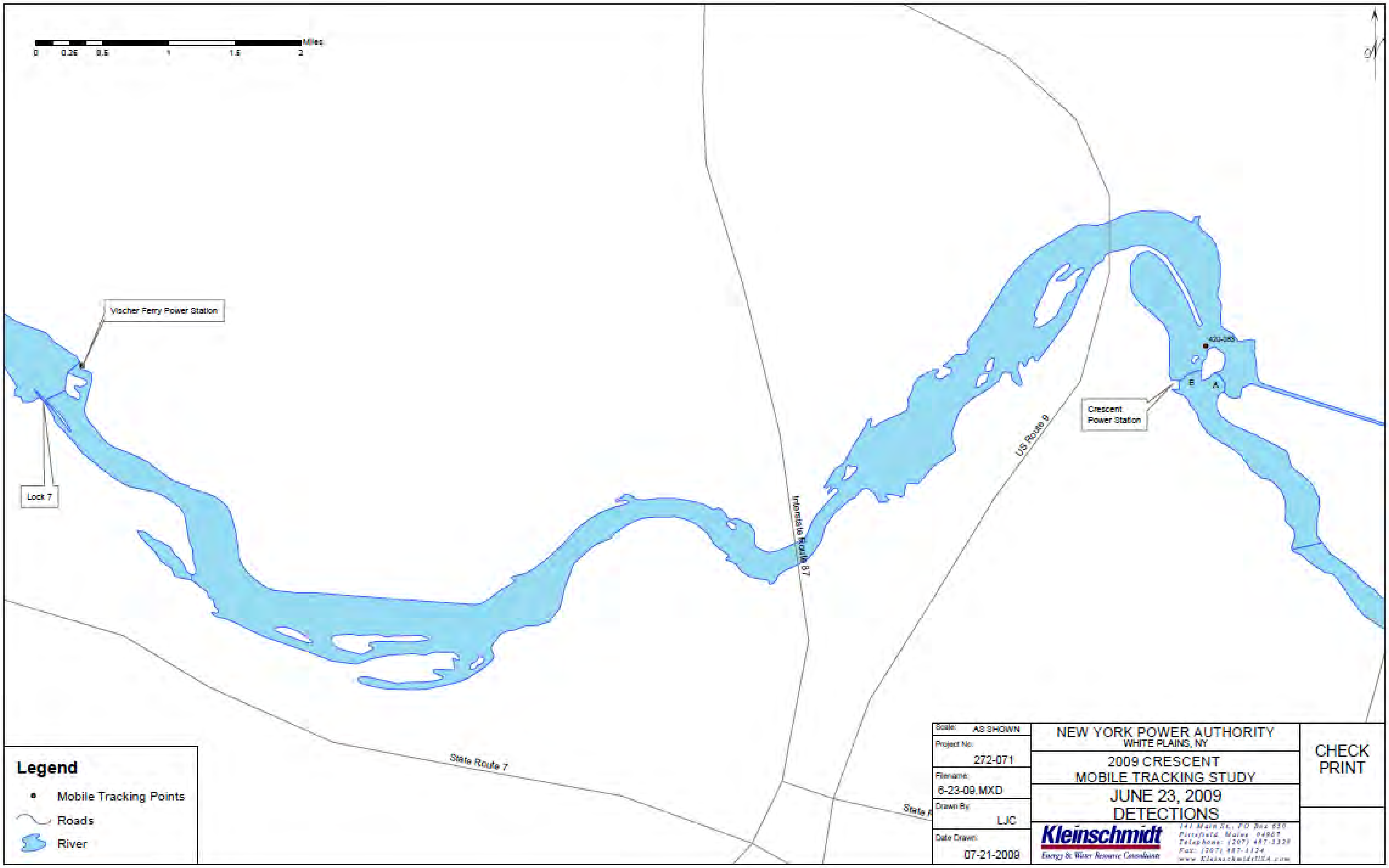


Figure 26. Location where radio tagged blueback herring were detected on June24, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.

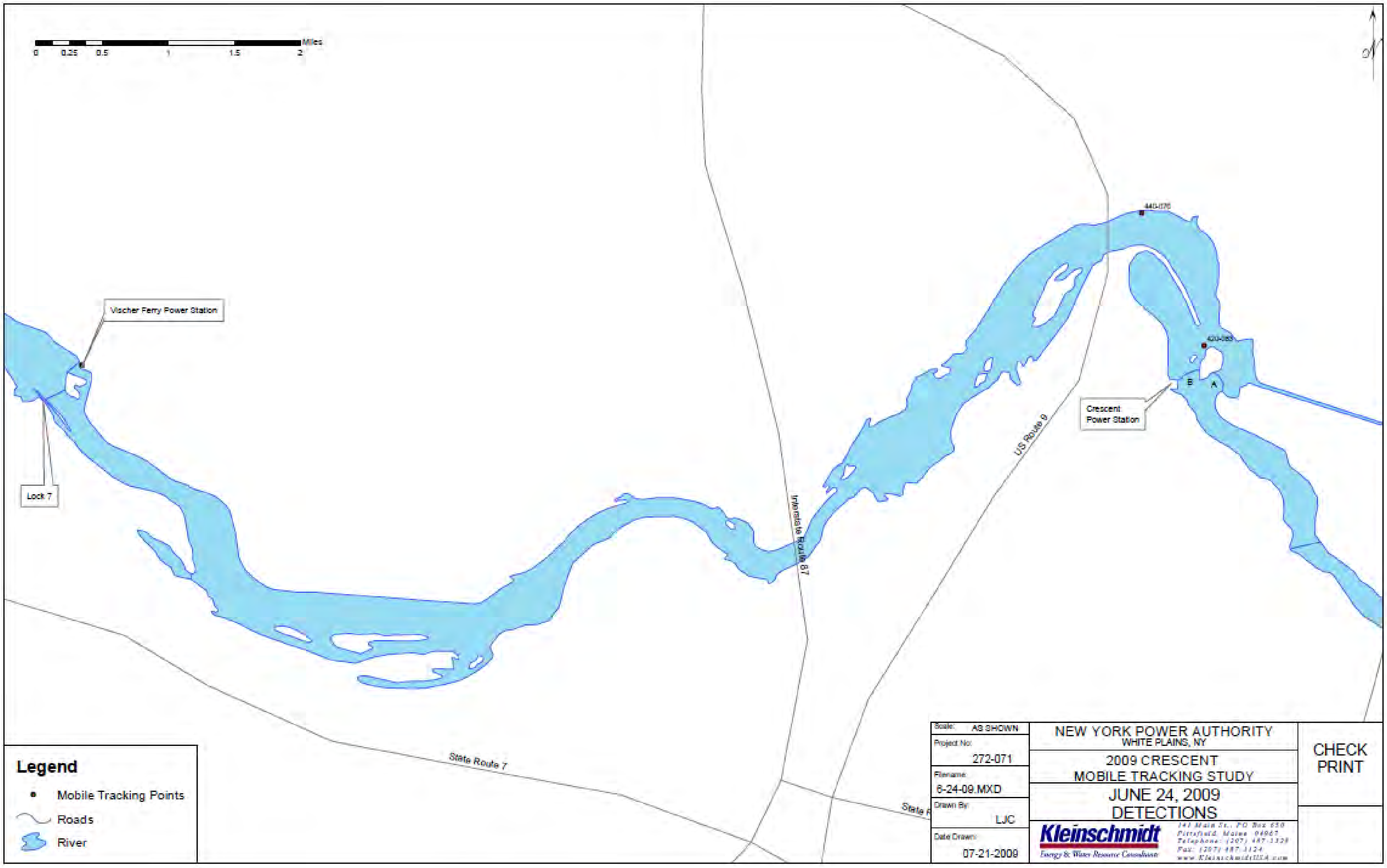


Figure 27. Location where radio tagged blueback herring were detected on June 25, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.

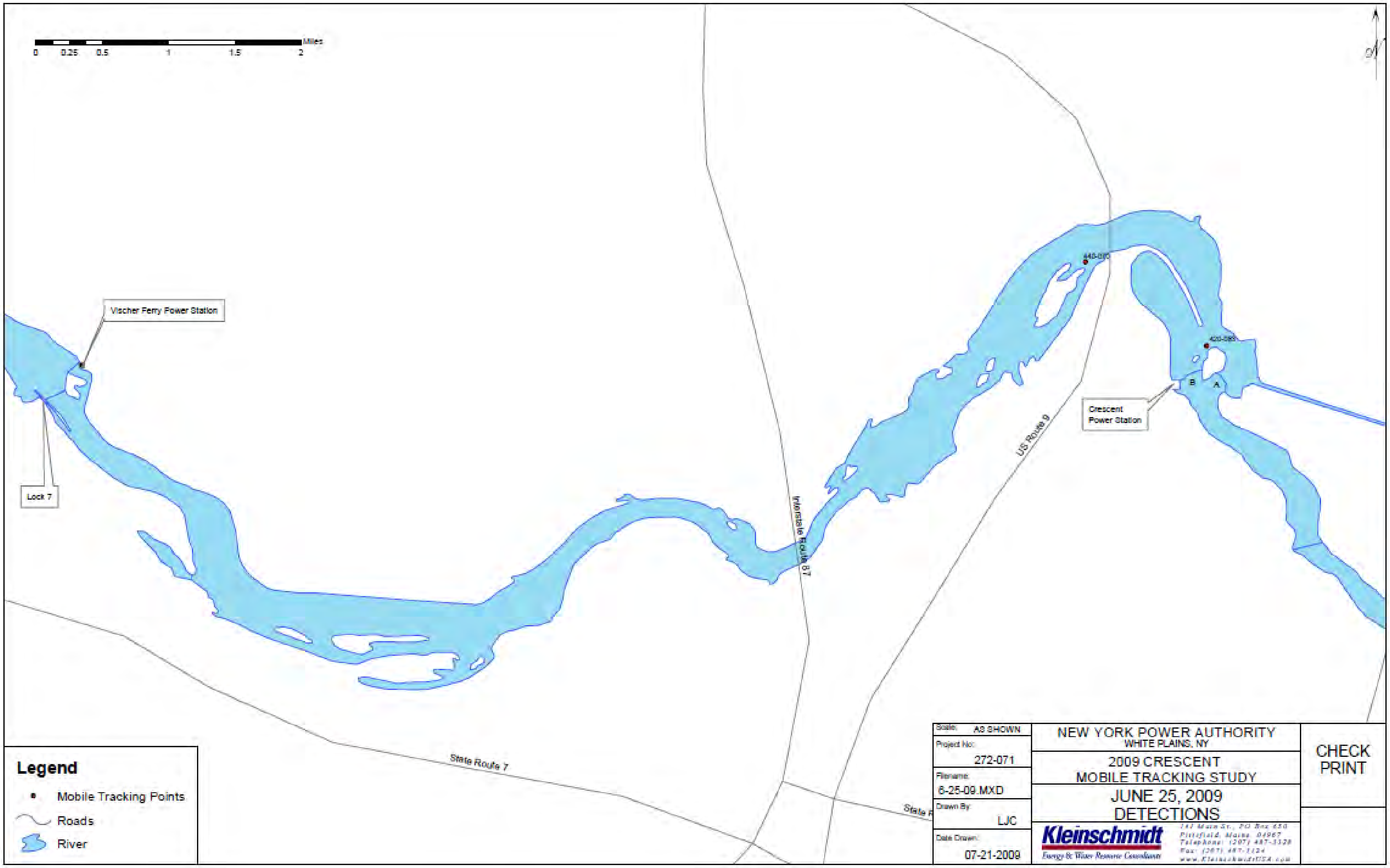


Figure 28. Location where radio tagged blueback herring were detected on June 26, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.

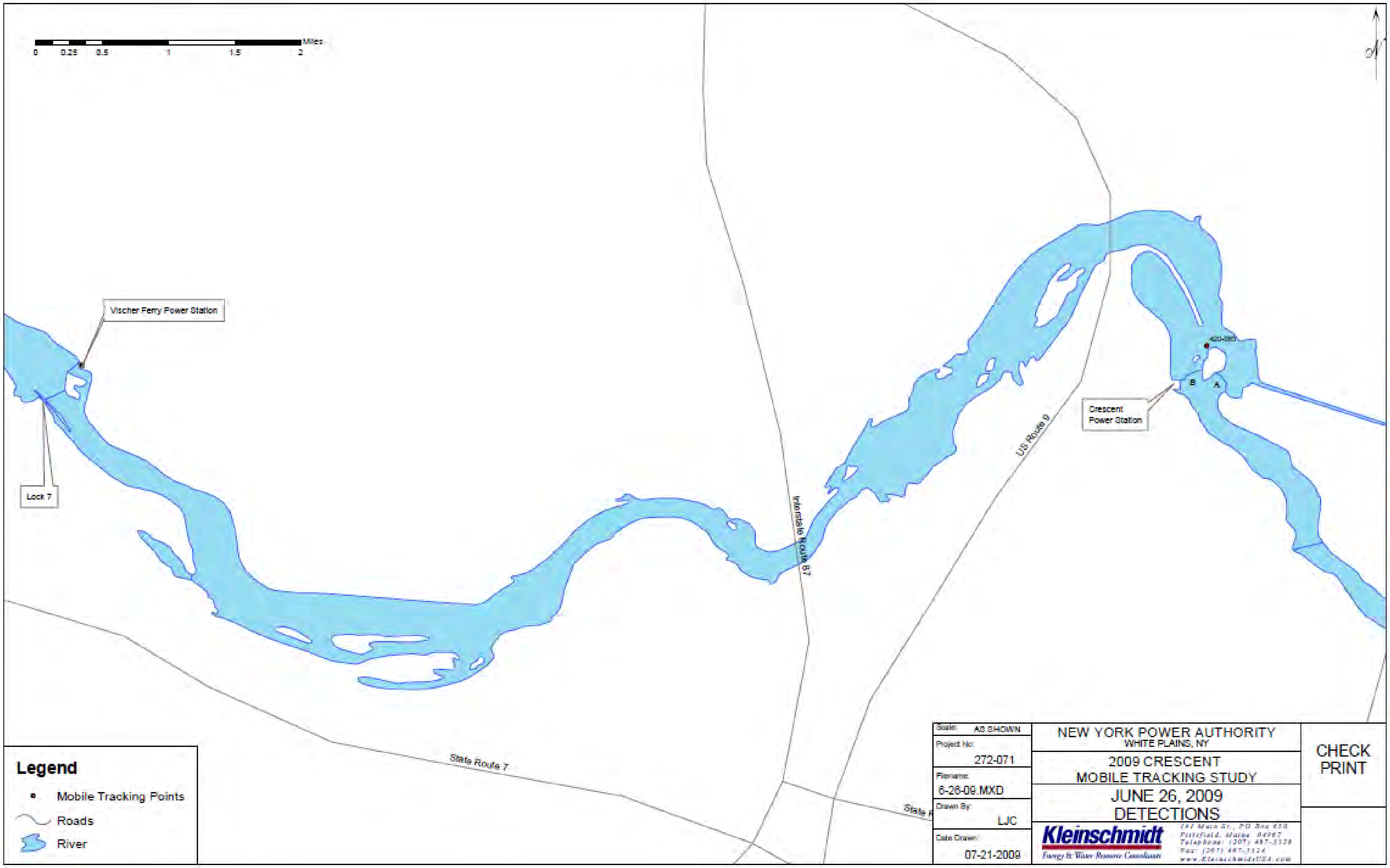


Figure 29. Location where radio tagged blueback herring were detected on June 29, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.

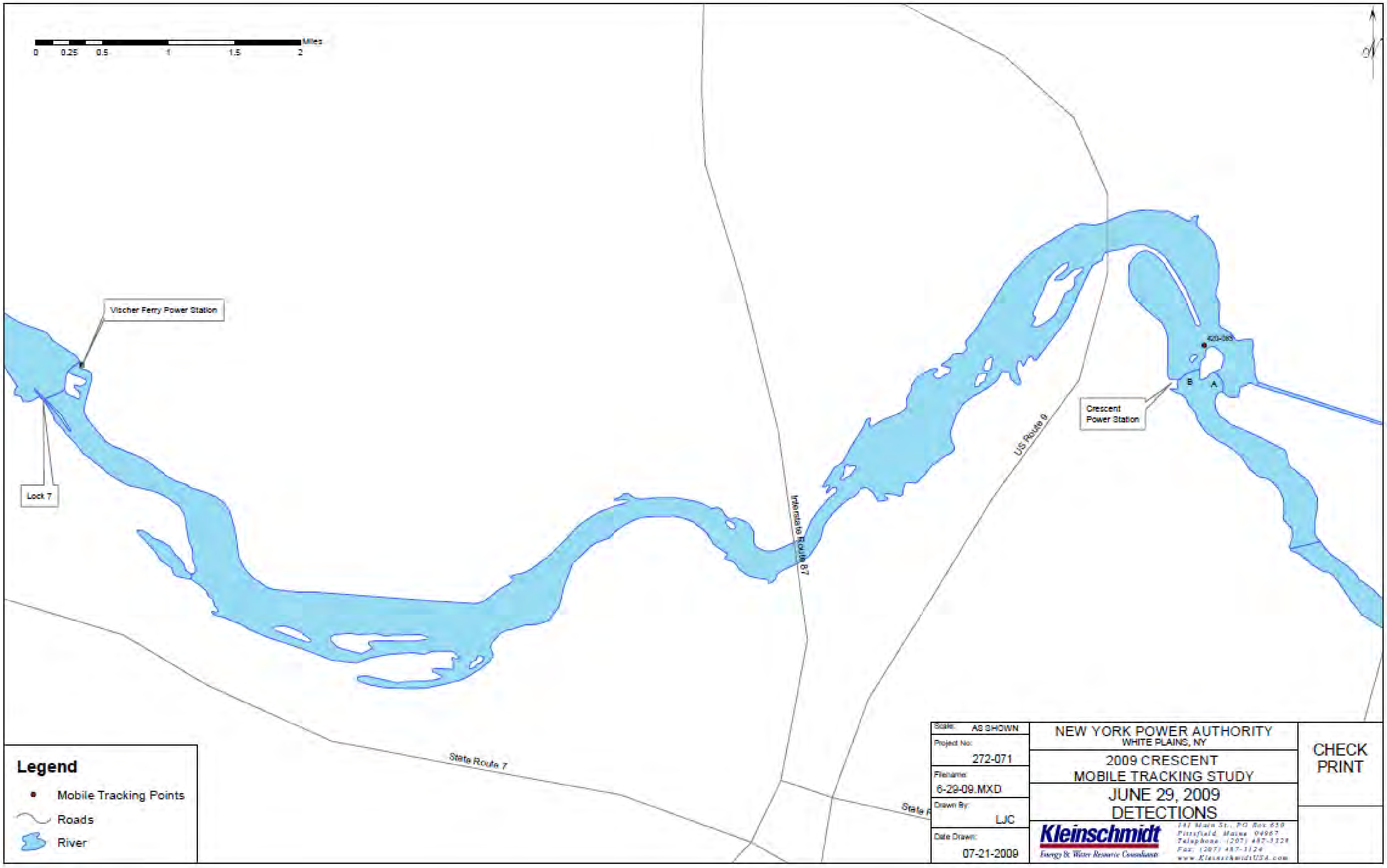


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Figure 30. **Location where radio tagged blueback herring were detected on June 30, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.**

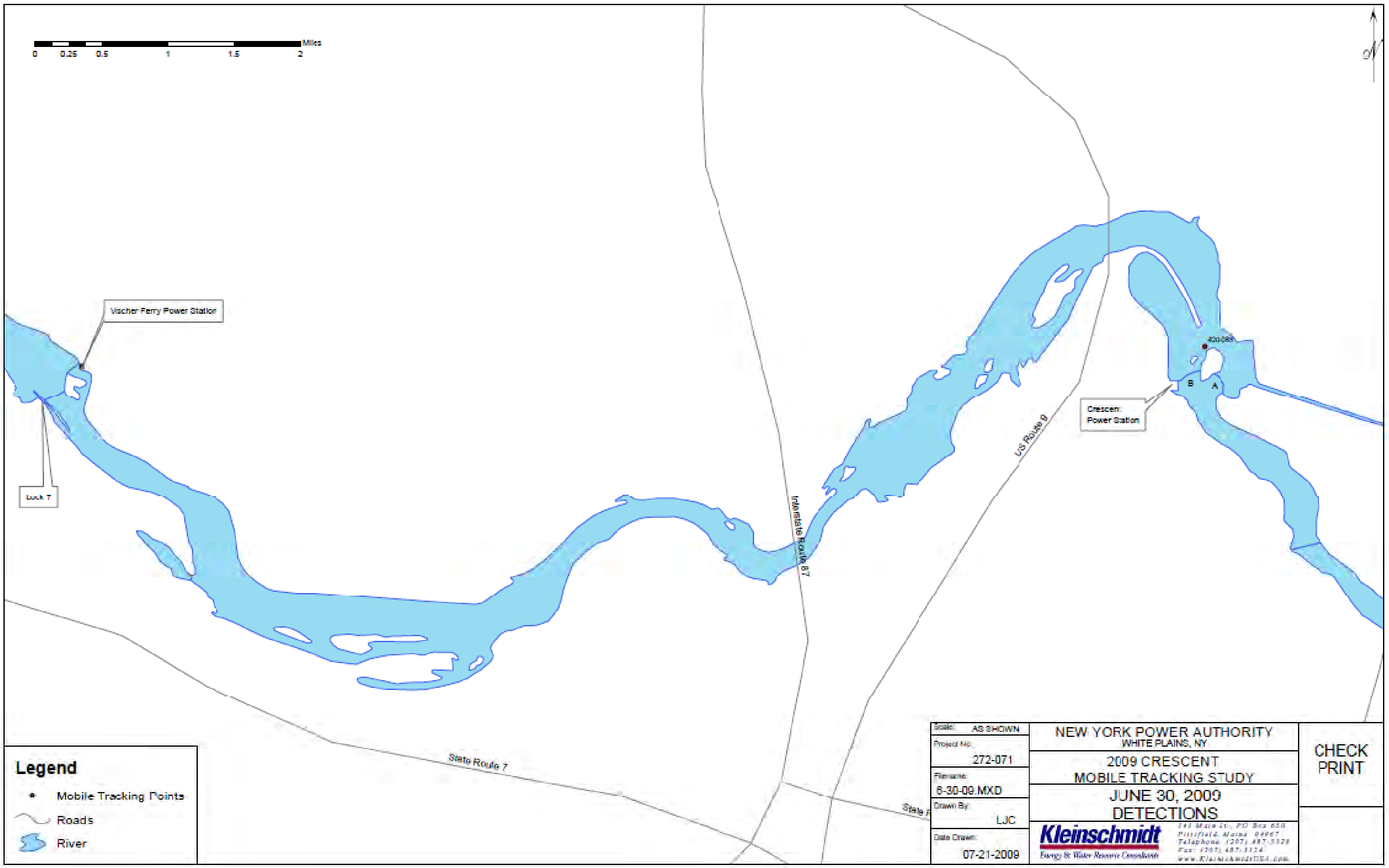


Figure 31. Location where radio tagged blueback herring were detected on July 1, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.

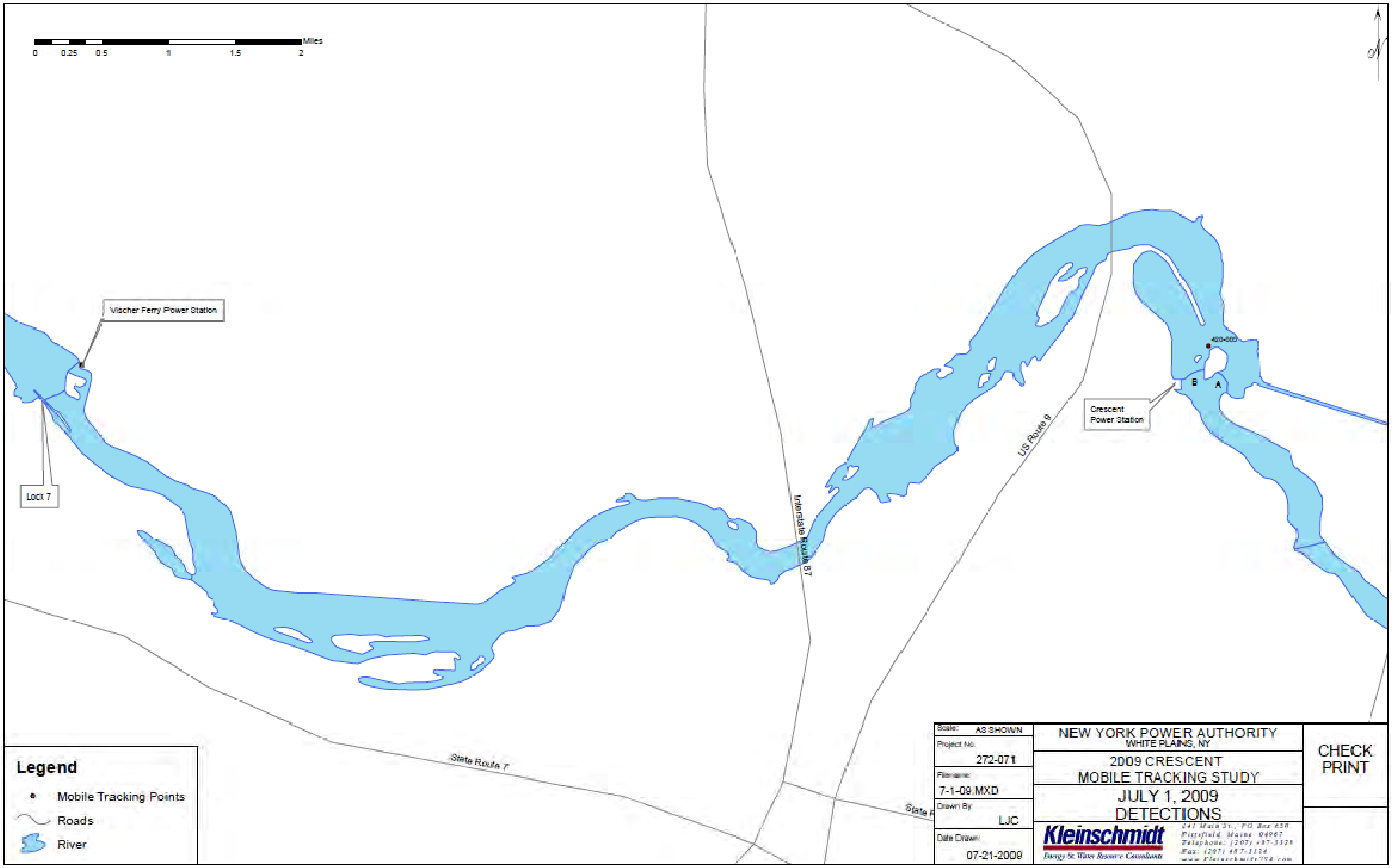


Figure 32. Location where radio tagged blueback herring were detected on July 2, 2009 during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project.

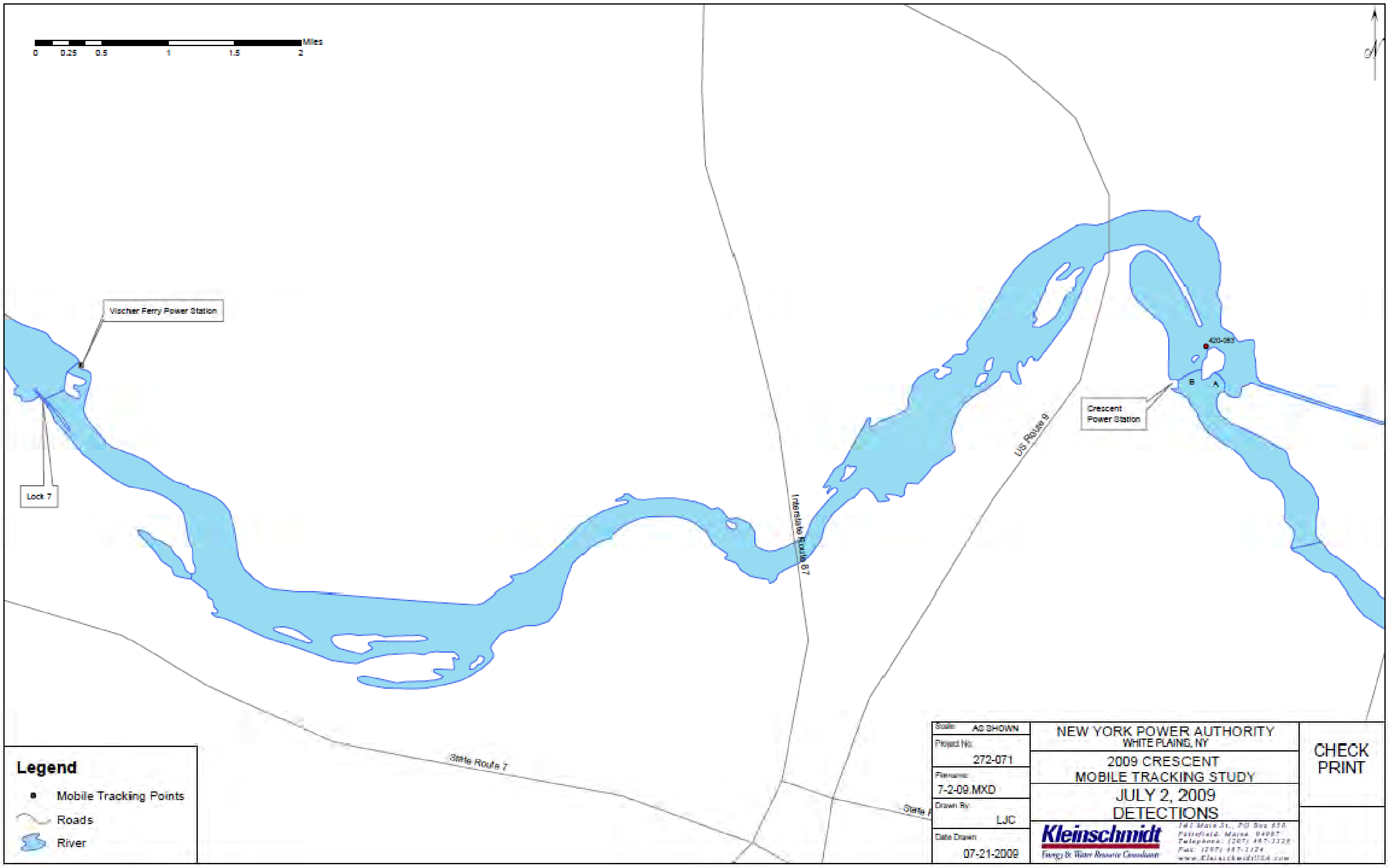
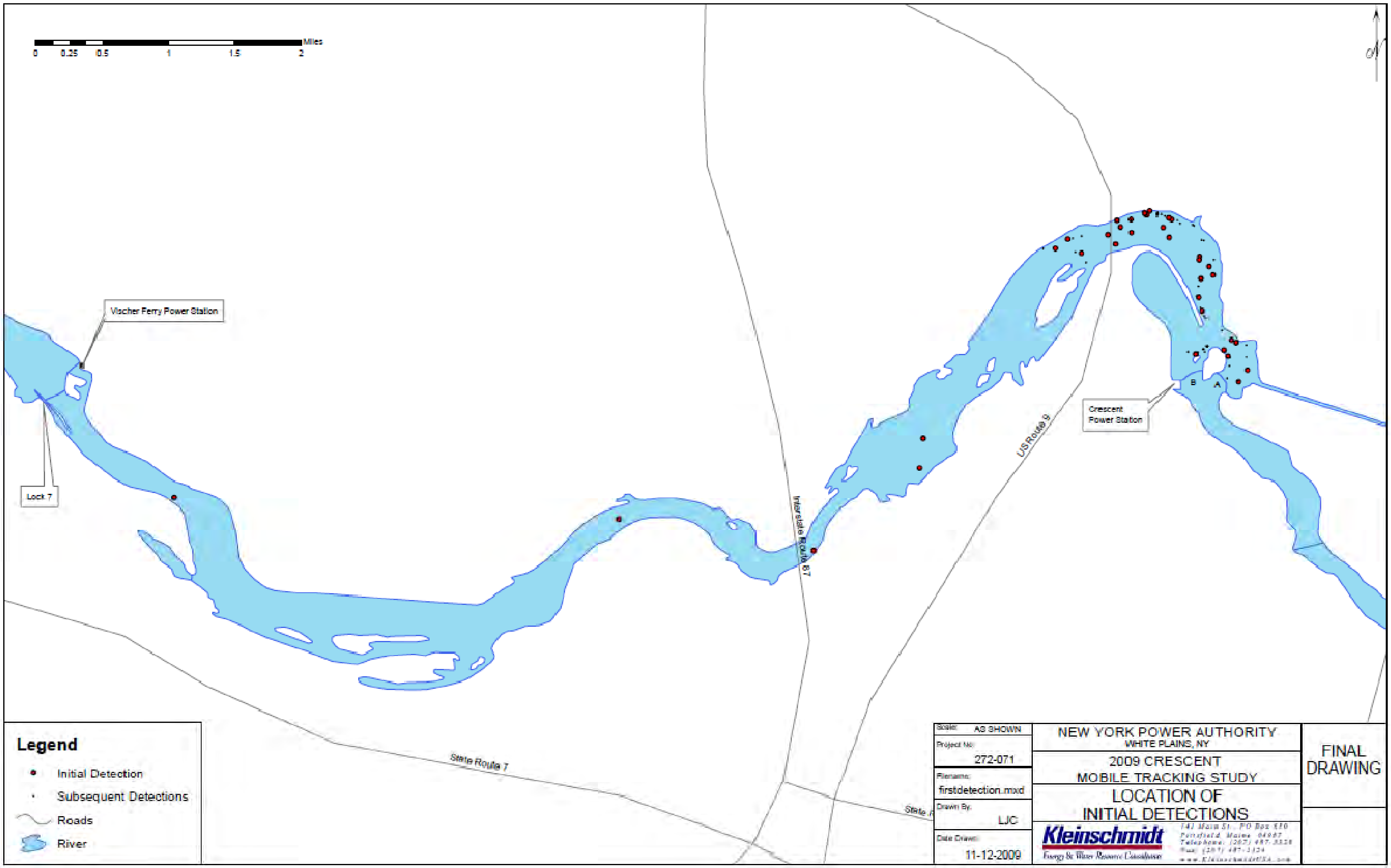


Figure 33. Location where radio tagged blueback herring were initially detected during the full-scale study using mobile telemetry at the Crescent Hydroelectric Project in 2009.



LOWER MOHAWK RIVER FISHERIES

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Overview

The 257 km Mohawk River is the second longest river in New York State with the lower 47 km located within the Capital District (Albany-Schenectady-Troy) area, the state's fourth largest metropolitan area. The river is also part of the New York State Barge Canal system. The magnitude of the resource, its close proximity to large numbers of people, and environmental assessment needs relating to commercial development necessitated updating fisheries information on the lower 122 km of river from Five Mile Dam, located 7.1 km upstream of Lock 16, downstream to the Hudson River. In 1979, the New York State Department of Environmental Conservation (NYSDEC) Region 4 Fisheries Office began a study of the lower Mohawk River to better understand its fisheries potential and management needs. A number of studies, primarily on the Crescent Dam to Lock 16 reach, were completed that culminated in the development of a fisheries management plan for the lower Mohawk River in 1994. Highlights of these fish studies are summarized.

River Description

Completion of the Erie Barge Canal in 1918 resulted in the canalization or obliteration of the succession of riffles, pool, and still waters that characterized the natural Mohawk River. Approximately 135 km of the 257 km free flowing river was changed to a series of permanent and seasonal impoundments. The 122 km lower Mohawk River contains five permanent dams, nine movable dams, nine locks, and five operational hydropower facilities. Another five locks and two guard gates are located within the 3.7 km landcut canal joining the Mohawk and Hudson Rivers that bypasses the 29.4 m high Cohoes Falls. All but 10.3 km of the lower river is canalized with 113 km containing a 61 m wide by 4.3 m foot deep shipping channel.

The Mohawk River can be classified into three channel basin types based on shape and use: natural river, river canal, and power pool. In the lower Mohawk River, the natural river section comprises a total of 10.3 km and is found in three reaches: Five Mile Dam to Lock 16, the Diversion Dam to Cohoes Falls, and at the mouth above the flooded branch sections to the New York State Dam. The river canal section extends 76.3 km from Lock 8 to Lock 16. The dams at Locks 8-15 are movable and only in place during the May through November navigation season and removed during the winter. These seasonal impoundments range in size from 74 to 248 ha. When these dams are removed, the river becomes free flowing throughout this reach. The 36.2 km power pool section extends from Lock 8 downstream to the Diversion Dam, Cohoes Falls to the New York State Dam, and the flooded stream sections at the mouth. These impoundments are permanent and range in size from 37 to 771 ha.

Effects of Erie and Barge Canal Construction

Completion of the Erie Canal in 1825 and the Erie Barge Canal in 1918 created a bypass around the Cohoes Falls that resulted in a direct waterway link between the Hudson River and Great Lakes. This bypass allowed fish to move east or west through the canal system to establish populations in other

In: Cockburn, J.M.H. and Garver, J.I., Proceedings from the 2009 Mohawk Watershed Symposium, Union College, Schenectady NY, 27 March 2009

watersheds or within the Mohawk River. Fish moving west through the canal system include sea lamprey, alewife, and white perch. Fish moving eastward include smallmouth bass and gizzard shad. This movement through the canal system is still occurring. Freshwater drum, moving eastward, were first documented in 1990 at Lock 7 and are now present throughout the river.

Riverwide Fish Surveys

Fish populations throughout the lower Mohawk River were sampled with trap nets, electrofishing, and gill nets primarily in June between 1979 and 1983. Seining and trawling efforts occurred August through October in 1982 and 1983. Fifty-six fish species were recorded compared to 48 during the 1934 surveys. Six species collected in 1934 were not collected during the 1979-83 surveys but 12 additional species were collected during the later survey. During the June sampling, blueback herring were the most abundant fish collected followed by smallmouth bass, white sucker, yellow perch, brown bullhead, and rock bass. Numerically, game species represented 12.1% of the total fish collected compared to 25.4% for panfish, and 62.6% for all other fish species. The most numerous species collected by seine were young-of-year blueback herring, emerald shiner, spottail shiner, and bluntnose minnow.

Differences in Fish Community Structure by Channel Basin Type

The June, 1979-83, sampling data indicated major differences in fish communities in the four permanent power pool impoundments and the eight seasonal river canal impoundments. Comparisons of the relative percentage of the three fish categories-game fish, panfish, and other fishes-show that the lower Mohawk River fish community changes from panfish dominance in the power pool impoundments to game species dominance in the river canal impoundments. Excluding the anadromous blueback herring, game and panfish in the power pool impoundments represented 9.4% and 65.2% of the fishes collected compared to 36.3% and 23.8% in the river canal impoundments.

Angler Use

The lower Mohawk River supports a popular, warmwater fishery. In 1982 on the Crescent Dam to Lock 16 reach, the estimated total fishing pressure was 115,245 trips or 389,033 hours which is equivalent to 45.9 trips/ha or 154.9 h/ha. Shore and boat anglers made an estimated 59,622 and 55,623 trips, respectively. No other large (> 405 ha) warmwater system in New York at the time was known to support fishing pressure exceeding the 154.9 h/ha recorded from the lower Mohawk River.

Angler Catch and Harvest

Shore and boat anglers each caught (creeled plus release) about 0.9 fish/h in 1982 on the lower Mohawk River; however shore anglers creeled 0.29 fish/h compared to the 0.15 fish/h for boat anglers. Smallmouth bass, the dominant species caught by both shore and boat anglers were caught at a rate of 0.36 and 0.73 fish/h, respectively. For shore anglers, smallmouth bass comprised 41% of the total catch followed by rock bass (17%), yellow perch (9%), crappie (6%), and suckers (5%). For boat anglers, smallmouth bass comprised 78% of the total catch followed by rock bass (8%), walleye (3%), fallfish (3%), bullhead (3%), and yellow perch (1%). Anglers removed an estimated 77,626 fish weighing an estimated 25,930 kg from the Crescent Dam to Lock 16 reach during the May through September fishing season in 1982 for a per hectare yield of 30.9 fish and 10.3 kg. The per hectare harvest of 9.6 smallmouth bass weighing 4.3 kg was the highest recorded for a New York water with a 30.5 cm size limit.

Changes in Smallmouth Bass Abundance, Size Structure, and Fishery

Smallmouth bass were the dominant game fish in the lower Mohawk River and the second most abundant species collected during the 1979-83 riverwide surveys. Electrofishing catch rates ranged from 17.3 fish/h in the

Crescent impoundment to 155.1 fish/h in the Lock 10 Pool and averaged 70.7 fish/h for the entire lower river. Except for the Lock 15 Pool, smallmouth bass catch rates were highest in the seasonal impoundments. The electrofishing catch rates were very high and indicative of a dense population. By comparison, spring electrofishing catch rates in eight New York lakes from 1978 to 1980 averaged 8.9smallmouth bass/h with individual collections ranging up to 43.2 smallmouth bass/h.

The quality of the smallmouth bass fishery was assessed through the 1982-86 angler diary program. During this five year program on the Crescent Dam to Lock 16 reach, cooperators averaged 1.10 smallmouth bass/h and 0.51 legal ($\geq$ 30.5 cm) bass/h. These catch rates were high and indicative of a very high quality fishery. In the St. Lawrence River, long recognized as one of the premier smallmouth bass fisheries in New York, diary cooperators from 1978 to 1980 recorded catch rates only half as high as those recorded in the lower Mohawk River. St. Lawrence cooperator catch rates averaged 0.60 fish and 0.32 legal fish/h, respectively.

In a similar 1996-97 diary cooperator study, smallmouth bass catch rates averaged 0.48 fish and 0.31 legal fish/h. Although these catch rates are still indicative of a good bass fishery, it represented a decline of 57% in the overall catch rate and a 40% decline in the legal catch rate from the very high 1982-86 cooperator catch rates. The diary data suggested a decline in smallmouth bass abundance, which was verified in a 1998 electrofishing survey of the Lock 8 Pool. This survey also revealed a change in the size structure of the bass population with fewer smaller bass and more larger bass present.

Smallmouth bass studies were conducted in the Locks 8, 10, and 14 Pools from 1985 through 1988 and these studies were repeated in 1999 and 2001 to verify the changes in bass abundance and size structure observed during the diary study and 1998 electrofishing study. In the 1985-88 studies, the electrofishing catch rate in the Lock 8, 10, and 14 Pools averaged 44, 69, and 35 fish/h compared to the average of 15, 9, and 8 fish/h recorded during the 1999 and 2001 studies, respectively. The RSD16 of smallmouth bass in the Lock 8, 10, and 14 Pool averaged 3%, 1%, and 0% in the early study and 29%, 40%, and 26% in the later study, respectively. The same three pools were electrofished in 2006 and the results were similar to those recorded in 1999 and 2001. The data suggests that the reduction in smallmouth bass abundance and the increase in larger fish occurring throughout the lower river in the eight seasonal impoundments are permanent. The reasons for this shift in abundance and size structure are not known but may be related to the establishment of zebra mussels in 1991. It is also not known whether a similar shift has occurred to the bass populations in the permanent impoundments downstream of Lock 8.

Contaminants in Fish

Contrary to popular opinion, all lower Mohawk River fish are safe to eat except for those fish caught at the mouth. The mouth is limited to catch and release fishing only because of elevated PCB levels in Hudson River fishes. This catch and release regulation applies to the Hudson River between the Troy Dam and Hudson Falls and includes all tributaries to the first impassible barrier which in the Mohawk River is the New York State Dam between Cohoes and Waterford. Currently, there are no health advisories on fish consumption from the lower Mohawk River. Historically, PCBs were a problem in the Mohawk River downstream of Lock 7 that resulted in an eat none health advisory for white perch and a one meal per month advisory for smallmouth bass in this 12 mile reach. However, these advisories were lifted in April, 1994, due to declining PCB levels which have fallen even further since then. White perch PCB levels in 1983, 1987, 1992, and 2006 were 7.3, 3.4, 1.3, and 0.5 ppm, respectively. Smallmouth bass PCB levels in 1983, 1987, 1992, and 2005 were 2.5, 2.1, 0.8, and 0.2 ppm, respectively. The US Food and

Drug Administration (USFDA) tolerance level for PCBs is 2.0 ppm. In the 2005 fish collections below Lock 7 and between Locks 8-9, mercury concentrations were consistently below the USFDA action level of 1.0 ppm. The three p,p'-DDT related compounds were frequently detected but their total concentrations were generally well below 0.1 ppm and well below concentrations considered harmful to human health or the environment. Several compounds were not detected in any sample. Non-detectable compounds include mirex, photomirex, trans-chlordane, heptachlor, heptachlor epoxide, aldrin, and lindane.

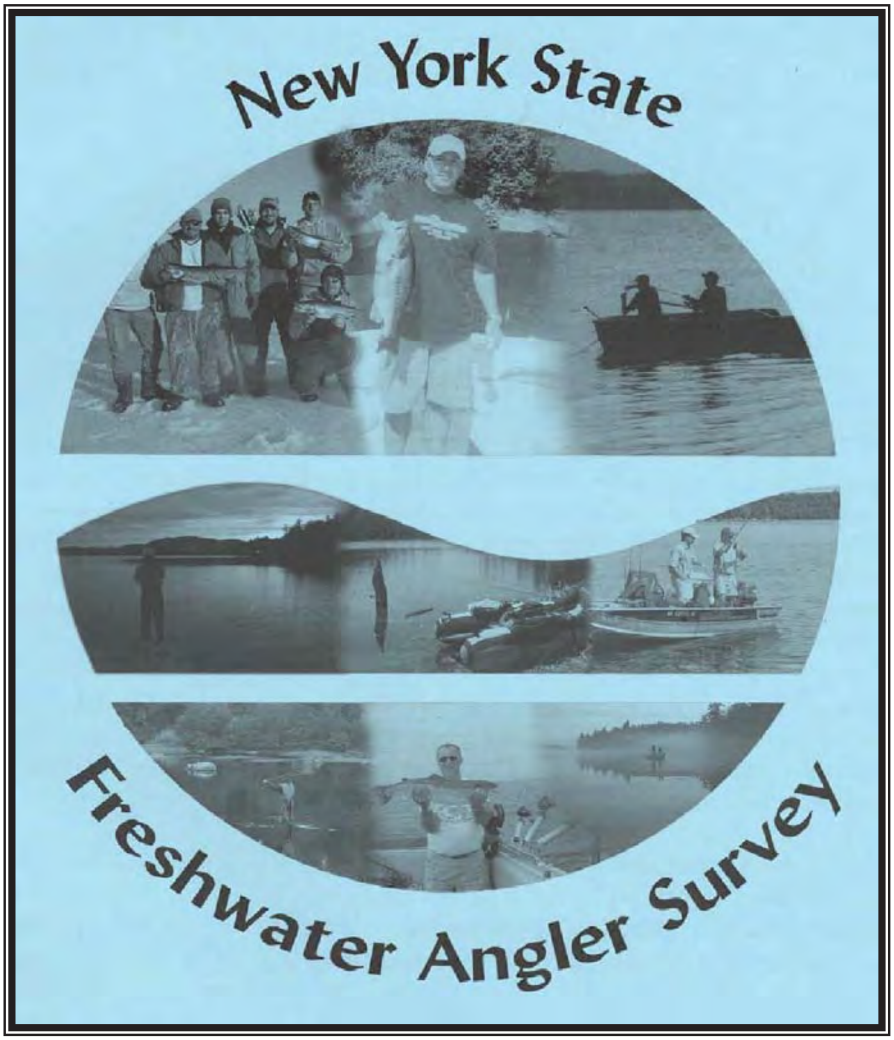
Summary

The lower Mohawk River supports an abundant and diverse warmwater fishery of high quality. It is a dynamic system whose fish community is still undergoing change. The smallmouth bass fishery has shifted from one dominated by fish in the 10-13 inch size range to one now dominated by fish 14 inches and larger. Freshwater drum, first collected in 1990, are now present throughout the river and locally abundant in some areas. Blueback herring abundance is declining throughout the river. Northern pike, once very rare, now provide trophy fishing opportunity throughout the river.

The river's close proximity to large numbers of people makes it an important recreational asset provided the public has access to the river and water quality remains good. Public and fee boat launch sites are located throughout the lower Mohawk River between Crescent Dam and Lock 16. Only the Lock 9 and 11 Pools have no boat launch sites. Shore fishing is most popular at the locks.

The lower Mohawk River fisheries management plan, completed in 1994, summarizes the historical background and the fishery. Fisheries issues were identified and included the following: hydropower development, stream flow fluctuation, stream diversion, zebra mussels, fishing ban, law enforcement, commercial fisheries, and fishing tournaments. Nineteen management strategies were developed including 31 specific recommendations for implementation. This management plan should be updated.

NEW YORK STATEWIDE ANGLER SURVEY 2007



SUMMARY

July 2009 (Revised)

New York State Department of Environmental Conservation
Bureau of Fisheries
625 Broadway
Albany, New York 12233

INTRODUCTION

With more than 7,500 lakes and ponds and 50,000 miles of rivers and streams New York State has some of the finest freshwater fishing in the country. There is world class fishing for a wide variety of coldwater and warmwater fish species. Whether smallmouth bass fishing on Lake Erie, brook trout fishing on a crystal clear Adirondack lake, Pacific salmon fishing on Lake Ontario, or fishing for stripers on the Hudson River, there's something special here for everyone.

BACKGROUND

Research for the 2007 New York State Freshwater Angler Survey was conducted by the Cornell University Department of Natural Resources, in cooperation with the New York State Department of Environmental Conservation (DEC) Bureau of Fisheries. The survey was implemented to learn more about fishing experiences in New York State, angler interests in different types of fishing opportunities, and angler opinions on fisheries management issues. The DEC will use the information obtained from the survey to carry out its mission in a manner that is responsive to the needs and desires of anglers.

To obtain this information, the statewide angler survey was conducted by mail in three phases over the course of 2007-08, focusing on fishing experiences in New York during calendar year 2007. For each survey phase, a random sample of 17,000 anglers age 16 and older was drawn from all license holders eligible to fish during the phase. Of the 17,000 questionnaires mailed out during each phase, between 700 and 1,100 were undeliverable and between 6,000 and 8,000 completed questionnaires were returned. This resulted in adjusted response rates ranging from 38% for phase 2 to 49% for phase 3. Collectively, over 20,000 anglers participated in the survey.

Results of the survey are documented in four reports. Each of the four reports are available on the DEC website as PDF documents and can be assessed at www.dec.ny.gov/outdoor/56020.html. Report 1 contains statewide estimates of angler effort and expenditures, as well as breakouts by region, and major water body. It also provides estimates of specific use of New York's fisheries broken out by species fished for, region fished, and water body. Report 2 assesses angler characteristics, preferences, satisfaction, and opinions on management topics. Report 3 provides estimates of angler effort and expenditures in New York State Counties. Report 4 compares two different survey methodologies used in this study and provides an analysis of trends in fishing effort.

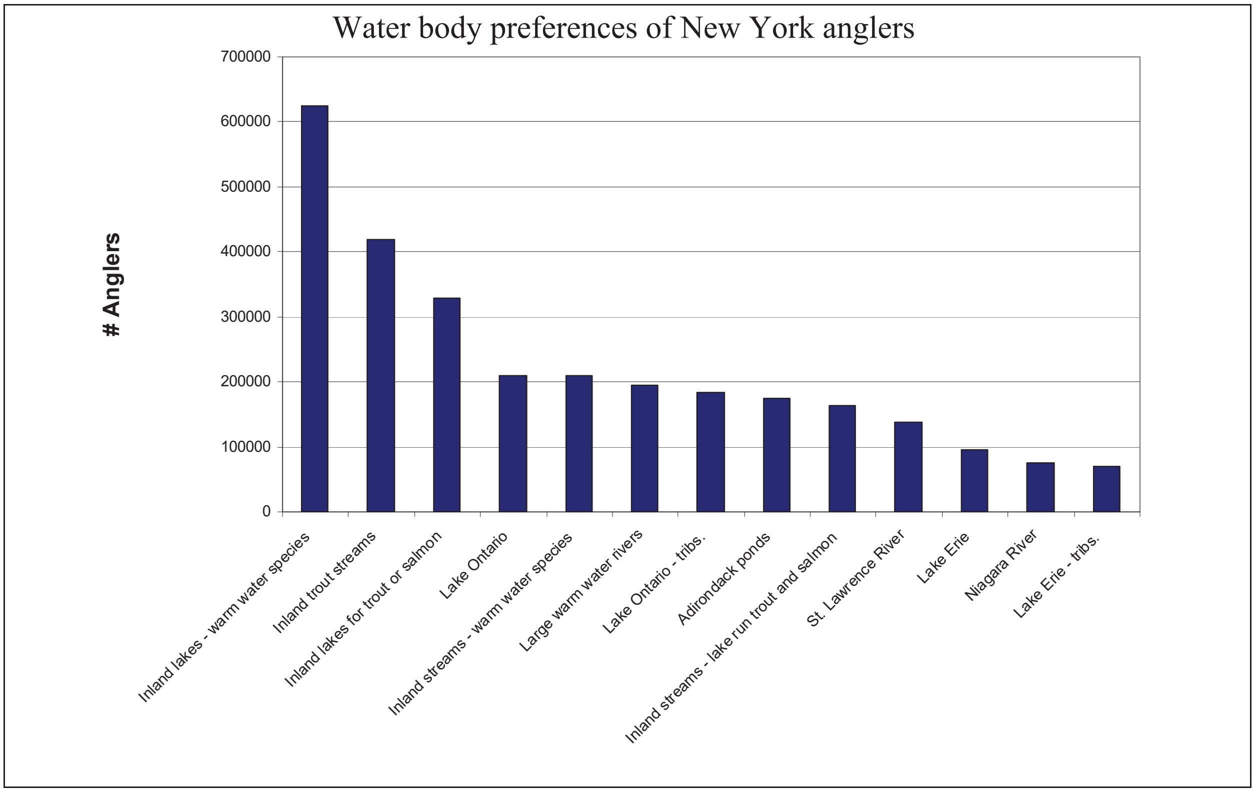
ANGLER PREFERENCES

Species Preferences

Black bass were the favorite species of 1/3rd of responding anglers and 3/4's ranked them among their top 5 favorite species to fish for. Trout, walleye, and yellow perch were each among the top five favorite species for about half of the anglers.

Water body Preferences

Most anglers (about 625,000 in total) indicated that they prefer to fish inland lakes for warmwater species. The next most preferred water body type was inland trout streams, preferred by half of the anglers.



Types of Fishing Opportunities

In the survey anglers were asked how important 18 different items were to their decision about where to fish. Of importance to almost all anglers (91%) was being able to fish in a water that contained a species they were interested in. Of lesser importance was the number or size of the fish present. Most anglers (79%) also wanted to fish a water that does not have a contaminant advisory. Many anglers (39%) expressed the desire to have new experiences – go to new places to fish.

Management Opinions

- From the list of possible actions that DEC might do to increase angler's enjoyment of their fish trips, most anglers desired an increase in the number of fishing access sites, improved facilities at existing sites, expanded opportunities to catch larger fish and increased opportunities to catch wild fish.

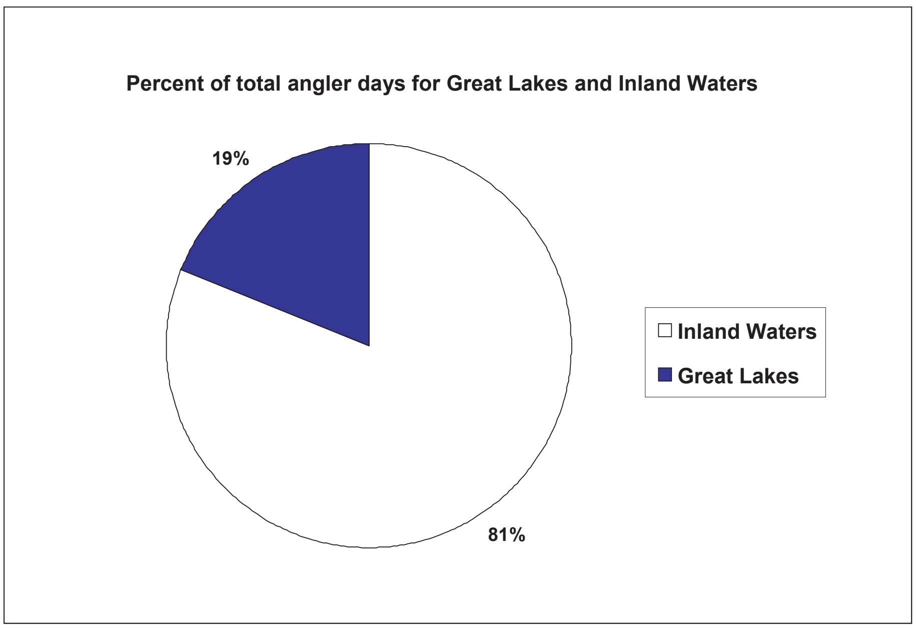
- Survey results suggest that only 1% of licensed anglers sold panfish in 2007. Fifty-two percent of survey respondents expressed an opinion about allowing the continuation of the sale of angler caught panfish. Of these, 77% felt that the practice should be prohibited. Support for a ban was lowest in Northern NY, but respondents residing in Regions 5 & 6 still favor banning the sale of angler caught panfish by a margin of nearly two to one.

- The majority of anglers are satisfied with DEC's stocking practices and want to see the current mix of stocked one and two year old brown trout maintained.

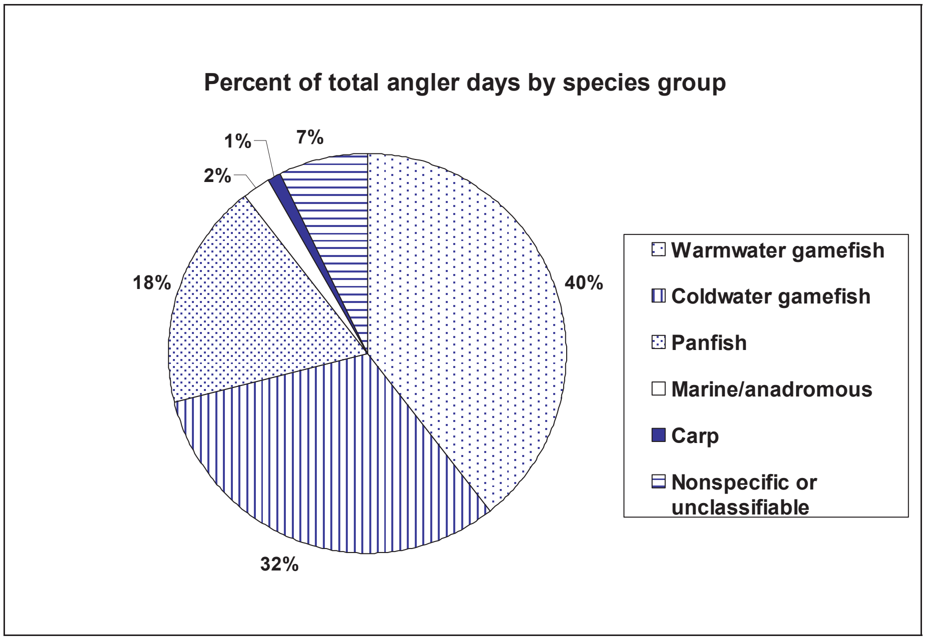
- Approximately 2/3rds of those surveyed expressed a desire for making New York's fishing regulations easier to understand.

FISHING EFFORT

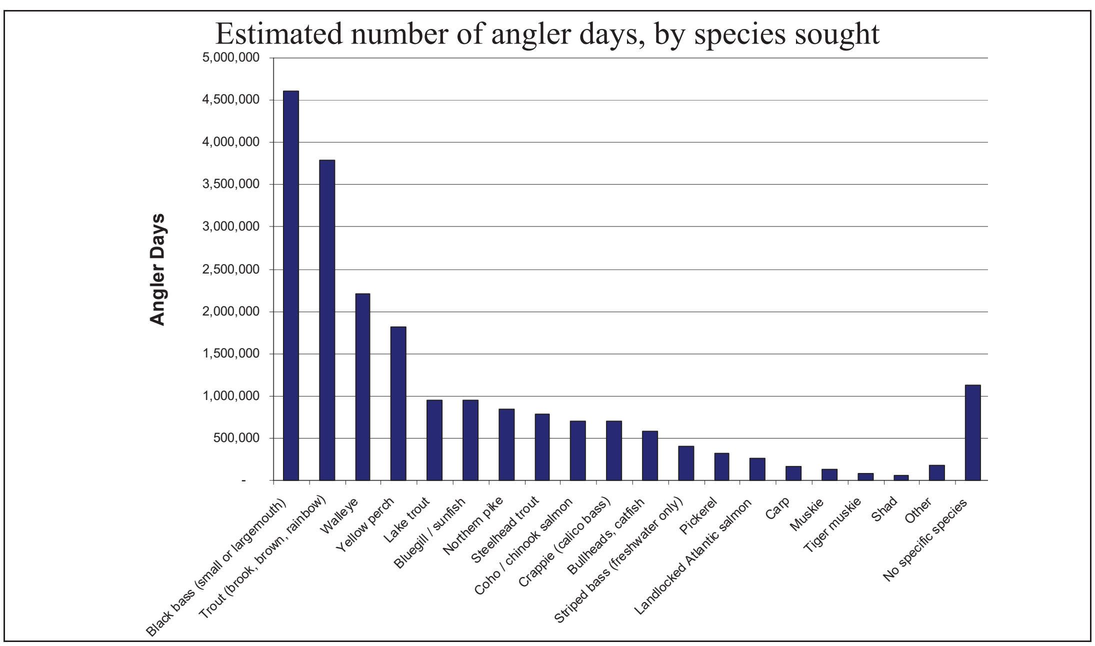
- Anglers spent an estimated 18.7 million angler days fishing New York's freshwaters in 2007. *An angler day is defined as any part of a day that a person spent fishing.* Effort divided between inland waters and Great Lakes waters was 81% and 19% respectively.



- Over 7 million days were spent fishing for warmwater gamefish. Almost 6 million days were spent in pursuit of coldwater gamefish. Fishing for panfish accounted for over 3 million days of effort, while fishing for marine/anadromous species in freshwater and carp accounted for less than half a million days each in 2007. Some anglers indicated that they fished for no species in particular or for other unclassifiable species, but this represented only 7 percent of the angler effort in 2007.

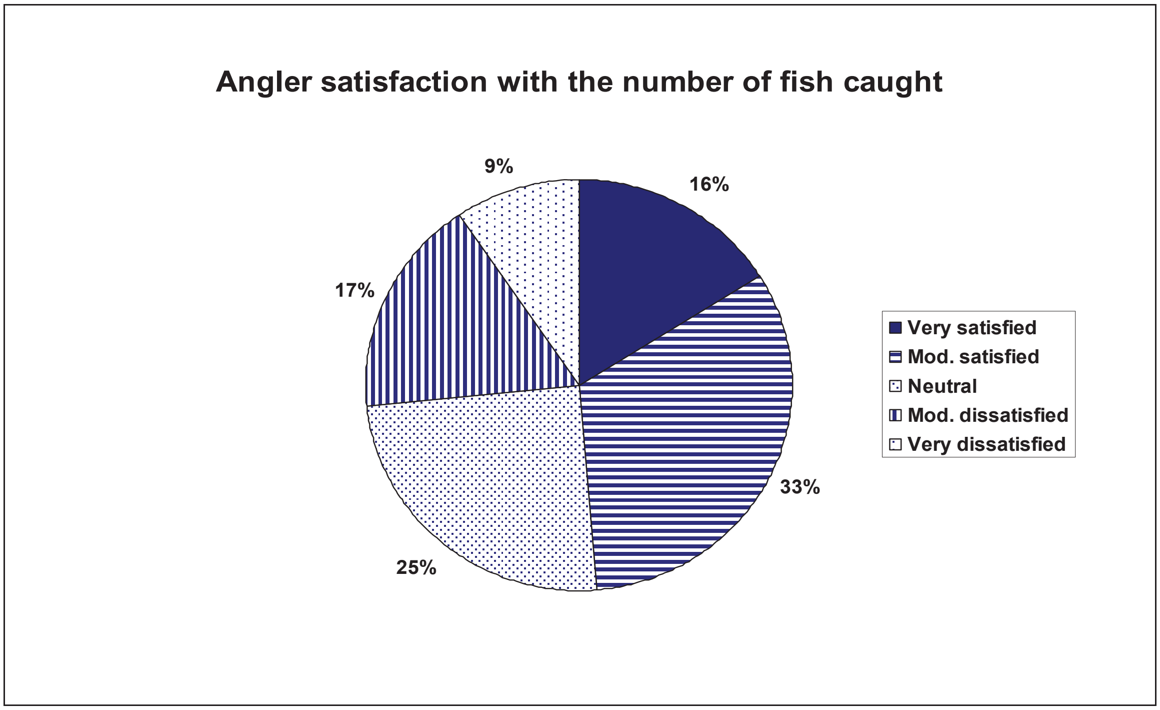


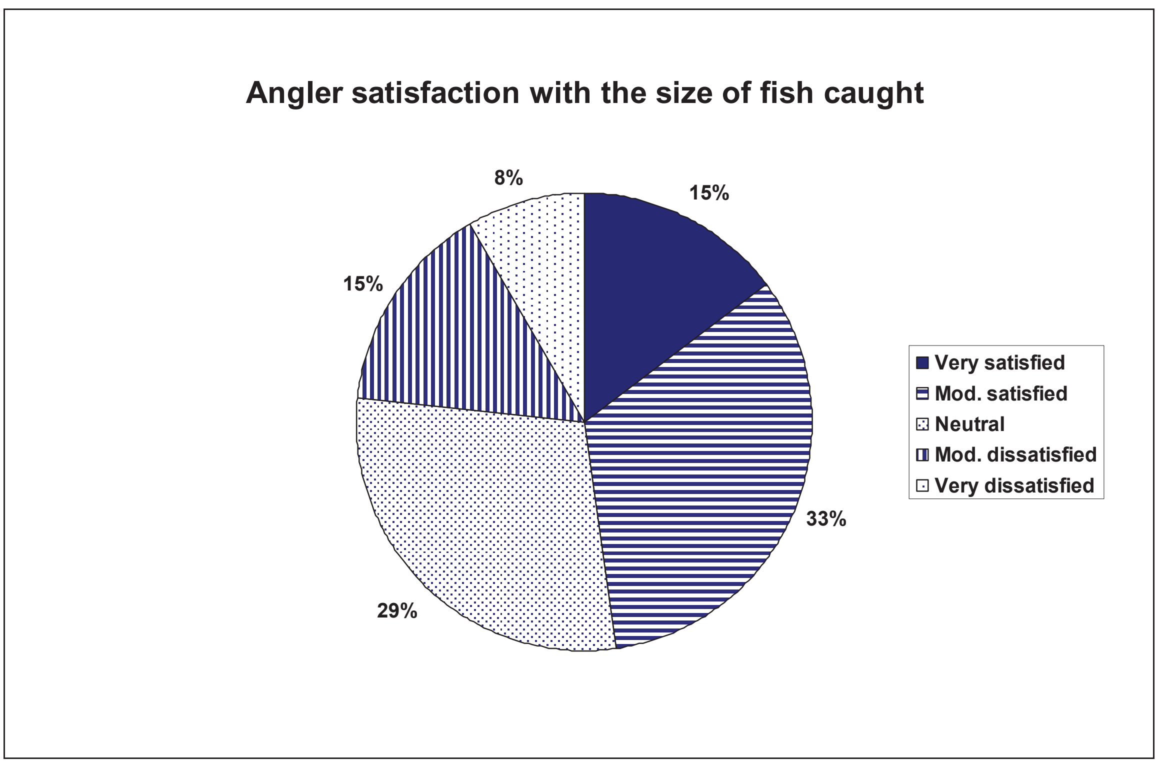
- The top species fished for in New York State was black bass (small or largemouth), which accounted for 4.6 million angler days. The three next most frequently fished for species or species groups were trout (brook, brown, or rainbow), walleye, and yellow perch accounting for over one million days of angler effort each.



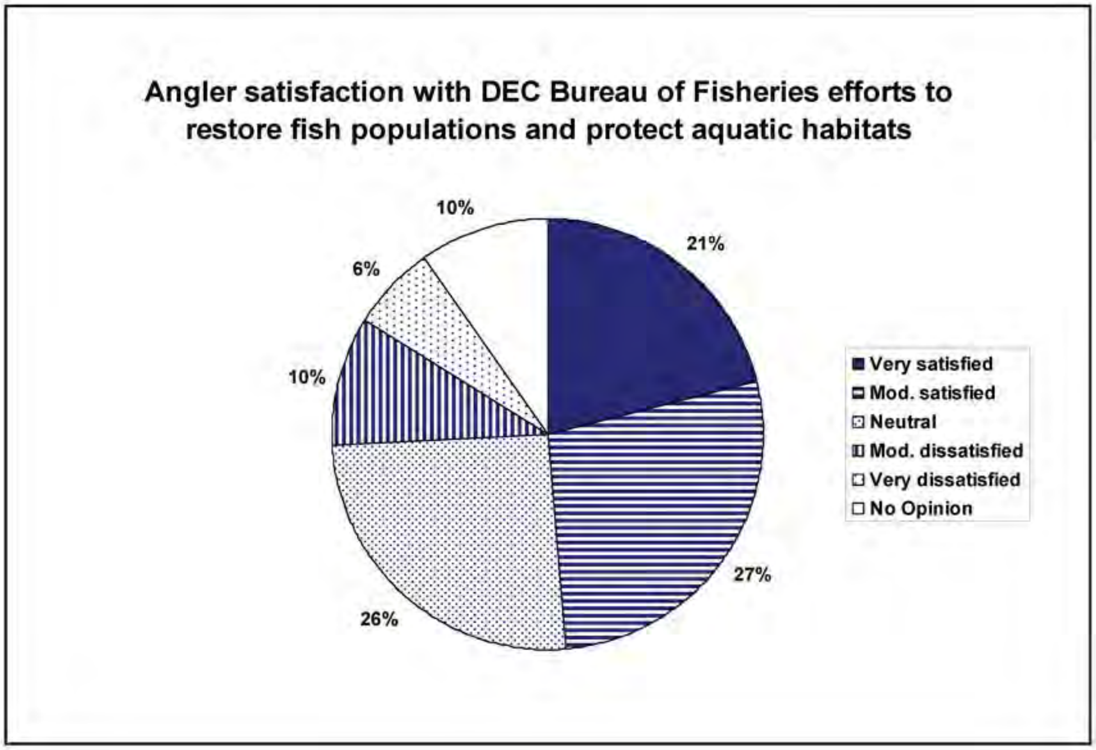
SATISFACTION

Approximately half of the anglers were satisfied with the number and size of fish they caught on their fishing trips.

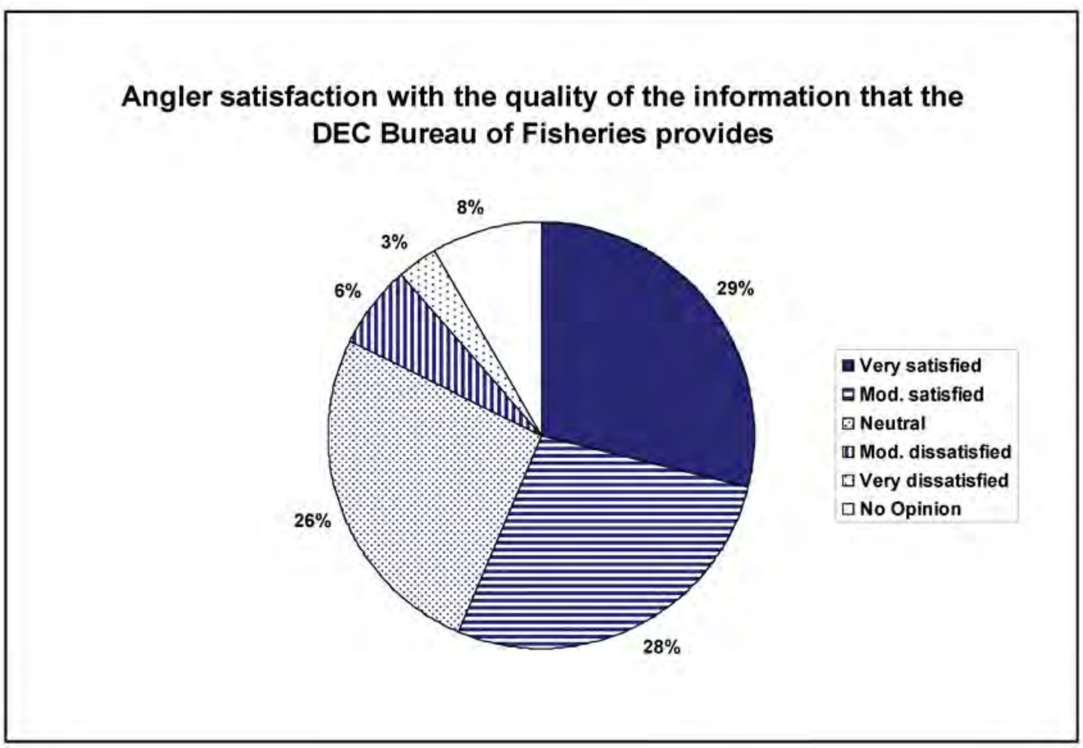




Almost half of the anglers were satisfied with the DEC Bureau of Fisheries efforts to restore fish populations and protect aquatic habitats.



Over half were satisfied or very satisfied with the quality of information that the Bureau provides, with only 9 percent indicating they were dissatisfied.



MOST FREQUENTLY FISHED WATERS

The top 10 most frequently fished water bodies in the state were:
1. Lake Ontario (1.3 million days)
2. Oneida Lake (786,000 days)
3. Lake Erie (658,000 days)
4. St. Lawrence River (651,000 days)
5. Hudson River (471,000 days)
6. Chautauqua Lake (414,000 days)
7. Niagara River (367,000 days)
8. Seneca Lake (340,000 days)
9. Salmon River (333,000 days)
10. Cayuga Lake (296,000 days)

EXPENDITURES

- New York's resident and nonresident anglers collectively spent an estimated $331 million at the fishing site and $202 million en route to the fishing site. Almost one-third (30%) of the total at-location expenditures were made by out-of-state anglers. Average daily trip-related expenses ($17.62 at-site plus $10.76 en route) for all anglers was $28.38 -- $22.36 for residents and $90.10 for nonresidents.

- The Great Lakes fishery generated an estimated $98 million in at-location expenditures, compared with $231 million for inland waters.

The five counties with the highest angler expenditures in 2007, at the location fished were:

• Oswego	$ 42,623,006
• Jefferson	$ 35,314,663
• St. Lawrence	$ 17,861,105
• Chautauqua	$ 15,353,656
• Warren	$ 13,804,053

TRENDS

- The estimated 18.7 million days spent fishing New York's freshwaters in 2007 was quite similar to the 1996 estimate of 18.6 million days. These estimates are both lower than the peak of 20.8 million days estimated in the 1988 survey. All of these estimates are higher than the 16 million days estimated in the 1970s.

- Effort associated with most of the major species increased between 1996 and 2007. Walleye and yellow perch effort increased substantially. There was also a sizeable increase in angler days for bluegill/sunfish over that same time period.

Estimated number of angler days fished by species sought, 1996 and 2007.				
	Angler Days			
	1996		2007	
Species Sought	Number	Confidence Limits, ±	Number	Confidence Limits, ±
Black Bass (small or largemouth)	4,627,280	215,840	4,613,610	265,493
Trout (brook, brown, rainbow, steelhead)*	4,044,620	309,340	4,572,639	316,038
Walleye	1,667,020	121,890	2,212,317	199,508
Yellow Perch	1,162,410	112,850	1,816,026	176,354
Lake Trout	762,050	92,070	954,511	100,865
Bluegill/Sunfish	647,600	71,970	944,978	117,242
Northern Pike	784,680	72,320	847,385	85,879
Coho/Chinook Salmon	604,190	64,560	700,250	74,832
Crappie (calico bass)	540,750	68,140	698,243	170,134
Bullheads, Catfish	511,540	65,560	578,396	83,513
Landlocked Atlantic Salmon	291,230	46,890	262,773	41,514
*Several categories had to be combined from the original data to create a comparable trout category.				

- Trends in angler effort by major water bodies can be traced back as far as the first statewide angler survey in 1973. While effort on some water bodies has remained relatively constant between 1996 and 2007 (e.g., Lake Erie, Salmon River), none of the major water bodies appears to have had level effort over the entire period (1973 to 2007). For example, Lake Ontario effort (and bays) increased rapidly into the 1980's and has gradually declined between 1996 and 2007.

Estimated number of angler days for major New York waters 1973, 1976-77, 1988, 1996, and 2007.					
	Angler Days				
Waterway	1973	1976-77	1988	1996	2007
Lake Ontario (and Bays)	664,000	1,027,000	2,568,610	1,730,350	1,553,223
St. Lawrence River	596,000	702,800	716,440	921,790	651,455
Lake Erie	697,000	663,000	945,500	609,340	657,821
Salmon River	126,000	178,100	329,090	344,230	332,827
Oneida Lake	693,000	703,400	782,400	573,060	786,401
Chautauqua Lake	283,000	417,700	438,980	460,090	413,961
Lake George	152,000	192,800	298,600	337,020	289,011
Niagara River	534,000	515,700	525,490	477,690	369,449
Hudson River	144,000	116,600	232,110	276,520	470,731
Delaware River (main stem)	*	*	163,219	146,160	128,344
Seneca Lake	274,000	399,800	350,130	455,500	340,290
Cayuga Lake	214,000	274,200	365,210	291,900	295,920
Lake Champlain	309,000	335,000	482,170	273,310	277,759
(Sources: Brown 1975, Kretser and Klatt 1981, Connelly et al. 1990, 1997.)					
*Comparable data not available					

- Recent significant increases in the estimated number of angler days include the Hudson River which totaled 470,731 in 2007, as compared with 276,520 in 1996, with notable increases in angler days expended for striped bass. Oneida Lake showed an estimated increase of over 200,000 angler days as compared to 1996, returning it to the level estimated in 1988.

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The survey was conducted by Tom Brown and Nancy Connelly of the Human Dimensions Research Unit at the Cornell Department of Natural Resources. Mr. Brown and Ms. Connelly designed and oversaw implementation of the survey, conducted the analysis of the data, and summarized the findings in four reports. The Bureau of Fisheries Angler Survey Team provided much input during the process, including in questionnaire design and analysis planning. Shaun Keeler and Steve Hurst of the New York State Department of Environmental Conservation (NYSDEC), Bureau of Fisheries, were the primary contacts throughout the study and headed up the Bureau Angler Survey Team. Other members of the team that provided invaluable help and support for the project were Melissa Cohen, Steve LaPan, Bill Culligan, Dan Bishop, Phil Hulbert, and Bill Schoch. NYSDEC consultant, Scott Houde, deserves recognition for the many hours he spent on sample selection. NYSDEC Bureau of Fisheries staff member, Casey Festa, is recognized for the many hours spent coding water bodies and checking data for the report.

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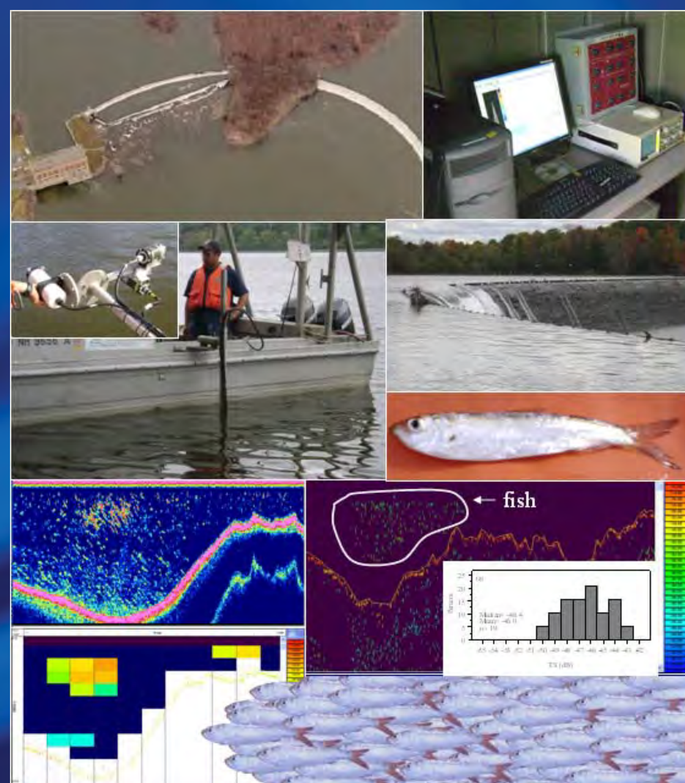
EDITOR'S NOTE
(Revisions / Corrections)

The Summary was modified in July 2009. Changes were to made to the *"Estimated number of angler days for major waters 1973, 1976-77, 1988, 1996, and 2007"* table to clarify the estimated angler days for the Delaware River (main stem). Some of the earlier yearly totals reported included estimated angler days for the West Branch Delaware River and East Branch Delaware River *(note that these are listed separately in Report 1 for year 2007).*

Hydroacoustic Studies of the Downstream Passage of Juvenile Blueback Herring in the Presence of Ultrasound at the Crescent Hydroelectric Project, Mohawk River, New York



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New York Power Authority
123 Main Street
White Plains, NY 10601
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December 2009

NORMANDEAU ASSOCIATES™
ENVIRONMENTAL CONSULTANTS

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Executive Summary

Juvenile blueback herring *Alosa aestivalis* migrate down the Mohawk River starting in late summer. The Federal Energy Regulatory Commission (FERC) license for the Crescent Hydroelectric Project (Crescent) stipulates that NYPA install an ultrasonic system to reduce the number of blueback herring passing through the turbines during their downriver migration and assess its effectiveness. Ultrasound has been shown to elicit avoidance reactions from river herring (blueback herring and alewives *Alosa pseudoharengus*).

At Crescent, the Mohawk River is impounded by two dams that are separated by an island. The main channel of the Mohawk River lies along the east side of the island. A shallower, secondary channel lies along the west side of the island and conveys water to the Crescent powerhouse. At Crescent, ultrasound is sound projected across the entrance of the secondary channel and is intended to steer juvenile blueback herring past the secondary channel and down the main channel.

Between 30 August and 5 October, 2008, the abundance of fish passing through the main channel upriver of the ultrasound (UM), in the main channel downriver of the ultrasound (DM), and in the secondary channel downriver of the ultrasound (DS) was continuously monitored using horizontally-aimed and upward-looking transducers attached to mounts located on the riverbed at each channel location. Flow and volume were also continuously monitored at DM and DS using an acoustic Doppler current profiler (ADCP) aimed across the channels from near shore. Data from the fixed-location transducers and the ADCPs were supplemented with data from a vessel-mounted echosounder with a horizontally- and a vertically-aimed transducer, and a vertically-aimed ADCP that traversed the river at multiple locations.

Cast net catches verified that juvenile blueback herring were present in the main channel and secondary channel; however, the fish communities of UM and DM were much more similar to one another than they were to that at DS, based on gill net catches. Furthermore, the depth profiles of UM and DM were much more similar to one another than they were to that at DS; DS was more shallow and narrow. Therefore, the abundance of fish passing through DM and UM was used to assess the percentage of fish that migrated past the entrance to the secondary channel.

The fixed-location transducers were well situated to monitor passage of fish through UM and DM, based on the distribution of fish observed with the vessel-mounted transducers. The percentage of fish at UM that passed through DM (31.3%) was almost three times greater than that expected (11.5%) based on the proportion of water volume that passed through DM compared with the combined water volume that passed through DM and DS, assuming that downriver movement of juvenile blueback herring is directly proportional to the water volume flowing through the main channel compared with the secondary channel. The most plausible explanation for the difference between the observed and expected values appears to be the presence of ultrasound that steered juvenile blueback herring past the entrance to the secondary channel. If ultrasound increased the proportion of fish at DM from 11.5% to 31.3%, the proportion of fish at DS decreased from 88.5% to 68.7%, which corresponds to about a 23% reduction in the number of fish entering the secondary channel. This reduction underestimates the reduction in blueback herring because it includes other fishes that most likely do not react to ultrasound.

Echo-integrated Estimates of Downstream Passage of Juvenile Blueback Herring from Fixed-location Hydroacoustic Monitoring

Introduction

Fixed-location hydroacoustics have been used for monitoring fish passage in rivers impounded by hydroelectric dams (Ransom et al. 1998; Skalski et al. 1996; Steig and Iverson 1998; Steig and Johnston 1996). Skalski et al. (1996) estimated turbine bypass efficiency to be from 76 to 97% for three species of salmonids (*Oncorhynchus* spp.) at Wells Dam on the Columbia River, Washington, using 25-29 split-beam transducers operating at 420 kHz. Steig and Johnston et al. (1996) and Steig and Iverson (1998) used horizontal scanning, 420-kHz spit-beam transducers to track fish trajectories and estimate fish density of downstream migrating juvenile salmonids at Rocky Reach and Rock Island Dams on the Columbia River, Washington, USA. Ransom et al. (1998) provides a review of fixed-location split-beam hydroacoustics for monitoring migration of salmonids from over a dozen river systems. Studies monitoring clupeids migrating in freshwater rivers, reservoirs, and lakes using fixed-location hydroacoustics is limited (Ross et al. 1993) compared to abundance and distribution of clupeids estimated by mobile hydroacoustic surveys (Brandt et al. 1991; Fabrizio et al. 1997; Nestler et al. 2002; Warner et al. 2002).

Acoustic backscatter can be quantified for estimating fish abundance by three principal methods: image analysis, echo integration and echo counting. Image analysis of acoustic backscatter collected from fisheries sonars can provide a relative index of fish abundance based on the video screen or echogram pixel intensity or counts of discrete clusters of similar pixel intensity (Gerlotto et al. 2000; Misund 1993). An echo can be defined as part of the received signal from scattering that is above a pre-defined detection threshold. The total echo energy of a sampled volume has been shown to be linear with fish abundance (Foote 1983), thus integration of echo energy over some distance, depth or time intervals can provide an estimate of fish density by dividing the echo integrals by a representative back-scattering cross-section of an individual fish (Brandt et al. 1991; Simmonds and MacLennan 2005). Conversion of echo integration data to fish densities assumes the fish are randomly and uniformly distributed throughout the cross section of the acoustic beam over many transmissions (Simmonds and MacLennan 2005). Individual targets can not be resolved from echo integration over large spatial or temporal intervals relative to the size or movement of the individual or when individuals are close together (i.e., within a half of a pulse length apart). Echo counting or tracking successive echoes can be used to estimate abundance and movement of individual fish (Clay and Medwin 1977; Kieser and Ehrenberg 1990; Mulligan and Kieser 1996; Ross et al. 1993; Simmonds and MacLennan 2005).

Anadromous fish such as clupeids and salmonids, encounter hydroelectric dams during their upstream or downstream migration. The potential impacts of physical obstruction or turbine-related mortality at hydroelectric facilities have been the subject of many hydroacoustic studies (Moursund et al. 2003; Skalski et al. 1996; Steig and Iverson 1998). Sound used as a fish deterrent has been studied as a method to reduce entrainment and increase passage of clupeids at hydroelectric dams (Gibson and Myers 2002; Nestler et al. 1992). The use of high-frequency sound of 122-128 kHz as a fish deterrence system has been shown to reduce impingement of alewives (*Alosa pseudoharengus*) at power plant intakes (Ross et al. 1996; Ross et al. 1993).

Juvenile blueback herring (*Alosa aestivalis*) migrate down the Mohawk River during the fall. During that time, they can migrate downriver through the main channel that leads to the Waterford Flight or through a secondary channel that conveys water to the Crescent Hydroelectric Project (Crescent). The primary objective of this study was to determine, using fixed-location hydroacoustics, if a system that produced ultrasound steered the preponderance of juvenile blueback herring past the entrance of the secondary channel so that they migrated down the main channel of the river. If the ultrasound system did not steer the preponderance of juvenile blueback herring past the entrance to the secondary channel, the objective was to determine if the proportion of fish migrating past the entrance to the secondary channel was significantly greater than that expected based on water flow. To address the first objective, the abundance of fish migrating through the main channel and through the secondary channel downriver of the ultrasound system was calculated and compared. If the abundance of fish migrating through the main channel was not the preponderance of fish migrating downriver through both the main channel and the secondary channel, the abundance of fish migrating down the main channel upriver of the ultrasound system and downriver of it was calculated and compared.

Methods

Sampling design.—Abundance of juvenile blueback herring migrating downstream in the Mohawk River upriver and downriver of the ultrasonic system (122-128 kHz) at Crescent was continuously monitored by fixed-location hydroacoustics from 30 August 2008 through 5 October 2008. A linear array of three 420-kHz side-looking, single beam transducers and two upward-looking, 420-kHz split-beam transducers were multiplexed to a digital echosounder (Model 243, Hydroacoustic Technology, Inc.[HTI], Seattle, WA, USA) at three locations: upstream of the ultrasonic system in the main channel (UM), downstream of the ultrasonic system in the main channel (DM), and downstream of the ultrasonic system in the secondary channel that leads to the hydroelectric turbine (DS; Figure 1). The average cross-sectional area of the river channel at each transducer array was 1,300 m^2 at UM, 1,111 m^2 at DM, and 549 m^2 a DS (Figure 2). The UM site extended from the east river bank to the east side of a shoal overgrown with water chestnut vegetation and <0.5 m in water depth. Water temperature recorded from two HOBO Water Temp Pro data-loggers during the study averaged 20.7°C and ranged from 16.7°C to 23.4°C (see Appendix A). The nominal beam widths were 6° x 12° for side-looking transducers and 15° circular for the up-looking split-beam transducers. Three poor performing 6° x 12° single beam transducers were replaced with 6° circular single beam transducers (Table 1). Collectively, the horizontally-aimed transducers on average sampled 12% of cross-section of the channel at UM, 15% of cross-section of the channel at DM, and 14% of cross-section of the channel at DS. Each transducer was configured to ping at a 0.2 ms pulse duration sequentially for a 2-minute interval at 5 Hz for the single beams and 10 Hz for the split beams. All transducers were calibrated using a US Navy standard transducer of known sensitivity (Urick 1983; see Appendix B). All transducers were fitted to steel pipe frames and mounted securely on the river bottom and operated from sheds (Figure 3).

Acoustic data collection.—Acoustic backscatter was quantified by echo integration in real time and acquired with DEP version 3.56 data acquisition software (HTI). Echo integration assumes the targets are randomly and uniformly distributed throughout the cross-section of the acoustic beam (Simmonds and MacLennan 2005). This assumption may be violated for a side-looking transducer if fish are consistently biased in their vertical (depth) distribution (e.g., surface oriented), but results could still be compared among locations with similar vertical fish distributions. A -50 dB on-axis echo integration threshold was used to exclude echo contributions

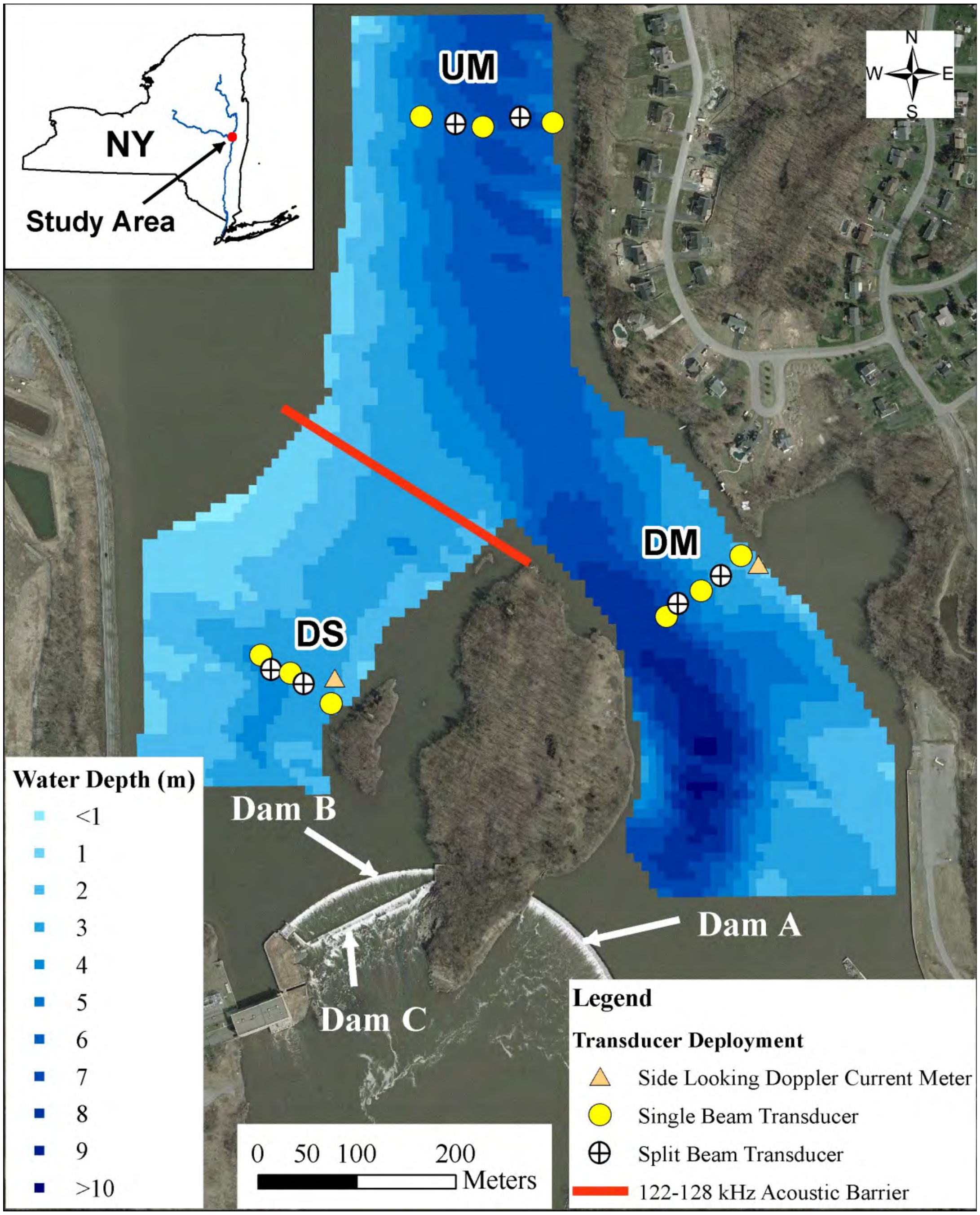

FIGURE 1.—Map of the fixed-location, hydroacoustic sampling design for monitoring migrating juvenile blueback herring through the Crescent Hydroelectric Project on the Mohawk River from 30 August through 5 October 2008. Bathymetry was spatial interpolated from bottom detections during a mobile acoustic survey on 20 September 2008 using a 420-kHz split-beam echosounder (See Appendix I).

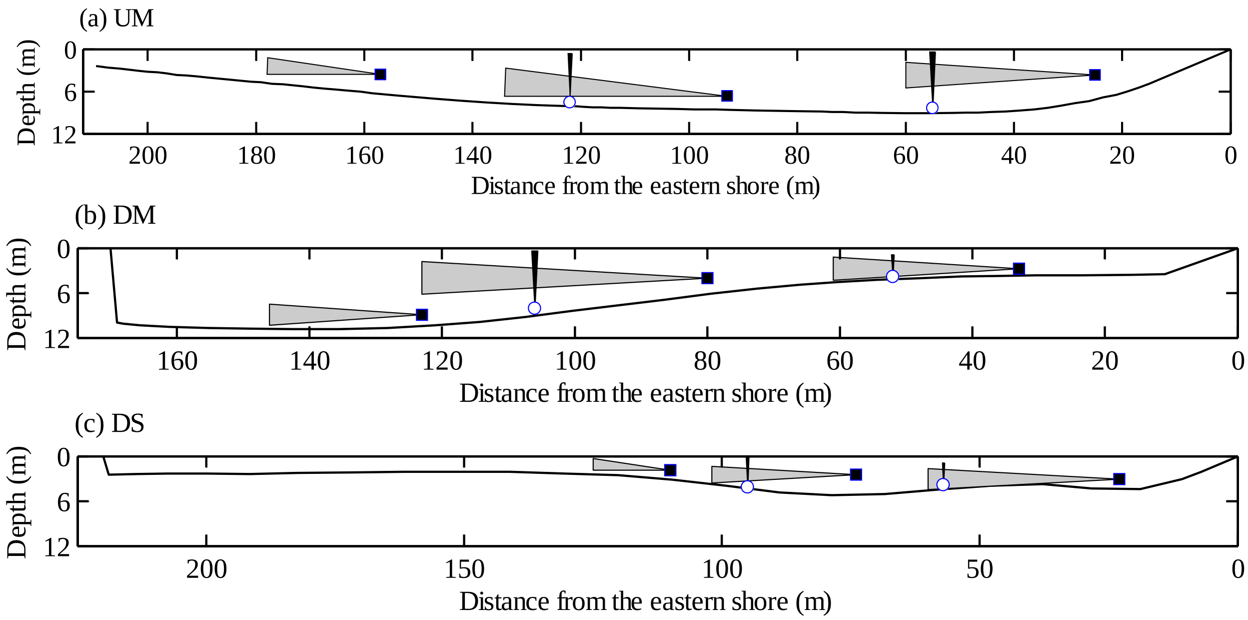

FIGURE 2.—Effective sampling cross-sectional areas of acoustic beams from three side-looking, 420-kHz single-beam transducers (solid squares) and two up-looking, split-beam transducers (open circles) relative to the cross-section of the Mohawk River being sampled (a) upstream of the ultrasonic system in the main channel (UM), (b) downstream of the ultrasonic system in the main channel (DM), and (c) downstream of the ultrasonic system in the secondary channel (DS) for continuous monitoring of migrating juvenile blueback herring from 30 August through 5 October 2008.

TABLE 1.—Sampling characteristics of the 420-kHz single-beam and split-beam transducers multiplexed to a digital echosounder (Hydroacoustics Technology, Inc., Model 243) used to monitor passage of juvenile blueback herring at the Crescent Hydroelectric Project.

Site	Channel location of the transducer (serial no.)	Beam Pointing Angle* (0°)	Beam type	3-dB beam width (°)	Amplitude scaling factor**	Transducer Height (m)	Maximum 1-m range stratum*** (m)	Bottom Water Depth (m)
UM	East (37)	0	Single	5.9 x 11.0	1.667×10^{-4}	1.8	35	5.5
	East (2110930)	90	Split	7.5 x 7.7	1.629×10^{-4}	0.4	7	8.8
	Middle (55)	0	Single	5.7 x 5.9	1.121×10^{-2}	1.8	40	8.5
	West (2110931)	90	Split	7.6 x 7.6	3.962×10^{-4}	0.4	6	8.2
	West (21-6)	0	Single	6.3 x 6.3	3.139×10^{-3}	1.9	21	5.5
DM	East (23)	0	Single	6.2 x 12.4	3.841×10^{-4}	0.9	28	3.7
	East (2110932)	90	Split	7.9 x 7.9	1.125×10^{-4}	0.4	2	4.3
	Middle (22)	3	Single	5.8 x 12.4	7.446×10^{-4}	0.9	42	4.9
	West (2110933)	90	Split	7.4 x 8.0	1.631×10^{-4}	0.4	6	8.5
	West (26)	3	Single	6.0 x 12.3	1.569×10^{-4}	1.8	25	10.7
DS	East (75)	0	Single	5.8 x 6.0	6.012×10^{-3}	1.5	26	4.6
	East (2110927)	90	Split	7.9 x 8.0	1.312×10^{-4}	0.4	2	4.3
	Middle (21)	0	Single	5.5 x 12.1	2.198×10^{-4}	1.5	27	4.0
	West (2110929)	90	Split	7.0 x 7.5	1.081×10^{-3}	0.4	3	4.6
	West (35)	0	Single	6.2 x 11.9	1.534×10^{-4}	1.8	14	3.7

[*] Beam pointing angle is reference to horizontal (e.g., 90° = up-looking from bottom, 0° = side-looking)
[**] Amplitude scaling factor converts voltage to s_v based on equipment sensitivity and beam width
[***] Echo energy was spatially integrated over 1-m range strata defining by the beginning range (e.g., 1 m represents the 1-2 m range interval).

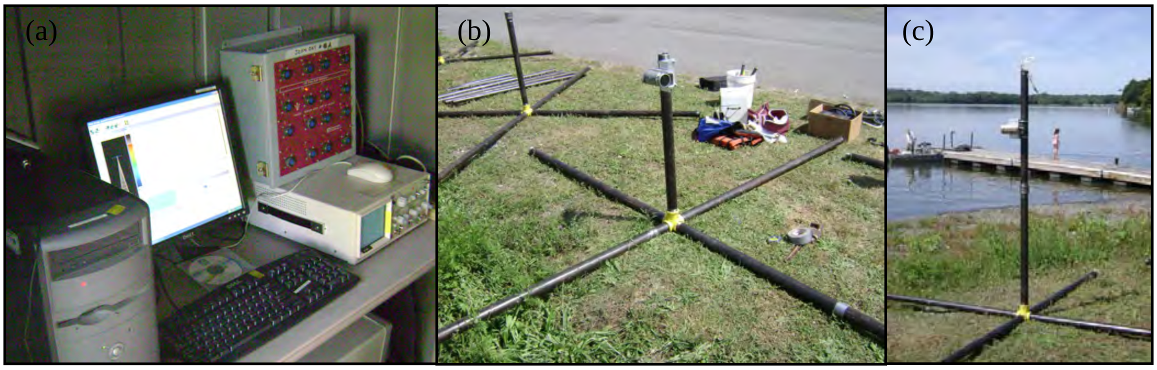

FIGURE 3.—(a) HTI scientific echosounder system (Model 243) with multiplexed 420-kHz single- and split-beam transducers installed in sheds at each of the three channel locations, (b) ~1-m and (c) 2-m high side-looking 6° x 12° elliptical single beam transducer attached to a steel pipe bottom mount.

from ambient noise based on several criteria. The sampling configuration was based on the assumption of quantifying large juvenile blueback herring schools as opposed to echo counting which would only count individuals on the periphery of schools or loosely-organized groups of fish (see Appendix C). A constant minimum threshold was conservatively selected to exclude noise and boundary interferences during real-time echo integration by the HTI echosounder system. Echo amplitudes were adjusted for beam spreading and absorption loss with an applied time-varied gain (TVG) function of $20\text{Log}_{10}R$ where R is range (m) and a range-dependent absorption loss gain (αR) where α = 54.8 dB/km (Foote 1983; Simmonds and MacLennan 2005). Echo energy (root-mean-square voltage) was integrated over 1-m range strata and 2-minute intervals.

Data analysis.—Data from real-time echo integration were displayed as an echogram and those strata with amplitude patterns classified as non-biological scatterers were excluded from analysis using Echoscape version 2.12 Build 12 software (HTI, Seattle, WA, USA; Figure 4). The acoustic index of abundance of juvenile blueback herring used was the volume backscattering coefficient (s_v), m^{-1}) defined by MacLennan et al. (2002) and Johannesson and Mitson (1983) as:

$$s_v = \frac{\sum \sigma_{bs}}{V_0} = V_{rms}^2 A_{equip}\,, \qquad \text{(Eq. 1)}$$

where σ_{bs} = backscattering cross-section (m^2), which is the physical quantity of the acoustic reflectivity of an individual and V_0 = sampled volume (m^3). The acoustic pressure scattered from the multiple targets in the insonified sample volume is converted at the transducer face to a voltage response which is a relative output. The relative output is scaled to provide absolute quantitative estimates of acoustic backscatter by applying the system parameters after adjusting for acoustic absorption loss and beam spreading. The root mean squared voltage (V_{rms}) was converted to s_v by multiplying by the amplitude scaling factor for the equipment (A_{equip}, in units of $m^{-1}V^{-2}$), which was defined as

$$A_{equip} = \frac{1}{c\tau\pi b_{av}^2(\theta,\phi)P_o^2G_x^2}\,, \qquad \text{(Eq. 2)}$$

where c = sound speed (m/s), τ = pulse duration (s), π = constant pi (~3.14), $b_{av}^2(\theta,\phi)$ = beam pattern factor, P_o^2 = transmit pressure level (μPa^2 at 1 m), and G_x^2 = squared through-system gain ($V_{rms}^2/\mu Pa^2$). Numerical fish density (ρ, fish/m^3) was estimated by

$$\rho = \frac{s_v}{\langle\sigma_{bs}\rangle}\,, \qquad \text{(Eq. 3)}$$

where $\langle\sigma_{bs}\rangle$ = the mean backscattering cross-section of an individual fish representative of the fish population being assessed, which can be

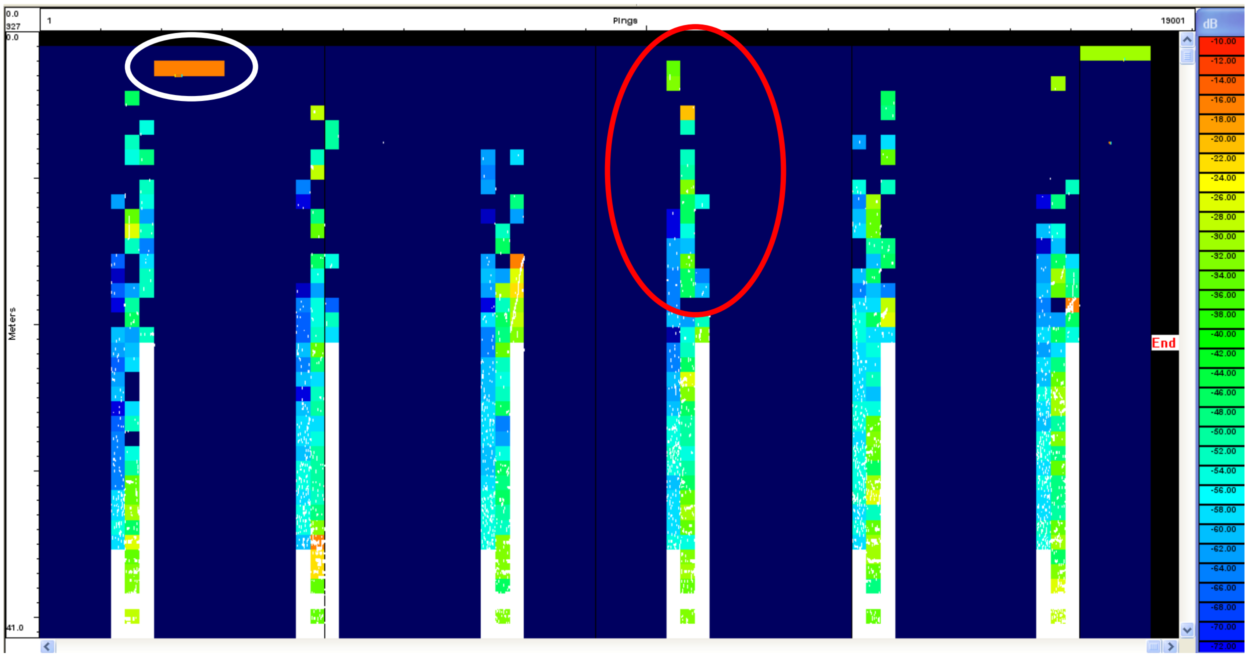

FIGURE 4.—An example of an echogram displaying echo integrated cells (2-minutes wide by 1-m high) with ping number on the x-axis and range on the y-axis. Features shown in red circles represent echo energy from fish detected by side-looking, single beam transducers sampled at 5 pings per second. The features within the white circle represent echo energy of fish detected in the up-looking split-beam transducers sampled at 10 pings per second. The white pixels are strata from the single beam transducers that are excluded from analysis as non-biological scatter (e.g., boundary interference).

extracted from the mean of the target strength (TS) distribution of the fish being surveyed by ($\langle\sigma_{bs}\rangle = \langle 10^{(TS/10)}\rangle$). For this study, the $\langle\sigma_{bs}\rangle$ used to derive fish densities was based on the estimated mean TS of juvenile blueback herring (-48.6 dB) from *in situ* split-beam measurements of verified schools of juvenile blueback herring in the Crescent headrace during mobile surveys on 3 and 5 October 2008 (see Appendices C and D). The species composition of the insonified aggregations of fish during the course of the study period were not 100% juvenile blueback herring based on gill net sampling, but echo integration would provide a reliable relative index of schooling juvenile blueback herring provided that fish assemblages at the sites compared were similar. Use of the mean TS of juvenile blueback herring to estimate fish density may have contributed to overestimating densities of juvenile blueback herring by inclusion of volume backscatter of larger fish. Therefore, fish densities estimated from echo integration by the side-looking single beam transducers served as a relative index of abundance for comparative purposes and not as absolute abundance.

The temporal and spatial distribution of juvenile blueback herring was described by hourly mean s_v time series for each site and location within each site, daytime and nighttime mean s_v, and vertical s_v distribution at each location with each site. The mean daily difference in mean s_v between day (0600-1700) and night (1700-0600) at each location within a site was tested (H_0: mean day-night s_v difference = 0) with a paired t-test.

The number of juvenile blueback herring that migrated downriver (N_d) at DM and UM during each day (n=37) was estimated as

$$N_d = TFA \qquad \text{(Eq. 4)}$$

where T = the number of seconds in a day, F = fish flux, and A = the cross-sectional area of the river channel in the vertical plane. Fish flux (number of fish/m^2 s) was estimated similarly to Mulligan and Kieser (1996) as

$$F = \bar{\rho}\,\bar{R}_d\ \bar{p}_d \qquad \text{(Eq. 5)}$$

where $\bar{\rho}$ = mean fish density over the acoustic beams for a time period (e.g., hour, day, or study period), $\bar{R}_d$ = mean net rate of downstream movement of fish, and $\bar{p}_d$ = proportion of fish moving downstream. Daily estimates of $\bar{R}_d$ and $\bar{p}_d$ at UM and DM were based on manually-tracked fish from the two bottom-mounted, up-looking split-beam transducers at each location (see Appendices E and F). Daily mobile ADCP transects (see Appendix G) were not performed at UM and DM, therefore A at UM was based on the channel geometry from a single ADCP transect and A at DM was based on an average cross-sectional area from continuous monitoring of the water level coupled with the channel geometry from an ADCP transect. Because relatively few fish were tracked at DS due to the narrow beam width and relatively shallow water (compared with UM and DM), N_d for DS was calculated using the time-series average for each parameter in equation 4.

The proportion of fish passing downstream through the main channel downriver of the ultrasonic system was defined as

$$P_{DM} = N_{DM} / N_{UM} \qquad \text{(Eq. 6)}$$

where $N_{DM} = N_d$ at DM and $N_{UM} = N_d$ at UM.

The expected number of downstream migrants at DM (N_{exp}) was estimated as

$$N_{exp} = N_{UM}\left(V_{DM} / \left(V_{DM} + V_{DS}\right) \right) \qquad \text{(Eq. 7)}$$

where V_{DM} and V_{DS} were the volume of water moving downstream at DM and DS, respectively, assuming that N_{DM} and N_{DS} are directly proportional to V_{DM} and V_{DS}. This assumption is reasonable for species (like blueback herring) that don't stage during downriver migrations (Gibson and Myers 2002). The sum of V_{DM} and V_{DS} provided an estimate of the volume of water passing through UM in the absence of continuous ADCP measurements at UM, N_{exp} was calculated using the time series of flow measurements that were subset based on observations when data were available at both DM and DS. Daily mean s_v and $\bar{\rho}$ were based on hourly averages. Daily $\bar{R}_d$ and $\bar{p}_d$ were based on pooled data of manually-tracked fish within a day at UM and DM. Daily water volumes were based on a sum of the hourly summed paired observations of volume estimates at DM and DS from continuous ADCP measurements. The volume at DS was derived from a velocity-index estimate of mean channel velocity while the volume at DM was based on the theoretical mean channel velocity (see Appendix G).

The comparison between N_{DM} and N_{exp} was made by testing the null hypothesis that the average daily difference was zero using a Wilcoxon signed-rank test for paired samples at $\alpha = 0.05$. A non-parametric test was used because values did not meet the normality assumption of a parametric paired t-test. An estimate for the number of downstream migrants at DS (N_{DS}) was also estimated based on the average of the entire time series but not compared to N_{DM} for the more limited time series or used in calculation of P_{DM} for several reasons. The depth distribution of fish between DS and DM was assumed to be quite different based on channel cross-sectional geometry, and therefore would not meet or equally violate the assumption for echo integration to be based on a random distribution of fish throughout the beam cross-section. The assumption of fish being randomly distributed vertically was tested at each up-looking, split-beam transducer location by comparing observed proportions of s_v in upper and lower water column to the expected proportions (1:1) of a uniform depth distribution using a chi-square test. Vertical s_v distributions between two locations were also compared using multiple pair-wise chi-square tests. A Bonferroni-corrected alpha level (α =0.05/15=0.003) was used to reduce the error rate of falsely rejecting the null hypothesis of no association between depth and location by making 15 pair-wise comparisons. The vertical s_v distribution was first pooled into two classes, surface and bottom based on a mid-depth, to avoid complications of comparing distributions of different number of bins (e.g., 2 depth bins at DS east compared to 7 depth bins at UM east).

As a result of a shallower channel at DS, the number of individuals that could be tracked by the split-beam transducers was insufficient to estimate daily N_{DS}. There was also uncertainty to the equality between N_{UM} and the sum of N_{DM} and N_{DS} as a result of potentially undetected fish at DS (e.g., passage over the heavily-vegetated shoal or between islands). Because s_v was not classified or partitioned by species, comparison in echo-integrated estimates of juvenile blueback herring abundance between sites assumes fish assemblages were similar between sites. Gill net sampling confirmed the fish community between DM and UM was similar, but was not similar between DS and DM (see Appendix H). For these reasons, and because UM and DM were more similar in channel cross-section and depth distribution of fish, N_{DM} and N_{UM} were compared.

Results and Discussion

Temporal distribution.—The temporal pattern and magnitude of s_v differed among river channels. The s_v at UM and DS was episodic but the episodes at UM were fewer and smaller than at DS (Figure 5). At UM, the highest s_v episode occurred from 6-7 September and a diel cyclic pattern occurred during a substantial portion of the time series. At DS, the highest s_v episode occurred on 4 September, i.e., before the highest episode at UM. At DM, the s_v episodes were negligible.

Diel differences in site-averaged s_v were observed at all three sites, but were not consistent among sites (Table 2). Daytime mean s_v in the middle channel of UM was on average less than the daytime mean s_v (Figure 6), but this diel difference was not significant in the east or west sides of the channel. At DM and DS, observed daytime mean s_v was significantly greater than nighttime mean s_v at all locations, except the west DM channel where nighttime mean s_v was significantly greater than daytime mean s_v. The greatest diel difference in mean s_v at DM and DS was observed in the east side of the channel, where mean s_v was significantly greater at day than at night (Figure 6, Table 2). The greatest diel differences were observed in the locations of highest overall mean s_v. The higher s_v during the night at UM and higher s_v during the day at DM and DS could not be explained unless if these diel differences were a result of juvenile blueback herring altering their behavior and detectability after encountering the ultrasound.

Spatial distribution.—The spatial pattern and magnitude of s_v differed within and among river channels. The s_v at UM middle and UM west was episodic but the highest episode occurred at UM middle from 6-7 September; the s_v episodes at UM east were negligible (Figure 7). The s_v at DM middle, DM east, and DM west was episodic but higher episodes generally occurred at DM east than at DM middle and DM west (Figure 8). The s_v was episodic at DS east and much higher at DS east than at DS, middle and DS west (Figure 9).

Vertical distribution of mean s_v was shown for each 1-m depth strata in Figure 10. In general, s_v was significantly different between the upper and lower water column at all locations, with the exception of DM west and UM east. The proportion of mean s_v between the upper and lower water column was significantly different among all pair-wise comparison except between DM west and UM east, DM west and UM west, DS east and UM east, DS east and DM west, and UM east and UM west.

The mean S_v and the mean fish density from the hourly-averaged time series were higher at DS than at UM and higher at UM than at DM (Table 3). At UM the mean S_v and the mean fish density were highest in the center of the channel; at DM and DS the means were highest in the eastern section of the channel.

Fish density and abundance.—The mean daily N_d was about 4.2 times higher at UM than at DM (Table 5). The average daily difference between

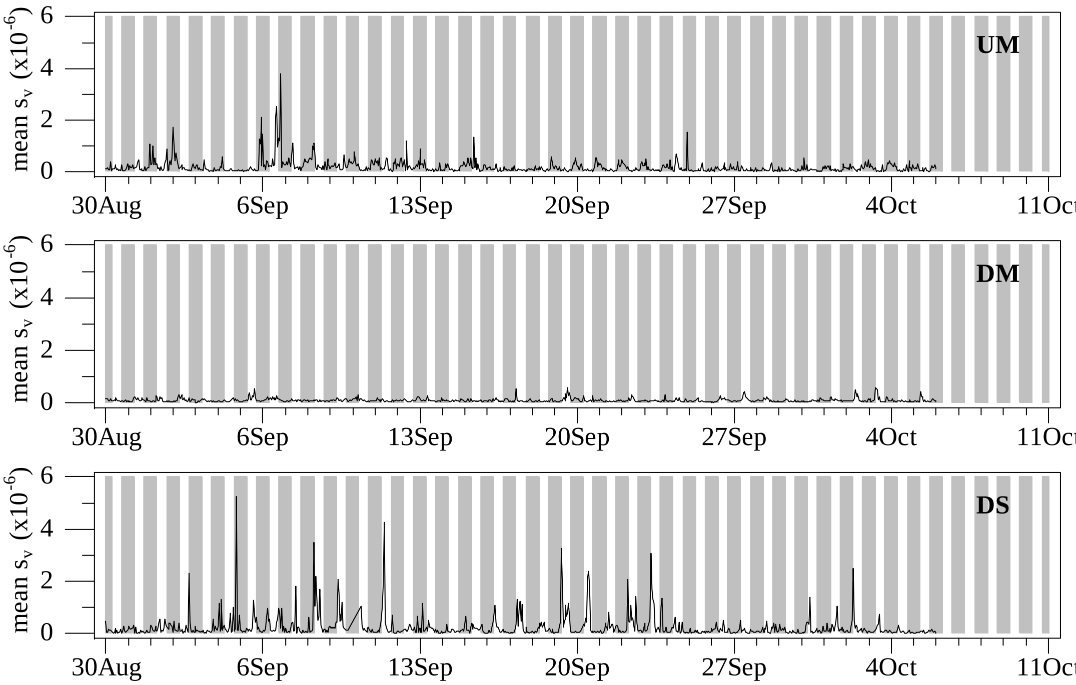

FIGURE 5.—Time series of the hourly mean volume backscattering coefficient (s_v, x10^{-6} m^{-1}) of fish detected by three side-looking, single beam transducers (420 kHz, HTI) sampling upstream of the ultrasonic system in the main channel (UM, top), downstream of the ultrasonic system in the main channel (DM) and downstream of the ultrasonic system in the secondary channel (DS) at Crescent Hydroelectric Project, Mohawk River, New York. Gray vertical bars represent a fixed night period (1700-0600).

TABLE 2.—Results from paired t-tests of day-night differences in site-averaged and transducer-averaged volume backscattering coefficients (s_v, m^{-1}) measured by three side-looking, single beam 420 kHz transducers (east, middle, and west channel locations) upstream of the ultrasonic system in the main channel (UM), downstream of the ultrasonic system in the main channel (DM), and downstream of the ultrasonic system in the secondary channel (DS) during the downstream migration of juvenile blueback herring (30 August – 4 October 2008) at the Crescent Hydroelectric Project, Mohawk River, New York.

Site	Channel location of the transducer	Mean* s_v (m^{-1}) Day (0600-1700)	Night (1700-0600)	Day-Night	*t*	*p*
UM	East	9.98×10^{-9}	10.97×10^{-9}	-0.99×10^{-9}	-0.50	0.6228
	Middle	2.06×10^{-7}	4.36×10^{-7}	-2.30×10^{-7}	-5.80	<0.0001
	West	2.20×10^{-7}	1.64×10^{-7}	0.56×10^{-7}	1.36	0.1818
	All	1.37×10^{-7}	2.15×10^{-7}	-0.81×10^{-7}	-3.87	0.0005
DM	East	2.56×10^{-7}	1.37×10^{-7}	1.18 x10-7	5.90	<0.0001
	Middle	6.98×10^{-8}	4.51×10^{-8}	2.47×10^{-8}	2.40	0.0217
	West	1.42×10^{-8}	5.21×10^{-8}	-3.78×10^{-8}	-4.94	<0.0001
	All	4.99×10^{-8}	3.01×10^{-8}	3.60×10^{-8}	4.87	<0.0001
DS	East	8.00×10^{-7}	3.29×10^{-7}	4.71×10^{-7}	3.34	0.0020
	Middle	1.01×10^{-8}	3.42×10^{-9}	6.66×10^{-9}	6.32	<0.0001
	West	7.97×10^{-8}	2.61×10^{-8}	5.36×10^{-8}	3.87	0.0004
	All	3.32×10^{-7}	1.34×10^{-7}	1.98×10^{-7}	3.62	0.0009

* Daily nighttime and daytime mean s_v were based on averages of the hourly mean s_v.

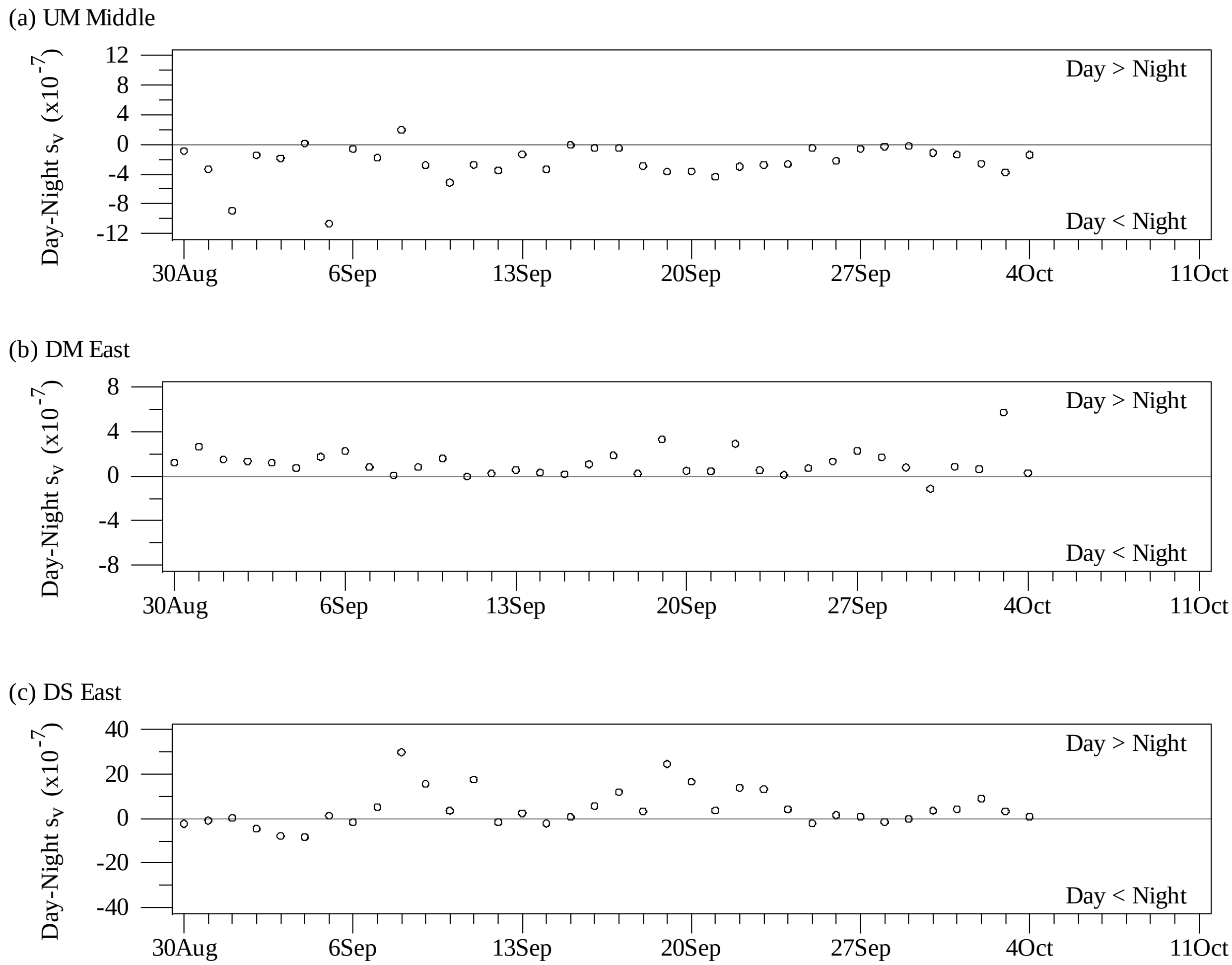

FIGURE 6.—Time series of the daily difference in mean volume backscattering coefficient (s_v, x10^{-6} m^{-1}) of fish between day (0600-1700) and night (1700-0600) detected by side-looking, single beam transducers (420 kHz, HTI) at the locations with the largest diel difference; (a) upstream of the ultrasonic system in the middle of the main channel (UM), (b) upstream of the ultrasonic system in the east main channel (DM), and (c) downstream of the ultrasonic system in the east secondary channel (DS) at Crescent Hydroelectric Project, Mohawk River, New York.

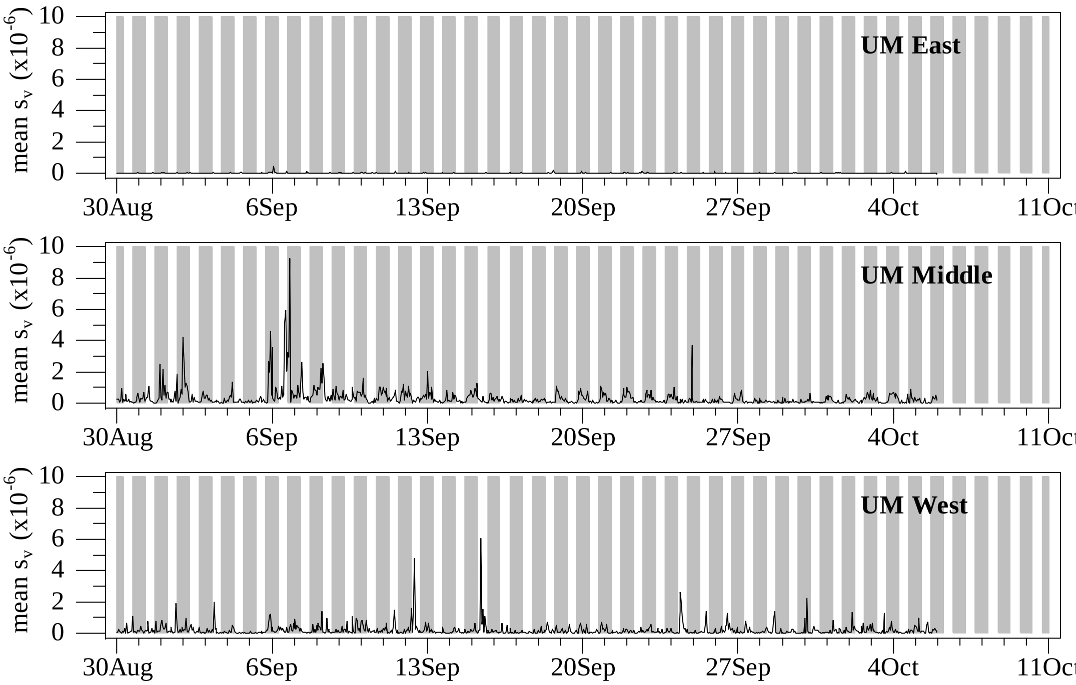

FIGURE 7.—Time series of the hourly mean volume backscattering coefficient (s_v, x10^{-6} m^{-1}) of fish detected by side-looking, single beam transducers (420 kHz, HTI) sampling the east (top), middle (center), and west (bottom) portions of the main channel upstream of the ultrasonic system (UM) at Crescent Hydroelectric Project, Mohawk River, New York. Gray vertical bars represent a fixed night period (1700-0600).

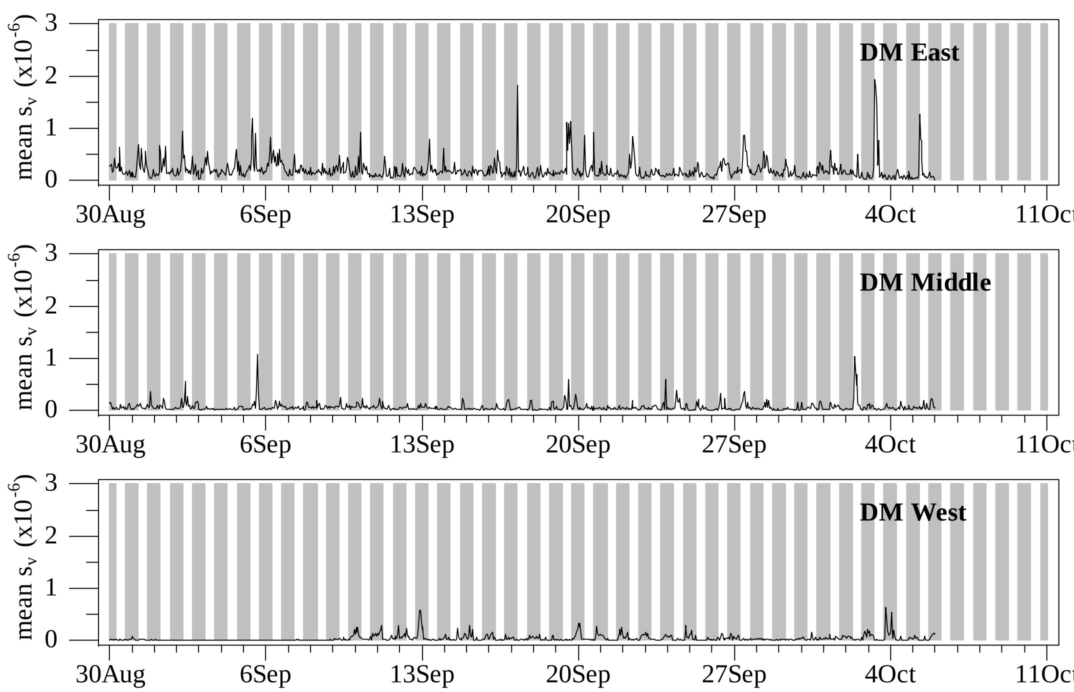

FIGURE 8.—Time series of the hourly mean volume backscattering coefficient (s_v, x10^{-6} m^{-1}) of fish detected by side-looking, single beam transducers (420 kHz, HTI) sampling the east (top), middle (center), and west (bottom) portions of the main channel downstream of the ultrasonic system (DM) at Crescent Hydroelectric Project, Mohawk River, New York. Gray vertical bars represent a fixed night period (1700-0600).

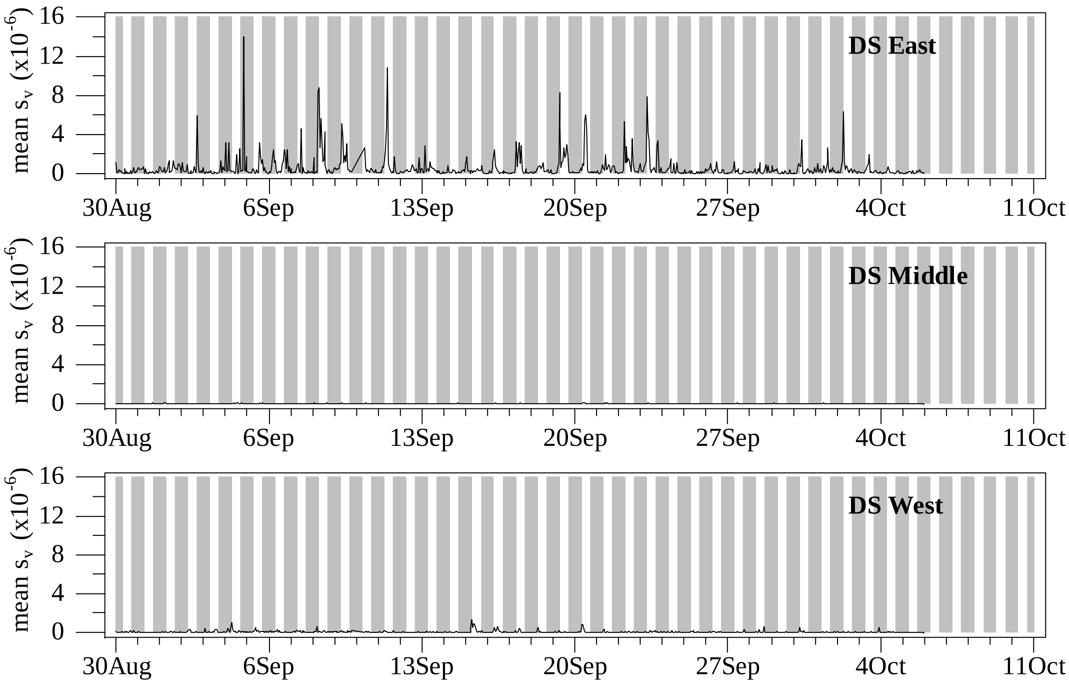

FIGURE 9.—Time series of the hourly mean volume backscattering coefficient (s_v, x10^{-6} m^{-1}) of fish detected by side-looking, single beam transducers (420 kHz, HTI) sampling the east (top), middle (center), and west (bottom) portions of the secondary channel downstream of the ultrasonic system (DS) at Crescent Hydroelectric Project, Mohawk River, New York. Gray vertical bars represent a fixed night period (1700-0600).

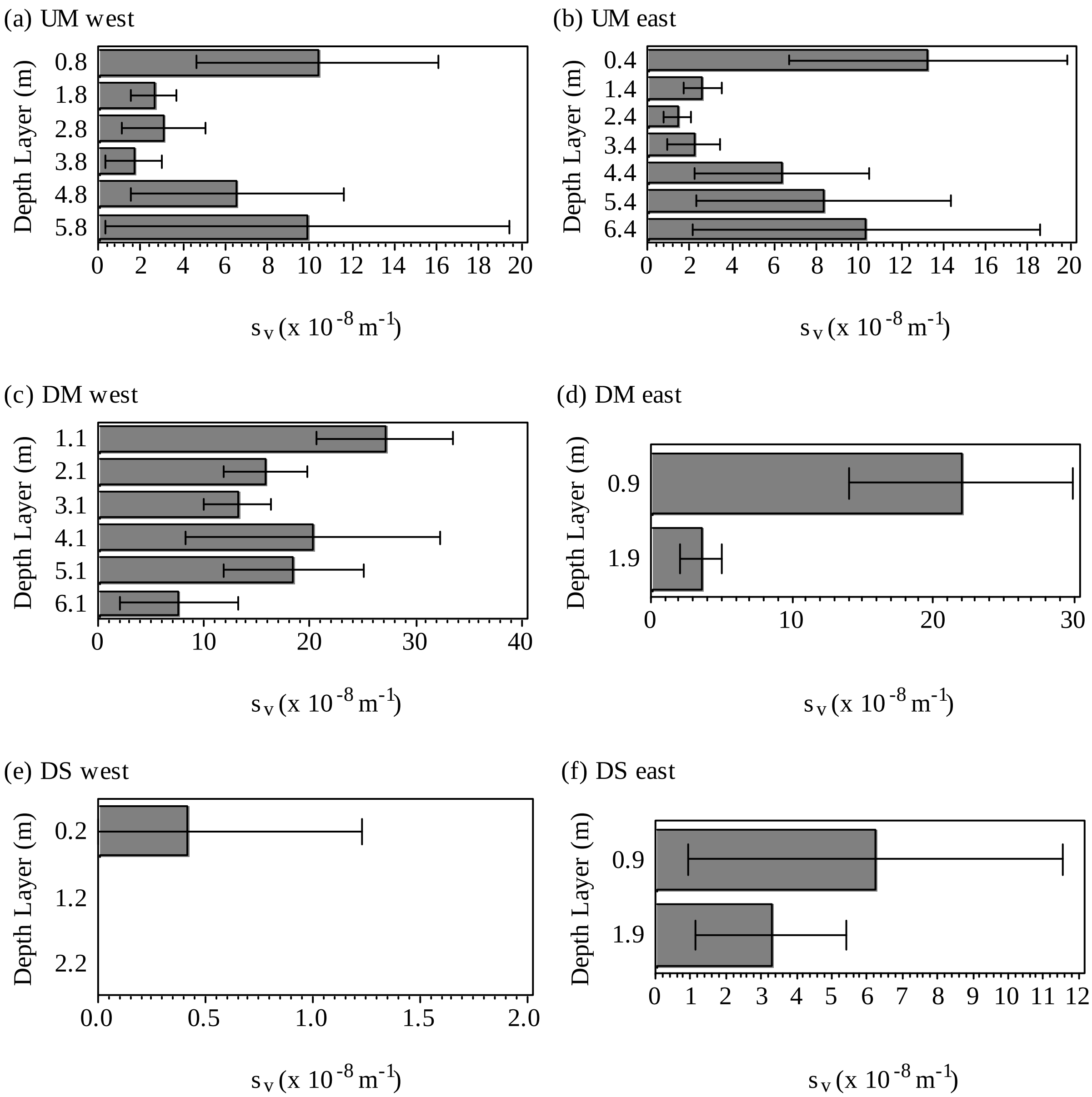

FIGURE 10.—Overall mean of the hourly mean volume backscattering coefficient (s_v, x10^{-8} m^{-1}) of fish detected by up-looking, split-beam transducers (420 kHz, HTI) for each 1-m depth strata (labeled by beginning depth referenced to the surface) upstream of the ultrasonic system in the main channel (UM), and downstream of the ultrasonic system in the main channel (DM) and secondary channel (DS) at Crescent Hydroelectric Project, Mohawk River, New York. Error bars represent 95% confidence limits.

TABLE 3.—Summary statistics of hourly mean fish density estimated by echo integration* of the volume backscattering strength (S_v) measured by three side-looking, single beam 420 kHz transducers (east, middle, and west channel locations) upstream of the ultrasonic system in the main channel (UM), downstream of the ultrasonic system in the main channel (DM), and downstream of the ultrasonic system in the secondary channel (DS) during the downstream migration of juvenile blueback herring (30 August – 5 October 2008) at the Crescent Hydroelectric Project, Mohawk River, New York.

		S_v (dB)		Fish density** (no. x $10^{-3}/m^3$)	
Site (*n*)	Channel location of transducer	Mean***	95% confidence limits	Mean	95% confidence limits
UM	East	-79.8	-80.8, -79.3	0.8	0.7–0.9
(888)	Center	-64.9	-65.2, -64.6	23.7	21.9–25.4
	West	-67.2	-67.7, -66.8	13.6	12.2–15.1
	All	-67.5	-67.9, -67.1	12.9	11.7–14.2
DM	East	-67.1	-67.3, -67.0	14.0	13.1–14.9
(887)	Center	-72.4	-72.7, -72.2	4.1	3.7–4.5
	West	-74.6	-75.0, -74.3	2.5	2.2–2.8
	All	-70.4	-70.6, -70.2	6.6	6.3–6.9
DS	East	-62.7	-63.3, -62.1	39.1	33.6–44.6
(875)	Center	-82.0	-82.6, -81.4	0.5	0.4–0.52
	West	-73.1	-73.8, -74.5	3.6	3.0–4.1
	All	-66.5	-67.2, -66.0	16.1	14.0–18.2

* Echo integration assumes a linear relation between scattering strength and fish density and that targets are uniformly and randomly distributed throughout the cross-section of the acoustic beam.
** Fish density was estimated by dividing the volume backscattering coefficient (S_v in linear domain, $10^{Sv/10}$) by the backscattering cross-section equivalent to observed mean target strength of juvenile blueback herring (-48.6 dB). Assumes 100% species composition of juvenile blueback herring or similar contributions of other species at each site for purposes of comparison.
*** Mean S_v represent an average of hourly mean estimates for each transducer or all pooled data. Statistics of the volume backscatter were performed in the linear domain and presented in decibel units.

TABLE 4.—Estimates (mean ± standard deviation) of fish flux (*F)* of down-migrating juvenile blueback herring upstream of the ultrasonic system in the main channel (UM) and downstream of the ultrasonic system in the main channel (DM) based on daily paired estimates (n=37) of volume backscattering strength (S_v), fish density (ρ), net rate of downstream movement (R_d), and proportion of fish moving downstream (P_d) from continuous, fixed-location hydroacoustic sampling* at Crescent Hydroelectric Project, Mohawk River, New York, from 30 August through 5 October 2008.

Site	S_v (dB re 1 m^{-1})	ρ** ($fish/m^3$)	R_d (m/s)	P_d	F ($fish/m^2$ s)
UM	-67.5 (-72.6, -65.2)	0.0129 (0.0090)	0.13 (0.04)	0.72 (0.14)	0.0012 (0.0010)
DM	-70.4 (-71.7, -69.4)	0.0067 (0.0017)	0.07 (0.04)	0.71 (0.15)	0.0003 (0.0020)

* At location, a 420-kHz calibrated echosounder (HTI) multiplexed three side-looking 420-kHz single-beam transducers for echo integration and two split-beam transducers for target tracking. A 500-kHz side-looking acoustic Doppler current meter was used to continuously monitor water flow and volume at DM and DS (UM was assumed additive of flow at DM and DS). DS=downstream of the ultrasonic system in the secondary channel.
** Fish density was based on the mean side-aspect target strength of juvenile blueback herring (-48.6 dB).

TABLE 5.–Daily estimates (mean ± standard deviation) of the proportion (P_{DM}) of juvenile blueback herring migrating downriver past a site in the main channel upriver of the ultrasonic system (UM) and downriver of it (DM) from continuous monitoring by fixed-location hydroacoustic sampling[*] at Crescent Hydroelectric Project, Mohawk River, New York, from 30 August through 5 October 2008 and three parameters used to P_{DM} were fish flux (F), number of downstream migrants (N_d), and expected number of downstream migrants at DM (N_{exp}) based on the daily proportion of water volume at UM that flowed by DM (mean=11.5%).

	F		N_d**			
Date	UM	DM	UM	DM	N_{exp}	P_{DM}
30-Aug	0.0009	0.0005	105,076	52,530	6,879	50.0
31-Aug	0.0013	0.0004	141,068	39,852	4,322	28.2
1-Sep	0.0017	0.0002	185,343	20,742	40,679	11.2
2-Sep	0.0016	0.0002	175,092	22,801	41,473	13.0
3-Sep	0.0003	0.0002	35,214	23,490	3,942	66.7
4-Sep	0.0006	0.0004	68,931	34,097	5,320	49.5
5-Sep	0.0023	0.0008	254,442	74,053	32,067	29.1
6-Sep	0.0055	0.0004	619,771	37,978	30,698	6.1
7-Sep	0.0031	0.0003	343,343	31,415	135,851	9.1
8-Sep	0.0031	0.0004	346,680	40,448	35,342	11.7
9-Sep	0.0016	0.0003	183,631	28,864	20,322	15.7
10-Sep	0.0012	0.0003	136,518	33,072	0	24.2
11-Sep	0.0017	0.0003	192,947	30,231	31,517	15.7
12-Sep	0.0012	0.0002	134,140	18,289	17	13.6
13-Sep	0.0010	0.0002	111,721	17,409	1,748	15.6
14-Sep	0.0006	0.0001	69,024	11,646	3,613	16.9
15-Sep	0.0022	0.0005	248,878	52,430	93,619	21.1
16-Sep	0.0008	0.0002	93,393	23,573	6,935	25.2
17-Sep	0.0006	0.0001	62,191	13,316	2,532	21.4
18-Sep	0.0011	0.0002	120,495	15,907	10,245	13.2
19-Sep	0.0007	0.0008	79,193	77,069	6,008	97.3
20-Sep	0.0012	0.0003	139,424	24,627	41,297	17.7
21-Sep	0.0010	0.0004	106,781	39,283	13,566	36.8
22-Sep	0.0010	0.0005	111,428	43,743	14,648	39.3
23-Sep	0.0002	0.0001	27,801	12,807	1,080	46.1
24-Sep	0.0012	0.0003	140,072	30,979	20,662	22.1
25-Sep	0.0005	0.0001	53,566	10,789	7,110	20.1
26-Sep	0.0012	0.0001	136,744	11,043	1,779	8.1
27-Sep	0.0006	0.0002	72,855	14,576	124	20.0
28-Sep	0.0005	0.0005	57,435	48,807	1,598	85.0
29-Sep	0.0005	0.0001	52,635	11,647	2,574	22.1
30-Sep	0.0007	0.0001	75,289	10,577	10,984	14.0
1-Oct	0.0007	0.0004	82,701	36,126	3,521	43.7
2-Oct	0.0008	0.0009	94,755	85,273	29,186	90.0
3-Oct	0.0012	0.0007	129,280	68,173	22,060	52.7
4-Oct	0.0009	0.0004	103,507	38,366	18,445	37.1
5-Oct	0.0005	0.0003	54,796	27,355	1,097	49.9
Mean	0.0012	0.0003	139,085	32,794***	18,996	31.3
Standard deviation	0.0010	0.0002	110,777	19,557	27,182	23.3

[*] At location, a 420-kHz calibrated echosounder (HTI) multiplexed three side-looking 420-kHz single-beam transducers for echo integration and two split-beam transducers for target tracking. A 500-kHz side-looking acoustic Doppler current meter was used to continuously monitor water flow and volume at DM and DS (UM was assumed additive of flow at DM and DS).

[**] Number of downstream migrants per day , $N_d = TFA$ where T=seconds per day and A =total cross-sectional area of the river channel (A=1,300 m^2 for UM and 1,111m^2 for DM)

[***] Significantly greater than expected based on a Wilcoxon signed-rank test for paired samples which tested the null hypothesis that the average difference between N_d and N_{exp} was equal to zero (p=0.003)

fish density at UM and DM was significantly greater than zero ($p < 0.001$). The mean daily F was about 4 times higher at UM than at DM (Table 4). The estimate of N_d at DS was 3,755 fish per hour or 90,120 fish per day based on F= 0.74 fish/m^{2}s and A = 549 m^2.

Effectiveness of the ultrasonic system.—The mean estimate for P_{DM} was 31.3% (Table 5). The average daily difference between the N_d and N_{exp} at DM was significantly different from zero (p=0.0003). The percentage of N_{UM} that passed through DM (31.3%) was almost three times greater than that expected (11.5%) based on the proportion of water volume that passed through DM, assuming that downriver movement of juvenile blueback herring is directly proportional to the water volume flowing through the main channel compared with the secondary channel. The most plausible explanation for the difference between the observed and expected values appears to be operation of the ultrasonic system at the entrance to the secondary channel. Operation of the ultrasonic system is also a reasonable explanation for why the highest mean s_v observed at UM was in the center and the highest mean s_v at DM was in the east, i.e., it guided fish away from the entrance to secondary channel to the eastern section of the main channel. If the ultrasonic system increased the proportion of fish at DM from 11.5% to 31.3%, the proportion of fish at DS decreased from 88.5% to 68.7%, which corresponds to about a 23% reduction in the number of fish entering the secondary channel.

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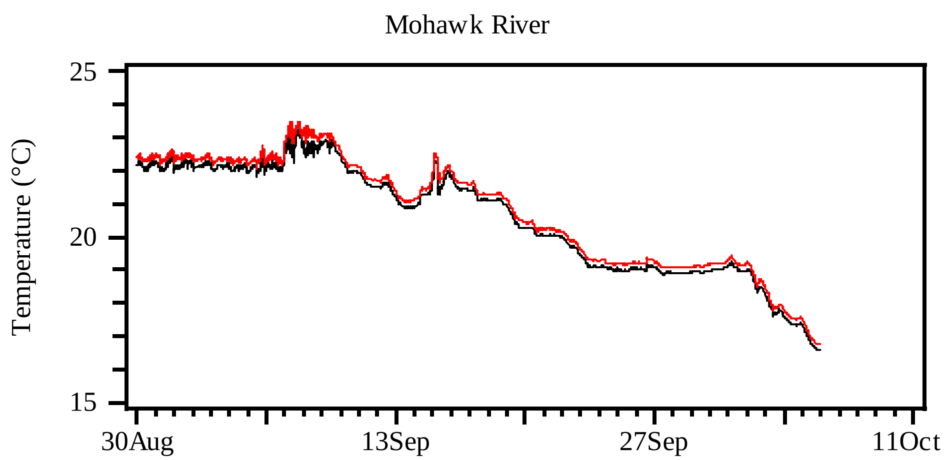
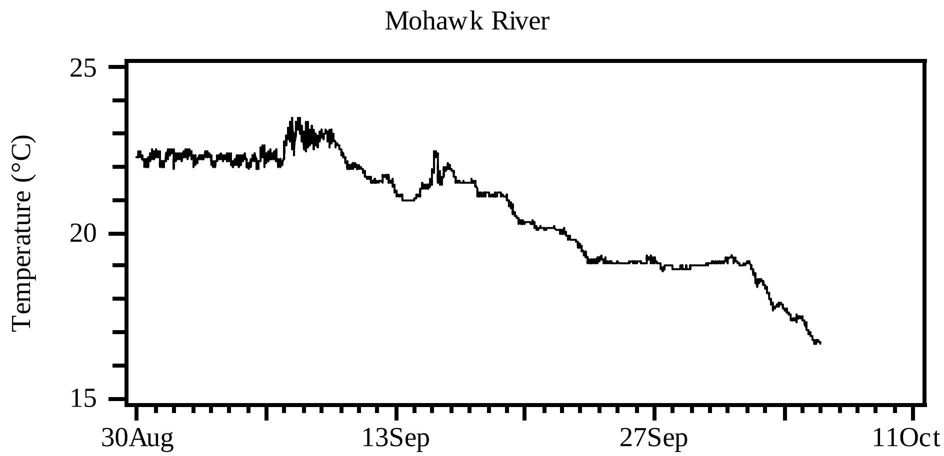
Appendix A – Continuous Monitoring of Water Temperature of the Mohawk River Upstream of Crescent Hydroelectric Project

Water temperature was continuously recorded every 5 minutes from 30 August through 5 October 2008 by two HOBO® Water Temp Pro data loggers (Onset Computer Corporation, Pocasset, MA, USA). The loggers were placed in a PVC shield and attached to rigid steel pole mount approximately 1.2 m (4 ft) from the river bottom in the middle of the channel of Mohawk River upstream of the ultrasonic system (transducer mount #3 at UM). The average difference in water temperature between logger #1 (S/N 558257) and logger #2 (S/N 558473) was -0.2°C (Appendix Figure A-1).

The maximum observed difference between loggers was 1.0 °C. Manufacturer accuracy and resolution was specified as ±0.2°C. For each time interval, water temperature measurements were averaged for an estimate of bottom water temperature. If a logger skipped an interval, the measurement from the other logger was used for bottom water temperature. Average bottom water temperature was 20.7 ± 0.1°C (± 95% confidence interval) with a minimum and maximum bottom water temperature of 16.7°C and 23.4°C, respectively (Appendix Figure A-2). Bottom water temperature dropped below 20°C on 21 September 2008 and below 18°C on 5 October 2008.



APPENDIX FIGURE A-1.—Water temperature recorded by HOBO® Water Temp Pro data loggers #1 (in black) and #2 (in red) at 1.2 m above river bottom in the middle of the channel of the Mohawk River upstream of the acoustic barrier from 30 August through 5 October 2008.



APPENDIX FIGURE A-2.—Average bottom water temperature recorded by HOBO® Water Temp Pro data loggers #1 and #2 at 1.2 m above river bottom in the middle of the channel of the Mohawk River upstream of the acoustic barrier from 30 August through 5 October 2008.

Appendix B – Laboratory and Sphere Calibration of Scientific Echosounders for Fixed-location and Mobile Hydroacoustic Surveys of Juvenile Blueback Herring at Crescent Hydroelectric Project

For quantitative measurements to be obtained from a hydroacoustic survey, it is important to calibrate the echosounder. Calibration provides a measure of quality control for reliable acoustic surveys. Calibration was performed before and after the study. Calibration was performed following the sphere calibration method described by Foote et al. (1987) and adopted as standard practice (Simmonds and MacLennan 2005) as well as by a standard U.S. Navy transducer in the laboratory. The following calibration was performed for the single- and split-beam transducers used for fixed-location and mobile surveys of fish at Crescent Hydroelectric Project.

Laboratory Calibration

A defining attribute of scientific-quality echo sounder systems is the ability to accurately calibrate the equipment to establish true sampling volumes and minimum fish detection thresholds across range. Digital scientific hydroacoustic systems like the Model 243 System (Hydro-acoustic Technology, Inc., Seattle, WA) are inherently stable, eliminating the potential for variable equipment sensitivity over time. Proper calibration provides the user with information regarding the power output and receiving sensitivity of the complete acoustic system. Calibration assures that an echo produced by a target of known acoustic size, while passing through the axis of the acoustic beam, will produce a known output voltage at the receiver portion of the echo sounder.

This information allows the user to determine the effective beam width over which fish of a particular acoustic size will be detected. Since transducers vary in sensitivity, the exact sensitivity must be quantified. By using calibration data, target strength information, and a transducer's beam pattern plot, the effective beam width for that transducer can be determined. This information is used to adjust the minimum size detection threshold, and to precisely calculate the transducers' sample volumes for each detected fish, allowing calculation of accurate estimates of fish numbers and distributions.

Prior to deployment and after the study, the Model 243 System was calibrated in the laboratory at the Hydroacoustic Technology, Inc. (HTI) facility in Seattle, relative to a US Navy standard transducer (E27) of known sensitivity. A detailed description of calibration of hydroacoustic systems can be found in Urick (1983). The Model 241 split-beam echosounder system used for mobile hydroacoustic surveys was also pre- and post-calibrated at the HTI facility using the standard transducer.

Each HTI laboratory calibration includes beam pattern plots, transmit and receive sensitivities vs. frequency over the operational bandwidth (frequency response curves). These calibration values are referenced during the acoustic system configuration to ensure uniform minimum fish size detectability across the sampling array (i.e., equalization of sensitivities of all transducers in the array). Other calibration data included source level at each transmit setting, receive sensitivity, receiver gain check at several ranges, transmitter check, frequency check, relative calibrator levels, and TVG check at several ranges.

The measured beam patterns were fitted to a polynomial equation for determining effective beam widths and detection volumes for counting echoes with amplitude or TS less than 6 dB above the detection threshold. Appendix Figures B-1 to B-15 show the fitted curves to the beam pattern measurements made during laboratory calibration for the transducers in Appendix Table B-1. Pre- and post-laboratory calibrations of the transducers used for fixed-location hydroacoustic sampling resulted in essentially equivalent sensitivities.

Sphere Calibration

A 21.2-mm tungsten carbide sphere was used to collect a statistically significant number of single target detections of a reference target with a known target strength (-44.3 dB re 1 m^2). In the field, the sphere was attached to a monofilament line, which has a similar acoustic impedance as water therefore didn't contribute to scattering in any meaningful way. The sphere was suspended in the acoustic beam from the research vessel by a fishing rod. This exercise was performed on 26 September and 4 October and was repeated before and after the study by HTI in their laboratory facility under more controlled conditions (e.g., temperature, currents, other scatterers). The sphere was also coated with a soap deterrent solution (e.g., Joy or Dawn) to prevent accumulation of small bubbles on the sphere surface. Field measurements revealed a substantial deviation from the expected target strength in the down-looking 15° split-beam transducer (Appendix Table B-2). This transducer collided with the river bottom during a survey on 27 September in which was later discovered to have damaged one of the electronic quadrants. After closer examination with the standard sphere under laboratory conditions and comparison of pre- and post-laboratory calibrations with a U.S. Navy standard transducer, a 3.2 dB offset was added to the 40LogR echo amplitudes and target strengths for mobile acoustic survey data collected by the 15° split-beam transducer after 27 September (Appendix Table B-3).

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APPENDIX TABLE B-1.—Transducers used during fixed-location hydroacoustic monitoring of juvenile blueback herring passage at Crescent Hydroelectric Project, Mohawk River, New York during fall 2008.

Site	Transducer[a] (serial no.)	Beam orientation	Beam type	3-dB beam width (degrees)
UM	East (37)	Horizontal	Single	5.9 x 11.0
	East (2110930)	Up	Split	7.5 x 7.7
	Middle (55)	Horizontal	Single	5.7 x 5.9
	West (2110931)	Up	Split	7.6 x 7.6
	West (21-6)	Horizontal	Single	6.3 x 6.3
DM	East (23)	Horizontal	Single	6.2 x 12.4
	East (2110932)	Up	Split	7.9 x 7.9
	Middle (22)	Horizontal	Single	5.8 x 12.4
	West (2110933)	Up	Split	7.4 x 8.0
	West (26)	Horizontal	Single	6.0 x 12.3
DS	East (75)	Horizontal	Single	5.8 x 6.0
	East (2110927)	Up	Split	7.9 x 8.0
	Middle (21)	Horizontal	Single	5.5 x 12.1
	West (2110929)	Up	Split	7.0 x 7.5
	West (35)	Horizontal	Single	6.2 x 11.9

APPENDIX TABLE B-2.—Standard sphere calibration results for the side-looking 6° and down-looking 15° split-beam transducers used during mobile hydroacoustic surveys at Crescent Hydroelectric Project during 2008. Calibration was performed using a 21.2-mm tungsten carbide sphere as a reference with target strength (TS) of -44.3 dB.

Calibration	Date	Minimum threshold	TS (dB)	SD (dB)	*n*	Offset
6° split-beam transducer (S/N 2004315)						
Pre-season, laboratory[1]	18 Aug	-50	-44.56	0.65	526	-0.26
Pre-season, laboratory	18 Aug	-55	-44.56	0.65	526	-0.26
Field measurements	4 Oct	-50	-38.99	2.20	300	5.31
Field measurements	4 Oct	-60	-40.57	2.58	362	3.73
Post-season, laboratory	29 Oct	-60	-42.79	2.03	11,171	1.51
15° split-beam transducer (S/N 2110928)						
Pre-season, laboratory	18 Aug	-50	-48.17	1.24	512	-3.87
Field measurements	26 Sep	-50	-43.25	2.22	362	1.05
Field measurements	4 Aug	-50	-49.17	0.37	20	-4.87
Field measurements	4 Aug	-60	-47.22	2.69	258	-2.92
Post-season, repaired quadrant[2]	29 Oct	-60	-42.81	2.86	3,994	1.49

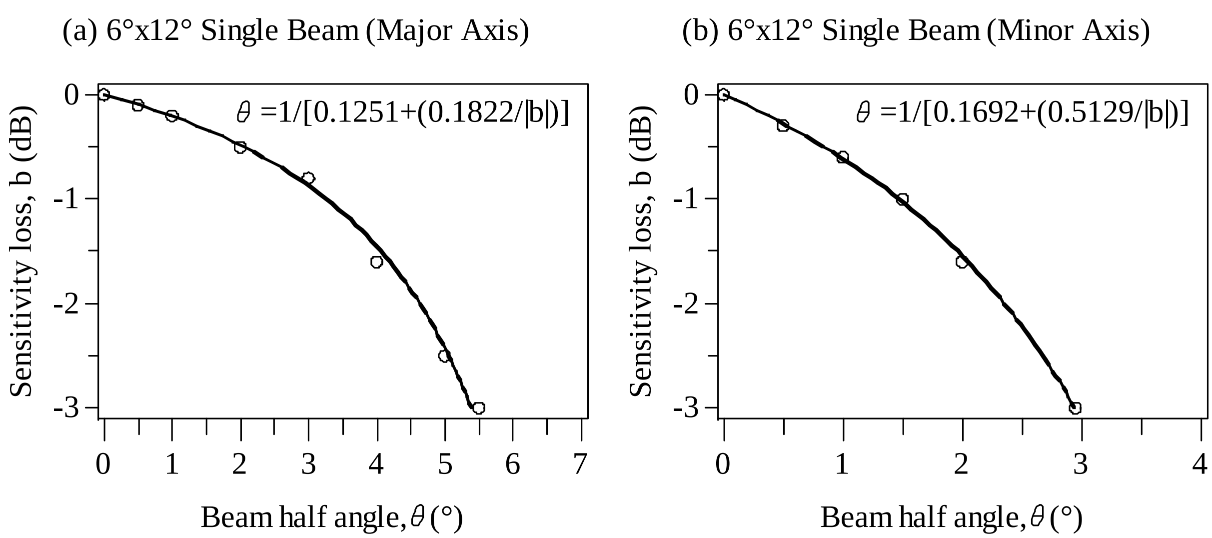
[1] Laboratory Calibration was performed by Hydroacoustic Technology, Inc. (HTI) with a US Navy standard transducer (E27, S/N 233) and HTI Model 241 echosounder

[2] On 27 Sep, the 15° transducer struck the river bottom causing damage to one of the quadrants

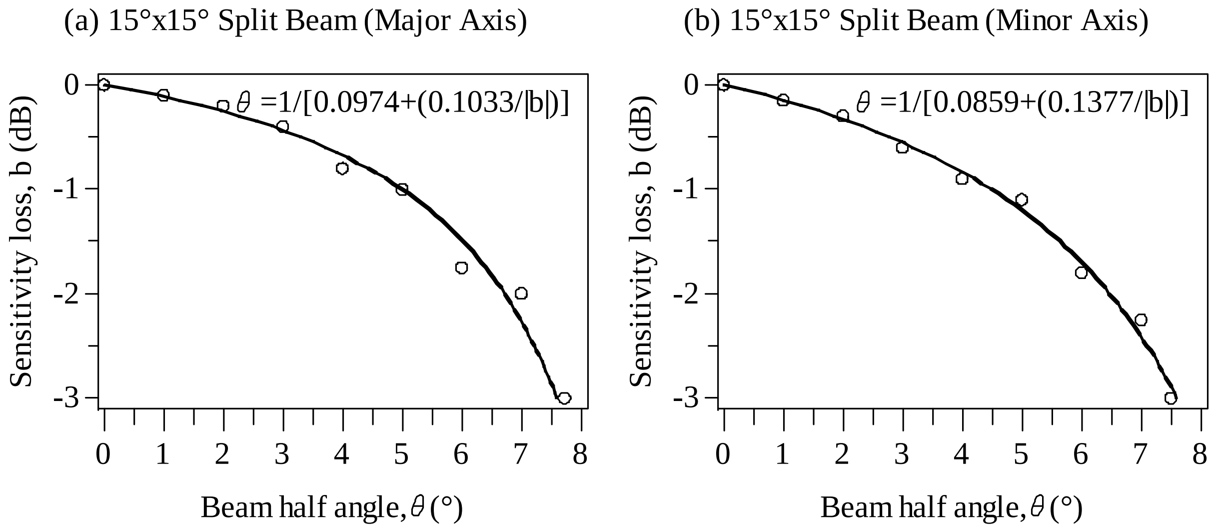
APPENDIX TABLE B-3.—Laboratory calibration results1 for the side-looking 6° and down-looking 15° split-beam transducers used during mobile hydroacoustic surveys at Crescent Hydroelectric Project during 2008. Calibration was performed by Hydroacoustic Technology, Inc. (HTI) with a US Navy standard transducer (E27, S/N 233) and HTI Model 241 echosounder.

					Transmit and Receive Sensitivity (dB re μPa at 1 m)			
Calibration	Date	$\theta_{3dB, along}$ (°)	$\theta_{3dB, across}$ (°)	b^2	SL_{20}	$G1_{40}$	$G1_{20}$	$SL_{20}+G1_{40}$
6° split-beam transducer (S/N 2004315)								
Pre-season	18 Aug	6.25	6.35	0.001042	222.67	-179.12	-158.16	43.55
Post-season	21 Oct	n/a	n/a	n/a	222.67	-178.95	-157.85	43.72
15° split-beam transducer (S/N 2110928)								
Pre-season	18 Aug	15.61	15.83	0.006996	214.86	-180.34	-159.37	34.52
Post-season, damaged quadrant[1]	21 Oct	n/a	n/a	n/a	212.67	-181.36	-160.12	31.32
Post-season, repaired quadrant	21 Oct	n/a	n/a	n/a	214.86	-179.95	-158.78	34.91

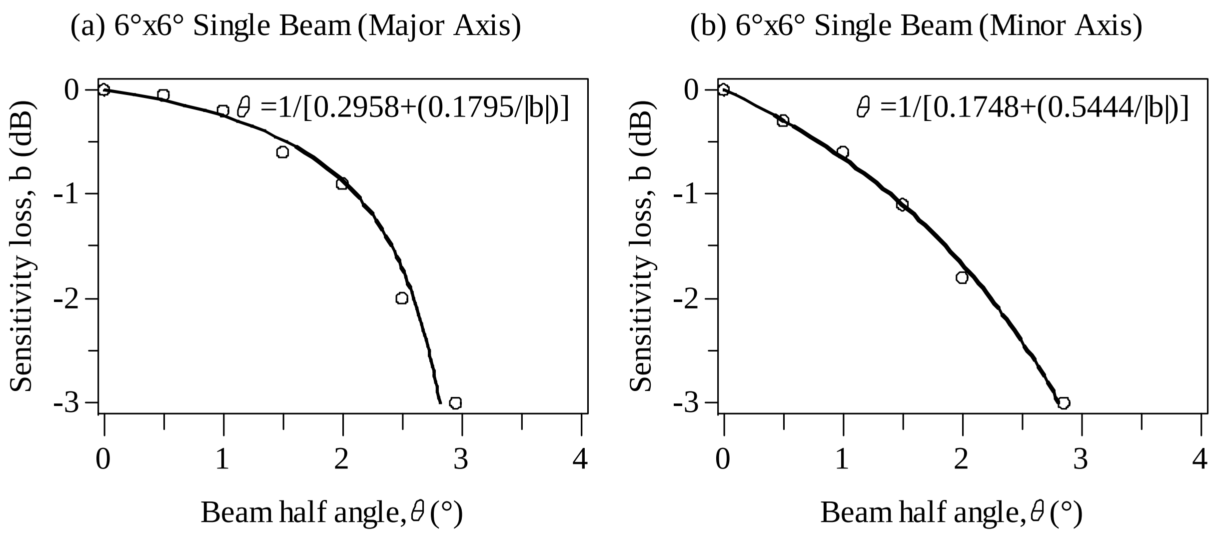
[1] θ_{3dB} =along-track (up,down) and across-track (left, right) beam widths at half-power points (3 dB down); b^2= beam pattern factor; SL_{20}=source level at 20 dB transmit power; $G1_{20}$ and $G1_{40}$ = receive sensitivity at 20LogR and 40LogR time-varied gain.
[2] On 27 Sep, the 15° transducer struck the river bottom causing damage to one of the quadrants
n/a = not available



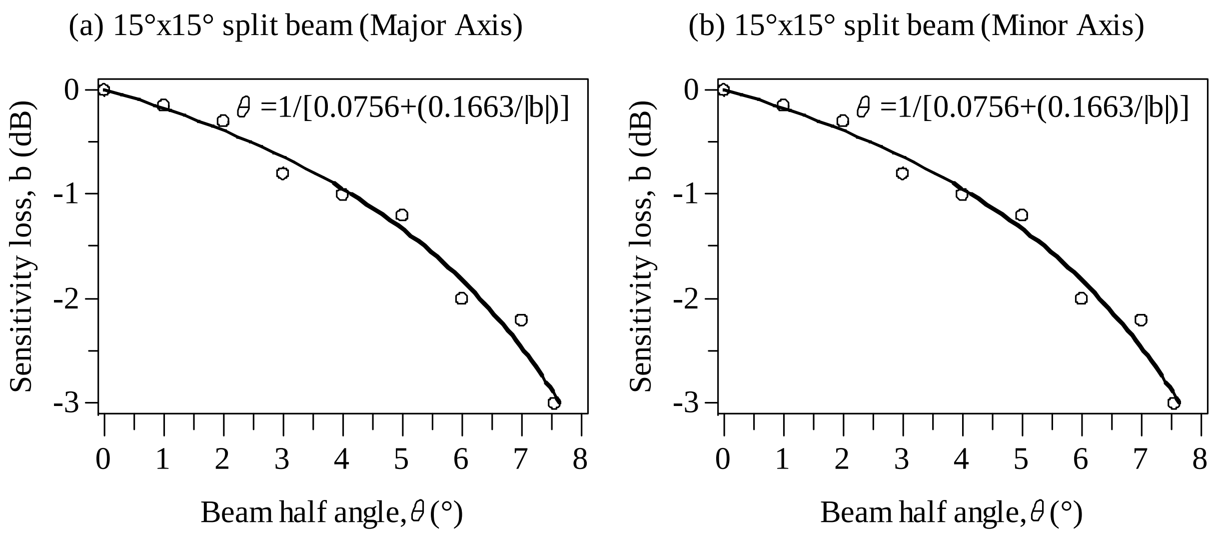
APPENDIX FIGURE B-1.—Fitted beam pattern at the half-power points (3-dB beam widths) for the (a) major and (b) minor axis of the single beam transducer (HTI, S/N 37) with a nominal beam width of 6° x 12° used at mount 1 (east) of the transducer array in the main channel upstream of the ultrasonic system (UM).



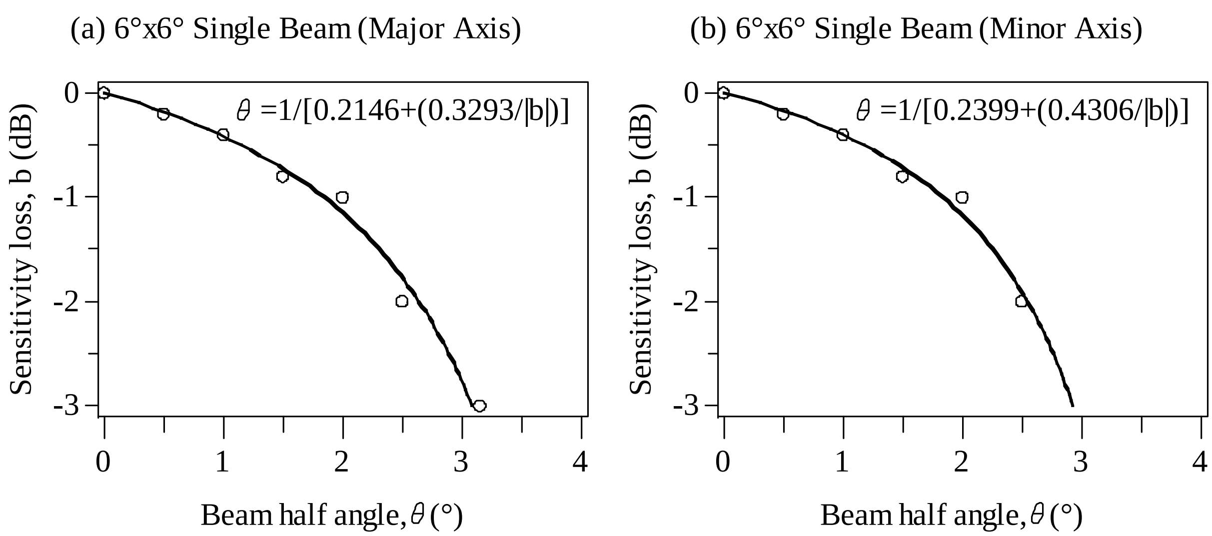
APPENDIX FIGURE B-2.—Fitted beam pattern at the half-power points (3-dB beam widths) for the (a) major and (b) minor axis of the split-beam transducer (HTI, S/N 2110930) with a nominal beam width of 15° x 15° used at mount 2 (east) of the transducer array in the main channel upstream of the ultrasonic system (UM).



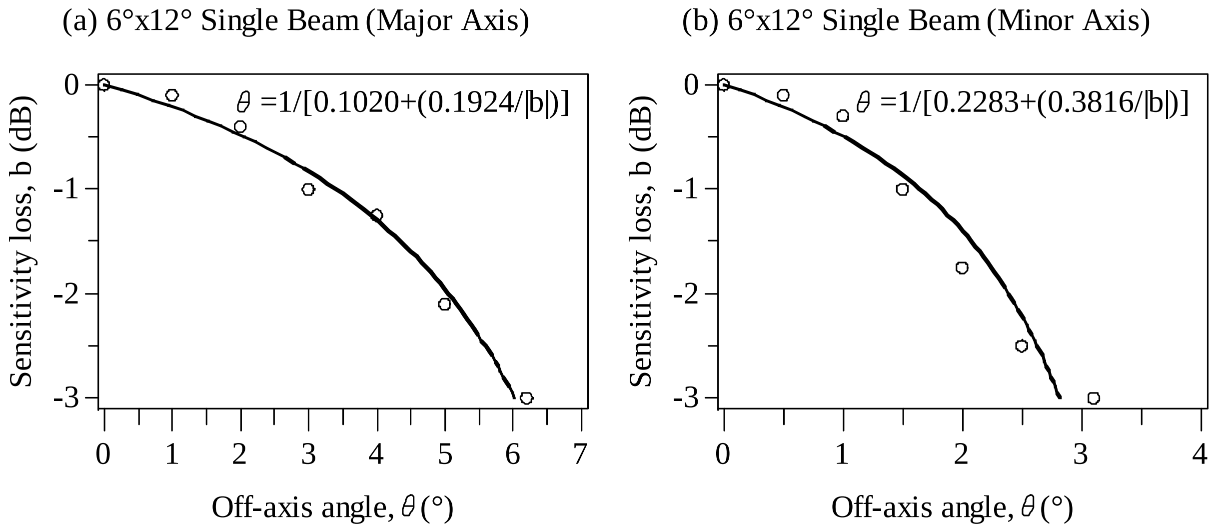
APPENDIX FIGURE B-3.—Fitted beam pattern at the half-power points (3-dB beam widths) for the (a) major and (b) minor axis of the single beam transducer (HTI, S/N 055-6) with a nominal beam width of 6° x 6° used at mount 3 (mid) of the transducer array in the main channel upstream of the ultrasonic system (UM).



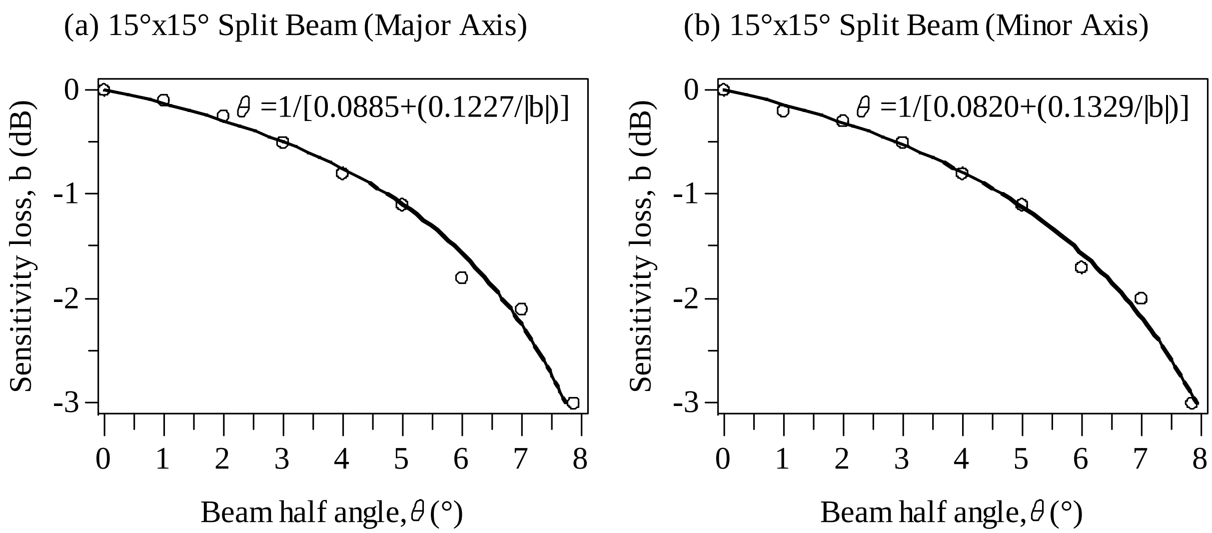
APPENDIX FIGURE B-4.—Fitted beam pattern at the half-power points (3-dB beam widths) for the (a) major and (b) minor axis of the split-beam transducer (HTI, S/N 2110931) with a nominal beam width of 15° x 15° used at mount 4 (west) of the transducer array in the main channel upstream of the ultrasonic system (UM).



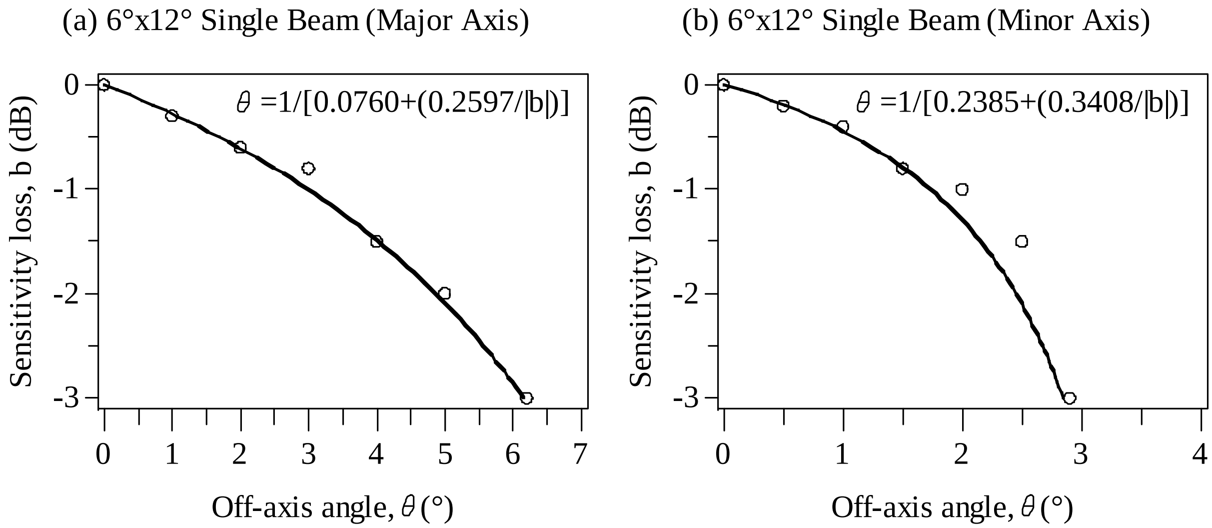
APPENDIX FIGURE B-5.—Fitted beam pattern at the half-power points (3-dB beam widths) for the (a) major and (b) minor axis of the single beam transducer (HTI, S/N 21-6) with a nominal beam width of used at mount 5 (east) of the transducer array in the main channel upstream of the ultrasonic system (UM).



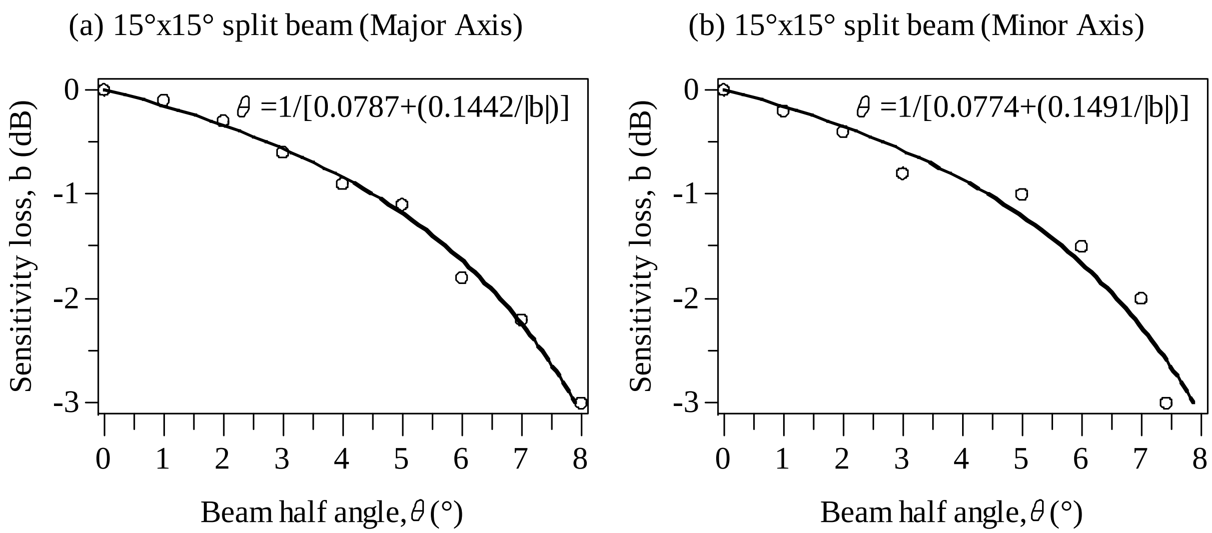
APPENDIX FIGURE B-6.—Fitted beam pattern at the half-power points (3-dB beam widths) for the (a) major and (b) minor axis of the single beam transducer (HTI, S/N 23) with a nominal beam width of 6° x 12° used at mount 1 (east) of the transducer array in the main channel downstream of the ultrasonic system (DM).



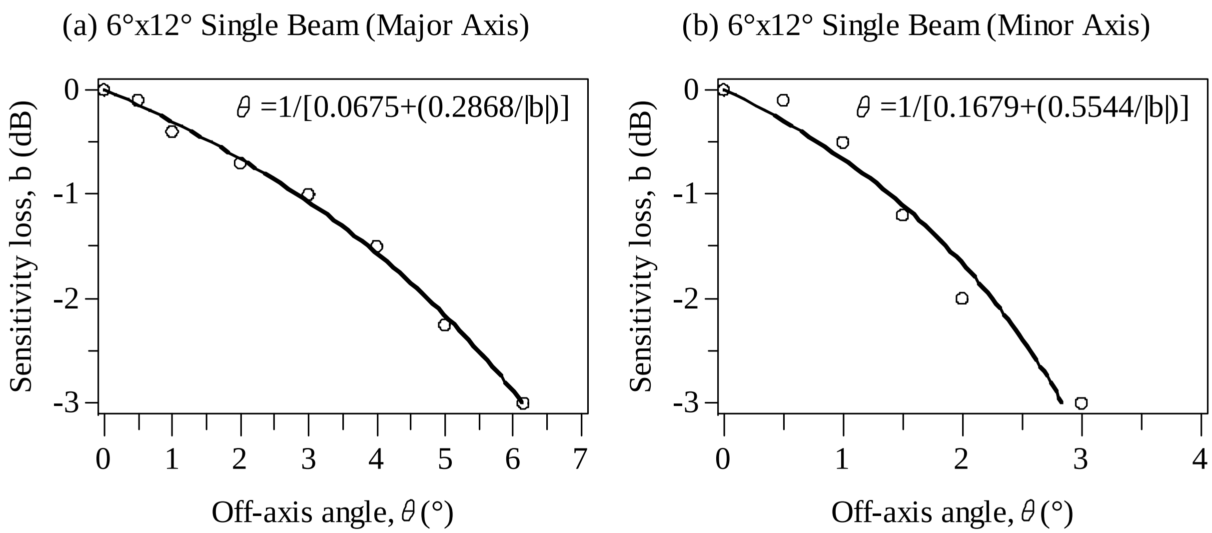
APPENDIX FIGURE B-7.—Fitted beam pattern at the half-power points (3-dB beam widths) for the (a) major and (b) minor axis of the split-beam transducer (HTI, S/N 2110932) with a nominal beam width of 15° x 15° used at mount 2 (east) of the transducer array in the main channel downstream of the ultrasonic system (DM).



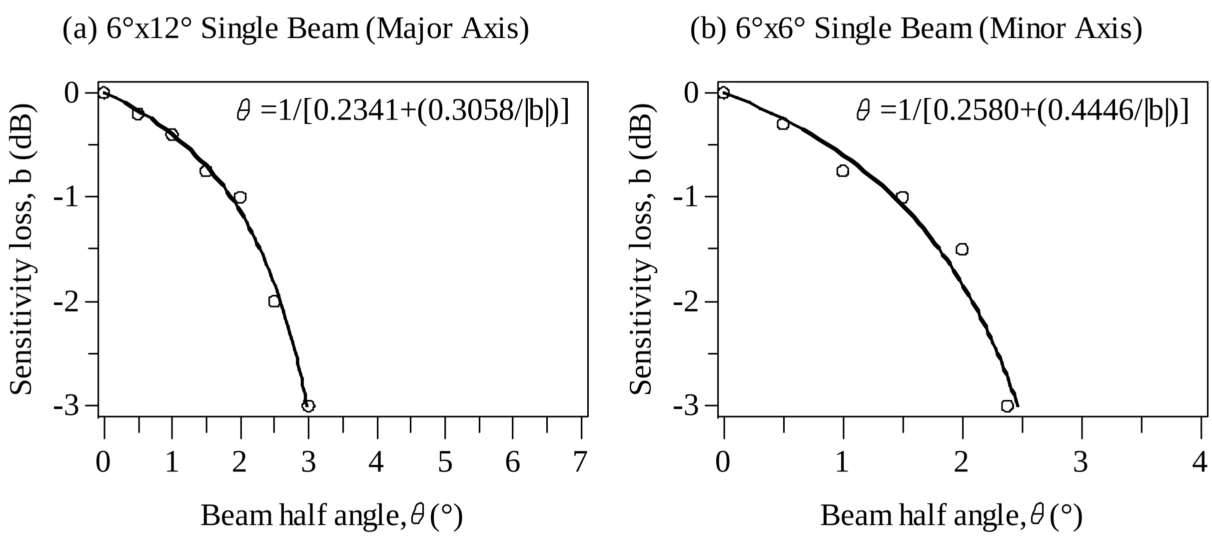
APPENDIX FIGURE B-8.—Fitted beam pattern at the half-power points (3-dB beam widths) for the (a) major and (b) minor axis of the single beam transducer (HTI, S/N 22) with a nominal beam width of 6° x 12° used at mount 3 (middle) of the transducer array in the main channel downstream of the ultrasonic system (DM).



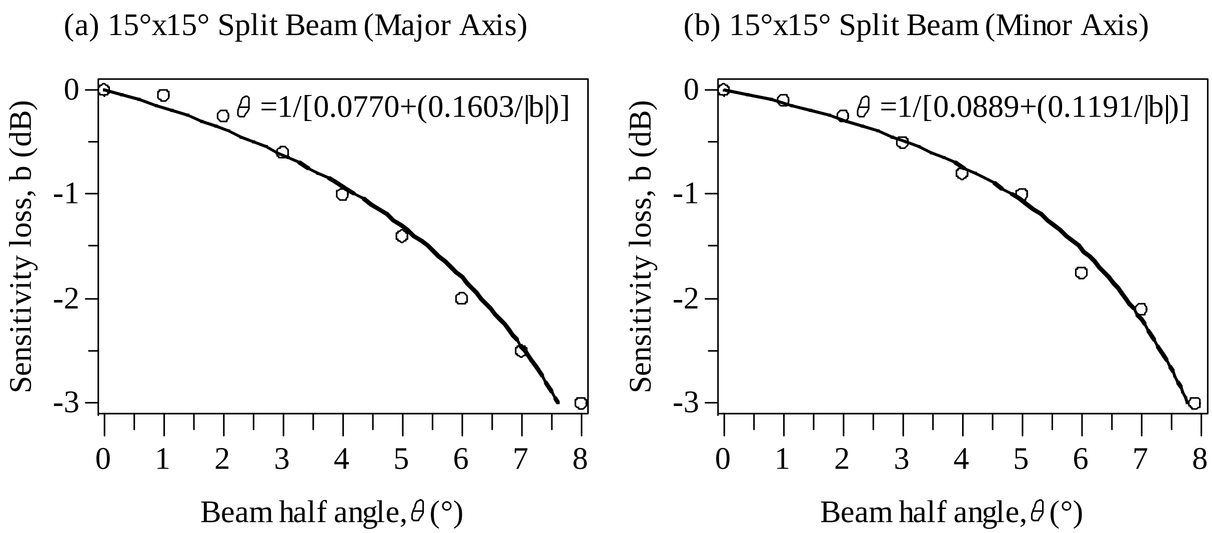
APPENDIX FIGURE B-9.—Fitted beam pattern at the half-power points (3-dB beam widths) for the (a) major and (b) minor axis of the split-beam transducer (HTI, S/N 2110933) with a nominal beam width of 15° x 15° used at mount 4 (west) of the transducer array in the main channel downstream of the ultrasonic system (DM).



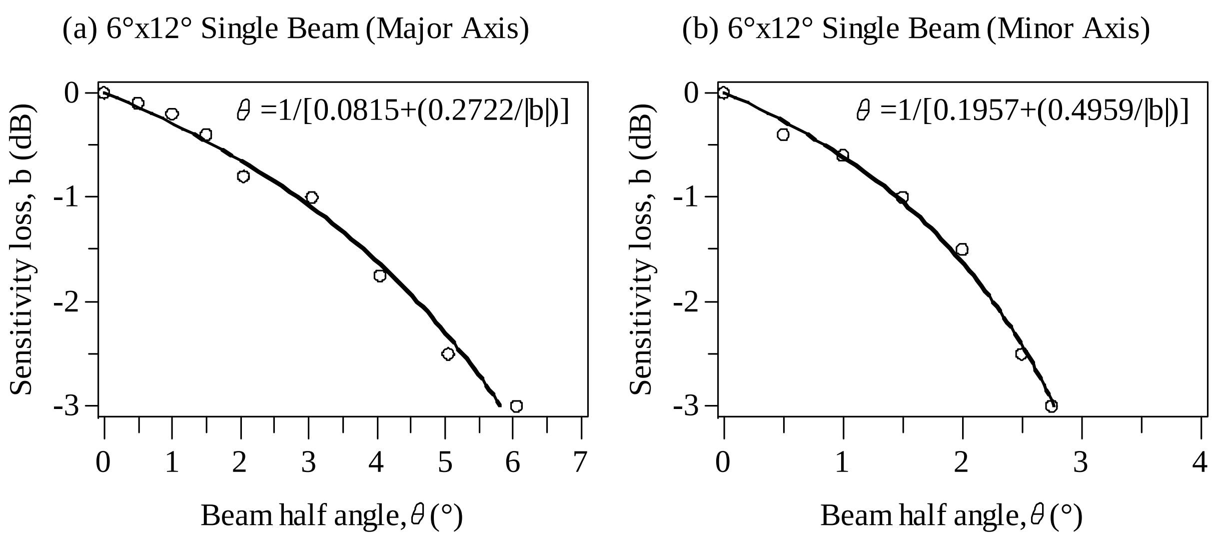
APPENDIX FIGURE B-10.—Fitted beam pattern at the half-power points (3-dB beam widths) for the (a) major and (b) minor axis of the single beam transducer (HTI, S/N 26) with a nominal beam width of 6° x 12° used at mount 5 (west) of the transducer array in the main channel downstream of the ultrasonic system (DM).



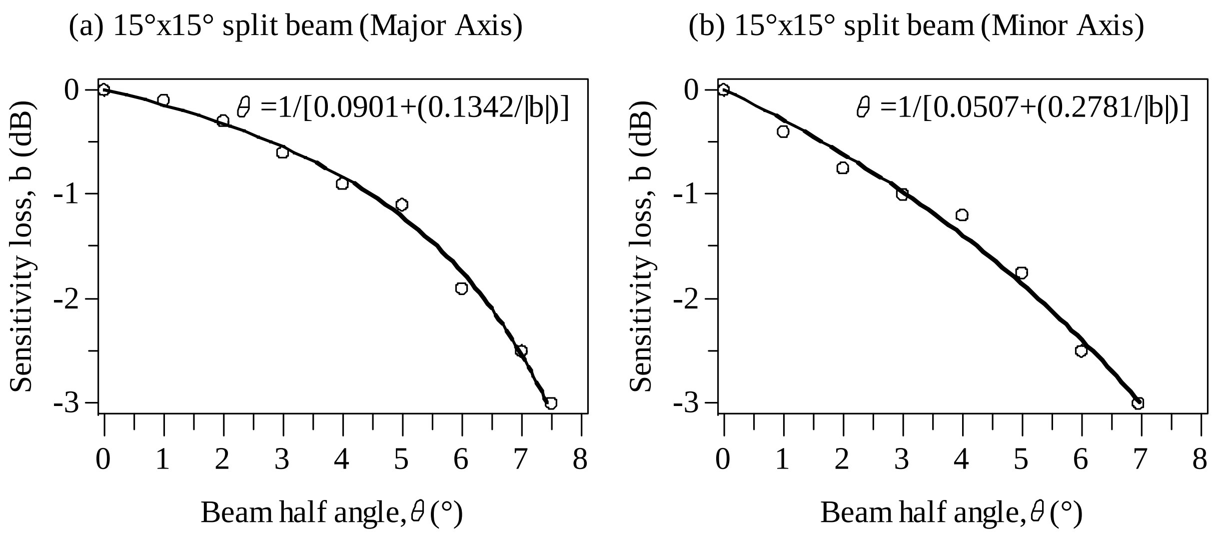
APPENDIX FIGURE B-11.—Fitted beam pattern at the half-power points (3-dB beam widths) for the (a) major and (b) minor axis of the single beam transducer (HTI, S/N 75) with a nominal beam width of 6° x 6° used at mount 1 (east) of the transducer array in the secondary channel downstream of the ultrasonic system (DS).



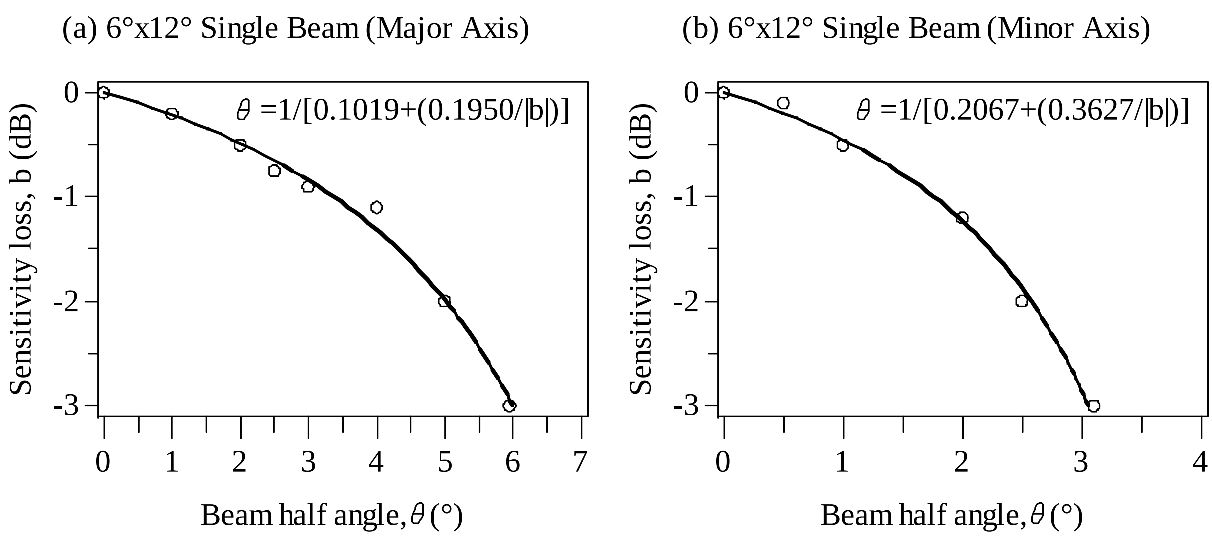
APPENDIX FIGURE B-12.—Fitted beam pattern at the half-power points (3-dB beam widths) for the (a) major and (b) minor axis of the split-beam transducer (HTI, S/N 2110927) with a nominal beam width of 15° x 15° used at mount 2 (east) of the transducer array in the secondary channel downstream of the ultrasonic system (DS).



APPENDIX FIGURE B-13.—Fitted beam pattern at the half-power points (3-dB beam widths) for the (a) major and (b) minor axis of the single beam transducer (HTI, S/N 21) with a nominal beam width of 6° x 12° used at mount 3 (middle) of the transducer array in the secondary channel downstream of the ultrasonic system (DS).



APPENDIX FIGURE B-14.—Fitted beam pattern at the half-power points (3-dB beam widths) for the (a) major and (b) minor axis of the split-beam transducer (HTI, S/N 2110929) with a nominal beam width of 15° x 15° used at mount 4 (west) of the transducer array in the secondary channel downstream of the ultrasonic system (DS).



APPENDIX FIGURE B-15.—Fitted beam pattern at the half-power points (3-dB beam widths) for the (a) major and (b) minor axis of the single beam transducer (HTI, S/N 21) with a nominal beam width of 6° x 12° used at mount 5 (west) of the transducer array in the secondary channel downstream of the ultrasonic system (DS).

Appendix C – *In Situ* Target Strength Measurements of Juvenile Blueback Herring from the Mohawk River, New York

Introduction

Target strength (TS) is the logarithmic measure of the backscattering cross section (σ_{bs}) of a single individual scatterer and is important in scaling echo integration data to fish density (MacLennan et al. 2002). Target strength has been previously estimated for a variety of species based on cage experiments (Boswell and Wilson 2008; Brooking and Rudstam 2009; Goddard and Welsby 1986; Nielsen and Lundgren 1999; Ona 2003), tethering of anesthetized live or dead fish (Boswell and Wilson 2008; Love 1969, 1971, 1977; Nakken and Olsen 1977; Reeder et al. 2004), wild fish (Barange et al. 1996; Fleischer et al. 1997; MacLennan and Menz 1996; Rudstam et al. 2003; Warner et al. 2002) and acoustic scattering models (Horne 2000; Reeder et al. 2004). Of the 17 methods of estimating TS described by Foote (1991), only a few methods may provide accurate TS measurements applicable to surveying. For example, TS measurements of tethered single fish have been widely practiced for determining tilt angle dependence of TS or for use in acoustic scattering models, but their application to estimating TS of wild fish requires knowledge of the distributions of body orientation of the fish being surveyed (Foote 1991). Because target strength of fish is dependent on body size, swimbladder morphology, frequency response, body orientation, and physiology, the most appropriate TS estimate for abundance estimation may be obtained from *in situ* measurements (Ona 1990; Simmonds and MacLennan 2005). The 5 to 25% of random error in fish abundance estimates due TS may be minimized if TS is representative of the fish species, size and orientation being surveyed (Simmonds and MacLennan 2005).

Blueback herring (*Alosa aestivalis*) are anadromous, schooling, coastal pelagic fish that range from northern Florida to New Brunswick (Munroe 2002). Adult blueback herring migrate into coastal rivers, including the Hudson River and Mohawk River in New York, during late spring to spawn (Schmidt et al. 1988). Several months after spawning in the Mohawk River, juveniles migrate downstream through the locks of the New York State Barge Canal, over dams, and through hydro-electric turbines. At the Crescent Hydroelectric Project (Crescent), the Mohawk River is impound-ed by two dams separated by an island. The licensee of Crescent was directed by the Federal Energy Regulatory Commission to study whether Crescent's operation was affecting the migration of blueback herring. A fixed-location hydro-acoustic study and repeated mobile hydroacoustic surveys were performed during September and October 2008 to estimate abundance of juvenile blueback herring migrating through the channels to both Crescent dams. The objective of this study was to estimate *in situ* target strength at 420 kHz for estimating density of juvenile blueback in the Mohawk River and compare results to other *in situ* and tethered-fish TS estimates for similar species.

Methods

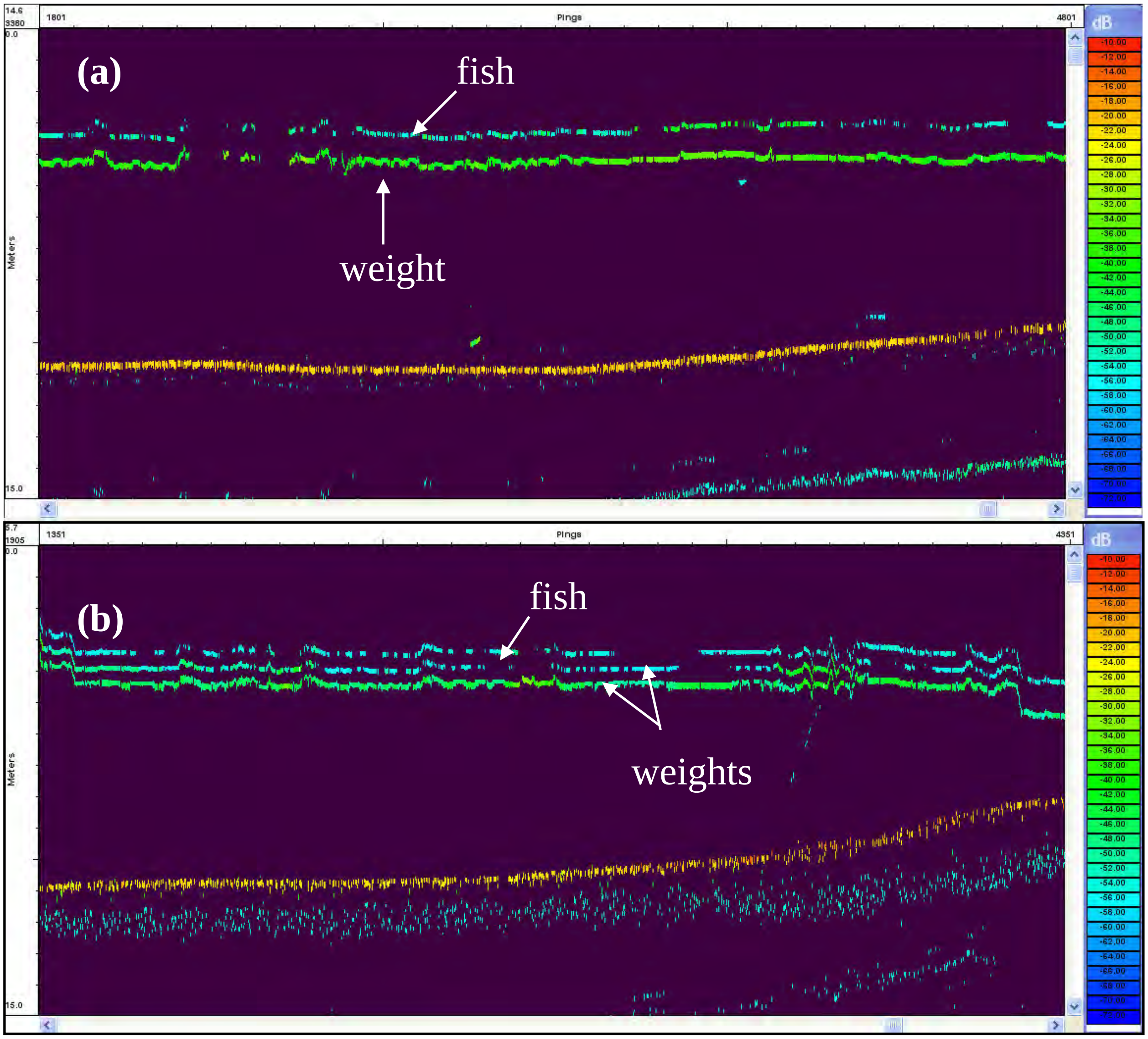
Target strength measurements (dB re 1 m^2) of juvenile blueback herring were taken on 3, 4, and 5 October 2008 from the Mohawk River at the Crescent Hydroelectric Project, New York, USA. *In situ* measurements were taken in the headrace at the powerhouse on 3 and 5 October 2008 and measurements of a single tethered fish were taken on 4 October 2008. All acoustic measurements were collected by a calibrated 420-kHz digital echosounder (Model 243, Hydroacoustic Technology, Inc.[HTI], Seattle, WA, USA) with two split-beam transducers (15° and 6° 3-dB beam widths). Equipment was operated aboard a 7-m aluminum vessel ("R/V Maritime"). The 6° transducer was aimed horizontally (5° down) from the vessel except when both transducers were positioned to aim downward during TS measurements of the single tethered fish. A pre- and post-laboratory calibration with a US Navy Standard transducer and a standard sphere calibration (21.2-mm tungsten carbide sphere with 8% cobalt binder) was performed to determine overall sensitivity (Foote et al. 1987; Simmonds and MacLennan 2005; Urick 1983).

Juvenile blueback herring were caught by cast net and kept in a live well until the tethering apparatus was prepared. A dead individual measuring 70 mm total length (TL) was tethered with 3.6-kg test monofilament line to the head, tail and a weight (metal nut) was suspended 0.5 m from the abdomen to maintain a general horizontal orientation for estimating dorsal-aspect TS (Appendix Figure C-1). The tethered fish was lowered by monofilament line to 3-4 m range from the transducers using a rod and reel and was insonified by each beam for a 500-1000 ping sequence while the vessel was adrift.

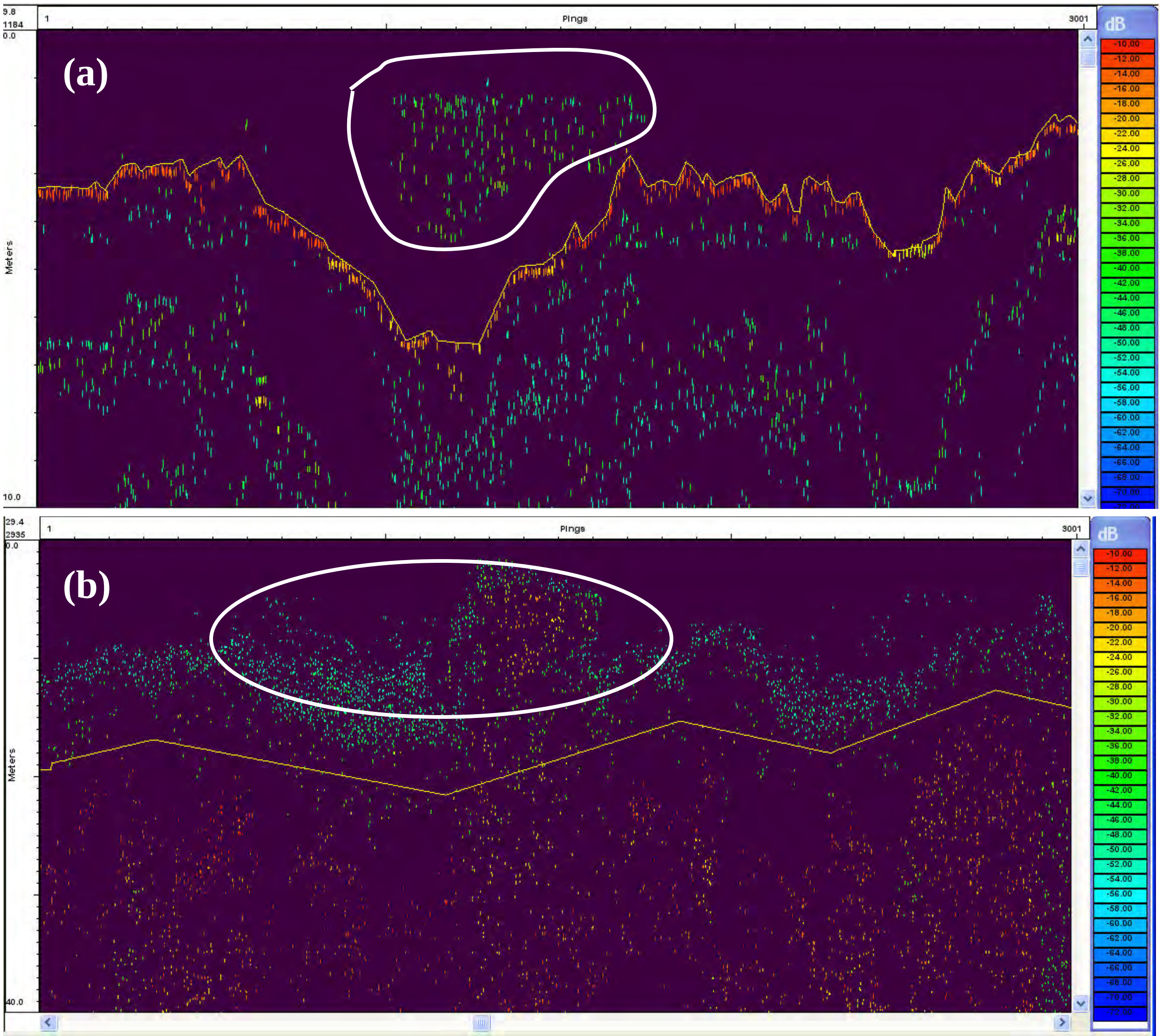
APPENDIX FIGURE C-1.—Juvenile blueback herring tethered by monofilament line to the head and tail for TS measurements.

Acoustic backscatter was adjusted for beam spreading and absorption loss with an applied time-varied gain (TVG) function of $40\text{Log}_{10}R$ where R is range (m) and a range-dependent absorption loss gain (αR) where α = 54.8 dB/km. Echoes were filtered and acquired using echo selection criteria in the DEP version 3.56 data acquisition software (HTI). The echo selection criteria used during data acquisition were the acceptance of targets within angles of the beam axis equivalent to half of the nominal beam width (-3 dB, half-power points), within the echo pulse envelope of 0.08 to 0.29 ms (3 to 14 digital samples), and above the minimum on-axis detection threshold (-60 dB for the tethered fish and -55 dB for the *in situ* measurements). Echoes from the individual fish were visually selected from echograms using Echoscape version 2.12 Build 12 software (HTI, Seattle, WA, USA; Appendix Figure C-2). To improve the TS estimate of the tethered fish, echoes included in the analysis were within one-third of the original off-axis angles (2.5° for 15° beam and 1° for the 6° beam), within a reduced echo pulse envelope (0.15-0.25 ms) and below a -42 dB maximum TS threshold. The *in situ* TS measurements were made on individuals associated with juvenile blueback herring schools observed in the headrace of the hydroelectric dam.

Species identification and size distribution of juvenile blueback herring were verified by samples collected by a 2.4-m radius monofilament cast net (1-cm square mesh). Echograms of the single targets detected during data acquisition were visually scrutinized and a subset was selected for analysis to minimize contributions of echoes from multiple targets within the schools (Appendix Figure C-3). This subset included those echo traces associated with the school's periphery or individual tracks. A 3.2 dB offset was added to TS values from the 15° split-beam transducer due to loss in sensitivity between pre- and post-calibrations. The loss in sensitivity was attributed to damage in amplifier electronics that determines echo phase position in one of the four transducer



APPENDIX FIGURE C-2.—Echograms of the echo traces of individual juvenile blueback herring tethered by monofilament line to (a) the mouth and gills and (b) the head and tail for measurement of target strength at all aspects as orientated in the 420-kHz down-looking split-beam transducers.



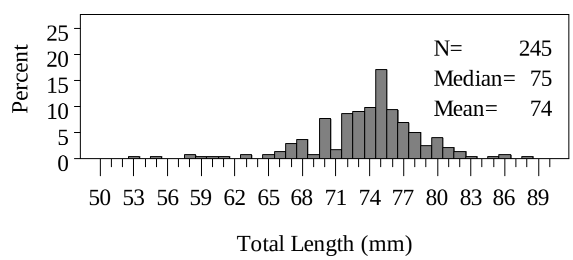
APPENDIX FIGURE C-3.—Echograms of the echo traces of a school of juvenile blueback herring circled in the headrace of the powerhouse at Crescent Hydroelectric Project on 5 October 2008 as detected by a (a) down-looking 15° and (b) side-looking 6° 420-kHz split-beam echosounder.

quadrants as a result of a bottom collision. Data manipulations, statistics, and plots were performed in SAS version 9.3 software (SAS Institute, Cary, NC, USA). Statistics on TS measurements were performed in the linear domain (i.e., back-transformed TS to σ_{bs} by $10^{(TS/10)}$) and presented in decibels ($=10Log_{10}(\sigma_{bs})$).

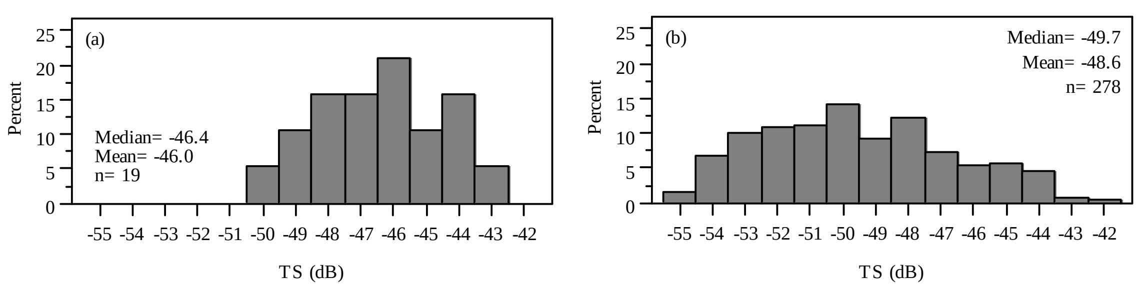
Results

In situ TS measurements.—Insonified juvenile blueback herring captured by cast net averaged 74 mm (range=53 to 88 mm; Appendix Figure C-4). The TS distribution of individual echoes extracted from these schools using both real-time single target detection criteria and visual inspection is shown in Appendix Figure C-5. Mean TS of juvenile blueback herring was -46.0 dB (95% confidence limits = -47.0 dB, -45.2 dB) for the down-looking 15° beam. The TS distribution of individual juvenile blueback herring detected by the side-looking 6° beam was positively skewed with a median of -49.7 dB and mean of -48.6 dB (-49.0 dB, -48.2 dB). The TS equivalent to the 75^{th} and 90^{th} percentiles of the σ_{bs} distribution was respectively -45.3 and -43.7 dB for the down-looking 15° beam, and -47.6 and -45.3 dB for the side-looking 6° beam.

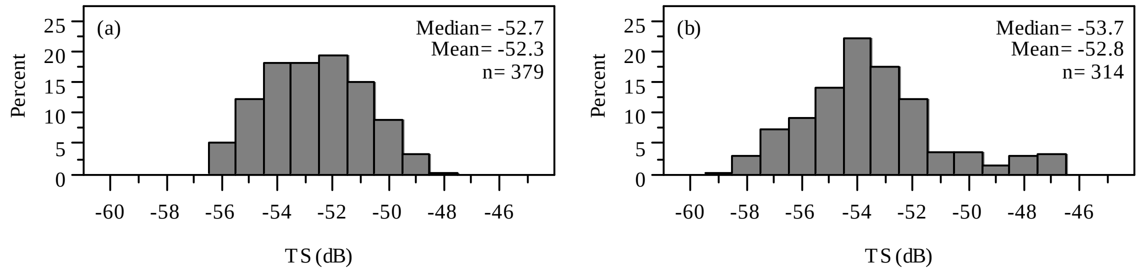
Tethered fish.—Assuming this fish was primarily horizontal, the dorsal-aspect TS distribution measured by the 15° beam peaked at -52 dB while the TS distribution measured by the 6° beam peaked around -54 dB (Appendix Figure C-6). Mean dorsal-aspect TS for the 70-mm dead tethered individual was estimated as -52.3 dB for the 15° beam and -52.8 dB for the 6° beam.



APPENDIX FIGURE C-4.—Length-frequency distributions of juvenile blueback herring captured by cast net in the headrace of the Crescent Hydroelectric Project, Mohawk River, NY.



APPENDIX FIGURE C-5.—Frequency distributions of target strength (TS, dB re 1 m^2) of visually selected single target detections associated with a school of juvenile blueback herring measured by a (a) down-looking 15° and (b) side-looking 6° 420-kHz split-beam echosounder on 3 and 5 October 2008 using real-time echo selection criteria of 0.15-0.25 ms echo envelopes. A minimum (-55 dB) and maximum (-42 dB) threshold was applied.



APPENDIX FIGURE C-6.—Frequency distributions of dorsal-aspect target strength (TS, dB re 1 m^2) of a dead 70-mm blueback herring tethered to the head and tail by monofilament line and insonified by a (a) 15° and (b) 6° 420-kHz split-beam transducer using restrictive echo selection criteria of (a) 2.5° off axis for the 15° transducer, (b) 1° off axis for the 6° transducer, and 0.15-0.25 ms echo envelopes.

Discussion

The mean TS from the *in situ* measurements taken by the down-looking 15° split-beam transducer (-46.0 dB) was 1.7 dB higher than the predicted dorsal aspect TS based on Love (-47.7 dB; 1977). The *in situ* TS distribution of juvenile blueback herring measured by the side-looking 6° split-beam transducer was wider and had a lower mean TS (-48.6 dB) compared to the side-aspect TS predicted by Love (-46.2 dB for 74-mm fish; 1977) but higher than predicted head- and tail-aspect TS (-58.9 and -61.7 dB, respectively). The wide unimodal TS distribution observed in the side-looking transducer and an intermediate mean TS supports a TS distribution from a mixture of body orientations relative to the incident wave field (yaw and pitch).

Probably the most often referred TS-size relation is by Love (1971, 1977) who described the average TS of individuals from 14 families including Clupeidae (Atlantic menhaden, *Brevoortia tyrannus*) as a function of size and acoustic wavelength. The estimated TS from the dorsal- and side-aspect (±15°) based on Love (1977) was respectively -48.3 dB and -46.7 dB for a 70-mm fish, and -47.7 dB and -46.2 dB for a 74-mm fish (average for fish measured *in situ*). The maximum TS difference for a 74-mm fish predicted by Love (1977) is 15.4 dB between tail and side aspect. The TS distribution of the dead 70-mm individual resulted in a bell-shaped distribution with a range of 8-12 dB and a mean TS (-52.8 for the 15° beam and -52.3 dB for the 6° beam) which was less compared to estimates by Love (1977; -48.3 dB).

Target strength distributions from the tethered fish and *in-situ* measurements ranged over 6 to 10 dB. The tethered fish may have underestimated TS if the swimbladder volume or area decreased during handling. Clupeids have physoclistous swimbladders and are able to release gas through the anal opening (Wahlberg and Westerberg 2003). Target strength measurements from live wild fish with high confidence of species identification usually offer the best estimates but variability in body orientation, swimbladder volume, single target detections and multiple scattering effects may contribute to variability of TS distributions. Target strength of blueback herring has not been published or widely studied so comparison to other studies are limited to general target strength estimates based on size or other clupeids like alewife (*Alosa pseudo-harengus*).

Target strength has been described for alewife from *in situ* measurements and scattering models. Warner et al. (2002) provided a significant positive relation between TS and length ($TS=20.53\log_{10}L-64.25$ where L= length in cm) from measuring wild alewife (range=25 to 152 mm TL) in Lake Ontario at 70 kHz. Based on this relation, target strength of a 74-mm alewife would be -46.4 dB which is 0.4 dB lower than the *in situ* mean TS for the 74-mm juvenile blueback herring measured by the down-looking transducer.

Brooking and Rudstam (2009) estimated mean target strength of 74-mm age-0 alewives at 70 kHz from net cage experiments during the day (-46.1 dB) and night (-46.9 dB). The estimates by Brooking and Rudstam (2009), although at a lower frequency than 420 kHz, were also similar to the in situ estimates presented here from a down-looking split-beam transducer.

Reeder et al. (2004) described the tilt angle effect on TS of adult alewife based on two scattering models from tank measurements of dead fish and morphology from CT imagery. Fleischer et al. (1997) developed a TS-length relation at 120 kHz from mixed catch of rainbow smelt (*Osmeius mordax*), bloater (*Coregonus hoyi*), alewives, ninespine sticklebacks (*Pungitius pungitius*) and threespine sticklebacks (*Gasterosteus aculeatusi*). For catch with no or little bloaters, $\log_{10}(L) = 1.904 + 0.019TS$ (Fleischer et al. 1997). Fabrizio et al. (1997) provided a TS-weight relation at 120 kHz for a mixed catch which included alewife as a dominant species ($\log_{10}W=4.242 + 0.064TS$ where W= weight in grams). The results from the latter three studies aren't readily applicable for purposes of deriving acoustic estimates of abundance for juvenile blueback herring.

The observed *ex situ* TS distributions were different than the *in situ* TS distributions for juvenile blueback herring. The effect of dead or stunned fish and the unknown condition of the swimbladder may have caused these estimates to be less representative of the true TS of free-swimming juvenile blueback herring during acoustic surveys (Simmonds and MacLennan 2005). Considering that the swimbladder may account for up to 90% of the acoustic backscatter (Foote 1980), handling of a live and dead blueback herring at the surface may release or purge their swimbladder producing lower TS estimates. For acoustic surveys that vertically integrate acoustic backscatter, the empirical mean *in situ* TS measured by the down-looking 15° split-beam transducer was most representative for scaling volume backscatter to fish density estimates of juvenile blueback herring.

Horizontal beaming is especially important in acoustically estimating fish abundance in shallow water where vessel avoidance may bias vertical echo integration (Hughes 1998; Kubecka and Wittingerova 1998) but mean TS used for scaling echo energy to fish densities should be representative of a wide TS distributions of fish in multiple directions and orientations rather than a maximum or near-maximum side-aspect TS as predicted by Love (1977). Boswell and Wilson (2008) developed a pooled TS-length relation ($TS=20\log_{10}TL_{cm}-65$) from side-aspect TS measurements of bay anchovy (*Anchoa mitchilli*) and Gulf menhaden (*Brevoortia patronus*) in *ex situ* experiments. Based on this TS-TL relation, the side-aspect TS for a 74-mm juvenile blueback herring would be -47.6 dB, which is 1 dB higher than the mean side-aspect TS observed in this study. Boswell and Wilson (2008) also observed TS estimates were higher for free-swimming fish than for tethered fish by 3-5 dB for anchovy and 5-9 dB for menhaden. For estimating abundance of juvenile blueback herring from horizontal beaming, the *in situ* TS distribution (mean= -48.6 dB) measured by the side-looking 6° split-beam transducer was the best available information to date for TS of juvenile blueback herring. For down-looking transducers, the mean *in situ* TS (-46.0 dB) measured by the 15° split-beam transducer provided the first estimates of TS of juvenile blueback herring at 420 kHz, which were similar to those estimates of other studies for juvenile alewives.

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Appendix D – Fish Abundance and Distribution from Mobile Acoustic Surveys during the Downstream Migration of Juvenile Blueback Herring in the Mohawk River at the Crescent Hydroelectric Project

Introduction

The use of mobile acoustic surveys with calibrated echosounders to remotely estimate abundance of fish populations has been well established (Rivoirard et al. 2000; Simmonds et al. 1992; Simmonds and MacLennan 2005). Density and abundance of fish from freshwater lakes and rivers have been routinely estimated from mobile acoustic surveys using the echo integration method and target strength to convert results to fish densities (Brandt et al. 1991; Rudstam et al. 2009; Rudstam et al. 2003; Wanzenböck et al. 2003; Warner et al. 2002). Mobile acoustic surveys have been used to assess distribution and population sizes of alewife *Alosa pseudoharengus* by Warner et al (2002), rainbow smelt *Osmerus mordax* by Rudstam et al. (2003), lake herring *Coregonus artedi* by Mason et al. (2005) and multiple species (Brandt et al. 1991; Fabrizio et al. 1997).

Echo integration is the standard method of deriving fish abundance estimates from acoustic backscatter collected by mobile acoustic surveys when the distribution of fish can limit the use of echo counting of single target detections. An echo can be defined as part of the received signal from scattering that is above a pre-defined detection threshold. The total echo energy of a sampled volume has been shown to be linear with fish abundance (Foote 1983), thus integration of echo energy over some distance, depth or time intervals can provide an estimate of fish density by dividing the echo integrals by a representative back-scattering cross-section of an individual fish (Brandt et al. 1991; Simmonds and MacLennan 2005). Conversion of echo integration data to fish densities assumes the fish are randomly and uniformly distributed throughout the cross section of the acoustic beam over many transmissions (Simmonds and MacLennan 2005).

Anadromous fish such as clupeids and salmonids, encounter hydroelectric dams during their upstream or downstream migration. The potential impacts of physical obstruction or turbine-related mortality at hydroelectric facilities have been the subject of many hydroacoustic studies (Moursund et al. 2003; Skalski et al. 1996; Steig and Iverson 1998). Sound used as a fish deterrent has been studied as a method to reduce entrainment and increase passage of clupeids at hydroelectric dams (Gibson and Myers 2002; Nestler et al. 1992). The use of high-frequency sound of 122-128 kHz as a fish deterrence system has been shown to reduce impingement of alewives at power plant intakes (Ross et al. 1996; Ross et al. 1993).

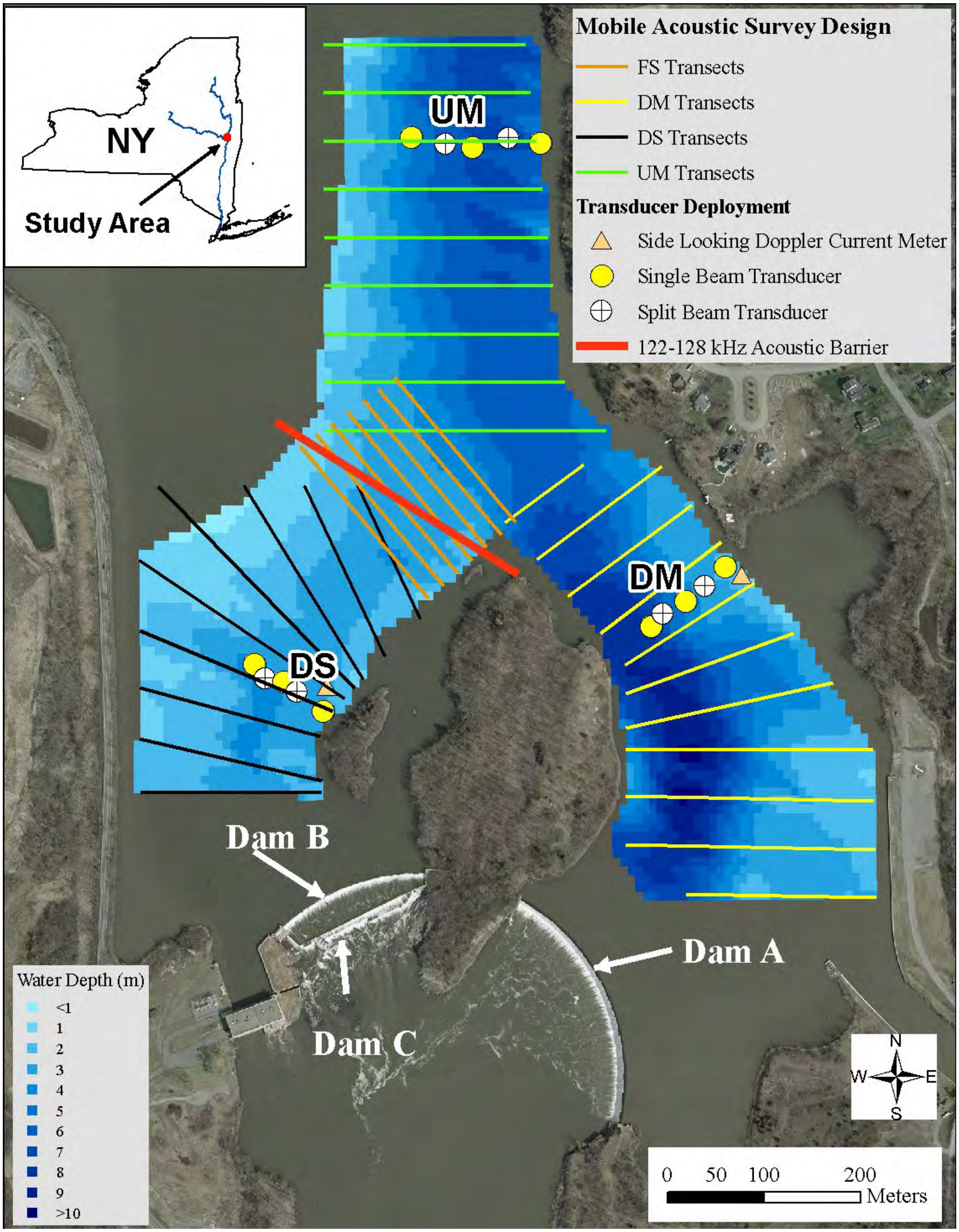
Juvenile blueback herring *Alosa aestivalis* migrate down the Mohawk River starting in late summer. Near the Crescent Hydroelectric Project (Crescent), some juvenile blueback herring migrate downriver through the main channel that leads to the Waterford Flight and some through a secondary channel that conveys water to the Crescent headrace. The objectives of a study done from August 29 through October 5, 2008 were: 1) to determine if the abundance of juvenile blueback herring migrating through the main channel compared with that through the secondary channel was significantly different from the expected abundance migrating through the main channel compared with that through the secondary channel, based on the volume of water flowing through each channel, and 2) to describe the spatial and temporal distribution of juvenile blueback herring in each channel and proximal to the ultrasound field. This report presents the spatial distribution of juvenile blueback herring from repeated mobile acoustic surveys.

Methods

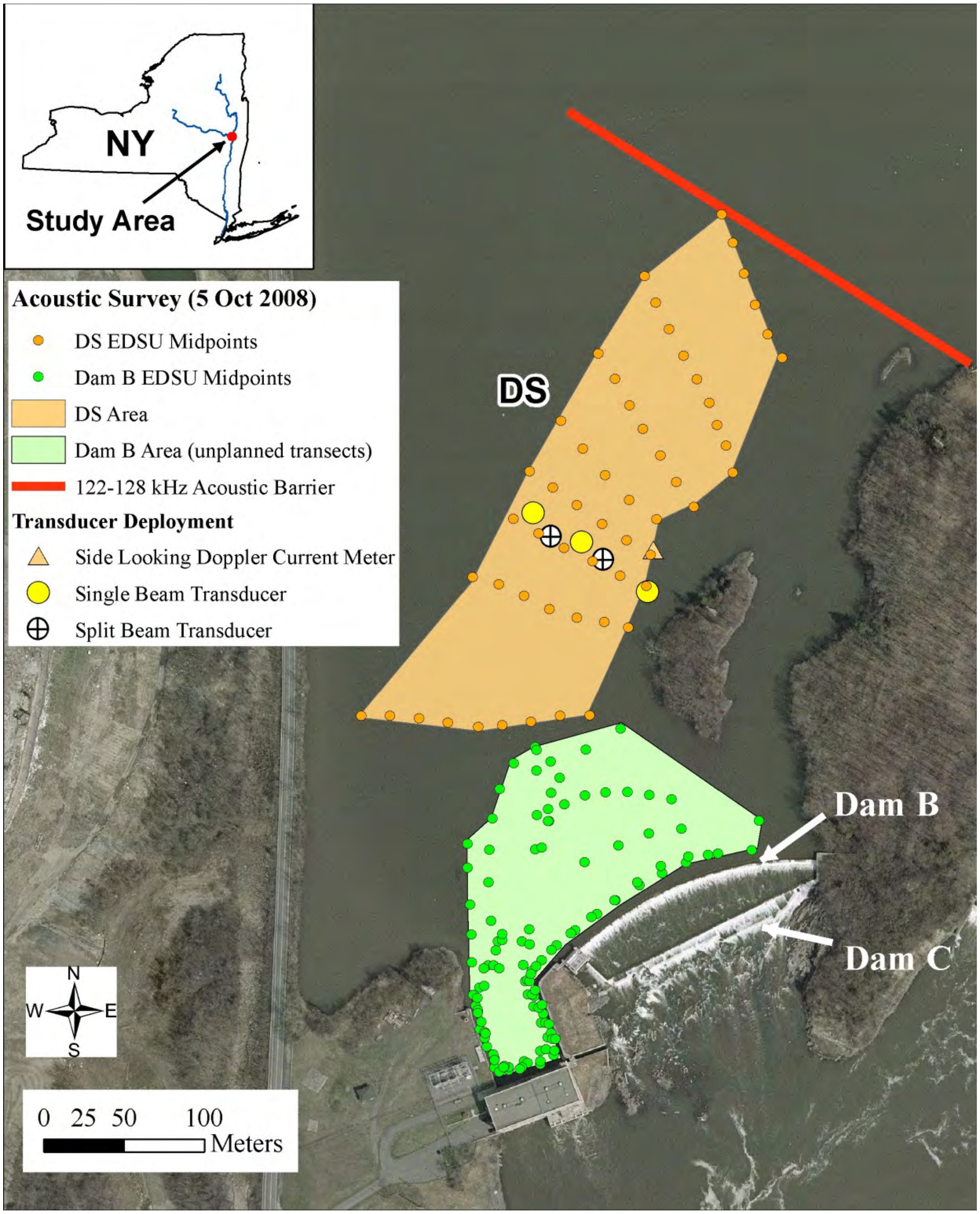
Sampling design.—Fish abundance and distribution was assessed by repeated mobile acoustic surveys between 18 September and 5 October 2008 when juvenile blueback herring were migrating downstream in the Mohawk River. The acoustic index of fish abundance was estimated from a systematic survey design of four sets of transects which were assumed representative of four areas upstream of Crescent: the main channel upstream of the ultrasonic system (UM), main channel downstream of the ultrasonic system (DM), secondary channel downstream of the ultrasonic system (DS), and the area over the ultrasonic system (FS) which was sampled over a fine-scale grid of seven transects 10 m apart (Appendix Figure D-1). The use of a systematic survey design has been shown to be optimal for estimating fish abundance by Simmonds and Fryer (1996) and its use has become standard practice (Simmonds et al. 1992). Transects were orientated across the channels and approximately perpendicular with water flow. Parallel transects were spaced approximately 50 m apart. Transect lengths were limited by water depth of that allowed sufficient clearance of the vessel (>1 m). Unplanned irregular transects during the survey on 5 October 2008 allowed for fish abundance to be estimated for the area immediately upstream of Crescent Dam B (DB) including the headrace (Appendix Figure D-2), and the headrace itself (HR; Appendix Figure D-3). The statistics of the survey design were reported in Appendix Table D-1. The surveys conducted on 1, 2, and 3 October 2008 were not included here because fish density estimates from echo integration was unavailable for most transects as result of a software malfunction during acquisition in which single target detections were saved but most of the echo integration data were not saved.

Acoustic data collection.—Acoustic backscatter was collected by a calibrated 420-kHz echosounder (Model 241, Hydroacoustic Technology, Inc. [HTI], Seattle, WA, USA) multiplexed with two split-beam transducers (15° and 6° 3-dB beam widths). A pre- and post-laboratory calibration with a US Navy Standard transducer and a standard sphere calibration (21.2-mm tungsten carbide sphere with 8% cobalt binder) was performed to determine overall sensitivity (Foote et al. 1987; Simmonds and MacLennan 2005; Urick 1983). Equipment was operated from a 7-m aluminum vessel ("R/V" Maritime). The 15° split-beam transducer was aimed vertically down and 6° split-beam transducer was aimed horizontally (5° down) from the vessel during surveys. The acoustic backscatter was quantified by echo integration in real time and acquired with DEP version 3.56 data acquisition software (HTI). Raw data was archived to a digital audio recorder (Sound Devices, LLC, Reedsburg, WI, USA), but data after 23 September 2008 were found to be corrupted during re-processing. Raw digital samples from 18 September are shown in Appendix Figure D-4. Data were georeferenced with positional fixes from a Garmin handheld DGPS unit. The echosounder system was powered by a Honda gasoline generator.

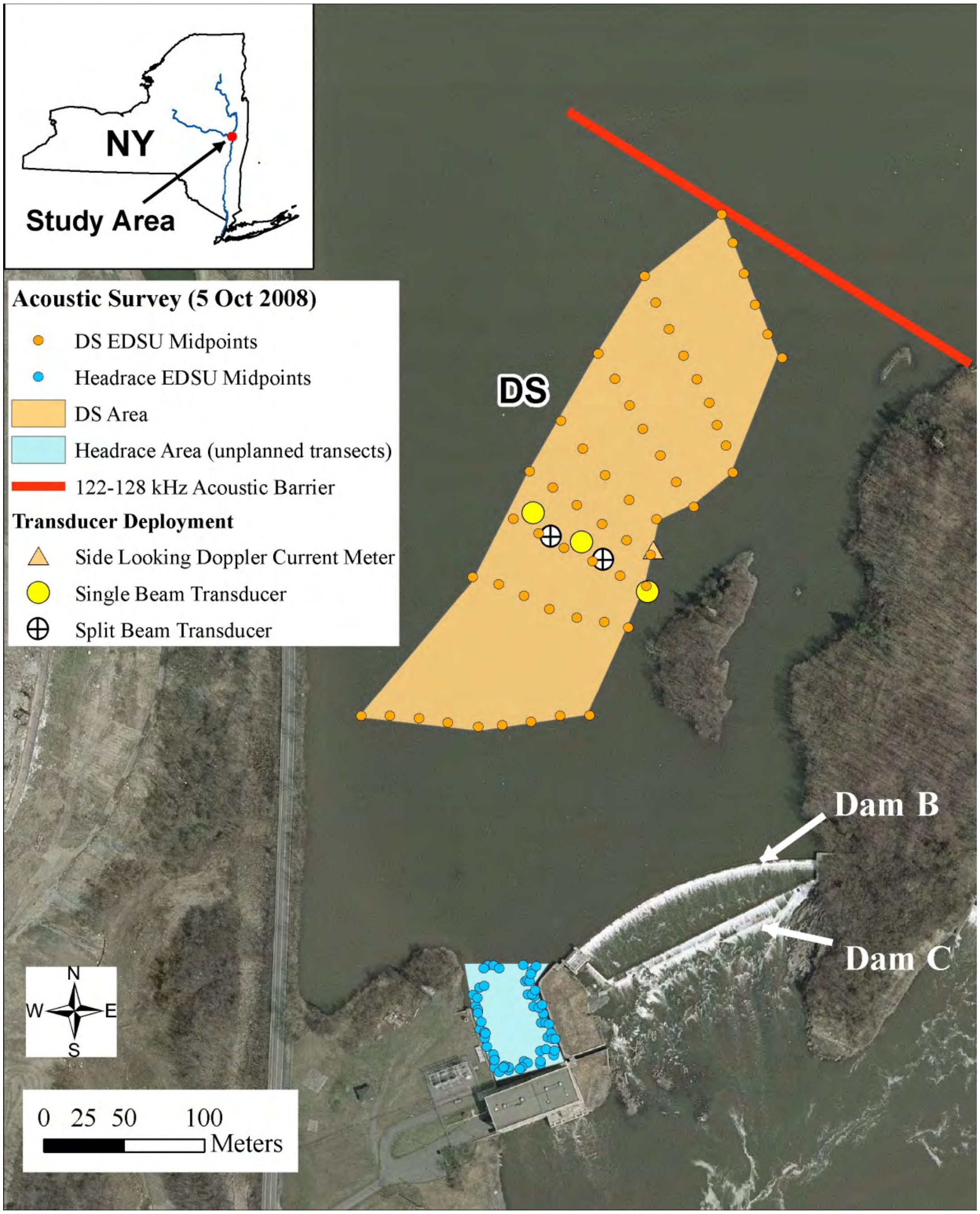
A -50 dB echo integration threshold was used to exclude echo contributions from ambient noise based on several criteria. The sampling configuration was based on the assumption of quantifying large juvenile blueback herring schools as opposed to echo counting. This threshold matches the echo integration threshold used in a concurrent study at Crescent using a continuous, fixed-location hydroacoustic sampling design. Echo amplitudes were adjusted for beam spreading and absorption loss with an applied time-varied gain (TVG) function of $20\text{Log}_{10}R$ where R = range (m) and a range-dependent absorption loss gain (αR) where α = 54.8 dB/km (Foote 1983; Simmonds and MacLennan 2005). Echo energy (root-mean-square voltage) was



APPENDIX FIGURE D-1.—Map of the systematic survey design of planned transects for repeated mobile hydroacoustic surveys with a 15° down-looking, split-beam echosounder (Model 241, HTI) at Crescent Hydroelectric Project on the Mohawk River. Areas of interest included upstream of an underwater ultrasonic system in the main channel of the Mohawk River (UM), downstream of the ultrasonic system in the main channel (DM), downstream of the ultrasonic system in the secondary channel (DS), and near the ultrasonic system over a fine-scale set of transects (FS).



APPENDIX FIGURE D-2.—Map of the midpoints for elementary distance sampling units (EDSUs) used for echo integration of acoustic backscatter from the water column collected by a 15° down-looking, split-beam echosounder (Model 241, HTI) sampled over unplanned transects in an area immediately upstream of Dam B (DB) and planned transects downstream of an underwater ultrasonic system in the secondary channel (DS) of the Mohawk River at the Crescent Hydroelectric Project, New York, during 5 October 2008.



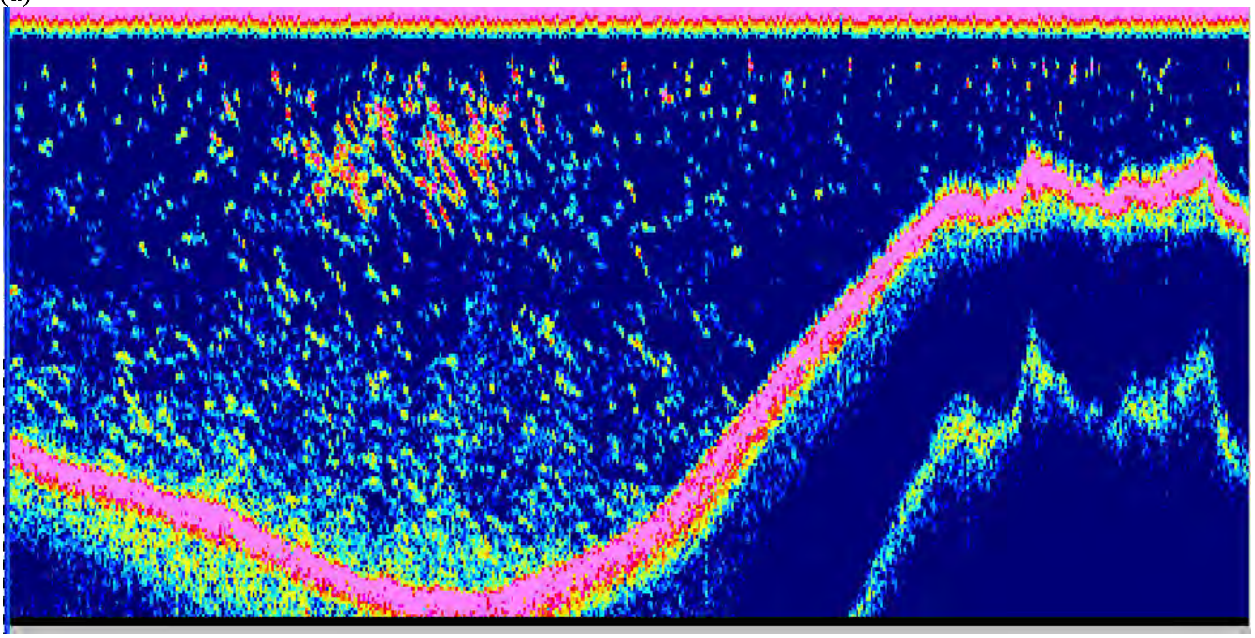
APPENDIX FIGURE D-3.—Map of the midpoints for elementary distance sampling units (EDSUs) used for echo integration of acoustic backscatter from the water column collected by a 15° down-looking, split-beam echosounder (Model 241, HTI) sampled over unplanned transects in the headrace (HR) and planned transects downstream of an underwater ultrasonic system in the secondary channel (DS) of the Mohawk River at the Crescent Hydroelectric Project, New York, during 5 October 2008.

APPENDIX TABLE D-1.—Summary statistics of the vessel tracks and sampling from acoustic surveys with a 15° split-beam echosounder of the Mohawk River at Crescent Hydroelctric Project, New York.

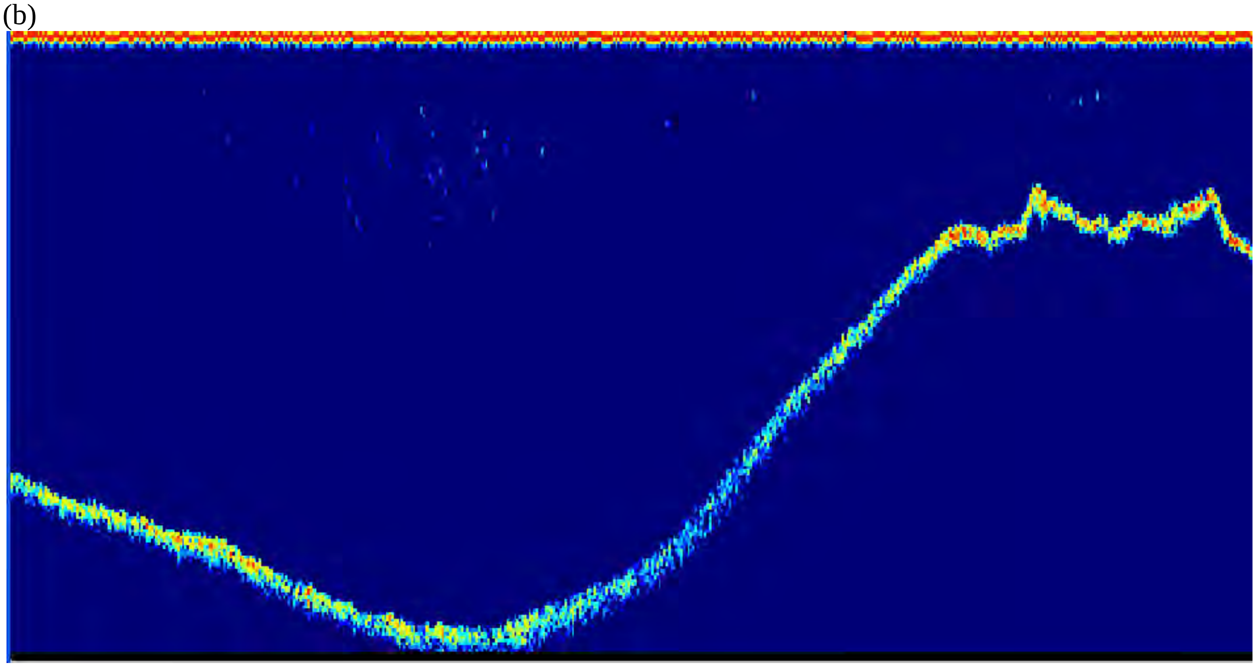
Date	Site*	Time	Number of transects	Mean EDSUs** per transect	Total EDSUs per site	Mean transect length	Survey area (m^2)
18-Sep	UM	2202-2316	10	13.3	133	256	95,576
	DM	0103-0134	11	10.6	117	231	95,306
	DS	2358-0036	9	7.3	66	142	35,256
	FS	—	—	—	—	—	—
20-Sep	UM	1642-1712	9	10.3	93	248	80,466
	DM	1808-1842	11	11.1	122	250	93,553
	DS	1734-1804	8	8.5	68	158	28,287
	FS	1847-1909	6	10.2	61	221	20,139
22-Sep	UM	1146-1225	11	10.1	111	226	88,716
	DM	1243-1319	11	11.7	129	254	92,028
	DS	1343-1413	9	8.1	73	163	40,496
	FS	1417-1440	7	10.0	68	223	22,514
23-Sep	UM	1309-1342	10	11.0	110	244	88,074
	DM	1404-1446	11	10.7	118	247	97,136
	DS	1512-1542	9	7.4	67	149	36,644
	FS	1549-1610	7	9.9	69	223	21,905
29-Sep	UM	1212-1328	10	16.0	161	341	79,346
	DM	1346-1442	11	11.2	134	292	78,088
	DS	1516-1555	10	11.2	112	200	43,393
	FS	1559-1624	7	11.4	80	238	18,952
05-Oct	UM	13-9-1342	10	11.4	114	238	79,506
	DM	1404-1446	11	10.5	116	240	92,417
	DS	1512-1542	8	6.9	55	147	37,612
	FS	1549-1610	7	10.3	72	219	20,644
	UT	1309-1328, 1400-1415	2	66.5	133	1119	22,650
	DB	—	n/a	n/a	120	n/a	19,851
	HR	—	n/a	n/a	58	n/a	3,131

* UM = upstream of the ultrasonic system in the main channel, DM = downstream of the ultrasonic system in the main channel, DS= downstream of the ultrasonic system in the secondary channel, FS=fine scale grid over the ultrasonic system, UT=all unplanned transects, DB=area upstream of Crescent Dam B including headrace, HR=Crescent headrace.
** EDSU = elementary distance sampling unit equivalent to a 2-minute averaging interval

(a)



(b)



APPENDIX FIGURE D-4.—An example of the echogram of the raw digital S_v samples from a mobile survey collected by a 15° down-looking, split-beam echosounder (Model 241, HTI) sampled downstream of an underwater ultrasonic system in the main channel (DM) of the Mohawk River at the Crescent Hydroelectric Project, New York, during 18 September 2008 with a (a) -80 dB minimum threshold and (b) -50 dB minimum threshold. Colors are proportional to S_v (warmer colors are higher S_v). Raw digital data were saved to *.wav files by digital audio recorder, reprocessed, and displayed in an echogram using Echoview v4.70 software (Myriax, Hobart, TAS, Australia).

integrated over elementary distance sampling units (EDSU) of approximately 18 m based on an elementary time sampling unit (ETSU) or averaging interval of 12 seconds at 3 knots (1.5 m/s).

Data analysis.– Data from real-time echo integration were post-processed by displaying the volume backscattering strength (S_v=10log$_{10}$(s_v)) for 1-m x 12-second strata in Echoscape software (HTI, version 2.12 Build 8) and flagging data for exclusion from analysis if high cells overlapped the river bottom (Appendix Figure D-5). The first 1.5 m of water was excluded from echo integration as determined by the transducer depth and near-field range of the transducer. The acoustic index of abundance of juvenile blueback herring used was the area backscattering coefficient (s_a), in units of m^2/m^2) defined by MacLennan et al. (2002) as

$$s_a = \int_{z_1}^{z_2} s_v \mathrm{d}z = \sum_{z=1}^{z_n} s_v \ , \qquad \text{(Eq. 1)}$$

where z = the first 1-m depth stratum to nth 1-m depth stratum in units of m, dz =change in depth in units of m, and s_v = volume backscattering coefficient in units of m^{-1} defined as

$$s_v = \frac{\sum \sigma_{bs}}{V_0} = V_{rms}^2 A_{equip} \ , \qquad \text{(Eq. 2)}$$

where σ_{bs} = backscattering cross-section (in units of m^2), which is the physical quantity of the acoustic reflectivity of an individual and V_0 = sampled volume (in units of m^3). The acoustic pressure scattered from the multiple targets in the insonified sample volume is converted at the transducer face to a voltage response which is a relative output. The relative output is scaled to provide absolute quantitative estimates of acoustic backscatter by applying the system parameters after adjusting for acoustic absorption loss and beam spreading. The root mean squared voltage (in units of V_{rms}) was converted to s_v by multiplying by the amplitude scaling factor for the equipment (A_{equip}, in units of $m^{-1}V^{-2}$), which was defined as

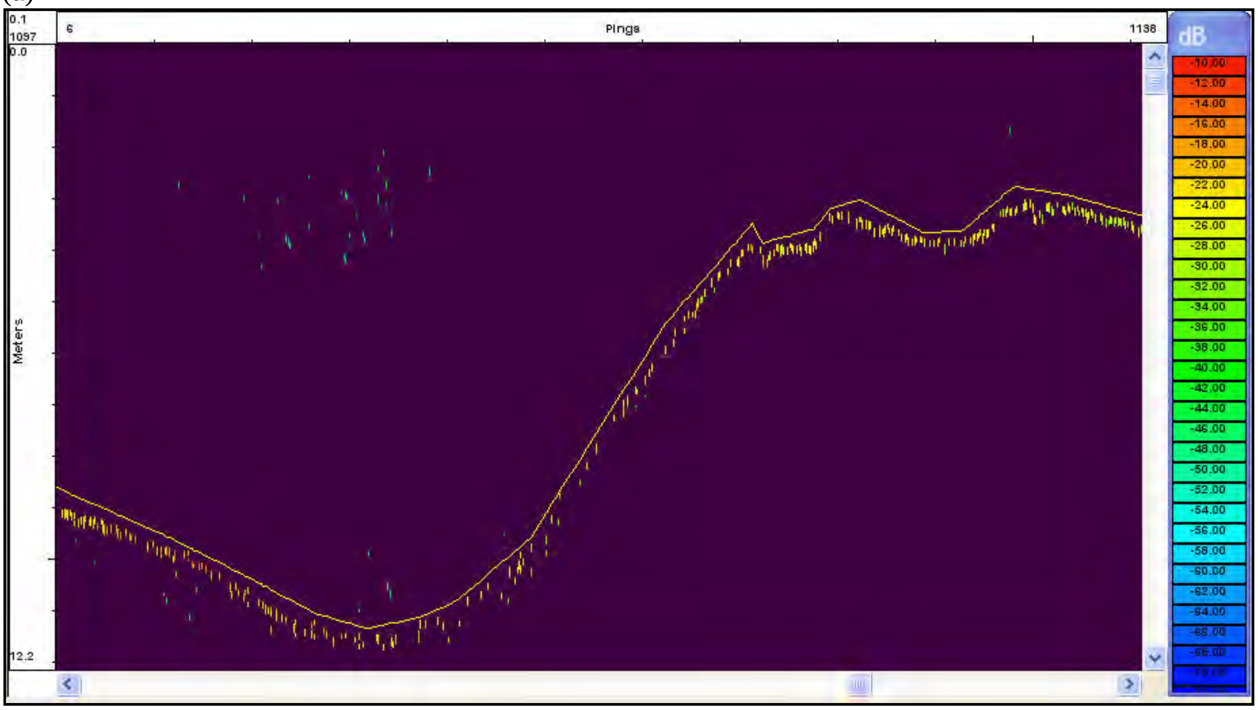
$$A_{equip} = \frac{1}{c \tau \pi b_{av}^2(\theta,\phi) P_o^2 G_x^2} \ , \qquad \text{(Eq. 3)}$$

where c = sound speed (in units of m/s), τ = pulse duration (in units of s), π = constant pi (~3.14), $b_{av}^2(\theta,\phi)$= beam pattern factor, P_o^2 = transmit pressure level (in units of μPa^2 at 1 m), and G_x^2 = squared through-system gain (in units of $V_{rms}^2/\mu Pa^2$). The A_{equip} constant was multiplied by a factor of 1.968 for data collected by the 15° split-beam transducer to adjust for loss in sensitivity between pre- and post-calibrations. The loss in sensitivity was attributed to damage in amplifier electronics that determines echo phase position in one of the four transducer quadrants as a result of a bottom collision. Numerical fish density expressed as number of fish under unit area of surface water (ρ, in units of fish/m^2) was estimated by

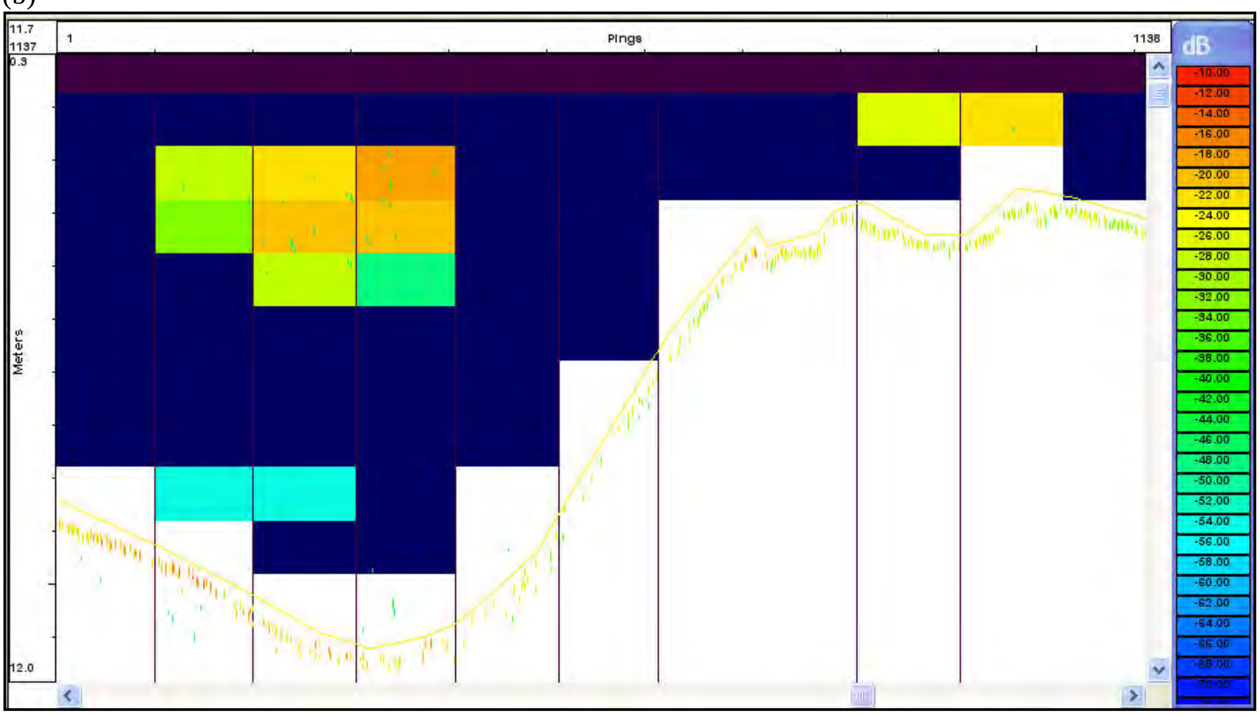
$$\rho = \frac{s_a}{\langle \sigma_{bs} \rangle} \ , \qquad \text{(Eq. 4)}$$

where $\langle \sigma_{bs} \rangle$ = the mean backscattering cross-section of an individual fish representative of the fish population being assessed, which can be extracted from the mean of the target strength (TS) distribution of the fish being surveyed ($\langle \sigma_{bs} \rangle = \langle 10^{(TS/10)} \rangle$). For this study, the $\langle \sigma_{bs} \rangle$ used to derive fish densities from the down-looking transducer was based on the estimated mean dorsal TS of juvenile blueback herring (-46.0 dB) from *in situ* split-beam measurements of verified schools of juvenile blueback herring in the headrace during mobile surveys on 3 and 5 October 2008 (see Appendix C). This TS estimate was reasonably similar to the TS of juvenile alewife estimated by Brooking and Rudstam (2009) and Warner et al. (2002). The numerical abundance (N) of juvenile blueback herring was estimated for each surveyed area by multiplying the mean fish density by the area of a convex polygon encompassing the valid EDSU midpoints for each set of transects (e.g., UM, DM, DS, FS).

(a)



(b)



APPENDIX FIGURE D-5.—Echogram of the (a) single target detections and (b) echo integration of the same data shown in Figure 4 but processed in real time using DEP version 3.56 data acquisition software (HTI) using a -50 dB minimum threshold and post-processed in Echoscape version 2.12 Build 12 software (HTI).

The species composition of the insonified aggregations of fish during the course of the study period were not 100% juvenile blueback herring based on gill net sampling, but echo integration would provide a relative index of schooling juvenile blueback herring provided that other fish species were not larger contributors to volume scattering or fish assemblages at the sites compared were not very different. Gill net catches suggested the species composition were similar between UM and DM but both were different from DS. Comparisons of juvenile blueback herring abundance among sites should be made with caution, as other fish species may contribute differently in DS compared to UM and DM. The presence of juvenile blueback herring was verified in DM and DS by multiple cast net catches. Use of the mean TS of juvenile blueback herring to estimate fish density may have contributed to overestimating densities of juvenile blueback herring by inclusion of volume backscatter of larger resident fish. The use of -50 dB minimum threshold may have also excluded a fraction of the juvenile blueback herring, which would bias the estimates low. Therefore, fish densities and numerical abundance estimated from echo integration by the mobile surveys served as relative measures of density and abundance for describing spatial distribution within channels and not as absolute abundance of juvenile blueback herring.

The spatial distribution of juvenile blueback herring was described by mapping the orders of magnitude of s_a for each survey using GIS (ArcMap v9.3, ESRI, Danvers, MA). To describe the vertical distribution of fish over multiple water depths, mean s_v was plotted for each 1-m depth stratum for each water depth defined by the maximum depth stratum.

Acoustically-derived fish densities and abundance were compared among sites from acoustic survey estimates using a non-parametric analysis of variance of ranked-transformed data with Tukey-adjusted post-hoc multiple pair-wise comparisons. Because the acoustic surveys were conducted over 17-day period, differences in rank-transformed fish densities among sites were also tested for each survey.

Data manipulations, statistics, and plots were performed in SAS version 9.3 software (SAS Institute, Cary, NC, USA).

Results and Discussion

Spatial distribution.—The distribution of s_a throughout the sections of the Mohawk River surveyed upstream of Crescent was mapped for each mobile acoustic survey with valid echo integration data (Appendix Figures D-6 to D-11). Fish appeared to be distributed in high fish densities in the east side of the headrace and in front of the trash racks of Crescent pump house on 5 October (Appendix Figure D-12). When the non-zero s_a values from each acoustic survey were superimposed onto a single map, fish in DS and DM appeared to be distributed more along the deeper channels (Appendix Figure D-13). The magnitude of s_a from the repeated mobile surveys appeared to more in DM and DS compared to UM suggesting some fish retention of migrating juvenile blueback herring. The distribution of s_a appeared more widespread in DM and UM but more concentrated on the east side of DS.

The depth distribution of fish within the surveyed areas was visualized three-dimensionally based on a composite of all s_v data from six acoustic surveys (Appendix Figures D-14 to D-27). The spatial distribution from these three-dimensional visualizations show higher densities of fish were distributed in the upper 4 meters, but fish were distributed throughout the water column of UM at lower densities. The lower s_v values observed in UM from all six surveys compared to DM and UM suggest fish gradually moved downstream in lower densities, then became concentrated in the shallow waters of DS and accumulated throughout more of the water column in DM.

The depth distribution from 1-m s_v layers of the water column appeared different among acoustic surveys (Appendix Figure D-28). Mean s_v was higher in shallower water with the exception on

18 September when mean s_v was highest in the top 2-4 m in deeper waters. In deep waters (>7 m) on 29 September, mean s_v was highest in mid-water to near bottom while in shallow water, mean s_v was highest in the 2- and 3-m depth strata. While s_v was generally higher in the top few meters, there were s_v peaks in mid-water column on 29 September and to a lesser extent on 20 and 22 September.

Comparisons among sites.—Acoustic estimates of fish density and abundance for each site from the acoustic surveys were summarized in Appendix Table D-2. Mean survey estimates of fish density and fish abundance were higher in DS than in DM and UM, but differences in fish density ($df_{model,\ error}$=2,15, F=0.70, p>0.05) and abundance ($df_{model,\ error}$=2,15, F=1.77, p>0.05) was not significant based on ANOVA of ranked data (Appendix Figure D-29). On the 5 October survey, ranked fish densities were significantly different among surveyed areas (Appendix Table D-3; Appendix Figure D-30). Fish density from unplanned transects of the Crescent headrace on 5 October was significantly higher than fish density from all other areas including the area extending from the headrace to immediately upstream of Dam B (DB). Fish density in DB on 5 October was significantly higher than fish densities in FS, UM and DS while fish density in DM was only significantly higher than fish densities in UM and DS. Fish density in FS, UM, and DS on 5 October was not significantly different.

Comparisons in fish density among sites for other surveys only showed few significant differences (Appendix Table D-3). Fish density in DS was significantly less than fish densities in DM and UM on 18 September. Fish density in DM was significantly higher than fish density in any other site on 23 September. Fish density in DM was significantly higher than fish density in UM on 29 September.

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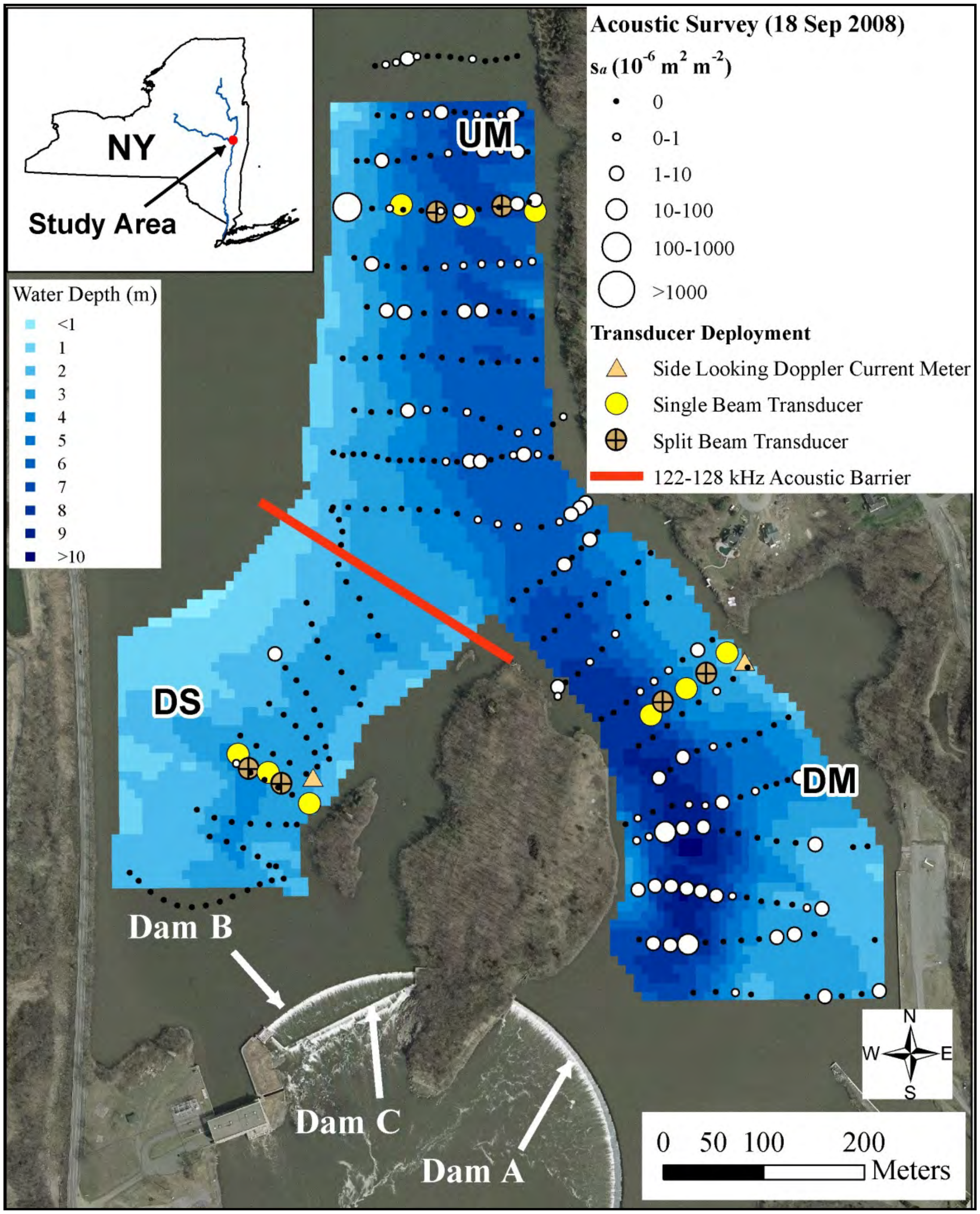
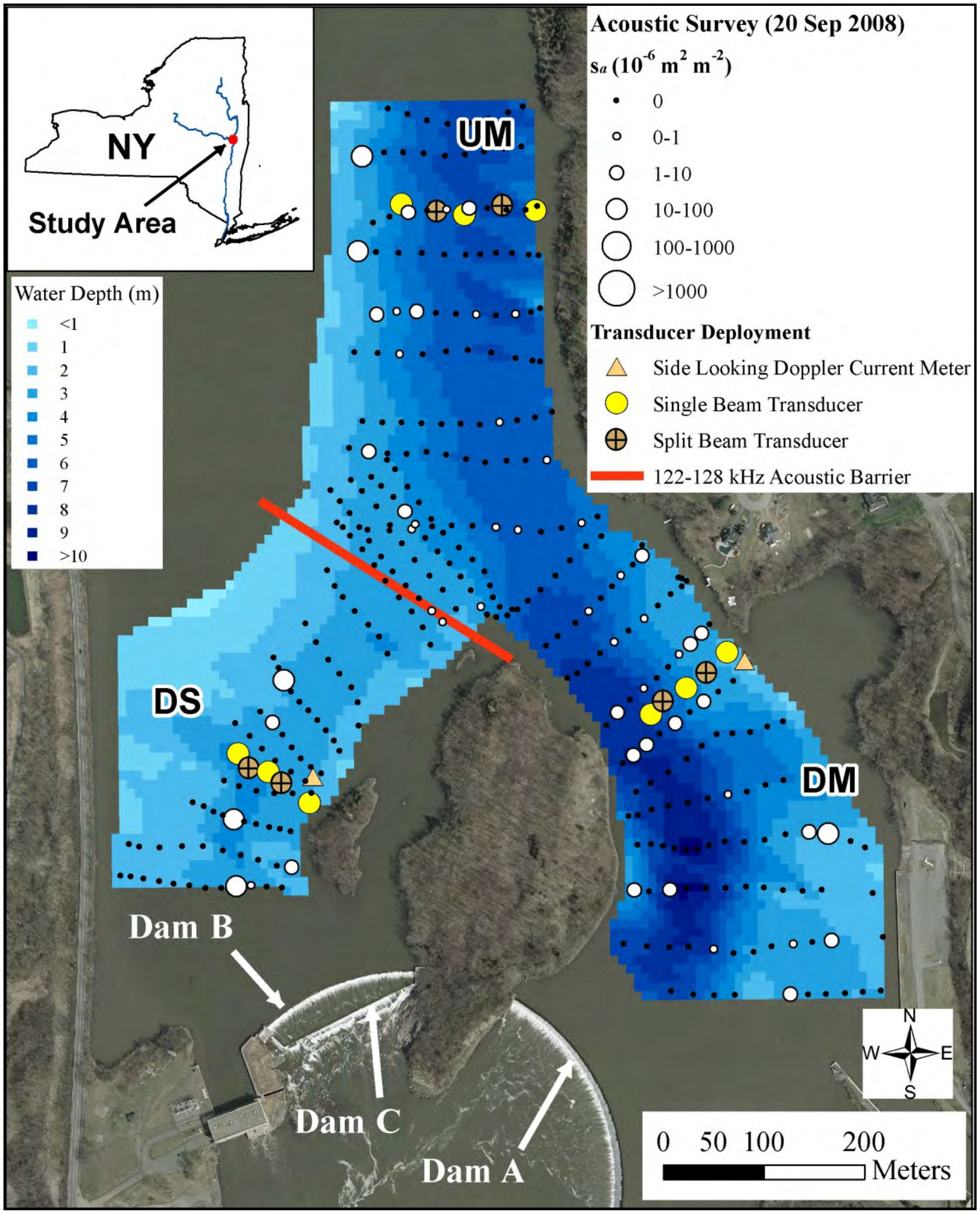
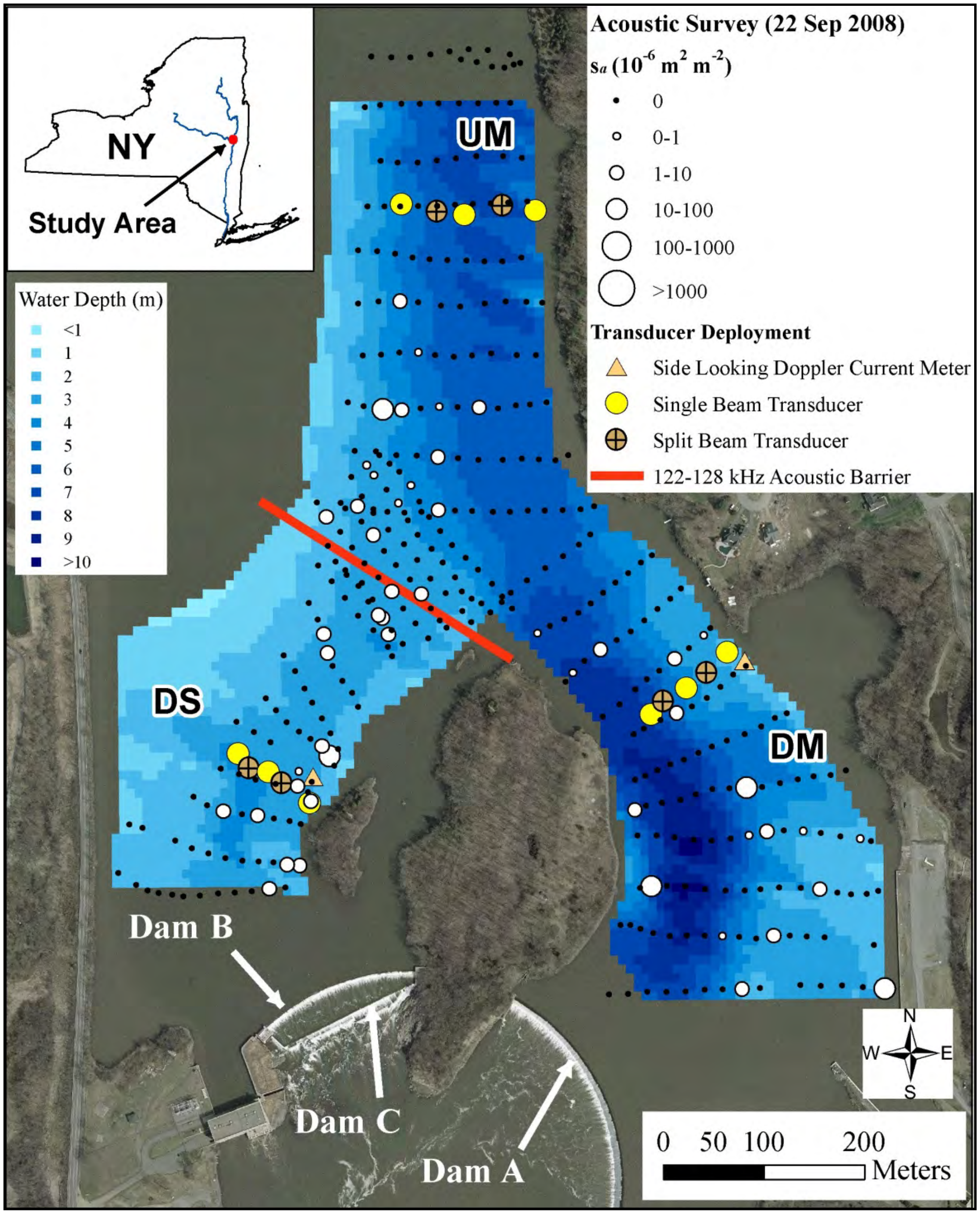


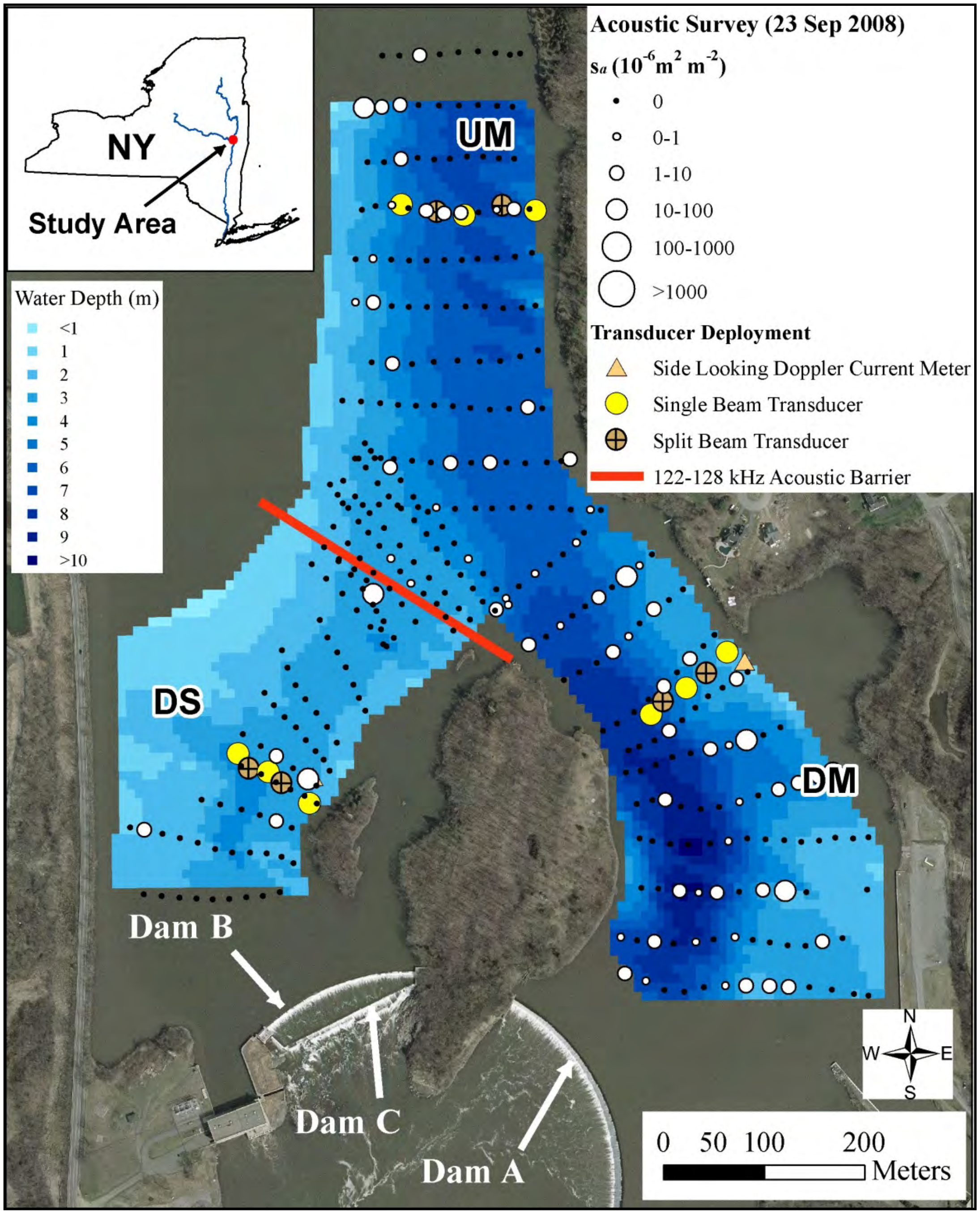
APPENDIX FIGURE D-6.—Map of the area backscattering coefficient (s_a) from real-time echo integration of acoustic backscatter over the water column sampled by a 15° down-looking, split-beam echosounder (Model 241, HTI) during a mobile acoustic survey at Crescent Hydroelectric Project on the Mohawk River. Areas of interest included upstream of an underwater ultrasonic system in the main channel of the Mohawk River (UM), downstream of the ultrasonic system in the main channel (DM), downstream of the ultrasonic system in the secondary channel (DS), and near the ultrasonic system over a fine-scale set of transects (FS) on 18 September 2008. Coordinates for s_a are the midpoint for the elementary distance sampling unit used for echo integration. A -50 dB minimum threshold was used.



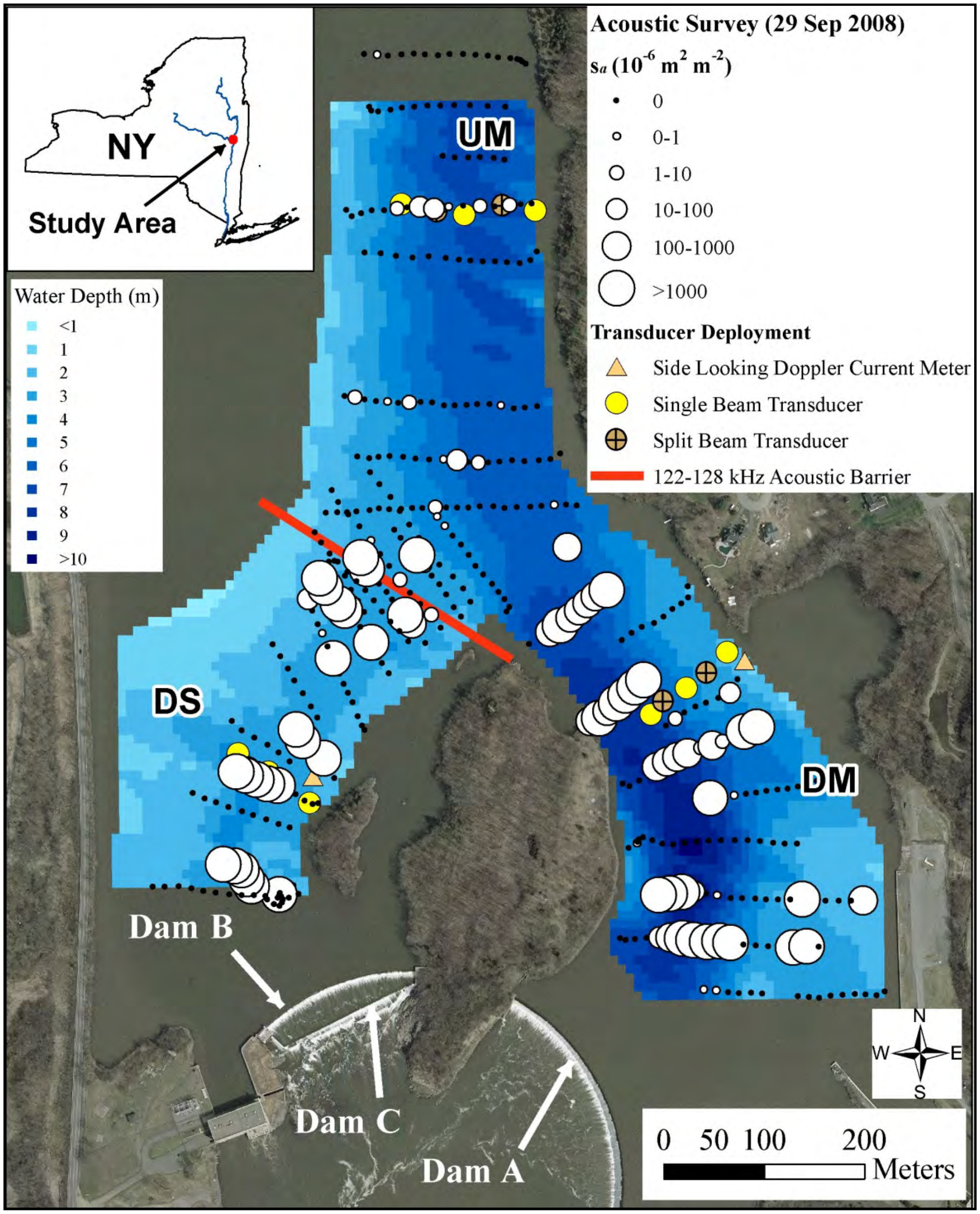
APPENDIX FIGURE D-7.—Map of the area backscattering coefficient (s_a) from real-time echo integration of acoustic backscatter over the water column sampled by a 15° down-looking, split-beam echosounder (Model 241, HTI) during a mobile acoustic survey at Crescent Hydroelectric Project on the Mohawk River. Areas of interest included upstream of an underwater ultrasonic system in the main channel of the Mohawk River (UM), downstream of the ultrasonic system in the main channel (DM), downstream of the ultrasonic system in the secondary channel (DS), and near the ultrasonic system over a fine-scale set of transects (FS) on 20 September 2008. Coordinates for s_a are the midpoint for the elementary distance sampling unit used for echo integration. A -50 dB minimum threshold was used.



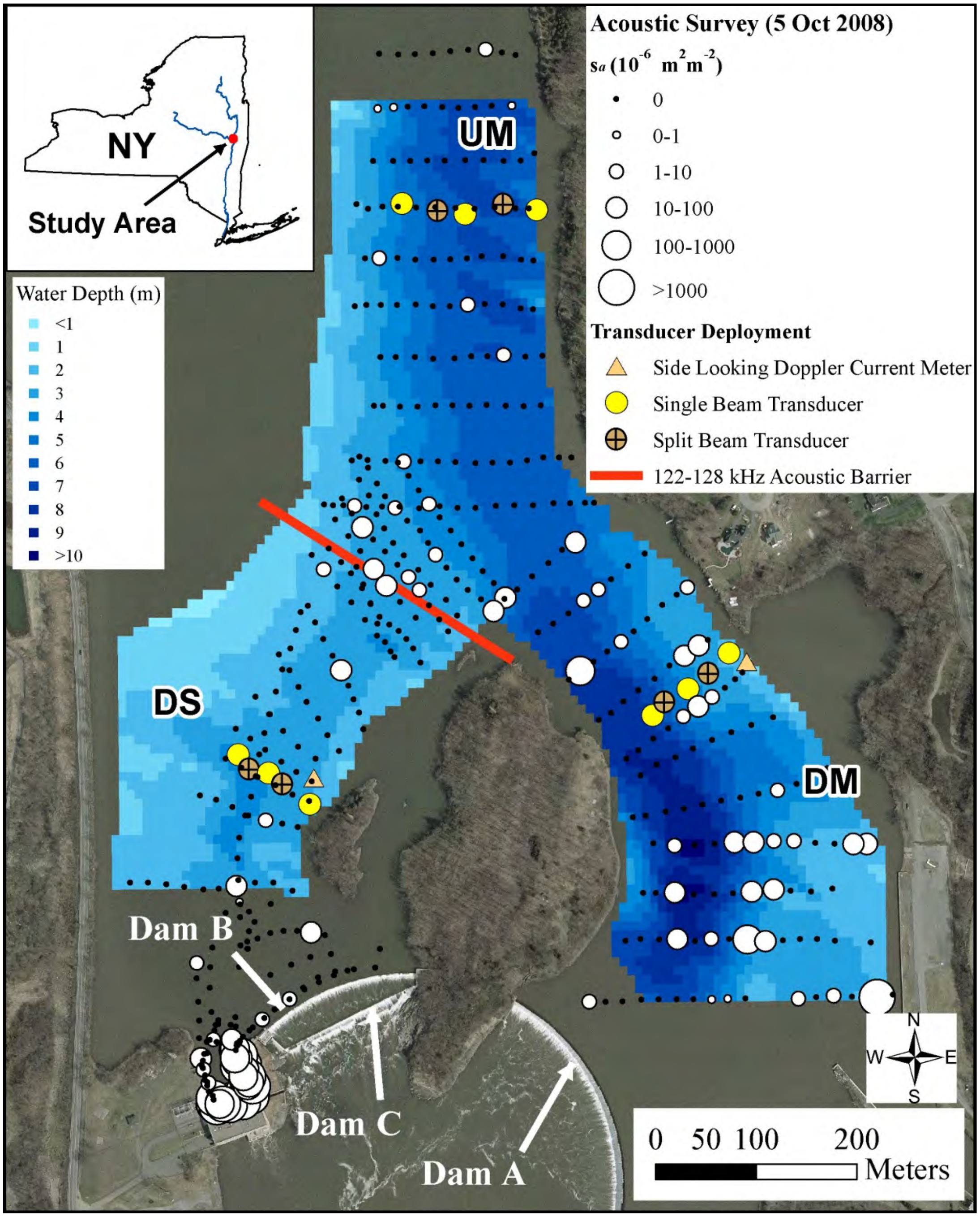
APPENDIX FIGURE D-8.—Map of the area backscattering coefficient (s_a) from real-time echo integration of acoustic backscatter over the water column sampled by a 15° down-looking, split-beam echosounder (Model 241, HTI) during a mobile acoustic survey at Crescent Hydroelectric Project on the Mohawk River. Areas of interest included upstream of an underwater ultrasonic system in the main channel of the Mohawk River (UM), downstream of the ultrasonic system in the main channel (DM), downstream of the ultrasonic system in the secondary channel (DS), and near the ultrasonic system over a fine-scale set of transects (FS) on 22 September 2008. Coordinates for s_a are the midpoint for the elementary distance sampling unit used for echo integration. A -50 dB minimum threshold was used.



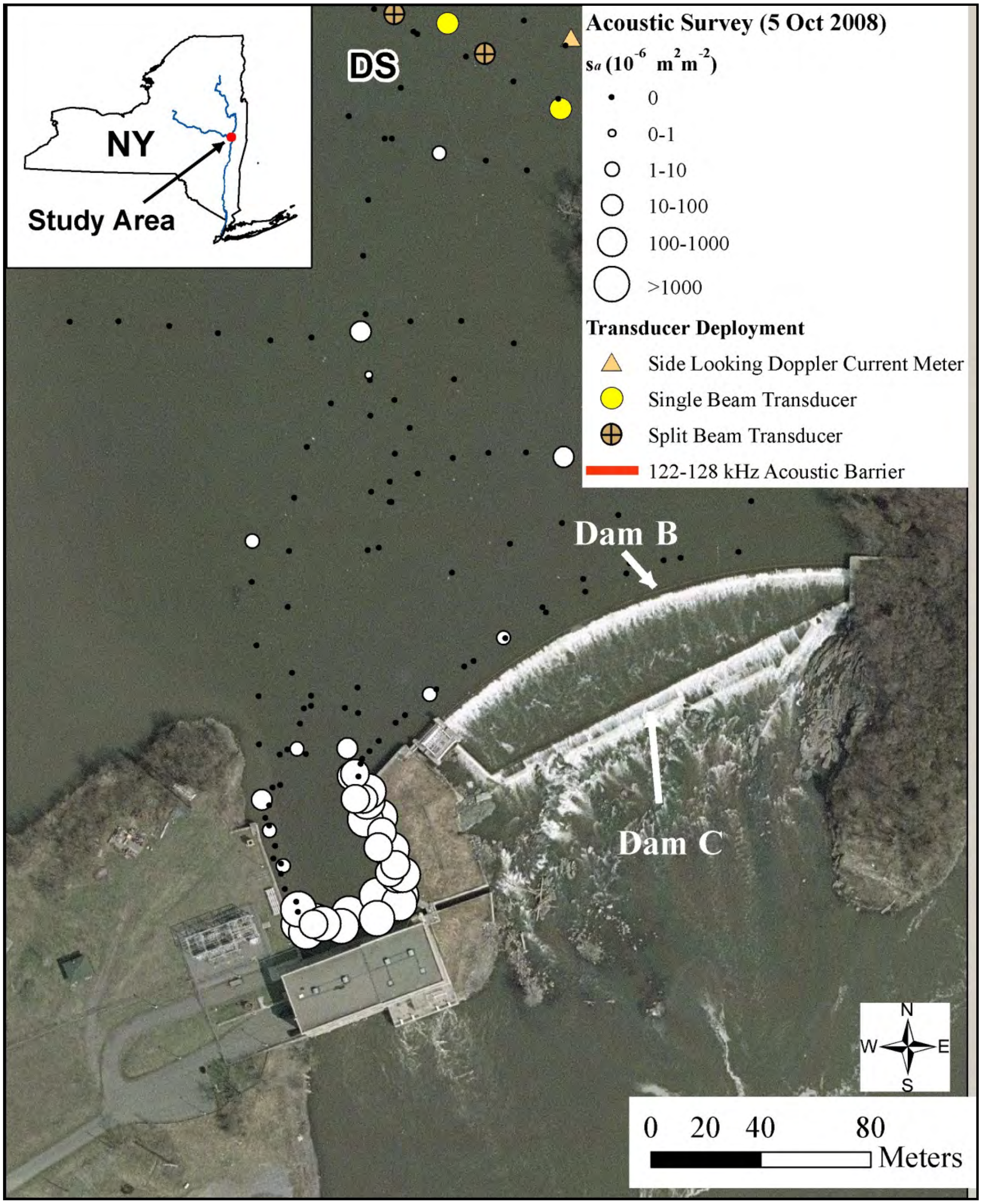
APPENDIX FIGURE D-9.—Map of the area backscattering coefficient (s_a) from real-time echo integration of acoustic backscatter over the water column sampled by a 15° down-looking, split-beam echosounder (Model 241, HTI) during a mobile acoustic survey at Crescent Hydroelectric Project on the Mohawk River. Areas of interest included upstream of an underwater ultrasonic system in the main channel of the Mohawk River (UM), downstream of the ultrasonic system in the main channel (DM), downstream of the ultrasonic system in the secondary channel (DS), and near the ultrasonic system over a fine-scale set of transects (FS) on 23 September 2008. Coordinates for s_a are the midpoint for the elementary distance sampling unit used for echo integration. A -50 dB minimum threshold was used.



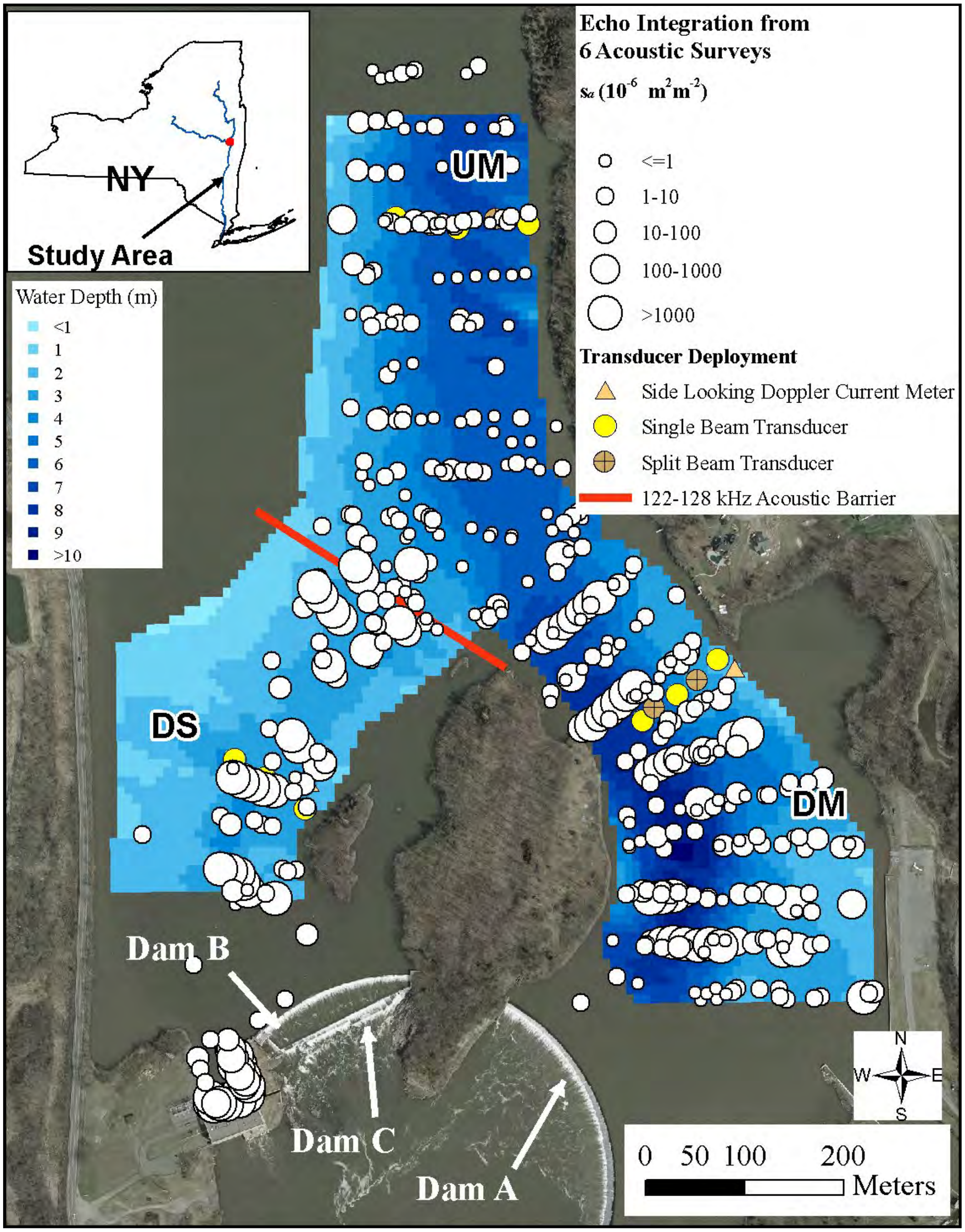
APPENDIX FIGURE D-10.—Map of the area backscattering coefficient (s_a) from real-time echo integration of acoustic backscatter over the water column sampled by a 15° down-looking, split-beam echosounder (Model 241, HTI) during a mobile acoustic survey at Crescent Hydroelectric Project on the Mohawk River. Areas of interest included upstream of an underwater ultrasonic system in the main channel of the Mohawk River (UM), downstream of the ultrasonic system in the main channel (DM), downstream of the ultrasonic system in the secondary channel (DS), and near the ultrasonic system over a fine-scale set of transects (FS) on 29 September 2008. Coordinates for s_a are the midpoint for the elementary distance sampling unit used for echo integration. A -50 dB minimum threshold was used.



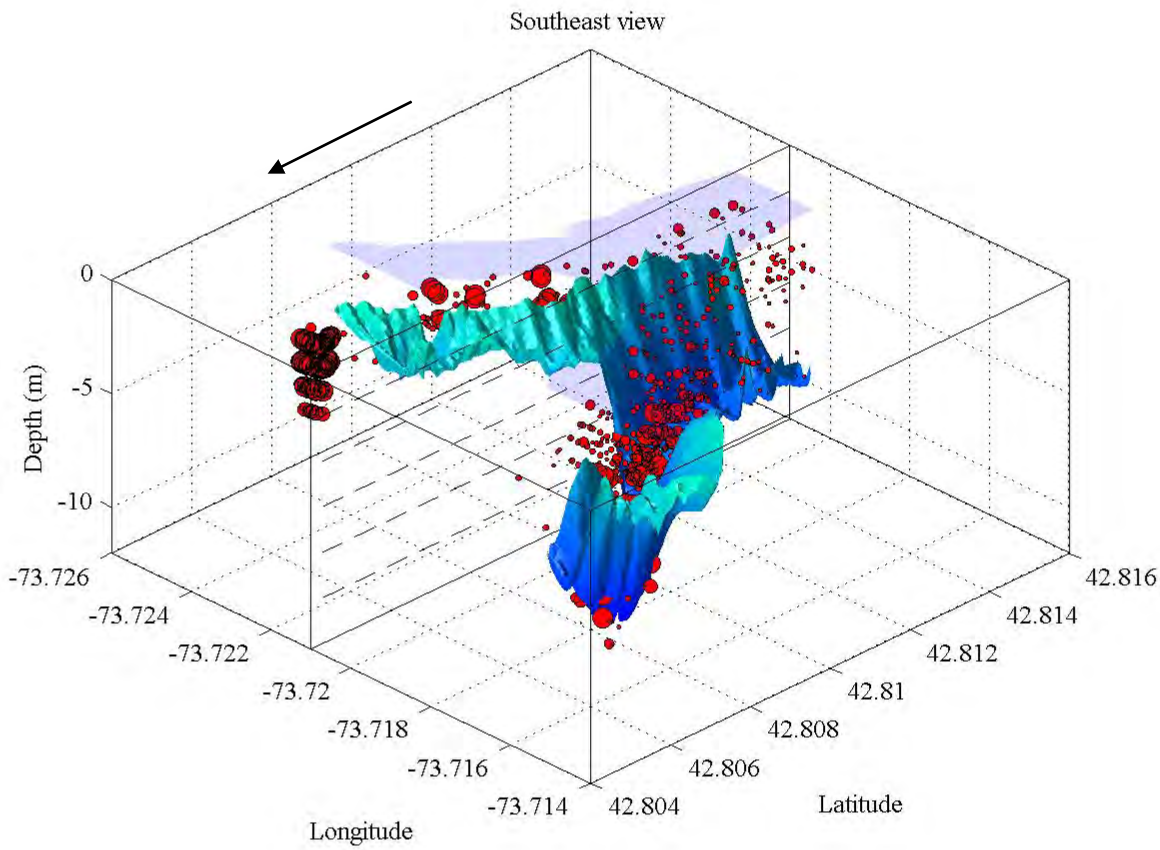
APPENDIX FIGURE D-11.—Map of the area backscattering coefficient (s_a) from real-time echo integration of acoustic backscatter over the water column sampled by a 15° down-looking, split-beam echosounder (Model 241, HTI) during a mobile acoustic survey at Crescent Hydroelectric Project on the Mohawk River. Areas of interest included upstream of an underwater ultrasonic system in the main channel of the Mohawk River (UM), downstream of the ultrasonic system in the main channel (DM), downstream of the ultrasonic system in the secondary channel (DS), and near the ultrasonic system over a fine-scale set of transects (FS) on 5 October 2008. Coordinates for s_a are the midpoint for the elementary distance sampling unit used for echo integration. A -50 dB minimum threshold was used.



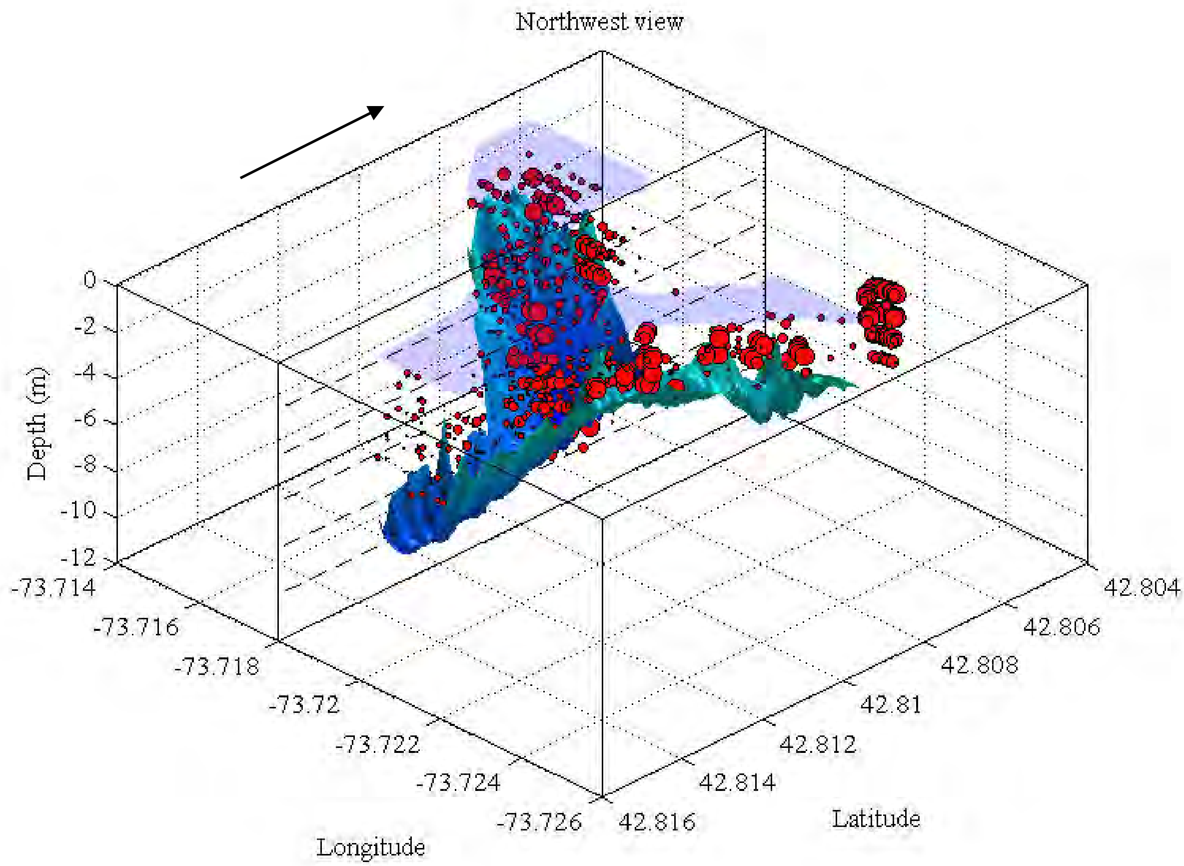
APPENDIX FIGURE D-12.—Map of the area backscattering coefficient (s_a) from real-time echo integration of acoustic backscatter over the water column sampled by a 15° down-looking, split-beam echosounder (Model 241, HTI) during a mobile acoustic survey of unplanned transects immediately upstream of Dam B and in the headrace at the Crescent Hydroelectric Project on the Mohawk River on 5 October 2008. Coordinates for s_a are the midpoint for the elementary distance sampling unit used for echo integration. A -50 dB minimum threshold was used.



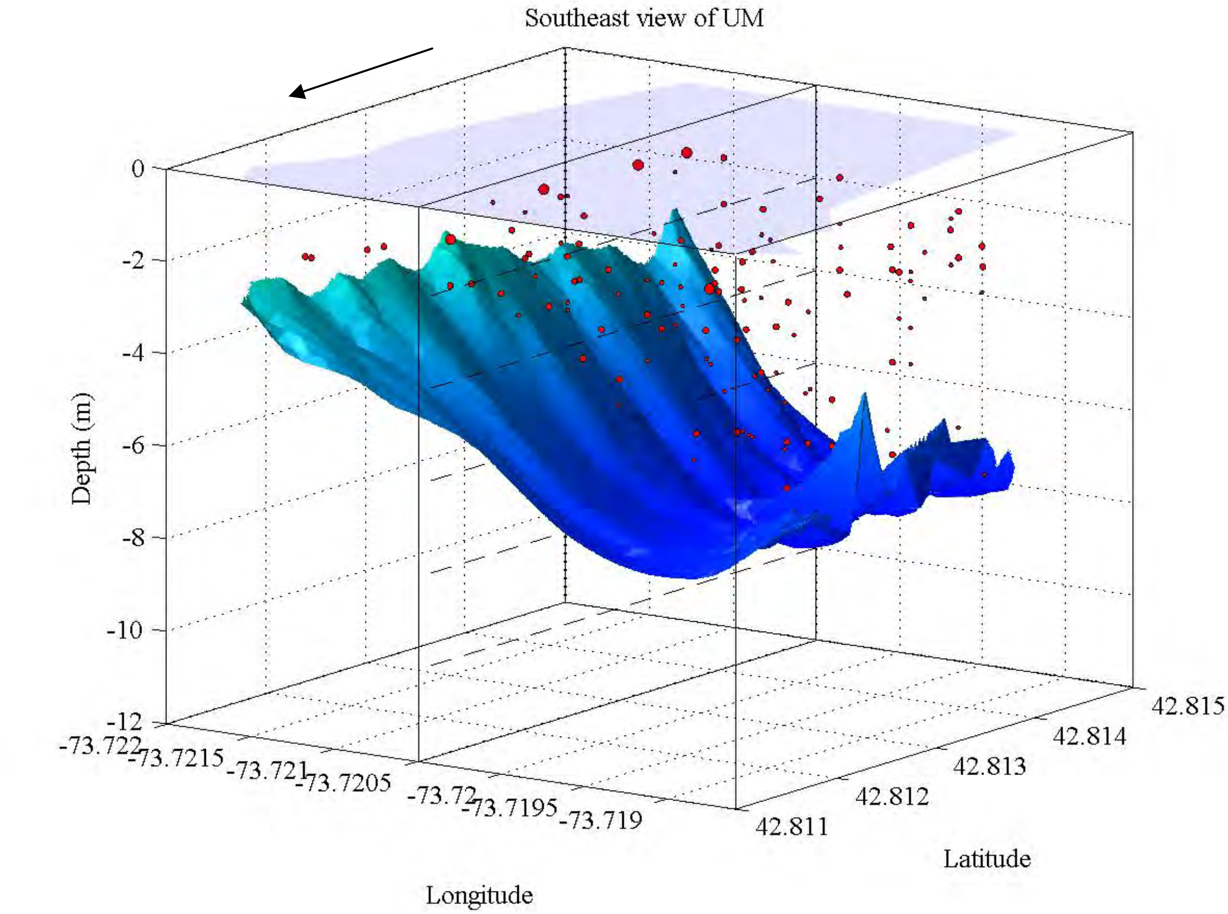
APPENDIX FIGURE D-13.—Map of the area backscattering coefficient (s_a) from real-time echo integration of acoustic backscatter over the water column sampled by a 15° down-looking, split-beam echosounder (Model 241, HTI) from multiple mobile acoustic surveys (18, 20, 22, 23, and 29 September 2008 and 5 October 2008) at Crescent Hydroelectric Project on the Mohawk River. Areas of interest included upstream of an underwater ultrasonic system in the main channel of the Mohawk River (UM), downstream of the ultrasonic system in the main channel (DM), downstream of the ultrasonic system in the secondary channel (DS), and near the ultrasonic system over a fine-scale set of transects (FS). Coordinates for s_a are the midpoint for the elementary distance sampling unit used for echo integration. A -50 dB minimum threshold was used.



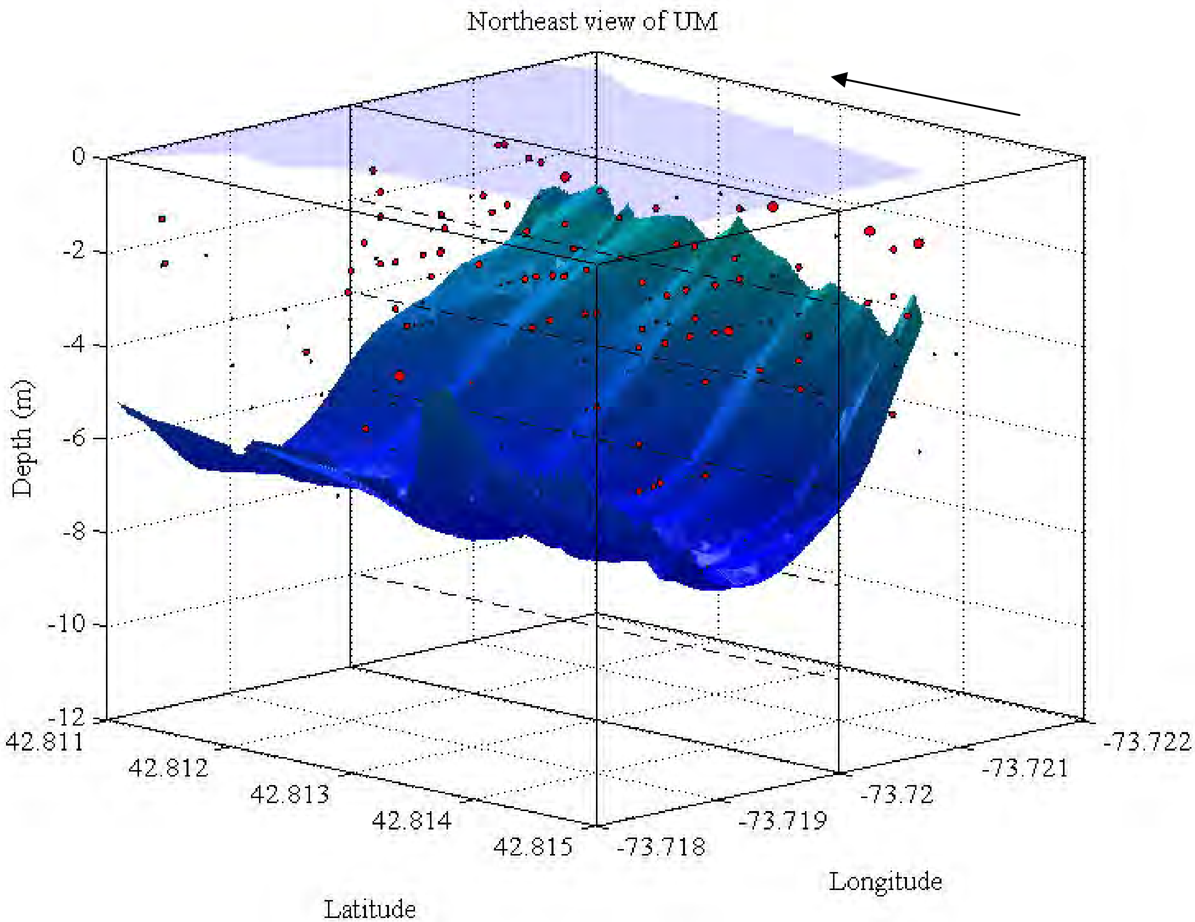
APPENDIX FIGURE D-14.—Three-dimensional view from the southeast of the spatial distribution of fish represented by red closed circles with size proportional to the magnitude of the volume backscattering strength from echo integration of 1-m deep x 12-s long strata over repeated mobile surveys (pooled data) of the Mohawk River at Crescent Hydroelectric Project with a down-looking, 420-kHz split-beam echosounder. Axes are not drawn to scale for visualization purpose. A semi-transparent blue layer indicates the water surface area of the portion of river in the plot. Arrow points down river.



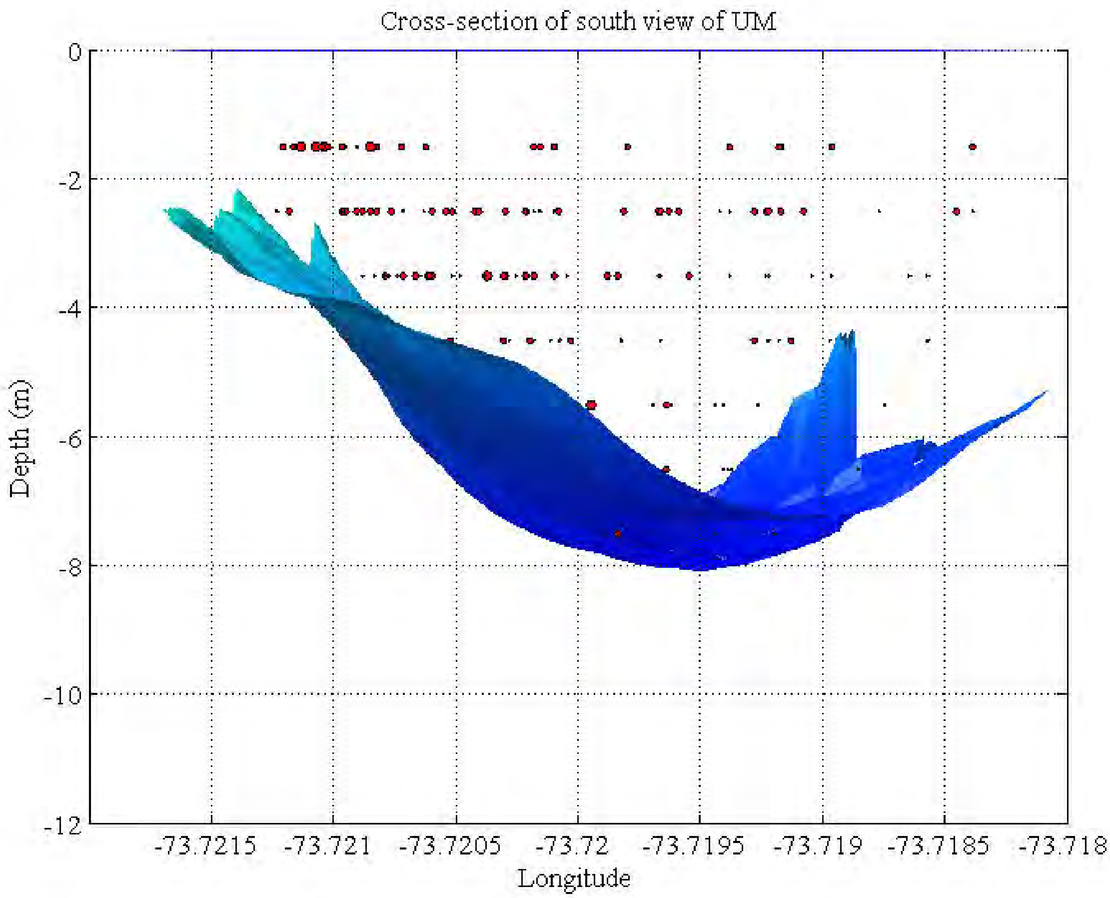
APPENDIX FIGURE D-15.—Three-dimensional view from the southeast of the spatial distribution of fish represented by red closed circles with size proportional to the magnitude of the volume backscattering strength from echo integration of 1-m deep x 12-s long strata over repeated mobile surveys (pooled data) of the Mohawk River at Crescent Hydroelectric Project with a down-looking, 420-kHz split-beam echosounder. Axes are not drawn to scale for visualization purpose. A semi-transparent blue layer indicates the water surface area of the portion of river in the plot. Arrow points down river.



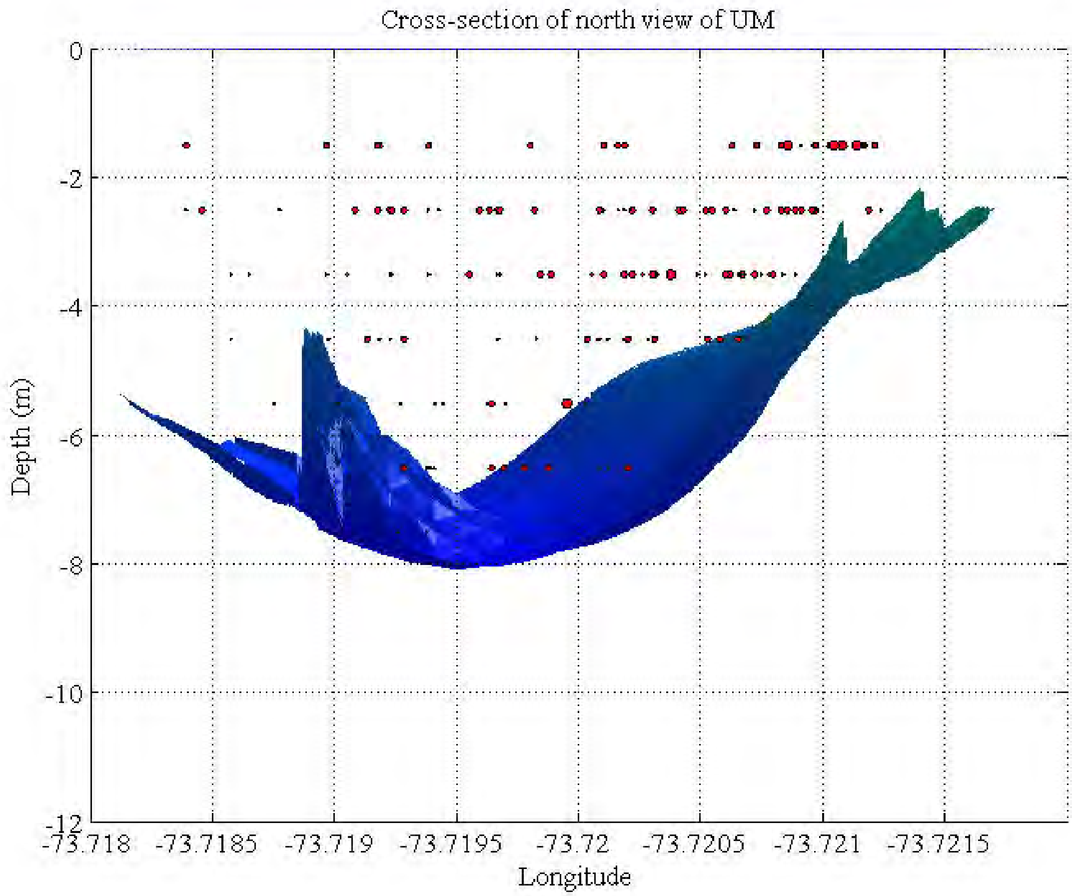
APPENDIX FIGURE D-16.—Three-dimensional view from the southeast of the spatial distribution of fish represented by red closed circles with size proportional to the magnitude of the volume backscattering strength from echo integration of 1-m deep x 12-s long strata over repeated mobile surveys (pooled data) of the main channel upstream of an ultrasonic system (UM) in the Mohawk River at Crescent Hydroelectric Project with a down-looking, 420-kHz split-beam echosounder. Axes are not drawn to scale for visualization purpose. A semi-transparent blue layer indicates the water surface area of the portion of river in the plot. Arrow points down river.



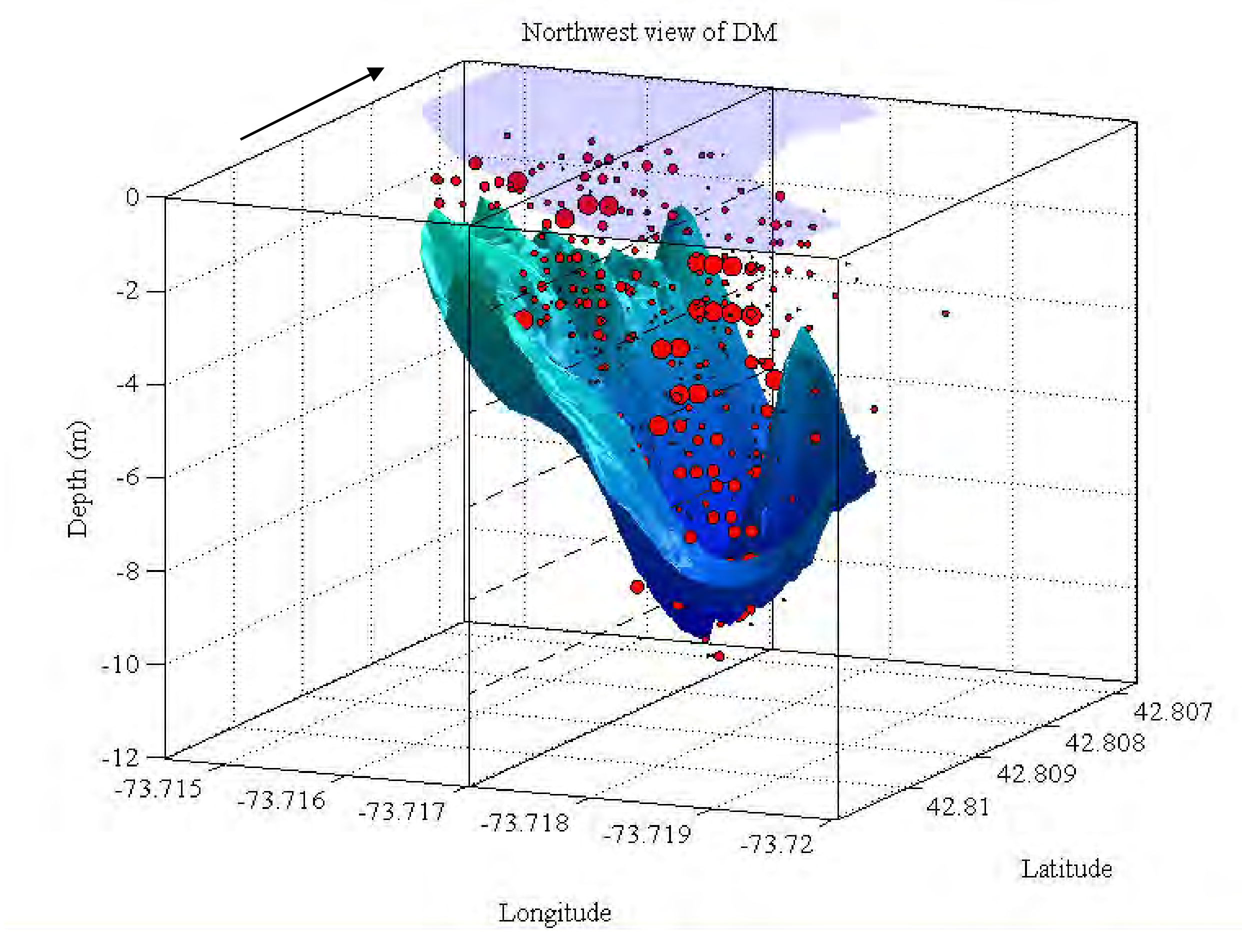
APPENDIX FIGURE D-17.—Three-dimensional view from the northeast of the spatial distribution of fish represented by red closed circles with size proportional to the magnitude of the volume backscattering strength from echo integration of 1-m deep x 12-s long strata over repeated mobile surveys (pooled data) of the main channel upstream of an ultrasonic system (UM) in the Mohawk River at Crescent Hydroelectric Project with a down-looking, 420-kHz split-beam echosounder. Axes are not drawn to scale for visualization purpose. A semi-transparent blue layer indicates the water surface area of the portion of river in the plot. Arrow points down river.



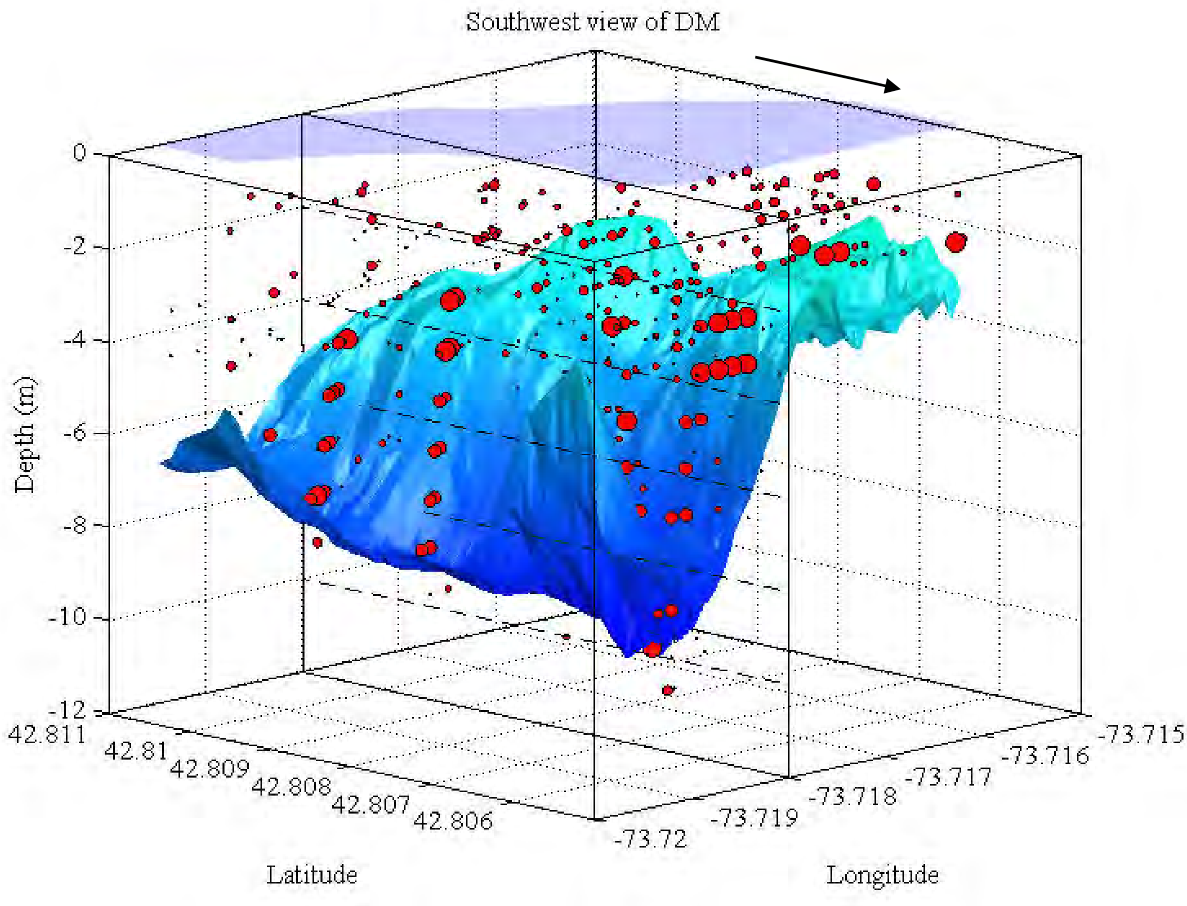
APPENDIX FIGURE D-18.—Cross-sectional view from the south of the spatial distribution of fish represented by red closed circles with size proportional to the magnitude of the volume backscattering strength from echo integration of 1-m deep x 12-s long strata over repeated mobile surveys (pooled data) of the main channel upstream of an ultrasonic system (UM) in the Mohawk River at Crescent Hydroelectric Project with a down-looking, 420-kHz split-beam echosounder. Axes are not drawn to scale for visualization purpose.



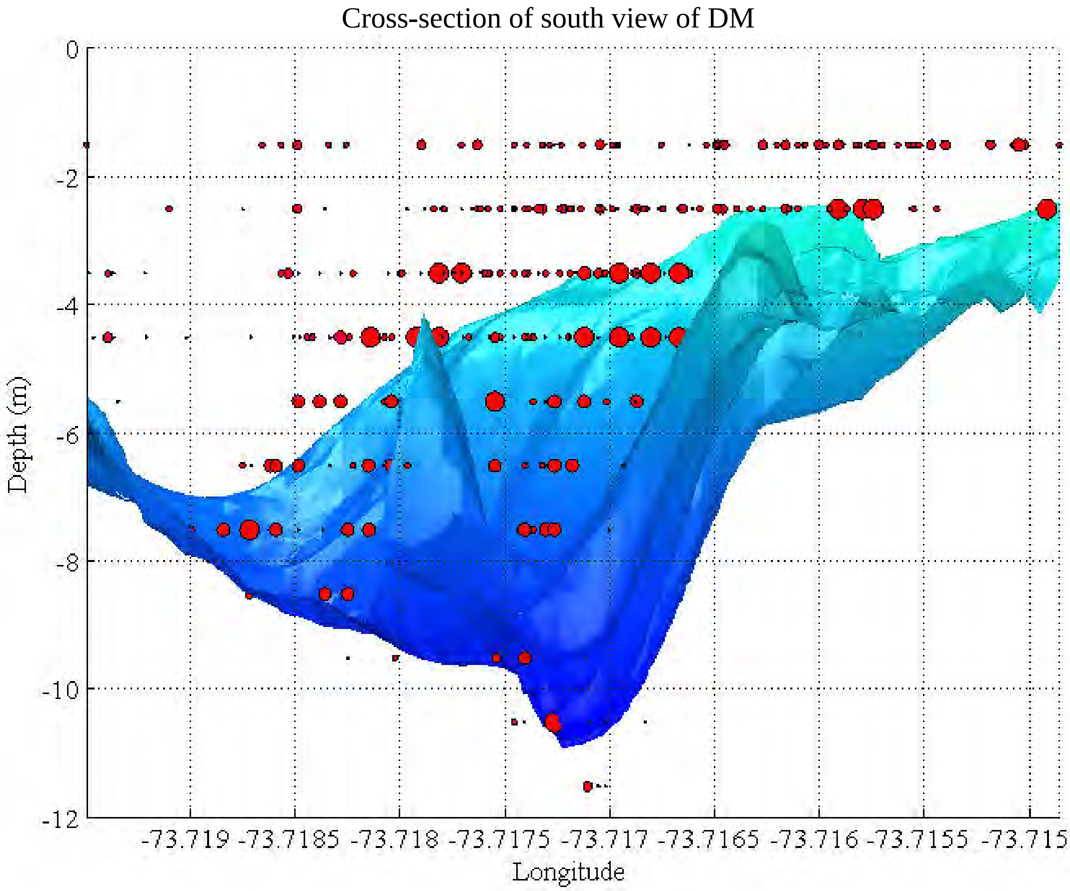
APPENDIX FIGURE D-19.—Cross-sectional view from the north of the spatial distribution of fish represented by red closed circles with size proportional to the magnitude of the volume backscattering strength from echo integration of 1-m deep x 12-s long strata over repeated mobile surveys (pooled data) of the main channel upstream of an ultrasonic system (UM) in the Mohawk River at Crescent Hydroelectric Project with a down-looking, 420-kHz split-beam echosounder. Axes are not drawn to scale for visualization purpose.



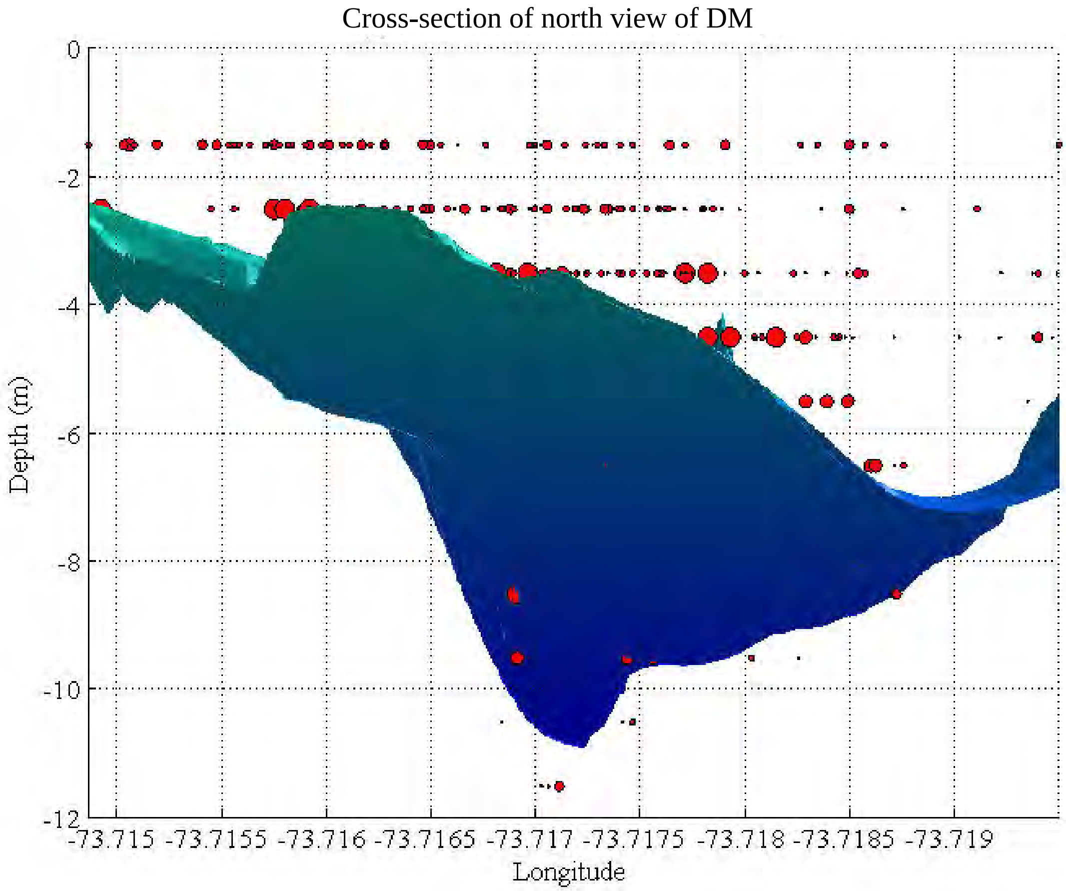
APPENDIX FIGURE D-20.—Three-dimensional view from the northwest of the spatial distribution of fish represented by red closed circles with size proportional to the magnitude of the volume backscattering strength from echo integration of 1-m deep x 12-s long strata over repeated mobile surveys (pooled data) of the main channel downstream of an ultrasonic system (DM) in the Mohawk River at Crescent Hydroelectric Project with a down-looking, 420-kHz split-beam echosounder. Axes are not drawn to scale for visualization purpose. A semi-transparent blue layer indicates the water surface area of the portion of river in the plot. Arrow points down river.



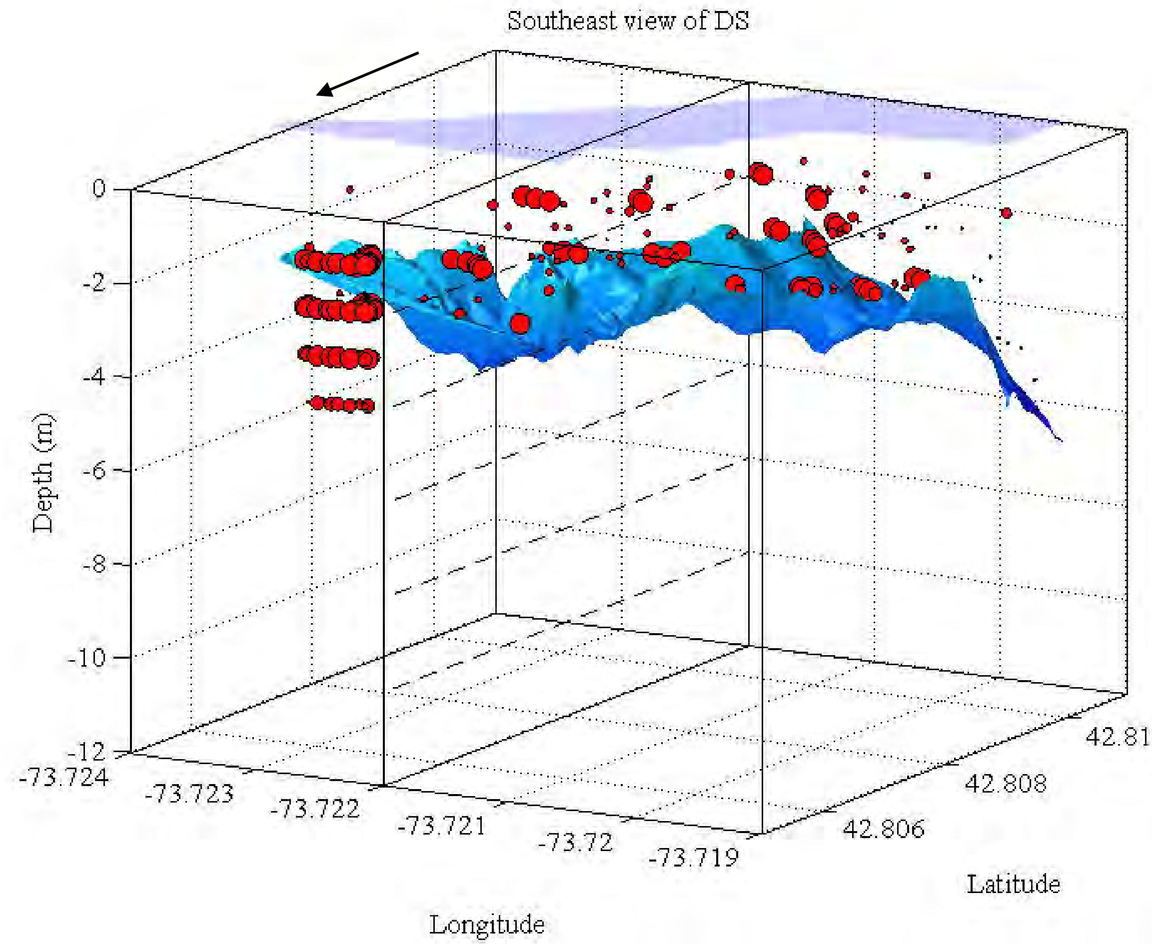
APPENDIX FIGURE D-21.—Three-dimensional view from the southwest of the spatial distribution of fish represented by red closed circles with size proportional to the magnitude of the volume backscattering strength from echo integration of 1-m deep x 12-s long strata over repeated mobile surveys (pooled data) of the main channel downstream of an ultrasonic system (DM) in the Mohawk River at Crescent Hydroelectric Project with a down-looking, 420-kHz split-beam echosounder. Axes are not drawn to scale for visualization purpose. A semi-transparent blue layer indicates the water surface area of the portion of river in the plot. Arrow points down river.



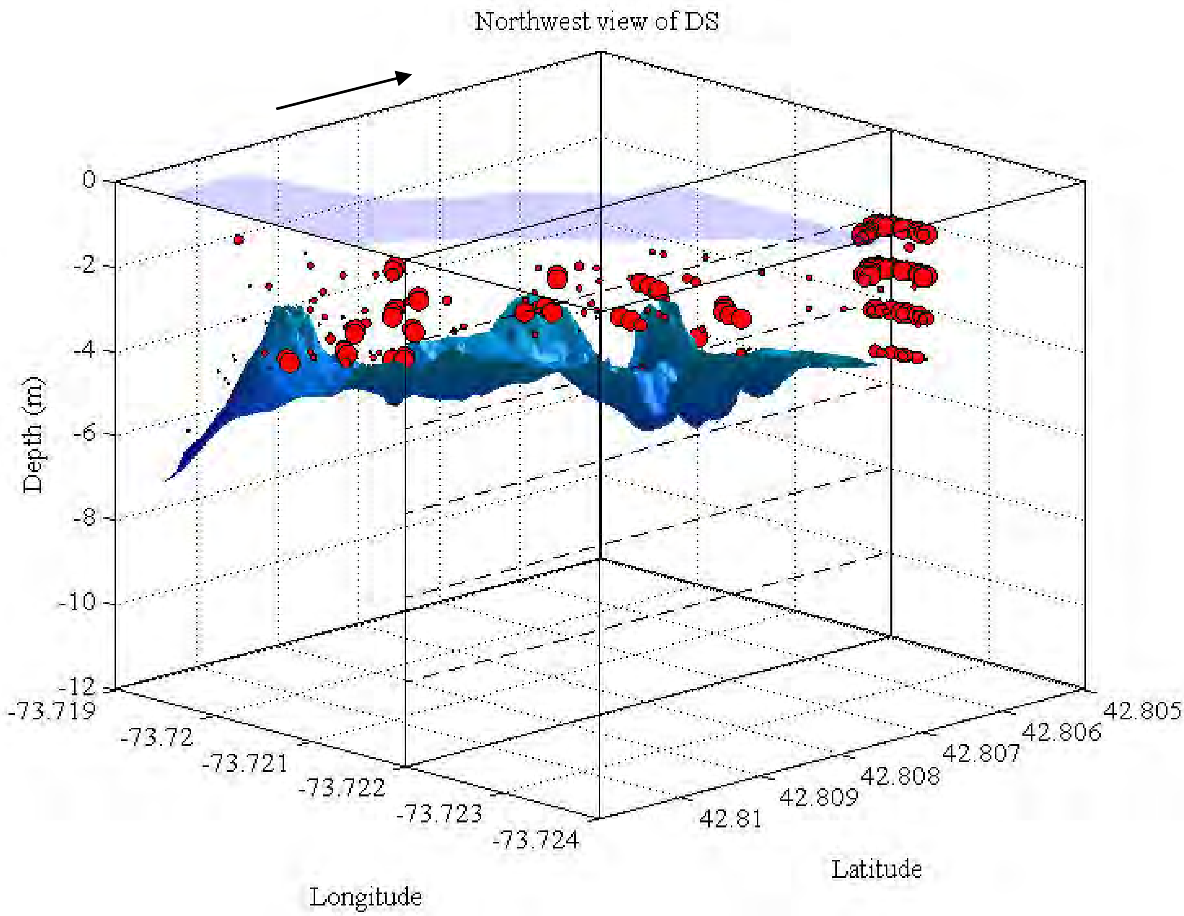
APPENDIX FIGURE D-22.—Cross-sectional view from the south of the spatial distribution of fish represented by red closed circles with size proportional to the magnitude of the volume backscattering strength from echo integration of 1-m deep x 12-s long strata over repeated mobile surveys (pooled data) of the main channel downstream of an ultrasonic system (DM) in the Mohawk River at Crescent Hydroelectric Project with a down-looking, 420-kHz split-beam echosounder. Axes are not drawn to scale for visualization purpose.



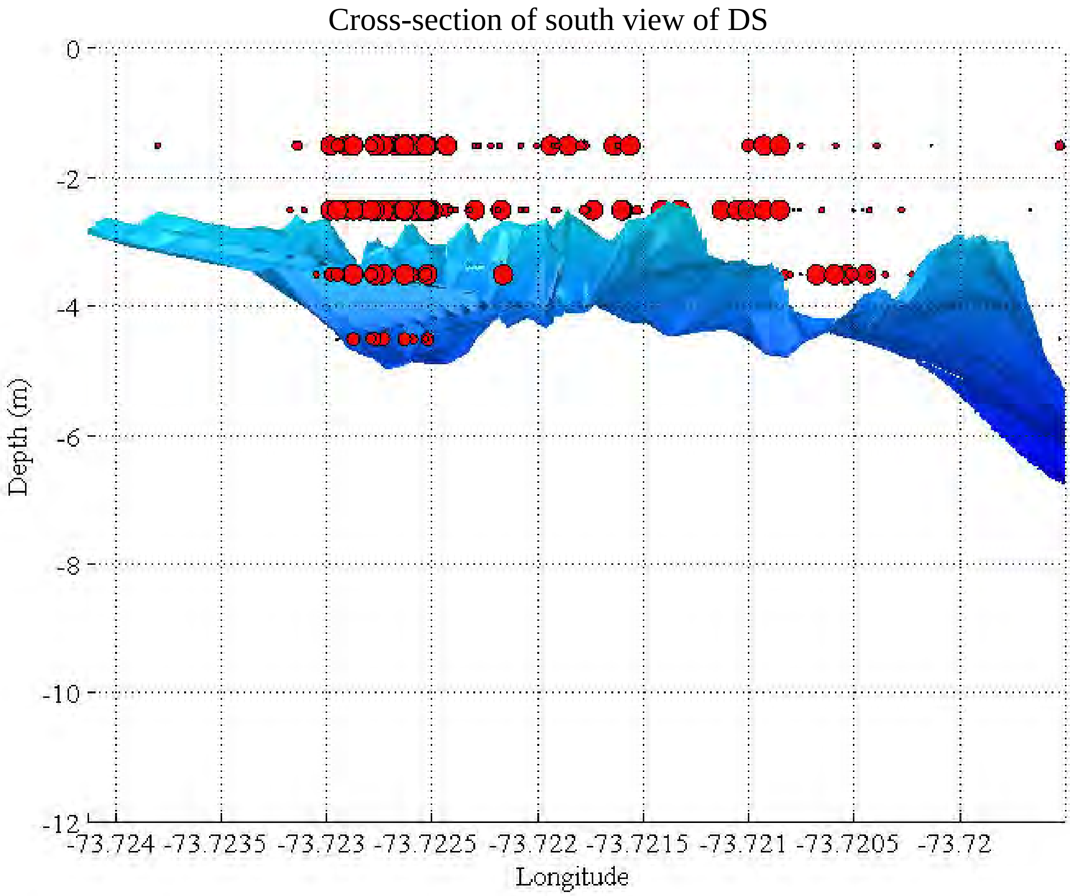
APPENDIX FIGURE D-23.—Cross-sectional view from the north of the spatial distribution of fish represented by red closed circles with size proportional to the magnitude of the volume backscattering strength from echo integration of 1-m deep x 12-s long strata over repeated mobile surveys (pooled data) of the main channel downstream of an ultrasonic system (DM) in the Mohawk River at Crescent Hydroelectric Project with a down-looking, 420-kHz split-beam echosounder. Axes are not drawn to scale for visualization purpose.



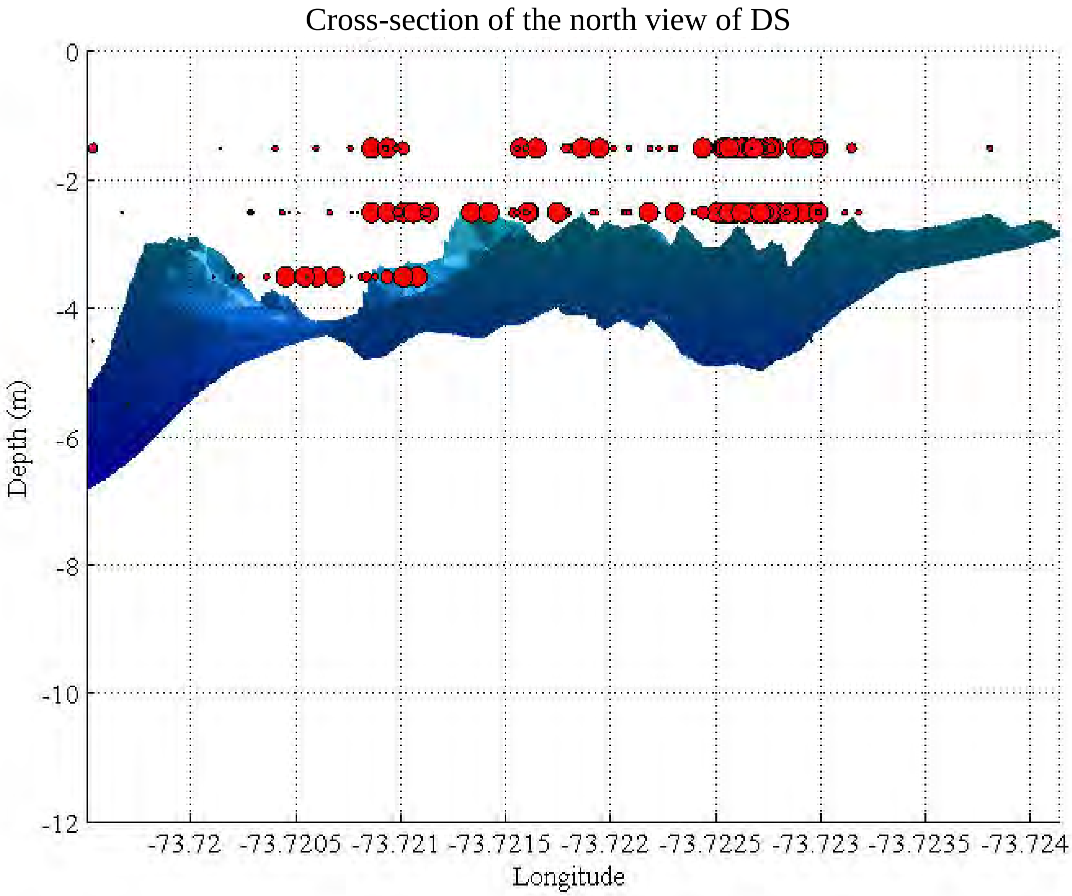
APPENDIX FIGURE D-24.—Three-dimensional view from the southeast of the spatial distribution of fish represented by red closed circles with size proportional to the magnitude of the volume backscattering strength from echo integration of 1-m deep x 12-s long strata over repeated mobile surveys (pooled data) of the secondary channel downstream of an ultrasonic system (DS) in the Mohawk River at Crescent Hydroelectric Project with a down-looking, 420-kHz split-beam echosounder. Axes are not drawn to scale for visualization purpose. A semi-transparent blue layer indicates the water surface area of the portion of river in the plot. Arrow points down river.



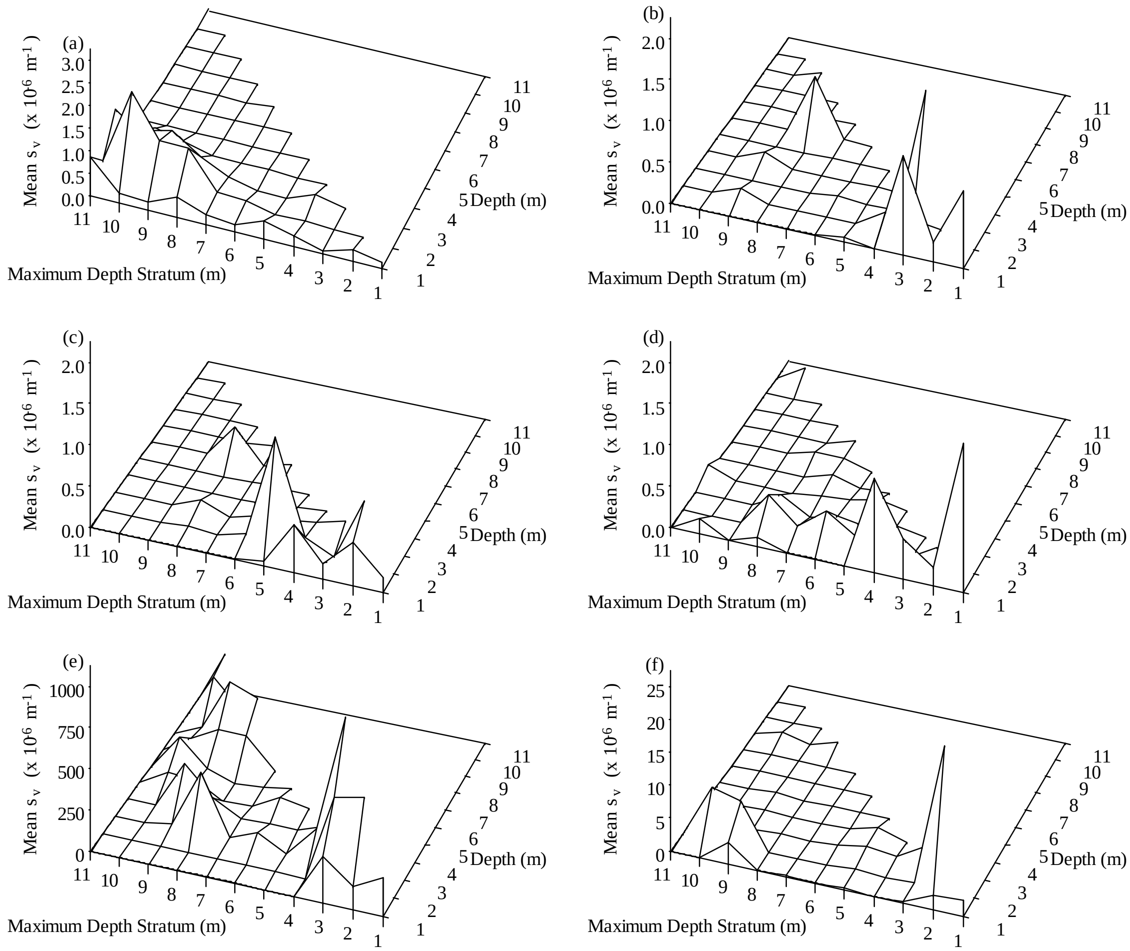
APPENDIX FIGURE D-25.—Three-dimensional view from the northwest of the spatial distribution of fish represented by red closed circles with size proportional to the magnitude of the volume backscattering strength from echo integration of 1-m deep x 12-s long strata over repeated mobile surveys (pooled data) of the secondary channel downstream of an ultrasonic system (DS) in the Mohawk River at Crescent Hydroelectric Project with a down-looking, 420-kHz split-beam echosounder. Axes are not drawn to scale for visualization purpose. A semi-transparent blue layer indicates the water surface area of the portion of river in the plot. Arrow points down river.



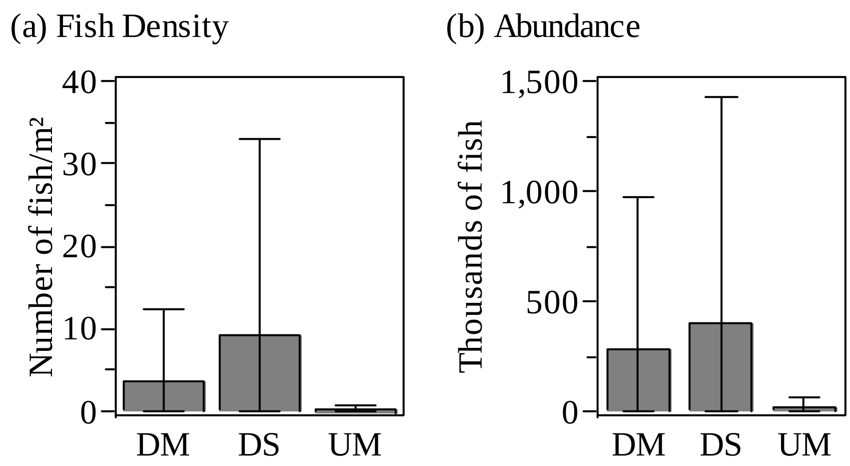
APPENDIX FIGURE D-26.—Cross-sectional view from the south of the spatial distribution of fish represented by red closed circles with size proportional to the magnitude of the volume backscattering strength from echo integration of 1-m deep x 12-s long strata over repeated mobile surveys (pooled data) of the secondary channel downstream of an ultrasonic system (DS) in the Mohawk River at Crescent Hydroelectric Project with a down-looking, 420-kHz split-beam echosounder. Axes are not drawn to scale for visualization purpose.



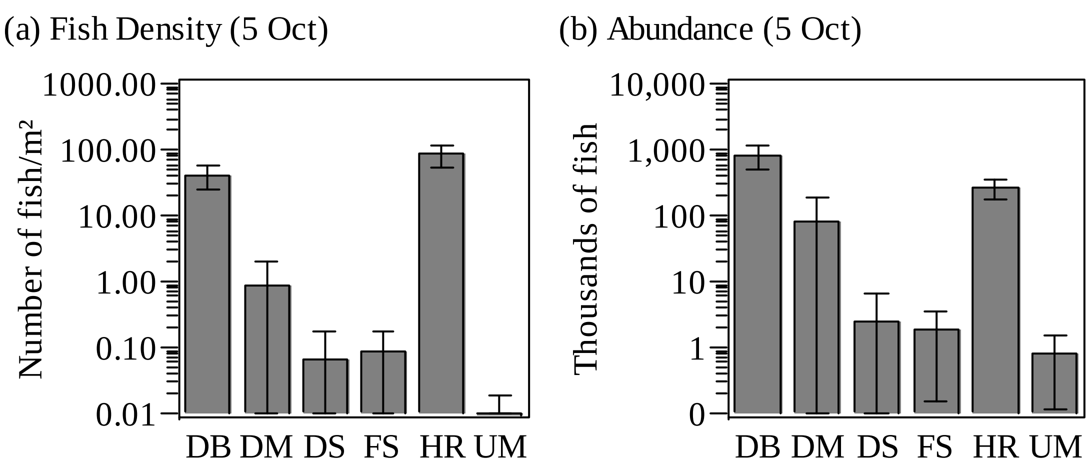
APPENDIX FIGURE D-27.—Cross-sectional view from the north of the spatial distribution of fish represented by red closed circles with size proportional to the magnitude of the volume backscattering strength from echo integration of 1-m deep x 12-s long strata over repeated mobile surveys (pooled data) of the secondary channel downstream of an ultrasonic system (DS) in the Mohawk River at Crescent Hydroelectric Project with a down-looking, 420-kHz split-beam echosounder. Axes are not drawn to scale for visualization purpose.



APPENDIX FIGURE D-28.—Surface plots of mean s_v (10^{-6} m^{-1}) distribution for each 1-m depth strata over the sampled water column for each depth profile with maximum depth strata from 1 to 11 m as sampled by a 15° down-looking, split-beam echosounder (Model 241, HTI) during mobile acoustic surveys over a pre-planned systematic transect grid of the Mohawk River at Crescent Hydroelectric Project on (a) 18 September, (b) 20 September, (c) 22 September, (d) 23 September, (e) 29 September, and (f) 5 October of 2008.



APPENDIX FIGURE D-29.—Mean density and numerical abundance of fish from survey estimates derived from real-time echo integration of acoustic backscatter over the water column sampled by a 15° down-looking, split-beam echosounder (Model 241, HTI) during repeated mobile acoustic surveys (n=6) over three areas of the Mohawk River at Crescent Hydroelectric Project and scaling results based on the mean dorsal target strength (-46.0 dB) of juvenile blueback herring. Areas of interest included upstream of an underwater ultrasonic system in the main channel of the Mohawk River (UM), downstream of the ultrasonic system in the main channel (DM), and downstream of the ultrasonic system in the secondary channel (DS).



APPENDIX FIGURE D-30.—Mean density and numerical abundance of fish derived from real-time echo integration of acoustic backscatter over the water column sampled by a 15° down-looking, split-beam echosounder (Model 241, HTI) during a mobile acoustic survey over a planned set of systematic transects and a set of unplanned random irregular transects over several areas of the Mohawk River at Crescent Hydroelectric Project. Areas of interest included immediately upstream of Dam B including the headrace (DB), upstream of an underwater ultrasonic system in the main channel of the Mohawk River (UM), downstream of the ultrasonic system in the main channel (DM), downstream of the ultrasonic system in the secondary channel (DS), and near the ultrasonic system over a fine-scale set of transects (FS) on 5 October 2008. Echo integration was based on a -50 dB minimum threshold and a scaling factor equivalent to the mean dorsal target strength of juvenile blueback herring (-46.0 dB).

Appendix TABLE D-2.—Summary statistics of acoustic estimates[1] of fish density[2] and abundance[3] from echo integration collected by acoustic surveys with a 420-kHz HTI split-beam echosounder during night (18 Sep 2008) and day (20, 22, 23, and 29 Sep 2008, and 5 Oct 2008) at Crescent Hydroelectric Project on the Mohawk River, New York.

		s_a (10^{-6} m^2/m^2)				Fish density (number/m^2)			
Date	Site[4]	Mean	95% confidence intervals		NASC (m^2/nmi^2)	Mean	95% confidence intervals		Estimated numerical abundance
18-Sep	UM	6.406	0	18.077	276.1	0.255	0.000	0.720	24,372
	DM	1.055	0	1.531	45.5	0.042	0.023	0.061	4,003
	DS	0.037	0.580	0.090	1.6	0.001	0.000	0.004	35
	FS	—			—	—			—
20-Sep	UM	0.462	0.027	0.897	19.9	0.018	0.001	0.036	1,480
	DM	0.548	0.152	0.944	23.6	0.022	0.006	0.038	2,041
	DS	2.049	0	4.479	88.3	0.082	-0.015	0.178	2,307
	FS	0.095	0	0.226	4.1	0.004	-0.001	0.009	76
22-Sep	UM	0.524	0	1.054	22.6	0.021	0.000	0.042	1,679
	DM	0.927	0.283	1.571	40.0	0.037	0.011	0.063	3,452
	DS	0.835	0.330	1.340	36.0	0.033	0.013	0.053	940
	FS	0.344	0.143	0.546	14.8	0.014	0.006	0.022	276
23-Sep	UM	0.573	0.237	0.908	24.7	0.023	0.009	0.036	2,008
	DM	1.349	0.584	2.114	58.2	0.054	0.023	0.084	5,218
	DS	0.895	0	1.942	38.6	0.036	-0.006	0.077	1,306
	FS	0.031	0	0.068	1.3	0.001	0.000	0.003	27

(Continued)

[1] s_a = area backscattering coefficient and NASC = nautical area backscattering coefficient

[2] Fish density (number of fish/m^2) was derived by s_a/σ_{bs} where the backscattering cross-section (σ_{bs}) used for conversion of echo integration to fish density was equivalent ($=10^{(TS/10)}$) to the mean *in situ* target strength (-46.0 dB).of a known juvenile blueback herring school observed in the headrace on 3 and 5 October 2008.

[3] Abundance was estimated by the product of mean fish density and the area of the maximum convex polygon encompassing the EDSU mid-points at each site.

[4] UM = upstream of the ultrasonic system in the main channel, DM = downstream of the ultrasonic system in the main channel, DS= downstream of the ultrasonic system in the secondary channel, FS=fine scale grid over the ultrasonic system, UT=unplanned transects, DB = immediately upstream of Crescent Dam B (DB), including the headrace (HR).

APPENDIX TABLE D-2.–Continued

		s_a (10^{-6} m^2/m^2)				Fish density (number/m^2)			
Date	Site	Mean	95% confidence intervals		NASC (m^2/nmi^2)	Mean	95% confidence intervals		Estimated numerical abundance
29-Sep	UM	33.156	0.000	67.094	1,429.1	1.320	0	2.671	104,733
	DM	520.491	304.361	736.621	22,434.0	20.721	12.117	29.325	1,618,070
	DS	1393.316	760.376	2026.255	60,054.0	55.469	30.271	80.667	2,406,962
	FS	964.150	382.693	1545.607	41,556.0	38.384	15.235	61.532	727,444
5-Oct	UM	0.260	0.036	0.483	11.2	0.010	0.001	0.019	822
	DM	22.393	0	52.878	965.2	0.891	-0.322	2.105	82,389
	DS	1.674	0	4.446	72.1	0.067	-0.044	0.177	2,506
	FS	2.248	0.184	4.312	96.9	0.089	0.007	0.172	1,847
	UT	937.304	561.233	1313.376	40,399.0	37.315	22.343	52.286	845,179
	DB	1038.846	625.625	1452.067	44,776.0	41.357	24.907	57.808	820,982
	HR	2148.546	1382.627	2914.464	92,605.0	85.535	55.043	116.027	267,811

[1] s_a = area backscattering coefficient and NASC = nautical area backscattering coefficient
[2] Fish density (number of fish/m^2) was derived by s_a/σ_{bs} where the backscattering cross-section (σ_{bs}) used for conversion of echo integration to fish density was equivalent (=$10^{(TS/10)}$) to the mean *in situ* target strength (-46.0 dB).of a known juvenile blueback herring school observed in the headrace on 3 and 5 October 2008.
[3] Abundance was estimated by the product of mean fish density and the area of the maximum convex polygon encompassing the EDSU mid-points at each site.
[4] UM = upstream of the ultrasonic system in the main channel, DM = downstream of the ultrasonic system in the main channel, DS= downstream of the ultrasonic system in the secondary channel, FS=fine scale grid over the ultrasonic system, UT=unplanned transects, DB = immediately upstream of Crescent Dam B (DB), including the headrace (HR).

APPENDIX TABLE D-3.—Non-parametric analysis of variance (ANOVA) from comparing rank-transformed, acoustically-derived fish densities among areas upstream of the ultrasonic system in the main channel (UM), downstream of the ultrasonic system in the main channel (DM), downstream of the ultrasonic system in the secondary channel (DS), over the ultrasonic system in fine-scale grid (FS), immediately upstream of Crescent Dam B (DB), including the headrace (HR) for each of the six mobile acoustic surveys with a 15° split-beam echosounder (Model 241, HTI) at Crescent Hydroelectric Project.

	ANOVA results			Tukey's multiple comparison tests*
Survey	*F*	$df_{model, error}$	*p*	(listed highest to lowest)
18 September	15.58	2,313	<0.0001	DM UM DS
20 September	2.17	3, 240	0.0919	NS
22 September	1.73	3,377	0.1608	NS
23 September	10.92	3, 360	<0.0001	DM UM DS FS
29 September	6.37	3,483	0.0003	DM FS DS UM
5 October	30.0	5, 529	<0.0001	HR DB DM FS UM DS

*NS = not significant (α=0.05), significant differences are separated by underlines.

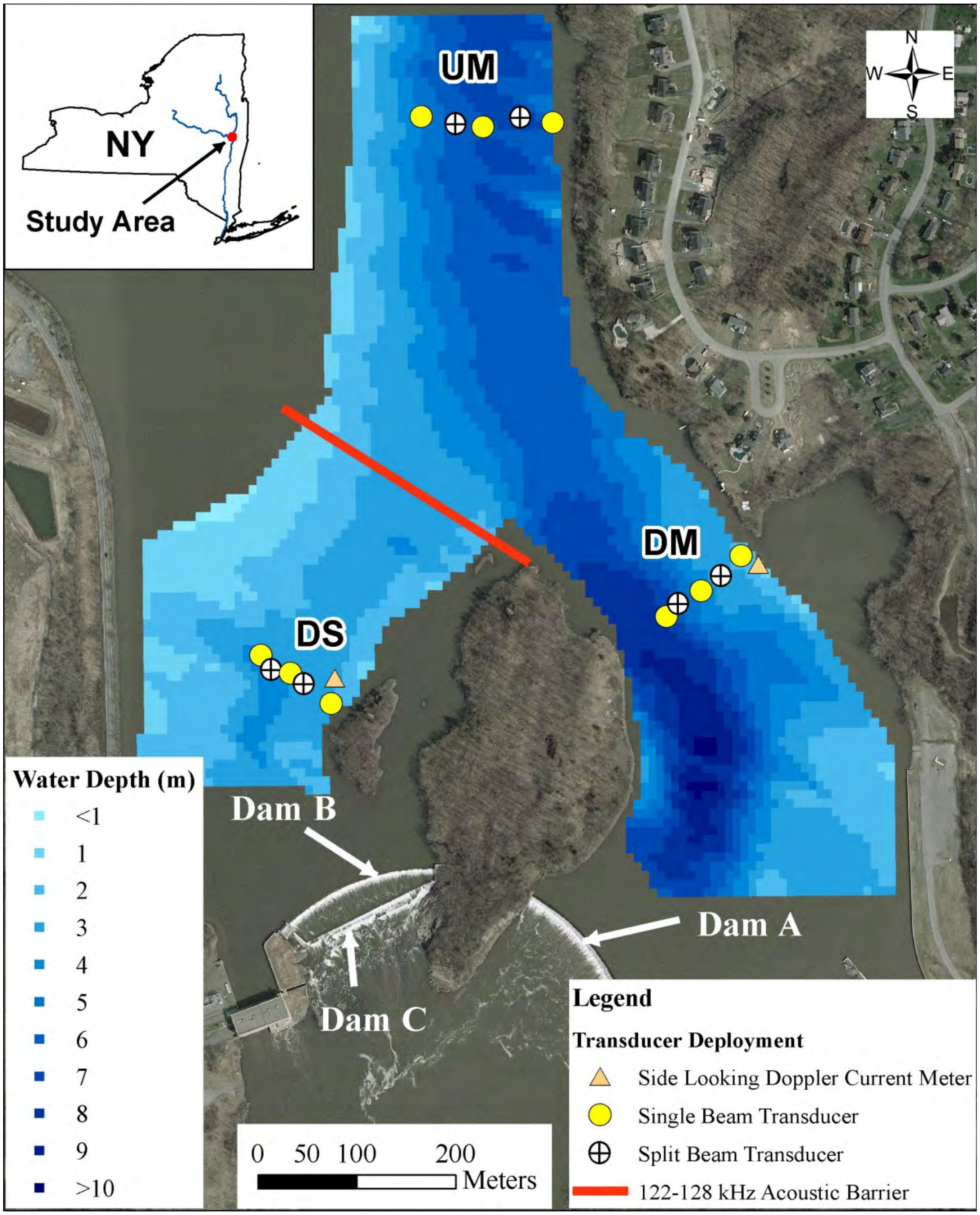
Appendix E – Estimates of Movement of Fish in the Mohawk River at the Crescent Hydroelectric Project from Continuous Target Tracking using Bottom-mounted, Up-looking 420-kHz Split-beam Transducers

Introduction

While acoustic and radio telemetry have been used to study adult fish movement and behavior in many applications, particularly fish passage at hydropower dams, stationary split-beam hydro-acoustics can also provide another method to monitor passage of juvenile fish without capture and handling. The method and application of using split-beam technology to detect and track single targets in acoustic beams to infer speed and direction, as well as provide improved estimates of target strength is reviewed by Ehrenberg and Torkelson (1996). As an example, Steig and Iverson (1998) used a horizontal split-beam scanning system to show the movement of juvenile salmonids toward the water flow when hydroelectric turbines at a dam on the Columbia River were operating in contrast to their milling behavior when the turbines were not operating, which explained the lower fish densities observed in lower flows. By contrast, Ransom et al. (1998) showed adult salmonids migrated with strong orientation toward the shore and bottom where water velocities were slowest. Arrhenius et al. (2000) used a stationary, bottom-mounted split-beam transducer mounted on the bottom of Cayuta Lake, New York to estimate average swimming speed (25.5 cm/s, n=30) of a group of targets believed to be dominated by alewives (*Alosa pseudoharengus*), but reported unrealistically high speeds (2-32 body lengths per second) for small targets. Mulligan and Chen (2000) provided a critique and review of the method used by Arrhenius et al. (2000) that stated the swim speed estimates were biased high due to cumulative errors in target location within the beam. Split-beam tracking can provide estimates of movement necessary to estimate fish flux and downstream migration based on first and last detections only (Mulligan and Chen 1998). In this study, three pairs of bottom-mounted 420-kHz split-beam transducers were aimed upward to track fish in the Mohawk River, New York, at the Crescent Hydroelectric Project during the fall downstream migration of juvenile blueback herring.

Methods

Study area.–Crescent Hydroelectric Project consists of three dams on the Mohawk River immediately downstream of the entrance to Lock 6 of the Erie Canal of the New York State Barge Canal Corporation. The two largest dams are separated by an island (Appendix Figure E-1). The main channel is impounded by Dam A, which has an opening (0.3 m high x 24.4 m long) in the flashboards to allow spillage of surface water for fish passage. The entrance to Lock 6 is on the main channel, immediately upstream of Dam A. A secondary channel of the Mohawk River flows on the west side of the island and leads to the powerhouse of the Crescent Hydroelectric Project. An ultrasonic (122-128 kHz) system was installed at the entrance to the secondary channel to project a sound field from the island to the west shore that would produce sound pressure levels shown to elicit an avoidance (~163 dB re 1 μPa) response in alewife (Dunning et al. 1992; Ross et al. 1993) and juvenile blueback herring (*Alosa aestivalis*; unpublished data). Individual movements were monitored using fixed-location hydroacoustics across three channel locations: upstream of the ultrasonic system in the main channel (UM),



APPENDIX FIGURE E-1.—Study area for the evaluation passage of down-migrating juvenile blueback herring using fixed-location hydroacoustics (420 kHz echosounders and 500 kHz Doppler current meters) in the Mohawk River at the Crescent Hydroelectric Project from 30 August through 5 October 2008.

downstream of the ultrasonic system in the main channel (DM), and downstream of the ultrasonic system in the secondary channel (DS).

Data collection.– All acoustic measurements were continuously collected at 10 Hz over 2-minute intervals by two calibrated 420-kHz digital split-beam echosounder mounted on the river bottom at each location and aimed upward. Echoes were detected by each transducer over six 2-minute periods per hour. Echoes were filtered and acquired using echo selection criteria in the DEP version 3.56 data acquisition software (HTI).

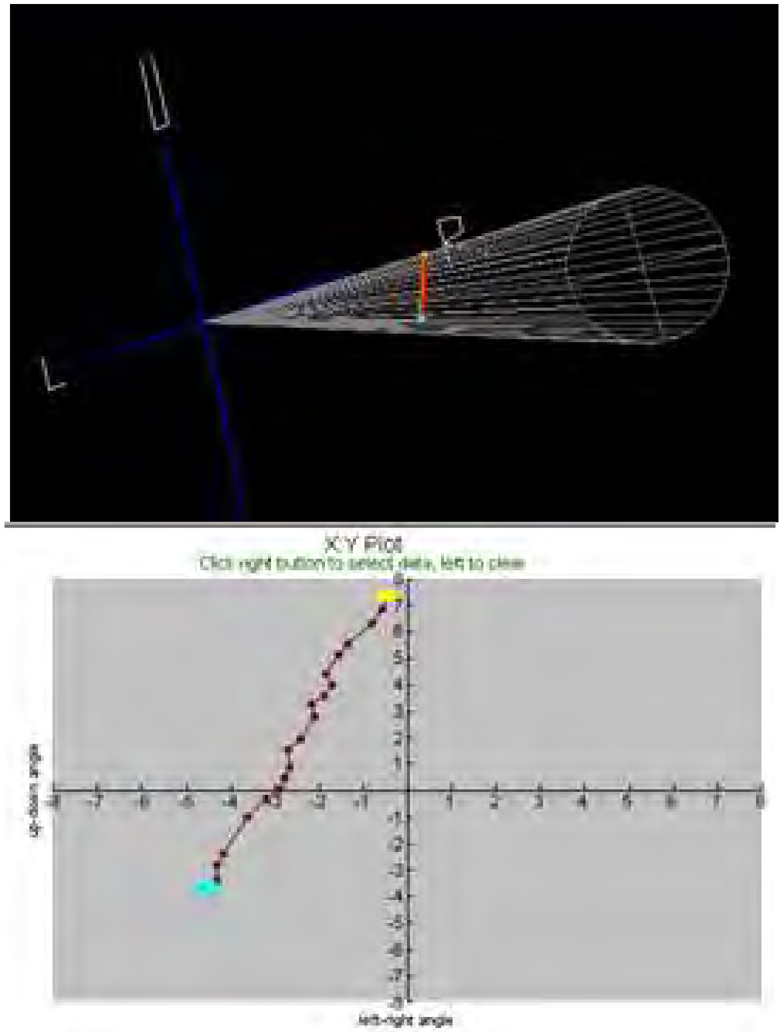
The echo selection criteria used during data acquisition were the acceptance of targets within angles of the beam axis equivalent to half of the nominal beam width (-3 dB, half-power points), within the echo pulse envelope of 0.08 to 0.29 ms (3 to 14 digital samples), and above the minimum on-axis detection threshold (-50 dB reference to 1 m^2). Acoustic backscatter was adjusted for beam spreading and absorption loss with an applied time-varied gain (TVG) function of $40\text{Log}_{10}R$ where R is range (m) and a range-dependent absorption loss gain (αR) where α = 54.8 dB/km.

Echoes from the individual fish were visually selected from echograms using Echoscape version 2.12 Build 12 software (HTI, Seattle, WA, USA; Appendix Figure E-2). Targets detected in the up-looking split-beam transducers were manually tracked using several criteria. Target tracks required a minimum of four individual echoes, with exception of targets with three echoes that traveled across the beam at close range. Single tracked targets also had no overlapping pings. Net distance of tracked targets was the distance between the location in the beam of first detection and the location of the last detection in the beam. Tracked targets displayed net distance in the y-direction (upstream/downstream). Of the tracked targets, a subset were selected that displayed less ping-to-ping variability in x-direction (showed more linear movement) and were considered more representative of migrating fish compared to stationary fish. The ventral TS for fish length equal to mean total length (73 mm) of juvenile blueback herring was used as a maximum threshold to remove targets with larger TS. The ventral TS for juvenile blueback herring was approximated as -46.4 dB based on the mean in situ dorsal TS (-46.0 dB) estimated in Appendix C and a 9% decrease between dorsal and ventral TS predicted by Love (1977) for a 73 mm fish. The mean angle and angular variation was calculated from the net direction moved from the point of first detection for all tracked targets, all tracked targets below the maximum TS threshold, all selected targets, and all selected targets below the maximum TS threshold. Percent of tracked targets that moved downstream was also calculated.

A Rayleigh test was used to test the significance of the mean angle of travel by tracked targets, i.e. H_0: direction of travel was uniformly distributed around a circle, H_A: distribution of directions traveled was not a uniform circular distribution (Zar 1984). The distributions of net direction of movement or angle of travel satisfied the assumption of unimodality for the Rayleigh test

Results and Discussion

Tracking results at each of the channel locations were summarized in Appendix Table E-1. At both UM and DM, there were no single targets tracked below a TS threshold equivalent to a mean ventral-aspect TS of juvenile blueback herring. However, over a thousand targets selected as fish were tracked at UM and DM. There were 81 targets tracked in the up-looking split-beam transducers at DS during the study period, with 12 tracks from fish with TS below the minimum TS threshold for juvenile blueback herring. The movement of all tracked targets and fish were directional as indicated by the significant mean angle of travel in a downstream direction with 64% of all targets moving downstream within the beam at DS (Appendix Figure E-3; Appendix Table E-1). Of these tracked targets, only 12 targets were below -46.4 dB with 75% having traveled downstream while detected within the beam, but their mean angle of travel was not significant. All selected tracked targets classified as fish at UM and DM showed a significant mean angle of travel in a downstream direction with 71-74% of fish moving downstream at a net rate of movement of 0.13 m/s (~2 body lengths per second) at UM and 0.07 m/s (~1 body length per second; Appendix Table E-1) at DM. The net rate of movement of all selected fish targets was highest at DS (0.16 m/s) where it had the highest water velocity (see Appendix G) and was the lowest at DM (0.07 m/s) where water velocity was the lowest.



APPENDIX FIGURE E-2.—Example of split beam tracking of single targets in the up-looking, 420-kHz split beams (top) for estimation of net rate of movement in downstream direction (net distance between first (yellow dot) and last (blue dot)/divided by duration in beam) as shown in be split-beam cross-section (below).

For purposes of estimating fish passage from fixed-location hydroacoustics, fish abundance can be adjusted to account for those fish not moving downstream and the rate of passage based on the proportion and net rate of movement of selected fish targets that moved downstream at each of the channel locations, with the assumption that these estimates are at least proportional to the true movement of juvenile blueback herring. The estimates of net rate of downstream movement may be overestimated, especially at UM and DM where no targets below the minimum TS threshold were detected. The true proportion of downstream movement may be higher for migrating juvenile blueback herring, which would underestimate numerical abundance of juvenile blueback herring passage. Despite the large numbers of tracked fish targets at UM and DM, tracked targets of the size equivalent to juvenile blueback herring were not detected whereas at least 12 targets were tracked at DS. At DS, the net rate of movement (0.09 m/s) of targets below the TS threshold for juvenile blueback herring was lower than the that for all fish targets but the percent downstream movement was slightly higher (75%) than that for all fish targets (73.5%). A possible explanation of the

APPENDIX TABLE E-1.—Summary statistics of target tracking within up-looking 420 kHz split-beam transducers.

			Mean (±SE) Net Rate of Movement (m/s)						
Site & Tracking Selections	N Targets	Mean TS (dB)	Downstream Movement	Upstream Movement	Pooled	% Downstream Movement	Mean Angle of Travel (º)	Angular Variation (º)	Raleigh Z
Upstream Main Channel									
All tracked targets	1,870	-40.0	0.13 (<0.01)	0.16 (0.01)	0.14 (<0.01)	65.4	185	68	154*
All tracked targets below -46.4 dB	0								
All selected 'fish' targets	1,084	-39.5	0.13 (<0.01)	0.19 (0.01)	0.14 (<0.01)	73.6	181	61	201*
All selected 'fish' targets below -46.4 dB	0								
Downstream Main Channel									
All tracked targets	2,459	-39.1	0.07 (<0.01)	0.13 (<0.01)	0.09 (<0.01)	66.2	229	63	369*
All tracked targets below -46.4 dB	0								
All selected 'fish' targets	1,084	-39.0	0.07 (<0.01)	0.14 (0.01)	0.09 (<0.01)	71.2	228	56	288*
All selected 'fish' targets below -46.4 dB	0								
Downstream Secondary Channel									
All tracked targets	81	-44.2	0.12 (0.02)	0.13 (0.02)	0.12 (0.01)	64.2	204	72	3.61 *
All tracked targets below -46.4 dB	43	-47.6	0.05 (0.01)	0.12 (0.03)	0.08 (0.02)	58.1	187	78	3.07 *
All selected 'fish' targets	34	-42.9	0.16 (0.03)	0.23 (0.06)	0.18 (0.03)	73.5	217	59	7.70*
All selected 'fish' targets below -46.4 dB	12	-47.6	0.09 (0.02)	0.34 (0.13)	0.15 (0.05)	75	203	64	1.69 NS

* H0: uniform circular distribution rejected, $p<0.05$
NS not significant

absence of tracked single target detections of juvenile blueback herring at UM and DM could be a result of two conditions. If migrating juvenile blueback herring moved at UM and DM in schools then single target detections may have been prevented while individuals at DS passing through the sound pressure field may dissociate from schooling behavior and making them more detectable at DS compared to those orientated in schools near the surface at UM and DM. Because UM and DM are deeper channels, if juvenile blueback herring were assumed to travel mostly at or near the surface, then single target detectability would be less at DM and UM.

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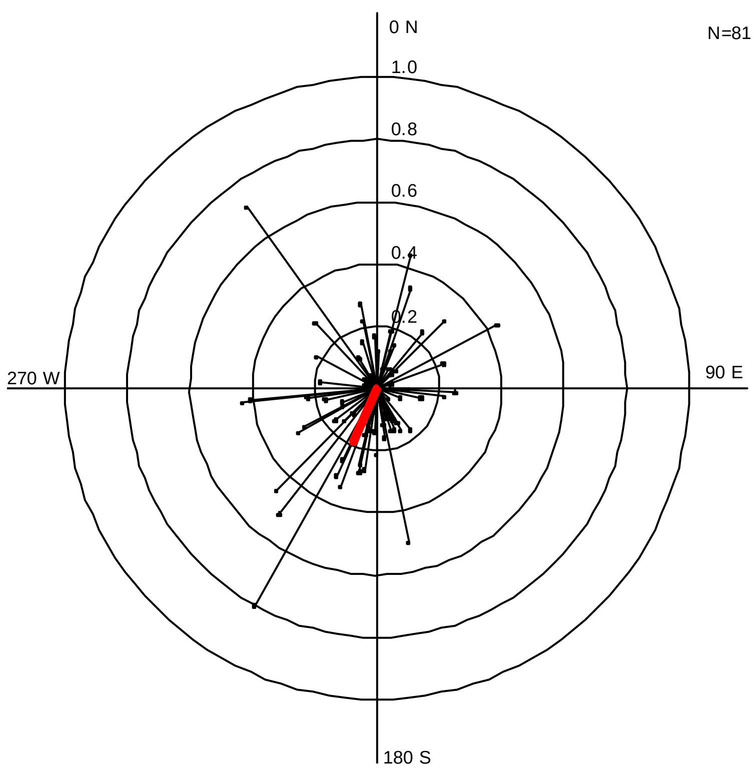


APPENDIX FIGURE E-3.—Example of mean angle of travel and mean swimming speed (red vector) from all individually tracked targets (black vectors) detected in the up-looking 420 kHz split-beam transducer in the side channel downriver of the acoustic barrier. Direction of vectors indicates net direction of movement and length of vectors indicates net rate of movement.

Appendix F – Fish Tracking at Dam A of the Crescent Hydroelectric Project, Mohawk River, New York

Introduction

Successful fish passage at dams is important to the migration of anadromous clupeids. One technique to quantify the abundance and movement of fish during migration and passage through hydropower dams is fixed-location split-beam hydroacoustics (Skalski et al. 1996, Daum and Osborne 1998, Ransom et al. 1998, Steig and Iverson 1998). Split beam technology offers the capability of determining the location of targets detected within the beam based on phase detection differences among four quadrants which enable the movement of individual targets to be tracked (Ehrenberg and Torkelson 1996).

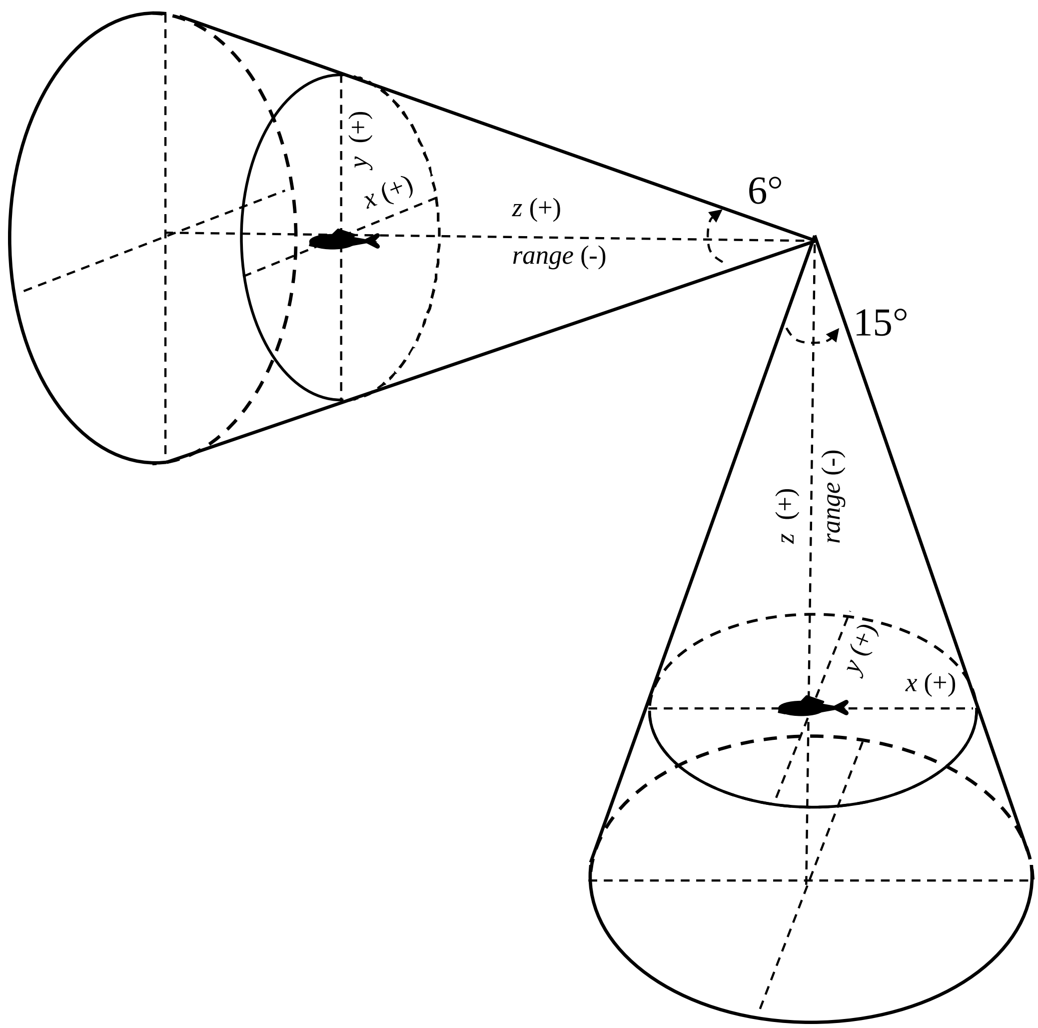
Split-beam transducers operating at 420 kHz were used for fixed-location monitoring and mobile surveys during the fall 2008 downstream migration of juvenile blueback herring to evaluate fish passage in presence of an acoustic deterrent system at the Crescent Hydroelectric Project, Mohawk River, New York. The acoustic deterrent system was designed to block juvenile blueback herring from entering the side channel that leads to the turbines and to guide them downstream through the opening in the flashboards of Dam A in the main channel. Avoidance to high-frequency sound by blueback herring and other clupeids has been used to reduce impingement at power plant intakes and turbine passage through hydropower dams (Nestler et al. 1992, Ross et al. 1996, Gibson and Myers 2002). However, at the Crescent Hydroelectric Project, the water flow is less in the main channel and the bypass is limited to a relatively small opening at the surface. If the acoustic barrier effectively deters fish from entering the side channel and guides them downstream in the main channel, fish are expected to pass through the opening of the flashboards in Dam A, or go through the locks of the Erie Canal.

The objective of this study was to estimate the direction and speed of juvenile blueback herring and other fish based on stationary acoustics from an anchored vessel near the opening in the flashboards at Dam A.

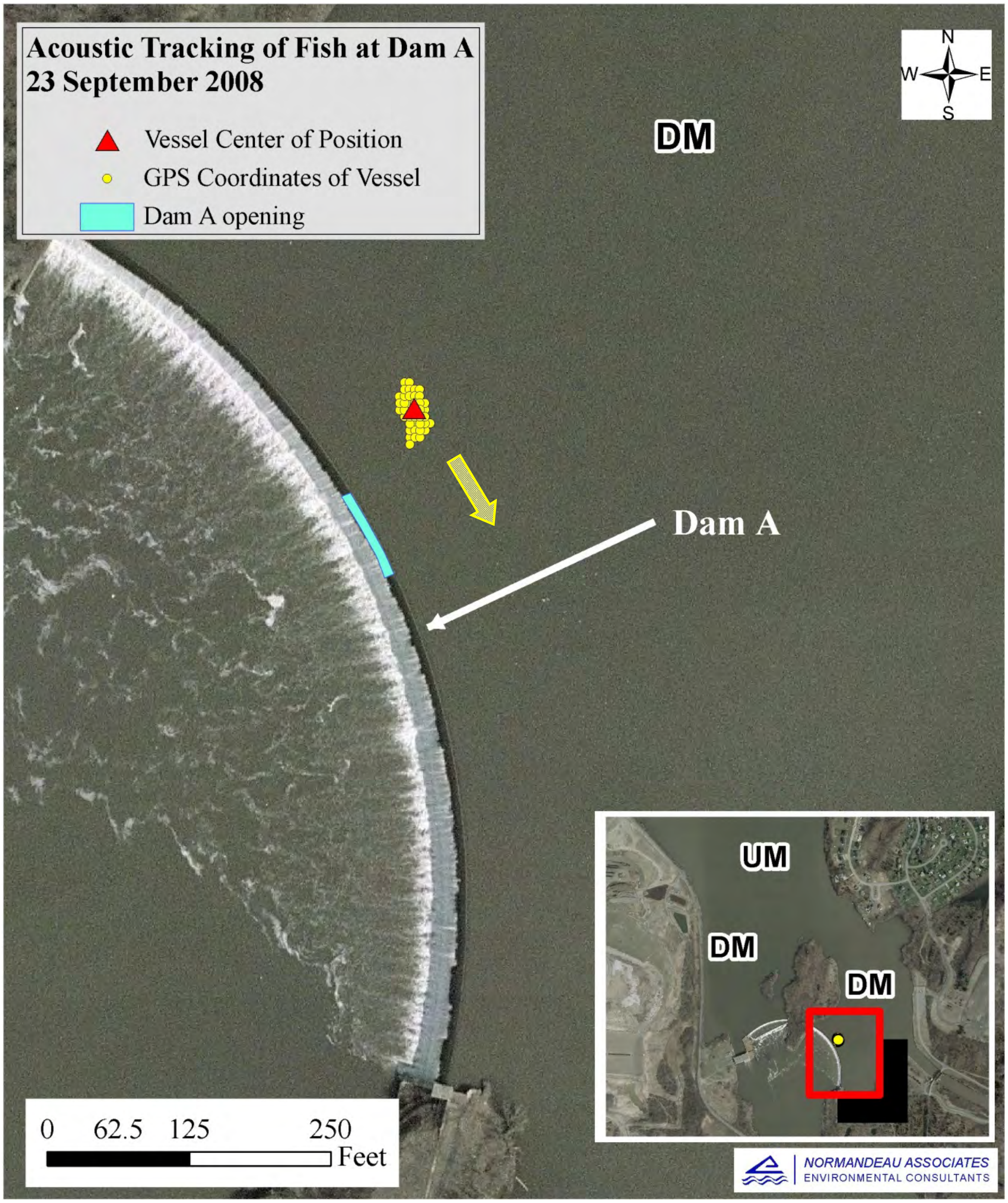
Methods

After a mobile hydroacoustic survey of the main channel downstream of the acoustic barrier on 23 September 2008, the survey vessel set two anchors between 1700 and 1900 near Dam A and collected stationary measurements of acoustic backscatter presumably as fish moved toward the opening (1 ft deep x 80 ft long) in the flashboards. Targets were detected by a 6° side-looking and 15° down-looking 420-kHz split-beam transducer. Individual targets were manually tracked using several criteria that include a minimum of four individual echoes, echo pulse duration within ±50% of the broadcast pulse duration, no overlapping pings (i.e., not more than one echo in a single ping), and other factors to aid interpretation such as ping-to-ping echo variability in position. Net distance of tracked targets was the distance between the location in the beam of first detection and the location of the last detection in the beam. Swimming speed was calculated as the cumulative echo-to-echo distance divided by the duration in the beam. The mean range of detection for the side-looking 6° split-beam was 33 m and the mean range of detection for the down-looking 15° split-beam was 6.7 m. The beam coordinate system for each transducer configuration is shown in Appendix Figure F-1.

The vessel set two anchors to maintain a relatively stationary position (Appendix Figure F-2). Movement of ±18 m is largely due to error of over 5000 GPS positional fixes and small-scale drift while anchored. The vessel was positioned so the side-looking transducer mounted on the port side was pointing in a direction (145° relative to North) that was considered relatively parallel to the opening in the flashboards at Dam A. The vessel was approximately 27 m (89 ft) from the opening in the flashboards. The positive (+) *x*-direction in the 6° split beam and positive (+) *y*-direction in the 15° split beam was assumed to be pointed in a perpendicular direction to the face of the opening in the flashboards of Dam A where fish are presumed to be passing. All echoes were above a -50 dB detection threshold. A maximum threshold was also applied to exclude targets with target strength (TS) greater than the predicted TS of juvenile blueback herring based on length of one standard deviation (0.3 mm) above the mean total length (mean=73 mm, n=90) from cast net catches. Maximum thresholds applied were -46.0 dB re 1 m^2 for the 6° beam data based on predicted side-aspect (±15°) TS and -47.5 dB re 1 m^2 for the 15° beam data based on dorsal-aspect TS (Love 1977).



APPENDIX FIGURE F-1.—Coordinate system relative to the fish location of the first detection within the 6° side-looking and 15° down-looking 420-kHz split-beam transducers for tracking movement within the beam.



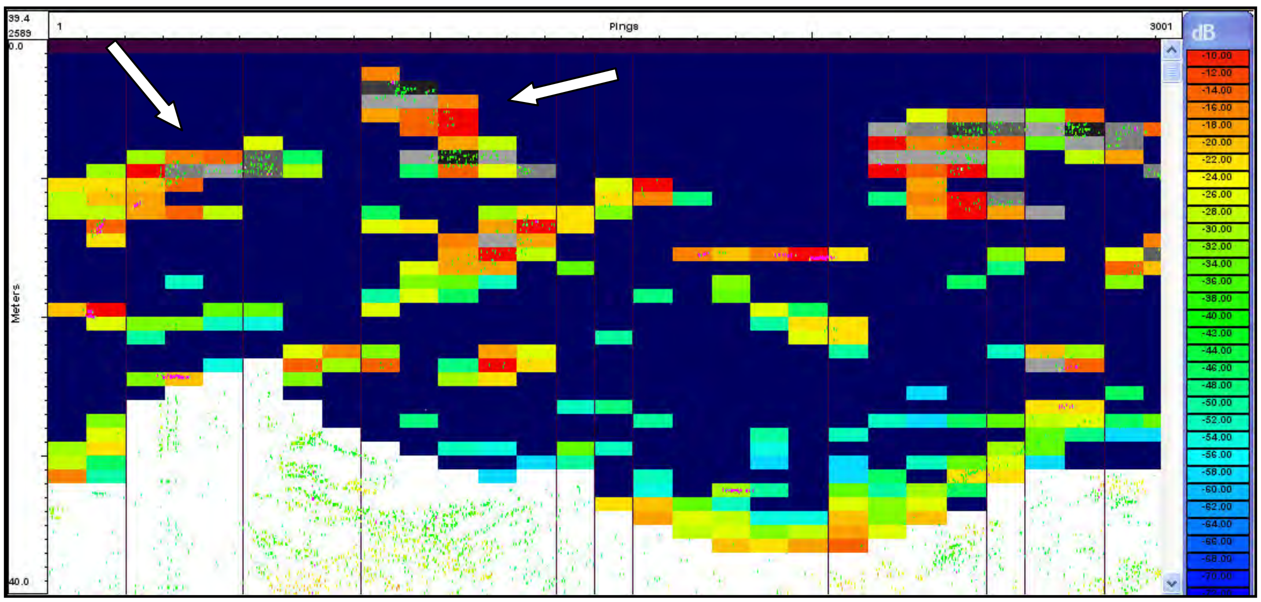
APPENDIX FIGURE F-2.—Vessel's GPS positioning (yellow dots) during stationary acoustic tracking of fish at Dam A opening (blue line) in the main channel downstream (DM) of the acoustic barrier. Yellow arrow points in the general direction of the side-looking 6° 420-kHz split-beam transducer.

The mean angle and angular variation was calculated from the net direction moved from the point of first detection for all tracked targets (all potential fish), above a minimum TS threshold to exclude juvenile blueback herring (fish larger than juvenile blueback herring) and all tracked targets below the maximum TS threshold (juvenile blueback herring). Percent of tracked targets that moved downstream was calculated as the percentage of targets with a positive net distance in the *x*-direction for the side-looking transducer and in the *y*-direction for the down-looking transducer. A Rayleigh test was used to test the significance of the mean angle of travel by tracked targets, i.e., H_0: direction of travel was uniformly distributed around a circle, H_A: distribution of directions traveled was not a uniform circular distribution (Zar 1984). The distributions of net direction of movement or angle of travel were first examined for unimodality, an assumption of the Rayleigh test. If the distribution was bimodal, angles were transformed to meet the assumption of a unimodal distribution before the Rayleigh test was performed (Zar 1984). If the distribution of angles had two modes lying in opposite directions along a diameter of a circle, the angles (θ) were doubled (=2θ) and if the doubled angle was greater than or equal to 360°, then 360° was subtracted from the doubled angle (=2θ-360°; Zar 1984). Mean angles and angular variations were calculated on transformed angles for bimodal distributions and raw angles for unimodal distributions and then back-transformed if needed by halving the final results. The mean angle of travel for bimodal distributions represented the direction of movement along an axis in either direction (mean angle or opposite direction).

Results and Discussion

Many groups of targets (i.e., schools of fish) and single target tracks were observed during stationary collection of acoustic backscatter near Dam A (Appendix Figure F-3). There were 460 targets tracked in the side-looking split-beam transducer and 10 targets tracked in the down-looking split-beam transducers at Dam A. Appendix Table F-1 provides the statistics on target strength, swimming speed, horizontal direction, and proportion of targets that moved downstream for both transducers for each threshold setting. The movement of all targets tracked in the horizontal beam was in opposite directions along an axis indicated by a significant mean angle of travel (2.4°) with 53% of targets moving downstream within the beam (Appendix Table F-1). Of these tracked targets, 37 tracked targets had a mean TS equivalent or below the maximum threshold representative of the upper SD of the TS-length distribution of juvenile blueback herring. Numerous clusters of targets believed to be transient fish schools were observed by the side-looking transducer (Appendix Figures F-3 and F-4). Cast net catches verified the presence of juvenile blueback herring near the vessel, thus the small target tracks and associated clusters of targets detected were classified as juvenile blueback herring tracks and schools with high confidence (Appendix Figure F-4). The average range at first detection of tracked juvenile blueback herring individuals was 21.4 m. Juvenile blueback herring individuals moved within the horizontal beam at a mean swimming speed of 0.14 m/s (or approximately 2 body lengths per second) in opposite directions along an axis defined by the mean angle of 13.5° relative to *x*-axis.

To investigate different swimming behavior within the beam, mean angle of travel and associated statistics were calculated for manually tracked targets with TS representative of juvenile blueback herring partitioned by depth at first detection regardless of distance from the vessel (≤2.5 m and >2.5 m) and distance from the vessel regardless of depth (≤15 m and > 15 m; Appendix Table F-2). With exception of 9 individuals ≤15 m from the vessel that moved in a significant mean angle of 53°, mean angles represented an axis of movement in opposite directions. Mean angle of travel along an axis ranged from approximately 5.4° for individuals within a depth of 2.5 m to 19.9° for individuals greater than 15 m from the vessel, but only one mean angle (19.9°) was significantly different from a uniform circular distribution (Appendix Figure F-5c; Appendix Table F-2). For perspective of the directions relative to the opening, the net movement were plotted and magnified (20X) in Appendix Figure F-6. For those individuals within the beam in front of the opening (>15 m from the vessel), 46% of the individuals moved on an average direction of 13° relative to the *x*-axis in the beam and 54% moved in the opposite direction (193°). For individuals detected between the vessel and the opening in the flashboards (≤15 m from the vessel), approximately 78% moved toward the dam at mean angle of 53° relative to the perpendicular direction toward the flashboards (*x*-axis of the beam). While 54% of all targets classified as juvenile blueback herring swam toward the flashboards, 46% of individuals swam in the opposite direction and were not attracted to the opening in the flashboards at an approximate distance of 27 m.



APPENDIX FIGURE F-3.—Echo integrals for each 10-s and 1-m averaging interval collected by the 6° side-looking 420-kHz split-beam transducer during stationary data collection of numerous schools of juvenile blueback herring (arrows point to a couple of schools as an example).

APPENDIX TABLE F-1.—Statistics of manually tracked single target detections from a 6° side-looking aimed in a direction parallel to the opening in the flashboards of Dam A and 15° down-looking 420-kHz split-beam transducer at a stationary position. Italicized results represent targets classified as juvenile blueback herring.

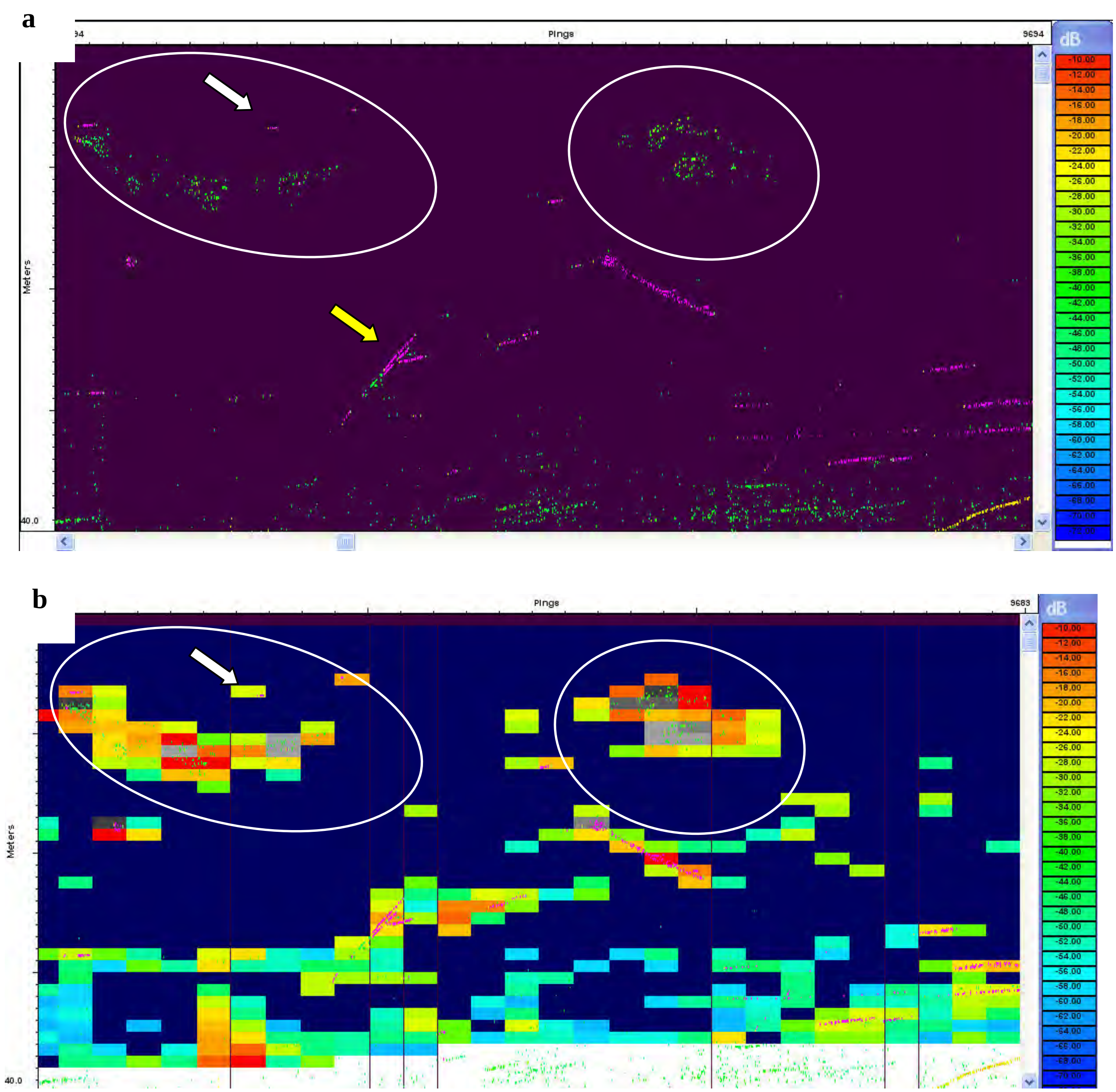
				Target Strength (dB re 1 m^2)						Swimming Speed[a] (m/s)		Horizontal Swimming Direction[b]			
Split-beam transducer and orientation	Minimum Detection Threshold	Maximum Detection Threshold	Number of Tracked Targets	Lower 95% C.I.	Mean	Upper 95% C.I.	Median	Min	Max	Mean	95% C.I.	Mean angle (°)	Angular deviation (°)	Rayleigh Z	% Net Downstream Movement
6° horizontal	-50.0	none	460	-38.2	-36.7	-35.6	-41.4	-48.5	-19.7	0.22	0.02	2.4[c]	28.9	110.7*	53.3
6° horizontal	-46.0	none	423	-37.9	-36.4	-35.3	-40.9	-46.0	-19.7	0.22	0.03	1.7[c]	28.5	107.0*	53.2
6° horizontal	*-50.0*	*-46.0*	*37*	*-47.0*	*-46.8*	*-46.5*	*-46.5*	*-48.5*	*-46.0*	*0.14*	*0.05*	*13.5*	*31.9*	*5.32**	*54.0*
15° downward	-50.0	none	10	-47.2	-44.5	-42.8	-44.9	-47.7	-40.0	0.11	0.05	9.5	70.8	0.56	80.0
15° downward	-47.5	none	9	-47.0	-44.2	-42.5	-44.8	-46.6	-40.0	0.11	0.06	15.2	71.3	0.46	77.8
15° downward	*-50.0*	*-47.5*	*1*	–	*-47.7*	–	–	–	–	*0.13*	–	*67.5*	–	–	*100.0*

[a] Swimming speed in the beam is calculated as the total echo-to-echo distance/duration in beam
[b] Swimming direction in the horizontal plane estimated from net direction between first and last detection in the beam
[c] Mean angle for axial movement from a diameterically bimodal distribution (i.e. axis for movement in opposite directions)
* H_0: uniform circular distribution rejected, $p<0.05$

APPENDIX TABLE F-2.—Target strength, swimming speed[a], and horizontal swimming direction[b] of juvenile blueback herring[c] manually tracked from single target detections by a side-looking 6° 420-kHz split-beam transducer within and two distances (≤15 m and >15 m) from an anchored vessel at Dam A opening. 0° ≈ heading perpendicular to the opening in the flash boards.

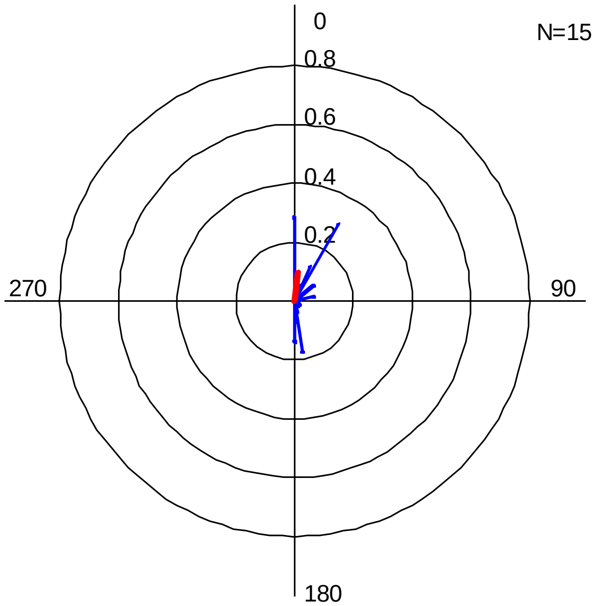
			Target Strength (dB re 1 m^2)						Swimming Speed (m/s)		Horizontal Swimming Direction			
Depth	Distance	Number of Tracked Targets	Lower 95% C.I.	Mean	Upper 95% C.I.	Median	Min	Max	Mean	95% C.I.	Mean angle (°)	Angular deviation (°)	Rayleigh Z	% Net Downstream Movement
≤2.5 m	All	15	-47.3	-46.9	-46.4	-46.6	-48.5	-46.1	0.10	0.05	5.4	30.6	2.78	60.0
>2.5 m	All	22	-47.0	-46.7	-46.4	-46.4	-48.2	-46.0	0.18	0.06	19.9[d]	32.3	2.93	50.0
All	≤15 m	9	-47.5	-46.9	-46.4	-46.9	-48.5	-46.1	0.08	0.07	53.0[d]	46.5	4.05*	77.8
All	>15 m	28	-47.0	-46.7	-46.4	-46.4	-48.5	-46.0	0.17	0.05	12.8[d]	30.4	5.27*	46.4

[a] Swimming speed in the beam is calculated as the total echo-to-echo distance/duration in beam
[b] Swimming direction in the horizontal plane estimated from net direction between first and last detection in the beam
[c] Single target detections with target strength above -50 dB and below -46 dB were classified as juvenile blueback herring; cast net samples verified the presence of juvenile blueback herring during sampling.
[d] Mean angle for axial movement from a diameterically bimodal distribution (i.e. axis for movement in opposite directions)
* H_0: uniform circular distribution rejected, $p<0.05$

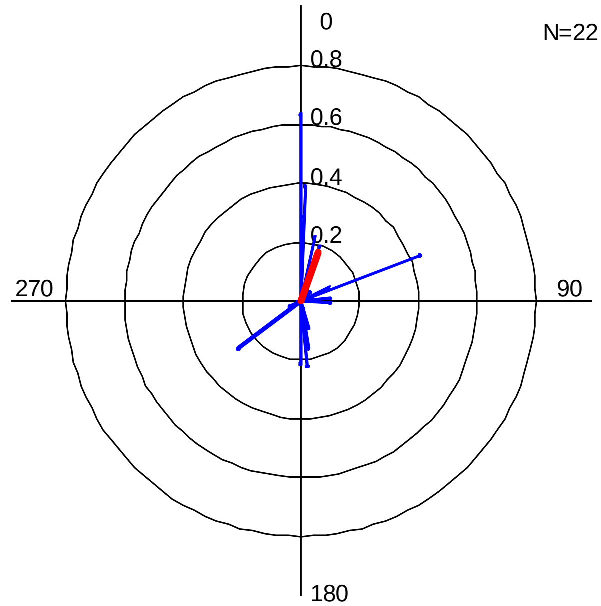


APPENDIX FIGURE F-4.—Echogram of the acoustic backscatter measured from the 6° side-looking 420-kHz split-beam transducer showing (a) tracks of small fish (white arrows) associated with schools (circles) believed to be juvenile blueback herring and tracks of larger fish (yellow arrows) and (b) echo integrals of the schools (circled).

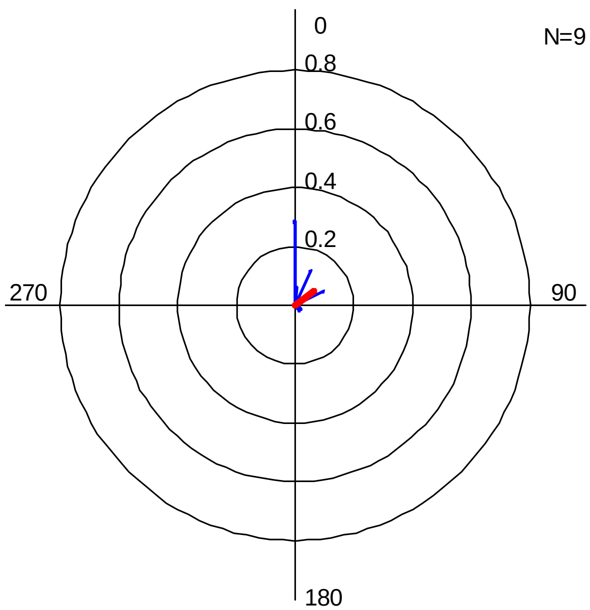
(a) ≤2.5 m depth



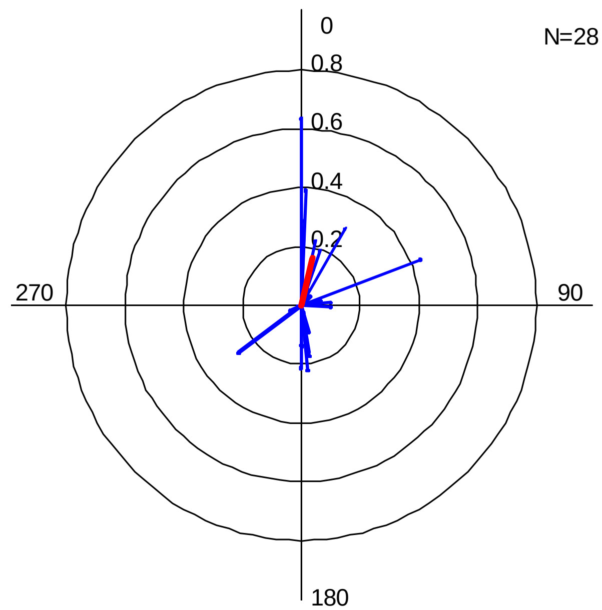
(b) >2.5 m depth



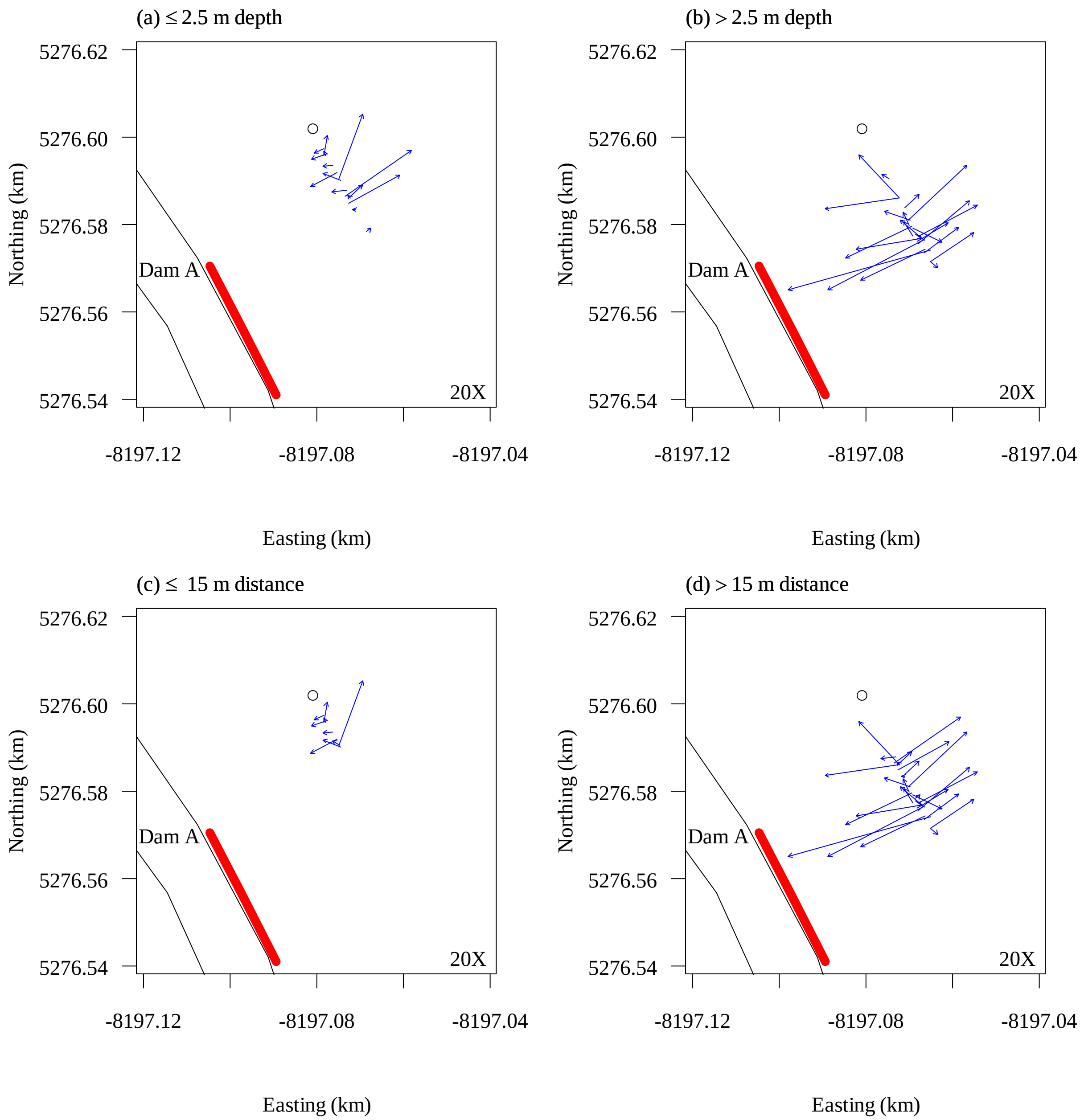
(c) ≤15 m distance



(d) >15 m distance



APPENDIX FIGURE F-5.—Mean angle of travel and mean swimming speed (red vector) from all individually tracked juvenile blueback herring (blue vectors) detected in the 6° side-looking 420-kHz split-beam transducer in the main channel downriver of the acoustic barrier near Dam A . Direction of vectors indicates net direction of movement and length of vectors indicates swimming speed. 0° is assumed to be perpendicular to opening in flashboards at Dam A. For (c-d), the mean angle indicates the axis of movement in opposite directions



APPENDIX FIGURE F-6.—Direction (arrow direction) and relative distance (arrow length, magnified 20x) of net movement of individually tracked juvenile blueback herring in (a) ≤2.5 m depth, (b) >15 m depth, (c) ≤15 m distance, and (d) >15 m distance from first detection in the 6° side-looking 420-kHz split-beam aimed parallel to the 24-m long opening in the flashboards (red line marker) of Dam A located in the main channel downriver of the acoustic barrier. Circle represents location of the anchored vessel during data collection.

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Appendix G – Continuous Flow Monitoring of the Mohawk River at the Crescent Hydroelectric Project using Fixed-location and Mobile Acoustic Doppler Current Profiling

Introduction

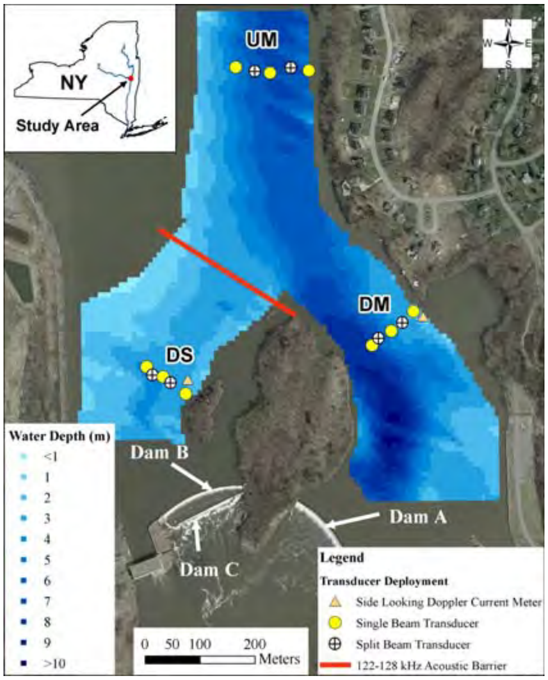
Water currents provide migratory fish with a physiological and metabolic advantage during sustained swimming. For many early life stages, river flow provides a mechanism for transport similar to movement of passive particles. Increasing river flow has been recognized as a potential factor in the timing of migration of clupeids (O'Leary and Kynard 1986; Yako et al. 2002). During the fall juvenile blueback herring (*Alosa aestivalis*) make their downstream migration down the Mohawk River, New York, which includes passing several hydroelectric dams either through the turbines or turbine bypass routes. At Crescent Hydroelectric Project, flow was continuously measured in two channels of the Mohawk River during the fall of 2008 when juvenile blueback herring made their downstream migration.

An ultrasonic system designed to deter blue-back herring from entering the secondary channel, which leads to the hydroelectric turbines, was installed and operated during flow measurements and continuous monitoring of fish passage using fixed-location hydroacoustics. Entrainment of fish by river flow has been considered as a potential factor that may reduce the effectiveness of acoustic deterrence systems (Ploskey et al. 2000; Goetz et al. 2001). For species that don't stage during migration, the rate of passage can be assumed to be proportional to flow (Gibson and Myers 2002). Flow is an important factor in the evaluation of fish passage. The primary purpose of this study was to collect flow measurements for comparing water flow and volume downstream of the in the main channel relative to the total volume of water moving downstream through both channels..

Methods

Fixed-location acoustic Doppler current profilers.—Water flow in the Mohawk River, New York, was measured at two locations immediately upstream of the Crescent Hydroelectric Project from 30 August through 5 October 2008 (Appendix Figure G-1). Vertical water height above the transducer and two-dimensional water velocity downstream of the ultrasonic system in the secondary channel (DS) and in the main channel (DM) were continuously measured over 2-minute averaging intervals by a 500-kHz Argonaut-SL acoustic Doppler current profiler (ADCP; Sontek/YSI Inc., San Diego, CA). The Argonaut-SL ADCP was mounted 1.5 m high on a 6-cm outer diameter steel pipe mount (Appendix Figure G-2). Each mount was deployed by scuba divers and secured with sand bags to the river bottom at a water depth of 2.4 m at DM and 3.7 m at DS. The axis for flow direction was marked on the transducer and the mount which allowed for alignment underwater by divers using a compass. Cable was secured to the bottom by sand bags and protected by metal conduit pipe from below the surface to the instrumentation shed. The instrumentation shed sheltered a laptop computer to record data in real time under AC power supplied by household power at DM and a Yamaha propane generator at DS.

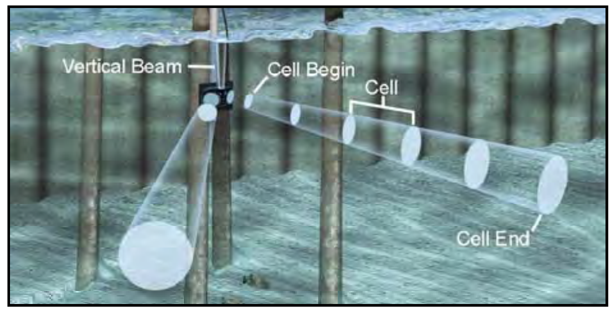
The Argonaut-SL ADCP had two horizontal beams pointed downstream and upstream at 50° apart that measures water velocity in the y-direction (+ = horizontally away from the instrument) and x-direction (+ = direction of



APPENDIX FIGURE G-1.—Location of the fixed-location hydroacoustic study at Crescent Hydroelectric Project.

APPENDIX FIGURE G-2.—Steel pipe mount with attached 500-kHz Argonaut-SL acoustic Doppler current profiler used to continuously measure river flow.

primary flow). The maximum horizontal range used for measurements was 42 m with ten 4-m cells at DM and 17-22 m with ten 1.5- or 2.0-m cells at DS (Appendix Figure G-3). Initially, the maximum horizontal range at DS was set to 22 m but was later reduced to 17 m to reduce boundary interference. During deployment, divers were given instructions to adjust tilting angle and heading to provide maximum range for horizontal cross-channel measurements. This was determined by checking the beam amplitudes versus range in the diagnostic module of the software (Appendix Figure G-4).

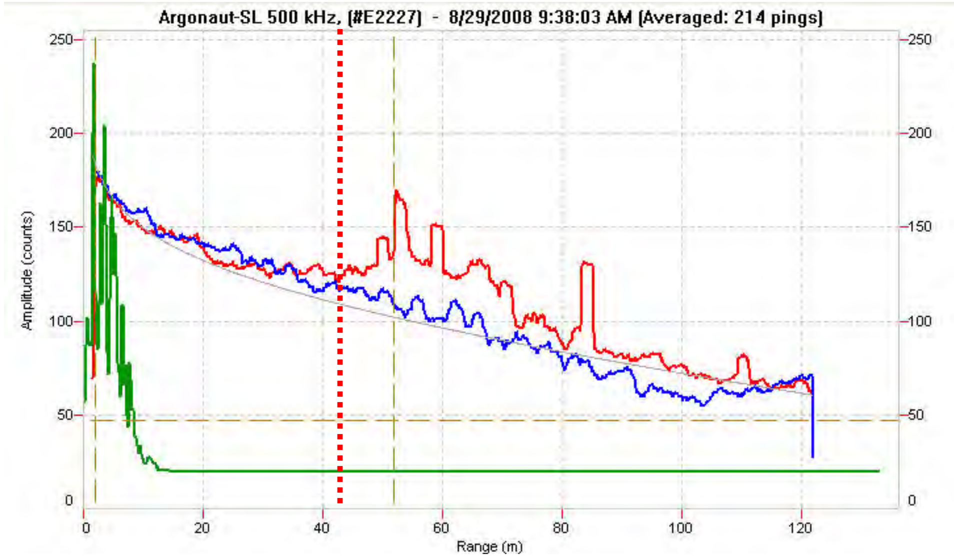


APPENDIX FIGURE G-3.—Image showing beam orientation of the vertical and two horizontal beams of the Argonaut-SL. *Image credit: Sontek/YSI Inc.*

Data were downloaded daily, which required brief (<2 minutes) interruptions for file transfer.

Mobile ADCP transects.—Independent flow measurements at each channel location were made almost every day while water velocity was being continuously measured by the Argonaut-SL ADCP. The mean water velocity and flow was independently estimated by a 1-MHz Sontek mini-ADCP RiverSurveyor system from a 6.1-m aluminum vessel, RV “Maritime.” Velocity-depth profiles were obtained while the vessel slowly (<2 knots) navigated along a transect from the east shore to the west shore in a course heading parallel to the direction from a location immediately downstream or upstream of the Argonaut-SL ADCP. Three-dimensional water-velocity profiles, bathymetry and area were measured across nearly the entire channel. The area and water velocity at the shallow (<1 m) shore edges was predicted by the Sontek RiverSurveyor version 4.60 software based on the distance to shore and slope estimated by the crew. Prior to each daily set of measurements, the compass of the ADCP was calibrated following the calibration module in the

(a)



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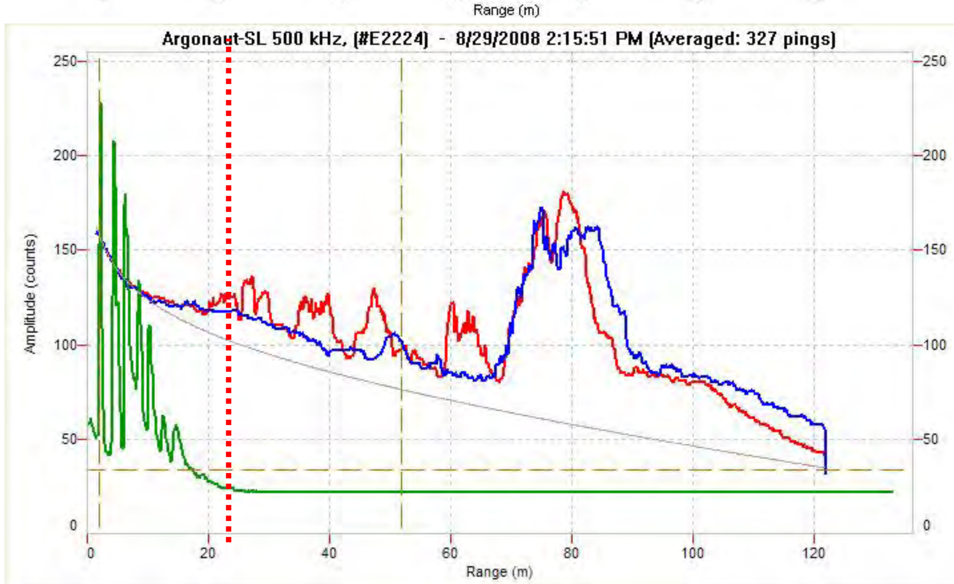


APPENDIX FIGURE G-4.—Averaged amplitude for each horizontal beam (blue and red curves) and vertical beam (green curve) of the Argonaut-SL ADCP as a function of range downstream of the ultrasonic system in the (a) main channel and (b) secondary channel of the Mohawk River. Peaks in amplitude indicate acoustic backscatter from a boundary and a maximum horizontal range (vertical dotted red line) was selected for data collection.

software (Sontek/YSI 2007a). Magnetic declination (-13.58°) for the site was entered in the software for direction correction during data acquisition. The blanking distance of the ADCP transducers was set to 0.75 m. The averaging interval and vertical cell size used for water velocity profiles was 30 s and 0.50 m, but later changed to 15 s and 0.25 m during the study for improved spatial resolution.

Analysis.—Water velocity was measured indirectly by the Doppler effect of the acoustic backscatter of passive particles in water which are assumed to move with the current. A vertical acoustic beam measures the range to the surface which is then added to system elevation off the river bottom to estimate river stage (H) referenced to the local datum. The local vertical datum used was the maximum water depth (i.e, H=0) The cross-sectional channel geometry was entered into the Sontek ViewArgonaut Data Collection and Post-Processing version 3.62 software from bathymetry obtained from depth soundings along a transect. Depth soundings used were from a preliminary transect made by a vessel equipped with a 1-MHz Sontek mini-ADCP to estimate channel geometry (Appendix Figure G-5).

The Argonaut-SL ADCP horizontally integrated water velocity across the river channel over a portion of the water layer. This measured velocity in the X-direction (V_x) was used to estimate mean channel velocity by either the theoretical or velocity-index calculation methods. The theoretical calculation was internally made by the software during data collection to estimate mean velocity of water in the channel by using a 1/6-power law relation based on the location of the measurement relative to the channel geometry (Morlock 1996; Yorke and Oberg 2002; Sontek/YSI 2007b). The velocity-index (or index-velocity) method used a linear regression equation to predict mean water velocity in the channel (V_m) based on V_x with or without river stage as a covariate (Sloat and Gain 1995; Morlock et al. 2002; Sontek/YSI 2007b). The two possible velocity index equations considered were

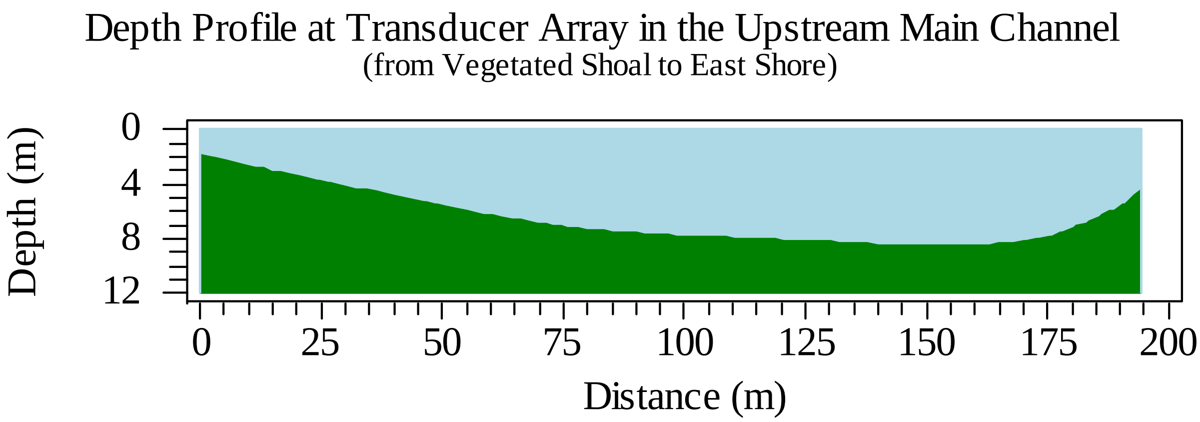
$$V_m = \beta_1 V_x + \beta_0 \qquad \text{(Eq. 1)}$$

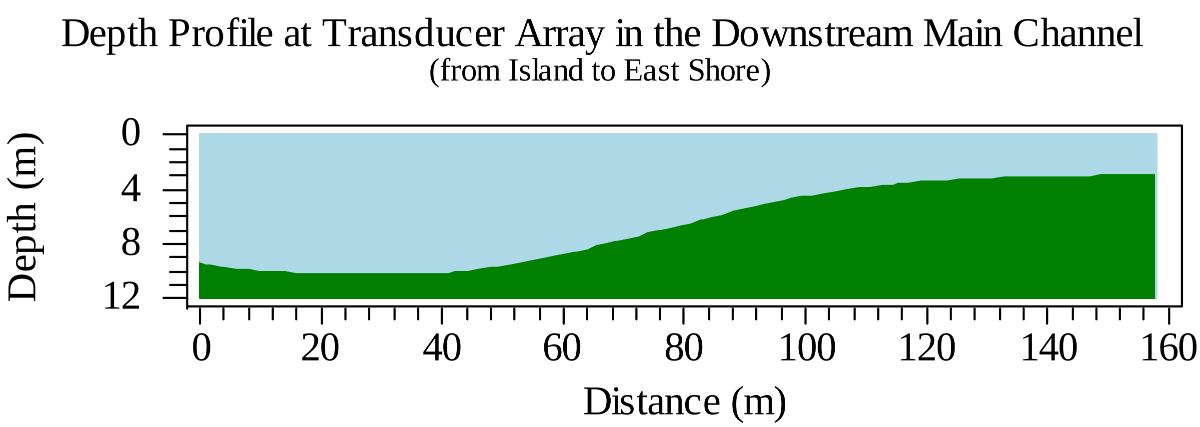
or $$V_m = (\beta_1 + \beta_2 H)V_x + \beta_0, \qquad \text{(Eq. 2)}$$

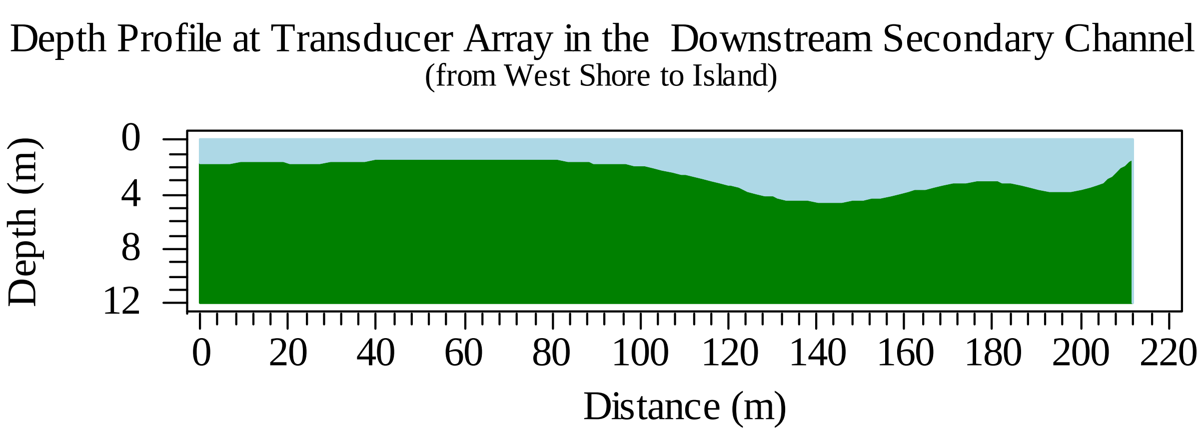
where β_1 = slope of the regression, β_0 = intercept of the regression, and β_2= coefficient for river stage. Flow or discharge (Q) was estimated by the product of the cross-sectional area of the channel (A) and V_m, either by theoretical calculation or velocity-index equation. Volume was estimated by the product of Q and elapsed time.

Prior to analysis, post-processing of daily measurements collected by the Argonaut-SL ADCP included removing erroneous data at the start or end of the time series, smoothing by a Gaussian filter (n=3), importing a revised channel geometry based on a transect of depth soundings with finer horizontal scale, changing units to metric, checking system elevation (9.619 m at DM and 3.35 m at DS), checking for other data anomalies, and exporting the data to an ascii file for analysis. Signal-to-noise ratios were typically between 20 and 60 dB and standard errors were 0.1-0.5 cm/s. The mobile ADCP transect data were processed in RiverSurveyor software (Sontek/YSI 2007a). Transects were truncated to those profile measurements made while the vessel was on course. Signal amplitude as a function of depth was visually scrutinized among profile measurements for acoustic anomalies. Transect data were excluded (void) if there were lost signal strength or DGPS positional fixes during the transect. Vessel speed relative to the river bottom was measured by bottom tracking, which was used to subtract from the measured velocity to estimate water velocity.

The best fit model (equation 1 and 2) was selected by to adjust channel velocity based on the water velocity (and river stage as a covariate) measured by the Argonaut-SL ADCP and the mean water velocity from mobile ADCP transects. The time series of flow variables from the Argonaut-SL ADCP and the discrete flow measurements from the mobile ADCP transects were imported into Sontek FlowPack version 1.20 software. FlowPack merged the two flow







APPENDIX FIGURE G-5.—Depth-profiles of the cross-section of the Mohawk River, New York, at each transducer array upstream of the ultrasonic system in the main channel (top), downstream of the ultrasonic system in the main channel (middle), and downstream of the ultrasonic system in the secondary channel.

measurements by time when both were available and created a subset of matched data. Linear, regression analysis was performed to determine the coefficients of the velocity-index equation.

All calculations were performed on the 2-minute averaged observations (i.e. measurements) and summarized as hourly and overall mean estimates. Data gaps in the time series of continuous monitoring by the Argonaut-SL ADCP were a result of power outages, interruptions during data transfer, or filled disk space. For purpose of comparing cumulative volumes of water passing through each channel, a subset of the times series based on paired observations was created so each channel had the same number of observations. Summary statistics were computed on an hourly basis for the full time series for describing the temporal patterns at a channel and based on paired 2-minute observations for comparing volumes between channels. Most of the paired data (94%) consisted of thirty 2-minute observations per hour. It was assumed that flow measurements with less than 30 2-minute observations within an hour was still representative of the flow conditions for that hour, but those hours with less than 10 (<33.3% of the hour) paired observations were considered insufficient and were excluded from comparative analysis of paired flow observations. Computations and statistics were performed using SAS software version 9.3 software (SAS Institute, Cary, NC).

Total (or net) volume was based on summation of volumes in either direction whereas downstream volumes were based on downstream flow (i.e., setting negative volumes to zero). The proportion of the river discharge volume flowing through the main channel was computed based on the best available flow information from the study. The cumulative downstream volume for each hour at DM and DS was used to derive hourly estimates of the proportion of water volume moving downstream in the main channel (DM/(DM+DS)) and ratio of DM to DS volumes.

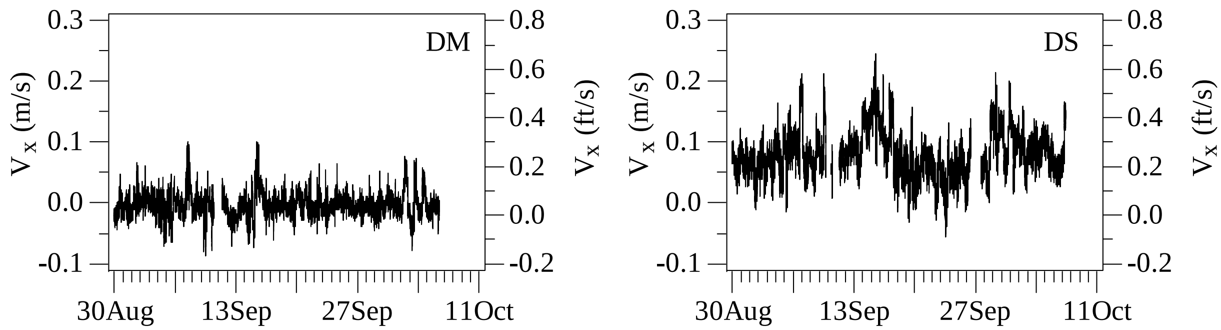
Results

A time series of the 2-minute observations of V_x and river stage measured by the Argonaut-SL ADCP was presented in Figures 6 and 7. The measured water velocity at DM fluctuated mostly between -0.05 m/s and 0.05 m/s with two peaks around 7-8 September and 15 September. The measured velocity at DS was significantly higher than at DM (paired t-test on paired hourly means, $p<0.001$, Appendix Table G-1).

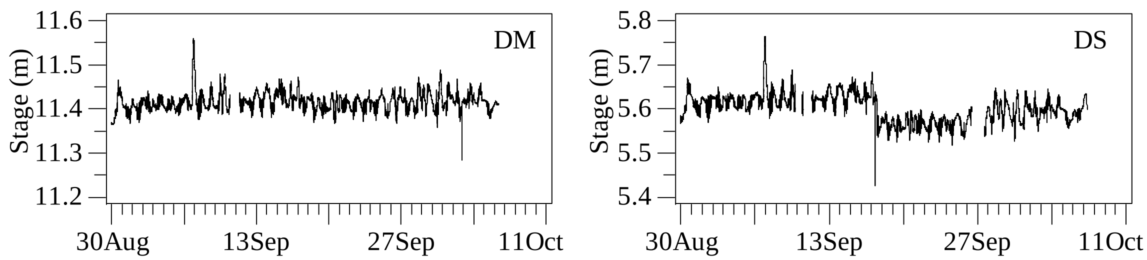
The statistics on all observations are reported in Appendix Table G-2. The measured velocity at DS peaked around 7-8 September, 15 September, and 29 September-2 October. River stage at DM (11.42 m) was relatively stable with an average daily range of 0.07 m with a peak (11.56 m) on 6 September and a drop (11.29 m) on 2 October (Appendix Table G-2). The time series of the measured river stage at DS showed a stepwise decline from around 5.62 m to 5.57 m on 17 September and then a step up to around 5.59 m on 27 September. The river stage at DS peaked at 5.77 m on 7 September. The drastic decline in river stage at DS on 17 September was a single 2-minute observation and at DM on 2 October was a few non-consecutive observations. These outlying observations were most likely a result of stationary fish in the vertical beam and as a result were excluded from analysis.

Based on the theoretical calculation of mean water velocity in the channel, hourly-averaged time series of V_m and flow peaked around 7 September, 15-17 September, and 1-2 October (Appendix Figures G-8 and G-9). Theoretical mean velocity and flow was significantly higher at DS compared to DM among paired hourly averaged values (paired t-test, $p<0.001$, Appendix Table G-1).

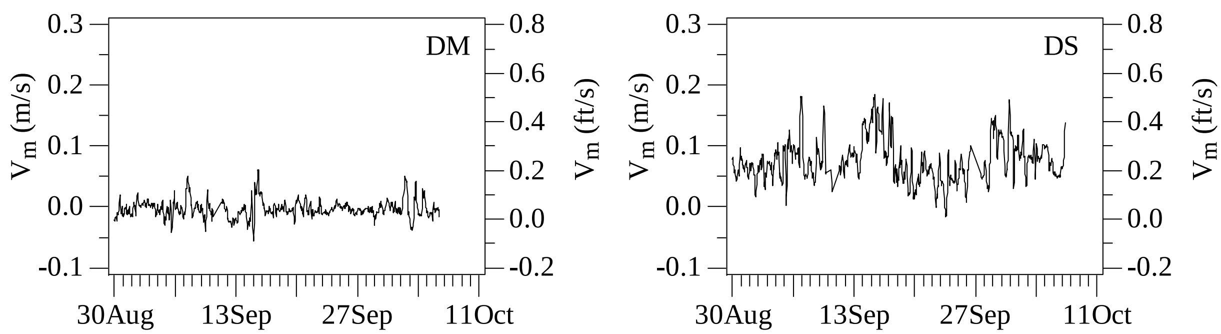
Independent flow measurements measured by the mobile ADCP transects over multiple flows and used to calibrate the continuous ADCP measurements were reported in Appendix Table G-3. Linear regression analysis did not result in a significant velocity-index relation between V_x and V_m at DM for either Equation 1 or 2 ($p>0.05$).



APPENDIX FIGURE G-6.—Horizontally-integrated water velocity (V_x) continuously measured over 2-minute average intervals by a 500-kHz Argonaut-SL acoustic Doppler current profiler downstream of the ultrasonic system in the main channel (DM) and secondary channel (DS) of the Mohawk River at the Crescent Hydroelectric Project from 30 August through 5 October 2008.



APPENDIX FIGURE G-7.—River stage continuously measured over 2-minute averaging intervals by a 500-kHz Argonaut-SL acoustic Doppler current profiler downstream of the ultrasonic system in the main channel (DM) and secondary channel (DS) of the Mohawk River at the Crescent Hydroelectric Project from 30 August through 5 October 2008.

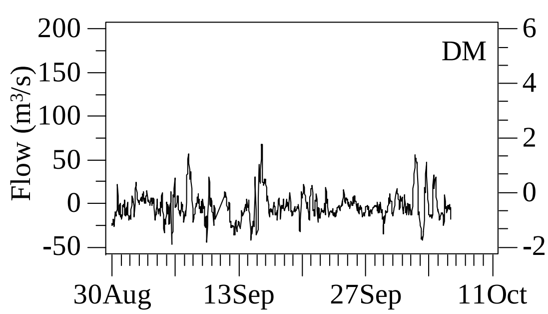


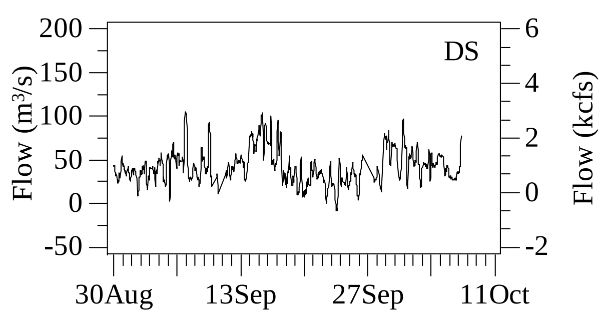
APPENDIX FIGURE G-8.—Hourly-averaged mean water velocity (V_m) estimated by the theoretical mean velocity calculation based on 1/6 power relation of the location of continuous velocity measurements made by a 500-kHz Argonaut-SL acoustic Doppler current profiler relative to the channel geometry downstream of the ultrasonic system in the main channel (DM) and secondary channel (DS) of the Mohawk River at the Crescent Hydroelectric Project from 30 August through 5 October 2008.

APPENDIX TABLE G-1.—Overall statistics of hourly estimates (n=819) from paired 2-minute observations of measured horizontally-integrated water velocity (V_x), river stage, estimated mean water velocity (V_m), cross-sectional area, total and downstream flow and volume downstream of the ultrasonic system in the main channel (DM) and secondary channel (DS) of the Mohawk River, New York, during continuous acoustic Doppler current profiling from 30 August through 5 October 2008.

Site	Parameter	Mean	S.D.	Minimum	Maximum	Sum
DM[a]	V_x (m/s)	-0.003	0.016	-0.064	0.069	
	River stage (m)	11.42	0.02	11.37	11.55	
	V_m (m/s), theoretical[b]	-0.003	0.014	-0.057	0.061	
	Cross-sectional area (m^2)	1,111.33	3.24	1,102.86	1,134.64	
	Total flow (m^3/s), theoretical	-3.30	16.21	-63.06	68.03	
	Downstream flow (m^3/s), theoretical	4.79	10.01	0.00	68.03	
	Total volume (m^3), theoretical	-109,490	537,634	-2,108,964	2,272,956	-89,672,195
	Downstream volume (m^3), theoretical	158,511	332,080	0	2,272,956	129,820,694
DS	V_x (m/s)	0.081	0.036	-0.017	0.193	
	River stage (m)	5.60	0.03	5.54	5.76	
	V_m (m/s), theoretical	0.077	0.035	-0.017	0.185	
	V_m (m/s), velocity index[c]	0.086	0.031	-0.011	0.205	
	Cross-sectional area (m^2)	549.38	6.91	535.30	584.99	
	Total flow (m^3/s), theoretical	42.58	19.66	-8.81	105.52	
	Total flow (m^3/s), velocity-index	47.50	16.98	-5.71	111.68	
	Downstream flow (m^3/s), theoretical	42.63	19.55	0.00	105.52	
	Downstream flow (m^3/s), velocity-index	47.60	16.74	5.06	111.68	
	Total volume (m^3), theoretical	699,919	331,639	-142,764	1,850,599	573,233,694
	Total volume (m^3), velocity index	778,678	283,585	-92,483	1,828,702	637,737,016
	Downstream volume (m^3), theoretical	700,698	329,931	0	1,850,599	573,871,727
	Downstream volume (m^3), velocity index	779,274	282,028	27,728	1,828,702	638,225,180
	Proportion of cumulative downstream volume at DM[d]	0.121	0.184	0.000	0.774	
	Ratio of cumulative downstream volume at DM and DS (DM/DS)	0.230	0.478	0.000	3.429	

[a] A velocity-index equation at this site was not statistically significant ($p>0.05$)
[b] Mean velocity was estimated by a theoretical calculation by 1/6 power relation algorithm in ViewArgonaut software
[c] A significant velocity-index equation ($V_m = 0.010+V_x(28.021-4.827(\text{river stage}))$, adj-$R^2$=0.690) was used to estimate mean velocity based on continuous measured velocities
[d] $DM_{theor.}/(DS_{vi}+DM_{theor})$.





APPENDIX FIGURE G-9.—Hourly-averaged water flow estimated by the theoretical mean velocity and cross-sectional area from continuous velocity and river stage measurements made by a 500-kHz Argonaut-SL acoustic Doppler current profiler downstream of the ultrasonic system in the main channel (DM) and secondary channel (DS) of the Mohawk River at the Crescent Hydroelectric Project from 30 August through 5 October 2008.

APPENDIX TABLE G-2.—Summary statistics of 2-minute averaged observations measured horizontally-integrated water velocity (V_x), river stage, estimated mean water velocity (V_m), cross-sectional area, total and downstream flow and volume downstream of the ultrasonic system in the main channel (DM) and secondary channel (DS) of the Mohawk River, New York, during continuous acoustic Doppler current profiling from 30 August through 5 October 2008.

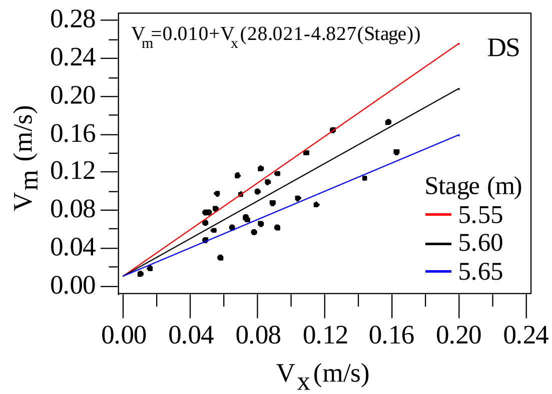
Site	Parameter	Mean	S.D.	Minimum	Maximum	Sum
DM[a]	*All observations (n=26,519)*					
	V_x (m/s)	-0.01	0.02	-0.09	0.10	–
	River stage (m)	11.42	0.02	11.36	11.56	–
	V_m (m/s), theoretical[b]	-0.01	0.02	-0.08	0.09	–
	Cross-sectional area (m^2)	1,111.28	3.39	1,089.08	1,135.62	–
	Total flow (m^3/s), theoretical	-3.60	16.73	-73.02	86.00	–
	Downstream flow (m^3/s), theoretical	4.50	10.32	0.00	86.00	–
	Total volume (m^3), theoretical	-3,998.70	18,595.42	-81,855.32	9,554.63	-106,041,593
	Downstream volume (m^3), theoretical	5,003.29	11,469.51	0.00	95,504.63	132,682,235
DS	*All observations (n=25,689)*					
	V_x (m/s)	0.08	0.04	-0.06	0.25	–
	River stage (m)	5.60	0.03	5.52	5.77	–
	V_m (m/s), theoretical	0.08	0.04	-0.05	0.24	–
	V_m (m/s), velocity index[d]	0.09	0.03	-0.06	0.32	–
	Cross-sectional area (m^2)	549.39	6.89	509.90	586.40	–
	Total flow (m^3/s), theoretical	42.27	19.92	-15.96	116.51	–
	Total flow (m^3/s), velocity-index	47.24	18.14	-33.28	160.91	–
	Downstream flow (m^3/s), theoretical	42.32	19.81	0.00	116.51	–
	Downstream flow (m^3/s), velocity-index	47.53	17.75	0.00	160.91	–
	Total volume (m^3), theoretical	23,297.20	11,153.80	-8,595.49	66,144.01	598,481,881
	Total volume (m^3), velocity index	25,977.99	10,014.56	-17,808.48	82,047.76	667,348,486
	Downstream volume (m^3), theoretical	23,322.04	11,096.85	0.00	66,144.01	599,119,915
	Downstream volume (m^3), velocity index	25,996.96	9,959.98	0.00	82,047.76	667,836,651

[a] A velocity-index equation at this site was not statistically significant ($p>0.05$)

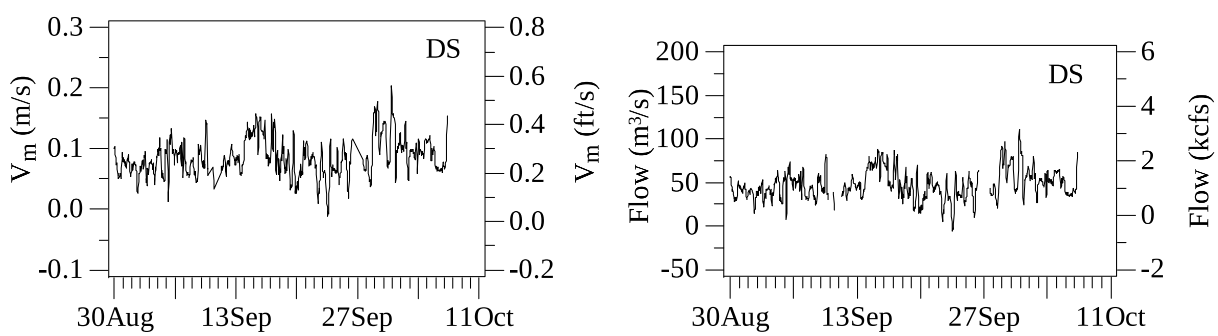
[b] Mean velocity was estimated by a theoretical calculation by 1/6 power relation algorithm in ViewArgonaut software

[c] Due to power outages or interruptions for data transfer, comparison of cumulative volumes were based on a subset of the time series when observations were available at both sites

[d] A significant velocity-index equation ($Vm = 0.010 + Vx(28.021 - 4.827(\text{river stage}))$, adj-$R^2=0.690$) was used to estimate mean velocity based on continuous measured velocities



APPENDIX FIGURE G-10.—The velocity-index equation used to calibrate the continuous measurements by the Argonaut-SL acoustic Doppler current profiler was based on this relation between measured velocity (V_x) and river stage, and the mean velocity (V_m) from multiple independent flow measurements for the entire channel downstream of the ultrasonic system in the secondary channel (DS) of the Mohawk River at the Crescent Hydroelectric Project from 30 August through 5 October 2008.

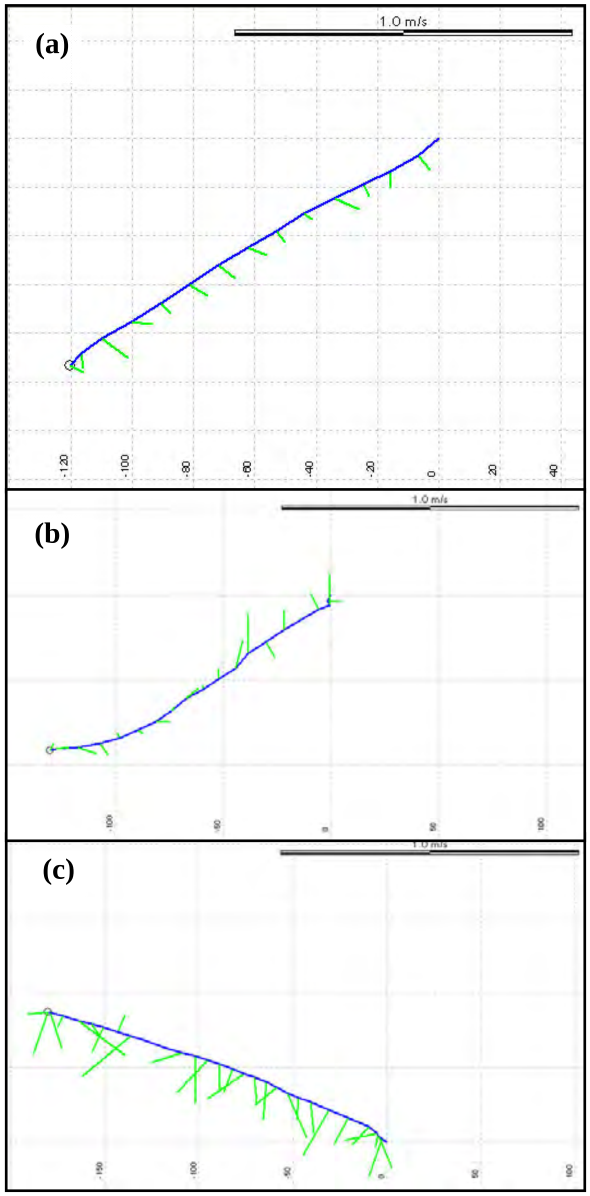


APPENDIX FIGURE G-11.—Hourly-averaged mean water velocity (left) and flow (right) estimated by the velocity-equation from continuous velocity and river stage measurements made by a 500-kHz Argonaut-SL acoustic Doppler current profiler downstream of the ultrasonic system in the secondary channel of the Mohawk River at the Crescent Hydroelectric Project from 30 August through 5 October 2008.

APPENDIX TABLE G-3.—Velocity-index calibration data based on measurements of mean water velocity (V_m) and flow (Q) estimated by cross-channel transects of water velocity depth profiles by a 1-MHz Sontek RiverSurveyor acoustic Doppler current profiler downstream of the ultrasonic system in the main channel (DM) and secondary channel (DS) of the Mohawk River from 30 August through 5 October 2008.

	DM		DS	
Date	V_m (m/s)	Q (m^3/s)	V_m (m/s)	Q (m^3/s)
30 Aug	0.027	29.860	0.059	32.322
31 Aug	b	b	0.073	39.272
1 Sep	0.002	2.152	0.019	10.281
2 Sep	b	b	b	b
3 Sep	0.019	21.278	0.062	33.861
4 Sep	0.017	18.413	0.049	26.918
5 Sep	0.023	25.575	0.114	61.830
6 Sep	0.023	24.898	0.062	33.940
7 Sep	0.038	41.973	0.030	16.078
8 Sep	b	b	b	b
9 Sep	0.015	16.883	c	c
10 Sep	b	b	c	c
11 Sep	0.001	1.138	0.097	52.805
12 Sep	0.021	23.526	0.086	46.939
13 Sep	0.022	23.836	0.078	42.566
14 Sep	b	b	b	b
15 Sep	b	b	0.173	94.450
16 Sep	0.021	23.410	0.110	59.704
17 Sep	0.008	8.815	0.142	77.341
18 Sep	0.057	63.491	0.119	63.464
19 Sep	0.010	10.484	0.141	75.014
20 Sep	0.017	18.678	b	b
21 Sep	0.016	17.725	0.098	52.395
22 Sep	0.007	8.115	0.013	6.800
23 Sep	a	a	a	a
24 Sep	0.023	25.847	0.082	43.720
25 Sep	0.018	19.622	0.117	61.864
26 Sep	0.025	27.918	0.100	53.370
27 Sep	0.019	20.446	0.067	35.381
28 Sep	0.025	27.646	0.088	48.379
29 Sep	-0.001	-0.771	0.165	89.830
30 Sep	b	b	0.078	41.368
1 Oct	0.016	17.452	0.093	50.633
2 Oct	0.009	10.099	0.066	35.173
3 Oct	0.028	31.207	0.057	30.950
4 Oct	0.014	15.829	0.124	66.958
5 Oct	0.036	39.454	0.070	37.598
Mean	0.019	21.207	0.088	47.373

[a] not sampled
[b] void, measurement anomalies
[c] no matching Argonaut-SL ADCP data



APPENDIX FIGURE G-12.—Depth-averaged water velocity vectors measured by 1-MHz RiverSurveyor acoustic Doppler current profiler along a transect across the main channel downstream of the ultrasonic system on (a) 18 September 2008 and (b) 5 October 2008, and across the secondary channel downstream of the ultrasonic system on 25 September 2008.

However, a velocity-index relation with river stage as a covariate (Equation 2) was found to be the best fit significant relation between V_x and V_m at DS (Eq. 1: Adjusted-$R^2 = 0.621$, $p < 0.05$; Eq. 2: Adjusted-$R^2 = 0.690$, $p < 0.05$). The additional variability in the linear relation between V_m and V_x that is explained by river stage can be shown by the predicted V_m lines based on three river stage levels encompassing the scattered data points (Appendix Figure G-10). An hourly averaged time series at DS was derived from continuous measurements of the Argonaut-SL ADCP based on the velocity-index Equation 2 (Appendix Figure G-11). The transects of depth-averaged water velocity profiles at DM showed low velocities in typical downstream directions but on many occasions velocity vectors were in reverse (upstream) direction for the eastern portion of the transect where the fixed-location, Argonaut-SL ADCP sampled (Appendix Figure G-12).

Based on cumulative volumes among observations when data were available at both sites, the distribution (Appendix Figure G-13) of the hourly proportions of water volume moving downstream at DM relative to the total downstream volumes ($volume_{DS}$+$volume_{DM}$) is skewed and the volume of water moving through DM averages 12.1% of the total volume (Appendix Table G-1). This estimate was based on flow estimates from the velocity-index calculated mean velocity at DS and the theoretical mean velocity at DM because this was considered the best available information. The volume of water moving downstream was significantly greater at DS than at DM based on hourly totals (paired t-test, $p < 0.001$).

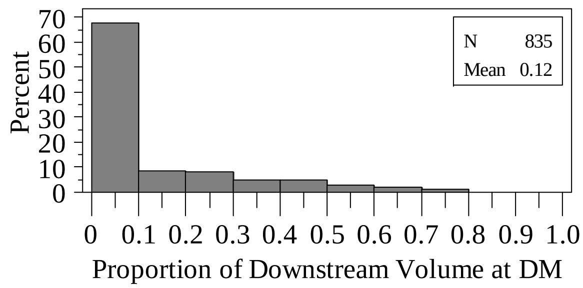
Discussion

The results from continuous monitoring of river flow by the Argonaut-SL and flow measurements made by water velocity depth profiles across the channels clearly showed water velocity, flow, and volume was significantly greater at DS than at DM. At DM, water could flow through two openings. On Dam A, there was an opening in the flashboards (0.3 m high x 24.4 m long) that allowed surface water spill over the dam. Water at DM also was used to fill navigation Lock 6 of the Erie Canal which was periodic in use between 0700 and 2200 hours before 10 September and between 0700 and 1700 hours starting 10 September.

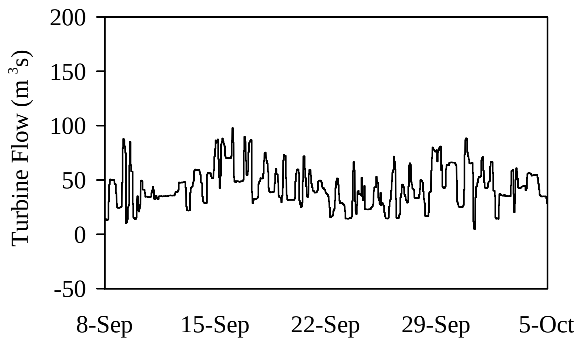
The depth-averaged water velocity vectors along the transect at DM periodically showed reverse flow on the eastern shore, which could be a periodic circulation pattern in DM as a result of water being drawn to DS and wind-driven surface currents or eddies. The variability at DM made it difficult to establish a velocity index equation when velocities were so low and periodic negative velocities were observed. As a result, the continuous measurements from the Argonaut-SL ADCP may underestimate the downstream flow at DM. Because water velocity was estimated by subtraction of the vessel velocity from the total velocity measured acoustically, water velocities could potentially be overestimated from mobile ADCP transects under low flow conditions as observed in DM. The use of downstream flow estimates from continuous measurements (mean 4.5 m^3s) at DM paired with the flow estimates at DS from velocity-indexing was justified by the robust sample size, temporal resolution for comparison, and marginal difference than theoretical water flow through the flashboard opening (~7.2 m^3s) compared to the flow estimates from mobile ADCP transects (21.2 m^3s).

The higher and variable water velocity at DS appeared to be a result of hydroelectric turbine operation. Appendix Figure G-14 shows the time series of turbine flow from 8 September through 5 October, which was reasonably similar (43.87 m^3s) to the estimated flow from measurements at DS. The mean total flow estimated from all observations of the velocity index measured by the Argonaut-SL ADCP (47.44 m^3s) and mobile ADCP transects (47.37 m^3s) were in agreement.

Despite some uncertainties in the flow estimates at DM, fixed-location and mobile ADCP measurements showed the water velocity and volume of water flowing through the secondary channel downstream of the ultrasonic system is at least an order or several orders of magnitude greater than in the main channel. If small juvenile blueback herring migrate downstream in direct proportion to river flow, then it is reasonable to assume that the number of fish and rate of passage in the secondary channel would be much greater than in the main channel.



APPENDIX FIGURE G-13.—Distribution of the hourly estimates of the proportion of volume of water moving downstream of the ultrasonic system in the main channel of the Mohawk River relative to the total volume of water moving downstream of the ultrasonic system at the Hydroelectric Project on the Mohawk River, New York from 30 August through 5 October 2008.



APPENDIX FIGURE G-14.—Time series of the water flow (cubic meters per second) through turbines of the Crescent Hydroelectric Project on the Mohawk River, New York from 8 September through 5 October 2008.

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Appendix H –Species Composition and Size Distribution of Insonified Fish Communities at Crescent Hydroelectric Project

Introduction

Species identification of acoustic targets is typically inferred from the location of fish in the water column, net catch data, knowledge of the species' habits, and their spectral signature (Horne 2000). During a study at the Crescent Hydro-electric Project (Crescent) in which the passage of downstream migrating juvenile blueback herring (*Alosa aestivalis*) were being continuously monitored by fixed-location 420-kHz single- and split-beam echosounders and periodically survey-ed by mobile hydroacoustics, the identity and composition of fish being sampled were important to the interpretation of the acoustic data. The study relied on a relative index of fish abundance derived from echo integration under the assumption that either the majority of the scattering contributions was from schools of juvenile blueback herring or the species composition and abundance of non-targeted species were similar between river channels being compared. Net sampling is a commonly-used technique to periodically verify species identification of acoustic targets during acoustic surveys (McClatchie et al. 2000). The primary purpose of this study was to test the assumption of similar fish communities being sampled acoustically at river channel locations for evaluation of passage of juvenile blueback herring in the presence of an underwater ultrasonic system. A secondary objective was to describe the size distribution of the fish assemblage and verify the presence of juvenile blueback herring.

Methods

A 45.7-m (150-ft) long x 2.4-m (8-ft) high experimental gill net with six different mesh panels (nominal bar mesh sizes of 0.5, 1.0, 1.5, 2.0, 2.5, and 3.0 inches) was soaked periodically at four locations in the Mohawk River near Crescent between 30 August and 5 October 2008. A 1.3-cm (0.5-inch) mesh x 61 m (200 ft) x 2.4 m (8 ft) gill net (small mesh gill net) was also used for additional sampling. Cast nets (2.4 m radius) were used to sample juvenile blueback herring near Dam A and the headrace (Appendix Figure H-1). The locations sampled by gill nets were upstream of the ultrasonic system in the main channel (UM), downstream of the ultrasonic system in the main channel (DM) and secondary channel (DS), and between the two islands (BI) separating the Crescent Dams A and B. Total length (TL) of fish was measured to nearest mm. The catch from the experimental gill nets describe the relative abundance and size of the fish assemblages in the Mohawk River near the transducer arrays with exception of small fishes and juvenile blueback herring which were only sampled by cast nets near Dam A and in the headrace.

Similarity in fish communities among channel locations was evaluated by first calculating a Bray-Curtis similarity index matrix (Clifford and Stephenson 1975) based on $\log_{10}(x+1)$-transformed CPUE using PRIMER version 5 software (Primer-E Ltd., Ivybridge, UK). A $\log_{10}(x+1)$ transformation was used to balance the weighting of the contribution of common and rare species in measures of similarity. Values of the indices ranged from 0 for absolute dissimilarity and 1 for absolute similarity. Differences in species community were based on analysis of similarity using the Bray-Curtis similarity index matrices (ANOSIM, Clarke 1993). Differences in total CPUE from the experimental gillnet were tested by analysis of variance (α=0.05) after transforming the data with a $\log_{10}(x+1)$ transformation. The multi-modal length distributions of fish caught in the experimental gillnet were compared among sites by multiple pair-wise comparisons using the non-parametric Kolmogorov-Smirnov two-sample test with a

Bonferroni correction (α=0.05/6 =0.008) to reduce Type I error. Juvenile blueback herring length distributions were also not normal and were compared using the Kolmogorov-Smirnov two-sample test (α=0.05). Length-frequency distributions were also converted to target strength (TS) distributions at 420 kHz based on TL-TS relationship at multiple aspects derived from an aggregated data set of multiple species (Love 1977).

Results and Discussion

Mean CPUE at DM was significantly greater than mean CPUE at DS and BI, but not UM (Appendix Table H-1). Shorthead redhorse was the most abundant fish at BI and DS sites followed by common carp at BI and walleye at DS (Appendix Table H-1). No shorthead redhorse were caught at DM. Common carp was the most abundant fish at DM followed by golden shiner. At the UM site, gizzard shad followed by common carp were the most abundant fish. Gizzard shad at UM (n=1) and DM (n=6) were also the only species caught in the small mesh gill net. The fish communities at DM and UM were not significantly different, but both were significantly different from the fish community at DS. The fish community at BI was significantly different compared to the fish community at DS and DM, but not UM. Diversity was greater at BI than at DS, but shorthead redhorse, walleye, and yellow perch were more abundant at DS.

Length-frequency distributions for the total experimental gillnet catch and at each site were multi-modal reflecting the different species and mesh sizes in the panels (Appendix Figures H-2 and H-3). The length-frequency distribution of the experimental gillnet were significantly different between BI and DM, BI and UM, DS and DM, and DS and DM. Of the 391 juvenile blueback herring caught by cast nets during the study, 335 were measured with a mean total length of 73 ± 0.5 mm (±95% C.I.; Appendix Figure H-4). Length-frequency distribution of juvenile blueback herring caught in headrace (median= 75 mm TL) were significantly different than the length-frequency distribution of juvenile blueback herring caught near Dam A (median=72 mm TL; Appendix Figure H-4).

The theoretical average TS distribution based on length distributions of fish caught in the experimental gill nets were derived for multiple aspects (±15°) at the DM, DS, and UM sites. These TS distributions were presented for the entire experimental gillnet catch in Appendix Figure H-5. The median side-aspect theoretical TS was -35.4 dB at DM, -32.4 dB at DS, and -36.4 dB at UM (Appendix Figures H-6 to H-8). The median theoretical ventral-aspect TS was -37.3 dB at DM, -34.2 dB at DS, and -38.3 dB at UM. The median dorsal-aspect TS was -37.0 dB at DM, -34.0 dB at DS, and -38.0 dB at UM. Tail-aspect TS was the minimum TS to be expected based on length distributions with median TS of -52.2 dB at DM, -49.5 dB at DS, and -53.1 dB at UM. The theoretical TS distribution of juvenile blueback herring, based on their length distribution and the TL-TS relation of Love (1977; Appendix Figure H-9), indicates that individual juvenile blueback herring insonified at tail or head aspect would not be detected as a result of being below the data collection amplitude threshold. The TS distribution based on length distribution of juvenile blueback herring caught by cast net near Dam A and in the headrace was shown in Appendix Figure H-10.

Based on the results from ANOSIM and comparisons of length-frequency distributions of the catch from gill nets, the assumption of similar fish community structure among the acoustically-sampled channels was not valid except between DM and UM. As a result of having a different species composition at DS compared to DM and UM, fish density and abundance estimates derived from echo integration should not be used as a relative index of juvenile blueback herring for comparing juvenile blueback herring between DS and the other two sampled sites.

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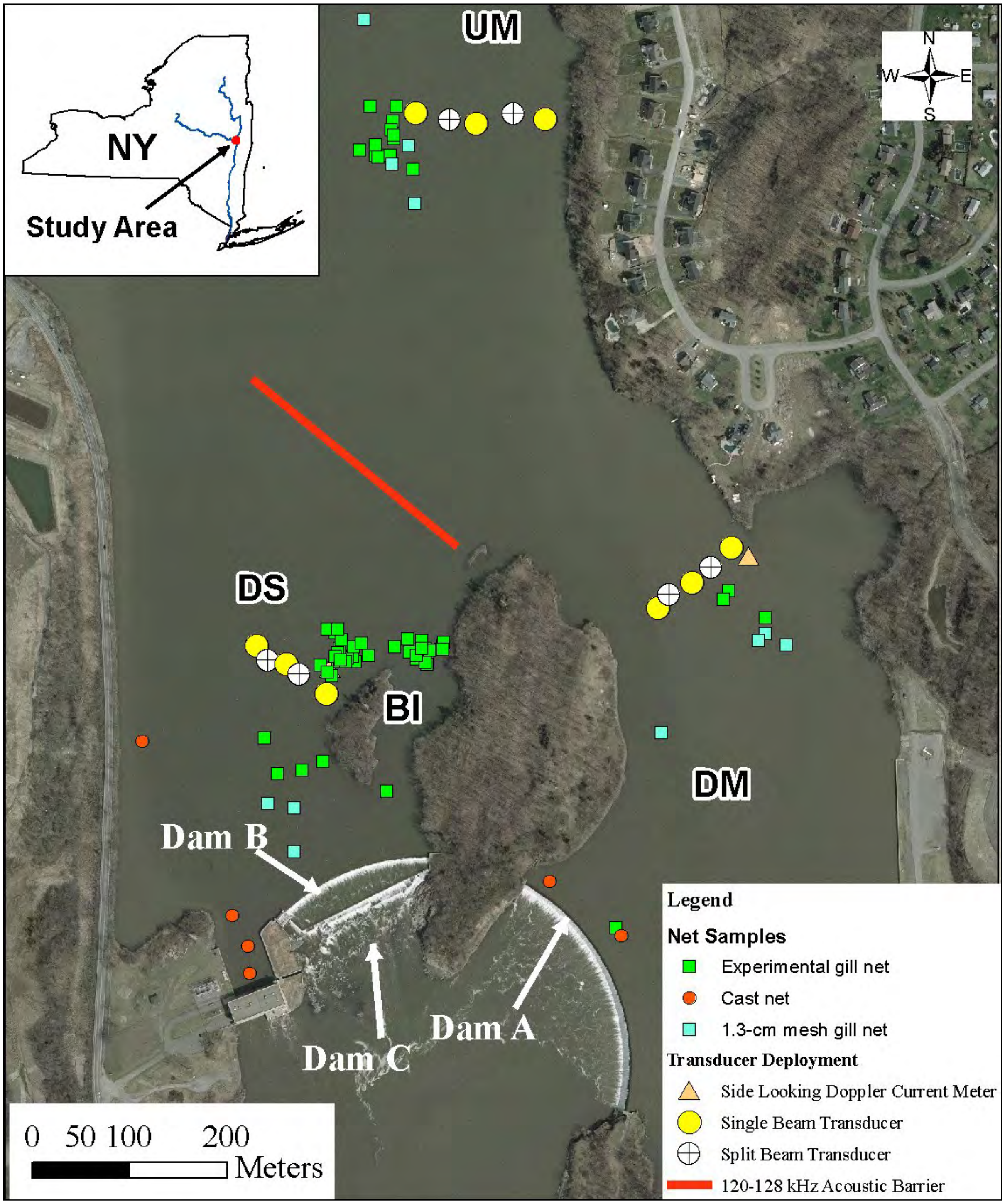
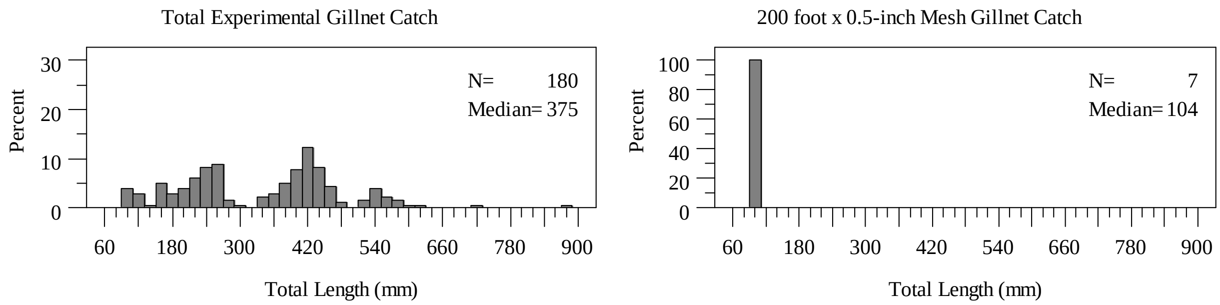
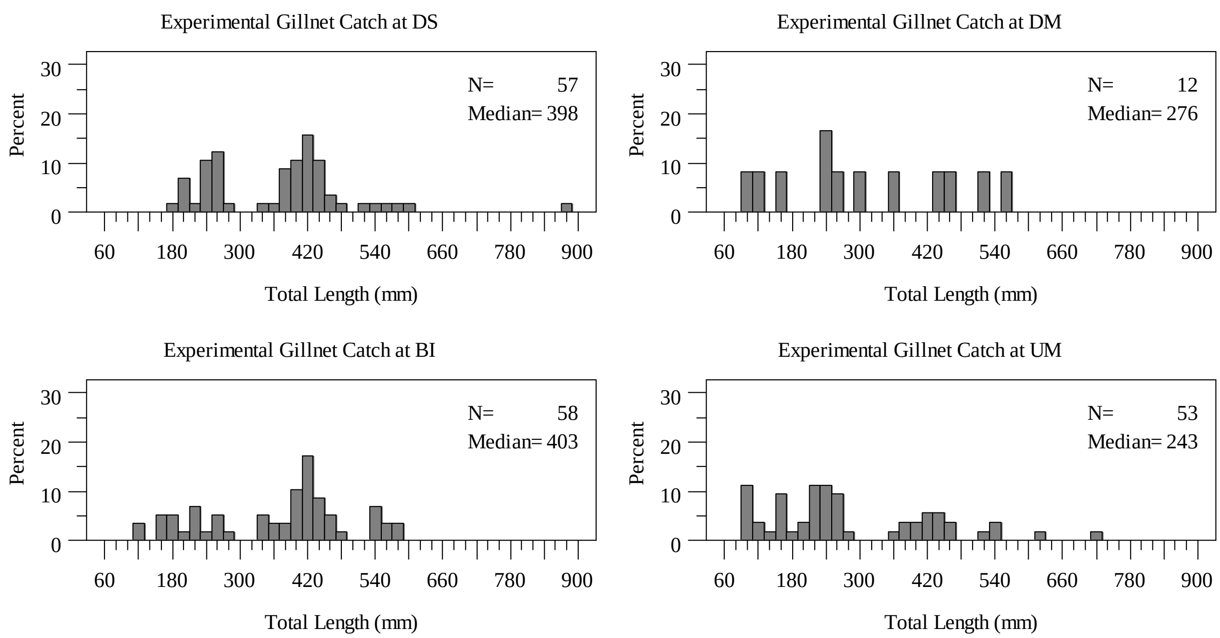


APPENDIX FIGURE H-1.—Map of the net sampling locations for direct sampling of the fish communities during fixed-location, hydroacoustic monitoring of migrating juvenile blueback herring at the Crescent Hydroelectric Project on the Mohawk River from 30 August through 5 October 2008.

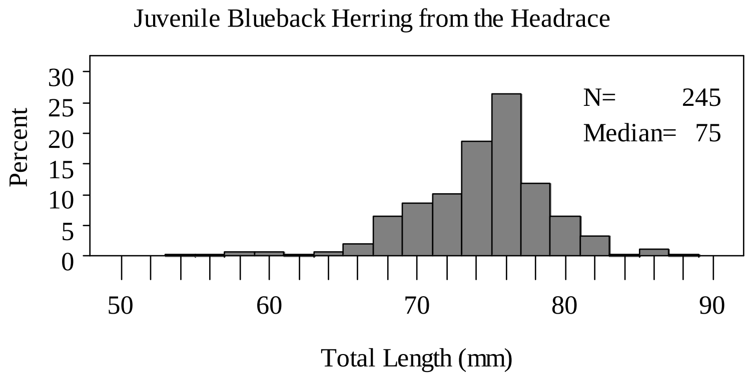


APPENDIX FIGURE H-2.—Relative length-frequency distribution of all fishes caught in the 45.7-m (150-ft) long x 2.4-m (8-ft) high experimental gill net (left) and 1.3-cm (0.5-inch) mesh x 61 m (200 ft) x 2.4 m (8 ft) gill net.

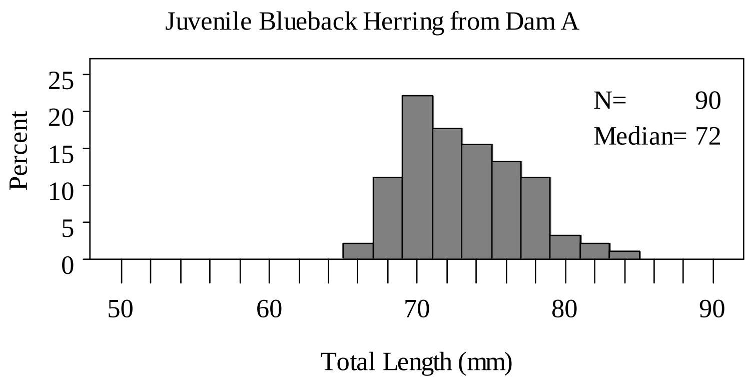


APPENDIX FIGURE H-3.—Relative length-frequency distribution of all fishes caught in the 45.7-m (150-ft) long x 2.4-m (8-ft) high experimental gill net from downriver of the ultrasonic system in the side channel (DS), main channel (DM), and between the two islands (BI), and upstream of the ultrasonic system in the main channel (UM).

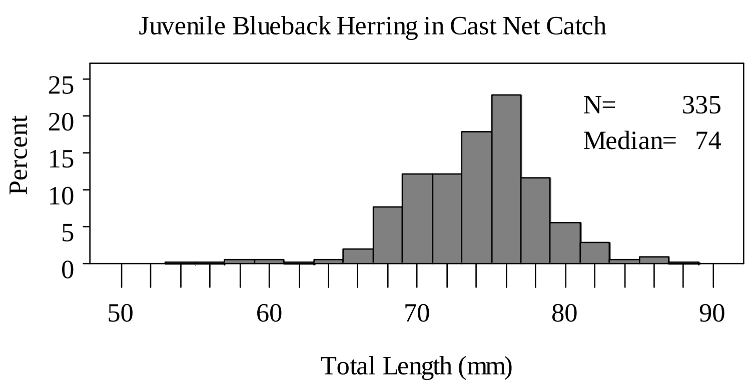
A



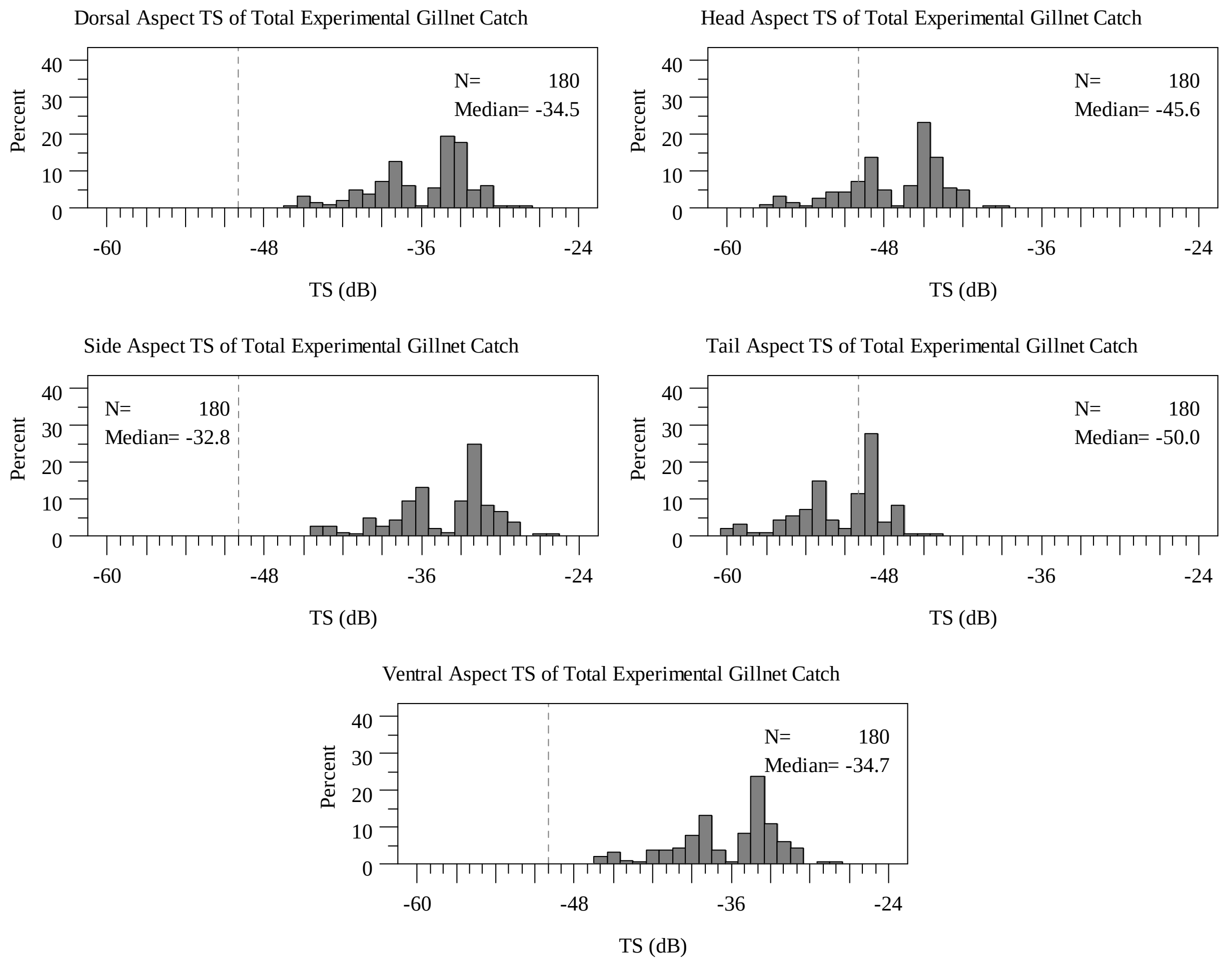
B



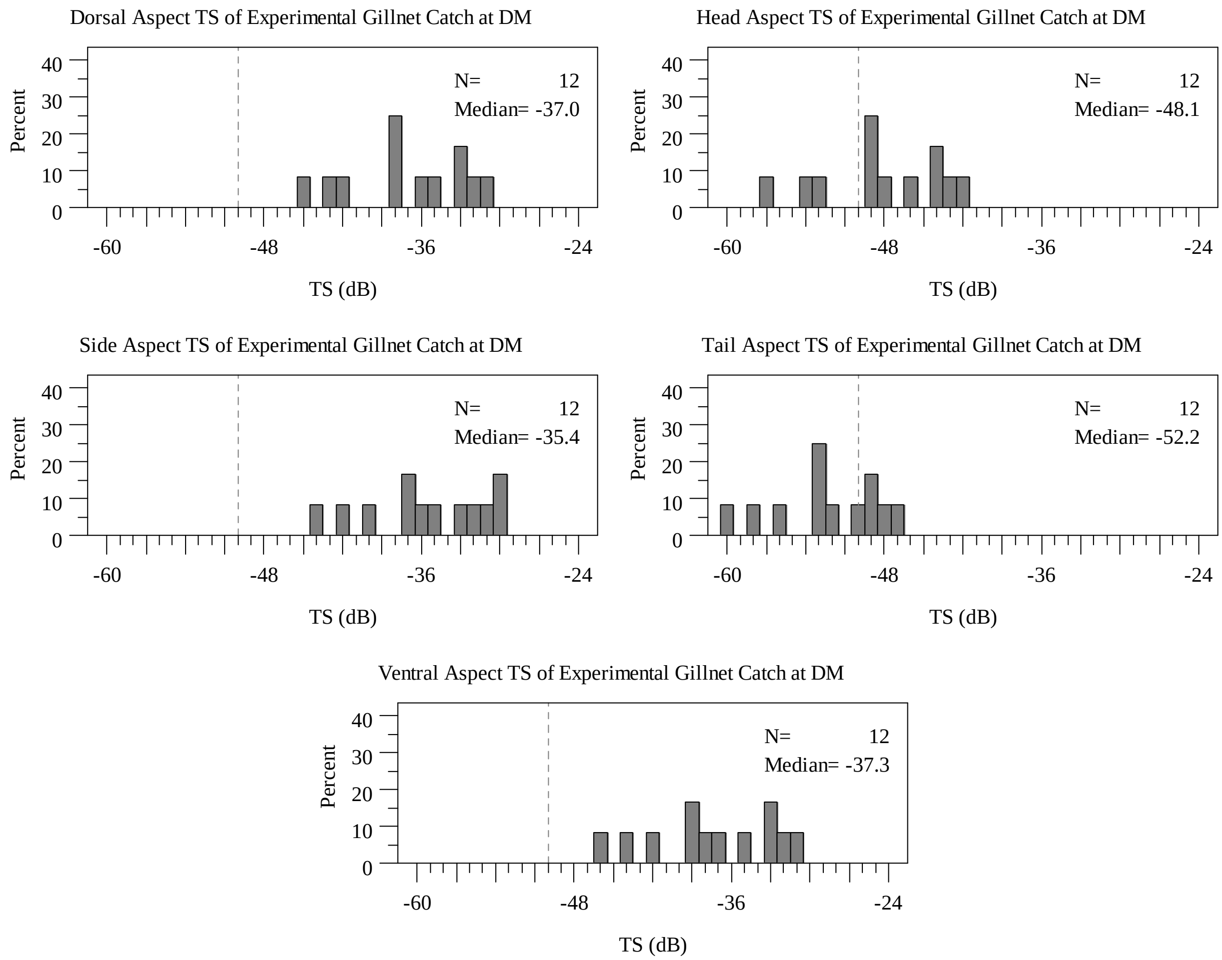
C



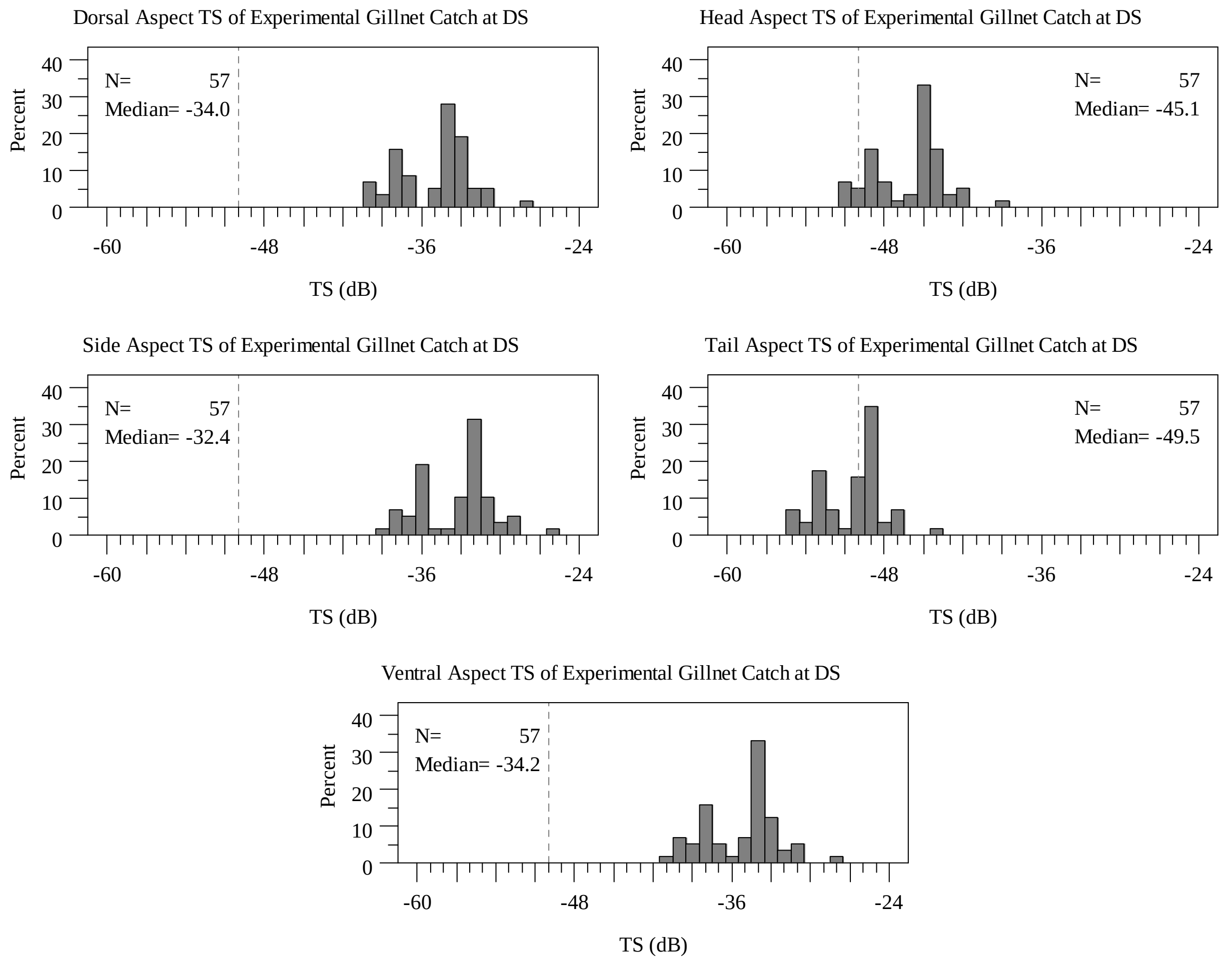
APPENDIX FIGURE H-4.—Relative length-frequency distribution of all juvenile blueback herring caught in cast nets from the headrace (A), near Dam A (B), and combined catch (C).



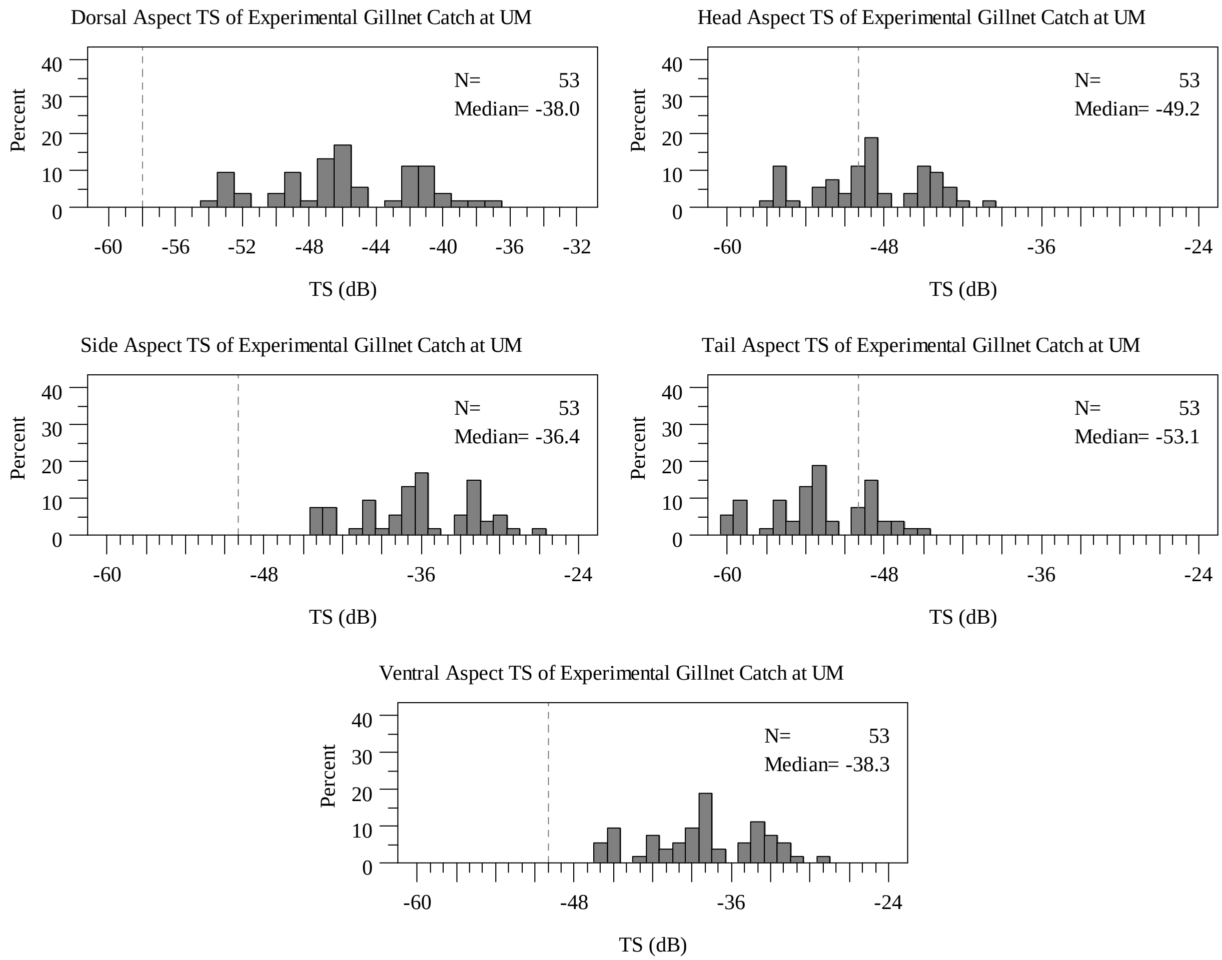
APPENDIX FIGURE H-5.—Relative frequency distribution of target strength derived from all aspects (Love 1977) based on total length of fish caught in experimental gill nets fished at all sites.



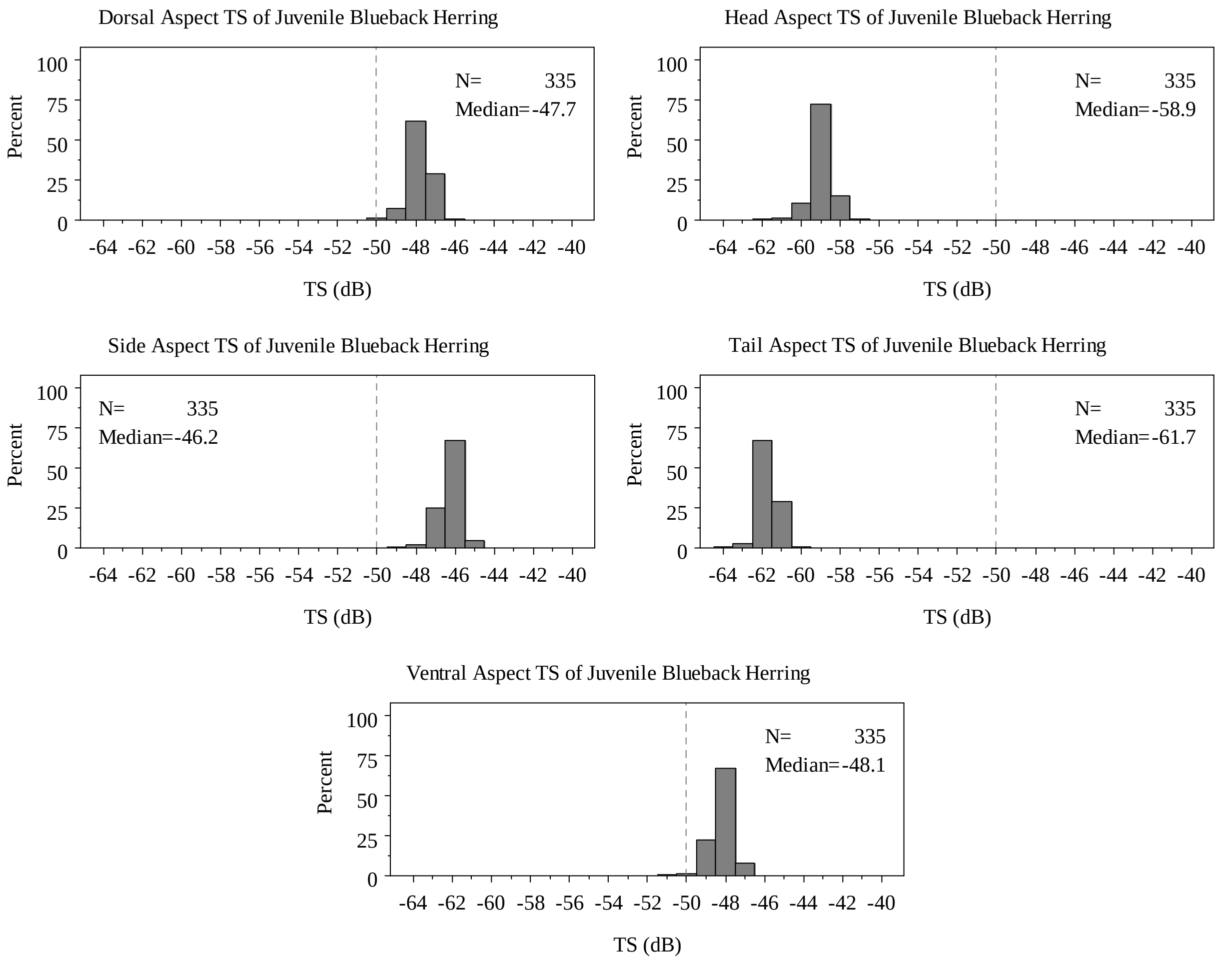
APPENDIX FIGURE H-6.—Relative frequency distribution of target strength derived from all aspects (Love 1977) based on total length of fish caught in experimental gill nets fished in the main channel downriver of the ultrasonic system (DM).



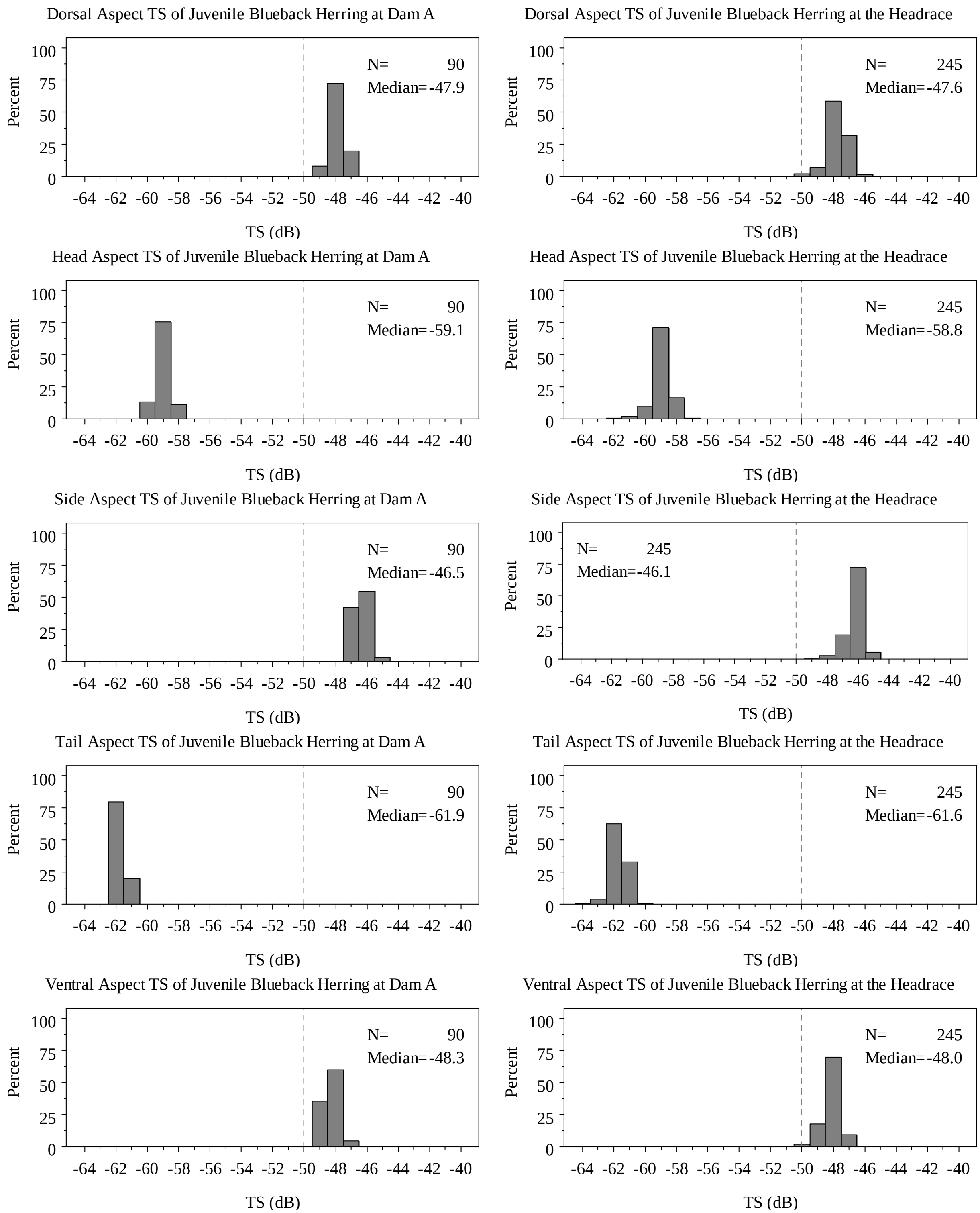
APPENDIX FIGURE H-7.—Relative frequency distribution of target strength derived from all aspects (Love 1977) based on total length of fish caught in experimental gill nets fished in the secondary channel downriver of the ultrasonic system (DS).



APPENDIX FIGURE H-8.—Relative frequency distribution of target strength derived from all aspects (Love 1977) based on total length of fish caught in experimental gill nets fished in the main channel upriver of the ultrasonic system (UM).



APPENDIX FIGURE H-9.—Relative frequency distribution of target strength of juvenile blueback herring derived from all aspects (Love 1977) based on total length of fish caught in the cast net fished at Dam A and in the headrace combined.



APPENDIX FIGURE H-10.—Relative frequency distribution of target strength of juvenile blueback herring derived from all aspects (Love 1977) based on total length of fish caught in the cast net fished at Dam A (left) and in the headrace (right).

APPENDIX TABLE H-1.—Total catch, mean catch per unit effort (CPUE), mean percent composition, and length statistics of fish caught in the 150-ft experimental gill net at sites between the two islands (BI), downstream of the ultrasonic system in the secondary channel (DS) and main channel (DM), and upstream of the ultrasonic system in the main channel (UM).

Site Common name	Scientific name	Catch statistics Total catch	CPUE (fish/h)	±95% C.I.	%	Total length (mm) n	Mean	±95% C.I.	Min.	Max.
Between the islands (n=25)										
Brown bullhead	*Ameiurus nebulosus*	2	<0.1	0.1	3.6	2	347	19	345	348
Common carp	*Cyprinus carpio*	8	0.1	0.1	13.8	8	553	15	531	578
Gizzard shad	*Dorosoma cepedianum*	5	0.1	0.1	8.7	5	281	149	165	450
Largemouth bass	*Micropterus salmoides*	2	<0.1	0.1	3.5	2	296	921	223	368
Logperch	*Percina caprodes*	2	<0.1	<0.1	2.9	2	119	83	112	125
Pumpkinseed	*Lepomis gibbosus*	4	0.1	0.1	6.9	4	186	35	167	217
Shorthead redhorse	*Moxostoma macrolepidotum*	23	0.4	0.3	39.7	23	401	27	240	478
Smallmouth bass	*Micropterus dolomieu*	3	0.1	0.1	5.2	3	392	79	357	418
Tessellated darter	*Etheostoma olmstedi*	1	<0.1	<0.1	1.7	1	150		150	150
Walleye	*Sander vitreus*	1	<0.1	<0.1	1.8	1	380		380	380
White sucker	*Catostomus commersonii*	5	0.1	0.1	8.8	5	349	143	220	438
Yellow perch	*Perca flavescens*	2	<0.1	0.1	3.4	2	241	521	200	282
All species		58	1.0	0.4	100.0	58	366	33	112	578
Downstream main channel (n=4)										
Blueback herring	*Alosa aestivalis*	1	0.3	0.9	8.9	1	257		257	257
Brown bullhead	*Ameiurus nebulosus*	1	0.3	1.0	10.4	1	350		350	350
Channel catfish	*Ictalurus punctatus*	1	0.1	0.4	4.1	1	436		436	436
Common carp	*Cyprinus carpio*	4	1.1	2.9	35.2	4	458	188	294	560
Freshwater drum	*Aplodinotus grunniens*	1	0.1	0.4	4.1	1	98		98	98
Golden shiner	*Notemigonus crysoleucas*	2	0.6	1.9	19.1	2	235	19	233	236
Pumpkinseed	*Lepomis gibbosus*	1	0.3	0.9	8.9	1	127		127	127
White crappie	*Pomoxis annularis*	1	0.3	0.9	9.6	1	155		155	155
All species		12	3.1	2.5	100.0	12	310	98	98	560
Downstream secondary channel (n=30)										
Common carp	*Cyprinus carpio*	5	0.1	0.1	8.0	5	332	148	230	511
Freshwater drum	*Aplodinotus grunniens*	2	0.1	0.2	9.5	2	462	254	442	482
Largemouth bass	*Micropterus salmoides*	1	<0.1	<0.1	1.9	1	412		412	412
Pumpkinseed	*Lepomis gibbosus*	1	<0.1	<0.1	1.4	1	186		186	186
Rock bass	*Ambloplites rupestris*	1	<0.1	<0.1	1.6	1	191		191	191
Shorthead redhorse	*Moxostoma macrolepidotum*	33	0.5	0.2	53.0	31	370	29	242	460
Smallmouth bass	*Micropterus dolomieu*	2	<0.1	<0.1	3.0	2	263	864	195	331
Tiger muskellunge	*Esox lucius x masquinongy*	1	<0.1	<0.1	1.6	1	870		870	870
Walleye	*Sander vitreus*	8	0.1	0.1	11.7	8	479	80	372	594
Yellow perch	*Perca flavescens*	5	0.1	0.1	8.2	5	225	35	195	268
All species		59	1.0	0.4	100.0	57	372	33	186	870
Upstream main channel (n=13)										
Blueback herring	*Alosa aestivalis*	7	0.3	0.6	12.5	7	231	36	145	254
Brown bullhead	*Ameiurus nebulosus*	2	0.1	0.1	3.4	2	330	705	274	385
Common carp	*Cyprinus carpio*	8	0.3	0.2	14.2	7	398	161	176	616
Freshwater drum	*Aplodinotus grunniens*	2	0.1	0.2	4.6	2	397	64	392	402
Gizzard shad	*Dorosoma cepedianum*	15	0.6	0.6	27.9	15	188	75	97	457
Golden shiner	*Notemigonus crysoleucas*	4	0.1	0.2	7.1	4	212	17	196	220
Largemouth bass	*Micropterus salmoides*	2	0.1	0.1	3.4	2	496	2891	268	723
Shorthead redhorse	*Moxostoma macrolepidotum*	8	0.3	0.3	12.8	6	396	75	262	463
Walleye	*Sander vitreus*	2	0.1	0.1	3.5	2	444	997	365	522
White bass	*Morone chrysops*	1	<0.1	0.1	1.7	1	162		162	162
Yellow perch	*Perca flavescens*	5	0.2	0.3	8.8	5	220	17	205	239
All species		56	2.0	1.2	100.0	53	284	41	97	723

Appendix I – Geostatistical Analysis of Bathymetric Data at the Crescent Hydroelectric Project

Bathymetric maps of the survey area at Crescent Hydroelectric Project were developed from geostatistical analysis of acoustic backscatter from the river bed collected by a 420-kHz split-beam echosounder (HTI Model 243) on 20 September 2008. Bottom echoes were manually detected from the echograms in Echoscape version 2.12 Build 12 (HTI, Seattle, WA, USA). Latitude and longitude coordinates from a Garmin GPS Model 76C (Garmin, Olathe, Kansas, USA) with WAAS DGPS correction were integrated with the acoustic data in DEP version 3.56 data acquisition software (HTI). At a vessel speed of approximately 1.5 m/s and a ping rate of 5 Hz, 5,717 bottom echoes were detected with 2,861 bottom echoes with redundant positions. Depth was averaged among echoes with the same coordinates providing 2,856 geostatistical bathymetric data points.

Geostatistical analysis was used to model the spatial (auto) correlation and variability of the bathymetric data for spatial interpolation using spatial statistical packages in R (R Development Core Team, 2008). Data were projected using the Mercator projection to provide a coordinate system that was distance and angle preserving. The origin was shifted to the most southwest data point and converted to kilometers (Appendix Figure I-1). The first step in the geostatistical analysis was to examine the stationarity condition of the data. A spatial stochastic process is strictly stationary if the probability distribution does not change from one location to another which is unrealistic for river bathymetry or fish abundance. Weak or second order stationarity assumes a process with a constant mean with a covariance defined as a function of distance and not location or direction (Schabenberger and Gotway 2005). Depth increased with increasing easting (x-direction) and data were bi-modally distributed (Appendix Figure I-2). To correct for trends in location, residuals from 1st- and 2nd-order polynomial equations on the spatial coordinates were examined (Appendix Figures I-3 and I-4). The 1st-order trend was defined as

$$\mu(s) = \beta_0 + \beta_1 s_x + \beta_2 s_y$$

where $s = s(x,y)$ is the two-dimensional Cartesian coordinate of the data point and β is the parameter coefficients for each term. The 2nd-order polynomial trend equation was defined as

$$\mu(s) = \beta_0 + \beta_1 s_x + \beta_2 s_y + \beta_3 (s_y)^2 + \beta_4 (s_y)^2 + \beta_5 s_x s_y$$

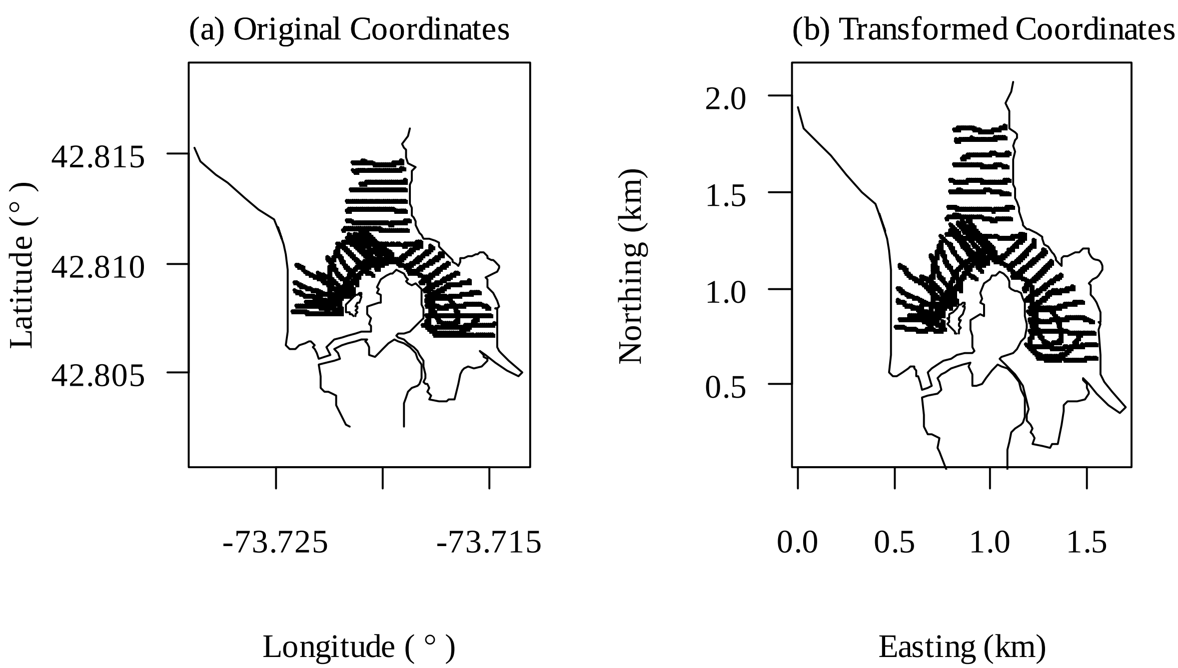
Exploratory residual plots led to the selection of a 2nd-order polynomial on the coordinates to detrend the data because the data were more randomly distributed with respect to easting or northing. Spatial dependencies that may develop differently in various directions (anisotropy) were examined using directional robust empirical semivariograms (Appendix Figure I-5). The presence of geometric anisotropy was indicated by the ratio (1.6:1) of the maximum correlation length at 120° to the correlation length at the perpendicular direction (Appendix Figure I-5). Because the 2nd-order polynomial trend equation didn't entirely remove the trend, geometric anisotropy may be detected when it is not truly present. Some direction-specific semivariograms are heavily influenced by the residual trend evidenced by the curve not reaching asymptote (sill). Directional semivariograms were fitted before and after transforming the spatial coordinates to correct the space for geometric anisotropy (Appendix Figures I-6 and I-7). Based on these directional semivariogram, the space correction appeared to have rotated the semivariogram patterns and did not remove the anisotropy. Because the deviation was not severe and bathymetry will be interpolated over short distances, robust empirical and fitted semivariograms were assuming an isotropic process for modeling the small-scale variation. Robust empirical semivariograms were fitted by weighted least squares with a matern semivariogram over several smoothing parameters (ν=0.5, 0.75, 1, and 2) and based on spherical and Gaussian covariance models (Appendix Figure I-8). A matern semivariogram with ν=2 was selected to describe the correlation between any two points.

The survey area was gridded by superimposing a 200 x 200 grid of points for spatial prediction of water depth (Appendix Figure I-9). Using the matern covariance model, 2nd-order spatial trend, and without anisotropic correction, bathymetry was predicted at the grid points using ordinary kriging and presented as a color surface map (Appendix Figures I-10 to I-12), depth contour map (Appendix Figure I-13) and a GIS study map (Appendix Figure I-14). The bathymetric maps clearly show the main channel to be deeper than the secondary channel. A GIS shapefile included elevation in feet (184.9 ft – water depth [ft]) referenced to the pond level at Crescent Dam B on 20 September 2009 as reported by the New York Power Authority.

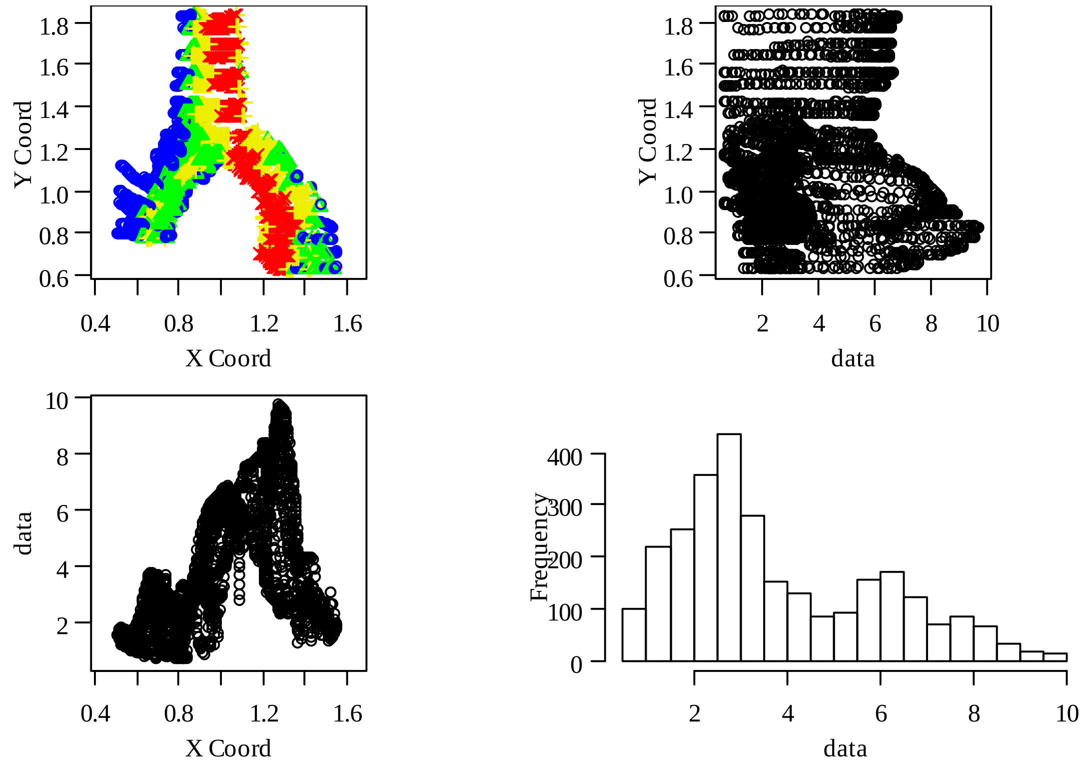
References

R Development Core Team. 2008. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria, www.R-project.org

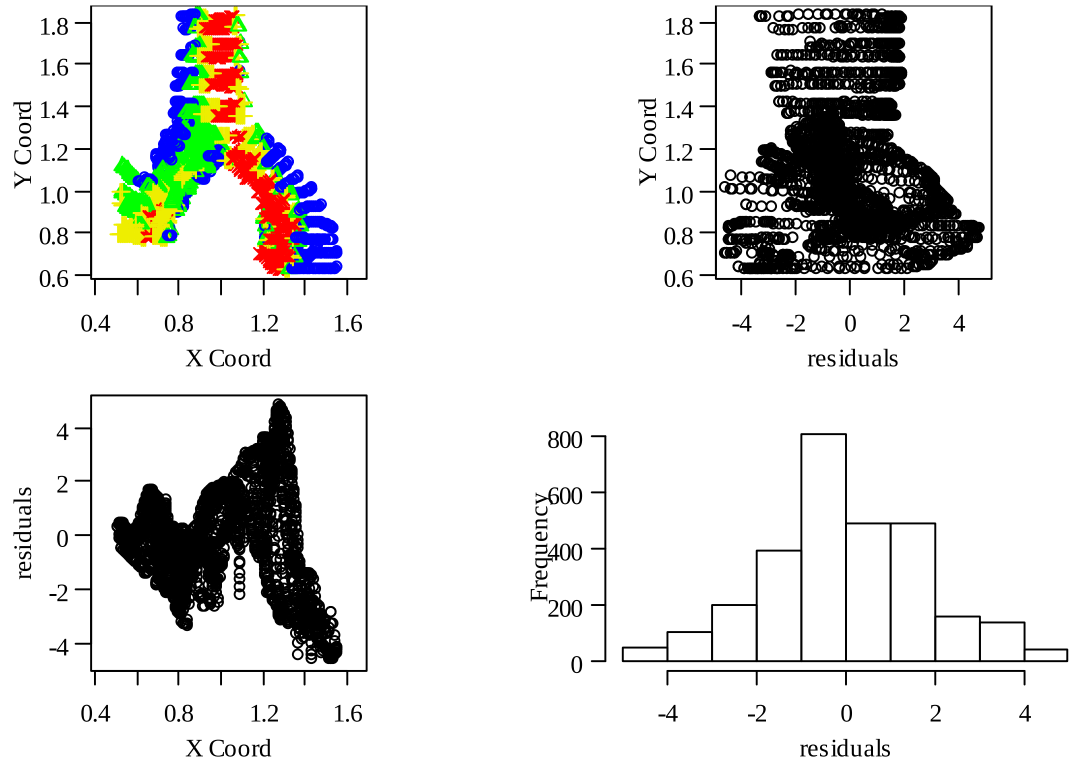
Schabenberger, O. and C.A, Gotway. 2005. Statistical Methods for Spatial Data Analysis. Chapman & Hall/CRC, Boca Raton, FL. p.488.



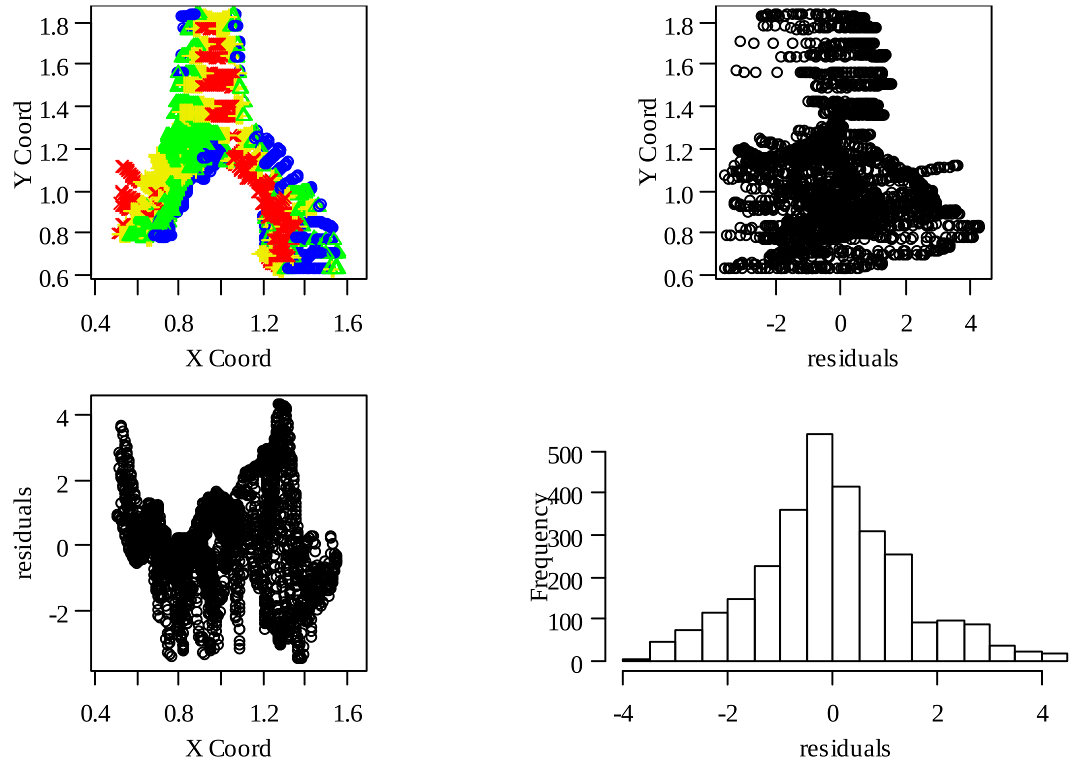
APPENDIX FIGURE I-1.—Locations of depth soundings from the 420-kHz split-beam echosounder were plotted in the (a) original coordinate system (WGS 1984) and (b) Mercator projection in km.



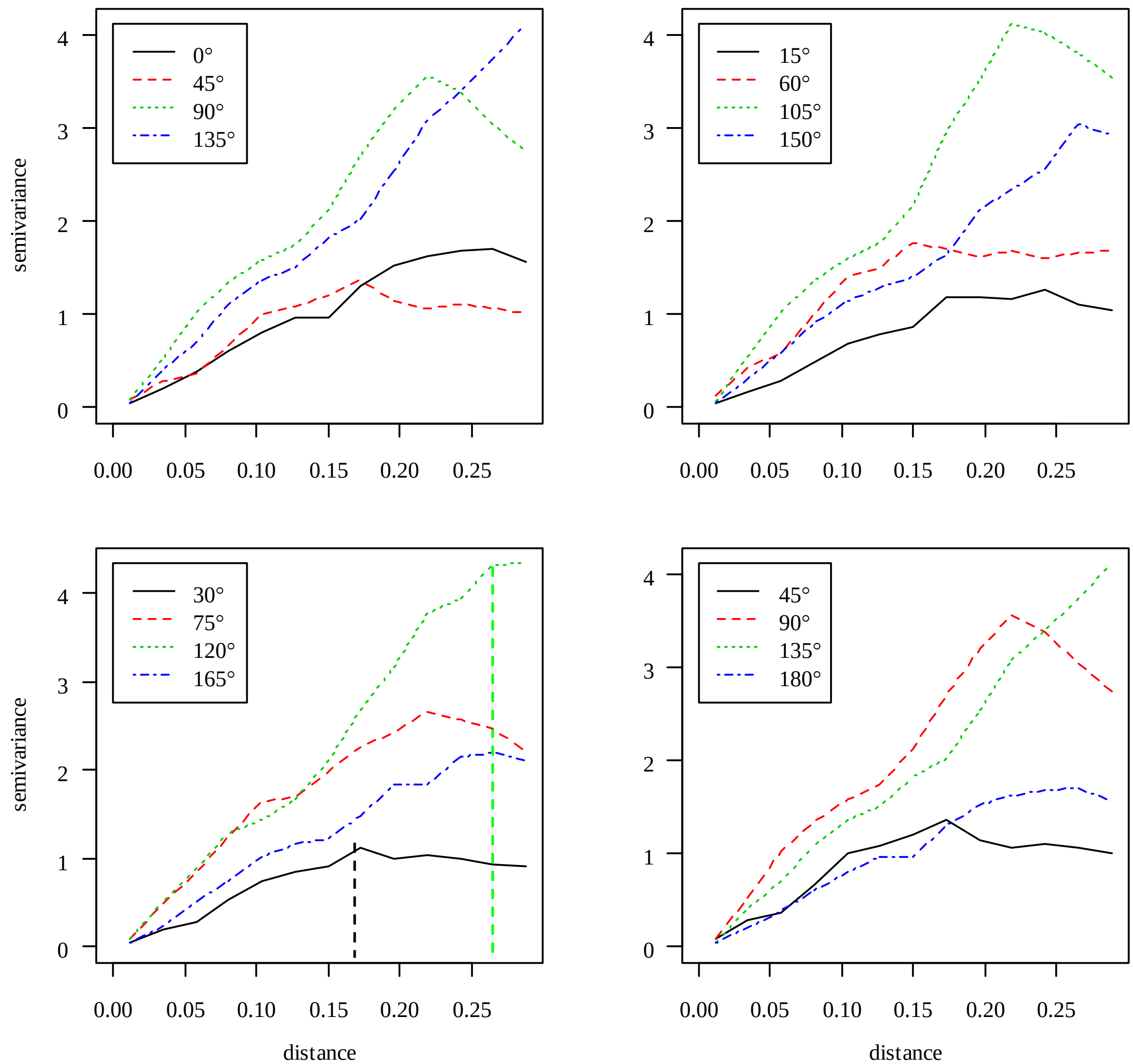
APPENDIX FIGURE I-2.—Plot of the geostatistical bathymetry data with colors proportional to different depths (m) (top left), relation between Northing (y) and depth (top right), relation between depth adn Easting (bottom left), and a histogram of the distribution of depths (bottom right) assuming a constant mean (no trend).



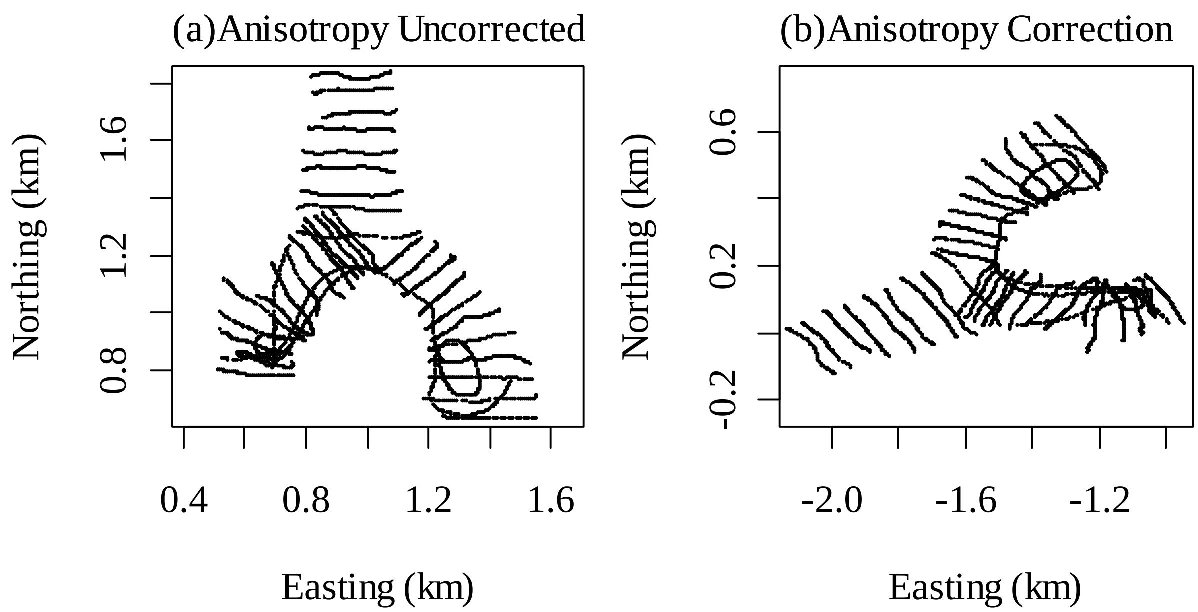
APPENDIX FIGURE I-3.—Plot of the depth residuals (m) from detrending the geostatistical bathymetry data assuming a 1st order polynomial relation on the spatial coordinates with colors proportional to quartiles (top left), relation between northing (y) and depth (top right), relation between depth and easting (bottom left), and a histogram of the distribution of the residuals (bottom right).



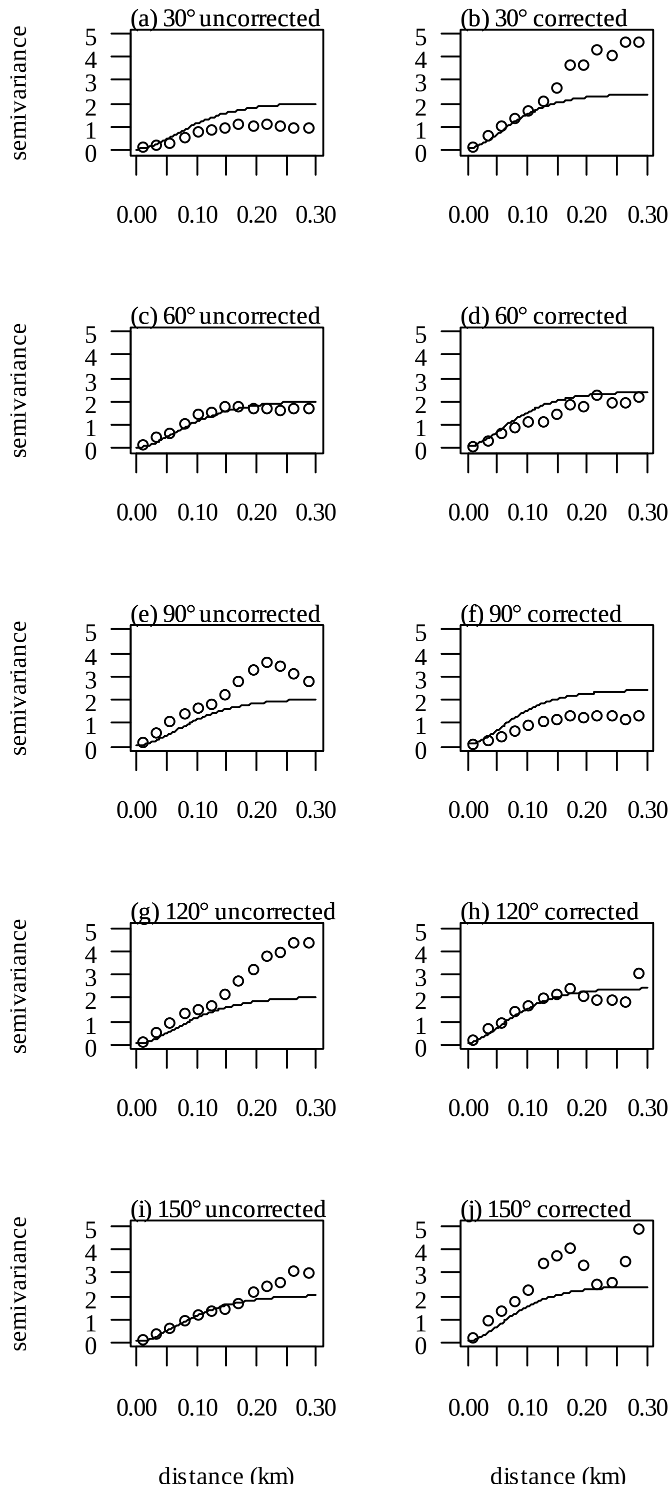
APPENDIX FIGURE I-4.—Plot of the depth residuals (m) from detrending the geostatistical bathymetry data assuming a 2nd order polynomial relation on the spatial coordinates with colors proportional to quartiles (top left), relation between northing (y) and depth (top right), relation between depth and easting (bottom left), and a histogram of the distribution of the residuals (bottom right).



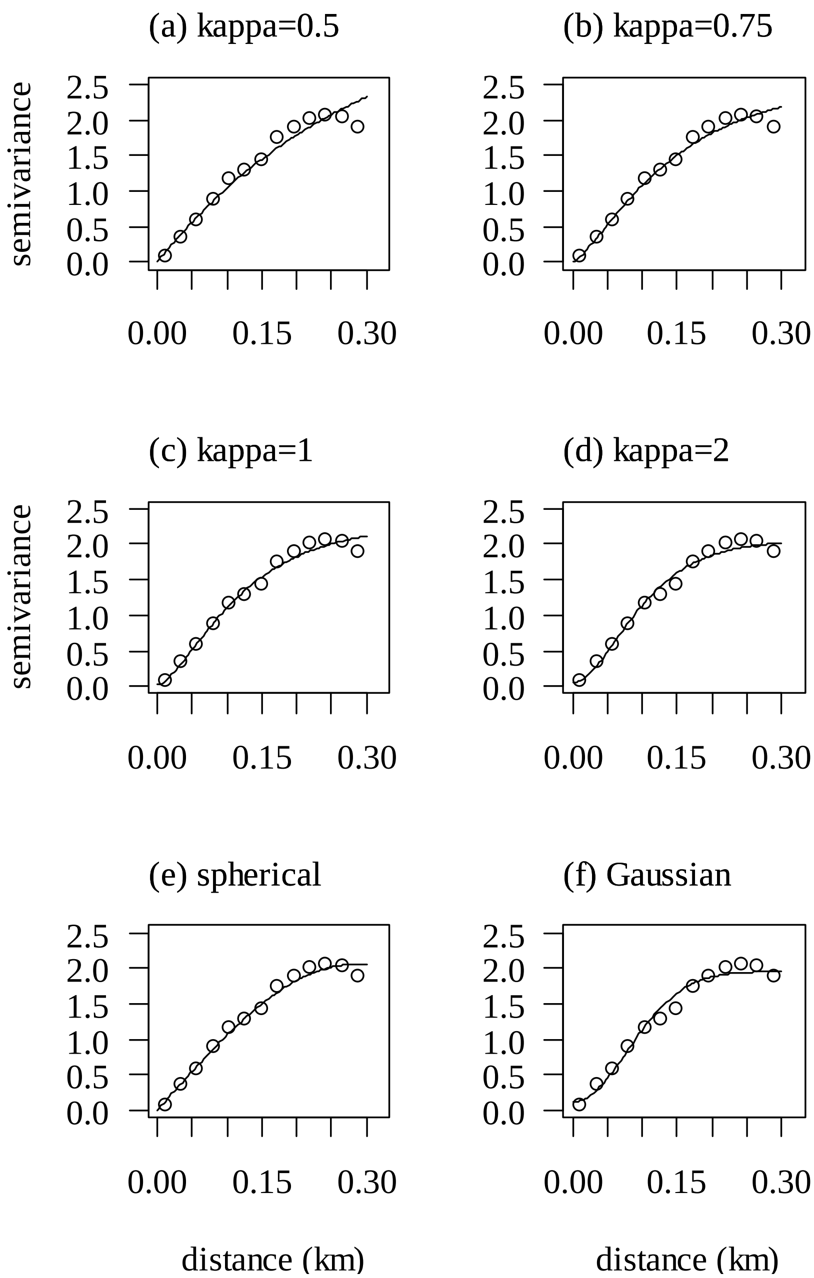
APPENDIX FIGURE I-5.—Detrended directional robust empirical semivariograms with 22.5° tolerance angle. The correlation length at 120° (black vertical dash line) is a ratio of about 3:1 to the correlation length (green vertical dash line) at a perpendicular direction (30°) indicating geometric anisotropy.



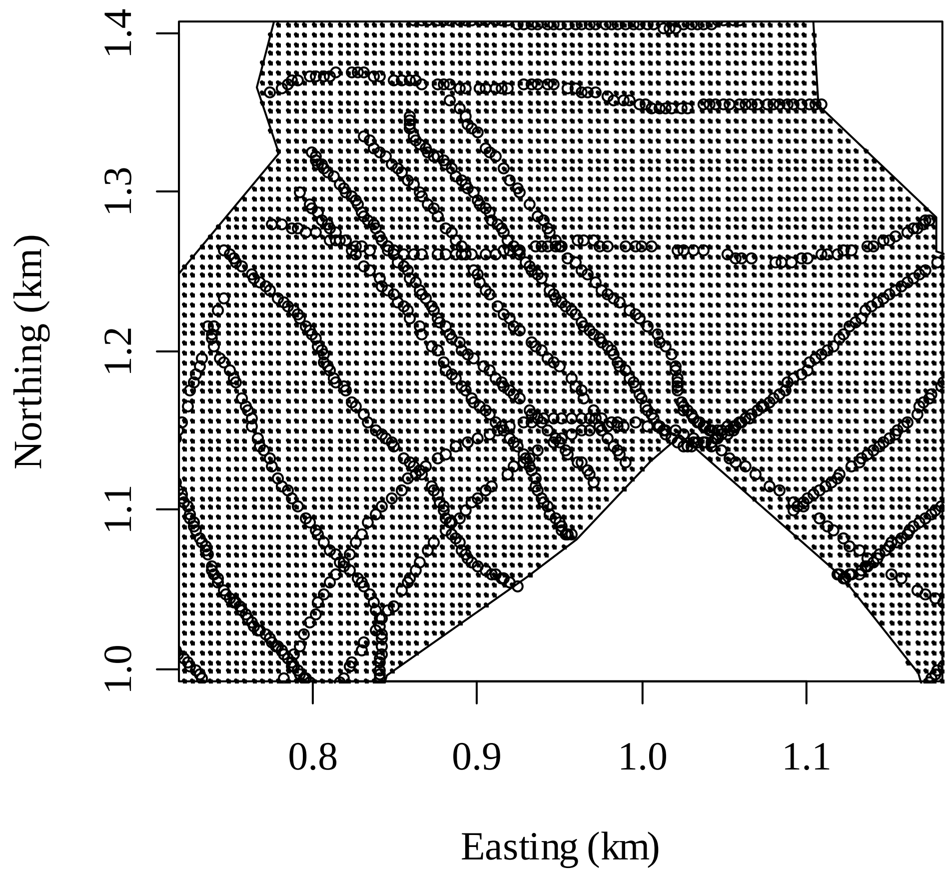
APPENDIX FIGURE I-6.—Two-dimensional space representing the depth sounding before (a) and after (b) correction of geometric anisotropy allowing for an isotropic semivariogram to be assumed.



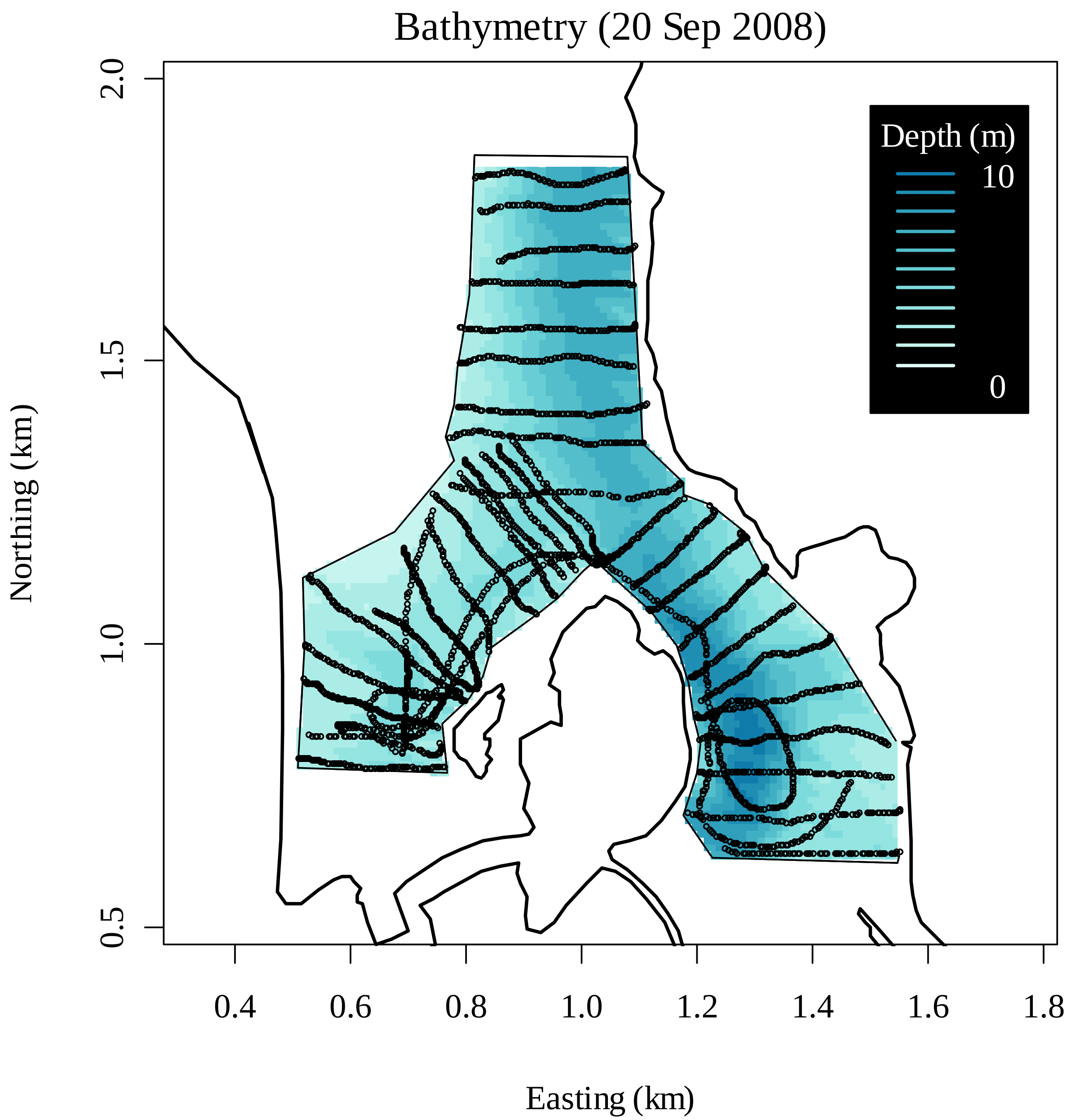
APPENDIX FIGURE I-7.—Robust empirical semivariograms (circles) of detrended depth soundings and fitted omnidirectional robust semivariogram models uncorrected and corrected for geometric anisotropy at (a and b) 30°, (c and d) 60°, (e and f) 90°, (g and h) 120°, and (i and j) 150° with matern covariance model (ν=2).



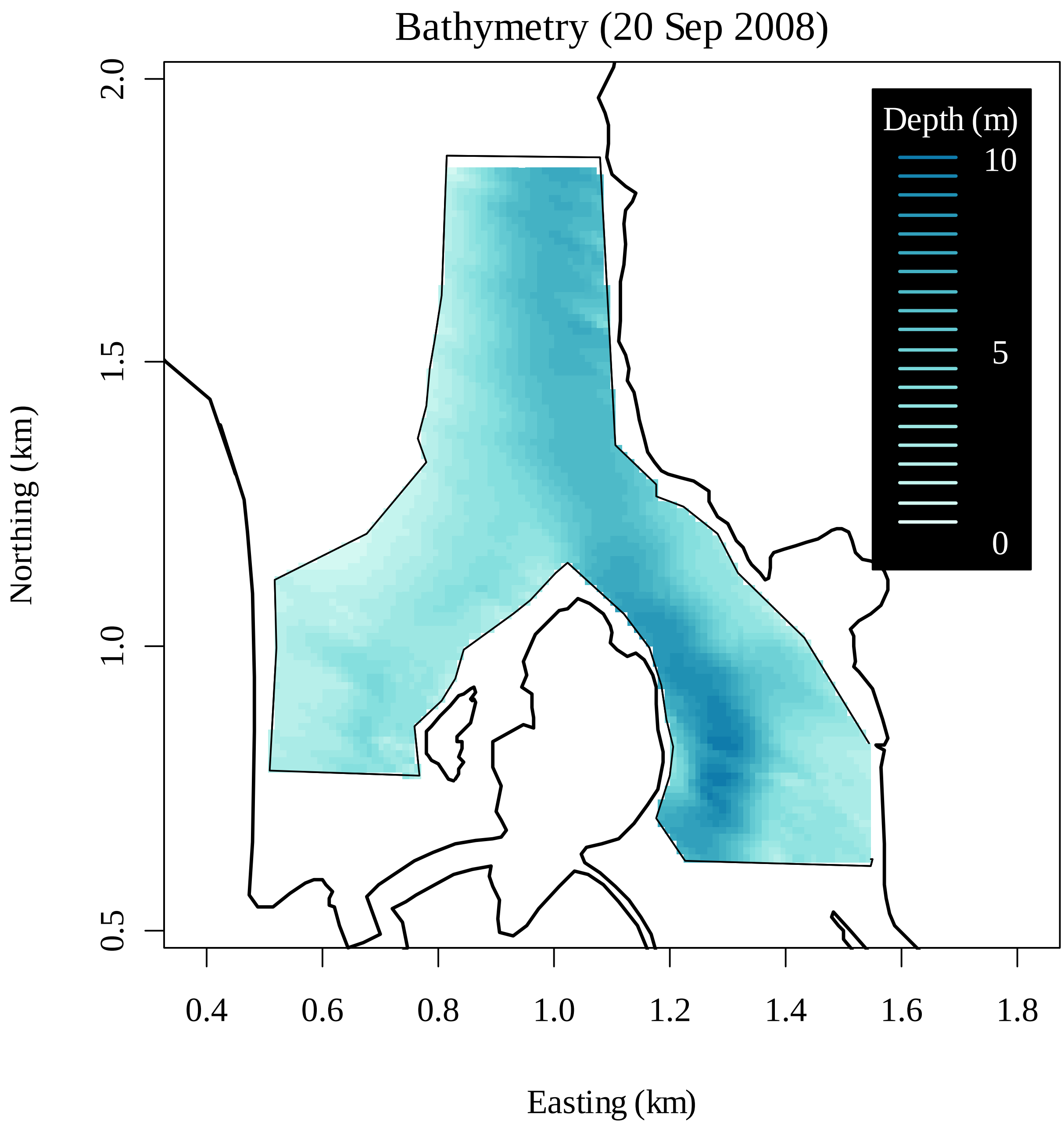
APPENDIX FIGURE I-8.—Omnidirectional robust empirical semivariograms of partially detrended depth soundings fitted with a matern covariance model with (a) ν=0.5 (=exponential covariance structure), (b) ν=0.75, (c) ν=1, (d) ν=2, (e) spherical covariance model, and (f) Gaussian covariance model assuming an isotropic process.



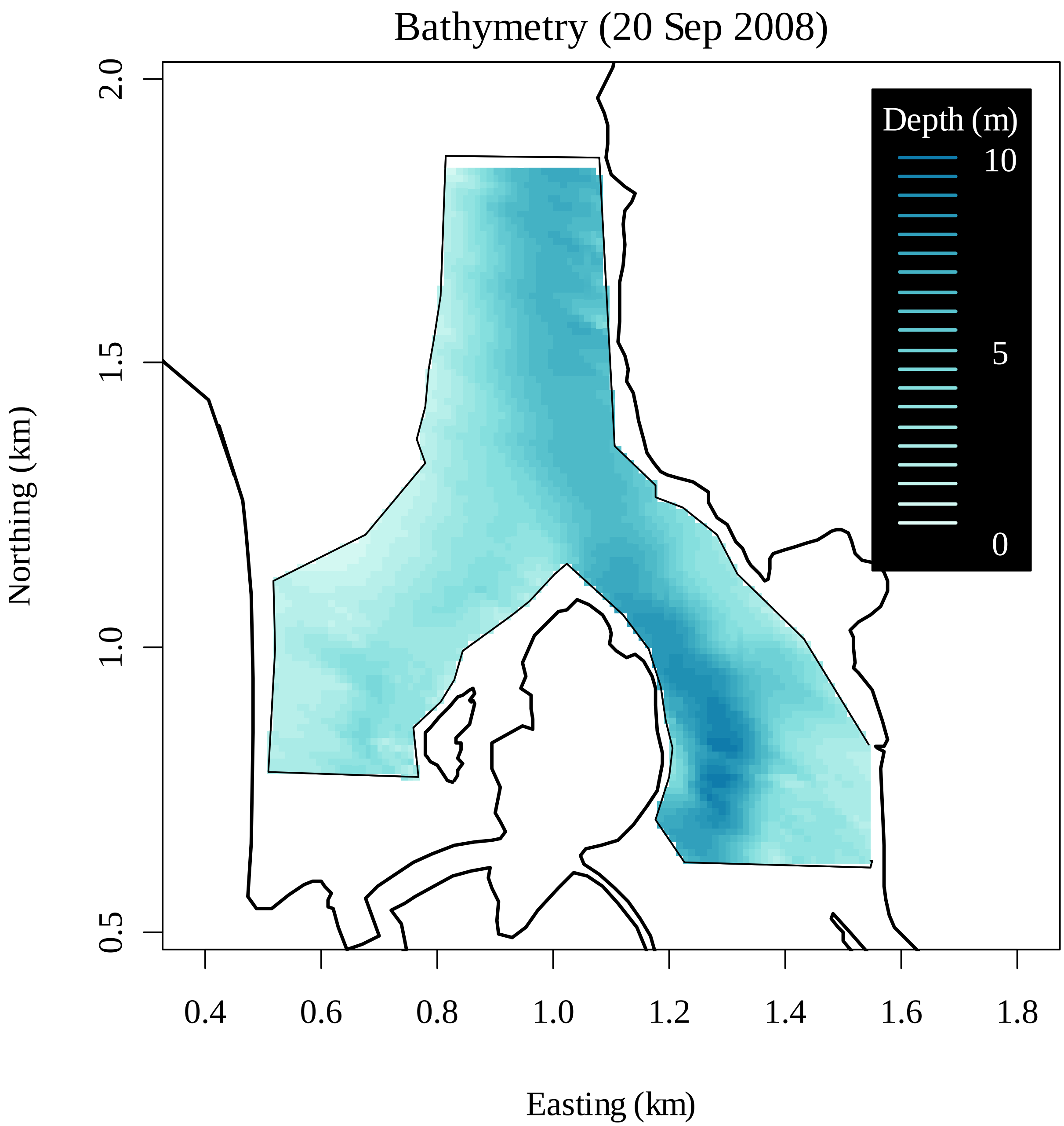
APPENDIX FIGURE I-9.—Plot of survey tracks and area with a 200 x 200 gridded points spaced 5.25 m in easting and 6.1 m in northing.



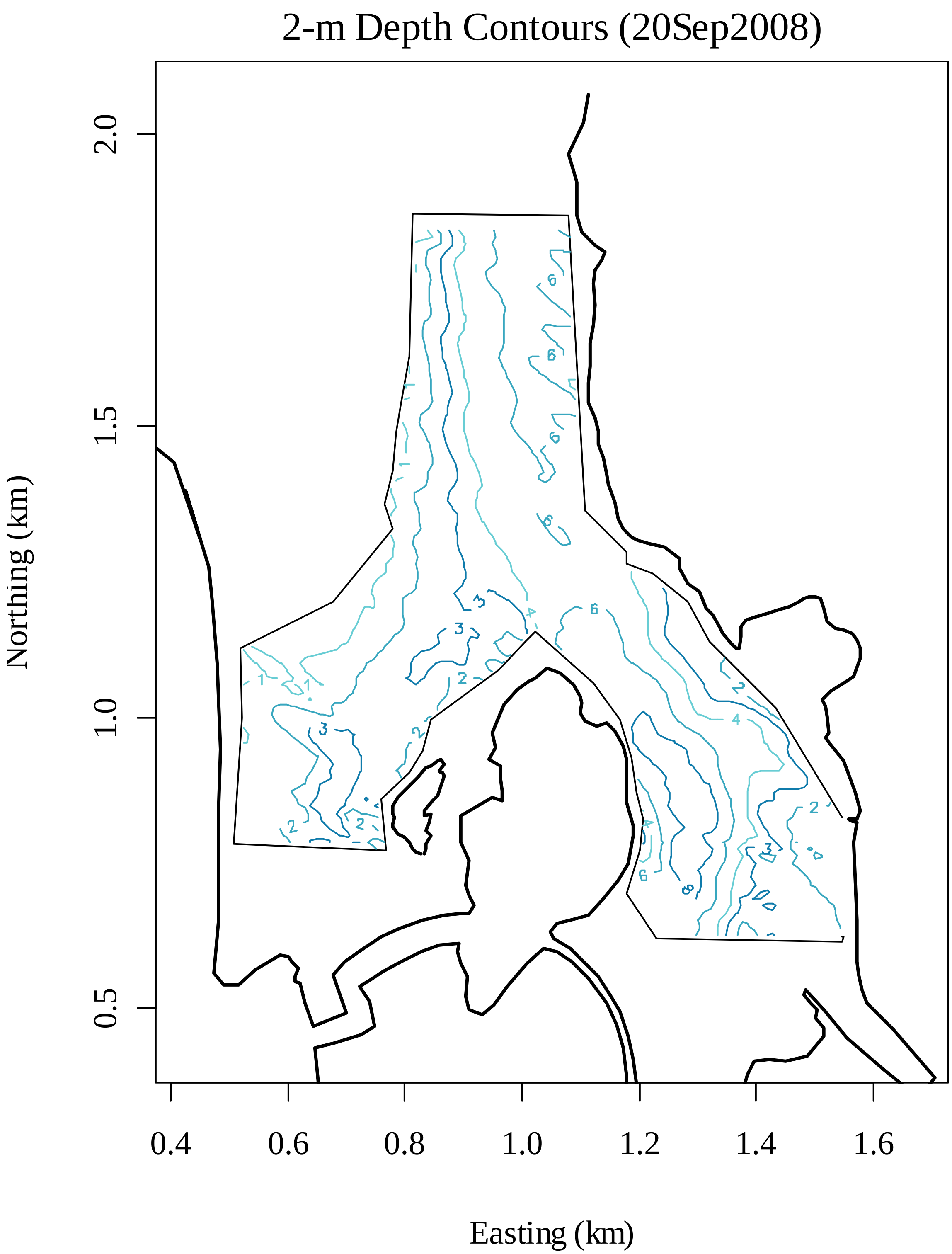
APPENDIX FIGURE I-10.—Bathymetry from ordinary kriging over 200 x 200 grid within the hydroacoustic survey area of the Mohawk River. Individual depth soundings displayed.



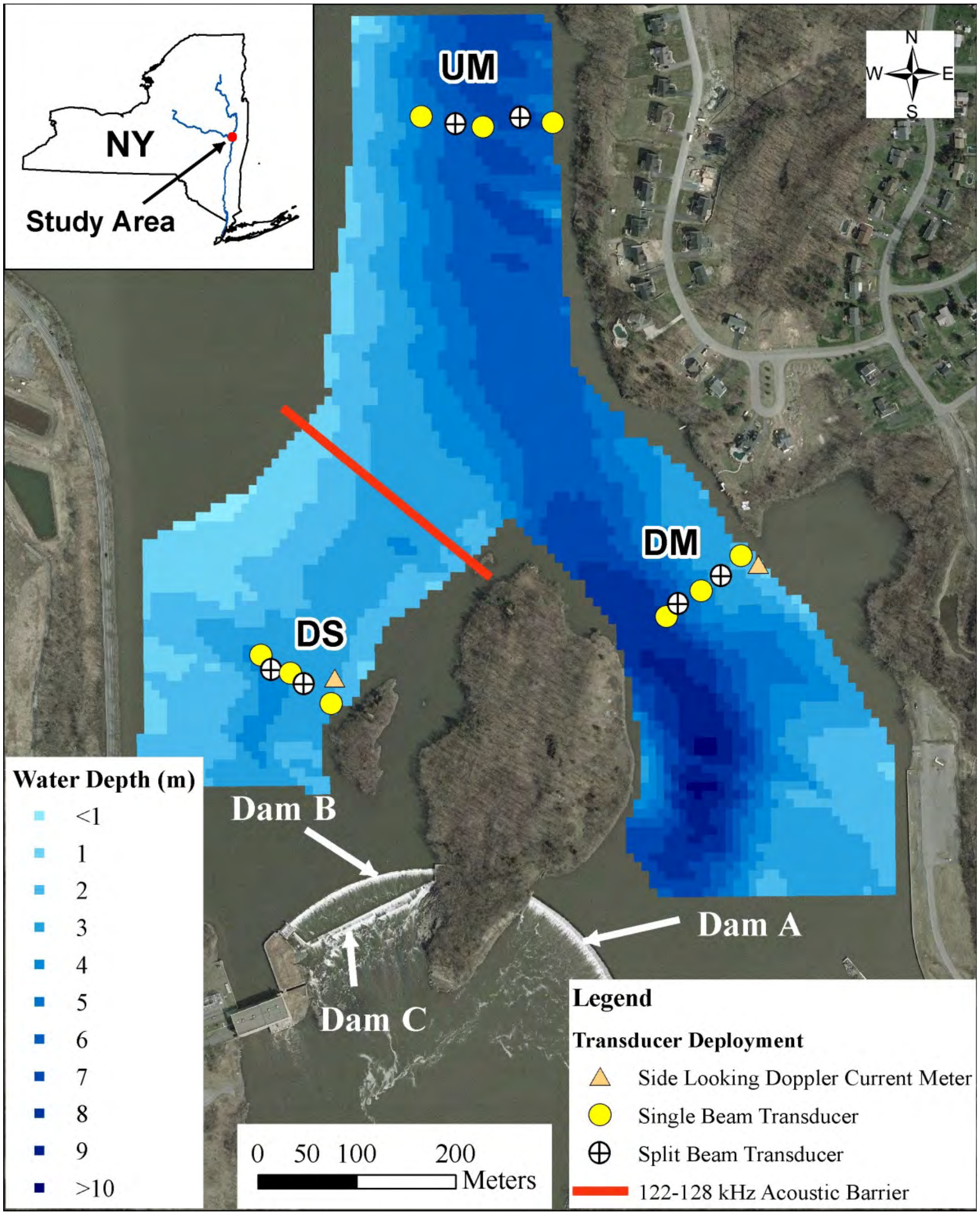
APPENDIX FIGURE I-11.—Bathymetry from ordinary kriging over 100 x 100 grid within the hydroacoustic survey area of the Mohawk River



APPENDIX FIGURE I-12.—Bathymetry from ordinary kriging over 100 x 100 grid within the hydroacoustic survey area of the Mohawk River using a fine scale color scale.



APPENDIX FIGURE I-13.—Depth contours based on ordinary kriging of depth soundings within the hydroacoustic survey area of the Mohawk River using a fine scale color scale.



APPENDIX FIGURE I-14.—Bathymetry at 1-m depth resolution imported into a GIS map based on ordinary kriging of depth soundings taken on 20 September 2008 within the mobile and fixed-location hydroacoustic survey area of the Mohawk River. UM=upstream of the ultrasonic system designed as an acoustic barrier to juvenile blueback herring passage in the main channel; DM = downstream of the ultrasonic system in the main channel; DS = downstream of the ultrasonic system in the secondary channel. Geostatistical modeling done in GeoR software.

Bureau of Fisheries
2009-10 Annual Report

State of New York
Department of
Environmental Conservation

2009-10 ANNUAL REPORT

Common Acronyms, Definitions and Units of Measure

Common Acronyms

ACOE: Army Core of Engineers

CPUE or CUE: catch per unit of effort - such as the number of fish caught per hour or fish caught per net.

DEC or NYSDEC: Department of Environmental Conservation.

DFWMR: Division of Fish, Wildlife and Marine Resources.

FWMA: Fish and Wildlife Management Act.

RM: river mile - denotes the distance upstream from the river mouth.

PFR: Public Fishing Rights.

TSMP: Toxic Substances Monitoring Program.

USGS: United States Geological Survey.

USFWS: United States Fish and Wildlife Service.

YOY: young of year - typically a fish that is captured by sampling in the same year it was hatched.

Definitions

Bottom trawl: a sampling technique where a net is dragged along the bottom of a water body behind a boat.

Creel Survey: a survey where anglers are interviewed about their catch.

Cross vane structure: a "U"-shaped structure of boulders or logs, built across the stream channel to reduce velocity and energy near the stream banks.

CROTS: Catch-Rate-Oriented-Trout-Stocking - the model used to develop stocking rates for trout streams that takes into account biological measures of the stream and stream carrying capacity, trout natural reproduction, hold-over of previously stocked trout, classification of the type of trout fishery managed for, measured or assumed angler effort and targeting an angler catch rate of 0.5 trout/hour.

Dreissenid mussles: a family of small freshwater mussels that attach themselves to stones or to any other hard surface.

Electrofishing: use of electricity to temporarily stun fish, allowing them to be captured.

Extirpated species: a species that no longer exists in the wild in a certain country or area.

Gill netting: a survey technique that uses a mesh net to ensnare fish.

Hydroacoustic survey: use of sound and reflected echoes from schools of fish to estimate abundance.

J-hook structure: an upstream directed, gently sloping structure designed to reduce bank erosion by reducing near-bank slope, velocity, velocity gradient, stream power and shear stress.

Pen reared: raising hatchery salmon or trout in a pen to "imprint" those fish to the pen rearing site. In theory, this will cause the fish to return to the pen rearing site to spawn.

PSD: proportional stock density - describes the portion of a fish population or sample that exceeds a size threshold. For example, the PSD for largemouth bass is the proportion of 12 inch and larger bass in the sample of largemouth bass that were stock size (8 inches and larger).

RSD 15: relative stock density greater than 15 inches - describes the proportion of fish larger than 15 inches in a population or sample of all fish exceeding a size threshold. For example, the RSD 15 for largemouth bass is the proportion of 15 inch and larger bass in a the sample of all largemouth bass that were stock size (8 inches and larger).

Secchi depth: the water depth in which the black and white colors of a disc can longer be distinguished from each other by an observer at the surface of the water.

Seining: using a seine net, a large net that hangs in the water due to weights along the bottom edge and floats along the top, to capture fish.

VHS/VHSv: Viral hemmoraghic septicemia - a serious disease of fish (not humans) recently introduced into New York State.

Year Class: a group of fish spawned during the same year.

Units of Measure

ºC: degrees Celsius - to convert from c to farenheit (f) = (farenheit -32) x 5/9.

ha: hectare - a metric system unit of area, 1 hectare = 2.47 acres.

hr: hour.

in: inch.

kg: kilogram - a metric system unit of weight, 1 kg = 2.2 pounds.

km: kilometer - a metric system unit of length, 1 km = 0.62 miles or 3,281 feet.

m: meter - a metric system unit of length, 1 meter = 3.28 feet.

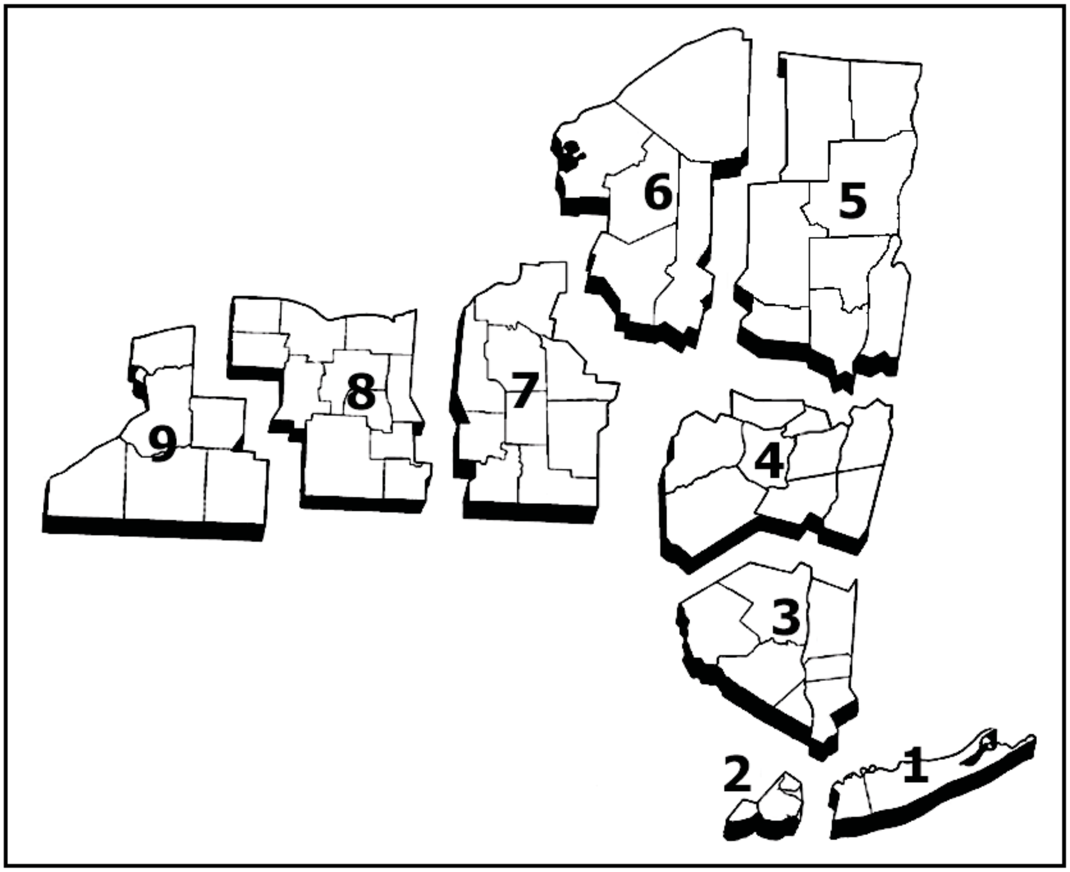
mm: millimeter - a metric system unit of length, 100 mm = 3.94 inches.

ppm: part per million - describes the density of a substance in another solid, liquid or gas (typically water, air).

ppb: parts per billion - describes the density of a substance in another solid, liquid or gas (typically water, air).

µg/l: micrograms per liter

DEC REGIONS



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INTRODUCTION

Introduction

The New York State Department of Environmental Conservation, Division of Fish, Wildlife and Marine Resources, Bureau of Fisheries delivers a diverse program and annually conducts a wide array of activities to accomplish its mission:

> ***Conserve and enhance New York State's abundant and diverse populations of freshwater fishes while providing the public with quality recreational angling opportunities.***

This report provides a summary of significant activities completed during fiscal year 2009-2010 by Bureau of Fisheries staff located in 9 regional offices, 2 research stations, 12 fish hatcheries, 1 fish disease laboratory, as well as the DEC Central Office in Albany. These activities are broken out by major resource or program categories including:

Species Management

Great Lakes Research
Warmwater Fisheries Management
Coldwater Fisheries Management
Inland Creel and Angler Surveys
Endangered/Rare Fishes

Fish Culture

Hatchery Infrastructure and Improvements
Experimental Evaluations
Egg Takes from Wild Fish
Fish Health Collections
Annual Production

Fish Health

Public Use and Outreach

Fishing/Boating Access
Aquatic Education/Outreach

Habitat Protection and Management

Fisheries/Angler Surveys

Technical Reports and Publications

Administration

Permits and Licenses
Bureau Staff

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SPECIES MANAGEMENT

Great Lakes Research: Lake Ontario

Sport Fishery Assessment

- In 2009, total Lake Ontario fishing boat effort was estimated at 77,863 fishing boat trips, which was comparable (+0.5%) to the 2004-2008 average. Total trout and salmon fishing success (charter catch per angler hour = 0.23) was the highest in the 25-year data series. The 2009 charter catch rate of Chinook salmon was the 5th highest in the data series. Charter catch rate for rainbow trout was the highest on record (76.0% higher than the 2004-2008 average) for the 2nd consecutive year. Total trout and salmon catch (228,287 fish) and harvest (122,723 fish) were dominated by Chinook salmon (44.4% and 44.8%, respectively) and rainbow trout (24.0% and 19.8%, respectively) for the 2nd consecutive year. Charter catch rate of coho salmon was the 3rd highest in the 25 year data series. The 2009 Atlantic salmon catch and harvest estimates were the highest since 1994 and catch rate was the 4th highest in the 25-year data series.

- Fishing boat trips targeting smallmouth bass during the traditional open season (3rd Saturday in June through September 30 when the creel survey ends) was an estimated 8,666 in 2009. Fishing quality for smallmouth bass along the south shore peaked in 2002 and has declined since then to the lowest levels observed since the survey began in 1985. Bass catch rate in 2009 declined 82.1% from the 2002 peak. This decline coincides with an exponential increase in round goby catches. Round goby is likely a contributing factor to the poor fishing quality; however, the current status of the southern shore bass population is unknown.

Anglers being surveyed as part of the sportfishery assessment.

Prey Fish Assessments

A trawl net full of baitfish collected as part of the preyfish asessment of Lake Ontario.

- In spring 2009, the abundance of adult alewife (age-2 and older) in U.S. waters of Lake Ontario was very similar to 2008, and higher than during 2004-2007. The 2009 biomass index increased from 2008 and was the highest observed since 2001. During 2003-2009, alewife condition in the fall has been higher than in any other period since the late 1970's, suggesting that the alewife population was at a level that does not depress food resources.

- After reaching historic lows in 2008, both number and weight indices for adult rainbow smelt increased in 2009 and were higher than 2007 or 2008. The number of age-1 rainbow smelt caught in 2009 was over double that observed in 2008, but still only 14% of the most recent high point in 2004. Sixty-five percent of the catch of rainbow smelt in 2009 was yearlings. Larger and older rainbow smelt remained scarce in 2009.

- During 2009 standard assessment trawling, USGS/DEC caught 66 deepwater sculpins, more than double the number of individuals collected in 2008. This continues the recent trend of increased catches of this species, once thought to be extirpated from Lake Ontario.

- The 2009 hydroacoustic survey of Lake Ontario preyfish populations consisted of five cross-lake transects and an Eastern Basin transect. Yearling and older alewife abundance (134 million fish) declined 45% from 2008 and remained relatively low at about 68% of the previous 5-year average. Alewife biomass (5,298 metric tons) also declined but was 18% greater than the 5-year average, principally due to the large average size of the 2005 year class which dominated the catches. The 2009 midsummer acoustic estimates of YOY smelt abundance and biomass in Lake Ontario increased slightly but remained relatively low, with 311 million fish and 1,714 metric tons, respectively.

SPECIES MANAGEMENT

Great Lakes Research: Lake Ontario

- In 2009, both the abundance and biomass indices for round goby decreased considerably from 2008. Gobies were first detected in 2002 and are now found along the entire south shore of Lake Ontario, with the highest population densities in U.S. waters just east of the Niagara River.

Coldwater Fisheries Management

- Fish stocking in the New York waters of Lake Ontario in 2009 included 1.76 million Chinook salmon, 250,420 coho salmon, 733,755 rainbow trout, 511,177 lake trout, 538,960 brown trout, and 74,000 Atlantic salmon.
- In 2009, 505,277 lake trout and 125,000 brown trout were stocked offshore by military landing craft in a continuing effort to reduce predation on newly stocked fish by double-crested cormorants and predatory fish.
- The 2009 mean length (35.2 in) and weight (19.45 lbs) of age-3 Chinook salmon in August, as measured from the open lake boat fishery, were the lowest and second lowest observed in the data series, respectively. Despite the declines in length and weight, condition in 2009, as determined from predicted weights of given length fish, was average for larger Chinook salmon (i.e. 36 in and 40 in fish). Condition of small Chinook salmon (i.e. 16, 20, and 24 in fish) was poor and the third lowest calculated.
- At Salmon River hatchery, the mean weight of age-1 Chinook males (jacks) sampled in 2009 was about 0.25 pounds above the long-term average. Age-2 male Chinook salmon were 0.3 pounds heavier than their historical average and females were 1.0 pound lighter than their historical average, but significantly heavier than the all-time low measured in 2007. Age-3 fish of both sexes were almost 2 pounds below their historical averages but significantly heavier than lows observed in recent years.
- Steelhead are sampled in the spring and, unlike Chinook and coho salmon, do not reflect growth during the 2009 growing season. Weights reported here reflect conditions prior to and including 2008. The mean weight of age-3 males was 5.2 lbs, only 0.1 lb lighter than the long-term average. The mean weight of Age-3 females was 6.1 lbs, 0.75 lbs lighter than the long term average, and significantly lighter than those sampled in 9 of the previous 21-years. The mean weight of Age-4 males was 8.0 lbs, 1.1 lbs lighter than average, but rebounding 1.5 lbs from the low observed in 2008. Age 4-females weighed 8.7 lbs, 0.8 lbs lighter than average and significantly lighter than 9 of the previous 21 years.
- Since the institution of seasonal base flows in the Salmon River, a dramatic increase in natural reproduction of Chinook salmon continues to be documented. Numbers of young-of-the-year Chinook salmon caught in 2009 were lower than anticipated, with a mean peak catch of 93 per haul during the last 3 weeks of May (mean=195, 2001-2008). This was probably a result of high flows that caused a relatively high rate of flushing of fish from the river during that time period. Flow during the previous October and average flow during May are both important factors for predicting parr year class strength.
- The twelfth year of pen-rearing steelhead and Chinook salmon along the New York shoreline of Lake Ontario was very successful due to low fish mortality at all sites, and a relatively high percentage of fish reaching target weights. A total of 94,060 steelhead trout (Washington and Skamania strains) were raised at nine pen sites comprising 14% of NYSDEC's Lake Ontario rainbow trout/steelhead stocking allotment in 2009. Six pen-rearing sites raised a total of 313,600 Chinook salmon, representing 18% of NYSDEC's 2009 Chinook stocking allotment.
- In 2008 and 2009, NYSDEC and the Ontario Ministry of Natural Resources began "mass marking" all stocked Chinook salmon (adipose fin clip on all Chinook; selected lots also receiving coded wire tags). This study will determine the relative contributions of wild and hatchery stocked Chinook salmon to the fishery. In 2010, mass marking technology will be used to begin evaluations of the performance of pen-reared Chinook salmon.

Coldwater fisheries management in Lake Ontario has produced an excellent salmon and trout fishery.

Lake Trout Restoration

- In 2009 the juvenile lake trout survival index was 2.4 times greater than the 2008 value, but remained low and was 72% below the average for the 1983-1989 year classes. In five out of the last eleven years, the survival index was about 3.5 times higher than the lows seen for the 1994–1996 year classes. In recent years, nearly all of the age-2 fish sampled were caught in the western end of Lake Ontario.

SPECIES MANAGEMENT

Great Lakes Research: Lake Ontario

- A total of 527 adult lake trout were captured in the September 2009 gill net survey. The 2009 catch per unit effort (CPUE) of 7.6 for adult fish was 56% below the 1986-1998 mean and 31% below the 1999-2004 mean. The 2005-2009 mature lake trout CPUEs were similar to the 1982 and 1983 values which pre-dated effective sea lamprey control and recruitment from the first large stocking in 1979.
- Sea lamprey wounding rates on lake trout remain much lower than pre-1985 levels, but were above the target level of two A1 wounds (fresh, with no signs of healing) per 100 fish for eight of the last thirteen years. A1 wounding rate in 2009 was 1.22 wounds per 100 fish and was below target for the second consecutive year after six years of rates exceeding the target.
- In 2009, three naturally produced (wild) age-2 (mean size: 220.3 mm, 8.7 in) lake trout were caught during bottom trawling. Survival of naturally produced lake trout to the fingerling stage in summer and fall occurred each year during 1993-2007 representing production of 15 consecutive year classes. We caught no wild yearling lake trout during 2005-2009 and have no evidence of a naturally produced year class in 2008. Low numbers of small (<100 mm, 3.9 in), wild fish captured in recent years (1997-2009) may be due in part to a change in bottom trawl gear that was necessary to avoid abundant dreissenid mussels.
- Condition of adult lake trout (weight of a 700 mm or 27.6 in total length fish) in 2007-2009 increased from the relatively low 2003-2006 values to a level equivalent to the high levels observed during 1996-1999 (mean of 3679.6g, 8.1 lb; the highest values in the data series).
- In 2009, lake trout harvest (4,733), catch (11,241), and harvest rate were among the lowest values recorded. Relatively poor fishing for lake trout in 2009 was likely due, in part, to the declines in adult population size since 2004 and the relatively good fishing for Chinook salmon, coho salmon and rainbow trout.

Warmwater Fisheries

- Catch-per-unit-effort (CPUE) of warmwater fish in the 2009 Eastern Basin index gill netting survey was 31.4 fish/gill net and was comparable to the previous 5-year (2004-2008) average. The catch was dominated by smallmouth bass (31.2%) and yellow perch (23.4%).
- Walleye abundance in 2008 was 23.3% and 35.5% above previous 5-year and 10-year averages, respectively. In 2009, we observed the third highest catch of age-1 walleye since the assessment began in 1976, suggesting a strong 2008 year class.
- Smallmouth bass abundance in the Eastern Basin as measured in index gill nets was 133.2% higher than the 5-year period (2000-2004) when CPUE was at record low levels. Recent improved smallmouth bass growth and condition continued in 2009 with record or near record high mean length-at-age for all ages 2-10, and continued high condition of larger bass. Improved growth and a reduction in cormorant predation pressure likely contributed to the increased CPUEs observed from 2005-2009 as compared to CPUEs during 2000-2004.
- Yellow perch abundance in 2009 decreased 33.8% compared to the 2004-2008 average. The decline in yellow perch CPUE may be due to the relatively high variability of yellow perch catch in the gill nets. The NYSDEC Lake Ontario fishing boat survey estimated the two years of highest yellow perch harvest occurred in 2008 and 2009, indicating relatively higher yellow perch abundance in areas outside of the eastern basin.
- Round gobies first appeared in the Eastern Basin assessment in 2005 in both gillnet catches and smallmouth bass diets. Goby occurrence in predator diets increased each year since. In 2009, 59% of non-empty smallmouth bass stomachs contained gobies. Gobies were present in walleye diets each year from 2006-2009 and have been found in northern pike and brown trout caught in this survey.
- In Lake Ontario's Eastern Basin white perch abundance in 2008 was more than 6-fold higher than the previous 5-year average and the highest since 1991. In 2009, white perch CPUE declined 61.0% from 2008; however, it was the 3rd most commonly caught fish in the assessment, and CPUE (3.0) was 19.8% and 73.3% higher than the previous 5-year and 10-year averages, respectively.
- At least one Lake sturgeon has been collected in the Eastern Basin in eleven of the last fifteen years suggesting improvements in population status.

Diets of Double-crested Cormorants and Impacts on Sportfish Populations

- Egg oiling on Little Galloo Island in 2009 reduced cormorant chick production by approximately 86%, thereby reducing the number of cormorant chick feeding days by 345,424. The resulting reduction in fish consumption was estimated at 18,000 smallmouth bass and 156,000 yellow perch.
- In 2009, smallmouth bass abundance in the Eastern Basin as measured by index gill nets was 133.2% higher than the 2000-2004 average (the period of lowest CPUEs on record). Recent trends may indicate a population response to reduced cormorant predation.

SPECIES MANAGEMENT

Great Lakes Research: Lake Ontario

- Estimated total fish consumption by cormorants from the Little Galloo Island colony in 2009 was 13.11 million fish, including 12.7 million round goby, 0.36 million alewife, 0.36 million yellow perch, 0.16 million rock bass, 0.10 million pumpkinseed, and 0.02 million smallmouth bass.


Double-crested cormorant

- Estimated total fish consumption by cormorants from three upper St. Lawrence River colonies (Ontario waters) in 2009 was 13.9 million fish (0.71 million pounds). Average annual fish consumption by cormorants from Griswold, McNair, and Strachan Islands since 1999 is 7.41 million fish.
- Since 1999, the cormorant reproductive suppression program on Little Galloo Island has cumulatively reduced fish consumption by chicks at the colony by 62.7 million fish, including approximately 9.2 million yellow perch and 2.4 million smallmouth bass.

Deepwater Cisco Re-introduction

- In February 2010, fertilized bloater (*Coregonus hoyi*) eggs were obtained from Lake Michigan and experimentally reared by the Lake Ontario Unit at the Cape Vincent Fisheries Station (CVFS). The deepwater cisco re-introduction project is being conducted collaboratively with the Ontario Ministry of Natural Resources, USFWS, and the Great Lakes Fishery Commission. A variety of experiments were performed, including shipments of "green" eggs and dead, ripe adults for fertilization experiments at CVFS. Over 188,000 eggs were exposed to milt; however, only 30% of eggs were actually fertilized. No green eggs or eggs stripped from freshly shipped females fertilized successfully. While no fish will be stocked into Lake Ontario from these experiments, great progress has been made and experimental work will continue in 2010 and beyond.

Lower Trophic Level Monitoring

- From 1995-2009, the biomonitoring program in Lake Ontario has measured indicators of lower food web status with the primary objective of evaluating temporal and spatial patterns in total phosphorus, soluble reactive phosphorus, chlorophyll a, Secchi depth, and crustacean zooplankton density, biomass, and size structure.
- Embayments remained the most productive habitat in 2009 with the highest zooplankton density and biomass, chlorophyll a, total phosphorus, and soluble reactive phosphorus, as well as the lowest water clarity.
- The lower trophic level indicators were similar in the nearshore and offshore habitats and indicative of oligotrophic conditions. In 2009, low spring total phosphorus, low summer chlorophyll a, and high secchi depth were among the most extreme recorded, indicating low productivity and high water clarity in Lake Ontario's nearshore and offshore waters.
- Spring total phosphorus has been below the goal of 10 micrograms/liter set by the Great Lakes Water Quality Agreement of 1978 in the offshore since 1995 and in the nearshore since 2005.
- The current alewife population apparently was not sufficiently abundant to suppress larger sized, invasive zooplankton (*Cercopagis pengoi* and *Bythotrephes longimanus*). Bythotrephes and Cercopagis remained important components of the zooplankton community in 2009; however, abundance and biomass of these two species during their respective peak periods were in the lower range of what has been observed since 1998. The increase of Bythotrephes abundance in 2005 coincided with the decreased biomass of crustacean zooplankton, particularly the significant decline of bosminids and cyclopoid copepods in nearshore and offshore waters.
- Overall, zooplankton biomass in Lake Ontario's offshore epilimnion (surface waters) has been declining since the late-1990s at a rate of 15% per year. Similar rates of decline occurred in the 1980s, resulting in a 99% reduction in zooplankton biomass within the epilimnion in the last three decades. Offshore summer epilimnetic zooplankton density declined 13% per year since the early 1980s.

Irondequoit Bay Electrofishing Survey

- An electrofishing survey of Irondequit Bay was conducted in 2009 to characterize the warm water fish community and complement gill net survey conducted in 2005. Two hundred sixteen individuals of 17 species were caught in 6.5 hours of electrofishing. 61% of the catch was largemouth bass, followed by yellow perch (8%), bluegill sunfish (6%), and walleye (5%). Analysis of the data and comparisons with previous surveys will be done at a later date.

State of the Lake Ontario Meetings

- These annual events bring together researchers and management officials from both State and Federal Governments to present the latest finding on the fishery of Lake Ontario. The meetings are held in Lockport, Mexico and Rochester. Rochester is usually one of the larger venues, and this year was no exception with over 120 people in attendance.

SPECIES MANAGEMENT

Great Lakes Research: Lake Erie

Sport Fishery Assessment

- An annual boat fishing survey found overall boat fishing effort on Lake Erie estimated as 268,942 angler-hours. This was a decline to the lowest measure observed in this 22 year data series. This decline seems mostly attributable to an accompanying decline in walleye fishing quality during 2009.
- Boat fishing survey results found smallmouth bass and yellow perch fishing quality to have been superb through recent years. Recent good spawning success suggests this good quality perch and bass fishing should continue in the near future.

A creel agent collecting information for the annual boat fishing survey.

Coldwater Fisheries Assessment

- Fish stocking in the New York waters of Lake Erie in 2009 totaled 512,632 fish including lake trout, rainbow trout (including steelhead), and brown trout. Steelhead accounted for most of this total with 272,000 yearlings stocked in nine tributaries.
- Surveys continued to assess abundance of wild, juvenile steelhead in Chautauqua Creek in anticipation of a fish passage initiative to increase steelhead access to 10 additional miles of upstream spawning and nursery habitat. Results of surveys through 2009 found few wild juvenile steelhead above barriers, highlighting the impact of these barriers and the anticipated benefits of achieving fish passage.

Warmwater Fisheries Assessment

- Survey netting found the dominant 2003 walleye year class as a very prominent component of the adult population at age-6. This same assessment detected only average spawning success since 2003, which indicates the adult population should gradually decline from a peak observed just a few years earlier.
- Smallmouth bass monitoring found this population slightly above long-term abundance levels, with moderate to high catches of juvenile bass detected through recent years. This forecasts abundance of the adult population to remain high in the near future.
- Predator growth rates were generally above long term average measures. In 2009, age-2 and age-3 smallmouth bass averaged 11.4-in and 13.7-in total length, respectively. Both of these measures in 2009 were approximately an inch longer than the average for bass in this 29-year time series.
- Survey netting measures for both adult and juvenile yellow perch in recent years have been especially high in Lake Erie, suggesting a large and stable adult yellow perch population will extend at least another few years.

Lake Trout Restoration

- Back-to-back annual treatments for sea lamprey for all key Lake Erie tributaries were completed in 2008 and 2009. These treatments are hoped to reduce sea lamprey wounding to below target levels beginning in 2010.
- Lake trout wounding rates and sea lamprey nest counts increased sharply in 2009, indicating that the Lake Erie sea lamprey population had been increasing just prior to initiation of aggressive treatments of all major sea lamprey spawning streams during 2008 and 2009.
- Standard survey netting found the abundance of lake trout has been slowly increasing since 2000. Much of the current population is comprised of young fish between 2 and 5 years old. A recently stocked Klondike strain of lake trout continues to show promise by demonstrating excellent subadult survival rates.

Prey Fish Assessments

- Bottom trawling results suggest that autumn forage fish densities in the New York waters of Lake Erie during 2009 were high relative to the history (1992-2009) of this annual trawling series. Through recent years rainbow smelt and round goby both contributed substantially to overall forage fish abundance.
- Examination of predator diets from netting surveys and from fish cleaning stations found predator diets dominated by rainbow smelt and round goby.

SPECIES MANAGEMENT

Great Lakes Research: Rivers

St. Lawrence River

Young of Year Northern Pike and Muskellunge Index

Standardized sampling of northern pike and muskellunge productivity has been ongoing in the St. Lawrence River since the year 2000. Northern pike young of year were low in abundance for both the Thousand Islands and Lake St. Lawrence in 2009, 0.06 and 0.1 fish/standard seine haul respectively. Muskellunge Y-O-Y were not collected in the Thousand Island samples, which is not unusual, but were found in abundance in Lake St. Lawrence (CUE = 0.91 fish/standard haul).

Lake St. Lawrence Warmwater Fish Stock Assessment

This annual index netting program took place in September of 2009. A total of 632 fish (CPUE=19.75 fish/net night) were collected. The catch was one of the higher for this index netting program. Of interest, smallmouth bass were at the lowest recorded density for this assessment (CPUE=1.0 f/nn). Walleye catch set a new record (CPUE=3.03 f/nn) and were comprised of predominantly age-2 fish. Yellow perch were found in abundance with a high proportion of the catch being >9 inches in length.

Angler Survey 2008-2009

The St. Lawrence River Angler Survey was completed in October of 2009. Boat anglers were interviewed over the 100 mile length of the St. Lawrence River from Cape Vincent to Massena. Preliminary results indicate that New York residents comprised the bulk of the anglers (72%). The bulk of anglers accessed the river from private residences or marinas (61.1%) while the remainder used public launches or state parks. On average approximately 337,000 angler hours were expended on an annual basis by boating anglers. An overall trend towards increased recreational boating and potentially decreased fishing activity was noted, along with the dominance of the catch and release philosophy of the angling public.

Thousand Islands Warmwater Fish Stock Assessment

Results of 2009 sampling with the greatest management significance include:

1) Northern pike abundance remains low, recruitment is relatively poor due to habitat loss,

2) Smallmouth bass abundance declined substantially reversing a recent increasing trend, and

3) Alewife abundance was surprisingly high.

The last time alewife abundance was near this level was 1986, when high St. Lawrence River abundance was thought to result from spillover from a very abundant Lake Ontario alewife population.

Upper and Lower Niagara River

Muskellunge Surveys

The Region 9 Fisheries Unit, a SUNY ESF PhD candidate, and a Niagara Musky Association volunteer completed several muskellunge surveys. In late May and early June, cooperative electrofishing efforts in the Buffalo Harbor/ Upper and Lower Niagara River collected 66 muskellunge, including 36 adults (> 30 in) and 30 sub-adults. Approximately 1/2 the adults were collected in the Upper Niagara River, 1/3 from the Lower Niagara River, and only a few adults were collected in Buffalo Harbor area. The sampling team collected a substantial number of sub-adult muskellunge, including a number of yearlings and two-year olds. Many of these fish were encountered in a basin associated with a tributary to the Upper Niagara River. This basin appears to be significant habitat for young muskellunge.

Electrofishing was conducted at several Upper Niagara River sites to assess relative abundance of young-of-year (YOY) muskellunge. At 102nd Street embayment, no young muskellunge were collected, which was disappointing. This particular embayment historically supported YOY muskellunge, however it was substantially disturbed and then restored during a sediment remediation project in the 1990's. In the previous year, a substantial number of YOY muskellunge were collected from the heavily vegetated embayment. YOY production at the embayment may be inconsistent from year to year and is likely influenced by annual changes in vegetated inshore habitat and other factors.

Electrofishing was conducted in the Lower Niagara on November 12th, primarily to collect adult muskellunge for genetic sampling. No adults were encountered, however 10 YOY muskellunge were collected at three sites downstream of Stella Niagara. Young muskellunge had been collected previously in 1995 at two of the sites located along the Ontario shoreline. Young muskellunge were also collected at a new location along the New York shoreline in the vicinity of Peggy's Eddy.

Juvenile muskellunge caught from the Niagara River.

SPECIES MANAGEMENT

Warmwater Fisheries Management: Lakes and Ponds

Region 1

Forest City Park Pond

An electrofishing survey was conducted on Forest City Park on May 12, 2009, to assess the bass/sunfish population. The pond was used as a source pond in 1994 for a trap-and-transfer project because of the extremely high catch rate of bass under 8 inches. The bass catch rate in 2009 was 20% of the catch rate in 1994. Bluegill are now more common than pumpkinseed.

Region 2

Clove Lake (Staten Island) General Biological Survey and Fish Health Surveillance, 9/15/09

An electrofishing survey of Clove Lake, Staten Island, revealed brown bullhead as a major proportion of the fish population. Most fell within the 5" – 8" size. Pumpkinseeds, bluegills and largemouth bass (up to 15") composed most of the other fish collected.

Rare Fish Investigation, Moravian Cemetery (Staten Island) 4/8/09

A 1909 record indicating bridle shiner (*Notropis bifrenatus*) once inhabited waters of Moravian Cemetery, Staten Island, triggered interest in determining if these fish were still present in the brook. A backpack electrofisher was used to collect fish of the brook. Although sunfish, largemouth bass and American eels were found, bridle shiners were not.

Van Cortlandt Lake (Bronx) Fish Survey with Fish Health Surveillance, 4/21/09

An electrofishing survey of Van Cortlandt Lake in April showed that while yellow perch were the greatest proportion of fish captured, the black crappie catch was also common. Also captured during the electrofishing survey were brown bullhead catfish over 13" in length, largemouth bass over 14" in length, white suckers and many sunfish.

Harlem Meer and Central Park Lake Fish Surveys, Central Park, 5/5/09 & 5/6/09

Electrofishing surveys of the Harlem Meer and Central Park Lake, both located in Central Park, were completed during two consecutive evenings in May. The capture of a northern snakehead in the latter prompted the 2009 surveys. A significant finding was an absence of large-sized largemouth bass in the Harlem Meer suggesting illegal harvest of these fish or insufficient amounts of prey. Alternatively, the Central Park Lake survey revealed a relatively large proportion of bass over 12 inches. No snakeheads were observed or captured.

Fish Survey of Meadow Lake

Routine surveillance of Meadow and Willow Lakes for the invasive northern snakehead continued with an electrofishing survey of Meadow Lake on July 6, 2009. Catch rates for snakeheads and other fish species were relatively low, most likely due to high water turbidity. The survey was notable for the capture of a 31" snakehead, the largest caught by Region 2 Fisheries staff to date. Snakeheads were first discovered in Meadow Lake in 2005.

Region 3

Toronto Reservoir

A boat electrofishing survey was conducted on Toronto Reservoir in the spring of 2009. Sixteen species were collected, with an abundant smallmouth bass population being documented. Interestingly, 24 walleye up to 30 inches long were collected. The walleyes are from a private stocking policy.

Region 4

Upper Blenheim-Gilboa Reservoir

The 360 acre upper Blenheim-Gilboa Reservoir was sampled with six gill nets. The catch of 12.2 fish/net indicates a sparse fish population. However, the catch of 7.5 walleye/net and 2.5 legal walleye/net suggests a high abundance of walleye in this reservoir.

Picking a gill net at Blenheim-Gioboa Reservoir.

Region 5

Loon Lake Walleye Assessment

On October 14 and 15, 2009, a post stocking walleye assessment was completed on Loon Lake, Warren County. Approximately 12,000 fifty day fingerlings were stocked

Warmwater Fisheries Management: Lakes and Ponds

on June 11, 2009, and will be stocked for each of the next four years. While we did not collect any of the stocked fish to evaluate their growth, three adult walleye ranging from 19 to 22 inches were collected by electrofishing. These walleye are remnants of previous attempts to establish a population in Loon Lake.

Rainbow Lake

Rainbow Lake, Town of Brighton in Franklin County, was sampled in the second week of June. Multiple year classes of walleye were caught, though the catch rate was modest at one walleye per net set. This rate was still much better than a similar netting effort done in 1997 after walleye stocking efforts by the Rainbow Lake Association. The size structure of the yellow perch population appears to have greatly improved from 1997 when this species dominated the fish community and were of small average size.

Lake Champlain Bass Population Monitoring Initiated

DEC and USFWS initiated nighttime electrofishing transects for centrarchid monitoring on Lake Champlain. The goal was to identify specific places which can be resurveyed in future years which are representative of the habitats of Lake Champlain.

Region 6

Five Falls Reservoir Percid Sampling

Five Falls Reservoir, one of the Raquette River impoundments, was evaluated for walleye in June of 2009. During Federal Energy Regulatory Commission (FERC) relicensing in 2002, requirements for increased spring bypass flows were initiated to enhance habitat for spawning walleye. Both gill netting and seining failed to produce any walleye. The lack of either adult or juvenile walleye implies that additional spring flows had a negligible effect on the overall walleye population.

Walleye Fingerling Evaluation

No young-of-the-year walleye were found in Black, Red and Payne Lakes (Jefferson and St. Lawrence Counties), but sampling did provide good indices of large (>15 inch) predator abundance which could affect fingerling stocking success. Predator abundance was high in all lakes. Stocking methods will be modified next year.

Black Lake Bass Evaluation

Black Lake, Jefferson County, sampling produced a good estimate of largemouth bass size distribution which showed no evidence of fish stockpiling just below the minimum length of 15 inches. This had been a concern of some local anglers, but no evidence was found requiring modified regulations.

Electrofishing boats are often used as a non-lethal method to sample fish populations.

Region 7

Panther Lake

An assessment of the fish community in Panther Lake, Oswego County, was completed in late spring to determine the existing predatory fish population. Local anglers expressed a desire for the DEC to stock walleyes in Panther Lake, which had been done periodically in the past. It was determined that the black bass and pickerel populations were fairly high, and therefore the probability of a successful walleye stocking program was low. It was decided that the existing tiger muskellunge stocking program should continue since it is a small but popular fishery.

Whitney Point Reservoir Summer Fish Assessment

Standard summer sampling was conducted on Whitney Point Reservoir, Broome County, in 2009 to monitor population trends of the reservoir's fish community, particularly walleye and crappie. The number of walleye caught per gillnet was almost twice the former record catch from the 2007 effort. Multiple sizes/year classes were represented from 8" (Age 0) up to 25" (Age 9+). Crappie populations continue to be depressed, and there appeared to be very few fish from the 2008 year-class present. Although the reason for poor crappie production is not clear, walleye may be playing a role in keeping crappie populations suppressed. Because walleye density is so high and recruitment of walleye via natural reproduction has been consistently high since the mid-1990s, a return to the statewide walleye regulation appears to be in order.

SPECIES MANAGEMENT

Warmwater Fisheries Management: Lakes and Ponds

Whitney Point Reservoir Electrofishing to Assess Juvenile Walleye Abundance

Fall sampling for juvenile walleye revealed strong year-classes of walleye were produced in both 2008 and 2009. Abundance of yearling (2008 year-class) walleye was the third highest of the eight years we have estimates for, and their average size (~11”) was good. Young-of-year (YOY) walleye were also abundant but the average size of these fish (>6”) was the smallest we have yet observed in fourteen years of sampling the reservoir. The 2008 year-class should contribute substantially to the future walleye fishery, but the small average size of the 2009 year-class will likely limit their overall contribution to the fishery.

Otisco Lake Fall Electrofishing to Assess Juvenile Walleye Abundance

Several walleye fingerlings from the spring 2009 stocking were captured during limited sampling in October, indicating the experimental stocking of 50-day old fish can be successful. However, abundance of these fish was relatively low indicating this year-class likely won’t contribute great numbers to the fishery as adults. Yearling walleye (stocked in 2008) were very abundant and continued to show good growth. This year-class should contribute significantly to the walleye fishery in another two to three years.

Region 8

Waterport Reservoir’s Fish Community Assessment

A fisheries survey of Waterport Reservoir in the Town of Carlton, Orleans County, was conducted from September 14 to 15, 2009. The purpose of the survey was to assess the overall fish community and the success of annual fingerling walleye stockings that have taken place since 1989. The game fish catch consisted of 6 walleyes, 73 largemouth bass, 14 smallmouth bass, and one northern pike. Three round goby, an invasive species, were captured in the reservoir for the first time. Initial results suggest that fingerling walleye stocking has resulted in a relatively small population.

Conesus Lake’s Fish Community Assessment

A fisheries survey of Conesus Lake, Livingston County, was conducted from September 21 to 24, 2009. The purpose of the survey was to assess the overall fish community and the success of fingerling walleye from DEC hatcheries that have been stocked periodically since 1984. The game fish catch consisted of 109 walleyes, 27 smallmouth bass, and nine northern pike. Twenty seven juvenile walleyes were collected, suggesting that survival of recently stocked fingerlings is good. Multiple year classes of walleye were captured. Further analysis is needed to draw conclusions about the walleye population. Only four yellow perch (0.4/net) were sampled, indicating that recruitment of this species is still suppressed by alewife predation.

Conesus Lake walleyes during their spring spawning run.

Waneta and Lamoka Lakes Fishery Surveys

An electrofishing survey was conducted on these lakes as part of on-going monitoring of the impacts of an aquatic plant treatment using the herbicide, tryclopyr. This survey represents the seventh and final year of annual spring and fall surveys. Results to date suggest there are no biologically significant affects on reproduction and growth of fish in these lakes that can be attributed to large scale, short-term vegetation control.

Waneta Lake Musky Netting

A netting survey was conducted on April 14-24, 2009, to evaluate the Waneta Lake muskellunge population. A total of 158 muskellunge were collected. Catch rates were lower than a similar 2005 survey, but were higher than results from the 1990s. Fifty-nine percent of the muskellunge were legal size (30 in) or greater. Further data analysis is needed to determine if the 2003 Sonar treatment to control Eurasion watermilfoil, which subsequently eliminated all vegetation for a period of two years, had negatively impacted the musky poplation.

Region 9

Silver Lake Fisheries Surveys

An electrofishing survey was conducted on Silver Lake to evaluate the fish community and examine the relative abundance and size distribution of yellow perch and walleye. Biologists had received several phone calls from anglers concerned that walleye abundance had declined. Although the data has yet to be analyzed, walleye numbers appeared to be comparable to the 2004 survey.

Warmwater Fisheries Management: Lakes and Ponds

Chautauqua Lake Trawl Surveys

In 2009, Regional Fisheries Staff sampled several locations in Chautauqua Lake with a bottom trawl (net is pulled behind boat to capture fish located on bottom). Results showed an increased abundance of smaller walleye. These results are encouraging in light of the low numbers of young walleye collected over the last several years. To compensate for low natural reproduction, Chautauqua Lake has been stocked with fingerling walleye since 2003.

Chautauqua Lake Fisheries Assessment

Fisheries staff completed the fall electrofishing assessment for bass, walleye and muskellunge. Both largemouth and smallmouth bass were abundant at most sites. Walleye, although not approaching historical levels of abundance, showed either good survival from stocking or an adequate natural hatch in 2008.

Cornell University Research

Ecology and Management of the Fish Communities in Oneida and Canadarago Lakes:

Researchers at the Cornell Biological Field Station at Oneida Lake completed their annual assessment of the fish communities in Oneida and Canadarago Lakes. Funded by a Federal Aid to Sportfish Restoration grant, these monitoring projects are the longest running warmwater fishery assessments in New York State and continue to provide valuable insight on the complex dynamics associated with warmwater fish populations in large northern lakes.

Oneida Lake

- The adult walleye population was estimated to be 368,300. Over the full span of the 1975 – 2009 data series, the adult walleye population has exhibited a significant decrease, but has shown a significant increase in the last decade, partly driven by a large 2001 year class, three years with restrictive harvest regulations, and a positive response to the cormorant hazing program.
- The yellow perch population was estimated to be 808,000 age-3 and older fish, which is a sharp drop from the 2008 estimate (1.6 million), but is similar to the 2007 estimate. It is expected that yellow perch numbers will fluctuate around 1 million fish in the near future.
- Walleye and yellow perch represented 46% of the total gill net catch whereas white perch comprised 44% of the catch. This was the second highest percent catch of white perch on record (behind 2007).

The Oneida Lake age-3 and older yellow perch population was estimated at 808,000 fish.

- Cormorant numbers averaged 128 birds from April through October. A diet analysis indicated that gizzard shad made up 67% of the food items found in cormorant stomachs whereas yellow perch represented 21% of the food items. Cormorants should not have had a measurable effect on percids in 2009.
- A new invasive species, *Hemimysis anomala* (bloody red shrimp), was discovered in the stomach of a white perch collected during routine gill net sampling. Subsequent sampling revealed the organism is widely distributed in Oneida Lake. Continued monitoring of fish diets and growth patterns, combined with routine limnological monitoring should allow us to detect potential impacts of this new invasive in the future.

Canadarago Lake

- Walleye natural recruitment was low again in 2009. Fry sampling since 2005 has produced few or no walleye fry. Yellow perch fry were abundant in 2005 and 2006, decreased dramatically in 2008 and rebounded in 2009.
- A mark recapture study yielded a population estimate of 14,233 adult walleye. This number will be adjusted after all scale samples are aged. The adult walleye population was estimated at 18,667 in 2004.
- Estimates of alewife abundance have steadily increased over the last 5 years and were at the highest level on record in 2009.
- Zooplankton average size (0.35 mm) was well below average, and biomass (95 µg/l) was also well below the long term ranges seen in Canadarago Lake. These declines are consistent with increased density of planktivorous fishes such as alewife.

Warmwater Fisheries Management: Rivers

Region 3

Northern Snakehead Eradication

In 2008, rotenone, a substance poisonous to fish, was used in Ridgebury Lake and Catlin Creek, Town of Wawayanda, Orange County, to eradicate northern snakeheads. A follow up survey in 2009 captured 2 adult snakeheads. Consequently, a second northern snakehead eradication effort occurred in the fall of 2009, including the use of three Mashmaster tractors from the USFWS to allow for a more thorough application of the rotenone. Twenty eight juvenile northern snakeheads were collected following the rotenone treatment in 2009. All the snakeheads collected came from the area downstream of where two adults had been collected earlier in the year. Upstream of this point (where a small dam impounding a private pond prevented upstream movement), no northern snakeheads were collected; indicating that the 2008 treatment may have been 100% successful in this section all the way up to including Ridgebury Lake. No snakeheads have been caught in Catlin Creek since the 2009 treatment.

USFWS Marshmaster in use applying rotenone to a marshy area of Catlin Creek.

Fall Tidal Hudson River Black Bass Electrofishing Surveys

Electrofishing surveys were conducted to sample the black bass populations in the tidal portions of the Rondout Creek and Esopus Creek during late October, 2009. The survey purpose was to help assess the Hudson River black bass population's response to a fall 2006 regulation change that increased the minimum size limit for bass from 12 inches up to 15 inches. In the tidal Rondout Creek, 182 largemouth bass and 5 smallmouth bass were collected in 2 hours of electrofishing. Nearly 45% of the bass collected were over 15". In the tidal Esopus Creek, 174 largemouth bass and 4 smallmouth bass were collected in 1.68 hours of electrofishing. Over 40% of the bass collected from the Esopus Creek were over 15". Over the next several years, the fishery will be monitored in a variety of ways to assess the effectiveness of the new size regulation.

Region 6

Mohawk River -Walleye Spawning Survey

Spawning walleye from Delta Lake were assessed in the Mohawk River in Westernville using boat electrofishing. High water initially caused sampling difficulty, but eventual results indicated that natural spawning is significant to the support of this important walleye fishery.

Region 7

Susquehanna River Migratory Fish Restoration Plan

Staff participated in a major effort to rewrite the "Migratory Fish Management and Restoration Plan for the Susquehanna River Basin." This document, jointly prepared by the member agencies of the Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC), is intended to guide present and future efforts to restore American shad, river herring, and other native migratory species in the Susquehanna River system. The document is available for public review at: http://www.fws.gov/northeast/susquehannariver.

Susquehanna R. Adult Smallmouth Bass Abundance

Electrofishing was conducted to compare the abundance of bass at Sandy Beach Park, Binghamton, relative to past sampling efforts at this same site. Since roughly 2003, anglers have complained about poor bass fishing in portions of the river. Sampling results from 2009 showed an increase in the abundance of legal sized bass along with a reasonably high abundance of bass between 6" and 12" compared to sampling done in 2005, 2007 and 2008. However, bass numbers are still approximately half of what were observed at this site in 1993. Since no dead fish were ever observed or reported in New York, reasons for the apparent decline are unknown. Possible causes include undiagnosed fish disease(s), pollution inputs associated with several major floods or a combination of both.

Susquehanna River YOY Smallmouth Bass Sampling

Shoreline backpack electrofishing was conducted in July to assess the relative abundance of young-of-year (YOY) smallmouth bass and to determine if *Columnaris* bacterial infections were present. The catch rate of 86 young-of-year/300 meter stretch of shoreline indicates that smallmouth bass production in 2009 was relatively low, based on Pennsylvania Fish and Boat Commission data collected for the past 20+ years. Also, none of the bass collected showed any signs of disease. Both findings were not a surprise given the relatively high river flows. Smallmouth bass production tends to be best in hot dry years while the worst disease outbreaks, in Pennsylvania's portion of the river, have occurred under these conditions as well.

SPECIES MANAGEMENT

Coldwater Fisheries Management: Lakes and Ponds

Region 3

Rondout Reservoir

Gillnets were set in Rondout Reservoir during two nights in early August with the objective of documenting the status of the trout population in the reservoir. This reservoir is currently stocked with brown trout yearlings and lake trout yearlings, with wild fish of both species also present. Of the 67 brown trout collected, 55 (82%) were of hatchery origin, indicating that this stocking policy contributes substantially to the brown trout population. All 18 of the lake trout collected were wild, indicating that the lake trout stocking policy may no longer be making a significant contribution to the fishery. Further netting is planned in 2010 to increase the size of the lake trout sample.

Region 4

Huggins Lake Brook Trout

Huggins Lake, Delaware County, is one of two wild brook trout ponds in Region 4. The population study estimated that there were 852 yearling and older brook trout in this 19 acre pond. The results are very similar from the estimated population of 841 brook trout recorded during a similar study in 2004. The largest brook trout collected measured 15.6 inches. Non-trout fish species continue to remain absent, allowing the brook trout population to remain stable.

Region 5

Four newly acquired ponds surveyed

Fisheries surveys were conducted on four ponds in Franklin County on lands where the DEC recently acquired recreational easements. Fish Hole and Grass ponds (Town of Franklin) and Balsam Pond (Town of Waverly) all contained brook trout. Mountain Pond (Town of Franklin) did not contain brook trout, but has water quality that could support brook trout. Stocking policies will be considered for all four waters.

Lake George Salmonid Survey

Annual monitoring of salmon and lake trout was conducted the week of November 9. Seven landlocked salmon of good size and condition were collected in three nets set near Hague Brook, Indian Brook and Shelving Rock Brook. In addition, 53 lake trout were collected, also of good size and condition. Results were similar to the results from the previous five years.

Lake George Fall Salmon Stocking

On October 14 and 15, approximately 3,000 landlocked salmon were stocked in the lake. These salmon were given an extra growing season in the Warren County Hatchery. The additional growth results in better survival and recruitment to the fishery than smaller, spring stocked salmon.

Chazy Lake

The Bureau of Fisheries conducted a general fisheries survey of Chazy Lake. The goal was to determine the current status of the fish community and assess the impacts of the recent introduction of northern pike. Initial analysis of the data indicated that lake trout have declined in abundance and the stocking of landlocked salmon continues to provide a fishery. Despite the known existence of northern pike, none were captured during the survey.

Region 6

Temescamie Hybrid Brook Trout Study

Netting surveys were conducted on 55 ponds stocked with the Temescamie Hybrid brook trout in the western Adirondacks to assess rates of natural reproduction and to look into using fish condition (lipid levels) to set stocking rates. Twenty-one of the 55 ponds had some wild fish, including 9 that had a significant number of wild fish. DEC staff are continuing to map out the seasonal changes in fish lipid levels to develop a method to use fish condition in setting stocking rates.

Region 7

2009 Owasco Lake Standard Gang Gill Netting

During July and August 2009, the Region 7 fisheries unit surveyed the coldwater fish community of Owasco Lake for the 10th time using standard Finger Lakes gang gill nets and standard netting sites. Previous surveys were carried out in 1976, 1977, 1979, 1982, 1985, 1988, 1991, 1994 and 2003. The primary purpose of the 2009 survey was to determine lake trout density and growth rate. An average of 14.5 lake trout were caught per net in the 2009 survey which was the second largest lake trout catch per net of the ten standard gang surveys. All but six of the 291 lake trout collected had fin clips, indicating the fishery continues to be sustained almost entirely by stocking.

Region 8

Canandaigua Lake Standard Gang Gill Netting

Canandaigua Lake was surveyed using standard Finger Lakes gill nets in order to assess the lake trout population, collect lake trout samples for the Toxic Substance Monitoring Program (TSMP), and collect lake trout and alewives for wild fish health surveillance at USFWS Lamar Fish Health Center. A total of 197 lake trout were collected for an average of 8.2 per net night. The 2009 catch rate ranks 4th out of the eight netting surveys that have been conducted on Canandaigua Lake and is the highest since 1985. Wild lake trout are estimated to contribute about 20% of the overall lake trout population. All lake trout and alewives submitted to Lamar tested negative for diseases of concern (including VHS).

SPECIES MANAGEMENT

Coldwater Fisheries Management: Rivers and Streams

Region 1

Brook Trout Surveys

An electrofishing survey was conducted on Yaphank Creek, Little Neck Run, and Beaverdam Creek to determine if brook trout were being negatively impacted by a leachate plume originating from the Brookhaven Town Landfill. The plume has already intersected Beaverdam Creek and may be discharging to Little Neck Run. In the 2009 surveys, brook trout were found in the same locations as they were in 1996. It does not appear that brook trout have been adversely affected by the landfill leachate plume.

Connetquot River CROTS Survey

The Region 1 Fisheries Unit completed a CROTS survey of the Connetquot River, collected trout for disease analysis, and developed an interim trout stocking plan based upon the results of the survey and DEC's trout management guidelines. CROTS takes carrying capacity into account. Management recommendations are to manage the upper section for wild brook trout, manage the middle section (immediately above the hatchery) by not stocking until the hatchery water supply can be separated from the river due to disease concerns (infectious pancreatic necrosis), and to stock the lower section with 2,700 trout in the spring and 900 trout in the fall.

Region 3

Neversink River tailwater "boat pools" sampling

Three standard boat pool sample sites below the Neversink Reservoir were sampled during July, 2009, to continue what was originally a three year series of trout biomass estimates along the Neversink tailwater. The 2004-2006 surveys were conducted to evaluate the three year experimental reservoir release program which was approved by the Delaware River Basin Commission. Total 2009 trout biomass estimates ranged from 42.1 lb/acre to 107.7 lb/acre, and were in line with past biomass estimates. The current release regime (known as the Flexible flow Management Plan) appears to be adequately protecting the trout habitat of this tailwater.

Willowemoc Creek

Willowemoc Creek was sampled by electrofishing in late July, 2009, to document survival of brown trout fall fingerlings. These fall fingerlings were fin clipped in 2007 and 2008 for the purpose of identification during this evaluation. A total of 27 trout were collected between two sites. All were brown trout with the exception of one brook trout. Six of the brown trout were wild (23%). None of the 16 hatchery brown trout had finclips. Based on these results, the fall fingerling policy was cancelled.

Wappinger Creek

Staff conducted an electrofishing survey of Wappinger Creek, a major Dutchess County trout stream, from August 18-21, 2009. This was the first major survey of Wappinger Creek since August 1992. Survey results documented a 20% decline in the brown trout population from the 1992 survey. Particularly disappointing was an apparent lack of any young of the year wild brown trout. A possible explanation for the low number of trout is that stream temperatures during the current survey ranged from 71 to 80 degrees F, compared to 68 - 73 degrees F in 1992. The summer of 2009 was unusually wet, and this may have contributed to the higher water temperatures given that the stream has three shallow lakes as its source. The impact of this warm surface runoff was evident in that the highest water temperature recorded (80 degrees F) was at the upstream most sampling station. In addition, the Wappinger Creek watershed has undergone a substantial amount of development since 1992, and runoff from roads and parking lots could have contributed to higher stream temperatures.

Region 4

Brook Trout Surveys

The Region 4 Fisheries Office completed the third year of a five year effort to survey many of the smaller streams throughout the nine county region to document the presence or absence of brook trout. The two man survey team sampled 776 streams, primarily in the Susquehanna watershed in Delaware and Otsego Counties, of which trout were found in 466 streams. Brook trout were found in 442 streams; brown trout were found in 184 streams. A total of 320 streams are now eligible for upgrading of their water classification, including 177 unprotected streams to protected status.

Backpack electrofishing a small stream looking for brook trrout.

Coldwater Fisheries Management: Rivers and Streams

East Branch Delaware River

Mark and recapture population studies were conducted to evaluate the impact of releases on the tailwater trout populations at the same four sites as in previous years. Trout abundance ranged from 21 to 217 trout/acre with the biomass ranging from 11.5 to 24.3 lbs/acre. Yearling brown trout were the dominant age group. Compared to the six year averages, trout abundance in 2009 was up at two sites, unchanged at one site, and down at one site; however, trout biomass was up at three sites and down at one site.

West Branch Delaware River

Mark and recapture population studies were conducted at the same four sites sampled most years since 1993 to assess the impact of releases on the tailwater trout populations. Trout abundance ranged from 19 to 187 trout/acre with the biomass ranging from 23.7 to 74.1 lbs/acre. Trout abundance and density were comparable to previous years. The percentage of trout 16 inches and larger ranged from 9 to 42% at the four sites.

Region 5

Batten Kill

The Batten Kill was sampled with backpack electroshocking units and a small barge-mounted generator. The fish data along with the creel survey conducted this year, will allow DEC staff to evaluate the stocking rates and regulation changes. Initial impressions are that the Batten Kill has substantial wild brown and brook trout populations and good survival and growth of stocked brown trout through the first summer.

Barge electrofishing the Batten Kill.

Region 7

Eastern Brook Trout Joint Venture

Region 7 staff surveyed 27 streams in 2009 as part of the Eastern Brook Trout Joint Venture study. These streams were in watersheds where brook trout were predicted to have been extirpated. Brook trout were fairly plentiful in the streams of the east branch of the Tioughnioga River watershed. No brook trout were found in the other presumed extirpated watersheds. Two waters were found that qualify for reclassification to a higher water quality standard.

Cayuga Inlet Juvenile Sea Lamprey Electrofishing Survey

An electrofishing survey was conducted on Cayuga Inlet, during August and September 2009, to determine the presence and density of juvenile sea lampreys above the Cayuga Inlet fishway. Results revealed the presence of juvenile lampreys, which were collected at an average rate of 37.8 per hour. Due to their uniform and large size, the juvenile lampreys collected were likely produced in 2007, the last year lamprey spawning nests were observed above the fishway. The 2009 survey catch rate was high, but juvenile lamprey do not appear to be as abundant as they were in the years prior to Cayuga Inlet being treated with lampricide, a lamprey poison, in 1986 and 1996. Prior to the 1986 lampricide treatment, juvenile lamprey were more than twice as abundant while their density prior to the 1996 treatment was approximately 50% higher. There are no plans to treat the 2007 year class due to cost constraints and to determine the effects of a single year class of sea lamprey on the trout and salmon populations.

2009 Cayuga Inlet Fishway Monitoring

Operation of the Cayuga Inlet fishway continued in spring 2009. The fishway collects fish migrating upstream to spawn. A total of 677 rainbow trout (145 more than the previous spring run), 2,467 white suckers and 1,839 sea lampreys were handled. The vast majority of the rainbows and all the white suckers were passed upstream. All the lampreys were killed to prevent them from spawning upstream. A total of 105,000 wild and 24,000 hybrid eggs were collected and transported to the NYS Bath Fish Hatchery for hatching and rearing. Twenty-four rainbow trout were sacrificed for fish health inspections (VHS, BKD, etc.). No diseases were found. All rainbow trout captured at the fishway were examined for the presence of wounds from sea lamprey attacks. The average wounding rate in 2009 was one of the lowest wounding rates ever observed on rainbow trout handled at the Cayuga Inlet fishway.

Coldwater Fisheries Management: Rivers and Streams

Cayuga Lake Tributary Sea Lamprey Nest Counts

Since 1979, sea lamprey spawning activity in Cayuga Lake tributaries has been monitored by counting the number of lamprey spawning nests found in index sections of Cayuga Inlet, Sixmile Creek, Cascadilla Creek, Fall Creek, Salmon Creek and Yawgers Creek. The total number of nests counted in 2009 (44) was much lower than both the numbers counted during the previous two years and the 30 year average (224 nests per year). The absence of nests in the index sections upstream of the Cayuga Inlet fishway likely indicates that adult lamprey were unable to migrate above it.

2009 Chittenango Creek Electrofishing Survey

On August 20, 2009, an electrofishing survey was conducted on Chittenango Creek to collect base line data on the brown trout population in the reach of stream where a catch and release/artificial lures only regulation will go into effect on October 1, 2010. A 500 ft. section downstream of Olmstead Road and a 600 ft. section downstream of Dyke Road were sampled. Fifty-six brown trout were collected at Olmstead Road and 24 brown trout were collected at Dyke Road. Of the 80 brown trout collected, 20 appeared to be stocked fish, based on observed fin erosion. Subsequent surveys will be used to make comparisons of the trout populations from before and after the regulation change.

Canasawacta Creek Electrofishing

Fish sampling was conducted at two sites on Canasawacta Creek, Chenango County, in order to document fish community characteristics prior to implementation of major habitat restoration work planned for 2010. Currently, much of the stream is warm and lacks significant amounts of deep holding water for trout. Not surprisingly, no trout were captured or observed during the survey. Planned habitat improvements should increase pool habitat, increase available shading over time, and ultimately allow for wild brook trout colonization from headwater areas where they are still locally abundant.

Region 8

Catharine Creek Rainbow Trout Production Survey

Catharine Creek, the main rainbow trout spawning tributary to Seneca Lake, was sampled during summer of 2009 to evaluate trout production. Rainbow trout abundance was estimated at 1,348 YOY trout/acre, well within the range from the 1970's (i.e. 732 to 3,259 trout/acre). Rainbow trout production in Sleepers Creek, the main tributary to Catharine Creek, was 4,083 YOY and age 1+ rainbow trout/acre, less than a third of estimates during the 1970's. It does not appear that rainbow trout production is a limiting factor to adult recruitment in Catharine Creek; however further evaluation of Sleepers Creek is warranted.

Finger Lake Spring Rainbow Trout Electrofishing

Spring rainbow trout spawning runs were monitored in March 2009 in Catharine, Cold Brook, Naples, and Springwater Creeks. Thirty one rainbow trout were caught in Cold Brook, the highest number of trout collected since 2000. Catharine and Naples Creeks' samples were within normal numbers. Springwater Creek numbers remain low.

Electrofishing Havana Glen, a tributary to Catherine Creek, in early spring.

Springwater Creek Rainbow Trout Production

Springwater Creek is the primary spawning tributary for the Hemlock Lake rainbow trout population. The rainbow trout fishery is currently supported entirely by natural reproduction. Standard sites on Springwater Creek have been sampled 13 times since 1962. Mean density of young-of-year rainbow trout was 1,910 per acre, which is lower than the long term average (3,808/acre) and ranked 10th among all years sampled. Mean density of yearling and older rainbow trout was 396 per acre, which is lower than the long term average (1,239/acre) and ranked 11th among all years sampled. Juvenile brown trout abundance appears to be increasing, especially in the lower reaches of the stream. Brown trout are likely competing with rainbow trout.

Region 9

Wild Brook Trout Monitoring in Allegany County

In June, 2009, an electrofishing survey of the wild brook trout population in Spring Mills Creek, located in southeastern Allegany County, was conducted. In 1992, a brown trout stocking policy was removed, eliminating further stocking, due to the existence of a wild brook trout population. Adult brook trout were found at all five sites and YOY brook trout at the upper four sites. DEC staff found an estimated 150 adult brook trout per mile of stream. The population appears to be relatively stable compared to the 1992 and 2002 surveys.

SPECIES MANAGEMENT

Coldwater Fisheries Management: Rivers and Streams

Famed Wiscoy Creek Trout Populations Evaluated

In August, 2009, an electrofishing survey of Wiscoy Creek and two of its major tributaries, Trout Brook and the N. Branch Wiscoy Creek, was conducted. On Wiscoy Creek, the number of yearling and older wild brown trout/mile averaged 956/mile which is considerably lower than was found in 2006 (1,432/mile). In Trout Brook, the number of yearling and older wild brown trout averaged 1,869/mile, higher than the 1,144/mile found in 2006. Yearling and older wild brook trout averaged 475/mile, higher than the 269/mile in 2006. The N. Branch of Wiscoy Creek was sampled at 3 sites with a wide variation in the numbers of yearling and older adult trout found depending on the amount of habitat at each site, ranging from 789/mile to 6,475/mile. The average 2,385/mile was higher than the 1,424/mile in 2006.

Wiscoy Creek brown trout.

Surveys Evaluate Wild Brook Trout in Improved Habitat

In June, 2009, an electrofishing survey of the wild brook trout populations in McIntosh and Beehunter creeks in Allegany State Park was conducted to determine the status of the wild brook trout population in the first year after habitat enhancement in McIntosh Creek. In both streams the abundance of adult brook trout dropped in half from 2008 to 2009. Both streams had few young-of-year and yearlings collected in 2008, so expectations were for low abundance of adults in 2009. A high abundance of young-of-year brook trout was found in both streams in 2009. The good 2009 hatch of trout combined with the enhanced habitat should increase the system's capacity to support wild brook trout.

Electrofishing MacIntosh Creek near a habitat improvement structure.

Surveys for Reclassifying Streams in Region 9

In the summer of 2009, surveys were done on small streams in Cattaraugus and Allegany Counties resulting in 14 streams in need of having their water classifications upgraded from class "C" to "Cts" (ts=trout spawning). Wild brook trout populations were found in these streams indicating they now meet the higher water quality classification. Once reclassified, permits will be required for persons wishing to disturb or encroach on the banks of the creeks, giving the DEC enhanced ability to protect the trout populations in the streams.

Native Brook Trout Collected in Cryder Creek, Allegany County

In September, 2009, an electrofishing survey of five tributaries to Cryder Creek was conducted. Four of the streams had never been sampled, and one of those was previously unknown. In the previously unknown stream, DEC staff found several wild brook trout and brook stickleback, a fairly uncommon species in western NY streams. One of the other previously unsurveyed streams contained a good wild brook trout population below a road culvert, but no fish were found above the culvert. This culvert is acting as a barrier to fish movement farther up the stream. The other two previously unsurveyed streams did not have any trout in the sites we sampled. The other stream that had been surveyed in the past still contains a good population of wild brook trout. All streams where we discovered wild brook trout populations will be included in a list of streams to have their water classifications upgraded to "supporting trout reproduction" (cts).

Inland Creel and Angler Surveys

Region 3

Kensico Reservoir Angler Diary Program 2009

Anglers recorded 217 trips totaling 573 hours of fishing, catching a total of 368 trout. The overall catch rate was 0.64 trout per hour. This is an increase compared to 2008, and still above the average catch rate of 0.51 trout per hour achieved by cooperators fishing from 1987 to 2008. Lake trout dominated the catch, comprising 96% of the total catch. Based on the data reported in 2009, approximately 85% of the lake trout are wild fish. This percentage is the highest we have seen during the diary program.

Region 5

Batten Kill Creel Survey

A creel survey of trout anglers on the Batten Kill was conducted from March to November 2009. This survey was conducted to compare to a similar creel survey conducted in 2002 and to evaluate catch and release regulations and stocking changes. Effort estimates range from 3 hours per acre in an unstocked and inaccessible reach to 585 hours per acre in a stocked and accessible reach. Overall catch rate was 0.60 trout per hour. Ninety-seven percent of anglers surveyed were either neutral or satisfied with the regulations and their angling experience.

Region 6

West Canada Creek Creel Survey

The 1967 creel survey on West Canada Creek reported a 0.5 fish/hour catch rate. Preliminary results from the 2007 creel survey (40 years later) indicate a similar or slightly higher catch rate of 0.54 fish/hour. Satisfaction with the fishing experience is good with 59% of interviewed anglers saying they were satisfied and 39% were very satisfied.

Region 7

2009 Cayuga Lake Angler Diary Program

Coldwater angler participation decreased from 2008 by nine angler cooperators and 325 angler trips. Thirty-four cooperators recorded data from 580 angler trips totaling 2,842 hours of effort for the year. The targeted catch rates of legal size lake trout (0.22/hour) and brown trout (0.04/hour) were similar to the previous year and remained in the range observed over the past several years. The targeted catch rates of legal size rainbow trout (0.006/hour) and landlocked salmon (0.02/hour) were lower than the previous year but within the range observed over the past several years.

2009 Owasco Lake Angler Diary Program

Coldwater angler participation decreased from 2008 by six angler cooperators and 15 angler trips. Thirteen cooperators recorded data from 124 angler trips totaling 608 hours of effort for the year. The targeted catch rates of legal size lake trout (0.20/hour) and brown trout (0.002/hour) were lower than the previous year and lower than the range observed over the past several years. The targeted catch rate of legal size rainbow trout (0.01/hour) was higher than the previous year and remained in the range observed over the past several years.

2009 Skaneateles Lake Angler Diary Program

Coldwater angler participation decreased from 2008 by four angler cooperators and 12 angler trips. Twenty-seven cooperators recorded data from 390 angler trips totaling 1,560 hours of effort for the year. The targeted catch rates of legal size lake trout (0.11/hour) and rainbow trout (0.17/hour) were similar to the previous year and remained in the range observed over the past several years. The targeted catch rate of legal size landlocked salmon (0.01/hour) was lower than the previous year and lower than the range observed over the past several years.

2009 Otisco Lake Angler Diary Program

Angler participation increased in 2009 and effort more than doubled. Fifteen cooperators recorded data from 316 angler trips totaling 1,306 hours of fishing effort for the year. The targeted catch rate of tiger musky (0.13/hour) was the best it's been in more than a decade while targeted catch rates for walleye (0.20/hour) and bass (0.59/hour) remained in the range we've observed over the past several years.

Region 8

Conesus Lake Warmwater Angler Diary Program

The angler diary program was continued on Conesus Lake for the 10th year. Fishing effort by angler diary keepers in 2008-2009 was lower than previous years despite the higher catch rates in 2009. Angler diary keepers caught largemouth bass (60% of the catch), smallmouth bass (18%), northern pike (18%) and walleye (4%). Most bass were between 12 and 15 inches. Northern pike averaged an impressive 30 inches. Anglers specifically targeting walleyes caught 0.25 walleye per hour, the best rate in recent years.

Honeoye Lake Warmwater Angler Diary Program

The angler diary program was continued on Honeoye Lake for the 21st year. Angler participation was similar to the two previous years but remains somewhat low. On average, anglers took 0.85 hours to catch one legal gamefish, very similar to last year's catch rate. Anglers who were specifically targeting largemouth bass continue to have an excellent catch rate of 3.9 bass/hour. Anglers who were specifically targeting walleye had a catch rate of 0.15 walleye/hour. This catch rate is down from last year and is below

Inland Creel and Angler Surveys

the target for New York State waters (0.25 walleye/hour). The walleye population will need to be assessed in the near future to determine the cause of the low catch rates.

Coldwater – Seneca, Keuka, Canandaigua, Candice, and Hemlock Lakes

The Angler Diary programs on Seneca Lake (37 years), Keuka Lake (42 years), Canandaigua Lake (37 years), Canadice Lake (19 years) and Hemlock Lake (19 years) were continued in 2009. The number of hours to catch a legal trout or salmon increased slightly from previous years for Seneca, Keuka, Canandaigua, and Candice Lakes, but catch rates remained good. Lake trout comprise over 90% of the trout and salmon catch in Seneca and Keuka Lakes and over 80% in Canandaigua, Canadice and Hemlock Lakes. The Atlantic salmon catch was up in Seneca Lake with over 100 legal Atlantic salmon reported. Seneca, Keuka, and Canandaigua Lakes appear to be predator heavy and forage poor; therefore fish were more willing to strike anglers offerings.

Region 9

Open Day of Inland Trout Season-Angler Counts

On April 1, 2009, (opening day of the regular trout season), an angler vehicle count survey on trout streams and lakes across Region 9 was conducted to determine relative angler use. Use rates on opening day is a good indicator of the intensity of seasonal angler use. DEC staff counted angler vehicles on 52 stocked streams, 8 stocked ponds and 4 wild trout streams. Whether or not a stream had been stocked pre-season did not appear to have as much to do with the number of angler vehicles counted as the size of the stream and its proximity to population centers did. The three streams with the heaviest use, Ischua Creek (98 vehicles), East Koy Creek (72 vehicles) and Cattaraugus Creek (58 vehicles), are large streams and are within an hour's drive of large population centers. Many smaller streams that had been stocked pre-season had either very low numbers of vehicles or in some cases none at all. Use was not particularly high on the stocked ponds. The four wild trout streams included in the angler count showed lower angler use than the major stocked streams, but higher use than many of the smaller streams that had been stocked.

Wiscoy Creek Angler Diary Program

In 2009, the Region 9 Fisheries Office conducted an angler diary program for Wiscoy Creek in Wyoming and Allegany Counties. The 2009 diary program duplicated studies done in 1997, 2001 and 2006. Overall catch rates on Wiscoy Creek in 2009 (0.77 trout/hour) were significantly lower than in the past three diary programs, adding to the electrofishing findings that the wild brown trout population in the creek is lower than in recent surveys.

Endangered/Rare Fishes

Region 1

Banded Sunfish and Swamp Darter Surveys

In 2009, Region 1 Fisheries Unit completed twenty-six rare and endangered species surveys to characterize the distribution of the banded sunfish (*Enneacanthus obesus*) and the swamp darter (*Etheostoma fusiforme*). Only one water was documented as having banded sunfish present. This unnamed water is within the Peconic River drainage area. No new locations were identified for the presence of swamp darters.

Region 6

Black River Lake Sturgeon Studies

In 2009 a total of 5 adult fish (CPUE= .04 fish/hr) were captured and tagged. A fish previously tagged (Floy Tag #1764) in 2006 was recaptured. Information from this recapture demonstrates potential spawning site fidelity or that a portion of the population is resident.

Black River lake sturgeon.

Paddlefish Recovery Program

Paddlefish rearing and stocking completed its 12th year in 2009. Production in 2009 was conducted at Oneida Hatchery. A companion rearing effort at SUNY Cobleskill was launched in 2009.

Lake Sturgeon Recovery

Lake Sturgeon eggs were taken at the St. Lawrence River below the Moses-Saunders Power Dam and were delivered in June 2009 to the Oneida Hatchery and to the SUNY Cobleskill Hatchery. Unfortunately there was no hatching of the eggs. Egg takes will still be pursued in Spring of 2011.

Endangered/Rare Fishes

Round Whitefish Recovery

Round whitefish were reared in 2009 to be stocked in Spring, 2009, in a previously inhabited but declining water, Chapel Pond.

Longear Sunfish Recovery

Longear sunfish have been reared in ponds in Jefferson County by the Region 6 DEC Unit. The Tonawanda strain was moved to other winter quarters (including S. Otselic Hatchery) in 2009-10. Late in 2009, fingerlings were stocked into Cayuga Creek in Buffalo.

Longeared sunfish.

Region 9

Radio-transmitters Surgically Implanted in Paddlefish

Paddlefish gill netting in the upper Allegheny River caught a total of 19 adult paddlefish, 14 of which were implanted with radio transmitters. To date, 30 paddlefish have received radio-transmitters: 29 were males and 1 female. By tracking the fish, biologists hope to identify spawning habitat in the upper Allegheny River. Paddlefish were extirpated from New York State until stocking efforts were initiated in 1998 in the Allegheny River system. The objective of the stockings is to establish a self-sustaining population of paddlefish in the section of river upstream of Kinzua Dam.

Adult paddlefish.

Young Paddlefish Implanted with Coded Wire Tags

Approximately 160 YOY paddlefish raised at the Oneida Hatchery received coded wire tags. The paddlefish were stocked in the fall of 2009 in a tributary of the Allegheny River as part of an effort by New York to restore paddlefish to the upper Allegheny River system.

Biologists Coauthor Scientific Manuscript on Paddlefish Restoration in NY and PA

DEC Biologists partnered with biologists from Pennsylvania to summarize efforts by Pennsylvania and New York to restore paddlefish to the Allegheny River system. The manuscript is included in the American Fisheries Society proceedings; Paddlefish Management, Propagation and Conservation in the 21st Century.

Longear Sunfish Stocked in Little Buffalo Creek

One thousand ninety four longear sunfish, classified as a threatened species in New York State, were stocked in sections of Little Buffalo Creek that contained preferred habitat for this species. The longears were raised at a rearing pond near Watertown. Biologists hope that these fish will eventually be capable of sustaining themselves through natural reproduction.

Gilt Darters Shipped to Tennessee

DEC biologists, assisted by PA Fish Commission biologists, collected gilt darters (extirpated from New York) from the Allegheny River in Pennsylvania (near East Brady). The darters were shipped overnight to a laboratory in Tennessee for subsequent breeding. If artificial propagation is successful, the offspring will be stocked in the Allegheny River in New York State.

Gilt darter in spawning colors.

FISH CULTURE

Hatchery Improvements

Caledonia Hatchery

Water supply dam repaired

A breach in the water supply dam at Caledonia Hatchery has been repaired so water levels can be maintained to provide maximum water to the water supply intake for the hatchery.

Salmon River Hatchery

New fish pump

A new fish pump was built at Salmon River Hatchery and used to move fish from inside rearing units to the marking trailer for marking 1.6 million Chinook salmon. The new pump saves a considerable amount of manual labor and time.

Composting Fish Carcasses

For the second consecutive year at Salmon River Hatchery, all fish carcasses from the fall salmon egg collection were composted. This has proved to be a more "green" way to dispose of fish carcasses. Approximately 9,100 carcasses were composted.

Rome

Pond enclosures a success

Two east pond enclosures at Rome Hatchery which were built in 2008 have been a great success. An average of 50,000 fish per year have been saved from bird predation.

Construction of Hatchery Rearing Building Begins

A ground breaking ceremony took place in September 2009 at the Rome Hatchery for a new hatchery rearing building. Commissioner Grannis attended the ceremony along with many local dignitaries. The building will house an early rearing area, office, conference room, and visitor center.

Hatchery System Wide

Vehicle Emission Retro-fits

To comply with new air emission standards, all diesel powered fish stocking and waste hauling vehicles are in the process of having diesel emission retro fits installed on their exhaust systems.

Experimental Evaluations

Bath Hatchery

Fish Food Evaluation

A fish food trial was conducted for 5 months on rainbow trout at Bath Hatchery to compare food conversion vs. cost from four different manufacturers. The food used came from BioOregon, Melick Aquafeeds, Silver Cup, and Zeigler Bros. The fish grew the fastest with BioOregon, but the most cost effective feed was from Zeigler Bros.

Chautauqua Hatchery

Egg disinfection experiment

An egg disinfection experiment was conducted at Chautauqua Hatchery to determine the effects of different concentrations of iodine on muskellunge eggs during the water hardening process to control VHS and other viruses moving between parent and egg. Two concentrations were used, and no significant difference in survival was observed. Given the results of the testing, muskellunge eggs will be disinfected at a 50 ppm concentration of iodine during water hardening.

Muskellunge Fingerling Transfer to Vermont

Chautauqua Hatchery raised and transferred 10,000 muskellunge fingerlings to the State of Vermont for restoration efforts in the Missisquoi River where historically there was a muskellunge fishery.

Onieda Hatchery

Special Stocking Program

A new program was established at Oneida Hatchery to produce 50-day walleye fingerlings for stocking. In the first year of this program, 254,000 fifty-day fingerlings were produced and stocked into nine study waters in New York State. The fish were marked as fry in an oxytetracycline bath, so in the future biologists can collect data from the marked walleyes.

Hatchery trucks meet new air emission standards.

FISH CULTURE

Egg Takes from Wild Fish

Landlocked Atlantic salmon

The egg take for landlocked Atlantic salmon at the Adirondack Hatchery met targets with about 1.2 million eggs collected. The collections from Little Clear were disappointing; the take relied heavily on brood stock maintained in the hatchery.

Lake trout

The egg take for Adirondack strain lake trout (from Raquette Lake) was poor; the number of eggs collected was roughly half of the target. Apparently the lake trout were ripe several days earlier than in past years, so the egg collection started after many of the lake trout had spawned.

Windfall Heritage strain of brook trout

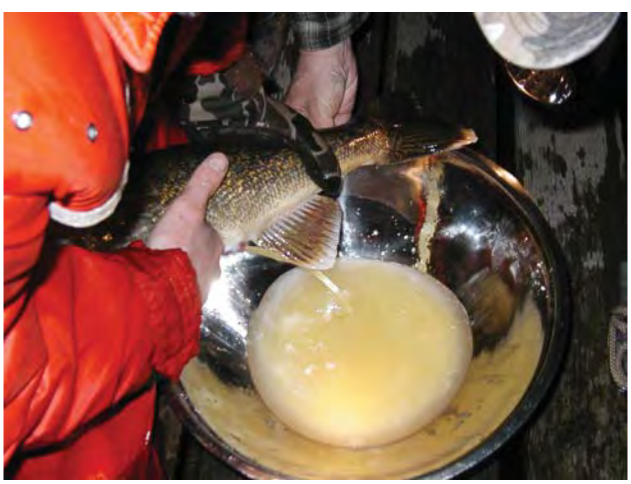
Good numbers of eggs were collected for the Windfall strain of brook trout from both Mountain and Black Ponds (Town of Brighton in Franklin County). These eggs will be reared at South Otselic.

Horn Lake Heritage strain of brook trout

On November 4, a very successful egg take of Horn Lake strain brook trout from Fishbrook Pond in Washington County was conducted, collecting more eggs than were targeted. Nearly 34,000 eggs were transferred to Warren County Hatchery for rearing.

Oswegatchie River Walleye Egg Take

Adult walleye in spawning condition were captured in April 2009 to supply fertilized eggs to the St. Lawrence Valley Sportsman's Club as part of an ongoing cooperative project initiated circa 1986. Walleye were collected by boat electroshocking at a rate of 391/hour, some of the highest densities ever encountered during this spawning run. Approximately 1 million eggs were fertilized and reared, with progeny returned to the St. Lawrence River.



Taking eggs from a large walleye.

Cayuga Lake Egg take

A total of 105,000 wild rainbow trout and 24,000 hybrid rainbow trout eggs were collected and transported to the NYS Bath Fish Hatchery for hatching and rearing.

Lake Sturgeon Egg Take

Lake sturgeon, a state threatened species, have been the subject of an active restoration program since 1993. An egg take attempt was made from St. Lawrence River fish at Massena in 2009. A total of 92 sturgeon were collected, of which 2 females and 9 males were held for spawning. Eggs were taken and fertilized (approximately 114,000) and split between two culture facilities. Unfortunately there were problems in fertilization, and no progeny were produced.

Heritage Strain Brook Trout Egg Take

In an effort to maintain genetically distinct populations of Adirondack brook trout (heritage strains), Region 6 completed egg takes for Little Tupper strain, primarily at Boottree Pond in the Massawepie Easement. Besides helping to maintain heritage genetics, these fish are thought to have a higher potential to thrive and spawn in the water conditions common to Adirondack ponds. Region 6 is in the process of establishing new brood waters for the various heritage strains in order to facilitate a greater reliance on heritage strain fish in the DEC stocking program.

Little Tupper strain brook trout from Boottree Pond.

Annual Production

Report Date 5/4/2010

ANNUAL STOCKING REPORT - BY SPECIES

January 1, 2009 - December 31, 2009

	LESS THAN 1"		1" - 4.24"		4.25" - 5.74"		5.75" - 6.74"		6.75" - 7.74"		7.75" Plus		TOTAL	
SPECIES	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT
Cold Water														
Brook Trout			154,320	3,404	235,065	8,677			400	54	160,580	50,614	550,365	62,749
Brown Trout			136,490	1,983	123,650	8,214	116,000	10,716	13,490	2,369	1,833,725	537,057	2,223,355	560,339
Rainbow Trout			55,100	743	75,100	4,838	50,660	4,217	15,000	2,500	356,402	103,490	552,262	115,788
Steelhead			80,000	1,067	599,150	23,990	246,160	20,108					925,310	45,165
Lake Trout					81,200	3,401	243,160	16,912	356,700	30,679	94,500	13,929	775,560	64,921
Splake											8,500	2,921	8,500	2,921
Landlocked Salm	677,810	23,314					51,100	5,113	96,770	12,105	390	1,854	826,070	42,386
Coho			155,000	3,832			95,420	7,340					250,420	11,172
Chinook			1,721,410	19,910	27,000	692							1,748,410	20,602
Cold Water Total	**677,810**	**23,314**	**2,302,320**	**30,939**	**1,141,165**	**49,812**	**802,500**	**64,406**	**482,360**	**47,707**	**2,454,097**	**709,865**	**7,860,252**	**926,043**
Warm Water														
Walleye	197,324,000	2,630	811,800	761	38,000	1,434							198,173,800	4,825
Muskellunge							2,450	70			19,590	1,514	22,040	1,584
Tiger Muskellung											77,760	9,167	77,760	9,167
Panfish											500	100	500	100
Paddlefish											160	53	160	53
Warm Water Total	**197,324,000**	**2,630**	**811,800**	**761**	**38,000**	**1,434**	**2,450**	**70**			**98,010**	**10,834**	**198,274,260**	**15,729**
Grand Total	**198,001,810**	**25,944**	**3,114,120**	**31,700**	**1,179,165**	**51,246**	**804,950**	**64,476**	**482,360**	**47,707**	**2,552,107**	**720,699**	**206,134,512**	**941,772**

Stocking loon lake

FISH HEALTH

Fish Health Collections/Fish Kill Investigations

Fish Health Collections

Fish Health

The NYSDEC Rome Fish Disease Control Center maintains a fish health program for the DEC hatchery system. No regulated diseases were found in any DEC hatchery and the overall health of the fish is excellent. To monitor the relative health of wild fish across the state, the Fish Disease Control Unit and the USFWS collaborated to conduct a statewide surveillance of regulated fish diseases and various emerging diseases from 27 locations, and no pathogens have been found.

New York City Reservoir tailwater mercury analyses

Fish samples were collected from Rondout Creek, Honk Lake, Neversink River, East Branch Croton River and West Branch Croton River as part of a mercury sampling program. The sections sampled were downstream of New York City operated reservoirs located on those rivers. The fish samples were analyzed for mercury, and approximately half of the samples were analyzed for PCBs and selected pesticides. Analyses were conducted by the Analytical Services Unit at Hale Creek Field Station. All results were below actionable levels.

Region 4 Fish Health Collections

Thirty game fish and 60 panfish (all the same species) were collected from Alcove Reservoir, Canadarago Lake, and the Mohawk River (below Lock 8) for fish disease testing. All fish tested negative for Viral Hemorrhagic Septicemia (VHS), spring viremia of carp (SVC), frunculosis, enteric red mouth, and infectious pancreatic necrosis (IPN).

Delaware Tailwater Mercury Testing

Brown and rainbow trout in the West and East Branches of the Delaware River downstream of Cannonsville and Pepacton Reservoirs had mercury concentrations averaging less than 0.2 ppm. Walleye from the West and East Branches averaged 0.63 and 0.7 ppm, respectively. Special health advisories for the consumption of fish from these two rivers are not necessary at this time.

Delta Lake – National Wild Fish Health Survey

Due to its proximity to the Rome Fish Hatchery, Delta Lake continues to be selected for the National Wild Fish Health Survey on an annual basis. Yellow perch, smallmouth bass, walleye, northern pike and chain pickerel were sent to the federal Lamar Fish Health Center as part of the survey. Lab results show that this water remains clear of significant fish diseases.

Hinckley Reservoir - National Wild Fish Health Survey

Hinckley Reservoir was sampled as part of the National Wild Fish Health Survey. Sixty yellow perch and 28 smallmouth bass were sent to the federal Lamar Fish Health Center as part of the National Wild Fish Health survey. Results of this and other surveys indicate that efforts to prevent the spread of important fish diseases such as VHS into the Mohawk watershed have, so far, been successful.

Region 7 - National Wild Fish Health Survey

Yellow perch were collected from Owasco Lake, bluegills and largemouth bass were collected from Panther Lake and walleyes were collected from Whitney Point Reservoir. These collections were shipped to the USFWS Fish Health Center in Lamar, Pennsylvania for health inspection. All these fish tested negative for a wide range of pathogens including VHS.

Cayuga Inlet Fish Health Inspection

Rainbow trout collected at the Cayuga Inlet fishway were transported to the Rome Lab for health inspection. The rainbow trout tested negative for a wide range of pathogens including VHS.

Fish Kill Investigations

Peconic River Fish Kill/Disease investigation

In March of 2009 the Peconic River experienced a fish kill for the second year in a row. In both years the primary species killed were bluegill and pumpkinseed sunfish, and the Regional Fisheries Unit was able to collect distressed fish and ship them to Cornell University for diagnosis. The fish sampled were found to have a heavy infestation with the gill fluke *Dactylogyrus* and a systemic infection with the bacterium *Pseudomonas putida*. To follow up, collections of apparently healthy sunfish were made from the area of the fish kill and an area where the kill did not occur in September and sent to Cornell. These fish were found to have light Dactylogyrus infestations and heavy internal parasitism of the renal, hepatic and cardiac tissues by digenean organisms (parasitic flatworms). No difference was found between the fish in the area where the kill occurred and where it didn't. Cornell's conclusion was that the heavy parasite burdens carried by these fish made them very susceptible to secondary infection and subsequent kills during stressful periods.

PUBLIC USE & OUTREACH

Fishing/Boating Access

Region 4

FWMA Cooperative Agreement-Susquehanna River

DEC entered into a cooperative agreement with the Otsego County Land Trust to provide anglers with 1,400+ feet of public fishing rights on the upper Susquehanna River. Development will include a parking area, footpath, information kiosk, and a cartop boat slide at this new site south of Cooperstown.

FWMA Cooperative Agreement-West Branch Delaware River

DEC entered into a cooperative agreement with the Deposit Wood Pellet LLC to keep open 1,200 feet of shoreline on the No Kill reach of the West Branch Delaware River tailwater trout fishery in Deposit. A 10-12 car parking area will be developed.

West Branch Delaware River Boat Launch

A trailered boat launch on the West Branch Delaware River tailwater by Deposit was completed in July. It involved the construction of an approximately 1,000 foot roadway, a 100 x 120 foot parking area, and a gravel launch. Hopefully, this access site will reduce conflicts between the wade and boat anglers in the 3.5 miles of river above the access site when river flows are boatable.

Region 9

Angler's Lot Completed on Noted Steelhead Stream

Fisheries staff coordinated with the Village of Westfield and NYS-DOT in the construction of a parking lot in the "catch and release" steelhead section of Chautauqua Creek. Chautauqua Creek, a premier steelhead stream that enters Lake Erie in Westfield, NY, in one of the most popular steelhead streams in Western New York.

Niagara River Aquatic Habitat and Access Projects Continue

Expansion of the parking lot at the Niagara Power Project fishing/observation platform overlooking the lower Niagara River began in 2009. This access improvement resulted from re-negotiation of the Federal Energy Regulatory Authority (FERC) license that expired in 2007. Parking was expanded from several exclusively ADA spots to a substantially larger number of ADA and all-use spots. Previously, anglers and observers had to park at the top of the Niagara escarpment and walk approximately ½ mile downhill to the platform. This unique fishing platform, situated over the massive power project discharge, provides outstanding angling for numerous sport fish, including muskellunge, salmon, trout, bass and walleye.

Lewiston (Niagara River) Launch Restored With Oxi-NRD Funds

Replacement of the Lewiston Boat Launch, the key boat launch site on the Lower Niagara River, began during the first week in October. Construction of new concrete pads and floating, universal access docks was funded through the Occidental Chemical/Natural Resource Damages Settlement. In addition to replacement of the platform, the grinder at the fish cleaning station was replaced and improvements to the cleaning table were completed. The launch pad construction followed a push-slab design where the concrete was poured into a form on-site and then pushed into position.

Central Office

Public Fishing Rights (PFR)

Just under 3 equivalent miles of PFR were acquired and purchase agreements were signed on another 3.2 miles. Waters include Hoosic River (Region 4), Black River (Region 6), Goodell Creek and N. Branch Wiscoy (Region 9) Two parking areas were also acquired on the Willowemoc Creek (Region 3) and Black River (Region 6).

RBFF/DEC Direct Mail Marketing of Lapsed Anglers

New York is one of over 30 states cooperating in this program to encourage lapsed anglers to once again purchase a fishing license. The overall response rate to the program in NY increased from 9.6% in 2008 to 10.8% in 2009. Despite this higher response rate, lift (the difference in response rate between the control and treatment group) was poor, not exceeding 1.5% in any of the cooperating states. New York had a lift of 0.5% in 2009. The poor lift was primarily attributed to the fact that fishing license sales were up nationwide this year as a positive response to poor economic conditions and license buyers were not influenced by the direct mail effort as they typically would have been.

New York State Boat Launch Directory Updated

Last printed in 2005, the New York State Boat Launching Sites Guide was recently updated and reprinted. Produced in cooperation with NYS Parks & Recreation and Canal Corp., the guide contains a listing of over 500 state and municipal access and boat launching sites. The boat launch coverage was also included in the DEC mapping gateway, providing anglers and boaters detailed driving directions to each site.

Aquatic Education/Outreach

Region 1

Region1 I FISH NY

The Region 1 Fisheries Unit I FISH NY Program conducted 36 out-of-school outreach and education programs reaching over 9,000 people during 2009-10. The Annual Spring Fishing Festival attendance topped 5,000 people for the second year in a row. Over 1,000 people attended 13 fishing clinics and 800 children were given fishing instruction in 11 programs at five different summer camps.

I FISH NY in school programs were conducted in 20 different schools, providing fishing instruction to nearly 2,000 children. Nearly all of these children went fishing as part of the program. This is a 33% increase in the number of schools and a 17% increase in the number of children taught from the previous year.

Spring Fishing Festival at Belmont Lake State Park.

Region 2

Region 2 I FISH NY

The Region 2 Fisheries Unit I FISH NY Program conducted 177 in-school events, creating 4,130 educational contacts (many students were given more than one lesson). Approximately 1,200 NYC public school students received two in-class lessons on fish anatomy, diversity, or freshwater ecology and were taken fishing at a local water body. In addition, 20 out-of-school outreach and educational programs were also conducted, reaching over 1,500 people.

Hutton Junior Fisheries Program Student Joins R2 Fisheries

A Brooklyn high school student accepted to the American Fisheries Society (AFS) Hutton Junior Fisheries Biology Program worked with R2 Fisheries during the summer of 2009. The AFS-sponsored Hutton Program seeks to encourage interest in fisheries careers in underrepresented groups by placing junior and senior high school students with fisheries professionals and awarding scholarships to these students. The student placed in Region 2 participated in fisheries surveys and fishing events while completing a project involving correlating fish age data with length and weight measurements obtained in the field. Both the student and Region 2 staff benefited from this program.

American Fisheries Society Hutton Scholarship student, Vincent Tao, helping students fish.

Fishing Club at Lincoln Square Community Center

Approximately 15 youth participated in the Region 2 I FISH NY program's first fishing club. Participants were taught fishing and aquatic education at a more advanced level than that provided in our one-day programs. An assessment and "graduation" were included in the club program.

Urban Park Ranger Aquatic Resources Training

Approximately 20 NYC Urban Park Rangers received a third training from I FISH NY staff on October 22, 2009. This training focused on local freshwater and saltwater fish identification and distribution, dangers of releasing invasive species, and fresh and saltwater fishing regulations, including information on the saltwater fishing license requirement. Staff from the NYS Department of Health also participated in this training and provided detailed information on fish consumption advisory information for the New York City area. Trainings such as these are invaluable in disseminating DEC information to a wider public than we can reach directly.

Website

Web pages for five New York City fishable water bodies were created. Pages describe fish species present with fishing advice, transportation directions and relevant regulations.

PUBLIC USE & OUTREACH

Aquatic Education/Outreach

AFS NY Chapter Presentation

The presentation "Program Assessment for Angling Outreach in an Urban Area: A Case Study from NYC Schoolchildren" was given by staff at the New York Chapter meeting of the American Fisheries Society in Lake George, NY. The presentation highlighted the importance of collecting baseline data on angling stewardship and attitudes and using multiple evaluation approaches where feasible. Results of the assessment indicated that students had anincreased interest in fishing after the in-school program. Evaluated students showed retention of lessons teaching reducing harm to fish caught and the need for regulations to keep fishing sustainable.

NYC Getting Started Fishing Brochure Produced

Staff developed the brochure "Getting Started Fishing in NYC" which provides the basics necessary for NYC residents to get started fishing in New York City (equipment, methods used to catch fish, regulations and contacts for more information).

Region 3

Suffern Sportsman Show

On March 4-7, 2010, thousands of anglers gathered at the Suffern Sportsman Show in Rockland County. Region 3 Fisheries Staff was on hand daily to promote fishing and to sell fishing licenses. People who visited the booth were able to talk fishing with our staff, receive literature, view mounts of our state record fish, and the kids were entertained while playing velcro-fishing! License sales totaled $14,280.

Region 3 Web Pages

A total of 18 new pages under "Places to Fish" were created for Region 3 waters. Additionally Region 3 continually updates a fishing hotline page weekly.

I FISH NY

Region 3 fisheries staff conducted 8 school programs reaching 610 kids, 8 fishing clinics reaching 650 people, 3 fishing festivals reaching 225 people and 4 summer camps reaching 235 campers. A total of 1,720 people were reached through these events.

Region 6

Jefferson County Environmental Awareness Days

Over 1,200 sixth graders were presented with information regarding Jefferson County waters and fish communities. Despite marginal weather and warnings that the fish were cold, slimy and attracting bees, hands on activities with iced fish generated great enthusiasm and many good questions.

Region 7

Outreach and Education Events

Regional staff conducted or assisted with 22 fishing education programs that reached almost 2,400 participants, including 12 school related programs/events reaching 1,455 students.

Surpise! This large grass carp was caught during a fishing clinic at the South Otselic Fish Hatchery.

New York State Fair

Regional fisheries staff worked at the fair helping man the Division of Fish, Wildlife and Marine Resources booth inside the DEC Aquarium building. Hunting and fishing licenses were sold using the DECALS automated licensing system which operated with very little down time. Questions from the public were answered during the license sales process.

Website

Regional staff added 32 new pages and 7 PDFs to the DEC web site. The pages were a mix of "Places to Fish" and "Biologist Reports." In addition, the Central New York hotline page was updated weekly. This page is the second most popular fisheries page, receiving over 113,000 page views in 2009-10.

Region 8

Local High School Students Learn About Fisheries Management

For the eighth consecutive year, Region 8 Fisheries staff cooperated with Delta Laboratories' Adopt-a-Stream program to provide about 80 Environmental Studies students from four area high schools a hands-on demonstration of fisheries management techniques. Boat electrofishing was demonstrated in Thousand Acre Pond in Mendon Ponds Park. Demonstrations were also given in water quality, benthic in-

Aquatic Education/Outreach

vertebrates, fish seining, and fish scale aging and data interpretation. Students had the opportunity to capture, handle, identify, and measure live native fish, and age fish scales.

Fishing Rod Lending Program

Regional Fisheries staff teamed up with the New York State Conservation Officers Association (NYSCOA), Shikar Safari, Dansville Rod and Gun Club and the Dansville Public Library to establish a library fishing pole lending program. Pole and reels, purchased with funds from the Federal Sport Fish Restoration Act, were supplied by the DEC. The Dansville Rod and Gun Club provided bobbers and hooks (with spares) and have agreed to service and repair the rods and reels. NYSCOA reprinted the "Getting Started, A beginner's Guide to Freshwater Fishing" booklets with funds from Shikar Safari. It is hoped that this effort will spread to other communities in Region 8.

Region 9

Outreach and Education Events

Regional staff conducted or assisted with 10 fishing education programs that reached almost 1,040 participants, including 2 school related programs/events reaching 220 students. Six promotional shows were attended, providing fishing related information to show attendees.

Teaching fish ID at the Tifft Fishing Clinic.

Website

Regional fisheries staff added 13 new webpages and 3 new PDFs to the DEC website. The webpages included "Smallmouth Bass Fishing on Lake Erie" and "Steelhead Fishing in Lake Erie Tributaries," both important fisheries in Western New York. Ice fishing pages were posted in response to inquiries by website visitors and anglers. Additionally, 30 PDF maps of Public Fishing Rights streams were updated to a more user friendly format that is the new state standard. Two fishing hotlines covering the major fishing waters of Region 9 and the western half of Region 8 were updated on a weekly basis. Those pages received 96,005 page views during the year, increasing 5 to 24 percent over the 2008-09 page views.

Central Office

Website

Central office staff posted 15 new web pages, 68 new PDF files and made 156 web page revisions during 2009-10. Most of the page revisions were updating the Spring Stocking Lists (what will be stocked in the current year) and the "Fish Stocking Lists" (what was stocked in the past year). Information varied, but many much needed web pages were added to our "Places to Fish" section and "Biologist Reports" section of the website. There are now over 600 pages of fisheries related content on the website.

Central Office I FISH NY

Central Office fisheries staff conducted 46 fishing education programs that reached approximately 1,850 participants, including 30 programs at summer camps reaching 879 campers.

Conservationist for Kids!

The spring 2010 "Fish" issue of the New York State Conservationist for Kids! (C4K) was produced and printed during 2009-10. The publication provided information about fresh and salt water fish, fish features, the aquatic food chain, a one page introduction to fishing, 15 common sportfish of New York, and fish related activities. The C4K is an insert that goes into every Conservationist magazine that is sent out by the DEC. In addition, this issue was sent to 260,000 fourth graders across New York. An additional 100,000 copies were printed for distribution at DEC Regional Offices, Fish Hatcheries and at events and fishing clinics.

Getting Started manuals

The "Getting Started: A beginners guide to freshwater fishing" manual was reprinted. The manual, first produced in 1992, has been revised several times. A total of 3,500 copies of the 73 page manual were produced. These manuals will be used to support fishing clinic activities.

Angler Education Kits

Angler Education Kits were assembled, consisting of a plastic tote with 25 rigged collapsible spincast rods, eye bolts with rope for teaching knots, several backyard bass for teaching casting, laminated fish for teaching fish identification, extra hooks and bobbers, and various literature for education purposes. The totes will easily fit into the trunk of a car, so the fishing clinic kits are highly mobile and can serve a greater audience as a result. They are intended to be loaned out to groups from Regional Offices.

Region 1

Region 1 Fisheries Unit coordinates cooperative water chestnut eradication in Swan Pond -

In 2008 the Region 1 Fisheries Unit conducted a water chestnut (*Trapa natans*) removal effort in Swan Pond in Calverton, removing about 120 plants. A follow up survey in 2009 was conducted to determine if any water chestnut remained in the pond. The survey found only two small patches of water chestnut, each consisting of less than 20 plants which were removed. Based upon the findings of this survey, it appears that this infestation was caught early enough that complete eradication will be possible.

Water chestnut, an invasive species, was pulled from both Swan Pond, Region 1, and Otisco Lake, Region 7 to prevent further spread.

Peconic River Ludwigia Removal

The Regional Fisheries Unit continued its cooperation in the effort to remove Ludwigia (floating primrose willow) from the Peconic River. Fisheries staff participated in both days of hand removal operations, providing instruction on identifying and pulling the plant and leading the downstream removal. This was the fourth year of hand removal operations and the success in Ludwigia control continued in 2009. After removing 60 cubic yards of Ludwigia in each of 2006 and 2007, only 6 cubic yards were found and removed in 2008 and only 4 cubic yards in 2009.

Hydrilla in Lake Ronkonkoma

In June of 2009, Division of Water staff discovered Hydrilla growing at two locations in Lake Ronkonkoma, Suffolk County. A follow up survey by Regional Fisheries Unit staff found Hydrilla at 16 of 22 sites sampled, but only at trace or sparse densities in all but one of the samples. Because the Hydrilla was so widespread in the lake, it is likely that it had been in the lake for several years at low levels without being detected. The wide distribution, sparse density and poor water clarity in the lake make hand removal impractical. Therefore, the best course of action was to raise public awareness of the problem and monitor it over time. To raise public awareness an invasive species drop box and signs were installed at the Lake Ronkonkoma Fishing Access Site. The Regional Fisheries Unit also agreed to monitor the infestation by conducting annual SAV surveys of Lake Ronkonkoma.

Region 5

New York Provided Rotenone to Help Stop Asian Carp

In concert with other Great Lakes States, New York did its share of preventing the spread of Asian Carp into the Great Lakes by providing 1,500 gallons of rotenone to Illinois to eliminate the dangerous invasive from a portion of the Chicago Sanitary and Shipping Canal. The hope is to prevent Asian carp from entering the Great Lakes, including NY portions of Lakes Erie and Ontario.

Brook trout and round whitefish restoration in Ledge Pond

The Bureau of Fisheries reclaimed Ledge Pond in the St. Regis Canoe Area on October 20-23, 2009 to remove non-native fishes. Expectations are to restock the pond with the Windfall Heritage strain of brook trout and with the endangered round whitefish.

Stream habitat structures in Kayaderosseras Creek at Kelly Park

As part of the permit for the Saratoga County Water Authority to run a water line from the Hudson River in the Town of Moreau to Malta, funds for stream habitat and restoration were provided for the Kayaderosseras and Snook Kill watersheds. Two J-hooks were placed in Kayaderosseras Creek to help stabilize the banks and create much needed fish habitat. Boulder clusters were created with extra stone that was not used for the J-hooks. The clusters create areas of cover and pockets of slow water for resting and feeding.

Region 6

Ecosystem-Based Management

As a member of the Sandy Creeks Ecosystem-Based Management Steering Committee, Regional Fisheries staff continued activities involving riparian and streambank restoration as well as education and outreach through the implementation of kiosks and interpretive panels.

Region 7

Otisco Lake Water Chestnut Control

In contrast to the previous three summers, Region 7 Fisheries staff did not have to spend any time pulling water chestnut from Otisco Lake in 2009. Instead, a volunteer group of approximately 10 individuals spent just a single evening hand pulling the relatively small patch of water chestnut plants from Turtle Bay. Fisheries staff spent just a half-day inspecting the entire lake shoreline for the presence of any satellite plants but found none. The labor intensive, annual hand pulling effort started in 2006 by Region 7 Fisheries staff has succeeded in dramatically reducing the number of water chestnut plants in Turtle Bay by approximately 85-90%. Continued hand pulling efforts in coming years are expected to eventually result in complete eradication of this invasive aquatic plant.

Ninemile Creek RR Tunnel Repair

Staff worked with owners of the Finger Lakes Railway Corporation to minimize negative impacts to Ninemile Creek, in Marcellus Falls, during emergency repairs to a pair of 100+ year old tunnels that carry the creek under the railroad. To help design a plan to reconstruct the stream approach to the tunnels, an expert on “Natural Stream Design” from the U.S. Fish and Wildlife Service was brought in at the urging of DEC Fisheries staff. The resulting design is expected to reduce the chances of future tunnel failure and has created quality trout habitat through the impacted reach of stream.

Mead Brook Fish Passage Improvement

Fisheries staff worked with local highway department officials to develop and implement a solution which improved fish passage and eliminated a scour hole at this known brook trout stream located in the Town of Cincinnatus, Cortland County. Through the addition of a double cross vane structure set downstream of the culvert at an elevation slightly higher than the invert of the culvert, a ten inch drop was eliminated which should allow for fish passage during almost any flow condition.

Gilmore Brook Culvert Fish Passage Project

Fisheries staff worked with local highway department officials to develop and implement a solution which improved fish passage and stabilized a failing rock retaining wall at a culvert on Gilmore Brook, in the Town of Norwich, Chenango County. The solution incorporated a single cross vane at the tail-out of the culvert plunge pool that was set at an elevation which eliminated a 9 inch drop at the culvert. The cross vane, in conjunction with the addition of a splash apron, is expected to eliminate undermining of the walls footer and improve fish passage through the culvert in this documented wild brook trout stream.

Mead Brook before fish passage improvement.

Mead Brook after fish passage improvement.

Region 8

Catharine Creek Aquatic Habitat Restoration, Revisited.

Catherine Creek aquatic habitat restoration projects were completed in 1999. A 10 year post construction photographic documentation effort was conducted in November 2009. Most sites appeared to be stable and performing as designed.

Region 9

Genesee River Bank Erosion Stabilized

Fisheries Staff and the ACOE designed and implemented a bank stabilization plan for the Genesee River near Scio, NY. Severe bank erosion had threatened County Rt 219 and caused siltation downstream of the site. Improvements included the towing in of large stone, the construction of bend-way weirs and the planting of vegetation cover (vegetation had not expanded as of spring, 2009). The weirs will move the thalweg (deepest part of the stream channel) away from the eroding bank, deepening the central channel, and providing fisheries habitat.

HABITAT PROTECTION/MANAGEMENT

Niagara River Shoreline Restored

Biologist Wilkinson and Environmental Conservation Officers investigated a report of fill placed along the banks of the Upper Niagara River. The material was removed and the bank stabilized, vegetated and restored to its original slope.

Experimental Vegetation Planted To Stabilize Stream Banks

An experimental planting of dwarf sand cherry along Chautauqua Creek was evaluated. The dwarf sand cherry were planted in April 2008 in an effort to reestablish the plant in WNY and determine its effectiveness. The plant is used in streambank stabilization and will tolerate inundation. The plants survived through a number of flood events and an ice-choked channel during the winter and should provide riparian cover, stability and aesthetic improvements.

Sprouted dwarf sand cherry.

DEC and DOT Partner on Cattaraugus Creek Bridge Protection

DEC staff provided oversight and support during the riprapping of a section of Cattaraugus Creek under the Route 16 bridge. Prior to stone placement, willow poles were planted to enhance habitat in the riparian zone.

Frog Island Design in the Niagara River

DEC biologists provided guidance towards the design for the Frog Island/Wetland habitat improvement project in the Upper Niagara River. The project consists of a new complex of emergent and submergent aquatic vegetation in an existing five acre area located between Strawberry Island and Motor Island that currently supports minimal aquatic vegetation. The primary goal is to protect emergent/submergent aquatic habitat that is being eliminated along the river due to water fluctuations, ice and recreational activities. The project is one of about a dozen habitat improvement projects that were negotiated as part of the settlement for the New York Power Authority (NYPA) Niagara Power Project.

Violation leads to Fish Habitat Improvements

Biologist Galati assisted in the final resolution of an enforcement action on Clear Creek (Ellington), a protected water that supports wild brown trout. The resolution involved restoring and enhancing a 2,500 foot reach with rock toe protection, bend-way weirs, vanes, tree revetments and willow pole planting. The enforcement action also resulted in monetary fines totaling $15,000.

Biologists Review Beaver Island/Niagara River Improvement Project

Biologist Galati provided comments to NYPA regarding the Beaver Island habitat project. As part of the Robert Moses relicensing, the southern tip of Beaver Island will be restored to its pre-existing wetland condition. Biologists expect this habitat to be heavily used by wading birds and as spawning and nursery habitat for fish.

Repairs completed to stream restoration project on Wiscoy Creek

In late April, Region 9 Fisheries assisted USFWS staff in repairing a stream diversion structure on Wiscoy Creek in Wyoming County. The structure was built in late summer, 2009, to return stream flow to the stream's original channel which contained high quality trout habitat. The structure was designed to allow bank full stream flows to overtop it. The overflow area, which had not had time to vegetate, was damaged during very high runoff in January, 2010. New fill was placed in the overflow area. Sod containing reed canary grass was placed over the fill and live willow clumps were also incorporated.

DEC Fisheries/Forestry Partner with Conservation Groups For Tree Plantings

This spring, Region 9 Fisheries staff coordinated with three local Trout Unlimited groups, a county highway department and a local university to plant over 3,200 shrubs and shade trees along public trout streams in the region. The shrubs, mostly streamco willow and red osier dogwood, have extensive root systems that help to hold stream banks in place and reduce erosion while the larger shade trees such as silver maple will eventually provide shading to help cool the streams. These trees were provided by the DEC Bureau of Forestry tree nursery in Saratoga.

FISHERIES/ANGLER SURVEYS

Name	Purpose
Region 1	
Beaver Brook	Brook Trout Assessment
Randall Pond	Centrachid survey/TSMP
Forest City Park Pond	TSMP/Disease/Centrarchid
Forge Pond	DOH/BNL/USFWS
Spring Lake	TSMP/Disease/Centrarchid
Freeport Reservoir	TSMP
Peconic Lake	Fish Kill
Upper Mills Pond	Fish Kill
Peconic River (BNL)	Radiation
Lake Ronkonkoma	Physical/Chemistry
Little Neck Run	Brook Trout Assessment
Yaphank Creek	Brook Trout Assessment
Beaverdam Creek	Brook Trout Assessment
Connetquot River	CROTS/Disease
Lake Ronkonkoma	Centrarchid survey
Sunken Meadow Creek	Other
29 Regional Waters	Rare/Endangered Species
Region 2	
Unnamed Waters (Staten Is.)	Rare/Endangered Species
Van Cortlandt Lake	Centrarchid Survey/Wild fish health study
Harlem Meer	Centrarchid Survey/Northern snakeheads
Central Park Lake	Centrarchid Survey
Meadow Lake	General Biological Survey/ Snakehead collection
Clove Lake	General Biological Survey/ wild fish health study
Region 3	
Beaver Kill	Disease testing
Alder Creek	Disease testing
Philipsburg Creek	Article 15 assessment
Braden Brook	Article 15 assessment
Fowlwood Brook	Article 15 assessment
Esopus Creek	Trout collection for radio telemetry study
Sylvan Lake	Water chemistry profile
Wappingers Creek	CROTS survey
Unnamed stream D-1-22-3-3	Article 15 assessment
Unnamed stream D-1-22	Article 15 assessment
Unnamed stream D-1-22-3-1-1	Article 15 assessment
Unnamed stream D-1-22-3-1	Article 15 assessment
Unnamed stream D-1-22-3	Article 15 assessment
Rondout Reservoir	Trout assessment
Neversink River	TSMP - Mercury
Honk Lake	TSMP – Mercury
Rondout Creek	TSMP – Mercury
Willowemoc Creek	Stocking evaluation
Neversink River	Population estimate
East Branch Croton River	TSMP – Mercury
West Branch Croton River	TSMP – Mercury
Swinging Bridge Reservoir	Percid Plan assessment
Rondout Creek (tidal portion)	Black bass pop. assessment
Toronto Reservoir	Warmwater fish assessment
Esopus Creek (tidal portion)	Black bass pop. assessment
Catlin Creek and tributaries	Northern snakehead eradication effort and follow-up assessment
Region 4	
Shaver Pond	Stocked trout assessment
Alcove Reservoir	Fish health collections
Canadarago Lake	Fish health collections
Mohawk River (below Lock 8)	Fish health collections
Otsego Lake	Walleye population study
Huggins Lake	Brook trout population study
West Branch Delaware River	TSMP
East Branch Delaware River	TSMP
Schoharie Creek (below B-G dam)	TSMP
Travis Pond	Centrarchid survey
Snyders Lake	Centrarchid survey
Upper Blenheim-Gilboa Reservoir	Percid sampling
Mohawk River (3 locations)	Adult blueback herring assess.
Snyders Lake	Percid survey
East Branch Delaware River	Trout population study
West Branch Delaware River	Trout population studies
Vly Creek	CROTS survey
West Kill	CROTS survey
Bear Swamp Pond	Biological survey
Vale Park Pond (lower and upper)	Biological survey
Pea Brook	CROTS survey
Beauchoix Brook	CROTS survey
Kinderhook Lake	Percid survey
Delaware River	Snorkel survey
Spring Brook (2 sites)	Trout population studies
Canadarago Lake	Percid survey
Hudson River (2 sites)	Bass wintering area assess.
Small stream surveys	Eastern brook trout joint venture project (776 streams)
Region 5	
Rock Pond	Other, see comments
Little Rock Pond	Post-Reclamation survey
Union Falls Pond	Other, see comments
Rainbow Lake	Whirling disease sampling
Oliver Pond	General biological survey
Clear Pond	General biological survey
Long Pond	Post-liming survey
Benz Pond	Post-liming survey
Icehouse Pond	Post-liming survey

FISHERIES/ANGLER SURVEYS

Name	Purpose
Lake Champlain	Centrarchid sampling plan
Lower Sargent Pond	General biological survey
St. Germain Pond	Pre-liming survey
Cooler Pond	Post-liming survey
House Pond	Pre-liming survey
Winch Pond	General biological survey
Duck Pond	Pre-liming survey
Holmes Lake	Post-liming survey
Grass Pond	General biological survey
Fishhole Pond	General biological survey
Unnamed Water	General biological survey
Coldspring Pond	Evaluate exp stocking water
Thirteenth Lake	General biological survey
Batten Kill	CROTS survey
Upper Chateaugay Lake	General biological survey
Loon Lake	Evaluate exp stocking water
Fishbrook Pond	Egg take
Lake George	Other
Lower Cascade Lake	Rare/endangered species
Castle Creek	General biological survey
Unnamed Water	General biological survey
Unnamed Water	General biological survey
Unnamed Water	General biological survey
Unnamed Water	General biological survey
Unnamed Water	General biological survey
Charter Brook	General biological survey
Black Creek	General biological survey
Unnamed Water	General biological survey
Unnamed Water	General biological survey
West Branch Black Creek	General biological survey
Unnamed Water	General biological survey
Unnamed Water	General biological survey
Dead Creek	General biological survey
Unnamed Water	General biological survey
Unnamed Water	General biological survey
Unnamed Water	General biological survey
East Hebron Brook	General biological survey
Unnamed Water	General biological survey
Schuyler Creek	General biological survey

Region 6

Name	Purpose
Delta Reservoir	TSMP/Wild Fish Disease
Hinckley Res	General Biological Survey
Mohawk River	Walleye Spawning Survey
Sauquoit Creek	Trout Population Survey
Lansing Kill	Trout Population Survey
Unnamed Trib to Otsquago Creek	General Biological Survey
Cold Brook	General Biological Survey
Hinckley Reservoir	Wild Fish Disease Survey
White Creek	General Biological Survey
Unnamed Water/Prospect Pond	General Biological Survey
Lake Ontario	Warmwater Fish Stock Asses.
Lake Ontario	Lower Trophic Level Samp.
Lake Ontario	White Perch Dist. Study
Staplin Creek	Stream Reclassification Surv.
Black River	Stocked Steelhead Monitoring
St. Lawrence River	Warmwater Fish Stock Asses.
Butterfield Lake	Walleye Pop. Evaluation
Red Lake	Walleye Pop. Evaluation
Red Lake	Walleye Stocking Evaluation
Black Lake	Walleye evaluation
Hart Brook	Trout Spawning Assessment
Taylorville Res.	Contaminant Survey
Beaver Lake	Contaminant Survey
Norwood Reservoir	Walleye Pop. Evaluation
Norwood Reservoir	Contaminant Sampling
Unnamed Trib to Tannery Creek	Env. Impact Survey
Green Pond	Hybrid Brook Trout Study
Clear Pond	Hybrid Brook Trout Study
Little Salmon Lake	Hybrid Brook Trout Study
Unnamed Trib to Twitchell Lake	Hybrid Brook Trout Study
Twitchell Lake	Hybrid Brook Trout Study
Trib of N Branch Moose River	Heritage Strain Brook Trout
Unnamed Outlet of Windfall Pond	Heritage Strain Brook Trout
Brandy Lake	Hybrid Brook Trout Study
Church Pond	Hybrid Brook Trout Study
Long Pond	Hybrid Brook Trout Study
Blue Pond	Hybrid Brook Trout Study
Razorback Pond	Hybrid Brook Trout Study
Clear Pond	Hybrid Brook Trout Study
Allen Pond	Hybrid Brook Trout Study
Lilypad Pond	Hybrid Brook Trout Study
Long Pond	Hybrid Brook Trout Study
Streeter Lake	Hybrid Brook Trout Study
Nicks Pond	Hybrid Brook Trout Study
Piercefield Flow	Contaminant Sampling
Glasby Pond	Hybrid Brook Trout Study
Cat Mountain Pond	Hybrid Brook Trout Study
Cowhorn Pond	Hybrid Brook Trout Study
Cleveland Lake	Hybrid Brook Trout Study
Payne Lake	Hybrid Brook Trout Study
Little Otter Lake	Liming Water Sample
Evies Pond	Hybrid Brook Trout Study
Long Pond	Hybrid Brook Trout Study
Pitcher Pond	Hybrid Brook Trout Study
Trout Pond	Hybrid Brook Trout Study
Little Trout Pond	Hybrid Brook Trout Study
Raquette River	Contaminant Sampling
Hedgehog Pond	Hybrid Brook Trout Study
Curtis Pond	Hybrid Brook Trout Study
Dog Pond	Hybrid Brook Trout Study
Clear Pond	Hybrid Brook Trout Study
Tamarack Pond	Hybrid Brook Trout Study
Bridge Brook Pond	Hybrid Brook Trout Study

FISHERIES/ANGLER SURVEYS

Name	Purpose
Bear Pond	Hybrid Brook Trout Study
Gregg Lake	Hybrid Brook Trout Study
Tied Lake	Hybrid Brook Trout Study
Buck Pond	Hybrid Brook Trout Study
Olmstead Pond	Hybrid Brook Trout Study
Spectacle Pond	Hybrid Brook Trout Study
Simmons Pond	Hybrid Brook Trout Study
Buck Pond	Hybrid Brook Trout Study
Brewer Lake	Hybrid Brook Trout Study
Round Pond	Hybrid Brook Trout Study
Pine Pond	Hybrid Brook Trout Study
Black Pond	Hybrid Brook Trout Study
Horseshoe Pond	Hybrid Brook Trout Study
Round Pond	Hybrid Brook Trout Study
Townline Pond	Hybrid Brook Trout Study
Fish Pole Pond	Hybrid Brook Trout Study
Boottree Pond	Hybrid Brook Trout Study
Deer Pond	Hybrid Brook Trout Study
Darning Needle Pond	Hybrid Brook Trout Study
Pine Pond	Hybrid Brook Trout Study
Middle Settlement Lake	Hybrid Brook Trout Study
Middle Branch Lake	Hybrid Brook Trout Study
Wolf Pond	Hybrid Brook Trout Study
Silver Dawn Lake	Hybrid Brook Trout Study
Round Lake	Hybrid Brook Trout Study
Long Lake	Hybrid Brook Trout Study
Cage Lake	Hybrid Brook Trout Study
Horn Lake	Liming Water Sample
Quiver Pond	Liming Water Sample
Evergreen Lake	Liming Water Sample
Hidden Lake	Liming Water Sample
Peaked Mountain Lake	Liming Water Sample
Big Hill Pond	Heritage Strain Brood Stock Management
Boottree Pond	Heritage Strain Brood Stock Management
Deer Pond	Heritage Strain Brood Stock Management
Evergreen Lake	Liming Water Sample
Oswegatchie River	Walleye Egg Take
Black River	Lake Sturgeon Monitoring
Stark Falls Res	Comp. Biological Monitoring
St. Lawrence River	Creel Survey
St. Lawrence River	YOY Esocid Index
Lake St. Lawrence	Warmwater Fish Stock Asses.
Lake St. Lawrence	Lake Sturgeon Monitoring
St. Lawrence River	Lake Sturgeon Monitoring and Egg Take
Five Falls Res.	General Biological Survey
N.Br. Sandy Creek	Stream Reclassification Surv.
Payne Lake	Wild Fish Disease Monitoring

Name	Purpose
Region 7	
Panther Lake	Centrarchid sampling plan
Whitney Point Reservoir	General biological survey
Bosket Lake	Fish kill investigation
Oakley Corners Pond	Fish kill investigation
Otisco Lake	Esocid sampling
Canasawacta Creek	Other, see comments
Susquehanna River	Fish disease monitoring
Owasco Lake	General biological survey
Green Lake	Percid sampling
Susquehanna River	Compare catch rate of smallmouth bass to those of past years
Whitney Point Reservoir	Percid sampling
Otisco Lake	Percid sampling
Chittenango Creek	CROTS survey
Cayuga Inlet	Spring rainbow trout/ lamprey/white sucker run assessment at fishway
Unnamed Water	Stream protection
Beaverdam Brook	Spring steelhead spawning run biological assessment.
Small stream surveys	Eastern brook trout joint venture project (28 streams)
Region 8	
Waneta Lake	Muskie population assess.
Brick Pond	Invasive species investigation
Sodus Bay	Fish disease investigation
Seneca Lake	Biological data collection from salmonids during lake trout derby
Canandaigua Lake	Biological data collection from salmonids during lake trout derby
Canandaigua Lake	Standard coldwater assessment with lake trout primary target
Irondequoit Bay	Walleye population assess.
Catharine Creek	RT production study
Springwater Creek	RT production study
Limeklin Creek	RT production study
Canisteo River	Walleye population assess.
Sleepers Creek	RT production study
Conesus Lake	Warmwater fish assessment
Waterport Reservoir	Walleye population assess.
Waneta lake	General biological survey
Lamoka Lake	General biological survey
Seneca Lake	Fish disease investigation
Springwater Creek	RT spring spawning run asses.
Catharine Creek	RT spring spawning run asses.

FISHERIES/ANGLER SURVEYS

Name	Purpose
Naples Creek	RT spring spawning run asses.
Cold Brook	RT spring spawning run asses.
Sleepers creek	RT spring spawning run asses.

Region 9

Name	Purpose
Rock City Brook	Reclassification/Brook trout population assessment
Mutton Hollow , T-6	Reclassification/Brook trout population assessment
Christian Hollow	Brook trout population asses.
Spring Brook	Brook trout population asses.
Spring Brook, T-2	Brook trout population asses.
Spring Mills Creek and tribs	Reclassification/Brook trout population assessment
McIntosh Creek	Habitat improvement eval/ Brook trout population asses.
Beehunter Creek	Brook trout population asses.
Ford Brook and tribs	Reclassification/Brook trout population assessment
Cheney Brook, T-1	Fish kill investigation
Trout Brook	BT & ST population asses.
N. Branch Wiscoy Creek	Brown trout population asses.
Cryder Creek tributaries	Reclassification/Brook trout population assessment
Goodell Creek	Habitat improvement eval.
Oatka Creek tributaries	Fish kill investigation

Lake Erie Unit

Name	Purpose
Lake Erie Commercial Fishery Assessment	Sampling to characterize Harvest & age composition of Lake Erie's commercial yellow perch fishery
Lake Erie Lower Trophic Monitoring Program	Index of lower trophic Indicators seasonally, including zooplankton density, nutrient concentrations, temperature and water transparency
Lake Erie Open Lake Sport Fishing survey	Creel survey measure of Sport fishing catch and effort from Lake Erie's boat fisheries for walleye, smallmouth bass and yellow perch
Lake Erie Tributary Angler Diary Program Diary	Index of fishing quality for Lake Erie's tributary steelhead fishery
Lake Erie Tributary Sea Lamprey Nest Density	Annual count to index the Concentration of sea lamprey nests in selected Lake Erie tributaries
Lake Erie Pelagic Forage Fish Assessment	Hydro-acoustic survey Program to characterize abundance and distribution of pelagic forage fish densities in eastern Lake Erie
Lake Erie Coldwater Community Assessment	Gill net index abundance, age composition, growth, and diet of lake trout, burbot and lake whitefish
Lake Erie Warmwater Community Assessment	Gill net index abundance, age composition, growth, and diet of walleye, yellow perch and smallmouth bass
Lake Erie Wild Steelhead Assessment	Electrofishing index abundance of juvenile wild steelhead perch in selected Lake Erie tributaries
Lake Erie Forage and Juvenile Fish Assessment	Bottom Trawl index of abundance, age composition and growth, of juvenile yellow perch and an array of forage fish species

Rare Fish Unit

Name	Purpose
Eightmile Creek	Pugnose Shiner Survey
Irondequoit Creek	Pugnose Shiner Survey
Johnson Creek	Pugnose Shiner Survey
Marsh Creek	Pugnose Shiner Surveyy
Salmon Creek	Pugnose Shiner Survey
Sodus Bay	Pugnose Shiner Survey
Salmon Creek	Pugnose Shiner Survey
Trib. of Tonawanda Creek	Pugnose Shiner Survey
Blind Sodus Creek	Pugnose Shiner Survey
Mudge Creek	Pugnose Shiner Survey
Sodus Creek	Pugnose Shiner Survey
Wolcott Creek	Pugnose Shiner Survey
Eighteenmile Creek	Longear Sunfish Survey
Allegheny River	Longear Sunfish Survey
Cayuga Creek	Longear Sunfish Survey
Ischua Creek	Longear Sunfish Survey
Johnson Creek	Longear Sunfish Survey
Niagara River	Longear Sunfish Survey
Tonaawanda Creek	Longear Sunfish Survey
W. Br. Conewango Creek	Longear Sunfish Survey
Watershed Update Stream Surveys:	143 surveys across NY documenting presence or absence of fish species.

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ADMINISTRATION

# Licenses and Permits Issued/Reviewed in 2009/10											
Permit Name	CO	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Region 7	Region 8	Region 9	Total
Farm Fish Pond	-	-	-	7	320	25	11	176	95	78	**712**
Stocking	-	5	-	174	13	50	51	25	19	8	**457**
Triploid Grass Carp	-	12	-	284	302	50	66	261	410	669	**2054**
Overland Transport of Bait	-	-	-	28	13	-	8	4	12	-	**65**
Fish Possession (over daily limit)	-	-	-	-	-	-	2	-	-	-	**2**
Piranha	-	2	8	-	-	2	2	-	1	-	**15**
Baitfish	-	-	-	72	50	-	69	-	80	-	**149**
Temporary Revocable Permit (TRP)	-	8	-	2	2	25	4	-	7	-	**48**
Article 15 Review	-	3	2	201	315	200	242	-	52	-	**1015**
Article 24 Review	-	25	-	146	-	-	5	-	-	-	**176**
Pesticide Permit Review	-	30	-	12	5	5	4	-	-	-	**56**
Bass Hatchery Permits (C.O)	13	-	-	-	-	-	-	-	-	-	**13**
Trout Hatchery Permits (C.O)	39	-	-	-	-	-	-	-	-	-	**39**
Trout Import Permit	7	-	-	-	-	-	-	-	-	-	**7**
Bass Import Permit	3	-	-	-	-	-	-	-	-	-	**3**
Fishing Preserve Licenses (C.O)	55	-	-	-	-	-	-	-	-	-	**55**
Fish Health Certificates (C.O)	19	-	-	-	-	-	6	-	-	-	**25**
Commercial Fishing Licenses	3	-	-	14	-	-	-	-	-	-	**17**
License to Collect and Possess (C.O)	-	-	5	-	-	-	-	-	-	-	**5**
Trout in the Classroom	-	-	-	112	23	-	-	-	-	-	**23**
Dangerous fish permit	-	-	-	-	-	-	1	-	-	-	**1**
Fish tagging (St. Lawrence River carp)	-	-	-	-	-	-	1	-	-	-	**1**
Totals	139	85	15	980	993	357	472	466	676	755	4938

BUREAU STAFF

Central Office

Administration
Arthur Newell — Biologist 4 (Aquatic)

Public Use and Extension

Woltmann, Ed	Biologist 3 (Aquatic)
Kozlowski, Greg	Biologist 2 (Aquatic)
Ernst, Joelle	Biologist 1 (Aquatic)
Disarno, Mike	Seasonal Fish & Wildlife Tech 1

Inland Fisheries

Keeler, Shaun	Biologist 3 (Aquatic)
Daley, James	Biologist 2 (Aquatic)
Loukmas, Jeff	Biologist 2 (Aquatic)
Holst, Lisa	Biologist 2 (Aquatic)
McKelvey, Amy	Env. Program Specialist 1
Richmond, Linda	Agency Program Aide
Sweeney , Paul	Calculations Clerk 2
Festa, Casey	Seasonal Fish & Wildlife Tech 1

Great Lakes Section
Culligan, William — Biologist 3 (Aquatic)

Fish Culture

Hulbert, Phil	Fish Culturist VI
Buell, Henry	Fish Culturist V
Armstrong, Dave	Fish Culturist V (through 11/10/09). Returned to Region 5 on 11/11/09.
LaBoissiere, Mary	Secretary 1

Region 1

Guthrie, Charles	Biologist 2 (Aquatic)
O'Riordan, Heidi	Biologist 1 (Aquatic)
Latremore, Erik	Fish & Wildlife Technician 2 (Promoted to Bio 1 in R6 - Jan. 2010)
Punzi, Amanda	Seasonal Env. Ed. Asst. (1/2 time)
Vullo, Charles	Seasonal Laborer (1/2 time)
Tenyenhuis, Ann	Sea Grant Extension Aid
Nichol, Malynda	Sea Grant Rec. Fisheries Specialist (Resigned Sept. 2009)

Region 2

Melissa Cohen	Biologist 2 (Aquatic)
Diallo House	Seasonal Environmental Edudcation Asst.
Alexander Brinton	Seasonal Laborer
James MacDonald	Sea Grant Rec. Fisheries Specialist
Darin Alberry	Sea Grant Program Aide

Region 3

Mike Flaherty	Biologist 2 (Aquatic)
Ron Pierce	Biologist 1 (Aquatic) retired 10/2009
Bob Angyal	Biologist 1 (Aquatic)
Larry Wilson	Biologist 1 (Aquatic)
Ryan Coulter	Biologist 1 (Aquatic)
Linda Wysocki	Fish & Wildlife Technician 3
Tim McNamara	Fish & Wildlife Technician 2
Dustin Dominesey	Seaonal Fish & Wildlife Tech 1

Region 4

Norm McBride	Biologist 2 (Aquatic)
Dan Zielinski	Biologist 1 (Aquatic)
Scott Wells	Biologist 1 (Aquatic)
Fred Linhart	Fish & Wildlife Technician 3
Dave Cornwell	Fish & Wildlife Technician 2
Kandy Collins	Keyboard Specialist 2 (ret Oct 09)
Tim Pokorny	Seasonal Fish & Wildlife Tech 1
Ian Kiraly	Seasonal Fish & Wildlife Tech 1
Rob Poprawski	Seasonal Fish & Wildlife Tech 1
Jeff Strassenburg	Seasonal Fish & Wildlife Tech 1

Region 5

William Schoch	Biologist 2 (Aquatic)
Richard Preall	Biologist I (Aquatic)
Emily Zollweg	Biologist I (Aquatic)
Rob Fiorentino	Biologist I (Aquatic)
Jennifer Sausville	Fish & Wildlife Technician 3
Bethany Stephenson	Seasonal Environmental Edudcation Asst.
Armstrong, Dave	Fish & Wildlife Technician 2 (returned from CO on 11/11/09)
Lin Frys	Fish & Wildlife Technician 1
Adam Kosnick	Fish & Wildlife Technician 1

Region 6

Frank Flack	Biologist 2 (Ecology)
Carlson, Doug	Biologist 1 (Aquatic)
McCullough, Russ	Biologist 1 (Aquatic)
Klindt, Rodger	Biologist 1 (Aquatic)
VanMaaren, Chris	Biologist 1 (Aquatic)
McDonald, Dick	Biologist 1 (Aquatic)
Erway, Dave	Biologist 1, Trainee 2 (Aquatic)
Latremore, Erik	Biologist 1, Trainee 1 (Aquatic) (Started January 2010)
Gordon, Dave	Fish & Wildlife Technician 2
Ressiguie, Les	Fish & Wildlife Technician 1
Calhoun, Lea	Fish & Wildlife Technician 1
Balk, Nicole	Fish & Wildlife Technician 1
Cunningham, Aimee	Fish & Wildlife Technician 1
Russell, Andy	Fish & Wildlife Technician 1
Rice, Travis	Seasonal Laborer
Niewieroski, Greg	Seasonal Laborer
Smith, Kate	Seasonal Laborer

Region 7

Bishop, Dan	Biologist 2 (Aquatic)
Lemon, Dave	Biologist 1 (Aquatic)

BUREAU STAFF

Everard, Jim	Biologist 1 (Aquatic)
Robins, Jeff	Biologist 1 (Aquatic)
Prindle, Scott	Biologist 1 (Aquatic)
Blackburn, Ian	Fish & Wildlife Technician 2
Richardson, Denise	Seasonal Fish & Wildlife Technician 1
Heider, Allie	Secretary 1

Region 8

Webster Pearsall	Biologist 2 (Aquatic)
Matt Sanderson	Biologist 1 (Aquatic)
Brad Hammers	Biologist 1 (Aquatic)
Amy Mahar	Biologist 1 (Ecology)
Peter Austerman	Biologist 1 (Aquatic)
Daniel Mulhall	Fish & Wildlife Technician 1
Robert Deres	Fish & Wildlife Technician 1

Region 9

Paul McKeown	Biologist 2 (Aquatic)
Michael Clancy	Biologist 1 (Aquatic)
Scott Cornett	Biologist 1 (Aquatic)
Joseph Galati	Biologist 1 (Ecology)
Michael Todd	Biologist 1 (Aquatic)
Michael Wilkinson	Biologist 1 (Aquatic)
James Zanett	Fish & Wildlife Technician 3
Jon Sztukowski	Fish & Wildlife Technician 1
Eric Stratton	Fish & Wildlife Technician 1

Lake Erie Unit

Einhouse, Don	Biologist 2 (Aquatic)
Markham, Jim	Biologist 1 (Aquatic)
Zeller, Doug	Fisheries Research Vessel Captain
Beckwith, Brian	Fish & Wildlife Technician 2
Zimar, Rich	Fish & Wildlife Technician 2
Szwejbka, Ginger	Secretary 1
Dusablon, Mark	Seasonal Fish & Wildlife Tech 1
Babcock, Carrie Ann	Seasonal Fish & Wildlife Tech 1
Andrews, Paul	Seasonal Fish & Wildlife Tech 1
Draves, John	Seasonal Fish & Wildlife Tech 1

Lake Ontario Unit

Steve LaPan	Biologist 2 (Aquatic)
Chris Balk	Biologist 2 (Ecology)
Jana Lantry	Biologist 1 (Aquatic)
Mike Connerton	Biologist 1 (Aquatic)
Alan Fairbanks	Research Vessel Captain
Gaylor Massia	Maintenance Assistant
Beverly Grant	Secretary 1
Tom Eckert	Fish and Wildlife Technician 1
Shane Grant	Laborer
Rich Chiavelli	Seasonal Fish & Wildlife Tech 1
Ben Carson	Seasonal Fish & Wildlife Tech 1
Aaron Harvill	Seasonal Fish & Wildlife Tech 1
Josh Fisher	Seasonal Fish & Wildlife Tech 1
Mike Siragusa	Seasonal Fish & Wildlife Tech 1
Tom Smith	Seasonal Fish & Wildlife Tech 1
Joe Dallas	Seasonal Fish & Wildlife Tech 1

Adirondack Fish Hatchery

Grant, Ed	Fish Culturist III
Cranker, Neil	Fish Culturist II
Aldinger, Fritz	Fish Culturist I
Klubek, Kenneth W.	Fish Culturist I

Bath Fish Hatchery

Osika, Ken	Fish Culturist III
Sweet, Robert	Fish Culturist II
Klesa, Rodney	Fish Culturist I
Raab, Kelly	Fish Culturist I
Robb, Steven	Fish Culturist I

Caledonia Fish Hatchery

Mack, Alan	Fish Culturist IV
Stein, Robert	Fish Culturist II
Zenzen, Stephen	Fish Culturist I
Schirmer, Jason	Fish Culturist II
Hubbard, Bruce	Fish Culturist II
Krause, Mark	Fish Culturist III
Hayden, Kevin	Fish Culturist I
Ward, Brian	Fish Culturist I

Catskill Fish Hatchery

Covert, Scott	Fish Culturist IV
Anstey, Timothy A.	Fish Culturist I
Judson, James L.	Fish Culturist I
Gennarino, Joseph	Fish Culturist II
Anderson, John	Fish Culturist III
Galbreth, Steve	Fish Culturist I
Weishan, Derek	Fish Culturist I, Trainee II

Chateaugay Fish Hatchery

Brue, Peter	Fish Culturist III
Jackson, Matt	Fish Culturist II
Haley, Adam	Fish Culturist I
McCarthy, Neal	Fish Culturist I
Ventiquattro, Thomas	Fish Culturist II
Goodale, Zachary	Fish Culturist I

Chautauqua Fish Hatchery

King, Larry	Fish Culturist III
DeFries, Eric	Fish Culturist II
Preston, Ron	Fish Culturist I
Gruber, Bradley	Fish Culturist I

BUREAU STAFF

Oneida Fish Hatchery

Babenzien, Mark	Fish Culturist IV
Rathje, Carl	Fish Culturist III
Evans, Bill	Fish Culturist II

Randolph Fish Hatchery

Mellon, Jon	Fish Culturist III
Hohmann, Barry	Fish Culturist I
Rambuski, Jim	Fish Culturist II
Borner, Richard	Fish Culturist II
Hulings, Raymond	Maint. Asst.
Brady, Trevor	Fish Culturist I

Rome Fish Hatchery

Lewthwaite, Robert	Fish Culturist IV
Woodworth, William	Fish Culturist II
Grabowski, Steve	Fish Culturist II
Wanner, Scott	Fish Culturist III
Draper, John Jr.	Fish Culturist I
Balduzzi, Kevin	Fish Culturist I
Matt, Kimberly	Keyboard Spec.
Hajdasz, William R.	Maint. Suprv.
Stercho, Jonathan	Fish Culturist I
Gray, John	Fish Culturist I

Salmon River Fish Hatchery

Greulich, Andreas	Fish Culturist IV
Dolan Stephen	Fish Culturist III
Domachowske, Dave	Fish Culturist II
Hurd, Karen	Keyboard Speci.
Boyer, Brian	Fish Culturist I
Nelson, Robert	Fish Culturist II
Edmonds, Brian	Fish Culturist I
Tabolt, Casey	Fish Culturist I

South Otselic Fish Hatchery

Emerson, Pat	Fish Culturist III
Ryan, Bruce	Fish Culturist I
Kielbasinski, Thomas	Fish Culturist II
Speziale, Mike	Fish Culturist I

VanHornesville Fish Hatchery

Kroon, Larry	Fish Culturist III
DuBois, Craig	Fish Culturist II
Watson, Lauren C.	Fish Culturist I

Fish Disease Control Unit (Rome Fish Hatchery)

Noyes, Andrew	Pathologist 2 (Aquatic)
Henson, Fred	Biologist 1
Batur, Mark	Fish Culturist I

Status of New York River Herring

K. Hattala, M. Dufour, R. Adams and A. Kahnle
New York State Dept. of Environmental Conservation
Bureau of Marine Resources
Hudson River Fisheries Unit

&

Hudson River Estuary Program

April 2010

Hudson River Estuary

Why are we here:

To provide information, then listen

- Background
  - Understand fish life history
    - Fish's role in the rivers & streams
  - Recent changes in the stock
- What is ASMFC & Amendment 2
- How to restructure Hudson's fisheries to meet ASMFC-A2 requirement
- It's YOUR fishery
  - What can you suggest?

Hudson River Estuary

“River herring”

Similar & difficult to tell apart

Alewife

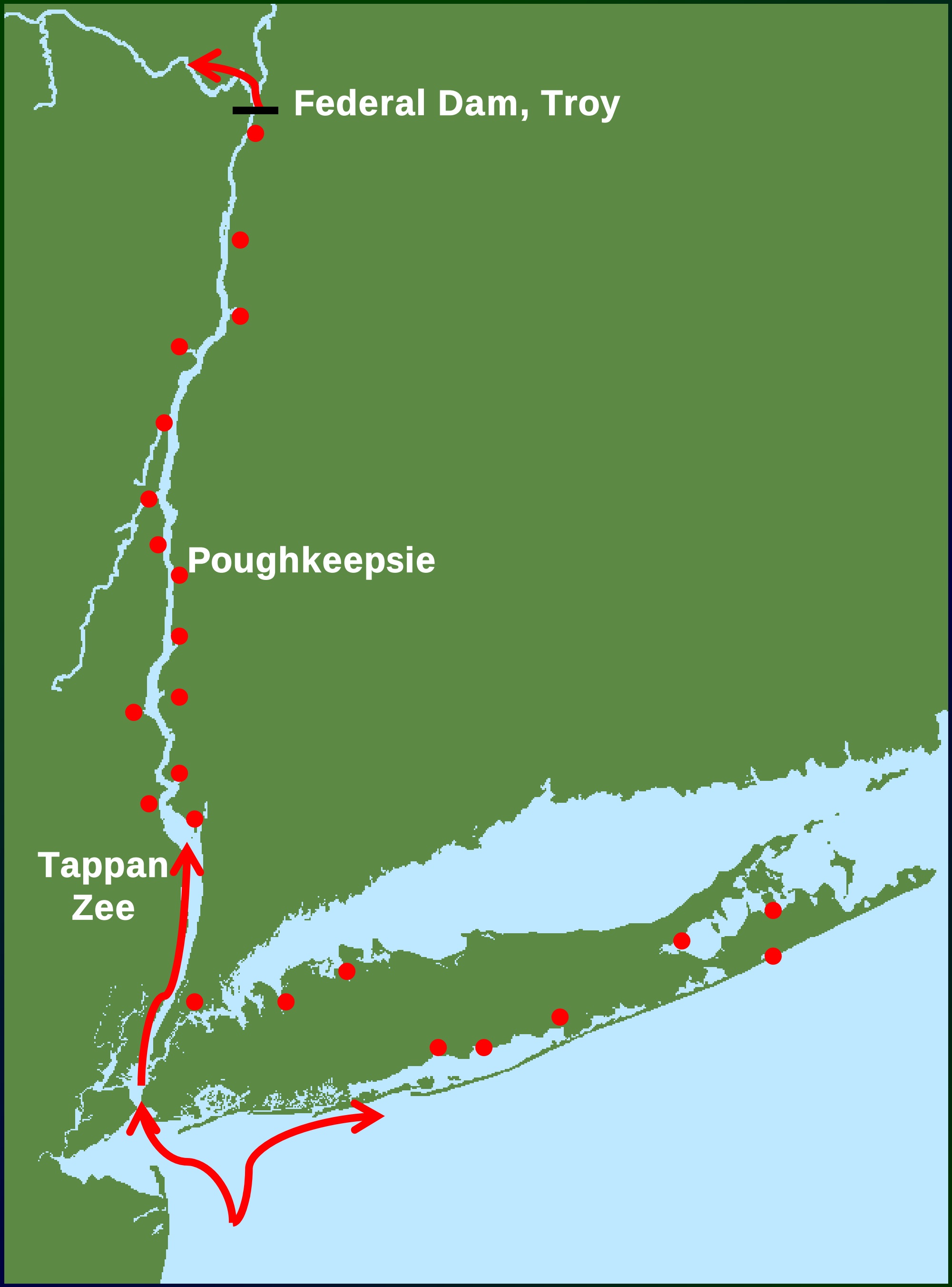
-Arrive Mar-early Apr
-Big eye, deeper body, white belly
-Spawns in streams, Hudson & tributaries

Blueback herring

-Arrives late Apr
-Small eye, slimmer body, black belly
-Spawns in streams, Hudson & tributaries, including Mohawk R.

- 1st summer in river, spends most of life in ocean, returns to river to spawn at ~ age 3-5
- Together, they are managed as “River Herring”

Hudson River Estuary



Spawning migration

-Enter rivers Mar-May

-Temperature specific (~47-50F)

-**Bluebacks** in Mohawk ~ May 1

-Spawning is widespread

-Commercial & Recreational Fisheries operate before & during spawning

- Some closures east end LI

Coastal Fish Management

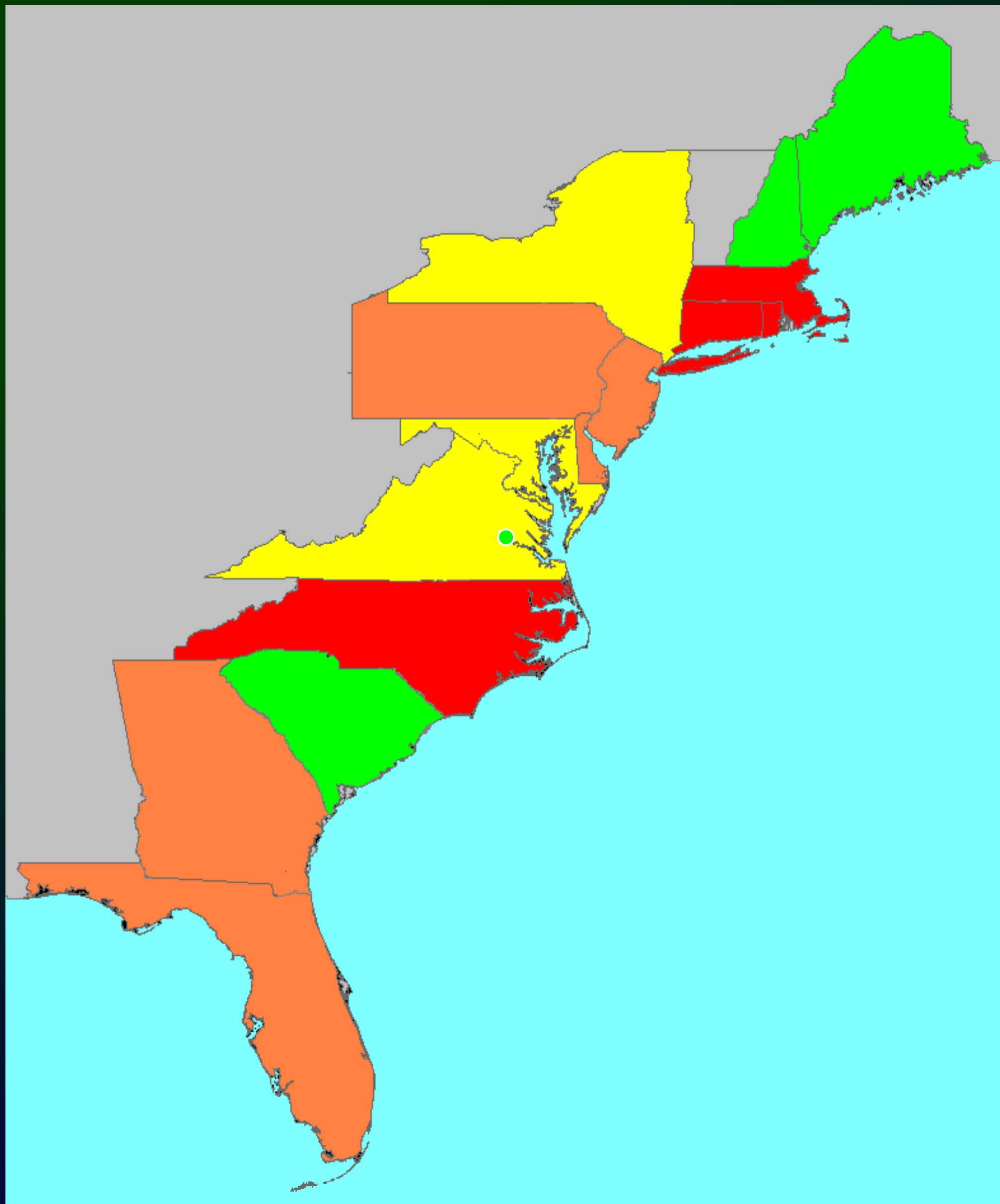
- Atlantic States Marine Fisheries Commission
  - 15 member coastal states ME-FL
  - 2 jurisdictions: PRFC, DC
  - 2 federal agencies: USFWS & NMFS
- Interstate Fisheries Management Plan for Shad and River herring
  - River herring- Amendment 2, May 2009

How does this affect you?

- Implementation of Amendment 2
- NY must prove river herring fishery is "sustainable" or *close all fisheries*
  - "will not diminish potential future stock reproduction or recruitment"
    - Means fish stock must have stable or increasing indices
- NY must have an approved fishery plan in place by Jan 2012
- Current fishery cannot be defended

Hudson River Estuary

Future status of Atlantic coast river herring fisheries after Jan 2012



- Closed
- Closure by 2012
- SFP* submitted
- SFP* not submitted

*Sustainable Fishery Plan submitted to ASMFC for review and approval

Hudson River Estuary

ASMFC Sustainable Fishery Plan required information

- Describe existing data
  - Commercial and Recreational fisheries
  - Spawning stock survey
  - Juvenile (yoy) abundance
- Outline fishery regulations
- Timeline to achieve “sustainable” fishery

Hudson River Estuary

Hudson Fisheries

Recreational

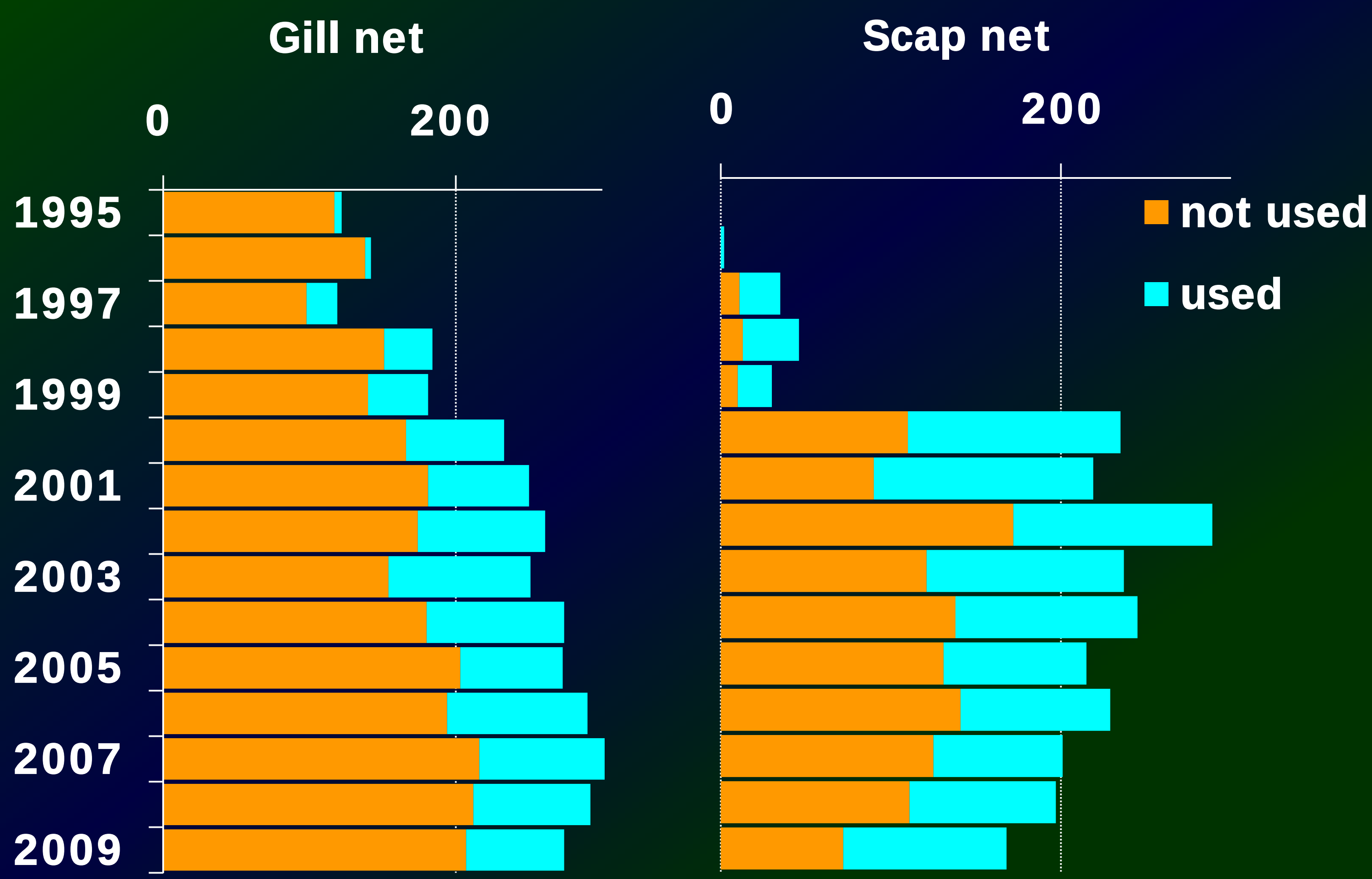
- Harvest fish for bait or personal use
- Recreational "commercial" fishers
  - Obtain marine permit
  - Harvest fish for bait, personal use or sells extra bait

Commercial

- Harvest for sale (to dealers, bait shop)
  - Herring sold to recreational fishers
- Charter boat operators
  - Catches herring; bait provided as part of trip
- Bait license
  - Cast net

Hudson River Estuary

Number of HR marine permits issued



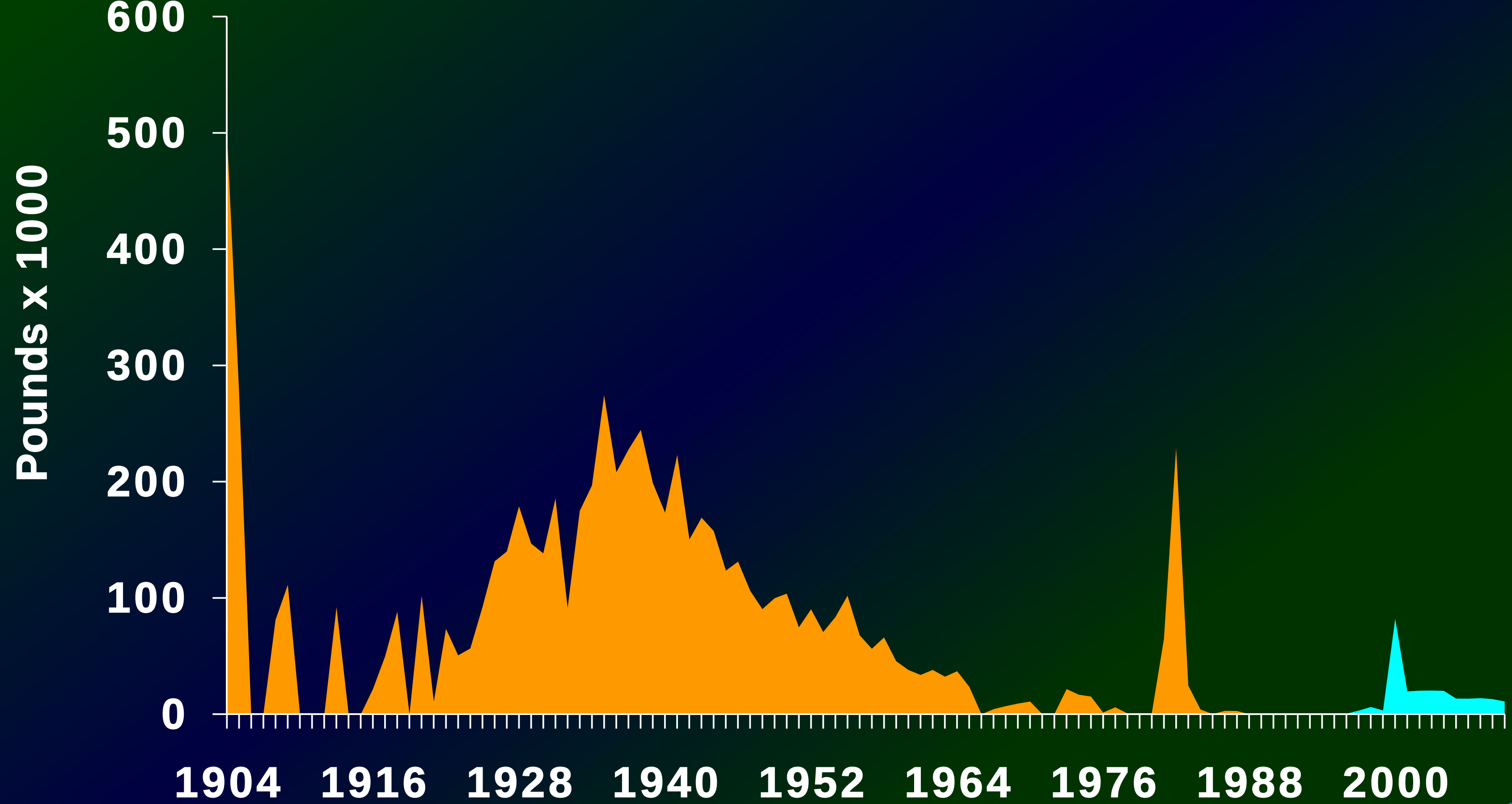
Available Fishery Data

- Hudson River
  - Commercial fishery
    - Mandatory Marine Permit catch & effort reports
    - Observer monitoring
      - Collect biological data, verify report data
  - Recreational creel surveys, fishing diaries
- Long Island – none of the above
- Ocean commercial bycatch
  - Portside sampling program with ME & MA
    - Funded by Hudson River Estuary Program Action Agenda

Hudson River Estuary

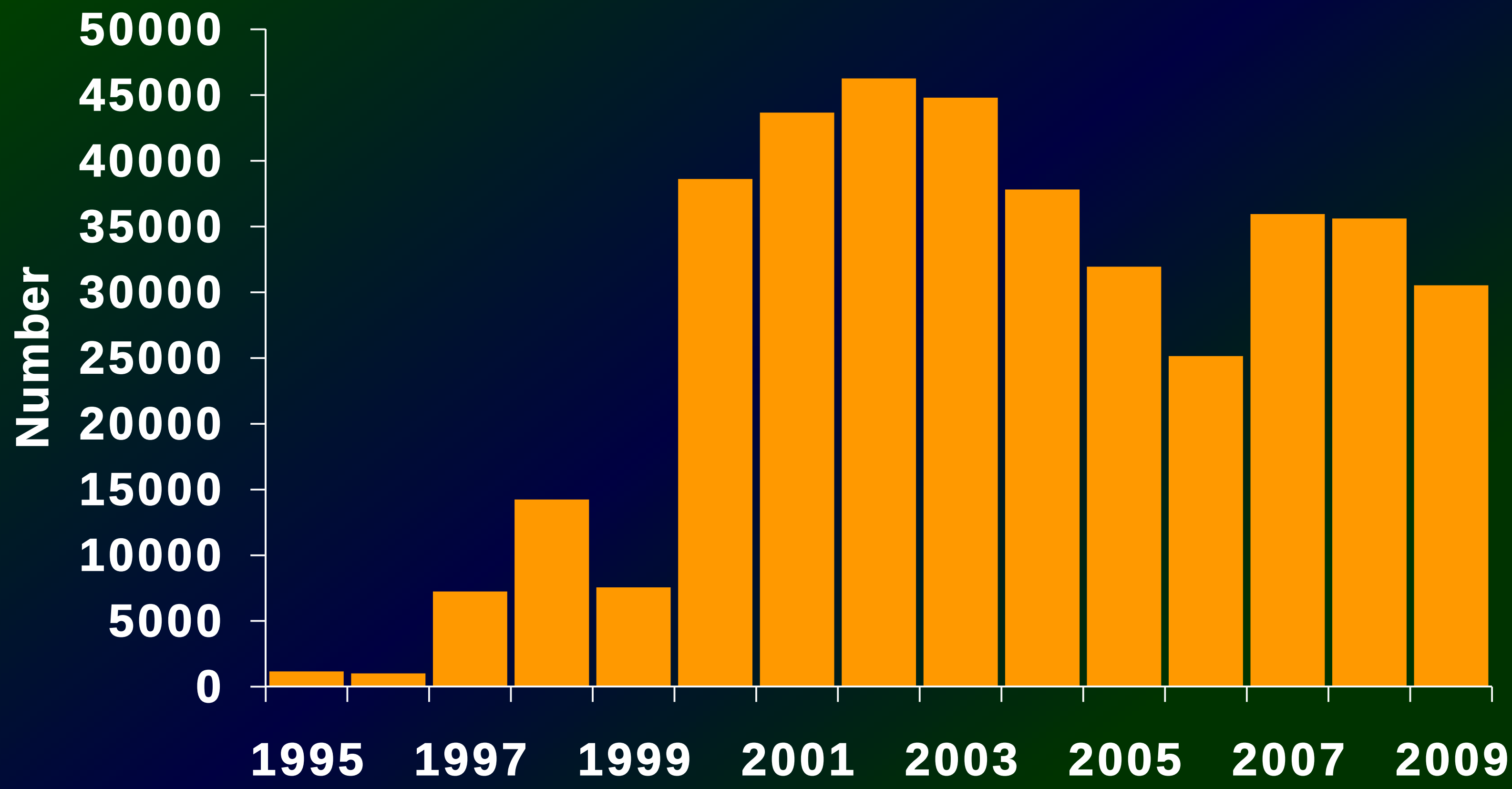
Historic NY commercial landings

Marine permits only



Hudson River Estuary

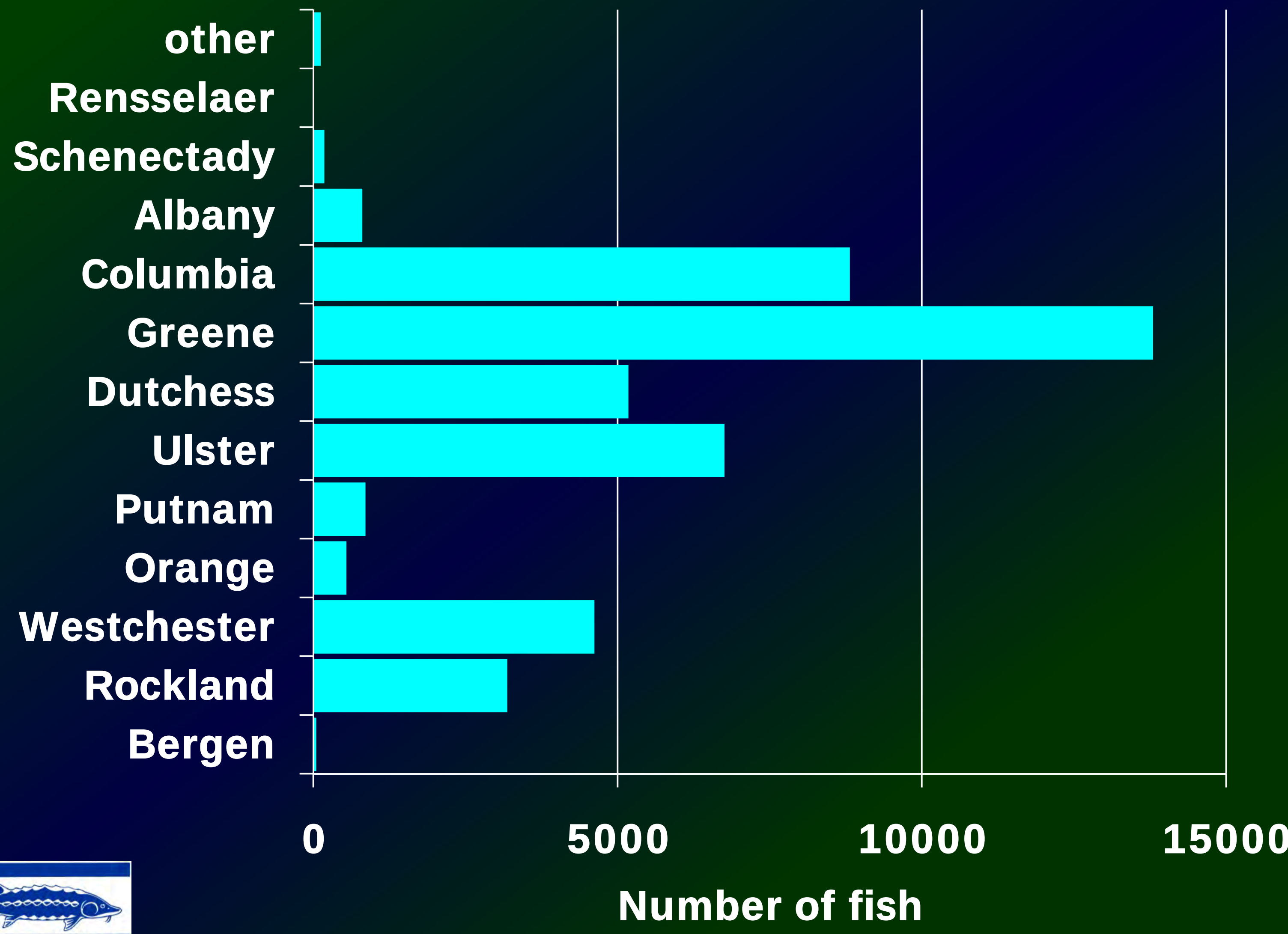
Commercial Hudson river herring landings



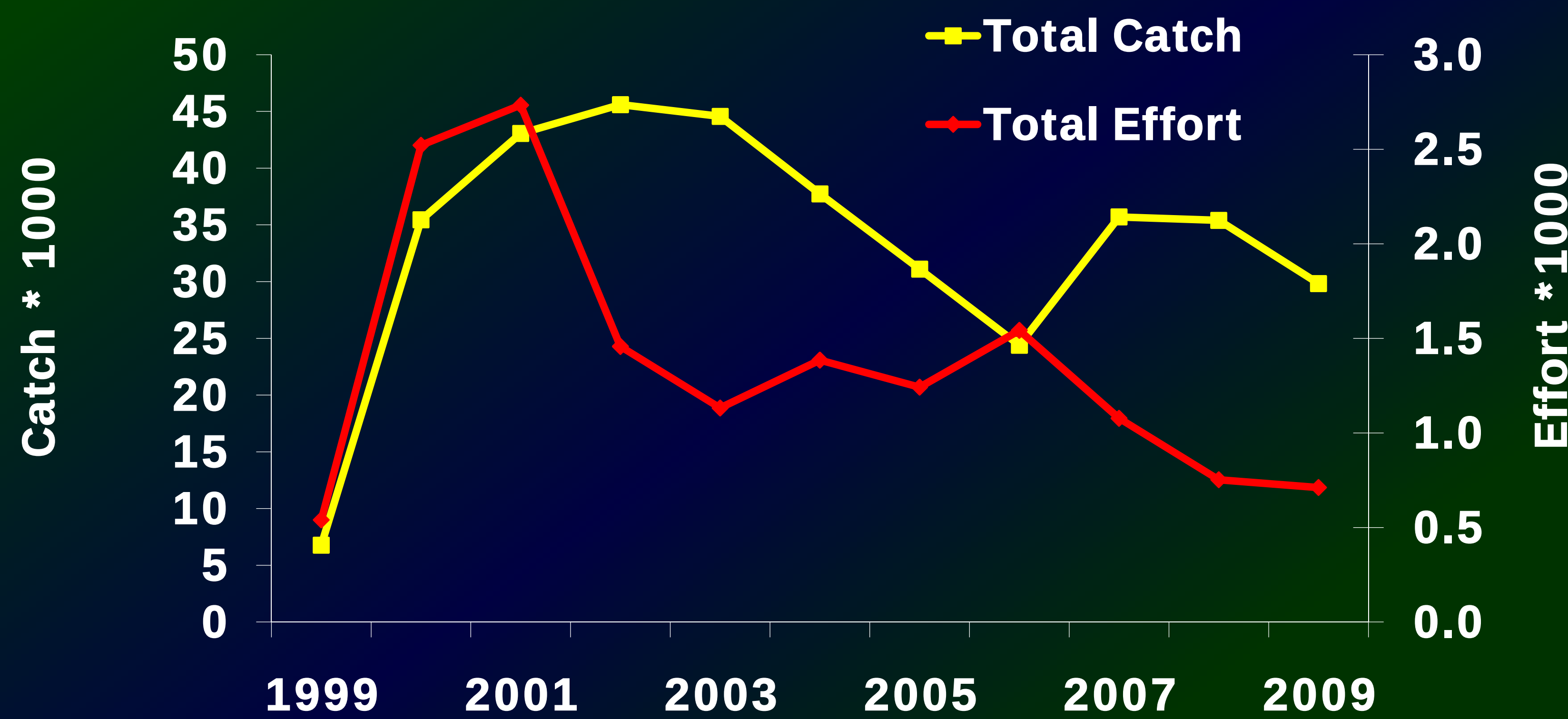
*2009 Marine permit catch reports as of 4/1/2010, not complete

HR Commercial river herring landings

2007-2008 mean

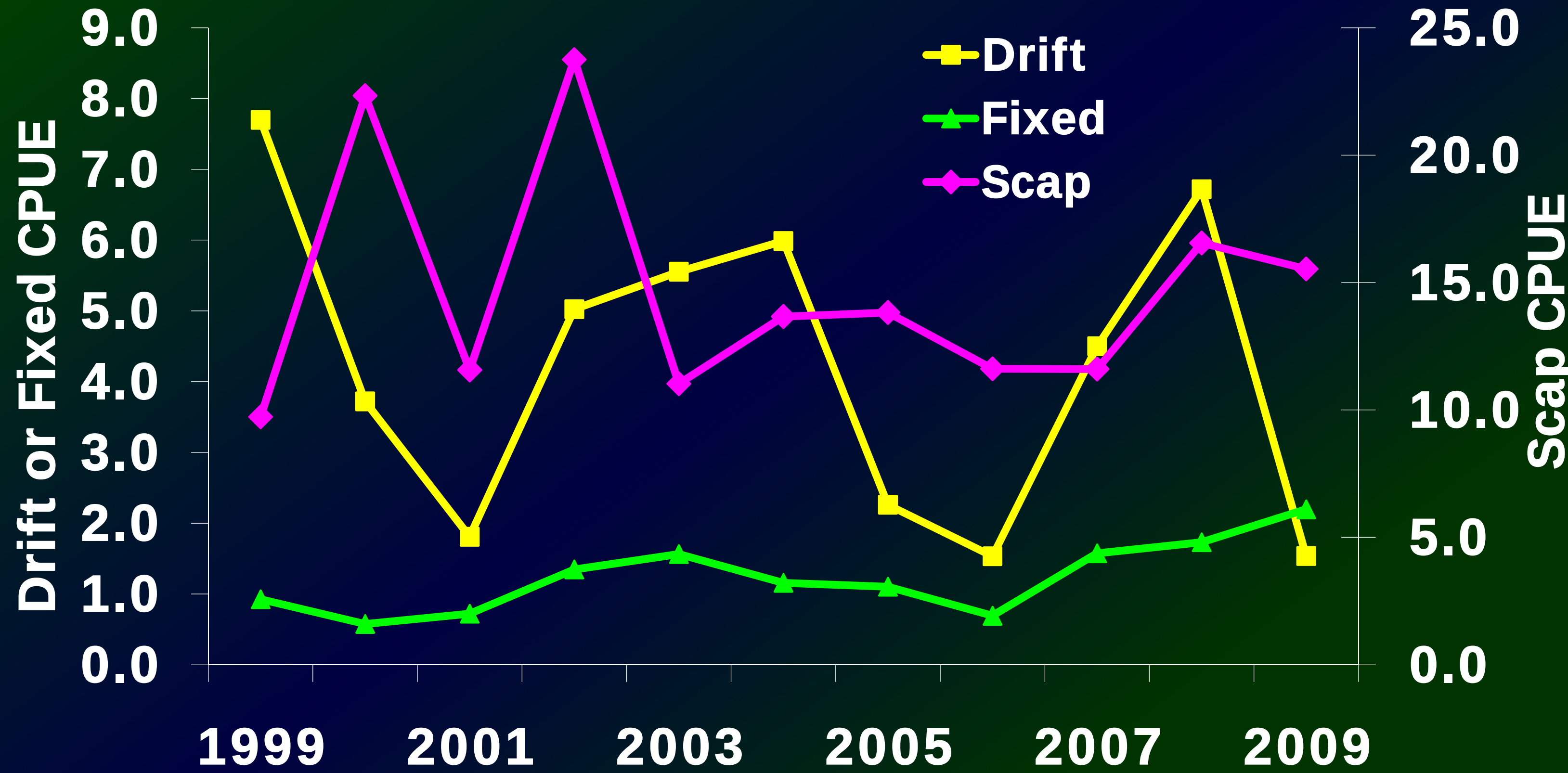


Total catch & effort Hudson's river herring commercial fishery (Mandatory marine permit report data)



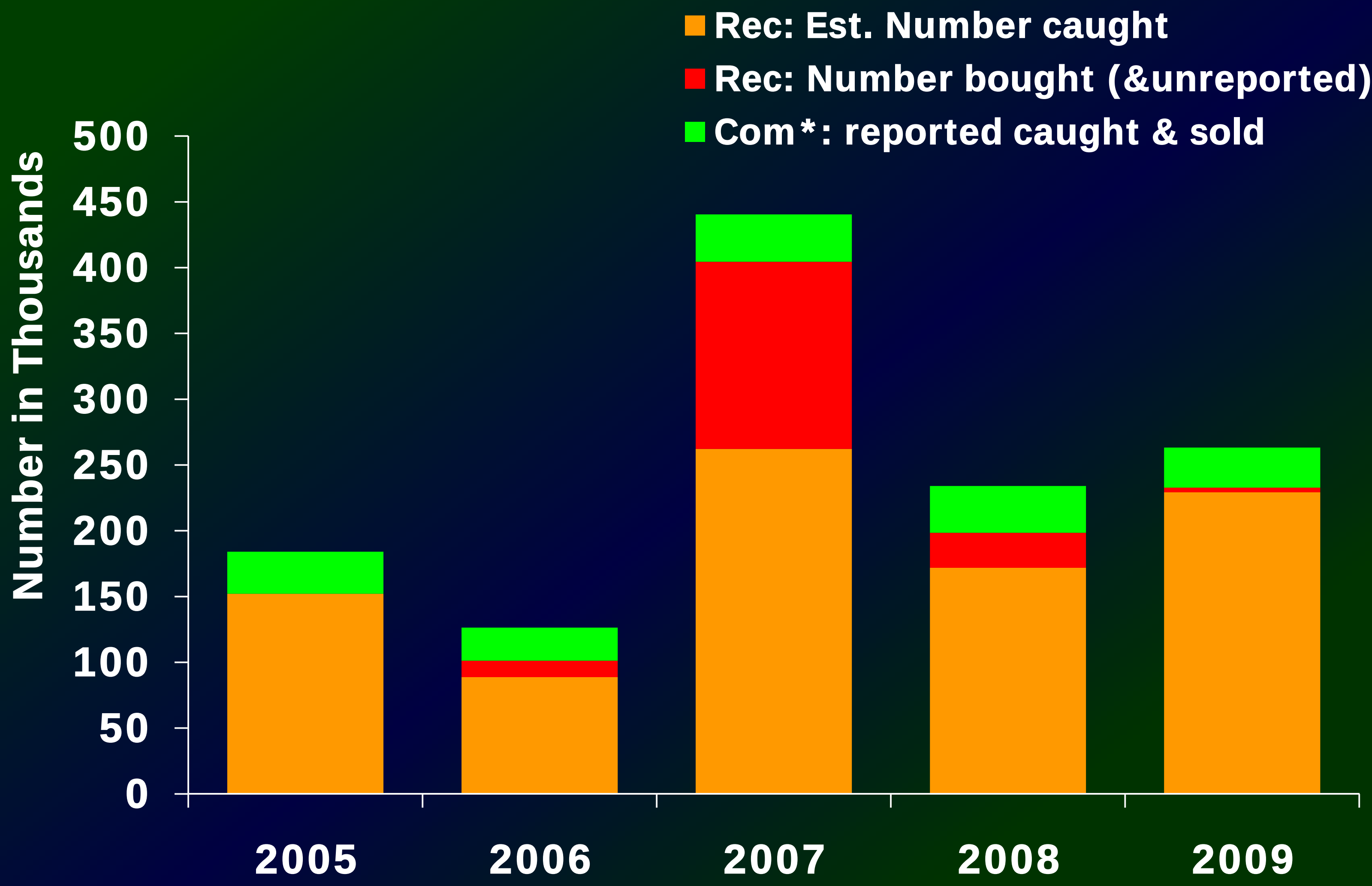
Hudson River commercial fishery

Mandatory Marine Permit report data



CPUE=catch (number of fish) / effort (net size x hours fished)

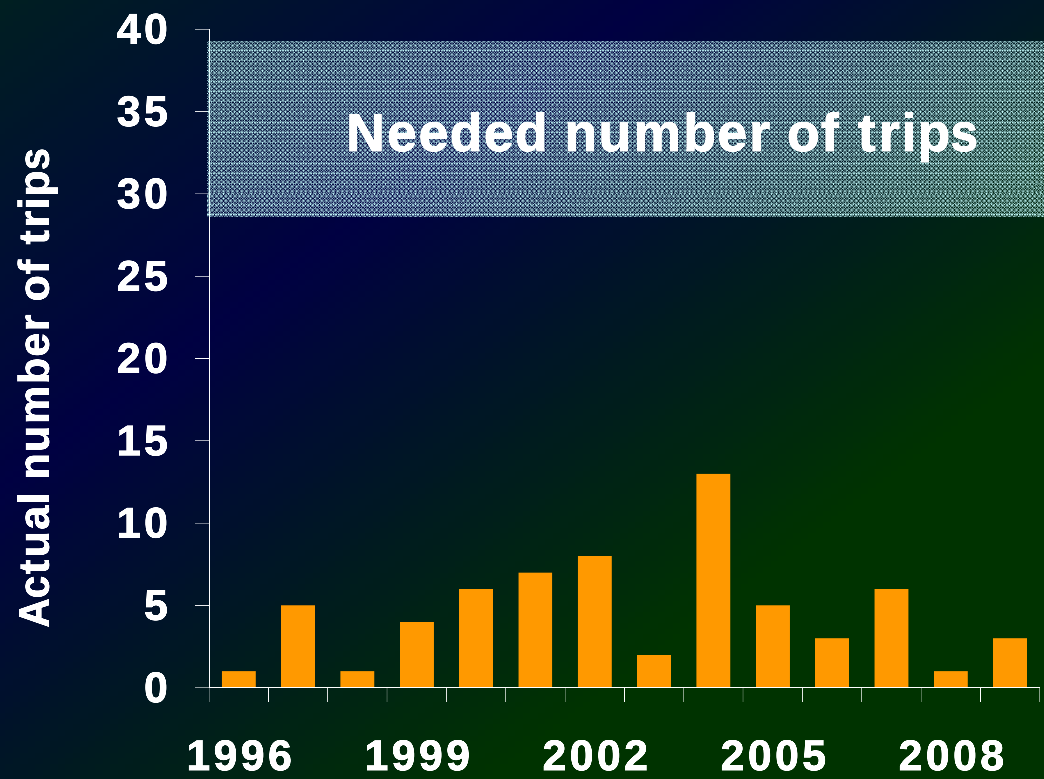
Herring use



*Commercial reports (marine permits, reporting rate unknown)
2009 data not yet complete
**Does NOT include BAIT NET LICENSE CATCH

Commercial fishery monitoring actual vs needed number of trips

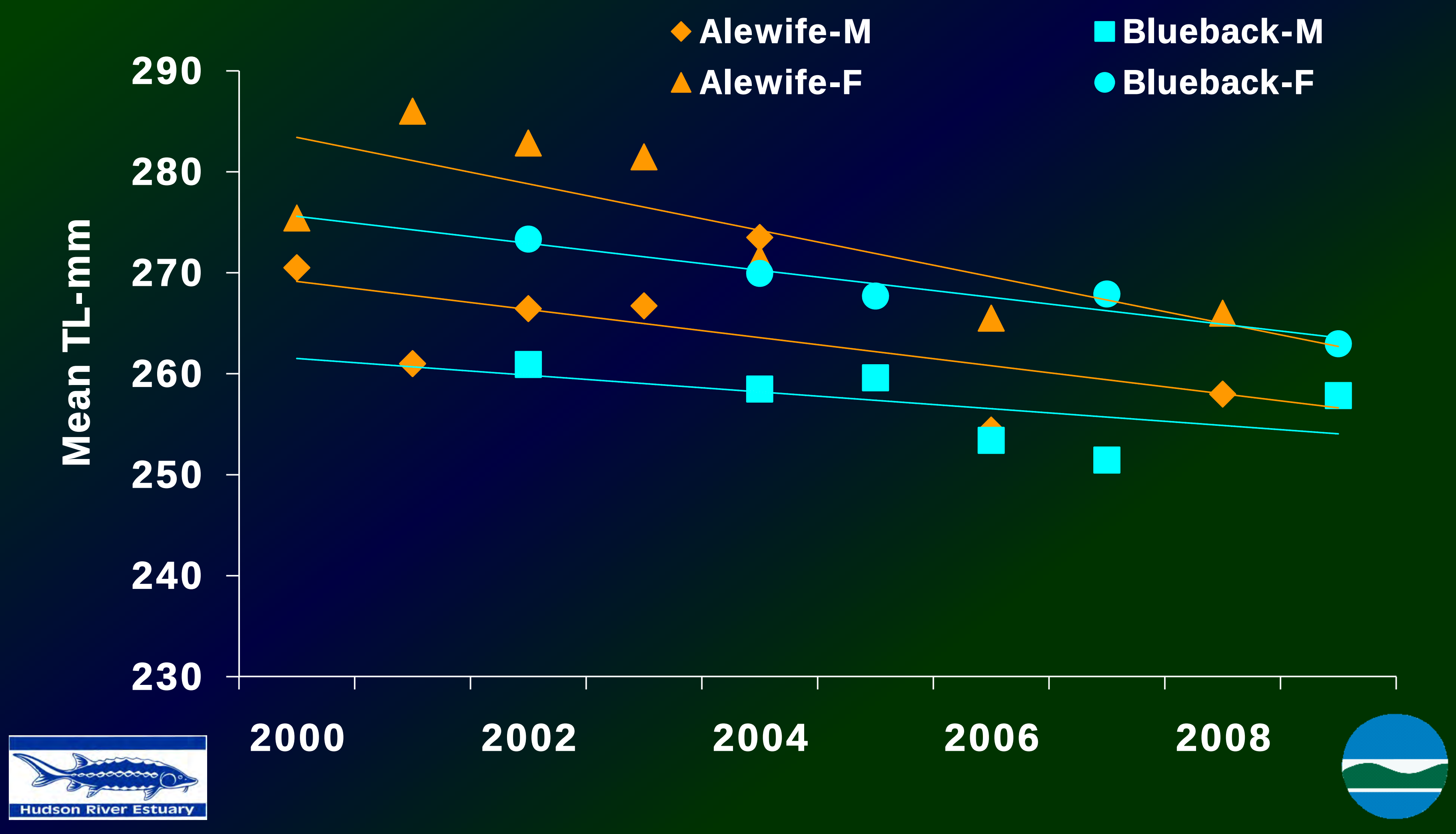
- -Observer data of drift & fixed gill nets
- - Need to add scap net
- -Verify reporting rate
- -Abundance trends
- -Collect bio data (size, scales) on catch



Hudson River Estuary

Change in annual mean total length

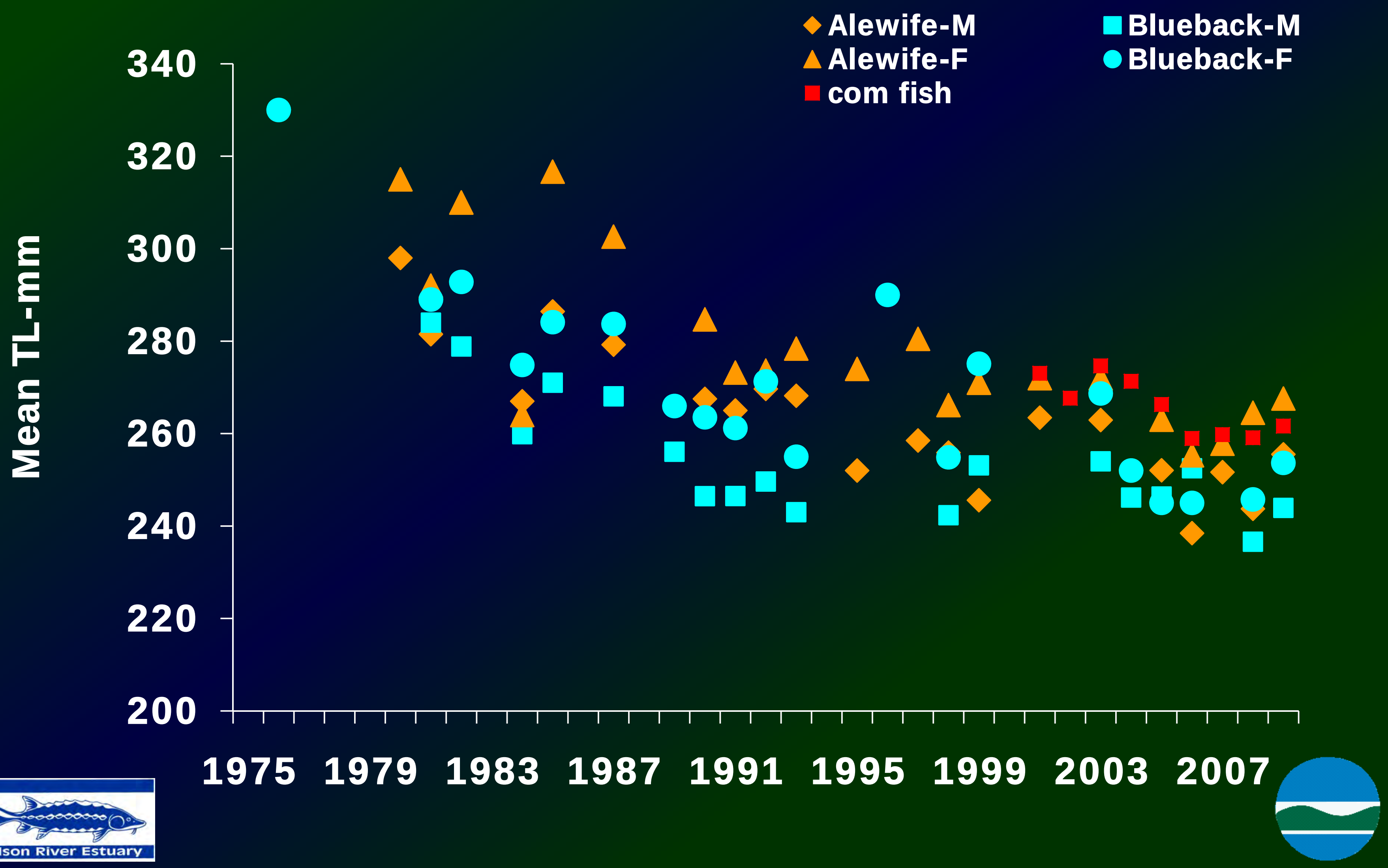
Commercial fishery catch monitoring

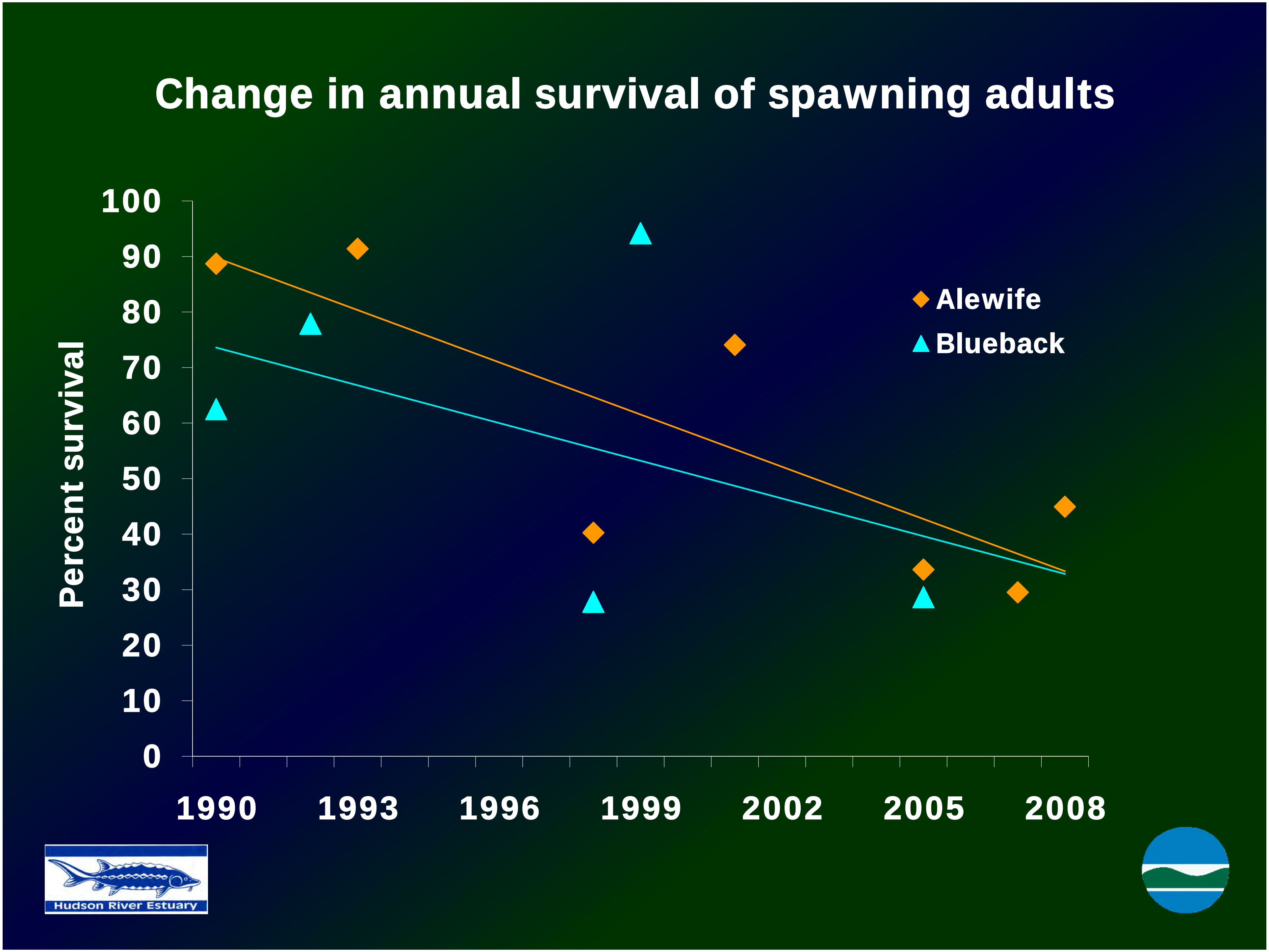


Available Fishery Independent Data

- Hudson River
  - Spawning stock survey
    - Biological samples
    - Survival rates
  - Young-of year abundance
- Long Island – none of the above

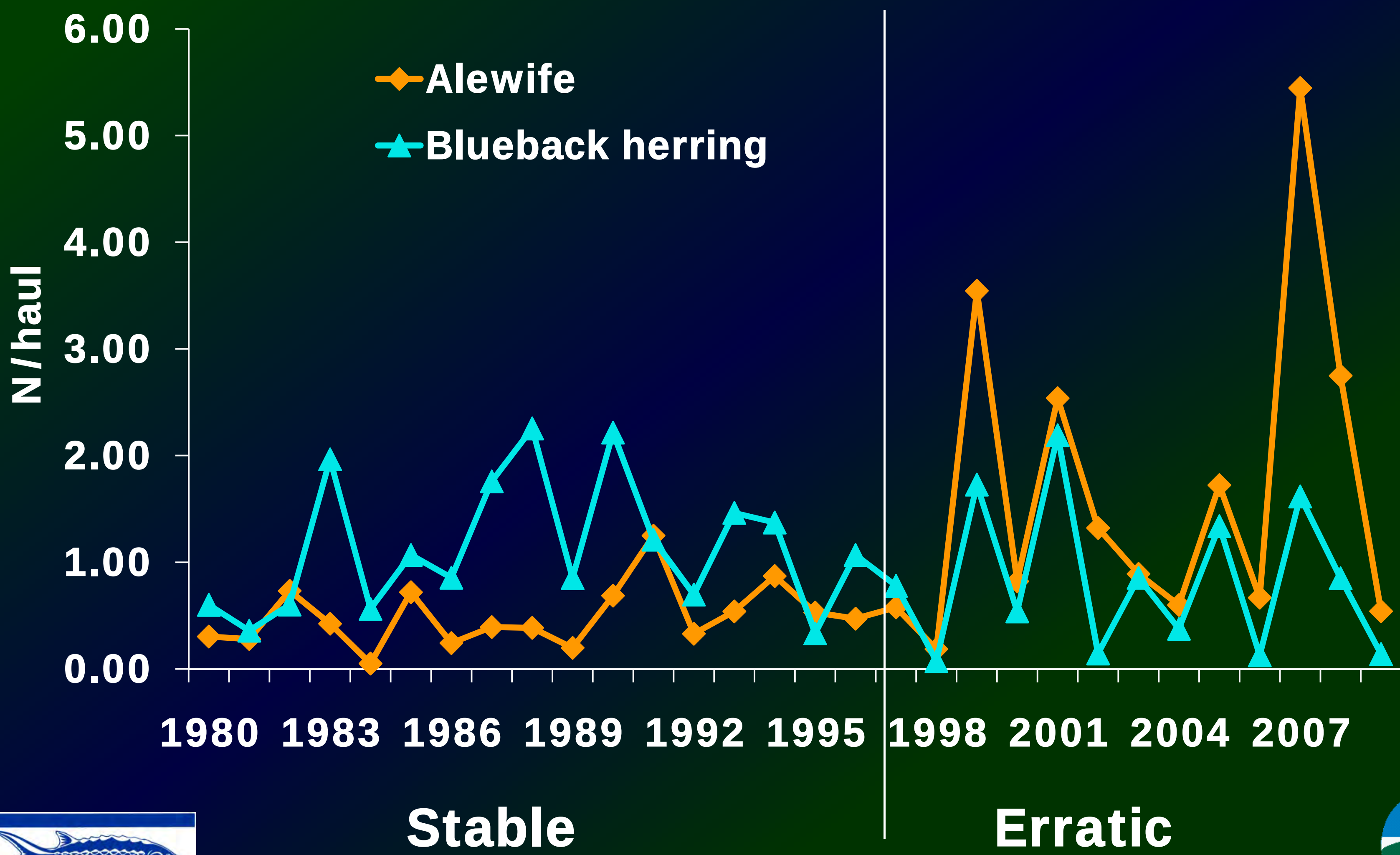
Change in spawning stock total length




Change in annual survival of spawning adults
Percent survival
100
90
80
70
60
50
40
30
20
10
0
1990
1993
1996
1999
2002
2005
2008
Alewife
Blueback
Hudson River Estuary

Changes in young of year relative abundance

On shore seine survey



Summary of changes in Hudson Stock

- Fishery data
  - Reported commercial CPUE confusing
  - Fish size & weight decreasing
- Spawning stock data
  - Adult survival decreasing
  - Fish size decreasing
- Erratic young of year index
- Anecdotal data

Hudson River Estuary

Causes of change

- Human causes
  - Fishing in river on spawning fish
  - Bycatch in ocean fisheries
  - Power plant entrainment &/or impingement
  - Habitat alteration
- Natural causes
  - Striped bass predation
  - Reduced yoy survival from food web impacts by zebra mussels

Hudson River Estuary

Creating a "Sustainable fishery" for the Hudson

- Need to change direction of current trends
  - Increase survival rate
  - Increase fish size
  - Stabilize/increase yoy
- How?
  - Decrease in fishing harvest
- For how long?
  - Initial timeline of 5 to 10 years

Current Hudson fishery regulations

Recreational

- Creel limit
  - None
- Closed areas
  - None
- Gear restrictions
  - Net size
- No fishing days
  - None
- Season
  - None
- Marine license

Commercial

- Catch limits
  - None
- Closed areas
  - No gill nets above I-90 & on Kingston Flats
- Gear restrictions
  - 600 ft gill net
- No fishing days
  - 36 hr river closure
- Season
  - Mar 15-Jun15
- Marine permit
  - Low fee ($1 to $30)

Future Hudson fishery regulations

Recreational

- Creel limit
  - None to ?
- Closed areas
  - None to ?
- Gear restrictions
  - Net size to ?
- No fishing days
  - None to ?
- Season
  - None to ?
- Marine license

Commercial

- Catch limits
  - None to ?
- Closed areas
  - No gill nets above I-90 & on Kingston Flats, enough?
- Gear restrictions
  - 600 ft gill net to ?
- No fishing days
  - 36 hr closure - longer ?
- Season
  - Mar 15-Jun15 to ?
- Marine permit
  - Low fee to ?

Hudson River Estuary

Questions?

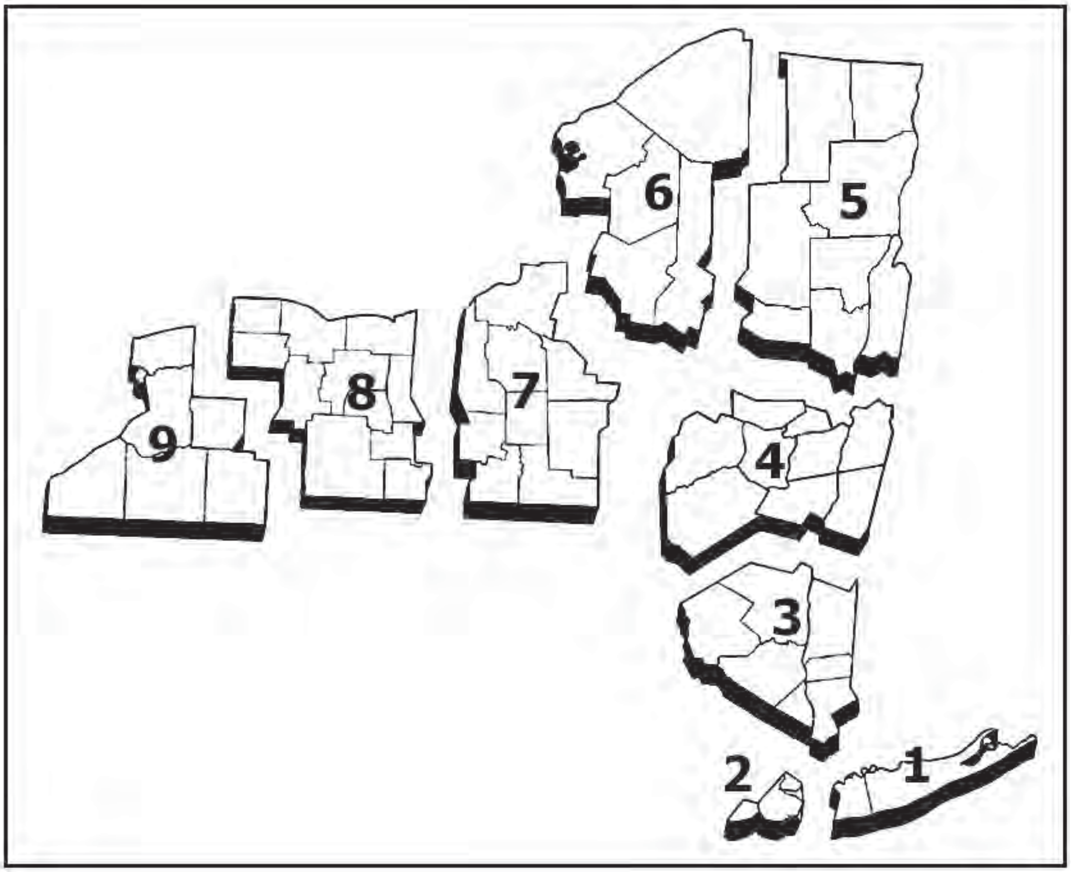
Photo from B. Young

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

BUREAU OF FISHERIES

2010-2011 ANNUAL REPORT

DEC REGIONS



Region 1
Stony Brook University
50 Circle Road
Stony Brook, NY 11790-3409
(631) 444-0280
fwfish1@gw.dec.state.ny.us

Region 2
1 Hunters Point Plaza
47-40 21st Street
Long Island City, NY 11101-5407
(718) 482-4922
fwfish2@gw.dec.state.ny.us

Region 3
21 S. Putt Corners Road
New Paltz, NY 12561-1696
(845) 256-3161
fwfish3@gw.dec.state.ny.us

Region 4
65561 State Highway 10
Suite 1
Stamford, NY 12167-9503
(607) 652-7366
fwfish4@gw.dec.state.ny.us

Region 5
Route 86, P.O Box 296
Raybrook, NY 12977-0220
(518) 897-1200
fwfish5@gw.dec.state.ny.us

Region 6
State Office Bldg.
317 Washington Street
Watertown, NY 13601-3787
(315) 785-2263
fwfish6@gw.dec.state.ny.us

Region 7
1285 Fisher Ave.
Cortland, NY 13045-1090
(607) 753-3095
fwfish7@gw.dec.state.ny.us

Region 8
6274 East Avon-Lima Road
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2010-11 Annual Report

New York State Department of Environmental Conservation
Bureau of Fisheries
Phillip J. Hulbert, Chief

Introduction

The New York State Department of Environmental Conservation, Division of Fish, Wildlife and Marine Resources, Bureau of Fisheries delivers a diverse program and annually conducts a wide array of activities to accomplish its mission:

> ***Conserve and enhance New York State's abundant and diverse populations of freshwater fishes while providing the public with quality recreational angling opportunities.***

This report provides a summary of significant activities completed during fiscal year 2010-2011 by Bureau of Fisheries staff located in 9 regional offices, 2 research stations, 12 fish hatcheries, 1 fish disease laboratory, as well as the DEC Central Office in Albany.

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Common Acronyms, Definitions and Units of Measure

Common Acronyms

ACOE: Army Corps of Engineers

BEF: Boat electrofishing

CPUE or CUE: catch per unit of effort - such as the number of fish caught per hour or fish caught per net.

DEC or NYSDEC: Department of Environmental Conservation.

DFWMR: Division of Fish, Wildlife and Marine Resources.

RM: river mile - denotes the distance upstream from the river mouth.

OMNR: Ontario Ministry of Natural Resources

PFR: Public Fishing Rights.

TSMP: Toxic Substances Monitoring Program.

USGS: United States Geological Survey.

USFWS: United States Fish and Wildlife Service.

YOY: young of year - typically a fish that is captured by sampling in the same year it was hatched.

Definitions

Bottom trawl: a sampling technique where a net is dragged along the bottom of a water body behind a boat.

Creel Survey: a survey where anglers are interviewed about their catch.

Cross vane structure: a "U"-shaped structure of boulders or logs, built across the stream channel to reduce velocity and energy near the stream banks.

CROTS: Catch-Rate-Oriented-Trout-Stocking - the model used to develop stocking rates for trout streams that takes into account biological measures of the stream and stream carrying capacity, trout natural reproduction, hold-over of previously stocked trout, classification of the type of trout fishery managed for, measured or assumed angler effort and targeting an angler catch rate of 0.5 trout/hour.

Dreissenid mussles: a family of small freshwater mussels that attach themselves to stones or to any other hard surface.

Electrofishing: use of electricity to temporarily stun fish, allowing them to be captured.

Extirpated species: a species that no longer exists in the wild in a certain country or area.

Gill netting: a survey technique that uses a mesh net to ensnare fish.

HUC: Hydrologic Unit Code. A categorization of watershed boundaries from the basin to the sub (small) watershed level (HUC12).

Hydroacoustic survey: use of sound and reflected echoes from schools of fish to estimate abundance.

Pen reared: raising hatchery salmon or trout in a pen to "imprint" those fish to the pen rearing site. In theory, this will cause the fish to return to the pen rearing site to spawn.

PSD: proportional stock density - describes the portion of a fish population or sample that exceeds a size threshold. For example, the PSD for largemouth bass is the proportion of 12 inch and larger bass in the sample of largemouth bass that were stock size (8 inches and larger).

RSD 15: relative stock density greater than 15 inches - describes the proportion of fish larger than 15 inches in a population or sample of all fish exceeding a size threshold. For example, the RSD 15 for largemouth bass is the proportion of 15 inch and larger bass in a the sample of all largemouth bass that were stock size (8 inches and larger).

Secchi depth: the water depth in which the black and white colors of a disc can longer be distinguished from each other by an observer at the surface of the water.

Seining: using a seine net, a large net that hangs in the water due to weights along the bottom edge and floats along the top, to capture fish.

VHS/VHSv: Viral hemmoraghic septicemia - a serious disease of fish (not humans) recently introduced into New York State.

Year Class: a group of fish spawned during the same year.

Units of Measure

^{o}C: degrees Celsius - to convert from c to farenheit (f) = (f - 32) x 5/9.

ha: hectare - a metric system unit of area, 1 hectare = 2.47 acres.

hr: hour.

in: inch.

kg: kilogram - a metric system unit of weight, 1 kg = 2.2 pounds.

km: kilometer - a metric system unit of length, 1 km = 0.62 miles or 3,281 feet.

m: meter - a metric system unit of length, 1 meter = 3.28 feet.

mm: millimeter - a metric system unit of length, 100 mm = 3.94 inches.

ppm: part per million - describes the density of a substance in another solid, liquid or gas (typically water, air).

ppb: parts per billion - describes the density of a substance in another solid, liquid or gas (typically water, air).

µg/l: micrograms per liter; equivalent to ppb,

Surveys Document the Need for Adjusting Walleye Stocking Policy in Lake Ronkonkoma and Fort Pond

Lake Ronkonkoma and Fort Pond are two of the largest lakes on Long Island and their fish populations have been dominated by an abundance of small white perch over the past few decades. Since the mid 1990's, DEC has stocked walleye in these waters in an effort to control the over abundance of white perch. A different stocking policy was adopted for each lake to analyze the most effective control methods. In Lake Ronkonkoma, 10,000 fingerling walleye, or twice the standard stocking rate of 20 fingerlings per acre, were stocked annually; whereas, in Fort Pond, 4,000 fingerling walleye, or the standard fingerling stocking rate per acre, were stocked biennially (every other year). Stocking biennially was used to test for higher walleye survival through decreased cannibalism of fingerlings, as has been reported in scientific literature. To analyze these two stocking policies, DEC's Region 1 Fisheries Unit completed triennial gill net and electrofishing surveys in Lake Ronkonkoma and Fort Pond. The 2010 results are as follows:

- In Lake Ronkonkoma, the overall electrofishing catch rate for white perch declined over 90% from a catch rate of 1,300 fish per hour in 2001 to 108 fish per hour in 2010. Gill net catches resulted in similar declines. The goal of reducing the white perch population was certainly achieved; however, the catch rates for walleye over the same period also declined, especially for quality (15-20") and preferred (>20") size walleye. The relative weight (a measure of relative plumpness) also declined dramatically for quality and preferred sized fish. These results led to the conclusion of a fish community that has shifted significantly toward the predator (walleye) and a reduction in the walleye stocking rate is warranted.
- In Fort Pond, the electrofishing catch rate for white perch increased over 200% from a catch rate of 300 fish per hour in 2001 to over 1,000 fish per hour in 2010. During the same time period, walleye catch rates declined, and walleye relative weight remained stable. It is clear from these results that the alternate year stocking of walleye is not controlling the white perch in Fort Pond and an increase in the stocking frequency is warranted.

From these results, the recommended stocking policies will change to 20 fingerling walleye per acre per year. That translates to 5,000 walleye per year for Lake Ronkonkoma and 4,000 walleye per year for Fort Pond. DEC's Region 1 Fisheries Unit will continue to monitor these waters on a triennial basis and adjust stocking rates as needed.

I FISH NY - Long Island

I FISH NY continued to offer fishing instruction to the public through public fishing events and clinics and in cooperation with private organizations, despite a decrease in staff and the loss of partnership with New York Sea Grant. By collaborating with New York State Office of Parks, Recreation and Historic Preservation, I FISH NY was able to offer three public fishing events at Long Island state parks, reaching a total of 2,750 people. An additional public clinic was held in collaboration with the Town of Brookhaven at Lake Ronkonkoma, providing 74 beginner anglers with fishing instruction and a fun fishing experience.

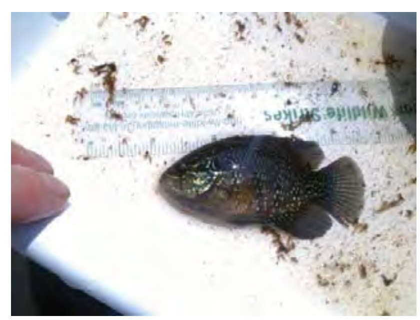
The DEC I FISH NY Program coordinated with Boy Scouts, Girl Scouts and other organizations, providing over 1,000 children with fishing education through I FISH NY clinics and summer camp programs. Participating Boy Scouts earned their fishing belt loops and Girl Scouts earned an I FISH NY fishing badge.

Staff reductions significantly affected the I FISH NY in school program. The program was only able to visit 4 schools in FY 2010-11 compared with 20 in FY 2009-10.

Species of Greatest Conservation Need: Banded Sunfish and Swamp Darter

In our continued effort to document the status and range of the species of greatest conservation need on Long Island, twelve rare and endangered species surveys were conducted during the summer of 2010.

Banded Sunfish: The range of banded sunfish (*Enneacanthus obesus*) appears stable. The species has been documented in 28 different waters within the Peconic River drainage, 14 of these are newly discovered locations since 2007, mostly from surveys of waters not previously surveyed. Not surprisingly, the presence of banded sunfish is well correlated with a healthy pine barrens/bog wetland community, and they are often found in waters where sweetpepper bush (*Clethra alrifoli*), buttonbush (*Cephalanthus occidentalis*), purple bladderwort (*Utricularia purpurea*), and yellow bladderwort (*Utricularia L*) occur. Banded sunfish were found to be extirpated from two locations where they were documented in the 1990's. One of these waters, Linus Pond, has been inundated by Phragmites in the last ten years and the other pond dried up completely in the drought of 2002 and is now fishless.

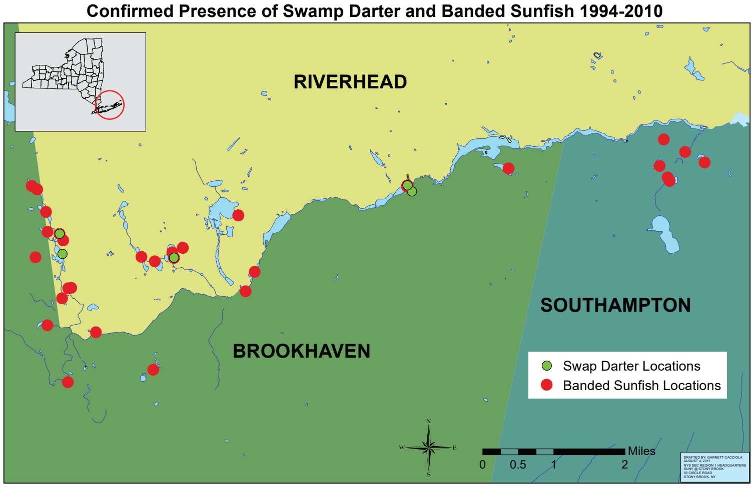


Swamp Darter: The range of the swamp darter (*Etheostoma fusiforme*) has contracted substantially in comparison to historical records. Historically swamp darters were reported from the Lake Ronkonkoma drainage, the Carmans River drainage and the Peconic River drainage. Recent surveys have been unable to document swamp darter in the

Lake Ronkonkoma or Carmans River drainages, but they have been documented at five locations in the Peconic River drainage. Swamp darters prefer flowing water and a sandy bottom and are often found at the connections between the banded sunfish ponds. One possible explanation for the loss of swamp darter from the Lake Ronkonkoma

drainage is that the most promising habitat for swamp darter now has abundant populations of mosquitofish (Gambusia affinis) and weather loach (Misgurnus anguillicaudatus), both non-native species.

Confirmed Presence of Swamp Darter and Banded Sunfish 1994-2010



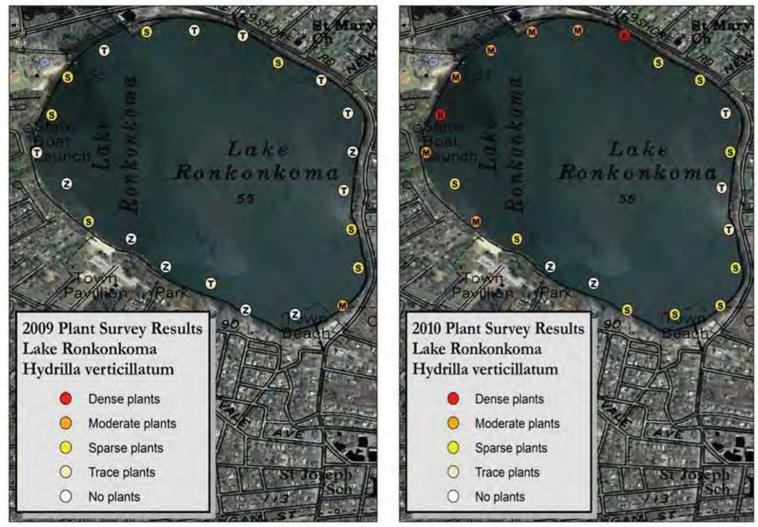
Invasive Species Control – One Step Forward, Two Steps Back

One Step Forward – Water Chestnut - The third year of water chestnut control on Swan Pond in Calverton found only one water chestnut plant, down from 2 in 2009 and 11 in 2008. With continued monitoring eradication appears possible.

One step back – Ludwigia - In 2009 victory appeared assured when two trips down the river found only a few small patches of the invasive plant. However, the cool June 2009 weather may have done as much as our removal efforts to suppress the growth of the weed. In 2010 the Ludwigia has made a strong comeback. This year it took about 90 hours to remove 4.5 cubic yards of Ludwigia. While this is a big improvement over 2007 when 666 hours were needed to remove 60 cubic yards, it is clear that without continued vigilance, it would only take a few years to return to the infestation levels of 2007.

Another step back – Hydrilla – Hydrilla was first documented in three waters on Long Island in 2008 and in Lake Ronkonkoma in 2009. The Regional Fisheries Unit conducted surveys of the hydrilla in Lake Ronkonkoma in 2009 and 2010 and found a substantial expansion of the plant in just one year (see survey map). The Regional Fisheries Unit will continue to monitor the spread of hydrilla and is working with stakeholders to develop a plan for control of hydrilla in Lake Ronkonkoma. (Figure Caption: Lake Ronkonkoma Hydrilla Survey Results, 2009 and 2010)

Lake Ronkonkoma Hydrilla Survey Results 2009 and 2010



2010-11 Region 1 Fisheries Staff

Guthrie, Charles	Biologist 2 (Aquatic)
Heidi O'Riordani	Biologist 1 (Aquatic)
Charles Vullo	Seas. Laborer (4/1/10 – 3/31/11)
Ann Tenyenhuis,	Environ. Ed. Asst. (4/1/10- 10/6/10) Sea Grant Ext. Aid (10/7/10 - 3/31/11)
Kaitlin Friedman	Fish and Wildlife Tech 1 (Seasonal) (6/17/10 – 10/27/10)
Cory Tizzio	Cobleskill Intern (5/20/10 – 8/20/10)

I FISH NY – NYC School Fishing Program

Spring fishing in school program: 50 classes, total students = 1145. Classes taught during 2010 included slightly higher number of students than in 2009 and incorporated new schools and age groups: Flushing International HS, Flushing, Queens; PS 340, Bronx; PS 277, Gerritsen Beach, Brooklyn; and K821 in Sunset Park, Brooklyn. These students fished in 2011.

Internal Fish Anatomy Lesson Launched:

Students at P.S. 262 in Rockaway, Queens were treated to an educational creation to teach internal fish anatomy. Internal and external fish anatomy of a gigantic striped bass shown on several sheets of overlaid plastic elicited "oohs and aahs" and provided the seventh-graders the opportunity to learn of the differences existing in the internal anatomy of different species of fish.

I FISH NY – Other Fishing Outreach

Naturemania: Fishing provided to approximately 40 students on Spring Break during New York Restoration Project's Naturemania event at Swindler's Cove, Harlem River, 4/1/10

Roosevelt Island Health & Fitness Day: 35 participants fishing in the East River off Roosevelt Island, 5/15/10

Roosevelt Island HS: Fishing clinics for summer school students, 715/10 and 7/22/10.

City of Water Day: I FISH NY joined numerous local groups promoting NYC's waterfront; taught fishing to more than 85 people despite temperatures over 100° F, 7/24/10.

Lincoln Square Community Center: Fishing clinic for approximately 20 youth at 68th St. Pier in Manhattan at the Hudson River, 8/19/10.

Solar 1 Go Fish Day: East River fishing clinic with approximately 25 in attendance, 9/11/10.

Little Red Lighthouse Festival, Ft. Washington Park: Fishing clinic with 169 participants in the Hudson River, 9/25/10.

Baisley Pond Park: Community fishing clinic, 61 participants, 10/9/10.

Zimmer Club: Outdoor recreation education program for Staten Island youth. R2 staff attended to discuss angling techniques, fishing regulations, licenses, and safe catch and release fishing, 3/19/10.

Warmwater Fisheries Surveys

Invasive Species Surveys: The lakes of Flushing Meadows Corona Park were surveyed by electrofishing four times during FY2010. Survey objectives included monitoring changes over time in catch-per-unit-effort (CPUE) of invasive northern snakeheads and CPUE of other fish populations of these lakes. Most of the shoreline of Meadow Lake was surveyed over two evenings in April and both Meadow and Willow Lakes were surveyed in October. CPUE was not found to have significantly increased or decreased for either the northern snakeheads or native fish of this system. One significant finding of the 2010 surveys was the capture of largemouth bass distributed into three size classes. This is the first time over five years of surveying these lakes that a top predator other than snakeheads has been found. Another significant finding was the collection of the two smallest snakeheads captured to date: they were 97mm and 99mm, leaving no doubt snakeheads are successfully reproducing here.

Prospect Park Lake Fish Disease Surveillance & General Biological Survey: An electrofishing survey of Prospect Park Lake, Brooklyn, was performed over two evenings in October, 2010. Objectives of this survey included fish collection for New York's Statewide Fish Disease Surveillance program and collection of data for fish population assessment. Fish samples were tested for four diseases. Negative results were found for all four. Data was compared to 2008 electrofishing data and while larger fish composed a greater proportion of bass captured in 2008, stock density indices calculated from both the 2008 and 2010 survey data indicate the largemouth bass and sunfish populations of Prospect Park Lake have a well-balanced predator-prey relationship. Comparison of young versus adult largemouth bass suggests that bass reproduction is neither too low nor excessive.

Willowbrook Pond, General Biological Survey: An electrofishing survey of Willowbrook Pond, Staten Island, was performed on 9/29/10. This was the first such survey of this lake and had been a long time coming as fish kills at Willowbrook Pond occurring within the past three years had been the only source of fish population data. Catch per unit effort (CPUE) of Willowbrook's fish was one of the highest for any

New York City water body surveyed with a CPUE of 1080 fish/hour. The CPUE of fish from Prospect Park Lake, in comparison, was 714 fish/hour. Comparison of size frequency distributions of largemouth bass and sunfish indicates a narrow size distribution of these fish. The number of young-of-the-year (YOY) sunfish was well over 1,000; larger sunfish were very few in number. In the case of largemouth bass, no YOY were found indicating a poor spawning season. The most recent Willowbrook Lake fish kill investigated occurred at the end of March and is a likely cause of spawning and recruitment problems.

Bronx River Survey, General Biological Survey: An electrofishing survey of three areas of the Bronx River was performed on 5/6/10. Species collected during the survey included redbreast sunfish, yellow bullhead, tessellated darter, eastern blacknose dace, pumpkinseed and white sucker. Results of this survey correlate well with those of a 2007 survey of the Bronx River and indicate the diversity of New York City's warmwater fish communities is greater than previously thought. Bronx River Alliance staff attended the first part of the survey and observed fish processing firsthand.

Other fishery surveys: **Mt. Loretto Unique Area Ponds:** Two freshwater ponds of DEC-managed Mt. Loretto Unique Area, Staten Island, were surveyed with a backpack electrofisher and seine. Bullheads, pumpkinseeds, and fish of the Gambusia and Fundulus genera composed the majority of the catch. **Central Park Lake:** This electrofishing survey followed-up a truncated 2009 survey and resulted in a size distribution skewed towards large largemouth bass. Another survey should be performed before concluding the warmwater population of this lake is unbalanced.

2010-11 Region 2 Fisheries Staff

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Darin Alberry	Environmental Education Assistant
Diallo House	Environmental Education Assistant
James MacDonald	Environmental Education Assistant

I NY[SM]

New York State Department of Environmental Conservation

Esopus Creek 2010 Creel survey

A full season creel survey was conducted on the 17.9 mile stocked section of the Esopus Creek to determine fishing pressure, harvest, catch rates, catch composition, and basic angler demographics. A total of 136 days were surveyed during the 2010 season, with 1,129 individual anglers being interviewed.

The majority of the fishing pressure on the Esopus Creek occurred below Allaben (Portal) in 2010 (Table 1). June accounted for the largest portion of the fishing pressure below the Portal but fishing effort continued through the summer. Catch rates are quite low before the first increment stocking, although fishing conditions at that time of year may contribute to the low catch rate. Catch rates generally peaked in June/July 2010, after the second increment stocking. Low catch rates in the Fall were primarily due to a large storm that damaged stream banks and caused severely turbid conditions during this period.

Table 1. Expanded Fishing Hours by Period of the Season and Stream Section

Period	(Dates)	Below Allaben	Above Allaben
Pre-stocking	(4/1 - 4/25)	2,429	365
Post first stocking	(4/26 - 5/27)	5,676	789
Post second stocking	(5/28 - 6/30)	8,470	285
July	(7/1 - 7/31)	4,605	231
August	(8/1 - 8/31)	2,954	205
September	(9/1 - 9/30)	3,299	203
October	(10/1 - 10/31)	806	316
November	(11/1 - 11/30)	805	172
Total hours fished for the season		29,044	2,566
Hours fished per acre of water		207	86

A total of 16,480 trout were estimated to have been caught (creeled or released). We estimate that 83% (13,678) of the trout which were caught by Esopus anglers in 2010 were released, with 2,142 estimated as being harvested. Catch rate by time period and stream section can be found in Table 2.

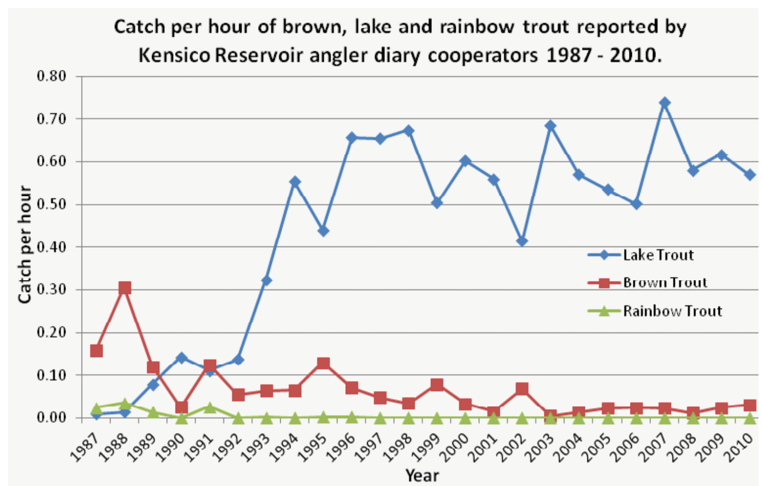
Table 2. Trout Catch Rates (trout/hour) by Period of the Season within 3 Stream Sections

Period	(Dates)	Below Phoenicia	Phoenicia to Allaben	Above Allaben
Pre-stocking	(4/1 - 4/25)	0.17	0.13	0.14
Post first stocking	(4/26 - 5/27)	0.83	0.97	0.27
Post second stocking	(5/28 - 6/30)	1.60	1.13	1.17
July	(7/1 - 7/31)	1.12	1.26	2.11
August	(8/1 - 8/31)	1.13	0.92	0.74
September	(9/1 - 9/30)	1.11	1.25	0.22
October	(10/1 - 10/31)	0.59	1.90	0.82
November	(11/1 - 11/30)	0.47	0.28	0.26

Angler opinions concerning the proposed institution of a catch and release regulation were negative. Instead, a "five trout with only two trout over 12 inches" regulation will be enacted, primarily to help spread out the harvest of the stocked two year old brown trout. This survey is being repeated in 2011, with the upper "Above Portal" section being designated as a "Fate of Stocked Trout" study reach.

Kensico Reservoir Trout Assessment

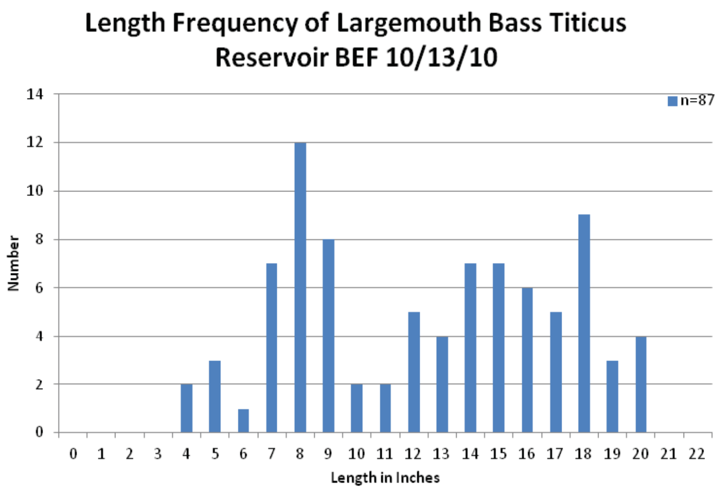
Two nights of gill net sampling in September yielded 68 lake trout and 5 brown trout. The lake trout averaged 18.6 inches and the largest was 29.6 inches and weighed 9 pounds. The brown trout averaged 17.8 inches and the largest was 24 inches and weighed 7 pounds. Stocked lake trout represented only 5.9% of the lake trout population (based on fin clips). Combining the data from this survey with angler diary program data, it is estimated that approximately 93% of the lake trout are wild fish. This percentage is the highest observed since the stocking program has started. Diary program catch rates of lake trout have increased from 0.14 caught per hour in 1990 to a fairly consistent catch rate of 0.60/hour for the last 5 years. Over this same time period brown trout catch rates have declined from 0.31/hour to 0.03/hour. The stocking program for lake trout in Kensico began in the 1980's with annual stockings of roughly 8,000 yearlings. Currently, 900 lake trout are stocked each year. Lake trout predation on brown trout is likely the cause of the brown trout decline. The creation of the self sustaining wild lake trout population will likely result a further reduction in lake trout stocking at Kensico Reservoir.



Titicus Reservoir Trout and Bass Assessment

A gill net survey was conducted on Titicus Reservoir for two nights in late June in order to sample the trout population and assess the effectiveness of the trout stocking program. A total of 29 trout were caught (28 brown trout and 1 rainbow trout) in 2 nights of gill netting in late June. Only 3 of the trout were over 12 inches, indicating that most of the trout sample was comprised of fish that were stocked this year. The possible reason for the lack of holdover fish could be the small summer trout zone (dissolved oxygen >= 5 ppm and temperature <= 70 F) that was measured at the time of this survey. A future netting survey will be conducted to see if this trend continues, and this may result in a stocking policy adjustment.

A boat electrofishing survey was also conducted in mid-October to assess the largemouth bass fishery. A total of 87 largemouth bass were collected, for a catch rate of 43.5 bass per hour. Largemouth bass were found in all sites sampled. Fifty seven percent of the bass collected were over 12 inches in length. Titicus Reservoir has a balanced population of largemouth bass, and offers anglers a good chance of catching bass over 18 inches.



Region 3 Outreach

The Region 3 Fisheries Unit I FISH NY Program conducted 7 school programs reaching over 500 students, 3 fishing festivals reaching 270 people, 9 fishing clinics reaching over 700 people and 8 summer camps reaching 165 campers. A total of over 1,600 people went fishing this year with the Region 3 I FISH NY Program!

A total of 35 new web pages under "Places to Fish" were created for Region 3 waters. *www.dec.ny.gov/outdoor/7940.html*

Additionally Regions 3 continues to update their fishing hotline web page. *www.dec.ny.gov/outdoor/42811.html*

Champlain Hudson Power Express

Staff participated in the environmental review of a proposed project that includes the installation of 333 miles of 1000 Megawatt DC electrical transmission lines. Most of this distance would require it to be buried in the waters of Lake Champlain, Hudson River, Harlem River and East River. Once completed, the project would transmit electricity from yet to be built hydroelectric and wind energy projects in Canada to New York City. The project could provide additional low cost energy to the metropolitan area. However, there are several potential environmental impacts to the aquatic communities in the waters where the cables would be located. DEC staff have invested significant time in negotiations with TDI and other parties in efforts to allow the project to proceed with a minimum of impact to the environment.

Northern Snakehead Monitoring

Region 3 Fisheries staff conducted three monitoring surveys in May and November within the Northern Snakehead Eradication Project area in Orange County. Various segments of Catlin Creek were sampled with a backpack electrofisher, and on November 22, Hyde Pond was sampled with a twelve foot electrofishing boat. No fish of any species were found in Catlin Creek. The pond, which was stocked in 2009 after the second rotenone treatment, contained a good population of largemouth bass, crappie, yellow perch and golden shiners. No snakeheads were found in any of the waters sampled.

2010-11 Region 3 Fisheries Staff	
Mike Flaherty	Biologist 2 (Aquatic)
Bob Angyal	Biologist 1 (Aquatic)
Larry Wilson	Biologist 1 (Aquatic)
Ryan Coulter	Biologist 1 (Aquatic)
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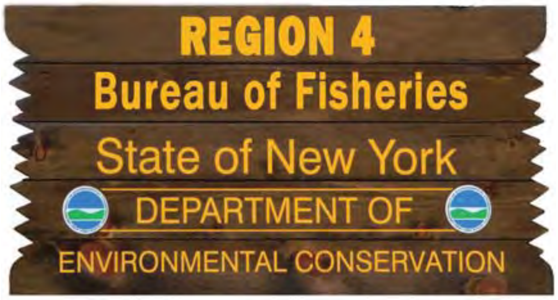
Tim McNamara	Fish & Wildlife Technician 2
Dustin Dominesey	Fish & Wildlife Technician 1 (seasonal)
Ryan Burns	Laborer 1 (seasonal)
Indie Bach	Cobleskill Intern

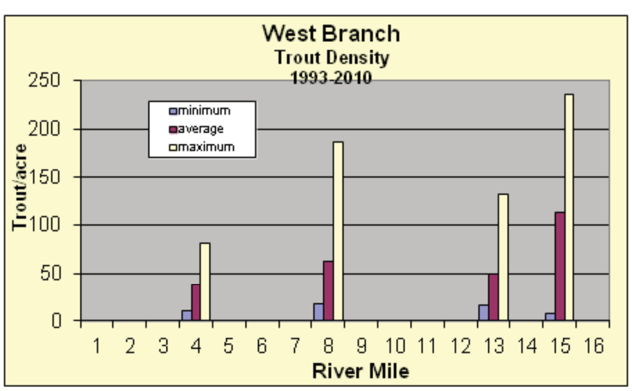


Otsego Lake Ice Fishing Creel Survey

Ice anglers made an estimated 1,991 trips to the 4,226 acre Otsego Lake and fished an estimated 9,814 hours between January 23 and March 13, the period of safe ice, with 84% of the effort directed towards salmonids, 15% towards warmwater species, and 1% targeted both. Ice fishing effort averaged a low 0.5 trips/acre or 2.3 hours/acre. Salmonid anglers caught an estimated 2,391 lake trout between 10.5 and 31.0 inches of which 989 were legal size (> 23 in) for an average catch of 0.29 fish/hour and 0.12 legal fish/hour. An estimated 330 lake trout (12% hatchery fish) were creeled at a rate of 0.04 fish/hour. The harvest of 0.08 lake trout/acre is considered low.

West Branch Delaware River Trout Population Studies

Mark and recapture trout population studies on the West Branch have been conducted at the same four sites for most years since 1993 as part of DEC's commitment to the interstate Delaware River Basin Commission to evaluate the effectiveness of the water releases program on trout populations in the 16.9 mile West Branch tailwater. A total of 1,413 unmarked yearling and older trout and 107 marked trout between 4.2 and 23.2 inches were collected including 1,271 wild brown trout, 13 hatchery brown trout, 128 rainbow trout and 1 brook trout. Trout abundance at these four study sites located at river mile 4.2, 8.8, 13.0, and 15.2 were 28, 63, 50, and 113 trout/acre with trout biomass averaging 25.6, 22.9, 45.9, and 72.7 lbs/acre, respectively. Compared to the long term averages, trout abundance and biomass were higher at the three upstream sites and down slightly at the downstream site.

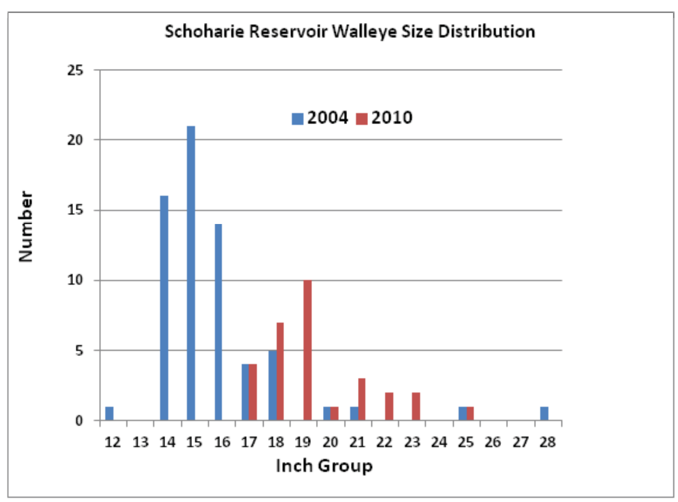


Eastern Brook Trout Joint Venture (EBTJV) Sampling

The fourth year of a five year project to survey the many smaller streams throughout the region to determine the presence or absence of brook trout was completed. The goal of this effort is to halt the decline of brook trout and restore fishable populations. To accomplish this goal, an updated inventory of brook trout waters is needed because many of these smaller streams have never been surveyed or the survey data is old and outdated. In 2010, a federally funded two man survey team sampled 671 streams including 418 streams where trout were collected. Brook trout were found in 355 streams, brown trout in 279 streams, and rainbow trout in 101 streams. For the four year period to date, a total of 2,967 small streams have been surveyed throughout the region including 1,290 streams that support trout. Brook trout were found in 1,091 streams, brown trout in 708 streams, and rainbow trout in 134 streams.

Schoharie Reservoir Walleye Netting

The 1,145 acre Schoharie Reservoir was gill netted in June to collect baseline information on the current status of walleye in this reservoir which will be used to help evaluate the effectiveness of the fingerling walleye stocking program. Approximately 23,000 walleye fingerlings are being stocked annually into the reservoir for five years beginning in 2010 in an effort to rebuild the walleye population and fishery. Ten gill nets were set overnight in the same general areas that were used in a 2004 survey. A total of 30 walleye from 17.1 to 26.0 inches were collected for an average catch of 3.0 fish/net compared to the 6.5 fish/net recorded in 2004. In 2004, 80% of the walleye collected were smaller than the smallest (17.1 in) fish collected in 2010. The data indicates no successful reproduction since 2007 as there were no Ages 1-3 walleye present in 2010.

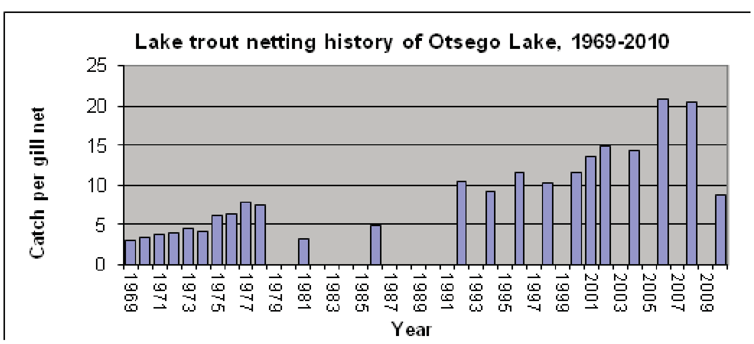


Canadarago Lake Walleye

The biannual gill netting of this 1,900 acre lake to monitor the abundance of walleye was completed in September. Although the catch of 11.8 walleye/net indicates an abundant population, it represents the fourth straight year of a continuing decline from the record 21.6 walleye/net recorded in 2003. Only 4.3% of the walleye collected in 2010 were sublegal (< 15 in) compared to 18.7% in 2008. In the five nettings from 1999 through 2008, the catch of sublegal walleye (range was 21.4% to 31.7%) averaged 28.5%. The decline in the abundance of adult and sublegal walleye is due to the growing population of alewife in the lake which preys extensively on larval walleye. This alewife predation resulted in the complete absence of walleye from the 2008, 2009, or 2010 year classes during the 2010 monitoring efforts. To maintain this walleye fishery and prevent further declines in walleye abundance, the lake will be stocked for 5 years with approximately 40,000 walleye fingerlings annually beginning in 2011. These fingerlings will be finclipped to allow evaluation of the effectiveness of this stocking program.

Otsego Lake Lake Trout

This 4,200 acre lake was netted for the 23rd time since 1969 to monitor the abundance of lake trout. The wild population is supplemented with the stocking of approximately 5,000 yearling lake trout annually. A total of 52 lake trout between 6.9 and 29.2 inches were collected for an average catch of 8.7 fish/net. This represents a 59% decline from the record catch of 21.2 fish/net recorded in 2008 and the 20.8 fish/net recorded in 2006. The 8.7 laker trout/net recorded in 2010 was the lowest recorded in the 12 nettings since 1986 and was due to the lowest catch (6 fish) of lake trout under 15 inches ever recorded going back to 1969. The nettings between 1992 and 2008 averaged 7.6 small lake trout/net. The record low abundance of lake trout under 15" is of concern and the cause of the decline is not known. It is recommended that the biannual lake trout monitoring be continued.



Exotic Loaches Found

Oriental weatherfish 'loach' were documented in the Manor Kill watershed of Schoharie County from June through Dec 2010. A large source population was found in a state wetlands feeding tributary 16 some 8.4 river miles above Schoharie Reservoir. Five instream ponds totaling 3 acres are infested with loach which continue to out-migrate downstream into the upper mainstem Manor Kill and are presumed to be in Schoharie Reservoir. Over 800 loaches from 2.0 to 7.0 inches were captured in 2010 with the largest individuals typically being gravid females. Loach eradication is unlikely because some property owners will not allow a rotenone treatment of their pond. The impact of this unauthorized introduction is not known.

2010-11 Region 4 Fisheries Staff

Norm McBride	Region 4 Fish Manager
Dan Zielinski	Biologist 1 (Aquatic)
Scott Wells	Biologist 1 (Aquatic)
Dennis Wischman	Fish and Wildlife Tech 3
Dave Cornwell	Fish & Wildlife Tech 1
Tim Pokorny	Seasonal Fish & Wildlife Tech
Rob Poprawski	Seasonal Fish & Wildlife Tech
Tobias Widger	Seasonal Fish & Wildlife Tech
Fred Linhart	Fish and Wildlife Tech 3 (retired Sept, 2010)
Jeff Strassenburg	Seasonal Fish & Wildlife Tech 1
Steve Swenson	Stream Protection Biologist (contract)

Lake Champlain Lamprey Control

Lake Champlain is nationally renowned for its smallmouth and largemouth bass fisheries. But due to intensive management efforts, the native lake trout and landlocked Atlantic salmon resources are experiencing a dramatic recovery. Salmon and trout management in Lake Champlain is conducted cooperatively with the US Fish and Wildlife Service (FWS), the Vermont Department of Fish and Wildlife (VTDFW), and the New York State Department of Environmental Conservation (NYSDEC). Controlling the abundance of parasitic sea lamprey is critical to those management efforts.

Lake Champlain lamprey treatments were conducted on the Salmon River, Little Ausable River, Ausable River, and Putnam Creek in New York during September 2010. In addition, Lewis Creek in Vermont was treated in October. The treatments went very well. In addition to treatments, barriers and trapping were employed to control spawning lamprey on Beaver Brook, Mullen Brook, and the Great Chazy River in New York, as well as several streams in Vermont.

The abundance of lamprey wounds on trout and salmon declined substantially in 2010 relative to recent previous years (Table 1). As expected, the fisheries for those species improved dramatically. Angler reports and electrofishing results show that the abundance and average sizes of trout and salmon increased dramatically with the decrease in lamprey wounding.

Continuing improvements in lamprey control are expected to further close the gap between observed wounding rates, and the rates established as objectives for the program. The FWS is improving their ability to detect and target concentrations of sea lamprey larvae on the deltas, and several delta treatments are scheduled for 2011. Also in 2011, expectations are to construct a lamprey barrier on the Morpion Stream in Quebec, which should prevent sea lamprey spawning in a system that we are unable to treat with lampricides.

Table 1. Sea lamprey wounding rates on Lake Champlain (main lake) lake trout and salmon during 2009 and 2010, compared with pre-control and eight-year experimental control program results.

	Objective	Pre-control	Exp. Control	2009	2010
Lake Trout	25	55	38	55	40
Salmon	15	51	27	31	15

Inland Waters

Various surveys were conducted on about 34 lakes and ponds, as well as the North Branch of the Saranac River. About 11 of the pond surveys were simple water chemistry checks to monitor acidification. Of those, two ponds (Benz and St. Germain) have marginal pH values and may be considered for liming. Great Sacandaga Lake was surveyed to assess the state's rainbow trout stocking policy of about 12,000 yearlings annually. Returns of trout were low, and the lake's summertime water quality is poor for trout. Loon Lake was sampled to assess the effectiveness of the "50-day" walleye fingerling stockings. Catch of young walleye indicate that the stockings have been effective in Loon Lake.

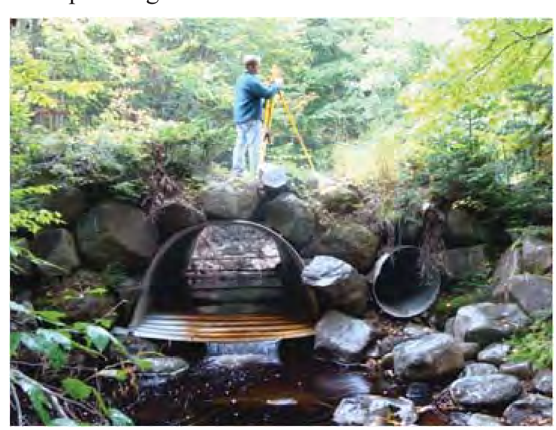
Purchases of land and recreational easements by the state opened various waters in Franklin County to the public in 2010. Two sections of the North Branch of the Saranac River, totaling more than 8 miles, provide access to excellent trout water. Headwater sections support a high abundance of wild brook trout. Other Franklin County waters opened to the public include: portions of Hays Brook and the Little Trout River; Figure Eight Ponds; Grass Pond; Fishhole Pond; Mountain Pond; and various other small ponds and headwater streams.

Brook trout restoration and management continued with egg takes for the Heritage strains, and repairs and maintenance to various fish barriers that control invasions by non-native fishes.

Habitat Protection

Efforts to make road culverts "fish friendly" were a priority in 2010. Undersized or improperly installed culverts can block fish movements and alter the channel morphology. In several instances biologists were able to influence designs for culvert repairs to minimize such problems. However, highway maintenance staff often seek to "slip line" failing old culverts rather than replace them. That process of placing a new, smaller diameter pipe inside the existing culvert, largely precludes making the kind of changes that are needed for passage of fish and other aquatic animals.

Substantial progress was made towards reclassifying hundreds of stream segments in the Champlain and St. Lawrence Watersheds. Fisheries, Habitat, and Division of Water staff reached agreement to upgrade many waters to higher, more protective, classifications. The upgrades will better protect streams from construction projects that might destroy aquatic habitat. Regulations incorporating the upgrades still need to be promulgated.



Before - a barrier to fish movement

After - fish can move freely

Staff Honored

Biologist, Rich Preall was awarded the 2010 Professional Resource Award by the New York State Council of Trout Unlimited. This statewide award was in recognition of Rich's work on the recovery of the endangered round whitefish and with Adirondack Heritage strains of

brook trout.

Public Access:

Two major boat launch projects were substantially completed and, as described on page 29, the "Crusher" boat launch on the Raquette River was completely rehabilitated in 2010. The Downtown Plattsburgh Boat Launch, built in cooperation with the City of Plattsburgh, will provide good access with plentiful parking to this section of Lake Champlain. This new facility will also enhance the City's cability to host large fishing tournaments which yield substantial economic benefits to the area. The other new site, the Rogers Island Pool Boat Launch, provides access to the Hudson River in the Fort Edward area (between Locks 6 and 7 on the Champlain Canal). The West Lake boat launch damaged by storms and a beaver dam blowout over the past few years, also had a new bulkhead installed and other necessary repairs completed.

Installation of launch ramp at Rogers Island Pool Boat Launch.

Installation of 3 lane launch ramp at City of Plattsburgh Boat Launch.

Landlocked Atlantic Salmon Returning to Tributaries of Lake Champlain

New York's Bureau of Fisheries has worked together with Vermont's Fish and Wildlife Department and the US Fish and Wildlife Service to restore salmon and lake trout in Lake Champlain. Progress from those efforts is encouraging, with good returns of salmon to various tributaries in 2010. During the fall of 2010, 51 adult salmon returned to the Willsboro Fishway on the Boquet River in Essex County. That is the most salmon collected in the Fishway in more than a decade. A fish lift on the Winooski River in Vermont had similar strong returns, and anglers are reporting good catches of salmon in New York's Saranac River. Similarly, anglers fishing Lake Champlain over the summer indicate that fishing was great for both salmon and lake trout. The restoration of these two native species provides substantial economic, recreational, and biological benefits. The recent improvements in the status of salmon and lake trout are largely due to improvements in the sea lamprey control program conducted by the three agencies.

2010-11 Region 5 Fisheries Staff	
Bill Schoch	Regional Fisheries Manager
Rich Preall	Senior Aquatic Biologist
Emily Zollweg	Senior Aquatic Biologist
Rob Fiorentino	Senior Aquatic Biologist
Jennie Sausville	Fish and Wildlife Technician 3
Beth Kress	Environ. Educator Assistant (Seasonal)
Adam Kosnick	Seasonal Fish and Wildlife Technician
Doug Peck	Seasonal Fish and Wildlife Technician

Eastern Lake Ontario/St. Lawrence River Warmwater/Coolwater Fish Stock Assessments

Over one-third of fishing effort in Region 6 occurs on eastern Lake Ontario or the St. Lawrence River. Warm/coolwater fish stock assessments are conducted by the regional fisheries management unit on the St. Lawrence River and by both regional and Lake Ontario units on eastern Lake Ontario to track condition of fish stocks in these waters. In the St. Lawrence River /Thousand Islands area smallmouth bass abundance increased from record lows in 1996-2004 and has varied without trend at moderate levels since 2006. Much of this increase has been due to faster growth and higher vulnerability to sampling of young fish. Northern pike abundance in the Thousand Islands remains depressed largely due to habitat changes resulting from water level regulation. Downstream in Lake St. Lawrence, smallmouth bass have shown greater abundance as well as increased growth rates, probably due to increased availability of round goby forage. Abundance of yellow perch in the Lake St. Lawrence area has increased since 2006 apparently as the result of several stronger than average year classes in recent years. Abundance of smallmouth bass in eastern Lake Ontario has increased substantially from record lows in 2000-2004, although it remains low relative to the levels of the 1970s, 1980s and early 1990s. Increases since 2005 have been attributed to reduced cormorant predation and increased growth and vulnerability of young fish to sampling gear. Recent increases in eastern Lake Ontario yellow perch abundance has also been attributed partly to reduced cormorant predation. Regional cormorant management reduced chick feeding and fish consumption by some 5.5 million fish, including 4,000 smallmouth bass and 109,000 yellow perch.

Lake Sturgeon Restoration

Lake sturgeon (Acipenser fulvescens) is currently listed as a Threatened species in New York State. Restoration activities have been ongoing since 1991. A tagging study began in 2010 to acquire biological data and provide the basis for movement studies throughout Lake Ontario and the St. Lawrence River. A total of 150 sturgeon were tagged with Passive Integrated Transponders (PIT tags) in 2010 from the Eastern Basin of Lake Ontario to just below the Robert Moses Power Project on the St. Lawrence River. Data was collected from both spawning populations and non spawning fish over a wide geographic range. Movement of up to 85 miles was documented for one fish. Lake sturgeon eggs (N=179,000) were taken in early June at the Robert Moses Power Project, Massena NY. A total of 124 sturgeon were processed with two egg bearing females providing eggs. Unfortunately eggs failed to show any sign of development after egg take.

Brook Trout Management

Trout fishing in the Adirondacks is a traditional and culturally important form of recreation. Brook trout are a keystone Adirondack fish species. In an effort to help maintain genetically native populations of brook trout (heritage strains), Region 6 completed an egg take for Little Tupper strain brook trout. Besides helping to maintain heritage genetics, the use of these fish in stockings is thought to provide fish that have a higher potential to thrive and spawn in the water conditions common to Adirondack ponds. This was the third year that an egg take was conducted from Boottree Pond, a brook trout population established in 2005. Region 6 is in the process of establishing new brood waters for the various heritage strains in order to facilitate a greater reliance on heritage strain fish in the DEC stocking program.

Development of a new Index of Trout Condition

Region 6 worked with Cornell University to determine the possibility of using fish tissue water content data to measure trout condition. The goal of the study was to develop a tool to assess stocking rates. Stocking rates would be adjusted to develop a fishery full of fish with high lipid levels (low water content) and a wide distribution of age classes. The study monitored seasonal changes in brook trout tissue water content in four stocked public ponds. The use of water content based condition was determined to be possible, but limited to long term studies of specific waters with tightly standardized sampling methodology and large sample size.

Habitat Protection

Fish habitat protection and management are basic elements of any fishery management program. When severe bank erosion threatened County and State highways along the Mohawk River in Westernville, NY the regional fisheries unit was afforded an unusual habitat management opportunity. Using the combined efforts of a suite of federal, state, county and local agencies, which provided time, expertise, equipment and materials, we were able to complete a large-scale project to restore the eroded bank and realign the stream to correct the immediate infrastructure problems and reduce the chance of having them recur. The completion of the stabilization project prevented sediment from causing habitat problems downstream and provided improved habitat for fish and wildlife on site.

Public Access

Providing public access to natural resources is a key regional program. During 2010-11 work advanced on development of three important sites providing fishing access to Lake Ontario: Mud Bay (essentially complete), The Isthmus, near Point Peninsula, and Three Mile Bay on Chaumont Bay.

Public Outreach

Regional outreach efforts included outdoor expos, conservation field days, environmental awareness days, fishing clinics, Envirothon and Earth day events which reached thousands of anglers, students and families throughout the region.

2010-11 Region 6 Fisheries Staff

Frank Flack	Biologist 2 (Ecology)
Russ McCullough	Biologist 1 (Aquatic)
Rodger Klindt	Biologist 1 (Aquatic)
Chris VanMaaren	Biologist 1 (Aquatic)
Dick McDonald	Biologist 1 (Aquatic)
Dave Erway	Biologist 1 (Aquatic)
Dave Gordon	Fish & Wildlife Technician 2
Les Ressiguie	Seasonal Fish & Wildlife Technician 1
Nicole Balk	Seasonal Fish & Wildlife Technician 1
Dan Ellis	Seasonal Fish & Wildlife Technician 1
Travis Rice	Seasonal Laborer
Doug Carlson	Biologist 1 (Aquatic) ETS Unit

Fall Sampling for 50-day Walleye Fingerlings in Otisco and Otter Lakes

Night electrofishing was conducted in October along 2.1 miles of Otisco Lake shoreline south of the causeway, to determine the relative success of our spring 2010 stocking of 45,000 50-day old fingerling walleye. A total of 61 young-of-year (YOY) walleye were captured, providing a rough population estimate of 2,222 YOY walleye in the lake south of the causeway. Growth of these young walleye was outstanding with their average length being 8.5 inches. Overwinter survival of these walleye is expected to be excellent given their large size.

Night electrofishing was conducted in late October 2010 to evaluate the success of the initial stocking of 5,200 50-day walleye fingerling in Otter Lake. Five larger walleyes were collected during two hours of electrofishing but no young-of-year were observed. Also observed were largemouth bass, smallmouth bass, northern pike, black crappie, sunfish not identified to species, brown bullhead, common carp, golden shiner and bowfin.

Whitney Point Reservoir Fall 2010 Walleye Assessment

Night electrofishing was conducted at four standard sampling locations along the Whitney Point Reservoir shoreline to monitor year class strength of walleye. A total of 772 young-of-year (YOY) walleye (2010 year class) were captured in 3.5 miles of shoreline sampling. Based on this catch we estimated that 62,610 YOY walleye were present in the reservoir. This is the third highest estimate of YOY walleye abundance in the 15 years of sampling that has occurred since 1994. Growth of the 2010 year class was very good with an average length of 202mm (8 inches).

Twenty-six (26) yearling walleye (2009 year class) were also captured which provided a population estimate of 1,748 age 1 walleye. The population estimate for this year class as YOY in 2009 was 26,885 so survival between the two sampling events was just 6.5%. Past survival estimates between age 0 and age 1 at Whitney Point Reservoir have ranged from 2% to 42%. Year classes with the lowest survival have generally been small as YOY. The 2009 year class followed this pattern and averaged just 154mm (6 inches) as YOY in October. It's likely that the surviving walleye were the largest individuals in the cohort (2009 range: 113–248mm) and the abundant food supply in 2010 enhanced growth of the survivors. Average size of yearlings in 2010 was 318mm (12.5 inches) which is the largest we've seen in the past six years.

Susquehanna River Smallmouth Bass Assessment

Several severe flood events in recent years along with multiple outbreaks of Columnaris bacteria infections in juvenile smallmouth bass since 2005 have raised concerns about the status of the river's bass population. Anglers have complained for several years that bass fishing, in some areas, has been poor. A boat electrofishing survey was conducted in September to compare the abundance of bass at two old sampling sites and to look for signs of Columnaris. Few fish were collected during an abbreviated sampling effort at Sandy Beach in Binghamton, but it is not clear whether this was a true reflection of low fish abundance or of problems experienced with the generator. Sampling conducted at the mouth of Nanticoke Creek in Endicott, yielded a catch of 50 smallmouth bass measuring between 96-458mm (4-18 inches). Of these bass, eleven were greater than or equal to the minimum length of 12 inches. The total catch of bass at this site was similar to previous years and the catch of legal bass was the highest in any of the surveys. Sampling results at Sandy Beach, though biased this year, seem to indicate problems with the bass population in this area. No bass captured at either site showed any signs of Columnaris infection.

Cayuga Inlet Fishway Monitoring – Spring 2010

Operation of the Cayuga Inlet fishway continued in spring 2010. A total of 583 rainbow trout were handled which was similar to the numbers handled during the past two years. Also handled were 4,407 white suckers and 1,190 sea lampreys. After processing, the rainbow trout and white suckers were passed over the fishway dam while the lampreys were killed to prevent them from spawning upstream. All rainbow trout handled at the fishway were examined for the presence of sea lamprey wounds. A total of twelve fresh wounds were observed on the 583 rainbow trout examined but only one wound was observed on the 75 rainbow trout in our primary index size of 500 mm to 549 mm (19.7 inch to 21.6 inch). The number of wounds observed was well below the threshold rate where we believe the lamprey population begins to impact trout and salmon survival (one wound per 10 rainbow trout in the index range).

Finger Lakes Angler Diary Cooperator Program

Angler catch data for the 2010 fishing season on the four eastern Finger Lakes was summarized and letters were sent to participating cooperators. The summaries are available on the DEC website at *www.dec.ny.gov/outdoor/27875.html*. A brief summary of each lake follows. The catch of nearly one legal gamefish/trip at Otisco Lake was on the low end of average and a decline in both effort and catch of walleye was the primary factor. Otisco Lake bass and tiger musky catch rates were similar to other years. At Skaneateles Lake, the trout and salmon catch rate of 1.1 legal fish/trip was lower than recent years but close to the long term average. Rainbow trout comprised 57% of the Skaneateles Lake catch; lake trout made up 38% and landlocked Atlantic salmon comprised the remaining 5%. Average sizes of all species were the highest ever recorded. At Owasco Lake, lake trout comprised 98% of the trout catch and average size was 23.6". Only two rainbows and no brown trout were caught in the open lake fishery. Finally, at Cayuga Lake, the legal salmonid catch of 1.4/trip was similar to recent years. Lake trout comprised 78% of the legal catch, rainbows 4%, brown trout 8%, and landlocked Atlantic salmon 10%. Average size of all trout and salmon was similar to past years.

Oneida Lake Joint DEC/Volunteer Cormorant Hazing Program

Federal funding for cormorant management on Oneida Lake was eliminated in 2010. In an effort to reduce cormorant predation during the fall migration, Region 7 Fisheries staff, Region 6 Wildlife staff, Conservation officers and citizen volunteers worked cooperatively to conduct harassment activities on the lake. The program came together quickly but by all accounts was fairly successful. Fortunately, high numbers of cormorants were never present during the September effort but in total approximately 5,000 cormorants were counted and harassed. Overall the program provided a valuable lesson on how to effectively conduct similar efforts in the future, if needed.

2010-11 Region 7 Fisheries Staff

Bishop, Dan	Biologist 2 (Aquatic)
Lemon, Dave*	Biologist 2 (Aquatic)
Robins, Jeff	Biologist 1 (Aquatic)
Prindle, Scott	Biologist 1 (Aquatic)
Everard, Jim	Biologist 1 (Aquatic)
Blackburn, Ian	Fish & Wildlife Technician 2
Richardson, Denise	Fish & Wildlife Technician 1
Boyden, Eric	Fish & Wildlife Technician 1
Heider, Althea	Secretary

**Replaced Bishop upon his promotion to Natural Resources Supervisor*

Great Lakes Research

Irondequoit Bay Fish Community Assessment

A survey was conducted from September 20 to 23, with the purpose of assessing the overall fish community and the success of DEC-stocked fingerling walleye. Two thousand twenty one individual fish of 18 species were collected from six gill net sites (336.8/net), including four game and eight pan fish species. The game fish catch consisted of 78 walleyes (13.0/net), seven northern pike (1.2/net), one largemouth bass, and three brown trout. Many walleyes were collected in the 15.75-17.75 inch range, which are likely age 2, suggesting good growth and survival of fingerlings stocked in 2008. These fish should be legal sized (>18 inches) by next year and should provide good walleye fishing for the next several years. In order of abundance, the pan fish catch consisted of white perch, yellow perch, and gizzard shad. Age determination and analysis of the data and comparisons with previous surveys will be done at a later date.

Warm Water Fisheries Management

Honeoye Lake Electrofishing Survey

Honeoye Lake was electrofished on May 11 and 18. The primary target was largemouth bass. Catch rate for largemouth bass was 95 per hour. This is a very high catch rate and is similar to past surveys. Forty-one percent of the largemouth bass sample consisted of fish in the 12 to 15 inch size range. A few bass exceeding five pounds were also collected. Anglers participating in the region's cooperative diary program also had excellent catch rates for bass last season, averaging 3.9 bass per hour. Honeoye Lake continues to provide an excellent largemouth bass fishery. Data from this survey will be further analyzed and compared to past surveys to determine if any major changes have occurred since the early catch and release bass season was opened.

Cold Water Fisheries Management

Experimental Sea Lamprey Barrier Installed

An experimental sea lamprey barrier was installed in Catharine Creek in an attempt to eliminate approximately 6 miles of sea lamprey spawning habitat. The perforated stainless steel barrier was attached to the farthest downstream "pool digger", an in-stream structure that is designed to stabilize the stream bed, provide resting and nursery areas for rainbow trout, and provide access to anglers. Catharine Creek, the main tributary to Seneca Lake, is one of two major sea lamprey producing streams for Seneca Lake. Sea lamprey, a parasitic fish that attaches to trout and salmon as well as a host of other fishes and sucks out their fluids, have been shown to negatively impact native lake trout, naturalized rainbow trout, and introduced Atlantic salmon and brown trout in Seneca Lake. High water during the spring of 2011, did not allow for the evaluation of the effectiveness of the barrier in control lamprey passage. Staff plan on observing nesting activity of adult sea lamprey in the future to help determine if this barrier is successful.

Cold Water Fisheries Management (Rivers) Wild Trout Surveys

Region 8 Fisheries Unit completed electrofishing surveys on 105 streams in 2010. The majority of the streams were in the Chemung River Basin, Chemung and Steuben Counties, with a few streams in the Oswego River and Genesee River drainages, Ontario and Livingston Counties. Trout were collected in 48 streams. Twenty six brook trout, eleven brown trout, two rainbow trout, and nine brook and brown trout streams were identified. Wild trout were documented for the first time in 31 streams. These streams will be added to a list of streams that qualify for reclassification.

Seneca Lake Sea Lamprey Control Program

Region 8 staff along with Bureau Chief Phil Hulbert met with staff from the United States Fish and Wildlife Service (USFWS) to discuss a joint effort in the control of Seneca Lake's sea lamprey. Department staffing changes have resulted in challenges to maintain the technical expertise needed to safely and efficiently perform complicated treatment plans within the Finger Lakes Sea Lamprey Control Program. As a result of this meeting, USFWS have agreed to assist the Department by providing equipment and experienced staff needed to complete the Catharine Creek stream treatment. Department staff will work jointly with USFWS staff by acquiring necessary permits and other preliminary pre-treatment requirements to meet all State regulations as well as providing the skilled staff necessary to perform the actual treatment. This cooperation is a perfect example of leveraging resources to achieve resource protection.

NEPA Approval for Sea Lamprey Control Program

The Finger Lakes Sea Lamprey Control Program received a big boost in November when Region 8's Fisheries Management Unit was informed that its application for a National Environmental Policy Act (NEPA) permit had been approved. The approval means several things for DEC and anglers in Seneca and Cayuga lakes. Federal Sport Fish Restoration funds will now be available to be used in future control efforts, including the purchase of lampricides and field and laboratory equipment. In addition to a new funding source, staff from the U.S. Fish and Wildlife Service's (USFWS) Lake Champlain Office have offered to assist with the next lamprey control treatment on Catharine Creek, scheduled for spring 2011.

The Region 8 Fisheries Management Unit is continually looking for ways to reduce the amount of chemical and staff time needed for these treatments. The inclusion of Federal monies and staff expertise within the Finger Lakes sea lamprey control program will enhance program effectiveness benefitting both anglers and the fishery resources they enjoy.

Public Fishing and Boating Access

Black Creek Fishing Access Site (FAS) Renovation

Repairs included the extension of the concrete pad to allow for safer and easier launching conditions at the Black Creek FAS located in Chili, Monroe County. This launch site provides angler access to quality northern pike, smallmouth bass, and walleye fishing on Black Creek and the Genesee River.

Angling Outreach and Education

Fishing Rod Lending Program

Three new libraries joined Dansville Public Library in the Region 8 Fishing Rod Lending Program in 2010. Under the program, poles and reels, purchased with funds from the Federal Sport Fish Restoration Act are supplied by the DEC. To provide educational material for the participants, the DEC teamed up with the New York State Environmental Conservation Officer Association (NYSCOA) and Shikar Safari to print copies of informative "Getting Started" fishing manual. In addition, Sport Fish Restoration Funds were used to obtain copies of the New York State Conservation's insert "Conservation for Kids – Fish". One of the unique features of the program is that each library is sponsored by a local organization, business, or individual(s) which takes on the responsibility of supplying the bobbers, hooks and sinkers, and keeping the equipment in working order.
The libraries and their sponsors include:

1) Dansville Public Library - Dansville Fish and Game Club. Rods were checked out 33 times for a total of 623 days, 19 adults and 38 children
2) Wood Library, Canandaigua - Clearly Aquatic Pond Service, Ultrafab Inc. and the Canandaigua Lake Duck Hunters Associ-ation. Rods were checked out 67 times on a three week basis.
3) Pulteney Public Library - Paul Schnipelsky, President, Board of Directors, and Donna Colvin. Rods were received late in year, yet five rods were checked out on weekly basis.
4) Woodward Memorial Library, LeRoy - Oatka Fish and Game Club. Rods were received too late in the year for any circulation in 2010.

Western Finger Lakes Tributaries Rainbow Trout Sampling

On March 24, despite air temperatures in the mid to upper twenties, approximately 150 spectators showed up to watch the Region 8 Fisheries Unit sample the Naples Creek rainbow trout spring spawning run. Naples Creek is a tributary to Canandaigua Lake. Sampling conditions were fair with water temperatures in the upper thirties. Sixty five rainbow trout were collected with the largest being an 8.2 pound female. Very few of the females collected had spawned, and a large number of them were found in the lower portions of the stream.

Assessment of the rainbow trout spring spawning run on Cold Brook a tributary to Keuka Lake was completed on the following day. A total of 36 rainbow trout were collected, the highest number since 2000. Fish appeared to be in excellent condition, with the largest fish being a 6.7 pound female. Twenty-four of the fish collected were females, with only one fish ready to spawn. Fish were spread throughout the creek. In addition to the rainbow trout, several resident brown trout up to 20 inches were also collected, which should provide anglers an additional angling opportunity.

Results from both streams combined with a forecast for cool weather suggests that there will be plenty of fish in both streams for the opening day of trout season on April 1.

Local High School Students Learn About Fisheries Management

For the ninth consecutive year, about 60 Environmental Studies students from four area high schools learned about fisheries management. Region 8 Fisheries staff cooperated with Delta Laboratories' Adopt-a-Stream program to provide hands-on demonstration of fisheries management techniques. Activities included a boat electrofishing demonstration and hands on opportunities in sampling water quality, benthic invertebrates, and seining fish. Student also learned about aging fish via scales and data interpretation.

2010-11 Region 8 Fisheries Staff	
Web Pearsall	Biologist 2 (Aquatic)
Matt Sanderson	Biologist 1 (Aquatic)
Brad Hammers	Biologist 1 (Aquatic)
Peter Austerman	Biologist 1 (Aquatic)
Amy Mahar	Biologist 1 (Ecology)
Bob Deres	Fish and Wildlife Technician 1
Dan Mulhall	Fish and Wildlife Technician 1
Eric Olsowsky	Fish & Wildlife Tech (Seasonal)
Andy Steiner	Fish & Wildlife Tech (Seasonal)
Chris Mandrino	Fish and Wildlife Tech (Seasonal)

DEC Fisheries/Forestry partner with conservation groups for tree planting efforts

In spring 2010, Region 9 Fisheries staff coordinated with three local Trout Unlimited groups, a county highway department and a local university to plant over 3,200 shrubs and shade trees along public trout streams in the region. The shrubs, mostly streamco willow and red osier dogwood, have extensive root systems that help to hold stream banks in place and reduce erosion while the larger shade trees such as silver maple will eventually provide shading to help cool the streams. Between 2005 and 2010, volunteer conservation organizations have planted 12,600 shrubs and 3,750 shade trees in Region 9. DEC Fisheries staff also planted 1,570 shrubs and 725 shade trees during that six year period. These trees were provided by the DEC tree nursery in Saratoga, NY.

Results of 2010 surveys to locate unknown wild brook trout populations in Western New York

Beginning in June, 2010 and continuing through at least 2012, Region 9 Fisheries will be conducting trout surveys on streams not previously surveyed in the far western end of New York State. Some surveys will also be completed on streams that have historically held brook trout populations, but may have lost them due to land use changes, expansion of beaver populations or introductions of exotic trout species.

Many of the brook trout (and other wild trout) populations may be found in streams that currently have a water classification that does not provide them with the fullest protection from disturbance. By documenting these populations, we will be able to offer these streams the fullest protection possible under Article 15 of ECL. During each survey where trout are found, an evaluation of threats to brook trout will be completed. These threats include impassable culverts and other barriers. Notes are also made of streams with potential for future habitat restoration work. Beginning in 2011, genetic samples of all brook trout will also be taken.

Results of field work in 2010 showed 66 sampling days producing 33 streams with only brook trout present, 31 streams with only brown trout present and 11 streams with mixed populations of both trout. A total of 386 streams were assessed, of which 101 were dry and 210 had fish, but no wild trout. At least one HUC 12 watershed was evaluated that will likely attain a status at the level of "population reduced" (50-90% of system containing wild brook trout) or possibly even "population intact" (>90% containing brook trout). We have also sampled a few streams containing individual wild brook trout that are much larger than the average found in low fertility western New York streams. Several wild fish of 11-12.5 inches have been found. It is not clear whether these larger fish are due to low population densities or if they are fish with greater growth potential than normal.

Fishing Hotlines

Two regional fishing hotlines are updated every Friday to provide area anglers with pertinent fishing information. Together, the hotlines cover the major fishing waters of region 9 and the western half of region 8. Each fishing hotline is available on the DEC website at http://www.dec.ny.gov/outdoor/fishhotlines.html and each can also be heard at (716) 855-FISH. The Lake Erie Fishing Hotline webpage had a total of 5,988 visits during July and 37,296 visits, year to date, an increase of 10% over same span in 2009. The Western New York Fishing Hotline webpage had a total of 2,596 visits during July and 22,792 visits, year to date, an increase of 20% over the same span in 2009. The automated phone hotline received 1,845 calls in July and 9,658 calls, year to date.

Common Carp collected for Cornell Fish Herpes Study

Fisheries staff collected 60 adult common carp for Cornell University fish pathologists. The fish will be examined for the presence of antibodies for Koi Herpes Virus (KHV), a disease that killed thousands of carp in Chautauqua Lake several years ago. Cornell University was unable to detected antibodies for Koi Herpes Virus (KHV), from the Chautauqua Lake sample.

Buffalo Harbor/Upper Niagara River Muskellunge Studies

Region 9 Fish Unit Staff spent considerable effort preparing a report summarizing study results from 2008 and 2009 surveys for assessing young-of-year and adult muskellunge in the Buffalo Harbor and Upper Niagara River. The studies were conducted cooperatively by staff from State University College of Environmental Science and Forestry at Syracuse (ESF) and DEC Bureau of Fisheries. ESF staff provided valuable review and input to the summary report. Federal Aid was used in part to fund these studies, and the report was prepared as a requirement for suc-

cessful completion of the work. The results of our efforts to capture muskellunge via electrofishing during spring suggest that suitable habitat for juvenile (yearling and age-2) muskellunge are limited. Efforts to identify and protect critical spawning and nursery habitat will continue with annual young-of-year surveys.

Lake Ontario Chinook Salmon Pen Project Assessment

Region 9 Fish Unit staff compiled results of quality control data collected for a Chinook salmon pen project conducted in spring 2010 by Niagara River Anglers Association on the lower Niagara River. The quality control effort included assessments of fin clip quality, presence/absence of coded wire tags, and dissolved oxygen monitoring at the pen site during the three-week rearing period. Both fin clip quality and percent of fish with a coded wire tag were very high, and dissolved oxygen values in the salmon pen were more than adequate to sustain the salmon. The quality control data will be incorporated into an assessment that compares whether there are differences in performance between batches of pen-reared and direct stocked fish in the lower Niagara River, as part of a much larger assessment being conducted at a number of Lake Ontario pen-rearing sites.

New Ice Fishing Access Site on Silver Lake, Wyoming County

Utilizing a grant from the DEC Habitat and Access Stamp Fund, the Village of Perry recently improved a 20 car parking lot for use by ice anglers. Formerly, the only public ice fishing access to this 836 acre lake was located on the south end at Silver Lake State Park. This new access site is located on Walker Road at the northeastern end of the lake. The Village of Perry plows the lot as needed through the winter.

McIntosh and Beehunter Creeks in Allegany State Park

In mid-June 2010, with the help of angler volunteers, brook trout were sampled at 35 sites on McIntosh and Beehunter Creeks. This was the third year of sampling to evaluate the habitat improvement work that DEC, TU, USFWS and Allegany State Park undertook on McIntosh Creek in July 2008. Habitat improvement activities consisted of 16 rock and log pool digging structures in a 1.5 mile section of the stream. Sampling began in June 2008 to evaluate the wild brook trout population before habitat work and four years (2009-2012) of post work sampling are planned. Beehunter Creek had no habitat work done and is used as our “control” stream for this project.

In our initial year of sampling (2008), before the habitat work, there were moderate numbers of adult wild brook trout, but essentially no reproduction with only one YOY found in McIntosh and 12 in Beehunter. We also found very low numbers of yearling trout. Almost the entire trout populations were made up of age 2 and 3 fish, with a couple fish that may have been 4 or 5 years of age. We fully expected to see fewer adults in 2009 as many of the adults we found in 2008 would have died naturally before the 2009 sampling. That is exactly what we saw. However, we were glad to see that the 2009 year class was very strong in both streams, indicating they had good spawning and rearing conditions.

In 2010, we anticipated much higher numbers of adults in both streams with the majority being yearlings. The numbers backed that up, with good numbers of adults (primarily yearlings) in both streams. In addition, we again saw good reproduction in 2010.

While the increase in abundance of adult wild brook trout in McIntosh Creek from 2008 to 2010 was statistically significant, we cannot say with confidence yet that this was due to the habitat work. A similar, but not statistically significant increase was also seen in Beehunter Creek from 2008 to 2010. Hopefully two more years of sampling will allow us to fully evaluate the success of this habitat improvement project.

2010-11 Region 9 Fisheries Staff

Paul McKeown	Biologist 2 (Aquatic)
Mike Clancy*	Biologist 2 (Aquatic)
Scott Cornett	Biologist 1 (Aquatic)
Joe Galati	Biologist 1 (Aquatic)
Mike Todd	Biologist 1 (Aquatic)
Mike Wilkinson	Biologist 1 (Aquatic)
Jim Zanett	Fish &Wildlife Technician 3
Rob Roth	Fish &Wildlife Technician 1
Eric Stratton	Fish &Wildlife Technician 1
Jon Sztukowski	Fish &Wildlife Technician 1

**Replaced McKeown upon his promotion to Natural Resources Supervisor*

Proposed Changes to Baitfish Regulations Available for Public Comment

As the 2010-11 year was about to end a Notice of Proposed Rule Making (NPR), containing proposed changes to the current "fish health-baitfish regulations", was prepared and filed with the Department of State (on March 22, 2011). The NPR contains proposed changes to the overland transport of uncertified baitfish by anglers, including baitfish that are personally collected. The proposed revisions, if adopted, would allow for overland transport of baitfish within three specified transportation corridors, provided the baitfish are only used in the same waters from which they are collected. This would facilitate the use of baitfish by anglers while retaining protection against the spread of fish pathogens to additional waters. The 45 day public comment period was to be initiated on April 6, 2011 and expire on May 23, 2011. During the summer of 2010 three public informational meetings were held, including one in Tonawanda NY, to obtain public feedback concerning the proposed baitfish regulations. The input received was utilized in making decisions for the proposed rule making that was subsequently developed.

Bureau Field Surveys Entered Into Statewide Fisheries Database

Data from a total of 1,635 fishery field surveys were received by the Bureau's Biological Survey Unit during 2010-11. Approximately 659 Eastern Brook Trout Joint Venture surveys were conducted. A total of 1,094 surveys were finalized and added into the Bureau of Fisheries Statewide Database. Two "Releases" containing updated data were distributed, primarily to Regional Bureau of Fisheries staff; one in April 2010 and a second in September 2010.

Sportfish Regulations for October 2012

Initial considerations for sportfish (freshwater) regulation changes were identified by the Bureau of Fisheries, as part of the early phase of the regulation process. At the end of the 2010-11 year, the Bureau was preparing to list these on the Department's website for initial public feedback. Obtaining public feedback during this informal phase helps DEC gauge public interest and concerns about the proposed changes before developing regulations to implement the changes. A subsequent formal rule making will be developed in the Fall of 2011, and will include a 45 day formal public comment period.

Changes being considered include modifications to the current seasons, size limits, and creel limits on certain waters for popular game fish species such as trout, salmon, walleye, black bass, pickerel, muskellunge, and tiger muskellunge. Additional suggested changes pertain to ice fishing on certain waters, as well as for establishing specific gear requirements for certain angling practices. If adopted, regulation changes would become effective on October 1, 2012.

Warmwater Fisheries Management

Stocking evaluation of 50 day old walleye fingerlings

An experimental walleye stocking program, initiated in 2009, was continued using 50-day old tank raised fingerlings from Oneida Hatchery. Ten lakes throughout the northern, central and western regions of the state were stocked in June with about 260,000 1.5 inch long fingerlings. Waters stocked included Loon Lake in Region 5, Black, Red, and Payne lakes in Region 6, Otisco and Otter lakes in Region 7, and Redhouse and Upper, Middle and Lower Cassadaga lakes in Region 9. The success of this program is being assessed through annual monitoring in the fall and with a full fish community assessment at the end of the five-year stocking schedule. Fall 2010 surveys documented the presence of stocked walleye at Loon and Otisco lakes.

Ecology and Management of the Fish Communities in Oneida and Canadarago Lakes

Researchers at the Cornell Biological Field Station at Oneida Lake completed their annual assessment of the fish communities in Oneida and Canadarago Lakes. Funded by a Federal Aid to Sportfish Restoration grant, these monitoring projects are the longest running warmwater fishery assessments in New York State and continue to provide valuable insight on the complex dynamics associated with warmwater fish populations in large northern lakes.

Oneida Lake

The spring 2010 adult walleye population was estimated to be 498,000, which represents a 29% increase in the population since 2007. The adult population benefitted from a higher than expected contribution from the 2006 year class. However, early indications are that the 2007-09 year classes will provide fewer adult fish. The population of adult walleye should be stable over the next few years, but may experience declines without the addition of another large year class after the 2006 cohort.

The adult yellow perch population was estimated to be just under 1 million fish. This represents an increase from the 2009 estimate, but well below 2008. It is expected that yellow perch numbers will fluctuate around 1 million fish in the near future.

Walleye and yellow perch represented 52% of the total gill net catch in 2010. White perch were 34% of the catch. Catches of white perch in recent years suggest that they are as abundant as yellow perch in Oneida Lake.

In 2009 a new invasive species, *Hemimysis anomala* (bloody red shrimp), was discovered in the diet of a white perch collected during routine gill net sampling. Subsequent sampling revealed the organism is widely distributed in Oneida Lake. Continued monitoring of fish diets as well as a directed sampling effort produced only one individual in 2010, suggesting that winter conditions in Oneida Lake may constrain growth of the Hemimysis population. Continued monitoring will be necessary to see if this species can establish in the lake.

The monitoring program on Oneida Lake has recently been adjusted to account for the expansion of nearshore fish community habitat, which has resulted from increased water clarity due to filter feeding by zebra and quagga mussels. In 2010, shoreline fyke net sampling resulted in the capture of approximately 3,000 fish of 28 different species. The most common species caught were yellow perch, pumpkinseed, bluegill, rock bass and gizzard shad. Fyke net sampling also has provided annual samples of species not typically seen in routine monitoring, including longnose gar, bowfin, yellow and brown bullheads, chain pickerel, sunfish, and black crappie. In 2011, a spring shoreline electrofishing survey will be implemented to supplement the nearshore fyke netting surveys.

Canadarago Lake

Walleye natural recruitment was low or absent again in 2010. Fry sampling since 2005 has produced walleye fry in only two years, 2006 and 2008. Young of year walleye catches in electrofishing samples have been very low or zero for the past 5 years. These results are consistent with increased alewife predation on walleye larvae. Adult walleye electrofishing catches have decreased since 2007 and the lack of young walleye in the catches indicates that the population will continue to decline in the near future.

Yellow perch fry were abundant in 2005 and 2006, decreased dramatically in 2008, rebounded in 2009, but were low again in 2010. Near-term, the yellow perch population should remain at levels consistent with recent years.

Estimates of alewife abundance have steadily increased over the last 6 years and were at the highest level on record in 2010.

Zooplankton average size and biomass continued to decline, which is an expected trend with the increased density of planktivorous alewife. Water clarity was the lowest observed in 20 years, indicating that grazing of zooplankton by alewife is allowing increased algal growth, despite colonization of the lake by zebra mussels.

An acoustic survey of submerged aquatic plants was conducted in August. Vegetation coverage was sparse at shallow depths, increased to 80% at the 3-4 m depth contour, and decreased to less than 7% at depths greater than 7 m. Average plant height followed a similar pattern, with a maximum of 0.85 m at the 3-4 m depth contour. Coontail dominated the plant community followed by Elodea and pondweed. A similar survey is planned for Oneida Lake in 2011. Results will be used to predict changes in habitat and to relate habitat extent and structure with fish community composition obtained from expanded nearshore sampling.

Coldwater Fisheries Management

New Coldwater Unit Leader Hired

On December 31, 2010, Fred Henson was hired as Coldwater Unit Leader. Fred replaces Jim Daley who was promoted to Fish Culture Section Head. Fred has worked for the Bureau of Fisheries since 2000 when he was hired as an aquatic biologist in Region One. From 2004 through 2010, he worked at the Fish Disease Control Unit at the Rome Fish Hatchery. Fred earned a B.S. degree in natural resources at Cornell University and an M.S. degree in fisheries from the University of Minnesota.

CROTS Review & Fate of Stocked Trout Study

In 2010, the Bureau of Fisheries began a statewide study to verify and update the key biological and fishery parameters used to calculate trout stocking rates under our Catch Rate Oriented Trout Stocking (CROTS) model in use since 1990. The study, conducted in partnership with the Fish and Wildlife Cooperative Unit at Cornell University, will yield fresh estimates of angling effort, seasonal patterns of angling effort, harvest rates, and total mortality rates of stocked trout.

During the 12 month period ending on March 31, 2011, a steering committee composed of biologists from Cornell University and DEC met to select streams for inclusion in the study and to establish standard methods for conducting the required creel surveys and fish population assessments. These preliminary tasks were accomplished and creel agents were hired to begin collecting information on eight streams around New York State in April 2011. The following streams are included in the study for the 2011 field season: Carmans River, Esopus Creek, W. Branch Delaware River, Oriskany Creek, Big Creek, Otselic River, Meads Creek, and East Koy Creek.

Brook Trout Stream Status Surveys

New York is one of 17 states on the eastern seaboard participating in the Eastern Brook Trout Joint Venture. The goal of this effort is to halt the decline of brook trout and restore fishable populations of this native trout. In support of this goal, DEC biologists are conducting stream surveys to determine the status of brook trout populations in watersheds where our information is outdated or absent. Ultimately, documentation of the presence of brook trout will confer legal protection on streams that may lack such protection now due to lack of information. In addition, the information will also allow prioritization of habitat restoration projects.

In 2010, one thousand, one hundred eighty-five stream surveys were completed under this federally funded project. The surveys were done in DEC regions 4, 8 and 9. The presence of brook trout was documented in 441 streams; some of which had never been previously surveyed.

Summary of EBTJV Surveys in Regions 4,8 &9

Region	Streams Surveyed	Brook Trout Found
4	671	355
8	128	42
9	386	44

Delaware River Basin Gaging Stations Funded

In order to assure the availability of data essential to the management of the highly productive trout fisheries in the tailwaters of New York City's Delaware River Basin reservoirs, a total of $48,290 was committed to support the operation of U.S. Geological Survey stream gages at the following locations:

- Diversion from Schoharie Reservoir
- Esopus Creek at Coldbrook
- East Branch Delaware River at Harvard
- West Branch Delaware River at Hale Eddy
- West Branch Delaware River at Hancock
- Delaware River at Lordville
- Delaware River at Callicoon
- Neversink River at Bridgeville

These instruments, which transmit flow and temperature measurements in real time, would otherwise be shut down. The data they collect are particularly important because of the exceptional value of the recreational trout fishery and because they allow monitoring of the biological effects of flow management plans which are frequently altered at the direction of the Delaware River Basin Commission. The data are available to the public at the following website: *http://waterdata.usgs.gov/ny/nwis/current/?type=sw&group_key=basin_cd*

Management of Rare & Endangered Fishes

Mussel Distribution in the Southern Lake Ontario Watershed

The DEC has completed the second year of a five-year project to determine distribution, density and status of native freshwater pearly mussel species (Unionacea) in the Southern Lake Ontario watershed. Mussels stabilize streambeds, diversify stream bottom habitat, provide nutrients to other benthic (bottom dwelling) invertebrates, filter suspended solids and pollutants from water, and are considered indicators of ecosystem health. In spite of the ecological importance of freshwater pearly mussels, they are among the most imperiled groups of animals in North America.

In most of Lake Ontario's southern tributaries, the current status of freshwater mussels is unknown. Between 2009 and 2010, 154 sites in 40 streams and 12 Erie Canal sites between Brockport and Clyde were surveyed. Live mussels were found in 53% of surveyed streams, with New York State Species of Greatest Conservation Need (SGCN) confirmed in 28% of the streams. Spent (empty) shells were found in an additional 15% of streams. Evidence of mussels was found in 16 streams in which there were no previous mussel records. In these surveys, 20 native mussel species were observed; 17 of the 20 species were found live, including nine SGCN. Two species thought to be extirpated (no longer occurring in New York) in the surveyed areas, deer toe and lilliput mussels, were found alive. In addition, the green floater mussel, a New York State threatened species was found.

Throughout the Erie Canal sites, native pearly mussels were found, as well as invasive bivalves such as zebra mussels, quagga mussels, and Asian clams. In Genesee River tributaries, species diversity and the number of SGCN present were greatest at sites where tributaries joined the Genesee River. For tributaries associated with Finger Lakes, the greatest mussel densities were found near lake outlets. The densest beds were dominated by common eastern elliptio mussels. Surveys of Rochester urban streams revealed high densities of only three common species.

Surveys continuing for 2011 through 2013 will focus on tributaries of the Finger Lakes, the Upper Genesee, and the Lake Ontario plains. All results from information collected in this five-year study will result in distribution maps, which will help guide future mussel conservation efforts.

Lake Sturgeon Restoration

Propagation

DEC staff gill netted adult sturgeon near the Moses Saunders Dam in the St. Lawrence River at Massena in an effort to collect eggs and sperm for rearing at the Oneida hatchery. 124 sturgeon were collected in late spring. Eggs and sperm were collected from 3 female and 9 male sturgeon and the fish returned to the river. Unfortunately, the eggs from this year's collection effort failed to develop for the second year in a row. Data about the collection procedure and the condition of the fish was collected and reviewed for clues to the cause of the failure. So far no cause is apparent and DEC is evaluating future lake sturgeon propagation options.

Stock Assessment

Collection and tagging of lake sturgeon in 2010 throughout the Eastern Lake Ontario and St. Lawrence corridor was highly successful. A total of 164 sturgeon were captured over a wide geographic range and 150 fish were PIT tagged. St. Lawrence fish received the bulk of the tags (84%); sturgeon in waters associated directly with Eastern Lake Ontario received the remainder (16%). Initial results from tag recapture data show that lake sturgeon are moving great distances where there are no barriers, but like to return to specific places during the year.

Assessment of the sturgeon population within the Oswego River basin continues through partnership with SUNY ESF, SUNY Oswego, and US Geological Survey. This year, federal State Wildlife Grant funds supported genetic analysis of the population established in Oneida Lake. The results indicated that these sturgeon display a healthy genetic diversity and may be suitable to use for as an egg source for the DEC hatchery once they mature. State Wildlife Grant funds also supported research on habitat quality and movement of sturgeon within the barge canal system. Results are anticipated to be available in 2012.

Paddlefish Restoration

Propagation

Spring of 2010 was a banner year for paddlefish production at Oneida Hatchery. Eggs received from University of Kentucky researcher Dr. Steve Mims resulted in 1,600 paddlefish being stocked into western New York waters. Fish averaging 14 inches were placed into Allegheny Reservoir, Chautauqua Lake, and Conewango Creek.

Stock Assessment

A State Wildlife Grant funded project continues to track radio tagged adult paddlefish. In 2010 a female estimated to be about 11 years old was found to have eggs remaining in her abdomen. DEC researchers suspect that she may have attempted to spawn earlier in the summer of 2010. This is the first evidence of fertile female paddlefish in New York since the 19th century. Over 10,000 juvenile paddlefish have been stocked into the Allegheny River and reservoir system. Through the SWG project, DEC staff hope to demonstrate that paddlefish have been successfully restored as a self-sustaining species in NY. In 2010, apparently wild-spawned juvenile paddlefish were observed at the head of Allegheny Reservoir, but staff were unable to capture any to verify whether or not they had implanted tags. DEC staff will continue to track radio tagged fish and attempt to capture young-of-year fish observed to document natural reproduction. The results of the paddlefish restoration evaluation project are expected in 2012.

Gilt Darter

DEC is attempting to reintroduce gilt darters to the Allegheny River System. Gilt darters have not been reported in New York since the 1930s. Adult gilt darters captured in Pennsylvania were delivered to a contract hatchery, Conservation Fisheries Incorporated (CFI), for the third year and to SUNY Cobleskill for the second year in September. Previous collecting trips to Pennsylvania yielded relatively small fish. For the first time in 2010, brood stock collection included adults that should be ready to spawn the next spring/summer. Collections during previous years included juvenile gilt darters that were slow at maturing while in captivity.

Spawning was not achieved by captive brood stock in spring 2009 because they were not mature. Some of those same individuals did reproduce in 2010 at CFI and 5 juveniles were still alive in Nov. 2010.

Longear Sunfish

Historically, longear sunfish occurred in Oneida Lake's outlet to the Oswego River, tributaries and bays of southwestern Lake Ontario and a tributary of the Niagara, Tonawanda Creek. Intensive sampling since 1999 throughout historic waters has shown that longear sunfish now have a sustained population in only one area, a 6 km section of Tonawanda Creek. In order to secure the status of this species, suitable stocking locations within the Tonawanda Creek sub-basin were identified. Longear sunfish collected from Tonawanda Creek were placed in breeding ponds near Watertown and 750 fingerlings averaging 17 mm in length were stocked. Fingerlings were placed at two locations in Ellicott Creek and one location in Tonawanda Creek. Stocked locations will be resampled periodically to check survival and document any natural reproduction.

Round Whitefish

Round whitefish were once an abundant sportfish found in ponds throughout the Adirondacks. Numbers declined throughout the 20th century resulting in their listing as endangered. Recent attempts at restoration of this species began with stocking at several locations in 2000. Evaluation netting in 2010 in Evergreen Pond showed favorable survival levels of round whitefish and evidence of reproduction. This is a major landmark in the recovery efforts for this species. Round whitefish were stocked in 2010 in Chapel Pond. DEC staff will continue to monitor the recovery of this species.

2010-11 Inland Section Staff

Section Head: Shaun Keeler **Biologist 3 (Aquatic)**

Coldwater Unit:
Fred Henson Biologist 2 (Aquatic)

Warmwater Unit:
Jeff Loukmas Biologist 2 (Aquatic)

Rare Fish:
Lisa Holst Biologist 2 (Aquatic)

Biological Survey Unit:
Linda Richmond Agency Program Aide
Paul Sweeney Calculations Clerk 2
Casey Festa Seasonal Fish & Wildlife Tech 1

Bureau of Fisheries
Lake Ontario Research Unit
State of New York
DEPARTMENT OF
ENVIRONMENTAL CONSERVATION

Sportfishery Monitoring

Each year from April through September, the Lake Ontario Research Unit conducts the Lake Ontario fishing boat survey at 30 access channels from the Niagara River in the west to the Association Island cut in the east. The survey tracks a multitude of trends in the open lake sportfishery, including angler effort, catch and catch rates, harvest and harvest rates, performance of stocked fish, and fish growth/condition. Lake Ontario fishing quality is best characterized by the number of trout and salmon caught per hour of active fishing (catch rate). In 2010, the catch rate for all trout and salmon combined was the second-highest observed since this survey began in 1985. In fact, 5 of the 6 highest combined catch rates were recorded between 2003 and 2010 (Figure 1). These exceptional catch rates are largely due to record or near record-high catch rates in recent years for Chinook salmon, rainbow trout (steelhead), and coho salmon. While fishing quality has been exceptional, angler effort (number of fishing boat trips) has not increased. (Figure 2)

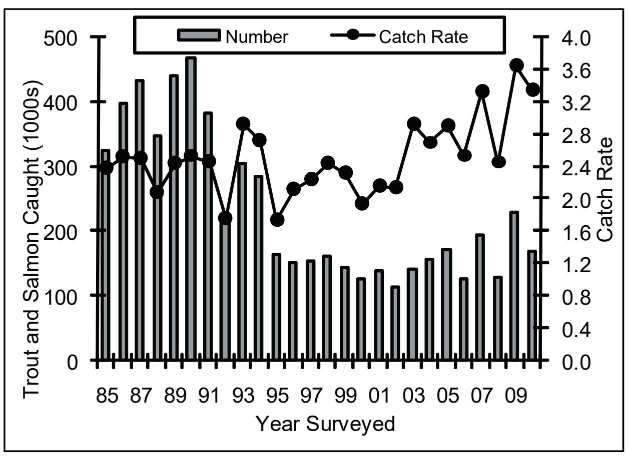


Figure 1. Total trout and salmon catch (bars) and catch rate (line/dots) for boats seeking trout and salmon, 1985-2010.

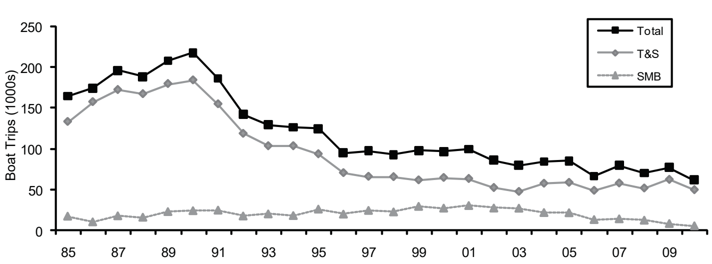


Figure 2. Seasonal estimates of total fishing boat trips, trips targeting trout and salmon (T&S), and trips targeting smallmouth bass (SMB) during the traditional open season (3rd Saturday in June-September 30 when the survey ended).

Preyfish Monitoring and Predator Growth/Condition

With over 5 million trout and salmon stocked annually into Lake Ontario by New York State and the Province of Ontario, it is important to monitor the abundance of bait or preyfish that trout and salmon predators feed on, as well as growth rates and condition of predators (also see Sportfishery Research). Partnering with USGS and OMNR, the LOU monitors relative abundance of alewife, rainbow smelt, sculpins, and round gobies. Alewife populations are of particular concern, as they are the primary food for Chinook salmon, the top predator in the lake. In 2010, adult alewife abundance declined to its lowest level since this survey began in 1978 (Figure 3). Abundance of age-1 or yearling alewife, however, increased markedly in 2010, contributing to increased growth of age-2 and 3 Chinook (Figure 4). Lake Ontario Chinook salmon continue to be the largest in the Great Lakes, and Lake Ontario predator demand in 2010 appeared to be in balance with available prey.

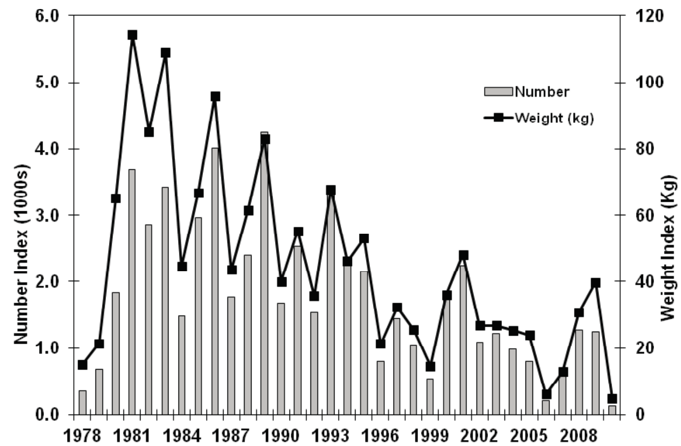


Figure 3. Abundance indices for adult (age-2 and older) alewife in the U.S. waters of Lake Ontario during late April-Early May, 1978-2010. (1 kg = 2.205 lbs)

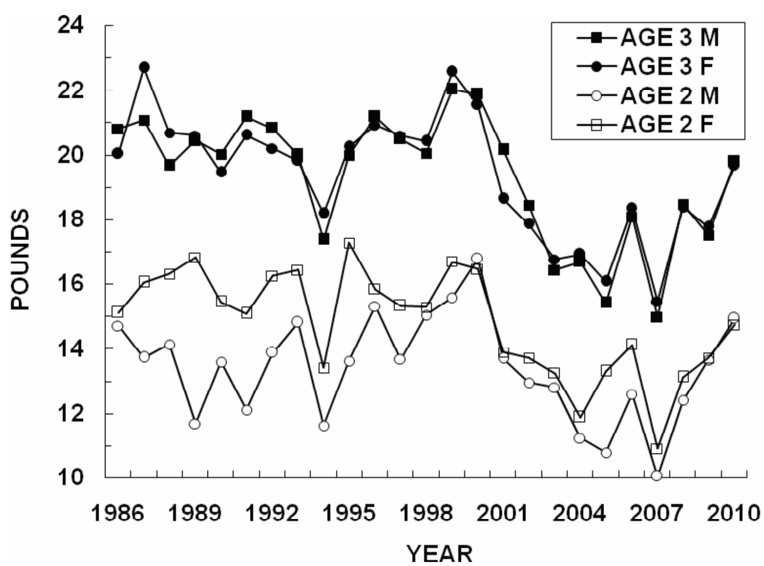


Figure 4. Mean weights of Chinook salmon ages 2-3 at Salmon River Hatchery 1986-2010.

Native Species Restoration

An international program to restore a naturally reproducing population of lake trout in Lake Ontario is ongoing. To measure progress, cooperative DEC/USGS bottom trawl (juveniles; July) and gill net (adults; Sept.) surveys are conducted annually at 14 sites from the Niagara Bar to Charity Shoals in the Eastern Basin. Catch of age-2 lake trout indicates survival remaining well below 1980s levels. While adult lake trout abundance increased for the 2nd consecutive year (following a record-low in 2007), abundance remains low due to continuing poor juvenile survival. On a positive note, survival of naturally produced lake trout to the fingerling stage in summer and fall occurred each year during 1993-2007.

Four species of deepwater cisco are considered extirpated from Lake Ontario, and the LOU has been collaborating with the OMNR, USFWS, and the GLFC to re-introduce these fish into the lake. In February, LOU staff took delivery of deepwater cisco eggs collected in Lake Michigan for experimental rearing at the Cape Vincent Fisheries Station. On 13 April, approximately 7,000 embryos were transferred to OMNR's White Lake Fish Culture Station, where researchers are better trained and equipped to conduct necessary research on early life feeding/dietary requirements. Plans are underway to collect more deepwater cisco eggs in February 2012 in Lakes Michigan and Superior.

Two milestones in Atlantic salmon restoration were achieved in 2010: the discovery by USGS staff of naturally reproduced Atlantic salmon smolts in the Salmon River, and a record-high angler catch rate for the open waters of Lake Ontario. While the reasons for these phenomena are not yet known, DEC is currently changing the strain of Atlantic salmon stocked into the lake, and OMNR has also expanded strain composition and numbers of stocked fish.

Warmwater Fisheries Assessment

Each year the LOU conducts index gill netting to assess the status of warmwater fish populations in Lake Ontario's Eastern Basin. In 2010, smallmouth bass catch remained well above the record-low levels experienced prior to Double-crested cormorant population management. Walleye abundance remains relatively stable, while yellow perch catch in 2010 was the second highest observed since 1984. Following a long period of low abundance, white perch numbers appear to be rebounding. At least one lake sturgeon has been collected in 12 of the last 16 years (4 in 2010), suggesting an increase in sturgeon abundance.

Sportfishery Research

Using Occidental Chemical Corportation Natural Resources Damages funds, the Bureau of Fisheries purchased a $1.3 million automated fish marking trailer in 2008 (Autofish - PICTURE). The Autofish system is capable of removing a fish's adipose fin and/or inserting a coded wire tag into the snout of the fish automatically at a high rate of speed and accuracy. Fin clipping and tagging give researchers tools to answer a variety of questions regarding the performance of stocked and wild fish. From 2008-2010, the Department and the OMNR "mass-marked" all Chinook salmon stocked into Lake Ontario with an adipose fin clip to determine the relative contributions of naturally reproduced ("wild") and hatchery stocked Chinook salmon to open lake and tributary fisheries. In recent years, high numbers of wild Chinook salmon in addition to stocked fish in Lake Huron are thought to have contributed to an imbalance between salmon and their primary prey, the alewife. The imbalance led to greatly reduced growth and condition of Chinook salmon, and had substantial, negative impacts on sportfisheries. In 2010, 34.6% of age-2 (2008 year class) Chinook salmon harvested by anglers in the New York waters of Lake Ontario were wild. The 2008 year class resulted from very low water flow in the Salmon River during fall 2007. It is anticipated that future results may reveal much higher levels of Chinook natural reproduction from the Salmon River when water flows are more favorable during the spawning and egg incubation periods.

2010-11 Lake Ontario Research Unit Staff

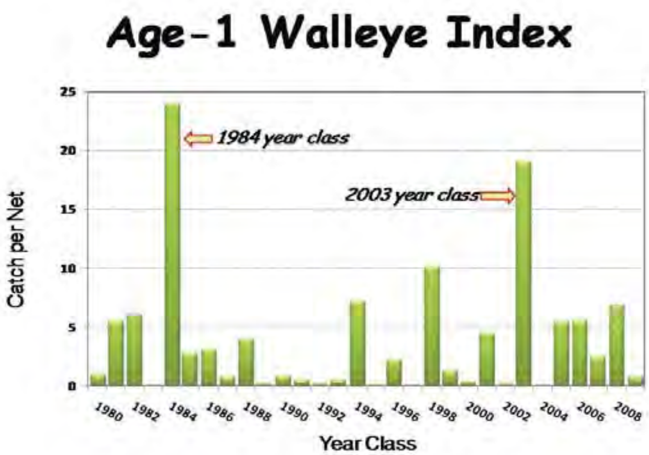
Steve LaPan	Biologist 2 (Aquatic)*
Jana Lantry	Biologist 1 (Aquatic)
Mike Connerton	Biologist 1 (Aquatic)
Alan Fairbanks	Fisheries Research Vessel Captain
Gaylor Massia	Maintenance Assistant
Beverly Grant	Secretary 1 (retired 9/30/10)
Josh Fisher	Fish & Wildlife Technician 1
Tom Eckert	Fish & Wildlife Technician 1
Ron Harrington	Fish & Wildlife Technician 1
Joe Dallas	Fish & Wildlife Technician 1
Rich Chiavelli	Fish & Wildlife Technician 1
Ben Carson	Fish & Wildlife Technician 1
Emily Tucker	Fish & Wildlife Technician 1
Mike Siragusa	Fish & Wildlife Technician 1
Shane Grant	Seasonal Laborer

** promoted to Biologist 3 10/18/2010*

Warmwater Fisheries Management

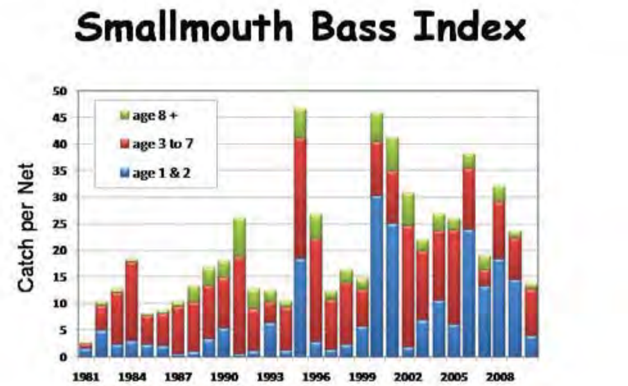
Walleye

Lake Erie's eastern basin walleye resource is composed of local spawning stocks, as well as contributions from summertime movements from western basin spawning stocks. The annual movement of western basin stocks is now well known via long-term tagging studies conducted throughout the lake. Walleye fishing quality in recent years has been mostly very good and largely attributable to excellent spawning success observed in 2003. However, the dominant 2003 year class has now begun to wane. Nevertheless walleye fishing quality was very good in 2011. Our most recent juvenile walleye surveys indicate average to good spawning success occurred from 2005 to 2008, but lower spawning success occurred in 2009, suggesting the decline of the adult population might somewhat moderate from the peak observed just a few years earlier.



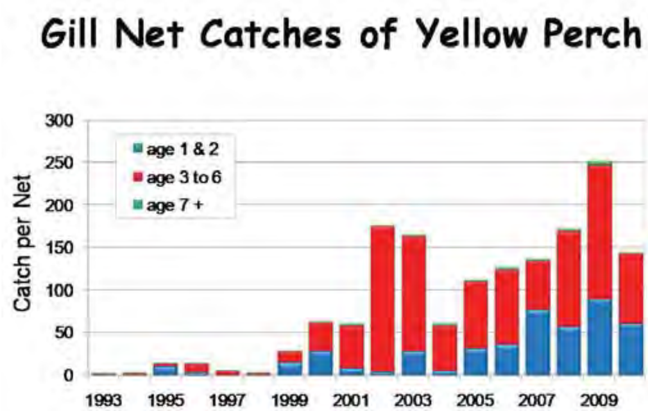
Smallmouth Bass

Lake Erie supports New York's, and perhaps the country's, finest smallmouth bass fishery. Generally stable spawning success, coupled with very high growth rates and good survival to old ages, produces high angler catch rates and frequent encounters with trophy-sized fish. However, the most recent bass monitoring program has found smallmouth bass abundance measures trending downward to slightly below long-term abundance levels, with recruitment to the adult population expected to be near average during the next few years.



Yellow Perch

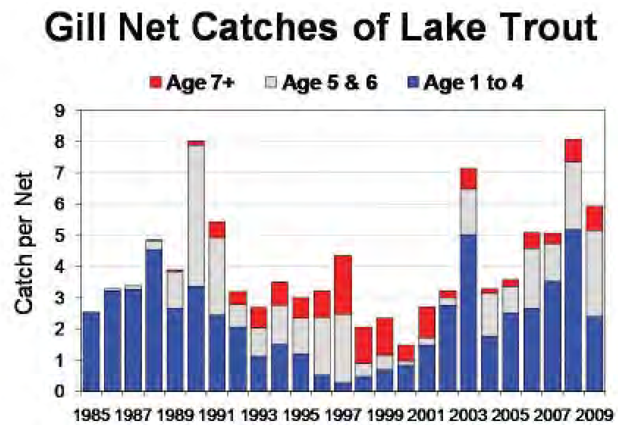
Lake Erie's yellow perch resource has experienced wide oscillations in abundance over the last 30 years, from a low ebb in the mid-1990's, to an extended recovery over the last decade. A large adult population continues to produce good angler catch rates especially during spring and fall seasons. Measures of juvenile perch abundance from 2005 to 2008 were especially high, below average during 2009, and near average in 2010. Overall, this pattern of recruitment suggests the recent large and more stable abundance of yellow perch will extend at least another few years.



Coldwater Fisheries Management

Lake Trout

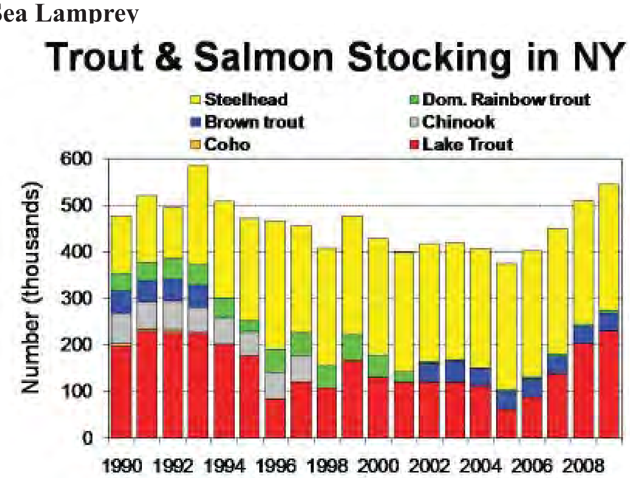
Rehabilitation of a self-sustaining lake trout population in the eastern basin of Lake Erie continues to be a major thrust in New York's Great Lakes coldwater fisheries management program. Lake trout have been stocked annually since 1978 and assessment programs monitor the status of progress. A revised lake trout rehabilitation plan was completed in 2008 and will guide future recovery efforts. Abundance of lake trout in the New York waters of Lake Erie has been slowly increasing since 2000 and has reached the levels found in the 1990s. However, lakewide abundance remains well below targets. Adult abundance (age 5+) also continues to increase, mainly due to successful recruitment of Klondike strain lake trout to this age category. Additional stocking and effective sea lamprey control are needed in order to build adult lake trout populations to levels where natural production is a possibility.



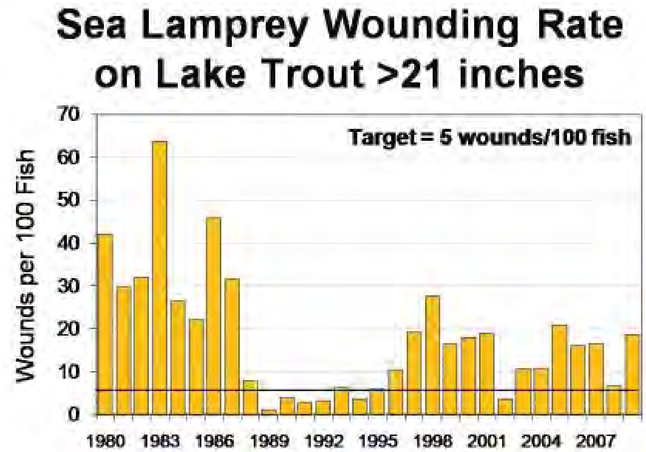
Steelhead and Salmonid Stocking

New York annually stocks around 270,000 steelhead and 35,000 brown trout into Lake Erie and its tributaries to provide recreational opportunities for both lake and stream anglers. Tributary angling for steelhead, assessed through an angler diary program, continues to show excellent fishing with average catch rates exceeding 0.50 fish/hour. Wild reproduction of steelhead also occurs which contributes to the fishery as well. Juvenile assessment programs conducted since 2001 confirmed substantial numbers of young-of-year steelhead present in the fall on many tributaries. Pre-passage monitoring is occurring on Chautauqua Creek in anticipation of a fish passage project that will hopefully improve natural reproduction in this stream. Fishing quality is expected to remain good in the near future.

Sea Lamprey

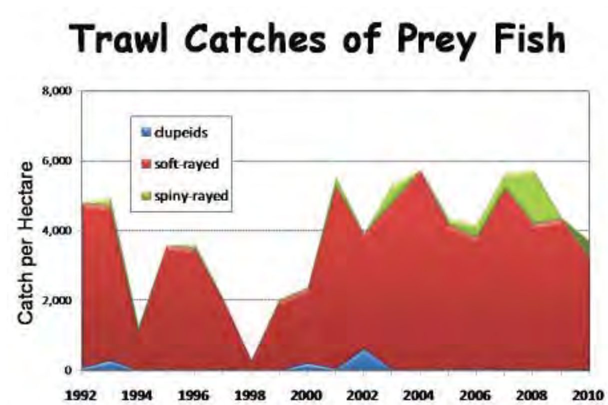


Sea lamprey invaded Lake Erie and the Upper Great Lakes in the 1920s and have played an integral part in the failure of many native coldwater fish stocks. Sea lamprey control in Lake Erie began in 1986 in support of lake trout rehabilitation efforts, and regular treatments are conducted to control lamprey populations. Annual monitoring consists of observations of sea lamprey wounds on lake trout and other coldwater fish species, and nest counts on standard stream sections. Both wounding rates and nest counts increased substantially in 2009 compared to 2008, indicating that the Lake Erie sea lamprey population is increasing. Back-to-back lampricide treatments of all key Lake Erie tributaries began in 2008 and continued in 2009. These treatments are expected to reduce sea lamprey wounding to below target levels beginning in 2010.



Prey Fish

The Lake Erie Unit also participates in a number of investigations to assess forage fishes and other components of the lake ecosystem. These investigations include trawl and sonar surveys of prey fishes, and predator diet studies. A variety of prey fish investigations beginning approximately 19 years ago found rainbow smelt as the dominant component of the open lake forage fish community. Through more recent years there has been a notable increase in prey species diversity accompanied by somewhat lower smelt abundance. Through recent years especially high abundances of round gobies and emerald shiners were encountered in both prey fish collections and predator diets. However, the most recent 2010 surveys found overall prey fish abundance trending somewhat downward, and particularly the contribution by gobies has declined in trawl surveys. Over time we expect these investigations to be useful in furthering our understanding of factors shaping the fish community.



2010-11 Lake Erie Research Unit Staff

Don Einhouse	Biologist 2 (Aquatic)
Jim Markham	Biologist 1 (Aquatic)
Doug Zeller	Fisheries Research Vessel Captain
Brian Beckwith	Fish & Wildlife Technician 2
Rich Zimar	Fish & Wildlife Technician 2
Ginger Szwejbka	Secretary 1
Mark Dusablon	Fish & Wildlife Technician 1
Carrie Ann Babcock	Fish & Wildlife Technician 1
Paul Andrews	Fish & Wildlife Technician 1
Kyle Nemecek	Fish & Wildlife Technician 1

Angler Education

In-School Fishing Education Programs

Two hundred seven formal education programs were conducted between April 1, 2010, and March 31, 2011, in DEC Regions 1, 2, 7 and 9. Of those, there were 194 in-school programs and 13 County Conservation Days where schools come to go through environmental programs in a round robin fashion. Most of those programs, 177, were done in DEC Region 2 (NYC). A total of 8,335 contacts with school kids were generated from these programs, including 5,934 in-school contracts and 2,401 contacts at County Conservation Days.

Fishing Clinics/Festivals

One hundred forty eight non-formal fishing education programs were conducted between April 1, 2010, and March 31, 2011, including 14 fishing festivals, 64 fishing clinics, 53 fishing clinics at summer camps, and 17 fishing clinics at campgrounds. Twenty three of these events were held in conjunction with a free fishing day or designated as a free fishing event. At those 148 fishing events, 12,037 people were reached, including 3,630 at fishing festivals, 5,484 at fishing clinics, 2,473 at summer camps and 450 at campgrounds. People attending fishing festivals generally received little to no fishing education, although there were usually seminars available to those who desired to learn more about fishing. People attending fishing clinics generally received between 30 to 60 minutes of fishing education followed by an opportunity to fish.

Library loaner rod program

Loaner fishing rods were made available in eight Capital District and Rochester area libraries. Of the eight libraries, two received rods too late in the season to loan any out. Four of the remaining six libraries reported loaning out 143 fishing rods between April 1, 2010, and March 31, 2011.

Fisheries webpages

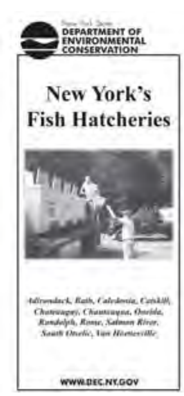
One hundred forty new fisheries web pages were posted on the NYSDEC website during the grant period. Most of these were Places to Fish pages (81 pages) and Biologist Reports pages (43 pages). In addition, 41 new fisheries PDFs were added to the website. In order to serve our website visitors more effectively, the main fishing page (http://www.dec.ny.gov/outdoor/fishing.html) was redesigned on January 11, 2011, to provide quick links to fishing content. This should result in more page visits on those quick linked pages. The fishing regulations page (http://www.dec.ny.gov/outdoor/7917.html) was also modified to make it easier to look up fishing regulations. An evaluation of the number of page visits will be used to determine the effectiveness of the main fishing page redesign.

Direct Mail Marketing of Fishing Licenses

New York continued its involvement in this cooperative effort managed by the Recreational Boating and Fishing Foundation to remind anglers to renew their fishing licenses. On May 27, 83,000 postcards were mailed out to lapsed anglers and 2009 program respondents. A second postcard was mailed to non-respondents on July 13. Each postcard included creative graphics and messaging designed to encourage anglers to renew their fishing license. Concurrent with this direct mail effort was a radio, print and on-line advertising campaign. The 12.5% overall response rate was the highest recorded for the three years this program has been conducted. New York's lift was 0.59, slightly above the national average of 0.52. Overall, the program resulted in the sale of 9,730 licenses for a total of $241,850 in license sales revenue. The direct mail component of this program contributed $11,335.

Fish Hatchery Brochures Reprinted

The general brochure covering all of the DEC fish hatcheries and individual brochures for each of the 12 DEC fish hatcheries were updated and printed. A total of 25,000 copies were printed through the Office of General Services (OGS). The publications discuss the unique operations and the fish raised at each facility and are very popular with visitors to DEC fish hatcheries.



Raquette River "Crusher" Boat Launch Rehabilitation

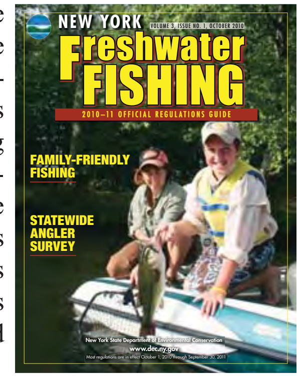
This popular Franklin County boat launch was reopened in June after being completely rehabilitated. A new launch ramp was installed, along with a new floating boarding dock. A separate access point for canoes and kayaks was developed to avoid conflicts with the launching of trailered boats. Parking areas and the entrance drive were regraded and paved with a crushed stone blend. The failing bulkhead was removed and a natural shoreline was reestablished using native stone and plantings.

Kiosk Displays Installed

In a continued effort to improve the availability of information of interest to anglers and boaters, new interpretatvie displays were installed at the the Coeymans (Hudson River) and Crusher (Raquette River) boat launch sites. Content on the panels included information on fish species present, a map of the water body, invasive species, a historical background and fishing regulations. Each panel is designed using a template, giving the display a more cohesive look. Two panels were also created for the newly constructed South Bay Fishing Pier that inform anglers what species they can catch and fishing regulations for Lake Champlain.

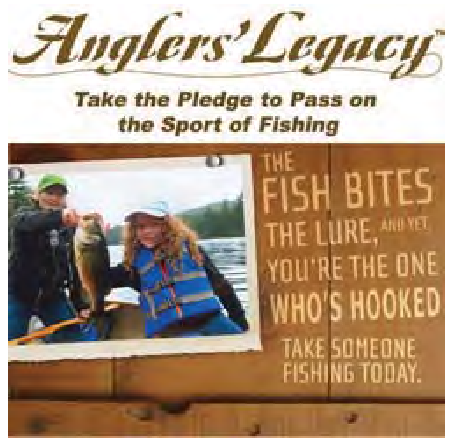
2010-11 Fishing Regulations Guide

The fishing regulations guide was increased from its former 5.25" x 7.25" size to 8" x 10.5" in an effort to increase advertising revenue and reduce overall production costs. The larger guide also allowed the font size to be increased to improve legibility. The 2010-11 guide had a youth/family fishing focus and featured articles on beginning fishing techniques and family-friendly fishing locations in New York. 750,000 guides were printed and distributed to license agents across the state. Although some anglers prefer the smaller size, a survey of anglers attending a major sports show indicated that this opinion was far from unanimous.



Angler Legacy in New York

Angler Legacy is a cooperative venture between DEC and the Recreational Boating and Fishing Foundation to encourage anglers to introduce others to the sport. New York currently ranks 5th in the country in the number of people who have taken the Angler Legacy pledge. Recent research noted that Angler Legacy Ambassadors introduced 3.3 youth and 4.2 newcomers to the sport of fishing, an increase of 73% and 68% respectively, over non-Ambassadors. Anglers interested in taking the pledge should go to *www.dec.ny.gov/outdoor/fishing.html.*



Angler Achievement Awards Program

The Angler Achievement Awards Program received 167 entries in 2010. Over 70% of the entries were entered into the Catch and Release Category, indicating that most anglers choose not to harvest their catch. Largemouth and smallmouth bass proved to be a popular species to fish for, taking up almost half of the entries received. State records remained unbroken in 2010.

2010-11 Public Use Staff

Edward Woltmann	Biologist 3
Gregory Kozlowski	Biologist 2
Joelle Ernst	Biologist 1 (Aquatic)
Michael DiSarno	Fish and Widlife Technician

Hatchery Infrastructure Improvements

Adirondack Hatchery – Lighting Upgrade

Subcontractors for National Grid replaced nearly all the original lights in the production areas of Adirondack Hatchery with energy efficient fluorescent lighting. Motion sensors were installed in appropriate areas of the hatchery buildings to further improve energy efficiency. This project was funded through Nation Grid's Small Commercial Lighting Program and DEC Division of Operations. There was no charge to the Bureau of Fisheries, Fish Culture Section. The new fluorescent lights are expected to save $7,500 per year in energy costs and improve lighting levels and quality.

Bath Hatchery – Flow Meter Installed to Meet SPDES Permit Requirements

The Bath Hatchery has three spring sources which feed the fish rearing units. These are the Main Spring Pond, Creek Spring, and Butternut Pond Spring. The Butternut Spring did not have a flow meter installed on it and therefore was in violation of our SPDES permit. During the fall of 2010 the flow from the Butternut Pond was diverted so that it flows into the Fountain Building. The Fountain Building is an aeration building which receives the flow from the Main Spring Pond. This project accomplished two things. It allowed us to measure the combined flow of both springs and also gave us more flexibility with the Butternut Spring water. In the past the Butternut water could only be used in one series of ponds. Now it can be used to feed all the units in the hatchery.

Chateaugay Hatchery – Fuel Tanks Replaced

In 2010 Chateaugay Hatchery replaced three old and deteriorating 275 gallon fuel tanks with new double paneled tanks that were installed with alarms. The alarms are precautionary measures that are activated in case of over fill and leakage. A 1,000 gallon tank was also unearthed and removed. It was replaced with a 1,000 gallon above ground tank with the same alarm system installed to reduce the possibility of spills.

Caledonia Hatchery – Traveling Screen Replaced

Caledonia Hatchery uses a "traveling screen" to trap debris that enters the hatchery via the intake water line from Spring Creek. If debris isn't trapped and removed it could rapidly plug pond screens and prevent proper water flow through the hatchery. The old screen was deteriorating and needed frequent repairs to keep it functioning.

Rome Hatchery – New Rearing Building and Visitor Center

A new rearing building/office/visitor center at Rome Hatchery is nearly complete. This past fall, brown trout and brook trout eggs were hatched in the new building and presently fish are being raised in the raceways. The office area is now occupied by hatchery staff and the conference room has already been used for meetings and health and safety training classes. Displays at the visitor center are being developed by the Outreach Section and will soon be completed so the public will have insight into our fish culture programs.

Rome Fish Disease Unit – New Dissection Trailer Installation

A trailer was purchased to serve as a necropsy and disease testing lab for the Rome Fish Disease Control Unit. The trailer will be sited on Fish Hatchery property but away and downstream from existing production ponds so that harmful pathogens will not be transmitted from fish samples taken from off site locations. Late last fall a new sewer line for the dissection trailer was installed via directional drilling under State Route 46 which runs adjacent to Rome Hatchery. A poured concrete pad and water, sewer, and electric connections are planned for 2011-2012.

Salmon River Hatchery – New Water Supply Well

Production at Salmon River is currently limited in part due to an insufficient supply of water. A hydro geological survey was conducted during the spring of 2010 to locate a water source to enhance the hatcheries water supply. From this survey, four sites were found to have a high potential for water. A test well was drilled at the location with the highest potential. The test well has been monitored and it has been producing acceptable quantities of water. Full development of this well is planned for 2011-2012.

Experimental Evaluations

Thiamine Water Hardening Experiment

A thiamine water hardening experiment was initiated during the wild rainbow trout egg collection at the Cayuga Inlet Fishway. Early Mortality Syndrome (EMS) has caused mortality in rainbow trout fry in the past and has been associated with a thiamine deficiency in the eggs. This experiment will determine the correct concentration of thiamine that can be used on the eggs during the water hardening process. By using the correct concentration of thiamine it is hoped EMS can be eliminated. The experiment will be under the direction of George Ketola of the Tunison Laboratory of Aquatic Science in Cortland.

Fall Egg Takes

Windfall Heritage Strain Brook Trout

Egg collection of the Windfall heritage strain of brook trout took place on October 26 and 27 in Mountain and Black Ponds. Three personnel from South Otselic Hatchery assisted the Region 5 Fish Management Unit in the egg collection process. A total of 50,000 eggs were collected over the two day period. The eggs were transported to the South Otselic Hatchery. The fish from these eggs will be stocked in selected waters under the Adirondack Heritage Strain Brook Trout Management Program.

Lake Trout From Cayuga Lake

The annual Cayuga Lake egg collection of lake trout eggs began October 4, 2010 at Taughannock Point on Cayuga Lake. For the next three days eggs were collected for a total of 424,000 eggs. Of this total, 363,000 eggs were used for lake trout production while 61,000 eggs were fertilized with brook trout to produce splake eggs. The eggs were transported each day to Bath Hatchery. The egg collection was completed using personnel from South Otselic Hatchery, Oneida Hatchery, and Bath Hatchery. The lake trout hatched from these eggs will be stocked throughout the state and the hatched splake will be released in the Adirondack Mountain region.

Salmon River Chinook and Coho Salmon

The annual Salmon River Fish Hatchery's chinook and coho salmon egg collection began on October 7 and October 15, respectively. The 6 day chinook egg collection resulted in 3.2 million eggs taken. For the coho egg collection, it took four days to complete with a total of 1.4 million eggs taken. The egg collection was completed using all personnel from Salmon River Fish Hatchery along with help from Oneida Fish Hatchery, Cape Vincent Field Station and the Region 6 Fish Management Unit. The salmon hatched from these eggs will be used in Salmon River Fish Hatchery's stocking program for Lake Ontario.

Adirondack Hatchery – Landlocked Atlantic Salmon Egg Take

745,000 total Atlantic salmon eggs taken; 620,000 from captive broodstock and 125,000 taken from broodstock in Little Clear Pond. The egg take target numbers were reduced due to staffing shortages, but enough eggs were taken to meet the needs of 2011 spring yearling stocking. Landlocked Atlantic salmon are stocked into many Adirondack waters, as well as the Finger Lakes and other selected waters around the state.

Spring Egg Takes

Salmon River Hatchery

Salmon River Hatchery's annual steelhead rainbow trout egg collection began April 4 and continued for the next three days. A total of 163,000 Washington strain and 129,000 Skamania strain eggs were collected. Target numbers for the egg collection were met and these numbers should be adequate to meet stocking numbers in future. All eggs have eyed and are doing exceptionally well. The fish hatched from these eggs will be stocked in tributary waters of Lake Ontario and Lake Erie. The egg collection was completed by personnel from Salmon River Hatchery and Oneida Hatchery.

Bath Hatchery

An egg collection of wild rainbow trout from the Cayuga Inlet Fishway began with eggs being taken on April 8. They were also taken on April 15, 22, and 29. A total of 153,500 wild rainbow trout eggs were collected. There were also 24,600 hybrid (wild rainbows x domestic rainbows) rainbow trout eggs taken. The domestic rainbows used for fertilizing the eggs were from Randolph Hatchery. Target numbers for the egg collection were met and these numbers should be adequate to meet stocking numbers in the future. The fish hatched from these eggs will be stocked in Cayuga Lake, Owasco Lake, and Skaneateles Lake. The egg collection was completed by staff from Bath Hatchery and the Region 7 Fish Management Unit in Cortland.

Fish Disease Control

Fish Health Testing Overview

The NYSDEC Fish Disease Control Unit at Rome Field Station oversees the fish health program for the state. The fish health program includes disease surveillance of the DEC hatchery system and wild fish living in rivers, streams and lakes.

State Hatchery Disease Testing

Samples from all lots of fish stocked from DEC hatcheries were tested prior to stocking and no harmful fish pathogens were found. In all, 50 different lots of fish were tested from our 12 hatcheries, including both production fish and parental brood stock. No regulated fish diseases were found in any DEC hatcheries and the overall fish health is excellent.

Wild Fish Disease Surveillance

Wild fish health is assessed annually in a cooperative program with the USFWS and the National Wild Fish Health Survey. Fish from 30 locations were tested at either the DEC Rome Field Station or the USFWS Fish Health Center in Lamar, PA and no harmful fish pathogens were found. Locations included sites from all regions in the state and fish collections included cold water and cool water species.

2010-11 Fish Culture Staff

CENTRAL OFFICE

Jim Daley	Fish Culturist 6
Dave Armstrong	Fish Culturist 5
Mary LaBoissiere	Secretary 1

ADIRONDACK

Matt Jackson	Fish Culturist 3
Fritz Aldinger	Fish Culturist 1
Neil Cranker	Fish Culturist 1
Kenneth Klubek	Fish Culturist 1

BATH

Ken Osika	Fish Culturist 3
Kelly Raab	Fish Culturist 1
Robert Sweet	Fish Culturist 2
Steven Robb	Fish Culturist 1

CALEDONIA

Alan Mack	Fish Culturist 4
Kevin Hayden	Fish Culturist 2
Mark Krause	Fish Culturist 3
Jason Schirmer	Fish Culturist 1
Robert Stein	Fish Culturist 2
Brian Ward	Fish Culturist 1
Stephen Zenzen	Fish Culturist 1

CATSKILL

John Anderson	Fish Culturist 4
Tim Anstey	Fish Culturist 1
Steve Galbreth	Fish Culturist 1
Joseph Gennarino	Fish Culturist 2
James Judson	Fish Culturist 1
Derek Weishan	Fish Culturist 1 (trainee)

CHATEAUGAY

Neal McCarthy	Fish Culturist 2
Zachary Goodale	Fish Culturist 1
Adam Haley	Fish Culturist 1

CHAUTAUQUA

Larry King	Fish Culturist 3
Eric Defries	Fish Culturist 2
Bradley Gruber	Fish Culturist 1
Ron Preston	Fish Culturist 1

ONEIDA

Mark Babenzien	Fish Culturist 4
Bill Evans	Fish Culturist 2
Carl Rathje	Fish Culturist 3

RANDOLPH

Richard Borner	Fish Culturist 3
Trevor Brady	Fish Culturist 1
Barry Hohmann	Fish Culturist 1
Raymond Hulings	Maintenance Assistant
Jim Rambuski	Fish Culturist 2

ROME

Robert Lewthwaite	Fish Culturist 4
Kevin Balduzzi	Fish Culturist 1
John Draper	Fish Culturist 1
Steven Grabowski	Fish Culturist 2
John Gray	Fish Culturist 1
William R. Hajdasz	Maintenance. Supervisor
Kimberly Matt	Keyboard Specialist
Jon Stercho	Fish Culturist 1
Scott Wanner	Fish Culturist 3
William Woodworth	Fish Culturist 2

FISH DISEASE CONTROL

Andrew Noyes	Pathologist 2 (Aquatic)
Mark Batur	Fish Culturist 1

SALMON RIVER

Andreas Greulich	Fish Culturist 4
Brian Boyer	Fish Culturist 1
Stephen Dolan	Fish Culturist 3
David Domachowske	Fish Culturist 2
Brian Edmonds	Fish Culturist 1
Karen Hurd	Keyboard Specialist
Robert Nelson	Fish Culturist 2
Casey Tabolt	Fish Culturist 1

SOUTH OTSELIC

Patt Emerson	Fish Culturist 3
Thomas Kielbasinski	Fish Culturist 2
Bruce Ryan	Fish Culturist 1
Mike Speziale	Fish Culturist 1

VAN HORNESVILLE

Larry Kroon	Fish Culturist 3
Craig DuBois	Fish Culturist 2
Lauren C. Watson	Fish Culturist 1

Summary of Fisheries, Creel & Angler Surveys

Survey Name	Purpose
Region 1	
Connetquot (Tidal)	Fish Disease
Lake Ronkonkoma	Centrarchid
Fort Pond	Centrarchid
Hards Lake	Centrarchid
Massapequa Res	TSMP
Little River	Alewife
Horn Pond	Rare/Endangered Species
Little Horn Pond	Rare/Endangered Species
Unnamed	Rare/Endangered Species
North Pond	Rare/Endangered Species
Big Reed Pond	Fish Kill
Nissequogue T3	Fish Disease
Swan River	Fish Disease
Connetquot	Fish Disease
Peconic River	Rare/Endangered Species
Sandy Pond	Rare/Endangered Species
Dog Ponds	Rare/Endangered Species
Ronkonkoma	Water Chemistry/Plankton
Nissequogue River	CROTS
Unnamed water	Rare/Endangered Species
Unnamed water	Rare/Endangered Species
Unnamed water	Rare/Endangered Species
Unnamed water	Rare/Endangered Species
Unnamed water	Rare/Endangered Species
Lake Ronkonkoma	Percid Sampling
Fort Pond	Percid Sampling
Carmans River (Tidal)	Other - White Perch
Fort Pond	Percid Sampling
Lake Ronkonkoma	Percid Sampling
Region 2	
Meadow Lake (4/7/10 & 4/8/10)	Invasive Species Survey
Central Park Lake (4/21/10)	General Biological Survey
Bronx River (5/6/10)	General Biological Survey
Mt. Loretto Ponds (8/18/10 & 9/8/2010)	General Biological Survey
Willowbrook Pond (9/29/10)	General Biological Survey
Willow Lake (10/13/10)	Invasive Species Survey
Meadow Lake (10/14/10)	Invasive Species Survey
Prospect Park Lake (10/18/10 & 10/19/10)	General Biological Survey & Fish Disease Surveillance
Region 3	
Rio Reservoir	Walleye spawning assessment

Summary of Fisheries, Creel & Angler Surveys

Survey Name	Purpose
Region 3 cont.	
New Croton Reservoir	Toxic Substances Monitoring Program
Titicus Reservoir	Trout Assessment Using Gill Nets
Esopus Creek (above Ashokan Reservoir)	Trout collection for radio tagging study
Catlin Creek	Northern snakehead eradication follow-up assessment
Hessian Lake	Toxic Substances Monitoring Program - Mercury
Rondout Reservoir	Trout Assessment Using Gill Nets
Kensico Reservoir	Trout Assessment Using Gill Nets
Titicus Reservoir	Centrarchid (bass and sunfish) assessment
Neversink River	Trout assessment
Esopus Creek (below Ashokan Reservoir)	Toxic Substances Monitoring Program - Mercury
Esopus Creek (above Ashokan Reservoir)	Trout population estimate/assessment
Region 4	
Kinderhook Lake	Centrarchid survey
Featherstonhaugh Lake	Centrarchid survey
Canadarago Lake	Centrarchid survey
Collins Lake	Centrarchid survey
Long Pond	Contaminant fish collections
Unadilla River	Warmwater river survey
Canadarago Lake	Percid gill netting survey
Schoharie Reservoir	Walleye gill netting survey
West Branch Delaware River	Trout population studies, fish health collection
East Branch Delaware River	Trout population studies, fish health collection
Manor Kill	CROTS survey
Bush Kill	Trout stream biological survey
Lisha Kill	CROTS survey
Tremper Kill	Trout stream biological survey
Sands Creek	Trout stream biological survey
Quacken Kill	CROTS survey
Read Creek	Trout stream biological survey
Cold Spring Creek	Trout stream biological survey
Cadosia Creek	Trout stream biological survey
Little Delaware River	Trout stream biological survey
Poesten Kill	CROTS survey
Delaware River	Snorkel survey
Stony Kill	CROTS survey
Batavia Kill Reservoir	Salmonid netting assessment
T16-Manor Kill	Loach investigations
1-137- Susquehanna River	Loach investigations
Humphries Brook	Trout stream biological survey
Otsego Lake	Salmonid netting assessment
Canadarago Lake	Walleye YOY fall survey

Summary of Fisheries, Creel & Angler Surveys

Survey Name	Purpose
Region 4 cont.	
Gilbert Lake	Contaminant fish collections
Hudson River	Black bass wintering area assessment
Small stream surveys (671 streams)	Brook trout presence/absence surveys.
Region 5	
Black Mountain Pond	Evaluate experimental stocking
Bone Pond	Post-liming survey
Upper Conglin Lake	Evaluate experimental stocking
Echo Pond	Post-liming survey
Fishbrook Pond	Egg take
Gay Pond	Pre-reclamation survey
Giants Washbowl	Post-Reclamation survey
Great Sacandaga Lake	Evaluate experimental stocking
High Pond	Other, see comments
Holmes Lake	Post-liming survey
House Pond	Pre-liming survey
Icehouse Pond	Post-liming survey
Lake Clear	Physical/Chemistry survey
Lake Lauderdale	Evaluate experimental stocking
Ledge Pond	Other, see comments
Ledge Pond	Other, see comments
Ledge Pond	Post-Reclamation survey
Little Green Pond	Rare/endangered species
Loon Lake	Evaluate experimental stocking
Lower Lost Pond	General biological survey
Upper Lost Pond	General biological survey
N. Br. Saranac River	CROTS survey
Oseetah Lake	TSMP collection
Prier Pond	Evaluate experimental stocking
Rhododendron Pond	Pre-reclamation survey
Round Pond	Post-Reclamation survey
Schroon Lake	TSMP collection
Schroon Lake	General biological survey
St. Germain Pond	Pre-liming survey
Twin Pond	Post-Reclamation survey
Cadyville Reservoir	TSMP collection
Unnamed Water	CROTS survey
Black Pond	Post-liming survey
Federation pond	Post-liming survey
Embody Pond	Pre-reclamation survey
Embody Pond	Physical/Chemistry survey
Unnamed Water	Whirling disease sampling
Middle Conglin Lake	Evaluate experimental stocking

Summary of Fisheries, Creel & Angler Surveys

Survey Name	Purpose
Region 5 cont.	
Sunrise Pond	Post-liming survey
Black Mountain Pond	Evaluate experimental stocking
Region 6	
St. Lawrence River Thousand Islands	Warmwater fish stock assessment
Lake St. Lawrence	Warmwater fish stock assessment
Eastern Lake Ontario	Warmwater fish stock assessment
Lake Ontario Biomonitoring	Lower trophic level monitoring
Eastern Lake Ontario Littoral	Development impact baseline survey
Mill Creek	Sediment impact evaluation
Black Lake	Fingerling walleye evaluation
Red Lake	Fingerling walleye evaluation
Payne Lake	Fingerling walleye evaluation
Mohawk River	Spawning walleye assessment
Oswegatchie River	Spawning walleye assessment & egg take
Black River	Fish kill recovery monitoring
St. Lawrence River Sturgeon	Lake sturgeon survey & egg take
Eastern Lake Ontario Sturgeon	Lake sturgeon survey
Black River Sturgeon	Lake sturgeon survey
St. Lawrence River Esocids	Pickerel, pike and muskellunge young-of-the-year survey
Razorback Pond	Endangered/threatened species survey (summer sucker)
Boottree Pond	Heritage strain brook trout survey & egg take
Big & Little Hill Ponds	Heritage strain brook trout survey & egg take
North & South Twin Lakes	Heritage strain brook trout survey & egg take
Delta Lake	Fish disease survey
Lake Bonaparte	Fish disease survey
Lake of the Woods	Fish disease survey
Black River Salmonids	Lake-run trout and salmon monitoring
Cleveland Lake	Brook trout condition index study (four seasonal surveys)
Long Pond	Brook trout condition index study (four seasonal surveys)
Pitcher Pond	Brook trout condition index study (four seasonal surveys)
Streeter Lake	Brook trout condition index study (four seasonal surveys)
Deer Pond	Heritage brook trout broodstock survey
Tamarack Pond	Heritage brook trout broodstock survey
Palmer Creek	Heritage brook trout survey
Evergreen Lake	Heritage brook trout survey
Peaked Mountain Lake	Heritage brook trout survey
Hidden Lake	Heritage brook trout survey
Stink Lake	Brook trout survey
Toad Pond	Brook trout survey
Robinson River	Brook trout survey
Cowhorn Pond	Brook trout survey
Sand Lake	Brook trout survey

Summary of Fisheries, Creel & Angler Surveys

Survey Name	Purpose
Region 6 cont.	
Mud Pond	Brook trout survey
Mill Creek	Brook trout survey
Mud Lake	Brook trout survey
Bridge Brook Pond	Brook trout survey
Cary Lake	Brook trout survey
Unnamed Water	Brook trout survey
Unnamed Water	Brook trout survey
Moss Lake	Lake trout survey
Grass River	General biological survey
Delta Lake	General biological survey
Adirondack Limed Waters	Water quality survey (16 waters in liming program)
Crystal Lake	Water quality survey (potential liming)
Clear Pond	Water quality survey (potential reclamation)
Twitchell lake	Water quality survey (pre-stocking)
Region 7	
Sherman Creek	Sampling demonstration for Trout Unlimited Camp
Tributary to Wylie Brook	Assess for presence of wild trout
Chenango River	Sampling demonstration for Rogers Environ. Ed. Center
Tributary to Susquehanna River-Afton	Determine presence of invasive Dojo Loach
Susquehanna River	Smallmouth bass abundance assessment
Whitney Point Reservoir	Fall Electrofishing to assess young-of-year walleye abundance
Otisco Lake	Fall Electrofishing to assess survival of stocked fingerling walleye
Jamesville Reservoir	Fall Electrofishing to assess need to reinstitute walleye stocking
Otter Lake	Fall Electrofishing to assess walleye abundance
Cazenovia Lake	Fish Kill Investigation
Skaneateles Lake	Fish Kill Investigation
Trib to Rice Creek	Brook trout population assessment
Rice Creek	Brook trout population assessment
Trib to Center Brook	Brook trout population assessment
Center Brook	Brook trout population assessment
Region 8	
Springwater Creek	Rainbow trout assessment
Naples Creek	Rainbow trout assessment
Cold Brook	Rainbow trout assessment
Seneca Lake	Fish health collection
Honeoye Lake	Warm-water fisheries assessment
Meads Creek	Fate of stocked trout study
Dry Run	Brook trout stream status survey
Sodus Bay	Warm-water fisheries assessment
Seneca Lake Derby	Sea lamprey assessment
Seneca Lake	Black bass sampling
Harlow Lake	General survey

Summary of Fisheries, Creel & Angler Surveys

Survey Name	Purpose
Region 8 cont.	
Mill Creek	Brook trout stream status survey
Pardee Hollow Creek	Brook trout stream status survey
Van Camper Creek	Brook trout stream status survey
Unnamed stream (PA-3-58-32-2)	Brook trout stream status survey
Unnamed stream (PA-3-58-3-8)	Brook trout stream status survey
Erwin Hollow Brook	Brook trout stream status survey
Sinclair Creek	Brook trout stream status survey
Unnamed stream (PA-3-58-3-10)	Brook trout stream status survey
Chamberlain Brook	Brook trout stream status survey
Maxwell Creek	Brook trout stream status survey
Unnamed stream (PA-3-58-27-5)	Brook trout stream status survey
Campbell Creek	Brook trout stream status survey
Curtis Creek	Brook trout stream status survey
Burr Hollow Brook	Brook trout stream status survey
Culver Creek	Brook trout stream status survey
Gulf Creek	Brook trout stream status survey
Unnamed stream (PA-3-58-28-23)	Brook trout stream status survey
Trout Run	Brook trout stream status survey
Deer Lick Run	Brook trout stream status survey
Jones Brook	Brook trout stream status survey
Switzer Brook	Brook trout stream status survey
Cohocton River	Brook trout stream status survey
Unnamed stream (PA-3-58-38-15)	Brook trout stream status survey
Unnamed stream (PA-3-58-38-19-2)	Brook trout stream status survey
Unnamed stream (PA-3-58-38-19)	Brook trout stream status survey
Fairbrothers Brook	Brook trout stream status survey
Oil Well Hollow Brook	Brook trout stream status survey
Unnamed stream (PA-3-58-44-1)	Brook trout stream status survey
Unnamed stream (ONT-117-201-11-3)	Brook trout stream status survey
Unnamed stream (ONT-117-201-11-4-1)	Brook trout stream status survey
Unnamed stream (ONT-117-201-11-7)	Brook trout stream status survey
Mill Creek	Brook trout stream status survey
Lyon Creek	Brook trout stream status survey
Hinkle Hollow Brook	Brook trout stream status survey
Unnamed stream (	Brook trout stream status survey
Unnamed stream (PA-3-58-3-12)	Brook trout stream status survey
Unnamed stream (PA-3-58-8-2)	Brook trout stream status survey
Unnamed stream (PA-3-58-3-3-2)	Brook trout stream status survey
Ten Mile Creek	Brook trout stream status survey
Unnamed stream (PA-3-58-35-1)	Brook trout stream status survey
Castle Creek	Brook trout stream status survey
Stocking Creek	Brook trout stream status survey

Summary of Fisheries, Creel & Angler Surveys

Survey Name	Purpose
Region 8 cont.	
Unnamed stream (PA-3-58-19-6)	Brook trout stream status survey
Rice Glen Brook	Brook trout stream status survey
Golf Creek	Brook trout stream status survey
Unnamed stream (PA-3-58-38-1-1)	Brook trout stream status survey
Unnamed stream (PA-3-58-38-6)	Brook trout stream status survey
Unnamed stream (PA-3-58-38-10-3)	Brook trout stream status survey
Unnamed stream (PA-3-58-32-2)	Brook trout stream status survey
Unnamed stream (PA-3-58-32-6)	Brook trout stream status survey
Unnamed stream (PA-3-58-34-1)	Brook trout stream status survey
Cotton Creek	Brook trout stream status survey
Unnamed stream (ONT-66-12-52-40-39-1)	Brook trout stream status survey
Unnamed stream (ONT-66-12-52-40)	Brook trout stream status survey
Unnamed stream (ONT-66-12-52-40-39)	Brook trout stream status survey
Reservoir Creek	Brook trout stream status survey
Nettle Creek	Brook trout stream status survey
Avery Hollow Brook	Brook trout stream status survey
Harrisburg Hollow Brook	Brook trout stream status survey
Smith Run	Brook trout stream status survey
Page Brook	Brook trout stream status survey
Twelve Mile Creek	Brook trout stream status survey
Unnamed stream (PA-3-58-39-10)	Brook trout stream status survey
Unnamed stream (PA-3-58-39-5)	Brook trout stream status survey
Lake Ontario-Webster	Black bass assessment
Lake Ontario-Pultneyville	Black bass assessment
Stanton Creek	Brook trout stream status survey
Unnamed stream (PA-3-58-28-23)	Brook trout stream status survey
McNutt Run	Brook trout stream status survey
Unnamed stream (PA-3-58-11-8)	Brook trout stream status survey
Michigan Creek	Brook trout stream status survey
Tannery Creek	Brook trout stream status survey
Unnamed stream (ONT-66-123-P286-18-2-9-2)	Brook trout stream status survey
Unnamed stream (PA-3-58-11-9)	Brook trout stream status survey
Unnamed stream (ONT-66-12-52-P286-18-2-8-5)	Brook trout stream status survey
Mill Creek	Brook trout stream status survey
Ganargua Creek	Brook trout stream status survey
Grimes Creek	Brook trout stream status survey
Cutler Creek	Brook trout stream status survey
Borden Creek	Brook trout stream status survey
Erwin Creek	Brook trout stream status survey
Neil Creek	Brook trout stream status survey
Post Creek	Brook trout stream status survey
Narrows Creek	Brook trout stream status survey

Summary of Fisheries, Creel & Angler Surveys

Survey Name	Purpose
Region 8 cont.	
Willis Creek	Brook trout stream status survey
Sleepers Creek	Rainbow trout production study
Naples Creek	Rainbow trout production study
Springwater Creek	Rainbow trout production study
Unnamed stream (ONT-117-201-16)	Brook trout stream status survey
Unnamed stream (ONT-117-184-18)	Brook trout stream status survey
Bulkley Creek	Brook trout stream status survey
North Branch Newtown Creek	Brook trout stream status survey
Sing Sing Creek	Brook trout stream status survey
Madison Creek	Brook trout stream status survey
East Creek	Brook trout stream status survey
Marsh Creek	Rare Fish Survey
Trout Run	Brook trout stream status survey
Deer Lick Run	Brook trout stream status survey
Davis Hollow Brook	Brook trout stream status survey
Reynolds Creek	Brook trout stream status survey
East Wayland Creek	Brook trout stream status survey
Miller Brook	Brook trout stream status survey
Salmon Creek	Brook trout stream status survey
Unnamed stream (PA-3-58-56)	Brook trout stream status survey
Irondequoit Bay	Brook trout stream status survey
Baker Creek	Brook trout stream status survey
Cameron Creek	Brook trout stream status survey
Goodhue Creek	Brook trout stream status survey
Beekman Hollow Brook	Brook trout stream status survey
Helmer Creek	Brook trout stream status survey
Tracy Creek	Brook trout stream status survey
Unnamed stream (PA-3-57-5-8-35)	Brook trout stream status survey
Tuscarora Creek	Brook trout stream status survey
Unnamed stream (PA-3-57-5-8-11-14)	Brook trout stream status survey
North Branch Tuscarora Creek	Brook trout stream status survey
Unnamed stream (PA-3-57-5-8-11-18)	Brook trout stream status survey
Hemlock Lake	Forage fish assessment
Conesus Lake	Forage fish assessment
East Lick Creek	Brook trout stream status survey
Unnamed stream (PA-3-57-5-8-11-2)	Brook trout stream status survey
Unnamed stream (PA-3-57-5-8-25)	Brook trout stream status survey
Unnamed stream (PA-3-57-5-8-31)	Brook trout stream status survey
Unnamed stream (PA-3-57-5-8-34)	Brook trout stream status survey
Catherine Creek	Sea Lamprey Assessment
Shequaga Creek	Sea Lamprey Assessment
Breakneck Creek	Sea Lamprey Assessment

Summary of Fisheries, Creel & Angler Surveys

Survey Name	Purpose
Region 8 cont.	
Mill Creek	Sea Lamprey Assessment
Spring Creek	Sea Lamprey Assessment
Bennetts Creek	Brook trout stream status survey
Ohuran Creek	Brook trout stream status survey
Elk Creek	Brook trout stream status survey
Red Spring Run	Brook trout stream status survey
Irondequiot Creek	General survey
Pokamoonshine Gulf	Brook trout stream status survey
Reynolds Gully Creek	Brook trout stream status survey
Unnamed stream (PA-3-58-31-7)	Brook trout stream status survey
Unnamed stream (PA-3-58-32-1-1)	Brook trout stream status survey
West Creek	Brook trout stream status survey
Limekiln Creek	Brook trout stream status survey
Spoonable Gully Creek	Brook trout stream status survey
Unnamed stream (ONT-117-201-11-4-2)	Brook trout stream status survey
Shovel Hollow	Brook trout stream status survey
Cohocton River	Brook trout stream status survey
Kirkwood Creek	Brook trout stream status survey
Dyke Creek	Brook trout stream status survey
Cryder Creek	Brook trout stream status survey
Region 9	
N. Branch Wiscoy Creek	Wild brown trout population assessment
Trout Brook	Wild brown trout population assessment
Clear Creek (Ellington)	Wild brown trout population assessment
McIntosh Creek	Habitat improvement evaluation
Beehunter Creek	Habitat improvement evaluation
Gill Creek	Stocked trout stream assessment
296 small streams in Allegany County	EBTJV surveys to document presence of wild trout populations
73 small streams in Wyoming County	EBTJV surveys to document presence of wild trout populations
24 small stream in Cattaraugus County	EBTJV surveys to document presence of wild trout populations
Cassadaga Lake Trap netting	Muskie brood stock assessment
Silver Lake Ice-out Electrofishing	Walleye Spawning stock survey
Chautauqua Lake Trawling	Forage fish assessment
Chautauqua Lake Electrofishing	Game Fish survey
Red House Lake Electrofishing	50 Day Walleye stocking evaluation
Cassadaga Lake Electrofishing	50 Day Walleye stocking evaluation
Buffalo Harbor/Upper Niagara River Young-of-Year Muskellunge Surveys	Monitor relative abundance of wild YOY muskellunge
Lake Erie Research Unit	
Lake Erie Commercial Fishery Assessment	Characterize harvest & age composition of commercial yellow perch fishery
Lake Erie Lower Trophic Monitoring Program	Index of lower trophic indicators seasonally, including zooplankton density, nutrient concentrations, temperature and water transparency

Summary of Fisheries, Creel & Angler Surveys

Name	Purpose
Lake Erie Research Unit cont.	
Lake Erie Open Lake Sport Fishing Survey	Determine sport fishing catch and effort from boat fisheries for walleye, smallmouth bass and yellow perch
Lake Erie Tributary Angler Diary Program	Assess fishing quality for Lake Erie's tributary steelhead fishery
Lake Erie Tributary Sea Lamprey Nest Density	Annual nest counts to index the concentration of sea lamprey nests in selected Lake Erie tributaries
Lake Erie Fish Cleaning Station Monitoring	Annual examination of angler caught walleye processed at cleaning stations to characterize size, age composition and stomach contents
Lake Erie Beach Seine Assessment	A new pilot survey to assess abundance and distribution of near shore young-of-year fishes in eastern Lake Erie
Lake Erie Coldwater Community Assessment	Gill net index of abundance, age composition, growth, and diet of lake trout, burbot and lake whitefish
Lake Erie Warmwater Community Assessment	Gill net index of abundance, age composition, growth, and diet of walleye, yellow perch and smallmouth bass
Lake Erie Wild Steelhead Assessment	Electrofishing index of abundance of juvenile wild steelhead trout in selected Lake Erie tributaries
Lake Erie Forage and Juvenile Fish Assessment	Bottom Trawl index of abundance, age composition and growth, of juvenile yellow perch and an array of forage fish species
Lake Erie Lake Trout Spawning Survey	Gill net survey to understand site selection by spawning phase lake trout in nearshore and offshore areas
Lake Ontario Research Unit	
Lake Ontario Alewife Bottom Trawl Survey	Assess yearling and adult alewife in Lake Ontario
Lake Ontario Rainbow Smelt Bottom Trawl Survey	Assess yearling and adult smelt in Lake Ontario
Lake Ontario Juvenile Lake Trout Trawl Survey	Assess juvenile lake trout in Lake Ontario
Lake Ontario Warmwater Fisheries Assessment	Assess warmwater fish populations in the Eastern Basin
Status of Lake Ontario's Lower Trophic Levels	Monitor trends in Lake Ontario productivity, including nutrients, chlorophyll a, and zooplankton populations
Lake Ontario Adult Lake Trout Assessment	Assess adult lake trout populations in Lake Ontario
Lake Ontario Fishing Boat Survey	Monitor trends in angler effort/catch/harvest in the open waters of Lake Ontario
Lake Ontario Chinook Salmon Mass Marking Program	Determine contribution of wild Chinook salmon to Lake Ontario sportfisheries and evaluate success of pen-rearing projects
Northern Pike and Muskellunge Monitoring in the Thousand Islands Region of the St. Lawrence River	Monitor northern pike and muskellunge spawning and nursery areas to assess reproductive success and influence habitat changes

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Permits & Licenses

A summary of licenses and permits reviewed or issued by the Bureau of Fisheries

DEC REGION

Permit Name	1	2	3	4	5	6	7	8	9	CO	Total
Farm Fish Pond			4	245		15	175	66	62		567
Stocking			183	23		25	37	8	9		285
Triploid Grass Carp		1	226	300		60	220	469	627		1903
Overland Transport of Bait			13	15		6	4	14	15		67
Fish Possession (over daily limit)			0			4	0	0	1		5
Piranha			0			1	2	0	2		5
Baitfish (C.O)			76	37		-	84	111			308
Temporary Revocable Permit (TRP)			1	3		3	12	3			22
Article 15 Review		3	417	287		446		54	400		1607
Article 24 Review			228			?		0	4		232
Pesticide Permit Review			16	5		-		6	3		30
Bass Hatchery Permits (C.O)						-					
Trout Hatchery Permits (C.O)						-					
Fishing Preserve Licenses (C.O)						-		1			1
Fish Health Certificates (C.O)						-					
Commercial Fishing Licenses			15*								15
License to Collect and Possess (C.O)		5				-	2	14			21
Other (please name)											
Trout in the Classroom			2/89	23							23
Hydropower Relicensing						8					8
Susquehanna R. Floating Lure							49				49
Adopt A Natural Resource								7			7
Permit to remove and destroy fish			1								1

** all eel weir permits*

New York State
Department of Environmental Conservation

Sustainable Fishing Plan for New York River Herring Stocks

Kathryn A. Hattala, Andrew W. Kahnle
Bureau of Marine Resources, Hudson River Fisheries Unit

and

Robert D. Adams
Hudson River Estuary Program

September 2011

Submitted for review
to the
Atlantic State Marine Fisheries Commission

EXECUTIVE SUMMARY

Amendment 2 to the Atlantic States Marine Fisheries Commission Shad and river Herring Interstate Fishery Management Plan requires member states to demonstrate that fisheries for river herring (alewife and blueback herring) within their state waters are sustainable. A sustainable fishery is defined as one that will not diminish potential future reproduction and recruitment of herring stocks. If states cannot demonstrate sustainability to the Atlantic States Marine Fisheries Commission (ASMFC), they must close their herring fisheries.

New York State proposes to maintain a restricted river herring (alewife and blueback herring) fishery in the Hudson River and tributaries and to close river herring fisheries elsewhere in the State. This proposal conforms to Goal 1 of the New York State Hudson River Estuary Action Agenda.

<u>Stock Status</u>

Blueback herring and alewife are known to occur and spawn in New York State in the Hudson River and tributaries, the Bronx River, and several streams on Long Island. The Hudson River is tidal to the first dam at Troy, NY (rkm 245). Data on stock status are available for the Hudson River and tributaries. Few data are available on river herring in streams in Bronx County, southern Westchester County, or on Long Island. River herring are absent in the New York portion of the Delaware River.

Hudson River: Commercial and recreational fisheries exploit the spawning populations of river herring in the Hudson River and tributaries. Fixed and drifted gill, cast and scap/lift nets are used in the main stem Hudson, while scap/lift and cast nets are used in the tributaries. Recreational fishers often use commercial net gears because permit fees remain at 1911 levels. Anglers also are allowed take of river herring with variety of small nets and hook and line. In the last ten years, about 250 fishers annually purchased commercial gill net permits and approximately 240 purchased commercial scap net permits. However only 84 gill net and 93 scap/lift fishers reported using the gear licensed. Fishers using commercial gears are required to report landings annually. Most river herring taken in the Hudson and tributaries are used as bait in the recreational striped bass fishery. Anglers and subsistence fishers take a few river herring from Long Island streams.

Data on commercial harvest of river herring are available since the early 1900s. Landings peaked in the early 1900s and in the 1930s and then declined through the 1980s. Landings increased again through 2003, but have since declined. Reported commercial harvest has remained below 50,000 river herring per year since the early 1990s. A series of creel surveys and estimates since 2001 indicated substantial and increasing harvest of river herring by recreational anglers from the Hudson River and tributaries. We estimated that approximately 240,000 river herring were harvested by recreational anglers in 2007. The extent of the loss of river herring through bycatch in ocean commercial fisheries remains largely unknown but is expected to be significant.

Fishery dependent data on river herring status since 2000 are available from commercial reports and from on-board monitoring. Catch per unit effort (CPUE) in fixed (anchored) gill nets fished in the main stem river has increased. Conversely, CPUE in scap nets fished in tributaries initially declined, but then varied without trend. Mean length of river herring observed in the commercial harvest has declined slightly since 2000. We feel that the CPUE in fixed gear below the Bear Mountain Bridge provides the best annual measure of abundance because it intercepts river herring migrating past the gear to upriver spawning locations..

Fishery independent data on size and age composition of river herring spawning in the Hudson River Estuary are available from 1936 and intermittently since the late 1970s. Sample size has been small in most years. The largest fish were collected in the 1930s. Size of both blueback herring and alewife has declined over the last 30 years. Age data were obtained from scales in 1936 and the late 1980s. Since then, ages were estimated from age length keys developed by Maine, Massachusetts, and Maryland. Observed and estimated age at length of Hudson River fish varied substantially among methods and thus age can only be used for trends within method. Annual mean age since the late 1980s has remained stable in blueback herring and female alewife, but declined in male alewife. Because of the uncertainty with estimated ages, we estimated annual mortality with length-based methods. Estimates varied substantially depending on assumed model inputs and therefore actual total mortality on the stocks remains unknown. However, we should emphasize that mortality on stocks must have been high in the last 30 years to have so consistently reduced mean size and presumably mean age. Within method, estimates of total mortality generally increased for both species since 1980. This increase was most pronounced in alewife.

Young of year production has been measured annually by beach seine since 1980. CPUE of alewife remained low through the late 1990s and has since increased erratically. CPUE of young of year blueback herring has varied with a very slight downward trend since 1980.

Streams on Long Island, Bronx and south shore of Westchester County: Limited data have been collected for some of the river herring populations in these areas. The data are not adequate to characterize stock condition.

Delaware River in New York: No records exist to document the presence of river herring in this portion of the river.

Proposed Fishery for the Hudson River

Given the inconsistent measures of stock status described above, we do not feel that the data warrant a complete closure of the Hudson River fishery at this time. New York State proposes a five year restricted fishery in the main-stem Hudson River, a partial closure of the fishery in tributaries, and annual stock monitoring. We set a sustainability target for juvenile indices. We will monitor, but not set targets for mean length from fishery independent spawning stock sampling and CPUE in the commercial fixed gill net fishery in the lower river below the Bear Mountain Bridge. We will also monitor age structure, frequency of repeat spawning, and total mortality from fishery independent sampling if we can resolve problems with age determination and mortality estimation.

A summary of existing and proposed restrictions is provided. Proposed restrictions to the recreational fishery include: a ten fish per day creel limit for individual anglers with a boat limit of 50, and a 10 fish creel limit per day for paying customers with a boat limit of 50 for charter vessels, no fishing within 825 ft (250m) of any man made or natural barrier in the main river and tributaries, no use of nets in tributaries, and the continuation of various small nets in the main river. Proposed restrictions to the commercial fishery and use of commercial gears include: a commercial verification requirement; a net ban in the upper 28 km of the main-stem estuary, shad spawning flats, or tributaries; gill net mesh and size restrictions; a ban on fixed gears or night fishing above the Bear Mountain Bridge; seine and scap/lift net size restrictions; extension of existing 36 hour lift period to all commercial net gears; increased net fees to account for inflation since 1911 when fees were set or the preferred option of creation of a new Hudson River Commercial Fish Permit; extension of the current Marine and Coastal District Charter /Party boat license to the tidal Hudson and tributaries at a cost of $250.00 annually; and monthly mandatory reporting of catch and harvest.

We should note that Draft Addendum 3 to Amendment 6 of the ASMFC Interstate Management Plan for striped bass stipulates that states should reduce fishing mortality on spawning stocks by 50%. If this draft is approved by the ASMFC Striped Bass Management Board, we may have to restrict effort in the recreational striped bass fishery. Restrictions may include a reduction in use of bait such as river herring. Any reduction in effort will likely reduce demand for river herring and thus reduce losses in the Hudson stocks.

Proposed Moratorium for streams on Long Island, Bronx County, the southern shore of Westchester County, and the Delaware River and its tributaries north of Port Jervis NY. Due to the inability to determine stock condition for these areas, the ASMFC Amendment 2 requires that a moratorium on river herring fishing be implemented.

This SFP does not directly address ocean bycatch but focuses on fisheries in New York State waters. New York is working with the National Marine Fisheries Service, the New England Fishery Management Council and the Mid-Atlantic Fishery Management Council to deal with this issue. Both councils are in the process of amending the Atlantic Herring and the Atlantic Mackerel, Squid and Butterfish Plans to reduce bycatch of river herring.

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2 INTRODUCTION

Amendment 2 to the Atlantic States Marine Fisheries Commission Shad and River Herring Interstate Fishery Management Plan was adopted in 2009. It requires member states to demonstrate that fisheries for river herring (alewife and blueback herring) within state waters are sustainable. A sustainable fishery is defined as one that will not diminish potential future reproduction and recruitment of herring stocks. If states cannot demonstrate sustainability to ASMFC, they must close their herring fisheries.

The following proposes a plan for a sustainable fishery for river herring in waters of New York State. The goal of this plan is to ensure that river herring resources in New York provide a source of forage for New York's fish and wildlife and provide opportunities for recreational and commercial fishing now and in the future.

The fisheries that existed back in colonial days in the Hudson Valley of New York undoubtedly included river herring among the many species harvested. River herring, comprised of both alewife (*Alosa pseudoharengus*), and blueback herring (*Alosa aestivalis*) were among the fish mentioned by early explorers and colonists – the French Jesuits, Dutch and English. Archaeological digs along the Hudson in Native American middens indicates that the fishery resources in the river provided an important food source to Native Americans.

Written records for river herring harvest in New York begin in the early 1900. Landings peaked in the early 1900s and in the 1930s and then declined through the 1980s. Landings increased again through 2003, but have since declined. Factors in addition to fishing have affected the stocks: habitat destruction (filling of shallow water spawning habitat) and water quality problems associated with pollution that caused oxygen blocks in major portions of the river (Albany and New York City). Water quality has improved over the last 30 years.

New York State does not augment wild river herring stocks with hatchery progeny. The New York City Parks Department initiated an experimental restoration program in which alewife were captured in a Long Island Sound tributary in Connecticut and released in the Bronx River above the first barrier. Limited returns to the river suggest that some reproduction has occurred from these stockings. A variety of non-governmental organizations along with state and federal agencies are working on development of fish passage for alewife in Long Island streams

3 MANAGEMENT UNITS

The management unit for river herring stocks in New York State comprises three sub-units. All units extend throughout the stock's range on the Atlantic coast.

- The largest consists of the Hudson River Estuary from the Verrazano Narrows at New York City to the Federal Dam at Troy including numerous tributary streams (Figure 1).
- The second is made up of all Long Island streams that flow into waters surrounding Long Island and streams on the New York mainland (Bronx and Westchester Counties) that flow into the East River and/or Long Island Sound (Figure 2).

- The third subunit consists of the non-tidal Delaware River and tributaries upriver of Port Jervis, NY.

Range of the New York river herring along the Atlantic coast is from the Bay of Fundy, Canada and Gulf of Maine south to waters off Virginia (NAI 2008).

A listing of most Hudson River tributaries, and streams on Long Island, and the Bronx and southern Westchester Counties are in Appendix Table A.

3.1 Description of the Management Unit Habitat

3.1.1 Hudson River and tributaries

Habitat Description

The Hudson River Estuary is tidal its entire length of 246 km from the Battery (tip of Manhattan Island) in New York City to the Federal Dam at Troy (Figure 1). The estuary is fresh water above Newburgh (km 90).

The estuarine portion of the Hudson River is considered a “drowned” river valley in that the valley slopes steeply into the river. Many of the tributaries below the Troy Dam are tidal for a short distance (usually about a kilometer) ending at a natural or man-made barrier, often built on a natural barrier. There are approximately 67 primary and secondary, both named and unnamed, tributaries to the tidal portion of the Hudson River Estuary (Figure 1). Schmidt and Cooper (1996) catalogued 62 of these tributaries for the presence or absence of barriers to migratory fish. They found that only one had no barrier for migratory fish, 31 were blocked (either partially or completely) by natural barriers, and the remaining 30 had artificial barriers, dams or culverts, that reduced or eliminated access for fish. We estimated stream length of all these tributaries to be about 97 km that is accessible to river herring below the first impassable man-made or natural barrier.

The Mohawk River is the largest tributary to the Hudson River. It enters the Hudson 2 km north of the Troy Dam. Cohoes Falls, a large scenic waterfall of 20 m is the first natural barrier on the Mohawk just upriver of the confluence with the Hudson. Access into the Mohawk system was created through the Waterford Flight – a series of five locks and dams, built as part of the Erie Canal to circumvent the falls. The canal lock and dam system was built in 1825, to connect the Hudson to central New York and Lakes Ontario and Erie. The Canal parallels and/or is part of the Mohawk River for the river’s entire length to Rome, a distance of 183 km. A series of permanent and seasonal pools make up the canal where it intertwines with the Mohawk River. Permanent pools created from hydro-power dams are found in the Waterford section. Temporary pools are created each year in early spring by removable dams (series of gates) that increase water levels to 14 feet (4.3 m) while the canal is in operation (May through November). During the winter months, the river is returned to its natural state of riffles and pools.

Habitat Use

Hudson River alewife, blueback herring and American shad are spring spawners. Alewives are the first of the herring to enter the estuary, arriving as early as mid-March with continued spawning through early May. Blueback herring prefer slightly warmer temperatures and arrive later, usually in April.

Adults of both species spawn in Hudson River tributaries and in the shallow waters of the main stem Hudson. Alewife prefer to spawn over gravel, sand and stone in back water and eddies whereas bluebacks tend to spawn in fast moving water over a hard bottom. Herring spawn in the tidal freshwater Hudson from Kingston (km 144) to Troy (km 256) (Figure 1) and its tributaries for approximately six to ten weeks, dependent on water temperature (Smith 1985, Hattala et al. 2011). Once spawning ends, most mature fish quickly return to ocean waters. The nursery area includes the spawning reach and extends south to Newburgh Bay (km 90), encompassing the freshwater portion of the Estuary.

Some blueback herring of the Hudson River migrate above the Federal Dam at Troy. A few continue upriver in the non-tidal Hudson as far as Lock 4 on the Champlain Canal (NAI 2007). However, most fish turn west into the Mohawk River. This larger portion migrates as far inland as Rome (439 km inland), via the Erie Canal and the Mohawk River. The canal system opens in New York on or about May 1st. Since most alewives are already spawning by then, they do not move into the system (J. Hasse, NYSDEC retired, personal communication).

Blueback herring began colonizing the Mohawk River in the 1970s. By 1982, they had migrated into Oneida Lake in the Great Lakes drainage. The number of herring using the Mohawk increased through the 1990s, but since 2000 herring have rarely occurred in the upper end of the River. Blueback herring were historically unable to access the Mohawk River until the locks of the Erie Canal provided upstream passage into the system. Now that they are established, however, they have become important forage for local sport fish populations.

3.1.2 Long Island and Westchester County

The herring runs in streams on Long Island are comprised almost exclusively of alewife (B. Young, NYSDEC retired, personal communication). Most streams are relatively short runs to saltwater from either head ponds (created by dammed streams) or deeper kettle-hole lakes. Either can be fed by a combination of groundwater, run-off or area springs. Spawning occurs in April through May in the tidal freshwater below most of the barriers. Natural passage for spawning adults into the head ponds or kettle lakes is present in very few streams.

There have been limited efforts to understand river herring runs on Long Island since 1995. Several known runs of alewives on Long Island occur in East Hampton, Southampton, Riverhead and Brookhaven. With the advent of a more aggressive restoration effort in Riverhead on the Peconic River other runs have come to light. Since 2006, an annual volunteer alewife spawning run survey has been conducted. This volunteer effort basically documents the presence or absence of alewives in Long Island Coastal Streams. In 2010 a volunteer investigation was initiated to quantify the Peconic River alewife run. Size and sex data have been collected for

2010 and 2011. A crude estimate of the runs size was also made in 2010, this effort was improved during 2011 with the placement of a video camera for recording alewife passage through the fish passage. These efforts have been undertaken to understand the Long Island Coastal streams and to improve the runs that exist there.

We have no record of river herring in any of the streams in southern Westchester County. In the Bronx River (Bronx County) alewives were introduced to this river in 2006 and 2008 and some adult fish returned in 2010. Monitoring of this run is in its early stages.

3.1.3 Delaware River

No records exist to document the presence of river herring in the New York portion of the Delaware River.

3.2 Habitat Loss and Alteration

Hudson River: Much spawning and nursery habitat in the upper half of the tidal Hudson was lost due to dredge and fill operations to maintain the river's shipping channel to Albany. Most of this loss occurred between the end of the 19th century (NYS Department of State 1990) and the first half of the 20th century. Preliminary estimates are that approximately 57% of the shallow water habitat (1,821 hectares or 4,500 acres) north of Hudson (km 190) was lost to filling (Miller and Ladd 2004). Work is in progress to map the entire bottom of the Hudson River. Data from this project will be used to characterize and quantify existing spawning and nursery habitat. While most of the dredge and fill loss affected American shad, it is suspected that herring were also affected as they spawn along the shallow water beaches in the river.

Very little, or no, habitat has been lost due to dam construction. The first major dam was constructed in 1826 at Rkm 256 at Troy. Prior to the dam, the first natural barrier occurred at Glens Falls, 32 km above the Troy Dam. The construction of the dam is not known to have reduced spawning or nursery habitat.

The introduction of zebra mussels in the Hudson in 1991, and their subsequent explosive growth in the river, quickly caused pervasive changes in the phytoplankton (80% drop) and micro- and macro- zooplankton (76% and 50% drop respectively) communities (Caraco et al. 1997). Water clarity improved dramatically (up by 45%) and shallow water zoobenthos increased by 10%. Given these massive changes, (Strayer et al. 2004) explored potential effects of zebra mussel impact on young-of-year (YOY) fish species. Most telling was a decrease in observed growth rate and abundance of YOY fishes, including both alewife and blueback herring. It is not yet clear how this constraint affects annual survival and subsequent recruitment.

Long Island: Most all streams on Long Island have been impacted by human use as the population expanded. Many streams were blocked off with dams to create head ponds, initially used to contain water for power or irrigation purposes. The dams remain; only a few with passage facilities. Many streams were also impacted by the construction of highways, with installations of culverts or other water diversions which impact immigrating fish.

Recent efforts at restoration look to provide fish passage over or around these barriers, or even removal of small obstructions. Permanent fish passage was recently installed on the Carmans River in the South Shore Estuary near Shirley, NY. This project was the result of advocacy and cooperation by environmental groups and local, state and federal agencies. Additional protections for the River are assured due to legislation enacted in 2011, and community awareness is building. An earlier cooperative effort resulted in the installation of a rock ramp passage in the Peconic River within the Peconic Bays Estuary. Local citizens monitor the spring alewife run in this river. As awareness of these successful efforts spreads, interest in replicating that success on other systems grows.

3.3 Habitat Water Quality

The Hudson has a very long history of abuse by pollution. New York City Department of Environmental Protection recognized pollution, primarily sewage, as a growing problem as early as 1909. By the 1930s over a billion gallons a day of untreated sewage were dumped into New York Harbor. (NYCDEP http://home2.nyc.gov/html/dep/html/news/hwqs.shtml)

New York City was not the only source of sewage. Most major towns and cities along the Hudson added their share. It was so prevalent that the Hudson was often referred to as an open sewer. Biological demand created by the sewage created oxygen blocks that occurred seasonally (generally mid to late summer) in some sections of the river. One of the best known blocks occurred near Albany in the northern section of the tidal estuary in the 1960s through the 1970s. This block often developed in late spring and remained through the summer months. It essentially cut off the upper 40 km of the Hudson for use as spawning and nursery habitat. A second oxygen block occurred in the lower river in the vicinity of New York City in late summer. This block could potentially have affected emigrating age zero river herring. This summer oxygen-restricted area occurred for decades until 1989 when a major improvement in a sewage treatment plant came on line in upper Manhattan. It took decades, but water quality in general has greatly improved in both areas since the implementation of the Clean Water Act in the 1970s and subsequent reduced sewage loading to the river.

4 STOCK STATUS

Following is a description of all available data for the Hudson's river herring stocks, plus a brief discussion of their usefulness as stock indicators. Sampling data are summarized in Tables 1 and 2. Sampling was in support of Goal 1 of the Hudson River Estuary Action Agenda and has been partially funded by the Hudson River Estuary Program.

4.1 Fisheries Dependent Data

4.1.1 Commercial Fishery

Commercial fisheries for river herring in New York State waters occur in the Hudson River Estuary and in marine waters around Long Island. Current commercial fishing restrictions for New York waters are listed in Appendix Table B.

The present commercial fishery in the Hudson River and tributaries exploits the spawning migration of both alewife and blueback herring. The primary use of commercially caught herring is for bait in the recreational striped bass fishery. The herring fishery occurs from March into early June annually, although some fishers report catching herring as late as July.

Ocean bycatch

River herring occur as bycatch in many commercial fisheries which are in the known migratory range of the Hudson stock from North Carolina up to the Gulf of Maine. Fishery bycatch is mostly un-documented but has the potential to harvest Hudson stock and many other stocks along the coast. In some years, estimated bycatch of river herring in the Atlantic herring fishery equaled or exceed the total of all coastal in-river landings (Cieri et al. 2008). More recent analyses by the National Marine Fisheries Service's Northeast Fisheries Science Center (2011) indicated that total annual incidental catch of river herring in all fishing fleets sampled by the Northeast Fisheries Observer Program during 1989-2010 ranged from 108 to 1867 mt. It is not known how much of current ocean river herring bycatch consists of Hudson River fish.

This SFP does not directly address ocean bycatch but focuses on fisheries in New York State waters. New York is working with the National Marine Fisheries Service, the New England Fishery Management Council (www.nefmc.org) and the Mid-Atlantic Fishery Management Council (www.mafmc.org) to deal with this issue. Both councils are in the process of amending the Atlantic Herring (Amendment 5) and the Atlantic Mackerel, Squid and Butterfish (Amendment 14) Plans to reduce bycatch of river herring.

Gear Use in the Hudson River and Tributaries

The fixed gill net fishery occurs in the mainstem river from km 40 to km 75 (Piermont to Bear Mountain Bridge, Figure 1). In this stretch, the river is fairly wide (up to 5.5 km) with wide, deepwater (~ six to eight m) shoals bordering the channel. Fishers use particular locations within this section away from the main shipping channel. Over the past ten years, an average of 22 active fishers participated in this lower river fixed gill net fishery annually. Nets are 3.7 to 183 m (12 to 600 ft) long. Above the Bear Mountain Bridge gill net fishers use both drift (~58%) and fixed gill nets (~42%). These gears are used up to km 225 (Castleton) where the river is much narrower (1.6 to 2 km wide). Approximately 60 fishers participate in this mid river gill net fishery. Nets range in size from 7.6 to 183 m (25 to 600 ft).

The other major gear used in the river herring fishery is scap nets (also known as lift and/or dip nets). The scap/lift net fishery occurs from km 70 to km 130 (Peekskill to New Baltimore), primarily in the major river herring spawning tributaries. Scap/lift nets range in size from 0.2 to 121.9 m^2 (0.5 to 400ft^2). On average, about 96 fishers participate annually.

Marine permits are required of fishers to use seines or scap nets greater than 36 ft^2, dip or scoop nets exceeding 14 in. in diameter, and all gill nets. Marine permit holders are required to report effort and harvest annually to the Department. Many marine permit holders are recreational anglers taking river herring for personal use as bait or food. It should be noted that over the last ten years, an average of over 260 gill net and 260 scap nets permits were sold annually. According to the required annual reports, however, only 36% of the permitees actively catch fish.

In addition to Marine permits, New York has a bait license that allows the take and sale of bait fish (river herring included) using seines and cast nets. As no reporting is required for this license, harvest of river herring using this license is unknown.

Commercial Landings and License Reporting

Recorded landings of river herring in New York State began in the early 1900s. Anecdotal reports indicate that herring only played a small part in the historic commercial fishing industry in the Hudson River. Total New York commercial landings for river herring include all herring caught in all gears and for both marine and inland waters. Several different time series of data are reported including several state sources, National Marine Fisheries Service (NMFS), and more currently Atlantic Coastal Cooperative Statistics Program (ACCSP). NMFS data do not specify river or ocean source(s) and landings are often reported as either alewife or blueback herring, but not both in a given year. It is unlikely that only one species was caught. From 1995 to the present, the Department has summarized landings and fishing effort information from mandatory state catch reports required for Hudson River marine permits. Full compliance for this reporting started in 2000. All Hudson River data are sent to NMFS and ACCSP for incorporation into the national databases.

Because of the discrepancies among the data series and the lack of information to assign the landings to a specific water body source, only the highest value from all sources is used to avoid double counting. Several peaks occur in the river herring landings for New York (Figure 3). The first peak occurred in the early 1900s followed by a lull (with some gaps) until the period prior to, during, and after World War II when landing peaked a second time. By the 1950s landings were in a serious decline. A few unusual peaks occurred in the NMFS data series. In 1966, 1.9 million kg were landed (omitted on Figure 3), followed by a series of years of low landings with another peak in 1982. Landings were low, with some data gaps during the rest of the 1980s through 1994.

Hudson River landings

Since 1995, landings have been separated between the Hudson and other water (marine). Harvest in the river was relatively low in 1995, but grew in response to the need for bait for the expanding striped bass recreational fishery. In-river landings peaked in 2003 and have slowly declined since then (Figure 4). The reason for the decline is unknown. The striped bass fishery and the need for bait have not diminished. It is possible that recreational fishers have shifted harvest to non commercial gears which do not have a mandatory reporting requirement. The landings from these “personal use” gears are unknown. Reporting rate from fishers using commercial gear is unknown.

The primary outlet for harvest taken by Hudson River marine permits is for the in-river bait industry. Since 2000, most commercially caught river herring have been taken by scap/lift nets (10 year mean of 48% of the catch) (Figure 5). The remaining 52% was split between drift and fixed gill nets.

Commercial Discards

From 1996 to 2010, river herring were not reported as discards on any mandatory reports targeting herring in the Hudson River or tributaries. Our commercial fisheries monitoring data, however, (See program description below) suggests otherwise. Since 1995, we have observed a 0.12% rate of discard in the anchored gill net fishery. Reasons for discards are unspecified. Discard rates are unknown for ocean fisheries.

Hudson River Commercial Catch Rates – Mandatory Reports

Relative abundance of river herring is tracked through catch per unit effort (CPUE) statistics of fish taken from the targeted river herring commercial fishery in the Estuary. All commercial fishers annually fill out mandatory reports. Data reported include catch, discards, gear, effort, and fishing location for each trip. Data within week is summarized as total catch divided by total effort (square yards of net x hours fished), separately by gear type (fixed gill nets, drift gill nets, and scap nets). Annual means are summarized in two ways. Above the Bear Mountain Bridge and within the spawning reach, annual CPUE is calculated as total catch/total effort. Below the Bear Mountain Bridge (km 75) and thus below the spawning reach, annual CPUE is calculated as an annual sum of weekly CPUE. Here, nets capture fish moving through to reach upriver spawning locations and run size is determined by number (density) of spawners each week as well as duration (number of weeks) of the run. The sum of weekly CPUE mimics area under the curve calculations where sampling occurs in succeeding time periods. The downside of using reported CPUE to monitor relative abundance is that results can be influenced by inter-annual, location, and inter-gear differences in reporting rate.

We use the CPUE of the fixed gear fishery below the Bear Mountain Bridge for estimating relative abundance because effort expended by the fishery below this bridge is much greater (~70% of fixed gill net effort) than in the river above this point (remaining 30%). Moreover, fixed gear below the bridge (rkm 40 to 75) is always fished in relatively the same location each year, is passive in nature, and intercepts fish that pass by. Annual CPUE for the lower river fixed gill net remained relatively flat until 2006 and has since increased (Figure 6).

We do not consider the CPUE of gears fished above the Bear Mountain Bridge and within the spawning reach as reliable an annual abundance indicator as that from fixed gill nets below the bridge. Upriver gears catch fish that are either staging (getting ready to spawn) or moving into areas to spawn and gears are generally not employed until fish are present. The gears include drift gill nets, scap nets and some fixed gill nets (Figure 5). Drift gill net CPUE is also more variable as it can be actively fished – set directly into a school of fish. Drifted gill net CPUE varied widely without trend through the time period. Scap net CPUE declined slightly from

2000 through 2003, and has since remained relatively stable (Figure 6). Fixed gill nets fished within the spawning reach show the same recent increasing trend as lower in the river, but effort expended is much less than below Bear Mountain Bridge.

Hudson River Commercial Catch Rates – Monitoring Program

Up until the mid-1990s, the Department's commercial fishery monitoring program was directed at the American shad gill net fishery, a culturally historic and economically important fishery. We expanded monitoring to the river herring fishery in 1996, but were limited by available manpower and the ability to connect with the fishers. Monitoring focused on the lower river fixed gill net fishery since we considered it to be a better measure of annual abundance trends (see section above).

Data were obtained by observers onboard fishing vessels. Technicians recorded data on numbers of fish caught, gear type and size, fishing time and location. Scale samples, lengths and weights are taken from a subsample of the fisher's catch. CPUE was calculated by the method used for summarizing mandatory report data (above).

Since 1996, 66 trips targeting river herring (lower river: 53; mid and upper river: 13) have been monitored. These trips were sporadic and sample size is low, from one to 11 trips per year. Because of these few samples, the resulting CPUE is considered unreliable for tracking relative abundance. However, active monitoring provided the only data on catch composition of the commercial harvest and we consider these data to be useful.

Commercial Catch Monitoring- Size and Age Structure

Commercial fixed gill net fishers use 1 ¾ to 2 ¾ inch stretch mesh sizes to target herring. Catch composition include fish caught in all meshes. For trend analysis of size change, we subset the data to include only fish caught in similar size mesh each year; these include gill nets of 2 ½ and 2 ¾ inch mesh.

Catch composition varied annually most likely due to the low number of monitored trips each year, and the timing of when the trips occurred. Annual sample size was relatively low, ranging from 40 to 185 fish from 2001 to 2007 (Table 3). Alewives were observed more often than blueback herring. The species difference may be the result of when the samples occurred (early or late in the run). The sex ratio of alewife in the observed catch was nearly equal (~ 50:50) in all years; more blueback herring females were caught than males (60:30 ratio). From 2001 to 2010, a slight decline was observed in mean total length (mm) for both alewife and blueback herring (Figure 7).

Age data for samples collected during the commercial monitoring program are yet to be analyzed (see discussion in Age section under FI programs below).

4.1.2 Recreational Fishery

Hudson River and tributaries: The recreational river herring fishery exists throughout the main-stem Hudson River, and its tributaries including those in the tidal section and above the Troy Dam (Mohawk River). Herring are sought from shore and boat by angling (jigging) and multiple net gears (see Appendix B). Boat fishers utilize all allowable gears while shore fishers predominantly use scap/lift nets, or angling (jigging). Some recreational herring fishers use their catch as food (smoking/pickling). However, the recreational herring fishery is driven primarily by the need for bait in the striped bass fishery.

The magnitude of the recreational fishery for river herring is unknown for most years. NYSDEC contracted with Normandeau Associates, Inc. to conduct creel surveys on the Hudson River in 2001 and 2005 (NAI 2003 and 2007). Estimated catch of river herring in 2001 was 34,777 fish with a 35.2% retention rate. When the 2001 data were analyzed, NAI found that the total catch and harvest of herring was underestimated due to the angler interview methods. In the 2001 survey, herring caught by fishers targeting striped bass were only considered incidental catch, and not always included in herring total catch and harvest data. Fishers were actually targeting herring and striped bass simultaneously. Corrections were made to the interview process for the 2005 survey and estimated catch increased substantially to 152,117 herring with an increased retention rate of 75.1% (Table 4). Although some fish were reported as released, we consider these mortalities due to the herring's fragile nature. We also adjusted the 2001 catch using the 2005 survey data. The adjusted catch rose to 93,157 fish.

We also evaluated river herring use by striped bass anglers using data obtained from our Cooperative Angler Program (CAP). The CAP was designed to gather data from recreational striped bass anglers through voluntary trip reports. Volunteer anglers log information for each striped bass fishing trip including fishing time, location, bait use, and fish caught, including length, and weight, and bycatch. In 2006 through 2010, volunteer anglers were asked to provide specific information about herring bait use. The annual proportion of angler days where herring was used for bait ranged from 71% to 93 % with a mean of 77%. The proportion of herring used by anglers that were caught rather than purchased increased through the time period (Table 4). Herring caught per trip varied from 1.6 to 4.8 and with the highest values in the last two years. Herring purchased per trip ranged from 0.63 to 1.5 with the lowest value in 2009. We calculated the total number of herring caught or purchased by striped bass anglers in 2007 as the estimated number of striped bass trips from a statewide creel survey (90,742) * average proportion of angler days using herring in the CAP in 2007 (0.77) * number of herring caught or purchased per trip in the CAP (1.8 and 1.7). The result was 125,502 caught and 115,816 bought for a total of 241,318 herring used.

The number of river herring taken from the Hudson River and tributaries for personal use as food by anglers is unknown.

Long Island: Alewives can be caught in many of the small streams on Long Island, though only the Peconic River sees more than occasional effort. No creel data are available but anecdotal information (B. Young, NYSDEC retired, personal communication) suggests that harvest is rising in the more easily accessible streams. Herring taken are used for personal consumption as well as for bait.

The town of Southampton, on Long Island's East End, has local ordinances in place to prevent fishing (dipping) during the alewife spawning runs.

Bronx and Westchester Counties: We do not know if any fishery occurs in the streams in Bronx and Westchester Counties that empty into the East River and Long Island Sound.

4.2 Fishery Independent Surveys

4.2.1 Spawning Stock Surveys – Hudson River

Several surveys have sampled the alewife and blueback herring spawning stocks of the Hudson River and tributaries. The spawning stocks are made up of the fish which have escaped from coastal and in-river commercial and recreational fisheries.

The earliest data is from a biological survey of the Hudson in 1936 by the then New York State Conservation Department (Greeley 1937). The sample size was small (25 fish) but indicates the fish were relatively large compared to recent data. More recent data on river herring come from several Department surveys. The longest dataset (1975-2000) is from an annual survey of chemical contaminants in fish that targeted multiple species within the Hudson River estuary. Fish were collected by electro-fishing and river herring sample size varied among years. In most years, length data were recorded for a sub sample of herring. The Department also conducted a two-year electro-fishing survey in 1989 and 1990, to examine the population characteristics of blueback herring in the Hudson and the Mohawk River, the Hudson's largest tributary. Data were obtained on length, age, and sex.

Limited data on river herring stock characteristics have also been collected during annual monitoring of American shad and striped bass spawning stocks. Sampling occurs in the main-stem Hudson River between km 145 and 232 from late April through early June. Fish are collected by haul seines and electro-fishing. The 10.2 cm stretch mesh in the haul seines was specifically designed to catch shad and striped bass and avoid river herring, but some large (> 280mm) herring were occasionally retained in these gears. Herring were an incidental catch of the electro-fishing. Data were collected on length, age, and sex of river herring caught in both gears.

In 1987, the Department began to target adult river herring during the spring spawning stock survey. From 1987 to 1990, two small mesh (9.5 mm) beach seines (30.5 and 61m) were occasionally used with some success. In 1998, we specifically designed a small haul seine (91 m) with an appropriate mesh size (5.1 cm) to target herring. It was designed to capture all sizes of herring present with the least amount of size, and age, bias. We have used this gear since 1999. Sampling occurs during the shad and bass survey within the area described above, using the same field crew.

We only use data from the least size-biased gears to describe characteristics of the herring spawning stock: electro-fishing, the beach seine (61m) and the herring haul seine (91m). As sample size varied among years, all data were combined to characterize size and weight composition of the spawning population. Mean total length and weight data are summarized for adults only (>=170mm TL).

4.2.2 Hudson River Spawning Stock - Characteristics

Mean Size and Growth

Mean size of fish has been calculated for all years that samples were obtained (Figure 8). Sample size is relatively small, however, in most years presented (n<34 fish). Adequate samples (n>34), following the method described by Lynch and Kim (2010) to characterize length (depicted with an X over the graph's data point) were collected in the late 1980s, early 1990s, then occasionally since 2001 for both species. Lengths have declined since the early 1980s. Since 2000, mean size of female alewife has been stable, but declined slightly in males (Figure 8). Mean size of blueback herring has declined for both sexes from 1989 to the present.

Age

The Department samples from the 1989-1990 were primarily blueback herring. The aging method used was that of Cating (1954), developed for American shad. More recent scale samples from Department surveys remain un-aged and therefore we have limited age or repeat spawn data directly from scales of Hudson River fish. In attempting to age Hudson River herring scales, we relied on techniques used by other state agencies. As an alternative, and for a very general picture of potential age structure, we estimated annual age structure using length at age keys from datasets provided by Maine, Massachusetts, and Maryland for alewife and Massachusetts and Maryland for blueback herring. We found that three state agencies differ enough in their technique to produce variation in the results.

Blueback herring: Age estimates using length-age keys differed from ages assigned by the Department for the 1989- 1990 samples and from each other for most years (Figure 9). In general, keys from MD and MA were mostly in agreement for male blueback herring in most years, but MA aged females slightly older (Figure 10). Ages from two through eight were present in the spawning stock. Most fish were ages three, four, and five. Mean age remained relatively stable among years within method (Figure 11).

Alewife: Age estimates using length-age keys from the three states differed from each other for alewife (Figure 12). In general, the ME key resulted in the youngest ages, followed by older ages from MA, then MD. Ages from two through eight or nine were present in the spawning stock. Peak age varied with key used and by sex; most fish were ages three or four for males and four or five for females. Mean age was youngest for the ME key, older for MA, and oldest for MD age key (Figure 13). Mean age for males was greater in 2001 and 2003, then dropped and remained relatively stable for 2005 through 2010. Mean age for females was slightly lower in 2008 and 2009 but by 2010 returned to the same level as estimated for 2001 and 2003.

Maximum age that the Hudson River herring stock can attain is unknown. Jessop (B. Jessop

DFO retired, personal communication) reported a maximum age of 12 for both alewife and blueback herring for the St. John's River in New Brunswick.

Given current uncertainty about aging methods and age of Hudson River river herring, we suggest that available estimates should only be used for a general discussion of age structure and for trends within estimate method. We do not feel that age estimates should be used to monitor changes in stock status or to set sustainable fishing targets until aging methods can be verified. This issue is currently being discussed in the ongoing ASMFC River Herring stock assessment where resolution to the differences in ageing methods is being sought..

Mortality Estimates

The variation in annual age structure translated into comparable variation in estimates of total mortality when various age-based estimation methods were used. This difficulty in estimating ages precluded the use of age-based mortality estimators. As an alternative, we explored use of the Beverton-Holt length-based method (Gedamke and Hoenig 2006) using growth parameters for length calculated from the 1936 length at age data (see section above). Since the definition of length at full recruitment (Lc) given by Nelson et al. (2010) seemed arbitrary, we estimated total mortality using the Nelson et al. (2010) and two additional Lc values. Results from the length based method were also influenced by $L\infty$. The Beverton-Holt method also relies on several population assumptions including continuous recruitment to the stock that the population is in equilibrium. Neither of these assumptions are true for Hudson herring stocks.

Total mortality estimates for alewife of both sexes varied tremendously within and among years depending on assumed model inputs (Figure 14). Estimates increased until 2006, after which a decline occurred to 2010. An even greater variation occurred for blueback herring (Figure 15) with a series of very high peaks followed by low values. Given this demonstrated sensitivity to model inputs, we suggest that total mortality of Hudson River river herring stocks remains unknown. However, we should emphasize that mortality on stocks must have been high in the last 30 years to have so consistently reduced mean size and presumably mean age. We do not feel that estimates of total mortality should be used to monitor stock change during the proposed experimental fishery unless uncertainty in estimation methodology can be resolved. Current uncertainty precludes use of total mortality to set sustainability targets.

4.2.3 Spawning Stock Surveys – Long Island

Young (2011) sampled alewife in the Peconic River 32 times throughout the spawning season in 2010. Sampling occurred by dip net just below the second barrier to migration at the lower end of a tributary stream. A rock ramp fish passage facility was completed at the first barrier near the end of February 2010. The author collected data on total length and sex and estimated the number of fish present based on fish that could be seen below the barrier. Peak spawning occurred during the last three weeks of April. The minimum estimate of run size was 25,000 fish and was the total of the minimal visual estimates made during each sample event. Males ranged from 243- 300 mm with a mean length of 263 mm. Females ranged from 243-313 mm with a mean of 273 mm.

4.2.4 Volunteer and Other river herring monitoring

The Department's Hudson River Fisheries Unit (HRFU), Hudson River Estuary Program and the Environmental Defense's South Shore Estuary Reserve Diadromous Fish Workgroup (SSER) have begun to incorporate citizen volunteers into the collection of data on temporal variation of and physical characteristics associated with spawning of river herring in tributaries. These data were not provided by the fishery dependent and independent sample programs discussed above. The volunteer programs also bring public awareness to environmentally important issues.

Long Island Streams

The SSER began a volunteer survey of alewife spawning runs on the south shore of Long Island in 2006. The survey is designed to identify alewife spawning in support of diadromous fish restoration projects. The survey also evaluates current fish passage projects (i.e. Carmans River fish ladder), and sets a baseline of known spawning runs. Data were available for surveys in 2006 – 2008. Monitoring occurred on six to nine targeted streams annually, with volunteer participation ranging from 24 to 68 individuals. Monitoring takes place from March through May. Alewife were seen as early as March 5 (2006) and as late as May 31 (2008). Data indicated that alewife use multiple streams in low numbers. It is not clear whether each stream supports a spawning population since total sightings were very low. The Carmans and Swan Rivers showed the most alewife activity and likely support yearly spawning migrations. The first permanent fish ladder on Long Island was installed in 2008 on the Carmans River. Information gathered during this study will aid in future construction of additional fish passage (Kritzer et al. 2007a, 2007b and Hughes and O'Reilly 2008).

In addition to the SSER, other interested individuals have also monitored Long Island runs (see Appendix Table A). Anecdotal data provides valuable information on tracking existing in-stream conditions, whether streams hold active or suspected runs, interaction with human land uses and suggestions for improvement (L. Penney, Town of East Hampton, personal communication). A rock ramp was constructed around the first barrier to migration on the Peconic River in early 2010 (B. Young, retired, NYS Dept of Environmental Conservation, personal communication). The Peconic River Fish Restoration Commission set up an automated video counting apparatus at the upriver end of this ramp. Data are still being analyzed.

The Department has conducted a similar river herring volunteer monitoring program annually since 2008 for tributaries of the Hudson River Estuary (Dufour et al. 2009, NYSDEC 2010, Hattala et al. 2011). We designed this project to gather presence–absence and temporal information about river herring spawning runs from the lower, middle and upper tributaries of the Estuary. Between nine and 11 tributaries were monitored annually by 70 to 213 volunteers in 2008, 2009, and 2010. Herring were seen as early as 31 March and as late as 1 June. River herring were observed in all but one of the tributaries. However, several tributaries with known strong historical runs had very few sightings. Water temperature seemed to be the most important factor determining when herring began to run up a given tributary. Sightings of herring were most common at water temperature above 50 F. Tributaries in the middle part of the estuary warmed the fastest each spring and generally had the earliest runs.

4.2.5 Young-of-the-Year Abundance

Since 1980, the Department has obtained an annual measure of relative abundance of young-of-the-year (YOY) alewife and blueback herring in the Hudson River Estuary. Although the program was designed to sample YOY American shad, it also provides data on the two river herring species. Blueback herring appear more commonly than alewife. In the first four years of the program, sampling occurred river-wide (rkm 0-252), bi-weekly from August through October, beginning after the peak in YOY abundance occurred. The sampling program was altered in 1984 to concentrate in the freshwater middle and upper portions of the Estuary (km 88-225), the major nursery area for young herring. Timing of samples was changed to begin in late June or early July and continue biweekly through late October each year. Gear is a 30.5 m by 3.1 m beach seine of 6.4 mm stretch mesh. Collections are made during the day at approximately 28 standard sites in preferred YOY herring habitat. Catch per unit effort is expressed as annual geometric and arithmetic means of number of fish per seine haul for annual weeks 26 through 42 (July through October). This period encompasses the major peak of use in the middle and upper estuary.

From 1980 to 1998, the Department's geometric mean YOY annual index for alewife was low, with only one year (1991) over one fish per haul. Since 1998, the index has increased erratically (Figure 16).

From 1980 through 1994, the Department's geometric mean YOY annual index for blueback herring averaged about 24 fish per haul, with only one year (1981) dropping below 10 fish per haul (Figure 16). After 1994, the mean dropped to around 17 fish per haul, and then began the same high-low pattern observed for alewife.

The underlying reason for the wide inter-annual variation in YOY river herring indices is not clear. The same erratic trend that occurred since 1998 has also occurred in American shad (Hattala and Kahnle 2007). The increased inter-annual variation in relative abundance indices of all three Alosines may indicate a change in overall stability in the system.

4.2.6 Conclusion

Over the last 30 years, the Hudson River stocks of alewife and blueback herring have shown inconsistent signs in stock status trends. Calculated CPUE for commercial gill net gears has increased in recent years, while CPUE in scap nets fished in tributaries initially declined, but has remained relatively stable since 2003. Apparent mortality increased on mature fish and as mortality rose, mean total length and weight declined. Similar trends occur in the both the fishery dependent and independent data. Recruitment has become extremely variable since the mid-1990s for both species. Some decline is occurring for YOY blueback herring while, counter-intuitively, there has been an increasing trend for YOY alewife. Anecdotal evidence from anglers and commercial fishermen suggest a decline in abundance in tributaries yet a dramatic increase of herring in the main-stem river in the last few years.

The upsurge in river herring used as bait for striped bass has placed herring in a tenuous position. With this continuing demand, declining size, and increasing mortality, careful management is needed despite variable but stable recruitment.

5 PROPOSED FISHERY CLOSURES

5.1 Long Island, Bronx County and Westchester County

Limited data that have been collected for Long Island river herring populations are not adequate to characterize stock condition or to choose a measure of sustainability. Moreover, there are no long-term monitoring programs in place that could be used to monitor future changes in stock condition. In 2010, the Peconic River Fish Restoration Commission installed a rock ramp to provide fish passage at the first dam on the Peconic River system. In the spring of 2011, a fish counting apparatus was installed upriver of this ramp. In addition, the Commission initiated biological fish sampling of species, sex, length and scales. If these operations continue in the future and if these provide information that could be used to set and monitor a sustainability target, we will consider a fishery for this river. Little data have been collected for river herring populations in the Bronx and Westchester Counties.

For the above reasons, New York State will close all fisheries for river herring in Long Island streams and in the Bronx and Westchester County streams that empty into the East River and Long Island Sound.

5.2 Delaware River

We have no data that suggest river herring occur in New York waters of the Delaware River. New York State proposes to close fishing for river herring in New York waters of the Delaware River to prevent future harvest should the Delaware stock rebound and expand upriver. This closure conforms to similar closures planned for the Delaware River and Bay by Pennsylvania, New Jersey, and Delaware.

6 PROPOSED SUSTAINABLE FISHERY

6.1 Hudson River and Tributaries

Given the mixed picture of stock status provided by available data on Hudson River herring, New York State proposes a restricted fishery in the main-stem Hudson River coupled with a partial closure of the fishery in all tributaries. We do not feel that the data warrant a complete closure of all fisheries. We propose that the restricted fishery would continue for five years concurrent with annual stock monitoring. We propose a five-year period because the full effect of our proposed restrictions will not become apparent until all age classes in the population have been exposed to the change. Most of the fish in the Hudson River herring spawning stocks are estimated to be three through seven years old and these ages predominate in the fishery. Sustainability targets would be set juvenile indices. We would monitor, but not yet set targets for mean length from fishery independent spawning stock sampling and CPUE in the commercial fixed gill net fisheries in the lower river below Bear Mountain Bridge. We will also monitor age structure, frequency of repeat spawning, and total mortality (Z) if we can resolve uncertainties about aging methods and mortality estimate methodology. Stock status would be evaluated during and after the five year period and a determination made whether to continue or change restrictions. Moreover, we do not know how much of the apparent high mortality is caused by bycatch in ocean fisheries and thus outside current scope of restrictions proposed in this plan.

Recreational harvest of river herring is much greater than reported harvest from commercial gears. Data from a creel survey in 2005 estimated approximately 152,000 herring were taken in the recreational fishery (NAI 2007) while some 31,000 herring were reported from commercial gears (Table 2). For this reason, we feel that restrictions to the recreational fishery will likely have a greater impact on take of herring than commercial restrictions.

We should note that Draft Addendum 3 to Amendment 6 of the ASMFC Interstate Management Plan for striped bass stipulates that states should reduce fishing mortality on spawning stocks by 50%. If this draft is approved by the ASMFC Striped Bass Management Board, we may have to restrict effort in the recreational striped bass fishery. Restrictions may include a reduction in use of bait such as river herring. Any reduction in effort will likely reduce demand for river herring and thus reduce losses in the Hudson stocks.

A summary of the following fishery restrictions are contained in Tables 5 and 6. These restrictions were based on public comments received from public information meetings held in the Hudson valley in 2010 in addition to the need to reduce harvest. Public suggestions for restrictions are listed in Appendix C.

6.1.1 Proposed Restrictions – Recreational Fishery

Recreational fishing season

Currently none; proposed season is March 15 to June 15.

Recreational Creel Limit

Currently there are no restrictions on daily take of river herring in the Hudson and its tributaries. To reduce harvest and waste, we propose to implement a restrictive recreational creel limit of ten river herring per day, or a total maximum boat limit of 50 per day for a group of boat anglers, whichever is less. A Charter boat captain (see Commercial Fishery Restrictions) will be responsible for a possession limit of 10 river herring per paying customer or a total maximum boat limit of 50 herring per day, whichever is less. Charter boat captains are required, at minimum, to hold a US Coast Guard "six pack" license, i,e. a maximum number of six passengers can be on board. However, most vessels fishing the Hudson relatively small (20 to 30 ft) with an average of four fares maximum.

Most of the river herring harvest is driven by striped bass fishermen catching herring for bait. Anecdotal reports and comments at public meetings suggest that many anglers take many more herring than they need for a day's fishing. The proposed creel limit will prevent such overharvest and avoid waste. We obtained an idea of potential harvest reduction from the proposed creel survey from data in the Cooperative Angler Program described in Section 2.1.3. Data were available on herring harvest during 502 trips. Since trip level reports often included more than one angler, we divided the reported herring catch by the number of anglers for an estimate of catch per angler trip. These data indicated that 56 percent of the catch per angler trips caught six or more herring suggesting that a five fish limit could reduce harvest by 56 percent.

To track harvest, New York will implement the on line creel survey/ diary program coordinated by ACCSP. It is scheduled to go live by Jan. 1, 2012. New York will increase public outreach to encourage angler use of this program. We will also continue the Cooperative Angler Program for comparison and for individuals not savvy with on-line tools.

Prohibit Harvest by Nets in Tributaries

Recreational anglers generally use hook and line (jigging) in the main-stem river and are allowed to use personal use gears (without a license) of scap/lift nets (36 sq ft or less), small dip nets, and cast nets. They are not required to report this catch and the number of herring taken by these gears is unknown. Anecdotal reports and observations suggest tributaries are popular locations for recreational harvest by these net gears, especially in the middle section of the estuary (Figure 1).

Information from the volunteer angler program along with anecdotal data on recreational harvest suggests that abundance of river herring, mostly alewife, has declined in some spawning tributaries. This may be due to the increased vulnerability to harvest as herring often concentrate in these tributaries in large schools to spawn. Tributaries with an impassable barrier close to the mouth confine fish to even smaller areas. For these reasons, we feel it prudent to close recreational harvest by nets from tributaries until measures of stock condition improve. We did not feel that it was feasible or desirable to enforce a closure on angling for river herring in tributaries.

In the main-stem Hudson, personal use nets will be allowed to continue but with a reduced size for scap/ lift nets (16 sq ft instead of 36 sq ft); seine, cast, and dip nets sizes will remain the same (Table 5).

Closed areas

Although personal-use net fishing by recreational anglers will not be allowed in tributaries, angling will continue. However, to further relieve fishing pressure in areas of fish concentration, in addition to the net ban, no fishing will be allowed within the River Herring Conservation Area (RHCA) defined as stream length within 250 m (825 feet) of any type of barrier, natural or man-made. This is similar to a fishing ban within 50 rods of fishways instituted in New York in 1895. Many of the Hudson's tributaries have natural (rapids) or man-made barriers a short distance in from the main river. River herring concentrate in great numbers below these barriers making them very vulnerable to any fishing. This closed area will allow them to spawn in this undisturbed stretch. The RHCA closure will effectively end all fishing in the eight smallest tributaries, or 14% of the tributaries in the estuary.

Above the Troy Dam, an area closure is already in effect for the "Waterford Flight", Lock 2 to Guard Gate 2, a series of dams and locks at the entrance to the Mohawk River. Within the Mohawk, a RHCA will be in effect below any of the remaining locks and dams up to Lock 21 in Rome.

Escapement period

None are proposed.

Licensing and reporting

In 2011, New York State implemented a recreational marine fishing registration. All anglers fishing for anadromous fish must register prior to fishing for migratory fish of the sea. For the Hudson this includes river herring and striped bass. The recreational and commercial fisheries for American shad were closed in the Hudson River in 2010.

By Jan 1 2012 New York, in cooperation with ACCSP, will start up an online angler survey. The Department will increase public outreach to strongly encourage fishers to use this new tool to aid in understanding recreational catch and harvest.

6.1.2 Proposed Restrictions – Commercial Fishery

License Required:

Currently, fishers using commercial, non-personal use size gears to take and /or sell fish must be in possession of a Marine Permit for that gear. Marine permits have an annual reporting requirement, but no requirements for proof that harvest was for commercial purposes. Recreational fishermen commonly purchase marine permits and use commercial gears because of the low cost. We propose to strengthen the commercial aspects of these gears by requiring proof that harvest was sold as a requirement for license renewal.

The overlap with gears licensed under the NY bait license will be minimized by requiring a Marine Permit to take river herring. Cast nets will be included under the Marine Permit licensing system.

Closed area

We propose to continue the current closures as listed in Table 6 and implement a new closure:

Prohibit Harvest by Nets in Tributaries: Closing the tributaries to harvest by nets will likely reduce overall harvest, but the actual size of this reduction is not known. We do not know the size of recreational net harvest from tributaries. We can infer current commercial harvest from tributaries by the number of fish taken in scap nets since most river herring taken in tributaries are taken by this gear and most scap nets are fished in tributaries. Mean annual reported harvest by commercial scap nets in the last five years was about 15,000 river herring or 48% of the total reported commercial harvest. The mean number of commercial fishing trips using scap nets during this time period was 611 trips which were about 59% of all reported trips in the estuary and tributaries. Elimination of commercial net harvest from these waters will eliminate commercial fishing in 175 miles, or approximately 65% of linear spawning streams in the Estuary and above the Troy Dam.

Gear Restrictions

All current gear restrictions will remain in place (Table 6). Other changes include:

Gill nets: Currently both anchor and drift gill nets are used in the mid and upper estuary above the Bear Mountain Bridge (> rkm75). Both gears catch herring, but losses can be higher in anchored nets because they are often not tended as frequently as drifted nets. This is especially the case with recreational fishermen who are often not experienced in use of gill nets. We propose to ban use of fixed gill nets in the Hudson River above Bear Mountain Bridge; drift gill nets are required to be tended by owners as they are fished. We don't know what reduction in harvest would result, but some will occur and the change will certainly reduce waste of fish.

Scap /Lift nets: Currently there are no limits on size of scap nets to be used. Mandatory reports indicate that the largest nets in use are 400 sq ft (20 by 20 ft). The proposed maximum net size is 10 ft by 10 ft.

Fyke and Trap nets: Although currently legal for the take of river herring, no commercial harvest is reported from these gears. We propose that their use not be allowed for harvest of river herring.

Commercial Net Permit and Fees

Commercial gears in the main-stem Hudson and tributaries are licensed under a NYSDEC Bureau of Marine Resources Marine Permit. Access to obtain a Marine Permit remains open, with no prior requirements. These commercial gears are often used by recreational fishermen because current permit fees are very low. Most fees were set in 1911 by the then New York Forest, Fish and Game Commission and no fee increases have occurred through the present time. Commercial gears such as gill nets can take high numbers of herring and are not considered to be recreational gear in New York. For the purposes of harvest in ocean waters (Marine and Coastal District), gill nets are considered commercial gear and their use for recreational purposes is not permitted.

We propose regulations to increase fees to account for inflation, to emphasize that nets are commercial gears, and to discourage casual use by recreational anglers. Current fee structure can be found in New York Code of Rules and Regulation- Part 35 (see http://www.dec.ny.gov/regs/4019.html). We considered two alternatives.

1. Increased gear and fishing vessel fees.

    a. In 1911, fees were $5.00 per each trap, seine or gill net, and $1.00 per scap net. These fees would translate to $115.00 per gill net or seine and $25.00 per scap net in today's (2011) dollars.
    b. Gill nets and seines can also be licensed by the linear foot of net rather than as a type of net. We propose that the current $ 0.05 per foot be increased to $1.00 per foot. Data from the mandatory reports indicates that the most recent (2010) licensed gill net lengths ranged from 10 ft ($10 fee) to 600 ft ($600 fee). Seines have no maximum length restriction in place; current use is 50 ft ($50 fee) to 100 ft ($100 fee).
    c. Another way to differentiate between recreational and commercial fishermen is to reinstitute the 1911 fishing vessel registration for the Hudson River, which is still active for other waters of NY. The 1911 fee of $15.00 for the smallest motorized vessel translates to $350.00 per vessel in today's dollars.

2. A single commercial gear permit.

    This approach simplifies the above combination of gear fees and is our preferred alternative.

    We would create a Hudson River Commercial Fish Gear Permit (HRCFGP): for individuals who want to harvest river herring or Atlantic menhaden; fee of $150. This would be instead of individual gear licenses.
    a. Qualifications needed: proof of previous sale to a licensed retail bait shop; if a business (retail bait shop), proof of business incorporation (LLC)
    b. If applicant holds a valid New York food fish or crab permit(s); cost of HRCFGP to be offset by valid permit fee(s)
    c. To include all restrictions as listed in Table 6.
    d. Gears to be used include anchored (fixed) and drifted gill nets, scap/lift nets, seines and cast nets (see Table 6 for size limitations)

Gear restrictions outlined above will still apply to any alternative chosen.

Closed Fishing Days

A 36-hour escapement period per week, from 6 AM prevailing time on Friday to 6 PM prevailing time on Saturday, is in effect for commercial gill nets from March 15 to June 15. We propose to expand this closure to include all commercial nets.

Reporting

Current mandatory reports of daily catch and effort data are submitted annually. We will continue to require these reports, but decrease the time of report submission to monthly.

Charter Boat License

In order to distinguish Charter Boat operators from recreational anglers, we propose to use the existing Marine & Coastal District Party & Charter Boat License (CPBL), as it exists for NY's Marine District. CPBL holders will follow all regulation as established for the Marine District with two exceptions: creel and size limit for striped bass will comply with limits set for the Hudson River above the G. Washington Bridge and the creel limit for a charter boat will be 20 river herring per day. Hudson valley charters can take up to three to six individuals per trip.

7 PROPOSED MEASURES OF SUSTAINABILITY

7.1 Targets

Juvenile Indices

We propose to set a sustainability target for juvenile indices using data from the time period of 1983 through 2010 for both species. We will use a more conservative definition of juvenile recruitment failure than described in section 3.1.1.2 of Amendment 2 to the ASMFC Interstate Fisheries Management Plan for Shad and River herring (ASMFC 2009). Amendment 2's definition is that recruitment failure occurs when three consecutive juvenile index values are lower than 90 % of all the values obtained in the base period. We will use a 75% cut off level. The 75% level for alewife is 0.35 (instead of 0.19) and 11.14 (instead of 2.86) for blueback herring (Figure 16).

The fishery will close system-wide if recruitment failure, defined as three consecutive years below the recruitment failure limit, occurs in either species and will remain closed until we see three consecutive years of recruitment greater than the target values.

7.2 Sustainability Measures

There are several measures of stock condition of Hudson River herring that can be used to monitor relative change among years. However, these measures have limitations (described below) that currently preclude their use as targets. These include mean length in fishery independent samples, catch per unit effort (CPUE) in the reported commercial harvest and age structure. We propose to monitor these measures during the fishery and use them in concert with the sustainability target to evaluate consequences of a continued fishery.

Mean Length

Mean total length reflects age structure of the populations and thus some combination of recruitment and level of total mortality. Mean total lengths of both river herring species in the Hudson River system has declined over the last 20 years and the means are now the lowest of the time series. Since this has been a persistent change in the face of stable recruitment, we suggest that the reduction in length has been caused by excessive mortality of adults within the river and during their ocean residency (bycatch). The bycatch fishery is a large unknown and not solely controlled by New York State to effect a change. Current annual reproduction now relies on a few returning year classes making the populations vulnerable to impacts of poor environmental conditions during the spawning and nursery seasons. We propose to monitor mean total lengths during the proposed fishery.

Catch per Unit Effort in Report Commercial

We suggest that CPUE values of the reported harvest reflect general trends in abundance. However, annual values can be influenced by changes in reporting rate and thus we do not feel that CPUE should be used as a target. Rather, we will follow changes within gear types and fisheries for general trends.

Age structure and Total mortality

We will monitor age structure, frequency of repeat spawning, and total mortality (Z) if we can resolve uncertainties about aging methods and estimate methodology discussed in Status Section 4.2.2.

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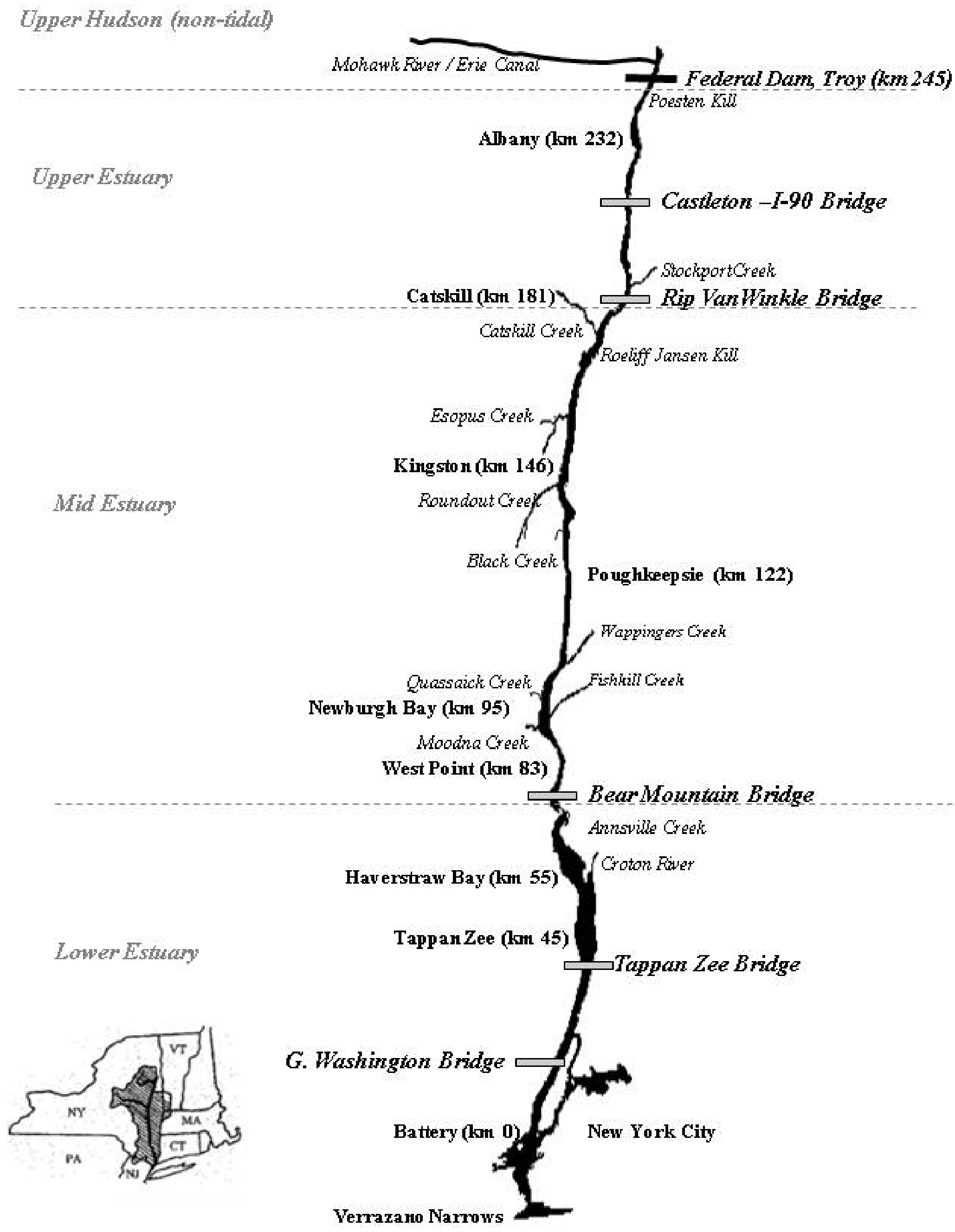


Figure 1 Hudson River Estuary with major spawning tributaries for river herring. (see Appendix Table A for complete list)

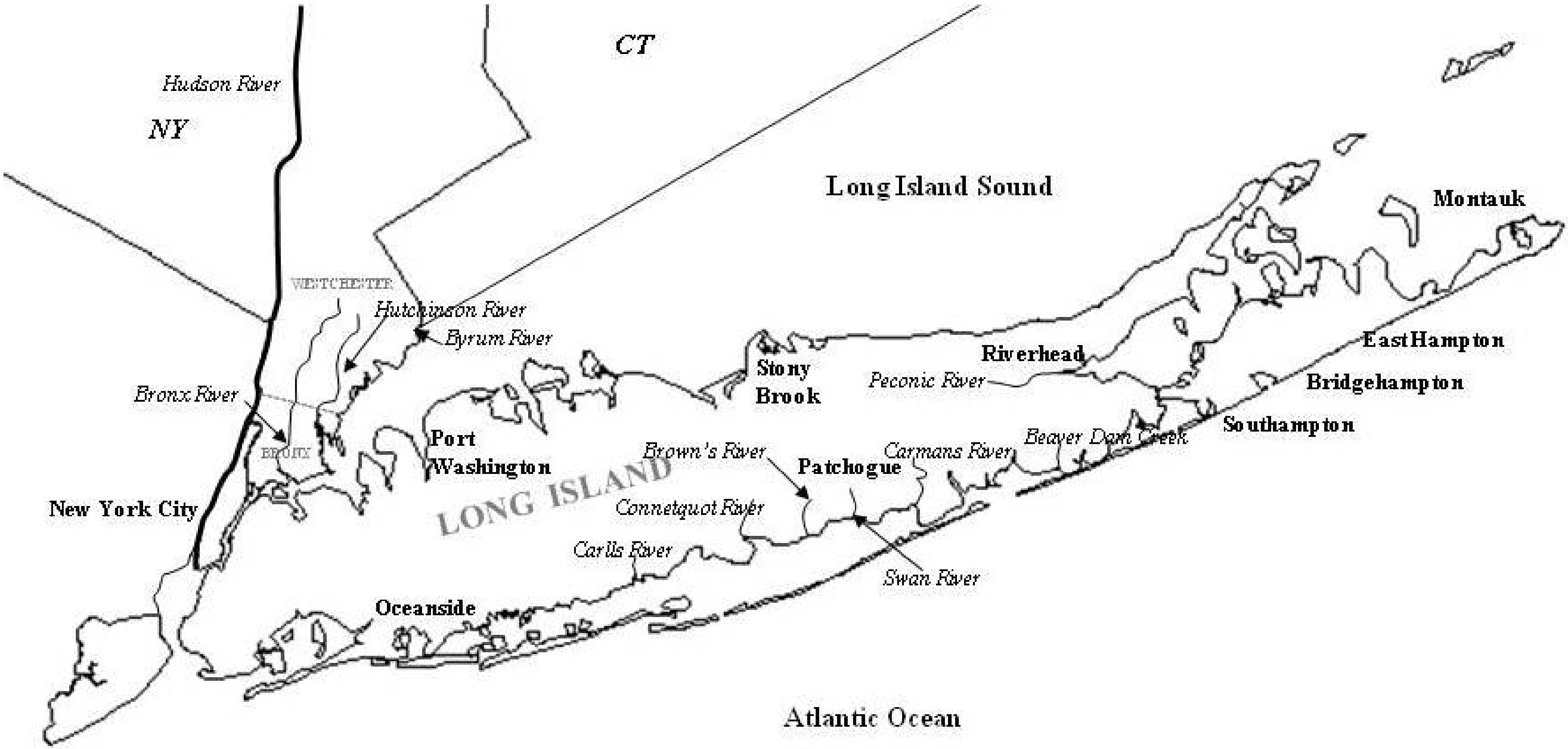


Figure 2 Long Island, Bronx and Westchester Counties, New York, with some river herring (primarily alewife) spawning streams identified (See Appendix Table A for list)

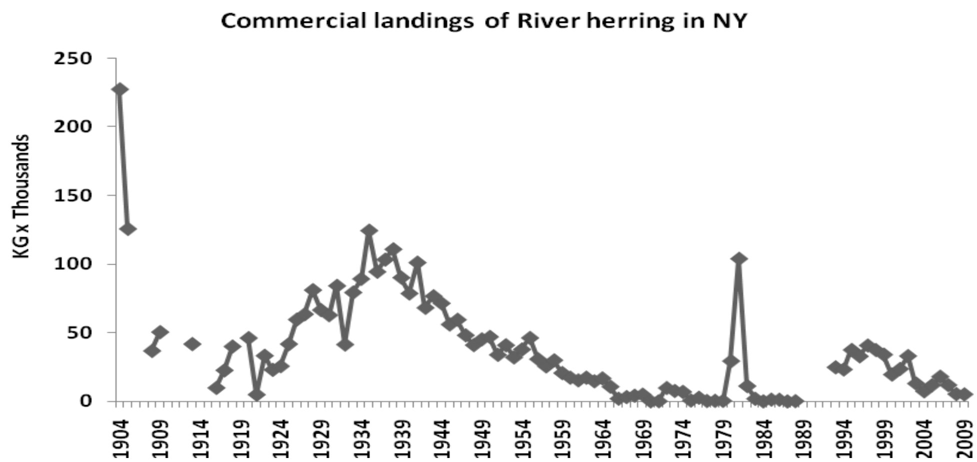


Figure 3 Commercial landings of river herring from all waters of New York State.

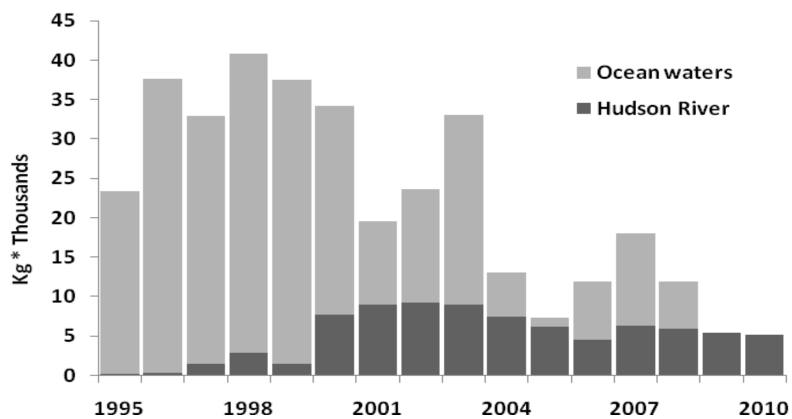


Figure 4 Commercial landings of river herring in the Hudson River and NY Ocean waters.

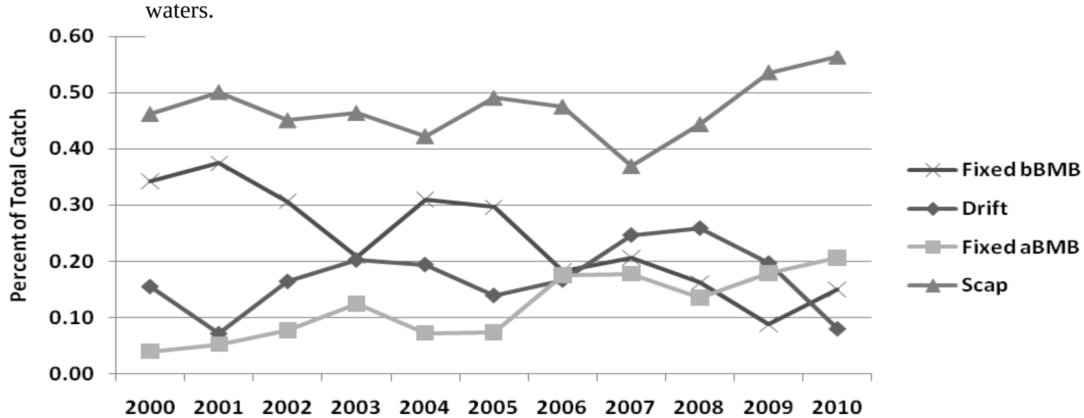
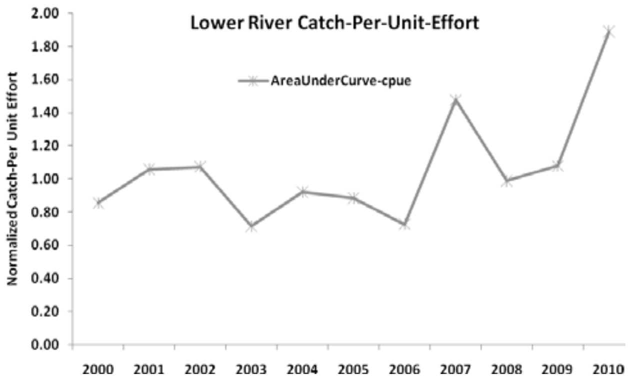


Figure 5 Percent commercial catch by gear of river herring in the Hudson River (a/b BMB=above and below Bear Mountain Bridge).



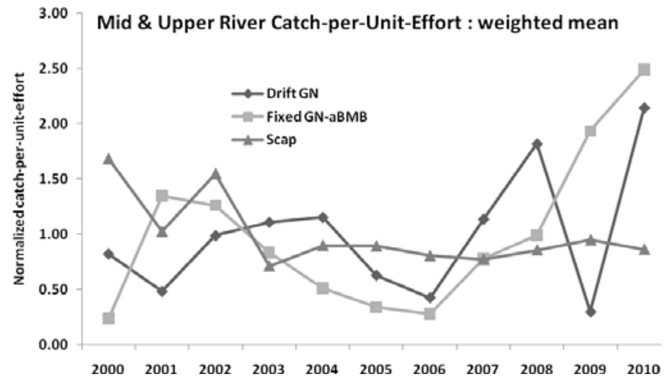


Figure 6 Catch per Unit Effort (number of fish per hours fished) by area of the river and gear. Lower estuary = below Bear Mountain Bridge [rkm 75]; Mid & Upper estuary = above the Bear Mountain Bridge.

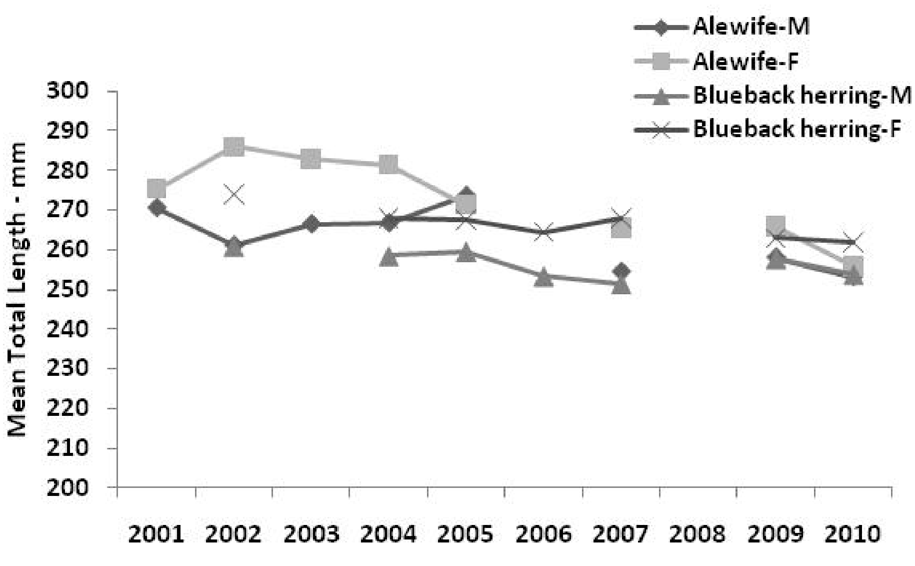
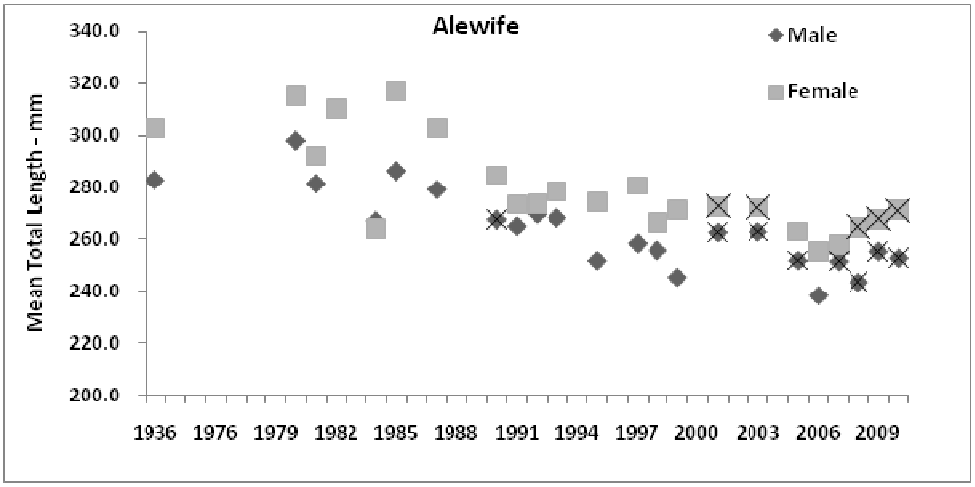


Figure 7 Mean total length of river herring collected from commercial fishery monitoring trips in the Hudson River Estuary



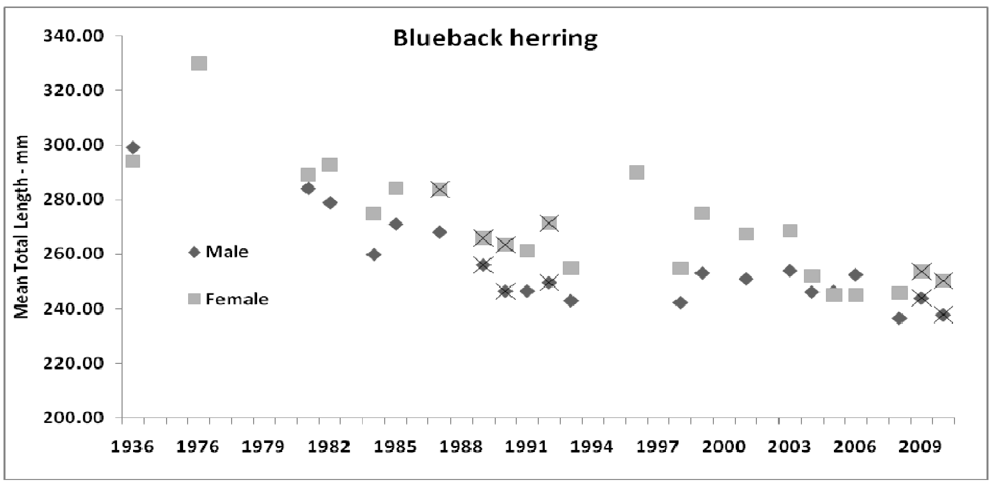


Figure 8 Mean total length of river herring in the Hudson River Estuary. Symbols with an "X" indicate adequate sample size (N>34) to characterize the stock.

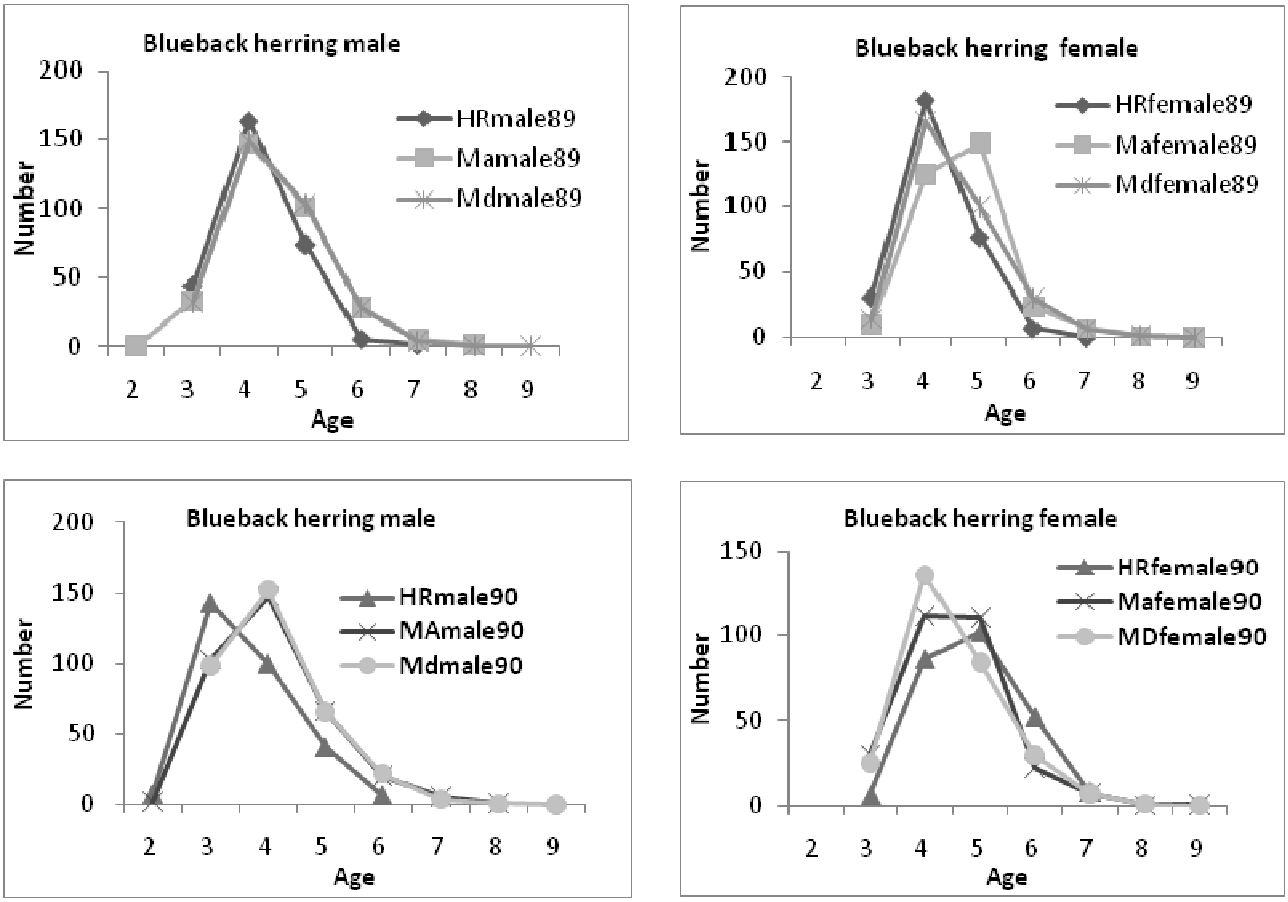


Figure 7 Hudson (HR) age structure and estimated age structure of Hudson River blueback herring based on length-at-age keys from Massachusetts (MA) and Maryland (MD) blueback herring.

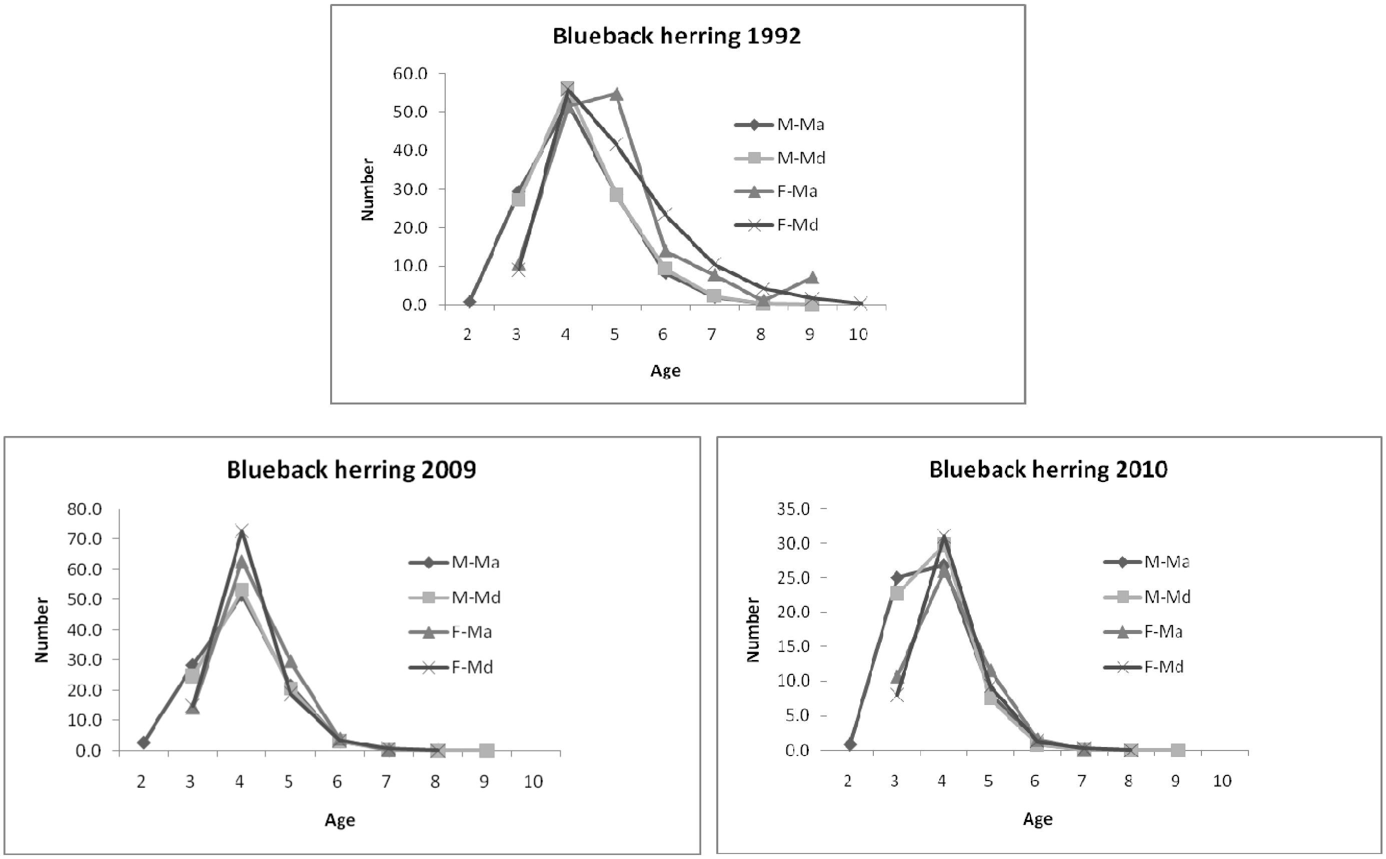


Figure 10 Estimated age structure of Hudson River blueback herring based on length-at-age keys from Massachusetts (MA) and Maryland (MD).

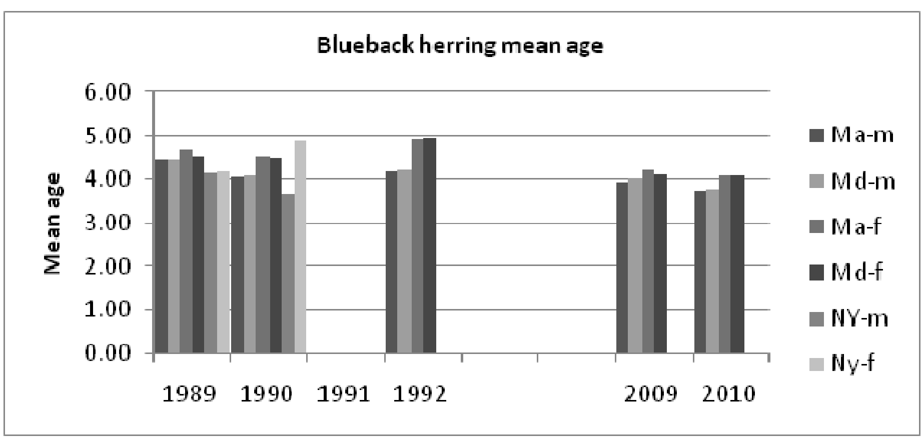


Figure 11 Mean age of Hudson River blueback herring based on length-at-age keys from Massachusetts (MA) and Maryland (MD).

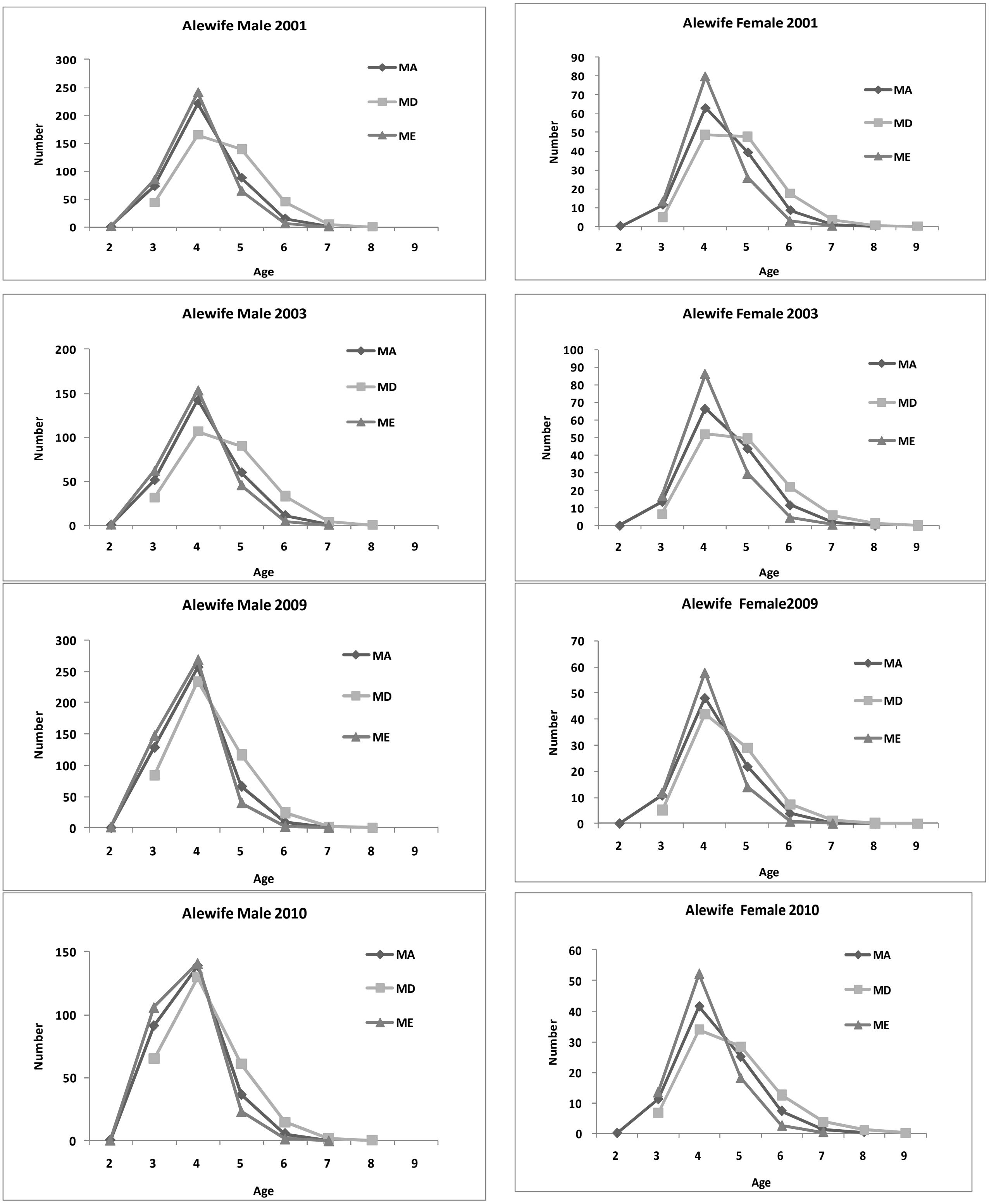
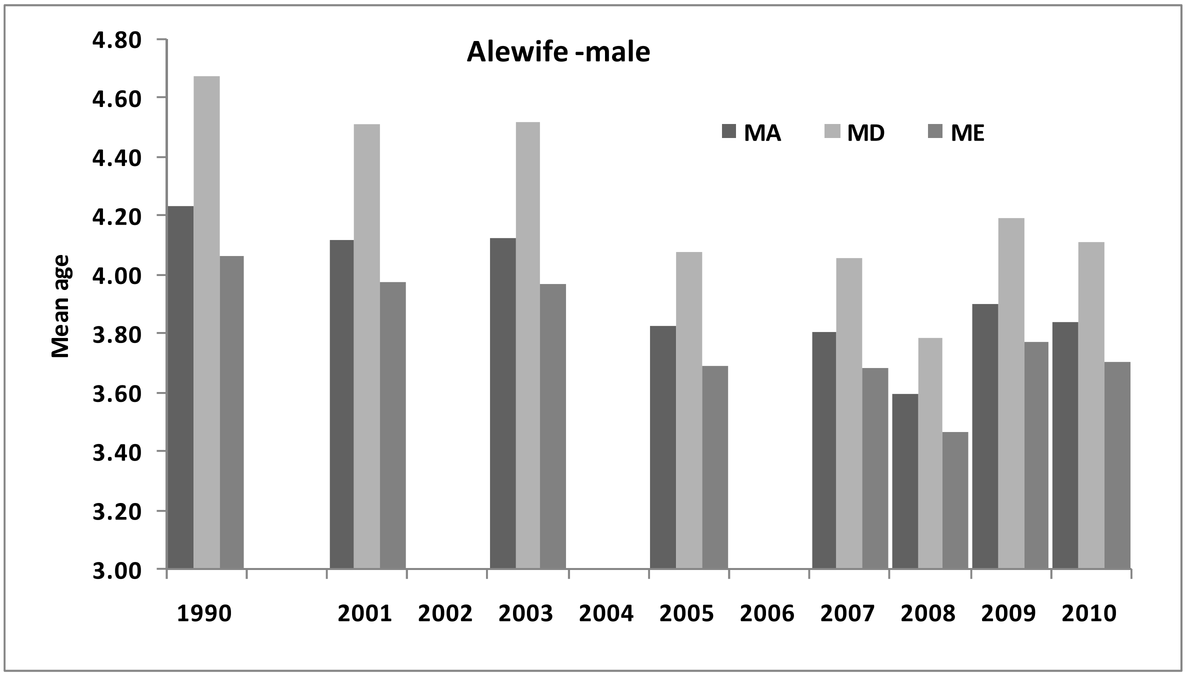


Figure 12. Estimated age structure of Hudson River alewife based on length-at-age keys from Maine (ME), Massachusetts (MA) and Maryland (MD).



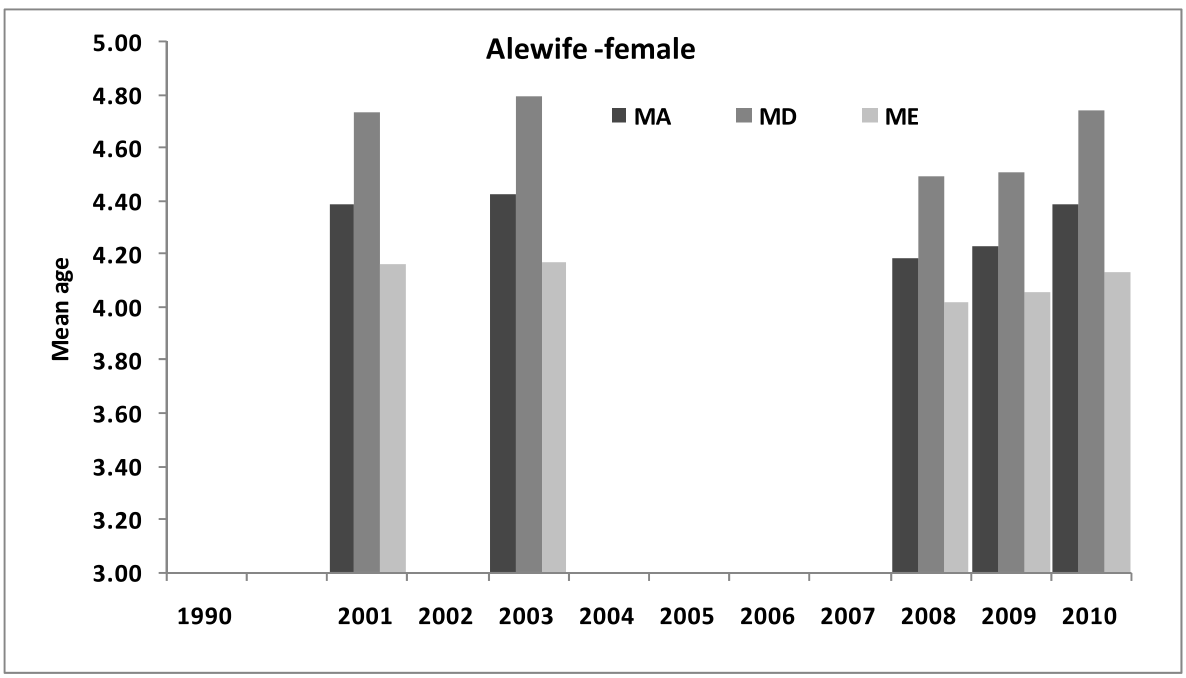
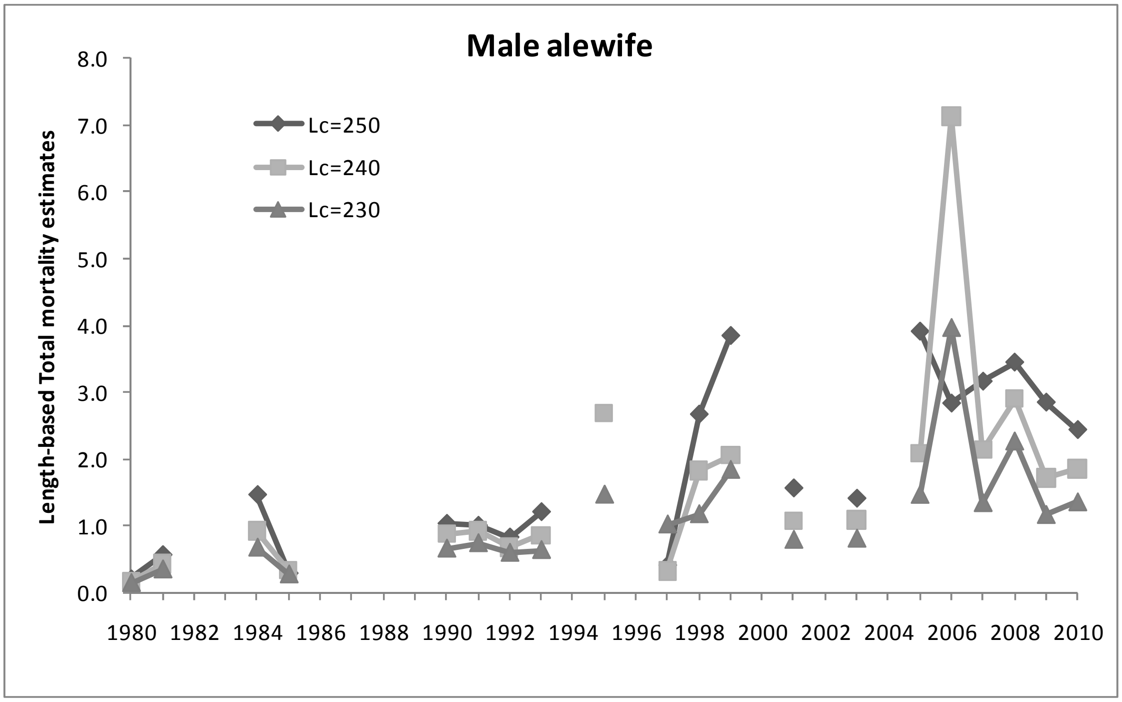


Figure 13. Mean age of Hudson River alewife, ages estimated from age-length keys from Maine (ME), Massachusetts (MA) and Maryland (MD).



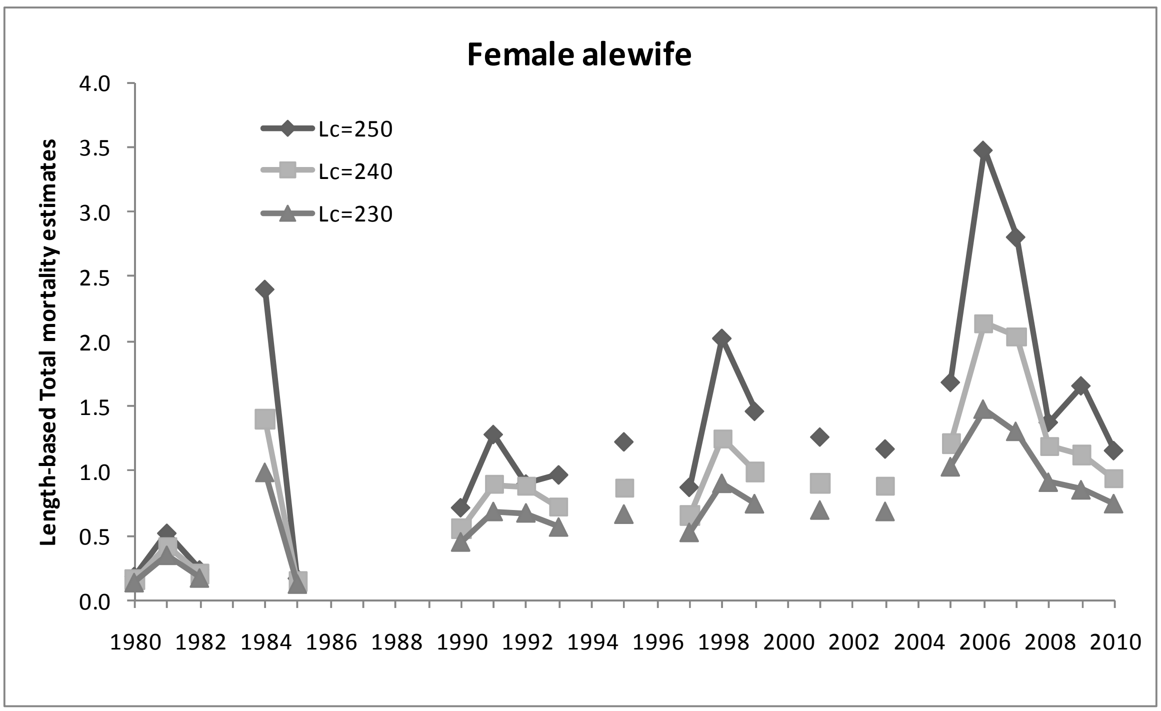
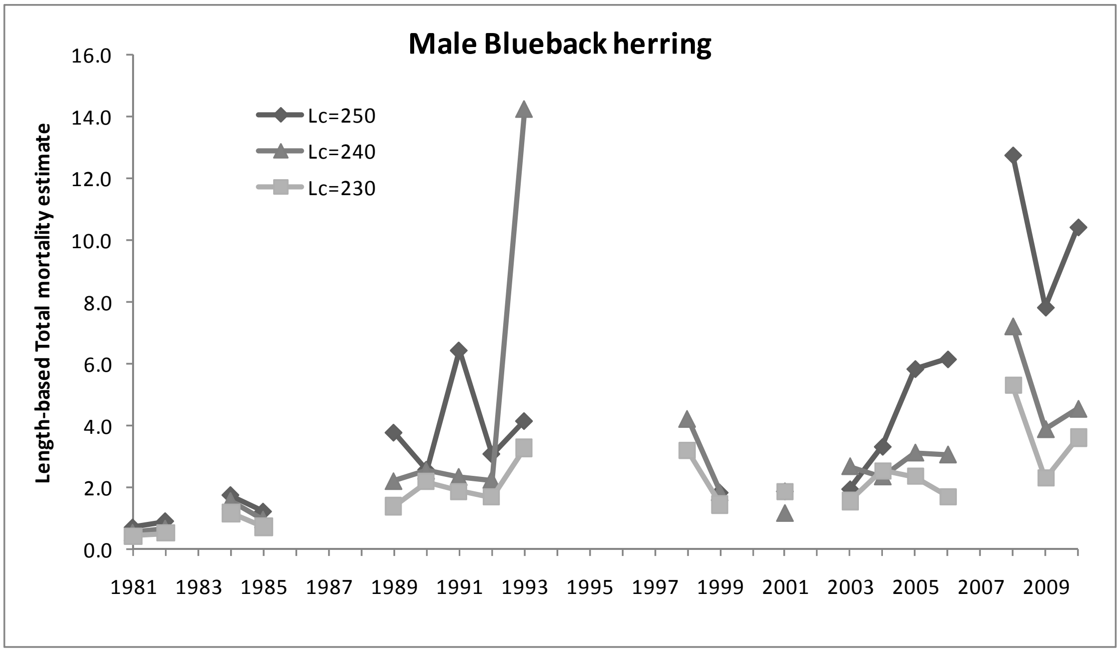


Figure 14. Length-based mortality estimates for Hudson River alewife. Lc =minimum length of fish caught in the sample gear.



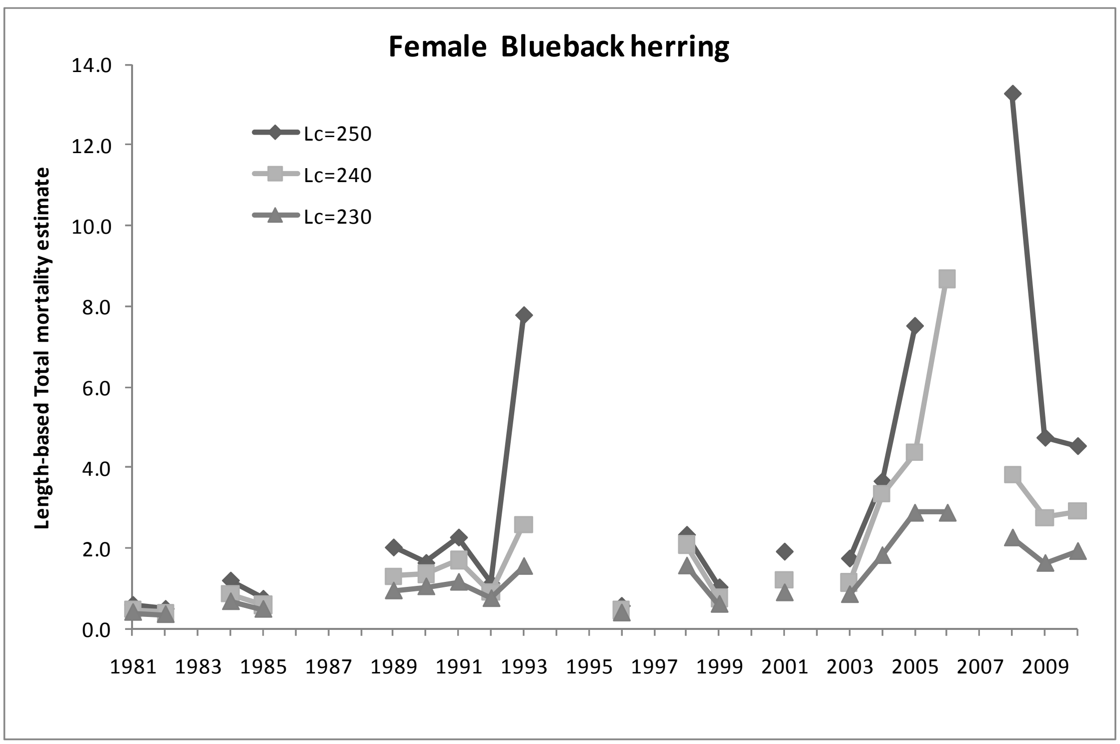


Figure 15 Length-based mortality estimates for Hudson River blueback herring. Lc =minimum length of fish caught in the sample gear.

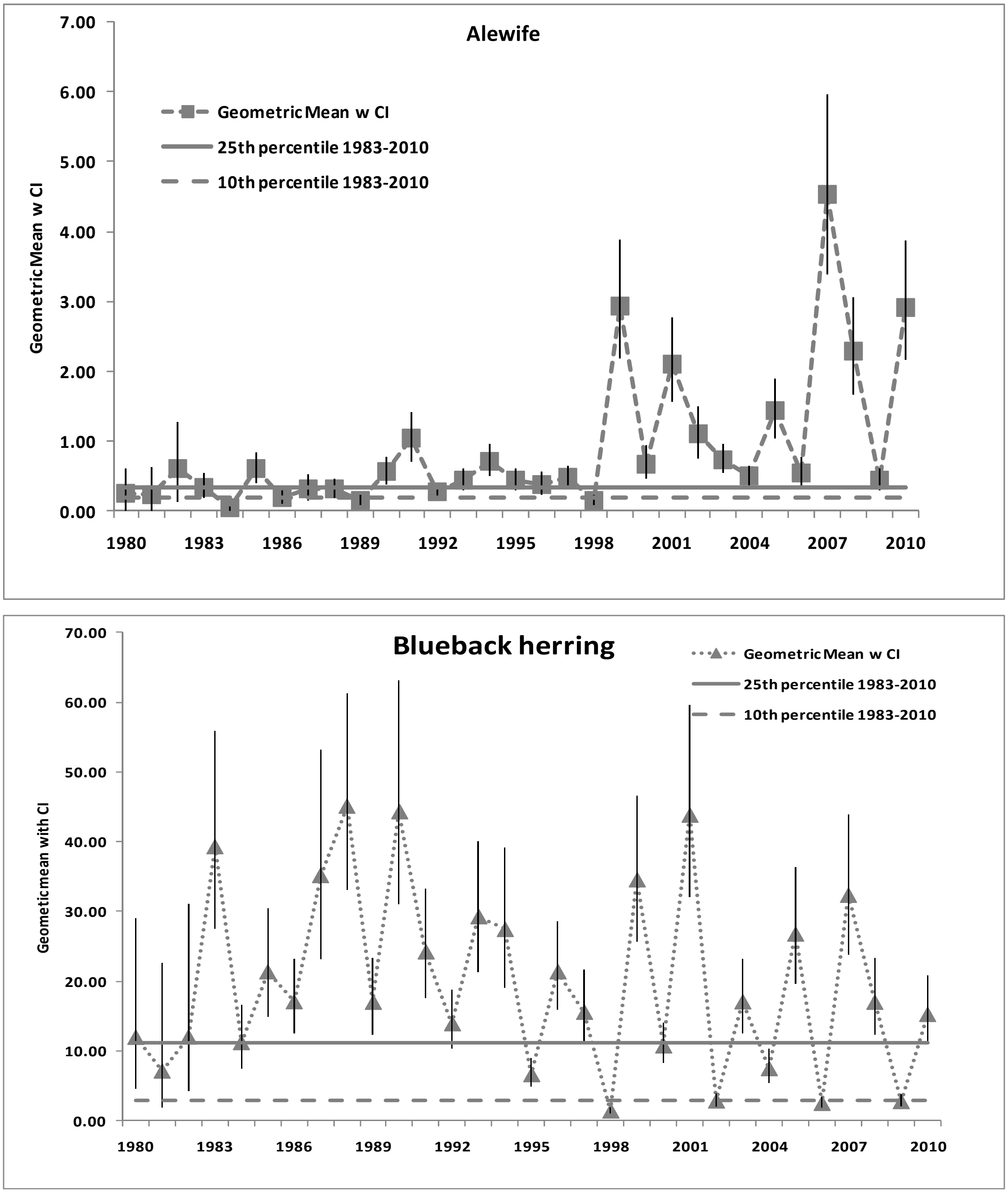


Figure 16. Annual young-of-the-year indices (with 95% CI) for alewife and blueback herring collected in the Hudson River Estuary.

Table 1. Summary of available fishery-dependent river herring data in Hudson River and Marine District of New York.

Data Type	Time period/ Details	Description	Usefulness as index
Fishery Dependent - Commercial			
Harvest	Historic data: -1904-1994: NMFS -1994-present: Hudson (see below)- NYSDEC; Marine waters- VTR/dealer report since 2002 -1994- present: transfer of historic NMFS data to ACCSP, data available in confidential and non-confidential form	- Provide catch and effort data - Not separated by area (river v marine) - River data reporting rate unknown	- Gives historic perspective - Provides trend data for state as a whole, but does not separate river(s) from ocean until 1994.
Marine monitoring	River herring most likely occur as bycatch in variety of fisheries	No port sampling in NY for 'herring'	
Hudson River Mandatory reports	- Began in 1995 through the present - Enforcement of reports in 2000 - Catch and effort statistics - Licenses are open access with low fees, many recreational fishers purchase and use commercial gears to obtain bait	- Data from 2000 to present good - Reporting rate unknown - Data separated by gear used: - Fixed gill net below Bear Mountain Bridge (BMB); passive gear below spawning area; consistent manner of fishing; weekly sum of CPUE approximating "area under curve" method - In spawning area above BMB - Drift gill (main-stem HR only) - active gear - Fixed gill (main-stem HR only) - less effort than below BMB - Scap/lift net (main-stem HR and tributaries)	Emigration area CPUE - Fixed GN below BMB: o Good indicator of abundance o increasing trend Spawning area CPUE o Drift GN - variable o Scap - Flat o Fixed GN- increasing
Hudson R. Fishery Monitoring	- Began in 1999 through the present - Onboard monitoring - Catch and effort statistics - Catch subsample	- Number of annual trips are low; co-occurs & conflicts with FI sampling - Catch samples low - NEED improved sample size to be useful	- Characterize catch
Fishery Dependent - Recreational			
Harvest (primarily sought as bait for striped bass; some harvest for personal consumption)	Creel surveys: - 2001, river-wide, all year - 2005, spring only - 2007, state-wide angler survey; effort for striped bass	- 2001: provides point estimate of effort for striped bass, ancillary river herring (RH) data - 2005 provides point estimate of RH harvest & effort for striped bass	Combination of effort for striped bass and point estimate of RH harvest; combine with below CAP data to estimate magnitude of recreational harvest for 2005 to the present.
Cooperative Angler Program	Data 2006-present	Diary program for striped bass anglers; includes data for RH catch or purchase, use by trip	Good RH use per trip- used above with rec. harvest to estimate total recreational harvest

Table 2. Summary of available fishery-independent river herring data in Hudson River, New York.

Data type	Time period/Agency	Description	Usefulness as index
Fishery Independent- Hudson River			
Spawning stock	1936: Biological Survey	Historic data, low sample size of 25 fish, species, sex, length & age	Indication of size change to present
	1975-1985: NYSDEC contaminant sampling	Sample size low and extremely variable by year	Indication of size change to present
	1989-1990 NYSDEC Hudson-Mohawk River.	Focused study, large sample size (1,100 fish): species, sex, length & age	Primarily blueback herring
	1999-2001 Normandeau Assoc. Inc. (NAI)	- Contract to assess gears for spawning stock survey - Developed own age key; not clear how compares to method of other Atlantic coast states	Primary gear used was size selective gill nets; precludes use for length analyses; need adjustment for ages
	2001 to present: NYSDEC spawning stock survey	Focused spawning stock survey; >300 fish collected most years; species, sex, length & scales (ageing not complete)	Sample design precludes use for catch-per-unit-effort data
	Overview of all above	*Problems*	*Ok to use*
		Spotty adequate sample size in most years (>34 per species, sex) to provide trend for length and weight	Good sample size for data 1989-99, 2001,-03,-05, -08 to present
		Ageing technique varies greatly from 1936, 1980s, NAI; techniques appear different from other Atlantic coast states - Mortality estimates from age structure (above) unusable as index	- Used ME, MA & MD age-length keys to estimate Hudson ages; - Results: a slight non-consistent bias of age difference, possibly attributed to ageing technique &/or growth differences (MD fish grow faster than MA) - Suggest use trend in mean age - Mortality estimates from age structure (above) unusable as index - Beverton-Holt length based too dependent on inputs (length at recruitment and age)
	Volunteer River herring surveys	- 2006 to present; documents presence/absence of river herring in Hudson tributaries and in some Long Island streams	- Not yet useful as index; provide a mechanism to improve future sampling for adult runs
Young-of-year Indices	1980 to present: annual yoy sampling standardized since 1984;	- July-Oct sampling within nursery area - Geometric mean number per haul - Catchability may be affected by habitat change	- Both species index variable - Alewife increasing - Blueback slight decreasing trend - Selected conservative target of 25th percentile

Table 3. Commercial river herring fishery monitoring data for the Hudson River Estuary.

On-board Observations on Commercial Trips																			
	N of trips	Alewife					Blueback herring					Unidentified "river herring"							
		Number			Sex ratio		Number			Sex ratio		Number			Sex ratio			Percent	
Year		M	F	U	M	F	M	F	U	M	F	M	F	U	M	F	Total	Alewife	Blueback
1996	1								43								43	0%	100%
1997	5	5	25	178	0.17	0.83											208	100%	0%
1998	1			114													114	100%	0%
1999	4			73										348			421	17%	0%
2000	6	19	18		0.51	0.49	3	32	480	0.09	0.91						552	7%	93%
2001	7	192	178	851	0.52	0.48											1221	100%	0%
2002	8			43			19	41	1225	0.32	0.68						1328	3%	97%
2003	2			171													171	100%	0%
2004	11	124	168	8	0.42	0.58	5	6		0.45	0.55	500	796	297	0.39	0.61	1904	16%	1%
2005	1			428										28			456	94%	0%
2006	3			1					246								247	0%	100%
2007	6			14					53					268			335	4%	16%
2008	1											44			0.50	0.50	44	0%	0%
2009	3	187	179	4	0.51	0.49	37	61		0.38	0.62						468	79%	21%
2010	1	80	42	2	0.66	0.34	33	70	6	0.32	0.68						233	53%	47%

Table 4. Estimated recreational use and take of river herring by Hudson River anglers.

Year	Herring Use* % of all CAP Trips using herring as bait	N-SB Trips using RH	N bought / trip	N caught / trip	Total RH use/trip	Estimated SB trips**	Trips using herring as bait**	Estimated Herring Use
2001						53,988	39,500	93,157**
2005	89%				2.36	72,568	64,500	152,117**
	Cooperative Angler Program Data							
2006	93%	263	1.47	2.57	4.04			
2007	70%	331	1.66	1.80	3.46	90,742	69,700	241,318***
2008	71%	445	0.86	1.64	2.50			
2009	77%	492	0.63	3.80	4.43			
2010	74%	527	0.67	4.80	5.48			

*Data from NYSDEC - HRFU Cooperative Angler Program (unpublished data)
**Creel survey data: NAI 2003, NAI 2007; 2001 estimated use modified using 2005 RH use per trip* 2001 trips using herring as bait
***Estimate calculated from overall average RH/trip (CAP) and Estimated SB trips from NYSDEC statewide angler survey

Table 5. Current and proposed recreational fishery regulations for a river herring fishery in the Hudson River.

Regulation	**Current 2010 Recreational**	**Proposed change- *new***
Season	All year	March 15 to June 15
Creel/ catch limits	None (any size, any number)	- *10 per day per angler or a maximum boat limit of 50 per day for a group of boat anglers (whichever is lower)* - *Charter boats: (see commercial fishing table)*
Closed areas	- None below Troy Dam - Closure from Guard gate 2 to Lock 2 on the Mohawk River	- the *River Herring conservation Area: No fishing within 825 ft (250m) of a man-made or natural barrier* - Closure from Guard gate 2 to Lock 2 on Mohawk River
Gear restrictions	-Angling -Scap/lift net: 36 sq ft or smaller - Dip net: 14" round or 13"x13" square - Seine: 36 sq ft or smaller - Cast net; 10ft diameter	- *All tributaries, including the Mohawk River above Troy: Angling only, no nets* - Main river below Troy Dam: Angling or the use of nets to obtain bait for personal use only as follows: - *Scap/lift net 16 sq ft or less* - Dip net: 14" round or 13"x13" square - Seine 36 sq ft or smaller - Cast net 10 ft diameter
Escapement (no fishing days)	None	None
License	Marine Registry	Marine Registry
Reporting	None	*New York angler diary on ACCSP website*

Table 6. Current and proposed commercial fishery regulations for a river herring fishery in the Hudson River.

Regulation	**Current 2010 Commercial**	**Proposed change - *new***
Season	Mar 15 – Jun 15	Mar 15 – Jun 15
Creel/ catch limits	None	*Charter boats: 10 fish per day per paying customer or a maximum boat limit of 50 fish per day,(whichever is lower)**
Closed areas	- No gill nets above I90-Castleton Bridge - No nets on Kingston Flats	- No gill nets above I90 - Castleton Bridge - No nets on Kingston Flats - *No nets in tributaries*
Gear restrictions	Allowed gears - Gill net o 600 ft or less o 3.5 in stretch mesh or smaller o No fishing at night in HR above Bear Mt Bridge - Seine >36 sq ft - No seine >100 ft allowed above I90 bridge - Scap/lift net no size - Fyke or trap net - Cast net not exceeding ten ft diameter	Allowed gears for river herring - Gill net o 600 ft or less o 3.5 in stretch mesh or smaller o No fishing at night in HR above Bear Mt Bridge o *No fixed gill nets above the Bear Mt Bridge* - Seine; no seine >100 ft allowed above I90-Castleton Bridge - *Scap/lift net 10 ft by 10 ft maximum* - Cast net not exceeding ten ft diameter
Escapement (no fishing days)	- 36 hr lift (applies only to gill nets allowed in the main river)	- 36 hr lift - *Applicable to all net gears*
Marine Permit	Marine Permit - Fees implemented in 1911 - Gill net $0.05/foot - Scap net <10 sq ft $1.00 - Scap net>10sq ft $2.00 - Seine $0.05/foot - Trap nets $3 to $10 - Fyke net $1 to $2 Bait license - Cast net $10	- *Marine permit only license to take anadromous river herring*, the only net gears allowed include drift and fixed gill net, scap/lift net,seine and cast net - Fees updated to include any of the following: 1a. Gill or seine net - $115; scap net $25 1b.Gill or seine $1 per foot 1c.Fishing vessel $350 2. Create Hudson River commercial fish permit; includes use of gillnets, scap/lift nets, seines and cast nets with all other restrictions as listed in this table; qualifications needed (see Sec 6.1.2, page 26)
Charter* Boat License	None for Hudson above the Tappan Zee Bridge	Require existing Maine &Coastal District Party boat/ Charter license for tidal Hudson and its tributaries- $250.00
Reporting	Mandatory daily catch& effort; one annual report	Mandatory daily catch& effort; *reports due monthly*

Appendix A. River herring streams of New York including tributaries of the Hudson River Estuary, and the Mohawk River; streams in the Bronx and Westchester Counties and on Long Island. (This list may not be complete).

Hudson River						
River Mile	County	Primary Tributary	Secondary Trib1	Secondary Trib2	M to barrier	Ft to barrier
18	Westchester	Saw Mill			100	328
24	Rockland	Sparkill Creek			1,620	5,315
25	Westchester	Wicker's Creek			240	787
28	Westchester	Pocantico River			950	3,117
33	Westchester	Sing-Sing			450	1,476
34	Westchester	Croton River			2,860	9,384
38	Westchester	Furnace Brook			820	2,690
38	Rockland	Minisceongo			2,100	6,890
39	Rockland	Cedar Pond Brook			4,500	14,765
43	Westchester	Dickey Brook			2,610	8,563
44	Westchester	Annsville Creek	Peekskill Hollow	Sprout Brook	1,140	3,740
44	Westchester	Annsville Creek	Peekskill Hollow		2,310	7,579
44	Westchester	Annsville Creek			3,000	9,843
46	Orange	Popolopen Creek			840	2,756
52	Putnam	Phillipse Brook			1,160	3,806
52	Putnam	Indian Brook			1,240	4,068
53	Putnam	Foundry Brook			880	2,887
55	Putnam	Breakneck Brook			160	525
57	Orange	Moodna Creek			4,740	15,552
58	Dutchess	Malzingah Brook (Gordon's Brook)			100	328
59	Dutchess	Fishkill Creek			980	3,215
67	Dutchess	Hunters Brook			180	591
67	Dutchess	Wappingers Creek	Hunters Brook		3,380	11,090
69	Ulster	Lattintown Creek	S. Lattintown		550	1,805
69	Ulster	South Lattintown			1,100	3,609
75	Dutchess	Falkill			100	328
76	Ulster	Twaalfskill	Highland Brook		400	1,312
78	Dutchess	Maritje Kill			190	623
81	Dutchess	Crum Elbow			270	886
84	Dutchess	Indian Kill			1,200	3,937
84	Ulster	Black Creek			1,670	5,479
87	Dutchess	Fallsburg Creek			2,000	6,562
87	Dutchess	Landsman Kill			2,100	6,890
91	Ulster	Roundout			3,820	12,533
98	Columbia	South Bay Creek			890	2,920
98	Dutchess	Saw Kill			970	3,183
100	Dutchess	Stony Creek			2,290	7,513
101	Ulster	Esopus Creek			1,850	6,070
105	Columbia	Cheviot Creek			380	1,247
110	Columbia	Roeliff Jansen Kill			9,320	30,579
112	Greene	Catskill Creek	Kaaterskill Creek		4,940	16,208
118	Greene	Murderers Creek			930	3,051
121	Columbia	Stockport Creek	Claverack Creek		1,250	4,101
121	Columbia	Stockport Creek	Claverack Creek	Kinderhook Cree	1,780	5,840
126	Greene	Coxsackie	Sickles Creek (dry)		1,270	4,167
128	Columbia	Mill Creek			1,870	6,135
131	Albany	Hannacroix			1,650	5,414
132	Albany	Coeymans			300	984
135	Renssalaer	Schodack	Muitzes Kill		10,900	35,763
136	Renssalaer	Vlockie Kill			1,880	6,168
137	Albany	Vloman Kill			1,130	3,708
137	Renssalaer	Papscanee	Moordener Kill		1,550	5,086
142	Albany	Normans Kill			2,970	9,745
144	Renssalaer	Mill Creek			210	689
149.5	Renssalaer	Wynants Kill			430	1,411
150	Renssalaer	Poesten Kill			310	1,017
Above Troy Dam		Mohawk River			183,000	600,423

Appendix Table A continued.

County	Stream
Bronx	Bronx River
	Hutchinson River
Westchester	Beaver Swamp Brook
	Blind Brook
	Byram River
	Mamaroneck River
	New Rochelle Creek
	Otter Creek

Long Island			
Shore	Stream &.or Pond with outlet	Tributary	Alewife Present?
South	Beaverdam Creek		Unknown
South	Browns River		Unknown
South	Carlls River		Confirmed
South	Carmans River		Confirmed
South	Connetquot River	Westbrook, Rattlesnake Creek	Unknown
South	Massapequa Creek		Confirmed
South	Mud Creek		Unknown
South	Patchogue River		Unknown
South	Penataquit Creek		Unknown
South	Swan River		Unknown
South	Champlin Creek		Unknown
South	Forge River		Unknown
South	Pipes Creek		Unknown
North	Beaver Brook		Unknown
North	Cold Spring Brook		Unknown
North	Fresh Pond/Baiting Hollow		Confirmed
North	Mill River, Oyster Bay		Unknown
North	Nissequogue River		Confirmed
North	Setauket Mill pond		Unknown
North	Stony Hollow Run, Ctrpt.		Unknown
North	Sunken Meadow Creek		Confirmed
North	Wading River		Unknown
East End	Alewife Brook		Confirmed
East End	Alewife Creek/Big Fresh Pond		Confirmed
East End	Big Reed Pond		Confirmed
East End	Ely Pond		Restoration stocking effort
East End	Gardiner Bay Creeks		Unknown
East End	Georgica Pond		Unknown
East End	Halsey's-Neck Pond		Unknown
East End	Hog Creek		Unknown
East End	Hook Pond		Unknown
East End	Ligonee Brook		Confirmed
East End	Mill Pond - Mecox Bay Ext.		Unknown
East End	Peconic River		Confirmed
East End	Sagaponack Pond - Jeremy's Hole		Unknown
East End	Scoy Pond		Restoration stocking effort
East End	Silver Lake/Moore's Drain		Unknown
East End	Stepping Stones Pond		Unknown

Appendix Table B. Summary of current (2010) fishery regulations for alewife and blueback herring in New York State.

Fishery / Area
Commercial Harvest:

Inland waters

Hudson River Estuary: G. Washington Bridge north to Troy Dam (River kilometer 19-245)
- Season: 15 March through 15 June
- 36 hour Escapement period (Friday 6 am to Saturday 6pm, prevailing time)
- Net size restriction: limit of 600 ft, mesh size restriction: mesh <3.5 inch stretch mesh
- Net deployment restrictions (distance between fishing gear > 1500 ft)
- Area restrictions (drifted gears allowed in certain portions of the river)

Long Island: No restrictions, except for some towns which have restricted fishing within their township

Marine Waters: Hudson River - G. Washington Bridge south; and waters including NY Harbor and around Long Island
- No limits or season.

Delaware River: NY portion, north of Port Jervis
- No commercial fishery exists in this portion; no rules prohibit it

Baitfish harvest: Take of bait fish (including alewife and blueback herring) are allowed with Bait License in the Inland water of New York State. Allowed gears are seines (all Inland waters) and cast nets in the Hudson River only.

Recreational Harvest:
- No daily limit
- No season
- Harvest can be by hook and line, and some net gears: dip nets (14inches round), scoop nets (13 x 13 inches square), cast net (maximum of 10 feet in diameter) and seine and scap / lift nets 36 square feet or less. Anglers must be registered with the New York Recreational Marine Registry.

Appendix C. Current regulations for river herring fisheries in the Hudson River watershed, and public suggestions for change summarized from meetings held in April, 2010. Published in the NYSDEC website: http://www.dec.ny.gov/animals/57672.html

Regulation	**Current 2010 Commercial**	**Public suggestions for change**
Season	Mar 15 – Jun 15	
Creel/ catch limits	None	- Possession limit of 24 fish for charter boats* - Have a 100 fish daily limit - Have some kind of quota
Closed areas	- No gill nets above I90 Bridge - No nets on Kingston Flats	- Add: Close tributaries to nets
Gear restrictions	- Gill net o 600 ft or less o 3.5 in stretch mesh or smaller o No fishing at night in HR above Bear Mt Bridge - Seine >36 sq ft - No seine >100 ft above I90 bridge	- Gill net o Shorten length to 100 or 200 ft o Add mesh size restriction o Limit net size - Allow no nets
Escapement (no fishing days)	- 36 hr lift (no gill nets allowed in the main river) - does not apply to scap nets in tributaries	- 36 to 72 hr closure - Stay away from the weekend (higher demand for bait)
License	Marine Permit - Varies by gear $1 to $30	- *require a charter boat license - Raise the price of a permit - Increase fee to $75 to $200 Include cast nets as commercial Marine Permit (currently need a bait license) - Make a lottery for obtaining marine permit
Reporting	Mandatory daily catch& effort	

Regulation	Current 2010 Recreational	Public suggestions for change
Season	All year	- Be more restrictive - Choose a season to protect alewife - Choose closure (season) based on water temperature
Creel/ catch limits	None (any size, any number)	- 5 to 10 a day - Allow a special limit for Charter boats: 24 /day - Need to know difference between creel and possession limit? - Make a slot size &/or size limit
Closed areas	None	- Close all the tributaries to fishing - Close the Mohawk to herring fishing - Have rotating tributary closures (changes every 3 years) - Close parts of tributaries
Gear restrictions	- Angling - 36 sq ft scap or smaller - 14" round or 13"x13" dip net - 36 sq ft seine - Maximum 10 ft diam. Cast net*	- No nets, angling only - No nets in tributaries - No nets or smaller gear
Escapement (no fishing days)	None	- Close fishing 3 or 4 days a week - Allow herring harvest either on odd or even days of the week - Close the run during peak of spawning - Time closures (hours during the day or night) - Opposed to day closures - Make no-fishing days enough to protect spawning - Have sliding closures during the week, i.e. "lure" days
License	Marine License $10	
Reporting	None	- Have a call-in number for harvest (like a HIP #) to get better information - Create a website for anglers to input what they catch

Other issues (other than a fishery) that are creating problems for river herring

- Chlorine discharge problems
- Ocean harvest is the problem- not the river fishery
- Increased silt (covers eggs)

<u>Long Island streams</u>: The lack of data means that no fishery will be allowed under the "sustainable" definition in the ASMFC Amendment 2 . Information on habitat and passage issues will be gathered.

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

BUREAU OF FISHERIES

2011-12 Annual Report

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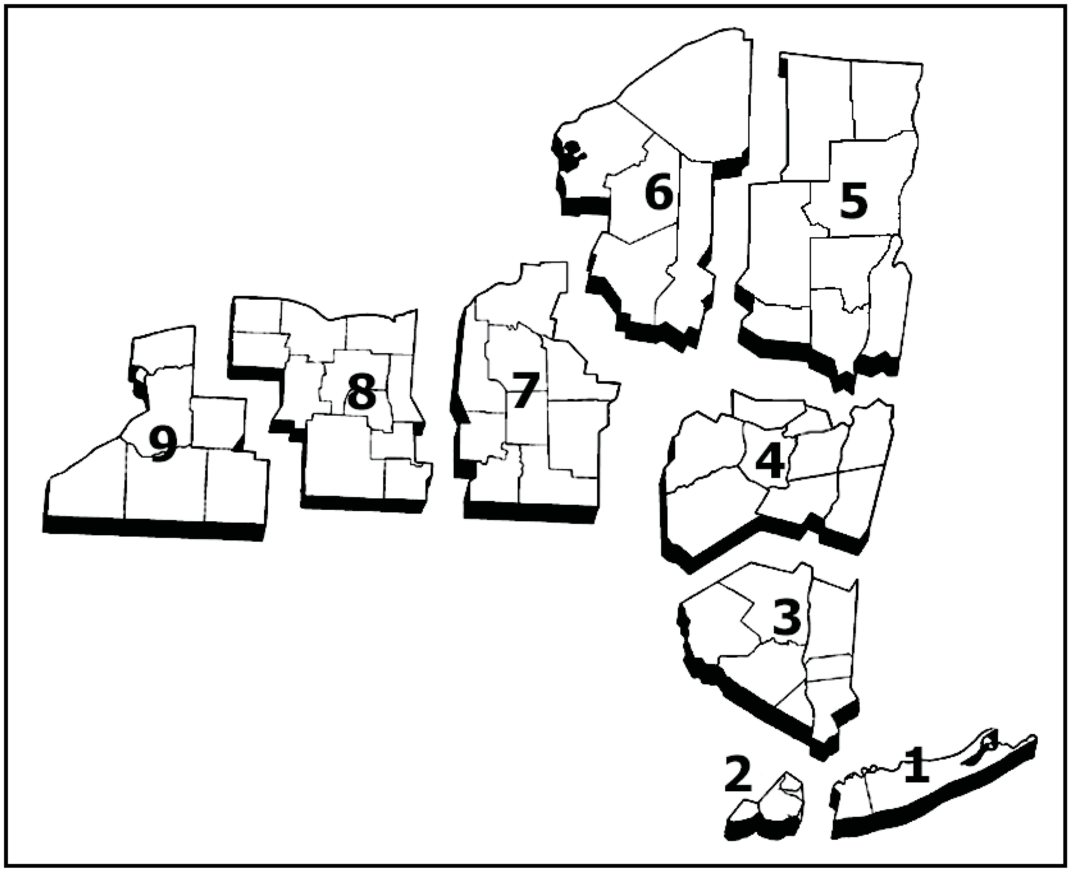
DEC REGIONS



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2011-12 Annual Report

New York State Department of Environmental Conservation
Bureau of Fisheries

Phillip J. Hulbert, Chief

Introduction

The New York State Department of Environmental Conservation, Division of Fish, Wildlife and Marine Resources, Bureau of Fisheries delivers a diverse program and annually conducts a wide array of activities to accomplish its mission:

> ***Conserve and enhance New York State's abundant and diverse populations of freshwater fishes while providing the public with quality recreational angling opportunities.***

This report provides a summary of significant activities completed during fiscal year 2011-2012 by Bureau of Fisheries staff located in 9 regional offices, 2 research stations, 12 fish hatcheries, 1 fish disease laboratory, as well as the DEC Central Office in Albany.

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Common Acronyms, Definitions and Units of Measure

Common Acronyms

ACOE: Army Corps of Engineers

BEF: Boat electrofishing

CPUE or CUE: catch per unit of effort - such as the number of fish caught per hour or fish caught per net.

DEC or NYSDEC: Department of Environmental Conservation.

DFWMR: Division of Fish, Wildlife and Marine Resources.

RM: river mile - denotes the distance upstream from the river mouth.

OMNR: Ontario Ministry of Natural Resources

PFR: Public Fishing Rights.

TSMP: Toxic Substances Monitoring Program.

USGS: United States Geological Survey.

USFWS: United States Fish and Wildlife Service.

YOY: young of year - typically a fish that is captured by sampling in the same year it was hatched.

Definitions

Bottom trawl: a sampling technique where a net is dragged along the bottom of a water body behind a boat.

Centrarchid/Centrarchidae: members of the sunfish family, including large and smallmouth bass, bluegill and pumpkinseed.

Creel Survey: a survey where anglers are interviewed about their catch.

Cross vane structure: a “U”-shaped structure of boulders or logs, built across the stream channel to reduce velocity and energy near the stream banks.

CROTS: Catch-Rate-Oriented-Trout-Stocking - the model used by the Bureau of Fisheries to develop stocking rates for trout streams that takes into account biological measures of the stream, stream carrying capacity, angling presuure and wild trout abundance.

Dreissenid mussles: a family of small freshwater mussels that attach themselves to stones or to any other hard surface.

Electrofishing: use of electricity to temporarily stun fish, allowing them to be captured.

Extirpated species: a species that no longer exists in the wild in a certain country or area.

Gill netting: a survey technique that uses a mesh net to ensnare fish.

HUC: Hydrologic Unit Code. A categorization of watershed boundaries from the basin to the sub (small) watershed level (HUC12).

Hydroacoustic survey: use of sound and reflected echoes from schools of fish to estimate abundance.

Pen reared: raising hatchery salmon or trout in a pen to “imprint” those fish to the pen rearing site. In theory, this will cause the fish to return to the pen rearing site to spawn.

Percid/Percidae: members of the perch family, including walleye and yellow perch.

PSD: proportional stock density - describes the portion of a fish population or sample that exceeds a size threshold. For example, the PSD for largemouth bass is the proportion of 12 inch and larger bass in the sample of largemouth bass that were stock size (8 inches and larger).

RSD 15: relative stock density greater than 15 inches - describes the proportion of fish larger than 15 inches in a population or sample of all fish exceeding a size threshold. For example, the RSD 15 for largemouth bass is the proportion of 15 inch and larger bass in a the sample of all largemouth bass that were stock size (8 inches and larger).

Secchi depth: the water depth in which the black and white colors of a disc can longer be distinguished from each other by an observer at the surface of the water.

Seining: using a seine net, a large net that hangs in the water due to weights along the bottom edge and floats along the top, to capture fish.

VHS/VHSv: Viral hemmoraghic septicemia - a serious disease of fish (not humans) recently introduced into New York State.

Year Class: a group of fish spawned during the same year.

Units of Measure

ºC: degrees Celsius - to convert from c to farenheit (f) = (f - 32) x 5/9.

ha: hectare - a metric system unit of area, 1 hectare = 2.47 acres.

hr: hour.

in: inch.

kg: kilogram - a metric system unit of weight, 1 kg = 2.2 pounds.

km: kilometer - a metric system unit of length, 1 km = 0.62 miles or 3,281 feet.

m: meter - a metric system unit of length, 1 meter = 3.28 feet.

mm: millimeter - a metric system unit of length, 100 mm = 3.94 inches.

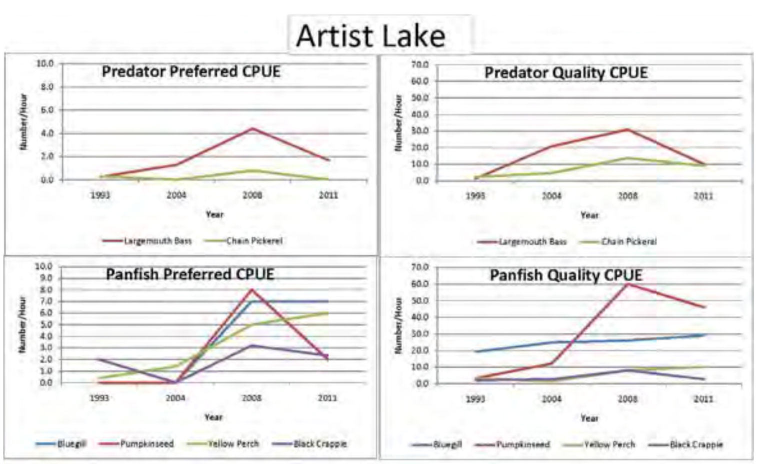
ppm/ppb: part per million/parts per billion - describes the density of a substance in another solid, liquid or gas (typically water, air).

µg/l: micrograms per liter; equivalent to ppb,

Surveys o two waters show community level benefits rom bass catch and release regulation

Electrofishing surveys of Grant Park Pond (Nassau County) and Artist Lake (Suffolk County) were completed to assess the impact of a catch and release regulation on the largemouth bass population. This regulation was put in place on Grant Park Pond in 1998 and Artist Lake in 2004 in an effort to improve the quality of the bass population. While overall Catch per Unit Effort (CPUE) for most species declined after the regulation change in both waters, CPUE for quality and preferred size fish increased for most species. At Grant Park Pond, the overall largemouth bass CPUE dropped from 60 bass/hour in 1991 to 33 bass/hour in 2011, but the CPUE of bass over 12 " (quality size) increased from 1.8 to 9.6 bass/hour and the CPUE for bass over 15" (preferred size) increased from 0 to 6.0 per hour. Over the same time period the overall bluegill CPUE decreased from 152/hour to 117/hour while bluegill over 6" (quality size) increased from 18.4/hour to 39.2/hour and bluegill over 8" (preferred size) increased from 0 to 31.2/hour.

Artist Lake has a more diverse fish community than Grant Pond and the results are more nuanced. In addition to largemouth bass and bluegill the lake also supports chain pickerel, pumpkinseed, yellow perch and black crappie. In 2008, the CPUE for quality and preferred size fish increased for nearly every species. However, in 2011 the CPUE for quality and preferred size bass, pickerel, and black crappie all declined. Bass and pickerel CPUE declined to near or below pre-regulation change levels while crappie and pumpkinseed CPUE remained above pre-regulation change levels. CPUE for quality and preferred size bluegill and yellow perch continued to increase from 2008 to 2011.



In both ponds the number of desirable size fish of all species has increased, though the increase has been more variable in Artist Lake. The most likely explanation for this is that the catch and release only regulation leaves more large bass in the population. These large bass are more effective at thinning small panfish, so that those remaining can grow larger, providing a more desirable size distribution of all species of fish for the angler.

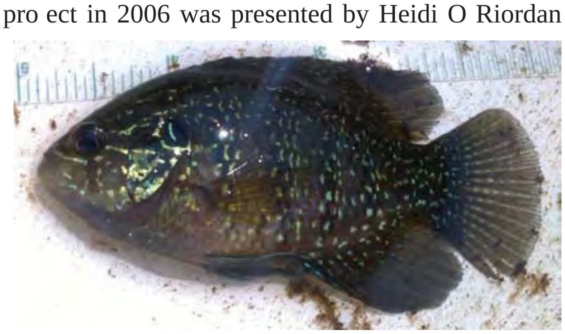
P T Tagging Pro ect Carmans River Southaven County Park:

Staff completed the construction and installation of eight antennas along the Carmans River to track the passage of PIT tagged alewife, brook trout, brown trout, rainbow trout and American eel. Of particular interest is the passage of these fish species over the fish ladder at Hards Lake and over the dam at Southaven Park Gate C. These antennas will track the passage of any of these fish that contain a small Passive Integrated Transponder (PIT) tag. PIT tags are relatively small, internal, and have an indefinite lifespan. When a tagged fish passes through an antenna, the fish s tag number is recorded, along with the date and time, by a data logger attached to the antenna. This information is stored and then later uploaded onto a laptop. Staff have also partnered with Cornell Cooperative Extension of Suffolk County in order to increase the number of antennas in place in the Carmans River and to increase the number of fish tagged. They have designed and built antennas for the tidal section below the Hards Lake dam and for two locations further upstream. Cornell staff will also tag white perch, yellow perch, brown bullhead, and common carp to determine their movement within the upper and lower (tidal) river.

In 2011, DEC staff successfully tagged 100 brown and 100 rainbow trout at the Catskill Hatchery with zero mortality. These fish represent 10   of the trout destined for this section of the Carmans River. Wild fish were also tagged and released, including four alewives and one American eel. More wild fish will be caught and tagged using Fyke nets and electrofishing in April 2012.

Threatened Fish Assessment

Ten waters in the Peconic River Drainage were surveyed during uly and August to search for banded sunfish *Enneacanthus obesus* and swamp darter *Etheostoma fusiforme*. Both species are threatened in New York State and are currently only known to exist in the Peconic Drainage on Eastern Long Island. Banded sunfish were collected from all ten waters. Swamp darters were found in two ponds. This was the first record of swamp darter from both waters. The ponds are within Suffolk County Parklands in the Town of Brookhaven. A single specimen from each location was collected for the New York State Museum. During each survey, a fin clip was collected from ten banded sunfish at each location for DNA sequencing. Brookhaven National Laboratory will be conducting the sequencing in an effort to determine the different strains of banded sunfish within the population. This information will be useful should any restocking efforts be undertaken as part of the recovery plan associated with the New York Comprehensive Wildlife Conservation Strategy. Surveys to determine the presence or absence of swamp darter will continue through the summer of 2012. A poster summarizing all of the banded sunfish data since the beginning of the pro ect in 2006 was presented by Heidi O Riordan at the New York



Banded Sunfish

Chapter of the American Fisheries Society meeting this past February. Information included capture methods, environmental and habitat preferences, population data, potential threats to these populations and an update on its current distribution. A copy of “In search of the Banded Sunfish *Enneacanthus obesus*” is available upon request.

I FISH NY Long Island

In 2011, the I FISH NY program reached approximately 6,350 people through fishing clinics and conservation day events. The I FISH NY program also worked with an additional 625 public school students through in class programs and charter boat fishing programs in collaboration with Nassau BOCES. Fishing clinics were offered to the public at Lake Ronkonkoma, Hempstead Lake State Park, Town of Brookhaven Corey Beach, and Town of Brookhaven Cedar Beach. A total of nine conservation day activities were held at local schools and parks.

Summer months are particularly busy. Activities include events for local Girl Scout and Boy Scout troops. Of note is the Deep Pond Fishing Clinic, which is held annually in June for Nassau County Boy Scouts. In 2011 the event was held in conjunction with the NYS DEC Free Fishing Weekend. This allowed parents to fish along with their children and made for a very enjoyable experience. This past summer 85 Boy Scouts earned their fishing badge through participating at this event. This year, every participant caught a fish, and for most this was their first time catching a fish.

In recent years due to staffing issues, I FISH NY in Region One has become dependent upon volunteer service. Our larger events would not be possible without this assistance. This past year we were fortunate enough to have over 75 volunteers at the Belmont Fishing Festival, and 50 volunteers assist at the Fall Fishing Festival. Public events have continued to show success without permanent DEC staffing. However, our in school programs have declined significantly from over 20 events per year (with three staff members), to 5 events per year (with one seasonal staff member). Our goal is to double the number of in school programs in the next fiscal year.

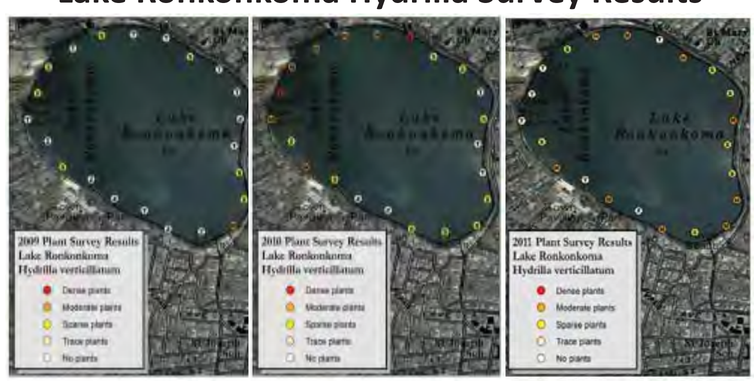
Invasive species control and monitoring continues

Region 1 Fisheries Staff in conjunction with the Peconic Estuary Program and numerous volunteers completed two water primrose (*Ludwigia)* removal operations in the Peconic River in 2011. The first, on August 5, covered most of the river with volunteers in canoes covering the river and DEC staff filling jon boats on Peconic Lake. The second operation on Sept 9, pulled the known remaining patches of Ludwigia from Grangebel Park on the Peconic River. These patches had grown substantially since they were documented in August. Each work day yielded a full pickup truck load of Ludwigia, for a total of nearly 6 cubic yards.

Follow up surveys of Peconic Lake showed some regrowth of Ludwigia in the areas where it was removed, and also revealed several patches upstream from the areas that were cleared. These areas will have to be addressed in 2012. It has become apparent that the total eradication of Ludwigia is not feasible. However the level of infestation is only about 10% of what it was at its peak in 2006 and 2007. Continued vigilance along with a continued hand removal effort should keep the infestation under control. Hand removal efficiency can be maximized by concentrating removal efforts in July when Ludwigia growth is sufficient to make it visible, but before biomass growth accelerates in August.

The annual August survey of the hydrilla infestation in Lake Ronkonkoma showed a less dense infestation than 2010. While there were more sites with moderate plant growth in 2011, the two sites with dense growth in 2010 had only trace vegetation in 2011. The hydrilla infestation doesn’t reach nuisance levels until late September, when use of the lake is declining. It then dies back completely over the winter. At the present time the hydrilla is not interfering with the use of the lake, so management is limited to monitoring and public education oriented towards preventing its spread to other water bodies.

Lake Ronkonkoma Hydrilla Survey Results



2009 2010 2011

2011-12 Region 1 Fisheries Staff

Charles Guthrie	Biologist 2 (Aquatic)
Heidi O’Riordan	Biologist 1 (Aquatic)
Charles Vullo	Seasonal Laborer (4/1/11 – 9/30/11)
Ann Ezelius	Environ. Education Assistant
Garrett Cacciola	SUNY ESF Intern (6/15/11-8/20/11)
Kathleen Marean	Seasonal Fish & Wildlife Technician
Chris Scott	Seasonal Fish & Wildlife Technician

Warmwater Fisheries Surveys

Oakland Lake

An electrofishing survey of Oakland Lake,   ueens was performed on 4/18/11. The last DEC electrofishing survey of this water body was in 1996. Fish species captured included largemouth bass, black crappie, bluegill and pumpkinseed. Chain pickerel, a relatively uncommon NYC fish species, were also collected. Catch per unit effort (CPUE) of all fish was 385/hr. CPUE for largemouth bass 12" and longer was 8 fish/hr and 5 fish/hr for bass 15" and longer. The heaviest bass captured was almost 6.5 lb. CPUE of chain pickerel 15" and greater was 3 fish/hr. Combined bluegill and pumpkinseed CPUE was 226 fish/hr for fish six inches and greater in length and 5 fish/hr for fish eight inches and greater in length. Fish were also collected for disease testing as part of the DEC statewide fish disease surveillance program. Collected fish did not test positive for any of the diseases they were tested for.

Wolfe's Pond

An electrofishing survey of Wolfe s Pond, Staten Island was performed on 4/21/11. The ma ority of species collected were warmwater fish species: black crappie, largemouth bass, pumpkinseed, bluegill, golden shiner, brown bullhead and common carp. CPUE of all fish was 357 fish/hr. CPUE of largemouth bass 12 inches and longer was 11 fish/hr and 3 fish/hr for bass 15" and longer. CPUE of black crappie eight inches and longer and 10 inches and longer was 7 fish/hr and 3 fish/hr, respectively. Combined bluegill and pumpkinseed CPUE was 50 fish/hr for fish six inches and longer. Due to its close proximity to Raritan Bay, Wolfe s Pond was also home to saltwater-tolerant fish such as gizzard shad, American eel and white perch. Unfortunately, the berm separating Wolfe s from the marine waters of Raritan Bay was breached during Hurricane Irene and the pond was overcome by salt water, destorying the freshwater fish population. The NYC Parks Department has plans to reconstruct the berm and restore Wolfe s pond. Data from our 4/21/11 survey should be helpful towards pond restoration.

Northern Snakehead Surveys

DEC Region 2 Fisheries has been monitoring the invasive species northern snakehead in Meadow and Willow Lakes of Flushing Meadows Corona Park since 2006. Until 2011, catch per unit effort (CPUE) of snakeheads has remained the same and that of other fish species has remained the same or increased. Fish data from electrofishing surveys on 10/18/2011 (Willow Lake) and 11/3/11 (Meadow Lake) showed a slight increase in CPUE for nearly all fish species in these lakes, including northern snakeheads. The increase in CPUE was likely due to improved water clarity which enhanced the collection of fish. Largemouth bass were found in 2011, as they were in 2010. This is significant as largemouth bass represent the only other top predator in these lakes.

Green Sunfish ound in Central Park

Green sunfish (Lepomis cyanelllus) were found during a 10/25/2011 electrofishing survey of the Harlem Meer in Central Park. This was the third survey of this water body in four years but the first time green sunfish have been found in any water body surveyed in Region 2. Other species of fish found during the survey included largemouth bass, black crappie, bluegill, pumpkinseed and yellow perch.

F SH NY

NYC School Fishing Program

Spring In-School fishing program: 61 classes, 1338 total students. Highlights include:

Gantry Park

After years of spring season fishing with the I FISH NY program, PS 148 (ueens) students were able to take advantage of the potentially great fishing the fall season offers in New York City. Each of three classes of elementary students caught fish with a blitz occurring during the final class where striper after striper was hauled over the railing, sometimes two at a time. Teachers, students and, especially, R2 fisheries staff were very pleased with the trip.

South Richmond High School

The ma ority of Region 2 s fishing outreach program is implemented in elementary and middle schools. In 2011, the program expanded into two high schools. One of these schools, South Richmond High School, is located across Hylan Boulevard from DEC s Mt. Loretto Unique Area. While the students from this school had experienced the trails, grasslands and forests of Mt. Loretto, they had not experienced the area s salt and freshwater resources. Through the I FISH NY program, the students learned of the diverse fishery resources of New York State and experienced them firsthand through both seining and fishing at one of the most valued open space areas of Staten Island. While the students did not catch any fish during their fishing trip, a few seine hauls in Raritan Bay yielded uvenile windowpane flounder, bay anchovies, and an assortment of marine invertebrates. These outdoor experiences, along with tree planting on April 29th, have increased South Richmond HS s connection to the local natural resources across the street.

Other Fishing Programs

PS 199, Saturday Environmental Program fishing at 68th St. Pier, Manhattan

Harlem YMCA, fishing at 125th St. Pier, Manhattan

Baisley Pond Family Fishing Clinic, ueens

Raritan Bay Festival at Conference House Park, Staten Island

National Park Service, unior Ranger Program, Ocean Breeze Pier and Wolfe s Pond Park, SI

CAMBA, fishing at Canarsie Pier, Brooklyn

Snapper Derby with NYC Parks, 68th St. Pier, Manhattan

PS 52, Summer School Program, Fishing at Prospect Park, Brooklyn

City of Water Day, Governor s Island, Manhattan

Workshops and Trainings

Harbor School Fishing Club

The NYSDEC I FISH NY program partnered with The Harbor School in New York City to establish a fishing club at the school s site on Governor s Island. The club will hold monthly meetings from anuary to April and then weekly meetings from April to the end of the school year. The I FISH NY program s aim is to establish an ethical approach to angling within the club while offering instruction to students and teachers alike, with an emphasis on training the teachers to provide fishing tutelage to future students. Training the teachers will allow the club to become self sustaining, allowing I FISH NY program staff to act in a supporting, rather than tutoring, role in years to come.

National Park Service New York City Parks Sta Training

Region 2 Fisheries staff led an angling training workshop for outreach professionals from both the National Park Service (NPS) and New York City Department of Parks and Recreation (NYC Parks). The workshop taught participants the fundamentals of setting up a fishing rod, aquatic education, fresh and saltwater recreational fishing regulations and fish consumption advisories. National Park Service staff are gearing up to implement fishing clinics for new anglers within Gateway National Recreation Area, and DEC s I FISH NY program is providing the angler training for the future angler trainers. The NPS and NYC Parks staff members were enthusiastic and followed instruction well. By the end of the class, they were familiar with basic knot tying and setting up a fishing rod, fish identification, rules and regulations that apply to New York City waters, and the basics of finding fish to catch in New York City. R2 staff hopes to coordinate events with both the NPS and NYC Parks in the future and has plans for additonal train-the-trainer programs. An additional training was also held for Prospect Park Alliance staff.

NYSMEA Share A Thon

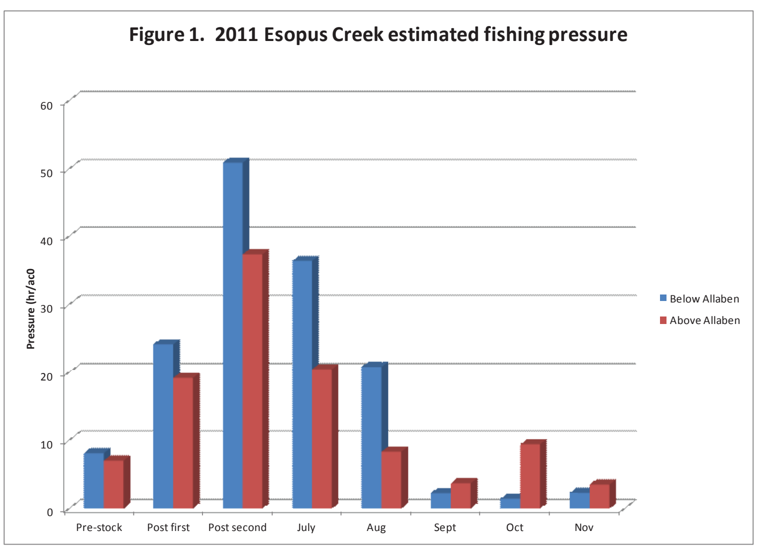
Region 2 Fisheries staff participated in a New York State Marine Educators Association "Share-A-Thon" workshop at Columbia Teachers College. The workshop provided useful, natural resource-focused, lesson plans to teachers. R2 staff presented the Fish Anatomy and Diversity lesson plans used in its I FISH NY classroom program and received an enthusiastic response from the teachers. These lesson plans utilize I FISH NY Go Fish playing cards and are a simple and effective way to teach students of different ages about fish anatomy and the diversity of fish found in New York State. Teachers of indergarten through high school participated in the workshop and will hopefully help get the word out to their students about the wonderful diversity of fish found in New York State.

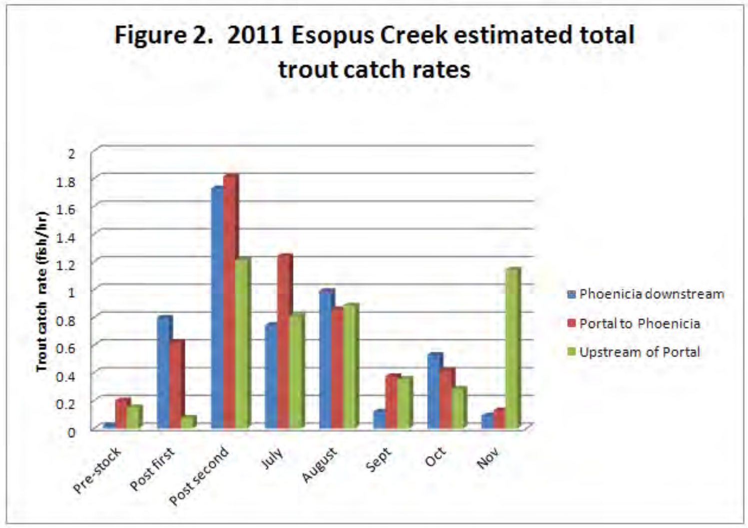
2 2 e ion 2 Fisheries Staff	
Melissa Cohen	Biologist 2 (Aquatic)
Darin Alberry	Environmental Education Assistant
Diallo House	Environmental Education Assistant
ames MacDonald	Environmental Education Assistant

Esopus Creek Creel Survey

A full season (April 1 November 30) creel survey was conducted on Esopus Creek during the 2011 season. The surveyed reach includes the 11.9 mile section from the Ashokan Reservoir to the Allaben portal (broken into two sub sections), along with the section from the portal upstream to Lost Clove (5.0 mi). A total of 134 days were sampled in 2011. The defining event(s) in 2011 were Hurricane Irene in late August, followed by tropical storm Lee shortly thereafter. The Esopus watershed was absolutely devastated by record flooding from Irene, and the creel schedule was reduced in the two weeks following the storm in response to no fishing pressure being observed in the watershed.

The overall season pressure estimate for the Esopus was 146 hr/ac below the portal, and 109 hr/ac above the portal. For analytical purposes, the "post second" period is the period of time from the second increment of stocking (generally late May) through une 30. Fishing pressure predictably rises after the first and especially second stocking increments, likely in response to both the placement of the fish as well as the onset of warmer weather. It is interesting that post-Irene, the five mile "above portal" section attracted more pressure than the 16 mile "below portal" section, since both were devastated by the flooding (Figure 1). Total trout estimated catch rates (Figure 2) follow a similar pattern as fishing pressure, with the highest catch rates following the placement of the two stocked increments. It is interesting that the "above portal" section showed such a high catch rate in November, however, this is likely skewed by a low sample size for that month. It will be interesting to see how the 2012 catch rates develop after the flooding of late 2011.



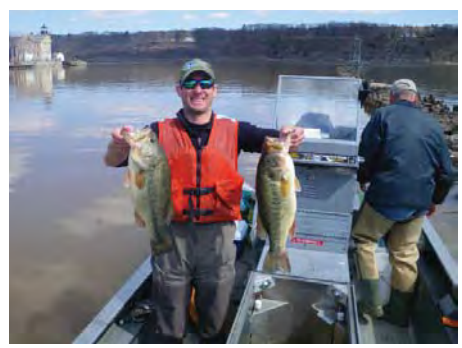


ensico and Rondout Reservoir ake Trout Management

Due to the abundance of wild lake trout noted by angler diary cooperators and recent fisheries surveys in ensico Reservoir and Rondout Reservoir, lake trout stocking will be terminated in both waters. In ensico Reservoir, 93 of the lake trout were determined to be of wild origin. In 2010, the angler catch rate for lake trout was 0.57 per hour and the fish averaged 19.3" in length.

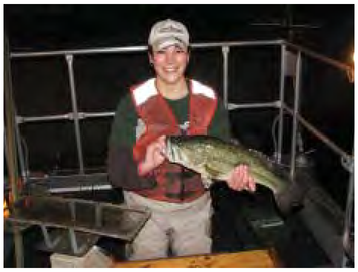
Lake trout were first introduced into Rondout Reservoir in 1976, with a stocking of 40,000 surplus Adirondack strain fall fingerlings. This increment survived to spawn around 1981. Starting in 1981, an annual stocking policy of 6,800 yearling lake trout was instituted. Gillnet survey data collected between 1990 and 2011 have documented a wild lake trout component of 64 to 89 in five survey samples through this time period, with the most recent surveys (2010 and 2011) containing 89 and 74 wild lake trout, respectively.

Tidal Esopus Creek Black Bass Monitoring



In early April, a boat electrofishing survey was conducted to monitor the overwintering population of black bass in the tidal Esopus Creek and the effect of the 15 inch minimum size regulation. This portion of the Esopus Creek is ad acent to the Hudson River and is known to be one of five important wintering areas for largemouth bass in the Hudson River Estuary. During the previous fall and winter, multiple flood events occurred within this watershed. These floods created a high level of turbidity in Ashokan Reservoir, resulting in New York City Department of Environmental Protection releasing turbid water into the lower Esopus Creek for an extended period of time. This survey resulted in 132 total black bass (117 largemouth and 15 smallmouth) being collected in 1.96 hours of electrofishing (67.4 bass/hour). This catch rate was down from previous years, however, poor water clarity of about 1 foot undoubtedly affected electrofishing efficiency. Despite the poor water clarity through the winter, the bass collected appeared to be healthy. Both largemouth and smallmouth bass averaged 16.1". Nearly 69 of the bass were over 15" and 97.7 of the bass were over 12".

Sylvan ake Bass Assessment



A boat electrofishing survey was conducted in May 2011 to assess the largemouth bass fishery in this 115 acre lake in Dutchess County. A total of 161 largemouth bass were collected, for a catch rate of 159 bass per hour. Forty eight percent of the bass collected were over 12 inches in length. Sylvan Lake currently has a healthy population of largemouth bass. Triploid grass carp were stocked in the spring of 2008 to help control Eurasian milfoil in the lake. The fisheries unit has documented a decline in the aquatic vegetation since this stocking and will continue to monitor the potential impacts on the bass fishery.

Rio Reservoir Walleye Assessment

Rio Reservoir (Sullivan/Orange Counties) was sampled by boat electrofishing on April 1, 2010 to investigate the presence of walleye. A total of 48 walleye were collected in approximately 45 minutes of electrofishing. Subsequent scale analysis during the past year indicated that these fish were four to six years of age, which provides evidence that they likely outmigrated from Swinging Bridge Reservoir (upstream) during a time when it was drastically drawn down to facilitate repair of its failing earthen dam. Swinging Bridge Reservoir is somewhat unique in that its walleye population exhibits successful year class recruitment during most years in the face of an abundant alewife population. It is suspected that the morphometry of Swinging Bridge Reservoir provides spatial separation of the two species, allowing larval walleye to evade alewife predation. Rio Reservoir does not exhibit this morphometry, and a Fall 2011 electrofishing survey failed to collect any young-of-year walleye. Given the demonstrated survival of introduced walleye in Rio Reservoir, a stocking policy of 8,700 fall fingerling walleye has been established. Stocking will commence during late summer 2012.

Stream Disturbance and Article 15 Permit Review

Following Tropical Storms Lee and Irene, Fisheries staff were called upon to issue General Permit Authorizations for emergency work along protected streams. During the period immediately following these storms through the end of March 2012, the Bureau of Fisheries, Bureau of Habitat, and Division of Environmental Permits staff issued a total of 496 General Permit authorizations in Region 3. Additionally during the first 30 days of the emergency, 295 Emergency Authorizations were recorded for work conducted before the General Permit was required. By the end of March, the total number of sites that were either visited or where some form of authorization was given had reached 888 sites.

Due to a shortfall in staff within Region 3 Division of Environmental Permits and Bureau of Habitat, staff participated in an experimental initiative to expedite the issuance of Article 15 permits by authorizing Region 3 Fisheries staff to draft and sign permits. The initiative would reduce the in house labor devoted to processing Article 15 permits by having only one agency staff member involved in the environmental review and procedure processing of this category of permit.

Tappan ee Bridge Replacement

The NYS DOT, NYS Thruway Authority and the Federal Highway Administration oined forces to gain the needed approval to construct a new three mile long bridge and demolish the existing Tappan ee Bridge span. Fisheries staff were assigned by the Division of Fish Wildlife and Marine Resources to coordinate DFWMR review of the DEIS and permit application for the work; including the Sediment Test Borings and the Pile Installation Demonstration Pro ect (PIDP) as well as the full bridge construction, slated to begin in August 2012.

The ma or potential impacts identified by staff stem from the underwater sound and pressure waves from the pile driving, dredging of approximately 175 acres of Hudson River shoal habitat and the suspension of sediment.

Fisheries staff are actively participating in the PIDP to ensure that measures are developed to minimize the effects of underwater sound from pile driving. This has the potential to harm millions of fishes, including the endangered Atlantic and shortnose sturgeon, if it is not reduced by sound attenuation systems.

Champlain Hudson Power Express CHPE

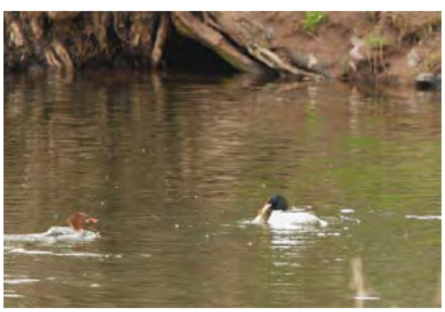
In February 2012, a oint Proposal was signed by parties to a Department of Public Service (DPS) application process for the construction of a 1000 MW bipole transmission facility proposed by Transmission Development Inc. (TDI). The CHPE will consist of two eight inch diameter cables, extending from the Canadian border across Lake Champlain, down the Hudson and Harlem Rivers and across the East River terminating in Astoria, ueens. Over a two year period, DEC staff negotiated several alterations to the proposed construction of the pro ect that will minimize the impacts to the affected waters. The burial depth was increased and the cable will be buried in a single trench, which will greatly reduce the magnetic field emanating from the system. The cable route was significantly modified, avoiding sections of the Hudson River used for Atlantic and shortnose sturgeon spawning, feeding and overwintering habitat. In addition, to ensure that any needed mitigation of impacts is identified in the future, TDI has agreed to create an environmental trust fund totaling 117.5 million. Details of the pro ect are available at: *www.chpexpress.com/index.php.*

2 2 e ion 3 Fisheries Staff	
Mike Flaherty	Biologist 2 (Aquatic)
Bob Angyal	Biologist 1 (Aquatic)
Larry Wilson	Biologist 1 (Aquatic)
Ryan Coulter	Biologist 1 (Aquatic)
Linda Wysocki	Fish Wildlife Technician 3
Tim McNamara	Fish Wildlife Technician 2
Dustin Dominesey	Seasonal Fish Wildlife Technician
Ryan Burns	Laborer 1 (seasonal)
Indie Bach	Laborer 1 (seasonal)

Upper West Branch Delaware River Creel Survey

A creel survey on the 30 mile reach of the upper West Branch Delaware River between Bloomville and Walton was conducted from April 1 through uly 4, 2011, to document fishing pressure and trout catch rates. This reach was stocked with a total of 12,820 yearling and 1,400 2-year old brown trout. Fishing pressure totaled 9,336 hours for an average of 47.5 _1.2 hours which was down about a third from the 75 hours/acre recorded on the same reach during creel surveys conducted in 1984 and 1985. The catch rate (released creeled) for trout in 2011 was 0.5 fish/hour and the creel (harvest) rate averaged 0.2 fish/hour which was comparable to the catch rate of 0.6 fish/hour and the creel rate of 0.3 fish/hour recorded during the 1984 and 1985 creel surveys. An estimated 5,266 trout were caught in 2011 of which 1,248 trout were creeled. Hatchery trout comprised over 90 of the creeled catch in 2011. During the 1984-85 surveys, wild trout comprised 30 of the creeled catch.

Common Merganser Diet Studies



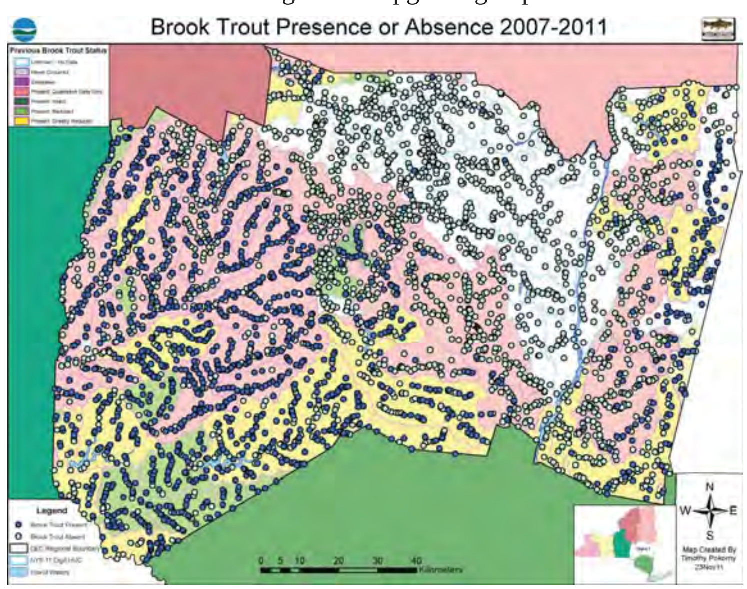
A diet study of common mergansers on the 36.4 mile reach of the upper West Branch Delaware River between the villages of Walton and Hobart was conducted between April 9 and une 26, 2011. Daily merganser abundance during the study period ranged from 5 to 141 birds and averaged 50_7 birds/sample day. These mergansers ate an estimated 7,330 (_ 1,928) yearling stocked brown trout which represents 53 of the fish stocked. This high predation mortality by mergansers may be a ma or contributing factor to the low survival of stocked trout in streams. During another element of this study, a 14 inch brown trout was regurgitated by a captured merganser. In 2010, a 14-15 inch two year old stocked brown trout was observed being eaten by a merganser. Thus, large trout are also vulnerable to merganser predation.

Sus uehanna River Rock Bass

Following several complaints from anglers concerning the scarcity of rock bass in the upper Susquehanna River, the five mile long Wells Bridge pool in Otsego County was boat electrofished. During an intensive 1992 fish population study on this pool, the catch of rock bass per sampling day ranged from 10.0 to 41.5 rock bass/hour for an overall average of 20.5 fish/hour. In the 2011 sampling effort, the catch of rock bass over the two day sampling effort ranged from 1.0 to 4.2 fish/hour for an overall average of 2.6 fish/hour. The catch of other warmwater game fish and panfish species were comparable with the earlier study. Region 7 and Pennsylvania fisheries biologists also report ma or declines in rock bass abundance in their reaches of the Susquehanna River which indicates that the decline is riverwide. Reasons for the decline in rock bass abundance are not known. Further studies are warranted.

Eastern Brook Trout oint Venture Pro ect

The fifth year of a five year pro ect to survey many of the smaller streams throughout Region 4 to determine the presence or absence of brook trout was completed in 2011. A federally funded two man survey team sampled 506 streams between une 2 and Sept 28 including 174 streams where trout were collected. Brook trout were found in 136 streams, brown trout in 75 streams, and rainbow trout in 41 streams. For the five year period from 2007 through 2011, a total of 3,475 small streams were surveyed throughout Region 4 including 1,468 streams that support trout. Brook trout were found in 1,226 streams, brown trout in 779 streams, and rainbow trout in 173 streams. One of the immediate benefits of this effort is that it identifies streams or stream segments that warrant upgrading of their water quality classification. Protected streams require a NYSDEC permit to work on the bed or banks of a stream. Unprotected streams generally do not require a stream disturbance permit. This study found that a total of 585 unprotected streams are now eligible for upgrading to protected status.



Tropical Storms rene and ee

Heavy rains, up to 13 inches in places, associated with Tropical Storms Irene and Lee on Aug 28 and Sept 7 resulted in ma or flooding and damage to all nine counties comprising Region 4, an area the size of Connecticut. The most widespread damages occurred in the upper East Branch Delaware River and throughout the Schoharie Creek watershed. At Schoharie Creek in Gilboa (RM 53.0), stream flow went from 10 cfs to an estimated peak of 108,000 cfs in less than 24 hours and was considered a 500 year flood event. Flood damage throughout the region was extensive. Hundreds of homes were destroyed. Many reaches of state, county, and town roads were washed away or badly damaged. Clean up and repair began immediately once flood waters receded. This effort remains ongoing and is expected to continue through 2012. Regional fisheries and habitat staff were extensively involved in the issuing of emergency Article 15 permits for work on the bed and banks of streams throughout the region. As of Feb 29, 1,417 emergency permits had been issued in Region 4 of which 744 were issued by regional fisheries/habitat staff. The Article 15 workload is expected to be much higher in 2012 because of the extensive and widespread flood damage last August and September.

Before

After

Upper West Branch Trout Population Studies

Mark and recapture trout population estimates with a portable boat shocker were conducted on four sections of the upper West Branch Delaware River between Bloomville and Walton in either late May and/or early une, depending upon flow conditions. Study reaches ranged from 4,917 to 12,689 ft long and covered 6.9 to 29.8 acres. A total of 427 trout (excluding 19 recaptures) were collected including 210 wild brown trout, 5 wild brook trout, 1 wild rainbow trout, 184 hatchery yearling brown trout, and 27 two year old hatchery brown trout. Trout density and biomass at Bloomville (RM 64.2) averaged 19.7 fish/acre and 8.5 lbs, respectively in une. At Delhi (RM 56.1), trout density and biomass in May averaged 9.3 fish/acre and 6.9 lbs/acre compared to 17.4 fish/acre and 6.6 lbs/acre in une. Trout density and biomass at Hamden (RM 46.3) averaged 15.0 fish/acre and 11.1 lbs/acre in une. At Walton (RM 38.8), trout density and biomass in May averaged 18.5 fish/acre and 11.0 lbs/acre compared to 9.7 fish/acre and 2.9 lbs/acre in une. Since this was the first study of its kind on the upper Delaware River, it is not possible to say whether the 2011 results are better or worse than that which occurred historically. However, the trout populations are comparable to those in other larger regional trout streams.

Fish Health Collections

Trout (minimum sample size 60 fish of all sizes per water) were collected from Horton Brook (tributary to the Beaver ill), Sands Creek (tributary to the lower West Branch Delaware River), and the Roeliff ansen ill in Columbia County for fish health testing. These fish were all shipped to the USFWS Lamar Fish Health Center in Pennsylvania where they were tested. This collection is part of an ongoing statewide effort to monitor fish health in waters across New York. All trout tested negative for viral hemorrhagic septicemia (VHS), spring viremia of carp, furunculosis, enteric redmouth, infectious pancreatic necrosis (IPN), whirling diseases, bacterial kidney disease, and infectious hemotopoietic necrosis (IHN). Both warmwater and salmonid fish species have been collected from a variety of waters throughout the region since 2008 for fish health testing. To date, wild fish populations throughout Region 4 remain free of these diseases.

Oriental Weatherfish oach Assessment

In a second season of monitoring New York s Oriental weatherfish (loach) populations, Region 4 Fisheries collected 2000 specimens in the Manor ill headwaters alone. This population appears to be growing exponentially despite efforts to reduce its size using dozens of baited fish traps. A trial to determine if loach can be successfully controlled with rotentone is tentatively planned for summer 2012, if permission and permits are obtained in time. Lab experiments on loach at SUNY Cobleskill resulted in 100 mortality although some specimens survived for up to 1.5 h. nown loach waters in Regions 7 and 9 were also sampled and loach were reconfirmed in Ball Creek (R9). A new population was discovered in R7 above the one found in 2010 suggesting that the Susquehanna River below Bainbridge is now infested with loach. Furthermore, collaboration at the AFS conference in Seattle (loach poster) revealed many states/provinces have loach problems and they can be a disease vector (flatworm).

2 2 e ion Fisheries Staff

Norm McBride	Region 4 Fish Manager
Dan ielinski	Biologist 1 (Aquatic)
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Dave Cornwell	Fish Wildlife Technician 1
Tim Pokorny	Seasonal Fish Wildlife Technician
Rob Poprawski	Seasonal Fish Wildlife Technician
evin Cronin	Seasonal Fish Wildlife Technician
eff Strassenburg	Seasonal Fish Wildlife Technician
Steve Swenson	Stream Protection Biologist (contract)

ake Champlain amprey Control

The abundance of, and fishing opportunities for, lake trout and landlocked Atlantic salmon continue to improve in Lake Champlain. Re-establishing salmon and lake trout is a cooperative effort of the US Fish and Wildlife Service (FWS), the Vermont Fish and Wildlife Department (VTFWD), and the New York State Department of Environmental Conservation (NYSDEC). Controlling the abundance of parasitic sea lamprey is critical to these management efforts.

Lake Champlain sea lamprey treatments were conducted on the Boquet River, Ausable River delta, and the Poultney River, as well as Lewis Creek in Vermont. High lake levels prevented treating Putnam Creek, and Mount Hope Brook. For the delta treatment, the US Fish and Wildlife Service (FWS) has improved both the process of identifying where lamprey larvae are abundant, and the ability to precisely apply lampricide to those locations. These technical improvements probably made this the most effective treatment of the Ausable delta to date. The Boquet River treatment was the first treatment in the Champlain basin to utilize TFM in combination with Niclosamide. The combination provides the same level of effectiveness while using roughly half the amount of chemical that would be required for a TFM only treatment. In addition to chemical treatments, barriers and trapping were employed to control spawning lamprey on Beaver Brook, Mullen Brook, and the Great Chazy River in New York, as well as several streams in Vermont.

The abundance of lamprey wounds on trout and salmon during 2011 was low relative to previous years. Angler reports and electrofishing results show that the abundances and average sizes of trout and salmon increased dramatically with the decrease in lamprey wounding. Similarly, returns of spawning salmon to the Willsboro Fishway on the Boquet River were the best in more than a decade: a total of 69 adult landlocked Atlantic salmon were collected during the fall. For additional information on the salmon fishing visit the DEC website at: *www.dec.ny.gov/outdoor/38369.html*.

Management o nland Waters

Various surveys were conducted on about 33 lakes, ponds, and streams. About 11 of the pond surveys were simple water chemistry checks to monitor acidification. Of those, two ponds (Benz and St Germain) were found to have pH values that may warrant liming.

Lake Algonquin Walleye Assessment

Lake Algonquin in Hamilton County was surveyed to evaluate the effectiveness of walleye fingerling stockings that occurred from 2002-2006. Unfortunately, no walleye were captured so the stocking effort was a failure. The lake does support trophy largemouth bass, and chain pickerel were common. Yellow perch brown bullhead, rock bass, pumpkinseed, smallmouth bass, golden shiner, white sucker and fallfish were also caught.

Middle Saranac Lake Survey

Middle Saranac Lake, a shallow productive 1,300 acre lake in Franklin County, was surveyed to evaluate its potential for walleye stocking. The lake was last surveyed in 1975, so a new survey was necessary to determine quality of the fish community. Nine sites were netted around the lake in a variety of habitats in late une. Unusually high numbers of fish were caught, particularly yellow perch and smallmouth bass. The yellow perch size structure was impressive with many perch over 10 inches long and some as large as 14 inches. Smallmouth bass were abundant in rocky habitat and averaged over 1.5 pounds. Only a few northern pike were caught. Rock bass, pumpkinseed, brown bullhead and white sucker were also captured. A single lake trout was a surprise capture in the deepest net set. Middle Saranac Lake has a maximum depth of 21 feet. Dissolved oxygen levels were excellent at all depths, and no thermocline (area of rapid temperature change) was present. This windswept lake has constant water mixing. The high quality of the yellow perch and smallmouth bass fishery in the lake negates thoughts of adding walleye. The fish community is in good balance and bass predation on stocked walleye fingerlings would be high.

Regional Egg Takes/Broodstock Management

Brook trout restoration and management continued with egg takes for the Heritage strains, and repairs and maintenance to various fish barriers that control invasions by non-native fishes. Egg takes were completed for Horn Lake strain brook trout on Fishbrook Pond (Washington County) and Windfall Strain on Mountain Pond and Black Pond (Franklin County). At Raquette Lake, the lake trout egg take resumed in the fall of 2011 after a one-year hiatus. Raquette Lake provides Adirondack strain lake trout eggs for hatchery production. Resuming collections in 2012 means that only one year s stocking will have been missed.

Public Access

Northville Fishing Pier

A universally accessible fishing pier was installed at the Northville Boat Launch Site on Great Sacandaga Lake. The Great Sacandaga Lake Advisory Council purchased the pier and gifted it to the DEC for all the people around the lake to en oy and use. DEC will be responsible for maintaining the pier including annual installation in spring, and removal prior to ice formation in the fall. The pier has a 40 foot gangway, 24 x 6 foot fishing area and a strong arm for support.

Finch Pruyn Acquisition

Recent easement acquisitions on Finch Pruyn lands in Hamilton County will improve access to Barker Pond and Cranberry Pond in the Town of Indian Lake to the north of Lake Durant. Staff hiked/bush whacked into both ponds in early uly and determined that brook trout were abundant and in good condition.

Habitat Restoration

Tropical storm Irene caused severe flooding in eastern portions of the region in August. Staff consulted with local municipalities in an attempt to minimize habitat damage from instream work conducted after the flood. A cooperative effort with DEC, the Department of Transportation, and the US Fish and Wildlife Service resulted in the installation of cross weirs, rock vanes and bankfull benches near four bridge sites. It is hoped that these demonstration pro ects will provide examples to local municipalities of structures which have a natural appearance yet protect infrastructure and restore habitat for fish. Elsewhere in the region, similar pro ects constructed over a period of years survived, and functioned well through Irene s flooding. Prior to Irene, staff, with help from Dr. ohn Braico of Trout Unlimited, worked to increase awareness of natural channel design concepts. Such approaches were recommended at meetings with various elected officials and landowners in Franklin and Clinton Counties for streams including the Lake Titus Outlet, the Trout River, and the North Branch Chazy River.

Batten ill Habitat Restoration Work Receives National Recognition

The Batten ill has been listed as one of ten "Waters To Watch" by the National Fish Habitat Action Plan. For more information, visit *www.fishhabitat.org*. The river was recognized due to the efforts of the Batten ill Watershed Alliance, US Fish and Wildlife Service, US Forest Service, NRCS, VT Fish and Wildlife, several Trout Unlimited Chapters, states, colleges, private and commercial donors and NYSDEC to re-establish habitat in the Batten ill for brook trout. These pro ects have also been supported by the Eastern Brook Trout oint Venture and the Partners for Fish and Wildlife Program. Several pro ects have been undertaken in recent years to create instream habitat for trout, to stabilize banks and riparian areas, and to work with the stream to achieve more stable geomorphology and improve river dynamics. Several more such pro ects are planned for 2011 and 2012.

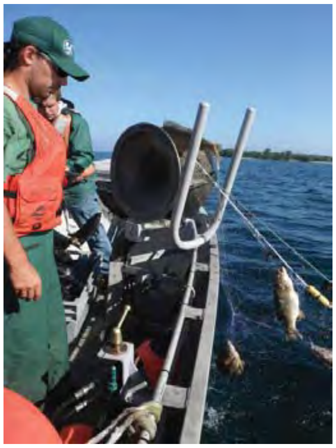
Nonnative Species ntroduction

Fisheries staff have been informed of an unfortunate nonnative species introduction which could have damaging impacts on the Raquette River watershed. Numerous black crappie were reported caught in an ice fishing derby held on Raquette Lake in early February. This confirms earlier reports received last summer from several anglers. Black crappie have been implicated in the demise of naturally reproducing walleye in other Adirondack lakes, particularly Black Lake in St. Lawrence County. Walleye in Tupper Lake, Piercefield Flow and Carry Falls Reservoir may ultimately pay the price for this illegal introduction.

2 2 e ion Fisheries Staff

Bill Schoch	Regional Fisheries Manager
Rich Preall	Senior Aquatic Biologist
Emily ollweg	Senior Aquatic Biologist *(transferred to Cortland 1/12)*
im Pinheiro	Senior Aquatic Biologist *(transferred from New Paltz 1/12)*
Rob Fiorentino	Senior Aquatic Biologist
ennie Sausville	Fish and Wildlife Technician 3
Beth ress	Environ. Educator Assistant (Seasonal)
Adam osnick	Seasonal Fish and Wildlife Technician
Doug Peck	Seasonal Fish and Wildlife Technician

Eastern ake Ontario/St awrence River Warmwater/Coolwater Fish Stock Assessments



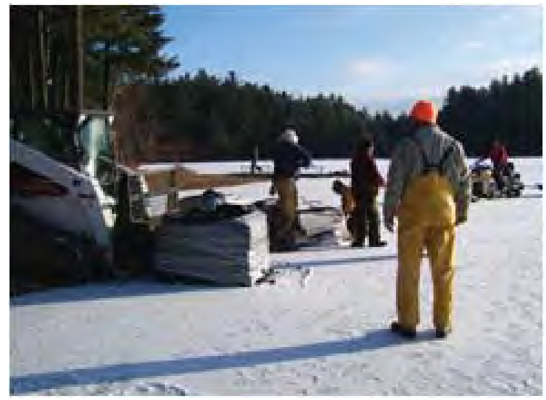
Over one-third of fishing effort in Region 6 occurs on eastern Lake Ontario or the St. Lawrence River. Warm/coolwater fish stock assessments are conducted by the regional fisheries management unit on the St. Lawrence River and by both regional and Lake Ontario units on eastern Lake Ontario. The assessments track condition of fish stocks in these waters. In the St. Lawrence River Thousand Islands area abundance of legal size smallmouth increased from record lows 1996-2004 and has varied at moderate levels since 2006. Much of this increase has been due to faster growth and earlier recruitment of young fish probably due to increased availability of round goby forage. Northern pike abundance in the Thousand Islands remains depressed largely due to habitat changes resulting from water level regulation. Walleye numbers remain above the long term average for Lake St. Lawrence. Smallmouth bass catch declined 30 from recent (2006-2010) levels, although remaining well above the record-low levels experienced from 2000-2004. Recent increases in eastern Lake Ontario and St. Lawrence River yellow perch abundance has been attributed partly to reduced cormorant predation. Regional cormorant management and a switch to round goby prey have reduced cormorant consumption of sport and panfish.

Brook Trout Management

Heritage Strain Egg Takes

In an effort to help maintain genetically unique native populations of Adirondack brook trout (heritage strains), Region 6 completed an egg take for Little Tupper strain brook trout. Besides helping to maintain heritage genetics, the use of these fish in stocking is thought to provide fish that are better able to thrive and spawn in the water conditions common to Adirondack ponds. This year s Little Tupper strain egg take occurred primarily at Boottree Pond in the Massawepie Easement. This was the fourth year that we were able to do an egg take from Boottrree Pond since this population of brook trout was established in 2005. Region 6 has four waters that serve as brood waters and is in the process of establishing new brood waters for the various heritage strains. This will eventually allow greater reliance on heritage strain fish in the DEC stocking program.

Offetting the Effects of Acid Precipitation



In an effort to counter the effects of acid rain, Little Otter Lake and Pitcher Pond were treated with agricultural lime during the month of February. The lime is applied during the winter so it can be spread out over the surface of the pond ice. The Region 6 liming program monitors a set of 21 brook trout ponds and lakes suitable for treatment under guidelines formalized in 1990. Without periodic liming, these waters would acidify to levels lethal to brook trout.

Management o Rare and Endangered Fishes

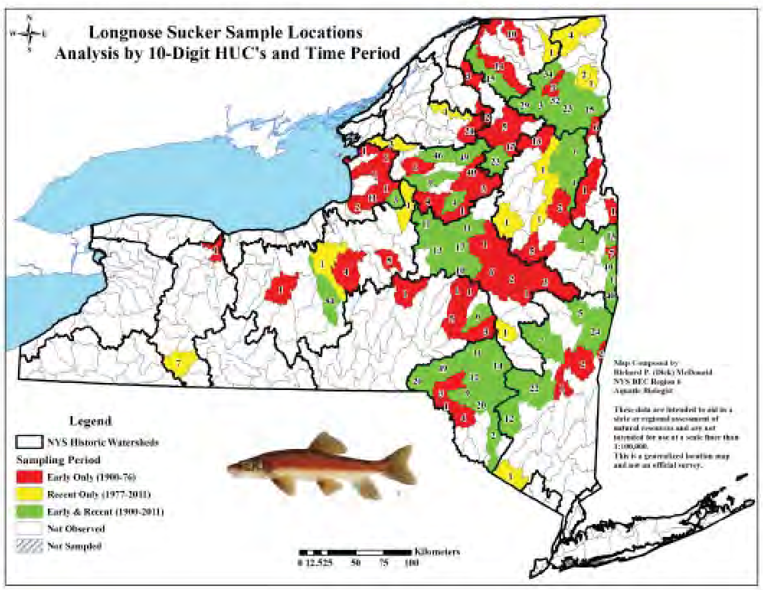
Lake Sturgeon Restoration

Lake sturgeon *Acipenser fulvescens* is a Threatened species in New York State. Restoration activities have been ongoing since 1991. A tagging study began in 2010 to acquire biological data and provide the basis for movement studies throughout Lake Ontario and the St. Lawrence River. A total of 247 sturgeon were collected in 2011 from the eastern basin of Lake Ontario and the St. Lawrence River to ust below the Robert Moses Power Pro ect. The ma ority of fish (226) were new captures and were tagged with Passive Integrated Transponders (PIT tags). Two recaptured sturgeon had moved from upper St. Lawrence River areas to a spawning congregation below the Robert Moses Power Pro ect, either by surviving a trip through the hydro facility turbines or by navigating the Eisenhower and Snell shipping locks. Lake sturgeon eggs (600,000) were taken in early une at the Robert Moses Power Pro ect, Massena NY, with eight egg bearing females providing eggs. Unfortunately eggs failed to show any sign of development after egg take.

Mapping of Rare and Endangered Fish Species

Region 6 Biologist Dick McDonald and ETS Biologist Doug Carlson produced maps identifying the locations of 41 rare fish species in New York State. Geographical Information Systems (GIS) software was used to construct the maps of the locations of these rare fish. The software was also used to analyze changes in their distribution from 1900-2011 within 18 historic watersheds.

Rare species are often under-represented in routine sportfish surveys. Therefore, Doug Carlson compiled all the records from the New York State Museum and the DEC Watershed Surveys to use in the analysis. Field biologists made special efforts to survey these rare species, and in many cases, detailed written location descriptions were converted to map coordinates to allow for the "atlasing" of data used in these newly created maps. This information was combined with that from the earlier comprehensive reviews of these species from the 1930s and late 1970s. The latest maps developed are being used to determine whether populations have reduced or expanded their distribution in New York State.



Habitat Restoration

Tropical Storms Irene and Lee proved to be extremely destructive to streams in the Mohawk River Valley. The steep gradient of the streams in the Mohawk Valley, coupled with the increasing urbanization of the region, led to widespread flooding and stream bank erosion. Region 6 fisheries staff responded to numerous calls from local municipalities and private land owners who had been flooded or had lost property due to streams eroding and changing course. The ma ority of problem sites were located in heavily populated areas or areas where roads and streams ran parallel to each other.

For example, ma or stream damage occurred in Oneida County in the Town of Paris, when Sauquoit Creek cut around an existing dam and then washed out a section of the NYS W railroad bed located ust a few hundred feet downstream. The railroad track was left suspended in the air, while the stream was forced to flow onto an ad acent apple orchard. The stream has been restored to its original location and work is planned to stabilize the site.

Public Access

During 2011-12 two important sites providing fishing access to Lake Ontario were completed: Mud Bay and Three Mile Bay (on Chaumont Bay). A new Fishermen s Parking Area on Stony Creek, a Lake Ontario tributary, was also opened.

Public Outreach

Regional outreach efforts included outdoor expos, conservation field days, environmental awareness days, fishing clinics, Envirothon and Earth day events which reached thousands of anglers, students and families and throughout the region.

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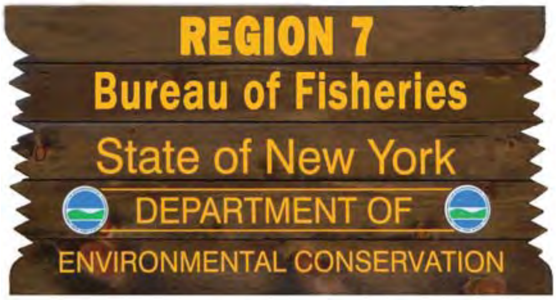

Spring 11 Cayuga nlet Fishway Monitoring

Operation of the Cayuga Inlet fishway continued in spring 2011. A total of 196 rainbow trout were handled. Thirty-two percent of the rainbow trout handled at the fishway had a hatchery fin clip indicating that stocked fish comprise a significant portion of the rainbow trout fishery. Propagation efforts continued with the collection of 153,530 wild and 24,630 hybrid rainbow trout eggs. Also handled were 3,777 white suckers and 802 adult sea lampreys on their spawning runs. The suckers were released upstream while the lampreys were killed to prevent them from spawning upstream. All rainbow trout handled at the fishway were examined for the presence of sea lamprey wounds. Only five wounds were observed on the 196 rainbow trout examined. No wounds were observed on the 18 rainbow trout in a 500-549 mm (19.7-21.6 inch) index group. The incidence of wounding on these fish was considered low and indicative of a small adult lamprey population in relation to the combined populations of host species (e.g., lake trout, rainbow trout, brown trout and landlocked Atlantic salmon).

Finger akes Angler Diary Cooperator Program

Angler catch data for the 2011 fishing season on the four eastern Finger Lakes were summarized and provided to participating cooperators. The summaries are available on the DEC website at *www.dec.ny.gov/outdoor/27875.html*. The legal game fish catch rate of 1.2 fish/trip at **Otisco ake** was higher than in 2010 and within the range observed over the past several years. Angler cooperators caught 160 legal size smallmouth bass which was the highest number caught in the 33 year Otisco Lake angler diary program. The walleye and largemouth bass catches were much higher than in the previous year while the brown trout and tiger musky catches were similar to the previous year. The legal salmonid catch rate of 1.0 fish/trip at **Skaneateles ake**, was lower than in 2010 but within the range observed over the past several years. Lake trout comprised 61 of the legal salmonid lake catch while rainbow trout and Atlantic salmon comprised 35 and 3 , respectively. The average size of kept rainbow trout (20.0 inches) and Atlantic salmon (21.8 inches) were the largest ever recorded. The legal salmonid catch rate of 1.4 fish/trip at **Owasco ake**, was lower than in 2010 but within the range observed over the past several years. Lake trout comprised 96 of the legal salmonid catch and the average size of kept lake trout was 21.1 inches. Only four legal size rainbow trout and one legal size brown trout were caught in the open lake fishery. The average size of kept rainbows (25.0 inches) was the largest ever recorded. At **Cayuga ake**, the legal salmonid catch rate of 1.8 fish/trip was higher than in 2010 and higher than the range observed over the past several years. Lake trout comprised 83 of the legal salmonid lake catch while rainbow trout, brown trout and Atlantic salmon comprised 2 , 4 and 11 , respectively. The average size of kept brown trout (22.8 inches) was the largest ever recorded.

Cayuga ake Standard Gang Gill Netting

During late uly and early August 2011, a total of 578 fish were collected including 399 lake trout, 15 brown trout and seven Atlantic salmon from Cayuga Lake using standard Finger Lakes gang gill nets. The main ob ectives of the 2011 survey, as in the previous surveys, were to evaluate the lake trout stocking policy, growth rate and the incidence of sea lamprey attacks on lake trout. Other species collected included alewife, yellow perch, white suckers, rainbow smelt, sculpin, and trout perch. Of the 399 lake trout collected, 363 had a hatchery fin clip indicating that the ma ority of the lake trout population continues to be represented by hatchery fish. The catch of 12.5 lake trout/ net in 2011 was slightly lower than the longterm average of 13.4 lake trout/ net. Overall, the lake trout catch in the standard gang surveys is indicative of a stable, medium density population maintained almost entirely by stocking. The growth rate of lake trout collected in the 2011 survey was good and similar to the growth rate found in the 2007 survey. Only one adult sea lamprey wound was found on the 44 lake trout in the 23.6 in. to 25.5 in. index group. This was the lowest incidence of wounding ever observed on lake trout in this index group collected during a Cayuga Lake standard gang survey. Beginning in 2013, the annual lake trout yearling stocking of 20,000 will be reduced to 15,000 in an effort to reduce predation on other sportfish species.

5 Day Walleye Fingerling Assessments o Otter and Otisco akes

Otter Lake

The second Otter Lake 50-day old walleye fingerling stocking was carried out on une 27, 2011 when 5,200 fingerlings were boat stocked in the mid-lake area. No walleye were collected or observed during a fall electrofishing survey. Competing fish species were abundant and likely a very significant contributor to the observed absence of walleye.

Otisco Lake

A night electrofishing survey conducted along three miles of Otisco Lake shoreline in early November captured only two young of year walleye. Both were in good condition and both had grown well (in excess of 7 inches). Sampling was likely influenced by the cold water temperatures and was probably not a good representation of the survival of the 44,000 50-day old stocked during the early summer. In recent years survival and growth of stocked walleye in Otisco Lake has been very good and we believe that abundance of adult walleye has increased substantially relative to the mid-2000 s.

Whitney Point Reservoir Fish Community Assessment

Sampling was conducted at this 1,200 acre reservoir in order to monitor long term trends in species abundance. Walleye and crappie abundance were of particular interest because the Department was contemplating a change in the walleye regulation at the reservoir that would replace the existing18-inch minimum size and 3 per day daily limit regulation with the more liberal statewide regulation of 15-inches and 5 per day. This change was being considered because the walleye population has increased dramatically since the late 1990 s while the abundance of white crappie (historically the lake s premier species) declined over the same period. However sampling results revealed that walleye numbers, though still high, appear to have dropped substantially from what was observed in 2009. Furthermore, fair numbers of one-year-old white crappie were also captured indicating that walleye predation on young crappie may not be as problematic as suspected. Based on these findings, along with angler feedback regarding the proposed change (mostly in opposition), the Department decided to retain the existing special walleye regulation at the reservoir.

Fall 11 Cormorant Ha ing on Oneida ake

Environmental Conservation Officers (ECO s) and Fish and Wildlife staff from Regions 6 and 7, along with trained volunteers completed another successful fall hazing effort at Oneida Lake. ECO s conducted hazing activities once per week during the month of September while Fish and Wildlife staff conducted weekly lake-wide cormorant counts from the last week in August through the first week of October. Cormorant abundance progressively declined from approximately 500 birds in late August and early September to a low of ust 90 birds on September 29. Abundance increased to 218 birds on October 7, a week after the final hazing effort was conducted. A total of 104 cormorants were collected by DEC staff to gather information on cormorant diets. Stomach content analysis, conducted by Cornell University researchers at Shackelton Point, revealed that sportfish comprised a significant portion of the diet of fall cormorants despite the presence of an extremely abundant year class of young-of-year gizzard shad in the lake. In past years, diet analysis indicated that cormorants fed almost exclusively on young gizzard shad when they were abundant in the fall. Researchers suspect that the exceptionally small size of young gizzard shad in 2011 caused cormorants to utilize other fish species more frequently than in past years.

Cayuga ake Sea amprey Assessment

Brief high water periods in 2007 and 2011 allowed limited numbers of adult lampreys to escape over the Cayuga Inlet fishway dam and spawn upstream. In 2011, regional fisheries staff found 74 lamprey nests in Cayuga Inlet and tributaries. This represents the tenth lowest count in 33 years and was well below the long-term average of 215 nests. An electrofishing survey was carried out in Cayuga Inlet and confirmed the presence of both a 2007 and 2011 lamprey year class. The density of 2007 year class lampreys was considerably lower than 1985 and 1995, the years preceding the only two lampricide treatments in Cayuga Inlet. This indicates that the number of uvenile lampreys produced in 2007 was likely not large enough to require an expensive lampricide treatment. However, the presence of a second year class is very problematic and a lampricide treatment may yet be required.

Characteristics o Salmon River Salmonids

Spawning populations of Lake Ontario Chinook and coho salmon (fall) and steelhead rainbow trout (spring) have been monitored annually since the mid-1980s at the NYSDEC Salmon River Hatchery in Altmar. Condition of chinook salmon, coho salmon and steelhead, as reflected by their average weight at various ages, were generally within the long-term average for each species. Unlike prior years when age 3 Chinooks typically dominated the returns, age 2 fish returned in record numbers in 2011. The coho and streehead runs were similar to recent years with age 2 fish dominating the coho returns and age 3 and 4 fish dominating the steelhead run.

Extension Education and Outreach

The Central New York fishing hotline *www.dec.ny.gov/outdoor/9218.html* , which is updated weekly, had 119,000 visits to the web page and another 8,733 telephone calls to the recorded hotline (607-753-1551). Seventeen new web pages and 15 PDF files were added for Central New York, and 36 existing pages were revised. Outreach events included seven sport or boat shows, six fishing clinics reaching over 750 new anglers, eight fishing festivals reaching over 230 people, and 18 school or camp related events that included over 1,000 students. These events included County Conservation Days, 4-H groups, Trout Unlimited Camp, Envirothon events and school events at the Salmon River Fish Hatchery.

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Althea Heider	Secretary

REGION 8
Bureau of Fisheries
State of New York
DEPARTMENT OF
ENVIRONMENTAL CONSERVATION

Seneca ake Sea amprey Control

In a continuing effort to control sea lamprey in Seneca Lake, staff from DEC Regions 4-8, the Division of Lands and Forest; and the Bureaus of Fisheries, Wildlife, and Habitat applied lampricide to Catharine Creek and some of its feeder streams. Sea lamprey are parasitic fish that have the potential to severely impact fish populations in the lake, particularly lake, rainbow, and brown trout. An 8.6-mile stretch of Catharine Creek has been recently treated with lampricide. The lampricide targets larval sea lamprey, killing them before they can transform into their parasitic adult form. In 2011, the stream treatment area was reduced from 8.6 miles to 7.6 miles based on improvements in lamprey migration barriers and pre-treatment survey data. After treatment, lamprey mortality was substantial and was effective across the target area. The next treatment is planned for 2014. Additional migration barriers should be in place that will further reduce the area requiring treatment. It is also anticipated that United States Fish and Wildlife Service will assist with the next treatment.

ake Trout Assessment euka ake

The lake trout population in euka Lake was assessed during a two week period in August using standardized Finger Lakes gill nets. This was the 10th survey conducted since 1979. Thirty-two nets were set resulting in the catch of 264 lake trout. Although data has not yet been analyzed, preliminary observations indicate that the population consists of a lot of fish in the 12 to 16 inch size range. Few large fish were collected, with the largest only 4.4 lbs. This is considerably smaller than maximum weights found for lake trout in other Finger Lake nettings. Only 11 of lake trout were larger than 20 inches. Mean relative weights of various size classes of lake trout ranged from 87 to 90, an indication that fish condition is low but not poor. Age and growth indices have yet to be determined. Mysids, or freshwater shrimp, were found in the ma ority of smaller lake trout stomachs. Larger lake trout stomachs were mostly empty, however those that were not contained sculpin, mysids, and a few alewives.

Preliminary observations suggest that the lake trout population in euka Lake is increasingly dominated by smaller fish. Angler diary results from recent years seem to suggest that fish are hungry and abundant, with catch rates being exceptional, but quality sized fish low in number. Regulations have been proposed increasing the allowable harvest of lake trout from 3 to 5.

Wild Trout Surveys

Electrofishing surveys were completed on 172 streams in 2011. Over a two year period, trout have been collected in 92 streams. The numbers of streams with each trout species combination collected are listed in Table 1. Wild trout were documented for the first time in 50 streams. These streams will be added to a list of streams that qualify for reclassification as wild trout streams.

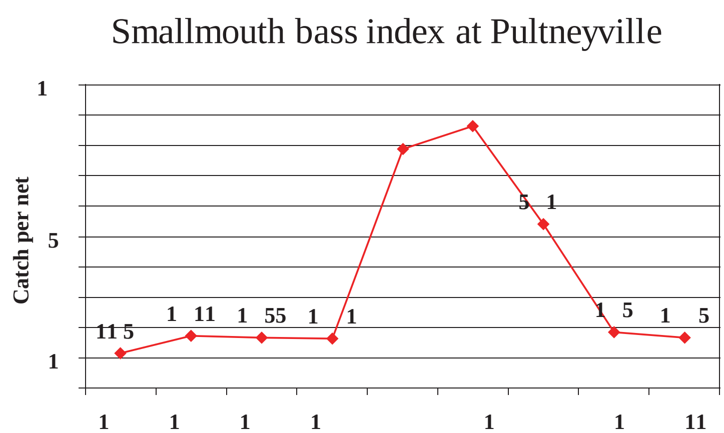
Table 1 Trout combinations found during 2011 surveys of Region 8 streams.

Species	Streams
Brook Trout only	37
Brown Trout only	28
Brook Trout and Brown Trout	15
Rainbow Trout Only	4
Rainbow Trout and Brook Trout	1
Rainbow Trout and Brown Trout	6
Rainbow Trout, Brown Trout, and Brook Trout	1
Total	92

Great akes Research

Sodus Bay's Fish Community Assessed

A survey of Sodus Bay was conducted from September 12 to 20, 2011, to assess the overall fish community and the success of the fingerling walleye stockings that have been conducted periodically since 1996. Sodus Bay has been surveyed approximately every five years, most recently in 2006. One thousand nine hundred and five individuals of 19 species of fish were collected from eight gill net sites (238/net), including four game and eight pan fish species. Most of the walleye caught were larger, older fish that were likely the result of stockings that took place from 1996-2000. Only two walleyes were collected in the 15.75-17.75 inch range, which are likely age 2, suggesting that the survival of fingerlings stocked in 2009 was poor. The pan fish catch was dominated by gizzard shad, yellow perch, and white perch.



Near-shore Warm Water Fish Community Assessment at Pultneyville

Index gill netting in Lake Ontario at Pultneyville showed the rock bass index of abundance was similar to the 2000-2001 level, the smallmouth bass index was slightly lower than 2010 and similar to the 1976-1979 level, and the yellow perch CPUE was the highest observed and 85 above the average estimates of all previous surveys. Three of the most common species from the 1976-1979 period (alewife, gizzard shad, and white perch) continued to decline through 2011. Two hundred and sixteen yellow perch (54.0 yellow perch per net) accounted for 60 of the 2011 catch. The second and third most frequently caught fish were smallmouth bass (19 of the catch, 16.75 smallmouth bass per net) and rock bass (15 of the catch). All smallmouth bass from Pultneyville that were sent for testing in both 2010 and 2011 were negative for VHSV.

Angling Outreach and Education

Local High School Students Learn About Fisheries Management

For the tenth consecutive year, staff cooperated with Delta Laboratories Adopt-a-Stream program to provide about 120 Environmental Studies students from four area high schools a hands-on demonstration of fisheries management techniques. Boat electrofishing was demonstrated in Thousand Acre Pond in Monroe County s Mendon Ponds Park. Demonstrations were also given in fish identification, water quality, freshwater mussel ID, fish seining, and fish scale aging and data interpretation. Students had the opportunity to capture, handle, identify, and measure live native fish, age fish scales, and handle and identify benthic invertebrates.

Fishing Rod Lending Program

Four partnering local libraries are finishing up the second year of the Region 8 Fishing Rod Lending Program. Each library has a partner who is responsible for supplying bobbers, hooks and sinkers and to provide maintenance of the rods and reels. We were extremely lucky that the first group to sign on, The Dansville Rod and Gun Club provided all the information necessary to obtain necessary material for the program on their website *www.dansvillefishandgame.org*.

Participating libraries and their local partners:

Dansville Public Library - Dansville Fish and Game Club. Rods checked out 10 times.

Wood Library, Canandaigua - Clearly Aquatic Pond Services, Ultrafab Inc., and the Canandaigua Lake Duck Hunters Association. Rods checked out 50 times.

Pulteney Public Library - Paul Schnipelsky, President, Board of Directors Pulteney Public Library and Donna Colvin. Rods checked out 22 times.

Woodward Memorial Library, LeRoy - Oatka Fish and Game Club, No report yet

While not all the Libraries have reported their use numbers for 2011 yet, all report positive responses from the communities

Public Fishing and Boating Access

Catharine Creek Fishing Parking Area Developed

Regional Operations staff developed a 10 vehicle Fishing Parking Area (FPA) on Catharine Creek in Chemung County. This area receives high fishing pressure during the spring and the new FPA will help get anglers off the side of State Route 14. There are approximately 1.1 miles of contiguous public fishing easements upstream and downstream of this FPA.

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Warmwater Fisheries Management

Cuba Lake Electrofishing Survey

Cuba Lake was electrofished on une 8 and 9, to assess the overall fish community, with special emphasis on walleye, smallmouth bass, and yellow perch. Catch rate for walleye was 43/hour, which is a high catch rate and is comparable to the long-term average of 45/hour. Walleye growth rates were slow as they have been for the past 60 years. About 75 of walleye collected were yearlings from the 2010 year class, indicating that abundant natural reproduction is occurring. Smallmouth bass catch rate was 26/hour, which is lower than a 2003 survey (39/hour), but is still double the New York State average smallmouth bass catch rate of 13 fish/hour. Yellow perch are by far the most abundant panfish in Cuba Lake (355/hour) followed by bluegill, pumpkinseed, and rock bass. Cuba Lake provides an excellent smallmouth bass and panfish fishery. Although no largemouth bass and few black crappie were collected, according to angler reports, a fishable population of both does exist in Cuba Lake.

Chautauqua Lake Trawl Survey

In an effort to assess the status of the forage fish community in Chautauqua Lake, Region 9 staff conducted trawl sampling twice per month in September and October of 2011. A standard 16 ft bottom trawl was towed at 14 standardized locations, 7 located in the north basin and 7 in the south basin. Age-1 yellow perch dominated the catch in 2011, which was not unexpected following the huge yellow perch year class (Age 0) found in 2010. The survey also indicates that black crappie, bluegill and pumpkinseed are continuing on an upward trend. White perch numbers continue on a downward trend, as catches have been way down from past surveys.

Great akes Fishery Management

First Report of Abundant Rudd Populations in North America

A technical ournal article with this title was published in February 2012 as a management brief in the North American ournal of Fisheries Management. The article was authored by Dr. evin apuscinski, SUNY College Environmental Science and Forestry (SUNY ESF) and co-authored by Dr. ohn Farrell (SUNY ESF) and Michael Wilkinson, Region 9 Fish Unit. The article describes unexpected findings of abundant rudd, a non-native member of the minnow family, in the Buffalo Harbor and Upper Niagara River during trap netting activities in 2007 and 2008. Rudd were the most frequently caught fish during both years of spring netting and constituted 48 of the fish caught during those years. Unlike most North American temperate fishes, the introduced rudd typically consumes a large portion of its annual diet as submerged aquatic plants. Rudd have been associated with changes to aquatic plant assemblages in other parts of the world.

Buffalo Harbor Sturgeon Netting

Lake sturgeon numbers seem to be increasing in the New York waters of Lake Erie. On une 6, 2011, six gill nets were deployed in the near shore area of Buffalo Harbor to determine if the gear can be used to survey adult lake sturgeon. The nets were fished for four hours and two adult male sturgeon where captured and processed. It has been determined that a spawning stock survey of the Upper Niagara River/ Buffalo Harbor area would be possible and a survey is planned for spring 2012.

Coldwater Fisheries Management

Eastern Brook Trout Joint Venture Surveys

Regional staff visited 548 streams in 2011 in an effort to document the presence of brook trout in small streams in Region 9. Of this total, 79 were found to be dry. In the 469 streams surveyed wild brook trout populations were found in 46 of the streams, wild brown trout in 78 streams and wild rainbow trout in 21 streams. Wild brook trout in these streams face threats to their existence such as competition with brown and rainbow trout, elevated water temperatures and poor land use practices. On the positive side, several surprisingly large specimens of wild brook and brown trout have been found in these mostly very small streams.

After two field seasons, the entire upper Genesee watershed (286 surveys) and most of the Erie-Niagara watershed (419 surveys) in Region 9 have been completed. A portion of the Allegheny watershed (222 surveys) has also been completed. A total of 934 streams have been assessed since 2010, of which 803 (86) have never been surveyed before. Wild brook trout were found in 90 streams, wild brown trout in 120 streams and wild rainbow trout in 21 streams. Of the 195 streams sampled that contained wild trout, 175 (90) need to have their water quality classifications upgraded in order to offer the streams maximum legal protection from disturbance. Man made barriers (mainly road culverts) potentially impassible to trout and other fish were identified on 158 streams in the surveys. This pro ect is currently planned to continue through 2013.

East Koy Creek Angler and Fisheries Surveys

From April 1 to October 15th, 2011, an angler use survey was conducted on East oy Creek in Wyoming County. A total of 83 days were surveyed throughout the season, resulting in 552 angler interviews. The vast ma ority of these interviews were in April, with low angler use noted through the summer and into the fall. Anglers reported catching a total of 852 trout, of which 74 were released, resulting in an average angler catch rate of 0.44 fish/hour (Table 1). The goal for a stocked stream in NY is to have an average catch rate of 0.5 fish/hour (one trout caught for 2 hours of fishing).

A total of 11,769 hours were estimated to have been spent fishing East oy Creek by anglers in 2011 (235 hours/acre of stream). This is considered light to moderate fishing intensity and is considerably less than was found in 1996 and 1997 studies on the creek (Table 1). In depth data analysis of the angler use and electrofishing surveys is being completed by Cornell University, as part of the state-wide "fate of stocked trout" study.

The angler use study was done in con unction with fish population sampling. In mid-May and again in late-August, Region 9 Fisheries staff, assisted by angler volunteers and a researcher from Cornell University, conducted trout population sampling on East oy Creek. The same four sites were electrofished in both months. Preliminary analysis showed fair numbers of hatchery trout remained in the stream in May and also in August, similar to surveys conducted in 1996 and 1997 (Table 1). Remaining hatchery trout included fish from all three stocking increments (March, April and May). This was good to see after such a brutally hot, dry summer. Substantial numbers of wild brown trout (higher than 1996 and 1997) were also sampled and wild trout outnumbered hatchery fish at three of four sites.

Although plenty of trout remained in the stream to provide good fishing, the angler use survey showed very little angling use occurred from mid-August to mid-October. Anglers are missing out on a good time of year to fish in East oy Creek.

Table 1 Results rom angler use and fish sampling studies on East oy Creek in 1 1 and 11

Year	Angler use hrs/ acre	Catch rate (fish/ hour)	Percent of fish released	Hatchery brown trout per mile	Wild brown trout per mile
1996	418	1.08	68	220	367
1997	831	1.06	78	241	251
2011	235	0.44	74	219	494

North Branch Wiscoy Creek Habitat Enhancement Project

The North Branch of Wiscoy Creek in Wyoming County is a high quality wild brown trout stream. Farming activities along the stream have left it abnormally wide and very shallow in many areas, providing very little in-stream shelter for adult trout. In 2009, a 0.6 mile section of public fishing rights was purchased on the stream, making it eligible for habitat work in 2011. The habitat enhancement work took advantage of the stream s potential to support a high abundance of quality size wild brown trout by decreasing the average width, increasing the depth and greatly increasing the amount of overhead bank shelter for adult wild trout.

In May, 2011 Trout Unlimited volunteers planted 1,110 shade trees along the pro ect area to provide shade and future large woody structure for the stream. Over a two week period in mid- uly 2011, Region 9 Fisheries staff, with extensive cooperation from USFWS, Wyoming County SWCD, NYS DOT and over 325 hours of volunteer effort from WNY Chapter of Trout Unlimited, installed fish habitat structures, including 57 "LUN ER" structures (456 total feet) along a 2,300 foot section of public fishing area on the North Branch. The crib-like structures were installed along the outside of bends, held in place by rebar and then had a new stream bank constructed over top of them, forming an artificial undercut bank. Areas where the structures were installed were deepened to approximately two feet and the stream width was narrowed by 1/4 to 1/3. Shade trees will be planted in areas where structures were installed in 2012. Funding for this pro ect came from a Great Lakes Basin Fish Habitat Partnership grant (Great Lakes Restoration Initiative).

Angler Outreach

Fishing Hotlines

The Lake Erie Fishing Hotline and the Western NY Fishing Hotline are updated every Friday to provide anglers with current information on where fish are biting and how to catch them. These popular angling resources cover the ma or fishing waters of Region 9 and parts of Region 8. Each hotline is available on the DEC website at *www.dec.ny.gov/outdoor/fishhotlines.html* or can be heard at (716) 855-FISH. Between April 1, 2011 and March 31, 2012, anglers visited the Lake Erie hotline 72,809 times, the Western NY hotline 52,406 times and the automated phone line 24,482 times. In all, anglers visited the hotlines 149,697 times during reporting period, for an average of 410 times per day.

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Inland Fisheries Section
Bureau of Fisheries
State of New York
DEPARTMENT OF
ENVIRONMENTAL CONSERVATION

Changes to Baitfish Regulations

The Department s baitfish regulations restricting the overland transport of uncertified baitfish by anglers were amended. They now allow for the overland motorized transport of personally collected baitfish within specified transportation corridors, as long as the baitfish are used in the same waters from which they are collected. Three transportation corridors were established: Lake Erie-Upper Niagara River; Lower Niagara River-Lake Ontario-St. Lawrence River, and Hudson River (between the Federal Dam at Troy and the Tappan ee Bridge). In addition to providing for personally collected baitfish, the new regulations make allowances for the overland motorized transport of uncertified baitfish purchased by anglers with the same restrictions.

Bureau Field Surveys Entered nto Statewide Fisheries Database

Data from 2,133 fishery field surveys were received by the Bureau s Biological Survey Unit during 2011-12. Approximately 1,619 Eastern Brook Trout oint Venture surveys were conducted. A total of 1,445 surveys were finalized and added into the Bureau of Fisheries Statewide Database. Data updates were distributed in September 2011 and December 2011.

Sportfish Regulations or October   1

A Notice of Proposed Rule Making (NPR), containing proposed changes to the freshwater sportfishing regulations, was announced in February 2012, initiating a 45 day public comment period, which extended into FY 2012-13. Proposed changes include modifications to the current seasons, size limits, and creel limits on certain waters for popular game fish species such as trout, salmon, walleye, black bass, pickerel, muskellunge, and tiger muskellunge. Additional proposed changes pertain to ice fishing on selected waters, as well as establishing specific gear requirements for certain angling practices. The comments received will be reviewed and assessed during the first quarter of FY 2012-13. Subsequently, a Final Rule Making will be packaged and submitted to the Department of State. Once adopted, the regulation changes will become effective October 1, 2012.

Proposed Changes to Regulations Governing the Sale/Transport o Black Bass

During 2011-12, a Notice of Proposed Rule Making (NPR) containing proposed changes to current regulations restricting the sale of black bass was prepared. More specifically, changes to the regulations governing the possession, transportation and sale of hatchery reared black bass in New York State were being considered to allow for the sale of black bass for human consumption. Under current Environmental Conservation Law (ECL), black bass may only be sold by holders of a Black Bass Hatchery License, or Fishing Preserve License. Regulations pertaining to the transportation of hatchery-reared bass would be expanded to provide for proper identification of these fish through retail markets while minimizing the opportunity for wild New York black bass to enter the market. The NPR is expected to be filed during the first quarter of 2012-13 initiating a 45 day public comment period. The comments received would then be reviewed and evaluated as part of the Department s decision on establishing a new regulation.

Warmwater Fisheries Management

Ecology and Management o the Fish Communities in Oneida and Canadarago akes

Researchers at the Cornell Biological Field Station at Oneida Lake completed their annual assessment of the fish communities in Oneida and Canadarago Lakes. Funded by a Federal Aid to Sportfish Restoration grant, these monitoring pro ects are the longest running warmwater fishery assessments in New York State and continue to provide valuable insight on the complex dynamics associated with warmwater fish populations in large northern lakes.

Oneida Lake

Abundance of adult walleye (age 4 and older) in 2011 was estimated at 459,500, which was a decline from the 2010 estimate of 498,000. Over the full course of the 56 year data series the adult walleye population has experienced a significant decrease, but has shown a significant increase in the last decade, partly driven by a large 2001 year class and three years with more restrictive harvest regulations combined with cormorant management. The adult population also benefitted from a higher than expected contribution from the 2006 year class; however, the 2007-09 year classes are expected to provide fewer adult fish. The population is expected to persist at levels between 350,000 and 450,000 over the next few years. Early indications are that the 2010 year class may be among the largest in recent years and if it remains strong it may offset the smaller 2007-09 year classes and help maintain the population above 400,000.

The adult yellow perch population was estimated to be ust over 1 million fish. This represents a slight increase from the 2009 and 2010 estimates, but well below 2008. Long term trends show a significant decline in adult yellow perch population size, but no trend is detectable over the last decade, suggesting a more or less stable, but much smaller population than was present in the lake in the 1960s   1980s. It is expected that yellow perch numbers will fluctuate around 1 million fish in the near future.

Walleye, yellow perch and white perch are the three most commonly caught species in standard fish community gill netting surveys, representing over 80   of the catch in most years. Walleye and yellow perch represented 51   of the total gill net catch in 2011, whereas white perch were 33   of the catch. Catches of white perch in recent years suggest that they are as abundant as yellow perch in Oneida Lake.

Increased water clarity due to filter feeding by zebra and quagga mussels has caused an expansion in the shoreline littoral habitat that favors species such as black bass, sunfish, and pickerel. The monitoring program for Oneida Lake was recently ad usted to account for the anticipated changes in the fish community. In 2011, shoreline fyke net sampling resulted in the capture of approximately 26 different species. Catches of most species were within the range of past years, with the exception of a particularly large year class of gizzard shad. Some other commonly caught species were yellow perch, white perch, pumpkinseed, bluegill, rock bass, smallmouth bass and black crappie. The fyke nets continue to produce catches of littoral species not represented in

the traditional gears used in the long-term studies. They have provided the only index of young of the year largemouth bass, and also show potential as an index for chain pickerel.

In spring 2011, a shoreline electrofishing survey was initiated with the goal of obtaining additional baseline data on the expanding littoral fish community, with a particular focus on largemouth bass, a species not routinely sampled with other gears. In all, 2,208 fish representing 30 different species were collected. Yellow perch were the most commonly caught species, followed by pumpkinseed, brown bullhead, bluegill, and logperch. Largemouth bass and walleye were the most prevalent predators collected. This survey will be conducted 2 of every 3 years and will be used as a littoral community index and provide comparative data for other survey techniques.

Creel surveys have not been a regular part of the sampling program, but have been conducted periodically, most recently from 2002-07. In 2011, a “limited” creel survey was conducted as a means to provide a reliable, yet low cost, annual estimate of the walleye catch and harvest. Surveys consisted of boat counts from a tower and angler exit interviews. Effort in 2011 was 214,660 boat hours, which was higher than observed in any year during the 2002-07 survey and continued a trend of increasing effort for the period 2002-11. 54 of anglers targeted walleye or walleye and other species and 35 of anglers targeted bass or bass and other species. The estimated catch and harvest rates for walleye during the open water season were 0.22/hour and 0.13/hour, respectively. The estimated annual walleye harvest was 54,094. Bass harvest rates were less than 10 of estimated catch rates, typical for this fishery, which is largely catch and release.

Canadarago Lake

Walleye fry abundance was low again in 2011, continuing a trend which began in 2005. The low abundance of fry is attributable to a steadily increasing population of alewife, which are known predators of fish fry and often have dramatic impacts on walleye reproduction. Yellow perch fry abundance was also reduced, but the impacts from alewife predation were not as severe. Walleye fry may be more vulnerable to alewife because they are less abundant and are present earlier in the season when fewer larval fish of other species are present to buffer predation. The reduction in fry abundance appears to be having an impact on the adult population as fall electrofishing surveys have documented a decline in the number of adult walleye during the past several years.

In response to the almost complete lack of successful walleye reproduction over the last 7 years and a declining adult population, a walleye stocking program was initiated in 2011. Approximately 40,000 advanced walleye fingerlings will be annually stocked in August for 5 years. The goal of this program is to boost walleye recruitment by offsetting some of the losses of young walleye to alewife predation. Annual assessments of the fish community will allow up to date tracking of stocking success.

Post Tournament Dispersal o Black Bass in ake Champlain

The increasing popularity of large-scale black bass tournaments on Lake Champlain has led to concerns about fish dispersal post-tournament. A study funded through a Sportfish Restoration Grant and conducted by SUNY Plattsburgh and Lake Champlain Sea Grant was initiated in 2011 to track movements of black bass following release from tournaments held at Plattsburgh. Largemouth and smallmouth bass were collected post weigh-in at 5 tournaments and anglers were interviewed to determine the approximate capture location of the fish. Over 1,500 bass were marked with external T-bar tags and 41 bass were implanted with radio transmitters. The ma ority of bass were originally caught by tournament anglers 10-30km from the tournament weigh-in site at Plattsburgh and less than 15 were originally captured less than 10km from the weigh-in site. The T-bar tag return rate was about 11 and the ma ority of these fish moved less than 3km from the release point. Only 10 of largemouth bass and 7 of smallmouth bass were recaptured more than 10km from the release point. The radio telemetry results were similar to the T-bar tag return data. Eighteen radio tagged fish were tracked over the summer and the ma ority moved less than 3km from the release point. Only 9 of largemouth bass and no smallmouth bass moved more than 10km from the release point. The radio tagged fish were tracked through the winter and results are pending analysis. A similar complimentary study will be conducted in 2012 and combined results from the 2 studies will allow for the development of recommendations to minimize the impacts of tournaments on the Lake Champlain bass fishery.

Statewide Black Bass Population Assessment

Black bass are the most sought after species of fish by New York anglers, but the last comprehensive statewide population assessment

occurred nearly 30 years ago. Since then black bass fisheries have become more tournament based and catch and release angling has become more prevalent. A 3 year study funded through a Sportfish Restoration Grant and conducted by the New York Cooperative Fish and Wildlife Research Unit was initiated in 2011 to compile black bass data from various large datasets and comprehensively assess population and environmental metrics. Initial efforts have focused on determining and selecting standardized data for further analysis. Multiple population parameters (relative abundance, growth, condition, etc.) will then be summarized for specific waterbody types (e.g, large rivers, small inland lakes, Great Lakes, etc.) and spatial and temporal trends will be assessed. This study will greatly enhance our current understanding of New York s bass populations and will result in the development and implementation of a management strategy.

Stocking Evaluation o 5 Day Old Walleye Fingerlings

An experimental walleye stocking program, initiated in 2009, was continued using 50-day old tank raised fingerlings from Oneida Hatchery. Eleven lakes throughout the northern, central and western regions of the State were stocked in une with about 299,000 1.5 inch long fingerlings. Waters stocked included Loon Lake in Region 5, Black, Red, and Payne lakes in Region 6, Otisco and Otter lakes in Region 7, and Chautauqua, Redhouse and Upper, Middle and Lower Cassadaga lakes in Region 9. The success of this program is being assessed through annual monitoring in the fall and with a full fish community assessment at the end of a five-year stocking schedule. Annual fall surveys from 2009-11 have documented the presence of stocked walleye at Loon, Otisco, Redhouse and Chautauqua lakes.

Annual Meeting o the New York Chapter o the American Fisheries Society

Bureau of Fisheries staff, including Ed Woltmann (Chapter President), oelle Ernst (Arrangements Chair), Gregory ozlowski (AV Chair) and Program Chairs eff Loukmas and Donald Einhouse organized and implemented the 2012 meeting of the American Fisheries Society. The meeting was held February 1-3 at the High Peaks Resort in Lake Placid and drew 150 participants. The general theme for the meeting was "Partnerships - Working collaboratively to effectively manage our fisheries." and included speakers from the United States Fish and Wildlife Service, Great Lakes Fishery Commission, United State Geological Survey, Southwick Associates and the Eastern Brook Trout oint Venture. DEC Commissioner oe Martens provided the opening remarks.

A special session on northern black bass management, held in con- unction with the meeting, included many prominent bass researchers from the U.S. and Canada. DEC oral presenters during the meeting included Chart Guthrie, Don Einhouse, Doug Stang, Doug Carlson, Geoff Eckerland, Shaun eeler and Rich Preall. Heidi O Riordan and Doug Carlson also provided poster presentations.

Coldwater Fisheries Management

CROTS Review Fate o Stocked Trout Study

The Bureau of Fisheries completed the first year of fieldwork for a multi-year statewide study to verify and update the key biological and fishery factors used to calculate trout stocking rates under our Catch Rate Oriented Trout Stocking (CROTS) method. This research, conducted in partnership with the Fish and Wildlife Cooperative Unit at Cornell University, will yield fresh estimates of angling effort, seasonal patterns of angling effort, harvest rates, and total mortality rates of stocked trout.

In 2011, bureau staff completed creel surveys and population estimates on the following streams: Carmans River, Esopus Creek, W. Branch Delaware River (upstream of Cannonsville Reservoir), Oriskany Creek, Big Creek, Otselic River, Meads Creek, and East oy Creek. The data were provided to Cornell University doctoral student Alexander Alexiades for analysis. The entire research team met twice in 2011 to review lessons learned from the first field season, to view preliminary analyses presented by Cornell, and to plan the 2012 field season.

Preliminary findings include: fewer hours of angling per acre relative to previous creel surveys and higher rates of catch and release for stocked trout. With the exception of the Carmans River and the Otselic River, average hourly catch rates for brown trout were equal to or greater than the CROTS target of 0.5 trout per hour. In the case of the Carmans River, this reflects the relative importance of wild brook trout and stocked rainbow trout to the recreational fishery.

For 2012, ayaderosseras Creek and inderhook Creek were added to the sampling roster. Creel surveys and population estimates will be repeated on all waters sampled in 2011 except for the West Branch of the Delaware which proved incompatible with the study sampling methods. By collecting these data over multiple years we can expect the results of the study to incorporate the inter-annual variation in hydrological, biological, and fishing conditions.

Delaware River Basin Gaging Stations Funded

In order to assure the availability of data essential to the management of the highly productive trout fisheries in the tailwaters of New York City s Delaware River Basin reservoirs, a total of 49,720 was committed to support the operation of U.S. Geological Survey stream gages at the following locations:

- Diversion from Schoharie Reservoir
- Esopus Creek at Coldbrook
- East Branch Delaware River at Harvard
- West Branch Delaware River at Hale Eddy
- West Branch Delaware River at Hancock
- Delaware River at Lordville
- Delaware River at Callicoon
- Neversink River at Bridgeville

These instruments, which transmit flow and temperature measurements in real time, would otherwise be shut down. The data they collect are particularly important because of the exceptional value of the recreational trout fishery and because they allow monitoring of the biological effects of flow management plans which are frequently altered at the direction of the Delaware River Basin Commission. The data are available to the public at the following website: *http://waterdata.usgs.gov/ny/nwis/current/?type=sw&group_key=basin_cd*.

Brook Trout Stream Status Surveys

New York is one of 17 states on the eastern seaboard participating in the Eastern Brook Trout oint Venture. The goal of this effort is to halt the decline of brook trout and restore fishable populations of this native trout. In support of this goal, DEC biologists are conducting stream surveys to determine the status of brook

trout populations in watersheds where information is outdated or absent. Ultimately, on waters where the presence of wild brook trout or other naturally reproducing trout species was previously un-documented, the results of these surveys will allow the DEC to upgrade the water quality classification of these waters to a level affording better legal protection from disturbance. In addition, the information will also allow prioritization of habitat restoration pro ects or efforts to reestablish brook trout.

In 2011, one thousand six hundred forty-one stream surveys were completed under this federally funded pro ect. The surveys were done in DEC regions 4, 7, 8 and 9. The presence of brook trout was documented in 324 streams; some of which had never been previously surveyed.

DEC Region	Total Streams Surveyed	Streams with confirmed Brook Trout
4	506	131
7	415	137
8	172	10
9	548	46

ake Ontario Tributary Angler Survey Fall 11

Four agents conducted an angler survey of 21 Lake Ontario tributaries across Regions 6-9 from September 2011 through April 2012. The total estimated effort for all tributaries from September through November was 1.1 million angler hours, with the Salmon River accounting for 68 of the total. The estimated number of angler trips during the survey period was 283,912, with the Salmon River contributing 65 of the total. Four other tributaries accounted for large shares of the effort: Eighteenmile Creek in Niagara County, Oswego River in Oswego County, South Sandy Creek in efferson County, and Oak Orchard Creek in Orleans County. Seventeen of 21 tributaries surveyed had reported catches of Chinook salmon, totaling an estimated 125,180 and 45,214 caught and harvested respectively. The Salmon River accounted for 68 of the catch and 70 of the harvest. Other top waters for Chinooks were Eighteenmile and Oak Orchard creeks as well as the Oswego and Black rivers. An estimated 30,676 Coho salmon were caught in 11 of the 21 tributaries surveyed and the Salmon River accounted for 95 of this total. Seventeen of the 21 tributaries had reported catches of steelhead totaling an estimated 58,846 fish with 5,366 harvested. The Salmon River had the highest estimated steelhead catch (67 of total) and harvest (68 of total). Other tributaries producing substantial steelhead catches included South Sandy, Maxwell and Oak Orchard creeks. Reported catches of brown trout occurred in13 of the 21 waters studied, with an estimated 38,050 and 6,613 caught and harvested respectively. The top brown trout tributaries were Eighteenmile, Sandy, and Maxwell creeks. The 2011 angler survey shows that Lake Ontario s tributary fishery has increased substantially and has now surpassed the open lake boat fishery in terms of angling effort.

Management of Rare & Endangered Fishes

The Rare Fish Unit is responsible for assessment and management of endangered, threatened, and special concern fish species, as well as species of greatest conservation need and otherwise rare and unusual species of fish and freshwater mussels. Highlights of some activities in the past year by Bureau staff are summarized below. Additional highlights of Bureau of Fisheries efforts to manage rare and endangered fishes can be found in the Region 1, 6 and 9 sections of this report.

Paddlefish Restoration

Propagation

2011 was another exceptional year for paddlefish production at Oneida Hatchery. Eggs received from University of entucky researcher Dr. Steve Mims resulted in 2,150 uvenile paddlefish being stocked into the Allegheny River drainage. Fish averaging 14 inches were placed into the Allegheny Reservoir, Chautauqua Lake, and Conewango Creek in late uly. Over 12,000 uvenile paddlefish have been stocked in these waters since 1998.

Stock Assessment

The results of the four year paddlefish restoration evaluation indicate that the stocking program has created a fairly abundant paddlefish population in the Allegheny Reservoir. A State Wildlife Grant funded pro ect allowed for gill netting and radio tracking of adult paddlefish from 2008 through 2011. During the entire sampling period, 6,839 hours of gill netting effort yielded 79 adult paddlefish, 44 of which were implanted with radio transmitters. No evidence of successful natural reproduction has been documented as of 2011. One female with eggs in her abdomen was collected in 2010. Radio telemetry data shows that some adult fish are migrating upstream in the spring and could be attempting to spawn if conditions are right. DEC staff conducted sampling for wild young of the year paddlefish in 2011 but none were collected. There is a confirmed problem with paddlefish migrating downstream and passing through the inzua Dam. However, sampling data and observations suggest that enough fish are staying in the reservoir to eventually restore a self-sustaining population. Periodic sampling will be conducted every 3 to 5 years to monitor the adult population and hopefully confirm natural reproduction in the near future.

Native Mussel Distribution in the Southern ake Ontario Watershed

Region 8 Fish and Wildlife staff completed the third year of a five-year pro ect to determine distribution, density, and status of native freshwater pearly mussel species in the Southern Lake Ontario watershed. In most of these tributaries, the current status of mussels is unknown.

Mussels stabilize streambeds, diversify stream habitat, provide nutrients to other benthic invertebrates, filter suspended solids and pollutants from water, and are considered indicators of ecosystem health. In spite of the ecological importance of freshwater pearly mussels, they are among the most imperiled groups of animals in North America. Species occurrences will be used to create distribution maps which will help guide future mussel conservation efforts.

To date, 237 sites along 67 streams and 17 Erie Canal sites have been surveyed. Live mussels were found in 38 of the surveyed streams, with Species of Greatest Conservation Need (SGCN) confirmed in 18 streams. Mussels were documented for the first time in 29 streams. Throughout the Erie Canal sites, both native pearly mussels and invasive bivalves were found.

Twenty native mussel species are represented in these surveys; 18 of the 20 species were found live, including ten SGCN. Two species found live, paper pondshell and lilliput, had not been reported from NYS in over 15 years, while a third species, deertoe, was previously unknown from this watershed. Deertoe is ranked by Natural Heritage Program as having only “5 or fewer occurrences” statewide. In addition, green floater mussel, a NYS threatened species was found.

A rare rainbow mussel *Villosa iris* listed as a Species of Greatest Conservation Need in New York State was recently found in Moorman Creek, Monroe County. A YouTube video (*www.youtube.com/watch?v=hxoMLCfhzUU*) captures this mussel as it displays its lure to mimic a crayfish and attract a hungry fish. When the fish tries to take a bite, its gills are filled with young mussels, termed “glochidia.” The glochidia are released when the mussel feels contact with the fish and attach to the fish s gills or fins. The unsuspecting fish provides food and aeration for the young mussels and a ride to a new home. Once metamorphosing into a uvenile, the mussel drops off the fish and burrows into the stream bottom, with the fish none the worse for the experience.

Round Whitefish Stocking and Assessment

Eggs for this endangered fish were taken in trap nets at Upper and Lower Cascade Lakes (Essex County) in late November 2011 and transferred to the Oneida Hatchery for rearing. 2,300 fingerling round whitefish were produced and stocked in Spring of 2012 in three Adirondack ponds. Recovery progress with this fish has been slow and steady. Based on sampling done through 2011, there appears to now be 10 ponds with self-sustaining populations throughout the Adirondacks.

New to the program this year was an attempt at a captive egg take. Round whitefish spawn under the ice in many of the ponds where they are found, making effective egg takes challenging to say the least. In early December 2011, adult round whitefish were collected by trap net in Little Green Pond near Adirondack Hatchery. These round whitefish were held through December inside one of the hatchery raceways. The fish ripened and attempted to spawn inside the raceway around Christmas. Based on this success, staff at Adirondack will hand strip eggs and sperm from a new batch of round whitefish in December 2012 and send them to the Oneida Hatchery for rearing. If successful, this will reduce the impact on the Cascade Lake s population.

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Bureau of Fisheries
Lake Ontario Research Unit
State of New York
DEPARTMENT OF
ENVIRONMENTAL CONSERVATION

The Bureau of Fisheries Lake Ontario Unit (LOU), based in Cape Vincent, is primarily responsible for delivering a lake-wide fisheries assessment and research program. The mainstay of the program is the Department s 70 ton Research Vessel Seth Green. Lake Ontario s sportfisheries have been valued at over 100 million annually and successful management requires that fisheries assessments and research be executed collaboratively. Delivery of our comprehensive program requires active partnerships with a number of institutions, including DEC Regions 6, 7, 8 and 9, the U.S. Geological Survey (USGS), the Ontario Ministry of Natural Resources (OMNR), the U.S. Fish and Wildlife Service (USFWS), the Great Lakes Fishery Commission (GLFC), Cornell University and the SUNY College of Environmental Science and Forestry. Our complete annual report can be accessed at: *www.dec.ny.gov/outdoor/27068.html*.

Sportfishery Monitoring

Each year from April through September, the LOU conducts the Lake Ontario fishing boat survey at 30 access channels from the Niagara River in the west to the Association Island cut in the east. The survey tracks a multitude of trends in the open lake sportfishery, including angler effort, catch and catch rates, harvest and harvest rates, performance of stocked fish and fish growth/condition. Lake Ontario fishing quality is best characterized by the number of trout and salmon caught per fishing boat trip (catch rate). In 2011, the catch rate for all trout and salmon combined was the highest observed since this survey began in 1985. In fact, 6 of the 7 highest combined catch rates were recorded between 2003 and 2011 (Figure 1). These exceptional catch rates are largely due to record or near record-high catch rates in recent years for Chinook salmon, coho salmon, rainbow trout (steelhead), and brown trout. While fishing quality has been exceptional, angler effort (number of fishing boat trips) has not increased (Figure 2).

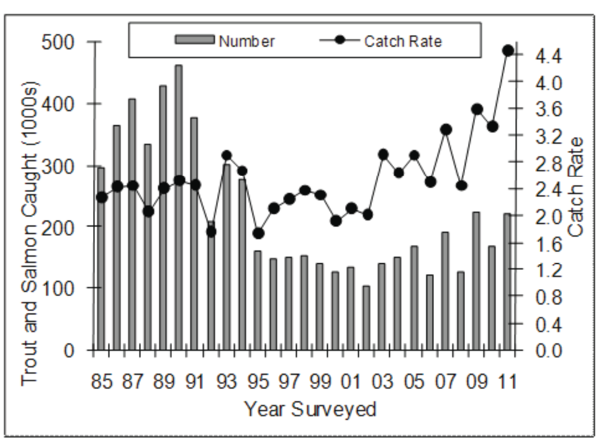

Figure 1. Total trout and salmon catch (bars) and catch rate (line/dots) for boats seeking trout and salmon, 1985-2010.

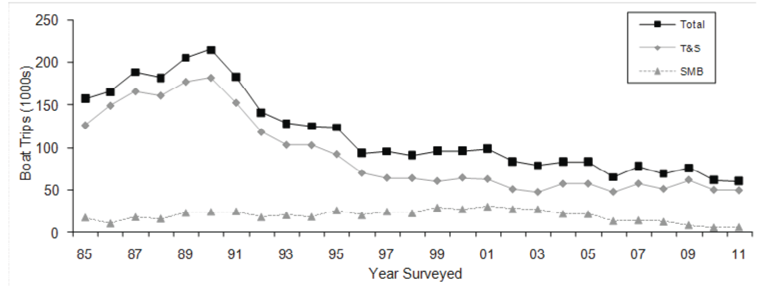

Figure 2. Seasonal estimates of total fishing boat trips, trips targeting trout and salmon (T&S), and trips targeting smallmouth bass (SMB) during the traditional open season (3rd Saturday in June-September 30 when the survey ended).

Preyfish Monitoring and Predator Growth/Condition

With over 5 million trout and salmon stocked annually into Lake Ontario by New York State and the Province of Ontario, it is important to monitor the abundance of bait or preyfish that trout and salmon feed on, as well as growth rates and condition of predators (also see Sportfishery Research). Partnering with USGS and OMNR, the LOU monitors relative abundance of alewife, rainbow smelt, sculpins, and round gobies. Alewife populations are of particular concern, as they are the primary food for Chinook salmon, the top predator in the lake. In 2011, adult alewife abundance and biomass indices increased from the historic low levels recorded in 2010 (Figure 3). Abundance of age-1 (yearling) alewife was above average despite a decreased adult spawning stock. Overall alewife abundance increased contributing to increased or stable size of age-2 and age-3 Chinook salmon (Figure 4). Lake Ontario Chinook salmon continue to be the largest in the Great Lakes, and Lake Ontario predator demand in 2011 appeared to be in balance with available prey.

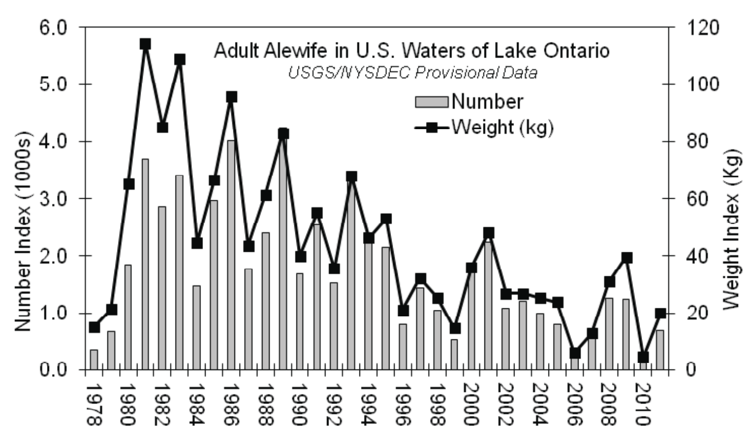

Figure 3. Abundance indices for adult (age-2 and older) alewife in the U.S. waters of Lake Ontario during late April-Early May, 1978-2011. (1 kg = 2.205 lbs)

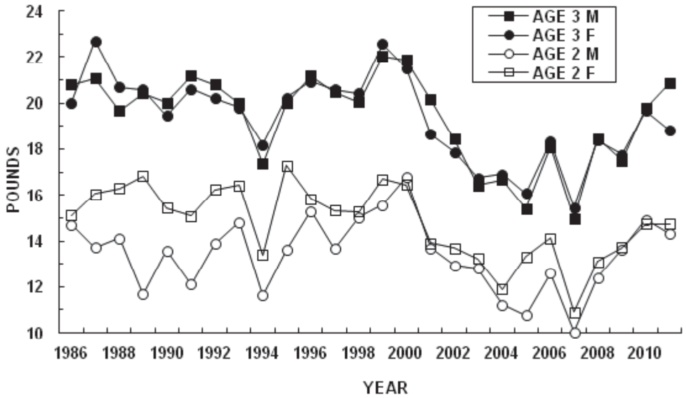

Figure 4. Mean weights of Chinook salmon ages 2-3 at Salmon River Hatchery 1986-2011.

Sportfishery Research

Using Lake Ontario Natural Resources Damages funds, the Bureau of Fisheries purchased a 1.3 million automated fish marking trailer (“AutoFish”) in 2008. The AutoFish system is capable of removing a fish s adipose fin and/or inserting a coded wire tag into the snout of the fish automatically at a high rate of speed and accuracy. Fin clipping and tagging give researchers tools to answer a variety of questions regarding the performance of stocked and wild fish. From 2008-2011, the Department and the OMNR “mass-marked” all Chinook salmon stocked into Lake Ontario with an adipose fin clip to determine the relative contributions of naturally reproduced (“wild”) and hatchery stocked Chinook salmon to open lake and tributary fisheries. nowing the relative roles of hatchery and wild salmon in the lake is very important for fisheries managers to better understand how stocking decisions can influence Chinook salmon population dynamics and predator/prey balance in Lake Ontario. High numbers of wild Chinook salmon in addition to stocked fish are thought to have contributed to an imbalance between predators and alewife in Lake Huron, greatly reducing growth and condition of Chinook salmon and negatively impacting sportfisheries. In 2011, 42.6 of age-1, 36.9 of age-2, and 35.9 of age-3 Chinook salmon in the New York waters of Lake Ontario were wild. These preliminary results indicate that although wild fish appear to be an important component of the Lake Ontario Chinook population and sportfishery, hatchery fish currently represent the ma ority, and stocking remains essential for the sustainability of the sportfishery and management of the lake ecosystem.

Native Species Restoration

An international program to restore a naturally reproducing population of lake trout in Lake Ontario is ongoing. To measure progress, cooperative DEC/USGS bottom trawl (uveniles; uly) and gill net (adults; Sept.) surveys are conducted annually at 14 sites from the Niagara Bar to Charity Shoals in the Eastern Basin. Catch of age-2 lake trout indicates survival remains well below 1980s levels. Adult lake trout abundance increased in recent years following historic lows observed during 2005-2007, and may have stabilized at levels observed during 1999-2004. Survival of naturally produced lake trout to the fingerling stage occurred each year during 1993-2007, representing production of 15 consecutive year classes. Wild yearlings captured in 2010 and 2011 were the first caught since 2005.

Four species of deepwater cisco are considered extirpated from Lake Ontario, and the LOU has been collaborating with the OMNR, USFWS, and the GLFC to re-introduce these fish into the lake. In 2011, LOU staff successfully incubated eggs from Lake Michigan. Eggs were transferred to OMNR s White Lake Hatchery where additional experiments determined the deepwater cisco s early feeding/diet requirements, and produced 220 yearlings for future broodstock development. In fall and winter of 2011-12, LOU staff continued collaboration with partners to develop gamete collection and culture techniques for cisco. Plans call for continued culture experiments and eventual reintroduction of these important fish to Lake Ontario.

Two milestones in Atlantic salmon restoration were achieved for a second consecutive year in 2011: during 2010 and 2011 USGS staff captured naturally reproduced Atlantic salmon smolts in the Salmon River, and angler catch rate of Atlantic salmon in the open waters of Lake Ontario remained at a record high level. The cause(s) of improved status of Atlantic salmon is not yet known.

Warmwater Fisheries Assessment

Each year the LOU conducts index gill netting to assess the status of warmwater fish populations in Lake Ontario s Eastern Basin. In 2011, smallmouth bass catch declined 30 from recent (2006-2010) levels, although remaining well above the record-low levels experienced prior to double-crested cormorant population management. Walleye abundance remained relatively stable, while yellow perch catch increased in recent years with 2011 catches being the third highest observed since 1984. Following a long period of low abundance, white perch numbers appear to be rebounding. At least one lake sturgeon has been collected in 13 of the last 17 years (4 in 2010), suggesting an increase in sturgeon abundance.

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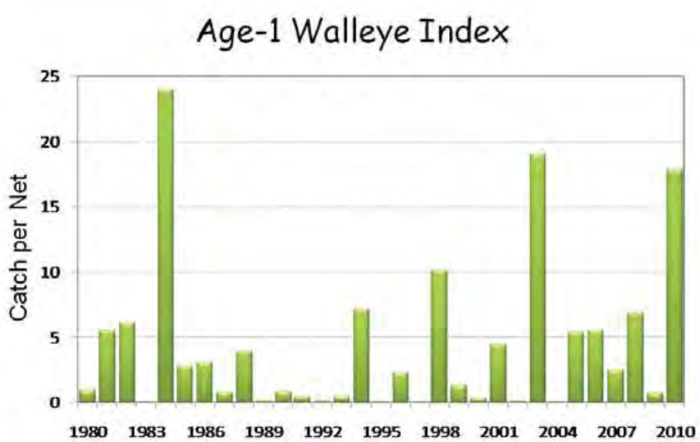
The Lake Erie Fisheries Unit is responsible for fishery research and assessment activities for one of New York s largest and most diverse freshwater fishery resources. A variety of annual programs are designed to improve our understanding of the Lake Erie fish community to guide fisheries management, and safeguard this valuable resource for current and future generations. The following shares ust a few of the highlights from the 2011 program year. The Lake Erie Unit s complete annual report is available on DEC s website at http://www.dec.ny.gov/outdoor/32286.html

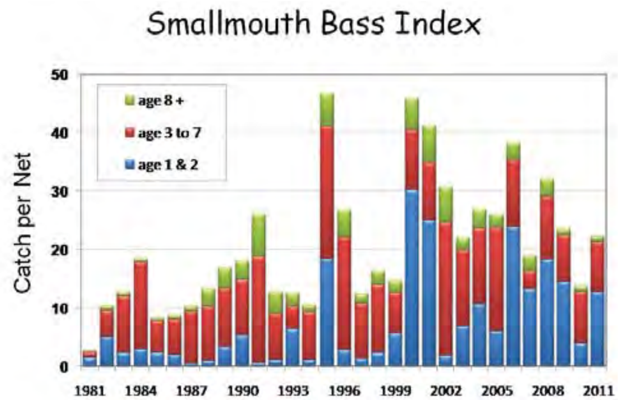
Walleye

Lake Erie s eastern basin walleye resource is composed of local spawning stocks, as well as contributions from summertime movements from western basin spawning stocks. The annual movement of western basin stocks is now well known via long-term tagging studies conducted throughout the lake. Walleye fishing quality in recent years has generally been very good and largely attributable to excellent spawning success observed in 2003. However, the dominant 2003 year class has now begun to wane. Nevertheless, walleye fishing activity and quality continue to be very good due to average to good spawning success that occurred from 2005 to 2008. Our most recent uvenile walleye survey indicates excellent spawning success in 2010. The good recruitment in recent years, especially from 2010, suggests that walleye abundance in the eastern basin will increase over the next few years.



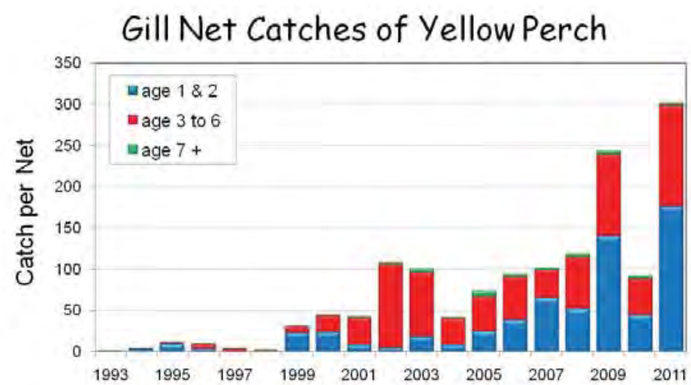
Smallmouth Bass

Lake Erie supports New York s, and perhaps the country s, finest smallmouth bass fishery. Generally stable spawning success, coupled with very high growth rates and acceptable survival, produces high angler catch rates and frequent encounters with trophy-sized fish. However, our most recent bass monitoring indicates a recent decline of the particularly large and older individuals. Our uvenile abundance measures indicate poor recruitment is expected from the 2009 year class; otherwise early signals suggest 2010 produced a much more abundant hatch of smallmouth bass.



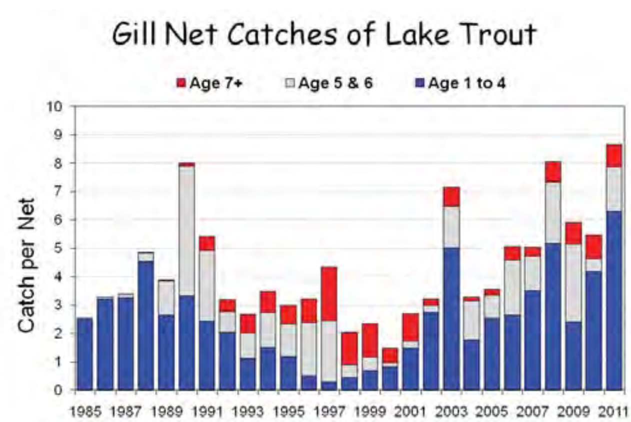
Yellow Perch

Lake Erie yellow perch populations have experienced wide oscillations in abundance over the last 30 years, from extreme lows in the mid-1990 s, to an extended recovery that s now lasted more than a decade. A large adult population continues to produce good angler catch rates, especially during spring and fall seasons. Abundance of uvenile perch in trawling and gill net surveys has been high in recent years, with record-high abundance of age-1 perch observed in 2011. Overall, this pattern of recruitment suggests that higher and more stable yellow perch abundance will extend at least another few years.



ake Trout

Rehabilitation of a self-sustaining lake trout population in the eastern basin of Lake Erie continues to be a ma or thrust in New York s Great Lakes coldwater fisheries management program. Lake trout have been stocked annually since 1978 and assessment programs monitor the status of progress. A revised lake trout rehabilitation plan was completed in 2008 and will guide future recovery efforts. Abundance of lake trout in the New York waters of Lake Erie increased dramatically to a

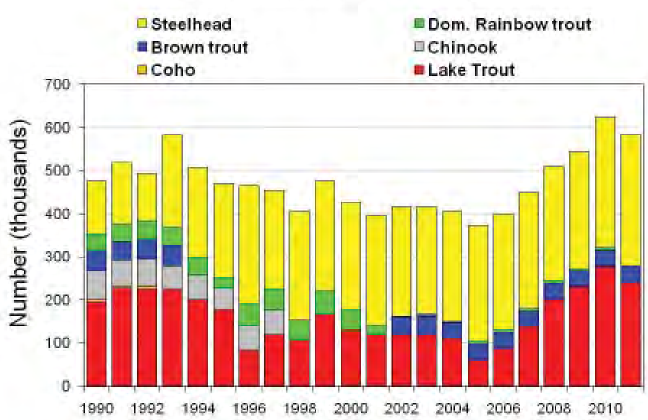


time-series high in 2011. The ma ority of the increase was observed in younger lake trout ages 1-4, mainly due to increased stocking levels over the past 4 years. Adult stocks remain at relatively low levels primarily due to a high sea lamprey population. Lakewide abundance estimates for all age groups still remain well below targets. Natural reproduction has not been detected in Lake Erie, and continued stocking and effective sea lamprey control are needed to build adult lake trout populations to levels where natural production is viable.

Salmonid Stocking

New York annually stocks around 270,000 steelhead and 35,000 brown trout into Lake Erie and its tributaries to provide recreational opportunities for both lake and stream anglers. Wild reproduction of steelhead also occurs which contributes to the fishery as well. Fall uvenile assessment programs conducted since 2001 confirmed substantial numbers of young-of-year steelhead present in many tributaries. Tributary angling for steelhead, assessed through an angler diary program, showed a sharp decline in fishing quality in 2010. A tributary creel survey is being conducted during the 2011-12 fishing season on the ma or Lake Erie tributaries. Combined with the 2011 cooperative diary program results, these surveys will help us determine the current status of the fishery.

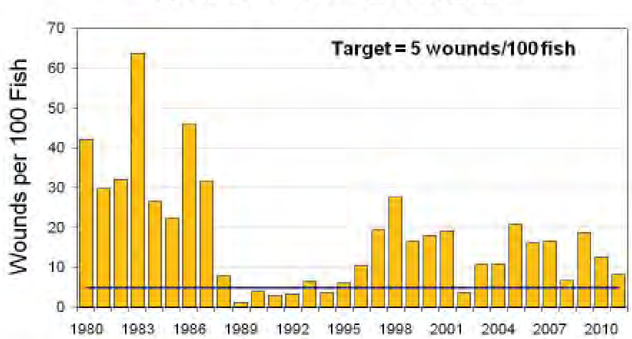
Trout & Salmon Stocking in NY



Sea amprey

Sea lamprey invaded Lake Erie and the Upper Great Lakes in the 1920s and have played an integral part in the failure of many native coldwater fish populations. Sea lamprey control in Lake Erie began in 1986 in support of lake trout rehabilitation efforts, and regular treatments are conducted to control lamprey populations. Annual monitoring consists of observations of sea lamprey wounds on lake trout and other coldwater fish species, and lamprey nest counts on standard stream sections.

Sea Lamprey Wounding Rate on Lake Trout >21 inches

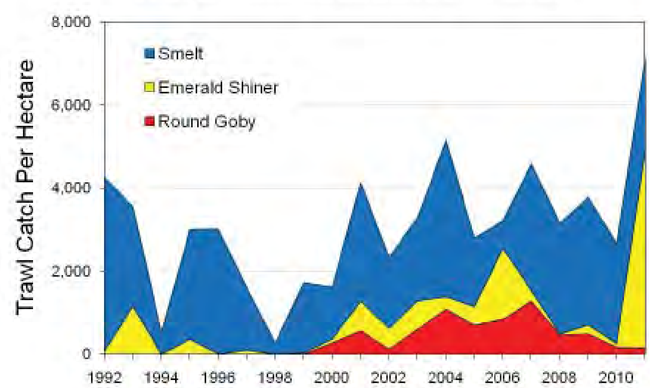


Wounding rates on lake trout continued to decline in 2011, but nest counts increased to their highest level since 1984, indicative of a high sea lamprey spawning population. Surveys indicate that the consecutive lampricide treatments of all key Lake Erie tributaries in 2008 and 2009 were successful in those streams, but the sea lamprey population remains high due to an unknown source of production.

Prey Fish

The Lake Erie Unit also participates in a number of surveys to assess forage fishes and other components of the lake ecosystem. These programs include trawl and sonar surveys of prey fishes, and predator diet studies. A variety of prey fish surveys beginning approximately 20 years ago found rainbow smelt as the dominant component of the open lake forage fish community. Beginning in 2000, there has been a notable increase in prey species diversity accompanied by somewhat lower smelt abundance, and in some years especially high abundances of round gobies and emerald shiners were encountered in both prey fish collections and predator diets. In recent years, overall prey fish abundance trended slightly downward, particularly the contribution by gobies in trawl surveys. In 2011, emerald shiner abundance increased dramatically while gobies remained at low abundance and smelt at average abundance. Over time we expect these investigations to be useful in furthering our understanding of factors shaping the fish community.

Forage Fish Abundance Trends



2 2 ake Erie esearch Unit Staff	
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yle Nemecek	Fish Wildlife Technician 1
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Ann Wilcox-Swanson	Fish Wildlife Technician 1

Stocking Trucks get a Makeover

With DEC s hatchery trucks traveling hundreds of thousands of miles each year to stock New York s waters, why not use them for free advertising The Bureau of Fisheries did ust that The rear tank of 21 DEC stocking trucks was outfitted with a 5 eye-catching decal illustrating fish and/or people fishing with an associated message encouraging people to get out fishing and purchase their fishing license. Costs for the truck wraps were extremely reasonable at 154 per wrap, including install. In comparison, advertising billboards cost 600 and up per month. With a life span of 3-5 years, having these decals installed will prove to be an extremely cost effective public outreach pro ect.

F SH NY Guide to Freshwater Fishing in New York State

The I FISH NY Guide to Freshwater Fishing was designed to promote the outstanding freshwater fishing that New York provides. This folded 36" x 37.5" map/brochure provides information on 320 lakes and 112 rivers found in the 9 DEC regions. The map also includes a host of general information of interest to a New York angler including information on purchasing a license, registering a boat, invasive species, common sportfish species and unique fishing opportunities in New York. The map can be obtained by contacting DEC by e-mail at *fwfish@gw.dec.state.ny.us*. It is also distributed through DEC offices, DEC fish hatcheries, sports shows and other events, tourism boards and selected Thruway and Northway rest areas. Over 7,700 maps were mailed last year.

In addition to the printed maps, "Public Fishing Lakes and Ponds" and "Public Fishing Rivers and Streams" Google Earth and Google Map files have been posted on the DEC website at *www.dec.ny.gov/pubs/42978.html* . These files recreate the information presented in the I FISH NY Guide to Freshwater Fishing brochure in a digital format that can also provide viewers with directions to these waters.

Fisheries Website Continues to Expand

Eighty-eight new webpages were posted on the DEC website in FY 2011/12. Pages added (by category) include: Places to Fish (38), regulations (15), biologist reports (12) and stocking (12). The new stocking pages, posted in March 2012, show the brook trout fingerling stocking history in Adirondack ponds. This new information will help brook trout anglers review several years of stocking history in one place that will help them choose which ponds they want to fish. In addition to the new pages, 68 new PDFs were posted.

Downtown Plattsburgh Boat aunch Opens

The Downtown Plattsburgh Boat Launch on Lake Champlain saw its first full year of operation in 2011. The boat launch is located off Dock Street on the shore of Lake Champlain ust south of the mouth of the Saranac River. The facility includes three launching and retrieval lanes with docks on each side of the ramp and along the shoreline. There are 31 vehicle and trailer parking sites, 12 car-only parking sites and additional parking in the ad oining parking lot. This site provides excellent access to a segment of the lake that has been lacking a large, modern boat launching facility. Plattsburgh has traditionally been the home base for many local, state and national bass tournaments. This new site will likely draw increased attention from these groups.

Rogers sland Pool Boat aunch Opens

A new boat launch on the upper Hudson River in the Village of Fort Edward (Saratoga County) opened for use in the Spring of 2011. The Rogers Island Pool Boat Launch provides a two lane concrete launch ramp, floating boarding docks and a gravel parking area for 25 cars and trailers. An information kiosk and invasive species disposal station are also provided. The boat launch provides access to a segment of the Hudson River below Fort Edward that had previously been difficult to access by motorboats. The area provides excellent warmwater fishing opportunities.

Three Mile Bay Boat aunch Opens

A new boat launch on Three Mile Bay (Chaumont Bay Lake Ontario) was opened for use in the Fall 0f 2011. The Three Mile Bay Boat Launch provides a 1 lane launch ramp, floating boarding docks and parking for 6 cars/trailer and 10 cars. An information kiosk and

invasive species disposal station is also provided. This new site is a significant improvement over the old marina that was once located on the site and provides convenient access to a very popular fishing location in Lake Ontario. The funding for the pro ect came from the Lake Ontario Natural Resource Damages Account that resulted from a settlement between New York State and the Occidental Chemical Corporation regarding Mirex contamination in Lake Ontario. Pro ects to be implemented under the settlement were selected after public review and comment and are summarized in the final Sportfishing Restoration and Spending Plan for the Lake Ontario System (2007).

Angler Achievement Awards

ust under 150 Angler Achievement Awards entries were received in 2011. The participation rate was slightly down from previous years, but nonetheless, saw some notable catches. Region 6 received the bragging rights as a new state record brook trout was established on une 15, 2011. The 5 pounder was caught from South Lake in Herkimer County and measured 22 inches. This is the sixth time the brook trout state record has been broken in seven years Another impressive catch was a 60" musky caught from the St. Lawrence River in efferson County on November 27, 2011. Overall, black bass (smallmouth and largemouth) entries continued to dominate the program with over 50 sent in. All but one of these was in the catch and release category.

iosks

Interpretive panels were designed and installed at the newly constructed Plattsburgh Downtown boat launch site. The four full color panels contained information on fish species present in Lake Champlain, historical background, fisheries management, invasive species and angling regulations. The purpose of creating this signage for each site is to give anglers and boaters "one stop shopping" for pertinent information we d like to convey.

Two panels were created and installed on the South Bay Fishing Pier on Lake Champlain. One panel provides illustrations of fish species present around the pier and the other provides the fishing regulations for the lake. Steve Grabowski of the Rome Fish Hatchery constructed custom frames for each panel.

Rome Fish Hatchery Visitor Center

In con unction with the modernization of the Rome Fish Hatchery an intepretative display was installed at the new visitor center. The Visitor Center provides a learning experience for people of all ages. Displays include: A Step Back in Time-the history of the Rome Fish Hatchery; A Fish s Tale-the life stages of trout and the day to day hatchery operations to raise them; Fishing s Great in New York State-promoting fishing opportunities across the state; and a coldwater aquarium including common NY trout species.

F SH NY Statewide mplementation

In-School Fishing Education Programs: One hundred sixty-three formal education programs were conducted between April 1, 2011, and March 31, 2012, in DEC Regions 1, 2, 3, 7 and 9. Of those, there were 147 in-school programs and 16 County Conservation Days where schools come to go through environmental programs in a round robin fashion. Most of those programs (120) were done in DEC Region 2. A total of 7,464 contacts with school kids were generated from these programs, including 5,039 in-school contracts and 2,425 contacts at County Conservation Days.

Fishing Clinics/Festivals: One hundred twenty-nine fishing education programs were conducted between April 1, 2011, and March 31, 2012, including 20 fishing festivals, 56 fishing clinics, 47 fishing clinics at summer camps, and 6 fishing clinics at campgrounds. Twenty three of these events were held in con unction with a free fishing day or designated as a free fishing event. At those 129 fishing events, 10,941 people were reached, including 4,638 at fishing festivals, 3,850 at fishing clinics, 2,338 at summer camps and 115 at campgrounds. People attending fishing festivals generally received little to no fishing education, although there were usually seminars available to those who desired to learn more about fishing. People attending fishing clinics generally received between 30 to 60 minutes of fishing education followed by an opportunity to fish.

2 2 ublic Use Staff	
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Gregory ozlowski	Biologist 2
oelle Ernst	Biologist 1 (Aquatic)
Michael DiSarno	Fish and Widlife Technician

Hatchery Infrastructure Improvements

Adirondack Hatchery   New Docks on   ittle Clear Pond and Structural Repairs to Manager s Residence

New docks were installed in the summer of 2011 at the dam house on Little Clear Pond for use during the landlocked salmon egg collection. The old docks were in poor condition. Structural improvements are on-going at the manager s residence and will be completed during the summer of 2012.

Catskill Hatchery   Replacement o rearing troughs pipelines and pole barn roo

Work was started by contractors in May of 2012 on the replacement of deteriorating rearing troughs, associated plumbing, and interior hatch house pipelines. Further work will commence on the exterior pipelines and the leaking pole barn roof will be replaced during the summer or fall of 2012.

Chateaugay Hatchery   Replacement o   nside Raceways

Installation of new fiberglass raceways will commence in uly of 2012. A preliminary inspection of the area where the raceways will be installed has taken place and some material has been purchased for the installation process. These new raceways will replace old concrete raceways which have numerous cracks and leaks. Newly hatched fish have been lost recently due to these cracks.

Chautau ua Hatchery   Water Tank Replacement

In the fall of 2011 the old water tank was demolished and a foundation was poured. During the winter, work commenced on the new above ground 80,000 gallon tank. Final work was completed in May 2012. This tank is used to hold water for the earthen ponds and inside raceways which hold walleye and muskellunge from late spring through the fall months.

Randolph Hatchery   Demolish Manager s Residence

The manager s residence at the Randolph Hatchery was demolished due to structural deficiencies and asbestos issues. A new modular home will be installed in 2012.

Rome Hatchery   New Rearing Building Visitor Center and Visi tor Parking   ot

A new rearing building/visitor center was completed and a dedication ceremony was held in September 2011. Displays for the visitor center were completed so that the public will have insight into our fish culture programs. The visitor parking lot was re-constructed with drainage catch basins, drain lines, fabric, and crusher run stone. These improvements have eliminated a chronic drainage problem and have helped contribute to a positive experience for visitors while visiting the hatchery.

Ribbon Cutting Ceremony at Rome Fish Hatchery

On September 23rd a ceremonial ribbon cutting was held at the Rome Fish Hatchery in Oneida County, hailing the renovation of one of the state s largest and most productive hatcheries. The new 2.1 million state-of-the art, energy-efficient facility houses an early fish rearing area, a visitors center, offices, a conference room, a workshop , and storage area. The ribbon cutting ceremony was attended by NYS Senator oseph Griffo, NYS Assemblyman Anthony Brindisi, and Rome Mayor ames Brown, along with leaders of NYS sportsman s organizations.

Each year the Rome Fish Hatchery hatches over 1.2 million trout eggs, and raises 1 million fingerling and 700,000 yearling brown and brook trout, including “heritage” strain brook trout native to NYS. They stock over 330 streams, lakes, and ponds, including 175 remote waters that are stocked by air. The Hatchery is responsible for inland stockings over a large part of central NYS, from Chenango and Madison Counties in the south, to Hamilton and Warren Counties in the Adirondacks.

Rome Fish Disease Control Unit   New Dissection Trailer

A new dissection lab for completing necropsy and disease testing was completed in the fall of 2011. The trailer is sited on fish hatchery property but away and downstream from existing production ponds so harmful pathogens will not be transmitted from fish samples taken from off-site locations. A large portion of the work was completed in-house by Bill Ha dasz.

Salmon River Hatchery New Deep Production Well and Roo or Assistant Manager s Residence

Production at Salmon River is currently limited in part due to an insufficient supply of water. From a previous hydrogeological survey, four sites were found to have a high potential for water. One site was picked and a test well was drilled. A production well was drilled next to the test well. Pump tests have been completed and a new pump with a metering system will be installed in une of 2012. A new standing seam metal roof was also installed on the assistant manager s residence to correct a chronic leaking roof problem.

South Otselic Hatchery Municipal Water ine Connection

Both the manager s residence and hatch house were connected to a municipal domestic water line in May of 2011. The line was extended from an existing line and has eliminated the use of a large horse power water pump to supply domestic water to the hatch house. It has also eliminated potential code violations in the hatch house and manager s residence.

Fall Egg Collections

ake Trout rom Cayuga ake

The annual Cayuga Lake egg collection of lake trout eggs began October 3 at Taughannock Point on Cayuga Lake. A total of 435,000 eggs were collected over a 3 day period. Of this total, 378,000 were used for lake trout production while 57,000 were fertilized with brook trout to produce splake eggs. The egg collection was completed using personnel from South Otselic Hatchery, Bath Hatchery, and Adirondack Hatchery. The lake trout hatched from these eggs will be stocked throughout the state. The splake will be stocked in the Adirondack Mountain region.

ake Trout rom Ra uette ake

The egg collection for Adirondack strain lake trout began on October 11 at Raquette Lake and continued until October 21. A total of 194,000 green eggs were collected and 103,000 sac fry have hatched from the eggs. These numbers should be adequate to fulfill the 2013 spring stocking requirements.

Salmon River Chinook and Coho Salmon

The annual Salmon River Fish Hatchery s chinook and coho salmon egg collection began on October 11 and October 14, respectively. The chinook egg collection took four days to complete with a total of 3.5 million eggs taken. The coho egg collection took five days to complete with a total of 1.6 million eggs taken. The salmon hatched from these eggs will be used in Salmon River Fish Hatchery s stocking program for Lake Ontario.

Adirondack Hatchery andlocked Salmon Egg Collection

The egg collection began on November 7 and ended on November 12. A total of 1.1 million eggs were collected. There were 258,000 collected from wild brood stock from Little Clear Pond and 876,000 from captive brood stock. Target numbers were reached so there should be enough salmon for stocking in the spring of 2013. Landlocked salmon are stocked into many Adirondack waters, as well as the Finger Lakes and other selected waters throughout the state.

Wind all Heritage Strain Brook Trout

Egg collection of the Windfall heritage strain of brook trout took place on October 26, 27, and November 1, 2011 in Mountain and Black Ponds. Personnel from South Otselic Hatchery assisted the Region 5 Fish Management Unit in the egg collection process. A total of 26,000 eggs were collected over the three day period. The eggs were transported back to South Otselic Hatchery. The fish from these eggs will be stocked in selected waters under the Adirondack Heritage Strain Brook Trout Management Program.

Spring Egg Collections

Salmon River Hatchery

Salmon River Hatchery s annual steelhead rainbow trout egg collection began on March 22 and continued for 3 days. A total of 2.3 million Washington strain and 102,000 Skamania strain eggs were collected. Target numbers for the egg collection were met and should be adequate to meet stocking requirements in the future. The fish hatched from these eggs will be stocked in tributary waters of Lake Ontario and Lake Erie.

Bath Hatchery

An egg collection of wild rainbow trout from the Cayuga Inlet Fishway began on March 15. Eggs were also taken on March 20, and March 26. A total of 198,000 wild rainbow trout eggs were collected. There were also 31,000 hybrid (wild rainbows x domestic rainbows) rainbow trout eggs taken. Target numbers were reached and should be adequate to meet stocking targets. Last year the egg take started the first week of April and ended the last week of April. So this year there will be close to an extra month of growth for the 2012 year class due to the early start date.

General

New Sta   Hired at New York State Fish Hatcheries

Attrition over the last several years reduced staffing to levels too low to maintain full fish production. Fortunately, DEC received approvals to fill eleven vacant hatchery positions. Ten of these were entry-level fish culturist positions to be stationed at hatcheries across the state. Fish culturists assist in all aspects of growing and stocking fish into New York s waters.

Also filled was a aquatic biologist position at the Fish Health Unit, located at the Rome Fish Hatchery. This biologist will assist our fish pathologist in the surveillance and treatment of fish diseases.   eeping fish healthy during the time they spend in the hatcheries is a critical component of overall production. Bringing the hatcheries back to the required staffing levels is a worthwhile investment, since it is estimated that anglers spend   530 million annually on fishing in New York, and a significant portion of this activity is supported by hatchery fish.

Cooperative E   ort with Virginia Results in Brown Trout Fry For New York State

The Rome Fish Hatchery unexpectedly suffered a severe loss of young brown trout due to bacterial infection and parasites, despite repeated therapeutic treatments. The loss would have caused a shortage of this year-class of brown trout, which would be scheduled to be stocked as yearlings in the spring of 2013. To help compensate for the loss numerous states were contacted to determine if they had a surplus of disease free brown trout that could be brought into DEC s fish hatchery system. Officials from the Virginia Department of Game and Inland Fisheries graciously offered to help out by providing approximately 150,000 brown trout fingerlings to DEC at no cost. These fish will be a great help in compensating for our loss of trout. Although it is not common for DEC to need additional fish to meet its program requirements, cooperation such as this among states in time of need is not unusual. The Department of Environmental Conservation has helped other states in the past and will continue to do so when possible.

Fish Disease Control

Fish Disease Control Unit Overview

The NYSDEC Fish Disease Control Unit (FDCU) at Rome Field Station oversees the fish health program for the state. The fish health program includes disease surveillance of both fish residing in the DEC hatchery system and wild fish living in rivers, streams and lakes. The unit also cares for the health of fish in the state hatchery system.

State Hatchery Disease Testing

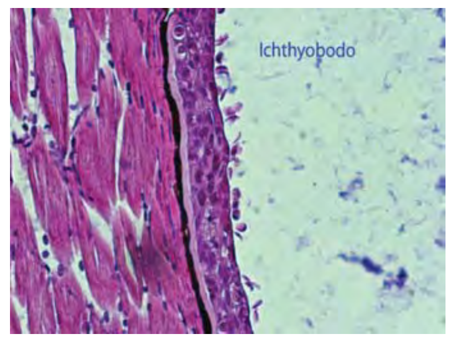
Samples from all lots of fish stocked from DEC hatcheries were tested prior to stocking. In all, 50 different lots of fish were tested from our 12 hatcheries, including both production fish and parental brood stock. No regulated fish diseases were found in any DEC hatcheries.

State Hatchery Fish Disease Epi ootics

A number of common fish diseases occur periodically in the DEC hatchery system and are managed by staff. These events can become very serious and result in the loss of significant numbers of fish, particularly if environmental or nutritional conditions are not optimal. Over the past year, disease epizootics occurring in the DEC hatchery system included:

Gyrodactylus infestation: Brook trout at several DEC hatcheries had a persistent skin infestation of the parasite Gyrodactylus. Gyrodactylus is usually quite treatable, however our brook trout seemed unusually vulnerable to recurrent infestations as treatments only had a very temporary benefit. Brook trout broodstock at Rome Field Station continue to be heavily infested.

Rome Hatchery brown trout fry loss: Fry "pinheadism" can occur when initially feeding fry fail to consume adequate nutrients early in development. These fish typically die. At both Rome and Catskill hatcheries, the occurrence of fry pinheadism in brown trout was unusually high in 2011. In Rome brown trout fry, pinheadism was immediately followed by a very acute and aggressive infestation of Ichthyobodo (a protozoan parasite), then Saprolegnia (water mold on gills), all in a period of weeks. Both of these parasites are usually treatable, but this epizootic was resistant to any treatments. In all, Rome lost 580,000 brown trout in ust a few weeks.



Persistent Bacterial Coldwater Disease: A persistent epizootic of bacterial coldwater disease (BCWD) caused by Flavobacterium psychrophilum developed at many of the DEC hatcheries during the reporting period. Certain hatcheries have routinely seen it in the winter, but in 2011-12, BCWD occurred in new species and new locations, such as Bath Hatchery rainbow trout.

Wild Fish Disease Surveillance

Wild fish health is assessed annually as part of a cooperative program with the USFWS and the National Wild Fish Health Survey. Fish from 33 locations were tested at either the DEC Rome Field Station or the USFWS Fish Health Center in Lamar, PA. Locations included sites from all regions in the state and collections included both cold water and cool water fish species. Significant pathogens

were isolated from fish in two collections. In August, 2011, brown trout from Castle Creek (Region 8) tested positive for whirling disease (Myxobolus cerebralis) and Lake Ontario lake trout tested positive for epizootic epitheliotropic disease virus (EEDv) in September.

Other Fish Health Pro ects

Experimental New Animal Drug Studies: The DEC has had an ongoing agreement with the FDA and USFWS to use Chloramine T to treat specific bacterial diseases when they occur. In return, the FDA will apply our treatment results in their drug approval process. Chloramine T was very effective in treating disease epizootics in 2011-12 and the drug should be approved very soon.

Healthy Fish Tissue Atlas: To enhance disease diagnosis accuracy, a healthy fish tissue atlas was prepared which includes all ma or tissues of fish families propagated in the state hatchery system. Because most of the current fish anatomy and physiology literature focuses on ust a few prominent fish species, having an atlas that includes other, less studied species (i.e. walleye and muskellunge) is vital for evaluating disease occurrence, progression, and management.

Furunculosis-Resistant Trout Project: The DEC s primary domestic brown and brook trout strains (Rome strain) were developed by the FDCU for disease resistance to bacterial furunculosis. Every year, fingerling Rome strain trout at Rome Field Station are infected with a significant dose of Aeromonas salmonicida intended to ensure continuance of the disease-resistant trait. In 2011, Rome strain brown trout and brook trout were successfullyinfected with a cocktail of eight different isolates of A. salmonicida from fish in Lake Ontario.

Fish Nutrition Study: The FDCU collaborated with the USGS to determine if essential oils extracted from cinnamon, garlic, and rosemary had nutritional benefit in protecting fish from a bacterial disease called furunculosis (caused by Aeromonas salmonicida). Our previous studies indicated that these oils directly suppressed A. salmonicida bacterial growth in plate culture, and the current study addressed whether these oils had similar protection when added to fish diets of fish exposed to this pathogen. We determined that none of the oils was effective strictly as a dietary additive, however cinnamon oil may have value in non-dietary applications and further investigation is being planned.

Annual Fish Production

S ECIES		ESS T AN		2		2						lus		TOTAL	
		NUMBE	EI T	NUMBE	EI T	NUMBE	EI T	NUMBE	EI T	NUMBE	EI T	NUMBE	EI T	NUMBE	EI T
Cold Water	**Cold ater**														
	Brook Trout	550	0	110,865	2,548	122,575	5,897	2,700	310	400	62	159,769	43,203	3 ,	2, 2
	Brown Trout	50	0	350	3	70,040	4,495	11,750	968	250,370	40,119	1,637,513	507,760	, , 3	3,3
	Rainbow Trout			84,000	889	95,850	5,266	69,350	6,600	21,200	3,120	346,884	83,684	,2	,
	Steelhead					868,150	37,963	50,990	3,960					,	, 23
	Lake Trout					57,500	2,645	203,100	13,166	298,150	27,750	163,910	20,444	22,	,
	Splake									12,100	1965	5640	1119	,	3
	Landlocked	2,966		84862	672	182380	10879	91,688	7,330	100,326	15434	489	1884	2,	3 ,
	Coho			155,000	3,890	140,750	10,504							2 ,	,3
	Chinook			1,768,290	21,709									, ,2	2 ,
	Cold ater Total	**3,**		**2,2 3,3**	**2 ,**	**, 3 ,2**	**,**	**2 ,**	**32,33**	**2,**	**,**	**2,3 ,2**	**,**	**, ,**	**,23**
Warm Water	**arm ater**														
	Walleye	210,402,000	2,806	609,846	796	87,000	2175							2 , ,	,
	Muskellunge			17260	20							31,860	2,486	, 2	2,
	Tiger Muskellunge											105,500	13,941	,	3,
	Panfish											500	167		
	Paddlefish											2,150	717	2,	
	arm ater Total	**2 , 2,**	**2,**	**2 ,**		**,**	**2**	0	0			**,**	**,3**	**2 ,2 ,**	**23,**
rand Total		**2 , ,**	**2,**	**2, 3 , 3**	**3 , 2**	**, 2 ,2**	**, 2**	**2 ,**	**32,33**	**2,**	**,**	**2, ,2**	**,**	**2 , 2 , 23**	**,3**

2 2 Fish Culture Staff

CENTRA OFF CE

im Daley	Fish Culturist 6
Dave Armstrong	Fish Culturist 5
Mary LaBoissiere	Secretary 1

AD RONDAC

Matt ackson	Fish Culturist 3
Fritz Aldinger	Fish Culturist 1
Neil Cranker	Fish Culturist 1
enneth lubek	Fish Culturist 1
Adam osnick	Fish Culturist 1 (trainee)

BATH

en Osika	Fish Culturist 3
elly Raab	Fish Culturist 1
Robert Sweet	Fish Culturist 2
Stephen Galbreth	Fish Culturist 1
Adam Haley	Fish Culturist 1 (trainee)

CA EDON A

Alan Mack	Fish Culturist 4
evin Hayden	Fish Culturist 2
Mark rause	Fish Culturist 3
ason Schirmer	Fish Culturist 1
Robert Stein	Fish Culturist 2
Brian Ward	Fish Culturist 1
Stephen enzen	Fish Culturist 1
Steven Robb	Fish Culturist 1

CATS

ohn Anderson	Fish Culturist 4
Tim Anstey	Fish Culturist 1
Steve Galbreth	Fish Culturist 1
oseph Gennarino	Fish Culturist 2
ames udson	Fish Culturist 1
Nathan Snyder	Fish Culturist 1
Mark Ferron	Fish Culturist 1 (trainee II)
Robert Poprawski	Fish Culturist 1 (trainee)

CHATEAUGAY

Neal McCarthy	Fish Culturist 2
Mike Disarno	Fish Culturist (trainee)
Doug Peck	Fish Culturist (trainee)
Mike Sicley	Fish Culturist (trainee)
Nicole Vogt	Fish Culturist (trainee)

CHAUTAU UA

Larry ing	Fish Culturist 3
Eric Defries	Fish Culturist 2
Bradley Gruber	Fish Culturist 1
Ron Preston	Fish Culturist 1

ONE DA

Mark Babenzien	Fish Culturist 4
Bill Evans	Fish Culturist 2
Carl Rath e	Fish Culturist 3
ohn Gray	Fish Culturist 1

RANDO PH

Richard Borner	Fish Culturist 3
Trevor Brady	Fish Culturist 1
Barry Hohmann	Fish Culturist 1
Raymond Hulings	Maintenance Assistant
im Rambuski	Fish Culturist 2
Derek Weishan	Fish Culturist 1

ROME

Robert Lewthwaite	Fish Culturist 4
evin Balduzzi	Fish Culturist 1
ohn Draper	Fish Culturist 1
Steven Grabowski	Fish Culturist 2
ach Goodale	Fish Culturist 1
William R. Ha dasz	Maintenance Supervisor
imberly Matt	eyboard Specialist
on Stercho	Fish Culturist 1
Scott Wanner	Fish Culturist 3
William Woodworth	Fish Culturist 2

F SH D SEASE CONTRO

Andrew Noyes	Pathologist 2 (Aquatic)
Geofrey Eckerlin	Biologist 1 (Ecology)
Mark Batur	Fish Culturist 1

SA MON R VER

Andreas Greulich	Fish Culturist 4
Brian Boyer	Fish Culturist 1
Stephen Dolan	Fish Culturist 3
David Domachowske	Fish Culturist 2
Brian Edmonds	Fish Culturist 1
aren Hurd	eyboard Specialist
Robert Nelson	Fish Culturist 2
oe Dallas	Fish Culturist 1 (trainee)
Leslie Resseguie	Fish Culturist 1 (trainee)

SOUTH OTSE C

Patt Emerson	Fish Culturist 3
Thomas ielbasinski	Fish Culturist 2
Bruce Ryan	Fish Culturist 1
Mike Speziale	Fish Culturist 1

VAN HORNESV E

Larry roon	Fish Culturist 3
Craig DuBois	Fish Culturist 2
Lauren C. Watson	Fish Culturist 1

Summary of Fisheries, Creel & Angler Surveys

Survey Name	Purpose
Region 1	
Carmans River, spring electrofishing	Fate of Stocked Trout Study
Carmans River Creel Census	Fate of Stocked Trout Study
Artist Lake	Centrarchid survey
11 small ponds in the Peconic Drainage	Banded sunfish, swamp darter surveys
Carmans River summer electrofish	Fate of Stocked Trout Study
Smith Pond	Toxic Substances Monitoring Program
Spring Lake	Toxic Substances Monitoring Program
Wantagh Creek	Coldwater habitat evaluation
Lower Peconic River and tributaries	Alewife monitoring
Region 2	
Oakland Lake	Fish health inspection
Wolfes Pond	General biological survey
Harlem Meer	General biological survey
Willow/Meadow Lake	Snakehead assessment
Region 3	
Tidal Esopus Creek	Overwintering largemouth bass assessment
Sylvan Lake	Centrarchid plan
Wappingers Lake	TSMP Collection
Lake Gleneida	Gill net trout assessment
Esopus Creek	Population estimate
Esopus creek	Fate of Stocked Trout Study assessment
Swinging Bridge Reservoir	Percid plan (October electrofishing)
Rio Reservoir	Percid plan (October electrofishing)
Rondout Reservoir	Gill net trout assessment
Crystal Lake	Trap net trout assessment
Middle Branch Reservoir	Tiger muskie and centrachid assessment (October electrofishing)
Tidal Wappingers Creek	Overwintering largemouth bass assessment
Tidal Rondout Creek	Overwintering largemouth bass assessment
Lower Esopus Creek	General biological survey (une)
Lower Esopus Creek	General biological survey (August)
Region 4	
T16 to Manor ill	Loach monitoring
Unnamed water (SR-137-1)	Loach investigation
West Branch Delaware River	Trout population studies
Schoharie Reservoir	Loach investigation
Arnold Lake	Centrarchid survey
Susquehanna River	Rock bass abundance assessment
East Sidney Reservoir	Centrarchid survey
Mohawk River (Lock 7-8)	Contaminant fish collection
Pepacton Reservoir	General biological survey
Cannonsville Reservoir	General biological survey

Region 4 cont.	
Potic Creek	CROTS survey
Mill Creek	CROTS survey
Trout Brook	Fish health collections
Sands Creek	Fish health collections
Downs Brook	Trout stream biological survey
East Branch Delaware River	Trout population study
Roeliff ansen ill	Fish health collections
Punsit Creek	CROTS survey
Indian Creek	CROTS survey
Horton Brook	Fish health collections
Trout Brook	Trout stream biological survey
Humphries Brook	Article 15 compliance survey
Schoharie Creek	Snorkel survey
Baxter Brook	Trout stream biological survey
Butternut Creek	CROTS survey
Arnold Lake	Percid netting
Canadarago Lake	Walleye YOY fall survey
Hudson River	Black bass wintering area survey
EBT V stream surveys (506 streams)	Brook trout presence/absence surveys
Region 5	
Lake Champlain (South Bay)	Walleye egg take and general survey
Little Green Pond (Franklin Co), Bug Lake and Eagles Nest Lake (Hamilton Co)	Round whitefish assessment
Eleven limed waters (three counties)	Annual chemistry monitoring of limed waters
Lake Algonquin (Hamilton County)	Walleye stocking evaluation, TSMP and disease sampling
Center White Creek, Mosely Brook (Washington Co)	EBT V follow up surveys
Barker Pond, Cranberry Pond (Hamilton Co), Vanderwhacker Pond and Big Cherrypatch Pond (Essex Co)	Brook trout stocking evaluations
Middle Saranac Lake (Franklin Co)	General biological survey, TSMP sampling
Davis Lake (Clinton Co)	Brown trout stocking evaluation, largemouth bass intro evaluation
Mud Pond (Clinton Co)	Evaluate split stocking policy of brook trout and brown trout.
Upper Saranac Lake (Franklin Co)	Collect bass for TSMP (mercury) analysis
Mettawee River (Washington Co)	CROTS habitat survey
Archer Vly (Saratoga Co)	New easement acquisition general biological survey
Button Brook (Clinton Co)	Article 15 trout presence verification
Cole Brook (Saratoga Co)	CROTS evaluation
Balfour Lake (Essex Co)	General biological survey (RT stocking evaluation)
Loon Lake (Warren Co)	Walleye stocking evaluation
Lake George	Trapnetting for landlocked salmon
Fishbrook Pond, Black Pond	Brook trout egg take
Region 6	
Moshier Creek	Acidification Recovery Investigation
Big Hill Pond	Brook Trout Egg Take
Boottree Pond	Brook Trout Egg Take

Region 6 cont.	
Deer Pond	Brook Trout Egg Take
Little Hill Pond	Brook Trout Egg Take
North Twin Lake	Brook Trout Egg Take
Baby Lake	Brook Trout Genetics
Honnedaga Brook	Brook Trout Genetics
Black Creek Lake	Eastern Brook Trout oint Venture
Otter Creek ,Unnamed Tributary	Eastern Brook Trout oint Venture
Skate Creek	Eastern Brook Trout oint Venture
Skate Creek Tributary	Eastern Brook Trout oint Venture
Big Oriskany Creeks	Fate of Stocked Trout Creel Survey
Oriskany Creek	Fate of Stocked Trout Population Surveys
Big Creek	Fate of Stocked Trout Population Surveys
Delta Lake	Fish Disease Investigation
Cranberry Lake	Fish Disease Investigation (2 surveys)
Clear Pond (Tamarack)	General Coldwater Fishery Survey
Clear Pond Outlet (Tamarack)	General Coldwater Fishery Survey
Cold Spring Creek	General Coldwater Fishery Survey
Eagle Creek	General Coldwater Fishery Survey
French Lake (West)	General Coldwater Fishery Survey
Independence Lake	General Coldwater Fishery Survey
Loon Hollow Outlet	General Coldwater Fishery Survey
Salmon Lake	General Coldwater Fishery Survey
Salmon Lake Outlet	General Coldwater Fishery Survey
Sauquoit Creek	General Coldwater Fishery Survey
Sugar River	General Coldwater Fishery Survey
Unnamed Water	General Coldwater Fishery Survey
Unnamed Water	General Coldwater Fishery Survey
West Branch Beaver River	General Coldwater Fishery Survey
West Branch Black Creek	General Coldwater Fishery Survey
Woodhull Lake	General Coldwater Fishery Survey
West Branch St Regis River	General Coldwater Fishery Survey (3 surveys)
Streeter Lake	Hybrid Brook Trout Study
Cleveland Lake	Hybrid Brook Trout Study (3 surveys)
Lake Ontario	Lake Sturgeon - uvenile Assessment
St. Lawrence River	Lake Sturgeon Egg Take
Black River	Lake Sturgeon Monitoring
St. Lawrence River	Lake Sturgeon Monitoring
Lake Ontario	Lake Sturgeon Monitoring (2 surveys)
Star Lake	Lake Trout Evaluation
Sylvia Lake	Lake Trout Evaluation
Massawepie Lake	Lake Trout Evaluation/Disease Investigation
Trout Pond	Lake Trout Evaluation/Disease Investigation
Boottree Pond	Limed Water Program
Brewer Pond	Limed Water Program

Region 6 cont.	
Buck Pond	Limed Water Program
Cleveland Lake	Limed Water Program
Deer Pond	Limed Water Program
Hedgehog Pond	Limed Water Program
Hidden Lake	Limed Water Program
Horn Lake	Limed Water Program
Horseshoe Pond	Limed Water Program
Little Otter	Limed Water Program
Little Otter Lake	Limed Water Program
Long Lake P162	Limed Water Program
Nicks Pond	Limed Water Program
Payne Lake (Lewis County)	Limed Water Program
Peaked Mountain Lake	Limed Water Program
Pine Pond	Limed Water Program
uiver Pond	Limed Water Program
Round Pond	Limed Water Program
Townline Pond	Limed Water Program
Evergreen Lake	Limed Water Program (2 surveys)
Pitcher Pond	Limed Water Program (2 surveys)
Lake Ontario	Lower Trophic Level Sampling
Black River	Stocked Steelhead Monitoring
Oswegatchie River	Walleye Egg Take
Black Lake	Walleye Evaluation
Payne Lake (efferson County)	Walleye Evaluation
Red lake	Walleye Evaluation
Lake Ontario	Warmwater Fish Stock Assessment, Eastern Basin
St. Lawrence River	Warmwater Fish Stock Assessment, Lake St. Lawrence
St. Lawrence River	Warmwater Fish Stock Assessment, Thousand Islands
Clear Lake	Wild Brook Trout Investigation
Unnamed Water (Clear Lake Outlet)	Wild Brook Trout Investigation
St. Lawrence River	Young-of-the-Year Esocid Index
Baby Lake	Brook Trout Genetics
Big Oriskany Creeks	Fate of Stocked Trout Creel Survey
Big Creek	Fate of Stocked Trout Population Surveys
Big Hill Pond	Brook Trout Egg Take
Black Creek Lake	Eastern Brook Trout oint Venture
Black Lake	Walleye Evaluation
Black River	Lake Sturgeon Monitoring
Black River	Stocked Steelhead Monitoring
Boottree Pond	Brook Trout Egg Take
Boottree Pond	Limed Water Program
Brewer Pond	Limed Water Program
Buck Pond	Limed Water Program
Clear Lake	Wild Brook Trout Investigation

Region 6 cont.	
Clear Pond (Tamarack)	General Coldwater Fishery Survey
Clear Pond Outlet (Tamarack)	General Coldwater Fishery Survey
Cleveland Lake	Hybrid Brook Trout Study (3 surveys)
Cleveland Lake	Limed Water Program
Cold Spring Creek	General Coldwater Fishery Survey
Cranberry Lake	Fish Disease Investigation (2 surveys)
Deer Pond	Brook Trout Egg Take
Deer Pond	Limed Water Program
Delta Lake	Fish Disease Investigation
Eagle Creek	General Coldwater Fishery Survey
Evergreen Lake	Limed Water Program (2 surveys)
French Lake (West)	General Coldwater Fishery Survey
Hedgehog Pond	Limed Water Program
Hidden Lake	Limed Water Program
Honnedaga Brook	Brook Trout Genetics
Horn Lake	Limed Water Program
Horseshoe Pond	Limed Water Program
Independence Lake	General Coldwater Fishery Survey
Lake Ontario	Lake Sturgeon Monitoring (2 surveys)
Lake Ontario	Lake Sturgeon - uvenile Assessment
Lake Ontario	Lower Trophic Level Sampling
Lake Ontario	Warmwater Fish Stock Assessment, Eastern Basin
Little Hill Pond	Brook Trout Egg Take
Little Otter	Limed Water Program
Little Otter Lake	Limed Water Program
Long Lake P162	Limed Water Program
Loon Hollow Outlet	General Coldwater Fishery Survey
Massawepie Lake	Lake Trout Evaluation/Disease Investigation
Moshier Creek	Acidification Recovery Investigation
Nicks Pond	Limed Water Program
North Twin Lake	Brook Trout Egg Take
Oriskany Creek	Fate of Stocked Trout Population Surveys
Oswegatchie River	Walleye Egg Take
Otter Creek ,Unnamed Tributary	Eastern Brook Trout oint Venture
Payne Lake (Lewis County)	Limed Water Program
Payne Lake (efferson County)	Walleye Evaluation
Peaked Mountain Lake	Limed Water Program
Pine Pond	Limed Water Program
Pitcher Pond	Limed Water Program (2 surveys)
uiver Pond	Limed Water Program
Red lake	Walleye Evaluation
Round Pond	Limed Water Program
Salmon Lake	General Coldwater Fishery Survey
Salmon Lake Outlet	General Coldwater Fishery Survey

Region 6 cont.	
Sauquoit Creek	General Coldwater Fishery Survey
Skate Creek	Eastern Brook Trout oint Venture
Skate Creek Tributary	Eastern Brook Trout oint Venture
St. Lawrence River	Lake Sturgeon Egg Take
St. Lawrence River	Lake Sturgeon Monitoring
St. Lawrence River	Warmwater Fish Stock Assessment, Lake St. Lawrence
St. Lawrence River	Warmwater Fish Stock Assessment, Thousand Islands
St. Lawrence River	Young-of-the-Year Esocid Index
Star Lake	Lake Trout Evaluation
Streeter Lake	Hybrid Brook Trout Study
Sugar River	General Coldwater Fishery Survey
Sylvia Lake	Lake Trout Evaluation
Townline Pond	Limed Water Program
Trout Pond	Lake Trout Evaluation/Disease Investigation
Unnamed Water	General Coldwater Fishery Survey
Unnamed Water	General Coldwater Fishery Survey
Unnamed Water (Clear Lake Outlet)	Wild Brook Trout Investigation
West Branch Beaver River	General Coldwater Fishery Survey
West Branch Black Creek	General Coldwater Fishery Survey
West Branch St Regis River	General Coldwater Fishery Survey (3 surveys)
Woodhull Lake	General Coldwater Fishery Survey
Region 7	
Otselic River	Population estimate of stocked trout
Whitney Point Reservoir	General biological survey
Sherman Creek	Demonstrate electrofishing to TU camp
Cayuga Lake (2 surveys)	Evaluate presence of lake sturgeon
amesville Reservoir	Walleye recruitment evaluation
Beaverdam Brook/Salmon R. Hatchery (2 surveys)	Steelhead and chinook/coho spawning run surveys
Cayuga Inlet Fishway	Spring rainbow trout spawning run/lamprey control
Cayuga Lake	General biological survey
Otter Lake	Walleye stocking evaluation
Otisco Lake	Walleye stocking evaluation
355 small streams in Oswego, Chenango, and Madison Counties	EBT V surveys to document trout presence
Region 8	
Seneca lake Trout Derby	Lamprey wounding Rates and general salmonid biological data
Meads Creek	Fate of Stocked Trout Study
172 Streams Region-wide	Surveys to document trout presence
euka Lake	Lake trout assessment
Lake Ontario (near-shore)	Water Fish Community Assessment
Beaver Brook	Post stream enhancement work assessment
Seneca- Cayuga Canal	Assist Bureau of Habitat - Fish Collection
Springwater Creek	Rainbow trout production survey
Limekiln Creek	Rainbow trout production survey

Region 8 cont.	
Cold Brook	Rainbow trout production survey
Sodus Bay	Warm water fishery assessment
euka Lake	Hydroacoutic cruise
Springwater Creek	Rainbow trout assessment
Catherine Creek	Rainbow trout assessment / lamprey wounding rates
Sleepers Creek	Rainbow trout assessment
McClure Creek	Rainbow trout assessment
Cold Brook	Rainbow trout assessment
Honeoye Lake	Walleye population estimate
Naples Creek	Rainbow trout assessment
Region 9	
East oy Creek electrofishing and angler use surveys	Part of Fate of Stocked Trout statewide study
548 small streams electrofishing surveys in Wyoming, Cattaraugus and Erie Counties.	EBT V survey to document brook trout presence
N. Branch Wiscoy Creek	Fish survey prior to habitat improvement work
McIntosh and Beehunter Creeks	Evaluation of habitat improvement pro ect
Stoddard Creek	Collection of brook trout for aging study
Cuba Lake	Warm and cool water fisheries management
Chautauqua Lake trawl	Assess forage abundance and panfish species composition
Chautauqua Lake Electro-Fishing	Evaluation of post-stocking changes on game fish community
Upper Cassadaga Lake	Document stocking survival of 50-day walleye
Middle Cassadaga Lake	Document stocking survival of 50-day walleye
Lower Cassadaga Lake	Document stocking survival of 50-day walleye
Red House Lake	Document stocking survival of 50-day walleye
Lake Ontario Research Unit	
Lake Ontario Alewife Bottom Trawl Survey	Assess yearling and adult alewife in Lake Ontario
Lake Ontario Rainbow Smelt Bottom Trawl Survey	Assess yearling and adult smelt in Lake Ontario
Lake Ontario uvenile Lake Trout Trawl Survey	Assess uvenile lake trout in Lake Ontario
Lake Ontario Warmwater Fisheries Assessment	Assess warmwater fish populations in the Eastern Basin
Status of Lake Ontario s Lower Trophic Levels	Monitor trends in Lake Ontario productivity, including nutrients, chlorophyll a, and zooplankton populations
Lake Ontario Adult Lake Trout Assessment	Assess adult lake trout populations in Lake Ontario
Lake Ontario Fishing Boat Survey	Monitor trends in angler effort/catch/harvest in the open waters of Lake Ontario
Lake Ontario Chinook Salmon Mass Marking Program	Determine contribution of wild Chinook salmon to Lake Ontario sportfisheries and evaluate success of pen-rearing pro ects
Northern Pike and Muskellunge Monitoring in the Thousand Islands Region of the St. Lawrence River	Monitor northern pike and muskellunge spawning and nursery areas to assess reproductive success and influence habitat changes
Lake Ontario Hydroacoustic Preyfish Assessment	Use hydroacoustic technology to develop lakewide estimates of alewife numbers and biomass
Lake Ontario Tributary Creel Survey	Monitor trends in angler effort/catch/harvest in ma or Lake Ontario tributaries. Supervised and reported by Region 7.
Lake Erie Research Unit	
Lake Erie Commercial Fishery Assessment	Sampling to characterize harvest age composition of Lake Erie s commercial yellow perch fishery

Lake Erie Research Unit cont.	
Lake Erie Lower Trophic Monitoring Program	Index of lower trophic indicators seasonally, including zooplankton density, nutrient concentrations, temperature and water transparency
Lake Erie Open Lake Sport Fishing Survey	Creel survey measure of sport fishing catch and effort from Lake Erie s boat fisheries for walleye, smallmouth bass and yellow perch
Lake Erie Tributary Angler Diary Program	Diary index of fishing quality for Lake Erie s tributary steelhead fishery
Lake Erie Tributary Sea Lamprey Nest Density	Annual nest counts to index the concentration of sea lamprey nests in selected Lake Erie tributaries
Lake Erie Fish Cleaning Station Monitoring	Annual examination of angler caught walleye processed at cleaning stations to characterize size, age composition and stomach contents
Lake Erie Beach Seine Assessment	A pilot survey to assess abundance and distribution of near shore young-of-year fishes in eastern Lake Erie
Lake Erie Coldwater Community Assessment	Gill net index of abundance, age composition, growth, and diet of lake trout, burbot and lake whitefish
Lake Erie Warmwater Community Assessment	Gill net index of abundance, age composition, growth, and diet of walleye, yellow perch and smallmouth bass
Lake Erie Tributary Angler Survey	Creel survey measure of catch and effort from Lake Erie s tributary fisheries for steelhead.
Lake Erie Forage and uvenile Fish Assessment	Bottom Trawl index of abundance, age composition and growth, of uvenile yellow perch and an array of forage fish species
Lake Erie Lake Trout Spawning Survey	Gill net survey to understand site selection by spawning phase lake trout in near-shore and offshore areas

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New York State Department of Environmental Conservation

Permits & Licenses

A summary of licenses and permits reviewed or issued by the Bureau of Fisheries

DEC REG ON

Permit Name	1				5					CO	Total
Farm Fish Pond			10	216	10	14	141	45	54		490
Stocking	6		180	87	200	23	25	17	6		544
Triploid Grass Carp	2		226	234	30	58	208	365	583		1706
Overland Transport of Bait			13	5		6		10	15		49
Fish Possession (over daily limit)						4	5		1		10
Piranha	1				1		1		2		5
Baitfish (C.O)	3			45			83	102			233
Temporary Revocable Permit (TRP)	4		1	1	20	3	11	7			47
Article 15 Review			469	227	200	474		81	391		1542
Article 24 Review	10		219	5					4		238
Pesticide Permit Review	25		16	4		6			8		59
Bass Hatchery Permits (C.O)										18	18
Trout Hatchery Permits (C.O)										36	36
License to Collect and Possess (C.O)								19			19
Other:											
Trout in the Classroom							10	2			12
Hydropower Relicensing						6					6
Adopt A Natural Resource								4			4
Emergency Permits (Irene/Lee)			431	757							1188
Total All Permits											

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Downriver Passage of Juvenile Blueback Herring near an Ultrasonic Field in the Mohawk River

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ARTICLE

Downriver Passage of Juvenile Blueback Herring near an Ultrasonic Field in the Mohawk River

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Abstract
At the Crescent Hydroelectric Project (Crescent), New York, the Mohawk River is impounded by two dams separated by an island, which creates two channels; the turbine channel conveys water to the hydroelectric turbines, and the main channel conveys water around the turbines. Our objective was to determine whether ultrasound could be used to divert juvenile blueback herring *Alosa aestivalis* from entering the turbine channel during their fall downriver migration. Fixed-location hydroacoustics (420 kHz) was used to continuously monitor fish passage in the main channel upriver and downriver of the 122–128-kHz ultrasonic projectors. A relative index of abundance was derived from echo integration of acoustic backscatter collected from three horizontally aimed single-beam transducers sampling across each channel, while the proportion and speed of fish moving downriver were estimated from upward-facing split-beam transducers. The presence of juvenile blueback herring was verified by castnetting. Fish migrated downriver episodically for periods of hours rather than days. The mean daily number of downstream migrants (N_d) in the main channel was estimated to be 4.2 times higher at the upriver site than at the downriver site. The estimate for N_d at the main-channel downriver site (N_{DM}) was compared with the expected N_d (N_{EDM}) based on the proportion of total river flow moving through the main-channel downriver site as measured by acoustic Doppler current profilers. The mean daily difference between N_{DM} and N_{EDM} was significantly different from zero. The estimated proportion of fish that passed the main-channel downriver site (31.3%) was almost three times greater than the proportion expected (11.5%). If it is valid to assume that water flow directly influences entrainment and impingement, then the significantly higher-than-expected number of blueback herring that migrated downriver in the main channel could be an indication that ultrasound at Crescent was partially effective in diverting fish.

The blueback herring *Alosa aestivalis* and the alewife *A. pseudoharengus*, collectively known as river herring, provide important social, economic, and ecological benefits according to the interstate fishery management plan prepared by the Atlantic States Marine Fisheries Commission (ASMFC 2009). The social and economic benefits include both use and nonuse values for current and future generations. The ecological benefits reflect the important contribution of river herring, during all life stages, to the dynamics of food chains in freshwater, estuarine, and marine habitats. However, the interstate fishery management plan documents a decline in commercial landings of river herrings along the Atlantic coast of the USA from 6.2 million kg in 1985 to less than 1.0 million kg in 2007. It identifies potential causes for the decline: overfishing, water withdrawal facilities, toxic and thermal discharges, channelization and dredging, land use changes, atmospheric deposition, and barriers to upstream and downstream migration. A specific concern regarding downstream migration relates to the mortality of fish that pass through turbines at hydropower facilities. Passage of fish through turbines is a process known as entrainment.

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FIGURE 1. Location of the Crescent Hydroelectric Project on the Mohawk River, New York.

Blueback herring are coastal pelagic fish that spend most of their adult lives at sea (Munroe 2002). The species' range extends from northern Florida to New Brunswick (Smith 1985). During late spring, adult blueback herring migrate into coastal rivers, including the Hudson River, to spawn (Schmidt et al. 1988). Migration of blueback herring up the Hudson River is blocked by the Federal Dam (Green Island, New York), located 246 km from the river's mouth. However, a lock at the dam allows adult blueback herring to migrate further upriver; some of those adults migrate into the Mohawk River, which is part of the Erie Canal section of the New York State Canal System (Figure 1).

The Erie Canal section, completed in 1918, is comprised of long navigable pools formed by dams. Locks situated adjacent to the dams allow vessels to pass between pools. Before construction of the Erie Canal section and its predecessor (the Erie Canal), blueback herring could not ascend the Mohawk River past Cohoes Falls, a 20-m-high, 396-m-wide natural barrier that is located about 2 km from the confluence of the Mohawk and Hudson rivers (Swan and Goss 2004). Five locks in the Erie Canal section, known as the Waterford Flight, circumvent Cohoes Falls. Adult blueback herring use the Waterford Flight and other locks in the Erie Canal section to migrate as far upriver as Rome, New York, which is located 160 km from the Federal Dam (Schmidt et al. 2003). After spawning, adult blueback herring migrate down the Mohawk River, and their migration is followed several months later by the downriver migration of juveniles. Downriver migration can occur via locks, over dams, or through the turbines of hydropower facilities. Hydropower facilities are associated with dams at six locations on the Mohawk River; one of those facilities is the Crescent Hydroelectric Project (hereafter, Crescent). Juvenile blueback herring have been visually observed in the Crescent headrace during months when downriver migration may occur (August–November).

The plan identifies ultrasonic barriers as a technology that may reduce entrainment of river herring at hydropower facilities. Clupeid fishes, including river herring, detect ultrasound (frequencies $>$ 20 kHz; Mann et al. 1997, 2001; Popper et al. 2004). River herring that detect ultrasound have been observed to avoid it (Dunning et al. 1992; Nestler et al. 1992; Dunning and Ross 2010). Ultrasound reduced the number of adult alewives near the cooling water intake of the James A. FitzPatrick Nuclear Power Plant (hereafter, FitzPatrick) on Lake Ontario by as much as 96% (Ross et al. 1993). It also reduced the number of adult alewives that entered the cooling water intake of FitzPatrick by as much as 96% (Ross et al. 1996) and reduced the number of juvenile blueback herring that entered the cooling water intake of the Arthur Kill Generating Station (hereafter, Arthur Kill) on the East River, New York, by 95% (Consolidated Edison 1994). However, an ultrasonic system at the Annapolis Tidal Hydroelectric Generating Station (hereafter, Annapolis) in Nova Scotia, Canada, was much less effective in diverting juvenile blueback herring and alewives away from a turbine intake and into a bypass (Gibson and Meyers 2002).

At Annapolis, no diversion of juvenile blueback herring was detected when all samples were included in the analysis; a 49% diversion rate was detected after the three largest samples were removed from the data set. Gibson and Myers (2002) suggested that a comparison of results from Annapolis and FitzPatrick may not be appropriate because fish had to be deflected from the intake and into a bypass at Annapolis, whereas they only had to be deflected from the intake at FitzPatrick. Based on the successful scientific demonstration of ultrasound's ability to reduce impingement of alewives at FitzPatrick, the successful application of ultrasound to reduce impingement of blueback herring at Arthur Kill, and the potential benefits of using ultrasound to reduce entrainment of blueback herring at hydropower facilities, an ultrasonic system was installed at Crescent to deflect juvenile blueback herring from the entrance of a channel that conveys water to the intake. Our goal was to determine whether juvenile blueback herring appeared to be diverted by the ultrasonic system at Crescent and, if so, whether the diversion rate was more similar to that at two steam-electric facilities (FitzPatrick and Arthur Kill) or to that at a tidal hydroelectric facility (Annapolis).

METHODS

Study Area

Crescent is located on the Mohawk River, about 8 km from the Federal Dam (Figure 1). It includes two dams (Dams A and B) that are separated by an island. The two dams impound the Mohawk River. Along the east side of the island lies the primary navigation channel (hereafter, main channel), which continues upriver. It is deeper than the channel that lies along the west side of the island (hereafter, turbine channel). The western boundary of the turbine channel is delimited by a large shoal, which is covered with a dense stand of European water chestnut *Trapa natans* during spring through fall. The turbine channel conveys water to the Crescent headrace and turbines.

When blueback herring migrate downriver and approach Crescent, they can continue down the main channel or follow the turbine channel. If blueback herring continue down the main channel, they can migrate further downriver by going through the Waterford Flight or over Dam A, which has a fixed crest elevation of 56.1 m. During the navigation season (usually from May to November), 0.3-m-tall flashboards are installed on top of the dam and the water level in the main channel is typically near an elevation of 56.4 m. When the water elevation is less than 56.4 m but greater than 56.1 m, blueback herring that go over Dam A do so through a 24.4-m opening in the flashboards. The opening in the flashboards is installed to facilitate downriver migration of blueback herring. When the water elevation in the main channel is greater than 56.4 m, blueback herring can go over the Dam A flashboards as well as through the opening in them. At a water elevation of 56.4 m, the flow rate through the opening in the flashboards is 7.1 m^3/s. If blueback herring follow the turbine channel, they can go through the Crescent turbines or over the flashboards on Dam B when the water elevation is greater than 56.4 m; however, there is no opening in the flashboards on Dam B. The combined flow rate through the four turbines at Crescent is designed to be a maximum of 171.6 m^3/s.

The Ultrasonic System

The ultrasonic system at Crescent was designed to produce band-limited sound between 122 and 128 kHz at an ambient sound pressure level (SPL) of at least 163 dB from surface to bottom and across the entrance of the turbine channel. (As in Burdic [1984], SPL is given as decibels referenced to 1 μPa; i.e., 163 dB denotes 163 dB re 1 μPa.) Band-limited ultrasound between 122 and 128 kHz at SPLs ranging from 144.7 to 163.1 dB elicited avoidance reactions from adult blueback herring in a tank (Dunning and Ross 2010). Ultrasound was produced by an array of eight piezoelectric projectors (hereafter, projector array) located near the entrance to the turbine channel, a distance of about 487 m from the Crescent headrace (Figure 2). This location was chosen rather than one closer to the Crescent headrace because the velocity of water flowing through the turbine channel increases as it approaches the headrace and as the cross section of the channel decreases. The location of the projector array was selected independent of this study. It was assumed that higher velocities would make it more difficult for juvenile blueback herring to avoid being entrained with the flow of water. Water flow overriding or superseding the reactions of fish to behavioral stimuli is the most cited reason for the failure of behavioral stimuli to successfully and consistently guide fish (Popper and Carlson 1998).

The eight projectors were attached to a metal frame that was mounted to a concrete platform. The platform was located on the riverbed in 4.6-m-deep water (at a water elevation of 56.4 m), about midway between the north end of the island separating Dams A and B and the shoal that forms the western boundary of the turbine channel entrance. Four projectors faced the north end of the island and four faced the opposite way—that is, all were aimed across the flow of water entering the turbine channel. This configuration (i.e., eight projectors mounted on a single platform and aimed across the opening of the turbine channel) was chosen partly because it was considered more practicable to install and maintain than a configuration with a series of projectors spaced across the opening of the turbine channel.

Proprietary computer software (Ultra Electronics Ocean Systems, Braintree, Massachusetts) was used to model the ultrasonic field generated by the projector array before the array was installed (Figure 3). The model assumed (1) absorbing boundaries at the surface and bottom and (2) no physical obstructions in the acoustic path between the transducer and the point in the field. After installation of the projectors, SPLs in the ultrasonic field were measured with a calibrated omnidirectional hydrophone. Measurements were taken at five representative points: directly above the projector array (near the surface of the water), at 10 m from the array (2.9 m below the surface) in the direction of the island separating Dams A and B, at 10 m from the array in the opposite direction (toward the shoal), adjacent to the island, and adjacent to the shoal. The SPL adjacent to the island was measured along a transect that ran parallel to the shoreline and as close to shore as possible from a 5.5-m-long, flat-bottom boat. The SPL adjacent to the shoal was measured along a transect that ran parallel to the edge of the water chestnut bed. The maximum SPL between 122 and 128 kHz was 165.5 dB directly above the array, 183.5 dB at 10 m from the array (in the direction of the island and in the opposite direction), 164.2 dB adjacent to the island, and 168.5 dB adjacent to the shoal. All of the measured values exceeded those predicted by the computer model.

Study Approach

We wanted to determine whether a greater proportion of juvenile blueback herring migrated downriver through the main channel when ultrasound was produced. The most rigorous way to do this would be to use a before–after–control–impact pairs (BACIP) design (Stewart-Oaten et al. 1986) like that used for demonstrating a reduction in the number of alewives entering the FitzPatrick intake due to ultrasound (Ross et al. 1996). In

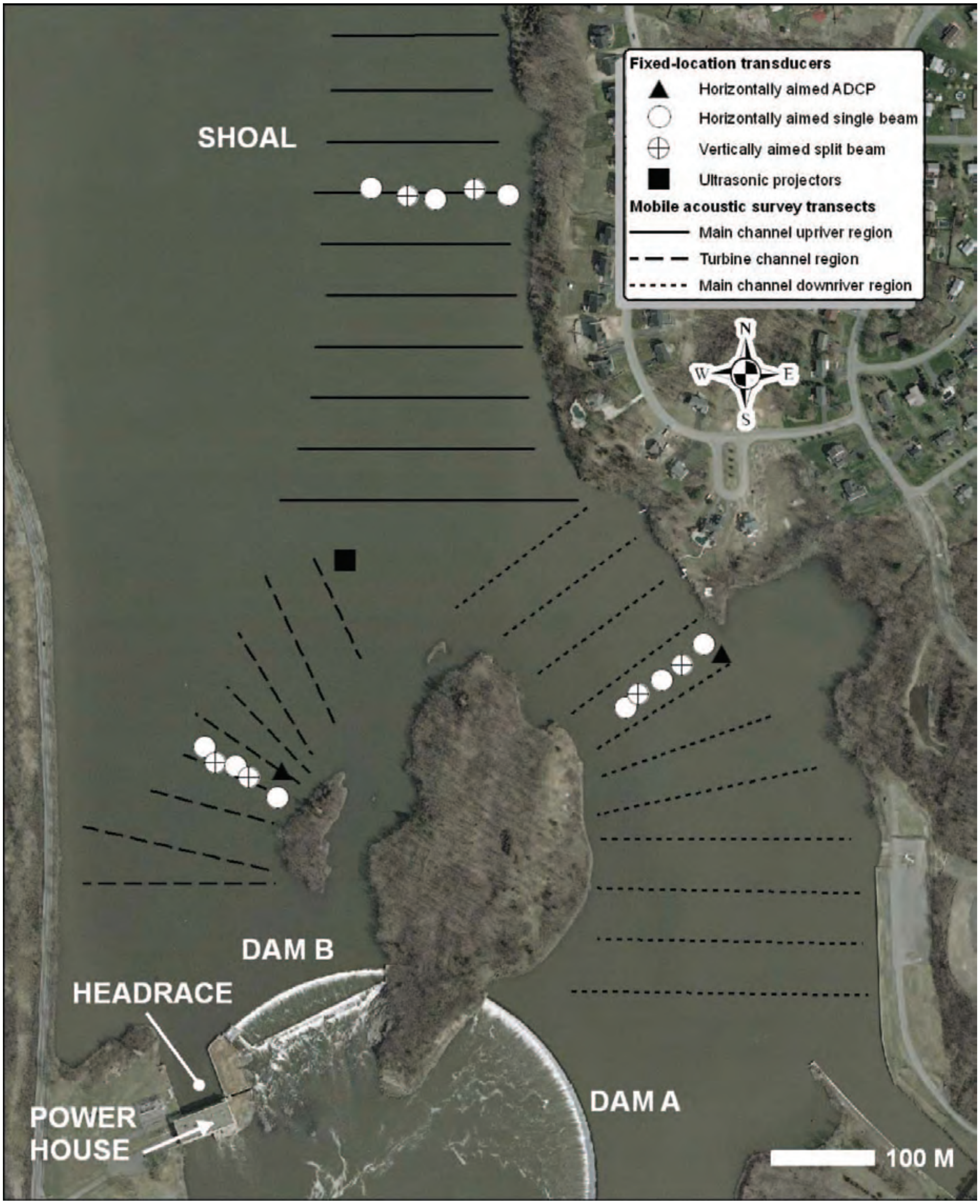

FIGURE 2. Locations of eight piezoelectric ultrasonic (122–128 kHz) projectors; horizontally aimed, 500-kHz acoustic Doppler current profilers (ADCPs); 420-kHz, horizontally aimed single-beam transducers and vertically aimed split-beam transducers (mounted from the river bottom); and mobile survey transects in the Mohawk River near the Crescent Hydroelectric Project during 2008.

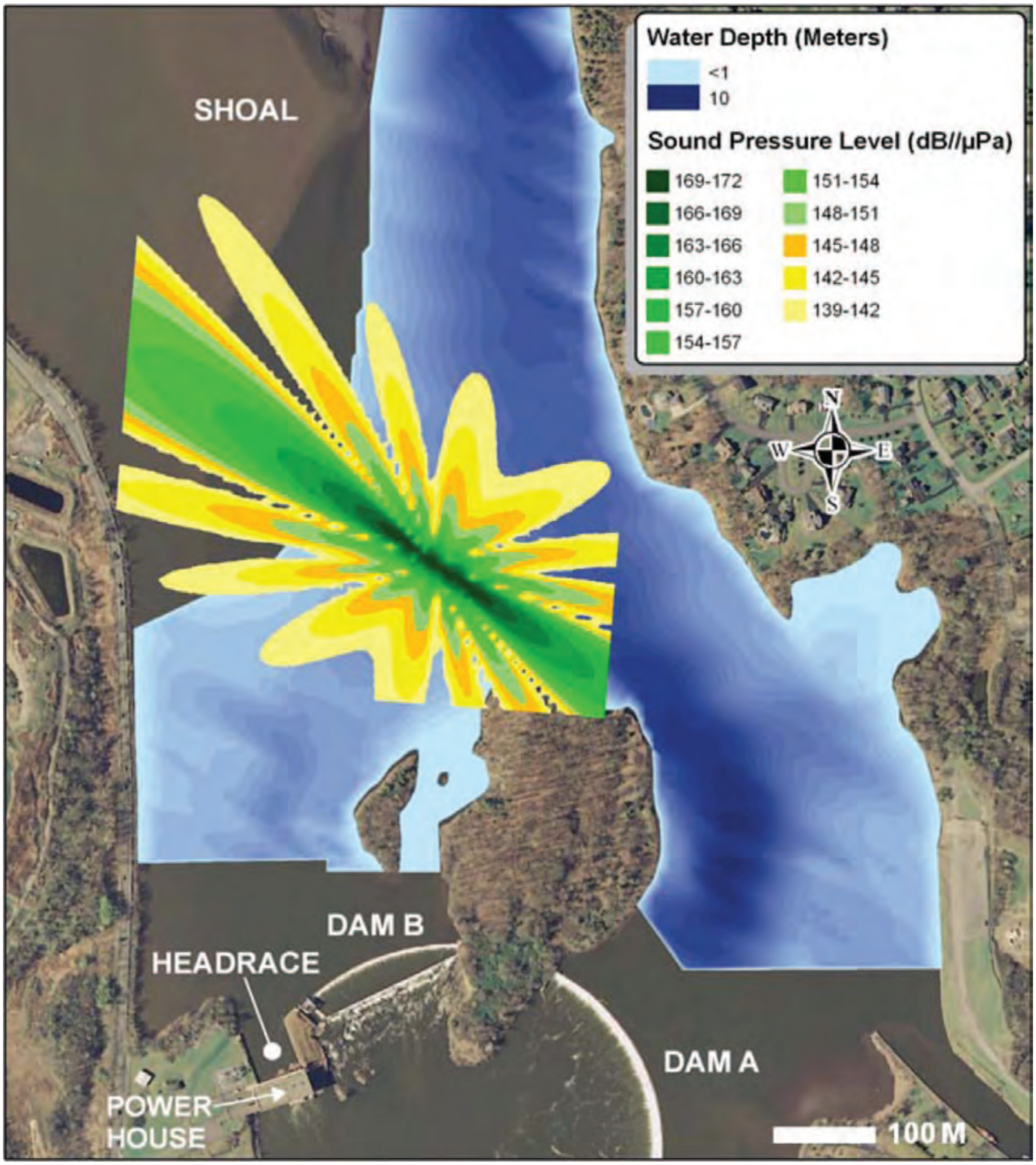

FIGURE 3. A computer-generated depiction of the ultrasonic field projected by the eight piezoelectric projectors at the Crescent Hydroelectric Project (sound pressure level is given in dB referenced to 1 μPa [dB//μPa]).

that technology demonstration, a BACIP design was used to test sets of paired samples at both the impact site (FitzPatrick) and a nearby control site (the Nine Mile Nuclear Power Plant). The lack of a control site with a channel configuration like that at Crescent precluded a comparison between control and impact sites.

Absent a control site, a before–after comparison could have been done at Crescent between time periods when ultrasound was produced and when it was not; this type of comparison was done at Arthur Kill (Consolidated Edison 1994). However, an assumption of such a design is that any before–after differences at Crescent would be due exclusively to ultrasound.

The assumption is unlikely to be valid unless the periods in which ultrasound is projected and the periods in which it is not projected account for natural variability in the temporal pattern of juvenile blueback herring during migration. Accounting for natural variability is unrealistic if the migration rate of juvenile blueback herring in the Mohawk River is unpredictable, similar to the migration rate observed in a coastal Massachusetts stream (Iafrate and Oliveira 2008). Furthermore, using a before–after design that does not accurately account for the temporal pattern of migration also risks having a large proportion of the juvenile blueback herring migrate downriver when ultrasound is not projected. In the Connecticut River, juvenile blueback herring migrated downriver in discrete schools and peak migration occurred over a relatively short period of time (O'Leary and Kynard 1986).

A before–after design was not used at Crescent; instead, ultrasound was projected at Crescent throughout the study period (30 August–5 October 2008). This was done for three reasons: there was limited information on the temporal pattern of downriver migration by juvenile blueback herring in the Mohawk River; state and federal regulatory agencies wanted a demonstration that most juvenile blueback herring migrated downriver through the main channel rather than through the turbine channel, regardless of the reason; and it seemed unlikely that most juvenile blueback herring would migrate downriver through the main channel under existing conditions because more water generally flows through the turbine channel than through the main channel due to power generation. The last reason assumes that the distribution of juvenile blueback herring between the main and turbine channels should be proportional to the volume of water that flows through those channels. This assumption seems sensible because (1) emigration of juvenile blueback herring from freshwater habitats (like the Mohawk River) is believed to occur in response to factors that include heavy rainfall and high water flow (Pardue 1983); and (2) direction and magnitude of flows were reasonable predictors of entrainment for three migratory pelagic species in two of the largest water diversions in the world (Grimaldo et al. 2009).

Even if most juvenile blueback herring were found not to migrate downriver through the main channel, ultrasound may still have been partially effective; in such a case, reconfiguring the ultrasonic field might be warranted to improve its performance. A potential indicator of partial effectiveness would be a greater-than-expected number of juvenile blueback herring migrating downriver through the main channel. The expected number of juveniles migrating downriver can be estimated based on the volume of water that flows through the main-channel upriver site and turbine channel site if the distribution of juveniles in the two channels is proportional to the volume of water that flows through those channels. The assumption that the volume of water directly influences entrainment and impingement has not been validated but appears to have been used in developing federal regulations and fishery management plans (USEPA 2001; ASMFC 2009). Therefore, we interpreted the results of this study from two perspectives: as though the assumption was valid and as though it was not valid.

Fixed-Location Hydroacoustics

Fixed-location hydroacoustics was used to continuously monitor fish passage at two typical main-channel sites: one site upriver of the projector array and one site downriver of the array. The maximum depth and average cross-sectional area were similar between the main-channel upriver (10 m and 1,300 m^2, respectively) and downriver (11 m and 1,111 m^2) sites. Fixed-location hydroacoustics has been used for monitoring fish passage in rivers that are impounded by hydroelectric dams (Skalski et al. 1996; Steig and Johnston 1996; Ransom et al. 1998; Steig and Iverson 1998). A linear array of three 420-kHz, horizontally aimed single-beam transducers (hereafter, horizontal transducers) was installed at each site (Figure 2). Two 420-kHz, vertically aimed split-beam transducers (hereafter, vertical transducers) were installed at the main-channel upriver site: one at a depth of 8.2 m and one at a depth of 8.8 m. A vertical transducer was also installed at the main-channel downriver site at a depth of 8.5 m. The transducers were attached to mounts placed on the riverbed and were multiplexed to a digital echosounder (HTI Model 243; Hydroacoustic Technology, Inc., Seattle, Washington). Fixed-location, horizontally aimed transducers are well suited for channels and other relatively shallow water bodies because they have the capability of detecting fish at ranges much greater than the depth of water, thus sampling a greater volume of water than that sampled by vertically aimed transducers (Pedersen and Trevorrow 1999). However, horizontal transducers do not provide information on the distribution of fish in the water column, whereas vertical transducers do provide such data.

The nominal beam width at the half-power points of the horizontal transducers was $6^\circ \times 12^\circ$, except for three transducers that malfunctioned and were replaced with 6° circular single-beam transducers. Collectively, the percentage of the channel cross section that was sampled by the horizontal transducers was about 12% at the main-channel upriver site, 15% at the main-channel downriver site, and 14% at the turbine channel site. The nominal beam width of the vertical transducers was 15°. The arrangement of the fixed-location transducers was designed to sample pelagic fishes. Each transducer was configured to ping (0.2-ms pulse duration) sequentially for a 2-min interval at 5 Hz (horizontal transducers) or at 10 Hz (vertical transducers). Prior to deployment, all transducers were calibrated by the manufacturer using a U.S. Navy standard transducer of known sensitivity (Urick 1983).

The fixed-location and mobile transducers measured acoustic backscatter. Acoustic backscatter was processed in real time by integrating the echo energy over 1-m range strata and 2-min intervals. Echo integration assumes that targets are randomly distributed throughout the cross section of the acoustic beam (Simmonds and MacLennan 2005). If this assumption is not met, data from horizontal transducers at sites with similar distributions of fish in the water column can still be compared.

Echo integration was selected instead of echo counting so that large schools of juvenile blueback herring could be quantified; echo counting would only be able to quantify individuals on the periphery of schools or loosely organized groups of fish. A minimum on-axis threshold of −50 dB was selected to exclude background noise, boundary interference, and reflective objects smaller than juvenile blueback herring during real-time echo integration. Echo amplitudes were adjusted for beam spreading and absorption loss with an applied time-varied gain function of $20 \cdot \log_{10} R$ (where R is range, m) and a range-dependent absorption loss gain of αR (where α equals 54.8 dB/km; Foote 1983; Simmonds and MacLennan 2005).

Mobile Hydroacoustics

Mobile hydroacoustics was used to supplement fixed-location hydroacoustics by providing data on the spatial distribution of fish in the study area and helping to confirm the presence and relative abundance of juvenile blueback herring that were seen in and near the Crescent headrace. It has been used in freshwater to assess the distribution of alewives (Warner et al. 2002), rainbow smelt *Osmerus mordax* (Rudstam et al. 2003), ciscoes *Coregonus artedi* (Mason et al. 2005), and multiple species (Brandt et al. 1991; Fabrizio et al. 1997).

A systematic mobile survey was conducted on 18, 20, 22, 23, and 29 September and 5 October 2008. Systematic mobile surveys are optimal for estimating fish abundance (Simmonds and Fryer 1996), and their use has become standard practice (Simmonds et al. 1992). Each survey consisted of 29 transects oriented across the river: 10 were located in the main channel upriver of the projector array (hereafter, main-channel upriver region), 11 were located in the main channel downriver of the projector array (hereafter, main-channel downriver region), and 9 were located in the turbine channel downriver of the projector array (hereafter, turbine channel region; Figure 2). Transects were limited in their extent by water depths less than 1 m. A vertically aimed, 420-kHz split-beam transducer with a 15° nominal beam width was mounted on the survey vessel and was connected to a digital echosounder (HTI Model 241). Data from the echosounder were georeferenced using a Global Positioning System unit.

Fish sampling

Identification of fish species that represent observed acoustic targets is typically inferred from knowledge about habitat preferences, location of fish in the water column, catch data, and spectral signature (Horne 2000; McClatchie et al. 2000). The species that are likely to be most abundant in the study area during August–October are juvenile blueback herring, emerald shiner *Notropis atherinoides*, spottail shiner *N. hudsonius*, and bluntnose minnow *Pimephales notatus* (McBride 2009); of these species, only the blueback herring and emerald shiner are pelagic (Scott and Crossman 1973). Pelagic habitats were sampled on 19 and 23 September and 2–5 October 2008 using a cast net that was 4.8 m in diameter and constructed with 12-mm stretch mesh. All fish collected were identified to species and measured to determine total length (mm).

River Flow

A fixed-location, horizontally aimed, 500-kHz acoustic Doppler current profiler (ADCP; Argonaut SL; SonTek/YSI, San Diego, California) was used to continuously measure water velocity and river height (H) and average those data over 2-min intervals at the turbine channel and main-channel sites. Each ADCP had two beams oriented 50° apart: one was pointed upstream, and the other was pointed downstream. This orientation provided measurements of water velocity along the main axis of the channel (V_x) and across it. The maximum horizontal range for measurements was 42 m at the main-channel downriver site and 17–22 m at the turbine channel site. The maximum horizontal range at the turbine channel site was initially set to 22 m but was reduced to 17 m because of boundary interference.

Water velocity and H were also measured daily along a transect near the turbine channel site and a transect near the main-channel downriver site using a 1-MHz ADCP (SonTek/YSI RiverSurveyor System) mounted on a boat that was traveling less than 3.7 km/h (2 nautical mi/h). Transects were run near the fixed-location ADCPs and across each channel. The area and velocity at shore edges less than 1 m deep were predicted by the ADCP software based on the distance to shore and the slope of the bottom (as estimated by the boat operators). Prior to each transect run, the compass of the boat-mounted ADCP was calibrated. The blanking distance of the boat-mounted ADCP was set to 0.75 m.

Data Analyses

Flow.—The volume of water that flowed through the main-channel downriver site and turbine channel site was estimated as the product of flow rate (Q) and elapsed time; Q was estimated as the product of the cross-sectional area of the channel (A) and mean water velocity in the channel (V_m), where V_m was estimated using either a velocity index equation (with or without H as a covariate) or a theoretical calculation (Morlock et al. 2002). The velocity index equation should be more accurate than the theoretical calculation because it included measurements from both the fixed-location ADCP and the boat-mounted ADCP (Sloat and Gain 1995; Morlock et al. 2002), whereas the theoretical calculation included measurements from the fixed-location ADCP only. The best-fit velocity index equation was used if a regression was significant; if not, the theoretical calculation was used. The theoretical calculation used a 1/6-power law relation based on the location of the measurement relative to the channel geometry (Morlock 1996; Yorke and Oberg 2002; SonTek/YSI 2007a).

Postprocessing of data collected by the fixed-location ADCPs was done prior to analyses by removing erroneous data at the start or end of the time series, smoothing with a Gaussian filter ($n = 3$), importing a revised channel geometry based on a transect of depth soundings with finer horizontal scale, verifying the ADCP elevation, checking for data anomalies, and exporting the data to an ASCII file. Signal-to-noise ratios were typically between 20 and 60 dB, and SEs were 0.1–0.5 cm/s. Postprocessing of transect data collected by the mobile ADCPs was done using RiverSurveyor software (SonTek/YSI 2007b). Signal amplitudes as a function of depth among water velocity profile measurements were visually scrutinized for anomalies in acoustic transmission or boundary interferences. Mobile ADCP data were excluded if signal strength or digital Global Positioning System coordinates were lost during data collection. Boat speed relative to the river bottom during transects was measured by bottom tracking. Boat speed was subtracted from the measured velocity to estimate water velocity.

A subset of paired 2-min-interval measurements was used for calculating the cumulative volume of water passing through the main-channel downriver and turbine channel sites. The subset included only those periods when data were available for both channels and excluded those when operational issues interrupted data collection. The 2-min estimates were used to calculate hourly estimates of volume. The proportion for each hour was used to calculate the mean proportion of water flowing downriver through each channel. A paired t-test was used to determine whether the hourly estimates of water volume flowing through the main-channel downriver and turbine channel sites differed. The hourly estimates were used to calculate the expected number of fish passing downriver at the main-channel downriver and turbine channel sites.

Fixed-location hydroacoustics.—The proportion of fish that passed downriver at the main-channel downriver site (P_{DM}) based on fixed-location hydroacoustics was calculated using data from the horizontally aimed transducers:

$$P_{DM} = {}^{N_{DM}}\!/_{N_{UM}}, \tag{1}$$

where N_{DM} is the number of fish that passed downriver at the main-channel downriver site and N_{UM} is the number of fish that passed downriver at the main-channel upriver site. The number of fish that passed downriver (N_d) at the main-channel upriver and downriver sites was estimated as

$$N_d = T \times A \times F, \tag{2}$$

where T is the number of seconds in a day, A is the cross-sectional area of the river channel in the vertical plane, and F is the fish flux.

Fish flux (expressed as the number of fish·m^{-2}·s^{-1}) was estimated as

$$F = \bar{\rho}\bar{R}_d\bar{p}_d, \tag{3}$$

where $\bar{\rho}$ is the mean numerical fish density (fish/m^3) estimated by the horizontal acoustic beams for a time period, $\bar{R}_d$ is the mean net rate of downstream movement of fish (m/s), and $\bar{p}_d$ is the proportion of fish moving downstream; this approach is similar to that used by Mulligan and Kieser (1996). Daily estimates of $\bar{R}_d$ and $\bar{p}_d$ at the main-channel upriver and downriver sites were based on manually tracked fish from the two vertically aimed split-beam transducers at each location. Daily mobile ADCP transects were not performed at the main-channel upriver site; therefore, A at the main-channel upriver site was based on the channel geometry from a single ADCP transect, and A at the main-channel downriver site was based on an average cross-sectional area from continuous monitoring of the water level coupled with the channel geometry from an ADCP transect.

Numerical fish density (ρ) was estimated as

$$\rho = \frac{s_v}{\langle\sigma_{bs}\rangle}, \tag{4}$$

where s_v is the volume backscattering coefficient of all fish targets in the water column that are above the threshold equivalent to the size of a juvenile blueback herring and $\langle\sigma_{bs}\rangle$ is the expected mean backscattering cross section of an individual juvenile blueback herring. We used fish density as an index of juvenile blueback herring abundance because volume backscatter was not discriminated for individual species. We set $\langle\sigma_{bs}\rangle$ equal to $10^{TS/10}$, where the expected target strength (TS) was equal to −48.6 dB referenced to 1 m^2 based on in situ split-beam measurements of verified schools of juvenile blueback herring in the Crescent headrace (Gurshin 2012, this issue). Johannesson and Mitson (1983) and MacLennan et al. (2002) defined s_v as

$$s_v = \frac{\sum\sigma_{bs}}{V_0} = V_{rms}^2 C_{equip}, \tag{5}$$

where σ_{bs} is the backscattering cross section (the physical quantity of the acoustic reflectivity of an individual fish), V_0 is the sampled volume, and C_{equip} is a calibration factor defined as

$$C_{equip} = \frac{1}{c\tau\pi b_{av}^2(\theta,\varphi)P_o^2 G_x^2}, \tag{6}$$

where c is the sound speed (m/s), τ is the pulse duration (s), π is a constant (~3.14), $b_{av}^2(\theta,\varphi)$ is the beam pattern factor, P_o^2 is the transmit pressure level (μPa^2 at 1 m), and G_x^2 is the squared through-system gain (V_{rms}^2/μPa^2).

We compared the estimate of N_{DM} with the expected number of fish passing downriver at the main-channel downriver site (N_{EDM}), estimated as

$$N_{EDM} = N_{UM}\left({}^{V_{DM}}\!/_{V_{DM} + V_T}\right), \tag{7}$$

where V_{DM} is the volume of water moving downriver at the main-channel downriver site and V_T is the volume of water moving downriver at the turbine channel site. This approach assumes that N_{DM} and N_d at the turbine channel site (N_T) are positively related to V_{DM} and V_T, which is reasonable for species like blueback herring (ASMFC 2009). The N_{EDM} was calculated using the time series of paired 2-min observations that were available at both the main-channel downriver site and the turbine channel site. Daily mean s_v and $\overline{\rho}$ were based on hourly averages. Daily $\overline{R}_d$ and $\overline{p}_d$ at the main-channel upriver and downriver sites were based on pooled data for manually tracked fish from the two bottom-mounted, upward-facing split-beam transducers at each location. Daily estimates of the water volume moving downstream were based on a sum of the hourly summed volume estimates from paired 2-min ADCP measurements at the main-channel downriver and turbine channel sites. The volume at the turbine channel site was derived from a velocity index estimate of mean channel velocity, while the volume at the main-channel downriver site was based on the theoretical mean channel velocity because development of the velocity index equation was not possible. The N_{DM} and N_{EDM} were compared by using Wilcoxon's signed rank test for paired samples (significance level $\alpha = 0.05$), which tested the null hypothesis that the average daily difference was zero. A nonparametric test was used because values did not meet the normality assumption of a parametric paired *t*-test. As a validation of the analysis, the mean daily difference between N_{UM} and the sum of N_{DM} and N_T was also tested against zero by using the same statistical test and by assuming that fish migrated from the main-channel upriver site through either the main-channel downriver site or the turbine channel site and were equally detected among the transducer arrays.

The vertical distribution of fish at the main-channel upriver and downriver sites was characterized using the average of the hourly mean s_v values from the vertical transducers. To test the null hypothesis that the vertical fish distributions at the main-channel upriver and downriver sites were equal, the hourly mean s_v values for each transducer were pooled into two categories: the upper half and lower half of the water column. The s_v values were compared using multiple pairwise χ^2 tests ($\alpha = 0.05$).

Mobile hydroacoustics.—Abundance of fish across all depth strata for the mobile hydroacoustic surveys was represented by the area backscattering coefficient (s_a), defined by MacLennan et al. (2002) as

$$s_a = \int_{z_1}^{z_2} s_v dz = \sum_{z=1}^{z_n} s_v, \quad (8)$$

where z_1 is the first 1-m depth stratum, z_n is the last 1-m depth stratum, dz is the change in depth, and s_v is defined in equation (5). The distribution of fish among depth strata was represented by s_v. Data from real-time echo integration were postprocessed by displaying s_v for cells derived from 1-m × 12-s strata. If cells with high s_v values overlapped the river bottom, they were excluded from analyses. Analyses also excluded the first 1.5 m of the water column based on a combination of transducer depth and poor coverage in the near field.

Differences in mean s_a among channel sites were tested for each survey using the nonparametric Kruskal–Wallis test, which does not require the assumption of data normality. If a significant difference was detected in mean s_a among channels ($\alpha = 0.05$), then multiple pairwise Kruskal–Wallis tests were performed to identify which means were different at a Bonferroni-adjusted α (0.017 for three comparisons; 0.008 for six comparisons) to minimize type I error.

RESULTS

Flow

The velocity index equation for the main-channel downriver site was not significant, both with H ($R^2 = -0.033$, $P = 0.77$) and without it ($R^2 = -0.071$, $P = 0.92$), for the period with the paired 2-min-interval measurements. However, for the same period, the velocity index equation for the turbine channel site was significant, both with H ($R^2 = -0.690$, $P < 0.05$) and without it ($R^2 = -0.621$, $P < 0.05$). Based on the velocity index equation for the turbine channel site with H as a covariate and the theoretical equation for the main-channel downriver site, the volume of water flowing downstream past the turbine channel site was significantly greater than the volume of water flowing downstream past the main-channel site ($t = 42.53$, df = 818, $P < 0.01$) and averaged 87.9% of the total volume of water flowing downstream past the two sites combined.

Fish Sampling

Sampling with cast nets collected 391 juvenile blueback herring, 5 brook silversides *Labidesthes sicculus*, 3 gizzard shad *Dorosoma cepedianum*, and 1 white sucker *Catostomus commersonii*. Total length ranged from 53 to 88 mm for the blueback herring (mean = 73 mm, $n = 335$; Figure 4), 35–70 mm for the brook silversides, and 108–110 mm for the gizzard shad. The total length of the white sucker was 135 mm.

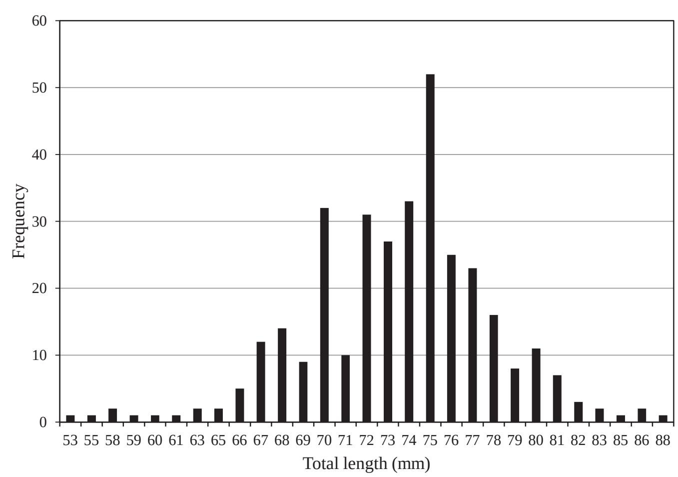

FIGURE 4. Length-frequency distribution for juvenile blueback herring (n = 335) collected with a cast net in the Mohawk River near the Crescent Hydroelectric Project during 19 September–5 October 2008.

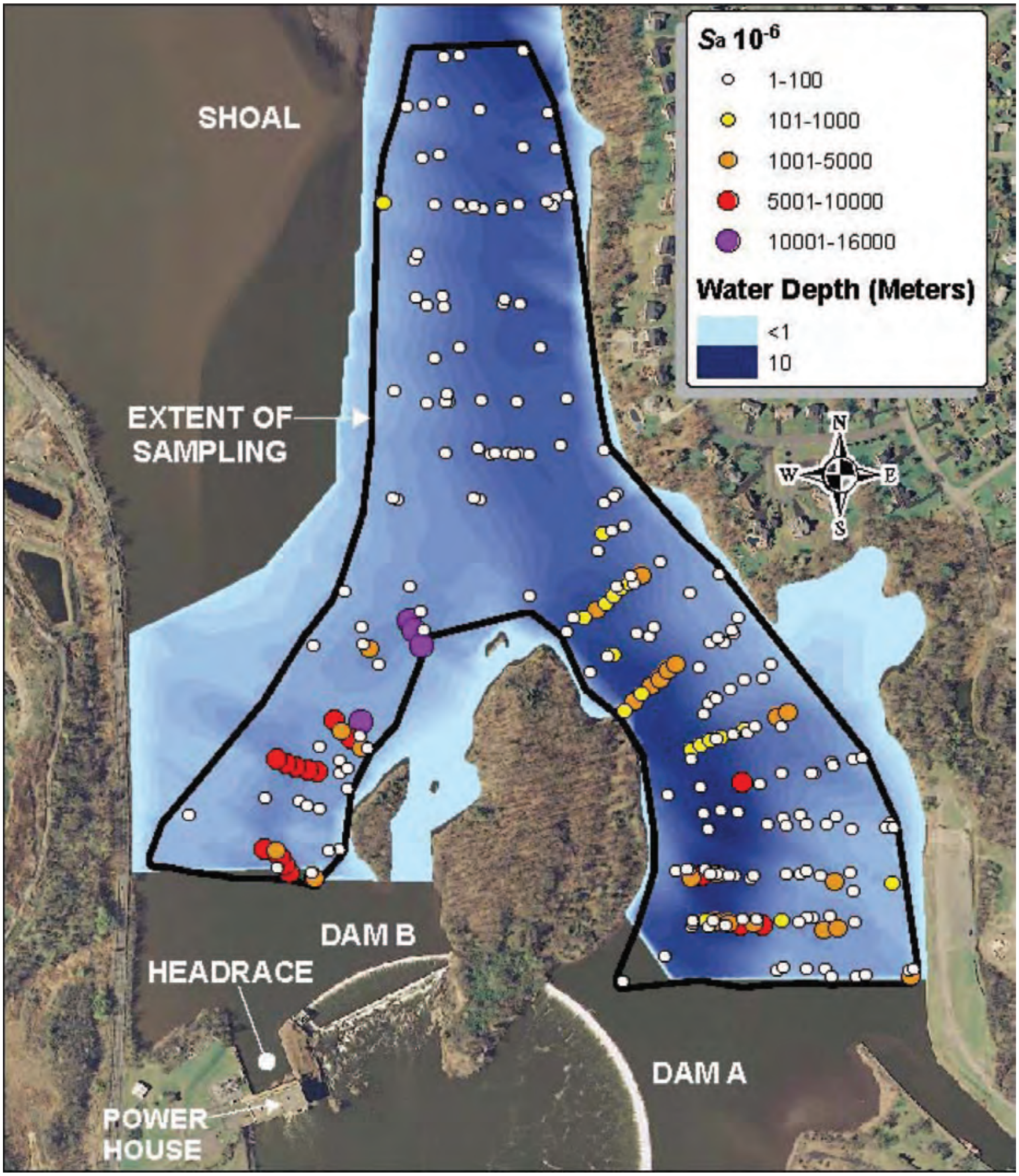

FIGURE 5. Distribution of area backscattering coefficient (s_a) values ($\times\ 10^{-6}$ m^2/m^2) from mobile acoustic surveys in the main channel and turbine channel of the Mohawk River near the Crescent Hydroelectric Project on 18, 20, 22, 23, and 29 September and 5 October 2008.

Mobile Hydroacoustics

Fish were distributed along the length of the study area and across the width of the river based on the nonzero values of s_a from all mobile acoustic surveys (Figure 5). In addition, fish were distributed throughout the water column based on a composite of s_v values from all mobile acoustic surveys in the main-channel upriver region, main-channel downriver region, and turbine channel region (Figure 6). During the first survey on 18 September, the mean s_a in the turbine channel region was significantly less than those in the main-channel upriver and downriver regions, but mean s_a was not significantly different between the two main-channel regions (Table 1). The mean s_a

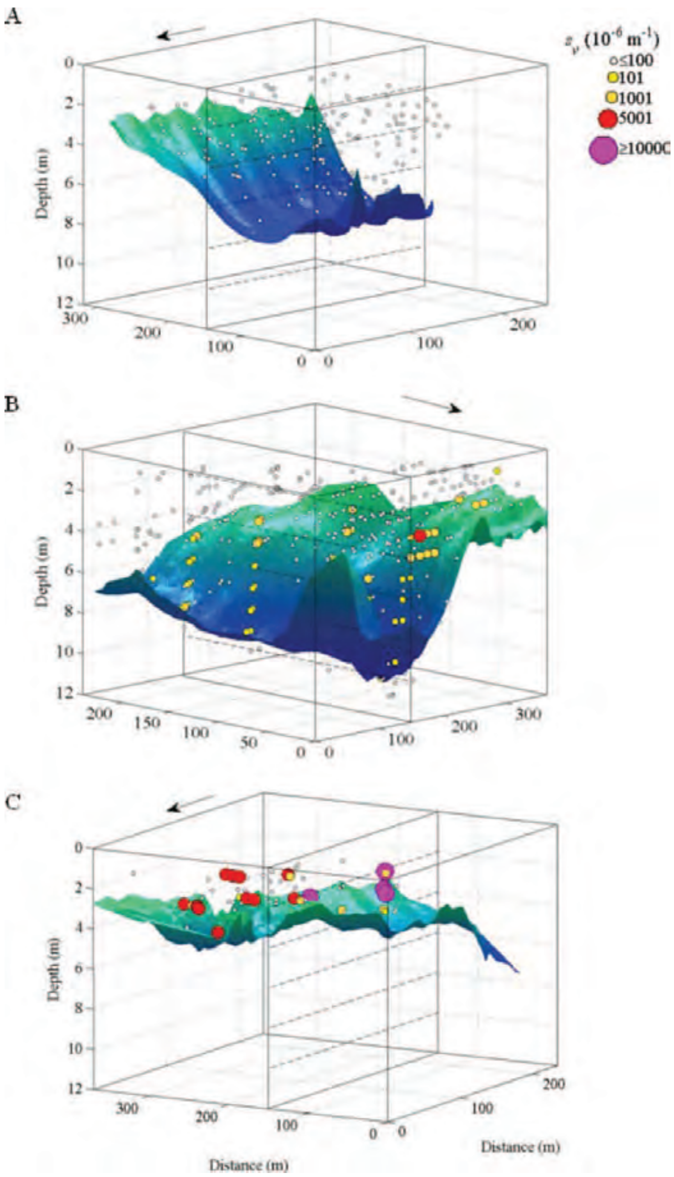

FIGURE 6. Three-dimensional, cross-sectional view of the composite spatial distribution of fish (represented by bubbles with size and color proportional to the magnitude of the mean volume backscattering coefficient [s_v; $\times$ 10^{-6}/m]) from echo integration of 1-m-deep $\times$ 18-m-long strata over repeated mobile echosounder surveys of the Mohawk River near the Crescent Hydroelectric Project during August and September 2008: **(A)** the main channel upriver of the ultrasonic projectors, **(B)** the main channel downriver of the ultrasonic projectors, and **(C)** the turbine channel. Arrow points downstream; blue-shaded surface layer represents the river bottom.

in the main-channel downriver region was significantly higher than that in the main-channel upriver region on 23 September, 29 September, and 5 October and was significantly higher than that in the turbine channel region on 23 September and 5 October. During the 5 October survey, the only survey in which data were collected at the Crescent headrace, the mean s_a in the headrace was significantly higher than those in the main-channel upriver, main-channel downriver, and turbine channel regions. By 5 October, the mean s_a was significantly higher in the main-channel downriver region than in the main-channel upriver region (74 times higher) and turbine channel region (13 times higher; Table 1).

Fixed-Location Hydroacoustics

The proportion of s_v in the upper half of the water column was 47% based on the vertical transducer set at 8.2-m depth in the main-channel upriver site, 46% based on the vertical transducer set at 8.8-m depth in the main-channel upriver site, and 55% based on the vertical transducer set at 8.5-m depth in the main-channel downriver site. The vertical distribution of mean s_v was not significantly different between (1) the two transducers at the main-channel upriver site ($\chi^2 = 0.0201$, $P = 0.887$), (2) the 8.2-m-deep transducer at the main-channel upriver site and the transducer at the main-channel downriver site ($\chi^2 = 1.281$, $P = 0.258$), or (3) the 8.8-m-deep transducer at the main-channel upriver site and the transducer at the main-channel downriver site ($\chi^2 = 1.620$, $P = 0.203$).

Fish migrated downriver episodically based on the s_v values from the horizontal transducers at the main-channel upriver site (Figure 7). Episodes of relatively high s_v (including those measured on 2, 6, 7, 13, 16, and 25 September) occurred for periods of hours rather than days. The s_v at the main-channel downriver site also reflected episodes of downriver migration, but the magnitude of the s_v values was smaller than that at the main-channel upriver site and the timing of the episodes did not correspond with the timing of those at the main-channel upriver site (Figure 8). During the study period, the hourly mean s_v at the main-channel downriver site (0.095 $\times$ 10^{-6}/m) was lower than that at the main-channel upriver site (0.175 $\times$ 10^{-6}/m).

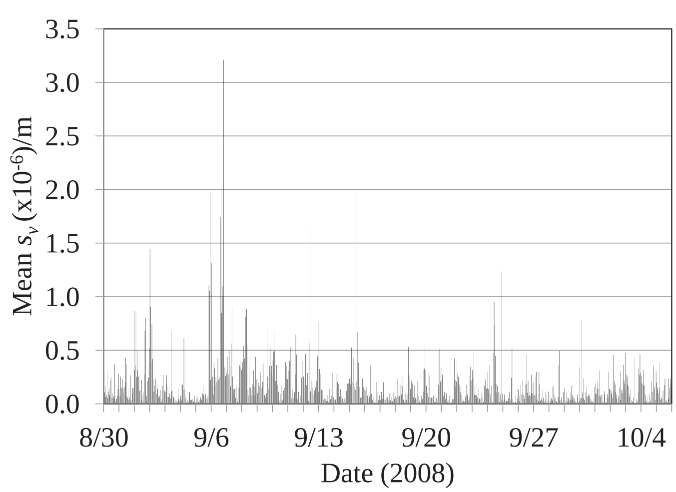

FIGURE 7. Hourly mean backscattering coefficient (s_v; $\times$ 10^{-6}/m) from three horizontal transducers in the main channel of the Mohawk River upriver of an array of eight ultrasonic projectors at the Crescent Hydroelectric Project.

TABLE 1. Abundance of fish, represented by the mean area backscattering coefficient (s_a; $\times$ 10^{-6} m^2/m^2) across all depth strata at four regions in the Mohawk River: (1) in the main channel upriver of the ultrasonic projector array at the Crescent Hydroelectric Project (Crescent), (2) in the main channel downriver of the projector array, (3) in the turbine channel downriver of the projector array, and (4) in the Crescent headrace. Data are from six mobile acoustic surveys conducted during September and October 2008. For a given survey date, means with a letter or letters in common are not significantly different. If the Kruskal–Wallis test detected a difference in mean s_a among regions for a survey date ($\alpha = 0.05$), pairwise Kruskal–Wallis tests were conducted (Bonferroni-adjusted $\alpha = 0.017$ for three comparisons or 0.008 for six comparisons).

	Survey date					
Region	18 Sep	20 Sep	22 Sep	23 Sep	29 Sep	5 Oct
Main channel upriver	6.4 z	0.5	0.5	0.6 z	33.2 z	0.3 z
Main channel downriver	1.1 z	0.5	0.9	1.3 y	520.5 y	22.4 y
Turbine channel	<0.1 y	2.0	0.8	0.9 z	1,393.3 zy	1.7 z
Headrace						2,148.5 x

Diel differences in mean s_v occurred at the main-channel upriver and downriver sites based on data from the horizontal transducers. At the main-channel upriver site, the nighttime mean s_v (0.22×10^{-6}/m) was significantly higher than the daytime s_v (0.14×10^{-6}/m; $t = -3.87$, $P = 0.001$). At the main-channel downriver site, the nighttime mean s_v (0.07×10^{-6}/m) was significantly lower than the daytime s_v (0.11×10^{-6}/m; $t = 4.87$, $P < 0.001$).

The difference between the mean N_d values at the main-channel upriver and downriver sites was similar in magnitude to the difference between the mean F-values at the main-channel upriver and downriver sites. The average daily difference between N_{UM} and the sum of N_{DM} and N_T (sum of N_{DM} and N_T was 11% less than N_{UM}) was not significantly different from zero (Wilcoxon's signed rank test statistic $W = 75.5$, $P = 0.273$), thus providing a measure of validity and agreement in the acoustic estimates of fish passage among the sites. The F at the main-channel upriver site was four times higher than that at the main-channel downriver site, while the N_d at the main-channel upriver site was about 4.2 times higher than that at the main-channel downriver site (Table 2). The mean estimate of P_{DM} (31.3%) was almost three times greater than the mean proportion of fish that were expected to migrate at the main-channel downriver site (11.5%). The average daily difference between N_{DM} and N_{EDM} was significantly different from zero ($W = 223.5$, $P < 0.001$).

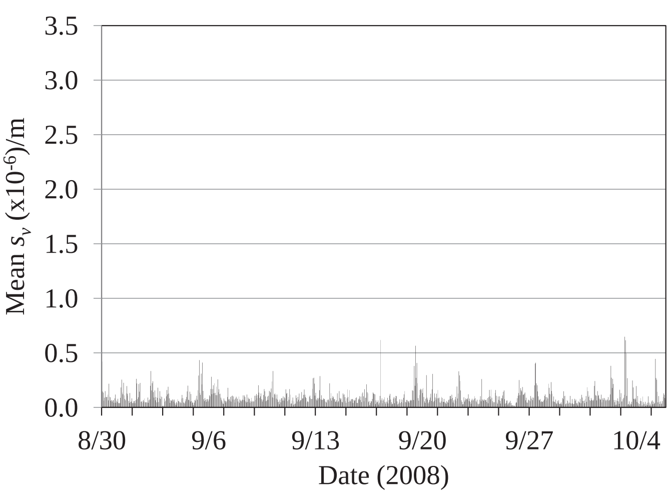

FIGURE 8. Hourly mean backscattering coefficient (s_v; $\times$ 10^{-6}/m) from three horizontal transducers in the main channel of the Mohawk River downriver of an array of eight ultrasonic projectors at the Crescent Hydroelectric Project.

DISCUSSION

Most of the fish that were detected by the transducers in this study were probably juvenile blueback herring because they were (1) prevalent in our collections during months when downriver migration was expected to occur, (2) found in pelagic habitat, and (3) observed in the Crescent headrace. If so, mobile hydroacoustics demonstrated that a considerable number of juvenile blueback herring entered the turbine channel and thus were not diverted downriver into the main-channel region by the ultrasonic system at Crescent. Furthermore, the number of juvenile blueback herring that migrated downriver at the main-channel downriver site (based on fixed-location hydroacoustics) was not indicative of a diversion rate as high as that attributed to an ultrasonic system at Arthur Kill (95%) for juvenile blueback herring or at FitzPatrick (96%) for adult alewives. If the ultrasonic system at Crescent increased the proportion of juvenile blueback herring that migrated downriver at the main-channel downriver site from 11.5% to 31.3%, then the proportion of juveniles that entered the turbine channel must have decreased from 88.5% to 68.7%, which corresponds to a diversion rate of about 23%.

Results from our study underscore the lesson that deployment of a behavioral technology that was previously demonstrated to be effective does not guarantee that the technology will be equally effective at a new site (Popper and Carlson 1998). This lesson was apparent at Annapolis, where the highest diversion rate for juvenile blueback herring (49%) was considerably lower than that for juvenile blueback herring at Arthur Kill or for adult alewives at FitzPatrick. At Annapolis, the lower diversion rate was attributed to a design requiring the fish to be directed to

TABLE 2. Daily estimates of fish flux (F; fish·m^{-2}·s^{-1}) and number of fish that migrated downriver (N_d) in the main channel of the Mohawk River, either upriver or downriver of the ultrasonic projector array at the Crescent Hydroelectric Project; the number of fish that were expected to migrate downriver at the main-channel downriver site based on river flow (N_{EDM}); the proportion of fish that migrated downriver at the main-channel downriver site (P_{DM};%); and the proportion that was expected to migrate downriver (P_{EDM}; %).

Date (2008)	Upriver F	Downriver F	Upriver N_d	Downriver N_d	N_{EDM}	P_{DM}	P_{EDM}
30 Aug	0.0009	0.0005	105,076	52,530	6,879	50.0	6.5
31 Aug	0.0013	0.0004	141,068	39,852	4,322	28.3	3.1
1 Sep	0.0017	0.0002	185,343	20,742	40,679	11.2	21.9
2 Sep	0.0016	0.0002	175,092	22,801	41,473	13.0	23.7
3 Sep	0.0003	0.0002	35,214	23,490	3,942	66.7	11.2
4 Sep	0.0006	0.0004	68,931	34,097	5,320	49.5	7.7
5 Sep	0.0023	0.0008	254,442	74,053	32,067	29.1	12.6
6 Sep	0.0055	0.0004	619,771	37,978	30,698	6.1	5.0
7 Sep	0.0031	0.0003	343,343	31,415	135,851	9.1	39.6
8 Sep	0.0031	0.0004	346,680	40,448	35,342	11.7	10.2
9 Sep	0.0016	0.0003	183,631	28,864	20,322	15.7	11.1
10 Sep	0.0012	0.0003	136,518	33,072	0	24.2	0.0
11 Sep	0.0017	0.0003	192,947	30,231	31,517	15.7	16.3
12 Sep	0.0012	0.0002	134,140	18,289	17	13.6	0.0
13 Sep	0.0010	0.0002	111,721	17,409	1,748	15.6	1.6
14 Sep	0.0006	0.0001	69,024	11,646	3,613	16.9	5.2
15 Sep	0.0022	0.0005	248,878	52,430	93,619	21.1	37.6
16 Sep	0.0008	0.0002	93,393	23,573	6,935	25.2	7.4
17 Sep	0.0006	0.0001	62,191	13,316	2,532	21.4	4.1
18 Sep	0.0011	0.0002	120,495	15,907	10,245	13.2	8.5
19 Sep	0.0007	0.0008	79,193	77,069	6,008	97.3	7.6
20 Sep	0.0012	0.0003	139,424	24,627	41,297	17.7	29.6
21 Sep	0.0010	0.0004	106,781	39,283	13,566	36.8	12.7
22 Sep	0.0010	0.0005	111,428	43,743	14,648	39.3	13.1
23 Sep	0.0002	0.0001	27,801	12,807	1,080	46.1	3.9
24 Sep	0.0012	0.0003	140,072	30,979	20,662	22.1	14.8
25 Sep	0.0005	0.0001	53,566	10,789	7,110	20.1	13.3
26 Sep	0.0012	0.0001	136,744	11,043	1,779	8.1	1.3
27 Sep	0.0006	0.0002	72,855	14,576	124	20.0	0.2
28 Sep	0.0005	0.0005	57,435	48,807	1,598	85.0	2.8
29 Sep	0.0005	0.0001	52,635	11,647	2,574	22.1	4.9
30 Sep	0.0007	0.0001	75,289	10,577	10,984	14.0	14.6
1 Oct	0.0007	0.0004	82,701	36,126	3,521	43.7	4.3
2 Oct	0.0008	0.0009	94,755	85,273	29,186	90.0	30.8
3 Oct	0.0012	0.0007	129,280	68,173	22,060	52.7	17.1
4 Oct	0.0009	0.0004	103,507	38,366	18,445	37.1	17.8
5 Oct	0.0005	0.0003	54,796	27,355	1,097	49.9	2.0
Mean	0.0012	0.0003	139,085	32,794	18,996	31.3	11.5

a bypass after they were deflected from the intake, whereas at Arthur Kill and FitzPatrick the fish only had to be deflected from an intake (Gibson and Myers 2002). At Crescent, juvenile blueback herring did not have to be directed to a bypass. They did, however, have to be guided across the opening of the turbine channel, a distance of over 250 m—more than 10 times the width of the intakes at Arthur Kill and FitzPatrick.

The difference in results at Crescent compared with those at Arthur Kill and FitzPatrick could have been contributed by (1) the relatively large distance across the opening of the turbine channel entrance at Crescent and (2) the differing configuration between the projector array at the Crescent entrance and those at the intakes of Arthur Kill and FitzPatrick. At Arthur Kill and FitzPatrick, projectors were located across the width of the intake and were pointed in the direction of water flowing into the intake; this configuration maximized the extent of the ultrasonic field in front of the intakes. Therefore, fish at Arthur Kill and FitzPatrick likely encountered ultrasound well before they experienced any detectable flow into the intake. In contrast, the projectors at Crescent were aimed across the flow of water entering the turbine channel, a configuration that maximized the extent of coverage across the entrance to the turbine channel at the expense of coverage upriver because the horizontal beam width of each projector at Crescent was only 14°. Therefore, if the projectors at Crescent had been aimed upriver, juvenile blueback herring might have detected ultrasound farther from the entrance of the turbine channel. Higher flow rates near the entrance to the turbine channel increased the likelihood of juvenile blueback herring being entrained into the turbine channel (absent the projection of ultrasound) if water flowing into the turbine channel is considered a water withdrawal from the main channel and if water flow directly influences entrainment of juvenile blueback herring, which is discussed below.

Reduction of juvenile blueback herring entrainment into the turbine channel, voluntary movement into the channel (if that occurred), or both would require an effective avoidance reaction across the entire width of the channel entrance. Since the entrance to the turbine channel is more than 10 times wider than the intakes at Arthur Kill and FitzPatrick and since there was water flowing into the turbine channel, it is likely that the frequency with which the fish encountered the ultrasonic field was greater for juvenile blueback herring at Crescent than for the fish at Arthur Kill or FitzPatrick. If so, and if the reaction of juvenile blueback herring diminished in strength after repeated exposure to ultrasound (as was reported by Dunning and Ross [2010] for adult blueback herring), then the likelihood of fish entering the turbine channel at Crescent would be higher than the likelihood of fish entering the intakes at Arthur Kill and FitzPatrick; thus, diversion would be expected to be lower at Crescent.

The configuration of the projector array at Crescent differed from the configurations at Arthur Kill and FitzPatrick not only by projecting sound across the flow of water that potentially could carry fish into an undesirable location, but also by producing an ultrasonic field with more distinct side lobes. Although blueback herring have the ability to detect the direction from which ultrasound is produced and typically swim away from the ultrasound's source (Nestler et al. 1992; Dunning and Ross 2010), those moving across the entrance to the turbine channel were exposed to a gradient of increasing SPLs that was not nearly as smooth as the SPL gradients at Arthur Kill and FitzPatrick. This may also have contributed to the difference in results at Crescent compared with those at Arthur Kill and FitzPatrick.

Our explanations for the difference in results at Crescent compared with those at Arthur Kill and FitzPatrick are speculative and based partly on the assumption that water flow was an important parameter influencing fish movements; that is, absent ultrasound, the numbers of fish impinged at Arthur Kill and FitzPatrick should have been directly related to the volume of water withdrawn by the intakes, and the number of juvenile blueback herring entrained into the turbine channel (where they would be susceptible to entrainment through the Crescent turbines) should have been directly related to the proportion of river flow through the channel. The assumption that water flow directly influences entrainment and impingement has not been empirically validated but appears to have been used in developing federal regulations and fishery management plans. For example, regulations issued by the U.S. Environmental Protection Agency for water intakes include national capacity and velocity requirements that are referred to as proportional-flow requirements (USEPA 2001). The objective of the requirements is to reduce intake flows at facilities that withdraw water from rivers, streams, lakes, reservoirs, estuaries, oceans, and other waters of the United States for cooling purposes. Another example is a recommendation included in the interstate fishery management plan (ASMFC 2009), which calls for reduced power generation at hydroelectric facilities during periods when river herring are migrating downriver.

If it is valid to assume that water flow directly influences entrainment and impingement, then the significantly higher-than-expected number of blueback herring that migrated downriver at the main-channel downriver site (i.e., based on the proportion of river flow through the main channel) could be an indication that the projector array at Crescent was partially effective in diverting fish. In that case, a higher diversion rate might be achievable by re-aiming the projectors that face the shoal so that they produce an ultrasonic field that extends further upriver. The objective of extending the ultrasonic field further upriver would be to deflect juvenile blueback herring farther offshore and around the entrance to the turbine channel. If the assumption that water flow directly influences entrainment is not valid, then the reduction in entrainment at hydroelectric facilities would likely be lower than expected if power generation is reduced when river herring are migrating downriver (i.e., as recommended by the Atlantic States Marine Fisheries Commission; ASMFC 2009).

The significantly higher-than-expected number of juvenile blueback herring that migrated downriver at the main-channel downriver site could be attributable to factors other than a reaction to ultrasound, including habitat preference, depth preference, or water turbulence near the entrance to the turbine channel. Juvenile blueback herring were distributed throughout the water column in the main channel upriver of the projector array. If juveniles in the main channel at depths greater than that at the entrance to turbine channel preferred to stay at those depths, they could continue migrating downriver to the main-channel downriver site with negligible exposure to ultrasound at SPLs above the threshold for a reaction. It is also possible that water flowing from the main channel into the shallower turbine channel welled up and caused turbulence, which juvenile blueback herring may have detected and avoided. Turbulence is thought to elicit rheotropic responses in fish (Arnold 1974). Unfortunately, we have no information on turbulence near the entrance to the turbine channel or on the reactions of juvenile blueback herring to such turbulence. Furthermore, because ultrasound was projected throughout the study period, the relative contribution of turbulence near the entrance to the turbine channel, habitat preference, depth preference, and the projector array at Crescent to the higher number of juvenile blueback herring at the main-channel downriver site cannot be determined. The inability to discriminate between the effects of ultrasound and other factors that might influence the downriver migration of juvenile blueback herring at Crescent illustrates the challenge of evaluating behavioral barriers at unique sites where a BACIP design cannot be used.

The number of fish that migrated downriver was lower at the main-channel downriver site than at the main-channel upriver site based on the fixed-location hydroacoustics; however, the abundance in both the main-channel downriver and turbine channel regions was higher than that in the main-channel upriver region based on the mobile hydroacoustics. One explanation for this discrepancy is that each mobile hydroacoustic survey provided information on the distribution of fish at a relatively discrete time but did not accurately capture the dynamic process of migration that was occurring. Alternatively, juvenile blueback herring may have accumulated in the main-channel downriver and turbine channel regions because juveniles did not leave these regions as fast as new migrants arrived. This could also partly explain why the abundance of juvenile blueback herring in the Crescent headrace was considerably higher than that in the turbine channel region. Another reason for higher abundance in the headrace was probably the concentrating of fish in a smaller cross-sectional area.

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Target Strength Measurements of Juvenile Blueback Herring from the Mohawk River, New York

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MANAGEMENT BRIEF

Target Strength Measurements of Juvenile Blueback Herring from the Mohawk River, New York

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Abstract
Target strength (TS) was estimated from in situ and ex situ measurements of juvenile blueback herring *Alosa aestivalis* during their fall downriver migration at the Crescent Hydroelectric Project in the Mohawk River, New York. The blueback herring is an ecologically important anadromous species that must transit fish passage facilities at hydroelectric dams. Measurements of TS are necessary to distinguish juvenile blueback herring from other fishes as well as to scale echo integration results to numerical fish densities during hydroacoustic studies. This study presents the first measurements of TS for juvenile blueback herring. The TS measurements were collected from an echosounder operating at 420 kHz with two split-beam transducers (one down-looking and one side-looking). Single echo detections associated with tracked fish echoes and the echoes at the periphery of schools in the headrace of the powerhouse were used in estimating in situ TS. Mean total length (TL) of 192 individuals captured by cast net was 75 mm. A single dead fish (70 mm TL) was tethered and suspended by monofilament line in both transducer beams, each orientated down; the mean TS of this fish was −52.3 decibels (dB) for the 15° beam and −52.8 dB for the 6° beam. The mean in situ TS was −46.0 dB in the down-looking beam and −48.6 dB in the side-looking beam. The in situ TS estimates were similar to those reported for similar-sized fish from published TS–TL relationships. The mean in situ TS for the down-looking beam was 0.1–0.5 dB higher than the predicted TS for similar-sized alewives *A. pseudoharengus* measured at 70 kHz in two studies. Results indicate that blueback herring and alewives have similar TSs and emphasize the importance of swim bladder condition and body orientation in influencing TS estimates for scaling acoustically derived fish density estimates.

Blueback herring *Alosa aestivalis* are anadromous, schooling, coastal pelagic fish that spend most of their lives at sea (Munroe 2002) and are managed by the Atlantic States Marine Fisheries Commission (ASMFC 2009). During spring, adult blueback herring undertake a spawning migration into coastal rivers from northern Florida to New Brunswick, including the Hudson River in New York (Schmidt et al. 1988). Some of the fish that enter the Hudson River continue migrating into the Mohawk River, which is part of the Erie Canal section of the New York State Canal System. The Erie Canal section is comprised of long navigable pools formed by dams.

Several months after blueback herring spawn in the Mohawk River, juveniles begin migrating downstream through the locks of the Erie Canal section, over dams, and through the turbines of hydroelectric facilities; one of these facilities is the Crescent Hydroelectric Project (hereafter, Crescent). Downriver passage of juvenile blueback herring was monitored by fixed-location and mobile hydroacoustics to evaluate the effectiveness of ultrasound in deterring fish from entering the turbine channel at Crescent (Dunning and Gurshin 2012, this issue); these evaluations required estimates of target strength (TS) for juvenile blueback herring.

Target strength (in decibels [dB] referenced to [re] 1 m^2) is the logarithmic measure of the backscattering cross section (σ_{bs}) of a single individual target and is important in scaling echo integration data to fish density (MacLennan et al. 2002). Target strength has been previously estimated for a variety of species based on cage experiments (Goddard and Welsby 1986; Nielsen and Lundgren 1999; Ona 2003; Boswell and Wilson 2008; Brooking and Rudstam 2009), tethering of anesthetized live fish or dead fish (Love 1969, 1971, 1977; Nakken and Olsen 1977; Reeder et al. 2004; Boswell and Wilson 2008), wild fish (Barange et al. 1996; MacLennan and Menz 1996; Fleischer et al. 1997; Warner et al. 2002; Rudstam et al. 2003), and acoustic scattering models (Horne 2000; Reeder et al. 2004). Of the 17 TS estimation methods described by Foote (1991), only a few methods may provide accurate TS measurements that are applicable to surveying. For example, TS measurements of tethered single fish have been widely used for determining tilt angle dependence of TS or for use in acoustic scattering models, but their application to estimating the TS of wild fish requires knowledge of the distributions of body orientation of the fish being surveyed (Foote 1991). Because the TS of fish is dependent on

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body size, swim bladder morphology, frequency response, body orientation, and physiology, the most appropriate TS estimate for abundance estimation may be obtained from in situ measurements (Ona 1990; Simmonds and MacLennan 2005). The 5–25% of random error in fish abundance estimates due to TS may be minimized if TS is representative of the species, size, and orientation of the fish being surveyed (Simmonds and MacLennan 2005). Prior published TS estimates for juvenile blueback herring were unavailable to use for acoustic estimation of abundance. Therefore, the objective of this study was to measure TS of juvenile blueback herring in the Mohawk River and compare the resulting estimates with TS estimates for similar species.

METHODS

In situ estimates of TS were based on measurements from free-swimming juvenile blueback herring in the headrace at the Crescent powerhouse on 3 and 5 October 2008 and from a single tethered juvenile blueback herring on 4 October. Multiple catches made with a cast net (2.4-m radius; 1-cm bar mesh) were used to confirm the presence of juvenile blueback herring ($n =$ 192) and determine their total lengths (TLs) before and after TS measurements of the free-swimming fish in the headrace. A dead individual (70 mm TL) that was caught by the cast net was tethered with 3.6-kg-test monofilament line at the head and tail and with a small weight suspended 0.5 m from the abdomen to maintain a general horizontal orientation of the fish during the estimation of dorsal-aspect TS. Using rod and reel, the tethered fish was lowered by a monofilament line to a 3–4-m range from the transducers (described below); the fish was then insonified by each beam for a 500–1,000-ping sequence while the vessel was adrift upstream of the dam.

All acoustic measurements were collected using a calibrated, 420-kHz digital echosounder (Model 243; Hydroacoustic Technology, Inc. [HTI], Seattle, Washington) with two split-beam transducers (15° and 6°, 3-dB beam widths) deployed from a 7-m aluminum vessel. Before and after TS measurements, the transducers were calibrated in the laboratory by the manufacturer using a U.S. Navy standard transducer (E27) of known sensitivity and a reference target (21.2-mm tungsten carbide sphere with 8% cobalt binder and a TS of −44.3 dB re 1 m^2) to determine overall sensitivity, frequency response curves, beam pattern measurements, and other settings (Urick 1983; Foote et al. 1987; Simmonds and MacLennan 2005). In addition, TS measurements of the reference target were collected in the field (Foote et al. 1987). The 6° transducer was aimed horizontally (5° down from horizontal) from the vessel except when both transducers were aimed downward during TS measurements of the tethered fish to increase dorsal-aspect echo detections, compare TS from two transducers with different beam widths, and ensure that measurements were made in the far field.

Echo amplitude was adjusted for beam spreading and absorption loss with an applied time-varied gain function of $40 \cdot \log_{10} R$ (where R is range, m) and a range-dependent absorption loss gain of αR (Simmonds and MacLennan 2005). Echoes were filtered and acquired using echo selection criteria in Digital Echo Processor version 3.56 (HTI) data acquisition software using a default sound speed of 1,500 m/s and an α of 54.8 dB/km based on expected average environmental conditions. The ping rate was 2.5 Hz for in situ measurements and 5 Hz for measurements of the tethered fish. The echo selection criteria used during data acquisition were the acceptance of targets (1) within angles of the central beam axis equivalent to half of the nominal beam width (−3 dB, half-power points), (2) within a maximum two-way beam compensation of 6 dB, (3) within an echo pulse duration of 0.40–1.45 when normalized to the transmit pulse duration (0.2 ms), and (4) above the minimum on-axis detection threshold (−60 dB for the tethered fish and −55 dB for the in situ measurements). Echoes from the individual fish were visually selected from echograms using Echoscape version 2.12 (HTI). A maximum TS threshold of −42 dB was only applied to in situ measurements to remove echoes that were considered to originate either from multiple targets or from another species. This threshold value was approximately the center of a 2-dB gap that separated the right tail of the main mode representing the majority of detections in the down-looking beam from several echoes with higher TSs. To improve the TS estimate from the tethered fish, echoes included in the analysis were within one-third of the original off-axis angles (2.5° for the 15° beam; 1° for the 6° beam) and within a reduced normalized echo pulse envelope (0.8–1.2 times the transmit pulse).

Echograms of the single targets detected during data acquisition were visually scrutinized, and a subset was selected for analysis to minimize contributions of echoes from multiple targets within the schools. This subset included those echo traces associated with a school's periphery or individual tracks. Statistics on TS measurements were performed in the linear domain (i.e., back-transformed TS to σ_{bs} by $10^{[TS/10]}$) and are presented in dB ($= 10 \cdot \log_{10} \sigma_{bs}$). The normality of the TS distributions was tested with a Shapiro–Wilk test at a significance level α of 0.05. Data manipulations, statistics, and plots were performed in the Statistical Analysis System version 9.2 (SAS Institute, Cary, North Carolina).

RESULTS

The mean TL of juvenile blueback herring captured with a cast net after acoustic measurements were taken on the free-swimming fish was 75 mm, and TL ranged from 65 to 88 mm (Figure 1). The mean TS of individual echoes from free-swimming fish was −46.0 dB for the down-looking transducer and −48.6 dB for the side-looking transducer (Table 1). Target strength of the free-swimming fish as measured by the down-looking 15° beam was normally distributed with a median that was 0.4 dB lower than the mean; the distribution of TS measurements from the side-looking 6° beam was positively skewed with a median that was over 1 dB lower than the mean (Figure 2). The TS equivalent to the 75th and 90th percentiles of the in situ σ_{bs} distribution was −45.3 and −43.7 dB, respectively, for the down-looking 15° beam and was −47.6

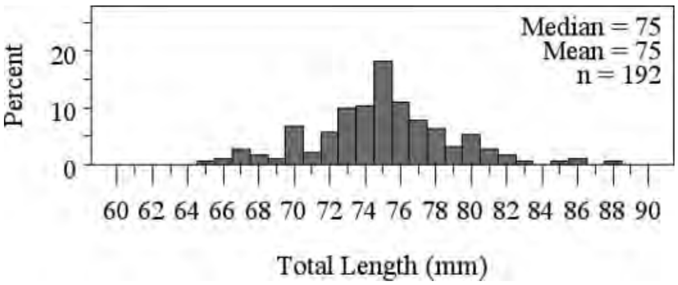

FIGURE 1. Length-frequency distributions of juvenile blueback herring captured by cast net in the headrace of the Crescent Hydroelectric Project on the Mohawk River, New York, 2008.

and −45.3 dB, respectively, for the side-looking 6° beam. The dorsal-aspect TS distribution of the tethered dead fish was positively skewed and peaked at −52 dB as measured by the 15° beam and at −54 dB as measured by the 6° beam (Figure 3).

DISCUSSION

Measurements from live wild fish for which there is high confidence of species identification usually offer the best TS estimates, but variability in size, body orientation, swim bladder volume, physiology, single-target detections, and multiple scattering effects may contribute to the variability of TS distributions. Fish abundance is often estimated from echo integration or counting echoes over a TS range based on a representative TS derived from an established TS–size relation and the size distribution of catches from verification sampling (Simmonds and MacLennan 2005). Target strength of blueback herring has not been published or widely studied, so comparisons of our results with those of other studies are limited to general TS estimates based on size for other clupeids like the alewife.

A commonly cited TS–TL relationship for fish was reported by Love (1971, 1977), who described the average TS of individuals from 14 families, including Clupeidae (Atlantic menhaden *Brevoortia tyrannus*), as a function of size and acoustic wavelength. The dorsal-aspect TS predicted based on Love's (1977) equation was 1.7 dB lower than the mean TS from the in situ measurements taken by the down-looking 15° transducer in our study (Table 1); therefore, use of the predicted dorsal-aspect TS would result in overestimation of the fish abundance estimate by 45% if we assume that the mean in situ TS was representative of the population. The broad in situ TS distribution of juvenile blueback herring as measured by the side-looking 6° transducer had a mean TS that was lower than the side-aspect TS predicted by Love (1977) but higher than the predicted head- and tail-aspect TSs (Table 1). The maximum TS difference for a 70- or 75-mm fish as predicted by Love (1977) is approximately 15 dB between the tail- and side-aspect angles. The TS distribution from in situ measurements taken by the side-looking transducer had a range of approximately 13 dB, while the dorsal-aspect TS distribution from the in situ measurements was approximately 7 dB wide.

Target strength has been described for alewives based on in situ measurements and scattering models. Warner et al. (2002) provided a significant positive relationship between TS and length ($TS = 20.53 \cdot \log_{10} L - 64.25$, where L = TL in cm) from measurements of wild alewives (range = 25–152 mm TL) in several lakes at 70 kHz. Based on this relation, the TS of a 75-mm alewife would be −46.3 dB, or 0.3 dB lower than the mean

TABLE 1. Target strength (TS; dB referenced to [re] 1 m^2; lower and upper 95% confidence limits are given in parentheses) of juvenile blueback herring measured by a 420-kHz, split-beam echosounder for in situ individuals associated with a school and for a tethered dead individual; TS estimates from other studies are provided for comparison (TL = total length).

Estimation method	TS (dB re 1 m^2)
In situ individuals (mean TL = 75 mm)	
Empirical mean for down-looking 15° beam	−46.0 (−47.0, −45.2)
Empirical mean for side-looking 6° beam	−48.6 (−49.0, −48.2)
Predicted from dorsal-aspect (±15°) TS–TL equation at 420 kHz (Love 1977)	−47.6
Predicted from side-aspect (±15°) TS–TL equation at 420 kHz (Love 1977)	−46.1
Predicted from head-aspect (±15°) TS–TL equation at 420 kHz (Love 1977)	−58.7
Predicted from tail-aspect (±15°) TS–TL equation at 420 kHz (Love 1977)	−61.6
Predicted from TS–TL equation for alewives *Alosa pseudoharengus* at 70 kHz (Warner et al. 2002)	−46.3
Mean for alewives (mean TL = 74 mm) in a net cage at 70 kHz (Brooking and Rudstam 2009)	−46.1 (day); −46.9 (night)
Tethered individual (TL = 70 mm)	
Empirical mean for down-looking 15° beam	−52.3 (−52.5, −52.1)
Empirical mean for down-looking 6° beam	−52.8 (−53.1, −52.4)
Predicted from dorsal-aspect (±15°) TS–TL equation at 420 kHz (Love 1977)	−48.2
Predicted from side-aspect (±15°) TS–TL equation at 420 kHz (Love 1977)	−46.7
Predicted from head-aspect (±15°) TS–TL equation at 420 kHz (Love 1977)	−59.3
Predicted from tail-aspect (±15°) TS–TL equation at 420 kHz (Love 1977)	−62.0

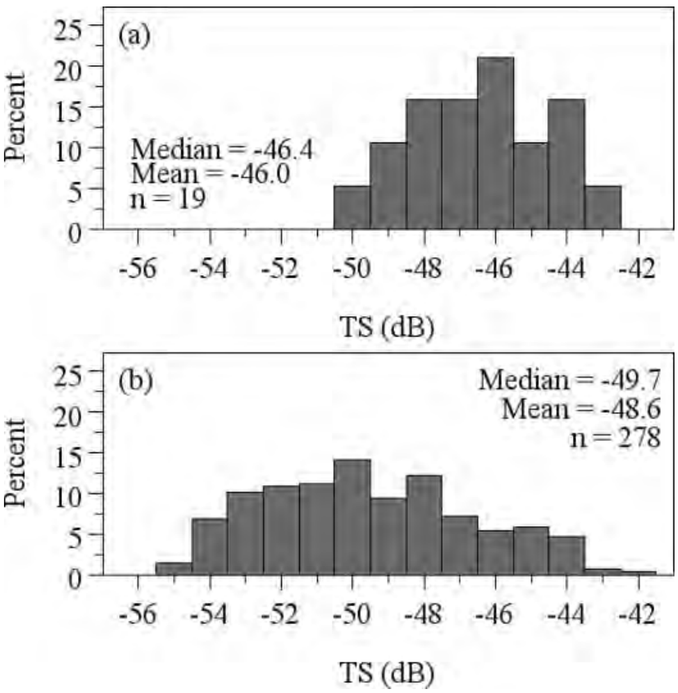

FIGURE 2. Frequency distributions of target strength (TS; dB referenced to 1 m^2) for visually selected single-target detections associated with a school of juvenile blueback herring, as measured by a 420-kHz echosounder with **(a)** a down-looking 15° split-beam transducer and **(b)** a side-looking 6° split-beam transducer on 3 and 5 October 2008 using real-time echo selection criteria of 6-dB maximum two-way beam compensation, an echo pulse envelope between 0.40 and 1.45 times the transmit pulse, a minimum threshold of −55 dB, and a maximum of −42 dB.

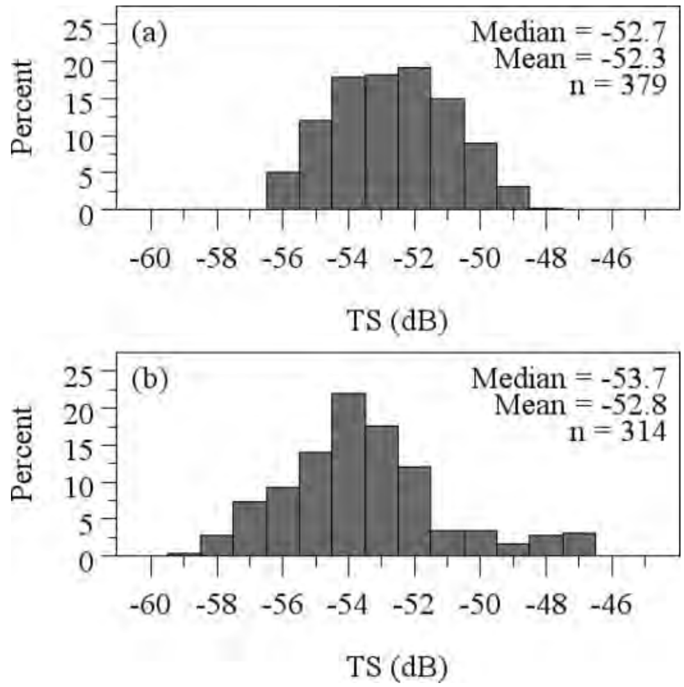

FIGURE 3. Frequency distributions of dorsal-aspect target strength (TS; dB referenced to 1 m^2) of a dead juvenile blueback herring (70 mm total length) that was tethered at the head and tail by monofilament line and was insonified by a 420-kHz echosounder with **(a)** a 15° split-beam transducer and **(b)** a 6° split-beam transducer using single echo detections based on an echo pulse duration between 0.8 and 1.2 times the transmit pulse, a minimum threshold of −60 dB, a 6-dB maximum two-way beam compensation, and an angular location of 2.5° off-axis for the 15° transducer or 1° off-axis for the 6° transducer.

in situ TS for juvenile blueback herring measured by the down-looking transducer; thus, the use of this relationship developed for alewives would potentially overestimate juvenile blueback herring abundance by 7%. Brooking and Rudstam (2009) estimated mean TS of age-0 alewives (mean TL = 74 mm) at 70 kHz from net cage experiments during the day and night (Table 1). The estimates by Brooking and Rudstam (2009), although obtained at a frequency lower than 420 kHz, were as little as 0.1 dB lower than the mean in situ TS we estimated with the down-looking transducer, therefore representing an abundance estimation difference as low as 2%.

The observed ex situ TS distributions were different than the in situ TS distributions for juvenile blueback herring. However, the in situ and ex situ TS distributions observed by both transducers did not appear to be truncated at the tails and were mostly unimodal, strongly indicating that bias from excluding echoes due to threshold choice was minimal. The effect of using dead or stunned fish and the unknown condition of the swim bladder may have caused TS estimates to be unrepresentative of the true TSs of free-swimming juvenile blueback herring during acoustic surveys (Simmonds and MacLennan 2005). Clupeids have physostomous swim bladders and are able to release gas through the anal opening (Wahlberg and Westerberg 2003). Considering that the swim bladder may account for up to 90% of the acoustic backscatter (Foote 1980), the handling of a live or dead blueback herring at the surface may release or purge that individual's swim bladder, thereby producing lower TS estimates. For acoustic surveys that vertically integrate acoustic backscatter, the mean in situ σ_{bs} measured by the down-looking 15° transducer was most representative of an individual juvenile blueback herring for acoustic estimation of fish density.

Horizontal beaming is especially important in acoustically estimating the abundance of fish in shallow water, where vessel avoidance or smaller sampling volumes may bias vertical echo integration (Hughes 1998; Kubecka and Wittingerova 1998); however, the mean TS used for scaling echo energy to fish densities should be representative of wide TS distributions of fish in multiple directions and orientations rather than a maximum or near-maximum side-aspect TS (i.e., as predicted by Love 1977). As shown in this study, the broad TS distribution and the lower-than-predicted mean in situ TS observed by the side-looking transducer support the idea that the TS distribution resulted from a mixture of body orientations relative to the incident sound wave. Boswell and Wilson (2008) developed a pooled TS–TL relationship ($TS = 20 \cdot \log_{10} TL - 65$) from side-aspect TS measurements of bay anchovy *Anchoa mitchilli* and Gulf menhaden *B. patronus* in ex situ experiments. Based on this TS–TL relation, the side-aspect TS for a 75-mm juvenile blueback herring would be −47.5 dB, which is about 1 dB higher than the mean side-aspect TS observed in this study. Boswell and Wilson (2008) also observed that TS estimates were higher for free-swimming fish than for tethered fish—by 3–5 dB for bay anchovy and by 5–9 dB for Gulf menhaden.

Representative individual TS estimates are important in providing fishery managers with accurate abundance estimates from hydroacoustics, particularly for the anadromous blueback herring, which is currently under petition for listing as threatened under the U.S. Endangered Species Act (NMFS 2011). For estimating fish abundance from horizontal beaming, the in situ TS distribution (mean = −48.6 dB) measured by the side-looking 6° transducer provided the best available information for TS of juvenile blueback herring. For down-looking transducers, the mean in situ TS (−46.0 dB) measured by the 15° transducer provided the first estimates of TS for juvenile blueback herring at 420 kHz, which were similar to TS estimates for juvenile alewives as reported in other studies. Our results also support the improved accuracy of acoustically estimating the abundance of a clupeid with an unknown TS by using the TS–TL relationship from a similar species in preference to the generic TS–TL relationship developed by Love (1977); furthermore, these results recommend caution in the use of experimentally derived TS estimates.

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Final Report to Cornell Water Resources Institute

"Relative Abundance of Blueback Herring (*Alosa aestivalis*) in Relation to Permanent and Removable Dams on the Mohawk River"

To: Water Resources Institute, Cornell University

From: Dr. Karin Limburg and Dr. Neil Ringler, SUNY – ESF

Date: April 15, 2012

Subject: Final report for blueback herring research on the Mohawk River

This report summarizes field and lab procedures as well as our findings.

Field sampling:

We conducted field sampling on the Mohawk River from May to July. The purpose of our field sampling was to determine the timing and distribution of the blueback herring spawning run. We used boat electrofishing gear to sample adult blueback herring at five sites on the Mohawk River. The sample locations were Locks 7, 9, 11, 15 and Little Falls, NY. All field sampling was done with assistance from the New York State Department of Environmental Conservation (NYSDEC). The sample dates, locations and personnel involved are summarized in the table below. No fish were collected on the final date (July 2) and so the sampling was terminated then.

Date	Location	Personnel
May 22	Little Falls, NY	Christopher Legard (SUNY-ESF graduate student) Dave Erway (NYDEC region 6)
May 23 - 24	Locks 7, 8, 9, 11 and 15	Christopher Legard Tiffany Evanchoff (SUNY-ESF Undergraduate) Scott Wells (NYDEC region 4)
June 12 - 13	Locks 7, 8, 9, 11 and 15	Christopher Legard Tiffany Evanchof Scott Wells
June 14th	Little Falls, NY	Christopher Legard Dave Erway
June 26th	Locks 7, 8, 9, 11 and 15	Karin Limburg (SUNY-ESF) Christopher Legard Scott Wells

Date	Location	Personnel
July 2nd	Little Falls, NY	Christopher Legard Dave Erway

Sample Processing:

A sub-sample of 230 fish was retained for laboratory analysis at SUNY-ESF. The sub-sample will be used to determine demographic information about the population (length, weight, age, sex ratio, gonadosomatic index, diet, migration history, number of repeat spawners, genetic make-up, and stable isotope data). All fish were weighed, measured, and samples were taken of scales, otoliths, gonads, stomach contents, gill rakers, and muscle tissue. Within the scope of this project, length, weight, age, sex ratio, gonadosomatic index, diet, and degree of repeat spawning were quantified.

Results:

Size, sex ratios, and GSI.

Table 1 shows mean size, weights, gonadal weights, and gonado-somatic (GSI) indices in May and June 2012. Males ranged in size (total length, TL) from 205 to 262, and females from 220 to 280 mm.

Table 1. Summary statistics for adult blueback herring in Mohawk river, spring 2012.

Date	N	Sex ratio (M:F)	Mean Total Length, mm	Mean Fork Length, mm	Mean wet weight, g	Mean Gonad weight, g	Mean GSI
May 23-24	124	79-45	239	212	119	9.6	0.086
June 12-13	98	75-23	235	209	100.1	4.9	0.049
June 26	7	5 to 2	246	218	111.9	5.4	0.050
Total	229	159-70	238	211	110.6	7.5	0.069

GSI was highest in May and stabilized in June, indicating that most spawning went on in May. This is consistent with previous observations.

Compared to an earlier study of Mohawk River blueback herring conducted by KL and Ian Blackburn in 1999-2001, adult spawners have declined in size significantly (Figure 1) and sex ratios have skewed toward males (Figure 2). This may reflect selective fishing at sea. Note that there are no directed marine fisheries on blueback herring, but bycatch is a well-known problem (ASMFC 2012).

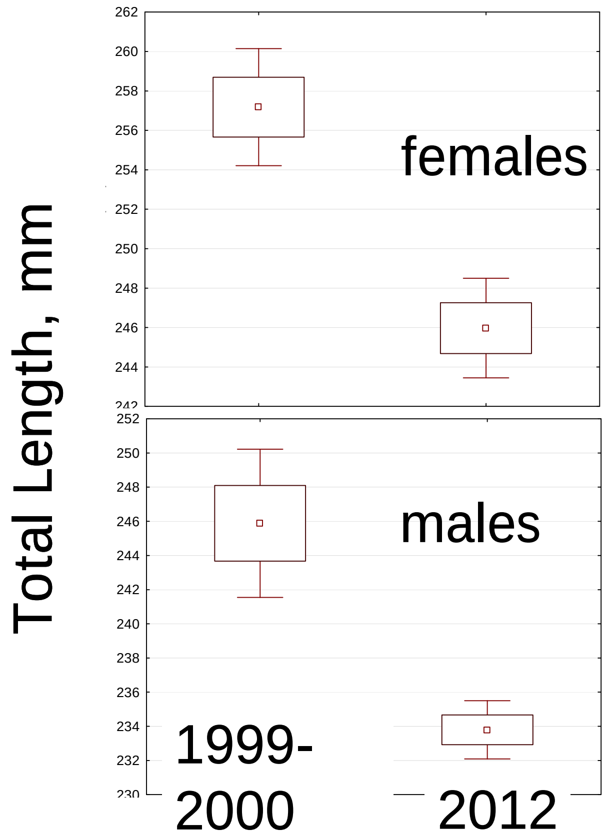

Figure 1. Lengths of blueback herring adults collected in spring spawning runs in the Mohawk and Hudson rivers in two time periods. Fish were collected with non-selective gear in both periods.

Diet.

Blueback herring were also observed to be feeding on benthic macroinvertebrates during the 2012 spawning run. This is consistent with earlier observations by Simonin et al. (2007), who reported feeding by blueback herring in the Hudson/Mohawk watershed, but only when fish were captured in uni-directional flow. Fish captured in the tidal Hudson River estuary were not observed to feed. Simonin et al. (2007) concluded that feeding occurs in unidirectional flow to subsidize the energy required to reach spawning grounds in the Mohawk and other tributaries.

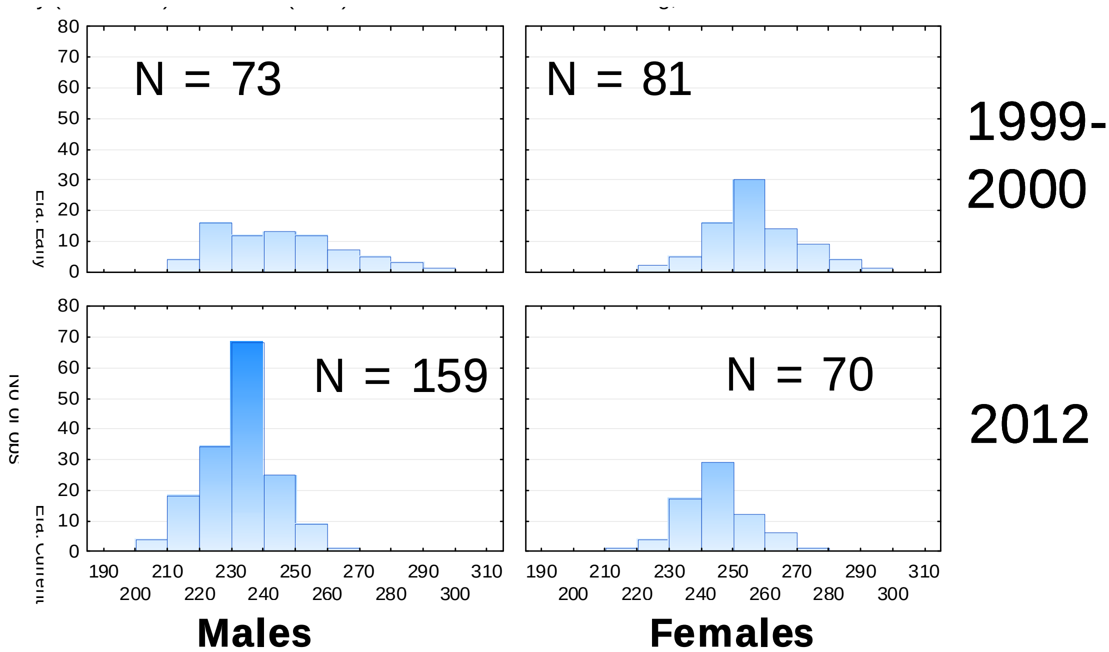

Figure 2. Size distributions of male and female blueback herring collected in the Hudson and Mohawk rivers in two time periods. Note the marked difference in sex ratios as well as changes in sizes.

Possible effects of dams.

No effects of dams was detected on size of spawning blueback herring in 2012, irrespective of sex or sampling date ($p > 0.2$). However, female GSI was significantly lower ($p < 0.05$) at Lock 15, the farthest upstream location at Little Falls, NY, suggesting that most spawning took place downstream of that location. Again, this is in agreement with earlier studies.

Anticipated products of this research: A manuscript will be developed over the summer. Also, the results will be disseminated to the Mohawk River and Hudson River Estuary Programs of the NYS DEC.

Conclusions.

Although this was a preliminary study, the findings thus far do indicate some substantial changes in the Mohawk River component of the Hudson River watershed's blueback herring stock; in particular, size of fish has declined over the past decade and the sex ratio is skewed toward males. If more funding can be found, then more demographic analysis (age, growth, and provenance via isotopic and trace elemental chemistry) could be performed on otoliths and tissues archived from these samples. This could help identify not only the origin of these fish (Mohawk, Hudson, or elsewhere), but also could shed light on marine habitat use. Given the parlous state of river herring (blueback herring and alewife), such information could be very useful for conservation management.

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Hydroacoustic Studies of the Downstream Passage of Juvenile Blueback Herring after Reconfiguration of the Ultrasound at the Crescent Hydroelectric Project, Mohawk River, New York

Presented To:
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Preface

Normandeau Associates, Inc. was contracted by the New York Power Authority (Contract No. 4500190871) to evaluate the safe downstream passage of out-migrating juvenile blueback herring after reconfiguration of ultrasonic projectors at the Crescent Hydroelectric Project during the fall of 2012. This report, titled "*Hydroacoustic Studies of the Downstream Passage of Juvenile Blueback Herring after Reconfiguration of the Ultrasound at the Crescent Hydroelectric Project, Mohawk River, New York*" serves as the comprehensive fish passage report required by the Federal Energy Regulatory Commission Order, dated 14 December 2011, Modifying Schedule for Comprehensive Downstream Fish Passage Effectiveness Study Report. This document was written following the style of the American Fisheries Society and served as the basis of a manuscript to be submitted for publication in the *North American Journal of Fisheries Management*.

List of Abbreviations, Acronyms, and Symbols

Term	Definition
τ	Pulse duration (ms)
ψ	Equivalent beam angle (steradians)
σ_{bs}	Backscattering cross-section (m^2)
°C	Degrees Celcius
μPa	Micro Pascals
A	Area (m^2) of part or entire cross-section of the river channel
ADCP	Acoustic doppler current profiler
A_{equip}	Amplitude scaling factor
ANOVA	Analysis of variance
c	Sound speed (m/s)
CPUE	Catch per unit effort
dB	Decibels
EDSU	Elementary distance sampling unit
ES	Echo strength (dB re 1 m^2)
FM	Frequency-modulated
H	River height or stage (m)
Hz	Hertz
I_{bs}	Intensity at the midpoint of the backscattered pulse
I_i	Intensity of the incident sound wave at the target
IPA	Integrated projector assembly
kHz	Kilohertz
m	Meter
MHz	Megahertz
N_{net}	Net passage of juvenile blueback herring (difference between downstream and upstream moving fish through the acoustic beams)
N_v	Fish density index for unbiased *in-situ* TS measurements (Sawada et al. 1993)
P_Q	Proportion of the downstream flow of the river through the downriver site in the main channel
Q	River flow or discharge (m^3/s)
R	Range between transducer and target
s	second
s_a	Area backscattering coefficient (m^2/m^2)
SED	Single echo detection
SPL	Sound pressure level
s_v	Volume backscattering coefficient (m^{-1})
S_v	Volume backscattering strength (dB re 1 m^{-1})
TS	Target strength (dB re 1 m^2)
TVG	Time-varied gain
V_0	Acoustically sampled volume (m^3)

V^2_{rms}	Root-mean-square squared voltage (volts^2)
V_m	Mean water velocity in the channel (m/s)
V_x	Water velocity (m/s) along the main axis of the river flow in the horizontal plane measured by a horizontally aimed acoustic Doppler current profiler
YOY	Young-of-the-year

Abstract

Populations of blueback herring *Alosa aestivalis*, an important anadromous forage fish in northeastern USA, have been depleted from historic levels and blueback herring are currently under consideration for protection under the Endangered Species Act. Measures to reduce mortality from many sources, including entrainment by hydroelectric turbines, are cited by fishery managers to be important to restoring populations back to sustainable levels. At Crescent Hydroelectric Project (Crescent) on the Mohawk River, New York, ultrasound (122-128 kHz broadband sound) was produced to deter blueback herring adults during their migration to sea from entering the intake channel to the Crescent headrace and turbines where mortality may occur. After being shown to be partially effective in 2008, the ultrasonic projectors were reconfigured to allow more exposure time to increasing sound pressure levels to juvenile blueback herring as they migrate downriver with the intention of increasing the number of blueback herring bypassing the turbines. In this study, fish passage at Crescent was monitored by multiple sampling methods from 8 September through 26 October 2012 to: (1) determine whether a greater proportion of juvenile blueback herring migrated down the main channel (bypassing the turbines) in the presence of the reconfigured ultrasound, (2) to evaluate the effectiveness of the reconfigured ultrasonic fish deterrent system for guiding out-migrating juvenile blueback herring away from the turbines to the main channel for downstream passage, and (3) describe temporal or spatial migratory patterns.

When juvenile blueback herring were present upstream of Crescent from 8 September through 10 October during the operation of the ultrasonic projectors, the CPUE of juvenile blueback herring caught by pelagic trawls in the downriver trawl region was 94% of the CPUE in the upriver trawl region and 250% of the CPUE in the intake channel. Repeated mobile acoustic surveys revealed mean density and total abundance of juvenile blueback herring was significantly greater in the downriver main channel region than in the intake channel region; the total abundance in the downriver main channel region averaged 35 times higher than in the intake channel region and averaged 91% of their sum. During the peak migration period of 20 September through 14 October, continuous monitoring by fixed-location horizontal transducers revealed that 76% of the cumulative net downstream passage of juvenile blueback herring at the upriver site occurred through the downriver site in the main channel, thus bypassing the turbines. This was significantly higher than expected based on the assumption that entrainment is proportional to river flow and higher than the proportion observed in presence of the previous ultrasound field. These results demonstrate significantly improved downstream passage at Crescent for the majority of out-migrating juvenile blueback herring.

1.0 Introduction

Blueback herring *Alosa aestivalis* is an important anadromous forage species of fish in northeastern USA, and is currently managed together with alewife *A. pseudoharengus* (collectively referred as river herring) under the interstate fishery management plan (FMP) prepared by the Atlantic States Marine Fisheries Commission (ASMFC 2009). The most recent stock assessment report declared stocks from many river systems, including the Hudson and Mohawk Rivers, as being significantly depleted from historic levels and several indices indicate declining trends in young-of-the-year (YOY) abundance (ASMFC 2012). This has led to both river herring species being candidates to be listed as threatened under the Endangered Species Act (NMFS 2011). While the stock status in the Hudson and Mohawk Rivers is considered depleted, the current population of blueback herring in this river system is considered stable based on conflicting trends in stock indicators (ASFMC 2012). The FMP identifies multiple factors contributing their population decline, such as overfishing, pollution, channelization and dredging, barriers to migration, mortality from fish entrainment by turbines at hydroelectric facilities and intakes at power plants.

The FMP identifies behavioral technologies for fish guidance as a mitigation measure to deter fish from entering intakes at water withdrawal facilities. High-frequency sounds greater than 20 kHz (ultrasound) have been shown to elicit avoidance responses by blueback herring (Nestler et al. 1992, Dunning and Ross 2010). When captive blueback herring were exposed to loud sounds ranging from 0.10 kHz to 420 kHz, Nestler et al. (1992) found the strongest avoidance response between 120 and 130 kHz. Field evaluations later revealed that transducers transmitting 124.6 and 130.9 kHz at a source level (SL) of 187 or 200 decibels referenced to 1 μPa at 1 m (dB re 1 μPa at 1 m) partially repelled blueback herring over a distance of 60 m for periods of up to 1 hour. Dunning and Ross (2010) found band-limited sound between 122 and 128 kHz at sound pressure levels (SPLs) ranging from 145 to 163 dB re 1 μPa to elicit avoidance reactions from adult blueback herring held in a tank.

On the Savannah River in Georgia, Ploskey et al. (1995) showed mean hourly rates of blueback herring passage at the Richard B. Russell hydroelectric dam in the presence of ultrasound was significantly lower by 56% than rates in the absence of ultrasound. At Annapolis Tidal Hydroelectric Generating Station located in Nova Scotia, Canada, Gibson and Myers (2002) demonstrated a 122-128 kHz ultrasonic system reduced fish passage through the turbines for American shad *A. sapidissima* by 42%, alewife by 48%, and blueback herring by 49%. When ultrasound was used in Lake Ontario at the cooling water intake of the James A. FitzPatrick Nuclear Power Plant, density of alewife near the cooling water intake decreased by as much as 96% and impingement of alewife was reduced by as much as 87% (Ross et al. 1993, 1996). The use of ultrasound for guiding blueback herring to safe downstream passage at other locations is supported by the experimental evidence and applied results for blueback herring and other alosines.

Adult blueback herring are known to navigate through several locks of the Erie Canal during their spring spawning migration up the Mohawk River in New York, USA (Schmidt et al. 2003). Adults migrating downriver following spawning and juveniles out-migrating to sea several months later may encounter dams at six hydropower facilities. Crescent Hydroelectric Project (Crescent), operated by the New York Power Authority, is one of those facilities where out-migrating juvenile blueback herring are known to encounter the headrace during their downstream migration (Dunning and Gurshin 2008). An ultrasonic projector array was installed and operated at Crescent from May through mid-November to deter blueback herring adults during their post-spawn downstream migration (May-July) and juveniles during their downstream migration (August-November) from entering the channel that leads to the Crescent headrace and turbines.

Dunning and Gurshin (2012) evaluated the passage of juvenile blueback herring in the presence of ultrasound at Crescent during fall of 2008. Fixed-location transducer arrays consisting of 420-kHz single and split-beam transducers continuously monitored volume backscatter of fish passing at three sites: upriver of the ultrasound in the main navigation channel, downriver of the ultrasound in the intake channel and downriver in the main navigation channel, and where an opening in the dam flashboards allowed fish to pass. The observed proportion of the number of downstream migrant fish that passed the downriver-main channel site (31.3%) was significantly more than the proportion expected (11.5%); based on the assumption that entrainment (and density) is proportional to river flow.

Prior to 2010, the ultrasonic projectors were back-to-back and pointed perpendicular to the flow and across the entrance of the intake channel to form an acoustic barrier. One of the conclusions from the 2008 evaluation was that a higher deterrence rate might be achieved if the projectors were re-aimed to extend the effective sound field further upriver so fish encounter an increasing sound gradient giving them time to avoid the entrance of the intake channel where water velocities were higher than the main navigation channel. As a result, beginning in 2010, the four westerly aimed projectors were re-aimed upriver by 45° toward the main channel.

In this study, fish passage at Crescent was monitored by an intensive sampling effort from 8 September through 26 October 2012 to: (1) determine whether a greater proportion of juvenile blueback herring migrated down the main channel in the presence of ultrasound, (2) to evaluate the effectiveness of the reconfigured ultrasonic fish deterrent system for guiding out-migrating juvenile blueback herring away from the turbines to the main channel for downstream passage, and (3) describe any temporal or spatial migratory patterns. Specifically, random-stratified pelagic trawl surveys and systematic mobile acoustic surveys were repeatedly made to allow comparisons of density and abundance of juvenile blueback herring to be made among regions in the Mohawk River near Crescent. Fish passage estimates from continuous fixed-location acoustic monitoring upriver and downriver of the ultrasonic projectors were used to compare the observed number of fish migrating downriver in the main channel to the expected number assuming fish passage was proportional to the measured river flow. Flow and temperature measurements complemented the fixed-location acoustic monitoring and mobile acoustic surveys for describing the fine-scale spatial and temporal and environmental patterns in the out-migration of juvenile blueback herring in the Mohawk River.

2.0 Methods

2.1 Study Area

Crescent is located on the Mohawk River approximately 8 km upstream of the confluence to the Hudson River, New York (Figure 1). Dams A and B, separated by an island, impounds the Mohawk River. The river channel that flows down the west side of the island conveys water through four hydroelectric turbines during power generation (hereafter, the “intake channel”). The primary navigation channel (hereafter, the “main channel”) continues to the east of the island toward Dam A and the entrance to Waterford Flight Lock 6 of the Erie Canal System. Out-migrating juvenile blueback herring currently have three turbine-bypass routes for downstream passage at Crescent: (1) down the main channel and through a 24.4 m wide and 0.3 m high opening in the flashboards installed on top of Dam A when the water level is above the fixed crest elevation of the dam (56.1 m), (2) spilling water over the flashboards of either Dam A or Dam B during high-flow events, and (3) down the main channel and through the Waterford Flight Lock 6. The observed maximum water depths of the sampled sections of the river during the study period were 4.9 m in the intake channel, 10.0 m upriver of the island in the main channel, and 12.8 m east of the island in the main channel, but deeper depths are known near Dam A. Dunning and Gurshin (2012) provide additional details about Crescent and the surrounding water bodies.

The ultrasonic projectors (Ultra Electronics Ocean Systems Inc., Braintree, Massachusetts) at Crescent consist of eight integrated projector assemblies (IPAs) orientated in two 2 x 2 block arrays (0.3 m apart for center of each transducer face). Each IPA contained all electronics necessary for signal generation, amplification, and transmission. Each transducer of an IPA had a nominal source level of 196 dB re 1 µPa at 1 m and a 13° x 30° beam width within 3 dB of the major response axis. The IPAs simultaneously transmitted broadband (122-128 kHz) pulses of 0.5-second duration at 1-second intervals. Figure 2 shows the spatial extent of the sound pressure levels (SPLs) within the ultrasonic field after re-aiming the four western IPAs upriver in the main channel. An omnidirectional hydrophone was used to measure and verify the SPL at several locations and depths on 28 June 2011. Based on these measurements, the effective SPL for an avoidance response by blueback herring was extended further than predicted by the model. For example, the SPL measurements ranged 177-180 dB re 1 µPa within a few meters north of the re-configured IPAs and decreased to 166 dB re 1 µPa at 140 m and 156-160 dB re 1 µPa at 350 m depending on depth.

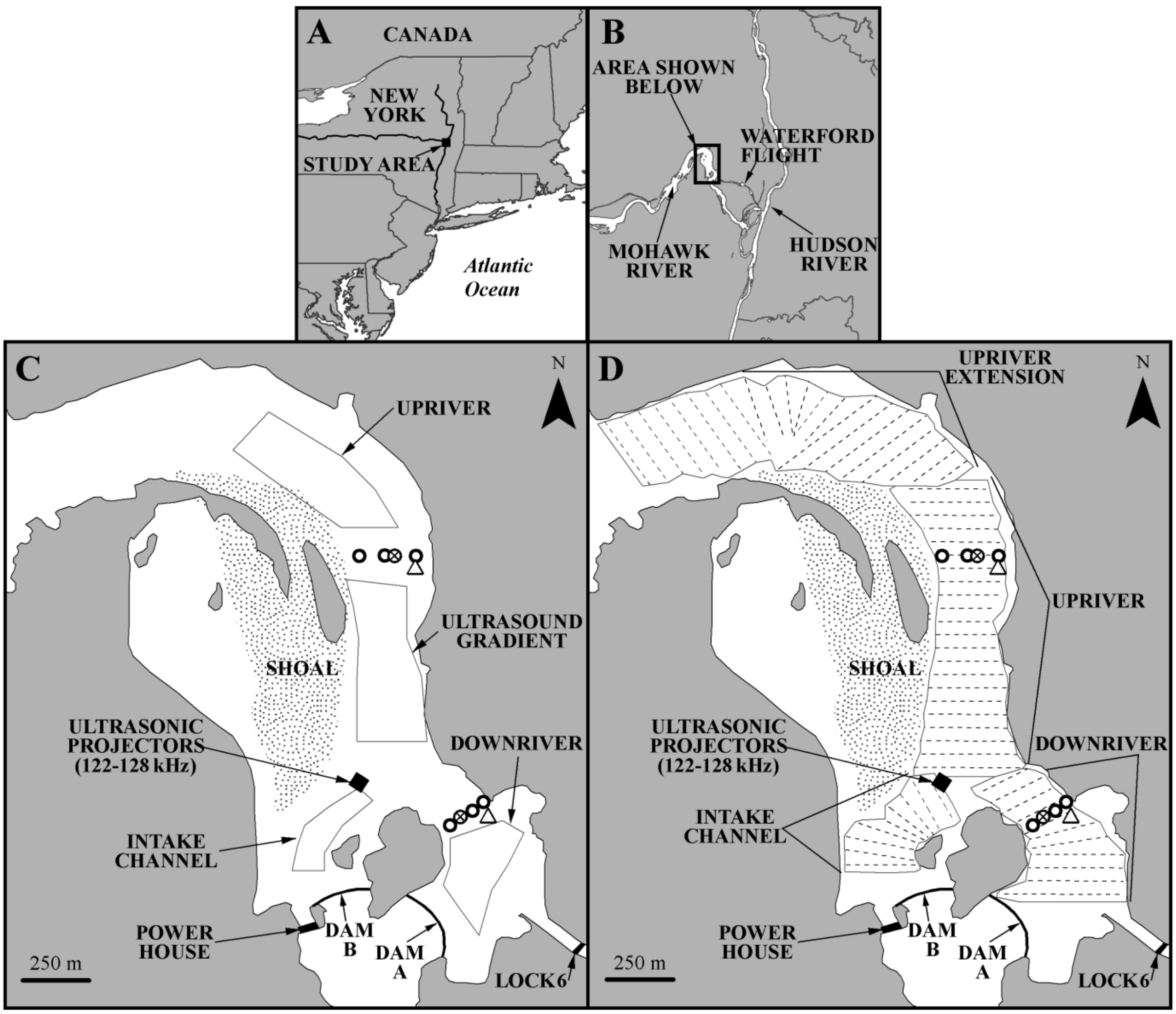

Figure 1. (A) Location of study area in New York, USA; (B) location of the study area in the Mohawk River, New York; (C) pelagic trawl regions (polygons), locations of split-beam transducers aimed horizontally (open circle) and vertically (crossed circles), and locations of horizontally aimed acoustic Doppler current meters (triangles)in the main channel upriver and downriver of the ultrasonic projectors; (D) mobile acoustic survey regions (polygons) sampled along transects (dashed lines).

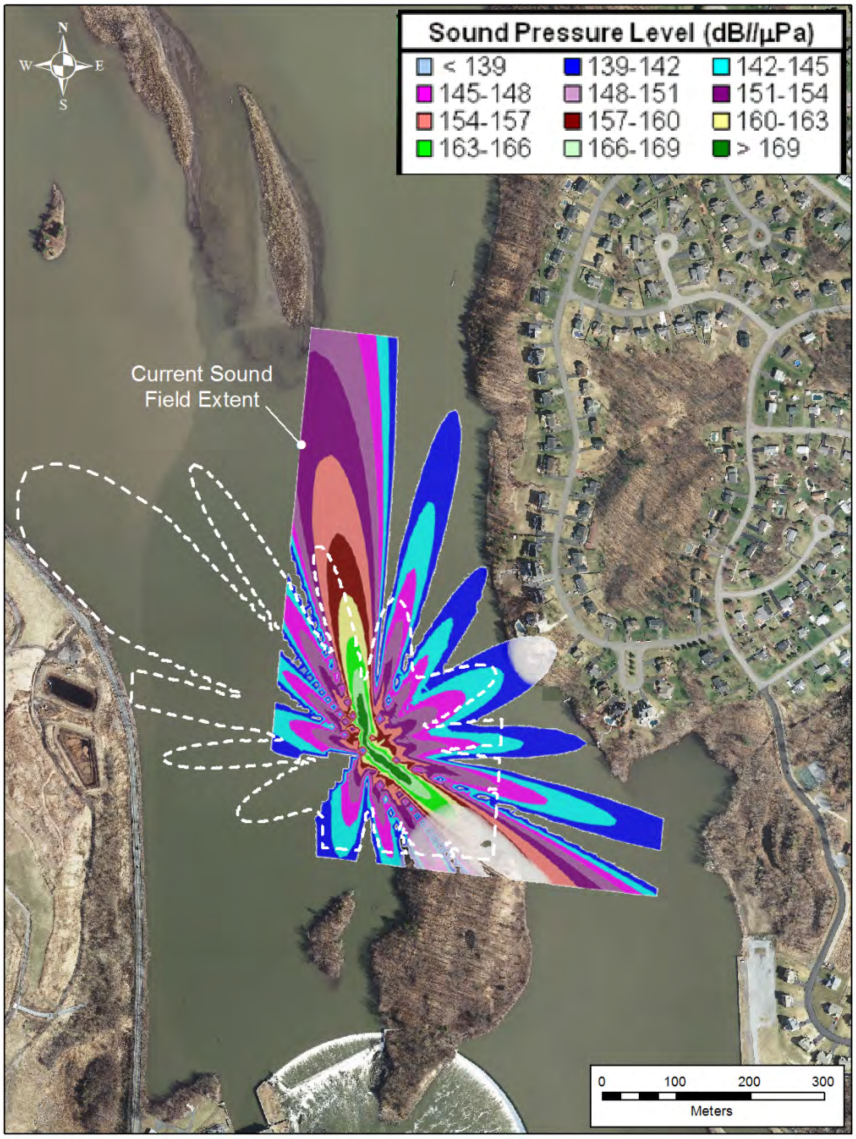

Figure 2. Prediction model of the ultrasonic field produced by eight integrated projector assemblies (IPAs) at the entrance of the intake channel at Crescent Hydroelectric Project, after re-configuring the four western IPAs by a 45° angle to point upriver in the main channel of the Mohawk River. The previous orientation of the ultrasonic field is shown as the dashed outline.

2.2 River Flow and Temperature Monitoring

To estimate expected downstream passage based on flow, a fixed-location, horizontally aimed, 500-kHz acoustic Doppler current profiler (ADCP; Argonaut SL; SonTek/YSI, San Diego, California) was used to continuously measure water velocity along the main axis of the river flow in the horizontal plane (V_x) and river height (H) over 2.5-minute averaging intervals at two locations; in the main channel upriver (hereafter, the upriver site) and in the main channel downriver (hereafter, the downriver site) of the ultrasonic projector array (Figure 1). Each ADCP was mounted 1.5 m high on a 6-cm outer diameter steel pipe mount secured to the river bottom at a water depth of 2.2 m at the downriver site and 1.6 m at the upriver site. The ADCP had two horizontal beams that were 50° apart: one was pointing upstream and the other downstream. The maximum horizontal range for measurements was 38 m at the downriver site and 34 m at the upriver site.

Because the continuous measurements made by the fixed-location ADCP only samples across a portion of the river, a calibration curve required true water velocity profile and total river discharge (i.e., flow) measurements across the river channel bank to bank near each site. Measurements were made daily by a 1-MHz ADCP mounted from the moving vessel at near idle speeds. The area and water velocity at the shallow (<1 m) shore edges was predicted by the Sontek RiverSurveyor software based on the distance to shore and slope measured by the crew using a laser range finder. Prior to each daily set of measurements, the compass of the ADCP was calibrated following the calibration module in the software (Sontek/YSI 2007a). A blanking distance of 0.75 m and magnetic declination adjustment (-13.8°) was applied to the measurements. The averaging interval and vertical cell size used for water velocity profiles was 15 s and 0.50 m, respectively. Water temperature was measured every 15 minutes by two redundant HOBO water temperature Pro v2 data loggers (Onset Computer Corporation, Bourne, Massachusetts) that were secured to the center transducer mount at the upriver site while fish passage was being monitored.

2.3 Trawl Sampling of Fish Populations

The presence, size, and abundance of juvenile blueback herring acoustically observed were verified by directly sampling the fish populations with a pelagic trawl. A 3-m long cone-shape net with 95-mm stretched mesh was attached to an aluminum frame (1.75 m wide and 1.15 m high). A 2.25-kg steel depressor was fastened with a 1-m chain to each bottom corner of the net frame. A 36-cm diameter polyurethane float-and-line from each top corner of the net frame held the top of the net 1 m below the surface while it was towed. A 7.5-m long aluminum vessel equipped with a hydraulic winch and adjustable mast-and-boom was used to deploy, tow, and retrieve the net which was attached to a 5-mm stainless steel wire by a bridle. When fully deployed, the net was approximately 30 m behind the vessel and towed along a 200-m towpath at 1.2 m/s (2.3 knots).

Four trawl sampling regions were defined in the river based on the depths and potential navigation hazards (Figure 1). The “upriver” trawl region was located upriver of the fixed-location hydroacoustic monitoring site where the sound pressure level was assumed to be unaffected by the ultrasonic projectors. The “ultrasound gradient” trawl region was defined as the region of the main channel between the upriver acoustic monitoring site and the ultrasonic projectors at the entrance to the intake channel. As blueback herring migrate downstream, they encounter increasing SPLs within this region, particularly in the western main channel. The “downriver” trawl region was defined as the area in the main channel between the downriver acoustic monitoring site and the buoy perimeter for Dam A forebay. The “intake channel” trawl region was defined as the area in the intake channel downriver of the ultrasonic projectors where water depths permit trawling. Each trawl region was sampled by three randomly selected tows along planned towpaths. HYPACK navigation mapping software (HYPACK Inc., Middletown, CT) and the Global Positioning System (Trimble DSM-232 receiver with sub-meter accuracy) was used for real-time positioning of the vessel and trawl operation along the towpaths. Between the start and end of each tow, acoustic data were concurrently collected by a downward-looking 420-kHz split-beam echo sounder (HTI). Trawl surveys were made on 11 nights between 9 September and 25 October. Trawling was restricted to night after daytime tows made on 9 and 18 September resulted in low catchability. All fish were identified to species, enumerated, and the total length (TL) of up to 50 individuals of the same species per tow was measured to the nearest mm. All fish were then released back to the river.

2.4 Mobile Acoustic Surveys of Fish Abundance

Mobile acoustic surveys have been used to provide estimates of the spatial distribution and abundance of many freshwater forage species (Brandt et al. 1991; Warner et al. 2002; Rudstam et al 2003), including blueback herring (Dunning and Gurshin 2012). Systematic acoustic surveys for blueback herring in the study area were completed during daylight on 9, 13, 19 September, and 3, 9, 19, and 26 October, 2012. A single acoustic survey was also done during the night of 23 September 2012 to confirm that blueback herring were more easily identified and classified in the echograms when they exhibited shoaling or schooling behavior during the day in contrast to the single fish echoes produced when they were distributed throughout the water column during the night. For each survey, the vessel equipped with a 420-kHz split-beam echo sounder surveyed at 4.0-4.5 knots along transects within three primary river regions: 9 transects in the intake channel downriver of the IPAs (hereafter, the “intake channel” survey region), 11 transects in the main channel downriver of the IPAs (hereafter, the “downriver main channel” survey region), and 22 transects in the main channel upriver of the IPAs (hereafter, the “upriver main channel” region; Figure 1). An extension of the upriver main channel (hereafter, the “upriver extension” survey region) was surveyed along an additional 22 transects on 9 September, 19 September, 19 October and 26 October to provide supplemental information on the presence and abundance of blueback herring before, during, and after the peak migration.

Transects were orientated perpendicular to the river channel at an approximate spacing of 50 m. A systematic survey design often leads to a more precise abundance estimate of patchily distributed fish and offers higher sampling efficiency (Simmonds et al. 1992; Simmonds and Fryer 1996). A 15° split-beam transducer was mounted to a pole attached mid-ship and 36 cm below the water surface. A frequency-modulated (FM) chirp signal was transmitted every 0.1 s at an effective pulse duration of 0.18 ms. The FM chirp was used to provide good spatial resolution and improve signal-to-noise ratio (Ehrenberg and Torkelson 2000), which was even more important during fixed-location acoustic monitoring. Raw digital data of the geo-referenced acoustic backscatter were collected and stored for later signal processing.

2.5 Continuous Acoustic Monitoring of Fish Passage

Fixed-location hydroacoustics is commonly used in rivers impounded by hydroelectric dams to monitor fish passage of salmonids (Banneheka et al. 1995; Mulligan and Kieser 1996; Skalski et al. 1996; Cronkite et al. 2004). This method has also been used to monitor schooling clupeids in shallow channels (Guillard et al 1998; Pederson and Trevorrow 1999; Dunning and Gurshin 2012). Fixed-location, horizontally aimed transducers (i.e. horizontal beaming) are well suited for channels and other relatively shallow water bodies because they have the capability of detecting fish at ranges much greater than the depth of water and thus, sample a larger volume of water and cross-sectional area of the channel than vertically aimed transducer (Kubecka and Wittingerova 1998; Pedersen and Trevorrow 1999; Enzenhofer and Cronkite 2000). The echo-counting technique used to estimate passage of large individual salmonids (Mulligan and Kieser 1996) is not applicable for monitoring juveniles of schooling species like blueback herring because preponderance of their overlapping echoes. As a result, echo integration of the volume backscatter collected by fixed-location horizontal beaming was used to derive estimates of juvenile blueback herring passage, as previously done for other fixed-location hydroacoustic studies of schooling species (Pedersen and Trevorrow 1999; Dunning and Gurshin 2012).

A linear array of three horizontally aimed split-beam transducers (hereafter, horizontal transducers) and one vertically aimed split-beam transducer (hereafter, vertical transducers) was installed to monitor fish passage at each of two sites; in the main channel upriver (hereafter, the upriver site) and in the main channel downriver (hereafter, the downriver site) of the ultrasonic projectors (Figure 1). While the maximum depth and mean cross-sectional area at the upriver (9.1 m and 1,497 m^2) and downriver sites (10.7 m and 1,277 m^2) were similar, there were some differences in their channel geometry (Figure 3). The upriver site was wider than the downriver site and had an expansive shallow heavily vegetated shoal on the west bank. The east bank at the downriver site gradually sloped to mid channel and the west bank was a vertical rock ledge. Each horizontal transducer was allocated to sampling the fish passage through a representative section of the channel cross-section (Figure 3). The vertical transducer was used primarily to aid interpretation of the echoes in the echograms obtained by the horizontal transducers and verify acoustic estimates of fish movement.

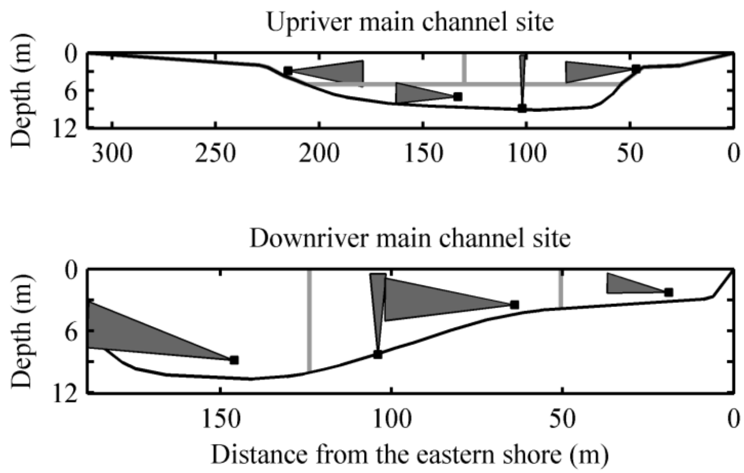

Figure 3. Schematic diagram from the side view looking upstream showing the cross-sectional area effectively sampled by the transducers (dark gray) deployed from the eastern shore (on right). The light gray lines stratify the river channel into three zones for allocating representative sampling of fish passage by the horizontally aimed transducers.

The transducers were attached to mounts placed on the river bed and multiplexed to a digital echo sounder (HTI Model 243, Hydroacoustic Technology, Inc., Seattle, WA). The acoustic center frequency of these transducers was 420 kHz which was selected partly because the hearing sensitivity for blueback herring and other alosines was less at this frequency compared to other commonly used fisheries echo-sounder frequencies (Nestler et al. 1992, Mann et al. 1997). An avoidance response from the echo sounders used to monitor fish passage was assumed to be negligible compared to the expected avoidance response at the frequency of the ultrasonic projectors. Table 1 provides the characteristics of each transducer and their sampling coverage of the river. All transducers were calibrated using a US Navy standard transducer of known sensitivity at the manufacturer prior to deployment (Urick 1983). Transducers transmitted a FM chirp pulse for an effective duration of 0.18 ms at 5 Hz for those that were horizontal and at 10 Hz for those that were vertical. The systematic sampling scheme consisted of the transducers to sequentially collect raw acoustic backscatter for consecutive 2.5-min intervals begin with the most eastern transducer at top of each hour. This sampling scheme resulted in each transducer collecting six 2.5-minute intervals spaced 10 minutes apart. Each day, the operation of both echo sounder systems was manually checked and the data retrieved.

Table 1. Configuration of 420-kHz split-beam transducers used to monitor juvenile blueback herring passage in the main channel of the Mohawk River upriver and downriver of ultrasonic projectors.

Location	Beam pointing angle (°)	3-dB beam width (°) Major axis (x)	Minor axis (y)	Effective range[a] (m)	Height off bottom (m)	Cross-sectional area of channel sampled m^2	%	Approximate volume sampled (m^3)
Upriver-East	-1	6.05	5.75	34	0.5	58	4.1	109.3
Upriver-Center	90	15.36	15.42	7.8	0.2	8	0.6	9.1
Upriver-Center	-1	6.37	6.39	30	1.8	50	3.6	87.8
Upriver-West	2	6.31	6.56	36	0.8	74	5.3	154.4
Downriver -East	6	6.26	6.34	18	0.8	18	1.5	18.5
Downriver -Center	6	6.28	6.27	38	0.8	79	6.6	172.7
Downriver -Center	90	15.47	15.81	7.1	0.2	7	0.6	7.1
Downriver -West	9	6.26	6.14	43	1.8	99	8.3	244.2

2.6 Data Analyses

2.6.1 Flow and Temperature

Water flow or river discharge (Q) through the upriver and downriver sites in the main channel was estimated as the product of the total cross-sectional area of the channel (A) and mean water velocity in the channel (V_m), where V_m was estimated using one of two velocity-index models. The two velocity-index models used a linear regression to predict V_m based on the V_x with or without H as covariate (Sloat and Gain 1995; Morlock et al. 2002). The mobile ADCP transect data were truncated to include only those profile measurements made while the vessel was on course. Vessel speed relative to the river bottom was measured by bottom tracking and used to subtract from the measured velocity to estimate water velocity. A paired data set consisting of V_x and H measured by the fixed-location horizontally aimed ADCP and V_m measured by the mobile ADCP transects matched closely in time were used in the linear regression analysis. The velocity-index model that was significant at the α level of 0.05 and had the highest R^2 was selected for estimating the mean water velocity and flow time series.

All calculations were performed on the 2.5 minute averaged observations and summarized as hourly estimates. Data gaps in the time series of continuous monitoring by the fixed-location ADCP resulting from a power outage (14 October 2012 09:00 through 17:00 at the upriver site) or interruptions during data transfer were linearly interpolated. Hourly net flow was computed as the average of flow observation in either direction (upstream and downstream) whereas hourly downstream flow was based on flows moving in the downstream direction only (i.e., setting negative flows to zero). For the purpose of comparing flows between sites, a subset of the time series based on paired hourly estimates was created so each fixed-location ADCP had the same number of observations. A Wilcoxon matched pairs, signed-rank test was used to test whether the mean hourly difference in V_m or downstream flow between the upriver and downriver site was significantly different than zero. Overall summary statistics were computed on the hourly-averaged data for the full time series to describe the temporal patterns at each site. Almost all of the paired data (>99.6%) consisted of 24 2.5-minute observations per hour. The proportion of the downstream flow of the river through the downriver site in the main channel (P_Q) was computed for each hour as the ratio of the hourly downstream flow estimates at the downriver site to the upriver site. Water temperature from the two redundant data loggers were averaged for time-series statistics of the bottom river temperature. Flow metrics were reported to the precision (0.1 cm/s) of the ADCP. All computations and statistics were performed using SAS software version 9.3 software (SAS Institute, Cary, NC) and Matlab software version 7.3 (Mathworks, Natick, MA).

2.6.2 Trawl Estimates of Abundance

Catch per unit effort (CPUE) of pelagic trawling was defined as the number of fish per 200-m tow and provided a relative index of abundance. Young-of-the-year blueback herring were determined by the length distribution in the trawl catch. The nighttime CPUE of YOY blueback herring was compared among trawl sampling regions during the period before the majority of YOY blueback herring migrated out of the study area. The CPUE data were $\log_{10}(x+1)$ transformed to meet the assumption of normality for analysis of variance (ANOVA) based on the Shapiro-Wilk test statistic. The variance of the transformed CPUE values was homogeneous among the trawl sampling regions based on the Levene’s test for homogeneous variance. A Tukey’s studentized range test for multiple pairwise comparisons was used to detect which regions were significantly different in CPUE of blueback herring. The arithmetic mean CPUE was reported for each region and survey.

2.6.3 Mobile Acoustic Survey Estimates of Abundance

Raw acoustic data files collected by the split-beam echo sounder from repeated mobile acoustic surveys were imported into Echoview software (v5.0, Myriax Software Pty. Ltd., Hobart, Australia) through an automation routine written in Visual Basic scripting language. All data were brought into a standard Echoview template loaded with preferred parameterization and settings following standard practices (Parker-Stetter et al. 2009; Rudstam et al. 2009; De Robertis and Higginbottom 2007). The echogram for each transect was stratified into 1-m depth layers and 20-m transect segments also called elementary distance sampling units (EDSUs). Echo integration (i.e. integrating the acoustic energy within each EDSU and depth layer provides an acoustic measure directly proportional to fish density assuming fish are randomly distributed within the beam over time (Foote 1983).

The volume backscattering coefficient (s_v, m^{-1}) quantifies the acoustic energy reflected back from the backscattering cross-sections (σ_{bs}, m^2) of all targets within a sampled volume (V_0, m^3) defined by MacLennan et al. (2002) as

$$s_v = \sum \sigma_{\text{bs}} / V_0 = V_{\text{rms}}^2 A_{\text{equip}} \qquad \text{(Eq. 1)}$$

where the root-mean-square squared voltage (V^2_{rms}) of the echo amplitude received by the transducer is multiplied by the amplitude scaling factor (A_{equip}; Johannesson and Mitson. 1983; Dunning and Gurshin 2012). The logarithmic measure of s_v, volume backscattering strength (S_v) in units of dB re 1 m^{-1}, is defined as

$$S_v = 10 \log_{10}(s_v) \qquad \text{(Eq. 2)}$$

The acoustic energy reflected from a single individual is quantified by σ_{bs} and defined as

$$\sigma_{\text{bs}} = R^2 I_{\text{bs}} / I_i \qquad \text{(Eq. 3)}$$

where R = range (m) between the transducer and target, I_i = intensity of the incident sound wave at the target, and I_{bs} = intensity at the midpoint of the backscattered pulse (Simmonds and MacLennan 2005). Target strength (TS, dB re 1 m^2) was defined as the decibel value of σ_{bs} (i.e., 10 $\log_{10}[\sigma_{bs}]$).

A range-dependent minimum S_v threshold equivalent to a minimum echo strength (ES) threshold was applied to the echograms to reduce the contribution of background noise and smaller scatterers to the density estimate of juvenile blueback herring (Rudstam et al. 2009). Echo strength is independent of range when a 40-Log$R$ time varied gain (TVG) is applied to compensate for beam spreading, but it is uncompensated for beam pattern. The appropriate minimum S_v threshold that is equivalent to a constant echo strength can be calculated from the following relation expressed in dB units as

$$S_{v,R} = \text{ES}_R - 20\log_{10}(R) - 10\log_{10}(c\tau\psi/2) \qquad \text{(Eq. 4)}$$

where, $S_{v,R}$ (dB re 1 m^{-1}) is the volume backscattering strength at range R (m), ES_R is the echo strength at range R (dB re 1 m^2), c is the sound speed (here equal to 1,480 m/s), τ is the pulse duration (s), and ψ is the equivalent beam angle (steradians). The ES threshold (-61 dB) that defined the range-dependent minimum S_v threshold was set to 6 dB lower than the minimum expected TS of juvenile blueback herring, which would allow fish to be insonified and detected at the edge of the 3 dB beam angle (6 dB loss from the minimum TS due to the two-way transmitting and receiving path of sound; Rudstam et al. 2009). Based on preliminary analysis and Gurshin (2012), the mean TS can vary around -48 dB but the left tail of the TS distribution below -55 dB is expected to be less than 5% of the fish. Echoview software automatically calculated and applied a range-dependent minimum S_v threshold to the echograms prior to classification and echo integration.

The surface exclusion zone (0.9 m depth) and bottom exclusion zone (approximately 0.75 m above the bottom detection) in the echograms were manually reviewed and modified as necessary to exclude interference or bias from bubble reverberation or bottom backscatter. Each echogram of volume backscatter was manually scrutinized and clusters of echoes were visually classified as “schools”, which were loosely defined as groups of overlapping echoes. These regions of classified school echoes were echo integrated and exported as area backscattering coefficient (s_a), defined by MacLennan et al. (2002) as

$$s_a = \int_{z_1}^{z_2} s_v dz \qquad \text{(Eq. 5)}$$

where z_1 and z_2 are the first and the last 1-m depth stratum, dz is the change in depth or range, and s_v is defined in equation 1.

The remaining volume backscatter of unclassified fish echoes above the threshold was apportioned to juvenile blueback herring by the proportion of single echo detections (SEDs) above -55 dB that were within a dorsal-aspect TS range expected for juvenile blueback herring (-52 to -42 dB; Gurshin 2012). Single echo detection criteria included a pulse length determination level of 6 dB, minimum and maximum pulse lengths of 0.6 and 1.5, maximum angular standard deviation of 0.6°, and 6-dB maximum beam compensation. Cells (1 m vertical x 20 m horizontal) within the echograms unsuitable for in situ TS estimation because high fish densities were excluded when the N_v index, defined by Sawada et al. (1993) and recommended by Rudstam et al. (2009), was greater than 0.1.

The areal density (D, fish/m^2) of juvenile blueback herring for the full water column of each 20-m EDSU (j) within each survey region (i) was then estimated as

$$D_{i,j} = \left(s_{a_{i,j},\text{school}} \Big/ \langle \overline{\sigma}_{\text{bs}} \rangle_{i,JBH}\right) + \left(s_{a_{i,j},\text{non-school}} \times P_{i,\text{JBH}} \Big/ \langle \overline{\sigma}_{\text{bs}} \rangle_{i,\text{all}}\right) \qquad \text{(Eq. 6)}$$

where $s_{a\ i,j,\text{school}}$ is the s_a attributable to echoes classified as schools of juvenile blueback herring along EDSU j of survey region i, $s_{a,i,j,\text{non-school}}$ is the remaining s_a (i.e. total $s_{a,}$ - $s_{a,\text{school}}$) along EDSU j in survey region i, $\langle\sigma_{\text{bs}}\rangle_{i,JBH}$ is the *in situ* mean TS for SEDs within the juvenile blueback herring TS-range within survey region i, and $\langle\sigma_{\text{bs}}\rangle_{i,\text{all}}$ the *in situ* mean TS for all single echo detections within survey region i. The applied $\langle\sigma_{\text{bs}}\rangle$ values used all single echo detections within each survey region during each survey. The total abundance of juvenile blueback herring for each region and survey was estimated by multiplying the mean areal density by the area of the region.

Systematic surveys of fish populations often result in data that are not independent and spatially auto-correlated (Rivoirard et al. 2000; Petitgas 1993, 2001). As a result, a two-stage geostatistical approach, commonly used in many fisheries applications (Rivoirard et al. 2000; Petitgas 1993; Gurshin et al. 2012), was taken to map the distribution of juvenile blueback herring. During the first stage, the spatial structure of the data (i.e., the spatial covariance) was explored through semivariogram modeling. Then, the model parameters from the semivariogram are used to spatially predict fish density at unsampled locations within in each survey region. The semivariogram describes the amount of spatial autocorrelation as a function of distance between any two locations. The robust empirical semivariogram (Cressie and Hawkins 1980) was used here similar to other fisheries applications (Páramo and Roa 2003; Mello and Rose 2005) to reduce the influence of many zero values and few large values. The semivariograms were then fitted with the exponential, spherical, and Gaussian covariance models using weighted least squares (Cressie 1993) and the final model selected based on minimization of the weighted least squares. In some cases a first-order polynomial on the coordinates was used to first de-trend the data before semivariogram modeling. The omnidirectional semivariograms assumed no geometric anisotropy after exploratory directional semivariograms were examined.

The spatial distribution of juvenile blueback herring for each mobile acoustic survey was mapped onto a fine-scale grid of 100 x 100 nodes enclosing the spatial extent of the data for each survey region and then clipped to the region polygon bounding the transects. Ordinary kriging without trend or universal kriging with the first-order trend on coordinates was used to spatially interpolate blueback herring densities at each node within the grid based on weighting observed densities at sampling locations within a moving local neighborhood of 40 points (approximately 150 m diameter area) based on the fitted semivariogram model (Rivoirard et al. 2000; Páramo and Roa 2003). The second-order stationarity assumption requiring the density to have a constant mean across the region and the variance between locations was dependent only on distance was assumed within the local neighborhood (Páramo and Roa 2003). Semivariogram modeling and kriging were performed using the package “geoR” in R statistical computing software (R Development Core Team, Version 2.13.2, 2012; Ribeiro and Diggle, 2001). The vertical distribution of juvenile blueback herring in the water column for each region was described by histograms of the proportion of the total s_a was in each 1-m depth layer.

2.6.4 Fish Passage Estimation

The total net passage of juvenile blueback herring (N_{net}) through the upriver and downriver sites based on continuous monitoring by fixed-location horizontal transducers was estimated by summing the $N_{\text{net},i}$ estimates from each river channel zone i estimated as

$$N_{\text{net},\,i} = N_{d,i} - N_{u,i} \qquad \text{(Eq. 7)}$$

where N_d and N_u is the number of fish moving downriver and upriver, respectively, through each channel zone. These parameters were estimated for each hour by the following equations:

$$N_d = T \times A \times \left(s_{v,\text{JBH}} \big/ \langle \sigma_{\text{bs}} \rangle_{\text{tx-diel}} \right) \times R_d \times P_d \qquad \text{(Eq. 8)}$$

$$N_u = T \times A \times \left(s_{v,\text{JBH}} \big/ \langle \sigma_{\text{bs}} \rangle_{\text{tx-diel}} \right) \times R_u \times (1 - P_d) \qquad \text{(Eq. 9)}$$

where T is the duration of the period in seconds, A is the cross-sectional area of the river channel zone in the vertical plane in m^2, hourly mean $s_{v,\,\text{JBH}}$ is the s_v attributable to juvenile blueback herring, $\langle \sigma_{\text{bs}} \rangle$ is derived from the mode TS specific to each transducer (tx) and diel period pooled across the time series, R_d and R_u is the net rate of downstream and upstream movement in the horizontal plane of tracked fish echoes classified as juvenile blueback herring average for daily diel period, and P_d is the proportion of the fish echoes classified as juvenile blueback herring that are moving downriver each for each hour. Data from adjacent hours were pooled for hours with fewer than 10 tracked echoes classified as juvenile blueback herring.

Data were imported into Echoview software following a standard template that included a -61 dB range-dependent S_v threshold and excluding blocks of SEDs where N_v was greater than 0.1. Analysis of data from the first couple of weeks of monitoring was complicated by the nighttime vertical migrations of midge insect larvae *Chaoborus* (Teraguchi and Northcote 1966). These insect larvae almost completely overwhelmed the echograms with their volume backscatter from their gas sacs at 420 kHz (Malinen et al. 2005; Knudsen et al. 2006; Figure 4). Three nighttime plankton tows with a 1-m diameter hoop net (0.5 mm mesh) confirmed the presence of a high abundance of 8-mm long *Chaoborus* sp.; other invertebrates caught in substantial numbers were plecopterans, dipterans, and odontates. Therefore, the mean echogram s_v was not a good index of abundance for juvenile blueback herring without several steps to remove the acoustic contributions of several dynamic sources. The techniques of Eckmann (1998), Malinen et al. (2005), and Jurvelius et al. (2008) to remove or quantify the acoustic contribution of *Chaoborus* to acoustic estimates of fish abundance, were not appropriate because a multi-frequency discrimination method was unavailable in this study and it was not practical to develop effective threshold curves on a dynamic nature for this study.

Instead, the s_v attributable to *Chaoborus* sp. and variable background noise levels attributable to scattering from other invertebrates, particles, wind, rain, or flow turbulence ($s_{v,\ noise}$) that exceeded the -61 dB range-dependent S_v threshold was estimated for each diel period and date in the study and then subtracted from mean s_v for each echogram ($s_{v,\ total}$) to remove these sources from the acoustic estimate of fish density. Daytime was defined as the period between one hour after sunrise and one before sunset. Nighttime was defined as the period between one hour after sunset and one hour before sunrise. Dawn and dusk were defined as the periods within one hour or less of sunrise or sunset, respectively. The daily diel-specific mean $s_{v,\ noise}$ was estimated from a randomly selected subset of five echograms from each daytime and nighttime period of every other date, defining a 100-ping sequence in each selected echogram, and then estimating the mean s_v for that sequence excluding fish echoes or other echo traces (e.g., bubbles). The mean $s_{v,\ noise}$ for days and nights not examined were linearly interpolated. Mean $s_{v,\ noise}$ for dawn and dusk was linearly interpolated between adjacent day and night periods.

The Echoview target tracking algorithm was used to identify juvenile blueback herring, estimate their swimming direction and downstream rate of movement, and identify factors other than fish that may have contributed to the total S_v. Single echo detection within cells where $N_v < 0.1$ were used for TS estimation and subsequent fish tracking (Table 2). The most effective tracking algorithm parameter values were determined through a manual iterative process using multiple echograms from each site (Table 2). The maximum ping gap value for the horizontal data was necessary due to the large ping-to-ping variability in side-aspect TS which often resulted in TS values below the minimum threshold (-55 dB) used for single echo detection. Due to decreasing signal-to-noise ratio as range increased from the horizontal transducers, lowering the minimum TS threshold resulted in a large number of SEDs and highly inefficient tracking. The shorter range of data for the vertical transducers (~7 m) combined with lower ping-to-ping TS variability in ventral-aspect fish allowed tracks to be identified using a minimum TS threshold of -70 dB. This lower TS threshold greatly improved the ability to continuously track individual bubbles as they rose through the water column. Once tracks were identified using SEDs > -70 dB, only SEDs greater than -55 dB were used for analysis.

Variable rates of gas bubbles rising from the sediment at the acoustic monitoring sites made a contribution to the acoustic estimate of fish density and it was necessary to remove this contribution (Figure 5). A randomly selected subset of echograms from the vertical transducer were examined to manually identify the distinctive (left-to-right) diagonal echo pattern of rising bubbles and to determine their mean s_v. Given the dynamic nature of bubble formation, the proportion of mean echogram s_v attributable to bubbles ($P_{bubbles}$) was estimated for each echogram. First, SEDs were tracked while in the acoustic beam. Of the tracked SEDs, the echo strength was converted to s_v using equation 4. The converted-track s_v values of all tracked SEDs (total) and tracked SEDs classified as bubbles were summed for each echogram, divided by the total number of valid digital samples in the echograms to derive an equivalent proxy for the mean bubble and total s_v, and then used the bubble-to-total ratio as an estimate for $P_{bubbles}$. Because the $P_{bubbles}$ estimates by manual classification versus automated tracking were shown to be similar for a subset from the vertical transducer data, automated tracking was used to classify the bubbles for each echogram collected by horizontal transducers and then estimate $P_{bubbles}$ as previously described. The mean $P_{bubbles}$ ranged 17-41% at the downriver site and 8-12% at the upriver site.

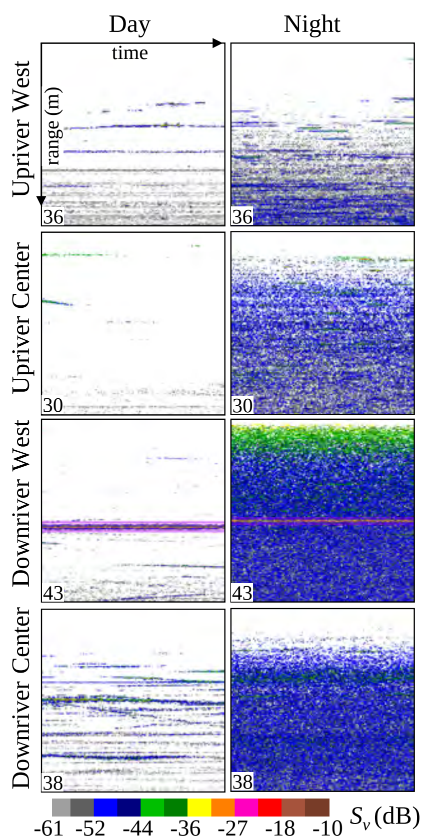

Figure 4. Echograms from horizontally-aimed transducers showing the influence of nighttime vertical migration of *Chaoborus* spp. on the volume backscatter strength (S_v dB re m^{-1}) at two upriver and two downriver locations. Data are from 9 September 2012 during the day (1100) and night (2100). Each echogram shows one minute of data collection with the range used for data analysis indicated at the bottom left, and the purple regions indicate data excluded from analysis.

Table2. Parameter values for N_v index, single echo detection, and fish track detection in echograms from fixed-location hydroacoustic transducer arrays.

		Transducer Configuration	
Method	Parameter	Horizontal	Vertical
Nv index	Cell thickness (m)	1	0.25
	Cell length (seconds)	30	15
Single	Target strength threshold (dB)	-55	-70
Target	Pulse length determination level (dB)	6	6
Detection	Minimum/Maximum Normalized Pulse Length	0.6/1.5	0.6/1.8
	Maximum beam compensation (dB)	6	8
	Major/Minor axis angles maximum standard deviation (degrees)	0.6	6.0
Fish	Major/Minor axis alpha (unitless)	0.7	0.4
Track	Major/Minor axis beta (unitless)	0.5	0.5
Detection	Range alpha/beta (unitless)	0.1	0.1
	Major/Minor axis exclusion distance (m)	2	6
	Range exclusion distance (m)	0.15	0.15
	Missed ping expansion (%)	0	0
	Minimum number of SEDs in track	4	10
	Minimum number of pings in track	5	15
	Maximum gap between SEDs (pings)	7	2

The acoustic contribution of residential fish species to the acoustic estimate of fish passage of juvenile blueback herring was minimized by subtracting a constant s_v representing their contribution ($s_{v,\text{ residents}}$). A time-series average of the minimum mean s_v within each daily diel period, after noise and bubble removal, was used to estimate $s_{v,\text{ residents}}$. In summary, the allocation of s_v by these steps led to the extraction of peaks in s_v from the time series of mean echogram s_v and interpreted the peaks as migration episodes by juvenile blueback herring. The $s_{v,\text{JBH}}$ can then be expressed as

$$s_{v,\text{ JBH}} = \left(s_{v,\text{ total}} - s_{v,\text{ noise}}\right) \times \left(1 - P_{\text{bubbles}}\right) - s_{v,\text{ residents}} \quad \text{(Eq. 10)}$$

The number of tracked fish echoes classified as juvenile blueback herring that moved in a downstream direction divided by the number moving in either downstream or upstream direction was used to estimate P_d of all juvenile blueback herring, assuming individual movements were representative of individuals not tracked (i.e., in schools). Downstream and upstream swimming direction was estimated as the net direction between the first and last SEDs in the track restricted to being within ±45° of the horizontal plane and within ±45° of being perpendicular to the major response axis of the beam. The distance in the horizontal plane between the first and last SEDs of tracked echoes classified as juvenile blueback herring moving downstream or upstream divided by the elapsed time in the beam was used for R_d and R_u.

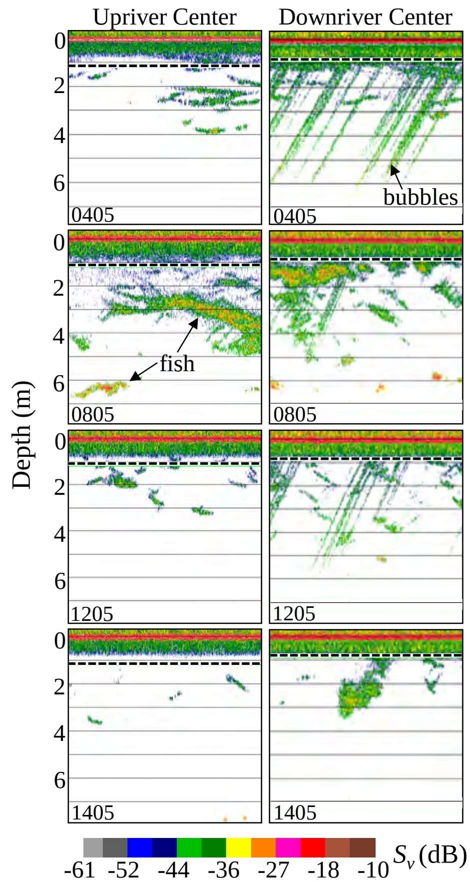

Figure 5. Echograms from vertically-aimed transducers recorded on 6 October 2012 comparing gas bubble release from the sediment at the upriver and downriver sites during concurrent time periods. Additionally, the temporal variability in bubble density and influence on the volume backscatter strength (S_v dB re m^{-1}) at the downriver site can be seen. The dashed line is the maximum analysis range used for exclusion of backscatter from the water surface.

2.6.5 Evaluation of Downriver Passage

Previous studies evaluated the effectiveness of ultrasound as a fish guidance technology by on-off or before-after-control-impact paired experimental designs (Ploskey et al. 1995; Ross et al. 1996; Skalski et al. 1996). In this study, the ultrasonic projectors were operating throughout the study for the same reasons given by Dunning and Gurshin (2012): the unknown patchy temporal distribution of the downstream migration of juvenile blueback herring limited the assurance of an adequately designed on-off experiment, and regulatory preference that most of the juvenile blueback herring migrated down the main channel rather than through the turbines. Assuming the passage and distribution of juvenile blueback herring through the main and intake channels are proportional to river flow, the observed cumulative passage of juvenile blueback herring that migrated downriver in the main channel was compared to the expected net passage ($N_{net,e}$), estimated as

$$N_{net,e} = N_{net,upriver} \times \left(Q_{downriver} / Q_{upriver} \right) \qquad \text{(Eq. 11)}$$

This flow assumption was believed to be reasonable because emigration patterns of river herring are believed to be related to water flow (Pardue 1983; Kosa and Mather 2001), alosines are attracted to higher current velocities (Barry and Kynard 1986; Moser et al. 2000), and water flow is a predictor of entrainment of migratory pelagic species (ASFMC 2009; Grimaldo et al. 2009). The densities of juvenile blueback herring estimated by trawls and mobile acoustic surveys were also compared among channel regions to provide further evidence of safe downstream passage.

The proportion of the observed cumulative N_{net} at the downriver site was also compared to the proportion (0.313) previously reported by Dunning and Gurshin (2012) prior to reconfiguring the ultrasonic projectors to improve the effectiveness of guiding juvenile blueback herring downriver in the main channel. The chi-square test was used to test for significant differences between the observed proportion in the cumulative net passage of juvenile blueback herring (in thousands) at the downriver site and the expected proportion based on either river flow or observed proportion in 2008 by Dunning and Gurshin (2012). These comparisons were made for the full time series (8 September through 26 October) and peak migration period. The peak migration period was chosen to exclude the early period of the study when observed migration events (i.e., peaks in N_{net}) were successively absent at the upriver site and fish were staging prior to out-migration. The migration period also excluded the time when juvenile blueback herring were not present or scarce, indicating the out-migration from upstream of the sites were complete. Patterns in migration were also investigated through correlation analyses between N_{net} and explanatory variables (e.g., flow, temperature, diel periodicity). All available information from ADCPs, trawls, mobile acoustic surveys, and fixed-location hydroacoustics was used in a complementary fashion to aid interpretation of the net fish passage estimates of juvenile blueback herring.

3.0 Results

3.1 River Flow and Temperature

The velocity-index model with the best fit was V_m = 0.024 –V_x(70.049-7.635H) ($F_{2,46}$ = 43.24, P < 0.001; R^2 = 0.65) at the upriver site and V_m = 0.024 –V_x(70.049-7.635H) ($F_{2,46}$ = 56.48, P < 0.001; R^2 = 0.71) at the downriver site. Figure 6 shows three high-flow events at three different levels of magnitude; the first peaking at 76 m^3/s on 19 September, the second peaking at 195 m^3/s on 16 October, and the third peaking at 372 m^3/s on 21 October. Flow only substantially increased at the

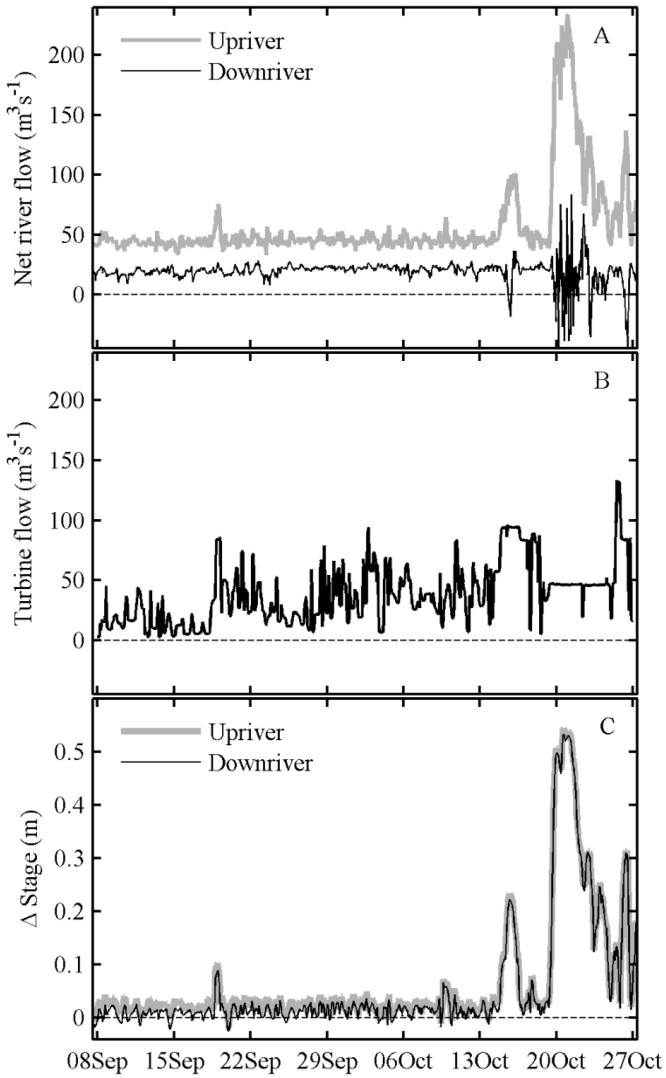

Figure 6. (A) Hourly mean river flow estimates based on velocity-index equation using continuous 2.5-minute observations by a 500-kHz horizontally aimed acoustic Doppler current profiler located near the eastern shore of the main channel of the Mohawk River, and upriver and downriver of the ultrasonic projectors; (B) Hourly flow through the turbines calculated by the power generation at Crescent Hydroelectric Project; and (C) change in hourly mean river stage at the two sites.

downriver site during the last high-flow event when flow through the turbines at Crescent was minimal. The mean hourly-averaged velocity at the upriver site (0.037 m/s) was significantly higher than that at the downriver site (0.015 m/s) based on the mean hourly difference being significantly greater than zero (P <0.001). The mean hourly-averaged downstream flow at the upriver site (57.333 m^3/s) was significantly higher than that at the downriver site (19.766 m^3/s) based on the mean hourly difference being significantly greater than zero (P <0.001). Based on the daily mobile transects (n = 49), the mean stream-wise water velocity at the downriver site was significantly higher in the western channel zone (0.032 m/s) than in the eastern channel zone (-0.002 m/s; t = 3.69; P < 0.001), but there was no difference between the western (0.054 m/s) and eastern (0.066 m/s) channel zone at the upriver site (t = -1.20; P = 0.234).

The near-bottom water temperature in middle channel at the upriver site was 24.0°C at the beginning of the study on 8 September and decreased to 12.2°C at the end of the study on midnight 27 October (Figure 7). The maximum and minimum observed water temperature was 24.8°C on 8 September and 12.1°C on 22 October. The two greatest drops in daily mean water temperature of approximately 0.9°C occurred when daily mean water temperature decreased from 23.5 to 22.6°C on 11 September and 16.0 to 15.1°C on 11 October.

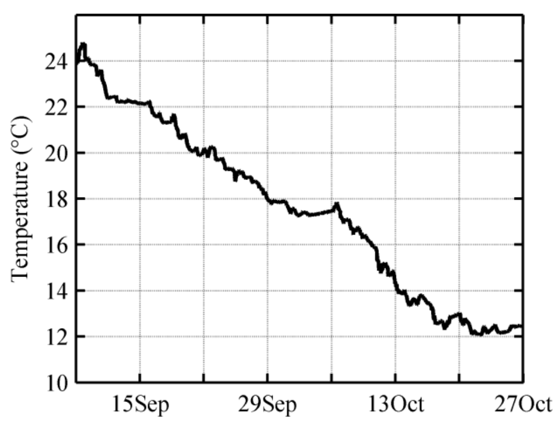

Figure 7. Water temperature in the Mohawk River measured every 15 minutes from 8 September through 26 October 2012 by two redundant HOBO Pro v2 data loggers attached to a transducer mount within 1 m of the river bottom and located at center of the main channel upriver of the ultrasonic projectors.

3.3 Trawl Estimates of Abundance

A single tow caught 6 blueback herring in the upriver region during the day on 9 September and daytime CPUE of blueback herring among all regions averaged 2.9 fish/tow on 18 September. Because nighttime CPUE among all regions averaged 83.1 fish/tow on 9 September and 275.4 fish/tow on 19 September, the daytime pelagic trawl catchability was considered low and comparisons in the trawl index of abundance was based on the 11 nighttime surveys from 9 September through 25 October. Of the 10,717 fish and nine species caught in nighttime trawl surveys, 98.8% were blueback herring (Table 3). Total length of these measured blueback herring averaged 70 mm and ranged from 52 to 111 mm (Figure 8). Mean total length of blueback herring was significantly different among regions (ANOVA: $F_{3,3780} = 12.48$; $P < 0.001$). Blueback herring were significantly larger in the downriver region and the intake channel region than in the upriver region by approximately 1 mm in total length (Tukey's test, $P < 0.05$). Blueback herring were also significantly larger in the downriver region than in the ultrasound gradient region (Tukey's test, $P < 0.05$). These small statistically significant differences among regions were considered not biologically significant. A small group of larger individuals were also seen, particularly on 10 October. A total of 95 individuals were greater than 80 mm and 26 individuals were greater than 90 mm.

Mean CPUE of blueback herring increased during the first two weeks in all regions, decreased over the next two surveys on 21 and 28 September, and then slightly increased on 2 October before continuing to decrease (Figure 9a). Between 9 September and 10 October when blueback herring catches were substantial, the mean $\log_{10}(x+1)$ transformed CPUE was significantly different among some regions (ANOVA: $F_{3, 80} = 5.74$; $P = 0.001$). $\text{Log}_{10}(x+1)$ transformed CPUE of blueback herring in the main channel upriver and downriver of the ultrasonic projectors were significantly higher than in the intake channel region, but not in the ultrasound gradient region (Figure 9b). The arithmetic mean CPUE in the downriver region (160.6 fish/tow) was approximately 94% of the CPUE in the upriver region (171.7 fish/tow) and was 2.5 times higher than the CPUE in the intake channel (64.3 fish/tow). On 15 October, few blueback herring were caught by the pelagic trawl and by 25 October only two individuals were caught in 12 tows (Figure 9c).

Table 3. Total catch and mean catch per unit effort (CPUE) of fish species caught by randomly selected 200-m tows with a pelagic trawl in four regions of the Mohawk River: upriver of the 122-128 kHz ultrasonic projectors and 420-kHz acoustic monitoring site, increasing downriver ultrasound gradient, intake channel downriver of the ultrasonic projectors, and main channel downriver of the ultrasonic projectors.

	Trawl sampling region									
	Upriver (*n* = 33)		Ultrasound gradient (*n* = 33)		Downriver intake channel (*n* = 33)		Downriver main channel (*n* = 33)		Total (*n* = 132)	
Species	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE
Black crappie			1	<0.1	1	<0.1			2	<0.1
Blueback herring	3,615	109.5	2,210	67.0	3,391	102.8	1,374	41.6	10,590	80.2
Bluegill					1	<0.1			1	<0.1
Brook silverside	13	0.4	15	0.5	5	0.2	20	0.6	53	0.4
Channel catfish	1	<0.1							1	<0.1
Common shiner			1	<0.1					1	<0.1
Gizzard shad	4	0.1			1	<0.1	1	<0.1	6	<0.1
Golden shiner							1	<0.1	1	<0.1
Spottail shiner	15	0.5	11	0.3	16	0.5	20	0.6	62	0.5
Total	3,648	110.5	2,238	67.8	3,415	103.5	1,416	42.9	10,717	81.2

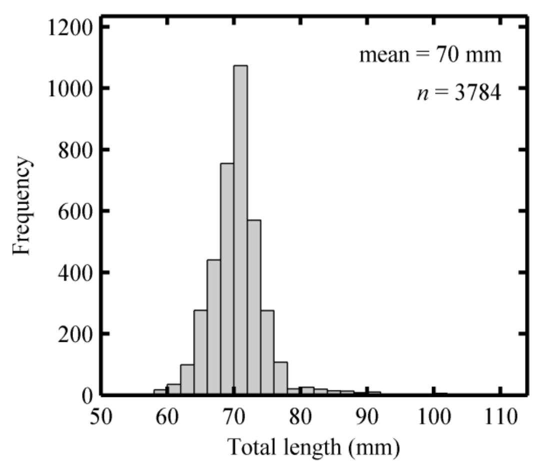

Figure 8. Total length distribution of juvenile blueback herring caught by randomly located 200-m tows (n = 132) with a pelagic trawl during the night from 9 September through 25 October 2012 in the Mohawk River near the Crescent Hydroelectric Project

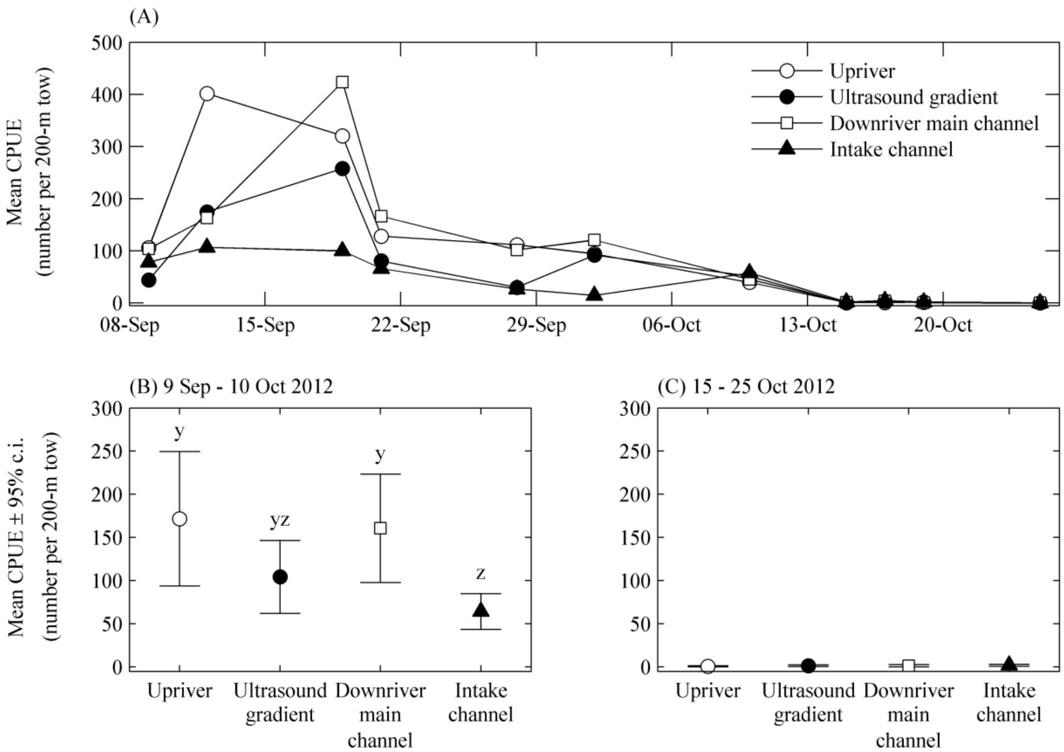

Figure 9. (A) Time series; Mean (± 95% confidence intervals) catch per unit effort (CPUE) of juvenile blueback herring caught during the night from (B) 9 Sep through 10 Oct 2012, and (C) 15 Oct through 25 Oct 2012 by pelagic trawl in four regions (of the Mohawk River: upriver of the 122-128 kHz ultrasonic projectors and 420-kHz acoustic monitoring site, increasing downriver ultrasound gradient, intake channel downriver of the ultrasonic projectors, and main channel downriver of the ultrasonic projectors.

3.4 Mobile Acoustic Survey Estimates of Abundance and Distribution

Fitted semivariogram models of the densities estimated by repeated mobile acoustic surveys found varying proportions of the variance to be explained by the spatial structure of juvenile blueback herring densities before and during their downstream migration. For example, a fitted Gaussian semivariogram model of juvenile blueback herring density on 3 October revealed that about 38% of the variance, based on the quantity between the *y*-intercept and the maximum, was explained by a spatial autocorrelation at a range of 110 m in the upriver main channel region, while spatial autocorrelation accounted for 38% of the variance out to a range of about 110 m in the downriver main channel region (Figure 10). The upper 3 m of the water column accounted for approximately 80-90% of the mean s_a averaged among the seven acoustic surveys which indicates juvenile blueback herring preferred this surface layer during the day (Figure 11).

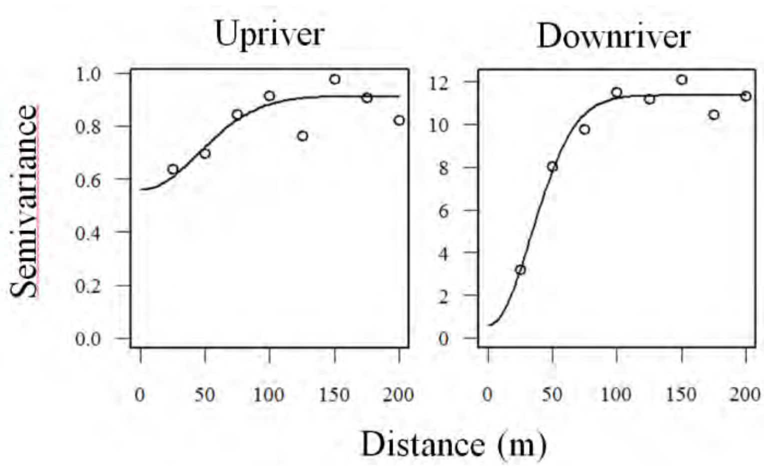

Figure 10. Two examples of an omnidirectional robust empirical (circles) semivariogram fitted with a Gaussian semivariogram model (lines) for acoustically derived density of juvenile blueback herring in the main channel upriver and downriver of the ultrasonic projectors at Crescent Hydroelectric Project, Mohawk River, on 3 October 2012.

Figure 12 illustrates the progression of juvenile blueback herring from being present throughout each survey region on 9 September to nearly absent in the river on 26 October. With exception of 9 September, densities were relatively low in the intake channel and higher in the downriver main channel. On 19 September, clusters of juvenile blueback herring were found far upriver, in front of the ultrasonic projectors, and downriver in the main channel, but only in a few patches of low density in the intake channel. The highest concentrations of juvenile blueback herring were seen in the downriver main channel region on 3 October but largely dissipated on subsequent surveys on 9, 19, and 26 October. During the same surveys, juvenile blueback herring were scarce in the intake channel. On 9 September, juvenile blueback herring were distributed at similar densities throughout all regions surveyed (Figure 13). However, the abundance within the smaller intake channel represented 50% or less than the abundance found in the main channel upriver or downriver of the ultrasonic projectors. Densities were relatively high at the upriver and downriver regions until 9 October and later when density and abundance was low throughout all regions.

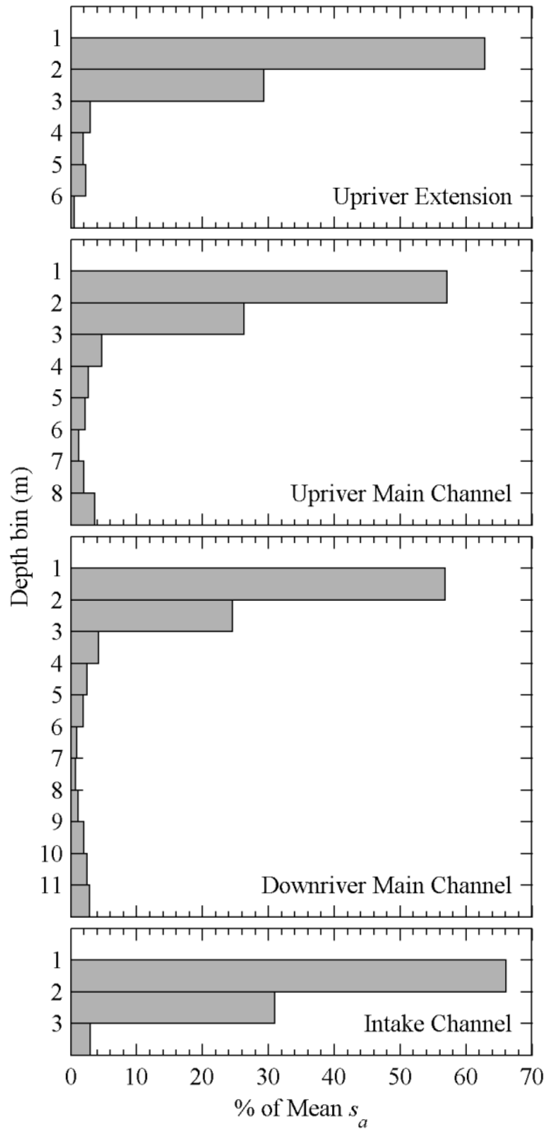

Figure 11. Contribution (%) of each 1-m depth layer to the total sa averaged over seven daytime acoustic surveys within four regions of the Mohawk River near the Crescent Hydroelectric Project: (1) the northern upriver extension sampled on four occasions, the main channel (2) upriver and (3) downriver of ultrasonic (122-128 kHz) projectors aimed to deter fish from entering the (4) intake channel.

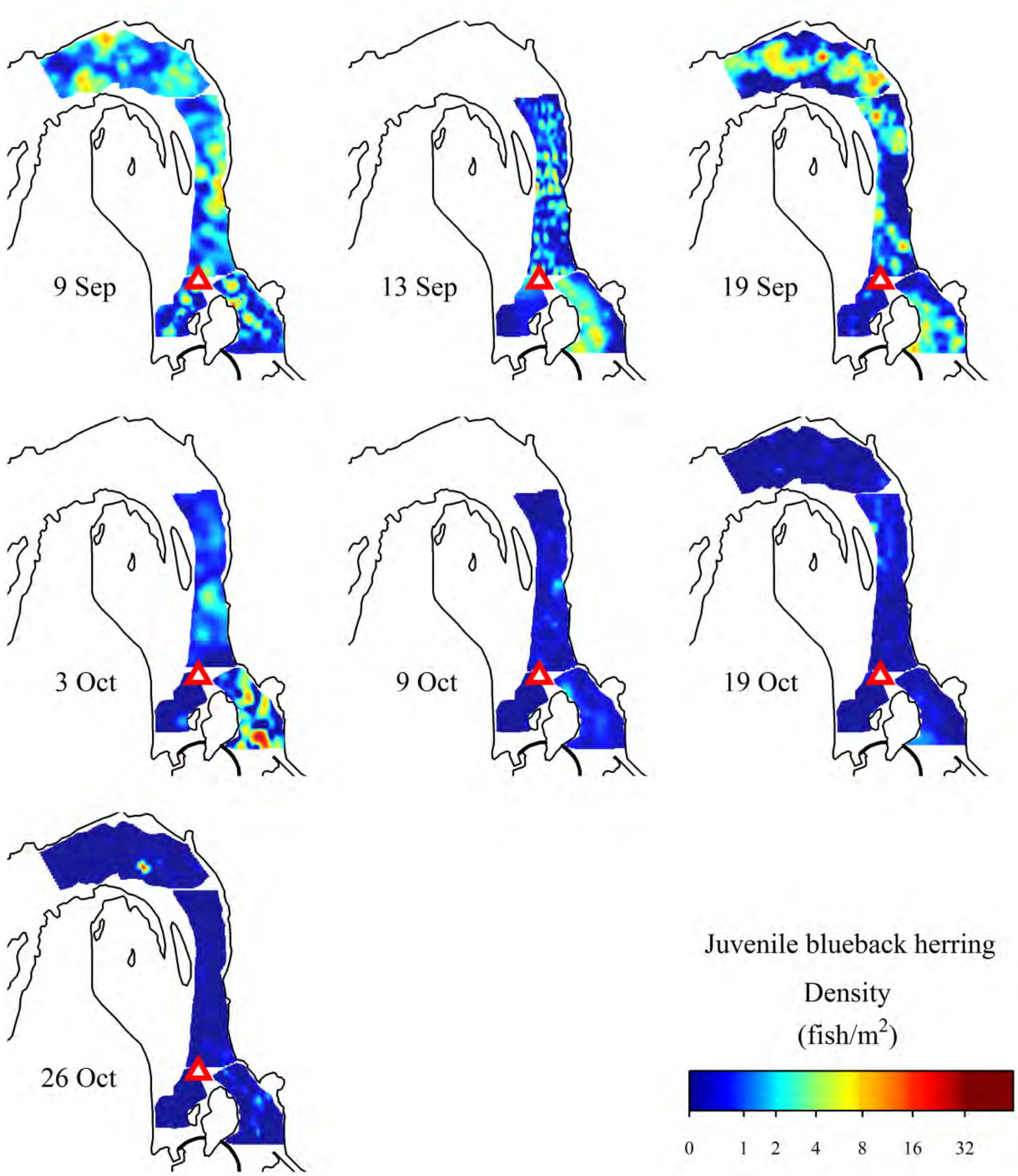

Figure 12. Kriged maps of the juvenile blueback herring density estimated from data collected by 420-kHz split-beam echo sounder on seven systematic acoustic surveys at Crescent Hydroelectric Project during the day between 9 September and 26 October 2012. Red triangle marks location of the ultrasonic projector.

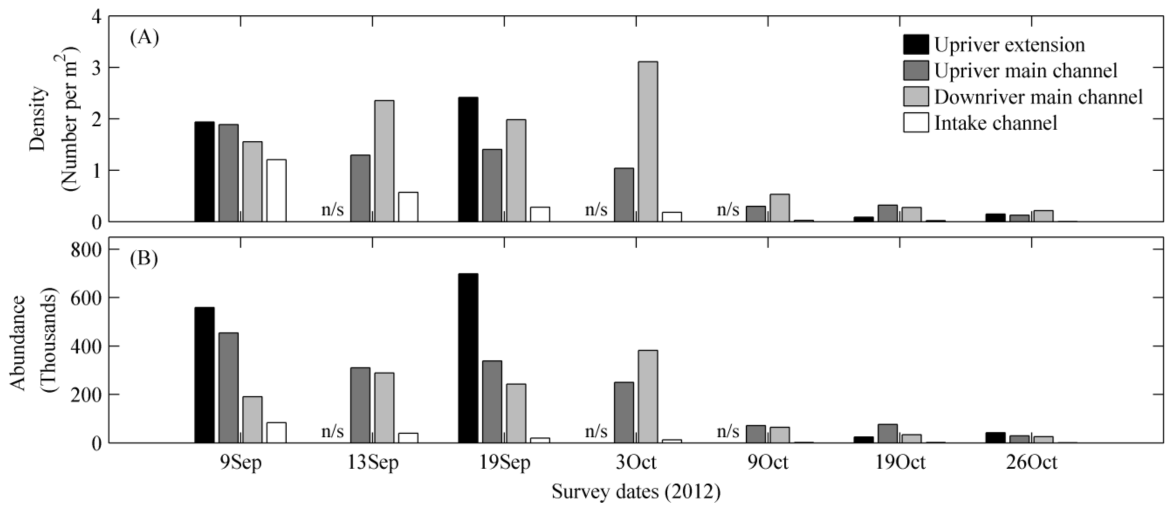

Figure 13. (A) Mean density and (B) total abundance of juvenile blueback herring sampled along cross-river transects surveyed by a vessel-mounted 420-kHz split-beam echo sounder within four regions of the Mohawk River near the Crescent Hydroelectric Project: (1) the northern upriver extension sampled on four occasions, the main channel (2) upriver and (3) downriver of ultrasonic (122-128 kHz) projectors aimed to deter fish from entering the (4) intake channel. n/s = not sampled.

Mean density and total abundance of juvenile blueback herring in the upriver and downriver main channel regions were not significantly different based on paired *t*-tests of the inter-regional differences among the seven acoustic surveys (Table 4). However, the mean density and total abundance of juvenile blueback herring in the upriver and downriver main channel regions were both significantly greater than the density and abundance in the intake channel among all repeated acoustic surveys. The density of juvenile blueback herring in the intake channel averaged 23% (range = 2 to 63%) of that in the upriver main channel region, while the density in the downriver main channel averaged 163% (range = 82 to 182%) of the upriver main channel region. The mean density of juvenile blueback herring averaged 20 times higher in the downriver main channel region than in the intake channel region. The total abundance of juvenile blueback herring in the intake channel region averaged 7% (range = 1 to 18%) of that in the upriver main channel region, while the density in the downriver main channel averaged 83% (range = 42 to 153%) of the upriver main channel region. The total abundance of juvenile blueback herring in the downriver main channel region averaged 35 times higher than in the intake channel region and averaged 91% of their sum (range = 70 to 97%).

Table 4. Paired t-tests for differences in mean density ($fish/m^2$) and total abundance (thousands) of juvenile blueback herring between regions in the main channel upriver (U) and downriver (D) of the ultrasonic projectors, and intake channel (I) among seven mobile acoustic surveys. The null hypothesis is the mean difference equals zero.

Region comparisons	Response variable	Mean difference	*t*	*P*
U – D	Density	-0.52	-1.68	0.143
U – D	Abundance	42.81	0.95	0.379
U – I	Density	0.58	4.24	0.005
U – I	Abundance	195.77	3.81	0.009
D – I	Density	1.10	2.78	0.032
D – I	Abundance	152.96	3.10	0.021

3.5 Continuous Monitoring of Downstream Fish Passage

3.5.1 Movements of Acoustically Tracked Individuals

The mean R_d (net rate of downstream movement) for juvenile blueback herring measured by horizontal split-beam tracking ranged 0.15 to 0.27 m/s (2.1 to 3.9 body lengths/s) when R_d was averaged by day, diel period, and site (Figure 14). During the night, the median of the daily diel-averaged R_d was not significantly different between sites based on non-overlapping box-plot notches. During dawn, day and dusk, the median daily diel-averaged R_d was significantly higher for fish passing through the west channel zone at the downriver site compared to all other sites based on the box-plots. In general within each site, mean R_d was higher during the day than at night. The mean of the daily diel-averaged R_u (net rate of upstream movement) was significantly less than the R_d (0.185 m/s or 2.6 body lengths/s) by approximately 0.01 m/s or 5% ($t = 4.39$; $P < 0.001$).

The mean hourly P_d (number of juvenile blueback herring moving downstream) ranged from 0.45 in the east main channel at the downriver site during dawn hours (0500-0700) to 0.68 in the center main channel at the upriver site during night hours (2000-0400). The P_d was higher at the upriver site compared to the downriver site during the night and dawn, while the sites were less different during the day and dusk (Figure 14).

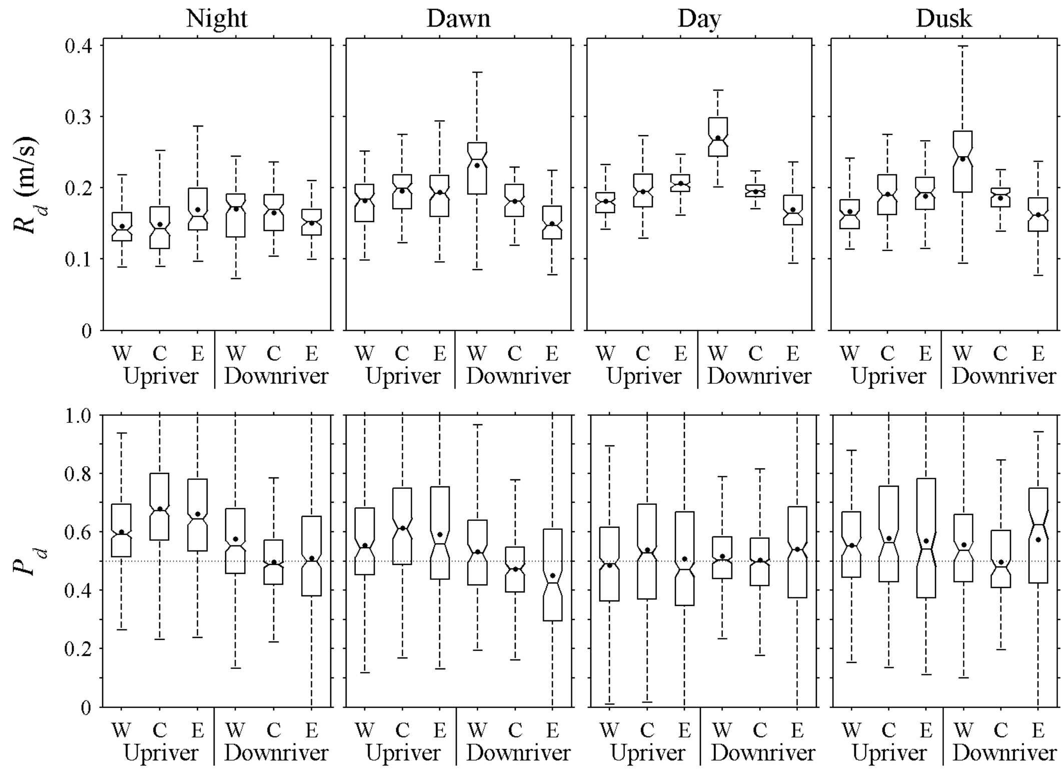

Figure 14. Box plots of net rate of horizontal downstream movement (R_d) of echoes classified as juvenile blueback herring (JBH) and the proportion of JBH-classified echoes moving in a net-downstream direction (P_d) based on target-tracking by horizontal split beam transducers located in the west (W), center (C) and east (E) zones of the main channel of the Mohawk River upriver (U) and downriver (D) from ultrasonic projectors during four diel periods (8 September-26 October 2012). Sample sizes for R_d and P_d were based on daily diel averages and hourly proportions, respectively. Box center line is the median, box extent is 25th and 75th percentiles, whiskers are +/- 1.5 times the interquartile range, and the dot is the mean. Non-overlapping notches indicate medians are significantly different at the 95% confidence level (McGill et al. 1978).

3.5.2 Net Passage of Juvenile Blueback Herring

Continuous monitoring by the horizontal transducers led to several acoustic observations of behavior and quantitative estimates of passage at each site from 8 September through 26 October. During the night, individual echoes were observed while clusters of multiple echoes (i.e., "schools") were largely absent. At dawn, echoes became clustered and school echoes were formed. Schools of juvenile blueback herring appeared to move through the beams in upriver and downriver directions at both sites. When peaks in $s_{v,\text{ JBH}}$ were observed, they typically occurred between 0600 and 1200. Figure 15 illustrates acoustic observations of juvenile blueback herring from echograms associated with a passage event.

During the period before 20 September, the upriver and downriver flux of observed echoes (schools during the day and individuals at night) resulted in consistently low daily and hourly net downstream passage estimates of juvenile blueback herring (Figure 16). Following a precipitation-driven increase in river flow on 19 September, peaks in daily and hourly net downstream passage were observed from 20 September through 6 October at the upriver site. The two peaks were observed at the upriver and downriver sites on 20 and 23 September but then net passage remained relatively low at the downriver site until 5-6 October when net downstream passage estimates were highest at both sites. After 14 October, when migration was considered complete based on the low abundance and few observations of juvenile blueback herring in the trawl and acoustic surveys, low net downstream passage increased slightly yet consistently. At both sites, there were hours when the net passage of juvenile blueback herring was in the upstream direction. The median net downstream passage was highest between hours 0700 and 0900 at the upriver site and at hour 1100 at the downriver site, where it was also lowest in the upstream direction at hour 0700 (Figure 17).

The cumulative net passage of juvenile blueback herring in Figure 18 depicts the net passage remaining low near zero until 20 September when net downstream passage at the upriver site increased through 6 October which was followed by no substantial change. At the downriver site, cumulative net downstream passage remained low and led to upstream movement, until two large pulses of juvenile blueback herring passed through on 6 and 8 October, and increased net passage. The cumulative net passage of juvenile blueback herring at the downriver site showed little change after 8 October. When the pre-migration and post-migration periods were included, the percentage of the net downstream passage of juvenile blueback herring at the upriver site that moved downriver in the main channel was about 43.3%, which was significantly higher than the percentage expected based on river flow by about 2 percentage points (40.9%; $\chi^2 = 28.7$; P <0.001) and the 31.3% for the first ultrasonic projector configuration observed by Dunning and Gurshin (2012; $\chi^2 = 482.7$; P <0.001). Inclusion of the net passage during the pre-migration and post-migration periods, which

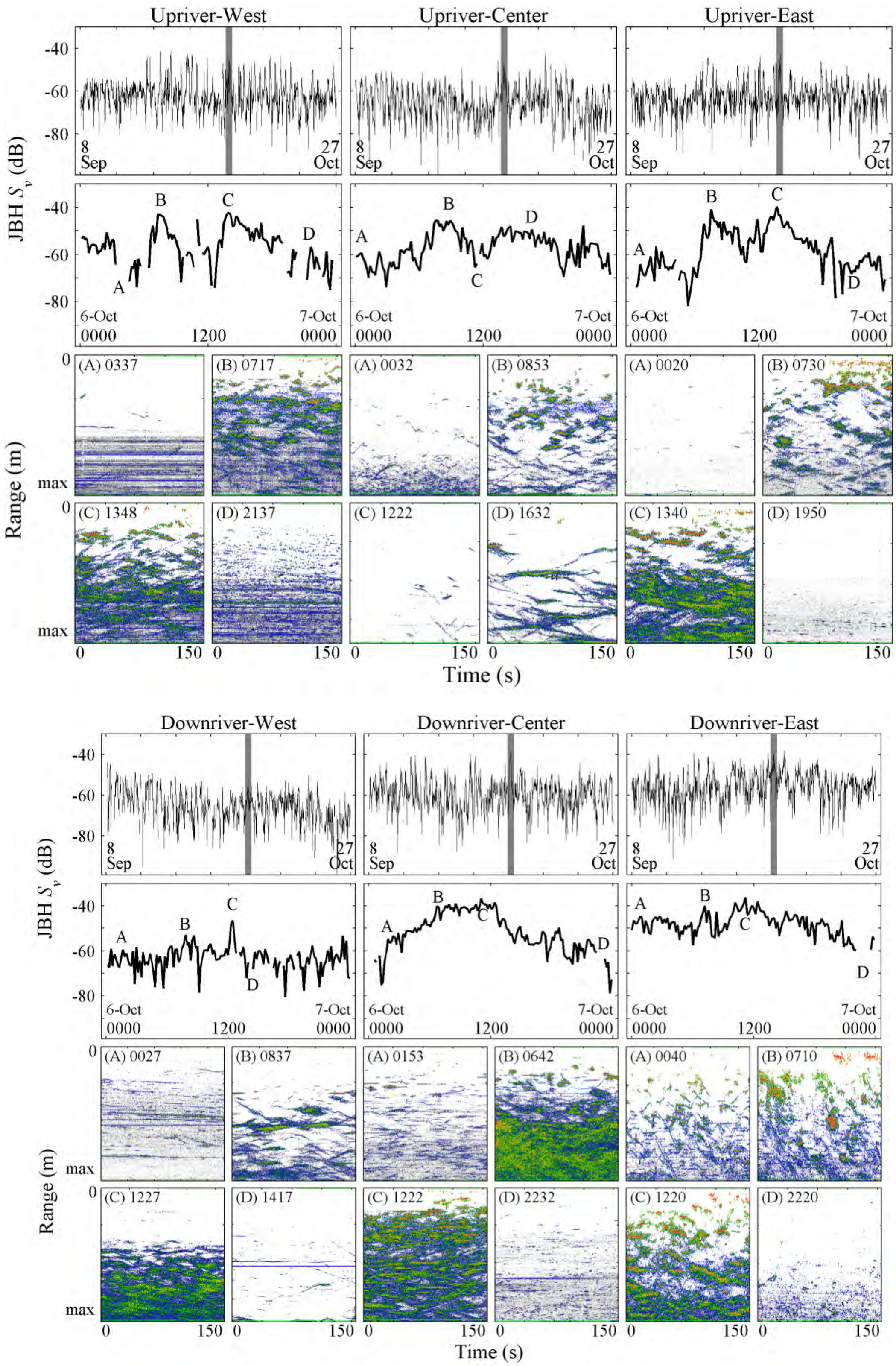

Figure 15. Time series of volume backscattering strength apportioned to juvenile blueback herring (JBH S_v) and selected echograms for each horizontal transducer from a 24-hour period on 6 October 2012.

could be in either direction at times, may not accurately represent passage of actively out-migrating juvenile blueback herring. During the peak migration period of 20 September through 14 October when peaks in net downstream passage were observed at the upriver site and represented 72% of the cumulative net downstream passage for the full time series, 76.0% of the out-migrating juvenile blueback herring passage at the upriver site moved downriver in the main channel, which was significantly higher than the percentage expected based on river flow by about 27 percentage points (49.1%; χ^2 = 2,408.5 ; P <0.001) and the percentage observed by Dunning and Gurshin (2012; χ^2 = 482.7; P <0.001).

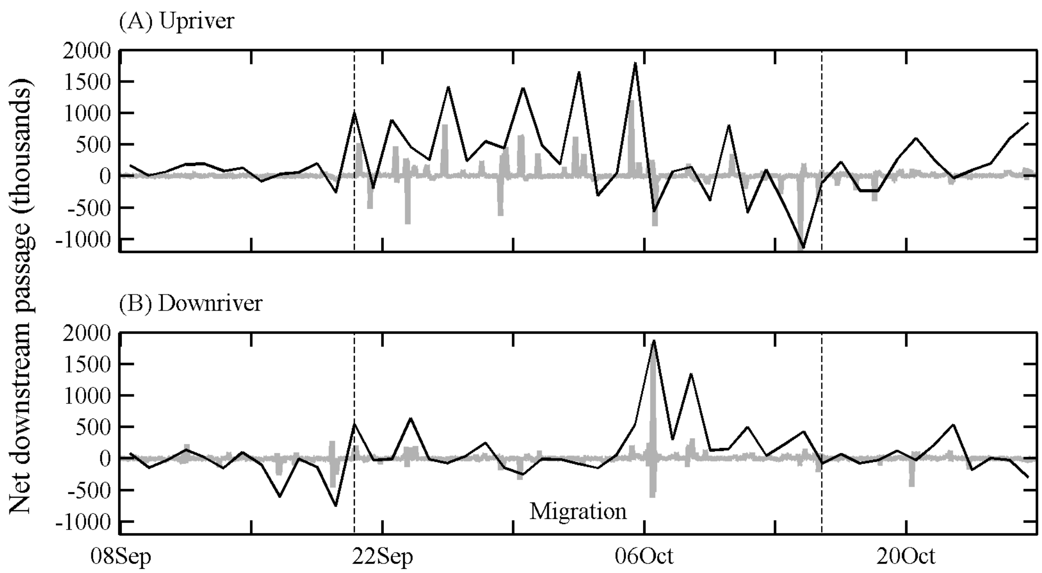

Figure 16. Hourly (gray) and daily (black) estimates of net downstream passage of juvenile blueback herring in the main channel (A) upriver and (B) downriver of ultrasonic projectors at Crescent Hydroelectric Project, Mohawk River from 8 September through 26 October 2012. The vertical dashed lines delineate the out-migration period from 20 September to 15 October. Note: negative net downstream passage indicates upstream movement.

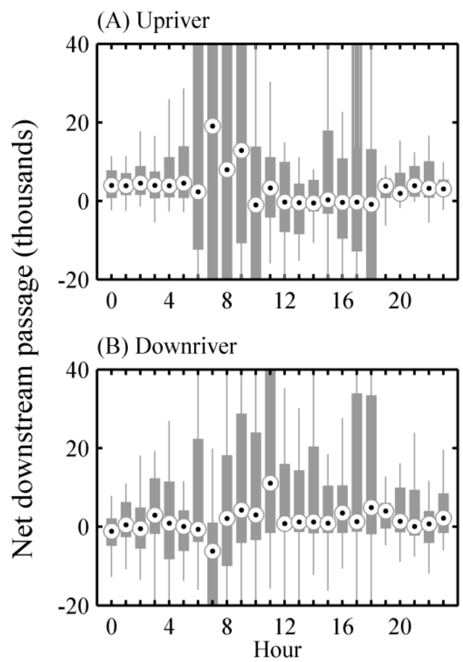

Figure 17. Box plots of hourly net passage estimates of juvenile blueback herring during the out-migration period of 20 September to 15 October 2012 in the main channel of the Mohawk River at sites located (A) upriver and (B) downriver from ultrasonic projectors. The box extent is the 25th and 75th percentiles, whiskers are +/- 1.5 times the interquartile range, and the symbol is the median.

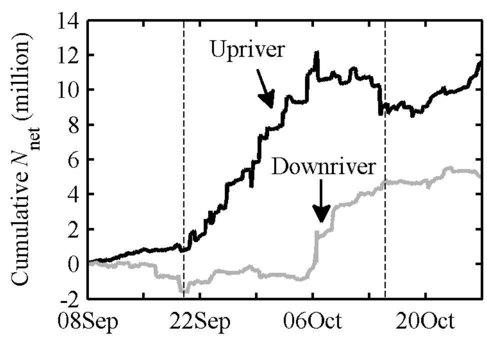

Figure 18. Cumulative net downstream passage of juvenile blueback herring in the main channel upriver and downriver of ultrasonic projectors at Crescent Hydroelectric Project, Mohawk River from 8 September through 26 October 2012. The vertical dashed lines delineate the out-migration period from 20 September to 15 October. Note: negative net downstream passage indicates upstream movement.

4.0 Discussion

Results from intensive spatial and temporal sampling by three principal sampling methods demonstrated that the preponderance of juvenile blueback herring migrated downriver in the main channel during fall of 2012 and avoided the intake channel leading to the hydroelectric turbines at Crescent, thus reducing the potential for turbine passage mortality. The acoustic size and visual patterns of the echoes in the echograms, coupled with the species identification and CPUE by trawls, confirmed that juvenile blueback herring were the principal pelagic species contributing to the observed transient peaks in volume backscatter. The period prior to 20 September was considered the pre-migration period because substantial peaks in net downstream passage were absent from observations made by the continuous acoustic monitoring at the upriver site and several observations of net upstream movement were observed at the downriver site. Since juvenile blueback herring were moving back and forth between sites or “milling” around in the Dam A pond before out-migration, then the rationale to exclude this period from a comparison between the two sites and exclude these fish from any downstream passage estimate can be justified. Nevertheless, the density and abundance of juvenile blueback herring in the intake channel during the pre-migration period was lower than the other regions.

Shortly after receiving approximately 8 cm of precipitation on 18 September and an additional 0.2 cm on 19 September, river flow increased from the low 40’s to 76 m^3/s at 0200 hours on 19 September. The first peak over 500,000 fish/hour at the upriver site was on 20 September when net downstream passage estimate increased at 1800 hours. Six additional peaks in daily net downstream passage were observed at the upriver site until 15 October when migration was considered largely complete. Defining 20 September through 14 October as the peak migration period was further supported by a steady decline in the trawl CPUE from 19 September through 15 October and a decline in density derived from mobile acoustic surveys from 19 September through 9 October. On 14 October, the region received in excess of 1 cm of precipitation which followed by a peak river flow of >100 m^3/s on 15 October. Following this high-flow event, juvenile blueback herring were nearly absent based on trawl and mobile acoustic surveys. The cumulative net downstream passage estimated from the continuous monitoring did not increase at the same rate during this post-migration period as during the migration period. However, there were a few peaks at both sites that could be explained by parameter estimation uncertainty or incomplete removal of resident fish s_v from total s_v later in the study when larger species dominated the fish community and few blueback herring were observed. The time series of daily or hourly net downstream passage and the cumulative net downstream passage show the majority of the fish passed the downriver site on 6 October after several peaks in net downstream passage were observed upriver.

Environmental factors have been investigated for explaining migration patterns of river herring among a variety of habitats. Kosa and Mather (2001) found downstream migration by juvenile alewife and blueback herring in small coastal streams in Massachusetts to peak in early summer between 1200 and 1600 hours and was explained in part by stream discharge, pond volume, surface area, depth, transparency and pH. In another Massachusetts' river, Iafrate and Oliveria (2008) described blueback herring to migrate out of the Herring River in Massachusetts over a single period between late September and October that coincided with a sharp decline in water temperature and no trend in precipitation levels. In continuous-flow systems, Yako et al. (2002) found peak downstream migration of juvenile river herring to coincide with the new moon during midday hours, and low rainfall, water visibility and zooplankton biomass. Declining water temperatures determined the time of the fall downstream migration of juvenile blueback herring in the Connecticut River (O'Leary and Kynard 1986). Peak migration occurred at 14-15 °C and ended by late October or early November when water temperature declined to 10 °C.

While O'Leary and Kynard (1986) observed activity by blueback herring throughout the 24-h period, peak activity occurred around 1800 hours and most movement peaks occurred during quarter-moon and new moon phases. In this study, the largest peak net downstream passage on 6 October occurred when water temperature began declining below 18 °C at 0.5 °C/day. While peaks in river flow didn't coincide with the peaks in net downstream passage observed at the upriver site, it is possible the first high-flow event may have triggered the almost daily pulses of out-migrating juvenile blueback herring and the next high-flow event may have flushed any remaining substantial number of fish through the opening in the flashboards or over the dam. Similar to other migratory patterns described, the peak activity of juvenile blueback herring occurred during early morning daylight hours.

Direction and magnitude of net passage of juvenile blueback herring by continuous acoustic monitoring in a shallow noisy riverine environment is subject to several dynamically changing sources of variability and uncertainty. In this study, a multi-step processing approach using multiple input parameters was used to derive the most reliable index of abundance and net passage of juvenile blueback herring. The time series for net downstream passage of juvenile blueback herring included episodes of upstream movement. In addition, the time series included small peaks in net downstream passage during the post-migration period when trawls and mobile acoustic surveys showed juvenile blueback herring were largely absent. On a fine temporal scale, estimates were most sensitive to the estimates of the proportion of fish moving downstream as a result of the directionality of tracked individual fish becoming no longer representative of the directional movement of dense schools. While upstream or downstream number of migrants may have been over or underestimated at times at the sample echogram resolution or pooled hourly estimates, this source of positive and negative bias was likely to cancel when cumulative net passage over many days was estimated.

The removal of the acoustic contributions of background noise, *Chaoborus* sp., bubbles, and resident fish may have been another source of error, but the removal techniques used in this study were appropriate and similar to other hydroacoustic studies in noisy environments (Malinen et al. 2005; De Robertis and Higginbottom 2007). The modal TS used in the acoustic estimation of fish density was obtained from each diel period based on the assumption that potentially different swimming behavior could change TS among diel periods and for each transducer to compensate for any differences in sound incidence angle or calibration error. The mode TS ranged from -50 and -44 dB which was similar in magnitude to Gurshin (2012) and Brooking and Rudstam (2009). The estimates used for net rate of downstream or upstream movement (averaged 2.4 to 2.6 body lengths/s) were consistent with the range of swimming speed reported for alewives from previous studies and split-beam tracking by Arrhenius et al. (2000).

The time series of net downstream passage shows periods of upstream movement while the mobile acoustic survey revealed over time that juvenile blueback herring congregated in the downriver survey region at higher densities. The back-and-forth movements at the downriver site and the accumulation of juvenile blueback herring downriver in the main channel provided some evidence of residency duration until they either exited through Waterford Lock 6 or a high-flow event like the one on 15 October facilitated their passage through the opening in the flashboards or over the dam. At time of high flow and high power generation, the river current flowed upriver in the east channel zone and downriver in the west channel zone; in essence an eddy effect can develop. This is also substantiated by the observed net rate of downstream movement of juvenile blueback herring being significantly higher in the west channel zone than in the east channel zone.

The evaluation of the effectiveness of the ultrasound at Crescent compared the observed cumulative net downstream passage estimates of juvenile blueback herring to the expected number based on the assumption commonly used in regulatory practice (EPA 2001; ASMFC 2009) that entrainment and impingement is directly proportional to volume or flow of water withdrawn by a power generation facility. Dunning and Gurshin (2012) interpreted their results as either (1) the flow null hypothesis is a valid assumption and the ultrasonic projectors were partially effective at diverting juvenile blueback herring from entering the intake channel, or (2) the observed proportion (31.3%) of juvenile blueback herring moving downriver was evidence that the flow assumption is invalid and could be explained by other abiotic and biotic factors. If (1) was the correct assumption, by reconfiguring the ultrasound to allow more exposure time of increasing SPLs to juvenile blueback herring as they migrate downriver, then their proportion moving downriver should increase if the ultrasound truly had an effective deterrence effect. If there was no relative increase of juvenile blueback herring moving downriver in the main channel, then perhaps an alternative mechanism explains the observed downstream passage through the main channel.

Three independent indices of abundance provide evidence that the preponderance of out-migrating juvenile blueback herring after reconfiguration of the ultrasound field are migrating downriver in the main channel and avoiding entrainment by the hydroelectric turbines. When juvenile blueback herring were present upstream of Crescent from 8 September through 10 October, the trawl CPUE in the downriver trawl region was 94% of the CPUE in the upriver trawl region and 250% of the CPUE in the intake channel. Repeated mobile acoustic surveys revealed mean density and total abundance of juvenile blueback herring was significantly greater in the downriver survey region than in the intake channel region; the total abundance in the downriver survey region averaged 35 times higher than in the intake channel region and averaged 91% of their sum. During the peak migration period of 20 September through 14 October, continuous monitoring by fixed-location horizontal transducers revealed that 76% of the cumulative net downstream passage of juvenile blueback herring at the upriver site occurred through the downriver site in the main channel, which was significantly higher than expected based on proportional river flow and higher than the proportion observed in presence of the previous ultrasound field (Dunning and Gurshin 2008). These results demonstrate significantly improved downstream passage at Crescent for the majority of out-migrating juvenile blueback herring and considering that turbine passage survival is expected to be 96% based on previous mortality studies (Mathur et al. 1996), the impact from Crescent Hydroelectric Project's power generating operations is considerably low.

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Tracking Blueback Herring in the lower Mohawk River.

Conference Paper · February 2013

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Tracking Blueback Herring in the lower Mohawk River

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Abstract

The blueback herring (*Alosa aestivalis*) and alewife (*A. pseudoharengus*) collectively known as 'river' herring are a very important fishery in the Hudson River Estuary but were historically isolated from the Mohawk River by Cohoes Falls. With the completion of the Erie Canal in 1825, anadromous species such as river herring gained access to the Mohawk via a series of canals and a unique 'run' of blueback herring developed during the spring spawning migration. The long-term decline in river herring along the eastern seaboard includes the lesser-known Mohawk River 'stock' as blueback herring density and migration distance have diminished over time.

To document the metrics and uniqueness of Mohawk River spawned blueback herring, DEC Region 4 Fisheries and SUNY ESF teamed up to sample the 2012 spring run. A total of five trips were made to the river between May 23 and June 26 with effort focused below four Canal Corp. dams and adjacent locks (E7, E9, E11, E15). These tailwaters were boat electrofished during the day and samples of blueback herring were harvested for analyses.

Approximately 1000 blueback herring adults were shocked in 5.25 h of 'on-time' boat electrofishing with 352 individuals collected in the survey. Gut analyses determined that migrating adults actively fed mostly on chironomids and fish eggs at all sites except below lock E15 (mostly Baetidae). Males outnumbered females (2.27:1) but were significantly smaller in TL ($P < 0.001$). Females had an insignificantly higher percentage of food items present in their stomachs vs. males (87:79, $P = 0.53$). Fullness ratios varied among collection dates and sites with no significant difference ($P = 0.09$) found between May and early June sampling. However by late June, the few adults that were found had much less food in their stomachs. Run timing was as expected with decreased adult density over time at lower sites; increased density at upper sites. CPUE was highest in late May (106/h) dropping to 88/h in early June to only 4/h in late June. These findings are important in providing more baseline data for the Mohawk River stock of blueback herring in support of protecting this fishery from future changes in climate and canal operations. New freshwater regulations are now in place for the 2013 fishing season to protect the current runs of river herring in NYS including several rivers where harvest will be prohibited.

Bureau of Fisheries

2013-2014 Annual Report

State of New York

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

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Fish Culture

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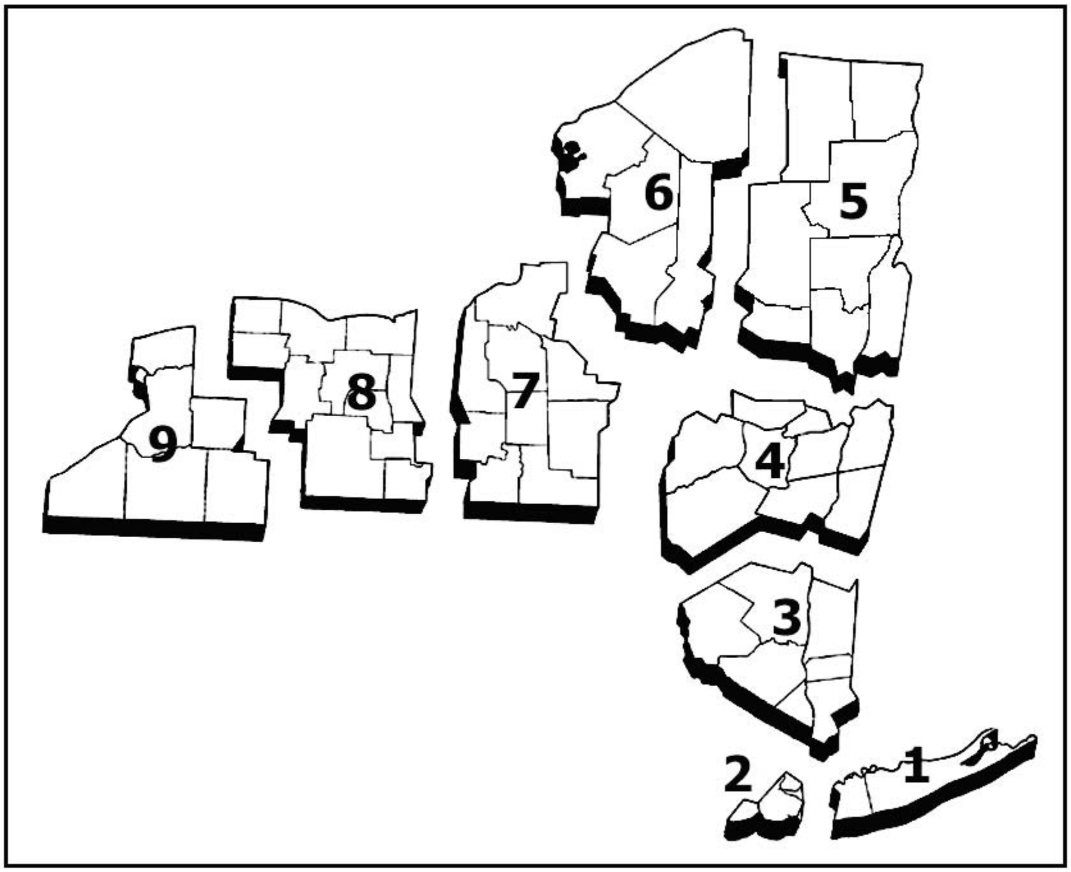
DEC REGIONS



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2013-14 Annual Report

New York State Department of Environmental Conservation
Bureau of Fisheries

Philip J. Hulbert, Chief

Introduction

The New York State Department of Environmental Conservation, Division of Fish, Wildlife and Marine Resources, Bureau of Fisheries delivers a diverse program and annually conducts a wide array of activities to accomplish its mission:

> ***Conserve and enhance New York State's abundant and diverse populations of freshwater fishes while providing the public with quality recreational angling opportunities.***

This report provides a summary of significant activities completed during fiscal year 2013-2014 by Bureau of Fisheries staff located in 9 regional offices, 2 research stations, 12 fish hatcheries, 1 fish disease laboratory, as well as the DEC Central Office in Albany. Activities are categorized according to the major objectives of the Divison of Fish, Wildlife and Marine Resources.

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2013-14 Annual Report

Common Acronyms, Definitions and Units of Measure

Common Acronyms

CPUE or CUE: catch per unit of effort - such as the number of fish caught per hour or fish caught per net.

OMNR: Ontario Ministry of Natural Resources

PFR: Public Fishing Rights.

USGS: United States Geological Survey.

USFWS: United States Fish and Wildlife Service.

YOY: young of year - typically a fish that is captured by sampling in the same year it was hatched.

Definitions

Bottom trawl: a sampling technique where a net is dragged along the bottom of a water body behind a boat.

Creel Survey: a survey where anglers are interviewed about their catch.

Conductivity: the ability of water to conduct an electric current. Waters of low conductivity are low in dissolved minerals.

CROTS: Catch-Rate-Oriented-Trout-Stocking - the model used by the Bureau of Fisheries to develop stocking rates for trout streams that takes into account biological measures of the stream, stream carrying capacity, angling presuure and wild trout abundance.

Electrofishing: use of electricity to temporarily stun fish, allowing them to be captured.

Extirpated species: a species that no longer exists in the wild in a certain country or area.

Fyke Net: a trap style net that is composed of a number of hoops surrounded by netting and usually has netted wings and a leader that direct fish into the net.

Gill Net: a vertical wall of netting that is typically set in a straight line and entangles fish as they try to swim through it.

Hazing - to discourage an animal from frequenting a waterbody.

HUC: Hydrologic Unit Code. A categorization of watershed boundaries from the basin to the sub (small) watershed level (HUC12).

Hydroacoustic survey: use of sound and reflected echoes from schools of fish or plants to estimate abundance or distribution.

Lentic: associated with still water such as a lake or pond

Littoral: the nearshore shallow water area of a waterbody

Lift - difference in license renewals between the control and treatment group.

Mesotrophic - an intermediate stage of lake productivity lying between oligotrophic (nutrient poor) and eutrophic (nutrient rich).

Oligotrophic - a water body that is low in nutrients.

Pen reared: raising hatchery salmon or trout in a pen to "imprint" those fish to the pen rearing site. In theory, this will cause the fish to return to the pen rearing site to spawn.

PIT Tag- an implanted tag that is used when an individual fish needs to be identified. The tag contains a series of numbers and letters that can be obtained by passing a "PIT Tag reader" over the implanted tag.

PSD: proportional stock density - describes the portion of a fish population or sample that exceeds a size threshold. For example, the PSD for largemouth bass is the proportion of 12 inch and larger bass in the sample of largemouth bass that were stock size (8 inches and larger).

Reclamation: the removal of non-native fish and restoration with native fish. Traditionally done to restore pond brook trout populations.

RSD 15: relative stock density greater than 15 inches - describes the proportion of fish larger than 15 inches in a population or sample of all fish exceeding a size threshold. For example, the RSD 15 for largemouth bass is the proportion of 15 inch and larger bass in a the sample of all largemouth bass that were stock size (8 inches and larger).

Seining: using a seine net - a net with weight on the bottom and floats on the top that is draggd through the water to capture fish.

Trap Net: similar to a fyke net but usually larger and rectangular in shape.

VHS/VHSv: Viral hemmoraghic septicemia - a serious disease of fish (not humans) recently introduced into New York State.

Year Class: a group of fish spawned during the same year.

Units of Measure

^{o}C: degrees Celsius - to convert from c to farenheit (f) = (f - 32) x 5/9.

ha: hectare - a metric system unit of area; 1 hectare = 2.47 acres.

hr: hour.

in: inch.

kg: kilogram - a metric system unit of weight; 1 kg = 2.2 pounds.

km: kilometer - a metric system unit of length; 1 km = 0.62 miles or 3,281 feet.

m: meter - a metric system unit of length; 1 meter = 3.28 feet.

mm: millimeter - a metric system unit of length; 100 mm = 3.94 inches.

ppm/ppb: part per million/parts per billion - describes the density of a substance in another solid, liquid or gas (typically water, air).

µg/l: micrograms per liter; equivalent to ppb,

SPECIES CONSERVATION & MANAGEMENT

Monitoring Fish Movement in the Carmans River

The two year study to assess the movement of brown and rainbow trout, brook trout, alewife, and American eel in the Carmans River continued in 2013. Significant findings from year two of this study include:

The majority of stocked trout (60.1% of yearling brown trout and 63.4% of yearling rainbow trout) remained at their stocked location with the remaining fish moving downstream (Fig.1).

The native brook trout in the river did not venture far from their capture location and did not move downstream to the tidal section of the River. Brook trout movement was primarily limited to moving into the known spawning section of the river in September, October, and November for both 2012 and 2013.

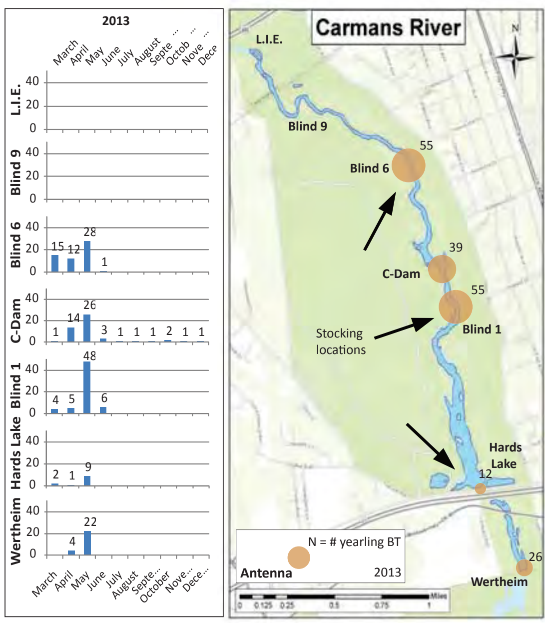
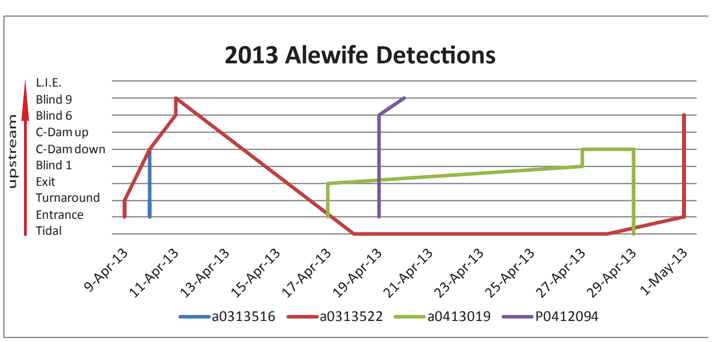


Figure 1. Movement of Pit Tagged Brown Trout

Twenty three percent of the alewife tagged in 2013 were detected at the fish ladder entrance. Only four alewife were detected at upstream antennas, one of which was originally transplanted from the Peconic River in 2012. Although the number of alewife detected upstream of the fish ladder increased slightly, numbers remained low, indicating that additional work will be required to improve alewife passage.



American eel were caught during electrofishing surveys, tagged and moved downstream to the tidal section of the Carmans to determine their homing capabilities as well as if they were able to navigate the fish ladder. Forty five percent of the American eel transplanted in 2012 and 2013 returned to the upstream section via the fish ladder. Also documented was the seaward migration of 21 American eel who were last detected in the tidal section during the months of October and November in both 2012 and 2013.

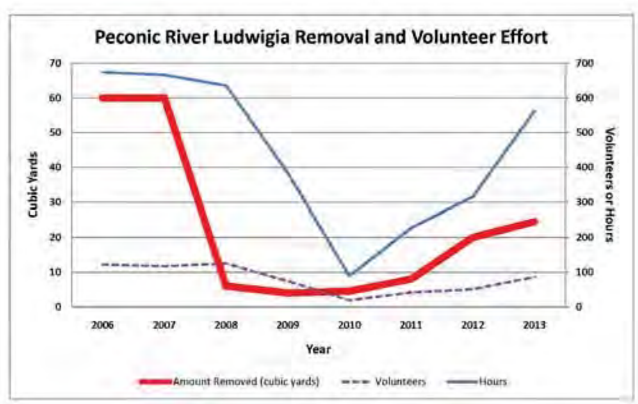
Massapequa Creek Brook Trout Restoration

In a continuing effort to restore brook trout to Massapequa Creek, Long Island Trout Unlimited (LITU) stocked 400 yearling and 50 two year old brook trout purchased from Cold Spring Harbor Fish Hatchery and Aquarium in April. The success of this stocking was assessed via an electrofishing survey conducted by the Region One Fisheries Unit in September. The survey was conducted downstream of the location stocked and three species of trout were caught: 14 brook trout, five brown trout and one rainbow trout. The brook trout ranged from 8.9 to 11.1 inches and were found as far as 1.5 miles downstream of the stocked location. The five brown trout averaged 10.9 inches, and the rainbow trout measured 9 inches. Both the brown and rainbow trout were likely previously stocked into the downstream reservoir. This past winter Cold Spring Harbor Fish Hatchery and Aquarium donated 500 yearling brook trout to the restoration effort. An additional stocking is planned for the Spring of 2014.

HABITAT CONSERVATION

Peconic River Ludwigia Control

The Ludwigia control operation started out strong in 2013. All known infestations were mapped with a Trimble GeoExplorer 6000 at the end of May and the first pull on June 8th was able to concentrate resources on the mapped areas with canoes and kayaks hitting the less dense infestations and jon boats going to the more dense areas. In one day 20 volunteers were able to remove about 2.5 cubic yards of Ludwigia covering all of the mapped infestations. Starting early in the season greatly reduced the volume of plant matter that needed to be removed.

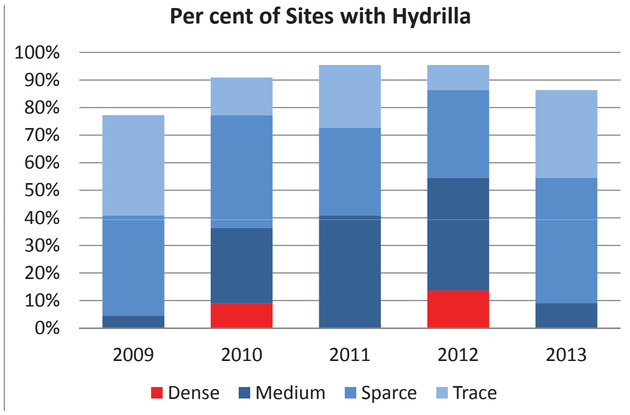


Unfortunately, a previously unknown infestation upstream from all earlier known infestations was found in early July and most of the removal effort in the following three pulls was spent on this infestation. In total, 86 DEC Staff and volunteers spent 563 hours pulling Ludwigia and managed to remove 24.5 cubic yards of the invasive plant from the Peconic River. This was the most number of pulls and the most vegetation removed since the first two years of the program in 2006 and 2007. Because the upstream infestation was found later in the season, not all of it could be removed which will necessitate further efforts in 2014.

Hydrilla in Lake Ronkonkoma and Blydenburgh Lake

The Hydrilla infestation in Lake Ronkonkoma declined substantially from previous years. In 2012 over 50% of the sites surveyed had moderate or dense Hydrilla and 95% of all sites had some Hydrilla, while in 2013 there were no dense Hydrilla stands found and less than 10% of the sites surveyed had moderate infestation levels (see Figure). The fraction of sites where Hydrilla was found dropped from 95% in 2012 to 85% in 2013.

The density of Hydrilla also declined in Blydenburgh Lake. Dense infestations dropped from nearly 80% of the sites surveyed in 2012 to about 40% in 2013. The Region 1 Fisheries Unit will continue to monitor these infestations and work with stakeholders to prevent the spread to other waters.



Water Chestnut Removal in Massapequa Creek System

Water chestnut was first discovered In Massapequa Lake, the lowest impoundment in the system in 2011. Water chestnut was documented in Massapequa Reservoir, the next impoundment up in 2013. The extent of the spread in the Reservoir is not near what it is in the Lake and is so far limited to a few locations on the eastern shoreline. Region One Fisheries Unit hand removed approximately 10 large garbage bags of the plant and seeds in September. This effort should reduce the spread of the aquatic plant in 2015. Nassau County has obtained a permit to remove the plant from Massapequa Lake with a harvester and hand-pulling and the permit has been modified to include upstream areas as well. Region One Fisheries will continue to assist Nassau County as needed.

PUBLIC SERVICE & CONSTITUENT SUPPORT

I FISH NY Long Island

The total number of fishing clinics and summer camp programs increased in 2013. Although overall numbers declined due to lower attendance at the major spring and fall Fishing Festivals, the I FISH NY Program reached nearly double the number of local residents (950) at fishing clinics as compared to 2012 (500). This significant increase in this number is owed to the addition of three fishing clinics. Two events were open to the public and were held at Fire Island National Seashore and Town of Brookhaven's West Meadow Beach. An additional clinic open to Village of Valley Stream residents was held on Free Fishing Weekend at the Village of Valley Stream Community Center A.J. Hendrickson Park Pond, reaching over 450 beginner anglers. Due to the major success of these clinics, all are scheduled to take place again in FY2014.

In FY2013, 11 of 16 newly rewritten I FISH NY lesson plans were posted on the DEC website for teachers and the public to utilize. They can be accessed at *www.dec.ny.gov/education/89975.html .*

Region 1 Fisheries staff participated in the statewide I FISH NY train-the-trainer program, a fishing training for summer camp counselors, at two 4H camps on the eastern end of Long Island. Freshwater fishing equipment was supplied by DEC's central office, while saltwater equipment was loaned by Region 1 for use by the campers. In order to receive free equipment, summer camps must report their fishing clinic numbers to DEC at the end of the summer camp season. The camp's fishing classes were very popular and well attended.

Students from Riverhead High School's Women in Science and Engineering (WISE) Program joined an all female crew led by the Region 1 Fisheries Unit on the Carmans River in early June for some hands-on experience in the field. Project WISE is an after school program that is geared to introduce female students who show an interest in science, math, and engineering, to the variety of careers in science through special projects and field trips. The all female crew, that included DEC Fisheries and Wildlife staff as well as Cornell Cooperative Extension staff, conducted an electrofishing survey of the Carmans River as part of the ongoing fish movement study being conducted on the river. DEC staff also demonstrated the gear and processes involved with running a fisheries survey and showed students some of the fish and insect species found in the river.

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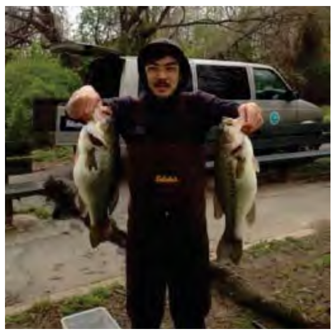
SPECIES CONSERVATION & MANAGEMENT

Warmwater Fishery Surveys

Golden Pond, Crocheron Park, Queens



Golden Pond in Crocheron Park, Queens was surveyed after receiving a report of a dead northern snakehead on the pond's shoreline. Staff used a backpack shocker, fyke net and seine to capture as many fish as possible. No snakeheads were captured but black crappie and largemouth bass were noted.

Harlem Meer, Central Park, New York

A boat electrofishing survey of the Harlem Meer, a ten-acre water body in the northeast corner of Central Park, Manhattan was conducted on April 30. This was the fourth DEC electrofishing survey of the Meer and was performed to determine fish species composition and the ecological balance of Meer fish populations. This survey also provided information on the extent of the population of the invasive fish species which were previously reported from the pond in 2008 and 2012. A total of 814 fish were captured in 78 minutes of electrofishing time. Three all-fish runs and one gamefish-only run were completed. The entire shoreline was covered twice during the survey and species captured consisted of largemouth bass, black crappie, yellow perch, golden shiner, pumpkinseed, bluegill and green sunfish. No American eel or northern snakehead were observed. Catch per hour (CPUE) of all fish was 810 and CPUE of largemouth bass was 223, the highest of any NYC water body surveyed to date. PSD of largemouth bass was 8.8, RSDp was 2.2; indicating an over-abundance of smaller-size fish.

Baisley Pond, Jamaica, Queens

A boat electrofishing survey of Baisley Pond, a 28-acre water body in Jamaica, Queens was conducted on May 9. Previous DEC electrofishing surveys of Baisley Pond were performed in 2001 and 2008. A total of 570 fish were captured in 94 minutes of electrofishing time. High turbidity and overgrowth of aquatic vegetation limited shoreline access in several areas. Species captured were largemouth bass, brown bullhead, pumpkinseed, bluegill, mummichog, black crappie and yellow perch. While young-of-the-year (YOY) bass were captured, most were over 200 mm and many were over 300 mm as reflected by the high PSD and RSDp values: 86 and 46, respectively. Catch per hour (CPUE) of all bass was 36, CPUE for stock size was 22, CPUE for quality size was 19 and CPUE for preferred size was 10. These numbers all increased from the 2008 survey.

Van Cortlandt Lake, Bronx

On May 30th, a boat electrofishing survey of Van Cortlandt Lake, an 18-acre water body in Van Cortlandt Park in the Bronx was conducted. A total of 345 fish were collected in 71 minutes of electrofishing time. Species captured were golden shiner, brown bullhead, white sucker, pumpkinseed, bluegill, largemouth bass, black crappie and yellow perch. Catch per hour (CPUE) of all largemouth bass was 55, CPUE for stock size bass was 47, CPUE for quality size bass was 19 and CPUE for preferred size bass was 6. These numbers were all greater than for a previous survey of Van Cortlandt Lake performed in 2009. Largemouth bass PSD and RSDp of 39 and 13, respectively, and sunfish PSD of 55 suggest the fish population of this lake is relatively balanced.

Long Pond, Staten Island

On September 16th and 17th a fisheries survey of Long Pond on Staten Island was conducted using a backpack shocker, 8' x 25' seine and a fyke net. Long Pond is a small (approximately 1.5 acres), shallow pond within a wooded area and is part of a park preserve, atypical for New York City. Not many fish were captured on the backpack electrofishing run: 20 fish were captured in 40 minutes of electrofishing time, none were over 70 mm. Conductivity was very low and might have been a reason for the low catch rate but small numbers and sizes of fish were also captured during two seine hauls. The overnight fyke net set captured four fish, all larger than those caught at the previous sites: three largemouth bass (345, 310 and 323 mm) and one bluegill (122 mm). Long Pond has been observed to have an extremely low water level during dry seasons which may contribute to low numbers and sizes of fish.

Martling's Pond, Clove Lake Park, Staten Island

On September 26th a boat electrofishing survey of Martling's Lake within Clove Lakes Park Staten Island was conducted. This was the first electrofishing survey of Martling's Lake, the middle of three lakes in Clove Lakes Park. A total of 328 fish were captured in approximately 60 minutes of electrofishing time which included an eighteen minute gamefish only run. Fish species captured were golden shiner, brown bullhead, pumpkinseed, bluegill, largemouth bass and black crappie. Eight common carp were observed. Catch per hour (CPUE) of all bass was 50, CPUE of stock size bass was 21, CPUE of quality size was 8 and CPUE of preferred size was 2. Bass PSD and RSDp were 38 and 9.5, just under generally accepted stock density index ranges for balanced fish populations. Brown bullhead CPUE was 104, relatively large for an electrofishing survey. CPUE of bluegill was 137 and CPUE of pumpkinseeds was 54 but all were relatively small in size. The largest bluegill or pumpkinseed captured was 166 mm.

Kissena Lake, Flushing, Queens

A boat electrofishing survey of Kissena Lake was conducted after Fisheries staff received information of the potential introduction of the invasive Asian swamp eel. A recent algal bloom limited visibility but out of nearly 700 fish captured, none were Asian swamp eels. A large number of young-of-the-year (YOY) yellow perch and black crappies were captured; other species caught or observed included largemouth bass, pumpkinseeds, bluegills, common carp and American eels. Catch per hour (CPUE) of all sizes of largemouth bass was 52; however, CPUE of bass 100 mm and over was relatively low and most were YOY. CPUE of stock size bass was 7.6, CPUE of quality size bass was 4.2 and CPUE of preferred size bass was 1.7. The largest black crappie capture was 305 mm but most captured were small. Black crappie PSD was 33.33 and RSDp was 11.11, CPUE of these fish over 130 mm was 13 per hour. CPUE of crappies less than 100 mm was 236. Past surveys have indicated good size-classes of black crappies in Kissena and this could occur again in a few years if these smaller fish are allowed to continue growing.

Northern Snakehead Monitoring, Meadow and Willow Lakes, Queens

Annual snakehead monitoring in Meadow and Willow Lakes in Flushing Meadows Corona Park, Queens, continued as both lakes were surveyed by boat electrofishing in Fall, 2013. Catch per hour of snakeheads did not change significantly from previous years nor did catch per hour of other fish species in these waterbodies, although the number of American eels increased: 701 of these fish were counted in 2013. The next highest number was 286 in 2010. Water clarity in 2013 was better than in previous years which likely contributed to the observation of eels and other fish species. Numbers of largemouth bass continue to be found, although to a lesser degree in Meadow Lake, for the third consecutive year since 2010. Largemouth bass had not been found during any surveys of the two lakes between 2006-2010.

PUBLIC SERVICE & CONSTITUENT SUPPORT

NYC I FISH NY Program

R2 Fisheries staff conducted programs in 59 elementary and middle school classrooms, reaching a total of 1,565 students. An additional 476 people were reached through 13 outreach events.

New Photo Program Launched

In an attempt to gather feedback from the over 1,500 students participating in the I FISH NY in-school program, staff implemented a photo program in which every student who catches a fish receives a photo of their catch in an I FISH NY graphic photo frame which contains DEC contact information should the child and their parent/guardian wish to fish again on their own. Many parents/guardians attend the fishing field trips with their children but many more do not and the photo serves as a reminder of the trip the children can take home to parents/guardians who may be prompted to take their child fishing on their own. Students who do not catch a fish receive a framed photo of their class at the fishing site.

Other Fishing Outreach and Training

Oasis Children's Summer Science School, Van Cortlandt Lake, Bronx

City of Water Day, Governor's Island, NY

Staten Island Greenbelt Summer Camp, Willowbrook Lake, SI

Harlem YMCA, 125th St. Pier, NY

Little Red Lighthouse Festival, Ft. Washington Park, NY

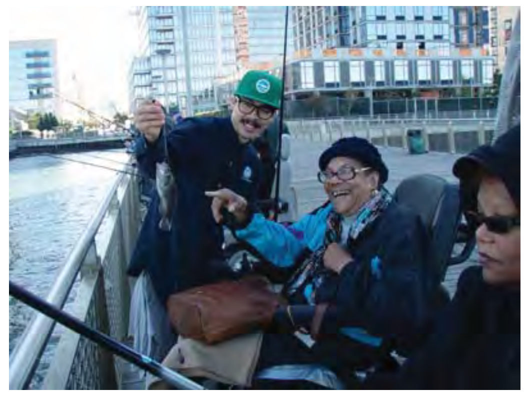
Bronx River Flotilla with Rocking the Boat, Bronx

MS Society, NYC Chapter fishing clinic, Williamsburg, Brooklyn

Harbor School Summer Camp, Governor's Island, NY

Raritan Bay Festival, Conference House Park, SI

Prospect Park Lake Clinic and Fishing line clean-up, Brooklyn



A happy angler at the MS Society Clinic

2013-14 Region 2 Fisheries Staff	
Melissa Cohen	Biologist 2 (Aquatic)
Steven Wong	Environmental Education Assistant
James MacDonald	Environmental Education Assistant
Khary Booker	Seasonal Laborer

SPECIES CONSERVATION & MANAGEMENT

Hudson River Largemouth Bass and Walleye Telemetry Study

In 2013, a pilot study was conducted to surgically implant Lotek CART tags into largemouth bass and walleye in the tidal Hudson River to track their seasonal movements and habitat preference. A total of 13 largemouth bass >15" were collected and tagged (7 from the tidal Rondout Creek and 6 from the tidal Esopus Creek) and 11 Walleye >18" were collected and tagged (10 from the tidal Rondout Creek and 1 from the tidal Catskill Creek). The Lotek CART tags (dual mode tags) allowed both our Hudson River Fisheries Unit and our Inland Fisheries Unit to successfully track these fish. With information gained from this pilot study we will be able to make some modifications to our study efforts in 2014/2015. Our sampling efforts for 2014/2015 will include tagging an additional 50 largemouth bass and 50 walleye using Lotek radio only tags for the largemouth bass and Lotek CART (acoustic/radio duel mode) tags for the walleye.

White Pond Walleye Assessment

A boat electrofishing survey was conducted on 10/8/13 to assess an experimental Walleye stocking program funded by the Sportsmen of Putnam County. Approximately 750 yearling walleye have been stocked annually. With 1.83 hours of on-time the Region 3 fisheries unit was able to cover the whole shoreline. A total of 8 walleye were collected. Results were presented to the Sportsmen. A total of 156 Largemouth Bass were also collected. Of those 156 largemouth bass only 3 fish were over 12 inches. The fisheries unit is going to further assess the largemouth bass population and determine if a special regulation will be needed.

Lake Minnewaska (Ulster County) Fisheries Survey

This State Park lake was sampled by night boat electrofishing in June 2013, with the purpose of documenting the fish species present in Lake Minnewaska, as well as updating the status of the largemouth bass population which was documented in 2012. Historically acidic for at least 80 years, golden shiner were reported to be present by Park personnel in 2008, and largemouth bass were reported present in early 2012. A total of 120 golden shiner and 44 largemouth bass were collected, with no additional fish species noted. We plan to return to Lake Minnewaska fairly regularly to document how the lake's fish population develops.

Rio Reservoir (Sullivan County) Walleye Assessment

Rio Reservoir was stocked with walleye advanced fingerlings in late summer 2012 as the first stocking in a five-year experimental stocking program, with the objective of establishing a walleye population. Walleye were not stocked in 2013 due to problems with the hatchery supply, however, fingerling stocking is scheduled to resume in 2014 for five additional years. The reservoir was electrofished in October 2013 roughly following the percid plan, with the objective of documenting survival of the 2012-stocked walleye, as well as the presence of any additional walleye. In 2.6 hours of electrofishing 18 age 1+ walleye were captured (the age class which would have been stocked in 2012), along with nine older walleye up to age 6+.

Swinging Bridge Reservoir (Sullivan Cty.) Walleye Assessment

Swinging Bridge Reservoir was electrofished in October 2013 roughly following the protocols of the Bureau of Fisheries' percid plan. The objective of this survey was to document survival of any naturally spawned walleye from the 2013 year class. No young-of-year walleye were collected, indicating a lack of survival of the 2013 walleye year class. Nine older walleye were sampled, representing an age range of 4+ to 7+. Only two white perch were sampled, which may indicate that this invasive species has not yet gained a foothold in this reservoir. Somewhat difficult wind, weather, and visibility conditions the night of this survey likely hampered sampling efficiency, so these results may not be entirely representative of the reservoir in October of 2013. A creel survey is currently (2014 season) being conducted on this reservoir, partly in response to anecdotal angler reports indicating that the walleye fishery may be declining here

Ashokan Reservoir (Ulster County) Fisheries Survey

A gillnet survey of Ashokan Reservoir was conducted in late summer 2013 with the objective of updating our data on the brown trout, rainbow trout, and walleye populations here. A total effort of 42 gillnet-nights was expended on the reservoir (both basins), fishing a combination of bottom variable mesh net, midwater fine mesh net (targeted at alewife), and midwater variable larger mesh net (targeted at pelagic predators). The majority of the sets were midwater larger-mesh midwater nets.

Fifteen fish species were collected, including the three "target" fish species. Walleye and brown trout catch per net-night was roughly similar to gillnet surveys conducted in 1988 and 1999 (the last years surveyed), while Rainbow Trout catch per net-night was an order of magnitude less than the previous two surveys. One new species was documented (white perch), which is a new introduction to this reservoir. It is speculated that this species may have ultimately come into Ashokan Reservoir from Schoharie Reservoir via the Shandaken Tunnel/Esopus Creek. White perch were first documented in Schoharie Reservoir in 2002. White perch were the second most abundant species collected in the gillnets, after alewife.

It is currently unknown if the decline in rainbow trout abundance is related to competition with white perch for forage, a decline in rainbow trout spawning/nursery habitat due to recent flood damage to the Esopus Creek and its tributaries, or other factors.

West Br. Croton River (West Br. Croton Reservoir Outlet) Brown Trout Assessment

This survey was conducted on 10/1/13 to monitor the brown trout population during a period of lower than historical flows. Two 300 foot sections of stream were sampled using stream electrofishing gear. A total of 700 brown trout were collected. Of those brown trout collected, 487 were young of the year and 197 were yearlings. One of the main concerns over the past 2 years was the effects that the low flows may have on spawning. Although we did not collect many "large" spawning brown trout, it was apparent from our collection that the trout have been successful spawning over the past 2 years.

Ridgebury Lake Northern Snakehead Surveillance

In 2008 and 2009, a two mile section of Catlin Creek (including four small private ponds and a 49 acre wetland) as well as Ridgebury Lake (28 acres), were treated with rotenone in an attempt to eradicate northern snakehead. If northern snakeheads were to have dispersed downstream from this treatment area, the fish could have traveled through a series of streams (Rutgers Creek – Wallkill River – Rondout Creek) and ultimately to the Hudson River.

To confirm that all northern snakehead have been removed from this watershed, and to document fishery restoration, follow-up fisheries surveys have been conducted. In the Fall of 2013, Ridgebury Lake was sampled by boat electrofishing. With a little over 1 hour of electrofishing on-time (0.6 hours collecting only gamefish) 12 black crappie up to 10.6 inches, 5 yellow perch up to 10 inches, 30 largemouth bass up to 15 inches, 50 bluegill, 9 yellow bullhead up to 14 inches, and one golden shiner were collected. No northern snakeheads or common carp were seen or collected. Despite stocking a total of 720 triploid grass carp from 2009 to 2012 for aquatic vegetation control, no triploid grass carp were seen or collected. Due to dense Eurasion milfoil and thick duckweed and watermeal on the surface of the water, this fish collection was very difficult and many fish were probably not visible to collect. Follow-up electrofishing will be needed in 2014 to do a more thorough job of assessing this fishery.

To further verify the presence or absence of northern snakehead in the Ridgebury Lake watershed, a collaborative effort with The Nature Conservancy (at Notre Dame University) and researchers from Central Michigan University to take water samples to test for the presence of northern snakehead environmental DNA (eDNA). A total of 260 2L water samples were collected throughout this watershed, including locations upstream of the treatment area and downstream to the tidal portion of the Rondout Creek at the Hudson River. These samples are being analyzed using a species specific PCR (polymerase chain reaction) marker and traditional PCR techniques. The results of these tests will become available in 2014. The samples that were already taken, as well as any additional samples collected from this watershed, will also be screened using digital PCR. The digital PCR method is more sensitive than traditional PCR and will also be used to help verify results.

HABITAT CONSERVATION

Tappan Zee Bridge Replacement

Region 3 fisheries staff provided on site monitoring during 2013 and 2014 for the Tappan Zee Bridge Replacement Project. Fisheries staff remained heavily involved in the environmental review of all aspects of the project. Numerous revisions in project design were negotiated with the Thruway Authority as well as a mitigation project totaling approximately $8 million. Since the DEC permit for the project was issued in January 2013 fisheries staff have reviewed and approved numerous plans and submissions required by the DEC permit. The Tappan Zee Constructors, the consortium of companies that won the contract to construct the new twin-span bridge, have now started the construction of the new bridge. Fisheries Staff will continue to monitor work at the bridge site to confirm that all DEC permit requirements are being met.

PUBLIC SERVICE & CONSTITUENT SUPPORT

Outreach and Education

The Region 3 I FISH NY program conducted 7 fishing festivals reaching 640 people, 14 fishing clinics reaching 710 people, 5 summer camp programs reaching 210 campers and 4 school programs reaching 305 students. A total of 30 programs were delivered with over 1,865 people going fishing or receiving fishing information this year from the Region 3 I FISH NY Program.

Staff also participated in a statewide "train the trainer" program where I FISH NY staff provides selected summer camps with fishing equipment and teaches the camp counselors how to fish, so they can teach the kids during camp.

Region 3 Fisheries staff set up and staffed a booth at the Suffern Sportsman Show in Rockland County. From February 27 through March 2, 2013, thousands of anglers attended the show. People who visited the booth were able to talk fishing with our staff, receive literature, and view mounts of our state record fish. The kids were entertained while playing velcro-fishing. Due to the switch to a new licensing system earlier in the month license sales were not available at this year's show.

2013-14 Region 3 Fisheries Staff	
Mike Flaherty	Biologist 2 (Aquatic)
Bob Angyal	Biologist 1 (Aquatic)
Larry Wilson	Biologist 1 (Aquatic)
Ryan Coulter	Biologist 1 (Aquatic)
Linda Wysocki	Fish & Wildlife Technician 3
Tim McNamara	Fish & Wildlife Technician 2
Dustin Dominesey	Seasonal Fish & Wildlife Technician
Indie Bach	Seasonal Fish & Wildlife Technician

SPECIES CONSERVATION & MANAGEMENT

Mohawk River Blueback Herring Assessment

Region 4 Fisheries teamed up with numerous interested parties again in 2013 to monitor the unique spawning run of blueback herring in the lower Mohawk River. Day electrofishing commenced in the Hudson River in 2013 below the Troy Dam to document fish use of the adjacent Federal Lock as it first opened for the season in late April. Sites in the Mohawk River expanded from below Canal Corp. Lock E2, above Lock E6 (Waterford Flight) and a repeat of 2012 sites upriver below Locks E7, 9, 11, 15. The survey continued into June but high water led to the unscheduled raising of several temporary Canal Corp. dams in our sampling reaches, thus ending our survey for the year. Total effort included 11 shocking runs over six days at six different sites on the main stem (2-4 sites/day) and ~3.5 hours of shocking (0.3 h avg/site).

Despite the shortened sampling season, 33 species and ~3000 individual fish (602 captured, 2359 observed) were documented in the Lower Mohawk River in this survey. Blueback herring were by far the most numerous fish species recorded (221 captured, 1578 observed) comprising almost 37% of the total catch and 67% of all fish observed but not netted. Spottail shiner, spotfin shiner, and smallmouth bass were also abundant. Data from the 2013 blueback herring assessment will be used in a graduate study advised by Dr. K. Limburg at SUNY ESF.

Otsego Lake

This popular 2-story lake has been sampled every other year by Region 4 Fisheries to assess the walleye population after their reintroduction in 2000. In September, gill nets were set at five different sites plus another two sets in November. Effort at these 12 sites lakewide resulted in a total soak time of 273.7 h (mean 22.8 h/net). Walleye were captured at 11 of 12 sites and 53% were of legal size for anglers (≥ 15” or 380mm TL). CPUE of .22 per hr and 5 per net indicate a moderate to high abundance of walleye. Multiple year classes of walleye were found indicating good survival of young. Very few walleye were captured at the south end of the lake (especially adults) versus the middle section and north end of the lake.

Canadarago Lake

This popular lake has been sampled every fall along the west shoreline in cooperation with Cornell University to assess the warmwater fishery (mostly Percids). A particular concern is the survival of stocked walleye fingerlings in the presence of alewife, an invasive species common to many inland lakes in NYS. The lake now receives a maintenance stocking of advanced fall fingerling walleye that are too large for adult alewife to consume.

Relatively poor weather conditions during the October 2013 survey actually resulted in increased catches of adult gamefish versus previous surveys. A total effort of 1.5 h produced 16 species of fish with yellow perch being the most numerous (N = 586). However, only 9% of yellow perch were of desirable size (≥8”). Only three smallmouth bass were captured (one over 12”). Fourteen of the 32 largemouth bass captured were ≥ 12” (legal size) with some adults weighing up to about five pounds. Good numbers of chain pickerel were found this fall but only 17% were of legal size (≥ 15”). A total of 17 walleye (11 fish/hr) with 88% of them ≥ 15” (legal size).

The percid fishery in the lake appears out of balance in recent years with an abundance of juvenile yellow perch, few larger perch, very few juvenile walleye and a top heavy population of older walleye. Walleye recruitment remains problematic, despite the larger size at stocking. However, the lake remains a very productive warmwater fishery for a variety of species. DEC will continue to stock walleye to maintain the species for angler harvest and we expect the quality of the yellow perch population will improve as the abundant juvenile fish grow to desirable sizes.

East Sidney Reservoir

This reservoir was sampled in September 2013 with gill nets, following a 2011 electrofishing survey. The netting results were disappointing. The 188 hours (mean 23.6 h/net) of gill net effort at eight sites around the reservoir produced mostly adult golden shiner (65%). Yellow perch absent in the 2011 electrofishing effort, comprised 17% of the gill net catch with 80% of those collected considered of desirable size to anglers (≥8” or 200mm). Unfortunately, no pumpkinseed and only 23% of the rock bass captured were of desirable size (≥8”). Similarly, only one of the seven largemouth bass and two of the 18 smallmouth bass were of legal size (≥12” or 305mm), species that were much more numerous in the 2011 spring electrofishing survey.

The netting results reveal a number of conclusions when compared to our 2011 shocking effort and the historical catches. Golden shiner are doing well in the reservoir and seem to be providing an abundant warmwater forage base for black bass. Chain pickerel were captured in the early survey but may now be absent in the reservoir. Brown trout still utilize the reservoir proper when the waters cool in the fall, which probably lasts through the following year into May. Each black bass species may utilize different parts of the reservoir as indicated by their relative abundance in capture data for the different sites over the two sampling nights in 2011. The joint survey results indicate the reservoir is a prime candidate for walleye reintroduction. A new 5-years walleye stocking policy may commence in the fall of 2015. With available spawning habitat upstream in Ouleout Creek and an abundant forage, walleye could become self-sustaining in the reservoir and available for angler harvest in 3+ years.

Kinderhook Lake

A survey was conducted to evaluate the tiger muskellunge stocking program in effect since 2008, and to collect American eel for contaminant analysis. Both this survey and the previous survey were conducted at night under similar conditions. In 3.8 hrs of electrofishing, two northern pike (one juvenile and one 30” adult), 25 largemouth bass and 33 smallmouth bass over 12” in size and over 400 white perch were collected. No tiger muskellunge were observed during the survey. Chain Pickerel, observed during the 2010 survey, were not collected in 2013. Seven American eel were collected during this survey and submitted for contaminant analysis.

Butternut Creek stocking change assessment

Butternut Creek is a tributary to the Unadilla River that remains cooler than most local streams. This is likely due to a steady influx of groundwater and the succession of adjacent farmland to forest. In 2011 a surprisingly high abundance of brook trout was noted (approximately 100 collected or observed), along with 19 holdover brown trout. To better protect the wild brook trout population a stocking change was implemented, terminating brown trout stocking.

In 2013 all seven sites were re-sampled during summer low flows. The numbers of brook trout recorded was down about 15% from 2011 with only 30 captured and another 16 observed. However, brook trout was still the 3rd most abundant species in the 2013 survey (9.6%) behind only cutlips minnow (12.0%) and mottled sculpin (11.2%), respectively among the 24 species and 312 individual fish captured. No brown trout were found at any of the sites but the number of burbot captured increased 37% from 2011. Burbot were common in the deeper lower reach sites. Presence of both brook trout and burbot in the lower reach of Butternut Creek reflects the persistence of this cool-water habitat.

The presence of multiple year classes of wild brook trout indicates successful recruitment, apparently with or without the presence of brown trout. It is important to note that due to major flooding in September 2011 caused by tropical storm Lee, results of this study are reflective of pre and post flooding conditions at the seven sampling sites where obvious changes have occurred to the streambed and banks. Further monitoring of this self-sustaining brook trout population is warranted to better understand the post-flooding changes in the fish community and response of brook trout in the absence of competing brown trout.

Hurricane Irene Trout Recovery Assessments

Three Region 4 trout streams impacted by Hurricane Irene in August 2011, were surveyed to determine whether their trout populations had returned to pre-storm levels. In the West Kill, 35 wild brown trout adults and numerous young of the year were noted. In the East Kill, trout numbers were also simlar to pre-Hurricane numbers, indicating that recovery of the trout population is well underway. Although some segments of the Batavia Kill appear to have rebounded from Irene, trout recovery appears slower than in the East or West Kill.

PUBLIC SERVICE & CONSTITUENT SUPPORT

2014 Ice Fishing Clinics

DEC’s Bureau of Fisheries teamed up with several stakeholders to conduct two free ice fishing clinics again this winter in Otsego County. These I Fish NY events are non-competitive and geared towards kids and newcomers to the sport. DEC staff from various offices and student volunteers provided support to anglers by drilling holes and setting/baiting tip ups and jigging rods. A heated pavilion was available at both events along with an assortment of warm food and beverages. Outreach and education materials, instructions, and ice fishing gear/bait were provided by DEC and OPRHP staff.

Despite the cold breezy weather on January 25th, about 50 locals came to a fish and game club in Hartwick and ice fished, catching a handful of mostly bluegill, along with a few largemouth bass, and black crappie. Many folks took advantage of the warm wood stove in the club house while one couple in particular enjoyed catching their first ever fish (bluegill) jigging through the ice. No fish were caught on tip ups despite several flags and one bait run. Special thanks to the Otsego County Sports Federation for sponsoring this event.

Later in the winter on Feb 19th, DEC teamed up with the OPRHP for the 5th annual free ice fishing clinic held on Otsego Lake at Glimmerglass State Park. Over 60 people came out to enjoy a nice day on the ice The beach house was open to all for the first time. Snowmobiles were used to transport gear on and off the ice due to excessive snow cover. The weather was much more pleasant than previous years but the bite was slow. Overall, only a few yellow perch and chain pickerel were caught along with one keeper lake trout. Despite the low catch rates, participants enjoyed this growing recreational winter sport.

2013-14 Region 4 Fisheries Staff

Chris VanMaaren	Regional Fisheries Manager
Dan Zielinski	Biologist 1 (Aquatic)
Scott Wells	Biologist 1 (Aquatic)
Dennis Wischman	Fish and Wildlife Technician 3
Dave Cornwell	Fish & Wildlife Tech.1 (retired 12/14)
Tim Pokorny	Seasonal Fish & Wildlife Technician
Anthony Bruno	Seasonal Fish & Wildlife Technician

SPECIES CONSERVATION & MANAGEMENT

Polliwog Pond Lake Trout Survey

Polliwog Pond, Town of Santa Clara, Franklin County, was surveyed on July 9-10, 2013, to assess survival of lake trout stocked there since 2004. The 208 acre pond has three deep basins and, historically, supported a native lake trout population. Polliwog Pond was reclaimed in the 1970's to eliminate competitive warmwater species. The reclamation did not succeed in eliminating yellow perch. Smallmouth bass were illegally introduced early in the 2000's and now dominate the inshore fishery. Polliwog Pond is stocked with brown trout and lake trout.

Fisheries staff set three gangs of small mesh gill nets (1.5"-2"-2.5") – one in each basin. These gangs are standard juvenile lake trout sampling gear and were identical to gangs used in recent surveys on Lake Placid and Lake George. A total of five lake trout were caught, ranging from 9 to 27 inches. This was a low catch rate, but does indicate survival and growth of multiple-year classes of lake trout. The largest lake trout caught had no clip, but likely originated from unclipped fish stocked as surplus in 2004. There was no evidence of natural reproduction, but it is still early in the restoration effort as most stocked fish would still be less than eight years of age (the typical maturation age for female lake trout in slow growth Adirondack lakes). Other species caught in the survey were yellow perch and white sucker. Anglers reported catching brown trout during the netting effort. Rich Preall caught numerous smallmouth bass along shore the day prior to the survey. Canoe/ kayak fishing appears to be a popular activity on Polliwog Pond.

Lake trout and brown trout stocking will be continued in Polliwog Pond although stocking numbers will be adjusted downwards. Forage for salmonids seems limited and growth of lake trout is average to below average. Water quality in this clear pond is excellent with good dissolved oxygen to at least 50 feet.

Lower Cascade Lake Round Whitefish Egg Take

The earliest ice-in conditions in many years did not hamper Fisheries and Propagation staff in gathering eggs from the endangered round whitefish in Lower Cascade Lake, Essex County. Regional staff chopped through ¾" of ice on November 21 to set a trapnet in Lower Cascade Lake. Returning on November 22, they found the trap brimming with 246 round whitefish ranging from 8-10." Thirty pairs of fish were stripped for eggs, yielding a gross count of 18,000. The fertilized eggs were transported to the Oneida Hatchery and will be raised to fingerling size for stocking in May 2014.

Technician Jennie Sausville lead the egg take effort. She instructed Neal McCarthy from the Chateaugay Hatchery and Matt Jackson and Adam Kosnick from the Adirondack Hatchery on where/how to set the trapnet in Lower Cascade Lake and how to take eggs from the small adults. Propagation staff will take over the round whitefish egg take effort next year. Continued cold weather lead to cancellation of plans to trapnet adult round whitefish from Little Green Pond near the Adirondack Hatchery and hold them until they spawned in a hatchery raceway. An ice thickness of 2.5" signaled the end of the 2013 field season.

Lower Sargent Pond Reclamation

Lower Sargent Pond in the town of Arietta, Hamilton County was reclaimed by Region 5 fisheries staff with the help of many others. Staff from Regions 3, 4, 6, 7 and 8 assisted with the application of Rotenone along with Central Office and Propagation staff. Lands and Forest and Operations assisted with logistics during the application. Safety while working with the State Trooper Aviation Unit helicopter was overseen by Forest Ranger Bruce Lomnitzer. R5 Bureau of Wildlife was a great help in dealing with the extensive amount of beaver activity in the inlet. Retired fisheries biologist Leo Demong was pivotal to the success of the project from the planning to implementation.

The pond had a reputation as a great brook trout water that produced quality trout and was able to withstand high fishing pressure. Largemouth bass and golden shiners had become abundant over the last 10 years reducing the naturally sustained brook trout population to just larger individuals. The pond was last reclaimed in 1971 by the DEC and was only stocked once with Little Tupper strain brook trout. The project was a great example of the professionalism that the DEC possesses and how a large project can be accomplished with our current work force. Lower Sargent Pond will be stocked in 2014 with Little Tupper strain brook trout. The restoration project had the support of many anglers and residents in Hamilton County and beyond.

The Lower Sargent Pond reclamation was the last treatment that Rich Preall and Bill Schoch will conduct as DEC biologists. Over the past 25+ years they have both contributed extensive amounts of time and energy to brook trout restoration. Bill has been and will continue to be a great advocate for brook trout and native Adirondack lake and pond fish communities. Rich's expertise in both application and rotenone bioassay will be greatly missed. Thank you both for your years of dedication and for keeping the program going over the years.

Lake Placid/Lake Trout Survey

Fisheries staff completed a survey of Lake Placid lake trout with great results! The survey was designed to capture smaller lake trout with the use of gill nets. The netting effort lasted three nights with a total of 167 lake trout captured. A majority of the captured fish were returned to the lake unharmed. Lake Placid has a naturally reproducing population of trout that seem to be doing just fine. A few of the larger lake trout in the lake also found their way into the nets. There were a few “lake monsters” which topped the scales at over twenty pounds. The survey also captured a handful of lake trout in excess of ten pounds, including the old male in this photo. This fish may have been a juvenile during the last juvenile lake trout survey from Lake Placid which was completed in 1992.

Saranac River Sea Lamprey Treatment

Efforts to control sea lamprey numbers continued this fall with four river treatments scheduled. On September 18 the Saranac River was treated for only the second time since the control program began in the early 90’s. Recent lamprey larval assessments by the U.S. Fish and Wildlife Service (USFWS) discovered enough lamprey to warrant this fall’s treatment. In addition to the Saranac, Putnam Creek in New York, as well as the Lamoille River and Stone Bridge Brook in Vermont, will also be treated this fall. The reduction of lamprey larval abundances will lead to improved growth and survival of salmon and lake trout.

Salmonid restoration objectives for Lake Champlain include reducing sea lamprey wounding rates to: 25 wounds per 100 lake trout in the 21-25 inch length size class; and 15 wounds per 100 salmon in the 17-21 inch size class. The 2012 lamprey wounding rate on lake trout increased from a 14-year low of 30 wounds per 100 fish in 2011 to 40 wounds per 100 fish in 2012 (Figure 1). The 2012 lakewide salmon wounding rate increased slightly from 19 wounds per 100 fish in 2011 to 21 wounds per 100 fish in 2012.

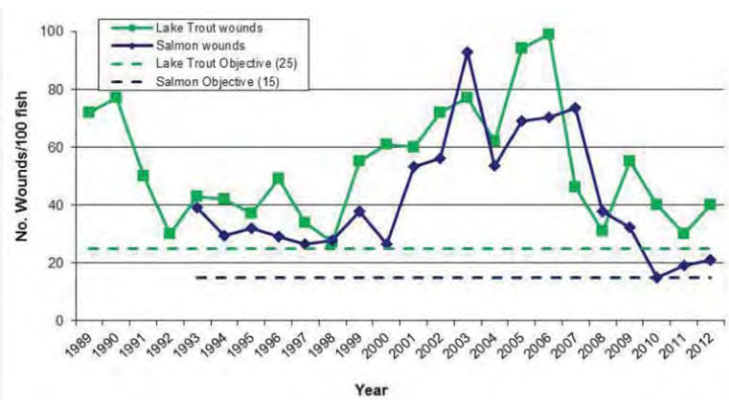


Figure 1. Sea lamprey wounding rates on 21-23 inch (total length) lake trout and 17-21 inch landlocked Atlantic salmon from Lake Champlain, 1989-2012.

Taylor Pond Juvenile Lake Trout Survey

Taylor Pond, Clinton County, was netted using standard juvenile lake trout gangs at the end of July. Six gangs were set on the bottom in deep water while a seventh gang was suspended in the thermocline for landlocked salmon. A total of 55 lake trout were captured which ranged in size from 7 -24 inches. Thirteen (25%) of these trout had fin clips which indicated they were stocked. Thus, 75% of the lake trout were wild. The catch rate of 9/gang is above average for Adirondack lakes. It appears that continued stocking of lake trout in Taylor Pond will be unnecessary. The suspended gang caught 11 landlocked salmon ranging 7-18 inches long. The salmon were in good condition and the high catch rate shows they are surviving well. Salmon stocking will be continued.

Handsome Pond Brook Trout Survey

Handsome Pond, Hamilton County, was netted in late July to assess recent stocking efforts of clipped Little Tupper strain brook trout. Handsome Pond is in the Little Tupper Lake watershed and has promise as a brood stock pond for this heritage strain. The pond is part of John Dillon Park which was developed for disabled access. A survey done in 2010 caught brook trout, but also caught largemouth bass. Members of the Handsome Pond Sportsmen’s Club, which still has access to the pond, have been actively fishing for and removing the bass. This netting caught 23 brook trout, only three of which had clips. Just two small bass were captured. Many of the unclipped brook trout were in a small size range that corresponded well with the clipped fish. There is a chance that poor fin-clip quality resulted in re-growth of fins and misidentification as wild fish. Overall, results of the netting were encouraging for future use of this pond as a brood stock water. Stocking of clipped Little Tuppers will be continued, but the clip will be switched to the adipose fin only (which does not regenerate).

HABITAT CONSERVATION

Water Temperature Monitoring

A long-term temperature monitoring program for selected streams and ponds was initiated. Onset brand temperature recorders have been placed in the West Branch Ausable River (Essex County), True Brook (Clinton County), Salmon River (Franklin County, Malone), Battenkill (Washington County) and Kayaderosseros Creek (Saratoga County). In addition, the Region will visit a variety of different trout ponds in central Franklin County monthly, from May through September to collect temperature and dissolved oxygen profiles. This long-term data set may help indicate which pond and stream types could be stressed by temperature changes.

2013-14 Region 5 Fisheries Staff

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SPECIES CONSERVATION & MANAGEMENT

Lake Sturgeon Management

Lake sturgeon (Acipenser fulvescens) is a Threatened species in New York State. Sturgeon restoration efforts began in 1991. A tagging study started in 2010 to acquire biological data and provide the basis for movement studies throughout Lake Ontario and the St. Lawrence River. A total of 90 sturgeon were collected in 2013 from the eastern basin of Lake Ontario and the St. Lawrence River downstream to just below the Robert Moses Power Project. Most of the fish (83) were new captures and were tagged with Passive Integrated Transponders (PIT tags). Lake sturgeon eggs (130,000) were taken in early June at the Robert Moses Power Project, Massena NY with 3 egg bearing females providing eggs. A cooperative effort between NYS DEC and the Genoa National Fish Hatchery (USFWS, Wisconsin) was successful in rearing approximately 14,000 fingerlings. Approximately 11,000 fish were stocked in the St. Lawrence, Raquette River, St. Regis River, and Salmon River (Franklin County). The remainder (≈3,000) were stocked into Cayuga Lake and the Genessee River in central New York. All fingerlings received Coded Wire Tags (CWT) prior to stocking for year class survival assessments in the future.

Eastern Lake Ontario/St. Lawrence River Warmwater Fish Stock Assessments

Over one-third of fishing effort in Region 6 occurs on eastern Lake Ontario or the St. Lawrence River. Warm/coolwater fish stock assessments are conducted by Region 6 on the St. Lawrence River and by both regional and Lake Ontario units on eastern Lake Ontario. The assessments track condition of fish stocks in these waters. In the St. Lawrence River Thousand Islands area abundance of legal size smallmouth increased from record lows in 1996-2004 and has varied at moderate levels since 2006. Much of this increase has been due to faster growth and earlier recruitment of young fish (largely due to availability of round goby forage) rather than increases in the total number of individuals in the population. Northern pike abundance in the Thousand Islands remains depressed largely due to habitat changes resulting from water level regulation. For Lake St. Lawrence walleye numbers have declined from a peak in 2010 but remain above the long term average. Abundance of legal size smallmouth bass in eastern Lake Ontario has increased substantially from record lows in 2000-2004 although it remains low relative to the levels of the 1970s, 1980s and early 1990s. Increases since 2005 have been attributed to increased growth and vulnerability of young fish to sampling. Regional cormorant management and a switch to round goby prey have reduced cormorant feeding and consumption of sport and panfish.

Brook Trout Management

Heritage strains of brook trout are genetically distinguishable from each other and other strains of brook trout and this makes them important to New York's biodiversity. Their unique adaptations also make them valuable tools in fisheries management. For a number of years, Region 6 has conducted annual heritage strain egg takes in order to further the propagation and distribution of these unique strains of brook trout. In fall 2013, egg takes for the Little Tupper strain were conducted on four waters: North Twin Lake, South Twin Lake, Boottree Pond, and Deer Pond. Fertilized eggs were transferred to the NYSDEC hatchery system. This is the sixth year that an egg take has been conducted on Boottree Pond and it produced the majority of the eggs.

Oswegatchie River Cooperative Walleye Project

Walleye brood stock were collected on the Oswegatchie River (Ogdensburg) on April 22 as part of an annual cooperative project with the St. Lawrence Valley Sportsman and Massena Fish and Game Club. Mature fish were captured by Region 6 personnel by boat electroshocking. Walleye were in various stages of spawning at the time of capture with both ripe and hard females collected. The run was difficult to evaluate due to high water and turbid conditions however it appeared typical. Approximately 2.3 million eggs were harvested and fertilized for rearing by the sportsman clubs. Progeny will be screened for diseases prior to release into the St. Lawrence River.

Walleye Fingerling Evaluation

Regional fisheries staff completed electrofishing sampling at Black Lake, Payne Lake and Red Lake in October 2013. The primary purpose of this sampling was to find evidence of survival of some of the 190,000 fifty-day fingerling walleye experimentally stocked in these lakes annually from 2009 through 2013. For the fifth year, no evidence of these walleye was found in any of the lakes. Sampling in Black Lake this year produced 17 adult walleye of the 2004 through 2008 year classes. Eight were from the 2007 year class, which was produced by natural reproduction and fry stocking only, suggesting that these sources of walleye may be appropriate for Black Lake. This possibility will be explored through further research.

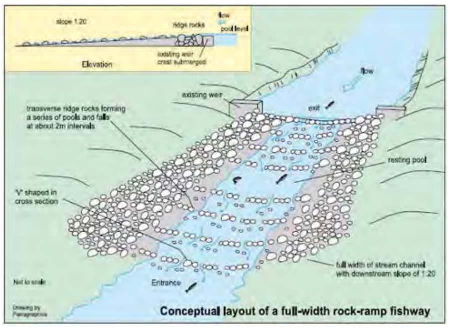
HABITAT CONSERVATION

Mitigating the Impacts of Acid Precipitation

Good water quality is vital to a thriving fish population. Many fish, including brook trout (Salvelinus fontinalis) cannot tolerate acidic conditions. In an effort to counterbalance the effects of acidification NYSDEC conducts a pond liming program which includes monitoring water quality in vulnerable waters. During the 2013 field season, Region 6 monitored water quality in 22 Adirondack lakes and ponds. Results for Lyon Lake which was limed in February 2013 with 80 tons of lime, indicate that the pH has improved. Water quality samples were taken in the summer and fall and the data. No pH improvement was found in Raven Lake, which is below the outlet of Lyon Lake. Hawk Pond was limed by helicopter in February 2014 with 35 tons of lime and will be monitored routinely. Region 6 staff also assisted in applying 30 tons of lime to Bear Pond in February 2014.

Fish Passage

Region 6 Fisheries personnel have been involved with reviewing fish passage designs for Emeryville, Natural Dam, and Eel Weir on the Oswegatchie River. We have encouraged the use of 'nature-like' fishways, such as the rock ramp, which are often less expensive, and more effective at passing a range of fish species, than conventional fishways. We continue to work on re-licensing efforts for the Upper and Lower Beaver Falls Hydropower Plants.



Conceptual layout of a full-width rock-ramp fishway

Flood Response

Rainfall that seemed to never end began falling on the Mohawk Valley in late June and continued until early July. Extensive flooding occurred in the valley causing massive destruction. Region 6 Fisheries staff responded to a multitude of calls from local municipalities and private landowners desperate to save their property. Contractors were busy "fixing" the streams on limited budgets. Development in floodplains exacerbated the extent of the flooding damage. Work is being done to address future flooding events in the Mohawk Valley and to minimize the property damage incurred during flooding and environmental damage due to flood response.

PUBLIC SERVICE & CONSTITUENT SUPPORT

Burdicks Crossing FAS Upgrade

The Burdick's Crossing Fishing Access Site on the Black River was upgraded to a concrete trailer launch through a Cooperative Use and Occupancy Agreement with the Town of Turin.

Outreach and Education

Regional outreach efforts included an outdoor expo in Jefferson County, conservation field days, environmental awareness days, fishing clinics, Envirothon and Earth Day events which together reached thousands of anglers, students and families and throughout the region.

Outreach Program to Ogdensburg 5th grade

Sturgeon stocking in the St. Lawrence River at Odgensburg was companioned with an outreach program for two classes of 5th graders at Madril Elementary School conducted by Douglas Carlson, rare fish biologist from the Watertown office. The 30 minute programs introduced the students to some special life history features of lake sturgeon and reasons for the DEC recovery program that has been underway since 1993. The students also had activities with fish movements in our northern rivers and with up-close looks at sturgeon and another migratory member of this river fish community, American eel.

2013-14 Region 6 Fisheries Staff

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SPECIES CONSERVATION & MANAGEMENT

Whitney Point Reservoir Summer Netting Survey

In alternate years, trap nets and gill nets are set at standardized locations throughout Whitney Point Reservoir, Broome County, to track changes in species composition, abundance, size and age structure of the fish community, particularly crappie and walleye. The July 2013 survey indicates that the fishery is doing well with abundant walleye and smallmouth bass, and average numbers of yellow perch and white crappie. Catches of walleye in both trap nets and gillnets were the highest in the history of the netting which started in 1988. Legal (≥18") walleye comprised approximately 10% of the catch and several over 24 inches were caught. Larger white crappie, some over 13 inches, were fairly abundant and comprised the majority of the crappie sample indicating no strong year classes have been produced in the past few years. As in past years bluegills were very plentiful in the trap net sample and the majority of those captured were of a quality size. Preliminarily, the results of the netting indicate that there is no immediate need to change any regulations at Whitney Point Reservoir.

Spring 2013 Cayuga Inlet Fishway Monitoring

Operation of the Cayuga Inlet Fishway continued in spring 2013. A total of 696 rainbow trout were handled for the season. R7 Fisheries and Bath Hatchery staff worked cooperatively to collect a total of 162,250 eggs which will be used to supplement the populations of wild rainbow trout in Cayuga, Skaneateles, Owasco, Seneca, and Canandaigua Lakes. In addition, another 25,760 eggs were used to create our "hybrid" rainbow trout which are simply a cross with our male domestic rainbows from our hatchery system. These hybrids are primarily used in Skaneateles Lake. Nearly 6,000 adult lampreys were captured and killed at the Cayuga Inlet Fishway during the spring 2013 spawning run. Lamprey wounding of rainbow trout at the Fishway was 0.18 wounds per fish, in the target index group of fish in the 19.7–21.6 inch size range. The increased wounding rate on rainbow trout is a result of ongoing recruitment of the 2007 year-class of sea lamprey to Cayuga Lake. The impact of this year-class on the trout fishery of Cayuga Lake appears greater than anticipated. The high number of adult lamprey captured at the Fishway indicates that this year-class was larger than expected relative to our previous estimates of their density as ammocetes in Cayuga Inlet.

Otisco Lake Walleye Sampling

Fall night electrofishing was conducted along 3.7 miles of the Otisco Lake shoreline to determine the relative success of the 2013 stocking of 44,000 50-day walleye fingerlings. First year survival of the stocked walleye is assessed by night electrofishing in the fall. In 2013, 94 Young-of-Year (YOY) walleye were captured along with 18 older (up to age 8) walleye. Length of the older walleye ranged from 12.1 to 22.7 inches. The YOY walleye showed good growth rates with an average length of 7 inches and all were caught south of the causeway, where the majority of the stocked walleye have been planted since 2002. Of the 44,000 stocked in June 2013, approximately 33,000 were stocked south of the causeway and 11,000 north of the causeway.

Using Serns' 1982 formula for estimating numbers of YOY walleye provides a population estimate of 3,908 in the south end of the lake below the causeway. If accurate, this estimate represents a 12% survival rate (based on the 33,000 stocked south of the causeway). The 12% estimated survival rate is the highest yet during this five year experiment at Otisco Lake. Previous survival estimates for 50-day walleye in Otisco range from 0.05 to 3% but it should be noted that our ability to sample was hampered by mechanical issues during 2009 and 2011, and by extremely low water levels in 2012. For perspective, the broad range of survival for these 50-day walleye is similar to what we observed previously from stocked "pond fingerling" walleyes.

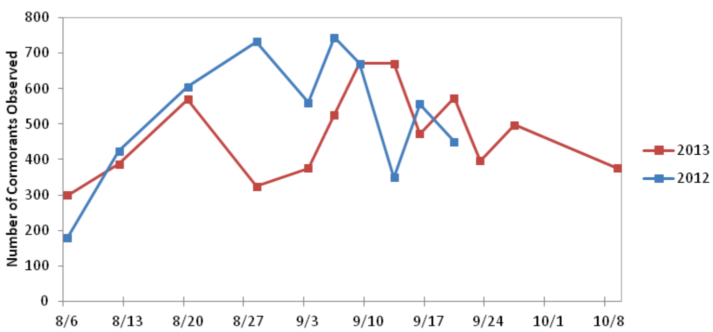
Gamefish were the target species and in addition to walleye, 16 tiger musky (8.3-31.2 inches), 37 smallmouth bass (6.2-17.3 inches), 29 largemouth bass (5.3-16.9 inches), and one brown trout (15.7 inches) were also collected.

Eaton Brook Reservoir Sampling

Two fisheries surveys were conducted on Eaton Brook Reservoir, a 272 acre lake in Madison County. The first was a two-night electrofishing survey in June, and the second was a two-day gill netting survey in July. The objectives of the surveys were to evaluate age, growth, abundance, and predator/prey balance of the reservoir's sportfish community. Additional objectives were to determine if stocked rainbow trout are surviving and if recent year classes of walleye are recruiting. Eaton Brook Reservoir is stocked annually with 2,000 year-old rainbow trout and roughly a million walleye fry. In total 621 fish were caught, representing 16 species. Largemouth bass were the most numerous with 172 caught, 28% of catch, followed by 94 bluegill, 91 pumpkinseed sunfish, 66 smallmouth bass and 60 chain pickerel. Ten walleye and one rainbow trout were also caught. Walleye ranged in size from 17.2 to 27.8 inches and in age from 5 to 12 years. The only rainbow trout caught was 12.8 inches and aged at 2 years old. That would make it from the 2012 stocking, which shows there is some potential for hold-over; especially considering the warm dry summer of 2012. Overall, size range and number of most of the sportfish species collected were indicative of balanced populations. Based on the abundance and other population characteristic of the species sampled, there appears to be no need to change any regulations at this time for Eaton Brook Reservoir.

Cormorant Management on Oneida Lake

A joint DEC and volunteer cormorant hazing program was again implemented at Oneida Lake in September 2013. As in the previous three years DEC Fish and Wildlife staff and Environmental Conservation Officers (ECO's) from both Regions 6 and 7 were involved with the hazing effort. Cormorant numbers declined by roughly half following the first DEC harassment effort in late August but increased in mid-September as the migration commenced. Although the number of cormorants ranged from 400 to 600 birds from mid-September through early October staff felt confident they would have been higher without the hazing effort. Most birds encountered during the latter half of September appeared naive to the hazing efforts indicating they were new birds to the lake. A total of 134 cormorants were killed in order to reinforce the hazing efforts and to collect data on what the birds were eating. Gizzard shad and emerald shiners were again an important part of the cormorant diets but adult yellow perch and panfish comprised a significant portion their diets for most of the month of September. In contrast to previous years, there was only one week (last week of September) in which gizzard shad comprised nearly the entire diet of the cormorants sampled. The size and abundance of young-of-year (YOY) gizzard shad in September appears to have a great influence on their utilization by cormorants at Oneida Lake. In past years when YOY gizzard shad were larger and more abundant they appeared to serve as a buffer against cormorant predation on other sportfish.



Number of Double Crested Cormorants Observed in 2012 and 2013

Chittenango Creek Electrofishing Survey

A two mile section of Chittenango Creek, a popular trout stream in Madison County, became a No Kill (NK) artificial lure only trout fishery in Oct 2010. On August 20, 2009, prior to implementation of the NK regulation, Region 7 Fisheries staff conducted an electrofishing survey at two sites within the proposed NK area to gather baseline data on the trout population. On August 20, 2013 fisheries staff re-surveyed those same two sites to determine whether the NK regulation has impacted the trout population in the reach. In 2009, 80 brown trout (73% wild, based on observations of deformed or eroded fins) were collected with a length range of 3.1-17.4 inches, and a mean length of 7.2 inches. The 2013 survey yielded 81 brown trout (67% wild) with a size range of 3.8-16.6 inches, and a mean length of 9.4 inches. We anticipated finding significantly more brown trout in 2013 as the result of the NK regulation but that was not the case. Despite similar numbers caught, the size distributions of the samples from the two surveys were significantly different. Increased mean size of the 2013 sample of trout was in part due to a nearly complete absence of young fish. Young-of-year trout (<4.2 in.) made up 44% of the brown trout sample in 2009 versus just 2.5% in 2013. The warm dry summer of 2012 and/or the major flooding that has occurred since may have affected survival of young trout. Increased abundance of older trout may be a result of the No-Kill policy.

DeRuyter Reservoir Walleye Assessment

Fall night electrofishing was conducted along 2.9 miles of the DeRuyter Reservoir shoreline to evaluate the relative success of the 2013 experimental stocking of 50,000 walleye fingerlings. The reservoir has historically received an annual stocking of 1.1-2.8 million walleye fry from the Department but 2013 was the first year of an experimental walleye fingerling stocking program undertaken by the DeRuyter Reservoir Association (DRA). The DRA hoped that stocking larger walleye fingerling at an extremely high density would result in more walleye in the lake. Unfortunately, no Young-of-Year (YOY) walleye were found, but 26 older walleye were collected. These walleye ranged from 3 to 11 years old and from 14.2 - 27.0 inches. Walleye collected were on the thin side with a mean relative weight (Wr) of 82.5 ± 6.1. A normal Wr range is 90-100. Given that no YOY were collected it would appear that there was limited success with the 2013 walleye stocking.

Jamesville Reservoir Walleye Assessment

Night-time boat electrofishing was conducted on October 10, 2013 to assess the current status of the walleye population in the reservoir as well as to attempt to assess the tiger muskellunge population which is also stocked by the Department. The entire perimeter of the lake was sampled, and 25 walleye (nine YOY) were collected, along with five tiger muskellunge. The catch rate of walleye was 13.7 fish per hour, a substantial improvement over the 2010 survey at 5.6 fish per hour, and 2011 at 4.7 fish per hour. Walleyes ranged in size from 7.1 to 26.3 inches and ranged in age from 0 to 9+ years. All the tiger muskellunge captured were less than 12.5 inches in length indicating they were part of September 2013 Department stocking of 1,700 fish. Jamesville Reservoir's history of consistent survival of stocked walleye clearly indicates that continued management of this species is warranted for the long term. Further evaluation of the success of the tiger musky stocking is necessary given the consistent lack of larger fish in our samples.

Salmon River (Redfield) Reservoir Survey

The Salmon River Reservoir in Oswego County was surveyed in June 2013 to determine the level of natural reproduction resulting from five years of juvenile walleye stocking in the reservoir (2004-2008). This survey was a replication of one completed in 2008 as a mid-project assessment. The numbers of walleye and yellow perch increased noticeably between the two studies, while the number of smallmouth bass declined considerably. Based on both the gillnet catch rate and the length-at-age results there appears to be a moderately abundant walleye population in the reservoir. Age data shows that the majority of the walleye in the population are from natural reproduction. Yellow perch numbers rose between the two surveys but are still in the low abundance range for New York State. The recent repeated droughts decreased the amount of submersed aquatic vegetation in the reservoir likely impacting the black bass population and lessening the predatory pressure on young walleye.

2013-14 Region 7 Fisheries Staff

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SPECIES CONSERVATION & MANAGEMENT

Lake Trout Assessment - Seneca Lake

Lake trout populations were assessed in Seneca Lake in July 2013, using standardized Finger Lakes gill nets. Lake trout were last surveyed in 2008. A total of 339 lake trout were collected for a catch rate of 10.3 net night, slightly higher than recent years. Based on fin clips, approximately 45% of lake trout collected were naturally reproduced, lower than in 2005 and 2008 where 65 and 60% were found to be wild fish. Overall condition of lake trout appeared to be good, with relative weights for the stock, quality, and preferred size groups at 107, 116, and 103, respectively. Lamprey wounding rates were 0.57 wounds/scars/fish in the 600-699 mm size range, which met the target rate. Rainbow smelt continue to be absent in both the gill nets and lake trout stomachs. In response to abundant lake trout populations, increased natural recruitment rates and potential negative impacts to other salmonines (i.e.rainbow trout, brown trout, and landlocked salmon), lake trout stocking rates were reduced by 33% in 2012 and harvest regulations liberalized from up to 3 to 5 lake trout/ per day also in 2012.

Catharine Creek Sea Lamprey Larval Assessment

Sea lamprey larval habitat, distribution, and abundance were assessed in a 10.5 mi reach of Catharine Creek in early fall using Great Lakes Fishery Commission protocol for Great Lakes Streams. Catharine Creek was last treated for sea lamprey larvae in 2011. The stream was split into two separate reaches: upstream and downstream of a pool digger that may have developed into a sea lamprey barrier. Results from downstream of the pool digger indicated that Type I habitat, which is prime sea lamprey larval habitat, accounted for only 1.1% of the total area while Type III habitat, which is extremely poor, was nearly 89% of available habitat. Larval abundance was estimated at 9,880 larvae. Upstream of the potential barrier, no Type I habitat was found and nearly 100% was Type III. Subsequently no sea lamprey larvae were discovered. Results indicate that very little Type I habitat is found in Catharine Creek, however downstream of the barrier, anywhere Type I or Type II habitat was found, so were sea lamprey larvae. Based on the results of this survey it is recommended that Catharine Creek be treated in 2014 and that the primary application point for the lampricide be located just upstream of the pool digger

Honeoye Lake Standard Gang Gill Netting

Staff conducted four nights (8 total nets) of gill netting on Honeoye Lake during September, 2013. This survey was conducted primarily to assess the walleye and panfish populations. Samples were also collected for fish disease testing and the Toxic Substance Monitoring Program. Honeoye Lake is well known for quality panfish and supports popular fisheries for black crappie in the spring and bluegills and pumpkinseeds throughout the open water and ice fishing seasons. The catch rate for black crappie was the highest we have had for this type of survey on Honeoye Lake. Eighty-nine percent of the black crappie sample consisted of sub-legal (< 9 inches) fish. The large numbers of sub-legal black crappie should lead to good fishing over the next few years, as these fish reach legal size. Catch rates for bluegills and pumpkinseeds were down significantly compared to our last netting in 2008. Although abundance of bluegills and pumpkinseeds appears to be down, their size structure is much more balanced than it was in 2008.

The catch rate for walleye was down slightly from 2008. Six percent of the walleye sample consisted of sub-legal (< 15 inches) fish. This was a significant change from our last gill netting in 2008, when 40% of the walleye sampled were sub-legal. The decrease in sub-legal walleyes is concerning. We have proposed raising the size limit on walleye from 15 to 18 inches because of a low 2012 population estimate, low angler diary catch rates, and high yellow perch abundance all suggest that the walleye population is down. In the short term, the proposed regulation change will protect some walleye that are currently in the 15 to 17 inch size range, but better survival of stocked walleye is needed to sustain the fishery in the long term.

Muskellunge Assessment – Waneta Lake

The muskellunge population in Waneta Lake was assessed using Oneida style trapnets set at three standard sites from 16-26 April 2013. A total of 158 muskellunge were collected. Total length, weight, sex, and maturity status were recorded and fish scales were collected for subsequent aging. In addition to muskellunge, information was collected on all other species of fish collected during the survey. Preliminary data analysis indicates that catch rate of 7.2 musky/net night was slightly higher than 5.5 musky/net night in 2009. Approximately 80% of muskellunge collected were > 30 inches, the current legal size limit. The largest muskellunge collected was 55 inches and weighed over 40 pounds. Natural recruitment based on fin clip examination indicated about 10% may be considered wild fish. Overall condition of muskellunge appeared to be good. Numerous quality sized yellow perch and black crappie were collected indicating a very good fishery exists for these species. Proposed statewide regulations to increase the minimum size limit for muskellunge from 30 to 40 inches should increase the potential of catching trophy size fish in Waneta Lake.

Wayne County Lake Ontario Bays Recreational Fishery Survey

From April 1, 2012 to March 31, 2013, staff conducted a recreational fishery survey on East, Port, and Blind Sodus bays in Lake Ontario. The bays support diverse warm water species and Port and Blind Sodus Bays are intensively managed for walleyes, each receiving biannual stockings of fingerling walleyes raised in DEC hatcheries.

Port, East, and Blind Sodus Bays provide excellent year-round panfish and bass, and good northern pike, fishing opportunities for those anglers who prefer to fish smaller, less heavily fished water bodies in Wayne County. Panfish catch rates were above those observed on other nearby Lake Ontario bays. Largemouth bass was the favorite open water gamefish target on the bays, consistent with the preferences of anglers surveyed during a recent statewide survey. The high release rate of bass, particularly legal sized bass, observed on these bays is consistent with the “catch and release” ideology practiced by most bass anglers today. No bass were harvested from the bays during the catch and release season from December through May. The Port and Blind Sodus Bay walleye catch rates are well below the statewide objective, despite modest walleye CPUEs from assessment surveys.

Staff Assist with Irondequoit Bay Lake Herring Stocking

Re-establishing self-sustaining populations of native whitefishes in Lake Ontario is the focus of cooperative efforts between the Department, the U.S. Geological Survey (USGS), the Ontario Ministry of Natural Resources (OMNR), the U.S. Fish and Wildlife Service (USFWS), and the Great Lakes Fishery Commission, with supporting research conducted by The Nature Conservancy (TNC). On November 14 and 20, 2013, staff assisted USGS and TNC staff with stocking lake herring in Irondequoit Bay. Lake herring were once an important prey fish in Lake Ontario, and supported important commercial fisheries that collapsed in the early 1950s largely due to over-harvest. In New York waters of Lake Ontario, lake herring historically spawned in Irondequoit Bay, Sodus Bay, the Sandy Ponds, and Chaumont Bay. The juvenile lake herring that were stocked originated from eggs collected by Department staff in Chaumont Bay during November and December, 2012. Lake herring eggs were hatched and juveniles reared at the USGS Tunison Laboratory of Aquatic Science in Cortland, New York.

Stocking of Lake Sturgeon in the Genesee R.

Re-establishing self-sustaining populations of native lake sturgeon in Lake Ontario is the focus of cooperative efforts between the Department, the U.S. Geological Survey (USGS), the U.S. Fish and Wildlife Service (USFWS), the Great Lakes Fishery Commission (GLFC), and the Seneca Park Zoo. On October 2, 2014, region 8 staff assisted USGS staff with stocking 1000 lake sturgeon fingerlings into the Genesee River.

Native Mussel Distribution in the S. Lake Ontario Watershed

Region 8 Fish and Wildlife staff completed the final year of a five-year project to determine distribution, density, and status of native freshwater pearly mussel species in the Southern Lake Ontario watershed. In most of the watershed’s streams, the current status of mussels is unknown.

To date, 416 sites along 126 streams and 27 Erie Canal sites have been surveyed. Live mussels were found in 63 of the surveyed streams, with Species of Greatest Conservation Need (SGCN) confirmed in 25 streams. Mussels were documented for the first time in over 50 streams. Throughout the Erie Canal sites, both native pearly mussels and invasive bivalves were found.

Twenty-three native mussel species are represented in these surveys; 20 of the 23 species were found live, including ten SGCN. Two species found live in several waterbodies, paper pondshell and lilliput, had not been reported from NYS in over 15 years, while a third species, deertoe, was previously unknown from this watershed. Deertoe is ranked by Natural Heritage Program as having only “5 or fewer occurrences” statewide. In addition, green floater mussel, a NYS threatened species was found at several sites along the Genesee River, as well in tributaries in the Upper Genesee and Finger Lakes basins.

PUBLIC SERVICE & CONSTITUENT SUPPORT

Fishing Pole Lending program

Two new libraries joined the Region 8 Library Fishing Pole Program in 2013, bringing the total number of libraries to seven. Regardless of the number of users, all the Librarians report the program generating a lot of positive comments.

- Dansville Public Library – Poles were checked out 34 times. Average length of each check out was 3 weeks.
- Wood Library (Canandaigua) - - Poles were checked out 62 times, each for a 3 week period.
- Pulteney Public Library - - Poles were checked out 18 times by 11 different people.
- Honeoye Public Library - - Poles were checked out 26 times, each for a 3 week period. The fishing pole lending program at the Honeoye Public Library was highlighted on National Public Radio featuring unique ways libraries nation-wide are serving communities.
- Woodward Memorial Library (LeRoy) - - Poles were checked out 23 times.
- Modeste Bedient Memorial Library (Branchport) - - Poles were checked out twice for 5 days.
- Hoag Library (Albion) - - Joined the program in the late fall, no poles were checked out.

High School Students Learn About Fisheries Management.

On October 9 and 10, 2013, for the twelfth consecutive year, Region 8 Fisheries staff cooperated with Delta Laboratories’ Adopt-a-Stream program to provide about 120 Environmental Studies students from four area high schools a hands-on demonstration of fisheries management techniques. Demonstrations were also given in boat electrofishing, fish identification, water quality, freshwater mussels, fish seining, and fish scale aging and data interpretation. Students had the opportunity to capture, handle, identify, and measure live native fish, age fish scales, and handle and identify benthic invertebrates.

Marsh Madness

For the fifth consecutive year staff cooperated with Cornell Cooperative Extension of Livingston County, to treat about 80 fourth graders from Livonia Intermediate School to live creatures from the Seneca Park Zoomobile at the Chip Holt Nature Center and an interpretive walk at the Conesus Inlet Wildlife Management Area to view northern pike and walleyes during their spawning migration runs.

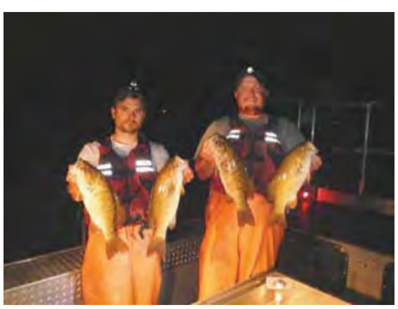
2013-14 Region 8 Fisheries Staff	
Web Pearsall	Biologist 2 (Aquatic)
Matt Sanderson	Biologist 1 (Aquatic)
Brad Hammers	Biologist 1 (Aquatic)
Peter Austerman	Biologist 1 (Aquatic)
Amy Mahar	Biologist 1 (Ecology)
Dan Mulhall	Fish and Wildlife Technician 1
Robert Deres	Fish and Wildlife Technician 1
Daniel Drake	Seasonal Fish & Wildlife Technician

SPECIES CONSERVATION & MANAGEMENT

Allegheny River Fish Community Survey

The Allegheny River watershed in New York State was sampled in 2013-2014 by boat and backpack electrofishing, electrified benthic trawling, and seining to assess the fish assemblage, and to evaluate the gamefish and panfish populations. A total of 319 sites were sampled within the Allegheny River watershed and resulted in the collection of 79 taxa. This included a group of 16 sportfish species, dominated by smallmouth bass and walleye, and caught primarily with boat electrofishing. Trawling proved effective in sampling the Percidae family and other small bodied channel species. Several rare, "threatened" or "endangered" species such as bluebreast darter (Etheostoma camurum), longhead darter (Percina macrocephala), and spotted darter (Etheostoma maculatum) were collected during this survey. In terms of species richness and diversity, the results of this survey compare favorably to the results of a 1937 survey by the New York Conservation Department; the last comprehensive survey of the Allegheny River watershed.

Quaker Lake Fisheries Survey



In the spring of 2013, Quaker Lake's fish community was sampled by boat electrofishing to assess the status of the warmwater fishery. Comparative data was available indicating bass populations had undergone size and/or structural changes since last surveyed in 2004. Population estimates indicate the smallmouth bass population had increased in abundance while largemouth bass abundance had remained fairly stable. The proportional stock density (PSD) of smallmouth bass indicated the population had maintained good size structure with no significant production problems. However, PSD and relative stock density (RSD380) values for largemouth bass indicate the population had become heavily skewed towards larger bass as a result of reproduction and/or recruitment problems. Evidence indicates yellow perch may be limiting largemouth bass recruitment. Supplemental evidence suggests competition with northern pike may have negatively impacted the size structure of largemouth bass as well. Analysis of all data suggests Quaker Lake's fish community was in transition, possibly establishing a new balance between fish species. The well balanced, growing smallmouth bass population remained as the lake's primary predator. However, the largemouth bass population, which had become structurally unbalanced, was represented as a secondary predator in lesser numbers. The yellow perch population, which dominated the catch during the 2013 spring survey, became established as Quaker Lake's most abundant prey species.

Chautauqua Lake Centrarchid Survey

The fish community in Chautauqua Lake was sampled during the spring of 2012, by boat electrofishing, to determine the status of the largemouth bass and smallmouth bass populations. This was the first spring electrofishing survey completed on Chautauqua Lake since 1996. Sampling effort was divided into 23 separate electrofishing runs. Thirteen runs were completed in the north basin and 10 runs were completed in the south basin. In total, 120 minutes were devoted to catching all fish and 450 minutes were devoted to catching game fish only. A total of 2,893 fish were captured during the study. Yellow perch were by far the most abundant fish collected, with largemouth bass being the most abundant game fish collected. The catch per unit effort of largemouth bass and smallmouth bass was 26.7/hr and 5.6/hr, respectively. The catch rate of largemouth bass was higher than the catch rate during the spring of 1996, and higher than averages from the New York State Bass Study. The catch rate of smallmouth bass was slightly lower than the catch rate in the spring of 1996 and lower than the statewide average. Proportional stock densities for both largemouth bass and smallmouth bass decreased since 1996, but still indicate a fairly balanced population with no significant production problems. Overall, the largemouth bass and smallmouth bass populations have either increased slightly (largemouth) or remained stable (smallmouth) since 1996 and should continue to provide quality angling opportunities.

Wild Brook Trout Stream Surveys

From June to October 2013, two seasonal Fisheries Technicians completed the fourth and final year of surveys on small streams across Region 9. Many of these streams had never been surveyed. The primary focus for this work (a part of the Eastern Brook Trout Joint Venture) was to locate undocumented wild brook trout populations or other wild trout species. This was a Federal Aid to Sportfish Restoration project. Work in 2010 focused on the upper Genesee River watershed. Work in 2011 work occurred in the Erie-Niagara watershed, while the 2012 and 2013 work occurred mainly in the Cattaraugus and Chautauqua County portions of the Allegheny River watershed. With the identification of these wild trout populations, efforts to upgrade water classifications to afford them additional legal protection have begun. Streams will also be prioritized for future habitat restoration and potential brook trout reintroduction efforts.

During 2013, the crew assessed 202 streams. Of this total, 13 were found to be dry. In the 189 streams electrofished, they found wild brook trout populations in 35 of the streams, wild brown trout in 26 streams and wild rainbow trout in 8 streams. Wild brook trout in these streams face threats to their existence such as competition with brown trout, elevated water temperatures and poor land use practices. On the positive side, several surprisingly large specimens of both wild brook and brown trout have been found in these mostly very small streams.

In four field seasons, a total of 1,583 streams have been assessed, of which 1,322 (84%) have never been surveyed before. Wild brook trout were found in 194 streams, wild brown trout in 213 streams and wild rainbow trout in 31 streams. Of the 373 streams sampled that contained wild trout, 365 (98%) need to have their water classifications upgraded in order to offer the streams maximum protections from disturbance. Sixty three percent of streams found to support wild trout currently have no permitting requirements for stream disturbance projects. Although an ancillary part of this project, man-made barriers (mainly road culverts), potentially impassible to trout and other fish were identified on 279 streams in the surveys.

Elton Creek trout population sampling

In August 2013, Region 9 Fisheries staff along with angler volunteers completed trout population sampling in both the stocked and wild trout sections of Elton Creek, in Cattaraugus County. Six sites were electrofished, duplicating sites sampled in 1991, 2001 and 2013. In 1991 and 2001, the area where all six sites were located was being stocked with hatchery brown trout. However in 2013, only the lower two sites were in the stocked section, stocking having been removed where the upper four sites were located in 2002. Sampling in 2013 was done to monitor the wild trout population and to evaluate the effects of removal of stocking on the wild trout.

For all sampling sites combined, the estimated abundance of adult (yearling and older) wild brown trout was 164/mile, which is lower than that found in 1991 (231/mile) or 2001 (243/mile). Conversely, the abundance of wild rainbow trout in 2013 for all sites combined (525/mile) was much higher than 1991 (117/mile) or 2001 (335/mile). A similar pattern of abundance was apparent when looking at just the sites in the unstocked section. However, both species were more abundant in the unstocked than the stocked section in all years – especially rainbow trout. This was likely due to better water temperatures for the survival and growth of trout in the upstream, unstocked section.

While wild brown trout abundance declined from 1991 to 2013, biomass of wild brown trout almost doubled for all sites combined during that period (17-31 pounds/acre), indicating the population was made up of much larger individuals in 2013. In fact, in 2013, of the estimated 164 adult wild brown trout per mile, 70/mile were >10 inches and 49/mile were >14 inches. Similar increases in biomass were observed for wild rainbow trout with the biomass increasing from 4 to 21 pounds/acre, for all sites combined, from 1991 to 2013. It is likely that the reduced abundance of fall-spawning wild brown trout was due to poor spawning and rearing conditions through the fall/winter the past couple years. The increased wild brown trout biomass may be related to more trout surviving to older age/larger size, due to decreased brown trout abundance and/or due to reduced angling harvest since stocking was eliminated in the upper section of the creek. The increased abundance and biomass of spring-spawning wild rainbow trout is likely due to successful spawning and rearing conditions, decreased angler harvest following the elimination of stocking in the upper section of the creek and/or increased voluntary release of trout. This phenomenon is similar to what we have seen on other Region 9 streams in recent years.

In 2013, at the two sampling sites in the stocked section, a very low abundance of hatchery brown trout were found from the previous spring's stocking. This is similar to 1991 and 2001 sampling and indicates that water quality in that section of stream may not be conducive to survival of the stocked trout through the summer months in the lower section of the stream.

PUBLIC SERVICE & CONSTITUENT SUPPORT

Angler Outreach

Fishing Clinics: Region 9 fishing education efforts included coordination and involvement in 5 youth and family free fishing clinics, reaching 567 youth anglers and their families. Two exceptionally strong free fishing day events at Tifft Nature Preserve and Chestnut Ridge County Park were provided in cooperation with the Erie County Federation of Sportsmen's Clubs.

Summer Camp Programs

Fisheries staff provided 6 fishing education programs for youth campers at DEC Rushford Environmental Camp, covering fishing education and instruction for a total of 319 campers. In an effort to offer fishing education to more youth summer camps than DEC staff can actually visit, the Train-the-Trainer program was provided for 3 water-based summer camps. The goal is to teach fishing education to the camp counselors who will in turn provide the training to their many campers throughout the summer. A total of 21 camp counselors received fishing education training and fishing equipment from DEC staff.

Fishing Hotlines

The Lake Erie and Western New York Fishing Hotlines are updated every Friday to provide western New York anglers with current info on productive fishing locations, baits, tips and techniques. Each hotline is available on the DEC website at *www.dec.ny.gov/outdoor/fish-hotlines.html* or can be heard at (716) 855-FISH. During the report period, anglers visited the Lake Erie hotline page 97,949 times, Western New York hotline page 84,349 times and the automated phone lines 25,099 times. In all, these popular angler resources were visited an average of 568 times per day.

2013-14 Region 9 Fisheries Staff	
Mike Clancy	Biologist 2 (Aquatic)
Scott Cornett	Biologist 1 (Aquatic)
Mike Todd	Biologist 1 (Aquatic)
Mike Wilkinson	Biologist 1 (Aquatic) retired 4/14
Chris Legard	Biologist 1 (Aquatic) hired 12/13
Jim Zanett	Fish &Wildlife Technician 3
Rob Roth	Fish &Wildlife Technician 1
Justin Brewer	Fish &Wildlife Technician 1
Amanda Wagner	Fish &Wildlife Technician 1
Tobias Widger	Fish &Wildlife Technician 1
Ashleigh Read	Fish &Wildlife Technician 1

SPECIES CONSERVATION & MANAGEMENT

Fishery Surveys Entered Into Statewide Fisheries Database

Data from a total of 820 fishery field surveys were received by the Biological Survey Unit during 2013-14. A total of 738 surveys were finalized and added into the Bureau of Fisheries Statewide Database (SWDB). A substantial number of the surveys received and processed by Central Office was a result of increased effort in recent years by some DEC Regions in conducting Eastern Brook Trout Joint Venture (EBTJV) surveys. Of the 738 surveys that were finalized 473 were EBTJV surveys. Updated copies of the SWDB containing newly entered data ("Releases") were provided and distributed three separate times, July, 2013, November 2013, and in March 2014.

New York Baitfish Use Survey

An angler survey on the use of baitfish was completed by the Cornell Human Dimensions Research Unit (HDRU). The Bureau worked closely with HDRU during the development of the survey including identifying topics to focus on. Primary purposes of the survey included obtaining more information and learning about how anglers in New York used baitfish, the species they fished for when using baitfish, where they fished, and the type of fishing they were engaged in. Secondly, the survey was utilized to obtain feedback on how the recent baitfish-fish health regulations and modifications impacted baitfish anglers, and anglers' views about the regulations.

Results of the survey show that the proportion of anglers who used baitfish while fishing in New York in the past five years is estimated to be 42%, or roughly 337,300 anglers. Of those an estimated 290,100 anglers used baitfish while fishing in New York in the past year. In addition to fishing with baitfish, almost all anglers also used artificial lures (94%) or other types of bait. Few anglers (3%) just fish with baitfish. Of those anglers who use baitfish, 77% fish from a boat, 52% ice fish and 51% fish from shore. When fishing with baitfish in New York in the past year, 25% used personally collected baitfish some of the time and 75% used only purchased baitfish. Most respondents (89%) obtained information about baitfish regulations from at least one of the four DEC sources listed in the questionnaire (i.e., fishing regulations guide, other DEC publications, DEC website, and DEC personnel). A majority also indicated they received information from the place where they purchased baitfish, making baitfish sellers an important conduit of information from DEC to anglers.

Most baitfish anglers in New York (84%) were at least slightly familiar with the 2006-2007 baitfish-fish health regulations. Far fewer (45%) were familiar with the newer 2011 regulations. Even among those who indicated that they had fished within the corridors since 2011 (which was the majority of the anglers using baitfish) only one-third were moderately or very familiar with the regulations. Just over half (53%) of those who had personally collected baitfish in 2012-2013 were moderately or very familiar with the regulations. Some anglers (23%) indicated that they previously used baitfish but have now stopped because of the baitfish regulations. Cornell HDRU staff estimated that roughly 107,150 anglers were impacted in this way by the regulations. The majority of baitfish anglers (58%) were satisfied or very satisfied with the job the DEC Bureau of Fisheries is doing using regulations as part of their approach to prevent the spread of fish diseases in New York. Few were dissatisfied (11%).

Some anglers engaged in activities that might lead to the introduction of aquatic invasive species: 35% of those fishing from a boat placed their baitfish in a recirculating livewell; 25% used baitfish in more than one water body some of the time; and 6% moved baitfish between water bodies most or all of the time. Sixty Five percent (65%) of those who bought certified baitfish indicated that at some point they had exchanged or supplemented the water in their bait bucket with water from the water body they were fishing in.

A draft report entitled "Anglers Who Use Baitfish in New York and Their Views on Recent Regulation Changes" was completed by Nancy A. Connelly and Barbara Knuth of the Human Dimensions Research Unit, Department of Natural Resources, Cornell University by the end of the 2013-14 fiscal year and was finalized in the summer of 2014.

Exemption for the Possession and Sale of Bighead Carp

The proposed rule-making that was developed and filed during the previous year (2012-13), for the purposes of removing the exception that has existed in statewide regulation allowing for bighead carp to be sold, possessed, transported, imported and exported in NYC and immediate vicinity was finalized, and became effective in August, 2013.

This created consistency with the "Asian Carp Prevention and Control Act" which added these fish as an Invasive and Injurious Species in 18 USC 42. This federal act went into effect in December 2010, making bighead carp federally prohibited from being imported and it is a Lacey Act violation if they are transported across state lines into New York. As a result of federal action, the exceptions in the state regulations were no longer legal and needed to be repealed.

Warmwater Fisheries Management

Ecology and Management of the Fish Communities in Oneida and Canadarago Lakes

Researchers at the Cornell Biological Field Station at Oneida Lake completed their annual assessment of the fish communities in Oneida and Canadarago Lakes. Funded by a Federal Aid in Sportfish Restoration grant, these monitoring projects are the longest running warmwater fishery assessments in New York State and continue to provide valuable insight on the complex dynamics associated with warmwater fish populations in large northern lakes.

Oneida Lake

Long term fish community changes in Oneida Lake are measured by assessing standard gill net catches. There were 2,005 fish caught in the standard gill nets in 2013, the highest observed since 2002. Catches continue to be dominated by yellow perch (35% of the catch), white perch (27%), and walleye (20%). These three species represent over 80% of the catch in most years, with white perch occasionally outnumbering yellow perch.

The estimated adult (age 4 and older) walleye population abundance was 360,003 in 2013, which was a decrease from the 2012 estimate of 480,200. The decline in the adult population likely resulted from several factors, including modest year classes recruiting into the adult population since 2010 and recent increases in harvest. Predicted recruitment from the 2010 and 2011 year classes (108,500 and 81,700 fish, respectively) are above recent harvest levels (54,000 – 60,000 fish/year) and should result in an increase in the adult population over the next 2 years. Over the full course of the 57 year data series the adult walleye population has experienced a significant decrease, but has shown a significant increase in the last decade.

The adult (age 3 and older) yellow perch population was estimated to be 1.7 million fish. Over the last four years the population has been increasing, likely as a result of relatively strong year classes produced from 2005-2008, which may have been aided by limited ice fishing opportunities over recent winters and a prolonged period of low cormorant numbers on the lake. Long term trends show a significant population decline, but no trend is detectable over the last decade, suggesting a more or less stable, but much smaller population than was present in the lake in the 1960s – 1980s.

Increased water clarity due to filter feeding by zebra and quagga mussels has caused an expansion in the shoreline littoral habitat that favors species such as black bass, sunfish, and pickerel. A nearshore fyke survey was recently added to the monitoring program to account for the anticipated changes in the littoral fish community. In 2013, 25 species were caught in the fyke nets, many of which were littoral species that are not typically caught with the traditional gears used in the long term studies. The fyke net survey has provided an index of young-of-year largemouth bass production and also shows potential as an index for sunfish and chain pickerel. It also will provide valuable data on production of nesting bass and sunfish to assess potential impacts of round gobies, which were confirmed in the lake in 2013.

In 2013, both full open water roving and access site creel surveys were conducted from the opening of the walleye season (first Saturday in May) to the end of September. Effort in 2013 was 218,570 boat hours, which continued a trend of increasing effort since 2002. More than 50% of anglers sought walleye specifically, or walleye and other species. About 30% of anglers targeted black bass. The estimated catch and harvest rates for walleye were 0.2/hour and 0.1/hour, respectively. The estimated annual walleye harvest was 58,947, which was very similar to the estimated annual harvest from 2012 (59,500). The smallmouth bass harvest rate was 0.03/hr with an annual total harvest of less than 4,700 fish, which is typical for this largely catch and release fishery.

Canadarago Lake

Walleye fry continue to be low in abundance, a trend which began in 2005. The low abundance of fry is attributable to an increasing population of alewife, which are known predators of fish fry and often have dramatic impacts on walleye reproduction. This has resulted in a decline in the number of juvenile walleye captured during recent surveys and is likely to impact the adult walleye population in the future. A boat electrofishing survey by DEC Region 4 in 2013 captured 17 total walleye, 15 of which were over 15 inches, an indication of recruitment problems.

In response to the almost complete lack of successful walleye reproduction and an adult population at risk of decline, a walleye stocking program was initiated. Approximately 40,000 advanced walleye fingerlings were annually stocked from 2011-2013. The same number of 50-day walleye fingerlings will be stocked in 2014 and 2015. The goal of this program is to boost walleye recruitment by offsetting some of the losses of young walleye to alewife predation. Annual assessments of the fish community will allow up to date tracking of stocking success.

Habitat Mapping of Oneida and Canadarago Lakes

Hydroacoustic and rake toss plant surveys were conducted to assess submerged aquatic vegetation (SAV) distribution and composition in Canadarago and Oneida Lakes. In Canadarago Lake, SAV percent cover and mean plant height were high in shallow areas and declined sharply between 5 and 6 m water depth. Coontail was the dominant plant species and waterweed, eelgrass, and naiad occasionally made up substantial portions of the samples. In Oneida Lake, SAV percent cover and mean plant height declined sharply between 4.5 and 5 m water depth. The most abundant plant species were eelgrass, coontail, naiad, pondweed, and milfoil. Compared to past surveys, milfoil and pondweed have decreased, while eelgrass and coontail have increased. Information from this study can be used to help understand fish community fluctuations, especially in near shore fish such as sunfish and black bass which can be strongly affected by SAV changes. Another survey of Oneida Lake is planned for 2016, which will allow us to continue to monitor long term changes in SAV.

Statewide Black Bass Population Assessment

Black bass are the most sought after species of fish by New York anglers, but the last comprehensive statewide population assessment occurred 30 years ago. Since then, black bass fisheries have become more tournament based and catch and release angling has become more prevalent. A 3 year study funded through a Federal Aid in Sportfish Restoration Grant and conducted by the New York Cooperative Fish and Wildlife Research Unit was initiated in 2011 to compile black bass data from various large datasets and comprehensively assess population and environmental metrics. Multiple population parameters (relative abundance, growth, condition, length frequency) were summarized for inland lakes, including Oneida Lake, and Lake Erie and the eastern basin of Lake Ontario. The influence of environmental metrics (e.g., water chemistry, landscape characteristics, lake size and shape, etc.) on black bass population metrics, and spatial and temporal trends, were also assessed. This study will be completed in 2014 and will enhance our current understanding of New York's bass populations and aid in the development of management strategies.

Stocking Evaluation of 50 Day Old Walleye Fingerlings

An experimental walleye stocking program, initiated in 2009, was continued using 50-day old tank raised fingerlings from Oneida Hatchery. Eleven lakes throughout the northern, central and western regions of the state were stocked in June with about 390,000 1.5 inch long fingerlings. Waters stocked included Loon Lake in Region 5, Black, Red, and Payne lakes in Region 6, Otisco and Otter lakes in Region 7, and Chautauqua, Redhouse and Upper, Middle and Lower Cassadaga lakes in Region 9. The success of this program is being assessed through annual monitoring in the fall, and a full walleye population assessment at the end of a five-year stocking schedule. Annual fall surveys from 2009-13 have documented survival of stocked walleye at Loon, Otisco, Redhouse and Chautauqua lakes. Full post-stocking population assessments will be conducted on Redhouse, Red, Payne, and Otisco lakes in 2014.

Sauger Conservation Management Plan

Sauger are members of the true perch family and are closely related to, and resemble, walleye. They were once prominent members of the Great Lakes and Lake Champlain fish communities, but have declined to the point where they are now considered critically imperiled in New York. A Sauger Conservation Management Plan was adopted in 2013 with a goal of establishing and maintaining sauger populations in all suitable waters of native watersheds by 2030. The objectives of the plan are to: (1) establish a self-sustaining sauger population in the upper Allegheny River watershed; (2) determine the sauger population status and document and improve habitat suitability in Lake Champlain; and (3) determine the suitability of Lake Erie's eastern basin watershed for sauger restoration. These objectives are designed to be implemented through 2020. Progress made towards meeting these objectives will serve as guidance in the selection of additional waters, and the development of new objectives and management recommendations for the period 2021 - 2030.

Coldwater Fisheries Management

CROTS Review & Fate of Stocked Trout Study

The Bureau of Fisheries completed the third and final year of fieldwork for a multi-year statewide study to verify and update the key biological and fishery parameters used to calculate trout stocking rates under our Catch Rate Oriented Trout Stocking (CROTS) method. This research, conducted in partnership with the Fish and Wildlife Cooperative Unit at Cornell University, produced fresh estimates of angling effort, seasonal patterns of angling effort, harvest rates, and total mortality rates of stocked trout. As an additional product of the research, these new estimates were used to build a computer model (Trout_2014) to allow biologists to evaluate current stocking policies, visualize the effect of changes, and develop new stocking rate tables.

In 2013, bureau staff completed creel surveys and population estimates on the following streams: Carmans River, Esopus Creek, Kinderhook Creek, Kayaderosseras Creek, Oriskany Creek, Big Creek, Otselic River, Meads Creek, and East Koy Creek. The data were provided to Cornell University graduate students Alexander Alexiades and Benjamin Marcy-Quay for analysis. The study results and a draft version of Trout_2014 were presented to the entire research team for review and user-testing in January 2014. The final report was submitted in March 2014. However, based on further comments received from bureau staff, some additional edits to the report and computer model are in progress.

Compared to the original CROTS parameter estimates, substantial changes were documented by this research effort. With the exception of the Carmans River and Kayaderosseras Creek, angling pressure (hours of angling/acre) was lower than documented in previous creel surveys. Over the course of the study approximately 75% of the trout caught were released by anglers; a substantially higher rate than assumed in the original CROTS model. However, the study also documented substantially higher rates of natural loss (predation, migration from stocked areas and all losses not associated with anglers) for stocked trout. The average daily natural loss rates observed in this study were 0.0147 (previously 0.002) for "A" or higher quality streams and 0.088 (previously 0.005) for "B" streams. At these rates, the density of stocked trout available to anglers decreases more rapidly after stocking than was originally modeled in CROTS and, contrary to CROTS predictions, very few stocked trout survive to the following spring. Despite these changes, the CROTS management objective of an average catch rate of one trout caught per two hours of fishing effort was met in most years for most of the streams in the study.

The next step for the Bureau of Fisheries is to use the information and the computer model produced by this research project to examine our current stocking policies and consider what adjustments should be made in order to ensure that hatchery trout provide the maximum fishing opportunity possible for the fishing license dollars invested in their rearing and distribution.

Wild Brook Trout Management Plan Revision

In 2013, work began to rewrite New York State's Wild Brook Trout Management Plan. The existing plan dates from 1979 and since then has served as a successful blueprint for the conservation and management of this species in Adirondack ponds and coastal streams. The rewrite committee, composed of Bureau of Fisheries biologists, met in September 2013 and January 2014 to identify what elements should be included in the new plan and to draft a structural outline. Input from brook trout experts beyond the agency contributed to the development and review of the outline.

Besides documenting the management actions taken by the Bureau of Fisheries under the existing plan and generally addressing advances in the relevant scientific disciplines, the new plan will include management guidance for brook trout populations in inland streams which were beyond the scope of the previous plan. In addition to providing direction for the bureau's brook trout management, the intended purposes of the plan include: promoting public understanding of the thinking behind the management policies, priorities and strategies for brook trout, providing academic researchers with an understanding of the bureau's top priorities for scientific information, helping biologists communicate clearly with policy-makers and orienting new biologists to the evolution of brook trout management in New York State.

With the completion of the structural outline, work in 2014 will shift to writing the various components of the plan as organized by the outline. The plan is scheduled for completion by March 2016.

Delaware River Basin Gaging Stations Funded

In order to assure the availability of data essential to the management of the highly productive trout fisheries in the tailwaters of New York City's Delaware River Basin reservoirs, a total of $52,155 was committed in 2013 to support the operation of U.S. Geological Survey stream gages at the following locations:

- Diversion from Schoharie Reservoir
- Esopus Creek at Coldbrook
- East Branch Delaware River at Harvard
- West Branch Delaware River at Hale Eddy
- West Branch Delaware River at Hancock
- Delaware River at Lordville
- Delaware River at Callicoon
- Neversink River at Bridgeville

These instruments, which transmit flow and temperature measurements in real time, would not otherwise be operated. The data they collect are particularly important because of the exceptional value of the recreational trout fishery and because they allow monitoring of the biological effects of flow management plans which are frequently altered at the direction of the Delaware River Basin Commission. The data are available at the following website: *http://waterdata.usgs.gov/ny/nwis/current/?type=sw&group_key=basin_cd*.

Management of Rare & Endangered Fishes

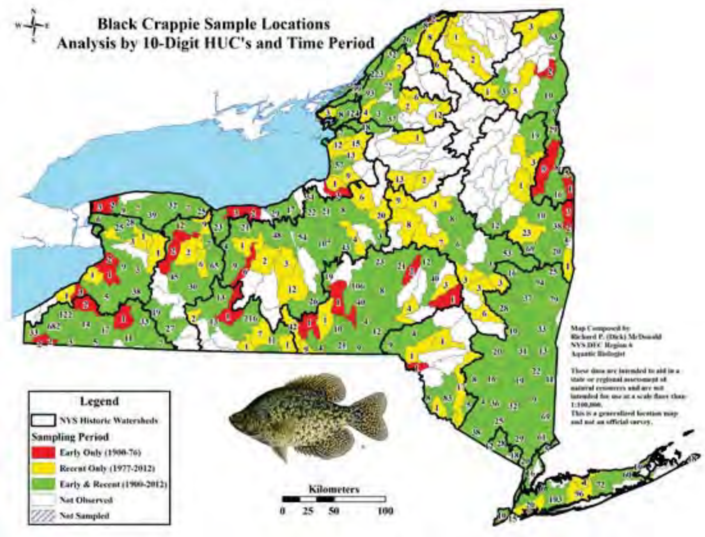
The Rare Fish Unit is assigned management of rare, endangered and declining species of fish and freshwater mussels. The Unit is composed of a Unit Leader in Albany and a Biologist and seasonal staff in the Region 6 office. Field work and planning is carried out by regional staff across the state. Active restoration is being conducted on several species and summaries are provided here and in the Regional summaries for Regions 5, 6, 8 and 9.

Summer Sucker Sampling

Staff are continuing to study the life history and distribution of Summer Sucker (Catostomus utawana) in the Adirondacks. Samples were taken from Little Moose Lake and Cowhorn Pond for genetics, morphology and age. Additional samples of an apparently new species were taken from Lower Ausable Lake, Elk Lake, Long Pond and Boreas Ponds. DEC staff are collaborating with the New York State Museum and Fordham University to clarify the status and distribution of suckers across the Adirondacks. There was a presentation of the progress to date at the annual Meeting of the New York Chapter of the American Fisheries Society.

Fish Atlas Maps Now Available on DEC Website

A review of the known current and historic distribution of New York's fish species resulted in the posting of 179 maps of the Department website. All locations are supported by verified specimen collections and give a broad view of statewide distributions of fish before 1977 and after 1977. These maps are intended to be part of an Atlas of New York Fishes to be published electronically in partnership with the New York State Museum in the near future. The completed maps can be found at: *http://www.dec.ny.gov/animals/84622.html*.



Species of Greatest Conservation Need List Review

DEC staff and fisheries experts from across New York met for two days in November to review the status of 50 fish considered for inclusion on the Species of Greatest Conservation Need (SGCN) list. New York, along with most other states, is in the process of updating its Wildlife Action Plan as required by the federal State Wildlife Grants Program. An integral first step in the planning process is the review of the previous SGCN list and considerations of new species to be added. Information on each species' known status and trends across North America, the Northeast or Great Lakes region, adjacent states, and status within New York was reviewed. Other factors such as threats and vulnerability were also considered. Results of the review will be incorporated into the new Wildlife Action Plan for New York, scheduled for completion in September of 2015.

Paddlefish Propagation and Stocking

984 Paddlefish were stocked into Allegheny Reservoir, Conewango Creek and Chautauqua Lake in August of 2013. Eggs for the propagation originated in the Ohio River in Kentucky. Paddlefish have been stocked in Allegheny Reservoir since 1999 and the fish seem to grow and survive well there, although no natural reproduction has yet been documented. Adult fish originating from the Allegheny Reservoir are frequently reported downstream in the Allegheny River in Pennsylvania. Conewango Creek stocking began in 2006 and the fish there should begin to mature within the next couple of years.

Gilt Darter Propagation and Stocking

2013 was the last year of a State Wildlife Grant funded effort to restore state endangered Gilt Darters to New York. They are native to the Allegheny River and the last previous report of Gilt Darters captured there was 1937. Fingerling gilt darters were reared by SUNY Cobleskill and stocked into the Allegheny River and Owayo Creek. The Allegheny River was also stocked with wild fish collected in East Brady, PA. These fish were tested for diseases prior to being stocked in the Allegheny River at Carrollton, NY.

Efforts to evaluate the survival of stocked gilt darters were completed in summer 2013 and there were two locations with re-captures. These catches were from 134 trawl efforts spread across 43 miles of river. Three juvenile gilt darters were caught and none of the hatchery fish were recovered. The only way to determine if this project was successful in restoring gilt darters to the New York watershed of the Allegheny River is with continued monitoring. Field sampling will indicate if natural reproduction is occurring if the gilt darters captured are not tagged. Future capture sites will also indicate where suitable gilt darter habitat is located, so that a more in-depth habitat analysis can be conducted.

Water	Date	Fings.	Juv.	Adults	Total
Allegheny River	11/2012	443	380		823
Oswayo Creek	11/2012	400			400
Allegheny River	11,12/2013	679	402	111	1116

Fish Community Sampling Manual

DEC staff have developed a new sampling manual aimed at documenting diversity of species and changes in fish communities over time. The manual is in its initial rounds of field testing and will be refined based on feedback from staff. The manual calls for four types of field gear; fyke nets, gill nets, boat electroshocking and seine netting. It is anticipated that when these four gears are used in combination on a body of water, greater than 90% of all fish species present will be sampled. We hope that this sampling methodology provides a compliment to the extensive sport fish sampling that already occurs across the state and improves our understanding of community dynamics, forage base and impacts of invasive species.

2013-14 Inland Section Staff

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Fred Henson Biologist 2 (Aquatic)

Warmwater Unit:
Jeff Loukmas Biologist 2 (Aquatic)

Rare Fish:
Lisa Holst Biologist 2 (Aquatic)

Biological Survey Unit:
Linda Richmond Agency Program Aide
Paul Sweeney Calculations Clerk 2

Lake Ontario Unit

The Bureau of Fisheries' Lake Ontario Unit (LOU), based in Cape Vincent, is primarily responsible for delivering a lake-wide fisheries assessment and research program. The mainstay of the program is the Department's 60 ton Research Vessel Seth Green, which was out of service for two weeks in 2012 to conduct scheduled maintenance. Lake Ontario's sportfisheries have been valued at over $112 million annually, and successful management requires that fisheries assessments and research be executed collaboratively. Delivery of our comprehensive program requires active partnerships with a number of institutions, including DEC Regions 6, 7, 8 and 9, the U.S. Geological Survey (USGS), the Ontario Ministry of Natural Resources (OMNR), the U.S. Fish and Wildlife Service (USFWS), the Great Lakes Fishery Commission (GLFC), Cornell University, and the SUNY College of Environmental Science and Forestry. Our complete annual report can be accessed at: *www.dec.ny.gov/outdoor/27068.html*.

SPECIES CONSERVATION & MANAGEMENT

Sportfishery Monitoring

Each year from April through September, the LOU conducts the Lake Ontario fishing boat survey at 30 access channels from the Niagara River in the west to the Association Island cut in the east. The survey tracks a multitude of trends in the open lake sportfishery, including angler effort, catch and catch rates, harvest and harvest rates, performance of stocked fish, and fish growth/condition. Lake Ontario fishing quality is best characterized by the number of trout and salmon caught per fishing boat trip (catch rate). In 2013, the catch rate for all trout and salmon combined was the fourth highest observed since this survey began in 1985. In fact, 8 of the 9 highest combined catch rates were recorded between 2003 and 2013 (Figure 1). These exceptional catch rates are largely due to record or near record-high catch rates in recent years for Chinook salmon, coho salmon, rainbow trout (steelhead), and brown trout. Open lake angler effort (937,822 angler hours) for trout and salmon has been relatively stable for over ten years (Figure 2).

Preyfish Monitoring and Predator Growth/Condition

With over 5 million trout and salmon stocked annually into Lake Ontario by New York State and the Province of Ontario, it is important to monitor the abundance of bait or preyfish that trout and salmon predators feed on, as well as growth rates and condition of predators (also see Sportfishery Research). Partnering with USGS and OMNR, the LOU monitors relative abundance of alewife, rainbow smelt, sculpins, and round gobies. Alewife populations are of particular concern, as they are the primary food for Chinook salmon, the top predator in the lake. Adult alewife abundance and biomass indices were very similar to 2012 (Figure 3). Abundance of age-1 (yearling) alewife was above average for the fourth consecutive year, and represents the largest year class recorded since the 1980 year class collected as yearlings in 1981. Average total lengths of age-1, -2, and -3 Chinook salmon were above their respective long-term averages, suggesting prey availability was not limiting Chinook growth. Condition, or relative "plumpness", of Chinook salmon was near the long-term average in 2013. Lake Ontario continues to produce the largest Chinook salmon in the Great Lakes.

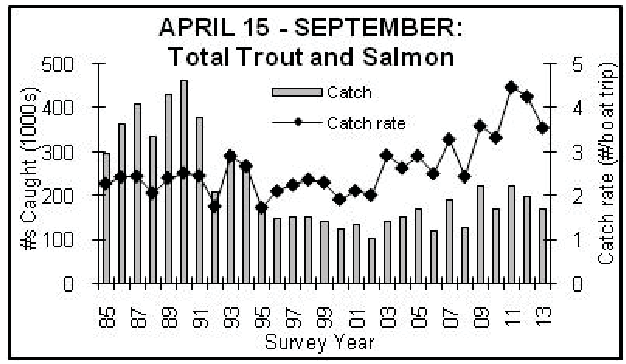

Figure 1. Total trout and salmon catch (bars) and catch rate (line/diamonds for boats seeking trout and salmon, 1985-2013.

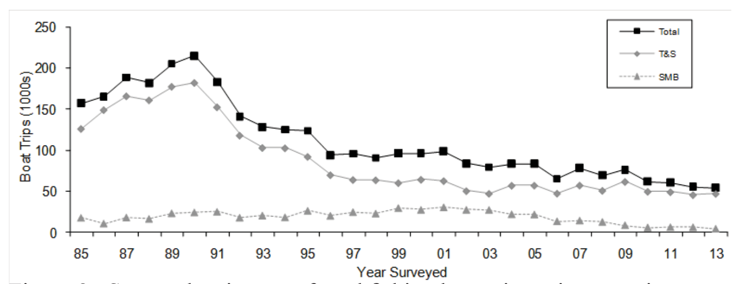

Figure 2. Seasonal estimates of total fishing boat trips, trips targeting trout and salmon (T&S), and trips targeting smallmouth bass (SMB) during the traditional open season (3rd Saturday in June-September 30 when the survey ended).

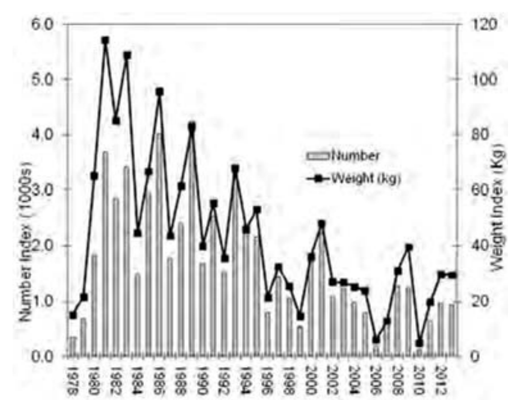

Figure 3. Abundance indices for adult (age-2 and older) alewife in the U.S. waters of Lake Ontario during late April-Early May, 1978-2013.

Sportfishery Research

Using Lake Ontario Natural Resources Damages funds, the Bureau of Fisheries purchased a $1.3 million automated fish marking trailer ("AutoFish") in 2008 (AutoFish - PICTURES). The AutoFish system is capable of removing a fish's adipose fin and/or inserting a coded wire tag into the snout of the fish automatically at a high rate of speed and accuracy. Fin clipping and tagging give researchers tools to answer a variety of questions regarding the relative performance of stocked and wild fish. From 2008-2011, the Department and the OMNR "mass-marked" all Chinook salmon stocked into Lake Ontario with an adipose fin clip to determine the relative contributions of naturally reproduced ("wild") and hatchery stocked Chinook salmon to open lake and tributary fisheries. Knowing the relative roles of hatchery and wild salmon in the lake is very important for fisheries managers to better understand how stocking decisions can influence Chinook salmon population dynamics and predator/prey balance in Lake Ontario. High numbers of wild Chinook salmon in addition to stocked fish are thought to have contributed to an imbalance between predators and alewife in Lake Huron, greatly reducing growth and condition of Chinook salmon and negatively impacting sportfisheries. The relative contribution (%) of wild Chinook salmon in the open lake sport fishery was approximately 50% each year 2010-2013. These preliminary results indicate that although wild fish are an important component of the Lake Ontario Chinook sport fishery, stocking remains essential for sustaining the sport fishery and managing the lake ecosystem.

Native Species Restoration

An international program to restore a naturally reproducing population of lake trout in Lake Ontario is ongoing. To measure progress, cooperative DEC/USGS bottom trawl (juveniles; July) and gill net (adults; Sept.) surveys are conducted annually at 14 sites from the Niagara Bar to Charity Shoals in the Eastern Basin. Adult lake trout abundance increased each year from 2008-2013, following historic lows observed during 2005-2007. In 2013, five age-1 and three age-2 naturally produced lake trout were collected in trawl surveys, providing first evidence of a 2012 "wild" year class and continued evidence of a 2011 year class.

Three species of deepwater coregonids (members of the whitefish family) are considered extirpated from Lake Ontario, and the LOU has been collaborating with the OMNR, USFWS, and the GLFC to re-introduce one species, bloater, into the lake. In 2013, bloater eggs were collected from Lake Michigan and reared at OMNR's White Lake Fish Culture Station and the USGS Tunison Laboratory. For a second consecutive year, bloaters were stocked into Lake Ontario. Stocking of bloaters is expected to continue annually, with a goal of restoring a self-sustaining population within 25 years.

Sea Lamprey Control

In an ongoing battle to combat the damaging impacts of sea lamprey on Lake Ontario sport fisheries, the GLFC and their sea lamprey control agents, the Department of Fisheries and Oceans Canada and the USFWS, conducted comprehensive control and assessment activities in Lake Ontario tributaries in 2013. In the adult phase, a single parasitic sea lamprey is capable of killing as much as 40 pounds of fish. Treatments to kill larval lamprey using lampricides were completed in nine tributaries (two in Canada, seven in NY). Treatments in New York included South Sandy Creek, Lindsey Creek, Little Sandy Creek, Orwell Brook, Trout Brook, Grindstone Creek and Fish Creek. Larval assessments were conducted on 38 tributaries (18 in Canada, 20 in NY). In 2012, the first purpose built sea lamprey barrier in New York's Great Lakes waters was completed on Orwell Brook, a tributary to the Salmon River. The low-head dam is designed to block migrating sea lampreys from reaching their spawning grounds, and features removable stop logs and an integrated sea lamprey trap. Trap operation in 2013 resulted in the capture of 435 adult lamprey, much higher than anticipated.

Warmwater Fisheries Assessment

Each year the LOU conducts index gill netting to assess the status of warmwater fish populations in Lake Ontario's Eastern Basin. In 2013, smallmouth bass abundance was comparable to the previous 5-year average and well above low levels observed in 2000-2004. Walleye abundance declined 40% compared to the previous 5-year average, which may be partly attributable to water temperature and higher alewife abundance altering walleye distribution. Yellow perch catch also declined below average levels in 2013. At least one lake sturgeon has been collected in 14 of the last 19 years (1 in 2013), suggesting an increase in sturgeon abundance.

St. Lawrence River Research

Muskellunge Research

Muskellunge are the focus of a popular and economically important fishery in the Thousand Islands region of the St. Lawrence River, where the NYS record 69 pound 15 ounce muskellunge was caught in 1958. In the late 1970s, muskellunge guides raised concerns that the quality of the muskellunge sport fishery had declined dramatically. In response, the Department conducted preliminary research leading to an increase in the muskellunge minimum size limit from 32 inches to 36 inches. Using Federal Aid in Sport Fish Restoration program funding, the Department contracted with the SUNY College of Environmental Science and Forestry (ESF) beginning in 1987 to conduct St. Lawrence River muskellunge studies. In the ensuing years, studies have identified over 80 muskie spawning and nursery areas that have been afforded additional levels of protection from habitat alteration. Research documenting first spawning of females at approximately 36 inches in length (6 years old) led to increases in the minimum size limit first to 44 inches, and then to 48 inches. A muskellunge release program was instituted that rewards anglers who release a legal-size muskie with a limited edition muskie print created by a renowned local artist. By the mid-1990s, these management actions contributed to a substantial increase in muskellunge angler catch rates, which reached the management plan target rate in 1999.

More recently, large-scale mortalities of pre-spawn female muskellunge caused by the newly introduced Viral Hemorrhagic Septicemia virus (VHSv) were documented in 2005 and 2006. Spring trapnet surveys at index sites sampled each year indicated declining spawning adult abundance since 2008, however, catches in 2013 rose to their highest level since 2009. Catches of young-of-the-year (YOY) muskellunge in index seine hauls also declined since 2004, but improved slightly in 2013 (Figure 1). An angler diary program, which indexes the relative quality of muskie fishing through angler catches, also indicates that angling success remains well below the target of 1 fish caught per 10 hours of fishing. A number of potential causes may be contributing to the apparent muskellunge decline, including habitat changes (vegetative and fish communities on nursery grounds), VHSv mortality, and the presence of round goby in spawning/nursery habitats. Investigations into the cause(s) for these declines are ongoing.

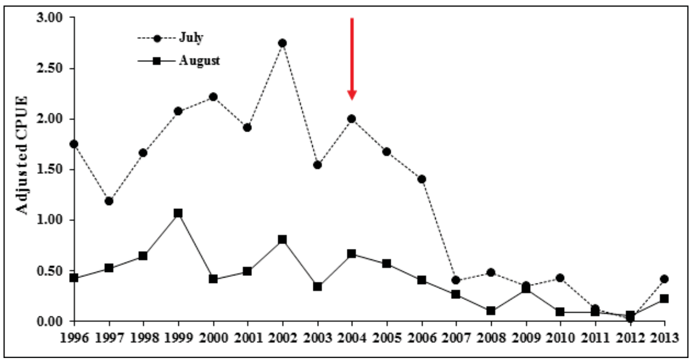

Figure 1. Catch per unit effort of YOY muskellunge captured in standardized seine hauls in eleven upper St. Lawrence River nursery sites from 1996 to 2013. A 9.14 m fine-mesh seine was used from July 15-31 and an 18.3 m large-mesh seine was used from August 15-31. The fine-mesh seine CPUE was doubled to standardize the area swept among the two gears. The arrow indicates the year prior to detection of VHSv (2004) and widespread mortality of muskellunge in the upper River.

Northern Pike Research

Northern pike spawn about one month earlier in the spring than muskellunge, and are more dependent upon the presence of submerged vegetation for spawning habitat. Long-term regulation of Lake Ontario and St. Lawrence River water levels by the International Joint Commission has reduced the natural range of water levels in the system, resulting in degradation of wetland habitats required by northern pike. Similar to muskellunge studies, ESF researchers have chronicled declines in the abundance of spawning adult and YOY northern pike in the Thousand Islands region. Ongoing research has focused on developing a better understanding of water level regulation impacts on wetland habitats, and conducting experimental habitat manipulations designed to improve natural reproduction of pike. Habitat manipulations include water level control structures used to restore more natural water level regimes in managed spawning marshes, and excavation of channels through cattail mats to restore fish passage to isolated pools of quality habitat.

Production of YOY northern pike in managed marshes was initially high, but has declined significantly since 2007. Low numbers of spawning adults, as well as a predominance of female pike, appear to contribute to low reproductive success. The YOY muskellunge seining survey at eleven index sites produced 3 northern pike YOY from the 30' seine series in 93 hauls and 6 in the 60' seine series in 90 hauls. Twenty two upper St. Lawrence River bays were sampled by seining and 12 YOY pike were captured (N=76 hauls; CPUE=0.158). Seine hauls at Delaney Bay, downstream of a managed spawning marsh, resulted in a catch of three YOY pike. Assessment of the efficacy of excavated channels in increasing northern pike reproduction is ongoing. More detailed information on muskellunge and northern pike studies can be found in the annual report: *http://www.dec.ny.gov/outdoor/27068.html.*

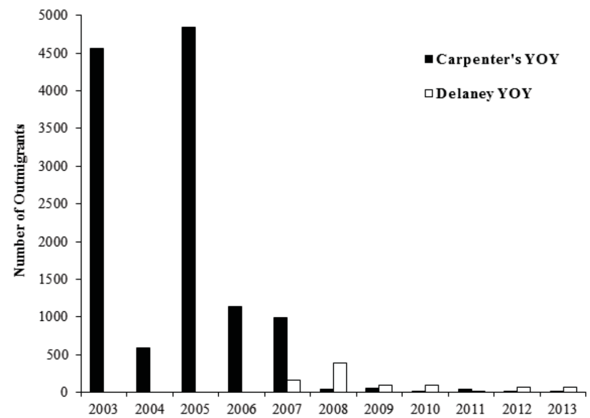

Figure 2. Number of out-migrant northern pike YOY from managed spawning marshes at Carpenter's Branch (2003 to 2012) and Delaney Marsh (2007 to 2013).

2013-14 Lake Ontario Research Unit Staff

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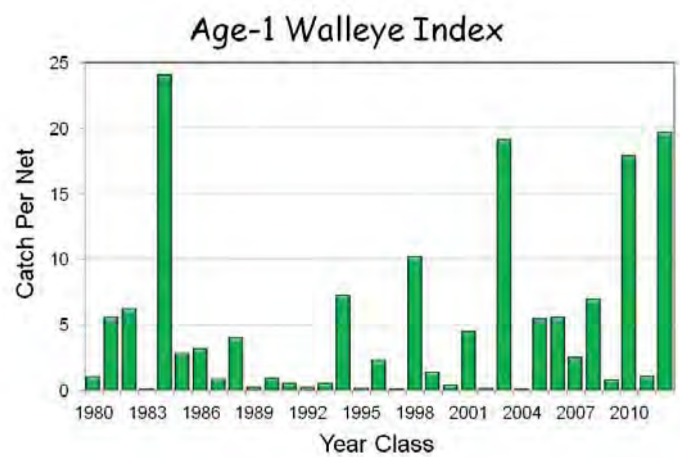
Errol Scheid	Fish & Wildlife Technician 1
Gaylor Massia	Maintenance Assistant
Rose Greulich	Fish & Wildlife Technician 1

The New York State Department of Environmental Conservation's Lake Erie Fisheries Unit is responsible for fishery research and assessment activities for one of New York's largest and most diverse freshwater fishery resources. A variety of annual programs are designed to improve our understanding of the Lake Erie fish community to guide fisheries management, and safeguard this valuable resource for current and future generations. This document shares just a few of the highlights from the 2013 program year. Our complete annual report is available on DEC's website at *http://www.dec.ny.gov/outdoor/32286.html*, or by contacting DEC's Lake Erie Unit office.

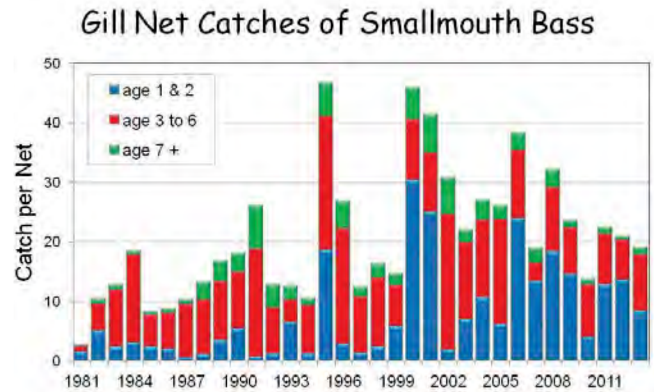
Walleye

Lake Erie's eastern basin walleye resource is composed of local spawning stocks, as well as contributions from summertime movements from western basin spawning stocks. The annual movement of western basin stocks is now well known via long-term tagging studies conducted throughout the lake. Walleye fishing quality in recent years has generally been very good and largely attributable to excellent spawning success observed in 2003 and again in 2010. New York's most recent juvenile walleye survey indicates another exceptional spawning year occurred in 2012. This abundant 2012 year class will start recruiting to the sport fishery in summer 2014. Overall good recruitment through recent years, especially from 2010 and 2012, suggests adult walleye abundance in the eastern basin will be satisfactory over the next few years.



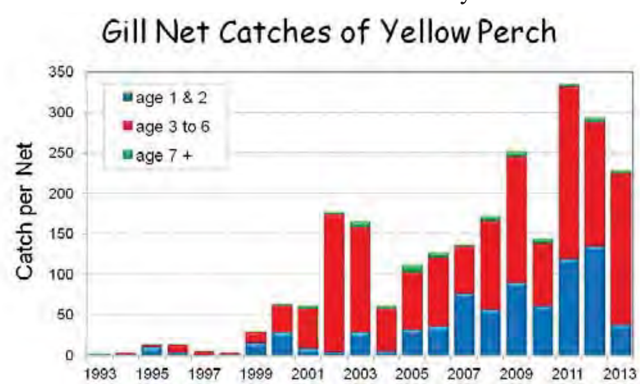
Smallmouth Bass

Lake Erie supports New York's, and perhaps the country's, finest smallmouth bass fishery. Generally stable spawning success, coupled with very high growth rates and acceptable survival, produce high angler catch rates and frequent encounters with trophy-sized fish. Our most recent data indicate a very gradual decline of abundance to near long term average measures. Our juvenile abundance measures suggest 2011 produced a moderately abundant smallmouth bass year class.



Yellow Perch

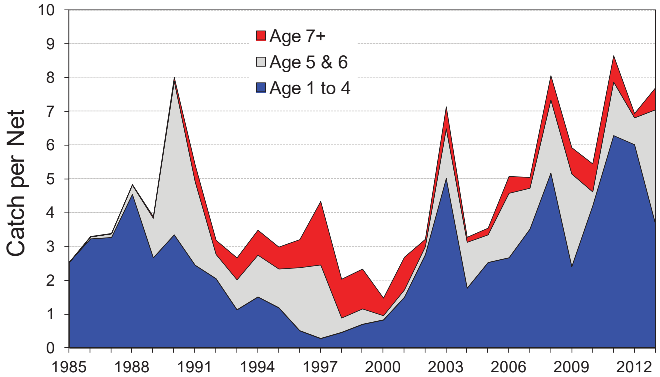
Lake Erie yellow perch populations have experienced wide oscillations in abundance over the last 30 years, from extreme lows in the mid-1990's to an extended recovery that's now lasted more than a decade. A large adult population continues to produce good angler catch rates, especially during spring and fall. Elevated juvenile perch abundance resulted from the 2005 to 2008 spawning years, and record-high abundance of juvenile yellow perch occurred in 2010. Spawning success from 2011 through 2013 was average to poor. Nevertheless, overall higher and stable adult yellow perch abundance should extend at least a few more years.



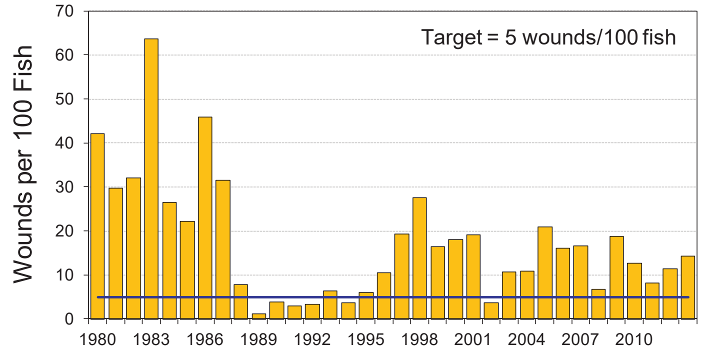
Lake Trout Restoration

Re-establishing a self-sustaining lake trout population in Lake Erie continues to be a major goal of New York's Great Lakes coldwater fisheries management program. Lake trout have been stocked annually since 1978 and assessment programs monitor progress towards restoration. A revised lake trout rehabilitation plan was completed in 2008 and guides current recovery efforts. Overall abundance of lake trout in the New York waters of Lake Erie remained high in 2013. The majority of the catch was young lake trout ages 1-4, mainly due to increased stocking levels over the past 5 years. Adult stocks (age 5 and older) increased in abundance in 2013, but lake trout age 7 and older remain relatively scarce. Survival of adults remains low, mainly due to high sea lamprey predation. Lake wide abundance estimates for all age groups still remain well below targets. Natural reproduction has not been detected in Lake Erie, and continued stocking and effective sea lamprey control are needed to build adult lake trout populations to levels where natural production is viable.

Gill Net Catches of Lake Trout



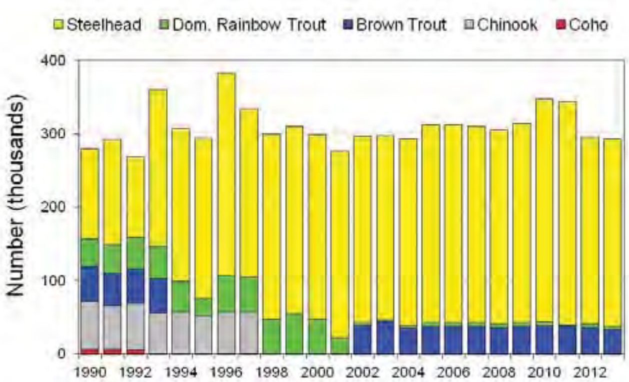
Sea Lamprey Wounding Rate on Lake Trout >21 inches



Salmonid Management

New York annually stocks approximately 270,000 steelhead and 35,000 brown trout into Lake Erie and its tributaries to provide recreational opportunities for both lake and stream anglers. Wild reproduction of steelhead also contributes to the fishery. Fall juvenile assessments conducted since 2001 confirmed substantial numbers of young-of-year steelhead present in many tributaries. Tributary angling for steelhead, assessed through an angler diary program, showed a sharp decline in fishing quality in 2010, followed by increases in 2011 and 2012. A pilot study to investigate emigration of stocked steelhead suggests stocking size may be influencing adult returns of New York stocked fish.

NYSDEC Trout & Salmon Stocking



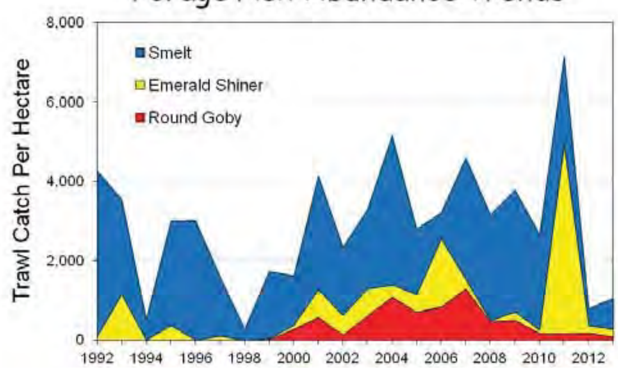
Sea Lamprey

Sea lamprey invaded Lake Erie and the Upper Great Lakes in the 1920s and have played an integral role in the decline of many native coldwater fish populations. Sea lamprey population control in Lake Erie began in 1986 in support of lake trout rehabilitation efforts, and regular treatments are conducted in an effort to reduce lamprey populations. Annual monitoring consists of observations of sea lamprey wounds on lake trout and other coldwater fish species, and lamprey nest counts on standard stream sections. Wounding rates on lake trout increased in 2013, indicative of a high sea lamprey population in Lake Erie. Inspections of sportfish species documented sea lamprey wounding on warm water species as well. Surveys conducted over the past three years indicate the largest source of Lake Erie's sea lamprey production may be the St. Clair River and not the traditionally monitored and treated Lake Erie streams.

Prey Fish

The Lake Erie Unit conducts a number of surveys to assess forage fishes and components of the lake's lower trophic level. These programs have included trawling, sonar surveys of prey fishes, predator diet studies, and lower food web monitoring. A variety of prey fish surveys beginning approximately 20 years ago identified rainbow smelt as the dominant component of the open lake forage fish community. Beginning in 2000, there has been a notable increase in prey species diversity accompanied by somewhat lower smelt abundance, and in some years especially high abundances of round gobies and emerald shiners were encountered in both prey fish surveys and predator diets. In recent years, overall prey fish abundance trended slightly downward, with notable declines of goby abundance in trawl surveys. In 2013, round goby abundance continued to decline while rainbow smelt slightly increased. Emerald shiner abundance remained stable at lower levels. Lower trophic monitoring indicated near shore eastern basin waters are currently best described as a mesotrophic environment favorable for walleye and yellow perch production. Over time we expect these investigations to be useful in furthering our understanding of factors shaping the fish community.

Forage Fish Abundance Trends



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Carrie Ann Babcock	Fish & Wildlife Technician 1
Jonathan Draves	Fish & Wildlife Technician 1
Jessica Wooten	Fish & Wildlife Technician 1
Ann Wilcox-Swanson	Fish & Wildlife Technician 1

Angler Achievement Awards

The Angler Achievement Awards Program received a total of 175 entries in 2013, a difference of only 1 entry compared to 2012. Over 77% of the entries received qualified under the Catch and Release Category, exhibiting the sound stewardship of participating anglers. Thirty-one entries were entered into the Annual Award Category (kept fish). For the 4th time in 5 years, a state record brook trout was declared. The 6 lb., 22.6" brook trout was caught by Richard Beauchamp on May 16, 2013 on a Lake Clear Wabbler from Silver Lake in Hamilton County.

An especially noteworthy story: On January 19, 2013 Richard Otty caught a 3 lb. 13 oz. crappie from Kinderhook Lake in Columbia County. Believing it was a potential new state record black crappie, he brought it to a local store for an official weight. White crappie are not common in the Upper Hudson watershed, so at quick glance it was thought to be a black crappie. Upon further examination of the physical characteristics, it became questionable as to whether it was a black crappie, white crappie, or even a hybrid. If the fish was indeed a black crappie it would have surpassed the current state record by 1 ounce. If it was a white crappie, it would have tied the current state record. A genetic analysis on the fish was performed by the NYS Museum and revealed that it was indeed a white crappie. Even though Mr. Otty's white crappie wasn't a record breaker, it was certainly an incredible catch and a provided a great story to be told.

Interpretive Signage at Boat Launch Sites

During 2013-2014, interpretive signage was designed and installed at Lake Champlain (South Bay), Cuba Lake, Fort Pond, Brant Lake and Schroon Lake. Each panel series has helpful information directed towards anglers and boaters. Content provided includes: fish species present, fisheries management actions, invasive species disinfection procedures, fishing and boating regulations and angling advice.With the increased concern over invasive species being introduced into Lake George, a number of panels were produced for installation at all Lake George boating access sites. The standard panel discusses appropriate disinfection procedures for cleaning boating and fishing gear after use. Outreach and education have proven to be an effective means of raising awareness in combating the spread of aquatic invasive species.

Free Sportfishing Clinics

Legislation passed in 2013 allowing for an unlimited number of Free Sportfishing Clinics to be held in New York State. This was a change from the traditional 4 free fishing clinics that used to be allowed for each DEC region. From April 1, 2013 – March 31, 2014, a total of 45 free sportfishing clinics were authorized, with over 1,500 participants attending. Guidelines for conducting an event, including a downloadable application can be found at *www.dec.ny.gov/outdoor/89811.html*. With the limited number of DEC I FISH NYstaff and their time, approving non-DEC groups and organizations to conduct free sportfishing clinics helps the program attain its primary goal to increase fishing participation in the state.

I FISH NY - Statewide Implementation

Angler education through the I FISH NY initiative continued in 2013/14. Although most DEC regions conduct some outreach efforts aimed at beginning anglers, these efforts are most prominent in the downstate region (DEC Regions 1 and 2) and the other DEC Regions containing dedicated outreach staff (DEC Regions 3, 7 and 9). Staff in DEC Central Office also conducted programs around the Capital District and the Adirondack Region.

In-School Fishing Education Programs

One hundred forty-five formal education programs were conducted between April 1, 2013 and March 31, 2014 in DEC Regions 1,2,3, 7 and 9. These included 126 in-school programs and 19 County Conservation days (schools come to go through environmental programs in a round robin fashion). Most of these programs (114) were conducted in DEC Region 2 (NYC). A total of 6,828 contacts with school aged kids were generated from these programs, including 4,760 in-school contacts and 2,068 contacts at County Conservation Days.
In support of the in-school program, lesson plants have been posted on the DEC website at *www.dec.ny.gov/education/89975.html*.

Fishing Clinics/Festivals

One hundred twenty-one programs were conducted reaching 10,972 people, including 5,385 at fishing festivals, 3,287 at fishing clinics, 2,226 at summer camps and 74 at DEC campgrounds. People attending fishing festivals generally received little to no fishing education, although seminars were generally available to those who desired to learn more about fishing. People attending fishing clinics generally received 30 to 60 minutes of fishing education followed by an opportunity to fish.

Train-the-Trainer

The train-the-trainer program for summer camps was significantly expanded during this fiscal year to include all of New York. Twenty-three train-the-trainer programs were given to 217 counselors. At least one program was given in every DEC region. Only 10 programs were conducted the previous year. The summer camps were provided with start-up equipment, educational materials and staff training. The camps provide the bait and the counselors to train the campers.

Isthmus at Point Peninsula Boat Launch Opens

Construction of this new boat launch providing access to eastern Lake Ontario in Jefferson County was completed in 2013. The site includes a gravel parking area for 25 cars and trailers, as well as parking for 10 cars. Additional amenities include a 2 lane launch ramp, 2 floating boarding docks a kiosk and invasive species disposal station. Accessible shoreline fishing is also provided. The project was completed using Lake Ontario Natural Resources Damages funds.

Peru Docks Boat Launch Improvements

The Peru Docks boat launch on northern Lake Champlain in Clinton County was rehabilitated in 2013. Activities included the extension of the existing 2 lane launch ramp to address power-loading issues and the renovation of the existing shoreline protection that was damaged by storms and high water levels over the past few years.

Round Lake Boat Launch Construction Begins

Construction of a new boat launch on Round Lake in Saratoga County began in 2013. The site was cleared of trees and debris and graded and a single lane launch ramp was installed using the push-slab construction technique. This technique involves the pushing of a conccrete slab formed upland into the lake using a bulldozer. Construction of this type avoids having to dewater the launch ramp location and also reduces turbidity and other problems that may occur with dewatering operations. The site is being constructed in cooperation with the Village of Round Lake who will be maintaining the site upon its completion in Spring 2014.

Great Sacandaga Lake Boat Launch Improvements

Installation of a boarding dock at the Town of Day (Saratoga County) boat launch on Great Sacandaga Lake was initiated in 2013 with the driving of steel piles that will be the primary support for the new dock. At 168 ft., this universally accessible dock will be the longest ever installed at a DEC boat launch and is necessary due to the significant seasonal water level fluctuations typical of the reservoir. The completed dock will be in place by the beginning of the 2014 boating season.

Boat Launch Modernization Plan Field Visits Continue

Field visits continued in 2013 in an effort to update the 25 year old "Strategic Plan for Modernization of Department of Environmental Conservation Waterway Access Facilities in New York State," site visits designed to assess the current state of the 185 sites that provide some form of trailered boat access were initiated. Twenty six sites were visited in DEC Regions 1, 4, 5 and 6. In total, 81 of the 137 sites that provide some degree of trailered boat access have been visited.

Direct Mail Marketing of Fishing Licenses

DEC's participation in the Recreational Boating and Fishing Foundation's (RBFF) Lapsed Angler Direct Mail Marketing Program continued in 2013. This cooperative effort to increase fishing license sales includes 40 states in the U.S. A reminder postcard is mailed to anglers who have let their fishing license lapse and the response rate is assessed by Southwick Associates, a contractor working for RBFF. In 2013, one half of the treatment group comprised of 85,996 anglers were mailed a 6" x 9" full color postcard, and the other half received a 4" x 6" black and white postcard. All postcards were mailed out on April 2. The overall lift of 0.84% was the highest ever recorded for the 5 years New York has participated in this program. The black and white post card that provided a reminder to the angler that they needed to renew their license had the highest lift rate (1.15%). New York's overall lift rate was almost double the 0.46% national average.

Aquatic Invasive Species (AIS) Spread Prevention

Extensive efforts were undertaken over the winter of 2013 in the development of new regulations designed to prevent the spread of aquatic invasive species by boaters using DEC boat launch facilities. The new regulations require boaters to drain their boats and remove all visible plant and animal material from the boat, trailer and associated equipment prior to launching or leaving DEC boat launch facilities. Responses to the over 150 comments were prepared as part of the rule-making process. *Note: The rulemaking package was approved by the Governor's Office and the regulations were enacted on June 4, 2014.*

Additional AIS related activities included participation in regular meetings of the team updating the New York State Aquatic Invasives Species Spread Prevention Plan and an continual upgrading of information provided on the Department website and boat launch kiosks.

2013-14 Public Use Staff	
Edward Woltmann	Biologist 3
Gregory Kozlowski	Biologist 2
Joelle Ernst	Biologist 1 (Aquatic)
Scott Cornwell	Fish and Widlife Technician
Ariel Gallo	Fish and Widlife Technician

Public Access Projects

Region	County	Waterbody	Description of Project
4	Albany	Normans Kill FAS	Boat slide/ bank repairs from high water event 2014 flood damage
4	Albany	Onesquethaw Creek PFR	Construction of 8 car parking lot.
4	Delaware	Susquehanna River (Southside FAS)	Improve parking lot for 6-7 cars in Coop with DOT R9 at Southside Dam
4	Delaware	West Branch Delaware (Walton) FAS	4 car parking lot completed.
4	Delaware	East Br. Delaware River (Hawk Island)	6 car parking lot completed.
4	Delaware	West Br. Delaware River (Hamden Park)	6 car parking lot, boat slide and fishing platform (built by Delaware Cty. completed.
4	Delaware	West Br. Delaware (Walton DOT pull off)	10 car parking lot, boatslide (built by Delaware County) completed.
4	Delaware	West Branch Delaware (Fitchs Bridge)	2 car parking lot completed (built by Delaware County)
4	Columbia	Queechy Lake	Damage to launch/dock repaired.
4	Greene	Basic Creek (FAS)	6 car parking lot completed.
5	Clinton	Lake Champlain (Peru Docks BLS)	Extension of ramp and shoreline stabilization completed.
5	Essex	Lake George (Mossy Point BLS)	Conversion to flush toilets, new pump out and conversion to town sewer system completed.
6	Jefferson	Lake Ontario (Point Peninsula)	Construction of a 2 lane boat ramp with floaitng docks; parking for 25 cars & trailers & 10 cars.
7	Madison	Chittenango Creek (off Route 13)	Construction of 6 car FPA and footpath completed.
7	Tioga	Owego Creek (Park Settlement Rd)	Construction of 8 car FPA completed in cooperation with Town of Candor.
7	Broome	Nanticoke Creek (Ames Rd.)	Construction of 6 car FPA completed.
7	Broome	Nanticoke Creek (Route 26)	Construction of 6 car FPA completed.
7	Madison	Lake Moraine	Grass island removed to improve access and decrease maintenance.
9	Erie	Eighteen Mile Creek	Construction of 12 car parking area off Basswood Drive.

Public Access Acquisitions

Region	County	Water	Acres/Miles	Cost	Date	Comments
4	Delaware	West Br. Delaware River	3.15 acres	N/A	1/31/2014	Cooperative Agreement with Town of Walton
4	Delaware	East Br. Delaware R. (Hawk Island)		N/A		MOU with DOT Region 9
4	Greene	Basic Creek		N/A		MOU with DOT Region 1
7	Madison	Chittenango Creek	0.5 eq. miles		11/13/2013	PFR
7	Tioga	E. Br. Owego Creek (Paisley Property)	0.76 eq. miles	$20,350	2/28/14	PFR
7	Tioga	Owego Creek (Park Settlement Rd)	.175 eq. miles	$3,937.5	12/20/13	PFR
7	Tioga	West Br. Owego Creek	12.4 acres			Donation from Finger Lakes Land Trust
7	Onondaga	Fabius Brook	.12 acres	$1,950		PFR
7	Onondaga	Ninemile Creek	5.5 acres		8/27/2013	Donation from Onondaga County Water Authority
8	Monroe	Sandy Creek PFR/FPA	.724 eq. miles	$36,333		PFR & FPA
9	Erie	Eighteen Mile Creek	10 acres	N/A		Agreement with Town of Hamburg

Habitat Improvement Projects

Region	Name of Water	Project	Cooperator Name	Comments
1	Peconic Lake	Ludwigia Control	Peconic Estuary Program	Fisheries Staff and volunteers spent 563 hours hand pulling 24.5 cu. Yds. of invasive Ludwigia.
1	Massapequa Creek	Water Chestnut removal	Nassau County	Fisheries Staff, Nassau County DPW and volunteers removed water chestnut from Massapequa Lake and Massapequa Reservoir.
4	East Branch Delaware	Tomannex	Trout Unlimited	Added toe wood and rock cluster
4	Wynants Kill	Streamside Plantings	Rensselaer Land Trust	Seedlings planted to restore streambank vegetation.
5	Lost Pond	Barrier Dam Repair	DEC	Leak in bank
5	East Branch Ausable River	Stream restoration/bank stabilization	DEC	River Mede Farm Property
5	West Pine Pond	Barrier Dam Repair	DEC	Leak in dam
5	Little Green Pond	Spawning habitat install	DEC	Planted stone beds near springs for smelt spawning.
5	Lower Sargent Pond	Reclamation	DEC	Removed largemouth bass and golden shiners.
5	Lower Sargent Pond	Barrier Dam Repair	DEC	Leak in dam
6	Hawk Pond	Pond Liming	N.Y. State Police	State Police helicopters transported 35 tons of lime.
6	Bear Pond	Pond Liming	Bear Pond Club	In cooperation with club moved 30 tons of lime.
6	Sandy Creek	Stream Improvement	USFWS	Streambank stabilization and in-stream structures at multiple sites
8	Cohocton River	Stream Improvement	Canandaigua Chapter Trout Unlimited	Installation of in-stream cover boulders and tree planting.
9	Wiscoy Creek	Stream Improvement		Intallation of stone channel block and toe-wood structures
9	Various waters	Willow planting	Local TU Chapters	

Habitat Improvement Projects

Region	Name of Water	Project	Cooperator Name	Comments
9	Upper Niagara River	Motor Island WMA Aquatic Habitat Restoration/Enhancement	New York Power Authority as required for Niagara Power Project FERC Re-licensing	Project concept was developed collaboratively with Region 9 DFWMR staff. Project consists of numerous shoreline treatments, along approximately 1,800 ft. of Niagara River riparian shoreline, to mitigate erosion and enhance shoreline habitat for fish and wildlife.
9	Upper Niagara River	Fish Attraction Structure—Boulder Field	New York Power Authority	150 Concrete blocks removed from Motor Island Project were beneficially re-used to create hydraulic cover in an area of the Niagara River that is adjacent to a popular fishing area
Lake Erie Unit	Chautauqua Creek	Fish Passage	ACoE and Village of Westfield	In July 2013 fish passage structures installed for two small dams through the Great Lakes Fisheries and Ecosystem Restoration Program (GLFER) program.

Hatchery Infrastructure Improvements

Work continued in 2013 to replace or repair aging hatchery infrastructure. Major projects included:

Catskill Hatchery

The access road to the main spring was rehabilitated by widening the road, installing new drainage culverts, and resurfacing the roadway with driveway stone. Access to the spring is needed 365 days a year and the condition of the road was becoming impassable especially during the winter months when snow would block the road due to the narrowness of it and not being able to clear the snow properly. Access has been greatly improved and it was especially tested during this past harsh winter.

Chautauqua Hatchery

A new standing seam roof is planned to be installed in the spring of 2014 for the assistant manager's residence, along with other improvements to the home, especially to the fascia and trim.

Randolph Hatchery

A new modular residence with garage was purchased and the installation was completed in the fall of 2013. The hatchery was without a residence as it was demolished in the spring of 2012 due to the discovery of asbestos throughout the building.

A new PVC head pipe was installed to improve water flow to the "B" ponds. The old steel head trough was the original head trough and was close to 60 years old and was cracked and leaking. A new roadway was completed to the earthen ponds which included a new culvert and driveway stone.

Rome Hatchery

Repairs were made to the main spring retaining wall in the fall of 2013. The cement wall was cracked and leaking and needed to be repaired immediately before a major leak occurred. This was a temporary repair and the complete spring wall and flow boxes are anticipated to be replaced in the summer of 2014. A new municipal water line was installed for domestic water to the hatchery and pathology lab in cooperation between the NYSDEC and the City of Rome.

Salmon River Hatchery

An inspection of the reservoir water line (the main water supply to the hatchery) was completed using an underwater camera in the spring of 2013. A continual reduced water flow has been occurring for the past few years to the hatchery. A study was completed on the deep well field which provided information on gallons per minute each well produced, size of pumps, and the condition of the pump screen. A new shallow well was completed near the hatchery and is providing a good flow of water. New aquariums for the visitor center have been designed and presently a contractor is on site installing all components. The original aquaria were small and outdated. These new aquariums will also be supplied with re-use water which will save overall on the water needed to operate these three aquaria.

South Otselic Hatchery

Engineering plans are being finalized that will encompass new outlet structures for the earthen ponds where walleye fry are raised. Many ponds will be combined into larger ponds which will benefit the raising of the fish and help collect the fish more efficiently. Multiple stairways will be built to help in getting the fish onto the truck from the collection areas. More automatic feeders were installed in the main hatchery building. These feeders replace old, outdated, and very loud feeders. The new "whisper feeders" will provide reliable and quieter operation which will benefit the fish and hatchery employees.

Van Hornesville Hatchery

Phase 1 of a rehabilitation project was completed in the fall of 2013 that included new drainage tiles and black- top pathways in the pond area of the hatchery. Also, new grating was installed in the outlet areas of the ponds. These replaced very old grating and has improved the safety of workers and visitors at the hatchery. Phase 2 of the construction will encompass further drainage piping and black top pathways to more ponds and the main spring.

Fall Egg Collections

Lake Trout from Cayuga Lake

The annual Cayuga Lake egg collection of Finger Lake strain lake trout began on October 8, 2013 at Taughannock Point on Cayuga Lake. A total of 375,000 eggs were collected over a 7 day period. Of this total, 328,000 were used for lake trout production while 47,000 were fertilized with brook trout to produce splake eggs. The egg collection was completed using personnel from South Otselic Hatchery, Bath Hatchery, and Oneida Hatchery. The lake trout hatched from these eggs will be stocked throughout the state. The splake will be stocked in the Adirondack Mountain region.

Lake Trout from Raquette Lake

The egg collection for the Adirondack strain of lake trout began on October 16, 2013 at North Point on Raquette Lake and continued until October 25, 2013. A total of 196,000 green eggs were collected. After a very successful egg hatch, the fish are doing extremely well and numbers should be adequate to fulfill the 2015 spring stocking requirements.

Salmon River Hatchery - Chinook and Coho Salmon

The annual Salmon River Fish Hatchery's chinook and coho salmon egg collection began on October 9 and ended on October 21, 2013. The coho egg collection began on October 11 and ended on October 21, 2013. Four million Chinook eggs and 1.6 million coho eggs were collected. The salmon hatched from these eggs will be used in Salmon River Fish Hatchery's stocking program for Lake Ontario.

Adirondack Hatchery – Landlocked Salmon Egg Collection

The egg collection began on November 6 and ended on November 10, 2013. A total of 1.1 million eggs were collected. There were 262,000 collected from wild brood stock from Little Clear Pond and 877,000 from captive brood stock. Target numbers were achieved so there should be enough landlocked salmon for stocking in the spring of 2015. These landlocked salmon are stocked into many Adirondack waters, as well as the Finger Lakes, and other selected waters throughout the state.

Windfall Heritage Strain Brook Trout

The egg collection of the Windfall heritage strain of brook trout took place on October 30 and November 6, 2013 in Mountain and Black Ponds in Franklin County. Personnel from South Otselic Hatchery, Chateaugay Hatchery, and the Region 5 Fish Management Unit participated in the egg collections. A total of 30,000 eggs were collected. The eggs were transported back each day to the South Otselic Hatchery. The fish from these eggs will be stocked in selected waters under the Adirondack Heritage Strain Brook Trout Management Program.

Windfall Domestic Brook Trout

The egg collection of the windfall hybrid brook trout (Windfall x Domestic) took place on November 7 and 8, 2013. A total of 145,000 eggs were collected from domestic female brook trout being held at Chateaugay Hatchery and were fertilized with male brook trout from Black Pond in Franklin County. A goal of 100,000 eggs was met and exceeded. The fish are doing very well and there are 108,000 fingerlings as of May 2014. This egg collection has occurred as a result of the continuing potential for the sale of our supplier of the Temiscamie hybrid brook trout eggs and the uncertainty for them to supply eggs to the NYSDEC in the future.

Spring Egg Collections

Salmon River Hatchery – Steelhead

Salmon River hatchery's annual steelhead rainbow trout egg collection began on April 4 and ended on April 10 for a total of 5 days, as eggs were not collected on the weekend. A total of 2 million Washington strain and 185,000 Skamania strain eggs were collected. The fish hatched from these eggs will be stocked in tributary waters of Lake Ontario and Lake Erie.

Bath Hatchery – Wild and Hybrid Rainbow Trout

An egg collection of wild rainbow trout from the Cayuga Inlet Fishway was on April 9 and April 17, 2014. A total of 208,000 wild rainbow trout eggs were collected. There were also 28,500 hybrid (wild rainbows x domestic rainbows) rainbow trout eggs taken. Target numbers were reached and should be adequate to meet future stocking targets.

Oneida Hatchery – Walleye

Oneida Fish Hatchery staff, with the assistance from other NYS hatchery staff, conducted trap netting operations for spawning walleyes between April 4th and 12th, 2013. Oneida Lake's ice completed breaking up on April 3rd, and hatchery staff began setting nets on April 4th. Nets were tended and emptied daily for seven days. Captured fish were transferred back to the facility, where eggs were collected and fertilized. Stripped walleyes were released back into Scriba Creek. Twelve trap nets were set, totaling 84 net lifts. The staff captured 21,631 walleyes, and collected 322 million eggs. A total of 4,848 females were stripped, averaging 66,460 eggs per female. A male to female ratio of 2:1 was used for fertilizing the eggs.

Chautauqua Hatchery – Muskellunge

Chautauqua Fish Hatchery's muskellunge egg take took place between April 30 and May 12. During that period six trap nets were set in Chautauqua Lake at standard index net locations. Water temperature ranged from 48 to 56 degrees Fahrenheit during the netting period. A total of 251 adult muskellunge were captured, from which we mated 43 pairs and collected 2,118,000 eggs.

Fish Disease Control

Fish Disease Control Unit Overview

The NYSDEC Fish Disease Control Unit (FDCU) at Rome Field Station oversees the fish health program for the state. The fish health program includes disease surveillance of (1) the DEC hatchery system, (2) fish living in wild rivers, streams and lakes, and (3) provide fish health care to fish in the state hatchery system.

State Hatchery Disease Testing

Each fish lot was tested from our 12 DEC hatcheries and cooperating facilities, including both production fish and parental brood stock; 56 inspections and 4,100 fish in all. From the Salmon River hatchery, *Aeromonas salmonicida* was isolated from spawning Chinook and coho salmon and *Renibacterium salmoninarum* from an adult steelhead. In 2012, an *Aeromonas salmonicida* epizootic occurred at the Rome hatchery and we were pleased that the disease was not detected there in 2013. No other program pathogens were detected in our inspections.

State Hatchery Fish Disease Epizootics

Bacterial Gill Disease (BGD)

A number of common fish diseases occur periodically in our hatchery system and are managed by our staff. These events can become very serious, particularly if environmental or nutritional conditions are not optimal. The majority of our clinical investigations in 2013 (60 of 69 cases) dealt with flavobacterial diseases. We routinely encounter three different flavobacterial diseases, bacterial coldwater disease (BCWD), columnaris disease, and bacterial gill disease

(BGD).

In 2013, a fourth flavobacterial disease first appeared at the Van Hornesville SFH in July. Clinical signs included skin hyperpigmentation on the tail and epithelial hypertrophy and erosion in the same area. A Flavobacterium-like organism was cultured and sequence analysis failed to identify species, only *Flavobacterium* or *Chryseobacterium* genera. Soon after the Van Hornesville discovery, the same bacterium was identified at other hatcheries receiving these fish from Van Hornesville. Losses weren't severe, but were persistent throughout the summer and early fall. Over time, it became resistant to Terramycin and topical Perox-Aid therapy was substituted with some success.

Furunculosis Abatement at the Rome Hatchery

Following the furunculosis epizootic of 2012, a two-year mitigation plan required biannual lot testing for the pathogen. Fish were tested in March and September of 2013 and no Aeromonas salmonicida was isolated. Two more inspections are planned in 2014 to fulfill the plan goals. At Rome Field Station, additional measures to minimize the discharge of harmful pathogens from the wet lab were pursued which include installing an ultraviolet water treatment unit, a protective curtain to minimize aerosol spread, and an assortment of disinfection methods for clothing and equipment. Once the hatchery successfully completes 4 consecutive pathogen-free inspections, then the abatement will conclude and normal hatchery operations may resume.

Wild Fish Disease Surveillance

Wild fish health is assessed annually in a cooperative program with the USFWS and the National Wild Fish Health Survey and the surveillance functions as an "early warning system" to detect harmful pathogens soon after they arrive in New York waters. We can also monitor the spread of these pathogens with continual surveillance. For this statewide survey in 2013, a wide range of fish species were collected from 27 locations (1,558 fish) and clinical testing was done at the USFWS fish health center in Lamar, PA. Epizootic Epitheliotropic Disease Virus (EEDv) was discovered in Lake Trout from two locations, Lake Ontario near Rochester, and Seneca Lake. Although Seneca Lake is connected to the Great Lakes via the Erie Canal system, this is the first inland detection of EEDv in New York. EEDv has been detected in Lake Ontario waters previously, including two locations in New York in 2012. In all cases, fish appeared healthy and no clinical disease was evident. This does raise some concern since the NYSDEC uses lake trout from nearby Cayuga Lake (Seneca strain) for egg production. Cayuga previously tested negative. The other egg source for lake trout (Adirondack strain) is Raquette Lake which also tested negative for all pathogens, including EEDv. *Nucleospora salmonis* was detected in previous years in Lake Ontario and Long Island, but we had no *N. salmonis* detections in 2013.

Other Fish Health Projects

Experimental New Animal Drug Studies

The DEC has ongoing agreements with the FDA and USFWS to use the drugs Chloramine T to treat specific bacterial diseases and Aqui-S as a fish anesthetic. In return, the FDA have applied our treatment results toward their drug approval process. Chloramine T has always been very effective and labels for use in trout, walleye and warmwater fish species were approved. The DEC continues to work toward label approvals for other important species such as tiger muskellunge and other cool water species. We use Aqui-S for many procedures that require sedation, including fish marking, radio tagging and egg collection. And our data suggest that Aqui-S performs much better than other sedatives, and we feel confident that FDA approval will come sooner rather than later.

Furunculosis-Resistant Trout Project

The DEC's primary domestic brown and brook trout strains (Rome strain) were developed by the FDCU for disease resistance to bacterial furunculosis. Every year, fingerling Rome strain trout at Rome Field Station are challenged with a significant dose of *A. salmonicida* intended to ensure continuance of the disease-resistant trait. In 2013, Rome strain brown trout and brook trout were successfully challenged with a cocktail including eight different isolates of *A. salmonicida* from fish in Lake Ontario.

Egg Maturity Assessment for Sturgeon Propagation

Unit staff assisted in the bureau lake sturgeon propagation project by conducting an egg maturity assay during spawning to improve fertilization success. In 2013, eggs were harvested from prospective females and egg maturity was assessed to identify females having ripe eggs. Of the seven females collected, this assay targeted three ripe females for fertilization, thus doing away with needless fish handling of unripe fish. Egg fertilization and was very successful.

2013-14 Fish Culture Staff

CENTRAL OFFICE

Jim Daley	Fish Culturist 6
Dave Armstrong	Fish Culturist 5
Mary LaBoissiere	Secretary 1

ADIRONDACK

Matt Jackson	Fish Culturist 3
Kenneth Klubek	Fish Culturist 1
Adam Kosnick	Fish Culturist 1 (trainee II)

BATH

Ken Osika	Fish Culturist 3
Kelly Raab	Fish Culturist 1
Robert Sweet	Fish Culturist 2
Stephen Galbreth	Fish Culturist 1
Adam Haley	Fish Culturist 1

CALEDONIA

Alan Mack	Fish Culturist 4
Kevin Hayden	Fish Culturist 2
Mark Krause	Fish Culturist 3
Jason Schirmer	Fish Culturist 1
Robert Stein	Fish Culturist 2
Brian Ward	Fish Culturist 1
Stephen Zenzen	Fish Culturist 1
Steven Robb	Fish Culturist 1

CATSKILL

John Anderson	Fish Culturist 4
Tim Anstey	Fish Culturist 1
Joseph Gennarino	Fish Culturist 2
James Judson	Fish Culturist 1
Nathan Snyder	Fish Culturist 1
Mark Ferron	Fish Culturist 1 (trainee II)
Robert Poprawski	Fish Culturist 1 (trainee II)

CHATEAUGAY

Neal McCarthy	Fish Culturist 2
Mike Disarno	Fish Culturist (trainee II)
Doug Peck	Fish Culturist (trainee II)
Mike Sicley	Fish Culturist (trainee II)
Nicole Vogt	Fish Culturist (trainee II)

CHAUTAUQUA

Larry King	Fish Culturist 3
Eric Defries	Fish Culturist 2
Bradley Gruber	Fish Culturist 1
Ron Preston	Fish Culturist 1

ONEIDA

Bill Evans	Fish Culturist 4
Neil Cranker	Fish Culturist 1

RANDOLPH

Richard Borner	Fish Culturist 3
Trevor Brady	Fish Culturist 1
Barry Hohmann	Fish Culturist 1
Raymond Hulings	Maintenance Assistant
Jim Rambuski	Fish Culturist 2
Derek Weishan	Fish Culturist 1

ROME

Kevin Balduzzi	Fish Culturist 1
John Draper	Fish Culturist 1
Steven Grabowski	Fish Culturist 2
Zach Goodale	Fish Culturist 1
William R. Hajdasz	Maintenance Supervisor
Kimberly Matt	Keyboard Specialist
Scott Wanner	Fish Culturist 3
William Woodworth	Fish Culturist 2

FISH DISEASE CONTROL

Andrew Noyes	Pathologist 2 (Aquatic)
Geofrey Eckerlin	Biologist 1 (Ecology)
Mark Batur	Fish Culturist 1

SALMON RIVER

Andreas Greulich	Fish Culturist 4
Brian Boyer	Fish Culturist 1
Stephen Dolan	Fish Culturist 3
David Domachowske	Fish Culturist 2
Brian Edmonds	Fish Culturist 1
Karen Hurd	Keyboard Specialist
Robert Nelson	Fish Culturist 2
Leslie Resseguie	Fish Culturist 1 (trainee II)

SOUTH OTSELIC

Pat Emerson	Fish Culturist 3
Thomas Kielbasinski	Fish Culturist 2
Bruce Ryan	Fish Culturist 1
Mike Speziale	Fish Culturist 1

VAN HORNESVILLE

Larry Kroon	Fish Culturist 3
Craig DuBois	Fish Culturist 2
Lauren C. Watson	Fish Culturist 1

Annual Fish Production

ANNUAL STOCKING REPORT - BY SPECIES
January 1, 2013 - December 31, 2013

SPECIES		LESS THAN 1"		1" - 4.24"		4.25" - 5.74"		5.75" - 6.74"		6.75" - 7.74"		7.75" Plus		TOTAL	
		NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT
Cold Water	**Cold Water**														
	Brook Trout	-	-	138,020	2,759	50,514	1,824	5,750	231	2,200	400	191,408	43,268	**387,892**	**48,482**
	Brown Trout					63,100	3,271	725	24	34,275	2,456	1,541,287	441,993	**1,639,387**	**447,744**
	Rainbow Trout			45,000	309			58,200	5,454	26,820	4,621	390,019	102,605	**520,039**	**112,989**
	Steelhead	10,000	-			580,900	24,966	209,630	19,401					**800,530**	**44,367**
	Lake Trout	330	-			10,200	306	140,060	9,138	556,710	51,904	77,400	12,119	**784,700**	**73,467**
	Splake									22,340	3,641			**22,340**	**3,641**
	Landlocked Salmon	104,068	1,371	153,695	504			169,080	16,320	130,582	16,154	51,471	11,716	**608,896**	**46,065**
	Coho			155,000	4,168			68,600	6,860					**223,600**	**11,028**
	Chinook			1,769,600	19,025									**1,769,600**	**19,025**
	Cold Water Total	**114,398**	**1,371**	**2,261,315**	**26,765**	**704,714**	**30,367**	**652,045**	**57,428**	**772,927**	**79,176**	**2,251,585**	**611,701**	**6,756,984**	**806,808**
Warm Water	**Warm Water**														
	Walleye	216,500,000	2,887	811,067	1,703									**217,311,067**	**4,590**
	Muskellunge	748,300	27	53,710	44							31,420	2,567	**833,430**	**2,638**
	Tiger Muskellunge	3,600	-									108,068	14,466	**111,668**	**14,466**
	Panfish											500	100	**500**	**100**
	Warm Water Total	**217,251,900**	**2,914**	**864,777**	**1,747**	**-**	**-**	-	-	**-**	**-**	**139,988**	**17,133**	**218,256,665**	**21,794**
RTE	**Rare\Threatened\Endangered**														
	Lake Sturgeon							10,100	300			3,500	389	**13,600**	**689**
	Paddlefish	301	67									683	152	**984**	**219**
	Round Whitefish	4,000	2	8,341	6									**12,341**	**8**
	RTE Total	**4,301**	**69**	8,341	6	**-**	**-**	10,100	300	**-**	**-**	4,183	541	**26,925**	**916**
Grand Total		**217,370,599**	**4,354**	**3,134,433**	**28,518**	**704,714**	**30,367**	**662,145**	**57,728**	**772,927**	**79,176**	**2,395,756**	**629,375**	**225,040,574**	**829,518**

Summary of Fisheries, Creel & Angler Surveys

Survey Name	Purpose
Region 1	
Peconic River Tributaries	Alewife Monitoring
Alewife Creek	Alewife Monitoring
Beaver Brook	Brook Trout survey
Carmans River	Fate of Stocked Trout Population Surveys
Upper Yaphank Lake	Pre-Dredging survey
Lower Yaphank Lake	Pre-Dredging survey
Carmans River	Monitoring movement of PIT Tagged Alewife, Brook Trout and American Eel
Carmans River Creel Census	Fate of Stocked Trout Creel Census
Mud Creek	Brook Trout Survey
Four Ponds in the Carmans River Drainage	Threatened/Endangered Species Monitoring (Swamp Darter)
Connetquot River	Disease Monitoring
Smith Pond	Toxic Substance Monitoring
Hempstead Lake	Toxic Substance Monitoring
Massapequa Creek	Brook Trout Survey
Hards Lake	Alewife Monitoring
Region 2	
Golden Pond, Crocheron Park, Queens	Northern snakehead investigation
Harlem Meer, Central Park, Manhattan	Centrarchid survey
Baisley Pond, Baisley Pond Park, Queens	Centrarchid survey
Van Cortlandt Lake, Van Cortlandt Park, Bronx	Centrarchid survey
Long Pond, Long Pond Park, Staten Island	General biological survey
Martling's Pond, Clove Lake Pond	Centrarchid survey
Kissena Lake, Kissena Park, Queens	Centrarchid survey
Meadow and Willow Lakes, Flushing Meadows Corona Park, Queens	Northern snakehead monitoring
Region 3	
Esopus Creek	Fate of Stocked Trout survey
Lake Minnewaska	Assessment of golden shiner and new largemouth bass populations
Tillson Lake	Fish Community survey
Esopus Creek (below Ashokan Reservoir)	Electrofishing evaluation of release from Ashokan Reservoir
Ashokan Reservoir	Two story gill netting survey
Rio Reservoir	Percid plan, walleye evaluation
Swinging Bridge Reservoir	Percid plan, walleye evaluation
West Branch Croton River	Trout assessment
White Pond	Percid plan, walleye evaluation
Ridgebury Lake	Invasive species eradication follow-up
Kensico Reservoir	Angler diary program
Region 4	
Hudson River	Blueback Herring Monitoring
Mohawk River	Blueback Herring Monitoring
Manor Kill T16	Weatherfish Monitoring
Schoharie Reservoir	Toxic Substances Monitoring Program (TSMP) Collection

Pepacton Reservoir	General Biological Survey
Blazer Pond	General Biological Survey
East Branch Delaware River	Trout Population Survey
Schoharie Creek	Special Regs Evaluation
Butternut Creek	CROTS Survey
Little Pond	General Biological Survey
Otsego Lake	Percid Sampling
East Sidney Reservoir	General Biological Survey
Canadarago Lake	Percid Sampling
Shingle Hollow Brook	Spill Fish Kill NRD assessment
Kinderhook Creek	Fate of Stocked Trout Study
North and South Lake	Tiger Musky assessment
Kinderhook Lake	Tiger Musky assessment
Hoosic River	Trout assessment
West Kill	CROTS post storm assessment
East Kill	CROTS post storm assessment
Batavia Kill	CROTS post storm assessment
Normans Kill	Black Bass regulations evaluation
Ouleout Creek	Trout assessment
Region 5	
Whey Pond	Brook Trout stocking evaluation
Puffer Pond	Brook Trout stocking evaluation
Burge Pond	Brook Trout stocking evaluation
Oxshoe Pond	Brook Trout stocking evaluation
Chub Pond	Brook Trout stocking evaluation
Brown Pond	Brook Trout stocking evaluation
Eighth Lake Essex Chain	Brook Trout stocking evaluation
Panther Pond	Brook Trout stocking evaluation
Handsome Pond	Brook Trout stocking evaluation
Meadow Pond	Brook Trout stocking evaluation
Bear Pond	Brook Trout stocking evaluation
Grass Pond	Brook Trout stocking evaluation
Ochre Pond	Brook Trout stocking evaluation
Crane Mountain Pond	Brook Trout stocking evaluation
Lake Placid	Lake Trout juvenile evaluation
Polliwog Pond	Lake Trout juvenile evaluation
Third Lake Essex Chain	Lake Trout juvenile evaluation
Fifth Lake Essex Chain	Lake Trout juvenile evaluation
Taylor Pond	Lake Trout juvenile evaluation
Blue Mountain Pond	Lake Trout juvenile evaluation
Lake George	Lake Trout juvenile evaluation
Schroon Lake	Lake Trout juvenile evaluation
Paradox Lake	Lake Trout juvenile evaluation
Schroon Lake	TSMP
Sunrise Pond	Limed Waters

Echo Pond	Limed Waters
Black Pond	Limed Waters
Icehouse Pond	Limed Waters
Benz Pond	Limed Waters
St. Germain Pond	Limed Waters
Region 6	
Big Creek	Fate of Stocked Trout Population Survey
Big and Oriskany Creeks	Fate of Stocked Trout Creel Survey
Big Hill Pond	Fish Disease Investigation
Black Lake	Walleye Evaluation
Black River	Lake Sturgeon Monitoring
Boottree Pond	Brook Trout Egg Take
Boottree Pond	Limed Waters Program
Brewer Lake	Limed Waters Program
Buck Pond	Limed Waters Program
Clear Pond	Limed Waters Program
Cleveland Lake	Limed Waters Program
Deer Pond	Fish Disease Investigation
Deer Pond	Brook Trout Egg Take
Delta Lake	Fish Disease Investigation
Delta Lake	Walleye Evaluation
Erie Canal	Contaminant Collection
Evergreen Lake	Limed Waters Program
Hedgehog Pond	Limed Waters Program
Hidden Lake	Limed Waters Program
Horn Lake	Limed Waters Program
Horseshoe Pond	Limed Waters Program
Kelsey Creek	Post Clean-up Evaluation
Lake of the Woods	Disease Investigation
Lake Ontario	Warmwater Fish Stock Assessment
Lake Ontario	Lower Trophic Level Study (12 surveys)
Lake Ozonia	Fish Habitat Evaluation
Lake Ozonia	Salmonid Survey
Lake St. Lawrence	Warmwater Fish Stock Assessment
Lansing Kill	General Biological Survey
Little Hill Pond	Fish Disease Investigation
Little Otter Lake	Limed Waters Program
Long Lake	Limed Waters Program
Mohawk River	General Biological Survey
Nicks Pond	Limed Waters Program
North Twin Pond	Brook Trout Egg Take
Oily Creek	Post Clean-up Evaluation
Oriskany Ck	Fate of Stocked Trout Population Survey
Oswegatchie River	Walleye Egg Take
Payne Lake (Jefferson County)	Walleye Evaluation
Payne Lake (Lewis County)	Limed Waters Program

Peaked Mountain Lake	Limed Waters Program
Perch River	Eel Collection
Pine Pond	Limed Waters Program
Pitcher Pond	Limed Waters Program
Pitcher Pond	Brook Trout Lipids Study
Quiver Pond	Limed Waters Program
Rainbow Falls Res	Contaminant Collection
Raven Lake	Acidified Waters Survey
Red Lake	Walleye Evaluation
Round Pond	Limed Waters Program
Sauqoit Creek	Contaminant Collection
Sixberry Lake	Fish Disease Investigation
Sixtown Pond	General Biological Survey
Skinner Ck	Unit Management Plan Survey
South Twin Pond	Brook Trout Egg Take
St. Lawrence River	Lake Sturgeon Egg Take
St. Lawrence River	Contaminant Collection
St. Lawrence River	Esocid Monitoring
St. Lawrence River	Warmwater Fish Stock Assessment
Tamarack Pond	Limed Waters Program
Townline Pond	Limed Waters Program
Unnamed Water	Unit Management Plan Survey
Unnamed Water	Unit Management Plan Survey
Region 7	
Chittenango Creek	CROTS
DeRuyter Reservoir	Percid Sampling
Whitney Point Reservoir	Percid Sampling
Otselic River	Population estimate
Cayuga Inlet/Fall Creek/Cayuga Lake	Lake Sturgeon spawning survey
Unnamed stream	Verify trout presence before replacing culvert fish passage barrier
Eaton Brook Reservoir	Centrarchid sampling
Balsam Pond	TSMP
Salmon River Reservoir/Redfield Reservoir	Percid Sampling
Otselic River	Creel Survey
Whitney Point Reservoir	General Biological Survey
Mad Brook	Fish kill investigation
Skaneateles Lake	Fish kill investigation
Cayuga Lake	Invasive species report
Eaton Brook Reservoir	General Biological Survey
6 small streams in Chenango and Broome Counties	Potential reclassification as trout streams
Cayuga Inlet Fishway	Finger lakes strain Rainbow Trout egg take, fish passage, Sea Lamprey removal trapping
Salmon River	Steelhead Egg Take
Salmon River	Salmon Egg Take
Cayuga Lake	Lake sturgeon survey
Cayuga Lake	Lake trout Egg Take

Jamesville Reservoir	Percid Sampling
Otisco Lake	Percid Sampling
Cazenovia Lake	Percid Sampling
Rice Creek	General Biological Survey
Otter Lake	Percid Sampling
Owasco Lake	Angler Preference Survey
Region 8	
Springwater Creek	Rainbow Trout spawning run evaluation
Catherine Creek	Lamprey control evaluation / Rainbow Trout spawning run evaluation
Sleepers Creek	Lamprey Control evaluation / Rainbow Trout spawning run evaluation
McClure (Havana Creek)	Lamprey Control Evaluation / Rainbow Trout spawning run evaluation
Naples Creek	Rainbow Trout spawning run evaluation
Cold Brook	Rainbow Trout spawning run evaluation
Irondequoit Creek	Investigate fish kill
Waneta Lake	Muskie population assessment
Meads Creek	Part of state-wide survey regarding Fate of Stocked Trout
Long Pond	Investigate fish kill
Seneca Lake (lake trout derby)	Lamprey Control Evaluation/ lake tout population assessment
Seneca Lake standard gang netting	Lamprey Control Evaluation/ lake tout population assessment
Meads Creek	General salmonid survey
Honeoye Lake	Part of state-wide fish health collection.
Honeoye Lake standard gang netting	Warm water fisheries assessment
Cohocton River	Evaluation of an in-stream restoration project.
Reynolds Gully Creek	Evaluation of an in-stream restoration project.
4 Mile Creek	General salmonid survey
Region 9	
East Koy Creek electrofishing and angler use surveys	Part of FOST statewide study
548 small stream electrofishing surveys in Wyoming, Cattaraugus and Erie Counties.	EBTJV survey to document brook trout presence
N. Branch Wiscoy Creek	Fish survey prior to habitat improvement work
Quaker Lake	Warm and cool water fisheries management
Chautauqua Lake Trap netting	Evaluation of Muskie brood stock health and Hatchery egg take
Chautauqua Lake Electro-Fishing	Evaluation of post-stocking changes on game fish community
Upper Cassadaga Lake	Document stocking survival of 50-day walleye
Middle Cassadaga Lake	Document stocking survival of 50-day walleye
Lower Cassadaga Lake	Document stocking survival of 50-day walleye
Red House Lake	Document stocking survival of 50-day walleye
Lake Ontario Research Unit	
Lake Ontario Alewife Bottom Trawl Survey	Assess yearling and adult alewife in Lake Ontario
Lake Ontario Rainbow Smelt Bottom Trawl Survey	Assess yearling and adult smelt in Lake Ontario
Lake Ontario Juvenile Lake Trout Trawl Survey	Assess juvenile lake trout in Lake Ontario
Lake Ontario Warmwater Fisheries Assessment	Assess warmwater fish populations in the Eastern Basin
Status of Lake Ontario's Lower Trophic Levels	Monitor trends in Lake Ontario productivity, including nutrients, chlorophyll a, and zooplankton populations
Lake Ontario Adult Lake Trout Assessment	Assess adult lake trout populations in Lake Ontario

Lake Ontario Fishing Boat Survey	Monitor trends in angler effort/catch/harvest in the open waters of Lake Ontario
Lake Ontario Chinook Salmon Mass Marking Program	Determine contribution of wild Chinook salmon to Lake Ontario sportfisheries and evaluate success of pen-rearing projects
Northern Pike and Muskellunge Monitoring in the Thousand Islands Region of the St. Lawrence River	Monitor northern pike and muskellunge spawning and nursery areas to assess reproductive success and influence habitat changes
Lake Ontario Hydroacoustic Preyfish Assessment	Use hydroacoustic technology to develop lakewide estimates of alewife numbers and biomass
Lake Erie Research Unit	
Lake Erie Commercial Fishery Assessment	Sampling to characterize harvest & age composition of Lake Erie's commercial yellow perch fishery
Lake Erie Lower Trophic Monitoring Program	Index of lower trophic indicators seasonally, including zooplankton density, nutrient concentrations, temperature and water transparency
Lake Erie Open Lake Sport Fishing Survey	Creel survey measure of sport fishing catch and effort from Lake Erie's boat fisheries for walleye, smallmouth bass and yellow perch
Lake Erie Steelhead Smolt Out-migration Study	Sampling to assess size specific out-migration patterns of newly stocked steelhead in selected Lake Erie tributaries
Lake Erie Tributary Angler Diary Program	Diary index of fishing quality for Lake Erie's tributary steelhead fishery
Lake Erie Tributary Sea Lamprey Nest Density	Annual nest counts to index the concentration of sea lamprey nests in selected Lake Erie tributaries
Lake Erie Fish Cleaning Station Monitoring	Annual examination of angler caught walleye processed at cleaning stations to characterize size, age composition and stomach contents
Lake Erie Beach Seine Assessment	A pilot survey to assess abundance and distribution of near shore young-of-year fishes in eastern Lake Erie
Lake Erie Coldwater Community Assessment	Gill net index of abundance, age composition, growth, and diet of lake trout, burbot and lake whitefish
Lake Erie Warmwater Community Assessment	Gill net index of abundance, age composition, growth, and diet of walleye, yellow perch and smallmouth bass
Lake Erie Forage and Juvenile Fish Assessment	Bottom Trawl index of abundance, age composition and growth, of juvenile yellow perch and an array of forage fish species

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Permits & Licenses

A summary of licenses and permits reviewed or issued by the Bureau of Fisheries

	DEC REGION										
Permit Name	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**CO**	**Total**
Farm Fish Pond			4	241		3	115	75	46		484
Stocking	7		171	40	131	26	32	14	8/9		430
Triploid Grass Carp	5		239	171	75	29	235	347/357	588/592		1703
Overland Transport of Bait			10			4	5	14	8		41
Fish Possession (over daily limit)					5		2	1			8
Piranha						3	1		2/2		6
Baitfish	3					85	92	92			272
Temporary Revocable Permit (TRP)			1	3	44	3	19	15	2		87
Article 15 Issued/Reviewed		1	454	654	15/20*	488/678	5	86	725		2623
Article 24 Issued/Reviewed	12		259		331/370						641
Pesticide Permit Review	26		26	5	12	0/6	10				85
Bass Hatchery Permits (C.O)										34	34
Trout Hatchery Permits (C.O)										31	31
License to Collect and Possess		4						20		2	26
Other:											
Trout in the Classroom									8		8
Hydropower Relicensing						0/6					6
Adopt A Natural Resource											
Fish Removal											
Commercial Fishing (Great Lakes)										9	9
Total - All Permits	**53**	**5**	**1164**	**1114**	**657**	**843**	**516**	**674**	**1392**	**76**	**6494**

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ARTICLE

Importance of Ultrasonic Field Direction for Guiding Juvenile Blueback Herring Past Hydroelectric Turbines

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Abstract
Populations of Blueback Herring *Alosa aestivalis*, an important anadromous forage fish in the northeastern USA, have declined from historic levels. Measures to reduce mortality from many sources, including entrainment by hydroelectric turbines, are cited by fishery managers to be important to restoring populations. At the Crescent Hydroelectric Project (Crescent) on the Mohawk River, New York, pulsed ultrasound (122–128 kHz) was used to deter adult and juvenile Blueback Herring migrating out to sea from entering the intake channel to the headrace and turbines, where mortality may occur. To increase the deterrence rate, the sound field was extended further upriver to expose juvenile Blueback Herring to an increasing sound gradient as they migrate downriver and allow them more time to avoid the intake channel. When juvenile Blueback Herring were present upstream of Crescent and exposed to an ultrasound field, mean catch per unit effort (CPUE) by pelagic trawling in the main channel downriver of the ultrasound was 94% of the mean CPUE in the upriver trawl region and 250% of the mean CPUE in the intake channel. Repeated mobile echo sounder surveys revealed that the abundance of juvenile Blueback Herring averaged 35 times higher in the downriver main channel region than in the intake channel region. During the peak migration period of September 20 through October 14, 2012, continuous fixed-location horizontal echo sounding showed the percentage of net downstream passage of juvenile Blueback Herring that bypassed the intake channel significantly increased from 31.1% to 76.5% after redirecting the ultrasonic field upriver. These results demonstrate that pulsed ultrasound, when properly directed, can be used effectively as a fish deterrent system to provide safe downstream passage of juvenile Blueback Herring at hydropower dams. At Crescent, this could increase annual survival by tens of thousands of fish or more.

Blueback Herring *Alosa aestivalis* is an important anadromous forage species of fish in the northeastern USA and is currently managed together with Alewife *A. pseudoharengus* (the two species collectively referred to as river herring) under the interstate fishery management plan (FMP) prepared by the Atlantic States Marine Fisheries Commission (ASMFC 2009). The most recent stock assessment report declared stocks from many river systems, including the Hudson and Mohawk rivers, as being substantially depleted from historic levels (ASMFC 2012). The FMP identifies multiple factors contributing to their population decline, such as overfishing, pollution, channelization and dredging, barriers to migration, and mortality from fish entrainment by turbines at hydroelectric facilities and intakes at power plants.

The FMP identifies technologies for fish guidance as mitigation measures to deter fish from entering intakes at water withdrawal facilities. These technologies use sensory stimuli, such as light, sound, flow, turbulence, and electric fields, to change local fish distributions at hydropower dams to improve fish passage (Schilt 2007). Ultrasound (frequencies greater than 20 kHz) can be detected by alosines but not by other clupeids (Mann et al. 1997; Popper et al. 2004), with some of

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these frequencies eliciting avoidance responses in Blueback Herring (Nestler et al. 1992; Dunning and Ross 2010). When captive Blueback Herring were exposed to loud sounds ranging from 0.10 to 420 kHz, Nestler et al. (1992) found the strongest avoidance response between 120 and 130 kHz. Field evaluations later revealed that transducers transmitting 124.6 and 130.9 kHz at a source level of 187 or 200 decibels referenced to 1 μPa at 1 m (dB re 1 μPa at 1 m) partially repelled Blueback Herring over a distance of 60 m for periods of up to 1 hour. Dunning and Ross (2010) found band-limited sound between 122 and 128 kHz at sound pressure levels (SPLs) ranging from 145 to 163 dB re 1 μPa to elicit avoidance reactions from adult Blueback Herring held in a tank.

The use of ultrasound for guiding Blueback Herring and other alosines safely downstream is supported by experimental evidence and field studies that show that ultrasound reduces entrainment and impingement. On the Savannah River in Georgia, Ploskey et al. (1995) showed that ultrasound significantly reduced the mean hourly rates of Blueback Herring passage through the turbines at the Richard B. Russell hydroelectric dam by 56%. At Annapolis Tidal Hydroelectric Generating Station located in Nova Scotia, Gibson and Myers (2002) demonstrated that a 122–128 kHz ultrasonic system reduced fish passage of Blueback Herring through the turbines by 49%. Dunning et al. (1992) found that Alewife schooled and strongly avoided broadband sound between 117 and 133 kHz with an SPL of 157 dB re 1 μPa at 1 m or greater. When ultrasound was used in Lake Ontario at the cooling water intake of the James A. FitzPatrick Nuclear Power Plant, the density of Alewife near the cooling water intake decreased by as much as 96% and impingement of Alewife was reduced by as much as 87% (Ross et al. 1993, 1996).

Adult Blueback Herring are known to pass through several locks of the Erie Canal during their spring upriver spawning migration up the Mohawk River in New York (Figure 1A, B; Schmidt et al. 2003). Adults migrating downriver following spawning and juveniles out-migrating to sea several months later may encounter dams at six hydropower facilities. The Crescent Hydroelectric Project (Crescent), operated by the New York Power Authority, is a facility where out-migrating juvenile Blueback Herring are known to encounter hydroelectric turbines (Dunning and Gurshin 2012). An ultrasonic projector array was installed in 2008 and since then has operated at Crescent from May through mid-November to deter Blueback Herring adults during their postspawn downstream migration (May–July) and juveniles during their downstream migration (August–November) from entering the channel that leads to the Crescent headrace and turbines. In a hydroacoustic study of fish passage at Crescent during the fall of 2008, the percentage of juvenile Blueback Herring that migrated downriver past the headrace and turbines (31.3%) was significantly higher than expected (11.5%) if entrainment (and density) is proportional to river flow (Dunning and Gurshin 2012).

Horizontally aimed ultrasonic projectors were used between 2008 and 2012, but the orientation with respect to flow was modified in 2010. In 2008, two sets of four projectors were pointed in opposite directions and perpendicular to flow to form an acoustic barrier across the entrance of the intake channel (Figure 1C). Dunning and Gurshin (2012) suggested that the deterrence rate might be increased if the projectors were redirected to extend the effective sound field further upriver so that fish encounter an increasing sound gradient. This would provide more time for juvenile Blueback Herring to respond to the ultrasound and avoid entering the intake channel regardless of water velocity. As a result, beginning in 2010, four western projectors were redirected upriver by 45° toward the main channel (Figure 1C).

In this study, fish passage at Crescent was monitored by an intensive sampling effort from September 8 through October 26, 2012, to (1) determine whether the majority of juvenile Blueback Herring migrated down the main channel in the presence of ultrasound and (2) evaluate the effectiveness of the reconfigured ultrasonic projectors for guiding out-migrating juvenile Blueback Herring away from the turbines to the main channel for downstream passage.

METHODS

Multiple acoustic and net sampling methods were used in a complementary fashion to measure Blueback Herring abundance at different scales in time and space. Stratified-random pelagic trawl surveys and systematic mobile echo sounder surveys were repeatedly conducted to compare the density and abundance of juvenile Blueback Herring over time and among regions in the Mohawk River upstream of Crescent. Fish passage estimates from continuous stationary horizontal echo sounding upriver and downriver of the ultrasonic projectors were used to compare the number of fish migrating downriver in the main channel to the number expected under two null hypotheses. Acoustic Doppler current profiler (ADCP) technology was used to continuously measure water velocity at each site and measure daily river discharge. Computations and statistics of discharge, trawl, and processed acoustic data were performed using SAS software version 9.3 (SAS Institute, Cary, North Carolina) and Matlab software version R2011b (Mathworks, Natick, Massachusetts).

Study Area

Crescent is located on the Mohawk River approximately 8 km upstream of the confluence to the Hudson River, New York (Figure 1). Dams A and B, separated by an island, impound the Mohawk River. The river channel that flows down the west side of the island conveys water through four hydroelectric turbines during power generation (hereafter, the "intake channel"). The primary navigation channel (hereafter, the "main channel") continues to the east of the island toward

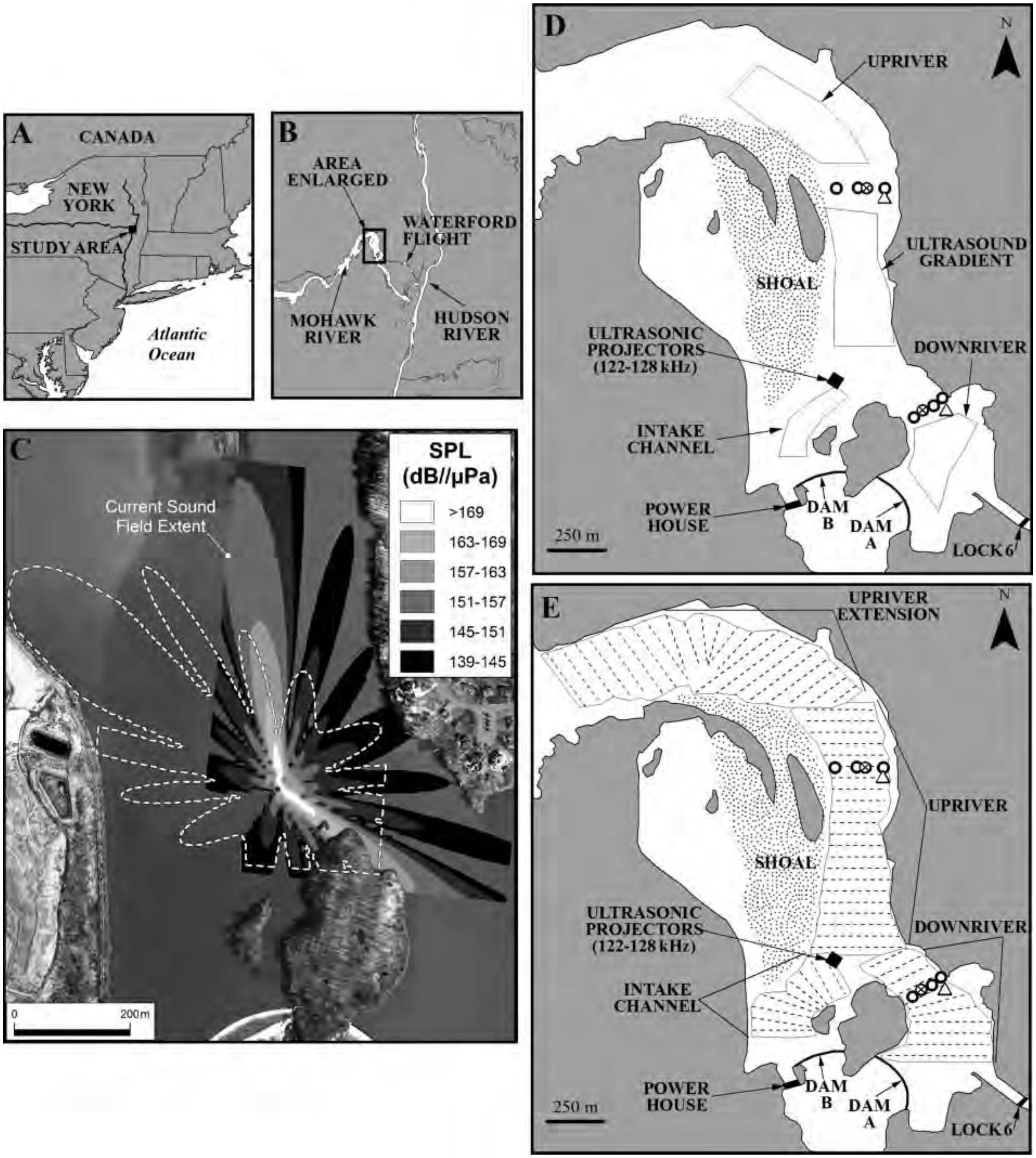

FIGURE 1. Location of the study area **(A)** in New York and **(B)** in the Mohawk River, New York. A model was created **(C)** predicting the ultrasonic field produced by eight integrated projector assemblies placed at the entrance of the intake channel at the Crescent Hydroelectric Project, after redirecting the four western projectors by a 45° angle to point upriver in the main channel of the Mohawk River; the previous orientation of the ultrasonic field is shown as the dashed outline. The maps of the study area in the main channel upriver and downriver of the ultrasonic projectors show **(D)** pelagic trawl regions (polygons), locations of split-beam transducers aimed horizontally (open circle) and vertically (crossed circles), locations of horizontally aimed acoustic Doppler current meters (triangles), and **(E)** mobile echo sounder survey regions (polygons) sampled along transects (dashed lines).

Dam A and the entrance to Waterford Flight Lock 6 of the Erie Canal System. Out-migrating juvenile Blueback Herring currently have three turbine bypass routes for downstream passage at Crescent: (1) down the main channel and through a 24.4-m-wide and 0.3-m-high opening in the flashboards installed on top of Dam A when the water level is above the fixed crest elevation of the dam (56.1 m), (2) in the water spilling over the flashboards of both Dams A and B during high-flow events, and (3) down the main channel and through the Waterford Flight Lock 6. A pond elevation of 56.4 m or higher was maintained to produce a minimum river discharge (7.1 m^3/s) through the flashboard opening at Dam A throughout the study. The observed maximum water depths of the sampled sections of the river during the study period were 4.9 m in the intake channel, 10.0 m upriver of the island in the main channel, and 12.8 m east of the island in the main channel. Dunning and Gurshin (2012) provide additional details about Crescent and the surrounding water bodies.

The ultrasonic projectors (Ultra Electronics Ocean Systems, Braintree, Massachusetts) at Crescent consisted of eight integrated projector assemblies (hereafter, "projectors") configured in two 2 × 2 block arrays (0.3 m apart from the center of each transducer face). Each projector contained all the electronics necessary for signal generation, amplification, and transmission. Each transducer of a projector had a nominal source level of 196 dB re 1 μPa at 1 m and a 13° × 30° beam width within 3 dB of the major response axis. The projectors simultaneously transmitted 0.5-s pulses at 1-s intervals and 125-kHz center frequency (122–128 kHz bandwidth containing ~99% of the acoustic energy). Figure 1C shows the spatial extent of the SPLs (root-mean-square [rms] pressure) between 122 and 128 kHz within the ultrasonic field. Sound level measurements made using a hydrophone at several locations and depths on June 28, 2011, showed that the effective SPL_{rms} known for an avoidance response by Blueback Herring ranged from 177 to 180 dB re 1 μPa within a few meters north of the reconfigured projectors and decreased to 166 dB re 1 μPa at 140 m and 156–160 dB re 1 μPa at 350 m, depending on depth.

River Discharge and Temperature Monitoring

To estimate the expected downstream passage based on flow, a 500-kHz ADCP (Argonaut SL; SonTek/YSI, San Diego, California) was horizontally aimed to continuously measure and average the along-channel water velocity along the river axis over a 34 or 38-m range (V_x) and river height (H) every 2.5 min at two locations: in the main channel upriver (hereafter, the "upriver site") and in the main channel downriver (hereafter, the "downriver site") of the ultrasonic projector array (Figure 1D, E). River discharge (Q) through the entire channel of the upriver and downriver sites was estimated as the product of the total cross-sectional area of the channel in the vertical plane (A) and the mean water velocity of the entire channel (V_m).

An estimate of V_m across the entire channel was made daily along a cross-river transect at each site by a vessel-mounted 1-MHz ADCP. The concurrent V_m, V_x, and H measurements were used to construct a velocity-index regression model for predicting a complete time series of V_m and Q from the continuous fixed-location ADCP measurements (Morlock et al. 2002; Dunning and Gurshin 2012). Hourly Q was based on V_m in the downstream direction only (i.e., setting negative V_m to 0). A Wilcoxon signed-rank test for paired data was used to test whether the mean hourly difference in V_m or downstream flow between the upriver and downriver site was significantly different than 0. Average bottom water temperature was described from measurements taken every 15 min by two water-temperature data loggers (HOBO Pro v2; Onset Computer, Bourne, Massachusetts) attached to the center transducer mount at the upriver site.

Trawl Sampling of Fish Populations

The size and abundance of juvenile Blueback Herring acoustically observed were verified by sampling the fish populations with a pelagic trawl. A 3-m-long cone-shaped net was attached to an aluminum frame (1.74 m wide and 1.14 m high). The stretched mesh size was 13 mm for the body and 4 mm for the cod end. A 2.25-kg steel depressor was fastened with a 1-m chain to each bottom corner of the net frame. A 36-cm-diameter polyurethane float-and-line from each top corner of the net frame held the top of the net 1 m below the surface while it was towed. A 7.5-m vessel was used to deploy, tow, and retrieve the net. When fully deployed, the net was approximately 30 m behind the vessel and towed upstream along a 200-m towpath at 1.2 m/s.

Four trawl-sampling regions were defined in the river based on the depths and potential navigation hazards (Figure 1D). The "upriver" trawl region was located upriver of the fixed-location hydroacoustic monitoring site where the SPL was less than 145 dB re 1 μPa. The "ultrasound gradient" trawl region was defined as the region of the main channel between the upriver acoustic monitoring site and the ultrasonic projectors at the entrance to the intake channel. As Blueback Herring migrate downstream, they encounter increasing SPLs within this region, particularly in the western main channel. The "downriver" trawl region was defined as the area in the main channel between the downriver acoustic monitoring site and the buoy perimeter for the Dam A forebay. The "intake channel" trawl region was defined as the area in the intake channel downriver of the ultrasonic projectors where water depths permit trawling.

Each trawl region was sampled by three randomly selected tows along planned towpaths. The HYPACK navigation mapping software (HYPACK, Middletown, Connecticut) and the Global Positioning System (Trimble DSM-232 receiver with submeter accuracy) were used for real-time positioning of the vessel and trawl operation along the towpaths. Between the start and end of each tow, acoustic data were concurrently collected by a downward-looking split-beam echo sounder (Model 241; Hydroacoustic Technology, Seattle) that operated at a nominal center frequency of 420 kHz. Trawl surveys were made on 11 nights between September 9 and October 25. All fish were identified to species and enumerated, and the total length (TL) of up to 50 individuals of the same species per tow was measured to the nearest millimeter. All fish were released back to the river. The target strength (TS) distribution of the Blueback Herring catch was estimated from the TS–TL relation for Alewife (Warner et al. 2002), which is also representative of juvenile Blueback Herring (Gurshin 2012).

Catch per unit effort (CPUE) from pelagic trawling, defined as the number of fish per 200-m tow, provided a relative index of abundance. Young-of-the-year Blueback Herring were identified by their length. The CPUE of young-of-the-year Blueback Herring was compared among trawl sampling regions during the period before the majority migrated out of the study area. The CPUE data were $\log_{10}(x + 1)$ transformed to meet the assumption of normality for analysis of variance (ANOVA) based on the Shapiro–Wilk test statistic. The variance of the transformed CPUE values was homogeneous among the trawl sampling regions based on the Levene's test for homogeneous variance. A Tukey's studentized range test for multiple pairwise comparisons was used to detect which regions were significantly different in CPUE of Blueback Herring.

Mobile Echo Sounder Surveys of Fish Abundance

The abundance of Blueback Herring near Crescent was estimated from seven mobile echo sounder surveys during the day. Blueback Herring were easier to classify in the echograms during the day when they were distributed as dense groups than during the night when they were distributed as single fish echoes throughout the water column (based on echograms verified by nighttime pelagic trawling; Luecke and Wurtsbaugh 1993; Fréon et al. 1996; Petitgas and Levenez 1996). Additionally, Blueback Herring were the dominant schooling species during the study period in the Mohawk River (Dunning and Gurshin 2012). For each survey, the vessel equipped with the same split-beam echo sounder used during trawling surveyed at 2.0–2.3 m/s along transects within four river regions: (1) the intake channel, (2) upriver and (3) downriver of the ultrasonic projectors in the main channel, and (4) a northern extension of the upriver main channel region (Figure 1E; Table 1).

Transects were perpendicular to the river channel and about 50 m apart. A systematic survey design often leads to a more precise abundance estimate of patchily distributed fish and offers higher sampling efficiency (Simmonds et al. 1992; Simmonds and Fryer 1996). A split-beam transducer with a 15° circular half-power beam width was mounted to a pole attached midship and 36 cm below the water surface. A 1.25-ms frequency-modulated chirp signal, sweeping from 415 to 425 kHz, was transmitted every 0.1 s at an effective pulse duration of 0.18 ms and pulse length of 0.27 m after filter compression to a narrow echo pulse to provide good spatial resolution and improve signal-to-noise ratio (Ehrenberg and Torkelson 2000). The echo sounder frequency was selected to minimize an avoidance response since the hearing sensitivity of Blueback Herring is much less at 420 kHz than at lower echo sounder frequencies (Nestler et al. 1992; Mann et al. 1997).

Continuous Echo Sounding of Fish Passage

Fixed-location echo sounding has been previously used to monitor schooling clupeids in shallow channels (Guillard 1998; Pedersen and Trevorrow 1999; Dunning and Gurshin 2012). Similar to other stationary acoustic surveys in shallow water (Kubecka and Wittingerova 1998; Enzenhofer and Cronkite 2000; Krumme and Saint-Paul 2003), horizontally aimed transducers (i.e., horizontal beaming) were used in this study because the relatively simple bottom topography, calm water surface conditions, and few storm events allowed fish to be detected at ranges greater than the depth of water and, thus, sampled a larger volume and cross-sectional area of the river channel than would vertically aimed transducers. As a result, echo integration of the volume backscatter collected by fixed-location horizontal beaming was used to derive estimates of juvenile Blueback Herring passage (Pedersen and Trevorrow 1999; Dunning and Gurshin 2012).

A linear array of three horizontally aimed split-beam transducers (hereafter, "horizontal transducers") and one vertically aimed split-beam transducer (hereafter, "vertical transducer") was installed to monitor fish passage at each of two sites; in the main channel upriver (hereafter, the "upriver site") and in the main channel downriver (hereafter, the "downriver site") of the ultrasonic projectors (Figure 1D, E). The transducers were attached to mounts placed on the riverbed and multiplexed to a digital echo sounder (HTI Model 243; Hydroacoustic Technology, Seattle). The nominal center frequency of these transducers was 420 kHz. Nominal half-power beam widths were 6° for horizontal transducers and 15° for vertical

TABLE 1. Mobile echo sounder survey effort in 2012 for estimating the abundance of juvenile Blueback Herring in the intake channel and upriver and downriver of the ultrasonic projectors in the main channel of the Mohawk River near the Crescent Hydroelectric Project. See Figure 1E.

Echo sounder survey region	Area (m^2)	Number of transects	Survey dates
Intake channel	69,261	9	September 9, 13, 19; October 3, 9, 19, 26
Downriver main channel	122,756	11	September 9, 13, 19; October 3, 9, 19, 26
Upriver main channel	240,392	22	September 9, 13, 19; October 3, 9, 19, 26
Upriver extension	288,846	22	September 9, 19; October 19, 26

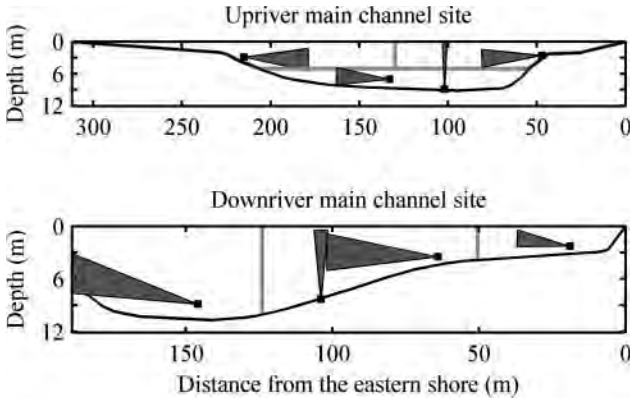

FIGURE 2. Schematic diagram from the side view looking upstream showing the cross-sectional area effectively sampled by the transducers (dark gray triangles) deployed from the eastern shore (on right). The light gray lines stratify the river channel into three zones for allocating representative sampling of fish passage by the horizontally aimed transducers.

transducers. While the maximum depth and mean cross-sectional area at the upriver (9.1 m and 1,497 m^2) and downriver sites (10.7 m and 1,277 m^2) were similar, there were some differences in their channel geometry (Figure 2). The horizontal transducers sampled approximately 13–16% of the channel cross section and monitored fish passage that was assumed representative of the entire channel. The vertical transducer was used primarily to aid interpretation of the echoes in the echograms obtained by the horizontal transducers and verify acoustic estimates of fish movement.

All transducers were calibrated using a standard transducer of known sensitivity at the manufacturer prior to deployment (Johannesson and Mitson 1983; ANSI/ASA 2012). A 0.18-ms frequency-modulated chirp pulse was transmitted every 0.2 s for horizontal transducers and every 0.1 s for vertical transducers. The systematic sampling scheme consisted of the transducers sequentially collecting raw acoustic backscatter for consecutive 2.5-min intervals, starting with the most eastern transducer at the beginning of each hour. This sampling scheme resulted in each transducer collecting six 2.5-min intervals per hour and spaced 10 min apart from September 8 through October 26, 2012.

Acoustic Data Processing

All raw acoustic data were imported into Echoview signal processing software (version 5.0; Myriax Software, Hobart, Australia) using preferred parameterization and settings following standard practices (De Robertis and Higginbottom 2007; Parker-Stetter et al. 2009; Rudstam et al. 2009). The volume backscattering coefficient (s_v; m^{-1}) and its decibel equivalent, volume backscattering strength (S_v; dB re m^{-1}), from echo integration was assumed to be proportional to fish density (Foote 1983) and quantified the acoustic energy reflected back from the backscattering cross sections (σ_{bs}; m^2) of all targets within the sampled volume as defined by MacLennan et al. (2002). A range-dependent minimum S_v threshold equivalent to a minimum echo strength threshold of −61dB was applied to the echograms to reduce the contribution of background noise and smaller scatterers to the density estimate of juvenile Blueback Herring (Rudstam et al. 2009). Target strength (TS [dB re 1 m^2] = 10 $\log_{10}\sigma_{bs}$) of single echo detections (SEDs) was determined from the echogram when fish density was low enough to avoid bias due to overlapping fish echoes, which was determined by echogram strata with an Sawada index less than 0.1 (Sawada et al. 1993; Rudstam et al. 2009).

Mobile echo sounder surveys.—The echogram for each survey transect was stratified into 1-m depth layers and 20-m transect segments called elementary distance sampling units (EDSUs). The surface exclusion zone (0.9 m depth) and bottom exclusion zone (approximately 0.75 m above the bottom detection) in the echograms were manually reviewed and modified as necessary to exclude interference or bias from bubble reverberation or bottom backscatter. Each echogram of volume backscatter was manually scrutinized, and clusters of overlapping echoes were visually classified as "schools." Juvenile Blueback Herring was the species most likely represented by these schools because (1) it was the most abundant schooling pelagic species previously found here at this time of year (Dunning and Gurshin 2012, (2) it was the most abundant species in pelagic trawl catches (see results), and (3) similar echo characteristics were observed during echo sounding of the trawl zone. These regions of classified school echoes were echo integrated and exported as an area backscattering coefficient (s_a), defined by MacLennan et al. (2002) as the s_v integrated over depth. The remaining volume backscatter of unclassified fish echoes above the threshold was apportioned to juvenile Blueback Herring by the proportion of SEDs within a dorsal-aspect TS range expected for juvenile Blueback Herring (−50 to −42 dB; Gurshin 2012).

The areal density (D; fish/m^2) of juvenile Blueback Herring for the full water column of each 20-m EDSU (j) within each survey region (i) was then estimated as

$$D_{i,j} = \left(s_{a_{i,j},\text{school}}/\langle\sigma_{\text{bs}}\rangle_{\text{i,JBH}}\right) + \left(s_{a_{i,j},\text{nonschool}} \times P_{i,\text{JBH}}/\langle\sigma_{\text{bs}}\rangle_{i,\text{all}}\right), \quad (1)$$

where $s_{a\ i,\ j,\ \text{school}}$ is the s_a attributable to echoes classified as schools of juvenile Blueback Herring along EDSU j of survey region i, $s_{a,\ i,\ j,\ \text{nonschool}}$ is the remaining s_a (i.e., total $s_{a,}$–$s_{a,\ \text{school}}$) along EDSU j in survey region i, $\langle\sigma_{\text{bs}}\rangle_{i,\ \text{JBH}}$ is the in situ mean TS for SEDs in survey region i that are within the juvenile Blueback Herring TS range, and $\langle\sigma_{\text{bs}}\rangle_{i,\ \text{all}}$ is the in situ mean TS for all SEDs in survey region i. The total abundance of juvenile Blueback Herring for each region and survey was estimated by multiplying the mean areal density by the area of the region.

A two-stage geostatistical approach was taken to map the distribution of juvenile Blueback Herring from spatially autocorrelated data collected by the systematic echo sounder surveys (Petitgas 1993; Páramo and Roa 2003; Mello and Rose 2005; Gurshin et al. 2013). During the first stage, the spatial structure of the data (i.e., the spatial covariance) was explored through semivariogram modeling (also known as "variograms"; see Cressie and Hawkins 1980; Petitgas 1993; Rivoirard et al. 2000), which describes the amount of spatial autocorrelation as a function of distance between any two locations. The semivariogram model parameters were then used to spatially predict fish density at unsampled locations within each survey region. A first-order polynomial on the coordinates was used to first detrend the data before semivariogram modeling. The omnidirectional semivariograms assumed no geometric anisotropy after examining directional semivariograms. Universal kriging with a first-order trend on coordinates and a 40-point moving local neighborhood was used to spatially interpolate Blueback Herring densities at each node of the 100 × 100 point grid within each survey region. Semivariogram modeling and kriging were performed using the package "geoR" in R statistical computing software (Ribeiro and Diggle 2001; R Development Core Team 2012). The vertical distribution of juvenile Blueback Herring in the water column was described by the proportion of the total s_a in each 1-m depth layer throughout each region.

Fish passage estimation.—The total net passage of juvenile Blueback Herring (N_{net}) through the upriver and downriver sites based on continuous monitoring by fixed-location horizontal transducers was estimated by summing the $N_{\text{net},\,i}$ estimates from three river channel zones (i), which were estimated as

$$N_{\text{net},i} = N_{d,i} - N_{u,i}, \qquad (2)$$

where N_d and N_u are the number of fish moving downriver and upriver, respectively, through each channel zone. These parameters were estimated for each hour by the following equations:

$$N_d = T \times A \times \left(s_{v,\text{JBH}} / \langle \sigma_{\text{bs}} \rangle_{\text{tx}-\text{diel}}\right) \times R_d \times P_d, \qquad (3)$$

$$N_u = T \times A \times \left(s_{v,\text{JBH}} / \langle \sigma_{\text{bs}} \rangle_{\text{tx}-\text{diel}}\right) \times R_u \times (1 - P_d), \qquad (4)$$

where T is the duration of the period in seconds, hourly mean $s_{v,\text{ JBH}}$ is the s_v attributable to juvenile Blueback Herring, $\langle \sigma_{\text{bs}} \rangle$ is derived from the TS mode specific to each transducer (tx) and diel period pooled across the time series, R_d and R_u are the net rates of downstream and upstream movement in the horizontal plane of tracked fish echoes classified as juvenile Blueback Herring averaged for each daily diel period, and P_d is the proportion of the fish echoes classified as juvenile Blueback Herring that are moving downriver for each hour. For estimating P_d, data from adjacent hours were pooled for hours with fewer than 10 tracked echoes classified as juvenile Blueback Herring.

After the most effective algorithm parameters were determined, split-beam tracking was used to estimate swimming direction, downstream rate of movement, and TS of individual fish echoes within the TS range of juvenile Blueback Herring. During the first few weeks of monitoring, nighttime vertical migrations of midge insect larvae *Chaoborus* sp. (Teraguchi and Northcote 1966), which were verified by net sampling, almost completely overwhelmed the echograms with volume backscatter from their gas sacs (Malinen et al. 2005; Knudsen et al. 2006). Therefore, the mean echogram s_v was not a good index of abundance for juvenile Blueback Herring without taking steps to remove the acoustic contributions of several dynamic sources.

The s_v attributable to *Chaoborus* sp. and variable background noise levels attributable to scattering from other invertebrates, particles, wind, rain, or flow turbulence ($s_{v,\text{ noise}}$) that exceeded the threshold was estimated for each diel period and date in the study and then was subtracted from the mean s_v for each echogram ($s_{v,\text{ total}}$) to remove these sources from the acoustic estimate of fish density. Daytime was defined as the period between 1 h after sunrise and 1 h before sunset. Nighttime was defined as the period between 1 h after sunset and 1 h before sunrise. Dawn and dusk were defined as the periods within 1 h or less of sunrise or sunset, respectively. The daily diel-specific mean $s_{v,\text{ noise}}$ was estimated from a randomly selected subset of five echograms from each daytime and nighttime period of every other date, defining a 100-ping sequence in each selected echogram, and then estimating the mean s_v for that sequence, excluding fish echoes or other echo traces (e.g., ascending bubbles). The mean $s_{v,\text{ noise}}$ for days and nights not examined were linearly interpolated. Mean $s_{v,\text{ noise}}$ for dawn and dusk was linearly interpolated between adjacent day and night periods.

Removal of acoustic contributions from gas bubbles rising at various rates from the sediment at the two monitoring sites was necessary to accurately estimate fish density. A randomly selected subset of echograms from the vertical transducer were examined to manually identify the distinctive (left-to-right) diagonal echo pattern of rising bubbles and to determine their mean s_v. Given the dynamic nature of bubble formation, the proportion of mean echogram s_v attributable to bubbles (P_{bubbles}) was estimated for each selected echogram. First, the echo strength from tracked SEDs was converted to s_v (Rudstam et al. 2009). The converted s_v values of all tracked SEDs (total) and tracked SEDs classified as bubbles were summed for each echogram and divided by the total number of valid digital samples in the echograms to derive an equivalent proxy for the mean bubble and total s_v, and then the bubble-to-total s_v ratio was used as an estimate for P_{bubbles}. Because the P_{bubbles} estimates by manual classification versus automated tracking were shown to be similar for the subset from the vertical transducer data, automated tracking was used to classify the bubbles for each echogram collected by the horizontal transducers and then P_{bubbles} was estimated as previously described. The mean P_{bubbles} was 0.17–0.41 at the downriver site and 0.08–0.12 at the upriver site.

The acoustic contribution of residential fish species to the acoustic estimate of fish passage of juvenile Blueback Herring was minimized by subtracting a constant s_v representing their contribution ($s_{v,\ \text{residents}}$). A time-series average of the minimum mean s_v within each daily diel period, after noise and bubble removal, was used to estimate $s_{v,\ \text{residents}}$. In summary, the allocation of s_v by these steps led to the extraction of peaks in s_v from the time series of mean echogram s_v and the interpretation of the peaks as migration episodes of juvenile Blueback Herring. The $s_{v,\ \text{JBH}}$ was expressed as

$$s_{v,\text{JBH}} = \left(s_{v,\text{total}} - s_{v,\text{noise}}\right) \times \left(1 - P_{\text{bubbles}}\right) - s_{v,\text{residents}}. \quad (5)$$

The number of tracked fish echoes classified as juvenile Blueback Herring that moved in a downstream direction divided by the number moving in either a downstream or upstream direction was used to estimate P_d of all juvenile Blueback Herring, assuming individual movements were representative of individuals not tracked (i.e., in schools). Downstream and upstream swimming direction was estimated as the net direction between the first and last SEDs in the track restricted to being within ±45° of the horizontal plane and within ±45° of being perpendicular to the major response axis of the beam. The distance in the horizontal plane between the first and last SEDs of tracked echoes classified as juvenile Blueback Herring moving downstream or upstream divided by the elapsed time in the beam was used for R_d and R_u.

Evaluation of Ultrasound Effectiveness on Downriver Passage

The effectiveness of the ultrasound in guiding out-migrating juvenile Blueback Herring past the intake channel was determined by testing two null hypotheses. First, if ultrasound has no effect on downriver passage, then the proportion of fish migrating downriver past the intake channel after redirecting the projectors should be equal to the proportion observed in the presence of the original ultrasonic field. In comparison to Dunning and Gurshin (2012), the second null hypothesis assumes that passage and distribution of juvenile Blueback Herring through the main and intake channels in the absence of ultrasound were proportional to Q. While the extent to which juvenile Blueback Herring behave functionally as plankton has not been empirically tested, this proportional-to-flow assumption was based on the following: emigration patterns of river herring are related to water flow (Pardue 1983; Kosa and Mather 2001), alosines are attracted to higher current velocities (Barry and Kynard 1986; Moser et al. 2000), and water flow is a predictor of entrainment of migratory pelagic species (ASMFC 2009; Grimaldo et al. 2009).

The chi-square test was used to test for significant differences between the observed proportion in the cumulative net passage of juvenile Blueback Herring (in thousands) at the downriver site and the expected proportion based on either the proportion of 0.313 observed in 2008 by Dunning and Gurshin (2012) for the original ultrasonic field or the downriver-to-upriver ratio of measured river discharge. The expected net passage ($N_{\text{net, e}}$) of juvenile Blueback Herring that migrated downriver in the main channel was estimated from the observed net passage upriver ($N_{\text{net, upriver}}$) as

$$N_{\text{net,e}} = N_{\text{net,upriver}} \times 0.313 \quad (6)$$

under null hypothesis 1 and

$$N_{\text{net,e}} = N_{\text{net,upriver}} \times \left(Q_{\text{downriver}}/Q_{\text{upriver}}\right) \quad (7)$$

under null hypothesis 2.

These comparisons were made for the full time series (September 8 through October 26) and the peak migration period. The peak migration period was chosen to exclude the early period of the study when observed migration events (i.e., peaks in N_{net}) were successively absent at the upriver site and fish were staging prior to out-migration. The migration period also excluded the time when juvenile Blueback Herring were not present or scarce, indicating the out-migration from upstream was complete.

The densities of juvenile Blueback Herring estimated by trawl and mobile echo sounder surveys were also compared among channel regions to provide further evidence of safe downstream passage. All available information from ADCPs, trawls, mobile echo sounder surveys, and fixed-location hydroacoustics was used in a complementary fashion to aid interpretation of the net fish passage estimates of juvenile Blueback Herring.

RESULTS

River Discharge and Temperature

The velocity-index models were $V_m = 0.024 - V_x(70.049 - 7.635H)$ ($F_{2,\ 46} = 43.24$, $P < 0.001$; $R^2 = 0.65$) at the upriver site and $V_m = 0.024 - V_x(70.049 - 7.635H)$ ($F_{2,\ 46} = 56.48$, $P < 0.001$; $R^2 = 0.71$) at the downriver site. There were three high-flow events of varying magnitude during the study: the first peaking at 76 m^3/s on September 19, the second peaking at 101 m^3/s on October 16, and the third peaking at 234 m^3/s on October 21(Figure 3A). The change in river stage increased from 0.1 to 0.5 m during these high-flow events (Figure 3B). River discharge only substantially increased at the downriver site during the highest-flow event (October 19–23) when discharge through the turbines at Crescent was coincidentally minimal. The mean hourly averaged V_m and Q at the upriver site (0.037 m/s and 57 m^3/s, respectively) was significantly higher than that at the downriver site (0.015 m/s and 20 m^3/s; $P < 0.001$). The near-bottom water temperature in the middle of the channel at the upriver site decreased from 24.0°C to 12.2°C during the study (Figure 3C).

Trawl Estimates of Abundance

Juvenile Blueback Herring was the most abundant species caught before out-migration was complete. Of the 10,717 fish and 9 species caught in nighttime trawl surveys, 98.8% were Blueback Herring. The other species caught were 62 Spottail Shiner *Notropis hudsonius*, 53 Brook Silverside *Labidesthes sicculus*, 6 Gizzard Shad *Dorosoma cepedianum*, 2 Black Crappie *Pomoxis nigromaculatus*, 1 Bluegill *Lepomis macrochirus*, 1 Channel Catfish *Ictalurus punctatus*, and 1 Common Shiner *Luxilus cornutus*. The total length of Blueback Herring averaged 70 mm and ranged from 52 to 111 mm. The mode of the TS distribution predicted from the length distribution of the Blueback Herring catch closely matched the observed TS modes from echo sounding (Figure 4).

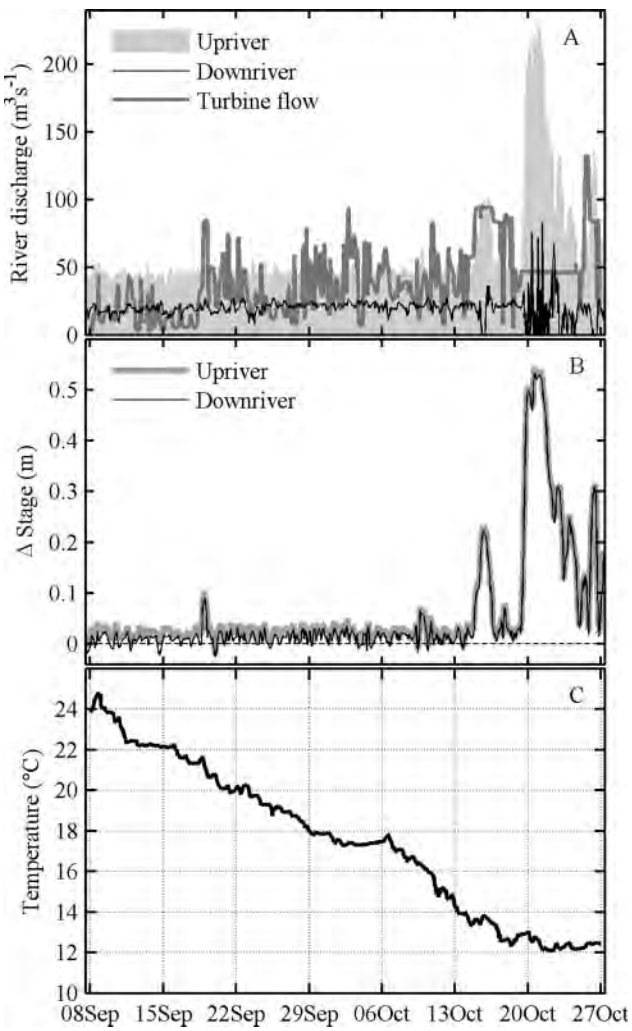

FIGURE 3. Characteristics of the Mohawk River, including **(A)** the hourly mean river discharge estimates based on a velocity-index equation using continuous 2.5-min observations by a 500-kHz horizontally aimed acoustic Doppler current profiler located near the eastern shore of the main channel upriver and downriver of the ultrasonic projectors, and hourly discharge through the turbines calculated by the power generation at the Crescent Hydroelectric Project, **(B)** the change in hourly mean river stage, and **(C)** the mean water temperature measured every 15 min by two HOBO Pro v2 data loggers attached to a transducer mount within 1 m of the river bottom and located at the center of the main channel upriver of the ultrasonic projectors.

The abundance of juvenile Blueback Herring differed among regions and over time. Mean CPUE of Blueback Herring increased during the first 2 weeks in all regions, decreased over the next two surveys on September 21 and 28, and then slightly increased on October 2 before continuing to decrease (Figure 5A). Between September 9 and October 10 when Blueback Herring catches were substantial, the mean $\log_{10}(x + 1)$ transformed CPUE was significantly different among some regions (ANOVA: $F_{3,\ 80} = 5.74$; $P = 0.001$). Transformed CPUE of Blueback Herring in the main channel upriver and downriver of the ultrasonic projectors was significantly higher than in the intake channel region, but not different than in the ultrasound gradient region (Figure 5B). The arithmetic mean CPUE in the downriver region (161 fish/tow) was approximately 94% of the CPUE in the upriver region (172 fish/tow) and was 2.5 times higher than the CPUE in the intake channel (64 fish/tow). On October 15, few Blueback Herring were caught by the pelagic trawl and by October 25 only two individuals were caught in 12 tows (Figure 5C).

Mobile Echo Sounder Survey Estimates of Abundance and Distribution

Echograms from the mobile echo sounder surveys contained predominantly clusters of overlapping echoes classified as juvenile Blueback Herring that were patchily distributed in the mid to upper water column. Geostatistical analysis revealed that an average of 79% of the variance in the density

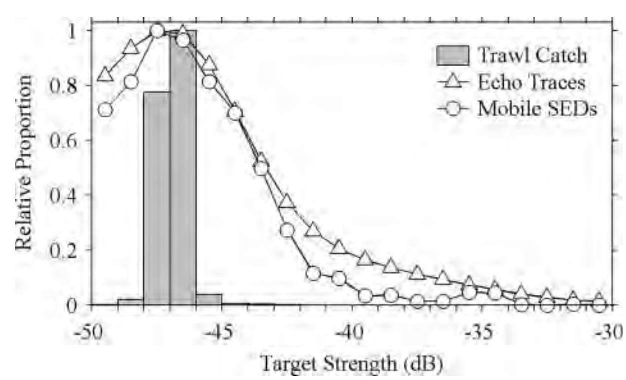

FIGURE 4. Frequency distribution of the predicted target strength (TS) based on the length of Blueback Herring caught by pelagic trawl (Trawl Catch), mean TS of echo traces from continuous fixed-location echo sounding (Echo Traces), and in situ TS of all single echo detections from all daytime mobile echo sounder surveys combined (Mobile SEDs).

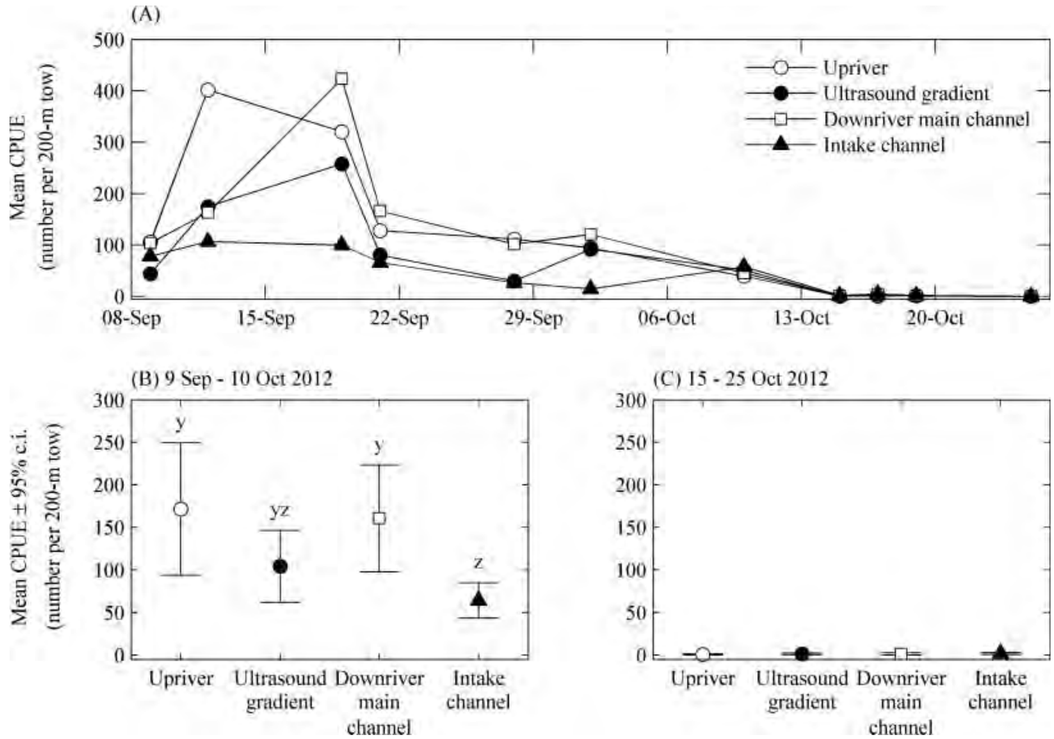

FIGURE 5. Catch per unit effort (CPUE) of juvenile Blueback Herring caught during the night by pelagic trawl showing **(A)** the survey-mean CPUE from September 9 through October 10, 2012, and the mean CPUE ± 95% confidence intervals (CI) of all trawls during **(B)** September 9 through October 10, 2012, (locations that share a letter are not significantly different) and **(C)** October 15 through October 25, 2012. The trawls were done in four regions of the Mohawk River: upriver of the 122–128 kHz ultrasonic projectors and 420-kHz fixed-location echo-sounding site (upriver), in the area of increasing downriver ultrasound gradient (ultrasound gradient), in the intake channel downriver of the ultrasonic projectors (intake channel), and in the main channel downriver of the ultrasonic projectors (downriver main channel).

of juvenile Blueback Herring was explained by spatial autocorrelation that ranged to an average distance of 145 m. Juvenile Blueback Herring were mostly found within 3 m of the surface during the day, where they accounted for about 80–90% of the mean s_a averaged among the seven echo sounder surveys.

Juvenile Blueback Herring progressed from being present throughout each survey region on September 9 to being nearly absent in the river on October 26 (Figures 6, 7). Juvenile Blueback Herring were distributed at similar densities throughout all regions surveyed at the start of the study, although the abundance in the intake channel was more than 50% less than in the other regions. Thereafter, densities were relatively low in the intake channel and higher in the downriver main channel. By September 3, clusters of juvenile Blueback Herring were found far upriver, in front of the ultrasonic projectors, and downriver in the main channel, but only in a few clusters of low density in the intake channel. The highest concentrations of juvenile Blueback Herring were seen in the downriver main channel region on October 3 but largely dissipated on subsequent surveys. During the same surveys, juvenile Blueback Herring were scarce in the intake channel.

28w?>Mean density and total abundance of juvenile Blueback Herring in the upriver and downriver main channel regions were not significantly different based on paired *t*-tests of the inter-regional differences among the seven echo sounder surveys (Table 2). However, the mean density and total abundance of juvenile Blueback Herring in the upriver and downriver main channel regions were both significantly greater than the density and abundance in the intake channel. The downriver main channel averaged 35 times more juvenile Blueback Herring than the intake channel and averaged 91% of the combined abundance in the intake and downriver main channel regions.

Continuous Monitoring of Downstream Fish Passage

The mean R_d for juvenile Blueback Herring measured by horizontal split-beam tracking ranged from 0.15 to 0.27 m/s (2.1–3.9 body lengths/s) when R_d was averaged by day, diel period, and site. The mean P_d ranged from 0.45 in the east main channel at the downriver site during dawn hours (0500–0700 hours) to 0.68 in the center main channel at the upriver site during night hours (2000–0400 hours). The P_d was higher at the upriver site than at the downriver site during the night and dawn, while the sites were less different during the day and at dusk. When P_d was less than 0.5, net downstream passage was negative and was interpreted as more fish moving through the acoustic beam in the upstream direction.

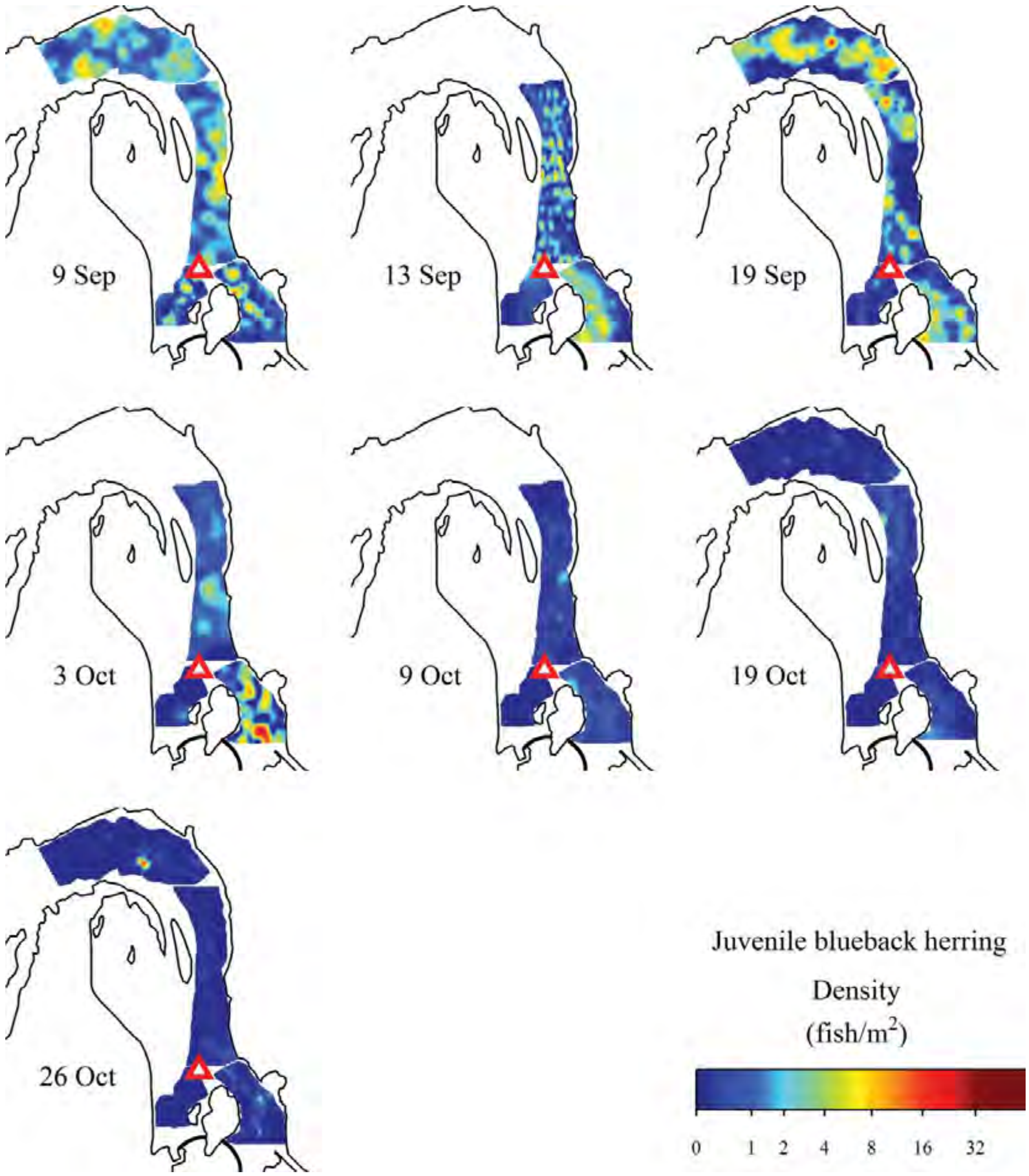

FIGURE 6. Kriged maps of the juvenile Blueback Herring density estimated from data collected by a 420-kHz split-beam echo sounder used on seven systematic echo sounder surveys at the Crescent Hydroelectric Project during the day between September 9 and October 26, 2012. The red triangle marks the location of the ultrasonic projectors.

A diel pattern was generally present in the echograms associated with a passage event of juvenile Blueback Herring (Figure 8). During the night, individual echoes were observed while clusters of multiple echoes (i.e., "schools") were largely absent. At dawn, echoes became clustered and school echoes formed. Schools of juvenile Blueback Herring appeared to move through the beams in upriver and downriver directions at both sites. When peaks in $s_{v,\ \mathrm{JBH}}$ were observed, they typically occurred between 0600 and 1200 hours.

The time series of net downstream passage show three patterns of variability interpreted as premigration, active outmigration, and postmigration periods (Figure 9). Net downstream passage was consistently low before September 20 and then peaked multiple times at the upriver site. Net downstream passage at the downriver site was relatively low between September 20 and October 6 until two large pulses of juvenile Blueback Herring passed through on October 6 and 8. Peak net downstream passage occurred at both sites during October 5–6 and then declined in the following days. This difference resulted in different inflection points in the cumulative curves for net downstream passage at the two sites (Figure 10). While net downstream passage after October 14 was variably low,

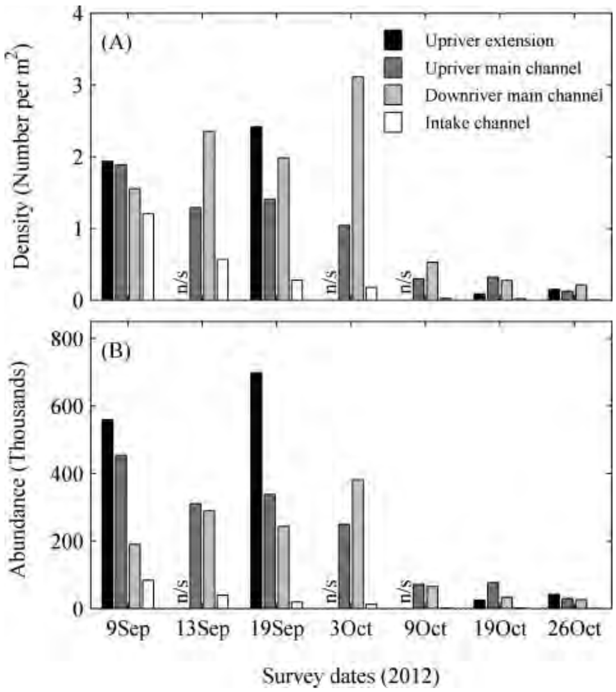

FIGURE 7. **(A)** Mean density and **(B)** total abundance of juvenile Blueback Herring sampled along cross-river transects that were surveyed by a vessel-mounted 420-kHz split-beam echo sounder within four regions of the Mohawk River near the Crescent Hydroelectric Project: (1) the northern upriver extension (sampled on four occasions; n/s indicates the dates not sampled), the main channel (2) upriver and (3) downriver of ultrasonic (122–128 kHz) projectors aimed to deter fish from entering the intake channel, and (4) the intake channel.

migration during this period was considered complete based on juvenile Blueback Herring being scarcely observed in the trawl and echo sounder surveys. The peak migration period of September 20 through October 14 represented 72% of the cumulative net downstream passage for the full time series.

During the peak migration period, 76.5% of the out-migrating juvenile Blueback Herring passage at the upriver site moved downriver in the main channel, which was significantly higher than the percentage observed by Dunning and Gurshin (2012) (31.3%; $\chi^2 = 7{,}905.8$, $P < 0.001$) and the percentage expected based on river flow (49.1%; $\chi^2 = 2{,}499.8$, $P < 0.001$). Within the peak migration period, the coefficient of variation (standard error/mean) of the mean daily net downstream passage was about 45% at the upriver site and 38% at the downriver site. The coefficient of variation of the mean hourly net downstream passage for each day within the migration period averaged 5% at the upriver site and 11% at the downriver site. Inclusion of the net passage during the premigration and postmigration periods, which could be in either direction at times, may not accurately represent passage of actively out-migrating juvenile Blueback Herring. However, even with the premigration and postmigration periods included, the percentage of the net downstream passage of juvenile Blueback Herring at the upriver site that moved downriver in the main channel was about 43.7%, which was significantly higher than 31.3% for the first ultrasonic projector configuration observed by Dunning and Gurshin (2012) ($\chi^2 = 825.4$, $P < 0.001$) and the percentage expected based on river flow (40.9%; $\chi^2 = 36.8$, $P < 0.001$).

DISCUSSION

These results demonstrate that the majority of out-migrating juvenile Blueback Herring avoided the intake channel after the ultrasonic field was redirected. After directing the ultrasonic projector upriver, continuous acoustic monitoring showed a significant increase in the proportion (76.5%) of juvenile Blueback Herring migrating downriver in the main channel during the peak migration period. Repeated echo sounder surveys show that the 35-fold difference in abundance between the downriver main channel and the intake channel was an order of magnitude higher than the average fivefold difference observed prior to redirecting the projectors (Dunning and Gurshin 2012). The net downstream passage of juvenile Blueback Herring through the main channel was significantly higher than expected, assuming passage was

TABLE 2. Arithmetic means and paired *t*-tests for differences in the density (fish/m^2) and total abundance (thousands) of juvenile Blueback Herring between regions of the main channel upriver and downriver of the ultrasonic projectors and in the intake channel among seven mobile echo sounder surveys. The null hypothesis is the mean difference equals 0.

Region	Density	Abundance
	Means	
Upriver main channel (U)	0.91	218.28
Downriver main channel (D)	1.43	175.48
Intake channel (I)	0.33	22.51
	Paired *t*-tests (*t*, *P*)	
U–D	−0.52 (−1.68, 0.143)	42.81 (0.95, 0.379)
U–I	0.58 (4.24, 0.005)	195.77 (4.24, 0.005)
D–I	1.10 (2.78, 0.032)	152.96 (3.10, 0.021)

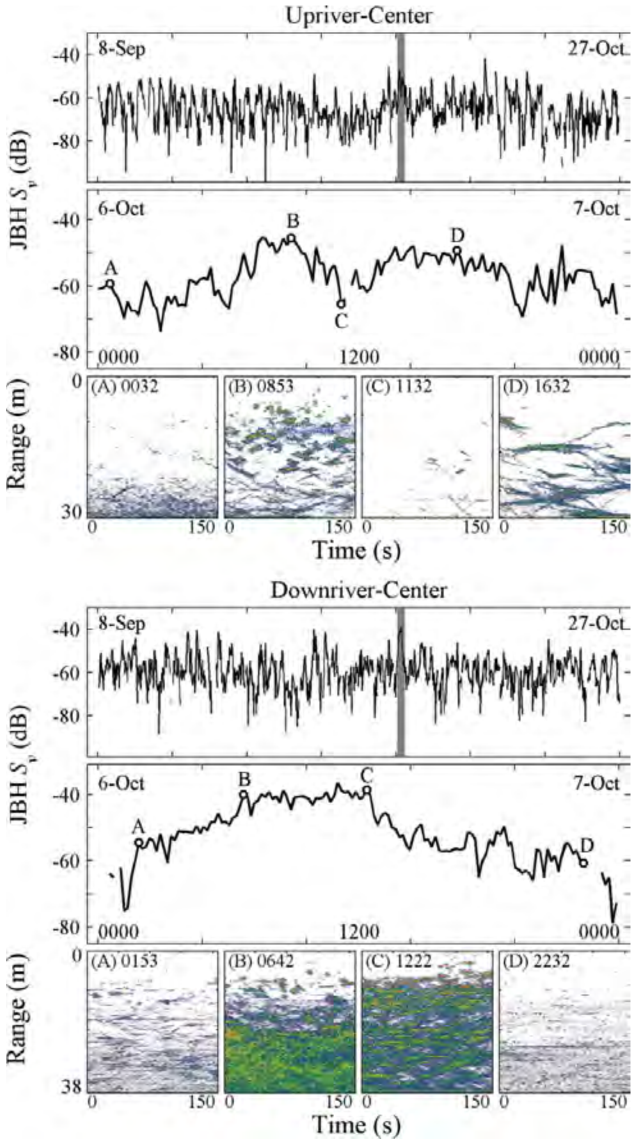

FIGURE 8. Volume backscattering strength apportioned to juvenile Blueback Herring (JBH S_v) for the centrally located horizontal transducers upriver (upper group of panels) and downriver (lower group of panels) of the ultrasonic projectors for the full survey duration (top panels within each upriver and downriver panel group), for a 24-hour period on October 6, 2012, during the peak migration (middle panels, and also the grey bar in the top panels), and for echograms sampled at A–D (labeled on the middle panels) within that 24-hour period showing the diel variability (bottom panels).

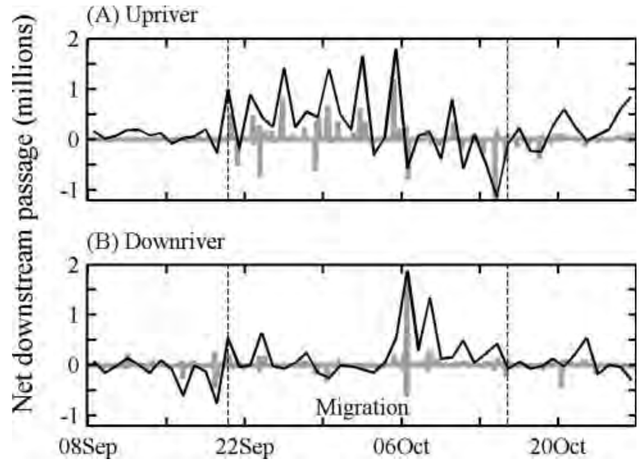

FIGURE 9. Hourly (gray) and daily (black) estimates of net downstream passage of juvenile Blueback Herring in the main channel **(A)** upriver and **(B)** downriver of ultrasonic projectors at the Crescent Hydroelectric Project on the Mohawk River from September 8 through October 26, 2012. The vertical dashed lines delineate the out-migration period from September 20 through October 14. Note that negative net downstream passage indicates upstream movement.

proportional to river discharge, which further supports the idea that the increased passage of juvenile Blueback Herring through the main channel was a result of redirecting the ultrasonic field and not a change in river discharge between the two studies.

The evaluation of the effectiveness of ultrasound as a fish deterrent at Crescent compared the observed cumulative net downstream passage estimates of juvenile Blueback Herring to the expected number based on the assumption commonly used in regulatory practice (ASMFC 2009; USEPA 2014) that entrainment and impingement is directly proportional to the flow of water withdrawn by a power generation facility. Previous studies evaluated the effectiveness of ultrasound as a fish guidance technology by on–off or before-after–control-impact paired experimental designs (Ploskey et al. 1995; Ross et al. 1996; Skalski et al. 1996). In this study, the ultrasonic projectors were operating throughout the study for the same reasons given by Dunning and Gurshin (2012): the unknown patchy temporal distribution of the downstream migration of juvenile Blueback Herring limits the assurance of an adequately

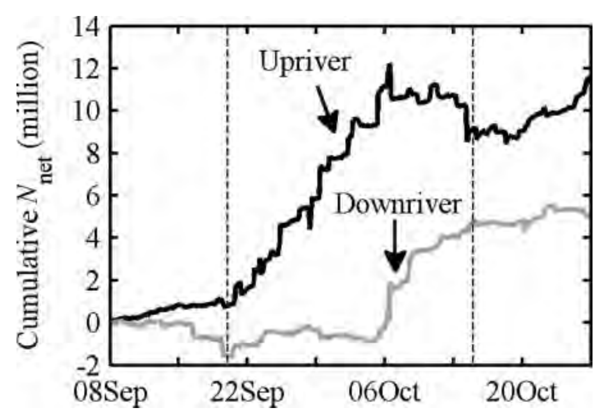

FIGURE 10. Cumulative net downstream passage of juvenile Blueback Herring in the main channel upriver and downriver of ultrasonic projectors at the Crescent Hydroelectric Project from September 8 through October 26, 2012. The vertical dashed lines delineate the out-migration period from September 20 through October 14. Note that negative net downstream passage indicates upstream movement.

designed on–off experiment and the regulatory preference that most of the juvenile Blueback Herring migrate down the main channel rather than through the turbines.

Dunning and Gurshin (2012) interpreted their results as either (1) the flow null hypothesis is a valid assumption and the ultrasonic projectors were partially effective at diverting juvenile Blueback Herring from entering the intake channel or (2) the observed proportion (31.3%) of juvenile Blueback Herring moving downriver was evidence that the flow assumption is invalid and could be explained by other abiotic and biotic factors. If (1) was the correct assumption, by reconfiguring the ultrasound to allow more exposure time to increasing SPLs for juvenile Blueback Herring as they migrate downriver, then their proportion moving downriver should increase if the ultrasound is an effective deterrent. If there was no relative increase of juvenile Blueback Herring moving downriver in the main channel, then perhaps an alternative mechanism explains the observed downstream passage through the main channel.

The results from intensive spatial and temporal sampling by three sampling methods demonstrated that the preponderance of juvenile Blueback Herring migrated downriver in the main channel during the fall of 2012 and avoided the intake channel leading to the hydroelectric turbines at Crescent, thus reducing the potential for turbine passage mortality. The acoustic size and visual patterns of the echoes in the echograms, coupled with the species identification and CPUE by trawls, confirmed that juvenile Blueback Herring were the principal pelagic species observed. The general migratory patterns observed were that juvenile Blueback Herring were moving back and forth between sites or “milling” around in the Dam A pond before out-migration, net downstream passage peaked at the upriver site and CPUE steadily declined throughout all regions during the migration period, and juvenile Blueback Herring were nearly absent following a high-flow event on October 15.

The time series of net downstream passage and the cumulative net downstream passage show that the majority of the fish passed the downriver site on October 6 after several peaks in net downstream passage were observed upriver. Net downstream passage showed periods of upstream movement, while the mobile echo sounder survey revealed over time that juvenile Blueback Herring congregated in the downriver survey region at high densities. The back-and-forth movements at the downriver site and the accumulation of juvenile Blueback Herring downriver in the main channel provided some evidence of residency duration until the fish either exited through Waterford Flight Lock 6 or a high-flow event like the one on October 15 facilitated their passage through the opening in the flashboards or over the dam. This result is consistent with the behavior of juvenile Blueback Herring moving downstream in response to environmental cues, such as high flow (Kosa and Mather 2001) or decreasing temperature (O’Leary and Kynard 1986; Iafrate and Oliveira 2008).

The direction and magnitude of net passage of juvenile Blueback Herring determined by continuous horizontal echo sounding in a shallow noisy riverine environment is subject to several dynamically changing sources of variability and uncertainty. Measurement error stemming from system calibration, TS, species classification, behavior, or environmental conditions can behave randomly over many observations and is often considered negligible to the sampling error (Demer 2004) or is incorporated in variance estimators (Skalski et al. 1996). In contrast to the imprecision caused by random error, potential sources of uncertainty associated with TS or behavior can contribute to systematic deviation from the true value (bias) up to 50% (Simmonds and MacLennan 2005). However, biased estimates can still provide useful relative indices of abundance (Rose et al. 2000).

In contrast to other fish passage studies that either did not quantify uncertainty or did not account for variability in noise or TS (Mulligan and Kieser 1996; Ransom et al. 1996), a multistep processing approach was used in this study to derive an index of abundance and net downstream passage of juvenile Blueback Herring based on parameters that accounted for periodic changes in fish swimming direction and speed, TS, and acoustic contributions from other scatterers (i.e., *Chaoborus* sp., bubbles, and other fish). The removal techniques of acoustic contributions of background noise, *Chaoborus* sp., bubbles, and resident fish used in this study were appropriate and similar to other hydroacoustic studies in noisy environments (Malinen et al. 2005; De Robertis and Higginbottom 2007).

Acoustic estimates of fish passage used the modal TS specific to each diel period and transducer to account for potential TS differences known to arise from diel variation in behavior and different sound incidence angles among transducers (Foote 1980; Luecke and Wurtsbaugh 1993; Hjellvik et al. 2004; Henderson et al. 2007). The direction of the horizontal transducers across the river channel was assumed to generally produce a side-aspect TS distribution when fish swim through the beam during their downstream migration. The TS mode observed by horizontal transducers ranged from −50 to −44 dB, which was similar in magnitude to Gurshin (2012) and Brooking and Rudstam (2009). The estimates used for the net rate of downstream or upstream movement (averaged 2.4–2.6 body lengths/s) were consistent with the range of swimming speeds reported for Alewives from previous split-beam tracking by Arrhenius et al. (2000).

While unquantified individual sources of error make the accuracy of the net downstream passage estimates difficult to assess as absolute abundance estimates, these estimates as suitable relative measures for testing the null hypotheses in net downstream passage were corroborated by the observed trends and verification provided by trawl and mobile echo sounder surveys. Diagnosing and quantifying the many potential sources of uncertainty in the downstream fish passage estimates was beyond the scope of this study. Further investigation into estimating uncertainty in multiparameter estimates of fish passage using simulation or resampling techniques (Rose et al. 2000) or Bayesian statistics (Punt and Hilborn 1997; Anderson et al. 2007; Fässler et al. 2009) is warranted for providing reliable absolute estimates of abundance of migratory anadromous fishes.

After directing the ultrasonic field upriver, the percentage of out-migrating juvenile Blueback Herring that bypassed the turbine channel increased from 31.3% to 76.5%. At Crescent, this improvement in downstream passage through the main channel represents the potential survival of an additional 76,840 juvenile Blueback Herring, based on an out-migration of 1 million Blueback Herring (a similar magnitude to what was observed in this study), a short-term turbine passage survival of 96% for the two Kaplan-type turbines (Mathur et al. 1996) and 70% for the two Francis-type turbines (Cada 2001), equal turbine use, and near 100% survival through the main channel. This study has demonstrated how pulsed ultrasound can improve downstream passage of juvenile Blueback Herring at hydropower dams when the ultrasonic field direction optimizes exposure to allow sufficient time for approaching fish to respond and avoid turbine intakes. The improved survival from ultrasonic fish deterrent systems can be considered beneficial to conservation efforts for restoring population levels of Blueback Herring, and possibly other alosines, especially if ultrasound is used at multiple dams on the same river or at sites with high turbine passage mortality.

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Bureau of Fisheries

2014-2015 Annual Report

Great Lakes Fisheries Management
Inland Fisheries Management
Public Use and Outreach
Fish Culture

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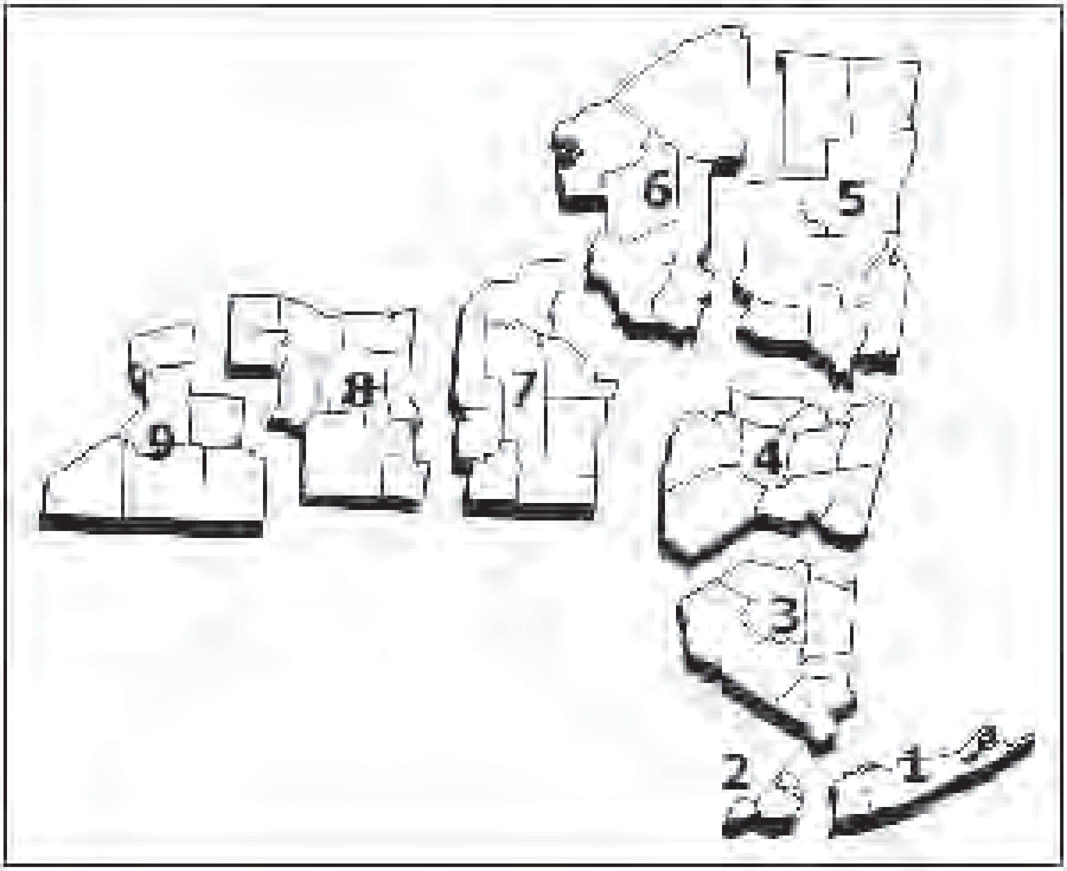
DEC REGIONS



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2014-15 Annual Report

New York State Department of Environmental Conservation
Bureau of Fisheries

Philip J. Hulbert, Chief

Introduction

The New York State Department of Environmental Conservation, Division of Fish, Wildlife and Marine Resources, Bureau of Fisheries delivers a diverse program and annually conducts a wide array of activities to accomplish its mission:

Conserve and enhance New York State's abundant and diverse populations of freshwater fishes while providing the public with quality recreational angling opportunities.

This report provides a summary of significant activities completed during fiscal year 2014-2015 by Bureau of Fisheries staff located in 9 regional offices, 2 research stations, 12 fish hatcheries, 1 fish disease laboratory, as well as the DEC Central Office in Albany. Activities are categorized according to the major objectives of the Divison of Fish, Wildlife and Marine Resources.

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Common Acronyms, Definitions and Units of Measure

Common Acronyms

AIS: Aquatic invasive species

CPUE or CUE: catch per unit of effort - such as the number of fish caught per hour or fish caught per net.

OMNR: Ontario Ministry of Natural Resources

PFR: Public Fishing Rights

USGS: United States Geological Survey

USFWS: United States Fish and Wildlife Service

YOY: young of year - typically a fish that is captured by sampling in the same year it was hatched.

Definitions

Bottom trawl: a sampling technique where a net is dragged along the bottom of a water body behind a boat.

Creel Survey: a survey where anglers are interviewed about their catch.

Conductivity: the ability of water to conduct an electric current. Waters of low conductivity are low in dissolved minerals.

CROTS: Catch-Rate-Oriented-Trout-Stocking - the model used by the Bureau of Fisheries to develop stocking rates for trout streams that takes into account biological measures of the stream, stream carrying capacity, angling pressure and wild trout abundance.

Electrofishing: use of electricity to temporarily stun fish, allowing them to be captured.

Extirpated species: a species that no longer exists in the wild in a certain country or area.

Fyke Net: a trap style net that is composed of a number of hoops surrounded by netting and usually has netted wings and a leader that direct fish into the net.

Gill Net: a vertical wall of netting that is typically set in a straight line and entangles fish as they try to swim through it.

Hazing - to discourage an animal from frequenting a waterbody.

HUC: Hydrologic Unit Code. A categorization of watershed boundaries from the basin to the sub (small) watershed level (HUC12).

Hydroacoustic survey: use of sound and reflected echoes from schools of fish or plants to estimate abundance or distribution.

Lentic: associated with still water such as a lake or pond.

Littoral: the nearshore shallow water area of a waterbody.

Lift - difference in license renewals between the control and treatment group.

Mesotrophic - an intermediate stage of lake productivity lying between oligotrophic (nutrient poor) and eutrophic (nutrient rich).

Oligotrophic - a water body that is low in nutrients.

Pen reared: raising hatchery salmon or trout in a pen to “imprint” those fish to the pen rearing site. In theory, this will cause the fish to return to the pen rearing site to spawn.

PIT Tag- an implanted tag that is used when an individual fish needs to be identified. The tag contains a series of numbers and letters that can be obtained by passing a “PIT Tag reader” over the implanted tag.

PSD: proportional stock density - describes the portion of a fish population or sample that exceeds a size threshold. For example, the PSD for largemouth bass is the proportion of 12 inch and larger bass in the sample of largemouth bass that were stock size (8 inches and larger).

Reclamation: the removal of non-native fish and restoration with native fish. Traditionally done to restore pond brook trout populations.

RSD 15: relative stock density greater than 15 inches - describes the proportion of fish larger than 15 inches in a population or sample of all fish exceeding a size threshold. For example, the RSD 15 for largemouth bass is the proportion of 15 inch and larger bass in a the sample of all largemouth bass that were stock size (8 inches and larger).

Seining: using a seine net - a net with weight on the bottom and floats on the top that is dragged through the water to capture fish.

Trap Net: similar to a fyke net but usually larger and rectangular in shape.

VHS/VHSv: Viral hemmoraghic septicemia - a serious disease of fish (not humans) recently introduced into New York State.

Year Class: a group of fish spawned during the same year.

Units of Measure

°C: degrees Celsius - to convert from c to farenheit (f) = (f - 32) x 5/9.

ha: hectare - a metric system unit of area; 1 hectare = 2.47 acres.

hr: hour.

in: inch.

kg: kilogram - a metric system unit of weight; 1 kg = 2.2 pounds.

km: kilometer - a metric system unit of length; 1 km = 0.62 miles or 3,281 feet.

m: meter - a metric system unit of length; 1 meter = 3.28 feet.

mm: millimeter - a metric system unit of length; 100 mm = 3.94 inches.

ppm/ppb: part per million/parts per billion - describes the density of a substance in another solid, liquid or gas (typically water, air).

µg/l: micrograms per liter; equivalent to ppb,

REGION 1
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SPECIES CONSERVATION AND MANAGEMENT

Walleye Management in Lake Ronkonkoma and Fort Pond

Walleye *Sander vitreus* fingerlings are stocked into Lake Ronkonkoma and Fort Pond every year as a supplemental predator in an effort to control the overabundant white perch *Morone americana* population. The Region 1 Fisheries Unit conducted gillnet and electrofishing surveys on both waters in the fall of 2014 to evaluate these stocking efforts.

When the lakes were last surveyed in 2010, the white perch population in Lake Ronkonkoma was down substantially but the walleye population was also down and walleye were showing poor growth. In Fort Pond on the other hand the white perch population was still out of control. As a result decisions were made to reduce the stocking in Lake Ronkonkoma from 10,000 walleye per year to 5,000 per year and increase the stocking in Fort Pond from 4,000 every other year to 4,000 every year. These were the first surveys of these water bodies since the stocking policy changes.

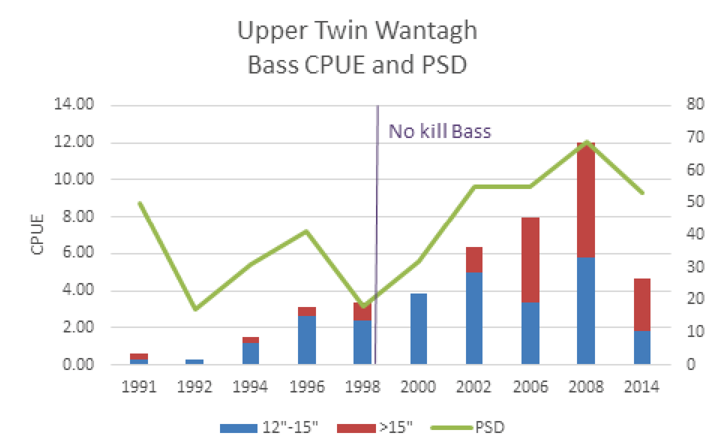
In Lake Ronkonkoma, the catch rates for walleye in the gill nets and electrofishing increased despite the reduction in stocking rates. Substantially more walleye over 15" were caught in 2014 than in 2010. The white perch showed little change in the catch rates of adult fish, but the catch rate of young of the year white perch increased substantially. It is too early to tell if this is a shift back toward overabundance of white perch or a single strong year class.

In Fort Pond the catch rate for walleye increased in both the gill nets and electrofishing as might be expected by the increased stocking rate. The gill net catch rate for walleye over 15" was the highest observed since 2001 and the electrofishing catch rate for walleye over 15" was near the highest observed over the same period. Despite the increase in walleye abundance, the white perch electrofishing catch increased to the highest recorded since 2001. This was primarily due to a very high catch of young of the year white perch. There were more large white perch as well including the highest ever electrofishing catch rate for white perch over 8" and the first ever memorable size white perch (>12") caught in Fort Pond.

At the present time no changes in management policy are warranted for Lake Ronkonkoma or Fort Pond. The Regional Fisheries Unit will resurvey both ponds in 2017 to continue monitoring the walleye stocking and the white perch populations.

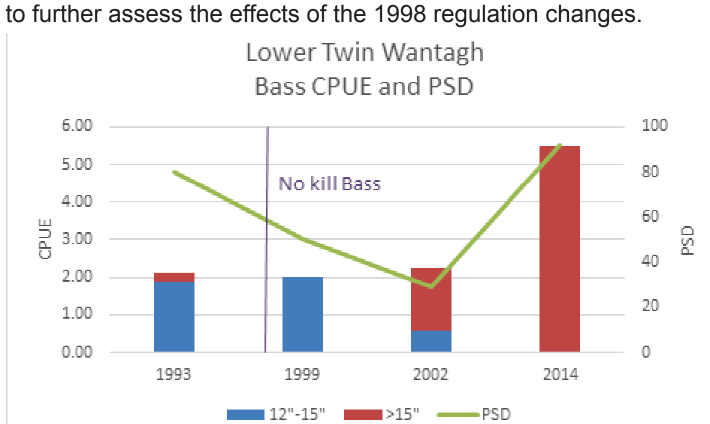
Black Bass Catch and Release Regulation Assessment

Upper Twin and Lower Twin Ponds in Wantagh, Town of Hempstead, Nassau County, were surveyed in 2014. This was part of a continuing effort to assess the results of the implementation of the Catch and Release Only Regulation for black bass in Nassau County in 1998. Catch rates for quality bass (12" and over) and preferred size bass (15" and over) increased since the regulation change in Upper Twin Pond. Survey results show a decline in larger bass in the 2014 survey, however, dense vegetation present during the survey may have prevented capture of the larger fish. Over the ten surveys conducted, 90% of all bass over 12" were caught after the regulation change. The Proportional Stock Density (PSD) for bass improved since the regulation change and continue to be in the optimal range (40 to 70) since 2002. Bluegill catch rates fluctuated across the surveys from 1991 through 2014, however, the highest catch rate for quality (6" and over) bluegill was in 2008 and the highest catch rate for preferred (8" and over) Bluegill was noted in 2014. The catch rate for quality-size (6" and over) pumpkinseed also increased in 2008.



Catch rates for preferred sized bass in Lower Twin Pond increased from 0.3 fish per hour in 1993 to 1.7 and 5.5 fish per hour in 2002 and 2014, respectively. The PSD value at 90, shows the population as being dominated by larger bass. Pumpkinseed and Bluegill catch rates decreased in Lower Twin Pond after the regulation change with zero preferred sized sunfish caught since the regulation change.

Overall, the size distribution of bass improved in both Upper and Lower Twin Ponds since the regulation changes in 1998. The results for sunfish varied. Additional waters in Nassau County will be monitored to further assess the effects of the 1998 regulation changes.



Post dredging survey on Upper Yaphank Lake

Upper Yaphank Lake was dredged by the Town of Brookhaven in 2013. Over the course of two months over 60,000 cubic yards of sediment were hydraulically dredged from the lake in an effort to remove the soft sediment from the lake and prevent regrowth of aquatic invasive species. The Regional Fisheries Unit completed pre and post dredging surveys of the lake to assess changes in the fish community in the lake. During the pre-dredging survey 14 species of fish were caught with largemouth bass, bluegill, pumpkinseed, golden shiner, brown bullhead and American eel being most numerous. The same six species were also the most numerous in the post-dredging survey. Six species were collected during the pre-dredging survey that were not collected in the post-dredging survey. All of these species were relatively rare in the pre-dredging survey with no more than nine individuals caught from any of these species. One species, the common carp, was not observed during the pre-dredging survey and one individual was observed during the post dredging survey. Stocked brown trout and rainbow trout were caught in both surveys. The catch of largemouth bass increased from pre-dredging to post-dredging while the bluegill and pumpkinseed catch declined. The increase in the bass catch rate was probably due to the reduced aquatic vegetation in the deeper water resulting in large bass moving inshore looking for cover which made them more vulnerable to electrofishing. This survey will be repeated in two to three years to assess the long term effects of the dredging project.

HABITAT CONSERVATION

Ludwigia Removal in the Peconic River

The Region 1 Fisheries Unit in cooperation with the Peconic Estuary program and with the assistance of DEC staff from the Bureau of Habitat and Forestry and numerous volunteers completed four hand pulling operations of floating water primrose *Ludwigia peploides* in the Peconic River this year. Over 25 cubic yards of Ludwigia was removed, mostly from the Upper Mills Pond section of the river. This was the area with the most extensive infestation, but less than half of the infestation was removed. Due to the loss of support from the Freshwater Anglers of Long Island, very little effort was expended on Peconic Lake and the infestation worsened there. Further upstream, the infestation which had been out of control in 2012, was nearly completely removed. It will have to be watched closely in future years to prevent re-establishment.

Two additional infestations, not connected to the river were documented this year. One in Swan Pond, just south of Peconic Lake and the other in a private stormwater pond in a development north of the river. The Swan Pond infestation was mapped, but no removal was attempted. The infestation in the private pond was treated with Glyphosate and will be monitored. The Peconic Estuary Program, Fisheries and the Long Island Invasive Species Management Area (LIISMA) are working together to develop a comprehensive management plan for future control efforts of Ludwigia.

Hydrilla Surveys on Lake Ronkonkoma and Blydenburgh Lake

The Region 1 Fisheries Unit completed the annual surveys of the extent of Hydrilla in Lake Ronkonkoma and Blydenburgh Lake in August of 2014. This was the sixth annual survey for Lake Ronkonkoma and the third annual survey for Blydenburgh Lake. Since 2009, Hydrilla has been the dominant aquatic plant species in Lake Ronkonkoma and in 2014 comprised 86% of all samples taken. However, it shows no trend toward increasing density. Because most of the lake is too deep for it, Hydrilla still covers less than 20% of the surface area of the lake. In Blydenburgh Lake the density of the infestation declined, but it remains to be the dominant species at 81% of all samples in 2014.

Water Chestnut Removal in Massapequa Creek

This nasty invasive plant was first discovered downstream of the creek in Massapequa Lake in 2011. Last year it was identified in the reservoir upstream of the lake, and now, unfortunately, it has expanded its range to the creek. The creek is currently under a new stocking protocol to reintroduce brook trout. Fortunately this plant remains in the ponded areas along the creek. Region One Fisheries Unit with the help of Freshwater and Marine Habitat staff as well as a handful of volunteers hand removed approximately 150 large waste bags of the plant and seeds in June, July, and August. A last visit to the site was done in September and only a few lingering plants were observed and removed. The ponds along the creek will be surveyed next spring to evaluate the effectiveness of the hand-pulling efforts, which will continue as needed.

PUBLIC SERVICE AND CONSTITUENT SUPPORT

I FISH NY Long Island

In 2014, the Region 1 I FISH NY Program held slightly fewer fishing events than the year before, but the overall attendance at I FISH NY events increased substantially. This was primarily due to much higher than average attendance at the major spring and fall Fishing Festivals, but attendance also increased at Fishing Clinics including a 50% increase in attendance at the two day Valley Stream Fishing Clinic held during Free Fishing Weekend. In 2014 a total of 11,292 people attended one of the 29 I FISH NY events held in the Region.

Region 1 Fisheries staff again participated in the statewide I FISH NY train the trainer program, a fishing training for summer camp counselors, at two 4H camps on the eastern end of Long Island. Freshwater fishing equipment was supplied by DEC's central office, while saltwater equipment was loaned by Region 1 for use by the campers. The camp's fishing classes were very popular and well attended.

In FY 2014 the Regional I FISH NY Program completed the posting of the I FISH NY Lesson Plans on the DEC website. A total of 16 lesson plans for grade levels 3 through 12, for both in class and out of class lessons. The lesson plans can be accessed at *http://www.dec.ny.gov/education/89975.html.*

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REGION 2
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SPECIES CONSERVATION AND MANAGEMENT

Bronx River Bioblitz

Fisheries staff participated in a multi-organization, comprehensive survey of the Bronx River on August 18, 2014. Multiple sites were sampled by DEC through backpack electrofishing while other organizations collected water quality data and conducted sampling for invertebrates. The fisheries data complements existing data on the Bronx River fish community species composition, part of a larger NYSDEC fish community study of the Bronx River ongoing since 2007. Additionally, fin tissue samples were collected from white suckers for genetic studies through Fordham University. The day was organized through the Bronx River Alliance and involved efforts by other government agencies, universities and non-governmental organizations including Columbia University, City University of New York, Fordham University, the Wildlife Conservation Society, Rocking the Boat and New York City Department of Parks and Recreation.

Brook Lamprey Investigation, Tibbetts Brook

Fisheries staff accompanied fisheries staff from the Canadian Museum of Nature on a search for American brook lampreys in Tibbetts Brook, a stream running into Van Cortandt Park in the Bronx from Westchester. The last brook lamprey record for Tibbetts Brook was from 1979 and a finding of this species would have been notable. Unfortunately, no brook lampreys were found during this survey but staff now has some expertise and knowledge to search elsewhere for these fish.

Prospect Park Lake Creel Survey

A creel survey of Prospect Park Lake (Brooklyn) anglers was completed in 2014. The survey was used to estimate angling pressure, catch rates, species targeted, demographics of anglers, angler comments and angling methods. The survey period was conducted between May 5th and November 4th, 2014. A creel agent counted and surveyed anglers every weekend day and on two randomly selected weekdays. Greatest angler effort occurred in June, with July having the second highest amount of effort.

Ohrback Lake Fishery Survey

A boat electrofishing survey of Ohrback Lake in Pouch Camp, Staten Island was completed on April 29th. Objectives of the survey were to determine species composition and collect fish for contaminant testing. The DEC recently obtained an easement for portions of Pouch Camp including most of Ohrback Lake. Species captured were those typical of warm water lakes in New York City with the exception of chain pickerel which have a limited distribution in New York City. Almost 90% of sunfish captured were less than six inches in length while the largemouth bass captured were in relatively large size ranges. The bass population was dominated by larger fish as reflected by the relatively high size indices of Proportional Stock Density (86) and Relative Stock Density (40). Size distribution of sunfish and largemouth bass suggests a moderate to low density of bass and high sunfish exploitation although low water temperature may have affected electrofishing catch rates.

Flushing Airport Invasive Species Monitoring

Fisheries staff continued monitoring a population of northern snakeheads at the site of the former Flushing Airport in College Point, Queens. This population was confirmed through angling in July, 2012. Eradication was not pursued as this freshwater wetland area is surrounded by marine waters making travel by these fish to other waters, unlikely. Age, length and weight Information collected during the 2014 angling survey of Flushing Airport snakeheads indicated most of the fish caught were one and two years of age. Comparison of length-weight data with that from snakeheads surveyed in Flushing Meadows Corona Park, where a population of northern snakeheads have been existing since at least 2005, indicates Flushing Airport snakeheads are smaller and likely food-limited. Introduction most likely occurred through one of two routes: 1) fish moved from the Meadow/Willow Lake system, north, through Flushing River and into the canal and Flushing Airport drainage basin; or 2) fish were released directly to the Flushing Airport drainage basin. Although the site is surrounded by a chain-link fence we observed several breaches of the fence through which people could enter.

PUBLIC SERVICE AND CONSTITUENT SUPPORT

NYC I FISH NY Program

R2 Fisheries staff conducted programs in 64 elementary and high school classrooms, reaching a total of over 2,200 students. An additional 533 people were reached through 10 outreach events and ten potential trainers were reached through train-the-trainer events.

Coordination with Other NYC Fishing Outreach Groups

On February 24th representatives from fresh and salt water fishing outreach groups in New York City met at the Long Island City Regional Office for the second of its kind workshop. A DEC Environmental Conservation Officer (ECO) provided information on fishing regulations, licenses and enforcement of these. Participants had the opportunity to ask questions and the ECO offered to provide assistance at fishing events of other groups. The NYS Department of Health provided details on the procedures involved in developing fish consumption advisories and shared a lesson plan on how to teach these at outreach events. Methods of teaching fishing regulations were shared among group participants and links to resources on lesson plans, regulations and consumption advisories were provided.

Groups represented at the meeting were the Prospect Park Alliance, Hudson River Park Trust, Battery Park City Parks Conservancy, the Lower East Side Ecology Center, the River Project, Solar 1, Urban Kid Adventurers, the Wildlife Conservation Society, Randall's Island Park Alliance, DEC Education, the DEC I FISH NY program, and the NYS Department of Health.

Fishing Event for Senior Citizens

On October 28th, Region 2 I FISH NY program hosted a multi-lingual Fishing Clinic for the Selfhelp Innovative Senior Center in Flushing, Queens. On an unseasonably warm day, 25 Cantonese speakers, all of them first time anglers, enjoyed a relaxed morning by Kissena Lake, catching more than 30 fish among them. Through a translator, Region 2 Fisheries Staff provided information about fishing licenses, places to fish, fish handling tips, and general assistance. Many participants expressed interest in pursuing angling as an activity to pursue with grandchildren. The event was open to the public and numerous walk-ins stopped by to experience angling for the first time and learn more about their local lake. Everyone enjoyed the day so much that plans are already in the works to return to Kissena in the spring.

Fishing Event with the National Park Service at Ft. Wadsworth, SI

On August 8, a fishing clinic was conducted at Gateway National Recreation Area, Ft. Wadsworth, Staten Island in collaboration with the National Park Service (NPS). The R2 I FISH NY program has fished with the NPS during summer camps and has also provided a train-the-trainer program but this was the first partnership at a weekend family event. The clinic was held at the northern tip of the beach with the Verrazano Bridge as background. While the NPS provided upland activities including a living history exhibition covering American history between the Revolutionary and Civil Wars, DEC Fisheries staff provided fishing education along the beach at Ft. Wadsworth to over thirty New Yorkers. Virtually every angler caught fish, mostly "snapper blues", and a lucky few caught up to 10 fish in a span of a few hours. Many of these participants were first time anglers and stayed the duration of the clinic to catch fish. A NYCares volunteer provided assistance at this event and has proven to be useful at other fishing clinics conducted over the year.

Multiple Sclerosis Society Fishing Clinic in Williamsburg

On September 10th R2 Fisheries staff hosted a fishing clinic for the New York Chapter of the Multiple Sclerosis Society at North 5th Street Pier in Williamsburg, Brooklyn. Approximately 30 participants enjoyed views of the Williamsburg Bridge and Manhattan while fishing and catching striped bass, oyster toadfish and black sea bass. As is typical for these clinics information on fishing regulations, licenses and fish consumption advisories was provided as was information on fish species of the East River. These annual MS Society fishing clinics have become so successful staff has added a spring clinic making these semi-annual events.

Other Fishing Outreach and Training

- Fishing outreach training for Prospect Park Audubon Center staff, Prospect Park, Brooklyn
- Prospect Park Earth Day Fishing Clinic and Family Fishing Clinic, Prospect Park, Brooklyn
- Raritan Bay Festival, Conference House Park, Staten Island
- Selfhelp Innovative Senior Center Fishing Clinic, Kissena Lake, Queens
- East Side YMCA Fishing for Summer Camp Youth, East River, Manhattan
- Baisley Pond Fishing Clinic, Baisley Pond, Queens
- Little Red Lighthouse Festival, Fort Washington Park, Manhattan
- Fishing Clinic with the National Park Service, Fort Wadsworth, Staten Island

2014-15 Region 2 Fisheries Staff

Melissa Cohen	Biologist 2 (Aquatic)
Steven Wong	Environmental Education Assistant
James MacDonald	Environmental Education Assistant
Dwane Binns	Seasonal Fish & Wildlife Technician
Ann Murphy	Seasonal Fish & Wildlife Technician

REGION 3
BUREAU OF FISHERIES

SPECIES CONSERVATION & MANAGEMENT

Hudson R. Largemouth Bass & Walleye Telemetry Study

After conducting a pilot study in 2013 fisheries staff learned that the Lotek CART tags (dual mode tags) worked best for walleye and allowed both our Hudson River Fisheries Unit and our Inland Fisheries Unit to track these fish. Lotek radio only tags were selected for the largemouth bass in 2014 because of their shallow water habitat preference. In 2014 we used a larger 4 element yagi antennae to increase our range of detection and a four stroke motor to cut down on interference while tracking.

In 2014 fisheries staff surgically implanted Lotek radio tags into largemouth bass and Lotek CART tags into walleye in the tidal Hudson River to track their seasonal movements and habitat preference. A total of 31 largemouth bass >15" were collected and tagged (13 from the tidal Rondout Creek and 18 from the tidal Esopus Creek) and 10 walleye >18" were collected and tagged (7 from the tidal Rondout Creek, 2 from the tidal Esopus Creek and 1 from the Catskill Creek). Both our Hudson River Fisheries Unit and our Inland Fisheries Unit were able to successfully track these fish in 2014. Sampling efforts will continue into 2015 tagging an additional 24 largemouth bass and 20 walleye. Data collected from this research project will be beneficial to managers to help protect and improve both these fisheries.

Lake Minnewaska (Ulster County) Electrofishing Survey

This State Park lake was sampled by night boat electrofishing in June 2014, with the purpose of documenting the fish species present in Lake Minnewaska, as well as updating the status of the largemouth bass population which was first documented in 2012. Historically acidic for at least 90 years, golden shiner were reported to be present by Park personnel in 2008, and largemouth bass were reported present in early 2012. Both largemouth bass and golden shiner were collected in electrofishing surveys in 2012 and 2013.

Electrofishing in June of 2014 collected 108 largemouth bass, with no other species collected. It is apparent from these results that the introduced largemouth bass may have completely eliminated the previously introduced golden shiner from Lake Minnewaska, an outcome which is further corroborated by the documentation of increasing water clarity in the lake in 2014. Uncontrolled golden shiner can reduce zooplankton populations, resulting in increased phytoplankton density.

Rio Reservoir (Sullivan County) Walleye Assessment

Rio Reservoir was stocked with walleye advanced fingerlings in late summer 2012 as the first stocking in a five-year experimental stocking program, with the objective of establishing a population there. Walleye were not stocked in 2013 due to problems with the hatchery supply, however, fingerling stocking resumed in 2014 and will continue for five additional years. The reservoir was electrofished in October 2014 roughly following the percid plan, with the objective of documenting survival of the 2014-stocked walleye, as well as the presence of any additional walleye. In 2.6 hours of electrofishing no young-of-year walleye were captured, with only three older walleye up to age 5+ captured.

Swinging Bridge Reservoir Walleye Assessment

Swinging Bridge Reservoir in Sullivan County was electrofished in October 2014 roughly following the protocols of the Bureau of Fisheries' percid plan. The objective of this survey was to document survival of any naturally spawned walleye from the 2014 year class. No young-of-year walleye were collected, indicating a lack of survival of the 2014 walleye year class. Six older walleye were sampled, representing an age range of 4+ to 5+. A total of 14 white perch were sampled, which may indicate that this invasive species is increasing in abundance in this reservoir, when compared to previous surveys. A creel survey was conducted during the 2014 open water season as well as two months during the following ice fishing season on this reservoir, partly in response to anecdotal angler reports indicating that the walleye fishery may be declining here. This is currently being analyzed.

Swinging Bridge Reservoir Creel Survey

In response to angler complaints about and observations of a declining walleye fishery, a full open water season (May 1 – November 30) creel survey was conducted on Swinging Bridge Reservoir. Additionally, a cold winter with corresponding good ice conditions allowed for the winter ice fishery to exist, with an additional two months of creel survey data collected during February and March 2015 when ice conditions were safe.

Although the data are currently being analyzed, preliminary results indicate that the open water (boat) fishery accounted for 1.5 times the fishing pressure as did shore anglers. Total open-water season fishing pressure was estimated to be approximately 25 hours/acre. A total of 1566 fish were observed by or reported to the creel agent, with the highest proportion (45%) being comprised of black bass (primarily smallmouth), followed by black crappie (26%). Walleye only comprised 5% of the open water season catch.

One interesting finding was the interest in fishing for common carp, especially amongst shore anglers. Overall, 58% of the anglers interviewed were shore anglers, and of these 28% were targeting common carp. This was the second most fished for shore angling category, following those shore anglers fishing for "anything" (60%).

Ridgebury Lake Northern Snakehead Surveillance

In 2008 and 2009 a two mile section of Catlin Creek (including four small private ponds and a 49 acre wetland), as well as Ridgebury Lake (28 acres), were treated with rotenone in an attempt to eradicate northern snakehead. If northern snakeheads were to have dispersed downstream from this treatment area, the fish could have traveled through a series of streams (Rutgers Creek – Wallkill River – Rondout Creek) and ultimately to the Hudson River.

To confirm that all northern snakehead have been removed from this watershed, and to document fishery restoration, follow-up fisheries surveys have been conducted. In the Fall of 2013 and 2014, Ridgebury Lake was sampled by boat elelctrofishing and a typical warmwater fish assemblage was documented. No northern snakeheads or common carp were seen or collected. Despite multipe stockings of triploid grass carp from 2009 to 2014 for aquatic vegetation control, no triploid grass carp were seen or collected via electrofishing. Due to dense Eurasian milfoil and thick duckweed and watermeal on the surface of the water, these fish collections were very difficult and many fish were probably not visible to collect. A winter kill was documented in March 2015, at which time approximately 20 triploid grass carp were found dead. The grass carp had obviously grown since stocking, so some limited success can be claimed from the previous grass carp stockings. Additional triploid grass carp will be stocked in 2015 to further reduce the nuisance levels of submerged aquatic vegetation at the lake.

eDNA Northern Snakehead Testing

A collaborative effort was conducted with The Nature Conservancy (at Notre Dame University) and researchers from Central Michigan University to take water samples to test for the presence of Northern Snakehead environmental DNA (eDNA). In 2013 a total of 260 2L water samples were collected throughout this watershed, including locations upstream of the treatment area and downstream to the tidal portion of the Rondout Creek at the Hudson River. These samples were analyzed using a species specific PCR (polymerase chain reaction) marker and traditional PCR techniques. The results of these tests were all negative. Additional samples were taken in 2014. The samples form 2014, as well as the 2013 samples, will be screened using digital PCR. The digital PCR method is even more sensitive than traditional PCR and will also be used to help verify results.

HABITAT CONSERVATION

Tappan Zee Bridge Replacement

Region 3 fisheries staff provided onsite monitoring during 2014 and 2015 for the $3.9 billion Tappan Zee Bridge Replacement Project. Fisheries staff conducted approximately three site visits per week overseeing various construction activities. Special attention was given to activities with the greatest impact on fish and the Hudson River. Over the past year this included concrete placement which can impact the pH of the river through concrete leachate, and pile driving which can impact fish and other organisms through sound and vibrations created from hammering. Fisheries staff also participated in monthly progress meetings held between DEC, Thruway Authority and Tappan Zee Constructors (the consortium of companies building the bridge). To reduce some of the sound and vibrations from pile driving, bubble rings were deployed around the piles during the hammering to help insulate the sound waves and reduce the range and magnitude of impact. Construction of the bridge is well under way with just over 51,000 cubic yards (CY) of concrete placed of the 200,000 CY's expected. Also, 992 piles of the 1,120 piles supporting the bridge have been driven. Other highlights include the completion of the first pier cap which will eventually support the new bridge's road deck and the arrival of the Left Coast Lifter (LCL). The LCL is one of the largest cranes in the world and took a 6,000 mile journey from San Francisco Bay, through the Panama Canal and arrived at the construction site during fall of 2014.

Rio Reservoir water release to Mongaup Creek

The Rio Reservoir is a hydroelectric impoundment on the Mongaup Creek along the Orange and Sullivan County line. The dam is owned and operated by Eagle Creek Renewable Energy, and in addition to generated hydroelectric power they must also make consistent water releases to sustain flow in Mongaup Creek. In November 2014, they had a catastrophic failure of their newly constructed 4 foot diameter minimum flow waterline. This resulted in an uncontrolled flow of water (500+ cubic feet per second) washing out the hillside that supported the main power generating penstock (see photo). Regional Fisheries Staff and Central Office and Regional Permit Staff worked with Eagle Creek to quickly provide the necessary, field work, plan review and permitting to reestablish stable conditions and repair necessary infrastructure. In mid-February the hillside was reconstructed and flow was reestablished in the penstock. The old minimum flow release structure was also reactivated at the same time. Between the November failure and mid-February, the required water flow was maintained by spill from the reservoir spillway. The reestablished minimum flow release structure will enable the release of cold water, which is essential to trout survival in the lower Mongaup Creek during the period of the year when warm water would otherwise spill over the dam.

PUBLIC SERVICE AND CONSTITUENT SUPPORT

I FISH NY Efforts

The Region 3 I FISH NY program conducted 16 fishing festivals reaching 1,273 people, four fishing clinics reaching 282 people, four summer camp programs reaching 167 campers and 1 school program reaching 92 students. The clinics targeted various groups including people with a disabilities, adult day care centers and inner city youth. Over 1,800 people were involved in the 27 programs conducted and either fished or received fishing information in 2014 from the Region 3 I FISH NY Program.

Staff also conducted 7 "train the trainer" programs teaching 64 camp counselors how to fish and providing the camps with fishing equipment, so they can teach the kids during camp.

World Hunting and Fishing Exposition

Region 3 Fisheries staff set up and staffed a booth at the World Hunting and Fishing Exposition at Rockland Community College in Rockland County. From February 27 through March 2, 2014, thousands of anglers attended the show. People who visited the booth were able to talk fishing with our staff, receive literature, and view mounts of our state record fish. The kids were entertained by playing Velcro-fishing.

2014-15 Region 3 Fisheries Staff

Mike Flaherty	Biologist 2 (Aquatic)
Bob Angyal	Biologist 1 (Aquatic)
Larry Wilson	Biologist 1 (Aquatic) - Retired 4/14
Ryan Coulter	Biologist 1 (Aquatic)
Michael DiSarno	Biologist 1 Trainee (Aquatic)
Linda Wysocki	Fish & Wildlife Technician 3
Tim McNamara	Fish & Wildlife Technician 2
Amanda Tong	Seasonal Fish & Wildlife Technician
Indie Bach	Seasonal Fish & Wildlife Technician
Jessica Goretzke	Seasonal Fish & Wildlife Technician

REGION 4

BUREAU OF FISHERIES

NEW YORK STATE OF OPPORTUNITY. Department of Environmental Conservation

SPECIES CONSERVATION & MANAGEMENT

Mohawk River Fishery Assessment

A two-year field study commenced in 2014 in cooperation with USGS staff out of the Troy office to assess the current status of fish assemblages in the Mohawk River and adjoining NYS Barge Canal in DEC Regions 4 and 6. Daytime boat electrofishing was conducted at 27 sites in various impounded and seasonal sections of the river from Crescent Lake (Waterford) above lock E6 upriver to lock E21 (Rome). Due to the long study area, alternate sections between locks were selected for sampling in the late spring of 2014 and 2015. A sample set of scales were collected to age walleye and black bass >1+ years old. Preliminary results suggest fish communities differ substantially between permanently and seasonally impounded sections of the river. CPUE for the fish community in permanently impounded sections was more than twice that of seasonally impounded sections. Centrarchids and yellow perch contributed most strongly to these differences but popular gamefish such as walleye were also more abundant in permanently impounded reaches presumably due to more deepwater (i.e., stable) habitat.

Seining was also conducted to collect smaller fish that might have been missed by the electrofishing effort. This produced several fish species not captured in the spring effort. Rainbow darter, a new invader to the river was added to the fish community analysis (spring effort) along with young-of-year gizzard shad, and stocked young-of-year tiger muskellunge. No round goby were collected in either of the river surveys although one specimen (first record) was collected by another party in September 2014 near Utica.

Results from 2015 effort will be combined with 2014 and used to compile a contemporary dataset to fully assess the spatial and temporal trends in the fish communities between reaches.

Also commencing in 2014 was a study of the river's invertebrate community conducted in cooperation with Onondaga Environmental Institute.

Canadarago Lake Fishery Assessment

The bi-annual summer gill net and annual fall boat electrofishing assessment of yellow perch and walleye in Canadarago Lake continued in 2014 in cooperation with Cornell University. Sampling included two gill nets set overnight once a month during May, June, July, and August (eight sites) around the lake. A water chemistry profile was completed at the start of each monthly netting. Fisheries staff also completed a one night electroshocking effort during the fall on the western shore and around Deowango Island to supplement the summer netting and search for stocked young-of-year walleye.

Gill net effort of 8 nets nights produced 19 species of fish with alewife being the most numerous (414 recorded). Only 21% of yellow perch were of desirable size to anglers (≥8"). Twenty smallmouth bass were captured (17 over 12") but only four largemouth bass were caught. A total of 101 walleye were recorded with 95% of them ≥ to the 15" legal size.

Total electrofishing effort of 1.5 h produced 17 species of fish with yellow perch being the most numerous (367 recorded). However, only 7.1% of yellow perch were of desirable size to anglers (≥8") despite a high CPUE of 245/h. Only three smallmouth bass were captured (one over 12") but 13 of the 41 largemouth bass were ≥ 12" (legal size) with some adults weighing up to about five pounds. Good numbers of chain pickerel were found with 60% being of legal size (≥ 15") indicating recent successful recruitment for the species. A total of seven walleye were collected with 100% of them ≥ 15" (legal size) and a relatively high CPUE of 5 fish/h.

Schoharie Reservoir

Schoharie Reservoir was sampled in cooperation with the New York City Department of Environmental Protection to determine the success of walleye stocking that began in 2011. Fish were also collected for a wild fish health assessment conducted by the USFWS. Angling, electrofishing, and gill netting were conducted at five sites around the reservoir on September 10 and 11, 2014. Approximately 2.5 h were spent angling on the reservoir targeting walleye for the fish health collections on the first trip. Another 1.0 h of shocking was completed along the shoreline at night on the 10th and the following morning to complete the survey (avg. 0.5 h per trip). Gill nets were also deployed to collect older walleye, with a total soak time of 6.5 h, averaging 3.3 h and 1-2 nets used per trip.

The overall survey effort resulted in the collection of 413 fish comprised of 20 fish species. Emerald shiner comprised almost half of the catch followed by spotfin shiner (19%). No other species comprised ≥ 10% of the catch. Angling resulted in a few sunfish, perch, and black bass collected, but no walleye. Very few panfish species were collected via boat shocking with only two of the 13 yellow perch and all three of the white perch collected of desirable size (≥8"). Only 19 black bass were collected with only two of each species exceeding the legal size (≥12"). Only one of the smallmouth bass was > 16".

Walleye numbers were low compared to the 2013 effort and the 15 fish comprised only 4% of the total catch with two fish of legal size (≥15"). The gill nets did capture multiple year classes of walleye from young-of-year to adult. Six of the fish were just under 15" and presumed to be 2-y olds that should grow to legal size by spring. Compared to other waters that we stock, the 50-day fingerlings appear to be surviving well in the turbid water and recruiting to legal size in three years as hoped. No Oriental weatherfish were found but recruitment of alewife was confirmed in the reservoir again this survey.

Otsego Lake

The bi-annual fall gill netting of Otsego Lake was conducted to assess the response of the salmonid fishery to a reduced annual lake trout stocking policy (~2,500 SY lake trout). Fish were also collected for fish disease testing. Three nets were set on consecutive nights at six designated sites in deep water around the lake. A water chemistry profile was completed at the start of the survey near the deepest part of the lake.

Overall, six gill nets collected a total of 123 fish (55 salmonids) in the September sets and a few dozen others fishes (mostly young yellow perch) were collected via seine. The numbers continue to decline for lake trout (49 individuals) with a catch per net of 8.3 fish, down from 14.0 in 2012, and well below a mean of 12.9 fish/net since alewife became dominant in 1992. A total of 10 walleye were also caught in the net which remain in good condition unlike many (but not all) of the lake trout. The poor fitness of most lake trout is thought to be a result of a lack of adequate forage resulting from an excess of predators in the lake and the introduction of zebra mussels to the lake.

Lake whitefish numbers indicated a minor resurgence in 2012 with 12 fish caught, the most caught since 1992 (21 fish), but only six individuals were collected in 2014. These numbers are consistent with the 14-year average of 5.8 fish per survey. Cisco numbers are below detection levels now with none collected by gill net since 2010 and <10 fish caught after 2004. Coregonid numbers are expected to increase in the absence of abundant alewife and collaborative research is under way between SUNY and DEC to restore habitat and perhaps re-stock lake whitefish in Otsego Lake. Fish health in the lake appears good for all fishes tested except lake trout which tested positive for Epizootic Epitheliotropic Disease (EED), a causative virus that infects mostly the epidermis tissue of young lake trout. The infection is probably due in part to the poor condition of most lake trout in Otsego Lake and is not expected to have a significant impact of the lake trout fishery. A new management strategy for the lake will be developed focus ing on the restoration of the coldwater salmonid fishery.

Onesquethaw Creek Brown Trout Assessment

An electrofishing survey was conducted on August 12, 2014 on Onesquethaw Creek to assess the current brown trout population at two possible habitat improvement sites (site 1 and 3) and one pristine site (site 2). The three sites were located in newly acquired public fishing rights sections on the Onesquethaw. Wild brown trout collected included 38 fish with a size range of 2.55 – 11.25 inches, and a mean length of 6.01 inches at site 1, 40 fish with a size range of 2.87 – 16.58 inches, and a mean length of 7.98 inches at site 2, and 103 fish with a size range of 2.64 – 9.69 inches, and a mean length of 4.03 inches at site 3. The estimated >1+ trout population for the PFR section was 110.49 trout/acre and 34.39 lbs/acre, respectively. No stocked trout were collected even though roughly 1,200 brown trout are stocked annually starting about 2.0 miles upstream of the PFR section.

Overall, this section of the Onesquethaw Creek can be valued as a high quality trout stream. This can probably be attributed to low summer water temperatures and quality trout habitat. .

PUBLIC SERVICE AND CONSTITUENT SUPPORT

Onesquethaw Creek PFR Acquisition

On July 15, 2014 NYSDEC officially acquired roughly 7,000 feet of PFR along the Onesquethaw Creek, including an access trail and parking area on Rupert Road, Town of Bethlehem, Albany County. This easement, purchased by NYSDEC from the Town of Bethlehem, gives anglers the right to fish along the stream where PFR signs are present. This PFR project was a success because of the collaboration between NYSDEC, the Town of Bethlehem and the Clearwater Chapter of Trout Unlimited.

2015 Otsego Lake - Ice Fishing Clinic

On February 18, 2015 OPRHP and DEC Bureau of Fisheries conducted their 6th annual free ice fishing clinic at Glimmerglass SP on Otsego Lake. This event, geared towards kids and those new to the sport of ice fishing, was again a success due to multi-agency staff collaboration and public participation. About 100 people attended the event and many fished despite the lengthy hike out on the lake in the snow and slush. A large solar-heated shanty with a color fish finder and black-n-white camera was of interest to some anglers, but most ventured about on the ice with jig'n rods in hand looking for biting fish amongst a field of tip ups staff had set. DEC staff baited hooks and answered many questions from new anglers on the rather nice (~30° F) calm sunny day. Staff were often outnumbered ~12-1 by the new anglers and soon ran out of rod/reel combos for everyone to jig with. Luckily additional support was provided by local SUNY Cobleskill students. Unfortunately, the bite was very slow on the flats off the beach. Overall about 10 fish were caught, mostly on tip ups baited with live Golden Shiners. Five or so Chain Pickerel from 14-20" were caught along with the same number of Yellow Perch from 8-12". A lone 27" Lake Trout was the biggest fish iced that day. No other species were captured in the event but several people went home with fillets.

Green Lake Accessible Fishing Pier

An accessible fishing pier was installed at the Green Lake Fishing Access Site. The fishing pier is pinned to the lake bottom which will remain year round, thus reducing the need for staff to remove and install the pier every spring and fall. The pier is located directly on the edge of the deep drop off in the lake which is one of the preferred shore fishing locations on the lake. The lake is stocked with 2-year-old brown trout and is open year round to trout fishing. The lake also contains bass, sunfish, crappie, yellow perch and pickerel.

2014-15 Region 4 Fisheries Staff

Chris VanMaaren	Biologist 2 (Aquatic)
Daniel Zielinski	Biologist 1 (Aquatic) - retired
Scott Wells	Biologist 1 (Aquatic)
Tim Pokorny	Biologist 1 (Aquatic) Trainee 2
Dennis Wischman	Fish and Wildlife Technician 3
Jackie Trosterud	Seasonal Clerk 1
Anthony Bruno	Seasonal Fish & Wildlife Technician

SPECIES CONSERVATION & MANAGEMENT

Lower Sargent Pond Post-Reclamation Survey

Lower Sargent Pond in the Town of Arietta, Hamilton County was reclaimed in 2013. A survey of the pond in July, 2014 to determine the success of the reclamation was performed using nets and traps. One metal minnow trap was set along with one 100' minnow net and five 30' minnow nets. Four experimental gill nets designed to catch fish of different sizes due to the varying mesh sizes in the net were also set. Twenty central mudminnows were captured. Mudminnows were never documented in Lower Sargent Pond until just before the reclamation. Their survival in the pond is not a problem because this species is not a serious competitor of brook trout. The main species targeted for the reclamation were brown bullhead, golden shiner and largemouth bass, and none of these species were captured or observed. Little Tupper strain brook trout were stocked in the pond in September, 2014.

Lake Trout Population Surveys

Lake trout assessments were completed on Piseco, Schroon and Paradox lakes, primarily to assess the status of the juvenile lake trout population.

Piseco Lake

These gill net surveys are part of a multi-year study of the lake trout population across Region 5. At Piseco Lake, the lake trout population appears to be in reasonably good shape with 132 fish collected. Stocking rates for lake trout were reduced in Piseco in 2010 to increase growth, and the improved condition of the lake trout in 2014 indicates the stocking rate reduction achieved its objective. It does appear, however, that the population is still dependent on stocking. No landlocked salmon were captured in nets suspended in the water column, perhaps due to water temperature conditions. Lake whitefish and rainbow smelt were also collected during the survey.

While it is likely that some natural reproduction of lake trout still exists, the relative lack of smaller lake trout in the sample combined with the increased growth rate and the improved condition of the lake trout population indicate the size of the lake trout population is being maintained at a reasonable level using the current stocking regime. Hence no management changes are recommended based on the survey results.

Spiny water flea was recently detected in this water and, as usual, great care was taken to sterilize all of the equipment that was used to prevent the spread of this invasive species. This survey may also serve as a baseline of information should spiny water flea impact these fish populations.

Schroon Lake

At Schroon Lake, both lake trout and yellow perch were collected and submitted for toxic substance monitoring. Lake trout sampling results indicate that the lake trout population is doing reasonably well with very good condition and growth rates. However, because of a relative lack of older lake trout, the size limit on Schroon may need to be increased to the statewide limit of 21 inches for protection of age six fish, the age at which lake trout become sexually mature. This naturally reproducing population is supplemented by annual stocking.

Paradox Lake

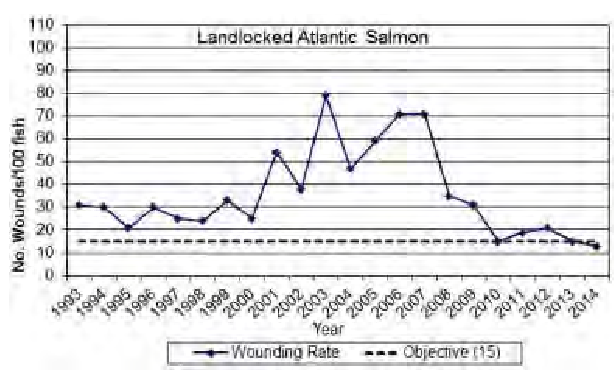
Although a small lake in comparison to the Region's other top lake trout waters, Paradox has a solid reputation as a lake trout producer, and our netting results reaffirmed that. Several 20+ inch fish including an 11 pounder were caught. Overall, the 2014 survey revealed a healthy population of lake trout with good growth and condition, and no management changes are needed. Paradox Lake is also noteworthy for its population of cisco, a large forage fish that undoubtedly contributes to the impressive growth rate of its lake trout. Of the waters surveyed, only Lake George and Lake Champlain have greater numbers of cisco.

Lake Champlain Lamprey Control

The Boquet, Salmon, Little Ausable and Ausable rivers and their deltas, the Saranac River delta, and the Great Chazy River were all treated to reduce the number of parasitic sea lamprey in Lake Champlain. A single treatment in Lewis Creek, Vermont was also completed. These treatments are part of an integrated management program to restore trout and salmon populations and their associated fisheries to Lake Champlain and its tributaries. While the U.S. Fish and Wildlife Service has now taken the lead, Region 5 fisheries staff and one staff member from Region 7 also assisted with these treatments. All the treatments appeared to be successful, with the exception of the Ausable River, where low flows in the South Fork of the Ausable prevented sufficient quantities of the control chemical from entering this stretch of river. A spring treatment of the South Fork, similar to the one conducted in 2007, will be conducted.

The trend for sea lamprey wounding rates on both landlocked Atlantic salmon and lake trout is positive, with decreases in wounding rates observed for both species. In fact, data from 2014 assessments show the lowest sea lamprey wounding rates since the long term sea lamprey control program began in 2002.

Another primary indicator of an improving fishery is the strength of annual spawning runs – which produced several record or near-record numbers in 2014. Additionally, anglers are reporting excellent catches of lake trout and landlocked salmon in both the lake and its tributaries.



Nellie and Bessie Ponds Brook Trout Surveys

These waters, located in the St. Regis Canoe Area, were reclaimed in 1990 and were stocked with Horn Lake Strain brook trout for two years following the reclamation. Natural spawning was deemed adequate in these waters after those initial stockings. Recent angler reports, however, indicated that the trout population may be in decline in both ponds, and these surveys were undertaken to answer that question. The surveys show that self-sustaining brook trout are still present in these ponds, although the brook trout populations in both have been reduced through the introduction of competing fish species including in Nellie Pond, newly documented white sucker and common shiner. In adjacent Bessie Pond, the brook trout also have competition from brown bullhead, golden shiner, and northern redbelly dace, as well as four newly documented species including white sucker, common shiner, creek chub, and fathead minnow.

Hybrid Brook Trout Performance

Often in the past we have stocked fall fingerling Temiscamie x Domestic strain brook trout in our brook trout ponds. In 2014 a switch to Windfall x Domestic fall fingerling hybrids was made in some ponds. In order to gage the performance of these new hybrids, a series of surveys in several ponds were completed. These ponds had a variety of fish populations that might influence the performance of the new strain. For instance, Ochre Pond contains brown bullhead, white sucker, and golden shiner as well as brook trout. Nineteen Temiscamie hybrids were collected during the survey, most in the 9-12 inch size range.

A similar survey in Meadow Pond evaluated the current Temiscamie hybrids, this time in a brook trout monoculture. The current brook trout population appears to be in fine shape, with good numbers of trout collected from several year classes with lengths up to 14”.

Finally in Bear Pond, the fish population was comprised of brook trout and pumpkinseed (sunfish). The Temiscamie hybrid brook trout population here looks to be in good shape with several year classes represented, with some in excess of 2 pounds.

The Windfall hybrids in these three ponds, along with those of Bone and St. Germain ponds which were surveyed in 2012 and 2013, respectively, will be evaluated in a few years to see how they perform in relation to the Temiscamie hybrid performance observed during these surveys. The results will provide an understanding of how this new strain of brook trout responds in a variety of fish community complexes.

Lake Pleasant Fisheries Survey

Region 5 Fisheries staff conducted a night-time electro-fishing survey of Lake Pleasant in June. The survey was conducted during the fourth year of a five-year experimental walleye fry stocking program to assess the success of the program. Unfortunately, no walleye were collected during the survey. This may have been partially due to the water temperatures, which had warmed just out of the optimal range for collecting walleye. The success of the walleye stocking will be evaluated again in the future with gill nets. The survey did reveal that smallmouth bass are quite abundant, with 78 individuals collected in a wide range of sizes including a fair number in excess of 16”.

Hudson Gorge Wilderness Area Survey Work

A concentrated survey effort was initiated to inventory the waters in and adjacent to the Hudson Gorge Wilderness Area. There have been recent state land acquisitions in this region, so up-to-date information on the fish populations in the area’s waters was needed for fisheries and unit management planning purposes. Waters surveyed included Dunk Pond, Huntley Pond, Pine Mountain Pond, Blue Ledge Pond, Carter Pond, Upper Carter Pond, Cheney Pond and Ross Pond. Of these waters, Dunk Pond, Huntley Pond and Ross Pond were found to have fair - good populations of Temiscamie x Domestic Hybrid brook trout. Cheney Pond was identified as a potential future reclamation candidate. The other waters were determined not to be suitbalbe for brook trout management.

Restoration of Fish Barriers

Region 5 Fisheries staff annually inspects fish barriers that have been constructed to prevent the upstream migration of unwanted, non-native fish species into Adirondack brook trout ponds. These barrier dams are often an integral part of protecting brook trout populations from competing fish species. Our annual inspection revealed two barrier dams in need of repair. At the Lost Pond barrier dam in the Moose River Plains, tree roots from a stump on the far side of the barrier had caused a wash-out, and almost all water was bypassing the barrier. Staff removed the top of the stump but found the base was still very much intact! Sand bags, bentonite (a clay product) and plastic sheeting were used to fill the hole under the stump and to create a new watertight seal. The barrier is once again serving its intended purpose.

At the West Pine Pond barrier dam the deck holding the screening was severely compromised following a high water event at ice out and had to be completely replaced. Every member of the fisheries staff participated in the repair of this important fish barrier, which protects a self-sustaining brook trout population from several non-native species including yellow perch and northern pike.

PUBLIC SERVICE AND CONSTITUENT SUPPORT

Boarding Dock Installed at Saratoga County Boat Launch

The Saratoga Boat Launch on Great Sacandaga Lake in the Town of Day has a dock! The floating dock was installed May 22 and is a welcomed addition. Due to the often windy conditions and lack of dock, launching and retrieving boats via the existing concrete ramp was often very difficult. The new floating dock, supported by steel piles, is 168’ long and is designed to accommodate the large water level fluctuations that occur on the lake.

2014-15 Region 5 Fisheries Staff	
Bill Schoch	Biologist 2 (Aquatic) - Retired
Lance Durfey	Biologist 2 (Aquatic)
Rich Preall	Biologist 1 (Aquatic) - Retired
Jim Pinheiro	Biologist 1 (Ecology)
Rob Fiorentino	Biologist 1 (Aquatic)
Thomas Shanahan	Biologist 1 (Aquatic)
Jonathan Fieroh	Biologist 1 (Aquatic)
Jennie Sausville	Fish and Wildlife Technician 3 - Retired
Dustin Dominesy	Seasonal Fish and Wildlife Technician
Jessie Maxfield	Seasonal Fish and Wildlife Technician
Brett D’Arco	Seasonal Fish and Wildlife Technician
Adam Kosnick	Seasonal Fish and Wildlife Technician

REGION 6
BUREAU OF FISHERIES

NEW YORK STATE OF OPPORTUNITY. | Department of Environmental Conservation

SPECIES CONSERVATION & MANAGEMENT

Lake Sturgeon Restoration

Lake sturgeon *Acipenser fulvescens* is a Threatened species in New York State. Sturgeon restoration efforts began in 1991. A tagging study started in 2010 to acquire biological data and provide the basis for movement studies throughout Lake Ontario and the St. Lawrence River. A total of 245 sturgeon were collected in 2014 from the eastern basin of Lake Ontario, mouth of the Oswegatchie River, and the St. Lawrence River downstream to just below the Robert Moses Power Project. Most of the fish (205) were new captures and were tagged with Passive Integrated Transponders (PIT tags). Lake sturgeon eggs (112,000) were taken in early June at the Robert Moses Power Project, Massena NY with 4 egg bearing females providing eggs. A cooperative effort between NYS DEC and the Genoa National Fish Hatchery (USFWS, Wisconsin) was successful in rearing approximately 25,555 fish. Hatchery capacity at both facilities was exceeded so stocking was split into two increments; 14,000 summer fingerlings and 11,555 fall fingerlings. Approximately 17,300 fish were stocked in the St. Lawrence, Raquette River, St. Regis River, Oswegatchie River, Black Lake, Cayuga Lake, Genesee River and Salmon River (Franklin County). The remainder (≈8,250) were stocked into bays of the eastern basin of Lake Ontario. All fingerlings received Coded Wire Tags (CWT) or OxyTetraCycline (OTC) prior to stocking for year class survival assessments in the future.

Black River Bay Lake Sturgeon Assessment

A spring pre-spawn sampling of lake sturgeon in Black River Bay (Lake Ontario) during the last 2 weeks of April, 2014. This survey is a continuation of annual research started in 2005 to assess lake sturgeon entering the Black River to spawn.

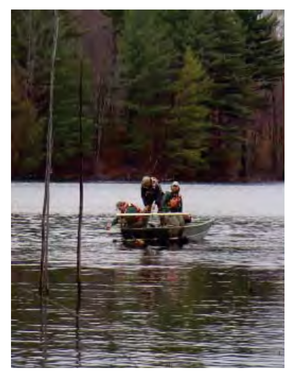
Staff captured 25 sturgeon consisting of 16 new fish and 9 recaptures from previous years. Fish were examined and scanned for an existing Floy® and PIT (Passive Integrated Transponder) tags. All untagged sturgeon received PIT tags after biological data was recorded. Fish were released immediately upon completion of processing.

One recapture was a fish originally tagged in 2005 in Oneida Lake by Cornell University. This fish left Oneida Lake via the NYS canal system, exited through the Oswego River, and navigated Lake Ontario to the mouth of the Black River. Tagging studies such as this are valuable in determining dispersal and growth rates. At the time of capture this fish was 19 years old weighed approximately 43 pounds.

Eastern Lake Ontario/St. Lawrence River Warmwater Fish Stock Assessment

Over one-third of fishing effort in Region 6 occurs on eastern Lake Ontario or the St. Lawrence River. Warm/coolwater fish stock assessments are conducted by Region 6 on the St. Lawrence River and by both regional and Lake Ontario units on eastern Lake Ontario. The assessments track condition of fish stocks in these waters. In the St. Lawrence River Thousand Islands area abundance of legal size smallmouth bass increased from record lows in 1996-2004 and has varied at moderate levels since 2006. This increase has been due to faster growth and earlier recruitment of young fish (largely due to availability of round goby forage) rather than improved recruitment or increases in the total number of individuals in the population. Northern pike abundance in the Thousand Islands remains depressed largely due to habitat changes resulting from water level regulation. For Lake St. Lawrence walleye numbers have declined from a peak in 2010 but remain above the long term average. Abundance of legal size smallmouth bass in eastern Lake Ontario has increased substantially from record lows in 2000-2004 although it remains low relative to the levels of the 1970s, 1980s and early 1990s. No strong year classes have been detected in recent years. Small increases in harvestable size bass since 2005 have been attributed to increased growth and vulnerability of young fish to capture. Continuing cormorant management and a switch to round goby prey have reduced cormorant feeding and consumption of sport and panfish.

Brook Trout Management



Heritage strains of brook trout are genetically distinguishable from each other and other strains of brook trout and this makes them important to New York's biodiversity. Their unique adaptations also make them valuable tools in fisheries management. For a number of years, Region 6 has conducted annual heritage strain egg takes in order to further the propagation and distribution of these unique strains of brook trout. In fall 2014, egg takes for the Little Tupper strain were conducted on Boottree Pond. Wild male Little Tupper brook trout were collected from South Twin Lake and their milt was used to fertilize some of the eggs collected from Boottree Pond. This was an attempt to bring wild selected genes into the gene pool. Fertilized eggs were transferred to the NYSDEC hatchery system where they will be raised and stocked in the fall as fingerlings. This is the seventh year that an egg take has been conducted on Boottree Pond.

Oswegatchie River Cooperative Walleye Project

Walleye brood stock were collected on the Oswegatchie River (Ogdensburg) on April 29, 2014, as part of an annual cooperative project with the St. Lawrence Valley Sportsman and Massena Fish and Game Club. Due to severe winter conditions which provided an extended snow melt and high cold river conditions, this year's collection was the latest to date for this project.

Mature fish were captured by Region 6 personnel by boat electroshocking. Walleye were in various stages of spawning at the time of capture with both ripe and hard females collected. The run appeared typical with numerous white suckers in proximity as they spawn concurrently with walleye. Approximately 2.2 million eggs were harvested and fertilized for rearing by the sportsman clubs. Progeny will be screened for diseases prior to release into the St. Lawrence River.

HABITAT CONSERVATION

Mitigating the Impacts of Acid Precipitation

Good water quality is vital to a thriving fish population. Many fish, including brook trout *Salvelinus fontinalis* cannot tolerate acidic conditions. In an effort to counterbalance the effects of acidification NYSDEC conducts a pond liming program which includes monitoring water quality in vulnerable waters. During the 2014 field season, Region 6 monitored water quality in 29 Adirondack lakes and ponds. Bear Pond which lies in the Five Ponds Wilderness Area was limed with 80 tons of lime. Lime is typically spread on the pond's frozen surface and mixes into the water once the ice melts in the spring. Two strains of brook trout which include the Horn Lake strain and the Temiscamie-Hybrid strain, have been stocked into Lyon Lake and Hawk Pond which are located in the Five Ponds Wilderness Area. The two strains were stocked together in the same water to create a "head to head" competition. Future surveys will be conducted in an attempt to determine which strain may be better suited for survival in Adirondack waters.

Erosion Mitigation on Sandy Creek (Jefferson Co.)

Staff assisted Jefferson Co Soil and Water in evaluation of erosion mitigation efforts on Sandy Creek. Like many streams Sandy Creek changes course regularly with the stream bed moving back and forth in the valley impacting property owners. Areas of intense erosion were treated with varying stabilization methods; root wad fortification, rock jetty and J hooks, and willow plantings. Four sites were evaluated with backpack electroshocking to assess the fish community in each site.

Three of four sites were stabilized in 2013, only one of which remained intact after high water in the fall of 2013. Two of these sites need extensive repair. The fourth site was completed in 2014. The fish community was found to be dominated by minnow species (cyprinids) at all sites. Diversity was highest at the two upstream sites (total species = 13) and noticeably lower at the downstream sites (total species = 7). Blacknose dace, bluntnose minnow, common shiner, cutlips minnow and fantail darter were the species most often encountered during sampling. Brown trout were collected at the upper sites where appropriate habitat was created.

Fish Passage

Region 6 Fisheries personnel have been involved with reviewing fish passage designs for Emeryville, Natural Dam, and Eel Weir on the Oswegatchie River. We have encouraged the use of 'nature-like' fishways, such as the rock ramp, which are often less expensive, and more effective at passing a range of fish species, than conventional fishways. We continue to work on re-licensing efforts for the Upper and Lower Beaver Falls Hydropower Plants. The Village of Gouverneur Hydroelectric facility began the licensing process in December of 2014 and will continue for the next couple of years.

PUBLIC SERVICE & CONSTITUENT SUPPORT

New/Upgraded Access Facilities

During 2014-15 three new access sites were constructed using the principals of Universal Access Design. The Wegatchie Fishing Access Site is a Universal Access, hand carry canoe/kayak/car-top boat launch on the Oswegatchie River in St. Lawrence County. Also built in St. Lawrence County is a new Universal Access, hand carry canoe/kayak/car-top boat launch on Fish Creek in the Fish Creek Wildlife Management Area. In Lewis County on the East Fork of the Salmon River, a new Universally Accessible Fishing Deck was constructed along with a new Universally Accessible Parking Area, an Access Aisle and an associated Access Lane to the fishing deck.

Outreach and Education

Regional outreach efforts contacted anglers and families at an outdoor expo, fishing clinics and Earth Day events. We also reached elementary school students at conservation field days and environmental awareness days, and high school students at Envirothon competitions. Together thousands of anglers, students and families throughout the region were exposed to information about fish, fishing and aquatic systems.

Jefferson County Environmental Awareness Days

Over two days, three members of the regional Fisheries staff, one from the Bureau of Habitat, and a staffer from Environmental Permits, participated in Jefferson County Environmental Awareness Days at the Fort Drum Natural Resources Area. The event was coordinated by Cornell Cooperative Extension. Hundreds of sixth graders from area schools were presented with information regarding Jefferson County waters and fish communities. Despite cold weather and warnings that the fish were cold, slimy and attracting bees, hands-on activities with iced fish generated great interest and enthusiasm.

2014-15 Region 6 Fisheries Staff

Frank Flack	Biologist 2 (Ecology)
Russ McCullough	Biologist 1 (Aquatic)
Rodger Klindt	Biologist 1 (Aquatic)
Dick McDonald	Biologist 1 (Aquatic)
Dave Erway	Biologist 1 (Aquatic)
Dave Gordon	Fish & Wildlife Technician 2
Seth Love	Seasonal Fish & Wildlife Technician
Amy Hoyt	Seaonal Fish & Wildlife Technician
	Rare Fish Unit
Doug Carlson	Biologist 1 (Aquatic) ETS Unit
Jeff Maharan	Seasonal Fish & Wildlife Technician

REGION 7

BUREAU OF FISHERIES

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

SPECIES CONSERVATION & MANAGEMENT

2014 Cormorant Management at Oneida Lake

For the fifth consecutive year DEC Fish and Wildlife staff from both Regions 6 and 7 conducted a cormorant management program on Oneida Lake. The main goal of this program is to reduce the number of cormorants on the lake in order to limit their impact on the lake's sportfish populations. Effort was increased in 2014 to address a recent trend of increasing numbers in the spring and summer months and to limit cormorant nesting activity. Department staff began hazing and egg oiling in mid-May and continued hazing and culling activities through fall. Of note, this was the first year of DEC hazing in which volunteers were not utilized. Counts and/or hazing took place from May 19th through October 29th on a total of 29 days. From May through the end of July cormorant numbers on the lake averaged in the low 100's (low of 74, high of 170). August saw an incremental increase in cormorant numbers up to a high count of 445 on August 19, which was also the highest count of the season. To reinforce our hazing efforts we also culled some birds as part of a diet study. A total of 232 cormorants were culled of which 183 were submitted to Cornell for diet analysis. Diets consisted of a mix of species with both young yellow perch and walleye comprising a significant portion of the diets. Given the diet composition, it is safe to say that Department hazing efforts saved large numbers of Oneida Lake sportfish from cormorant predation in 2014.

Spring 2014 Cayuga Inlet Fishway Operations

Fishway operations continued in spring 2014 and for the season 549 rainbow trout were handled and 5,300 adult sea lamprey were killed. The lamprey wounding rate on rainbow trout, within the target index size range (19.7–21.6 in.), was 0.33 wounds/trout - well above the management objective of < 0.23 wounds/trout. For comparison observed wounding rate on Rainbow trout in the spring of 2013 was 0.18 wounds/trout and nearly 6,000 adult lampreys were trapped at the Fishway. This spring's wounding rate was higher than anticipated. The 2007 year class of lamprey in Cayuga Inlet, which went untreated, proved to be substantially larger than our earlier ammocoete (juvenile lamprey) surveys suggested. The high wounding rates are an indication that they have had a significant impact on the trout and salmon fishery of Cayuga Lake. This information reinforced the need to conduct the lampricide treatment in Cayuga Inlet in August 2014 especially since our ammocoete surveys indicate that the density of 2011 year class of juvenile lamprey was nearly double that of the 2007 year class.

Cayuga Inlet Sea Lamprey Control

Historically, Cayuga Inlet produced the vast majority of sea lamprey in the Cayuga Lake system in years when adults successfully reached the high quality spawning and rearing habitat present upstream of the flood control dam in Ithaca. In most years they are unable to get above this dam but occasionally high lake levels and/or high flow conditions allow them to "escape" over the dam. These conditions were present during May/June 2007, 2011, and 2014 and resulted in significant production of sea lamprey larvae in Cayuga Inlet. The 2011 year class was determined to be exceptionally large and on August 19-20, 2014 the aquatic pesticide, TFM, was applied to 5.5 miles of the lower Cayuga Inlet to kill them before they could migrate down to Cayuga Lake. The treatment was successful at removing both the 2011 and 2014 year classes of larval Sea Lamprey. Lamprey control in Cayuga Inlet protects populations of trout and salmon in Cayuga Lake, and is an important part of DEC's ongoing efforts to provide high quality fishing opportunity in both the lake and its tributaries. If not eliminated, the 2011 year class would have migrated to the lake in 2015 to begin the predatory phase of their life cycle. Thousands of larval lamprey were killed during the treatment, while mortality of non-target aquatic organisms was minimal. A heavy rainstorm at the end of the treatment rapidly dispersed the chemical into lower Cayuga Inlet and out into Cayuga Lake. Here, exposure to sunlight over the next few days quickly broke the TFM down, allowing us to lift the water use restriction advisory after only five days. This project was only possible because of the cooperative effort by Fisheries staff and equipment from five DEC regions (Regions 4, 5, 6, 7, and 8) and Central Office.

A follow-up electrofishing survey of Cayuga Inlet found no surviving larvae in any of the areas which previously held high densities of larval sea lamprey. Sea lamprey wounding rates on lake trout had already decreased from 83% in 2012, to 40% in 2013 as the density of parasitic sea lamprey in Cayuga Lake, from the uncontrolled 2007 year-class, declined. As the remaining lamprey (from the 2007 year class) in the lake mature, spawn, and die, we expect that the number of fresh wounds on the lake's trout and salmon will decrease markedly over the next year and then remain low. This should result in a better fishing experience for anglers targeting these fish.

Fall Sampling for Cayuga Inlet Juvenile Rainbow Trout

In early September, staff conducted an abbreviated survey to assess the current status of the Cayuga Inlet wild rainbow trout population. Wild rainbow trout production from Cayuga Inlet makes up a substantial portion of the overall population of rainbow trout found in Cayuga Lake. Concerns about the level of wild trout production in the Inlet have lingered since a 1997 diesel spill impacted much of the stream. The trout population was last assessed in 2004 and seemed to have fully recovered relative to pre-spill wild trout densities. The intent of this survey was to determine the current level of wild trout production in Cayuga Inlet since several major floods over the past decade have caused extensive erosion and an apparent decline in quality trout habitat. We sampled seven of the eleven sites from 2004 and found an abundant, although somewhat reduced, population of juvenile Rainbow Trout. In 2014 the number of juvenile trout captured ranged from 31 to 800 trout per acre while in 2004 catches ranged between 31 and 1,344 per acre. The overall average for the 2014 survey was 372 trout per acre, compared to an average of 536 trout per acre in the 2004 survey. The differences observed between the two years may very well reflect typical year-to-year variations in production rather than an actual decline. Additional sampling in future years will help determine whether the stream is still actually capable of supporting the level of wild rainbow trout production observed in the past.

Whitney Point Reservoir Fall Walleye Sampling

Night electrofishing was conducted in early October along the Whitney Point Reservoir shoreline to monitor year class strength of walleye. A total of 726 walleye were captured in 3.5 miles of shoreline sampled. Of those captured, 613 (84% of the catch) were young-of-year (YOY) which ranged in size from 6 - 9.5 in. and 3 fish (<1% of the catch) were of legal size, the largest of which measured 22.2 in. The average length of YOY walleye was approximately 8 in. which is about average compared to past years. Searns' (1982) formula for estimating YOY walleye population sizes provides an estimate of 49,200 YOY present in the reservoir. This is one of the larger year classes sampled in the reservoir over the history of this sampling program which has been conducted in most years since 1994. Given both the abundance and size of the YOY walleye they should provide the adult population a significant boost in numbers in 3-4 years.

Lake Moraine Sampling

Lake Moraine is a 261 acre lake located in the Town of Madison, Madison County. Two fisheries surveys were conducted on the lake during the summer of 2014. The first was a two-night electrofishing survey in June, and second was a two-day gill and fyke netting survey in July. One of the prime objectives for the surveys was to determine if stocked tiger musky are surviving and recruiting to the fishery. Additionally, we sought to develop a picture of the overall fish community of the lake. In total, 1,093 fish were caught, representing 15 species. Pumpkinseed sunfish were the most numerous fish in the sample with 224 caught (20% of catch). The next most abundant species captured was bluegill (n = 171, 15% of catch), followed by yellow perch (n = 137, 13% of catch), golden shiner (n = 134, 12% of catch), chain pickerel (n = 132, 12% of catch), and largemouth bass (n = 110, 10% of catch). Thirty-two walleye were also caught (3% of catch). No tiger musky were captured or observed during the survey, indicating little or no recruitment in recent years. Sample results suggest that panfish populations are subject to high angler harvest but predator populations are fairly well balanced with good numbers of legal length black bass and chain pickerel present. Because of the poor tiger musky recruitment, boat stocking will be tried for several years to see if survival of stocked fish improves. Given the apparent success of the Lake Moraine Association's sporadic walleye stocking program, the Department is considering an experimental walleye policy at some point in the future.

Otisco Lake 2014 Fish Community Survey

Otisco Lake is a 2,236 acre eutrophic lake lying wholly within Onondaga County, near the City of Syracuse. It is the most easterly of the eleven Finger Lakes and is eighth in size. A Fish Community Survey was conducted on Otisco Lake during the summer and fall of 2014. Multiple sampling gears consisting of fyke nets, standard inland gillnets, bag seine, and boat electrofishing were used during the survey. The purpose of the survey was to develop an overall picture of the fish community and to monitor the stocking program for tiger musky and walleyes. Overall, 2,343 fish were caught, representing 23 species. Of note, yellow bullhead were collected for the first time in Otisco Lake. Bluegill were the most numerous species captured with 667 caught (29% of catch) followed by white perch (n= 335, 14% of catch), smallmouth bass (n=161, 8% of catch), and yellow perch (n=145, 6% of catch). Other gamefish captured included largemouth bass (n=92, 4% of catch), walleye (n=71, 3% of catch), tiger musky (n=12, 1% of catch), and brown trout (n=1, < 0.001% of catch). Walleye gill net and electrofishing catch per unit effort (CPUE) was 5.9/net night and 4.8/hour, no walleye were collected with the fyke net. These CPUE's would suggest that Otisco Lake has a moderate to abundant walleye population. Walleye showed good growth rates with walleye reaching the legal size of 18-inches between age-3 and age-4. The tiger musky ranged in length from 7.5 (recently stocked) to 35.3 inches, with a mean length of 22.1 inches. Tiger musky gill net and electrofishing CPUE was 0.4/net night and 3.2/hour; as with walleye, no tiger musky were collected with the fyke net. Data analysis is still ongoing and a final report should be available by early 2016

2014 Finger Lakes Angler Diary Cooperator Program

Angler catch data for the 2014 fishing season on the four eastern Finger Lakes were summarized and letters sent to participating cooperators in late-March 2015. Data from this program provides DEC with information on growth rates, stocked fish recruitment, and angler success rates which help guide our management efforts. A brief summary of each lake follows, but the full summaries are available on the DEC website at *www.dec.ny.gov/outdoor/27875.html*. At Otisco Lake, the legal game fish catch rate of 1.3 fish/trip is one of best observed in the history of the program and this was driven, in part, by the record number of legal walleye that were caught. Otisco cooperators also caught better than average numbers of legal largemouth bass and tiger musky. At Skaneateles Lake, the legal salmonid catch rate of 1.6 fish/trip is similar to that observed in recent years. Lake Trout comprised 85% of the legal salmonid lake catch while rainbow trout and landlocked Atlantic salmon comprised 12% and 4%, respectively. At Owasco Lake, the legal salmonid catch rate of 1.2 fish/trip was up slightly from the previous year. Lake trout continue to dominate the fishery comprising 95% of the legal salmonid lake catch but a few legal size rainbow and brown trout were also caught in the open lake fishery. At Cayuga Lake, the legal salmonid catch rate of 2.2 legal fish/trip was up somewhat compared to the past several years. Lake trout comprised 83% of the legal salmonid lake catch while rainbow trout, brown trout and landlocked Atlantic salmon comprised 3%, 7% and 3%, respectively.

PUBLIC SERVICE & CONSTITUENT SUPPORT

Salmon River Fish Hatchery School Tours

The Pacific salmon (Chinook and Coho) egg collection at the Salmon River Fish Hatchery, Altmar, NY, is a very popular event for school groups to see in mid-October. These school groups range from home schooled students all the way up to Aquaculture majors from area colleges. During October of 2014 around 600 students from 12 different school groups took part in educational tours at the hatchery. Students learned about the Lake Ontario fishery and ecosystem, were able to witness the egg collection process taking place in the spawn house, see natural spawning activity taking place in Beaver Dam Brook, learn how to tell the two species apart, and how salmon find their way back to their spawning streams, just to name a few things. Students were also able to get a close up look at some adult salmon that were used for display. For most of them it was the closest they had been to such large fish and many were eager to have their picture taken with one.

2014-15 Region 7 Fisheries Staff	
Dave Lemon	Biologist 2 (Aquatic)
Jeff Robins	Biologist 1 (Aquatic)
Scott Prindle	Biologist 1 (Aquatic)
Jim Everard	Biologist 1 (Aquatic)
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Ian Blackburn	Fish & Wildlife Technician 2
Heather Bull	Seasonal Fish & Wildlife Technician
Greg Cocquyt	Seasonal Fish & Wildlife Technician
Erika Stoddard	Seasonal Fish & Wildlife Technician
Althea Heider	Secretary

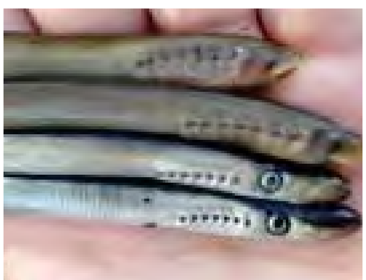
REGION 8
BUREAU OF FISHERIES

NEW YORK STATE OF OPPORTUNITY. Department of Environmental Conservation

SPECIES CONSERVATION & MANAGEMENT

Lamprey Control Shifts to Catharine Creek Canal

Because the Catharine Creek treatment was canceled due to high flows throughout the Spring treatment period, control efforts shifted to the Catharine Creek canal, immediately downstream of Catharine Creek. In late October Region 7 and 8 staff successfully treated approximately 34.5 acres of the canal with the lampricide Bayluscide. Sea lamprey larvae mortality ranged from 2,200 – 7,150. This estimate is similar to the 2008 canal treatment and exceeds estimates of sea lamprey mortality experienced in Catharine Creek TFM treatments in recent years. Additionally, transformers accounted for nearly 20% of the lamprey that were collected. Based on estimates from Great Lakes Fishery Commission studies that show one adult lamprey can account for the loss of up to 40 pounds of fish, 88,000-286,000 pounds of Seneca Lake fish were potentially spared loss to lamprey predation. These results lessen the impacts of not being able to treat Catharine Creek in the spring.



Cold Brook (Keuka Lake Inlet) Rainbow Trout Survey

Six sites in Cold Brook were electrofished on August 25-27 to look for age 0 and age 1 and older rainbow trout. Cold Brook is the main tributary to, and the main source of naturally produced rainbow trout in Keuka Lake. Only 19 young-of-year (YOY) rainbow trout were collected resulting in an average of 669 YOY rainbow trout/acre. This was the lowest density recorded of the 15 surveys conducted since production monitoring began in 1968. Conversely, 42 age 1 and older rainbow trout were collected resulting in an average of 1,645 age 1 and older trout/acre, the 2nd highest density recorded. Two significant rain events occurred in the area in mid-May around the time the rainbow trout fry would be vulnerable to extremely high flows. This may be one reason for the low number of YOY collected. Two sites on both Naples Creek, the main rainbow trout producing tributary for Canandaigua Lake, and Catharine Creek, the main rainbow trout producing tributary for Seneca Lake, which have a similar sampling history as Cold Brook and also experienced these rain events, were surveyed to determine if there were similar reductions in rainbow trout YOY density. Although the sample was small, site to site comparisons with previous years also showed extremely low YOY production in 2014 indicating that these storms may have negatively impacted rainbow trout reproduction.

Lake Trout Assessment – Canandaigua Lake

The lake trout population in Canandaigua Lake was assessed during early July using standardized Finger Lakes gill nets. This was the 7th standard lake trout survey conducted on Canandaigua Lake since 1978. Catch rates were lower than previous years with 141 lake trout caught in twenty-four nets. Some large lake trout in the 8 to 12 pound range were collected and the overall sample averaged 2.9 pounds. Mean relative weights of various size classes of lake trout ranged from 89 to 94. These values are typical for Canandaigua Lake lake trout and are an indication that fish condition is average.

Hatchery-reared lake trout receive a fin clip prior to being stocked into Canandaigua Lake to distinguish them from naturally produced fish. Spring yearlings and fall fingerlings currently receive different fin clips to assess the success of each stocking period. Approximately 83% of the sample consisted of stocked lake trout, indicating a small amount of successful natural reproduction of lake trout is occurring in Canandaigua Lake. Approximately 54% of stocked lake trout in the sample consisted of fish stocked as fall fingerlings compared to 46% stocked as spring yearlings. This indicates that the annual stocking of 12,100 yearlings and 24,100 fall fingerlings are both viable options at this time for Canandaigua Lake.

Wild Trout Surveys

Electrofishing surveys were completed on 236 streams in 2014. Over a four year period (2010 through 2012 and 2014), 702 streams were sampled and trout were collected in 179. The numbers of streams with each trout species combination collected are listed below. Wild trout were documented for the first time in 124 streams. These streams will be added to a list of streams that qualify for reclassification as wild trout streams.

Species	# Streams
Brook Trout Only	67
Brown Trout Only	55
Brook Trout and Brown Trout	30
Rainbow Trout Only	19
Rainbow Trout and Brown Trout	6
Rainbow Trout and Brook Trout	1
Rainbow Trout, Brook Trout, Brown Trout	1
Total	**179**

Assessment of Merganser Predation in Spring Creek

Regional staff had received numerous reports of poor fishing in Spring Creek in Livingston County during the spring of 2014. Spring Creek had traditionally provided an excellent fishery for wild brown trout. The winter of 2013-2014 was very cold and many large water bodies that normally don't freeze, froze over completely. Mergansers, fish-eating ducks, are a frequent winter visitor on the Great Lakes and the larger lakes of interior New York. When these large bodies freeze, mergansers move to open water to feed. The spring-fed sections of Spring Creek provided open water over the winter and were frequented by mergansers. This was the first time mergansers had been seen on Spring Creek at the Caledonia Fish Hatchery for at least 30 years. Region 8 fisheries staff surveyed the Veteran's section of Spring Creek on November 13, 2014. The results were compared to results of the last time the Veteran's section was surveyed in 2001 and Oatka Creek in 2003. While abundance was lower, it appeared that the numbers and percentages of the size and age groups were similar, although it did seem like the number and percentage of yearlings should have been higher. Given this data, Region 8 biologists concluded that absent further merganser predation, the trout population in Spring Creek should naturally recover fairly quickly.

Angler Diary Cooperator Programs

Western Finger Lakes


Warmwater
Fish Species
FISHING DIARY
for
Angler Cooperators

The Angler Diary programs were continued on Canandaigua (42 years), Seneca (42 years) and Keuka (47 years) Lakes in 2014. Total number of angler trips were 232 (all time low), 843 (all time low), and 783 for Canandaigua, Seneca, and Keuka Lakes, respectively. Catch of legal trout per hour ranged from 1.6 legal trout/hour in Keuka to 2.7 legal trout/hour in Canandaigua. Salmonine catch composition continues to remain at more desirable levels than in the early 2000's in Canandaigua and Seneca Lakes with lake trout accounting for about 71-78% of trout caught. However in Keuka Lake, 98% of salmonines caught were lake trout, indicating very little contribution to the fishery from brown trout, rainbow trout and Atlantic salmon. The lake trout population in Keuka Lake continues to be sustained entirely by naturally reproduced fish, whereas the other lakes have variable natural recruitment rates that require supplemental stockings to maintain the lake trout fishery. In all three lakes, brown trout populations, almost entirely dependent on stocking, appear to contribute little to overall catch. Canandaigua Lake continues to be the one western Finger Lake with a significant contribution of rainbow trout constituting 20% of all trout caught. Regulations were recently enacted to improve the overall trout fishing experience in the western Finger Lakes. The diary program remains an integral part in the evaluation of these new regulations.

Conesus Lake

Fishing effort by volunteer angler diary keepers in 2014-2015 was similar to 2013-2014. Overall it took diary-keeping anglers 3.94 hours to catch one legal game fish. For anglers targeting bass, the catch rate was 0.42 legal bass/hour. Largemouth bass accounted for 44% of the total game species caught. Eighty-seven percent of the largemouth bass catch was composed of legal-sized fish. Of the legal largemouth bass caught, all but 10 were released. Although most of the bass were less than 14 inches, anglers did catch 17 memorable fish greater than 18 inches. Smallmouth bass comprised 10% of the total game fish catch, 95% were legal size, and all but one were released. Ten smallmouths caught were larger than 18 inches. Northern pike made up 38% of the total game fish catch. Ninety-five percent were legal size, with fish averaging 28.2 inches in total length. Thirteen tiger muskies were caught, one was a memorable fish of 38.5 inches. Five walleyes were caught by cooperating angler diary keepers. Eleven panfish were caught at a rate of 0.38 panfish per hour including 9 yellow perch that were caught by one diary keeper while ice fishing.

Honeoye Lake

The 2014-15 fishing season (April 1, 2014 through March 31, 2015) was the 26th consecutive year for the Honeoye Lake Volunteer Angler Diary Program. Twenty-one diary cooperators recorded information from 662 fishing trips during the 2014-15 season.

Overall it took diary cooperators 0.74 hours to catch one legal game fish. This catch rate was primarily driven by excellent largemouth bass fishing. Anglers targeting largemouth bass averaged 2.1 bass per hour. Eighty-four percent of the largemouth bass caught were legal size (12 inches or larger), including seven over 20 inches.

This year 42 walleye were caught with 33 harvested. This is down compared to last year. Anglers who were specifically targeting walleye had a catch rate of 0.40 walleye/hour. Although the total walleye catch is down, the catch rate for anglers specifically targeting walleye is much higher than last year and above the target for New York State waters (0.25 walleye/hour). Most of the walleye reported were 18 inches or larger. Although it is nice to see some large walleye caught in Honeoye Lake, there is concern that only 24% of the walleye were in the 15 to 18 inch range and none of the catch consisted of sub-legal walleye (< 15 inches). The walleye size limit was increased to 18 inches in Honeoye Lake starting April 1, 2015. This diary program will be one of our tools used to evaluate this change.

Black crappie, bluegills, chain pickerel, pumpkinseeds, smallmouth bass, and yellow perch all provided good fishing during the 2014-15 season. Honeoye Lake continues to produce very large bluegills and pumpkinseeds.

Conesus Lake Fish Community Assessed

From September 23-25, fisheries staff conducted a fish community assessment of Conesus Lake using standard gangs of gill nets. Surveys are done at 5 year intervals and are the primary means of assessing the success of the fingerling walleye stocking program and yellow perch population parameters, and also as another recapture sample for the walleye population estimate. Eleven species were caught, including 183 walleyes (26.1/net), 11 northern pike, and 20 smallmouth bass. Seven jaw tagged walleyes were caught. The walleye CPUE is very high, suggesting that the population estimate of 5100 adult walleyes calculated during the spring is underepresenting the actual walleye population. Data analysis is ongoing, and a report is expected in late 2015.

PUBLIC SERVICE & CONSTITUENT SUPPORT

Fishing Pole Lending program

Six libraries were actively involved in the Region 8 Library Fishing Pole Program in 2014. Regardless of the number of users, all the Librarians report that the program generates many positive comments.

- Dansville Public Library – Poles were checked out 53 times, similar to the 49 from 2013.
- Wood Library (Canandaigua) – Poles were checked out 45 times, down slightly from the 62 in 2013.
- Pulteney & Honeoye Public Libraries – No report.
- Woodward Memorial Library (LeRoy) – Poles were checked out 17 times, similar to 23 from 2013.
- Modeste Bedient Memorial Library (Branchport) - Doubled

2014-15 Region 8 Fisheries Staff

Web Pearsall	Biologist 2 (Aquatic)
Matt Sanderson	Biologist 1 (Aquatic)
Brad Hammers	Biologist 1 (Aquatic)
Peter Austerman	Biologist 1 (Aquatic)
Amy Mahar	Biologist 1 (Ecology)
Robert Deres	Fish and Wildlife Technician 2
Dan Mulhall	Fish and Wildlife Technician 1
Eric Olsowsky	Seasonal Fish & Wildlife Technician
Ashleigh Read	Seasonal Fish & Wildlife Technician
Ariel Gallo	Seasonal Fish & Wildlife Technician

REGION 9

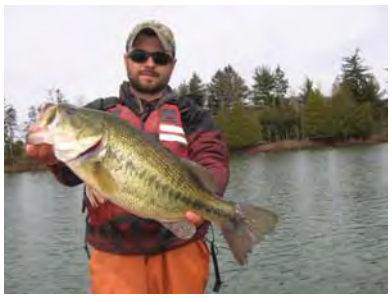
BUREAU OF FISHERIES

NEW YORK STATE OF OPPORTUNITY. Department of Environmental Conservation

SPECIES CONSERVATION & MANAGEMENT

Chautauqua Lake Fisheries Management

Black Bass Survey



A boat electrofishing survey of the black bass population was completed during the spring of 2014. Sampling effort was divided into 23 separate electrofishing runs. Thirteen runs were completed in the north basin and 10 runs were completed in the south basin. A total of 2,508 fish, representing 17 species, were collected during 9.5 hours of electrofishing. Pumpkinseed sunfish and yellow perch were the most abundant species collected and largemouth bass were the most abundant game fish collected. The catch rates of largemouth bass and smallmouth bass were 29.5 fish/hr and 5.7 fish/hr respectively. The catch rate of largemouth bass in 2014 was slightly higher than the catch rate in 2012 and was higher than the statewide average. The catch rate of smallmouth bass was similar to the catch rate in 2012 and was also above the statewide average. The proportional stock density was within the desired range for both largemouth bass and smallmouth bass and both species reached legal size of 12 inches by age five. The bass population continues to remain stable and Chautauqua Lake is one of the best bass fishing lakes in New York.

Fall Walleye Survey

A total of 342 walleye were collected during 7.5 hours of electrofishing for a catch rate 45.7 fish/hr. The catch rate of adult walleye was 10 fish/hr and the catch rate of young-of-year walleye was 35.7 fish/hr. The catch rate of adult walleye indicates a moderate population density and the catch rate of young-of-year walleye is one of the highest catch rates on record for Chautauqua Lake. The average length of adult walleye was 530 mm and the average length of young-of-year walleye was 200 mm. Most walleye reached legal size of 18 inches during their sixth growing season.

Muskellunge Egg Take

The Region 9 fisheries unit and Chautauqua Fish Hatchery staff conducted a trap net survey on Chautauqua Lake to collect muskellunge eggs for the New York State hatchery system and to assess the status of the muskellunge population in the Chautauqua Lake. Six Oneida style trap nets were set for two weeks beginning April 28th, 2014. A total of 353 adult muskellunge were collected during 84 trap net nights for a catch rate of 4.2 fish/net. The total length of all muskellunge collected ranged from 26.4 in to 52.2 in with a mean of 37.3 in. The catch rate in 2014 was the second highest catch rate on record since the early 1970's. In addition to large numbers of fish, there was also an abundance of large sized muskellunge in Chautauqua Lake during 2014. This year marks the second year in a row that fish over 50 inches have been collected during the egg take. In 2014, three muskellunge greater than 50 inches were collected and 25% of all muskellunge were greater than 40 inches.

Clear Creek and Lime Lake Outlet Trout Assessment

Region 9 fisheries staff and angler volunteers sampled the Clear Creek (Arcade) and Lime Lake Outlet wild brown and rainbow trout fisheries in northeastern Cattaraugus County. In 2014 the same sites that had been sampled several times since the early 1990s, with the latest being in 2007, were electrofished. In Clear Creek, the overall abundance of adult wild brown trout and total biomass has varied substantially over time, with the lowest values being found in 2014. While no clear trend is evident from 1995-2000, both adult brown trout abundance and biomass have been declining since 2002. The number of brown trout >9 inches appeared very stable from 1995-2000, with some increase in 2002 and 2007 and a dramatic decrease in 2014. Similarly on Lime Lake Outlet, brown trout abundance and biomass peaked in 1998 and has been declining, with the lowest values found in 2014. In both streams, the percent of the adult brown trout catch consisting of yearlings has remained fairly stable. This indicates reproduction/recruitment of brown trout may be relatively stable and observed variation of the adult brown trout population may be due to other factors such as available adult trout habitat, water quality and/or other mortality factors such as predation. Several wild brown trout 15-18 inches long were captured in this year's surveys.

The wild rainbow trout populations in Clear Creek and Lime Lake Outlet from the early 1990s through 2007 showed an overall increasing trend in abundance of adult trout and biomass. Adult rainbow trout abundance and biomass peaked in 2007, but declined >50% in 2014. The abundance of rainbow trout >9 inches in 2014 was also at historical lows. As with brown trout, it appears that the substantial decline in adult rainbow trout from 2007 to 2014 involved several year classes.

Adult trout habitat on Clear Creek at all sites has varied substantially over the sampling years, while two of the four sites on Lime Lake Outlet varied substantially. It is not clear if habitat changes at survey sites were representative of the streams as a whole. Floods approaching or exceeding 100 year levels impacted both watersheds in 1996 and 1998 and the streams seem to still be adjusting from their impacts.

For reasons associated with spawning site locations and susceptibility to floods, total catch of young-of-year brown trout in 2014 differed greatly between the two streams. Young-of-year brown trout catch in 2014 for Clear Creek was the second lowest in the sampling period. Numbers collected declined every year from a high in 1997 to a low in 2007. The numbers of young-of-year rainbow trout collected in 2014 was the lowest recorded in the sampling period. Numbers of young-of-year rainbow trout collected has varied greatly with the highest number collected in 2007. In Lime Lake Outlet in 2014, we collected the most young-of-year brown trout in the entire sampling period, with the next highest collections coming in 1992 and 2007. Based on the low numbers of young-of-year rainbow trout collected most years in Lime Lake Outlet, it is likely that most reproduction leading to recruitment occurs in tributaries.

In spite of substantial population declines in 2014, the total of 890 adult wild trout/mile and 53 pounds/acre indicates Clear Creek and Lime Lake Outlet (669 adult wild trout/mile, 68 pounds/acre) still support good populations of wild trout capable of producing an outstanding fishery. With the populations of both resident trout species showing large declines, it is likely that factors such as available adult trout habitat, water quality or other mortality factors including predation are the causative agents at work. It is also possible that increased winter/spring flood events have been negatively affecting reproduction in Clear Creek

Genesee River Angler Diary Program

The Genesee River diary program covers the entire river in Region 9 from the Pennsylvania state line downstream to Letchworth State Park. The river is managed as a stocked trout fishery from the PA line downstream to Belmont. The river also has a substantial population of smallmouth bass throughout its length. Diary programs have also been used on the river in 1988, 1989 and 2010.

A total of 19 diarists report a large number of trips made (237) and hours fished (749) in 2014. The majority of diarist trips were made by anglers targeting trout (84%) and occurred in the months of April, May and June (61% of total trips). A total of 450 yearling brown trout (91% released), 179 two-year-old or older brown trout (80% released), 120 rainbow trout (90% released), 13 brook trout (92% released) and 222 smallmouth bass (all released) were reportedly caught by diarists.

The combined average catch rate for brown trout and rainbow trout in 2014 of 1.17 fish/hour was well above the management objective of 0.5 fish/hour. Although only 39 trips targeted bass, the average catch rate for smallmouth bass in the diary program was very high at 2.01 fish/hour. The diarist's average catch rate for brown and rainbow trout combined in 2014 (1.17 fish/hour) was very similar to the 2010 (1.33 fish/hour) and 1988 (1.38 fish/hour) diary programs, but lower than the rate found in the 1989 program (2.40 fish/hour).

Stream Habitat Enhancement Monitoring

Region 9 fisheries staff, and angler volunteers conducted trout population sampling on the North Branch Wiscoy Creek. Habitat enhancement work was completed on a 2,100 foot section of the stream in July 2011. This work involved installation of over 450 feet of LUNKER structures which act as artificial undercut bank habitat for trout. Two years of trout population assessment was completed prior to the habitat project. In 2014, the third year of post-habitat enhancement fish population sampling was completed. In addition to sampling the enhanced section, two additional sites on the N. Branch and on Trout Brook were sampled as "control sites".

Compared to pre-habitat enhancement surveys (2010 and 2011), the abundance of brown trout larger than 12 inches more than doubled by 2014 in the enhanced section, while it fell substantially in the two control sites. Biomass of adult brown trout also increased significantly, more than doubling from 2010 to 134 pounds/acre in 2013, but had fallen back to 70 pounds/acre in 2014. Numbers of young-of-year brown trout captured fluctuated substantially between 2010 and 2014 at all sites.

PUBLIC SERVICE & CONSTITUENT SUPPORT

Angler Education

Region 9 fishing education efforts included coordination and involvement in 4 free youth and family fishing clinics, reaching 466 youth anglers and their families. Two exceptionally strong free fishing day events at Ellicott Creek County Park and Chestnut Ridge County Park were provided in cooperation with the Erie County Federation of Sportsmen's Clubs.

Summer Camp Programs

Fisheries staff provided 7 fishing education programs for youth campers at DEC Rushford Environmental Camp, covering fishing education and instruction for a total of 375 campers. In an effort to offer fishing education to more youth summer camps than DEC staff can actually visit, the Train-the-Trainer program was provided for 4 water-based summer camps. The goal is to teach fishing education to the camp counselors who will in turn provide the training to their many campers throughout the summer. A total of 15 camp counselors received fishing education training from DEC staff. Fishing equipment and fishing education lesson plans were also provided to the camps.

Fishing Hotlines

Management of the Lake Erie Fishing Hotline and Western New York Fishing Hotline continued in 2014. The hotlines are updated every Friday to provide western New York anglers with current info on productive fishing locations, baits, tips and techniques. Each hotline is available on the DEC website at *www.dec.ny.gov/outdoor/fishhotlines*.html or can be heard at (716) 855-FISH. During the report period, anglers visited the Lake Erie hotline page 95,498 times, Western New York hotline page 80,224 times and the automated phone lines 22,388 times. In all, these popular angler resources were visited an average of 543 times per day.

2014-15 Region 9 Fisheries Staff	
Mike Clancy	Biologist 2 (Aquatic)
Scott Cornett	Biologist 1 (Aquatic)
Mike Todd	Biologist 1 (Aquatic)
Mike Wilkinson	Biologist 1 (Aquatic) retired 4/14
Chris Legard	Biologist 1 (Aquatic)
Jim Zanett	Fish &Wildlife Technician 3
Justin Brewer	Fish &Wildlife Technician 1
Amanda Wagner	Fish &Wildlife Technician 1
Tobias Widger	Fish &Wildlife Technician 1
Kyle Keys	Fish &Wildlife Technician 1

INLAND FISHERIES SECTION

BUREAU OF FISHERIES

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Fishery Surveys Entered Into Statewide Database

Data from a total of 745 fishery field surveys were received by the Biological Survey Unit during 2014-15. A total of 559 surveys were finalized and added into the Bureau of Fisheries Statewide Database (SWDB). One hundred and eighty five of the surveys that were finalized were a result of the Bureau's continued effort in support of the Eastern Brook Trout Joint Venture (EBTJV). Updated copies of the SWDB containing newly entered data ("Releases") were provided and distributed at three separate times during the year; in July 2014, October 2014, and in January of 2015. The SWDB contains survey data for biological surveys conducted at Inland waters since 1988. In addition to the surveys that have been entered into the SWDB, 510 historical surveys (i.e. referred to as the Greeley surveys) have been entered into a separate database and will be distributed regionally in 2015.

The Bureau continued to investigate and pursue electronic data collection and recording in the field. In 2014, further field testing of an MS access form proposed to replace the paper "Individual Fish" form was completed using the Panasonic Toughbook tablets. Performance was extremely satisfactory with respect to speed of data entry. On the basis of cost, it was decided that the next tablets purchased would not be field-hardened models. The biggest remaining obstacle to fully electronic fish data collection is development of an alternative data verification procedure that would allow proofed fish records to be appended to the master database without compromising its structural integrity.

The SWDB proved most useful for two important studies being conducted for the Bureau of Fisheries by the Fish and Wildlife Coop Unit at Cornell. Geographically referenced records of brook, brown and rainbow trout queried from the SWFDB were the primary dataset used to construct the catchment level brook trout assessment. Secondly, data contained in the SWDB was compiled and summarized as part of a statewide black bass study, including to evaluate important population metrics such as relative abundance, growth, condition, and size structure for inland lakes. Both of these efforts are described in further detail, in the Coldwater Fisheries Unit and Warmwater Fisheries Unit Sections of this report.

Amendments to Sportfish Regulations

During 2014-15 amendments were made to the sportfishing regulations. This rule making included a broad array of changes to the sportfishing regulations such as adjustments to season dates and creel limits for specific species, both statewide as well as for specific waters; as well as changes pertaining to fishing gear and the collection and use of baitfish. In addition, many of the changes were the result of the Bureau's effort to consolidate regulations where possible and eliminate special regulations that are no longer warranted or have become outdated.

A Notice of Public Rule Making (NPR) was published in the State Register on October 15, 2014 announcing the proposed changes, as well as initiating a public comment period that ran through December 1, 2014. Subsequently, the changes to the sportfish regulations were finalized with the filing of a final rulemaking (NOA) with the Department of State on February 23, 2015. The regulation changes became effective on April 1, 2015 and are included in the 2015-16 Fishing Guide. Some of the specific changes included modifying the Statewide and Great Lakes regulations for muskellunge; initiating a catch and release season for trout for sections of the Salmon River (Franklin County) and Ninemile Creek (Onondaga County); establishing a special trout regulation of "a daily creel limit of five fish with no more than two fish longer than 12 inches," for many waters in Herkimer, Jefferson, Lewis, Oneida, and St. Lawrence counties; and establishing year-round trout seasons, with catch and release fishing only from October 16 through March 31, for several streams in Western New York.

Warmwater Fisheries Management

Ecology and Management of the Fish Communities in Oneida and Canadarago Lakes

Researchers at the Cornell Biological Field Station at Oneida Lake completed their annual assessment of the fish communities in Oneida and Canadarago Lakes. Funded by a Federal Aid in Sportfish Restoration grant, these monitoring projects are the longest running warmwater fishery assessments in New York State and continue to provide valuable insight on the complex dynamics associated with warmwater fish populations in large northern lakes.

Oneida Lake

Long term fish community changes in Oneida Lake are measured by assessing standard gill net catches. There were 1,293 fish caught in the standard gill nets in 2014, the lowest observed since 2003. Walleye represented 32% of the catch, exceeding both yellow perch (26% of the catch) and white perch (25%) for the first time in the entire data series. These three species represent over 80% of the catch in most years.

The estimated adult (age 4 and older) walleye population abundance was 442,000 in 2014, which was an increase from the 2013 estimate of 360,000. The increase in the adult population is the result of a relatively large 2010 year class recruiting into the fishery. The 2010 year class is the largest year class at age 4 since 1987, and constitutes 36% of the entire adult population. Over the full course of the 57 year data series the adult walleye population has experienced a significant decrease, but has shown a significant increase since 2000.

The adult (age 3 and older) yellow perch population was estimated to be 596,000 fish, a 64% reduction from 2013. This decline may be in part due to the inherent variability of gill net catches, but relatively small year classes from 2009-2011 and perhaps a higher than normal level of harvest due to an extended ice fishing season in 2013-14 may also account for it. Additional years of sampling, and an expansion of sampling locations in nearshore areas of the lake, will be required to assess the true magnitude of the decline and the overall status of the population. Long term trends show a significant population decline, but no trend is detectable over the last decade, suggesting a more or less stable, but much smaller population than was present in the lake in the 1960s – 1980s.

Increased water clarity due to filter feeding by zebra and quagga mussels has caused an expansion in the shoreline littoral habitat that favors species such as black bass, sunfish, and pickerel. Nearshore fyke net and boat electrofishing surveys were recently added to the monitoring program to account for the anticipated changes in the littoral fish community. In 2014, 30 species were caught in the fyke nets, many of which were littoral species that are not typically caught with the traditional gears used in the long term studies. The fyke net survey has provided an index of young-of-year black bass production and also shows potential as an index for sunfish and chain pickerel. It also will provide valuable data on production of nesting bass and sunfish to assess potential impacts of round gobies, which were first confirmed in the lake in 2013 and distributed throughout the lake in 2014.

Spring boat electrofishing survey sportfish catches were dominated by largemouth bass (12/hour), chain pickerel (7/hour), walleye (5/hour), and smallmouth bass (4/hour). Yellow perch, brown bullhead, pumpkinseed and rock bass made up the majority of the panfish and non-sportfish catch. Spring electrofishing provides a good complement to fyke nets for assessing the nearshore fish community and provides the only index for adult largemouth bass and best index for chain pickerel. Timing of the initiation of electrofishing surveys was fortuitous, as there are now three years of surveys in advance of establishment of round goby to facilitate assessment of any community responses to this new invader.

In 2014, an access site creel survey was conducted during June and July, which provides an accurate estimate of complete open water season walleye catch and harvest rates. Estimated effort in 2014 was 217,548 boat hours, which continued a trend of increasing effort since 2002. About 50% of anglers sought walleye specifically, while 35% sought only bass. The estimated walleye catch rates for June and July were 0.16/hour and 0.33/hour, respectively (a catch rate exceeding 0.25/hour is characteristic of an excellent fishery). The overall harvest rate was 0.22/hour. The estimated total harvest was 60,192 walleye, which was slightly more than the estimated total harvest of 58,947 in 2013 and 59,500 in 2012. Smallmouth bass catch rates in June and July were 0.49/hour and 0.25/hour, respectively. There were very few smallmouth bass harvested (0.01/hour).

Canadarago Lake

Walleye fry continue to be low in abundance, a trend which began in 2005. The low abundance of fry is attributable to an increasing population of alewife, which are known predators of fish fry and often have dramatic impacts on walleye reproduction. This has resulted in a decline in the number of juvenile walleye captured during recent surveys and is likely to impact adult walleye population abundance in the future. In 2014, all walleye captured in a boat electrofishing survey and most collected in a gill net survey were age 7 or older, a clear indication of recruitment problems.

In response to the almost complete lack of successful walleye reproduction and an adult population at risk of decline, a walleye stocking program was initiated in 2011. Approximately 40,000 advanced walleye fingerlings were stocked from 2011-2013. In 2014, Canadarago Lake was stocked with 40,000 50 day walleye fingerlings, and will be similarly stocked again in 2015. The goal of the stocking program is to boost walleye recruitment by offsetting some of the losses of young walleye to alewife predation. Annual assessments of the fish community will allow up to date tracking of stocking success.

Statewide Black Bass Population Assessment

A 3-year study assessing the current status of black bass (largemouth bass and smallmouth bass) populations in New York was completed in September. The last comprehensive black bass population study in New York was conducted about 30 years ago and since that time black bass fisheries and many associated aquatic habitats have undergone significant changes. Catch and release and tournament angling have become much more prevalent, a winter and spring catch and release fishing season was implemented, and ecologically impactful invasive species such as zebra mussels and round gobies have been introduced into many waters. Thus, a new foundation of black bass population information was needed in order to assess responses to these changes.

The study was conducted by the New York Cooperative Fish and Wildlife Research Unit at Cornell University and funded through a Federal Aid in Sportfish Restoration Grant. Largemouth and smallmouth bass population data were compiled and summarized from 4 long-term fisheries databases (Lake Erie, Eastern Basin Lake Ontario, Oneida Lake and the Statewide Fisheries databases). Important population metrics such as relative abundance, growth, condition, and size structure were summarized for inland lakes, including Oneida Lake, and Lake Erie and the eastern basin of Lake Ontario. The influence of environmental parameters, spatial patterns, and population trends through time were part of the assessment. Results indicated that both largemouth and smallmouth bass populations are generally doing well throughout the state and some metrics have improved over the time series of the databases, providing some evidence that bass populations are adjusting to changing conditions in a positive way.

Stocking Evaluation of 50 Day Old Walleye Fingerlings

An experimental walleye stocking program, initiated in 2009 in nine lakes in central and western regions of the state, was continued using approximately 50 day old tank raised fingerlings from Oneida Hatchery. These nine lakes (Upper, Middle, and Lower Cassadaga Lakes, Redhouse Lake, Payne Lake, Otisco Lake, Loon Lake, Black Lake and Red Lake) were stocked for 5 consecutive years with about 250,000 1.5 inch long fingerlings and assessed every fall for young of year survival. Stocking ended for these lakes in 2013 and full walleye population assessments were conducted on the Cassadaga Lakes, Redhouse Lake, Red Lake, Payne Lake, and Otisco Lake in 2014 to assess the success of the program. No walleye were collected from the Cassadaga Lakes, and few walleye were collected from Redhouse, Red, and Payne Lakes, indicating that the stocking experiment in these waters was unsuccessful in establishing walleye fisheries. Walleye were commonly captured from Otisco Lake, indicating that the program can be successful in certain waters. Black Lake and Loon Lake will be evaluated in 2015. Other lakes, including Chautauqua Lake, Otter Lake, Rio Reservoir, Sacandaga Lake, Kiwassa Lake, St. Regis Falls Impoundment, Canadarago Lake, and Lake Pleasant have subsequently been added to the stocking program and will be evaluated after being stocked for 5 years.

Sauger Management

Sauger were historically common in the Great Lakes, Lake Champlain, and St. Lawrence River watersheds of New York, but are now one of the state's most imperiled fish species, perhaps now occurring only as a remnant population in Lake Champlain. An objective of NYSDEC's recently adopted Sauger Conservation Management Plan is to establish a sauger population in the Allegheny River watershed above the Kinzua Dam, which blocks the downstream population in Pennsylvania from accessing the reservoir and upper river in New York. To achieve this objective, a 5-year stocking plan was established in 2014.

Approximately 33,000 sauger fry from Ohio River brood stock were donated by the West Virginia DNR in early spring 2014 and reared in a pond at the NYSDEC Chautauqua Hatchery. In June, 5,700 2-inch long sauger fingerlings were stocked in the upper Allegheny Reservoir. In September, the NYSDEC Region 9 Fisheries Unit surveyed the reservoir near the stocking location using a combination of boat electrofishing and trawling to determine survival and growth of the stocked sauger. Fifty young of the year sauger were captured (5 from trawls, 45 from boat electrofishing). The average length of sauger caught via boat electrofishing was 6.4 inches and the catch rate was 18/hour. These are strong indications that survival and growth of the stocked sauger were good. To protect sauger during the restoration process, fishing for sauger was prohibited statewide.

Coldwater Fisheries Management

CROTS Review & Fate of Stocked Trout Study

In March 2014, the Fish and Wildlife Cooperative Research Unit at Cornell University completed its evaluation of the catch rate oriented trout stocking (CROTS) method. The report, based on fieldwork completed between 2011 and 2013, concluded that the method was fundamentally sound but that several important parameters had changed markedly (increased rate of non-angling mortality, decreased angling effort and decreased harvest rate) since CROTS was first used to calculate stocking rates for New York trout streams in 1990.

Since then, the findings of the report have been carefully reviewed, studied and discussed within the Bureau of Fisheries. Ongoing dialogue with Cornell has resulted in several further revisions to the report for the purpose of clarity and to correct some problems identified by bureau staff. A meeting was held in Ithaca in January 2015 to discuss questions arising from the study. Some additional analyses have since been conducted by Cornell at the request of bureau staff.

At this stage, no changes in stocking strategy have been made and several ideas for further research are under consideration. The bureau is taking a slow and methodical approach in considering the findings of the CROTS study and assessing whether adjustments in stocking strategy could provide for a more reliable return of stocked trout to anglers.

New York State Brook Trout Assessment Completed

In 2015, the Bureau of Fisheries completed an assessment of the current distribution of wild brook trout in New York State as part of its participation in the Eastern Brook Trout Joint Venture (EBTJV); a partnership of conservation organizations and state and federal natural resource management agencies dedicated to halting the decline of wild brook trout and restoring fishable populations of the species within its native range. The other state agency partners have completed similar assessments and the data has been combined to produce a range-wide assessment at the catchment level (a small watershed unit that results in a very high resolution map). This new assessment replaces an assessment, completed in 2006 at a much coarser scale, which lacked sufficient detail to fully support the conservation strategies of the partnership.

New York's assessment was informed primarily by over six thousand biological surveys completed since 2007 with the specific objective of documenting the status of brook trout in watersheds where prior information was non-existent, outdated or inadequate. A computer model used these data to predict the presence or absence of brook trout in adjacent catchments that were not surveyed and construct a comprehensive statewide map. This map was then subjected to two rounds of review and revision by Bureau of Fisheries biologists. The first round of review resulted in the production of a revised map enhanced by the inclusion of survey data from two additional sources: the New York State Fish Atlas and the Adirondack Lake Survey Corporation. In the second round of review, biologists carefully examined the revised map looking for catchments where model predictions were at odds with their professional judgment or knowledge. For example, biologists made revisions to catchment classifications based on their knowledge of waterfalls or other barriers to fish passage that were not known to the computer model. Thus, the final product incorporates extensive survey data, model predictions and professional judgment at a fine geographic scale.

In addition to providing for an enhanced understanding of the range-wide status of wild brook trout, the new assessment will allow for more effective prioritization of conservation efforts. Within NYSDEC, the assessment is already being used to integrate brook trout conservation benefits into the prioritization of riparian revegetation projects.

Coldwater Habitat Management and Monitoring in the New York City Watershed

The upper reaches and tributaries of the Delaware River support one of most productive trout fisheries east of the Mississippi River. The fishery depends upon releases of cold water from three water supply reservoirs operated by New York City under a Flexible Flow Management Plan (FFMP) that is negotiated between New York City and the states of New York, New Jersey, Pennsylvania and Delaware. The FFMP is, in turn, based on the outcome of legal proceedings among the above parties which culminated in 1954 in a United States Supreme Court decree. In this management context, NYSDEC's habitat protection objectives are contained in recommendations set forth on January 12, 2010 in concurrence with the Pennsylvania Fish and Boat Commission. Both the FFMP and the joint fisheries recommendations can be found on the website of the Delaware Rivermaster: *http://water.usgs.gov/osw/odrm/index.html*

In order to assure the availability of flow and temperature data essential to coldwater fisheries management in the tailwaters of New York City's Delaware and Catskill reservoirs, a total of $53,730 was committed in 2014 to support the operation of U.S. Geological Survey stream gages at the following locations:

- Diversion from Schoharie Reservoir
- Esopus Creek at Coldbrook
- East Branch Delaware River at Harvard
- West Branch Delaware River at Hale Eddy
- West Branch Delaware River at Hancock
- Delaware River at Lordville
- Delaware River at Callicoon
- Neversink River at Bridgeville

These instruments, which transmit flow and temperature measurements in real time, would not otherwise be operated. The data they collect are available to the public at the following website: *http://waterdata.usgs.gov/ny/nwis/current/?type=sw&group_key=basin_cd*

Beyond supporting the operation of the USGS gages, Bureau of Fisheries staff from Regions 3 and 4 deploy an array of temperature recording sensors at strategic locations downstream of the three Delaware reservoirs on an annual basis to provide additional information to evaluate the performance of the FFMP with respect to the habitat protection objectives described above. A report summarizing the data collected from this monitoring effort for the period 2011-2014 was completed in 2015.

Management of Rare & Endangered Fishes

Lake Sturgeon Recovery Activities

Restoration efforts for Threatened Lake Sturgeon *Acipenser fulvescens* that began in 1991 continued in 2014.

Lake sturgeon eggs (112,000) were taken in early June at the Robert Moses Power Project, Massena NY from four egg bearing females. A cooperative effort between NYS DEC and the Genoa National Fish Hatchery (USFWS, Wisconsin) was successful in rearing approximately 25,555 fish. Approximately 17,300 fish were stocked in the St. Lawrence, Raquette River, St. Regis River, Oswegatchie River, Black Lake, Cayuga Lake, Genesee River and Salmon River (Franklin County). The remainder (≈8,250) were stocked into bays of eastern basin of Lake Ontario. All fingerlings received Coded Wire Tags or OxyTetraCycline marks prior to stocking for year class survival assessments in the future.

A tagging study was started in 2010 to acquire biological data and provide the basis for movement studies throughout Lake Ontario and the St. Lawrence River. A total of 245 sturgeon were collected in 2014 from the eastern basin of Lake Ontario, mouth of the Oswegatchie River, and the St. Lawrence River downstream to just below the Robert Moses Power Project. Most of the fish (205) were new captures and were tagged with Passive Integrated Transponders (PIT tags).

A more intensive annual stocking survival assessment is conducted monthly from May to October by USGS staff. Regional staff assisted with the October 23, 2014 sampling. Overall cumulative survival of lake sturgeon stocked into the Genesee River exceeds 30%.

In contrast to lake sturgeon populations throughout the Lake Ontario, Finger Lakes and St. Lawrence area that were stocked as part of recovery, the New York portion of Lake Erie appears to be experiencing natural recovery. The spawning population of lake sturgeon in Buffalo Harbor was surveyed from 2012 – 2014 by the Region 9 fisheries unit and the Lake Erie fisheries research unit. Sampling occurred for two weeks during late May and early June each year. Sturgeon were collected using a combination of daytime gill nets and overnight set lines. A total of 109 lake sturgeon were caught during three years of sampling. All fish were tagged with an external tag, an internal PIT tag and had a section of pectoral fin spine removed for age determination. We found 22 age classes with fish ranging from 8 years old to 84 years old. However, most fish were less than 20 years of age.

Region 8 Staff Assist with Stocking Lake Herring into Irondequoit Bay

Re-establishing self-sustaining populations of native whitefishes in Lake Ontario is the focus of cooperative efforts between the Department, the United States Geological Survey (USGS), the Ontario Ministry of Natural Resources (OMNR), the U.S. Fish and Wildlife Service (USFWS), and the Great Lakes Fishery Commission (GLFC), with supporting research conducted by The Nature Conservancy (TNC). Lake herring were once an important prey fish in Lake Ontario, and supported important commercial fisheries that collapsed in the early 1950s largely due to over-harvest. In New York waters of Lake Ontario, lake herring historically spawned in Irondequoit Bay, Sodus Bay, the Sandy Ponds, and Chaumont Bay.

In September and November 2014, Regional staff assisted USGS with stocking lake herring in Irondequoit Bay. The juvenile lake herring that were stocked originated from eggs collected by Department staff in Chaumont Bay during November and December, 2013. Lake herring eggs were hatched and juveniles reared at the USGS Tunison Laboratory of Aquatic Science in Cortland, New York. Irondequoit Bay is adjacent to the Rochester Area of Concern (AOC), and is the focus of national efforts to restore habitats and human uses impacted by historic chemical contamination.

Round Whitefish Restoration

Egg takes were attempted at Upper and Lower Cascade lakes once again in late 2014. The nets yielded few round whitefish and a small number of eggs were sent to Oneida Hatchery for rearing in late November. In spring of 2015, we had good eye-up and hatching success with these few eggs and ended up with 650 one and a half inch fish to stock into Fishbrook Pond in Washington County. This new location for round whitefish was reclaimed in 1995 and has become a brood stock water for Horn Lake strain brook trout. This remote pond is an ideal location for round whitefish, and they are compatible neighbors with our native brookies. A second round of stocking in Fishbrook is planned for Spring of 2016, assuming a successful egg take in the fall of 2015.

Native Mussel Distribution in the Upper Susquehanna Watershed

Region 8 Fish and Wildlife staff completed the first year of a five-year project to determine distribution, density, and status of native freshwater pearly mussel species in six major subbasins of the Susquehanna, Lake Erie, and Allegheny Watersheds. Mussels stabilize streambeds, diversify stream habitat, provide nutrients to other benthic invertebrates, filter suspended solids and pollutants from water, and are considered indicators of ecosystem health. In spite of the ecological importance of freshwater pearly mussels, they are among the most imperiled groups of animals in North America.

In 2014, 45 sites were surveyed along 18 streams in the Chemung subbasin of the Susquehanna Watershed. Evidence of mussels (live animals or empty shells) was found in nine of the surveyed streams, with Species of Greatest Conservation Need (SGCN) confirmed in five streams. Mussels were documented for the first time in eight of the streams.

Twelve mussel species are represented in these surveys, including four SGCN. Streams with greatest species richness include Fivemile Creek, Cohocton River, and Mud Creek. Mussel community composition varied by stream. Green floater, a NYS threatened species, was found at several sites along the Chemung River and in one of its upstream tributaries. Species occurrences will be used to create distribution maps which will help guide future mussel conservation efforts.

Allegheny River Native Fish

Intensive surveys of the Allegheny River with electrified trawl nets in 2014 revealed a more robust population of bluebreast darter than previously thought to exist there. This colorful darter is listed as Endangered in New York and is only native to the Allegheny. During three days of sampling in the summer, 66 bluebreast darters were collected. A similar survey effort in 2013 collected 56 bluebreast darters. Historic surveys had only encountered a handful of these darters on 20 occasions dating back to the 1930s.

By contrast, the 2014 trawls only collected one gilt darter. Gilt Darters were re-introduced to the Allegheny in 2012 and 2013 through a combination of captive reared fish and trapped and transferred fish from Pennsylvania. The captured fish bore an elastomer tag that indicated it was a captive reared fish stocked in 2013. Previous surveys in 2013 recaptured a total of 3 gilt darters in the river. Future surveys are planned to monitor for natural reproduction by the stocked gilt darters.

Region 6 Rare Fish Management Update

Life history studies about time of spawning, sizes, ages and genetics of summer sucker were summarized in an overview of characteristics and locations in ponds of the Adirondacks. The eastern variant of the late spawning sucker was caught in Fish Pond (previously known from 1972) and in Thirty-Six Outlet (first time), both of the northeast Adirondacks region. This extended our knowledge of the number of waters inhabited by late-spawning suckers to 11 in the western Adirondacks (summer sucker) and to 6 waters in the east (unnamed eastern variant).

Planning for a pugnose shiner recovery program in bays of Lake Ontario began in 2014 and includes establishing a population, like that in Sodus Bay into Chaumont Bay. There is also a study to get underway about relationships of pugnose shiner to habitats of submerged aquatic vegetation in the St. Lawrence River. This will be part of a graduate program at SUNY Brockport, funded by FEMRF. The NYS Fish atlas is nearing completion as a series of maps, for the entire group of 180 fish that was installed on the DEC webpage in 2013. The entire atlas project, including extensive descriptions of their distribution as annotations, was submitted for peer review to be published in the NYS Museum Record in 2015.

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LAKE ONTARIO RESEARCH UNIT
BUREAU OF FISHERIES

NEW YORK STATE OF OPPORTUNITY. Department of Environmental Conservation

The Bureau of Fisheries' Lake Ontario Unit (LOU), based in Cape Vincent, is primarily responsible for delivering a lake-wide fisheries assessment and research program. The mainstay of the program is the Department's 60 ton Research Vessel Seth Green, which was hauled-out in 2014 for maintenance and installation of two new transducers. Lake Ontario's sportfisheries have been valued at over $112 million annually, and successful management requires that fisheries assessments and research be executed collaboratively. Delivery of this comprehensive program requires active partnerships with a number of institutions, including DEC Regions 6, 7, 8 and 9, the U.S. Geological Survey (USGS), the Ontario Ministry of Natural Resources and Forestry (OMNR), the U.S. Fish and Wildlife Service (USFWS), the Great Lakes Fishery Commission (GLFC), Canada Fisheries and Oceans (DFO), Cornell University, and the SUNY College of Environmental Science and Forestry. The complete annual report can be accessed at *www.dec.ny.gov/outdoor/27068.html*.

SPECIES CONSERVATION & MANAGEMENT

Sportfishery Monitoring

Each year from April through September, the LOU conducts the Lake Ontario fishing boat survey at 30 access channels from the Niagara River in the west to the Association Island cut in the east. The survey tracks a multitude of trends in the open lake sportfishery, including angler effort, catch and catch rates, harvest and harvest rates, performance of stocked fish, and fish growth/condition. Lake Ontario fishing quality is best characterized by the number of trout and salmon caught per fishing boat trip (catch rate). In 2014, the catch rate for all trout and salmon combined was the third highest observed since this survey began in 1985. In fact, 9 of the 10 highest combined catch rates were recorded between 2003 and 2014 (Figure 1). These exceptional catch rates are largely due to record or near record-high catch rates in recent years for Chinook salmon, coho salmon, rainbow trout (steelhead), and brown trout. Open lake angler effort (917,662 angler hours) for trout and salmon has been relatively stable for over ten years (Figure 2).

Preyfish Monitoring and Predator Growth/Condition

With over 5 million trout and salmon stocked annually into Lake Ontario by New York State and the Province of Ontario, it is important to monitor the abundance of bait or preyfish that trout and salmon predators feed on, as well as growth rates and condition of predators (also see Sportfishery Research). Partnering with USGS and OMNR, the LOU monitors relative abundance of alewife, rainbow smelt, sculpins, and round gobies. Alewife populations are of particular concern, as they are the primary food for Chinook salmon, the top predator in the lake. Despite strong year classes produced in 2009-2012, the severe winter of 2013-2014 impacted the alewife population leading to poorer condition and some spring die-offs around the lake. Still, the adult alewife abundance index in 2014 was very similar to the previous three years and near the previous ten year average (Figure 3). Catches of age-1 alewife in 2014 were very low indicating relatively poor reproductive success in 2013. Chinook salmon growth and condition were below average during summer 2014, likely reflecting poorer alewife condition, and cooler summer 2014 water temperatures.

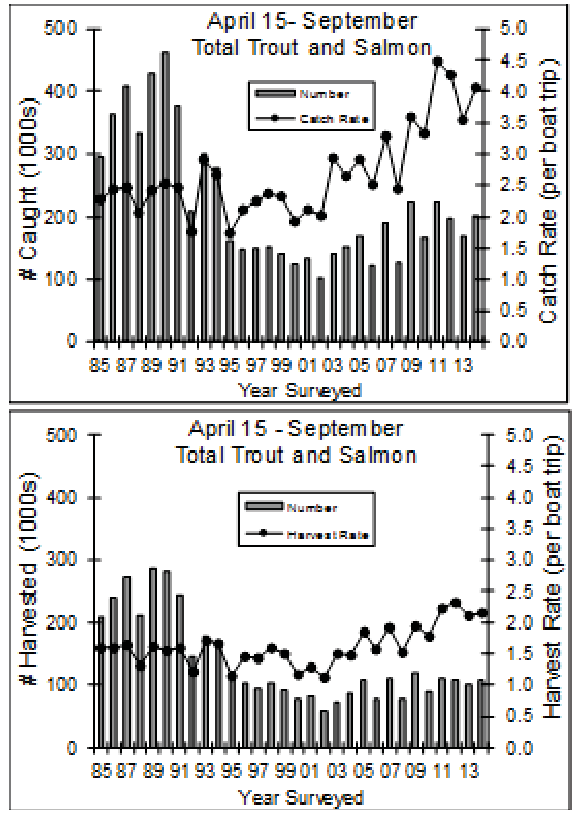

Figure 1. Total trout and salmon catch (bars) and catch rate (line/diamonds; top graph) and harvest (bars) and harvest rate (lines/diamonds; bottom graph) for boats seeking trout and salmon, 1985-2014.

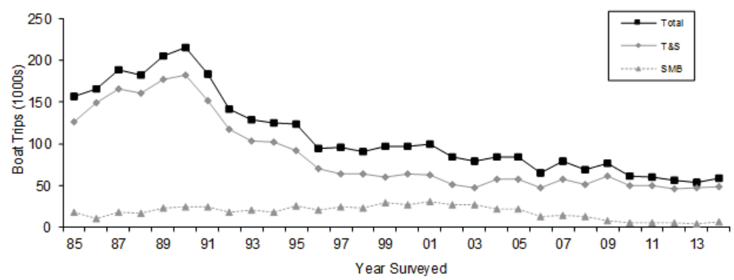

Figure 2. Seasonal estimates of total fishing boat trips, trips targeting trout and salmon (T&S), and trips targeting smallmouth bass (SMB) during the traditional open season (3rd Saturday in June-September 30 when the survey ended).

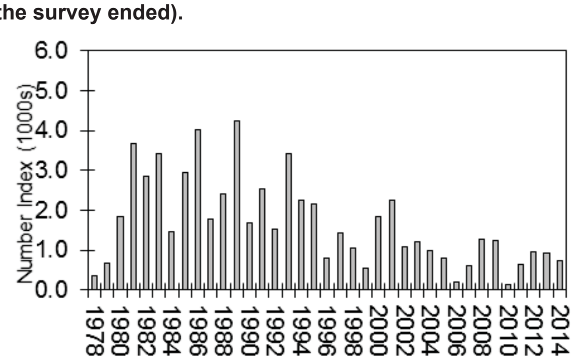

Figure 3. Abundance indices for adult (age-2 and older) alewife in the U.S. waters of Lake Ontario during late April-Early May, 1978-2014. (1 kg = 2.205 lbs)

Sportfishery Research

Using Lake Ontario Natural Resources Damages funds, the Bureau of Fisheries purchased a $1.3 million automated fish marking trailer ("AutoFish") in 2008. The AutoFish system is capable of removing a fish's adipose fin and/or inserting a coded wire tag into the snout of the fish automatically at a high rate of speed and accuracy. Fin clipping and tagging give researchers tools to answer a variety of questions regarding the relative performance of stocked and wild fish. From 2008-2011, the Department and the OMNR "mass-marked" all Chinook salmon stocked into Lake Ontario with an adipose fin clip to determine the relative contributions of naturally reproduced ("wild") and hatchery stocked Chinook salmon to open lake and tributary fisheries. Knowing the relative roles of hatchery and wild salmon in the lake is very important for fisheries managers to better understand how stocking decisions can influence Chinook salmon population dynamics and predator/prey balance in Lake Ontario. High numbers of wild Chinook salmon in addition to stocked fish are thought to have contributed to an imbalance between predators and alewife in Lake Huron, greatly reducing growth and condition of Chinook salmon and negatively impacting sportfisheries. The relative contribution (%) of wild Chinook salmon in the open Lake Ontario sport fishery averaged approximately 47% from 2010-2014. These results indicate that although wild fish are an important component of the Lake Ontario Chinook sport fishery, stocking remains essential for sustaining the sport fishery and managing the lake ecosystem.

DEC's Salmon River Hatchery aims to stock Chinook salmon at sizes which promote good survival and imprinting to stocking sites. Tagging of Chinook salmon by LOU has also provided valuable information to managers regarding the effectiveness of hatchery stocking methods. Returns of tagged Chinook salmon to the Salmon River hatchery suggest a high degree of homing by fish stocked at the Salmon River and a low degree of straying from other stocking sites to the hatchery. Preliminary results of another LOU stocking strategy evaluation indicate that stocking and holding salmon in pens for a period of a few weeks prior to release provides better relative survival than stocking salmon directly into the lake.

Native Species Restoration

An international program to restore a naturally reproducing population of lake trout in Lake Ontario is ongoing. To measure progress, cooperative DEC/USGS bottom trawl (juveniles; July) and gill net (adults; Sept.) surveys are conducted annually at 14 sites from the Niagara Bar to Charity Shoal in the Eastern Basin. Adult lake trout abundance increased each year from 2008-2014, following historic lows observed during 2005-2007. In 2014, 47 age-1 and 70 age-2 naturally produced lake trout were collected in trawl surveys, the largest catch of naturally produced lake trout in nearly 40 years of surveys.

Three species of deepwater coregonids (members of the whitefish family) are considered extirpated from Lake Ontario, and the LOU has been collaborating with the OMNR, USFWS, and the GLFC to reintroduce bloater into the lake. In 2014, bloater eggs were collected from Lake Michigan and reared at OMNR's White Lake Fish Culture Station and the USGS Tunison Laboratory of Aquatic Sciences in Cortland. For a third consecutive year, bloaters were stocked into Lake Ontario via this international partnership. Stocking numbers have increased each year, highlighting great advances made in bloater culture techniques at these facilities. Stocking of bloaters is expected to continue annually, with a goal of restoring a self-sustaining population within 25 years.

Sea Lamprey Control

In an ongoing battle to combat the damaging impacts of sea lamprey on Lake Ontario sport fisheries, the GLFC and their sea lamprey control agents, the Department of Fisheries and Oceans Canada and the USFWS, conducted comprehensive control and assessment activities in Lake Ontario tributaries in 2014. In the adult phase, a single parasitic sea lamprey is capable of killing as much as 40 pounds of fish. Treatments to kill larval lamprey using lampricides were completed in ten tributaries (four in Canada, six in NY). Treatments in New York included Lindsey Creek, tributaries to the Salmon River (Trout, Orwell, and Beaverdam Brooks), Little Salmon River, Ninemile Creek, Sandy Creek, and Oak Orchard Creek (Marsh Creek). Larval assessments were conducted on 49 tributaries (27 in Canada, 22 in NY). In 2012, the first purpose built sea lamprey barrier in New York's Great Lakes waters was completed on Orwell Brook, a tributary to the Salmon River. The low-head dam is designed to block migrating sea lampreys from reaching their spawning grounds, and features removable stop logs and an integrated sea lamprey trap. Orwell Brook was treated for the second time since construction of the barrier and post-treatment evaluation surveys yielded no evidence of sea lampreys.

In addition, the USGS Tunison Laboratory of Aquatic Sciences, in partnership with DEC, is rearing and stocking another coregonid, lake herring. In 2014, 145,000 lake herring were stocked into Irondequoit Bay on Lake Ontario

Warmwater Fisheries Assessment

Each year the LOU conducts index gill netting to assess the status of warmwater fish populations in Lake Ontario's Eastern Basin. In 2014, smallmouth bass abundance declined to the lowest level observed since 2004 and among the lowest in 39 years of netting. Walleye abundance was similar to that observed in recent years and, with the presence of moderate to strong year classes, is expected to remain relatively stable for the next few years. In 2014, yellow perch catch declined to the lowest level in the time series. Perch catches are more variable than other fishes because of their schooling nature; however, a lower population level is likely given angler reports of reduced yellow perch fishing quality in 2014. At least one lake sturgeon has been collected in 14 of the last 20 years (none in 2014), suggesting an increase in sturgeon abundance.

St. Lawrence River Research

Muskellunge Research

Muskellunge are the focus of a popular and economically important fishery in the Thousand Islands region of the St. Lawrence River, where the NYS record 69 pound 15 ounce muskellunge was caught in 1958. In the late 1970s, muskellunge guides raised concerns that the quality of the muskellunge sport fishery had declined dramatically. In response, the Department conducted preliminary research leading to an increase in the muskellunge minimum size limit from 32 inches to 36 inches. Using Federal Aid in Sport Fish Restoration program funding, the Department contracted with the SUNY College of Environmental Science and Forestry (ESF) beginning in 1987 to conduct St. Lawrence River muskellunge studies. In the ensuing years, studies have identified over 80 muskie spawning and nursery areas that have been afforded additional levels of protection from habitat alteration. Research documenting first spawning of females at approximately 36 inches in length (6 years old) led to increases in the minimum size limit first to 44 inches, and then to 48 inches. A muskellunge release program was instituted that rewards anglers who release a legal-size muskie with a limited edition muskie print created by a renowned local artist. By the mid-1990s, these management actions contributed to a substantial increase in muskellunge angler catch rates, which achieved the management plan catch rate target in 1999.

Large-scale mortalities of pre-spawn female muskellunge caused by the newly introduced Viral Hemorrhagic Septicemia virus (VHSv) were documented in 2005 and 2006 (picture 2. dead muskies on tarp). Spring trapnet surveys at index sites sampled each year indicated declining spawning adult abundance since 2008, with marginally improved catches in 2013 and 2014. (Figure 1). Catches of young-of-the-year (YOY) muskellunge in index seine hauls also declined since 2004, but improved slightly in 2013 and 2014 (Figure 2). An angler diary program, which indexes the relative quality of muskie fishing through angler catches, also indicates that angling success remains well below the target of 1 fish caught per 10 hours of fishing. A number of potential causes may be contributing to the apparent muskellunge decline, including habitat changes (vegetative and fish communities on nursery grounds), VHSv mortality, and the presence of round goby in spawning/nursery habitats. Investigations into the cause(s) for these declines are ongoing.

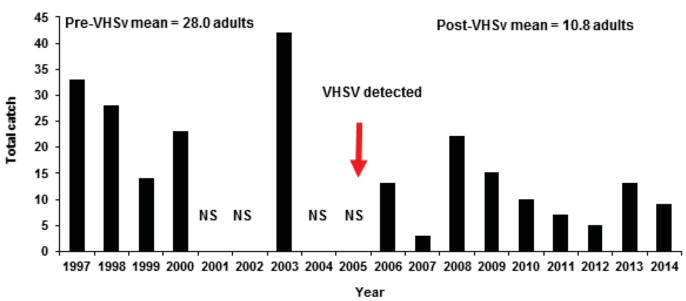

Figure 1. Total catch of muskellunge during spring trapnet sampling during 1997- 2014. Sites and effort are approximately equal over the series. Samples were not collected in 2001-02 and 2004-05 (NS) because of a decision of the Esocid Working Group to monitor muskellunge every third year. Following VHSV outbreak it was decided to resume annual monitoring.

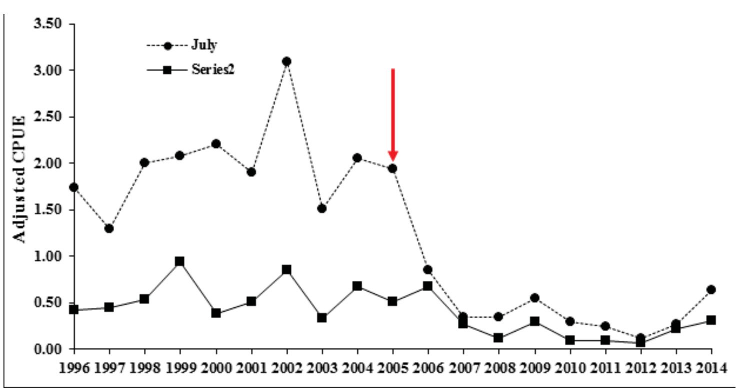

Figure 2. Catch per unit effort of YOY muskellunge captured in standardized seine hauls in eleven upper St. Lawrence River nursery sites from 1996 to 2014 (July= 30' seine series; Series 2= 60' seine). The arrow indicates the year VHSv (2005) was detected resulting in widespread mortality of adult muskellunge in the upper River.

Northern Pike Research

Northern pike spawn about one month earlier in the spring than muskellunge, and are more dependent upon the presence of submerged vegetation for spawning habitat. Long-term regulation of Lake Ontario and St. Lawrence River water levels by the International Joint Commission has reduced the natural range of water levels in the system, resulting in degradation of wetland habitats required by northern pike. Similar to muskellunge studies, ESF researchers have chronicled declines in the abundance of spawning adult and YOY northern pike in the Thousand Islands region. Ongoing research has focused on developing a better understanding of water level regulation impacts on wetland habitats, and conducting experimental habitat manipulations designed to improve natural reproduction of pike. Habitat manipulations include water level control structures used to restore more natural water level regimes in managed spawning marshes, and excavation of channels and pools in cattail mats.

Production of YOY northern pike in managed marshes was initially high, but has declined significantly since 2007. Low numbers of spawning adults, as well as a predominance of female pike, appear to contribute to low reproductive success. Seine hauls at Delaney Bay, downstream of a managed spawning marsh, resulted in a catch of only 12 YOY pike in 2014. The YOY muskellunge seining survey at eleven index sites caught 5 northern pike YOY in the 30' seine series in 92 hauls and 16 in the 60' seine series in 90 hauls. Eight upper St. Lawrence River bays were sampled by seining and 27 YOY pike were captured (N=57 hauls). Assessment of the efficacy of excavated channels in increasing northern pike reproduction is ongoing.

More detailed information on muskellunge and northern pike studies can be found in the Lake Ontario Unit annual report which can be accessed at *www.dec.ny.gov/outdoor/27068.html*.

2014-15 Lake Ontario Research Unit Staff

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SPECIES CONSERVATION & MANAGEMENT

The New York State Department of Environmental Conservation's Lake Erie Fisheries Research Unit is responsible for fishery research and assessment activities for one of New York's largest and most diverse freshwater fishery resources. A variety of annual programs are designed to improve our understanding of the Lake Erie fish community to guide fisheries management, and safeguard this valuable resource for current and future generations. This document shares just a few of the highlights from the 2014 program year. The complete annual report is available on DEC's website at *www.dec.ny.gov/outdoor/32286.html*, or by contacting DEC's Lake Erie Unit.

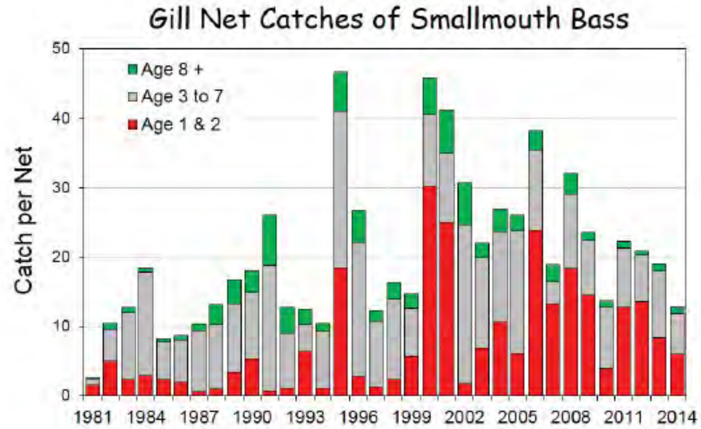
Warmwater Fisheries Management

Walleye

Lake Erie's eastern basin walleye resource is composed of local spawning stocks as well as contributions from summertime movements of western basin spawning stocks. Walleye fishing quality in recent years has generally been very good and largely attributable to excellent spawning success observed in 2003 and again in 2010. Measures of walleye fishing quality in 2014 were the highest recorded in 27 years. New York's most recent juvenile walleye survey indicates a poor spawning year in 2013. However, the abundant 2012 year class began recruiting to the sport fishery in summer 2014. Overall good recruitment through recent years, especially from 2010 and 2012, suggests adult walleye abundance in the eastern basin will remain satisfactory the next few years. A new research initiative beginning in 2015 will use acoustic telemetry to study walleye movement and assess the contribution of western basin migrants to the New York walleye fishery. A $100 reward will be associated with the return of each tagged fish along with the internal acoustic tag.

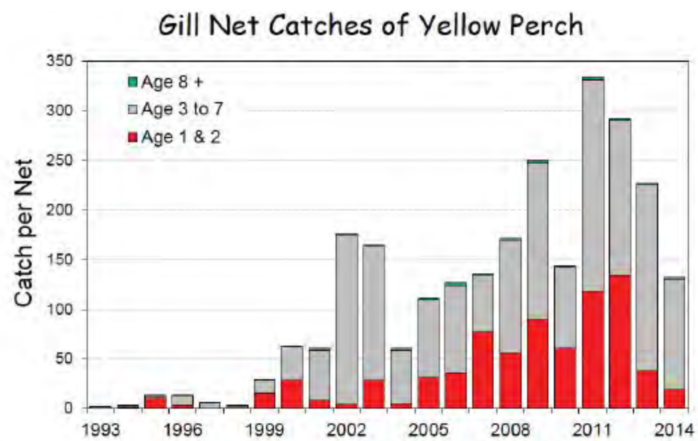
Smallmouth Bass

Lake Erie supports New York's, and perhaps the country's, finest smallmouth bass fishery. Bass fishing quality in 2014 was the second highest observed in the 27 year series of monitoring, with the peak observed in 2013. Generally stable spawning success, coupled with very high growth rates and acceptable survival, produce high angler catch rates and frequent encounters with trophy-sized fish. Most recent data indicate a very gradual decline of abundance to near long term average measures. Juvenile abundance measures suggest 2012 produced a moderately abundant smallmouth bass year class.



Yellow Perch

Lake Erie yellow perch populations have experienced wide oscillations in abundance over the last 30 years, from extreme lows in the mid-1990's to an extended recovery that's now lasted well over a decade. A large adult population continues to produce good angler catch rates, especially during spring and fall. Declining levels of juvenile yellow perch have resulted in an overall decline in the population over the past three years. Spawning success from 2011 through 2013 was average to poor. This decrease has yet to influence yellow perch angler quality which was the highest in the 27 year series in 2014.



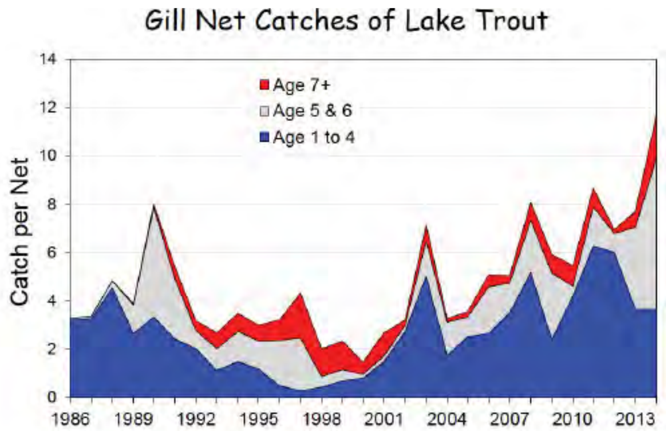
Coldwater Fisheries Management

Lake Trout Restoration

Re-establishing a self-sustaining lake trout population in Lake Erie continues to be a major goal of Lake Erie's coldwater program. Lake trout have been stocked since 1978 and annual assessments monitor progress towards restoration objectives. A revised lake trout rehabilitation plan was completed in 2008 and guides current recovery efforts. The overall index of abundance of lake trout in the New York waters of Lake Erie continues to increase and was at its highest level in 29 years of monitoring in 2014. The majority of the catch was young adult lake trout ages 4-6. Adult fish (age 5 and older) were also at their highest abundance in 2014; lake trout age 10 and older remain scarce. Basinwide estimates surpassed targets for adult abundance for the first time. However, adult survival for some lake trout strains remains low, mainly due to high sea lamprey predation. Natural reproduction has not yet been detected in Lake Erie, and continued high stocking levels and sea lamprey control are needed to build adult lake trout populations to levels where natural production is viable.

Salmonid Management

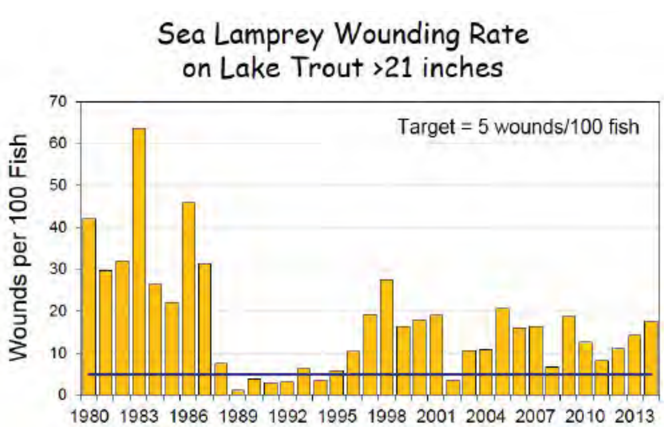
New York annually stocks approximately 255,000 steelhead and 35,000 brown trout into Lake Erie and its tributaries to provide rec-



reational opportunities for both lake and stream anglers. Wild reproduction of steelhead also contributes to the fishery. Fall juvenile assessments conducted since 2001 confirmed substantial numbers of young-of-year steelhead present in many tributaries. A long term annual angler diary program continues to monitor characteristics of the tributary steelhead fishery. In addition, a tributary angler survey is being conducted in 2014-15 to determine the current status of the steelhead fishery. A pilot study to investigate emigration of stocked steelhead suggests stocking size may be influencing adult returns of stocked fish. An expanded investigation is planned for 2015-16 which should provide insights on the influence of stocking size and location on adult returns.

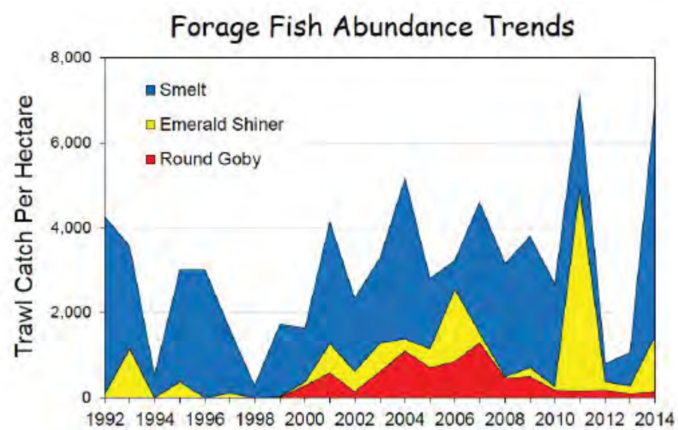
Sea Lamprey

Sea lamprey invaded Lake Erie and the Upper Great Lakes in the 1920s and have played an integral role in the failure of many native coldwater fish populations. Great Lakes Fishery Commission coordinated sea lamprey control in Lake Erie began in 1986 in support of lake trout rehabilitation efforts, and regular treatments are conducted to reduce sea lamprey populations. Annual monitoring undertaken by NYSDEC includes observations of sea lamprey wounds on lake trout and other fish species, and lamprey nest counts on stream sections. Wounding rates on lake trout increased in 2014, indicative of a high sea lamprey population in Lake Erie. Inspections of sportfish species documented sea lamprey wounding on warmwater species as well. Surveys conducted over the past four years indicate the largest source of Lake Erie's sea lamprey production may be the St. Clair River rather than traditionally monitored and treated Lake Erie streams.



Prey Fish

The Lake Erie Unit conducts a number of surveys to assess forage fishes and components of the lake's lower trophic levels. These programs have included trawling, sonar surveys of prey fishes, predator diet studies, and lower food web monitoring. A variety of prey fish surveys beginning approximately 20 years ago identified rainbow smelt as the dominant component of the open lake forage fish community. Beginning in 2000, there has been a notable increase in prey species diversity accompanied by somewhat lower smelt abundance, and in some years especially high abundances of round gobies and emerald shiners were encountered in both prey fish surveys and predator diets. In recent years, overall prey fish abundance trended slightly downward, with notable declines of goby abundance in trawl surveys. Overall abundance of forage-sized fishes was the second highest in the series in 2014, mainly due to especially high abundance of young-of-the-year rainbow smelt and emerald shiners (all life-stages). Round gobies appear to have stabilized at low levels of abundance. Lower trophic monitoring indicated nearshore eastern basin waters are currently best described as a mesotrophic environment favorable for percid production. Over time we expect these investigations to be useful in furthering our understanding of factors shaping the fish community.



2014-15 Lake Erie Research Unit Staff	
Don Einhouse	Biologist 2 (Aquatic)
Jim Markham	Biologist 1 (Aquatic)
Jason Robinson	Biologist 1 (Aquatic)
Doug Zeller	Fisheries Research Vessel Captain
Brian Beckwith	Fish & Wildlife Technician 2
Rich Zimar	Fish & Wildlife Technician 2
Ginger Szwejbka	Secretary 1
Carrie Ann Babcock	Fish & Wildlife Technician 1
Jonathan Draves	Fish & Wildlife Technician 1
Kyle Keys	Fish & Wildlife Technician 1
Ann Wilcox-Swanson	Fish & Wildlife Technician 1
Robert Lichorat	Fish & Wildlife Technician 1

PUBLIC SERVICE & CONSTITUENT SUPPORT

I FISH NY Angler Recruitment Efforts

Angler education through the I FISH NY initiative continued in 2014/15. Although most DEC regions conduct some outreach efforts aimed at beginning anglers, these efforts are most prominent in the downstate region (DEC Regions 1 and 2) and the other DEC Regions with dedicated outreach staff (DEC Regions 3, 7 and 9). Staff in DEC Central Office also conducted programs around the Capital District and the Adirondack Region. The webpages outlining I FISH NY program offerings were revised and are available at *www.dec.ny.gov/outdoor/89362.html.*

In-School Fishing Education Programs

One hundred forty-seven formal education programs were conducted between April 1, 2014 and March 31, 2015 in DEC Regions 1, 2, 3, 4, 5, 7 and 9. These included 142 in-school programs and 5 County Conservation days (schools come to go through environmental programs in a round robin fashion). Most of these programs (118) were conducted in DEC Region 2 (NYC). A total of 6,124 contacts with school aged kids were generated from these programs, including 5,584 in-school contacts and 540 contacts at County Conservation Days. In support of the in-school program, lesson plans have been posted on the DEC website at *www.dec.ny.gov/education/89975.html*, including 5 in the past year.

Fishing Clinics/Festivals

One hundred twenty-six programs were conducted reaching 13,237 people, including 7,388 at fishing festivals, 3,244 at fishing clinics, 2,222 at summer camps, 272 scouts and 111 at DEC campgrounds. People attending fishing festivals generally received little to no fishing education, although seminars were generally available to those who desired to learn more about fishing. People attending fishing clinics generally received 30 to 60 minutes of fishing education followed by an opportunity to fish.

Fishing with Seniors

For the first time since its inception, the I FISH NY program conducted two senior-focused fishing clinics- one in Albany, NY and the other in Flushing, Queens. The Queens event was a multi-language event reaching 25 Cantonese speaking participants through an interpreter. These events offer the perfect opportunity for seniors to get back in touch with fishing- a memorable experience they can share with their grandchildren.

Train the Trainer Initiative

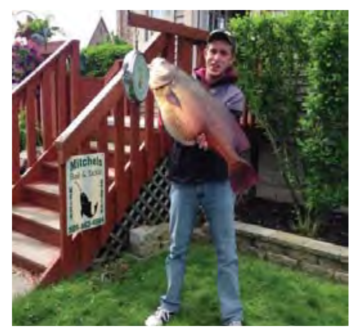
Since 2013, the I FISH NY program continues to expand its train the trainer efforts. Providing fishing education training to summer camp counselors so that they in turn, can teach a fishing program to their campers, allows DEC to reach many more children than they would otherwise be able to. Each 2+ hour training session covers topics on sportfish identification, fishing regulations, safety, knot tying, basic tackle and techniques, places to fish, and advanced lure techniques. Overall, Fisheries Staff from Regions 1, 3, 7, 9 and Central Office collectively covered 33 camps and taught 296 counselors.

I FISH NY Beginners' Guide to Freshwater Fishing

The "I FISH NY Beginners' Guide to Freshwater Fishing" is an upgrade of the popular "Getting Started: A beginners guide to freshwater fishing" manual (first produced in 1992). The new manual will be a complete re-write and designed in full color. The previous manual was produced in black and white. Four chapters have been completed, including "The Fishes of New York," "Basic Fishing Tackle and Techniques," "Care of Your Catch" and "Safe and Responsible Angling." These chapters have been posted on the DEC website at *www.dec.ny.gov/outdoor/98506.html*. Five additional chapters are anticipated to be finalized during 2015-16.

2014 Angler Achievement Awards

The Angler Achievement Awards Program received a total of 157 entries in 2014, a slight decline compared to 2013. Over 75% of the entries received qualified under the Catch and Release Category, exhibiting the sound stewardship of participating anglers. Nineteen entries were entered into the Annual Award Category (kept fish). Two state records were established exactly one month apart- a 60 lb. (inland) striped bass was caught from the Hudson River in Orange County on May 14th by Eric Lester and on June 14th a 26 lb. 9 oz. freshwater drum was caught by James VanArsdall from Lake Ontario's Irondequoit Bay (Monroe County).



Free Sportfishing Clinics

In 2013 legislation passed allowing for an unlimited number of Free Sportfishing Clinics to be held in New York State. This was a change from the traditional 4 free fishing clinics that used to be allowed for each DEC region. Compared to the 39 events that were held in 2013, the number of approved free sportfishing clinics has grown exponentially. During the 2014/2015 fiscal year DEC approved 118 free sportfishing clinics, with an estimated 11,500+ participants! Downstate New York (Regions 1-3) conducted the majority of the clinics. These events are a great way to introduce people to the sport of fishing, as well as reconnect those who have taken on other activities.

Interpretive Signage at Boat Launch Sites

Interpretive signage was designed and installed at Round Lake (Saratoga County). Each panel series has helpful information directed towards anglers and boaters. Content provided includes: fish species present, fisheries management actions, invasive species disinfection procedures, fishing and boating regulations and angling advice.

Second Pond Boat Launch Upgrade Completed

The Second Pond (Lower Saranac Lake) boat launch in Franklin County reopened for public use in 2014 following a complete rehabilitation. A new asphalt paved 100 car and trailer parking area was installed that includes parking for both day use boaters and overnight campers. A new two lane launch ramp was constructed and a pair of floating boarding docks installed. New kiosks, landscaping and accessibility improvements completed the upgrades to this popular boat launch.

New Boat Launch Constructed on Round Lake

Construction of a new boat launch on Round Lake (Saratoga County) was completed in 2014 in cooperation with the Village of Round Lake. The new site includes asphalt paved parking for 9 cars and trailers and 11 cars. A single lane launch ramp, informational kiosk and floating boarding dock were also installed. The new site replaces a hazardous informal launch location on this very popular warmwater fishery approximately 20 minutes north of Albany.

Boat Launch Upgrades Underway

Rehabilitation of the Forge Pond Boat Launch (Suffolk County), Upper Saranac Lake (Franklin County) and Lake George Beach (Warren County) began in 2014. At Forge Pond, a popular warmwater impoundment on the Peconic River, a former hand carry launch site will be converted into a single lane trailered boat launch site.

At Upper Saranac Lake, the site will be modernized to include paved parking a new launch ramp and boarding docks. A boat flushing station will also be installed to address concerns associated with the spreading of microscopic aquatic invasive species.

At Lake George Beach, the existing degraded launch ramp in the middle of the beach will be removed and replaced by a new two-lane launch ramp at the southeast corner of the site. A 25 car and trailer parking area dedicated to the site will be provided that will remain open during the entire openwater season. Expanded parking will be provided during the non-beach season.

Direct Mail Marketing of Fishing Licenses

DEC's participation in the Recreational Boating and Fishing Foundation's (RBFF) Lapsed Angler Direct Mail Marketing Program continued in 2014. This collaborative effort to increase fishing license sales includes 40 states in the U.S. A reminder postcard is mailed to anglers who have let their fishing license lapse and the response rate is assessed by Southwick Associates, a contractor working for RBFF. On April 2, 85,762 post cards were mailed to resident lapsed anglers with 5,772 anglers purchasing a license during the 42 day evaluation period. The overall lift rate of .76% was slightly below the .84% lift noted in 2013.

New Boat Launch Regulations Target Invasive Species

In an effort to reduce the spread of aquatic invasive species to and from DEC boat launch facilities, new regulations were enacted on June 4, 2014. The regulations require all boaters to remove all visible plant and animal material from their boats and trailers and to drain their boats before launching and before leaving the site at the end of their boating trip.

NY Fishing, Hunting and Wildlife App

On May 14, 2014, the free NY Fishing, Hunting & Wildlife App was released for iPhones and Droid phones. The App features sections on Fishing, Shellfishing, Hunting, Trapping, Watchable Wildlife and Licensing Details. It also has a news feed, an events calendar and advanced GPS feature that allows users to identify and locate New York's many fishing, hunting and wildlife watching sites. A great feature is that the app can be used offline in mobile "dead zones," so people can use most of the features of the App without having a network connection. On the Fisheries portion of the App, extensive work was done to convert the format of the Fishing Regulations to be mobile friendly. The current projection is that sometime in the next year more people will get their information from mobile devices than from desktop/laptop computers. The release of this App will allow us to connect better with our users. The app is a collaborative effort between Parks by Nature Network® and NYSDEC. Additional information can be found on the DEC website at *www.dec.ny.gov/outdoor/96470.html* .

2014-15 Public Use and Outreach Staff	
Edward Woltmann	Biologist 3
Gregory Kozlowski	Biologist 2
Joelle Ernst	Biologist 1 (Aquatic)
Scott Cornwell	Fish and Widlife Technician

Public Access Projects

Region	County	Waterbody	Description of Project
1	Suffolk	Forge Pond (Peconic River)	Convert 10 car parking with hand launch to 10 car & trailer and 5 car parking with concrete ramp and loading dock and ADA compliant canoe and kayak launch. Construction begun 9/14. Expected completion 6/15.
4	Otsego	Oaks Creek (Parslow Cooperative Area)	New parking lot for 6-8 cars, new kiosk, and footpath extension.
4	Otsego	Susquehanna River (Collliersville BLS)	MOU with DOT Increase parking lot (15 c) add boat slide.
5	Franklin	Second Pond (Saranac Lakes chain)	Rehabilitation of existing site including new docks, ramps, toilet facilities and increased parking
5	Saratoga	Round lake	Construction of new site. 9 trailer/vehicle and 11 vehicles, concrete ramp; separate launch area for canoes/kayaks
5	Saratoga	Great Sacandaga Lake	Installation of a new 168' floating dock to enhance functionality during windy conditions and highly variable water levels
5	Essex	Balfour Lake	New car-top launch; accessible trail from the 4-car parking lot to the water
5	Franklin	Meacham Lake	Develop new site in new location to avoid too-shallow area of old site; under planning & design
5	Franklin	Upper Saranac Lake	Complete rebuild including new docks, ramps, and boat flushing station (completion date 5-28-15)
5	Warren	Lake George	Complete rebuild including porous pavement, new docks, ramps & boat washing station (completion date 5-28-15)
6	St. Lawrence	Oswegatchie River @ Wegatchie FAS (on Yellow Lake State Forest)	4-6 car parking with an additional Universal Access Parking. Universal Hand Carry canoe/kayak/car-top boat launch.
6	St. Lawrence	Fish Creek (on Fish Creek WMA)	4-6 car upper parking lot with an additional Universal Access Parking nearer to the waterbody. Universal Hand Carry canoe/kayak/car-top boat launch.
6	Lewis	East Fork of the Salmon River	4-6 car upper parking lot with an additional Universal Access Parking nearer to the waterbody. Universally Accessible Fishing Deck was also constructed at this site.
7	Oswego	Little Sandy Creek (Town Landfill FAS)	Constructed a 10 car parking area
7	Oswego	Deer Creek (Deer Creek FAS)	Constructed a six car parking area to serve anglers fishing Deer Creek through the Sandy Creek State Forest. Will serve a dual purpose by providing parking for hunters.
7	Tompkins	Fall Creek (Old Stage Road FAS)	Constructed a four car parking area
7	Tompkins	Fall Creek (Hinman Road FAS)	Constructed a four car parking area
7	Madison	Oneida Lake (South Shore BLS)	Installed solar lighting to assist in night-time launch activity
7	Broome	Skaneateles Lake	Installed solar lighting to assist in night-time launch activity
7	Broome	Oquaga Creek (Sandford FAS)	Constructed a four car parking area.
7	Cayuga	Owasco Inlet (Warner Rd. FAS)	Constructed an eight car parking area.
8	Schuyler	Cayuta Lake	New dock and accessible canoe/kayak launch installed.
8	Monroe	Black Creek FAS	Parking lot paved, fishing platform constructed, accessible canoe/kayak launch installed, new kiosk, new benches, walkways, guide rails.

Public Access Projects

Region	County	Waterbody	Description of Project
8	Monroe	Slater Creek (Slater Creek Park)	New parking lot, railing, removal of chain link fence. Bank stabilization. New management agreement with Town of Greece.

Public Access Acquisitions

Region	County	Waterbody	Acres/Miles	Cost	Date	Comments
4	Albany	Onesquethaw Creek	.032 mi	$17,489.00	7/15/14	
4	Albany	Onesquethaw Creek	.178 mi		7/15/14	
4	Albany	Onesquethaw Creek	.107 mi		7/15/14	
6	Oneida	Fish Creek	4.5 acres	$14,900.00	10/8/14	
7	Tioga	Owego Creek	.070 mi	$2,400.00	7/21/14	
7	Tompkins	Owego Creek West Branch	.065 mi	$2,400.00	2/10/15	
9	Allegany	California Hollow Brook	.127 mi	$4,000.00	8/11/14	

Habitat Improvement Projects

Region	Name of Water	Project	Cooperator Name	Comments
4	Unnamed Stream	Install habitat features in Brook Trout spawning stream	Private Property, funded by owner, Duane LaFever	A 50 foot reach will be rechanneled with step pools, rocks will be placed for habitat, a stone water jack will be installed, three boulders will be placed for habitat, rock vanes will be installed for bank stabilization and a toe wood structure will be installed. We advised the owner on what to do and where to place habitat improvement features.
4	Horse Brook	Remove a double barrel bridge structure that is a barrier.	Trout Unlimited	Region was approached by Trout Unlimited regarding potential barriers in the Beaverkill and East Branch of the Delaware River watersheds. Region assisted in the design of the project and conducted a presence/absence survey to make sure brook trout would not be displaced. The project will open 2.3 miles of stream to trout spawning.
4	Looking Glass Pond	Create Bass spawning beds in pond	DEC	
5	Lost Pond	Barrier Dam Repair	DEC	Located in the Moose River Plains area.
5	Clear Pond	Barrier Dam Repair	DEC	Located in the Siamese Ponds Wilderness Area; protects a Horn Lake strain brook trout monoculture.
5	Whey Pond	Barrier Dam Repair	DEC	Located in the Rollins Pond campground.
5	West Pine Pond	Barrier Dam Repair	DEC	Located in the Saranac Lake Wild Forest, near the southwestern edge of the St. Regis Canoe Area.
5	Little Fish Pond	Barrier Dam Repair	DEC	Repair materials (lumber, cement and sand bags) flown in during fall via helicopter for extensive repair work during summer 2015. Located in the St. Regis Canoe Area, the dam protects multiple trout waters from non-native yellow perch and bass.
6	Bear Pond	Pond Liming	DEC/NY State Police	State Police helicopters transported 80 tons of lime.
6	East Fork of the Salmon River	Streambank stabilization and habitat improvement.	DEC Lands and Forests, Operations and Fisheries	Installed root-wad streambank stabilization structures and a pool digger in conjunction with a Universally Accessible Fishing Deck as well as access road improvements.

Habitat Improvement Projects

Region	Name of Water	Project	Cooperator Name	Comments
7	Chittenango Creek	Bank Stabilization and Trout Habitat Enhancement	Madison County Chapter of Trout Unlimited/ U.S. Fish and Wildlife Service	Habitat and Access Stamp funds were used to purchase the rock used to create rock vanes for stabilizing and enhancing several areas of stream. These funds were also used to purchase several dozen 1”-6” diameter trees that were planted along the bank to shade the stream. TU covered contractor costs to construct the rock vanes while the USFWS designed and oversaw construction of the structures. The USFWS also supplied machinery and manpower to haul and plant the trees.
9	Mansfield Creek	Stream improvement	USFWS/TU	Installation of toe-wood bank protection and LUNKER fish cover stuctures.
9	Spring Brook	Stream improvement	SWCD/TU/Village of Springville	Installation of LUNKER fish cover structures and longitudinal stone bank protection.
9	Various Waters	Shade tree and willow planting	Local TU chapters	2,400 trees and shrubs planted along trout streams by TU Chapter volunteers.

Hatchery Infrastructure Improvements

Work continued in 2014 to replace or repair aging hatchery infrastructure. The majority of these projects were funded through the New York Works program. Major projects included:

Bath Hatchery

A new outdoor kiosk and interpretive area was constructed with the help of the Bath Hatchery crew, Region 8 Operations, and the Public Use and Outreach Section. This new area will benefit the public as it explains the past history of the Bath Fish Hatchery and it helps explain the overall mission of the Fish Culture Section. Excellent interpretive signs were developed which explain the egg collection process, fish propagation at the hatchery, and statewide fish stocking methods using trucks, planes, barges, and helicopters.

Catskill Hatchery

A pond replacement project is planned for the summer of 2016 due to concrete deterioration in the pond walls. Many production ponds will be replaced along with the covered brood stock ponds. In anticipation of the project, new drain lines and valves were installed in the summer of 2014 for the raceways in the pole barn building so they could be used for holding brown trout brood stock during the construction phase of the project. The brood stock are under light control and need a special enclosed area that could replicate the holding area they are presently occupying in the pond area. Presently, the pond replacement project is under design.

Chautauqua Hatchery

Due to an aging boiler system that is used for heating the main hatchery building and heating the water used for the inside raceway fish production, replacement of the existing system will occur in the fall of 2015. The ultra violet water purification system is also antiquated and will also be replaced in the fall of 2015. Presently, these two project contracts are at the Office of State Contracts being reviewed. Once the contracts have been approved they will be awarded and construction will begin in October 2015.

Caledonia Hatchery

In the summer of 2014 many of the Caledonia Hatchery buildings, which date back to the 1800's, received cosmetic improvements to their exteriors and a fresh coat of paint. Many of the roadways at the hatchery were paved and drainage pipe and gratings were installed in the pond area of the hatchery. This project was completed just in time for the 150th anniversary celebration of the hatchery. During the winter of 2015 the raceway area and stairway of the main hatchery building were painted. This was a project that was long overdue and since it has been completed it complements the paving and exterior painting projects.

Fourteen new inside raceways were purchased. These raceways will replace the sixty year old deteriorating inside raceways in the main hatchery building. Installation is planned for the summer of 2016.

Chateaugay Hatchery

Thirteen new outside raceways were delivered recently and installation is anticipated for the summer of 2016. These raceways will replace 50-60 year old raceways that have been leaking for many years. Contracts for the demolition of the old raceways and construction of a new cement pad are being prepared. The actual raceway installation will be completed "in-house" by hatchery employees from Chateaugay Hatchery and Rome Hatchery.

Oneida Hatchery

Two new boilers and a rotating drum water filtration system will soon be installed in the main hatchery building. These new systems will replace antiquated systems that have been in the main hatchery building since it was built over 20 years ago. The contract has been awarded and the boiler installation is planned for the summer of 2015. The installation of the rotating drum filter is anticipated for the fall of 2015.

Salmon River Hatchery

A contract for the replacement of the roof on the main hatchery building has been awarded and construction should be completed in August 2015. New aquariums for the visitor center have been installed along with a supporting water recirculation system and a water chiller unit. Additional work still needs to be completed on the aquariums before they are operational. It is expected they will be in use by the fall of 2015.

South Otselic Hatchery

The engineering design for the new outlet control structures for the earthen ponds which hold fingerling walleyes is close to being completed along with design work which will combine smaller ponds into larger ponds. Soil test borings of the earthen pond berms and test pit excavations in the existing pond bottoms were completed in the fall of 2014 in preparation for combining ponds. Overall, the improvements will help in the efficiency of collecting the walleyes from the earthen ponds.

Van Hornesville Hatchery

Phase II of the installation of new drainage pipes and asphalt walkways along with new asphalt in portions of the hatchery access roads and a new cement apron in the main hatchery building entrance area are being designed. Completion of the project will be in the summer/fall 2015.

New Hatchery Trucks Arrive

Sixteen new Freightliner six-tank stocking trucks were purchased in 2014. Most were used throughout the state during the 2015 spring stocking season replacing trucks purchased in 2000 and 2002. Most of the older stocking trucks were each nearing 200,000 miles or greater and were prone to breakdowns and repairs. The new trucks are outfitted with the most up-to-date exhaust emission control devices which will help "green" the fleet of vehicles and ultimately benefit the environment in many ways. The trucks along with new stocking tanks, aerators, industrial batteries to operate the aeration system, and all necessary hardware were purchased using NY Works III Funding.

150th Anniversary of the Caledonia Hatchery Celebrated

The 150th anniversary celebration of Caledonia hatchery took place on August 9 and 10, 2014. Hundreds of visitors attended along with elected officials and DFWMR Division Director Patricia Riexinger. Speeches were delivered by the invited officials. Tours of the hatchery were conducted. Booths were set-up by local history groups, Trout Unlimited, and a local fish and game club. It was a great success!

Fall Egg Collections

Lake Trout from Cayuga Lake

The annual Cayuga Lake egg collection of lake trout eggs (Finger Lake strain) began October 7, 2014 at Taughannock Point on Cayuga Lake. For the next two days eggs were collected for a total of 355,000 green eggs. Of this total, 313,000 eggs were used for lake trout production while 42,000 eggs were fertilized with brook trout from Randolph hatchery to produce splake eggs. The eggs were transported each day to Bath Hatchery. The egg collection was completed using personnel from South Otselic Fish Hatchery, Rome Fish Hatchery, and Bath Fish Hatchery. The lake trout hatched from these eggs will be stocked throughout the state and the hatched splake will be released in the Adirondack Mountain region.

Lake Trout from Raquette Lake

The annual Raquette Lake egg collection of lake trout eggs (Adirondack strain) began on October 14, 2014 at North Point on Raquette Lake. For the next ten days eggs were collected for a total of 88,000 green eggs. The eggs were transported each day to Chateaugay Fish Hatchery. The egg collection was completed using personnel from Chateaugay Fish Hatchery, Rome Fish Hatchery, Adirondack Fish Hatchery, and the Region 5 Fish Management Unit.

Salmon River Hatchery- Chinook and Coho Salmon

The annual Salmon River Fish Hatchery's chinook and coho salmon egg collection began on October 14 and October 20, 2014, respectively. The chinook egg collection took six days to complete with a total of 4.3 million green eggs taken. Eggs were collected from 900 ripe females. For the coho egg collection, it took seven days to complete and 1.5 million green eggs were taken. Eggs were collected from 566 ripe females. Target numbers were reached for both species of fish. The egg collection was completed using personnel from Salmon River Fish Hatchery and the Salmon River Steward's Program. The salmon hatched from these eggs will be used in Salmon River Fish Hatchery's stocking program for Lake Ontario.

Adirondack Hatchery – Landlocked Salmon Egg Collection

The egg collection began on November 5 and ended on November 10, 2014. A total of 1.2 million eggs were collected. There were 180,100 collected from wild brood stock from Little Clear Pond and 1,034,705 from captive brood stock. Of the 1.2 million eggs collected, 103,200 pure Sebago strain eggs were transferred to Tunison Laboratory in Cortland, NY for a research project to determine better return of stocked salmon smolts.Target numbers of eggs were achieved so there should be enough landlocked salmon to meet future target numbers. These landlocked salmon are stocked into many Adirondack waters, Lake Champlain, Lake Ontario, as well as the Finger Lakes, and other selected waters throughout the state.

Windfall Heritage Strain Brook Trout

The annual egg collection for the Windfall strain of brook trout took place at Mountain Pond in Franklin County (DEC Region 5) on October 29 and 30, 2014. Three trap-nets were set for two nights and eggs and milt were stripped from a total of 48 pairs of brook trout. A total of 25,000 green eggs collected. The egg collection was completed using personnel from South Otselic Hatchery, Rome Hatchery, and the Region 5 Fish Management Unit.

Windfall X Domestic Brook Trout

The annual milt collection at Black Pond in Franklin County (DEC Region 5) for the genetic cross of Windfall strain brook trout and "domestic" brook trout took place on November 5 and 6, 2014. Milt from eleven males was used in the fertilization process along with 15 domestic females for a total collection of 40,000 green eggs. The egg collection was completed using personnel from South Otselic, Rome, and Chateaugay hatcheries.

Egg-Take for Round Whitefish

Region 5 Fisheries staff, along with staff from the Adirondack Hatchery, conducted an egg take for round whitefish in Lower Cascade Lake in late November. Lower Cascade Lake is an important broodstock water for this species which is endangered in New York State. The timing of the spawn for round whitefish often makes this effort problematic, and 2014 was no exception, as more than an inch of ice covered the lake the night before this netting effort was to begin. We were able to chop enough ice to set the net; and to tend and retrieve it the next day, but the egg take was poor. It may be that the shifting ice or refreezing lifted the trap-net slightly off of the lake bottom, resulting in a poor catch. Five of the six female round whitefish caught were ripe, but a total of only five pairs of round whitefish could be stripped for their eggs in 2014. The eggs were taken to a hatchery for rearing to eventually stock other waters in an effort to expand the number of waters where this species is found.

Spring Wild Fish Egg Collections

Salmon River Hatchery – Steelhead

Salmon River Hatchery's annual steelhead rainbow trout egg collection began on April 4 and ended on April 7 for a total of 4 days of egg collecting. A total of 2.4 million Washington strain and 209,000 Skamania strain eggs were collected achieving the target number. The fish hatched from these eggs will be stocked in tributary waters of Lake Ontario and Lake Erie.

Bath Hatchery – Wild and Hybrid Rainbow Trout

An egg collection of wild rainbow trout from the Cayuga Inlet Fishway was held on April 10 and April 16, 2015. A total of 190,690 wild rainbow trout eggs were collected. There were also 29,230 hybrid (wild rainbows x domestic rainbows) rainbow trout eggs taken. Target numbers were reached and should be adequate to meet future stocking targets.

Oneida Hatchery – Walleye

Oneida Fish Hatchery staff, with the assistance from other NYS hatcheries and regional fisheries staff, conducted trap netting operations for spawning walleyes between April 16th and 22nd, 2015. Oneida Lake's ice completed breaking up on April 16th, although hatchery staff began setting nets on April 15th. Twelve trap nets were set, totaling 84 net lifts. Nets were tended and emptied daily for seven days. Captured fish were transferred back to the facility where eggs were collected and fertilized. Stripped walleyes were released back into Scriba Creek. The staff captured 13,462 walleyes, and collected 262.8 million eggs. A total of 5,176 females were stripped, averaging 50,773 eggs per female. A male to female ratio of 2:1 was used for fertilizing the eggs. Low creek flows prevented regular formalin treatments after the initial treatment. Without this preventative measure to prevent fungus from growing on the eggs, the eggs required much more manual handling (sifting and syphoning) to remove the affected eggs. The eye up percentage was 72.3% resulting in 188,640,000 fry. The fry were transferred to two other NYS DEC hatcheries and stocked into 13 water bodies across New York State.

Chautauqua Hatchery – Muskellunge

Chautauqua Fish Hatchery's muskellunge egg take took place between April 27 and May 8. During that period six trap nets were set in Chautauqua Lake at standard index net locations. Water temperature ranged from 46 to 65 degrees Fahrenheit during the netting period. A total of 152 adult muskellunge were captured, from which we mated 32 pairs and collected 911,600 eggs.

Fish Disease Control

Statewide Fish Health

Two separate pathogen surveillance programs are conducted annually in New York. The first is an ongoing statewide survey to identify waters where regulated pathogens may be present in fish populations. Cornell University performs the second survey through a program to investigate diseases in wild fish.

Wild Fish Pathogen Surveillance Program

For the statewide survey, a wide range of fish species were collected from 20 locations (1,407 fish) and clinical testing was done at the USFWS fish health center in Lamar, PA. Three different pathogens were isolated this year, all from salmonids. EEDv was isolated from one location this year, from lake trout in Otsego Lake. In previous years, EEDv was isolated from several locations annually, and consistently from Lake Ontario. Newly discovered Salmonid Herpesvirus 5 (NaHV) was identified from lake trout in two different locations, including Lake Ontario and Otsego Lake. In fact, the previous reports of EEDv in Lake Ontario were probably NaHV instead. The two viruses share similar homologies and couldn't be distinguished by the previous PCR method. Finally, *Myxobolus articus* was isolated from brook trout at two different locations, Slush Pond in the Adirondack Mountains, and the Connetquot River in Long Island. None of New York's eight regulated fish pathogens were detected in our wild fish collections. Also not found in 2014 was Nucleospora salmonis which has been consistently found in previous years.

Wild Fish Disease Investigations

Cornell staff conducted 16 fish disease investigations in 2014. Viral Hemorrhagic Septicemia was isolated from gizzard shad in Dunkirk Harbor, Lake Erie in March. The investigation was initiated as a result of a prominent fish kill. Epizootics like this are common with shad in spring, yet VHS isn't always found. Alewives collected during concurrent fish kills at two different locations on Lake Ontario were negative for VHS in May. In those cases, lesions were consistent with VHS, although no cause was identified. Many other cases were fish with commonly occurring diseases and were often small scale events. This included a small scale kill of yellow perch and rock bass due to a *F. columnare* (Columnaris) outbreak on Canandaigua Lake in June and Lymphosarcoma in northern pike in Lake Ontario in October.

In November, anglers reported seeing lethargic steelhead listlessly floating down the Salmon River. Thiamine deficiency was determined to be the cause and an effort was made to inject all feral adults arriving at the hatchery with thiamine. As of this report, 1,153 fish have been injected in four different trials. The mortality rate so far is 30% and largely due to gluco-regulatory collapse where those fish simply lacked the energy to recover from the trauma of handling.

Hatchery Fish Health and INAD Projects

The overall health of fish in our hatchery system has been remarkable. Many diseases we routinely encountered in previous years, such as prominent *Saprolegnia* in our trout brood stock and *Gyrodactylus* infestations in our brook trout have been mostly resolved. Also, our hatchery system has been free of harmful program viruses, such as IPN, for decades. We do have commonly occurring bacterial disease issues that are addressed routinely, but these diseases are very manageable.

Progress of Furunculosis Abatement at Rome SFH

In the summer of 2012, a serious epizootic of furunculosis occurred at the Rome hatchery and was linked to the importation of a very susceptible brown trout lot from Virginia. By September, an abatement plan was developed that included (1) destroying 800,000 still infected fish, (2) bi-annual inspections of all lots at 2% prevalence interval for two years, and (3) only Rome strain trout could be cultured on site. Rome strain brook and brown trout on site during the event were spared because they were largely unharmed during the epizootic. *Aeromonas salmonicida* was not detected in 2013 or 2014 inspections, so the hatchery classification was upgraded to 'A' in September. However, during spawning activities at Rome Field Station in November, clinical Furunculosis was evident in a few dozen adult Rome Strain brown trout. These 4-yr old fish were on site during the 2012 event and we speculate that the rigors of spawning may simply have triggered disease activity in latent fish. After eggs were successfully collected, the entire year class of fish was destroyed. All other lots, including brook trout, were retested and no *A. salmonicida* was isolated which demonstrates the resiliency of the strain. It's worth noting that **none** of the fish in Rome Hatchery production tested positive at any time this year.

Flavobacterial Diseases

In 2014, the usual epizootics of bacterial gill disease, bacterial cold water disease, and columnaris disease appeared throughout our hatchery system along with other undescribed Flavobacteria. These comprise the majority of our clinical hatchery work. In our quest to reduce Terramycin use, we did have success using Perox-Aid and Chloramine T in combatting columnaris disease and bacterial coldwater disease on several occasions. We found the key was early detection and early drug administration.

Investigational New Animal Drug (INAD) Work

INAD projects included Chloramine T (INAD 9321) and Aqui-S (11-741) this year and we plan to include Oxytetracycline in our 2015 work. With the Chloramine T approval being limited to certain fish species and diseases, we collaborated with the Aquatic Animal Drug Approval Partnership (AADAP) to study Chloramine T efficacy against columnaris in tiger muskellunge at our South Otselic Fish Hatchery. The fish were naturally infected, and one group was treated with Chloramine T (20 mg/L) and the control group was untreated. After 17 days, the treated group had a cumulative mortality of 12.6% versus 81.8% for the control group. The study report has been submitted to the FDA for review. In 2015, we plan to conduct a similar study using OTC-343 at the South Otselic Fish Hatchery.

Hatchery Inspection Program

The DEC's Fish Disease Control Unit (FDCU) annually inspects all lots of fish in DEC culture programs, both domestic and from wild sources. In 2014, our inspections included domestic trout cultured in our hatcheries, plus various species of wild fish used in egg collections intended for hatchery propagation. In all, we conducted 56 inspections in 2012 totaling 5,196 fish. *Aeromonas salmonicida* was isolated from chinook and coho adults during egg collections at the Salmon River and production fish at the Rome State Fish Hatchery in 2014 and an atypical variant of *Yersinia ruckeri* was isolated from wild brook trout from Big and Little Hill Ponds in the Adirondacks. These fish are used as gamete sources for our heritage Brook Trout program and the fish are not removed from the site. No other program pathogens were detected in our hatcheries.

2014-15 Fish Culture Staff

CENTRAL OFFICE

Jim Daley	Fish Culturist 6
Dave Armstrong	Fish Culturist 5
Mary LaBoissiere	Secretary 1

ADIRONDACK

Matt Jackson	Fish Culturist 3
Kenneth Klubek	Fish Culturist 1
Adam Kosnick	Fish Culturist 1
Doug Peck	Fish Culturist 1

BATH

Ken Osika	Fish Culturist 3
Kelly Raab	Fish Culturist 1
Robert Sweet	Fish Culturist 2
Stephen Galbreth	Fish Culturist 1
Adam Haley	Fish Culturist 1

CALEDONIA

Alan Mack	Fish Culturist 4
Kevin Hayden	Fish Culturist 2
Mark Krause	Fish Culturist 3
Jason Schirmer	Fish Culturist 1
Robert Stein	Fish Culturist 2
Brian Ward	Fish Culturist 1
Stephen Zenzen	Fish Culturist 1
Steven Robb	Fish Culturist 1

CATSKILL

John Anderson	Fish Culturist 4
Tim Anstey	Fish Culturist 1
Joseph Gennarino	Fish Culturist 2
James Judson	Fish Culturist 1
Nathan Snyder	Fish Culturist 1
Michele Zeigler	Fish Culturist 1
Robert Poprawski	Fish Culturist 1

CHATEAUGAY

Neal McCarthy	Fish Culturist 2
Anthony Bruno	Fish Culturist (Trainee I)
Logan Grishaber	Fish Culturist (Trainee I)
Mike Sicley	Fish Culturist
Nicole Vogt	Fish Culturist

CHAUTAUQUA

Larry King	Fish Culturist 3
Eric Defries	Fish Culturist 2
Bradley Gruber	Fish Culturist 1
Ron Preston	Fish Culturist 1

ONEIDA

Bill Evans	Fish Culturist 4
Mark Ferron	Fish Culturist 1

RANDOLPH

Richard Borner	Fish Culturist 3
Trevor Brady	Fish Culturist 1
Barry Hohmann	Fish Culturist 1
Raymond Hulings	Maintenance Assistant
Jim Rambuski	Fish Culturist 2
Derek Weishan	Fish Culturist 1

ROME

John Gray	Fish Culturist 1
John Draper	Fish Culturist 1
Steven Grabowski	Fish Culturist 2
Zach Goodale	Fish Culturist 1
William R. Hajdasz	Maintenance Supervisor
Kimberly Matt	Keyboard Specialist
Scott Wanner	Fish Culturist 3
William Woodworth	Fish Culturist 2

FISH DISEASE CONTROL

Andrew Noyes	Pathologist 2 (Aquatic)
Geofrey Eckerlin	Biologist 1 (Ecology)
Mark Batur	Fish Culturist 1

SALMON RIVER

Andreas Greulich	Fish Culturist 4 - retired
Stephen Dolan	Fish Culturist 3
David Domachowske	Fish Culturist 2
Brian Edmonds	Fish Culturist 1
Karen Hurd	Keyboard Specialist
Robert Nelson	Fish Culturist 2
Leslie Resseguie	Fish Culturist 1 (trainee II)

SOUTH OTSELIC

Pat Emerson	Fish Culturist 3
Thomas Kielbasinski	Fish Culturist 2
Bruce Ryan	Fish Culturist 1
Mike Speziale	Fish Culturist 1

VAN HORNESVILLE

Larry Kroon	Fish Culturist 3
Craig DuBois	Fish Culturist 2
Lauren C. Watson	Fish Culturist 1 - retired

Annual Fish Production

ANNUAL STOCKING REPORT – BY SPECIES
January 1, 2014 - December 31, 2014

SPECIES		LESS THAN 1"		1" - 4.24"		4.25" - 5.74"		5.75" - 6.74"		6.75" - 7.74"		7.75" Plus		TOTAL	
		NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT
Cold Water	Cold Water														
	Brook Trout			463,305	7,831	28,699	984	4,410		10,844		190,201	51,310	697,459	60,105
	Brown Trout			41,020	652	113,080	7,004	37,500	3,160	235,665	40,198	1,590,732	460,209	2,017,997	511,253
	Rainbow Trout			71,025	474	25,500	1,419	77,150	6,581			301,996	77,200	475,671	85,674
	Steelhead					638,850	23,549	137,500	9,546					776,350	33,095
	Lake Trout			14,000	77	547,964	13,059	498,000	32,281	154,110	15,408	74,900	13,427	1,288,974	74,252
	Splake											21,040	4,848	21,040	4,848
	Landlocked Salmon			455,409	801	1,000	63	162,928	15,824	172,430	21,833	12,637	2,805	804,404	41,326
	Coho					130,000	8,125							130,000	8,125
	Chinook			1,969,790	22,607									1,969,790	22,607
	Cold Water Total	-	-	3,014,549	32,472	1,485,093	54,183	915,488	67,392	573,049	77,439	2,191,506	609,799	8,179,685	841,285
Warm Water	Warm Water														
	Walleye	211,636,000	3,649	618,052	732									212,254,052	4,381
	Muskellunge	438,000	16	14,160	18							26,900	2,363	479,060	2,397
	Tiger Muskellunge			34,800	114							100,660	8,962	135,460	9,076
	Panfish											500	100	500	100
	Warm Water Total	212,074,000	3,665	667,012	864	-	-	-	-	-	-	128,060	11,425	212,869,072	15,954
RTE	Rare\Threatened\Endangered														
	Lake Sturgeon	7,400	25			4,100	82			500	32			12,000	139
	Round Whitefish	10,500	4											10,500	4
	Lake Herring	144,670	2,824											144,670	2,824
	RTE Total	162,570	2,853	-	-	4,100	82	-	-	500	32	-	-	167,170	2,967
Grand Total		212,236,570	6,518	3,681,561	33,336	1,489,193	54,265	915,488	67,392	573,549	77,471	2,319,566	621,224	221,215,927	860,206

Summary of Fisheries, Creel & Angler Surveys

Survey Name	Purpose
Region 1	
Peconic River	Alewife Spawning Survey
Little River	Alewife Spawning Survey
Alewife Creek	Alewife Spawning Survey
Beaver Brook	Brook Trout Survey
Beekman Creek	Brook Trout Survey
Hempstead Lake	Fish Kill Survey
Peconic Lake	Centrarchid/ Community survey
Upper Lake	Post Dredging Survey
Upper Twin Pond	Centrarchid Survey
Halls Pond	TSMP
Grant park Pond	TSMP
Lower Twin Pond	Centrarchid Survey
Wantagh Mill Pond	Centrarchid Survey
Sandy Pond	Threatened Species
Unnamed Pond	Threatened Species
Fox Pond	Threatened Species
Connetquot River	Disease Monitoring
Hards Lake	Alewife Survey
Railroad Pond #1	Threatened Species
Lake Ronkonkoma	Vegetation/Water Chemistry
Lily Pond	Special Collections
Underhill Pond #1	General Biological Survey
Underhill Pond #2	General Biological Survey
Lake Ronkonkoma	Percid/Centrarchid Survey
Fort Pond	Percid/Centrarchid Survey
Swan Pond	Threatened Species
Ronkonkoma Swamp	Other- Loach (Invasive Species) collection
Region 2	
Bronx River Electrofishing Survey	
Collaborative Comprehensive Bx. River Survey	
Willow Lake Electrofishing Survey	
Meadow Lake Electrofishing Survey	
Oakland Lake Electrofishing Survey	
Prospect Park Lake Electrofishing Survey	
Willowbrook Lake Electrofishing Survey	
Tibbetts Brook Electrofishing Survey	
Flushing Airport Fish Survey	
Region 3	
Swinging Bridge Reservoir	Creel Survey
Ridgebury Lake	Invasive Species Eradication follow-up
Lake Minnewaska	Assessment of new introduction (bass and shiners)
Round Lake	Water Chemistry profile

Titicus Outlet	Trout population assessment
Kisco River	General Biological Assessment
Esopus Creek	Electrofishing evaluation of water release from Ashokan Reservoir
Swinging Bridge Reservoir	Percid Plan Walleye evaluation
Rio Reservoir	Percid Plan Walleye evaluation
Titicus Reservoir	Percid Plan Walleye evaluation
Region 4	
T16 Manor Kill	Invasive Fish Monitoring (O. weatherfish)
Goodyear Lake	General Biological Survey and TSMP Collection
Shingle Hollow Brook	Fish Kill Investigation
Little Pond	General Biological Survey
Mohawk River (with USGS) - contract	General Biological Survey
Canadarago Lake x2	Summer and Fall Percid Sampling
Schoharie Creek	Special Regs Evaluation
Upper Blenheim-Gilboa Reservoir	TSMP Collection
Unadilla River	TSMP Collection
Delta Pond	General Biological Survey
Blazer Pond	General Biological Survey
E. Greenbush Pond	General Biological Survey
Ouleout Creek	CROTS and General Biological Survey
Walloomsac River	General Biological Survey (Access)
North-South Lake	TSMP Collection
Onesquethaw Creek	CROTS Survey
Unnamed Waters (8 trout streams)	General Biological Survey (trout p/a)
Schoharie Reservoir	Fish Disease Monitoring
EB Delaware River (tailwaters)	General Biological Survey (trout)
Otsego Lake	General Biological Survey (salmonids), Fish Disease Monitoring
Hudson River	2014 Day on the Hudson Event
Poesten Kill	General Biological Survey
Mohawk River (with OEI) - contract	General Biological Survey
Region 5	
Lake Champlain	Rare/endangered species
Halfway Creek	CROTS survey
Panther Pond	Physical/Chemistry survey
Slush Pond	Whirling disease sampling
Lake Placid	Juvenile lake trout survey
Crane Mountain Pond	General biological survey
Little Clear Pond	Physical/Chemistry survey
Grass Pond	Physical/Chemistry survey
Lindsey Pond	Physical/Chemistry survey
Little Green Pond	Physical/Chemistry survey
Bone Pond	Physical/Chemistry/Post-liming survey
Rat Pond	Physical/Chemistry survey
Sunday Pond	Physical/Chemistry survey
Duell Pond	Physical/Chemistry survey

Meadow Pond	General biological survey
Lake Pleasant	Evaluate experimental stocking water
Bear Pond	General biological survey
Grass Pond	General biological survey
Schroon Lake	Juvenile lake trout survey
Ochre Pond	General biological survey
Paradox Lake	Juvenile lake trout survey
Federation Pond	Post-liming survey
Sunrise Pond	Post-liming survey
St. Germain Pond	Pre-liming survey
Echo Pond	Post-liming survey
Black Pond	Post-liming survey
Piseco Lake	Juvenile lake trout survey
Icehouse Pond	Post-liming survey
High Pond	Pre-liming survey
Panther Pond	Physical/Chemistry survey
Benz Pond	Post-liming survey
Bessie Pond	General biological survey
Nellie Pond	General biological survey
Lower Sargent Pond	Post-Reclamation survey
House Pond	Post-liming survey
Holmes Lake	Post-liming survey
Dunk Pond	General biological survey
Huntley Pond	General biological survey
Lake George	Population estimate
Ross Pond	General biological survey
Blue Ledge Pond	General biological survey
Pine Mountain Pond	General biological survey
Carter Pond	General biological survey
Unnamed (Upper Carter) Pond	General biological survey
Gulf Brook	General biological survey
Cheney Pond	General biological survey
Rock Pond	General biological survey
Little Rock Pond	General biological survey
Rock Pond	General biological survey
Hudson River	TSMP collection
Raquette Lake	Brood stock monitoring
Mountain Pond	Brood stock monitoring
Black Pond	Brood stock monitoring
Fishbrook Pond	Egg take
Lower Cascade Lake	Rare/endangered species
Region 6	
Barrett Creek	Connectivity Study
Bear Pond	Limed Waters Program
Big Hill Pond	Fish Disease Investigation

Black River	Lake-Run Salmonid Monitoring
Boottree Pond	Brook Trout Egg Take
Boottree Pond	Limed Waters Program
Brewer Lake	Limed Waters Program
Buck Pond	Limed Waters Program
Clear Pond	Limed Waters Program
Cleveland Lake	Limed Waters Program
Deer Pond	Fish Disease Investigation
Deer Pond	Brook Trout Egg Take
Delta Lake	Fish Disease Investigation
Delta Lake	Walleye Evaluation
Effley Falls Reservoir	Contaminant Collection
Elmer Falls Reservoir	Contaminant Collection
Hedgehog Pond	Limed Waters Program
Hidden Lake	Limed Waters Program
Fox Creek	Connectivity Study
Guffin Creek	Connectivity Study
Hawk Pond	Limed Waters Program
Horn Lake	Limed Waters Program
Hickory Lake	Bass Evaluation
Horse Creek	Connectivity Study
Horseshoe Pond	Limed Waters Program
Lake Ontario	Lake Sturgeon Evaluation
Lake Ontario	Warmwater Fish Stock Assessment
Lake Ontario	Lower Trophic Level Study (12 surveys)
Lake St. Lawrence	Warmwater Fish Stock Assessment
Little Hill Pond	Fish Disease Investigation
Little Otter Lake	Limed Waters Program
Long Lake	Limed Waters Program
Lyon Lake	Limed Waters Program
Moshier Reservoir	Contaminant Collection
Nicks Pond	Limed Waters Program
North Twin Pond	Brook Trout Egg Take
Oswegatchie River	Walleye Egg Take
Payne Lake (Jefferson County)	Walleye Evaluation
Payne Lake (Lewis County)	Limed Waters Program
Pine Pond	Limed Waters Program
Pitcher Pond	Limed Waters Program
Quiver Pond	Limed Waters Program
Raven Lake	Acidified Waters Survey
Red Lake	Walleye Evaluation
Round Lake	Limed Waters Program
Sandy Creek	Salmonid Evaluation
Slender Pond	Limed Waters Program
Soda Pond	Limed Waters Program

South Colton Reservoir	Contaminant Collection
South Twin Pond	Brook Trout Egg Take
St. Lawrence River	Lake Sturgeon Egg Take
St. Lawrence River	Lake Sturgeon Evaluation
St. Lawrence River	Esocid Monitoring
St. Lawrence River	Warmwater Fish Stock Assessment
Stony Creek	Salmonid Evaluation
Sunshine Pond	Limed Waters Program
Tamarack Pond	Limed Waters Program
Three Mile Creek	Connectivity Study
Townline Pond	Limed Waters Program
Twitchell Lake	General Biological Survey
101 Surveys DEC Regions 3-9	Rare Fish Assessment
Region 7	
Chittenango Creek	Creel
Ninemile Creek	Creel
Glacier Lake (Clark Reservation State Park)	General Biological Survey
Cazenovia Lake	Percid Sampling
Lake Moraine	Centrarchid Sampling
Dryden Lake	Centrarchid Sampling
Otisco Lake	Community Survey
Hunts Pond	Centrarchid Sampling
Owego Creek	Habitat assessment prior to improvement project
Cayuga Inlet	Juvenile Trout
Owasco Inlet	Juvenile Trout
Hemlock Creek	Juvenile Trout
Susquehanna River	TSMP
Whitney Point Reservoir	Percid Sampling
17 small streams in Chenango and Broome Counties	Potential reclassification as trout streams
Cayuga Inlet Fishway	Finger lakes Rainbow Trout egg take, fish passage, Sea Lamprey removal
Salmon River	Steelhead Egg Take
Salmon River	Salmon Egg Take
Cayuga Lake	Lake Sturgeon survey, Lake Trout Egg Take
Otisco Lake	Percid Sampling
Otter Lake	Percid Sampling
Region 8	
Conesus Inlet and Lake	Walleye Population Estimate
Seneca Lake	Monitor Fishing Tournament
Cohocton River	Evaluation of habitat improvement work (TU Project)
Canandaigua Lake	Lake Trout population survey
Black Creek	General Biological Survey
Springwater Creek	Rainbow Trout spawning run evaluation
Cold Brook	Rainbow Trout spawning run evaluation
Naples Creek	Rainbow Trout spawning run evaluation
Catherine Creek	Lamprey Control Evaluation / Rainbow Trout spawning run evaluation

Sleepers Creek	Lamprey Control Evaluation / Rainbow Trout spawning run evaluation
McClure Creek	Lamprey Control Evaluation / Rainbow Trout spawning run evaluation
Conesus Lake	Percid population survey
Spring Creek	Impact of Mergansers on Brown Trout Populations
Seneca Lake	Fish Community Survey
Birdseye Hollow Pond	Fish Kill Investigation
Queen Catharine March	Fish Kill Investigation
Lake Ontario (Pultneyville)	Fish Kill Investigation
Lake Ontario (Sandy Creek)	Fish Kill Investigation
Canandaigua Lake	Fish Kill Investigation
Seneca Lake	Fish Disease Monitoring
236 Various Tributaries	EBTJV Surveys
Region 9	
Red House Lake	Evaluate 50-day Walleye stocking program
Chautauqua Lake	Esocid sampling
Chautauqua Lake	Centrarchid sampling
Chautauqua Lake	Percid sampling
Lake Eire	Lake Sturgeon sampling
Upper Cassadaga Lake	Evaluate 50-day Walleye stocking program
Lower Cassadaga Lake	Evaluate 50-day Walleye stocking program
Niagara River	Fish community sampling
North Branch Wiscoy Creek	Third year post-habitat enhancement evaluation of trout population
Clear Creek - Arcade	Wild trout population estimate
Lime Lake Outlet	Wild trout population estimate
Cayuga Creek	CROTS survey
Canacadea Creek	CROTS survey and Fishkill investigation
Goodell Creek	Post-habitat restoration evaluation of trout population
Buffalo Creek tributary	Culvert assessment and trout population survey
Lake Ontario Research Unit	
Lake Ontario Alewife Bottom Trawl Survey	Assess yearling and adult alewife in Lake Ontario
Lake Ontario Rainbow Smelt Bottom Trawl Survey	Assess yearling and adult smelt in Lake Ontario
Lake Ontario Juvenile Lake Trout Trawl Survey	Assess juvenile lake trout in Lake Ontario
Lake Ontario Warmwater Fisheries Assessment	Assess warmwater fish populations in the Eastern Basin
Status of Lake Ontario's Lower Trophic Levels	Monitor trends in Lake Ontario productivity, including nutrients, chlorophyll a, and zooplankton populations
Lake Ontario Adult Lake Trout Assessment	Assess adult lake trout populations in Lake Ontario
Lake Ontario Fishing Boat Survey	Monitor trends in angler effort/catch/harvest in the open waters of Lake Ontario
Lake Ontario Chinook Salmon Mass Marking Program	Determine contribution of wild Chinook salmon to Lake Ontario sportfisheries and evaluate success of pen-rearing projects
Northern Pike and Muskellunge Monitoring in the Thousand Islands Region of the St. Lawrence River	Monitor northern pike and muskellunge spawning and nursery areas to assess reproductive success and influence habitat changes
Lake Ontario Hydroacoustic Preyfish Assessment	Use hydroacoustic technology to develop lakewide estimates of alewife numbers and biomass
Lake Erie Research Unit	
Lake Erie Commercial Fishery Assessment	Sampling to characterize harvest & age composition of Lake Erie's commercial yellow perch fishery

Lake Erie Lower Trophic Monitoring Program	Index of lower trophic indicators seasonally, including zooplankton, nutrient concentrations, temperature and water transparency
Lake Erie Open Lake Sport Fishing Survey	Creel survey measure of sport fishing catch and effort from Lake Erie's boat fisheries for walleye, smallmouth bass and yellow perch
Lake Erie Steelhead Smolt Out-migration Study	Sampling to assess size specific out-migration patterns of newly stocked steelhead in selected Lake Erie tributaries
Lake Erie Tributary Angler Diary Program	Diary index of fishing quality for Lake Erie's tributary steelhead fishery
Lake Erie Tributary Sea Lamprey Nest Density	Annual nest counts to index the concentration of sea lamprey nests in selected Lake Erie tributaries
Lake Erie Fish Cleaning Station Monitoring	Annual examination of angler caught walleye processed at cleaning stations to characterize size, age composition and stomach contents
Lake Erie Beach Seine Assessment	Continue pilot survey to assess abundance and distribution of near shore young-of-year fishes in eastern Lake Erie
Lake Erie Coldwater Community Assessment	Gill net index of abundance, age composition, growth, and diet of lake trout, burbot and lake whitefish
Lake Erie Warmwater Community Assessment	Gill net index of abundance, age composition, growth, and diet of walleye, yellow perch and smallmouth bass

Reports and Presentations

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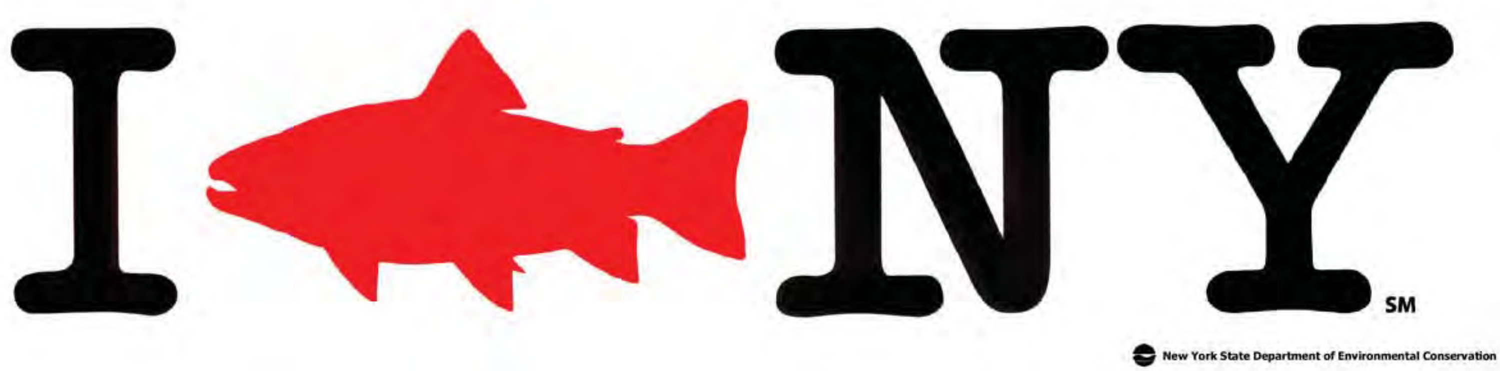

Permits & Licenses

A summary of licenses and permits reviewed or issued by the Bureau of Fisheries

DEC REGION

Permit Name	1	2	3	4	5	6	7	8	9	CO	Total
Farm Fish Pond			5	143		13	130	63	57		411
Stocking	7		138	26	81	42	35	16	7		352
Triploid Grass Carp	2	1	208	241	36	47	268	355/361	650		1814
Overland Transport of Bait			10	6		6	6	15	12		55
Fish Possession (over daily limit)					2		2		1		5
Piranha		1	1				2				4
Baitfish			80	42		49	112	77			360
Temporary Revocable Permit (TRP)			3	1	37	5	18	13	4		81
Article 15 Issued/Reviewed		2	440	228	311			82	321		1384
Article 24 Issued/Reviewed	14		231	5	1	*561/814					1065
Pesticide Permit Review	30		31	24	19	6	31	10	12		163
Bass Hatchery Permits (C.O)										20	20
Trout Hatchery Permits (C.O)										31	31
License to Collect and Possess		4						4	10	3	21
Other:											
Trout/Salmon in the Classroom			59	25	2/4						90
Hydropower Relicensing						0/3					3
Adopt A Natural Resource											
Fish Removal											
Commercial Fishing (Great Lakes)										5	9
Triploid Grass Carp Importer/Supplier											

**Issued/Reviewed*

RETIREMENTS

The Bureau of Fisheries would like to acknowledge the following recent retirees for their years of service to the Bureau and their contribution to the effective management of the freshwater fisheries of New York State.

Andy Gruelich
Salmon River Fish Hatchery

Lauren Watson
VanHornsville Fish Hatchery

Joe Galati
Region 9 Fisheries

Bill Schoch
Region 5 Fisheries

Mike Wilkinson
Region 9 Fisheries

Dan Zielinski
Region 4 Fisheries

Jennie Sausville
Region 5 Fisheries

Rich Preall
Region 5 Fisheries

Larry Wilson
Region 3 Fisheries

MIDDLE MOHAWK RIVER-BARGE CANAL FISH SURVEY AND FISHERY, 1981-1985

D.M. Carlson (2015)

ABSTRACT

The middle Mohawk River and Barge Canal defined as the 94 km (58 mi) section between Oneida Lake and Montgomery County, was surveyed in 1981-85 to describe fish communities. Water levels are regulated by 6 locks and dams in this highly modified section. Catches were compiled from gill nets, seine nets and electrofishing. Forty-eight fish species were captured, with white suckers and yellow perch caught most frequently. The recreational fishery in 1983-84 was dominated by panfish and smallmouth bass, and the angling pressure in 1981-83 averaged 198 hr/ha (80 hr/acre). Comparisons to surveys in the lower Mohawk River in 1979-83 showed substantial differences in catch rates and growth rates of sportfishes like walleye. Species lists for both Mohawk River sections, lower and middle are also compiled for times up to 2014, for a combined 71 species.

INTRODUCTION

The earliest thorough fish surveys of the Mohawk River took place in 1934, long after modifications related to a navigation system began in the 1820s. In the late 1970s, the New York State Department Environmental Conservation (DEC) began a series of fish surveys in the lower and middle sections of the Mohawk River and Barge Canal. McBride (1985, 2009) reported on findings in the lower section, and this report will provide similar information for surveys from the middle section. This study on the middle section in the 1980s was not made available previously, and it is being brought up to date with more recent surveys through 2014. These summaries are useful to planning efforts for improved resource management, like by McBride (1994) and an initiative in 2012 to gather all available information for use in a watershed management plan that intends to conserve and protect fish, wildlife and their habitats (NYSDEC 2012). The information provided herein will also benefit an ongoing study of current fish communities (George et al. 2014).

The fish species and their relative abundances in this system have been affected by many factors including canals across watershed boundaries, lock systems around waterfalls, stocking and incidental introductions. Several species from farther west in the canal system have gained access to this middle section of the Mohawk River through the Barge Canal, including those noted in the 1930s, like emerald shiner (Greeley 1934). Surveys of the middle Mohawk River in 1934 were limited to a few spots and registered only 33 species (Bishop 1934). Surveys farther west in the Barge Canal and in the Oswego watershed east of Oneida Lake were reported by Greeley (1928). In addition to the survey sites in 1981-85 reported on here, there have been only a few others in the mid-1970s (unpublished data files) and they remain generally obscure.

STUDY AREA

The study area (middle river section and Barge Canal west) includes the 94 km (58 mi) of New York State Barge Canal in DEC Region 6 (between Oneida Lake and East Canada Creek, in Oneida and Herkimer counties, Figure 1). It has 23 km (14 mi) of separate canal cut that is west of the entrance of the Mohawk River and 71 km (44 mi) of “canalized” Mohawk River channel (Table 1). There are an additional 63 km (39 mi) of the Mohawk River in its original streambed and alongside the canal that has been seasonally deprived of its natural flows. The Barge Canal is maintained as a series of lock-pools for navigation at an average depth of 4.3 m (14 ft) from May-October. Lock pools west of Marcy, Locks 20-22, are maintained at the navigation levels or depths from November to April and this was in place during the study years of 1981-85. After the navigation season, from November to April, lock pools east of Marcy or16-19 are lowered to about half the typical depths but most habitats are changed very little. The only exception to this and only in present times (since 1987), Lock Pool 17 was equipped with hydropower and is maintained at bank full levels throughout the year. The downstream sections outside of this study area, in Lock Pools 8-15, is controlled by the dams being lifted from November-April and the river becomes shallower and free flowing (McBride 1985). Flow conditions are described in more detail by Shindel (1969).

The Barge Canal follows an east-west preglacial valley (Moore 1935) from Oneida Lake to its confluence with the Mohawk River at Rome. Over this 23 km (14 mi), it has two locks (Locks 22 and 21) and descends 16 m (51 ft) (Bishop 1935); it then follows the Mohawk River east for 71 km (44 mi). The channels of the Barge Canal and the "old" Mohawk River remain separate from Rome to Frankfort, through Lock-Pools 20, 19 and parts of 16-18 (Figure 1). This results in three major habitat types, canal-cut (or barge canal), canalized channel and natural channel. Canal-cut habitat is in a new channel away from the old river and makes-up about half the surface area of this segment (Table 1). The next 26 km (16 mi) of the Barge Canal, from Frankfort to East Canada Creek, is canalized river in the historic channel, for all but three short segments (total of 6.8 km, 4.2 mi). These segments bypass the mouth of West Canada Creek, Little Falls and East Canada Creek below Five Mile Dam. Downstream of this study area, the canalized river continues downstream as the main habitat-type to Cohoes Falls, near the mouth of the river at Troy, NY for 113 km (70 mi).

The study section, spanning from Oneida Lake to Montgomery County, was divided into three reaches. Reach 1 is west of the Mohawk River at Rome and includes the Barge Canal from Oneida Lake to Rome. Reach 2 is from the confluence with the Mohawk River to Lock 19 (near Frankfort Dam), and Reach 3 is from Lock 19 to East Canada Creek. East Canada Creek joins the Mohawk River separate from the Barge Canal or in a bypass around Lock 16 (Figure 1). The entire Barge Canal study area includes 690 ha (1,707 acres), excluding the separate natural channel. Also there are 113 ha (281 acres) west of Rome or west of the Mohawk River (calculated from Hasse 1984).

The natural channel of the Mohawk River separate from the Barge Canal remains as several segments (Figure 1). The most upstream is a 10 km (6.3 mi) stretch from Rome to Nine Mile Creek (in Reach 2) and has flows which are commonly limited to about 1.4 m^3/s (50 ft^3/s) with a gradient of 0.06% (Hasse 1981). The outflow from the Rome Sewage Treatment Plant provides about 1/4th of the flow for this more southern natural river section, to Oriskany Creek (Hasse 1981). The natural river channel from Rome to Oriskany Creek has a very limited surface water runoff because the Mohawk River flows from the north have been rerouted to the canal. Most of the natural river channel is in Reach 2, accounting for 47 km (29 mi), and about two thirds of this distance is downstream of Oriskany Creek. Downstream of Oriskany Creek, the natural channel of the Mohawk River is typically 31 m (100 ft) wide and has some pools with aquatic vegetation. Downstream of Utica, tributaries like West Canada and East Canada creeks contribute substantial flow to the short sections of natural channel in some seasons, and the widths are typically 39 m (125 ft) (Hasse 1981).

The Mohawk River is a 5th order stream (Strahler number) from above Delta Reservoir near Rome downstream through most of Lock-Pool 20 to Oriskany Creek where it is a 6th order stream. This classification continues to the confluence with West Canada Creek, where it becomes 7th order.

Oriskany Creek and East Canada Creek are both 5th order streams (Figure 1) and all three of these tributaries have traits of trout streams that contrast to the lowland character of the Mohawk River/Barge Canal study section. The watershed area is 3,471 km^2 (1,340 mi^2) at Little Falls, and the average discharge at the USGS gage is 79.4 m^3/s (2,804 ft^3/s). Stream widths ranged from 15-62 m (50-201 ft) from May to October and are maintained at 4.3 m (14 ft) deep. Bottom substrates are predominantly gravel, sand and silt. The bottom types differ substantially among these habitat types (canalized channel and natural channel) and canalized sections are described in detail for the lower river (McBride 1987). Water quality improvements prior to 1980, from the industrial and sewage pollution of decades earlier, are described by Hasse (1981, 1999). There are additional improvements reported more recently, 1986-1990, as indicated by an analysis of the macroinvertebrate fauna (Bode et al. 2004).

Public use of these waters is high because of their locations near populated areas. The waters are popular for boating and generally productive for fishing. River access sites are located on maps by New York State Canals (2015), and fishing opportunities are described by Keesler (1992) and Gugnacki (1987). Fish consumption is currently subject to advisories concerning carp, largemouth bass and tiger muskellunge due to contaminants.

The only historic natural barrier to fish (prior to locks and dams) was the series of rapids at Little Falls. Farther downstream and 116 km (72 mi) below this study section is the noteworthy Cohoes Falls, near the mouth. The locks around Cohoes Falls allow a few ocean migrant species like blueback herring and American eel access to this upstream area. American eel were the only fish to historically ascend the falls.

METHODS

The data presented in this report are derived from a series of surveys conducted by DEC Region 6 personnel in the early 1980s. These surveys combined four major sampling approaches: gill netting in main channel areas, electrofishing and seining in shallow areas, trap nets in back waters and angler cooperator records from throughout the area (Table 2). Gear for sampling fish included gill nets with six mesh sizes (25-89 mm or 1-3.5 in stretch) to a length of 46m (150 ft) and a height of 1.85 m (6 ft), backpack electrofishing gear with 180 V DC, the regional boat electrofisher with 220 V DC, Oneida Lake trap nets (1.2 m or 4 ft), and a 9.2 m (30 ft) minnow seine. Sampling gear was generally similar to that used in the lower Mohawk River (McBride 1985). Catches from the lower Mohawk River from 1979-83 (McBride 1985) were compared to those in this study.

Most of the site visits, 128 of the 136, were completed in 1981-82. The Barge Canal west of Rome was sampled in May, June and September 1981 with mostly gill nets (Table 2). Mohawk River sites east of Rome were in the navigation canal for 86 sites and in the natural and separate river for 23 sites. They were typically sampled during the same summer months with the same gear. Analysis of these catches included lengths, weights and catch per effort. Size quality indices were calculated with Proportional Stock Density (PSD) for sportfish according to Green (1989) and Forney et al. (1994). Ages of fish were estimated at time of capture using scales. Common names of fishes follow the standards of Page et al. (2013), and scientific names are provided in Appendix A. These sites and gear deployment were described in detail in the electronic records of the DEC Historic Fisheries Records and NY Fish Atlas Data Base, and the locations are geo referenced in Appendix B.

Data from additional sampling at 37 sites in 1975-80 were available for comparison from Hasse (1981) and from the DEC Historic Fisheries Records, but were not analyzed for the present report. An historic list of species was compiled from surveys conducted prior to the 1980s. There were also samples at 39 tributary mouths in 1981-82 adjacent to the Mohawk River and Barge Canal, and these catches were summarized separately from others within the Mohawk River and Barge Canal.

Angler effort and behavior were assessed in the Mohawk River and Barge Canal between Oneida Lake and East Canada Creek (Figure 1) with 134 interviews on 5 days from May 14-June 26, 1983 to determine catch and harvest rates of sportfishes. An example of the interview form is shown in Appendix C. Interviews in this May-June period were not adequate for measuring bass catch rates because it was mostly before the bass season opened. Additionally, from May to December 1984, angler cooperators recorded their fishing trips with over 1,800 hrs of angling in warmwater angler diary handbooks supplied by DEC. This included dates of angling, duration and catches by experienced fishers. As a separate effort, angler counts were completed in areas near the locks during 1983 (Festa 1984) and were combined with aerial counts described by Hasse (1984).

Sample sites were identified by rivermile (RM) designations taken from the Barge Canal using "Grand Canal Cruising Guide" (1974) maps. Examples of rivermile designations include RM 0 at Buffalo, RM 211 at Oneida Lake, RM 223 at the Mohawk River juncture at Rome and RM 265 at E. Canada Creek. The sites were later labeled with Universal Transverse Mercator (UTM) coordinates and entered in the DEC Fish Atlas Data Base (unpublished files at DEC Region 6) in Microsoft Access and shown in Appendix B. Historic fish records separate from those reported for 1981-85 came mostly from DEC surveys and from the NYS Museum and American Museum Natural History, as stored in the NY Fish Atlas data base. Additional catch records from 1986-2014 are described for the entire Mohawk River/Barge Canal and these came from records, along with gear descriptions as stored in DEC electronic archives and the Fish Atlas Data Base.

RESULTS AND DISCUSSION

Fish species occurrence

Forty-eight fish species were collected from 140 sites from 1981-1985 (Table 3). Forty-three species were found in the Mohawk River reach east of Rome and five others were found in only the Barge Canal, western reach or Oswego drainage (Reach 1). Sixteen introduced species, or species found outside their native range, were also caught along with the 27 species native to the Mohawk watershed (Table 3). Reach 2 of the middle Mohawk River and Barge Canal, containing 79 km (49 mi) of channel from Rome to Lock 19 (Table 2), had higher species richness (37) than the reaches downstream or to the west. The eastern-most or downstream Reach 3, with 54 km (33 mi) of channel and extending to East Canada Creek, had 32 species. The most highly modified canal, or western reach that is within the Oswego watershed (Reach 1), had only 30 species, including a few species that were more typical of Oneida Lake, like freshwater drum, gizzard shad and creek chubsucker (Table 3).

A summary of surveys in the middle Mohawk River and Barge Canal (including west of Rome) prior to 1981 and of others through 2014 showed a total of 66 species (Table 4). This included 8 species seen only after 1986, and the list also had four species not seen again after 1934: redside dace, comely shiner, tadpole madtom and margined madtom (Table 4).

Tributary mouths were characterized as small bays of the otherwise straightened artificial waterway of the canalized Mohawk River. Fish records from these 38 sites from 1981-85 included 12 species (Table 5) that were not found in samples of the canalized or bypassed reaches, including: rainbow trout, brook trout, central mudminnow, central stoneroller, redside dace, fathead minnow, margined madtom, tadpole madtom, burbot, blackside darter, slimy sculpin and mottled sculpin. Three of these were caught in the Mohawk River in the next time period, 1986-2014, including central mudminnow, central stoneroller and fathead minnow (Table 4). Most of the other nine species were more typical of tributaries than the larger river and they are not included in the lists for the Mohawk River and Barge Canal.

Fish abundance
White sucker, yellow perch, gizzard shad, yellow bullhead and white perch were the most frequently caught fish from 1981-85 (Table 3). The most numerous sportfish, collected with gill nets were yellow perch and white perch (Table 6). Comparisons between river reaches showed the western canal-cut (Oneida Lake to Rome) had highest gill net catch rates of walleye, yellow perch, smallmouth bass and white perch (Table 6), which may relate to the proximity of Oneida Lake. The natural channel had the highest abundance of rock bass, 2/gill net, but the lowest abundance of all species, 6/net. The catch rate of all species per reach ranged from 6-43/net.

Gamefish catch rates
Walleye relative abundance averaged 1.5/gill net for all reaches, and had a PSD of 46 (Table 7). Walleye were most abundant in the western area, in the Barge Canal reach that connects with Oneida Lake (Reach 1), averaging 4 fish/net (Table 6). Walleye catches in this reach by angler diary cooperators in 1984 were low, 0.01/hr (Table 8). However, this may have resulted because the cooperators targeted other species. Higher values within Reach 1 came from west of Lock 21 (within 5 mi of Oneida Lake), at 0.11 walleye/hr. When considering just the main channel sections east of here, the Mohawk River and Barge Canal (Reaches 2 and 3), the average angler cooperator catch rate for walleye was 0.2/hr (Table 8). Another area with high walleye catch rates in 1984 was below Five Mile Dam, with a catch rate of 0.14/hr. Walleye catch rates by anglers in the entire study were moderate-low, 0.06/hr, when compared to most of the other rivers of northern or central New York, typically ranging from 0.3-0.5/hr (Forney et al. 1994). Even though walleye were recognized as a major component of the fishery (Festa et al. 1987), only these two smaller areas in 1984 had catch rates in a favorable (or average) range, ≥0.1 walleye/hr [as described by Forney et al. (1994) for New York lakes], and the overall estimate of abundance therefore becomes “average”. The goal for enhancing walleye fisheries by DEC (Festa et al. 1987) is to provide anglers who target walleyes with catch rates greater than 0.2/hr. This is a higher standard than catch rates for angler cooperators irrespective of their target species. There was no specific management for walleye enhancement here and the fishery is below the standard.

Smallmouth bass had relatively low abundance in gill net catches, ranging from 0.2-0.8/net (Table 6), and the size structure, with a PSD of 19%, was substantially lower than in the lower Mohawk River, 49% (McBride 1985). Additionally, the angler diary catch rates from the Mohawk River (Reaches 2-3) in 1984 were “good” (D. Green, Cornell Univ., personal communication 1990), averaging 0.3/hr (Table 8). However, this was substantially below those recorded in the lower Mohawk River, averaging 1.1/hr (McBride 2009).

Angler catch rates that can be connected to the angler counts for 1981-83 were from interviews in May-June 1983 (springtime only). This was during the last year of angler counts, and the total catch averaged

0.5 fish/hr (Table 8). Overall catch rates in 1984 (angler cooperators) were also less than 1 fish/hr and were highest for smallmouth bass and walleye (Table 8).

Angling effort

Angling effort was estimated from 1981-83 to provide a three-year average of 198 hr/ha (80 hr/acre) over the open water season or May--October (Hasse 1984) and the estimate for 1983 was 257 hr/ha (104 hr/acre). The area with highest angling effort in 1983 was in Reach 1, at about 594 hr/ha (240 hr/acre), and the local area around Lock 21 had 2,750 hr/ha (1,111 hr/acre) (Hasse 1984). Field notes in 1973 also recognized this area near Locks 21 and 22 as having heavy spring and summer angling effort (Hasse 1981). In 1982, the entire study area of the Barge Canal from Oneida Lake to Montgomery County averaged 198 hr/ha (80 hr/acre). In comparison, fishing pressure in the lower Mohawk River in 1982 was 156 hr/ha (63 hr/acre) (McBride 1994). Angler effort in the western canal reach from Oneida Lake to Lock 21 was unusually high because of the extension of the Oneida Lake fishery with walleye and other sportfish. It had 1,297 hr/ha (524 hr/acre) and angler effort in the reach east of Lock 21 (including the Mohawk east of Rome) was 89 hr/ha (36 hr/acre).

Growth rates

Walleye in the middle Mohawk River had grown to sizes for legal harvest (381mm or 15 in) after their 5th summer (age 4). Growth rates were compared to those in the lower Mohawk River, and walleye and white bass grew slower than in the lower Mohawk River (Table 9). This downstream section, contrasted to the upstream section, had a forage base more consistently enriched by migratory blueback herring. Growth rates for white perch, rock bass, smallmouth bass and yellow perch were similar to those in the lower Mohawk River (McBride 1986).

Comparison to Mohawk River downstream, 1979-83

These studies on both the middle Mohawk and lower Mohawk River were planned in the late 1970s, and it was intended that comparisons be possible, just as there would be comparisons within the individual reaches of those two segments. Within the lower Mohawk, there were substantial habitat differences between: 1) the two permanent pools nearest to the mouth with substantial shallow areas and 2) the next section upstream with Lock-Pools 8-15 having very few shallow areas (McBride 1985). Because of the similarities between Lock Pools 8-15 (lower river) and Lock Pools16-20 (middle river), both with very few shallow areas, the five lock-pools of the middle Mohawk River (16-20) were compared to the eight pools of the lower Mohawk River (8-15). These lock pools were more similar because of the depth characteristics, most of the year, resulting in negligible submerged aquatic vegetation.

During these Mohawk River studies of 1979-85, catch rates from gill nets for all species were similar between both river sections (lower and middle), 28 fish/gill net (Table 11). Catch rates were also similar for white sucker, about 7 fish/net. There were differences in catch rats between the two sections for blueback herring, smallmouth bass and walleye (Table 11). Blueback herring were abundant in the middle Mohawk River in the 1980s but not recorded prior to then nor since 2009 (Carlson et al. in preparation). Further downstream in the lower Mohawk River, blueback herring continue to make spring migrations for spawning as documented in recent surveys (Wells et al. 2013) and provide a major forage supply as juveniles for piscivorous fish (McBride 2009). Comparisons with the other types of sampling gear, like boat electrofishing were not practical since they were not used in a consistent frequency between the two studies.

The only other comparisons of catch between the middle and the lower river in the 1980s were with species richness and overall catch as relative abundance. The lower Mohawk River catches were tabulated as two segments in Table 12. Species richness had 43 species in the section with permanent pools, and the next-upstream segment with lock pools (that were lowered in winter) had 40 species (Table 10). This compares to 43 species in the middle Mohawk River with five lock-pools and the natural channel segments. The fishes with highest relative abundance in both sections of the lower Mohawk River were blueback herring and white sucker, while the next upstream section or the middle Mohawk River had highest relative abundance of white sucker, yellow bullhead and white perch (Table 12). These differences are the result of blueback herring being seasonal migrants and not traveling through all the locks. Other important species across both sections were shorthead redhorse, rock bass and yellow perch.

Comparisons to present times

The species lists for all time periods for both sections, 1930s to 2014 included 68 in the lower river and 63 in the middle river (Table 13). There were fewer samples before 1979 than after 1979, and expectedly there were more species in the later period. Five species were recorded in only the early period, or before these study periods: redfin pickerel, redside dace, lake chub, comely shiner and margined madtom. There were 71 species in both sections combined, and only 45 species (Table 13) were native to those sections (upstream of Cohoes Falls).

OVERVIEW AND CONCLUSION

The environmental sensitivities of additional species seen in 1981-85 compared to those in earlier surveys offers the best overall comparison between periods. In general, water quality was poor in the 1930s and it was much improved by the 1970s and 1980s (Hasse 1981, 1999). The earliest known surveys of these Mohawk River reaches (from Rome to Lock 20) were in 1934 using a seine, and Bishop (1935) found 21 species in the natural river (21 km or 12.8 mi) and only 9 in the Barge Canal (Table 4). Even though this gear has many limitations for sampling species in deeper water, it provided a good glimpse into what was present. This was followed by the inclusion of more pollution intolerant species (Halliwell et al. 1999). Unfortunately a more complete list of species inhabiting the Mohawk River before the canal construction or even before 1934 is unavailable.

The fish community in the Mohawk River was dominated by typical riverine species, and the species richness, 71, appears similar to other rivers of New York (ranging from 45-78, from unpublished data by author). However there is an uncommonly large proportion that are non-native (37%), like that known for the entire watershed (Carlson and Daniels 2004). Several of the smaller and more sensitive species that have been reported in tributaries or in early records would probably be more widespread if the depths and habitats were not so dramatically modified and consistently altered. Some of these species include eastern silvery minnow, rosyface shiner, lake chub, pearl dace, longnose sucker, stonecat and tadpole madtom.

The following conclusions are offered:

- The Middle Mohawk River and Barge Canal is a highly modified river section and the fish community has changed dramatically over the 90 years of record. In 1934 there were only a few sample sites resulting in 33 species and over the entire period there were 63 species.

- Catch rates of panfish in the Mohawk River 1981-85 with gill nets were highest for yellow perch and white perch and there were frequent catches of white sucker and gizzard shad. Walleye and smallmouth bass were important in the sport fishery and size structure and growth rate estimates were provided.
- Comparisons to studies in the lower Mohawk River in 1979-83 showed a few differences and several similarities. Walleye, smallmouth bass and blueback herring were caught at higher numbers with gill nets in the lower river. Overall, forty-three species were caught in the middle river and 48 in the lower river. Similarities between the two study segments included gill net catch rates for all species and for white sucker.
- The fish community is diverse and offers a popular recreational fishery. Protection of habitats and improvement to fishing access are priority management actions. Specific management efforts to enhance the fishery have been recommended for the lower Mohawk River (McBride 1994), and other similar steps might be considered for this section after the current study (George 2015) is completed.

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Figure 1. Mohawk River and Barge Canal study segment showing river reaches and habitats as natural channel or canalized river.

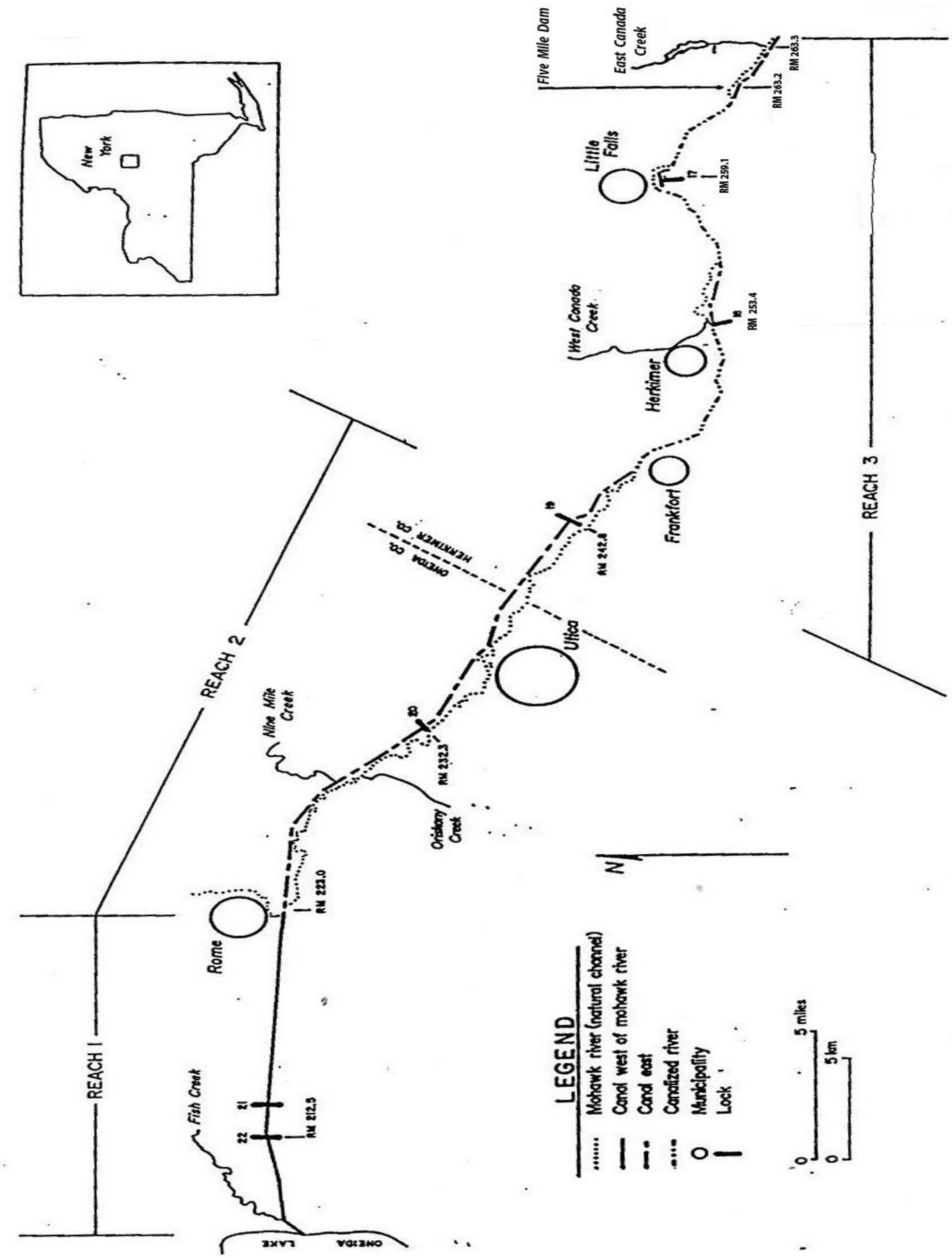


Table 1. River reaches and habitat types in the middle Mohawk River and Barge Canal.

Reach	Description	Water name	River kilometer	River miles	Habitat
1	Oneida Lake to Rome	Barge Canal (west)	22	13.9	canal
2	Rome to Lock 19	Mohawk River	32	19.7	canal
3	Lock 19-East Canada Creek	Mohawk River	39	24.2	canal and canalized river
2	Rome to Lock 19	Mohawk River (old)	47	29	natural channel
3	Lock 18-East Canada Creek	Mohawk River (old)	15	9.1	natural channel
1-3	Barge Canal/Mohawk R. total		71	43.9	
2-3	Mohawk River total		132	82	

Table 2. Sampling gear and effort for middle Mohawk River and Barge Canal, 1981-85.

Gear (years)	No. sites on Barge Canal/Mohawk River	No. sites on natural channel	No. sites on Barge Canal west	Total
	Reach 2-3	Reach 2-3	Reach 1	
gill nets (no. /net night, 1981-85)	80	11	26	117
seine (1981, 1982)	2	5	2	9
boat shocker (1982)	2	2		4
stream shocker (1981, 82, 84)	1	3		4
trap net (1982)		2		2
total	85	23	28	136
angling (hrs) (1983 interviews)	265		123	388
angling (hrs) (1984 diaries)	1,328		543	1,871

Table 3. Fish caught in the middle Mohawk River and Barge Canal to Oneida Lake as percent frequency occurrence, 1981-85.

	Mohawk R. Reach 2-3 all habitats %	Mohawk R. Reach 2-3 canalized &canal %	Mohawk R. (old) Reach 2-3 natural channel %	Barge Canal (west) Reach 1 canal %	Entire Reach (1-3) no. fish
American eel	0.9	1.3			1
blueback herring	5.4	7.6		17.9	57
gizzard shad	42.9	60.8		60.7	330
rainbow trout				7.1	3
brown trout	1.8	2.5		10.7	5
northern pike	2.7	2.5	3.4	21.4	10
chain pickerel	0.9		3.4	10.7	4
tiger muskellunge	2.7	1.3	6.9		6
goldfish	2.7	1.3	6.9		3
common carp	32.1	34.2	27.6	35.7	109
hornyhead chub	0.9	1.3			18
cutlip minnow	5.4		20.7		1
golden shiner	26.8	35.4	3.4	50.0	352
common shiner	12.5	3.8	27.6	3.6	109
spottail shiner	8.9	2.5	20.7	7.1	160
spotfin shiner	0.9	1.3			1
bluntnose minnow	10.7	1.3	27.6		697
blacknose dace	3.6		10.3		9
longnose dace	4.5		13.8		20
creek chub	8.9		24.1	7.1	280
fallfish	12.5	3.8	37.9	10.7	116
longnose sucker	0.9		3.4		1
white sucker	84.8	88.6	75.9	71.4	1788
creek chubsucker				3.6	2
northern hog sucker	10.7	6.3	24.1	3.6	24
shorthead redhorse				7.1	2
yellow bullhead	50.0	67.1	10.3	35.7	406
brown bullhead	20.5	24.1	10.3	50.0	74
stonecat	7.1	5.1	13.8		28
tadpole madtom				3.6	2
banded killifish	0.9		3.4		1
brook stickleback	1.8		6.9		2
white perch	49.1	64.6	6.9	39.3	407
white bass	21.4	27.8	3.4	39.3	119
rock bass	26.8	21.5	44.8	60.7	258
pumpkinseed	21.4	20.3	24.1	28.6	103
bluegill	4.5	5.1	3.4	17.9	14
smallmouth bass	25.0	19.0	41.4	32.1	102
largemouth bass	12.5	13.9	10.3		24
white crappie	23.2	31.6			113

Table 3. (cont.)	All habitats Reach 2-3 %	Canalized & canal Reach 2-3 %	Natural channel Reach 2-3 %	Canal Reach 1 %	Entire Reach 1-3 no. fish
black crappie	8.0	11.4		17.9	58
greenside darter	1.8		6.9		2
fantail dater	0.9		3.4		5
tessellated darter	14.3	1.3	37.9	3.6	172
yellow perch	46.4	58.2	17.2	75.0	432
logperch	7.1	3.8	13.8		16
walleye	29.5	38.0	10.3	82.1	178
freshwater drum				3.6	1
no. spp (48)	43	33	35	30	48
no. native spp	27				
no. sites	112	79	29	28	140

*Initial identification was within this genus and later collections resulted in relabeling as shown. Grey highlighting designates species found only in the Barge Canal section west of Mohawk R. Non-native species to the Mohawk watershed are designated with underline.

Table 4. Fish species captured in the Mohawk River, Rome to Little Falls.

	Year			
Species	1934	1973-83	1981-85	1986-2014
lake sturgeon				x
American eel		x	x	
blueback herring		x	x	x
gizzard shad		x	x	x
rainbow trout		x		
brown trout			x	x
brook trout		x		
central mudminnow				x
northern pike		x	x	x
chain pickerel	x		x	x
tiger muskellunge			x	x
central stoneroller		x		x
goldfish		x	x	
redside dace	x			
common carp	x	x	x	x
cutlip minnow	x		x	x
e. silvery minnow	x			
hornyhead chub			x	x
golden shiner	x	x	x	x
comely shiner	x			
satinfin shiner				x
emerald shiner	x	x		x
common shiner	x	x	x	x
spottail shiner	x	x	x	x
rosyface shiner	x	x		x
spotfin shiner		x	x	x
bluntnose minnow	x	x	x	x
fathead minnow	x			x
e. blacknose dace	x	x	x	x
longnose dace	x	x	x	x
rudd				x
creek chub	x	x	x	x
fallfish	x	x	x	x
longnose sucker	x	x	x	x
white sucker	x	x	x	x
northern hog sucker	x	x	x	x
shorthead redhorse				x
yellow bullhead		x	x	x
brown bullhead	x	x	x	x
channel catfish				x
stonecat		x	x	x
tadpole madtom	x			
margined madtom	x			

Table 4. (cont.)

	1934	1973-83	1981-85	1986-2014
brindled madtom		x		x
trout-perch				x
banded killifish	x	x	x	x
brook silverside				x
brook stickleback	x		x	x
white perch		x	x	x
white bass		x	x	x
rock bass		x	x	x
green sunfish				x
pumpkinseed	x	x	x	x
bluegill		x	x	x
smallmouth bass	x	x	x	x
largemouth bass	x	x	x	x
white crappie	x	x	x	x
black crappie	x	x	x	x
greenside darter			x	x
fantail dater		x	x	x
tessellated darter	x	x	x	x
yellow perch	x	x	x	x
logperch		x	x	x
walleye	x	x	x	x
freshwater drum				x
round goby				x
no. spp (66)	33	42	43	57
no. sites	12		140	

Table 5. Fish species caught (frequency occurrence) from tributaries of Mohawk River and Barge Canal (including west of Rome).

	west of Rome	Mohawk R tribs
gizzard shad	1	2
rainbow trout		2
brown trout	1	1
brook trout		2
central mudminnow	1	3
chain pickerel		2
tiger muskellunge		2
central stoneroller		14
redside dace		5
common carp	3	1
cutlip minnow	1	3
golden shiner	3	2
common shiner	3	24
spottail shiner	1	8
bluntnose minnow	4	16
fathead minnow	1	2
blacknose dace		25
longnose dace		14
creek chub	1	28
fallfish	2	2
white sucker	3	28
northern hog sucker		7
yellow bullhead	1	
brown bullhead	2	7
tadpole madtom	1	
margined madtom	1	
burbot	1	
banded killifish	1	4
brook stickleback	2	8
white perch		1
rock bass	2	3
pumpkinseed	3	3
smallmouth bass	2	5
largemouth bass		1
fantail dater		11
tessellated darter	2	18
yellow perch	3	1
logperch	3	7
blackside darter	1	
walleye		2
mottled sculpin		1
slimy sculpin		1
no. sites	5	34

Table 6. Gill net catch rates and numbers of sportfish and other species in natural channel and canal habitats in the middle Mohawk River and Barge Canal to Oneida Lake, 1981-85.

	Mohawk R. Reach 2-3 all habitats no./net	Mohawk R. Reach 2-3 canalized & canal no./net	Mohawk R. (old) Reach 2-3 natural channel no./net	Barge Canal (west) Reach 1 canal no./net
American eel	0.01	0.01		
blueback herring	0.21	0.24		0.75
gizzard shad	2.72	3.10		2.04
rainbow trout				0.11
brown trout	0.02	0.03		0.11
northern pike	0.02	0.03		0.25
chain pickerel				0.11
tiger muskellunge	0.01	0.01		
goldfish	0.01	0.01		
common carp	0.85	0.92	0.36	0.39
hornyhead chub*	0.01	0.01		
golden shiner	1.92	2.18	0.09	3.89
common shiner	0.03	0.04		0.04
spottail shiner	0.01	0.01		0.46
creek chub				0.11
fallfish	0.15	0.12	0.36	1.71
white sucker	5.65	6.28	1.18	7.21
creek chubsucker				0.04
northern hog sucker	0.07	0.08		0.07
shorthead redhorse				0.07
yellow bullhead	4.29	4.86	0.27	0.86
brown bullhead	0.46	0.50	0.18	1.04
stonecat	0.12	0.12	0.18	
tadpole madtom				0.07
white perch	3.06	3.45	0.27	4.68
white bass	0.81	0.90	0.18	1.64
rock bass	0.58	0.41	1.82	1.68
pumpkinseed	0.33	0.37		0.50
bluegill	0.04	0.05		0.36
smallmouth bass	0.31	0.33	0.18	0.75
largemouth bass	0.22	0.24	0.09	
white crappie	1.21	1.38		
black crappie	0.58	0.67		0.21
tessellated darter				0.04
yellow perch	1.90	2.15	0.09	8.96
logperch	0.02	0.03		
walleye	0.62	0.67	0.27	4.36
freshwater drum				0.04

Table 6. (cont.)

	All habitats	Canalized & canal	Natural channel	Canal
no. spp (38)	30	30	14	30
total	26	29	6	43
no. sites	89	78	11	28

Table 7. Size and abundance of sportfish in the middle Mohawk River and Barge Canal caught by gill net and angling.

	no. caught	mean length. (mm)	Size quality PSD	RSD	Abundance indices Angler Diaries (1984, no./hr)	Angler Interviews (1983, no./hr)	Gill net (no./net)
smallmouth bass							
gill net	182	211	19				0.4
angling (1983-84)	231	290	62		0.14	0.07	
walleye							
gill net	178	277	46	3			1.5
angling (1983-84)	118	406	76	15	0.06	0.01	
bullhead	276	196			0.02	0.03	17.0
white perch	388	206					3.4
rock bass	366	168			0.04	0.05	0.9
crappie	166	213			0.01	0.17	1.0
yellow perch	364	183			0.02	0.13	3.6

PSD and RSD are size structure indices according to Forney et al. (1994) and Green (1989)

Table 8. Angler catch by creel census (interviews) in 1983 and angler diary cooperator records in 1984.

Species	Catch, from records: Creel census 1983	Catch, from records: Diary cooperators 1984	Catch rate (no./hr): 1983 May-Jun all areas	Catch rate (no./hr): 1984 Open water season Oneida L. to Rome	Catch rate (no./hr): 1984 Open water season Mohawk River
northern pike		5			0.01
carp	16	40	0.04		0.06
white sucker	9	2			
brown bullhead	13	39	0.03	0.01	0.03
white perch		5			0.01
white bass	1	8			0.01
rock bass	45	109	0.05		0.19
sunfish	31	15	0.01	0.01	0.01
smallmouth bass	56	244	0.07	0.04	0.33
largemouth bass	1	37			0.06
white crappie	9		0.03		
black crappie	55	15	0.14		0.01
yellow perch	88	45	0.13	0.02	0.04
walleye	10	106	0.01	0.01	0.16
Total	209	571	0.53	0.1	0.61
no. sites (records)	134	98			
no. hrs	388	1871		543	967

Table 9. Growth rate (length at capture) of sport fish in the middle Mohawk River and Barge Canal, based on scale analysis in 1983. Comparison vales are shown for the lower Mohawk River.

	Age (years)						
	1	2	3	4	5	6	7
Walleye	**214**	**222**	**330**	**376**	**426**	**473**	**473**
(no.)	2	5	4	6	1	1	1
Smallmouth bass		**198**		**286**			
(no.)		4		6			
Rock bass		**139**	**149**	**184**	**219**		
(no.)		2	6	3	7		
Yellow perch	**135**		**178**	**251**	**267**	**226**	**287**
(no.)	7		25	8	3	3	3
White bass	**152**	**183**	**264**	**325**	**343**	**373**	
(no.)	4	15	10	6	5	2	
White perch		**196**	**221**	**234**			
(no.)		12	14	3			
Lower Mohawk R (compiled from McBride 1986)							
Walleye	251	366	414	475	549	597	
Smallmouth bass	104	201	262	312	348	384	
Rock bass	79	130	170	203	216	226	
Yellow perch	117	188	234	251	279		

Table 10. Fish species encountered during sampling in middle Mohawk and lower Mohawk River, 1979-85. Values for the middle Mohawk River are in frequency occurrence from all gear types.

	Lower Mohawk mth-lock8 lower 3 pools	Lower Mohawk lock 8-16 other 9 pools	Mid-Mohawk R. lock 16-20 all habitats %	Mid-Mohawk R. (old) reach 2-3 natural channel %
American eel	x	x	0.9	
blueback herring	x	x	5.4	
alewife	x			
<u>gizzard shad</u>	x	x	42.9	
<u>brown trout</u>			1.8	
<u>northern pike</u>	x	x	2.7	3.4
chain pickerel	x	x	0.9	3.4
<u>tiger muskellunge</u>	x		2.7	6.9
central stoneroller		x		
<u>goldfish</u>	x	x	2.7	6.9
<u>common carp</u>	x	x	32.1	27.6
cutlip minnow	x		5.4	20.7
eastern silvery minnow	x			
hornyhead chub			0.9	
golden shiner	x	x	26.8	3.4
satinfin shiner	x	x		
emerald shiner	x	x		
common shiner	x	x	12.5	27.6
spottail shiner	x	x	8.9	20.7
rosyface shiner	x	x		
spotfin shiner	x	x	0.9	
bluntnose minnow	x	x	10.7	27.6
fathead minnow	x	x		
blacknose dace			3.6	10.3
longnose dace			4.5	13.8
creek chub		x	8.9	24.1
fallfish	x	x	12.5	37.9
longnose sucker			0.9	3.4
white sucker	x	x	84.8	75.9
northern hog sucker		x	10.7	24.1
shorthead redhorse	x	x		
white catfish	x			
yellow bullhead	x	x	50.0	10.3
brown bullhead	x	x	20.5	10.3
channel catfish	x			
stonecat		x	7.1	13.8
brindled madtom	x	x		
trout-perch	x	x		
banded killifish		x	0.9	3.4

Table 10 (cont.)

	Lower 3 pools	Other 9 pools	All habitats	Natural channel
brook stickleback			1.8	6.9
white perch	x	x	49.1	6.9
white bass	x	x	21.4	3.4
striped bass	x			
rock bass			26.8	44.8
redbreast sunfish	x			
pumpkinseed	x	x	21.4	24.1
bluegill	x	x	4.5	3.4
smallmouth bass	x	x	25.0	41.4
largemouth bass	x	x	12.5	10.3
white crappie	x	x	23.2	
black crappie	x	x	8.0	
greenside darter			1.8	6.9
fantail dater			0.9	3.4
tessellated darter	x	x	14.3	37.9
yellow perch	x	x	46.4	17.2
logperch	x	x	7.1	13.8
walleye	x	x	29.5	10.3
no.spp (57)	43	40	43	35

Table 11. Comparison of gill net catch rates in lower Mohawk River, pools 8-16 and middle Mohawk River, pools 17-19.

	lower Mohawk R. pools'8-16 canalized mean no./net	middle Mohawk R. pools 16-20 canalized & canal no./net
American eel		0.01
blueback herring	7.8	0.24
gizzard shad		3.10
brown trout		0.03
northern pike		0.03
tiger muskellunge		0.01
goldfish		0.01
common carp	0.6	0.92
hornyhead chub		0.01
golden shiner	0.7	2.18
common shiner		0.04
spottail shiner		0.01
fallfish	1.5	0.12
white sucker	7.0	6.28
northern hog sucker	0.5	0.08
shorthead redhorse	3.5	
yellow bullhead	0.2	4.86
brown bullhead	1.2	0.50
stonecat	1.1	0.12
white perch	0.9	3.45
white bass	0.2	0.90
rock bass	3.3	0.41
pumpkinseed		0.37
bluegill	0.3	0.05
smallmouth bass	2.2	0.33
largemouth bass		0.24
white crappie		1.38
black crappie	0.4	0.67
yellow perch	3.1	2.15
logperch		0.03
walleye	1.7	0.67
no. spp (38)	18	30
total	28	29
no. sites		78

Underline designates species not native to the Mohawk River upstream of Cohoes Falls, near the mouth.

Table 12. Relative abundance of fish species caught in gill nets in the lower Mohawk River, 1979-82 and in the middle Mohawk River, 1981-85.

	Lower Mohawk perm pools 1979-80	Lower Mohawk seasonal pool 1981-82	Middle Mohawk 1981-85
American eel			0.04
blueback herring	17.8	23.3	0.81
gizzard shad	0.2		10.34
brown trout			0.09
northern pike			0.09
tiger muskellunge			0.04
goldfish	0.2		0.09
common carp	6.2	1.1	3.25
hornyhead chub			0.04
golden shiner	6	0.9	7.31
common shiner			0.13
spottail shiner			0.04
fallfish	1	3.4	0.56
white sucker	14.3	20.8	21.50
northern hog sucker		0.4	0.26
shorthead redhorse	4.6	10.9	
yellow bullhead	1	0.1	16.32
brown bullhead	3.7	3	1.75
stonecat		2.6	0.47
brindled madtom		0.1	
white perch	5.9	0.6	11.62
white bass	0.1	0.1	3.08
rock bass	9.5	10.7	2.22
pumpkinseed	5.1		1.24
bluegill	0.2	0.1	0.17
smallmouth bass	5.3	7	1.20
largemouth bass	0.1		0.85
white crappie	1.3		4.62
black crappie	0.6	0.4	2.22
yellow perch	14.5	8.5	7.22
logperch			0.09
walleye	1.9	6	2.35
sum	100	100	100
total no.			2340
No. spp.	21	19	30

Underline designates species not native to the Mohawk River upstream of Cohoes Falls, near the mouth.

Table 13. Fish species encountered during sampling in middle Mohawk River and lower Mohawk River through 2014, before and after 1979.

	lower Mohawk before 1979	lower Mohawk after 1979	mid-Mohawk R. before 1979	mid-Mohawk R. after 1981
lake sturgeon		x		x
American eel	x	x	x	x
blueback herring	x	x	x	x
alewife	x	x		
American shad		x		
gizzard shad		x	x	x
rainbow trout		x	x	
brown trout		x		x
brook trout		x	x	
central mudminnow	x	x		x
redfin pickerel	x			
northern pike		x	x	x
chain pickerel	x	x	x	x
tiger muskellunge		x		x
central stoneroller		x	x	x
goldfish	x	x	x	x
redside dace			x	
lake chub	x			
common carp	x	x	x	x
cutlip minnow	x	x	x	x
eastern silvery minnow	x	x	x	
hornyhead chub	x			x
golden shiner	x	x	x	x
comely shiner			x	
satinfin shiner	x	x		x
emerald shiner	x	x	x	x
common shiner	x	x	x	x
spottail shiner	x	x	x	x
rosyface shiner	x	x	x	x
spotfin shiner	x	x	x	x
bluntnose minnow	x	x	x	x
fathead minnow	x	x	x	x
blacknose dace		x	x	x
longnose dace		x	x	x
rudd		x		x
creek chub	x	x	x	x
fallfish	x	x	x	x
longnose sucker	x		x	x
white sucker	x	x	x	x
northern hog sucker	x	x	x	x
shorthead redhorse	x	x		x

Table 13. (cont.)

	Lower Mohawk	Lower Mohawk	Mid-Mohawk R.	Mid-Mohawk R.
white catfish		x		
yellow bullhead	x	x	x	x
brown bullhead	x	x	x	x
channel catfish		x		x
stonecat	x	x	x	x
tadpole madtom	x	x	x	
margined madtom			x	
brindled madtom		x	x	x
trout-perch	x	x		x
banded killifish	x	x	x	x
brook silverside	x	x		x
brook stickleback	x	x	x	x
white perch	x	x	x	x
white bass		x	x	x
striped bass	x	x		
rock bass	x	x	x	x
redbreast sunfish		x		
green sunfish		x		x
pumpkinseed	x	x	x	x
bluegill	x	x	x	x
smallmouth bass	x	x	x	x
largemouth bass	x	x	x	x
white crappie	x	x	x	x
black crappie	x	x	x	x
greenside darter	x	x		x
rainbow darter		x		
fantail dater	x	x	x	x
tessellated darter	x	x	x	x
yellow perch	x	x	x	x
logperch	x	x	x	x
walleye	x	x	x	x
freshwater drum		x		x
round goby				x
no. spp. (71)	50	65	51	58
no. native spp (45)	36	38	36	36

Underline designates species not native to the Mohawk River upstream of Cohoes Falls, near the mouth.

Appendix A Common and scientific names of fishes used in this report.

lake sturgeon	*Acipenser fulvescens*
American eel	*Anguilla rostrata*
blueback herring	*Alosa aestivalis*
gizzard shad	*Dorosoma cepedianum*
rainbow trout	*Oncorhynchus mykiss*
brown trout	*Salmo trutta*
brook trout	*Salvelinus fontinalis*
central mudminnow	*Umbra limi*
northern pike	*Esox lucius*
chain pickerel	*Esox niger*
tiger muskellunge	*E. lucius x E. masquinongy*
central stoneroller	*Campostoma anomalum*
goldfish	*Carassius auratus*
redside dace	*Clinostomus elongatus*
lake chub	*Couesius plumbeus*
common carp	*Cyprinus carpio*
cutlip minnow	*Exoglossum maxillingua*
eastern silvery minnow	*Hybognathus regis*
hornyhead chub	*Nocomis biguttatus*
golden shiner	*Notemigonus crysoleucas*
comely shiner	*Notropis amoenus*
satinfin shiner	*Cyprinella analostana*
emerald shiner	*Notropis atherinoides*
common shiner	*Luxilus cornutus*
spottail shiner	*Notropis hudsonius*
rosyface shiner	*Notorpis rubellus*
spotfin shiner	*Cyprinella spiloptera*
bluntnose minnow	*Pimephales notatus*
fathead minnow	*Pimephales promelas*
e. blacknose dace	*Rhinichthys atratulus*
longnose dace	*Rhinichthys cataractae*
rudd	*Scardinius erythrophthalmus*
creek chub	*Semotilus atromaculatus*
fallfish	*Semotilus corporalis*
longnose sucker	*Catostomus*
white sucker	*Catostomus commersonii*
northern hog sucker	*Hypentelium nigricans*
shorthead redhorse	*Moxostoma macrolepidotum*
yellow bullhead	*Ameiurus natalis*
brown bullhead	*Ameiurus nebulosus*
channel catfish	*Ictalurus punctatus*
stonecat	*Noturus flavus*
tadpole madtom	*Noturus gyrinus*
margined madtom	*Noturus insignis*
brindled madtom	*Noturus miurus*
trout-perch	*Percopsis omiscomaycus*

Appendix A. (cont.)

banded killifish	*Fundulus diaphanus*
brook silverside	*Labidesthes sicculus*
brook stickleback	*Culaea inconstans*
white perch	*Morone americana*
white bass	*Morone chrysops*
rock bass	*Ambloplites rupestris*
green sunfish	*Lepomis cyanellus*
pumpkinseed	*Lepomis gibbosus*
bluegill	*Lepomis macrochirus*
smallmouth bass	*Micropterus dolomieu*
largemouth bass	*Micropterus salmoides*
white crappie	*Pomoxis annularis*
black crappie	*Pomoxis nigromaculatus*
greenside darter	*Etheostoma blennioides*
rainbow darter	*Etheostoma caeruleum*
fantail dater	*Etheostoma flabellare*
tessellated darter	*Etheostoma olmstedi*
yellow perch	*Perca flavescens*
logperch	*Percina caprodes*
blackside darter	*Percina maculata*
walleye	*Sander vitreum*
freshwater drum	*Aplodinotus grunniens*
round goby	*Neogobius melanostomus*
mottled sculpin	*Cottus bairdi*
slimy sculpin	*Cottus cognatus*

Appendix B Sample sites, dates and gear for the Mohawk River/Barge Canal 1981-85 survey.

Date	site description	County	ws	site location code	NYTME	NYTMN	gear
5/14/1981	3.2 KM W OF MOHAWK R	ONEI	OS	HDEC_23175_1	460000	4783300	Gill net
5/14/1981	3 KM W OF MOHAWK R	ONEI	OS	HDEC_23175_2	460200	4783300	Gill net
5/14/1981	1.5 KM W OF MOHAWK R	ONEI	OS	HDEC_23175_3	461700	4783100	Gill net
5/14/1981	0.5 KM W OF MOHAWK R	ONEI	OS	HDEC_23175_4	462700	4783100	Gill net
5/14/1981	0.2 KM W OF MOHAWK R	ONEI	OS	HDEC_23175_5	463000	4783100	Gill net
5/14/1981	3 KM W OF MOHAWK R	ONEI	OS	HDEC_23176_2	460200	4783300	Gill net
5/18/1981	3 KM W OF MOHAWK R	ONEI	OS	HDEC_23176_1	460200	4783300	Gill net
5/18/1981	0.1 KM W OF MOHAWK R ON S BANK(RMI VALUE IS IN CANAL MILES)	ONEI	OS	HDEC_23176_3	463000	4783100	Gill net
5/20/1981	0.2 KM W OF MOHAWK R(RMI VALUE IS CANAL MILES)	ONEI	OS	HDEC_23177_1	463000	4783100	Gill net
5/20/1981	0.1 KM W OF MOHAWK R(RMI VALUE IN CANAL MILES)	ONEI	M	HDEC_23177_2	463000	4783100	Gill net
5/20/1981	AT CONFLUENCE OF MOHAWK R(RMI VALVE IS IN CANAL MILES)	ONEI	M	HDEC_23177_3	463200	4783000	Gill net
5/21/1981	0.5 KM W OF LOCK 22	ONEI	OS	HDEC_23178_1	447000	4784000	Gill net
5/21/1981	1 KM W OF LOCK 22	ONEI	OS	HDEC_23178_2	446500	4783900	Gill net
5/21/1981	2 KM W OF LOCK 22	ONEI	OS	HDEC_23178_4	445500	4783700	Gill net
5/21/1981	2 KM W OF LOCK 22	ONEI	OS	HDEC_23178_5	445500	4783700	Gill net
5/22/1981	BETWEEN LOCKS 21 & 22	ONEI	OS	HDEC_23179_1	448800	4784000	Gill net
5/22/1981	BETWEEN LOCKS 21 & 22	ONEI	OS	HDEC_23179_1	448800	4784000	Gill net
6/17/1981	OLD ERIE CANAL AT NEW LONDON DRY DOCK	ONEI	OS	HDEC_23181_1	452900	4783800	Electric shocker
9/9/1981		ONEI	M	HDEC_23180_1			Gill net
9/9/1981		ONEI	M	HDEC_23180_5			Gill net
9/9/1981		ONEI	M	HDEC_23180_6	455000	4783600	Gill net
9/9/1981		ONEI	M	HDEC_23180_7			Gill net
9/9/1981		ONEI	M	HDEC_23180_8	448800	4784000	Gill net
9/9/1981		ONEI		HDEC_23180_9			Gill net
9/10/1981		ONEI	M	HDEC_23180_2	456600	4783500	Gill net
9/10/1981		ONEI	M	HDEC_23180_3	459000	4783300	Gill net
9/10/1981		ONEI	M	HDEC_23180_4	452400	4783800	Gill net
10/8/1981		ONEI	M	HDEC_23183_1	475100	4777600	Seine
4/20/1982			M	HDEC_23067_1			Gill net
4/20/1982			M	HDEC_23067_2			DJ nets
4/20/1982			M	HDEC_23067_3			Gill net
4/20/1982		ONEI	M	HDEC_23184_1			Gill net
4/21/1982			M	HDEC_23068_1			Gill net
4/21/1982			M	HDEC_23068_2			Gill net
4/21/1982		ONEI	M	HDEC_23068_3			Gill net
4/21/1982		ONEI	M	HDEC_23068_4			Gill net
4/21/1982		ONEI	M	HDEC_23068_5			Gill net
4/22/1982		ONEI	M	HDEC_22997_3			Gill net
4/22/1982		ONEI	M	HDEC_22997_4			Gill net

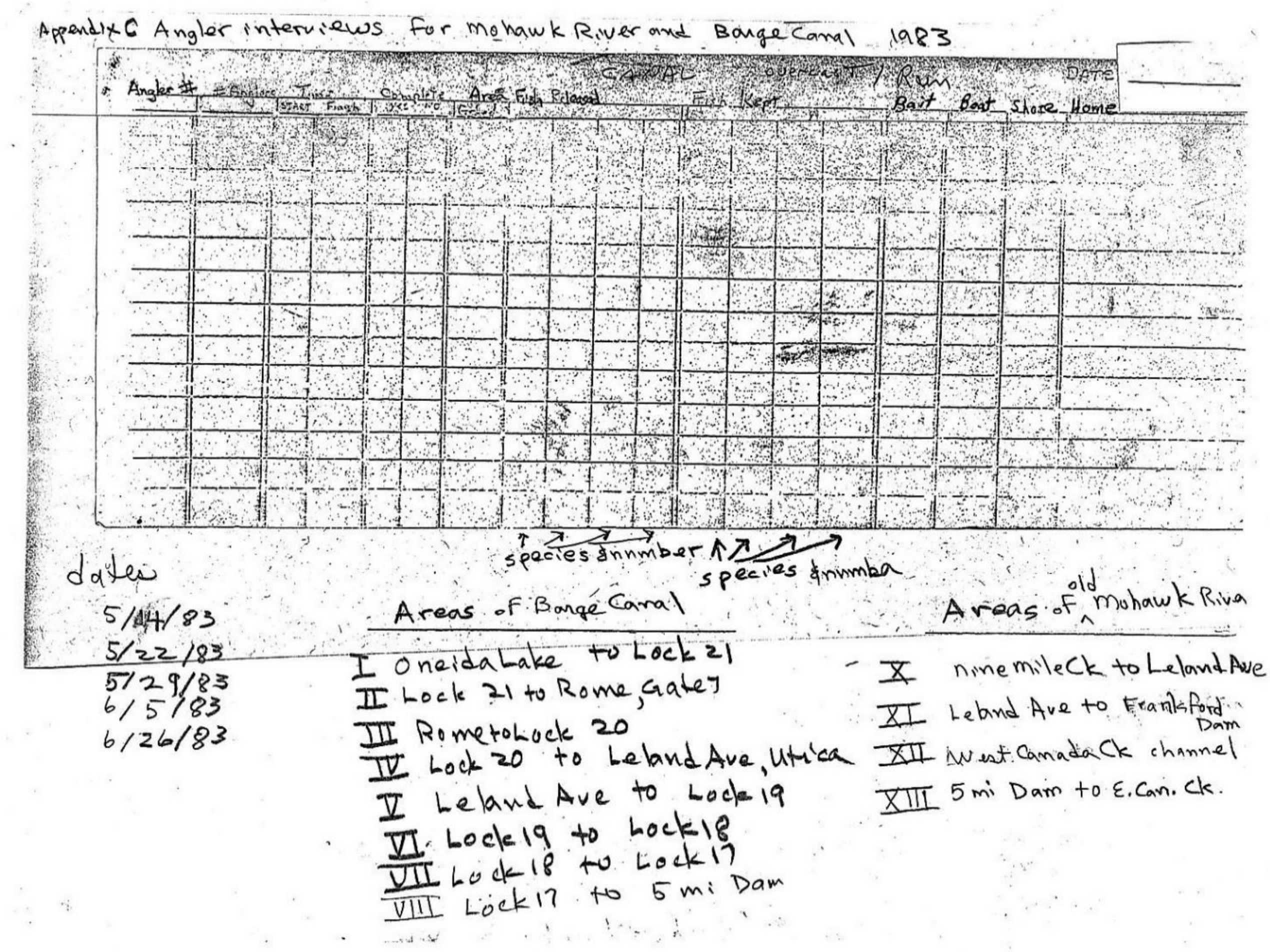
4/22/1982		ONEI	M	HDEC_23068_6			Gill net
4/22/1982		ONEI	M	HDEC_23068_7			Gill net
4/23/1982		HERK	M	HDEC_22963_1			Gill net
4/23/1982		HERK	M	HDEC_22963_2			Gill net
4/23/1982		ONEI	M	HDEC_22997_1			Gill net
4/23/1982		ONEI	M	HDEC_22997_2			Gill net
4/27/1982		ONEI	M	HDEC_22998_1			Gill net
4/27/1982		ONEI	M	HDEC_22998_2			Gill net
4/27/1982		ONEI	M	HDEC_22998_3			Gill net
4/27/1982		ONEI	M	HDEC_22998_4			Gill net
4/28/1982		ONEI	M	HDEC_22999_1			Gill net
4/28/1982		ONEI	M	HDEC_22999_2			Gill net
4/28/1982		ONEI	M	HDEC_22999_3			Gill net
4/28/1982		ONEI	M	HDEC_22999_4			Gill net
4/29/1982		HERK	M	HDEC_22961_1			Gill net
4/29/1982		HERK	M	HDEC_22961_2			Gill net
4/29/1982		ONEI	M	HDEC_23000_1			Gill net
4/29/1982		ONEI	M	HDEC_23000_2			Gill net
4/30/1982		HERK	M	HDEC_22960_1			Gill net
4/30/1982		HERK	M	HDEC_22960_2			Gill net
4/30/1982		HERK	M	HDEC_22960_3			Gill net
4/30/1982		HERK	M	HDEC_22960_4			Gill net
5/18/1982		HERK	M	HDEC_22962_1			Gill net
5/18/1982		HERK	M	HDEC_22962_2			Gill net
5/18/1982		HERK	M	HDEC_22962_3			Gill net
5/18/1982		HERK	M	HDEC_22962_4			Gill net
5/19/1982		HERK	M	HDEC_22512_3			Gill net
5/19/1982		HERK	M	HDEC_22512_4			Gill net
5/19/1982		HERK	M	HDEC_22964_1			Gill net
5/19/1982		HERK	M	HDEC_22964_2			Gill net
5/20/1982		HERK	M	HDEC_22500_1	500016	4762695	Gill net
5/20/1982		HERK	M	HDEC_22512_1			Gill net
5/20/1982		HERK	M	HDEC_22512_2			Gill net
5/20/1982		HERK	M	HDEC_22513_1	498091	4762772	Gill net
5/21/1982		HERK	M	HDEC_22490_1			Gill net
5/21/1982		HERK	M	HDEC_22490_2			Gill net
5/21/1982		HERK	M	HDEC_22500_2			Gill net
5/21/1982		HERK	M	HDEC_22500_3			Gill net
6/3/1982	AT T288	ONEI	M	HDEC_23282_1	461900	4801900	Electric shocker
7/7/1982	1 KM ABV T172	HERK	M	HDEC_22501_1	505500	4763000	Seine
7/7/1982	1.5 KM ABV T172	HERK	M	HDEC_22501_2	505000	4763200	Seine
7/7/1982		HERK	M	HDEC_22515_1			Gill net
7/7/1982		HERK	M	HDEC_22515_2			Gill net
7/7/1982		HERK	M	HDEC_22515_3			Gill net
7/7/1982		HERK	M	HDEC_22515_4			Gill net
7/7/1982		HERK	M	HDEC_22515_5			Gill net

7/7/1982		HERK	M	HDEC_22515_6			Electric shocker
7/12/1982	2.7 KM ABV T180	HERK	M	HDEC_22516_1	500400	4762400	Gill net
7/13/1982	AT T159, Little Falls bypass channel	HERK	M	HDEC_22463_1	510983	4765183	Electric shocker
7/13/1982	1 KM ABV T172	HERK	M	HDEC_22502_1	505500	4763000	Electric shocker
7/14/1982	0.5 KM BEL T180	HERK	M	HDEC_22502_2	503400	4763300	Electric shocker
7/15/1982		MONT	M	HDEC_22206_1			Seine
7/15/1982	1.4mi abv t195 (Bonny Bk)	HERK	M	HDEC_22965_1	491129	4768093	Gill net
7/15/1982	1.5mi abv t195 (Bonny Bk)	HERK	M	HDEC_22965_2	491023	4768181	Gill net
7/15/1982		HERK	M	HDEC_22965_4			Gill net
7/15/1982		HERK	M	HDEC_22965_5			Gill net
9/8/1982		ONEI	M	HDEC_23053_1			Gill net
9/8/1982		ONEI	M	HDEC_23053_2			Gill net
9/8/1982		ONEI	M	HDEC_23053_3			Gill net
9/8/1982		ONEI	M	HDEC_23069_1			Gill net
9/8/1982		ONEI	M	HDEC_23069_2			Gill net
9/8/1982		ONEI	M	HDEC_23069_3			Gill net
9/8/1982		ONEI	M	HDEC_23069_4			Gill net
9/9/1982	.2mi blw t187 (Steele Ck)	HERK	M	HDEC_22518_3	497452	4763224	Gill net
9/9/1982		HERK	M	HDEC_22966_1			Gill net
9/9/1982		HERK	M	HDEC_22966_2			Gill net
9/9/1982		HERK	M	HDEC_22966_3			Gill net
9/9/1982		HERK	M	HDEC_22966_4			Gill net
9/9/1982		HERK	M	HDEC_22966_5			Gill net
9/9/1982		HERK	M	HDEC_22966_6			Gill net
9/10/1982	.2mi abv T178, Ft. Herkimer	HERK	M	HDEC_22503_1	503328	4762983	Gill net
9/10/1982		HERK	M	HDEC_22503_2	505663	4762621	Gill net
9/10/1982	0.2mi abv outlet to Canal, at ouitlet P5447	HERK	M	HDEC_22503_3	506689	4762860	Gill net
9/10/1982	.3mi abv T163	HERK	M	HDEC_22503_4	508395	4763011	Gill net
9/10/1982	.2mi abv t186	HERK	M	HDEC_22518_1	498343	4762642	Gill net
9/10/1982		HERK	M	HDEC_22518_2			Gill net
9/10/1982	at t183	HERK	M	HDEC_22518_2	499894	4762677	Gill net
9/14/1982	100 M BEL T178A	HERK	M	HDEC_22504_1	503200	4762700	Seine
9/14/1982	AT T185	HERK	M	HDEC_22517_1	498900	4762300	Seine
9/14/1982	AT 216(RMI VALUE IS TAKEN FROM BARGE CANAL MILEAGE)	ONEI	M	HDEC_23071_1	479400	4774700	Seine
9/14/1982	1 KM ABV T222(RMI VALUE IS IN CANAL MILES)	ONEI	M	HDEC_23071_2	474700	4778100	Seine
9/15/1982		ONEI	M	HDEC_23066_1			Gill net
9/15/1982		ONEI	M	HDEC_23066_2			Gill net
9/15/1982		ONEI	M	HDEC_23066_3			Gill net
9/16/1982		ONEI	M	HDEC_23070_1			Gill net
9/16/1982		ONEI	M	HDEC_23070_2			Gill net
9/16/1982		ONEI	M	HDEC_23070_3			Gill net
7/13/1983	0.5 KM ABV T219 TO 50 M BEL	ONEI	M	HDEC_23072_1	478000	4774700	Seine
6/26/1984	FRANKFORT DAM UPSTREAM 4 KM	HERK	M	HDEC_22967_1			Gill net
6/26/1984	FRANKFORT DAM UPSTREAM 4 KM	HERK	M	HDEC_22967_3			Gill net
6/27/1984	FRANKFORT DAM UPSTREAM 3 KM	HERK	M	HDEC_22967_10			Gill net

6/27/1984	FRANKFORT DAM UPSTREAM 3 KM	HERK	M	HDEC_22967_11			Seine
7/24/1984	AT T222	ONEI	M	HDEC_23073_3	475300	4777000	Seine
7/24/1984	AT 223	ONEI	M	HDEC_23073_4	473600	4778900	Seine
7/24/1984	MTH AT MOHAWK R/H-240-222	ONEI	M	HDEC_23111_1	475400	4777100	Electric shocker
7/26/1984	AT 219	ONEI	M	HDEC_23073_1	478200	4774500	Electric shocker
7/26/1984	0.5 KM BEL T221	ONEI	M	HDEC_23073_2	476800	4775600	Electric shocker
8/29/1984	0.2 KM ABV THRUWAY	ONEI	M	HDEC_23074_1	476800	4775600	Boat shocker
8/29/1984	AT THRUWAY	ONEI	M	HDEC_23074_3	476800	4775600	Boat shocker
8/29/1984	JUST BEL T219	ONEI	M	HDEC_23074_4	478200	4774500	Boat shocker
8/30/1984	BETWEEN T219 AND BARNES AVE	ONEI	M	HDEC_23074_5			Boat shocker
5/16/1985	1.6 KM FROM ONEIDA L	ONEI	OS	HDEC_23185_10	441800	4783300	Other, see description
5/16/1985	1.6 KM FROM ONEIDA L	ONEI	OS	HDEC_23185_2	441800	4783300	Other, see description
5/16/1985	1.6 KM FROM ONEIDA L	ONEI	OS	HDEC_23185_3	441800	4783300	Other, see description
5/16/1985	1.6 KM FROM ONEIDA L	ONEI	OS	HDEC_23185_4	441800	4783300	Other, see description
5/16/1985	1.6 KM FROM ONEIDA L	ONEI	OS	HDEC_23185_5	441800	4783300	Other, see description
5/16/1985	1.6 KM FROM ONEIDA L	ONEI	OS	HDEC_23185_7	441800	4783300	Other, see description
5/16/1985	1.6 KM FROM ONEIDA L	ONEI	OS	HDEC_23185_9	441800	4783300	Other, see description
6/25/1985	BEL MOSS ISLAND	HERK	M	HDEC_22466_1			Gill net
6/25/1985	AT 158	HERK	M	HDEC_22466_2	511700	4765100	Gill net
6/25/1985	0.5 KM BEL T153	HERK	M	HDEC_22466_3	515400	4763800	Gill net
6/25/1985	1.4 KM BEL T152	HERK	M	HDEC_22466_4	515400	4763800	Gill net
6/27/1985	JUNCTION OF MOHAWK R AND BARGE CANAL(RMI VALVE IN CANAL MI)	ONEI	M	HDEC_23211_1	463200	4783000	Gill net
6/27/1985	0.9 KM E OF JUNCTION OF MOHAWK R AND BARGE CANAL OFF N BANK	ONEI	M	HDEC_23211_2	464000	4783000	Gill net
6/27/1985	0.9 KM W OF JUNCTION OF MOHAWK R AND BARGE CANAL OFF N BANK	ONEI	OS	HDEC_23211_3	462300	4783200	Gill net
6/28/1985	W OF JCT OF MOHAWK R AND BARGE CANAL OFF S BANK(RMI-CANAL MI)	ONEI	OS	HDEC_23212_1	463000	4783100	Gill net
6/28/1985	W OF JCT OF BARGE CANAL AND MOHAWK R OFF N BANK(RMI-CANAL MI)	ONEI	OS	HDEC_23212_2	463000	4783100	Gill net
6/28/1985	1.1 KM W OF JCT OF BARGE CANAL AND MOHAWK R OFF N BANK	ONEI	OS	HDEC_23212_3	462000	4783100	Gill net
6/28/1985		ONEI	M	HDEC_23212_4	463200	4783000	Gill net

Codes for county include Oneida (ONEI) and Herkimer (HERK), and watershed codes include Oswego (OS) and Mohawk (M).

Appendix C. Angler interview form for Mohawk River and Barge Canal, 1983.



Appendix C Angler interviews for Mohawk River and Barge Canal 1983

CANAL overcast / Rain DATE

Angler # | # Anglers | Time (Start, Finish) | Complete (yes, no) | Area | Fish Released | Fish Kept | Bait | Boat | Shore | Home

species & number — species & number

dates
5/14/83
5/22/83
5/29/83
6/5/83
6/26/83

Areas of Barge Canal
I Oneida Lake to Lock 21
II Lock 21 to Rome, Gates
III Rome to Lock 20
IV Lock 20 to Leland Ave, Utica
V Leland Ave to Lock 19
VI Lock 19 to Lock 18
VII Lock 18 to Lock 17
VIII Lock 17 to 5 mi Dam

Areas of old Mohawk River
X nine mile Ck to Leland Ave
XI Leland Ave to Frankfort Dam
XII West Canada Ck channel
XIII 5 mi Dam to E. Can. Ck.

New York Water Science Center News Volume 20, April 2015

New York Water Science Center Director
Ward Freeman

Visit the New York Water Science Center Web site at:
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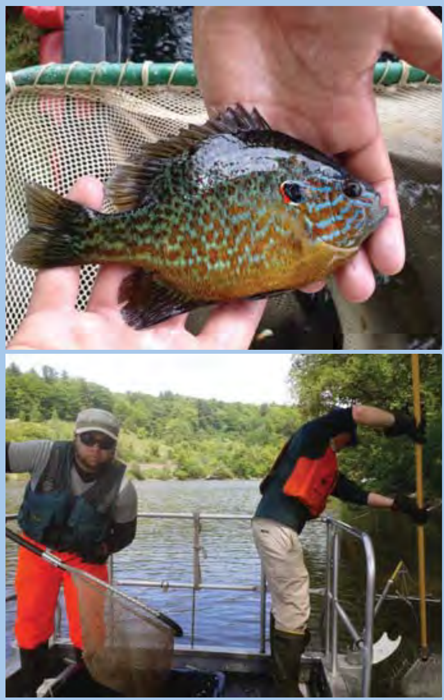
U.S. Geological Survey, New York Water Science Center Newsletter

Trends in Fish Assemblages | Status of American Eel Populations | Flood Inundation Mapping Prattsville | Ice Jam Monitoring | Hydrologic Conditions

Spatiotemporal Trends in Fish Assemblages of the Mohawk River

The mainstem of the Mohawk River extends from Lake Delta Dam near Rome, NY downstream to its confluence with the Hudson River near Cohoes, NY. It supports a diverse fishery that is used extensively by recreational anglers. Smallmouth bass (*Micropterus dolomieu*) and walleye (*Sander vitreus*) are among the most popular game species with anglers but past biological surveys have documented at least 56 fish species that inhabit the river. An extensive fish survey of the Lower Mohawk River was last conducted by the New York State Department of Environmental Conservation (NYSDEC) from 1979-1983. Some key findings of this research included: (1) The river supported an abundant and fast growing smallmouth bass population, (2) Anadromous blueback herring (*Alosa aestivalis*) were a critical forage species for the ecosystem, (3) Fish communities were notably different in permanent versus seasonally impounded reaches, and (4) The river received heavy angling pressure.

The river has apparently undergone many changes in the 30 years since this survey. The nonnative and invasive zebra mussel (*Dreissena polymorpha*), which was first observed in 1991, spread throughout the lower river by 1993. Freshwater drum (*Aplodinotus grunniens*) became established around 1990 and northern pike (*Esox lucius*) have increased in abundance as well. Meanwhile, the runs of anadromous blueback herring are becoming weaker and preliminary data suggest smallmouth bass are becoming less abundant. Finally, upgrades of the flashboards at several of the seasonal dams may allow for the repeated raising and lowering of these devices during the warm weather season to mitigate flood impacts. The extensive changes that have occurred in this ecosystem over the past 30 years warrant a comprehensive fish-community inventory to assess the current status of fish



Photos showing (A) a native Pumpkinseed (*Lepomis gibbosus*) and (B) USGS Scientists electroshocking fish in the Mohawk River.

assemblages in the mainstem of the Mohawk River.

The U. S. Geological Survey (USGS) and the NYSDEC will conduct fish community surveys at a minimum of 24 locations during 2014 and 2015. The surveys will be completed using boat electrofishing of near-shore habitats. The resulting data will be analyzed to a) assess the condition of current fish assemblages, b) identify the relative abundance of common species, c) identify spatial differences associated with seasonal or permanent impoundments, and d) assess temporal changes in the fish community over the past 30 years. Field efforts will also focus on collections of American eel, blueback herring, and smallmouth bass where practical in order to obtain data and tissues needed to support collaborative research and monitoring efforts.

A Message From the Director

"We are now past the halfway point in Fiscal Year 2015 and, I know I may be jinxing us but, while funding allocations were slow to arrive this year, it has been a fairly quiet year in terms of funding challenges. Similarly, it has also been fairly quiet in terms of weather challenges. To make us better able to face the challenges should our current weather pattern change, we have flood hardened, to a much higher level, a number of streamgages throughout the State and implemented several network operational enhancements. As I mentioned in the last newsletter, in cooperation with New York State Canals, the USGS has added 18 new streamgages and reactivated or enhanced operations at 4 others. These 22 sites are part of the Governor's upstate New York flood warning system and are all now in and operational. Several of these new streamgages are in the Mohawk basin. Which is appropriate since the Mohawk basin is the primary focus of this issue of the newsletter. In this issue, you will learn about several programs including how fish populations in the Mohawk have changed over the last 30 years; ice-jam monitoring in the Mohawk near Schenectady; and flood inundation mapping for the Schoharie Creek at Prattsville NY. I am also happy to announce that new detailed elevation data (LiDAR Quality level 2) will be available for all of Schoharie County and part of Montgomery County in May, 2015, providing complete LiDAR coverage for the Schoharie Creek basin. These data will provide information needed to develop additional flood-inundation maps for other communities in the Schoharie basin. We hope to identify funding partners to help make these new flood-inundation maps a reality.

As always, I am interested in hearing from you. Please feel free to contact me about these or any other issues or program opportunities you may wish to discuss. I can be reached at (518) 285-5658 or dc_ny@usgs.gov."

PROPOSAL -- Status of American Eel populations in the Mohawk River Basin

The waters of the Mohawk River basin are inhabited by one of the richest fish communities on the East Coast. The American Eel, Anguilla rostrata, is a unique member of this community, exhibiting a catadramous (maturing in fresh water and spawning in salt water) life history. Like many migratory fish, the American Eel has suffered a general decline across the East Coast largely attributed to barriers to migration, habitat degradation, and other anthropogenic disturbances. A recent study by Machut et al. (2007) and the implementation of a NYSDEC-initiated citizen science juvenile Eel monitoring program (Bowser and others, 2012) have greatly improved our understanding of Eel distribution and behavior in the Hudson River and tributaries. However, little work has addressed the distribution of American Eel in the Mohawk River basin or the factors that drive this distribution. The presence of Eels in this basin has been confirmed only by a handful of DEC fish surveys (aimed at sampling other species) over the past 30 years and their densities and distributions in this watershed are largely unknown.

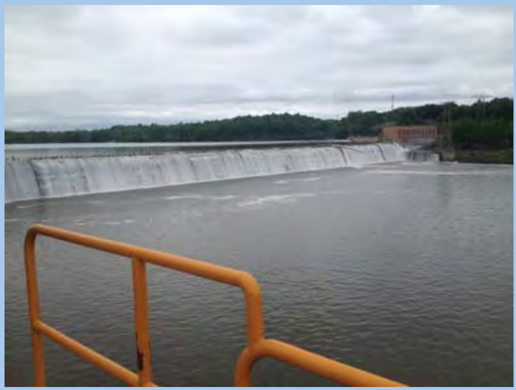
The 2012-2016 Mohawk River Basin Action Agenda has identified conserving fish, wildlife, and their habitats as a top priority. A Fisheries Management Plan for the Lower Mohawk River (McBride, 1994) is the most comprehensive document concerning the status of and challenges facing the Mohawk River fishery. One of McBride's management recommendations is to "initiate fish studies based on specific needs as they may arise." Machut's recent Hudson River Eel study and the 2009 installation of a downstream fish passage at the School Street Hydroelectric Project around Cohoes Falls now provide a pressing need to extend our understanding of American Eel distributions in the Mohawk River. Additionally, the recent success of the citizen science juvenile Eel monitoring program on Hudson River tributaries suggests that this program could be utilized in the Mohawk basin if tributaries supporting robust Eel populations could be identified.

The primary objective of this proposal is to determine if American Eel are present or absent in waters near the mouths of tributaries to the Mohawk River. Related goals are to qualify their relative abundance and potential distribution throughout the watershed.

The objectives of this proposal will be met by conducting surveys for American Eels at 15 or more sites on Mohawk River tributaries (multiple sites may be located on some large tributaries) during the summer of 2015. Field crews of 3-4 researchers or volunteers will conduct single pass electrofishing surveys (using a backpack electrofisher). Best efforts will be made to sample during low flow periods to maximize capture efficiency. The tributaries and exact study reaches will be selected to maximize the probably of encountering Eels based on habitat assessments and locations of past Eel captures.

The specific tasks for this effort and approximate timeline are:
• Select sites using map resources and reconnaissance surveys as needed (April-May, 2015)
• Conduct electrofishing surveys at 15 or more sites (June-September, 2015)
• Compile and analyze data (October-December, 2015)
• Provide draft report (January, 2016)
• Publish report (February-March, 2017)

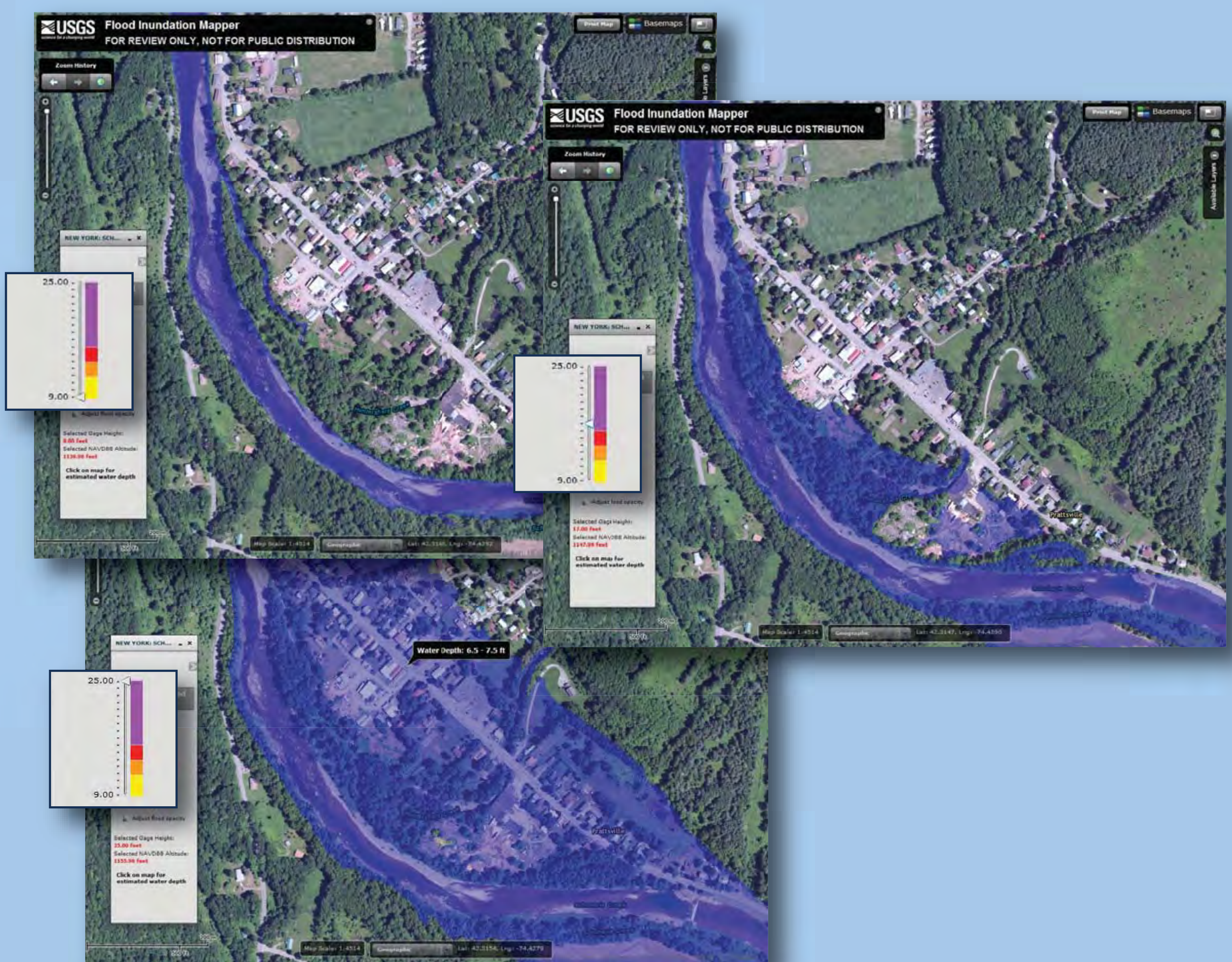
The USGS will publish a report with site locations and presence/absence and relative abundance (catch per unit effort) data summarized in tabular form. This publication will have little or no interpretation but will be citable.



Photos showing (A) American Eel, shown here, have experienced populations declines across the East Coast, (B) It is unclear if the system of impoundments on the Mohawk River (dam at Lock 7 shown here) has limited the abundance of American Eel in this watershed, (C) One of many tributaries to the Mohawk River that will be screened for the presence of American Eel.

UPDATE -- Flood-Inundation Maps for the Schoharie Creek at Prattsville, New York

Digital flood-inundation maps for a 2.6 mile reach of the Schoharie Creek at Prattsville, New York, have been created by the U.S. Geological Survey (USGS) in cooperation with the New York State Department of Environmental Conservation. Flood profiles were computed for the stream reach by means of a one-dimensional step-backwater model; this model is based on existing models, and updated to reflect current ground conditions following the August 2011 flood. This hydraulic model was used to compute 17 water-surface profiles for flood stages at 1-foot intervals referenced to the USGS streamgage Schoharie Creek at Prattsville, N.Y. (station number 01350000) for stages 9 to 25 feet. The 9-ft stage reflects near-bankfull flow and the 29-ft stage is associated with a flow that exceeds the estimated 0.2-percent annual-exceedance-probability flood (500-year recurrence interval flood). Maps for stages 9, 17, and 25 feet are shown. These flood-inundation maps will be available on the USGS Flood Inundation Mapper website, which displays current (USGS) and predicted (from the National Weather Service Advanced Hydrologic Prediction Service) stages, has a variety of basemaps, and allows users to interact with the model results and inundation scenarios.

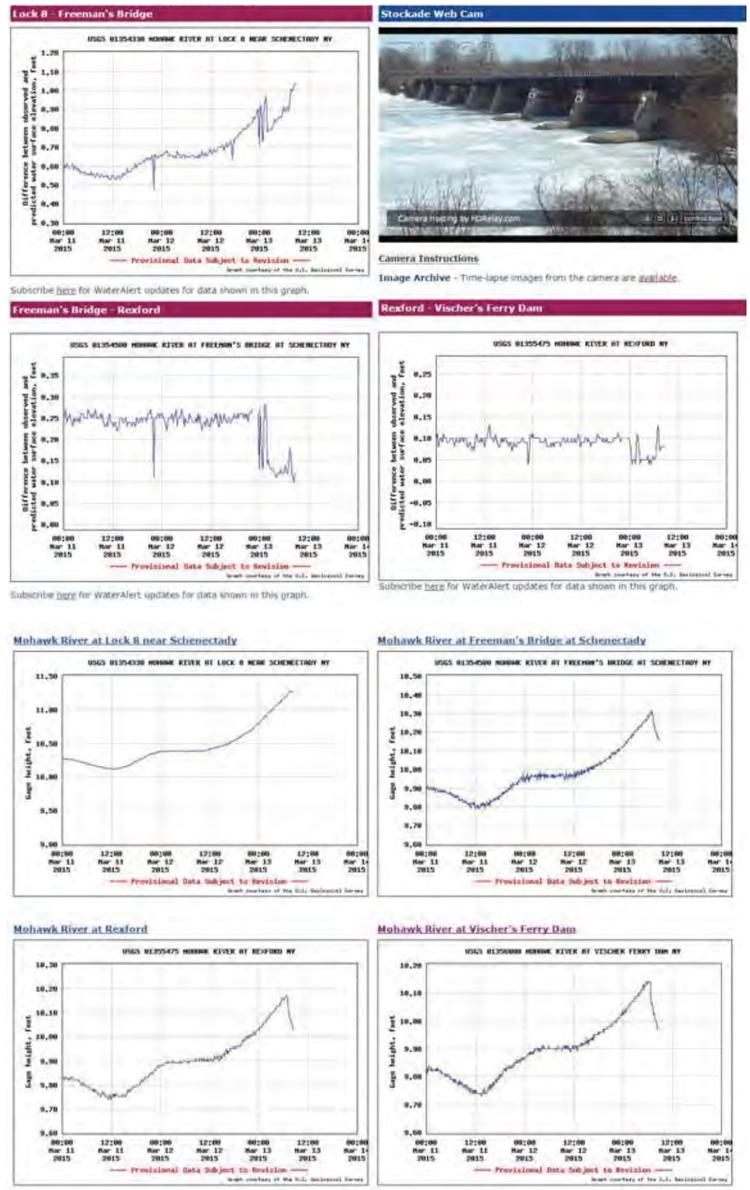


Mohawk River Ice Jam Monitoring

The Mohawk River between New York State Barge Canal Locks 7 and 8 near Schenectady, NY is susceptible to ice jams during periods of river-ice break-up. Ice jams in this reach typically form at channel constrictions, bridge piers, lock and dam structures, and sections with a reduced floodplain (Foster and others, 2011). Ice jam related flooding can result from backwater associated with the jam or from water released downstream when a jam fails Schenectady is particularly vulnerable to ice jam related flooding; Lederer and Garver (2001) estimated that 80% of historic Mohawk River floods in Schenectady have been associated with winter snowmelt and associated ice floes.

In cooperation with the New York State Department of Environmental Conservation's Mohawk River Basin Program, the New York State Power Authority, Brookfield Renewable Power, and Union College, USGS is monitoring river elevation at four streamgages between Locks 7 and 8. A web camera installed at a fifth location, between the gages, in the Stockade District of Schenectady, provides real-time images of the river during winter months.

Photos showing (A) Ice jam in Mowhawk River, and (B) USGS Hydrologist installing Mohawk River “Jam Cam.”

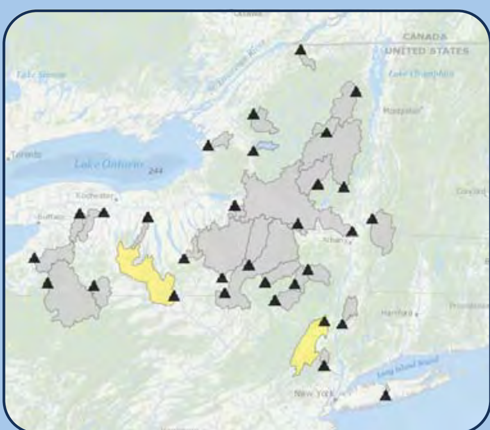


These plots depict the difference in water elevation between what is observed and what is predicted at a gage. Predictions are referenced to ice-free conditions, so when there is no ice in the river to restrict flow, the values are about zero. Increases in the prediction values between the gages indicates that streamflow is restricted and an ice jam is causing water to backup. A positive value can be thought of as extra water stored in the river due to ice. It is important to keep in mind that these plots generally reflect conditions between the gages. Ice jams occurring outside of the river-reach indicated (eg. Lock 8 or Freeman’s Bridge) may not be reflected in the values shown.

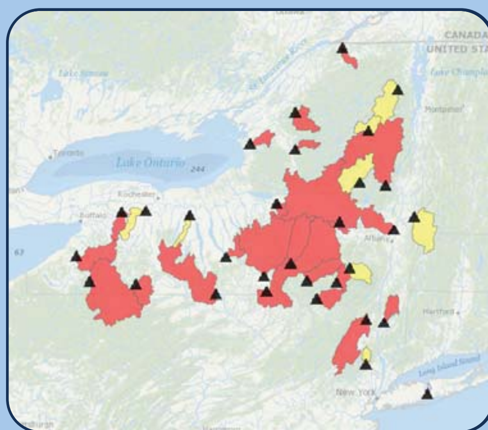
Surface-Water and Groundwater Conditions in New York

Monthly and seasonally (shown below), hydrologists at the New York Water Science Center synthesize and summarize streamflows and groundwater levels for New York. Visual representation of the streamflow and groundwater conditions are shown on the NY WSC's Hydrologic Conditions Mapper. During Autumn and winter (2015) streamflow was in the wet or normal ranges at nearly all of the index stations. Groundwater levels at the observation wells varied from wet to very dry, with the majority of the wells in the wet or normal ranges. February and March; however, streamflow was generally in the dry to very dry range at most of the index stations. Groundwater levels at the observation wells (in February and March) varied around the State from wet to very dry with the majority of the wells in the dry or very dry ranges.

A. Streamflow

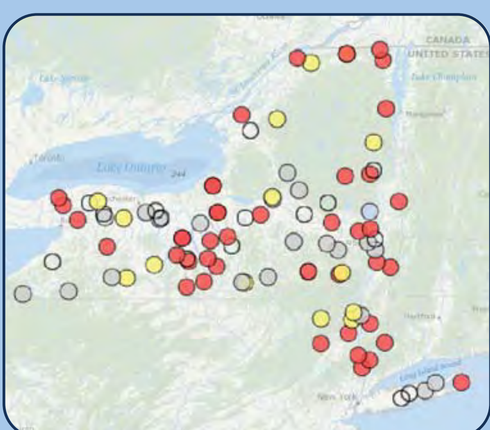


Autumn 2014

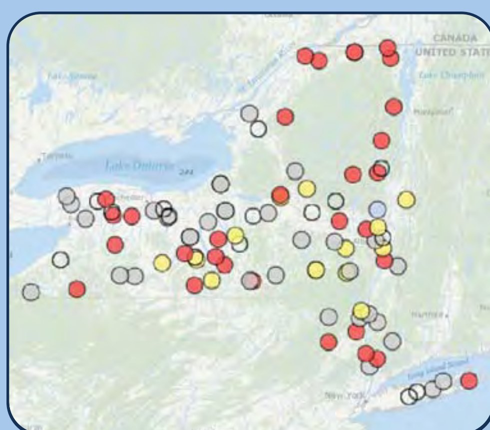


Winter 2015

B. Groundwater



Autumn 2014



Winter 2015

EXPLANATION

Basin boundry ▲ Streamgage ● Groundwater well

Percentages of Monthly Means (Period of Record)

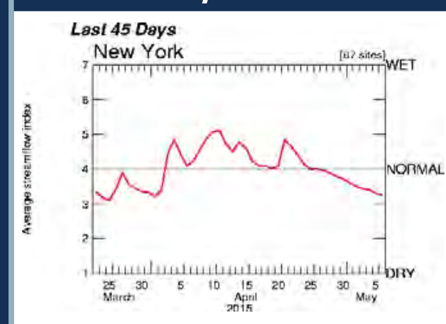
Seasonal conditions at selected (A) streamgages and (B) groundwater wells in New York. USGS maintains and operates most streamgages and groundwater wells in cooperation with various federal, state, and local agencies. Winter (January, February, March), Spring (April, May, June), Summer (July, August, September), Autumn (October, November, December).

USGS Water Watch & Groundwater Watch

WaterWatch is a USGS World Wide Web site that displays maps, graphs, and tables describing real-time, recent, and past streamflow conditions for the Nation. Real-time streamflow information (stage and flow) generally is updated on an hourly basis. WaterWatch provides maps that show the location of more than 3,000 long-term (30 years or more) USGS streamgages.

Groundwater Watch is a USGS World Wide Web site that displays maps, graphs, and tables describing groundwater level data from wells currently in a regular measurement program. Three types of water-level data are displayed, including periodic, continuous data that are periodically retrieved, and real-time data generally updated on an hourly basis. Groundwater Watch contains water levels and well information from more than 20,000 wells that have been measured by the USGS or USGS cooperators at least once within the past 365 days.

45 Day Index Plot



Among other things, WaterWatch summarizes streamflow conditions in a region (state or hydrologic unit) in terms of the long-term typical condition at streamgages in the region. For example, this plot shows that streamflow over the last 45 days was at or below normal conditions for New York.

FEATURED ARTICLE

Groundwater Quality in the Mohawk River Basin, New York, 2011

Water samples were collected from 21 production and domestic wells in the Mohawk River Basin in New York in July 2011 to characterize groundwater quality in the basin. The samples were collected and processed using standard U.S. Geological Survey procedures and were analyzed for 148 physiochemical properties and constituents, including dissolved gases, major ions, nutrients, trace elements, pesticides, volatile organic compounds (VOCs), radionuclides, and indicator bacteria.

The Mohawk River Basin covers 3,500 square miles in New York and is underlain by shale, sandstone, carbonate, and crystalline bedrock. The bedrock is overlain by till in much of the basin, but surficial deposits of saturated sand and gravel are present in some areas. Nine of the wells sampled in the Mohawk River Basin are completed in sand and gravel deposits, and 12 are completed in bedrock. Groundwater in the Mohawk River Basin was typically neutral or slightly basic; the water typically was very hard. Bicarbonate, chloride, calcium, and sodium were the major ions with the greatest median concentrations; the dominant nutrient was nitrate. Methane was detected in 15 samples. Strontium, iron, barium, boron, and manganese were the trace elements with the highest median concentrations. Four pesticides, all herbicides or their degradates, were detected in four samples at trace levels; three VOCs, including chloroform and two solvents, were detected in four samples. The greatest radon-222 activity, 2,300 picocuries per liter, was measured in a sample from a bedrock well, but the median radon activity was higher in samples from sand and gravel wells than in samples from bedrock wells. Coliform bacteria were detected in five samples with a maximum of 92 colony-forming units per 100 milliliters.

Water quality in the Mohawk River Basin is generally good, but concentrations of some constituents equaled or exceeded current or proposed Federal or New York State drinking-water standards. The standards exceeded are color (1 sample), pH (1 sample), sodium (9 samples), chloride (1 sample), sulfate (2 samples), dissolved solids (7 samples), aluminum (3 samples), iron (8 samples), manganese (6 samples), radon-222 (10 samples), and bacteria (5 samples). Fecal coliform bacteria and Escherichia coli (E. coli) were each detected in one sample. Concentrations of fluoride, nitrate, nitrite, antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, selenium, silver, thallium, zinc, and uranium, and gross alpha activities, did not exceed existing drinking-water standards in any of the samples collected. Methane concentrations in two samples were greater than 28 milligrams per liter, and the maximum measured concentration was 44.3 milligrams per liter.

SELECT NYWSC PUBLICATIONS

Coon, W.F., 2014, Development and use of a basin-scale hydrologic model for the Onondaga Lake basin: ClearWaters, New York Water Environment Associates, Inc., v. 44, no. 3, p. 31-33.

Reynolds, R.J., Anderson, J.A., and Williams, J.H., 2015, Geophysical log analysis of selected test and residential wells at the Shenandoah Road National Superfund Site, East Fishkill, Dutchess County, New York: U.S. Geological Survey Scientific Investigations Report 2014–5228, 30 p.

Heisig, P.M., 2015, Hydrogeology of the Ramapo River - Woodbury Creek valley-fill aquifer system and adjacent areas in eastern Orange County, New York: U.S. Geological Survey Scientific Investigations Report 2014-5156, 23 p., 1 pl.

Phillips, P.J., Schubert, C.E., Argue, D., Fisher, I.J., Furlong, E.T., Foreman, W.T., Gray, J.L., Chalmers, A.T., 2015, Concentrations of hormones, pharmaceuticals and other micropollutants in groundwater affected by septic systems in New England and New York: Science of The Total Environment, v. 512-513, p. 43-54, doi:10.1016/j.scitotenv.2014.12.067

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Fischer, J.M., Phillips, P.J., Reilly, T.J., Focazio, M.J., Loftin, K.A., Benzel, W.M., Jones, D.K., Smalling, K.L., Fisher, S.C., Fisher, I.J., Iwanowicz, L.R., Romanok, K.M., et al, 2015, Estuarine bed-sediment-quality data collected in New Jersey and New York after Hurricane Sandy, 2013: U.S. Geological Survey Data Series 905, 42 p., plus CD-ROM, http://dx.doi.org/10.3133/ds905.

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USGS
science for a changing world

The USGS Water Mission Area (WMA) has the principal responsibility within the Federal Government to provide the hydrologic information and interpretation needed by others to achieve the best use and management of the Nation's water resources. WMA actively promotes the use of its information products by decision makers to:

- Minimize loss of life and property as a result of water-related natural hazards, such as floods, droughts, and land movement.
- Effectively manage groundwater and surface-water resources for domestic, agricultural, commercial, industrial, recreational, and ecological uses.
- Protect and enhance water resources for human health, aquatic health, and environmental quality.
- Contribute to wise physical and economic development of the Nation's resources for the benefit of present and future generations.

If you have an environmental or resource-management issue in which you would like to partner with the USGS to investigate, please contact any of our senior management staff (listed below). Projects are supported primarily through the Cooperative Water Program. This is a program through which any State, County, or local agency may work with the USGS to fund and conduct a monitoring or investigation project

★ ★ ★ ★

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Bureau of Fisheries

2015-2016 Annual Report

Great Lakes Fisheries Management
Inland Fisheries Management
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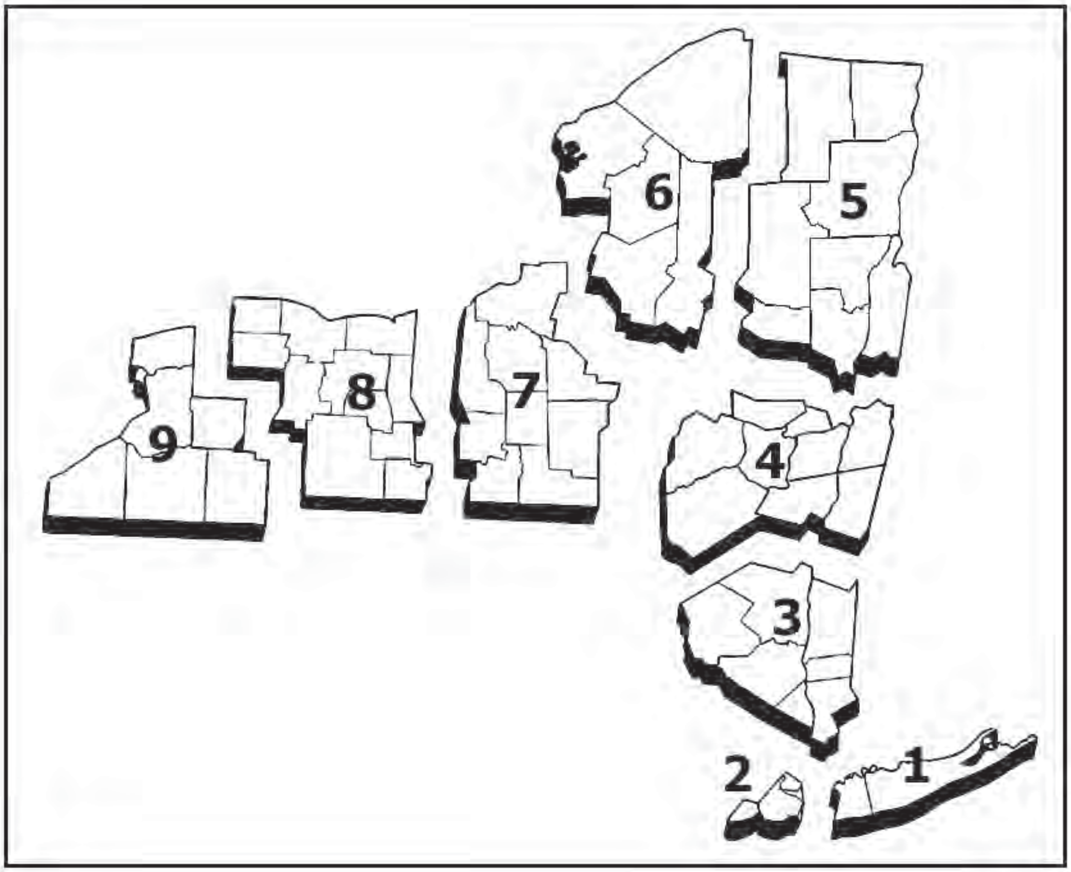
DEC REGIONS



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2015-16 Annual Report

New York State Department of Environmental Conservation
Bureau of Fisheries

Philip J. Hulbert, Chief

Introduction

The New York State Department of Environmental Conservation, Division of Fish and Wildlife, Bureau of Fisheries delivers a diverse program and annually conducts a wide array of activities to accomplish its mission:

> ***Conserve and enhance New York State's abundant and diverse populations of freshwater fishes while providing the public with quality recreational angling opportunities.***

This report provides a summary of significant activities completed during Fiscal Year 2015-2016 by Bureau of Fisheries staff located in 9 regional offices, 2 research stations, 12 fish hatcheries, 1 fish disease laboratory, as well as the DEC Central Office in Albany. Activities are categorized according to the major objectives of the Divison of Fish and Wildlife.

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2015-16 Annual Report

Common Acronyms, Definitions and Units of Measure

Common Acronyms

AIS: Aquatic invasive species

CPUE or CUE: catch per unit of effort - such as the number of fish caught per hour or fish caught per net.

OMNR: Ontario Ministry of Natural Resources

PFR: Public Fishing Rights

USGS: United States Geological Survey

USFWS: United States Fish and Wildlife Service

YOY: young of year - typically a fish that is captured by sampling in the same year it was hatched.

Definitions

Bottom trawl: a sampling technique where a net is dragged along the bottom of a water body behind a boat.

Creel Survey: a survey where anglers are interviewed about their catch.

Conductivity: the ability of water to conduct an electric current. Waters of low conductivity are low in dissolved minerals.

CROTS: Catch-Rate-Oriented-Trout-Stocking - the model used by the Bureau of Fisheries to develop stocking rates for trout streams that takes into account biological measures of the stream, stream carrying capacity, angling pressure and wild trout abundance.

Dreissenid Mussels: a family of exotic mussels including zebra and quagga mussels.

Electrofishing: use of electricity to temporarily stun fish, allowing them to be captured.

Environmental Justice Area: sections of New York State with high percentages of low income or minority households.

Extirpated species: a species that no longer exists in the wild in a certain country or area.

Fyke Net: a trap style net that is composed of a number of hoops surrounded by netting and usually has netted wings and a leader that direct fish into the net.

Gill Net: a vertical wall of netting that is typically set in a straight line and entangles fish as they try to swim through it.

Hazing - to discourage an animal from frequenting a waterbody.

HUC: Hydrologic Unit Code. A categorization of watershed boundaries from the basin to the sub (small) watershed level (HUC12).

Hydroacoustic survey: use of sound and reflected echoes from schools of fish or plants to estimate abundance or distribution.

Lentic: associated with still water such as a lake or pond.

Littoral: the nearshore shallow water area of a waterbody.

Lift - difference in license renewals between the control and treatment group.

Mesotrophic - an intermediate stage of lake productivity lying between oligotrophic (nutrient poor) and eutrophic (nutrient rich).

Oligotrophic - a water body that is low in nutrients.

Pen reared: raising hatchery salmon or trout in a pen to “imprint” those fish to the pen rearing site. In theory, this will cause the fish to return to the pen rearing site to spawn.

PIT Tag- an implanted tag that is used when an individual fish needs to be identified. The tag contains a series of numbers and letters that can be obtained by passing a “PIT Tag reader” over the implanted tag.

PSD: proportional stock density - describes the portion of a fish population or sample that exceeds a size threshold. For example, the PSD for largemouth bass is the proportion of 12 inch and larger bass in the sample of largemouth bass that were stock size (8 inches and larger).

Reclamation: the removal of non-native fish and restoration with native fish. Traditionally done to restore pond brook trout populations.

RSD 15: relative stock density greater than 15 inches - describes the proportion of fish larger than 15 inches in a population or sample of all fish exceeding a size threshold. For example, the RSD 15 for largemouth bass is the proportion of 15 inch and larger bass in a the sample of all largemouth bass that were stock size (8 inches and larger).

Seining: using a seine net - a net with weight on the bottom and floats on the top that is dragged through the water to capture fish.

Trap Net: similar to a fyke net but usually larger and rectangular in shape.

VHS/VHSv: Viral hemmoraghic septicemia - a serious disease of fish (not humans) recently introduced into New York State.

Year Class: a group of fish spawned during the same year.

Units of Measure

°C: degrees Celsius - to convert from c to farenheit (f) = (f - 32) x 5/9.

ha: hectare - a metric system unit of area; 1 hectare = 2.47 acres.

hr: hour.

in: inch.

kg: kilogram - a metric system unit of weight; 1 kg = 2.2 pounds.

km: kilometer - a metric system unit of length; 1 km = 0.62 miles or 3,281 feet.

m: meter - a metric system unit of length; 1 meter = 3.28 feet.

mm: millimeter - a metric system unit of length; 100 mm = 3.94 inches.

ppm/ppb: part per million/parts per billion - describes the density of a substance in another solid, liquid or gas (typically water, air).

µg/l: micrograms per liter; equivalent to ppb,

SPECIES CONSERVATION AND MANAGEMENT

Nassau County Black Bass Regulation Assessment

South Pond, Smith Pond, and Mullener Pond, all within the Town of Hempstead, were surveyed in 2015. This was part of a continuing effort to assess the impact of the catch and release only regulation for black bass in Nassau County implemented in 1998.

South Pond was previously surveyed in 1992, 1995, 1998, 1999, and 2002. The most abundant fish caught per hour of electrofishing were bluegill and pumpkinseed (Figure 1). Proportional Stock Densities (PSDs) of 35 for pumpkinseed and 39 for the bluegill indicate an improved size structure for both populations. The catch rate and size structure (PSD 42) of chain pickerel also improved. Catch rates for yellow perch have increased since 1998, however, fish over 8 inches in length remain scarce. This prompted implementation of a special 8 inch minimum size and 15 fish daily limit regulation for yellow perch in 2004. Unfortunately, the quality of the yellow perch population has not improved. The largemouth bass population has also not improved since the 1998 regulation change, as reflected by the low numbers of quality and preferred fish captured (Figure 2). Other species caught were American eel, common carp, and brown bullhead.

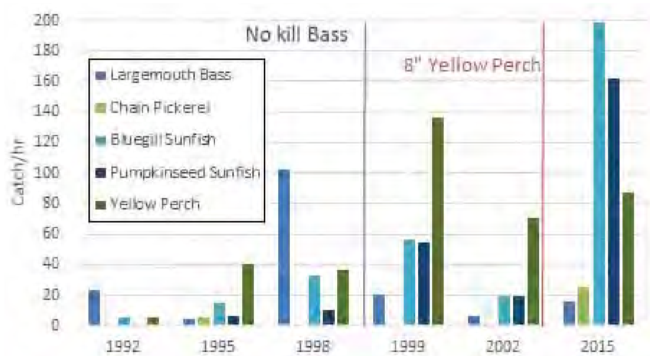

Figure 1 Overall electrofishing catch per hour of species from South Pond before and after largemouth bass and yellow perch regulation

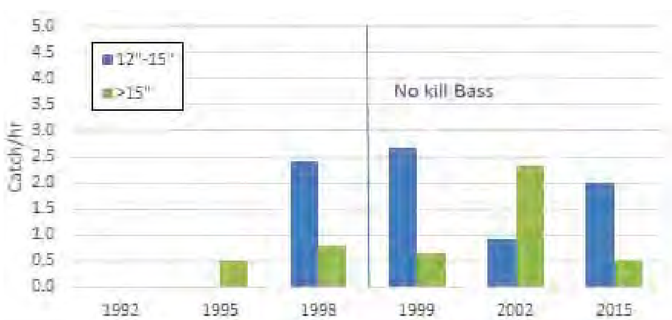

Figure 2. Electrofishing catch rates of quality (12"-15") and preferred (>15") largemouth bass from South Pond 1992-2015.

Smith Pond was previously surveyed in 1994. As in the previous survey, pumpkinseed were the most abundant species, with a catch rate of 141 fish per hour. The quality of the pumpkinseed population remained poor, with only one fish measuring over 6 inches. American eel were the second most abundant fish collected with 28 in this survey and 61 in 1994. A total of 22 largemouth bass were caught, 18 of which were under eight inches, and four of which were greater than 15 inches. In 1994, 42 largemouth bass were caught (20 bass < 8 in, 13 bass 8-12 in, and nine bass 12-15 in). Only 11 bluegill were caught, with only one fish over 6 inches. Goldfish, common carp, golden shiner, and brown bullhead were also collected.

Mullener Pond was surveyed in 1938 and 1995 with seine nets. In 1938 the pond contained largemouth bass, American eel, chain pickerel, brown bullhead, and pirate perch. It was dredged in 1993 and restocked with largemouth bass, bluegill and pumpkinseed in 1994. In the 1995 survey, juveniles of all of these species were caught. A boat electrofishing survey was conducted in 2015. Pumpkinseed were the most abundant species caught (438 fish per hour), followed by largemouth bass (66 fish per hour), bluegill (74 fish per hour), golden shiner (45 fish per hour), two brown bullhead, and one goldfish. Forty-one American eel were also observed. PSDs were calculated for both sunfish species and showed well balanced populations (pumpkinseed PSD 39 and bluegill PSD 21). The PSD for largemouth bass was 94, indicating that the population is unbalanced with a high ratio of quality size bass. However, good numbers of sub-stock size bass were caught indicating good recruitment. Overall the pond has a good predator to prey ratio and anglers report being satisfied.

Brook Trout Surveys

Ten waters were surveyed as part of the Eastern Brook Trout Joint Venture initiative. Surveys targeted locations where brook trout had been documented historically. Species composition was recorded as well as stream characteristics and water quality parameters to determine habitat conditions.

Of the ten streams surveyed, brook trout were documented in four. The Patchogue River maintains a naturally reproducing population and has not been stocked by the NYSDEC since 1955. Beaver Brook also maintains a naturally reproducing population which is the result of a restoration effort that began in the late 1990's. Massapequa Creek currently receives brook trout annually as part of an ongoing restoration effort. The creek shows good year round survival but has yet to show natural reproduction. Finally, Rattlesnake Creek is a tributary to the Connetequot River where NY State Parks stocks brook trout. Efforts to document additional locations for brook trout will continue.

Peconic Lake Fish Community Assessment

A fish community assessment was conducted on Peconic Lake (Forge Pond) in 2014 and 2015. The purpose of the survey was twofold. First to document rare fishes in the system and second to develop a baseline fisheries status prior to the opening of the expanded Forge Pond Fishing Access Site in June of 2015.

Peconic Lake is the largest impoundment on the Peconic River on eastern Long Island. Both banded sunfish and swamp darter are known to exist only in the Peconic River system in New York State. While they have been documented from the river and ponds near Peconic Lake, they had not previously been documented from Peconic Lake. This survey documented the presence of Swamp Darter in Peconic Lake, but no banded sunfish were noted. Tessellated Darter, which are widely distributed on Long Island, were also noted in the lake for the first time.

This survey, when compared with electrofishing surveys from 1998, 2006 and 2008, showed that Peconic Lake maintains a consistently robust bass population with very consistent catch rates between years and PSD and RSD values within or very near the desired range in all years (Figure 3). Bluegill and Pumpkinseed populations are also consistently strong with good catch rates and favorable PSD and RSD values in all years. White perch reappeared in the 2014 and 2015 surveys in low numbers. They were abundant in Peconic Lake in the 1980's, but had not been collected since 1997.

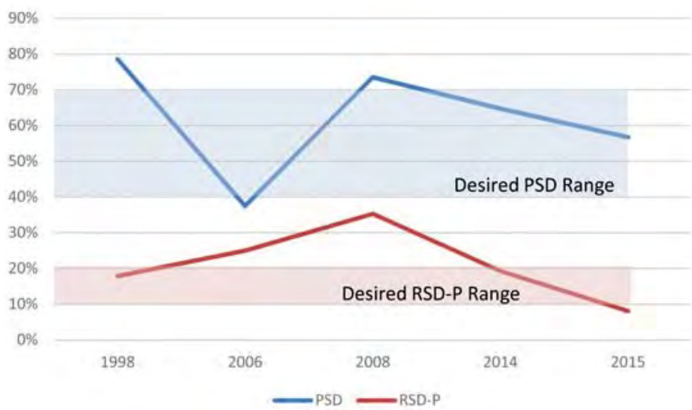

Figure 3. Peconic Lake largemouth bass PSD & RSD-15 values.

Fresh Pond Fishery Survey

Located on the far eastern end of the Island and nearly a mile off the nearest paved road, Fresh Pond in Hither Hills State Park is probably the most remote pond on Long Island. It is unfortunately also the only pond on Long Island with a health advisory for eating largemouth bass due to mercury contamination. The Fisheries Unit completed a survey of Fresh Pond in September 2015 to get the bass retested for mercury and to monitor the status of the fishery in comparison to previous surveys in 1994, 1996 and 2005.

Fresh Pond has good populations of largemouth bass, bluegill, pumpkinseed, yellow perch and black crappie. Brown bullhead and banded killifish are also present. In 2015, the catch rates for quality and preferred size fish for the five most common species were the highest of any of the surveys since 1994. Largemouth bass and black crappie had favorable PSD and RSD P values, while the PSD and RSD P values for the other three species were low. It is notable that five black crappie over 12 inches were caught. This is the first time that black crappie this large have been caught in Fresh Pond. The collection for mercury analysis was competed and results are pending.

HABITAT CONSERVATION

Aquatic invasive species control

The Region 1 Fisheries Unit remained active in monitoring and coordinating the control of aquatic invasive species in the Region. The Fisheries Unit hired the first ever Access Site Steward on Long Island to inform users of the Forge Pond Fishing Access Site of the new aquatic invasive species regulations and how to prevent the spread of aquatic invasive species. Between mid-May and mid-August the access site steward conducted over 500 interviews of site users.

In cooperation with the Peconic Estuary Program, the Fisheries Unit coordinated four hand pull operations of Ludwigia on the Peconic River. Using jon boats, canoes and kayaks Fisheries Staff and volunteers were able to remove over 25 cubic yards of Ludwigia from the Peconic River. The Fisheries Unit also continues to monitor and control water chestnut in the Massapequa Reservoir and Creek system, removing over 10 cubic yards in 2015.

Hydrilla is also a species of concern on Long Island. Since it was first discovered on Long Island in 2008, Hydrilla has been found in nine water bodies in Nassau and Suffolk Counties. Of these, only one, Lake Ronkonkoma, has a public boat launch. In most of the others boating is prohibited or severely restricted. Annual monitoring, shows that Hydrilla density in Lake Ronkonkoma has decreased since a peak in 2012 (Figure 4). Hydrilla is limited to less than 20% coverage of the lake because most of the lake is too deep for it.

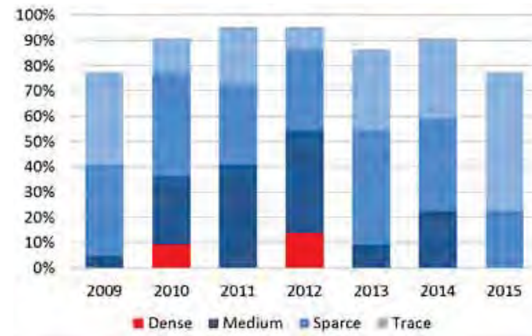

Figure 4. Lake Ronkonkoma Hydrilla density 2009-15.

PUBLIC SERVICE AND CONSTITUENT SUPPORT

I FISH NY Long Island

In 2015, the Region 1 I FISH NY Program conducted 41% more fishing clinics/events than the previous year (41 clinics vs. 29 clinics), despite a cancellation of 8 clinics in 2015 vs. 1 clinic in 2014. Total attendance at these events remained about the same at just over 11,000 people in both years. This was primarily due to the lower attendance at the spring and fall Fishing Festivals that had windy weather that dampened enthusiasm for outdoor activities.

I FISH NY significantly increased the effort in the "Train-the-Trainer" clinics for summer camps. The program conducted 7 trainings, instructing 108 counselors, compared to just 3 trainings reaching 22 counselors the previous summer. This effort appears to have paid off, with trainers reaching 3,139 campers in 2015 vs. 1,382 campers the previous year; an increase of approximately 125%!

Additionally, though the I FISH NY Program visited and conducted its in-class program at the same number of schools as in 2014, more kids were reached (351 vs. 241). This is believed to be due to teachers combining their classes (ie. all 4th graders rather than one or two of the grade's classes). This resulted in nearly double the number of school fishing excursions. As a result, 348 kids participated in 7 fishing trips during 2015 vs. 105 kids in 4 programs the year before, an increase of 231%.

2015-16 Region 1 Fisheries Staff

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REGION 2
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NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

SPECIES CONSERVATION AND MANAGEMENT

Central Park Fisheries Surveys

Boat electrofishing surveys were conducted on the 100th Street Pool and Harlem Meer in Central Park on April 15th and April 23rd, respectively. The Harlem Meer survey was the fifth electrofishing survey of this water body since 2008. Largemouth bass PSD and RSD were 51 and 8, respectively. These indices indicate a balanced population, and are an improvement over indices from previous surveys. Previous surveys indicated that largemouth bass were slow growing and size structures were skewed towards smaller fish, which suggested that these fish were stunted. Current findings indicate a reversal of this condition which should translate into larger sizes of bass in the population. The largemouth bass catch rate for all sizes (110/hr) was less than half the rate of the last two surveys but high relative to statewide bass catch rates. The catch rate for bass over eight inches was relatively high compared to that found in other surveys of the Meer (106/hour) as was that for bass over twelve inches (54/hour) and fifteen inches (9/hour), indicating a shift in size distribution to larger sized bass.

The 100th Street Pool electrofishing survey was the first of this water body. Species collected consisted of largemouth bass, bluegill, pumpkinseed and yellow perch. Despite the relatively small size of this water (1.7 acres), largemouth bass up to 16 inches were collected. The entire pond shoreline was covered in one 18-minute electrofishing run. Catch rates were 130/hour for all sizes of bass, 63/hour for bass eight inches and greater, 27/hour for bass twelve inches and over, and 7/hour for bass fifteen inches and over. Bluegills were generally larger than those sampled from other New York City (NYC) waterbodies. Typically, bluegills over 200 mm in length are rare except in the Harlem Meer and Prospect Park Lake. The maximum length of bluegills caught in the 100th Street Pool survey was 230 mm and catch rate of bluegills 200 mm and greater was 9/hour, the highest catch rate for these fish in any NYC water body surveyed. Yellow perch sizes were also significantly greater than for other NYC waters, with lengths approaching twelve inches. The catch rate of yellow perch over 10 inches was 60/hour, which is over ten times greater than for any other NYC waterbody.

Central Park Creel Surveys

Creel surveys of the ten-acre Harlem Meer and 18-acre Central Park Lake, both in Central Park, Manhattan, were conducted from May 5th – November 6th, 2015. Having both water bodies situated in Central Park allowed the creel agent to travel to each twice daily using a bicycle. These were the first DEC Fisheries creel surveys of Central Park waters and were implemented to estimate angling effort and to determine catch rates, target species and angler demographics. Angler comments were also solicited. Prior to the survey, angling effort was anticipated to be higher at the Meer than at the Lake and this was found to be the case. Overall effort at the Meer (20,792 angler hours) was 13 times greater than at the Lake (1,627 angler hours). July was the month in which the greater amount of effort occurred for the Harlem Meer, whereas the greatest monthly effort at the Lake occurred in May and declined each month until October. The overall effort estimated for the Harlem Meer surpassed that estimated for Prospect Park Lake during a 2014 creel survey (16,761 angler hours). The greatest number of comments concerned removal of litter and excess algae; the second highest comment concerned stocking fish.

PUBLIC SERVICE AND CONSTITUENT SUPPORT

NYC I FISH NY Program

School Fishing Program

R2 Fisheries staff brought approximately 1,520 students fishing at NYC water bodies, providing in-class lessons to all prior to fishing field trips.

Kissena Lake Free Fishing Weekend Collaborative Fishing Clinic

On June 27th of New York's free fishing weekend, Region 2 Fisheries/I FISH NY staff coordinated a fishing clinic at Kissena Lake, Queens in collaboration with a variety of groups both within and outside of DEC. Groups who provided fishing-related information included DEC Law Enforcement, DEC Education, NYC Parks and Recreation Urban Park Rangers and the NYS Department of Health who sent a Chinese-speaking intern to reach out to the predominantly Chinese-American population attending the Kissena Lake clinic. DEC Fisheries and Urban Park Ranger staff provided free fishing to participants as did the Bayside Anglers, a local angling group who holds an annual fishing clinic at Kissena Lake during free fishing weekend.

Other Fishing Outreach and Training

- Prospect Park Earth Day, Brooklyn: April 17th, 2015
- MS Society Fishing Clinics, Brooklyn: June 24th and September 16th, 2015
- National Park Service Summer fishing clinics, Staten Island: July 1st, 8th and 15th, 2015
- City of Water Day, Governor's Island, NY: July 18th, 2015
- Coastal Cleanup Day with Bronx River Alliance, Bronx: September 19th, 2015
- PS 2 after-school program, Brooklyn: September 23rd, 2015
- Little Red Lighthouse Festival, NY: September 26th, 2015
- Bayswater State Park fishing clinic: October 4th, 2015
- Innovative Senior Center fishing clinic, Queens: October 21st, 2015
- Prospect Park family nights (train the trainer programs): July 30th and August 5th, 2015

NYC Urban Park Rangers Train the Trainer Program

On March 17, Region 2 Fisheries staff performed a fishing training program at the Prospect Park Audubon Center, Brooklyn, for approximately 20 New York City Urban Park Rangers. The rangers host fishing groups of their own, primarily using bamboo poles. The training was designed to increase their general knowledge and help them expand into casting and using reels. Topics covered included fish identification, invasive species, fishing regulations and licenses, types of bait, rigging rods and terminal tackle, knots, fishing techniques, gear repair and maintenance, and practical skills such as unhooking turtles. The training ended with a fishing session where the rangers could practice their skills. Feedback from the training was overwhelmingly positive and we will be working closely with this group throughout the fishing season.

Online Access to Saltwater Fishing Access Sites

In collaboration with staff from the Bureau of Marine Resources, Region 2 Fisheries has produced a Google Earth map of all the saltwater fishing sites in the New York City area. Each site listed on the map contains information on location, mass transit access, and the amenities at the site. Each link also comes with a reminder to register for the free Recreational Marine Fishing Registry. Eventually, information about additional amenities will be added to the map and one day the map may be expanded to cover fishing sites throughout the marine district. The map can be found at *http://www.dec.ny.gov/pubs/42978.html*.

New York National Boat Show

In January, regional fisheries staff supported Central Office fisheries staff at the New York Boat Show at the Jacob Javits Center in New York City. The show is a popular destination for New York boating enthusiasts and sportsmen. DEC's booth, which focused on preventing the spread of aquatic invasive species, was highly relevant to show visitors. In addition to invasive species outreach, over the course of the 4 day event, staff answered questions about fishing licenses, fishing regulations, and other topics, or exchanged tips with attendees. Hundreds of people stopped by the booth to collect literature, check out a juvenile zebra mussel, pick up an I FISH NY sticker, or pose with a life-sized portrait cutout of a trophy striper. Fisheries staff also provided fishing-related activities for the many children in attendance. It was a great opportunity to interact with sportsmen from all over the region.

NYC Fishing Outreach Group Meeting

On March 31, Region 2 Fisheries hosted the third annual Fisheries Outreach Group (FOG) meeting for the New York City area. Representatives from 14 different organizations attended, including those represented at past FOG meetings such as the Randall's Island Park Alliance, Central Park Conservancy, Hudson River Park Trust and the Prospect Park Audubon Center; and newcomers such as the Chinese American Planning Council, Region 1 Fisheries and the Brooklyn Fishing Club. Topics of discussion included the development of a map of freshwater and saltwater NYC fishing sites and ideas for fish consumption advisory outreach across different languages and cultures. Steve Heins from the Division of Marine Resources presented a Powerpoint on the impacts of climate change on northeast coast fisheries and its impact on interstate fisheries management. The afternoon session, led by DEC Region 2 Education staff, had the approximately 25 attendees break up into small groups to devise fishing-outreach lesson plans to a variety of different audiences in various settings. Evaluation forms completed by attendees indicated the meeting was valuable to those attending. Suggestions by attendees will be incorporated into the next meeting.

Invasive Species Regulation Enforcement

On January 8th, 2016 Region 2 DLE ECOs Bastedo and Buffa and Lieutenant Bobseine requested species identification of live weather loaches seized from the Fulton Fish Market in Bronx, NY. These fish closely resembled *Misgurnus anguillicaudatus*, prohibited under New York State Invasive Species Regulation 6 NYCRR Part 575.3, and were reported by the seller to be of the non-regulated weather loach species *Misgurnus mizolepis*. Region 2 fisheries staff counted rays of dorsal, anal and pectoral fins and made a preliminary identification of *M. mizolepis*. The fish were then brought to Frank Greco at the NY Aquarium for confirmation of this identification. Mr. Greco was able to use fin ray counts and body morphology to confirm these fish were, indeed, *M. mizolepis* and therefore not regulated under NYS's invasive species regulations.

Weather Loach

2015-16 Region 2 Fisheries Staff	
Melissa Cohen	Biologist 2 (Aquatic)
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SPECIES CONSERVATION & MANAGEMENT

Hudson R. Largemouth Bass & Walleye Telemetry Study

From 2013 to 2015, fisheries staff surgically implanted Lotek radio only tags into 68 largemouth bass and Lotek CART tags (dual mode tags) into 41 walleye from the tidal Hudson River. Both our Hudson River Fisheries Unit and Inland Fisheries Unit were able to successfully track these fish and plan to continue efforts through June 2016.

Largemouth bass >15" were collected and tagged from the Rondout and Esopus Creeks (overwintering areas) in April and May and released at the site of capture. Results to date show 72% of tagged bass were located in creek mouths during the spawning period. These same creek mouths are also overwintering areas, illustrating their importance as bass habitat during both seasons. A high percentage of tagged bass used Water Chestnut beds during the summer months. This known invasive plant may be providing the most available submergent aquatic vegetation (SAV) habitat option in the main river during this time. If greater SAV diversity develops in the future, bass habitat preferences for other vegetation types may start to become evident. Most tagged bass moved to the main river during the summer months, travelling an average of 2.9 miles. This suggests a relatively small home range considering all the available river miles.

Walleye > 18" were collected and tagged from the Rondout, Esopus and Catskill Creeks (spawning tributaries) in March and April and released at the site of capture. A high percentage of walleye left these tributaries once spawning was complete. Some walleye traveled as far as 20 miles on the main river from their spawning location. The majority of the tagged walleye returned to the spawning tributaries in March.

In February 2016, two posters were presented at the New York State American Fisheries Society annual meeting. The first poster included the surgical implantation techniques used for this study and the second focused on largemouth bass movements and habitat preferences.

Ashokan Reservoir (Ulster County) Spring Electrofishing

As a follow-up to 2013 and 2015 surveys noting low rainbow trout and walleye numbers and an increasing white perch population in Ashokan Reservoir, select areas of the reservoir were electrofished in late March and early April 2016. The goal of the survey was to look for spawning concentrations of rainbow trout and walleye in both the west and east basins. A similar survey was conducted in the early 1990's, and this survey was intended to provide comparison data.

The Ashokan Reservoir east basin sample was conducted along the downstream length of the low-head Dividing Weir which was not spilling water at the time of the survey. Two walleye, along with 33 rainbow trout, were collected, which was a considerable improvement over the 2015 rainbow trout collection.

The Ashokan Reservoir west basin sample was conducted in mid-April 2016 at the mouth of the Esopus Creek, the major tributary. Thirteen rainbow trout were collected or observed, with 22 walleye (all male) collected.

These results seem to indicate that the rainbow trout population in this system is rebounding from the low catch/effort documented during the 2013 gillnet survey and 2015 electrofishing survey.

Lake Stahahe (Orange County) Fish Community Survey

Region 3 fisheries staff conducted a fish community survey of Lake Stahahe in Orange County. This was done to assess the fish assemblage post introduction of triploid grass carp and Brazilian Elodea. Lake Stahahe provides a typical warm water fishery for many users accessing Harriman State Park. During the 2015 surveys, 11 different species of fish were collected. Since 1936, six other fisheries surveys were conducted on Stahahe and a total of 15 fish species were documented. During the 2015 surveys, five of these species were not documented while triploid grass carp was the only new fish species sampled. At 20% of the total catch, and a proportional stock density (PSD) of 82, black crappie appear to be providing anglers with a quality fishery. Largemouth bass abundance appears to be fair, but no fish were collected over 17 inches. Bluegill were very abundant and accounted for 37% of the total catch, but were relatively small with a PSD of 17. Three triploid grass carp were collected and appeared to be in good health. Submerged aquatic vegetation is still abundant in the lake, but Brazilian Elodea is no longer present according to NYS Parks vegetation surveys.

Rio and Swinging Bridge Reservoir (Sullivan County) Walleye Assessments

Confirming findings from 2014 surveys, no young of the year walleye were sampled from either Rio or Swinging Bridge Reservoirs during October 2015 electrofishing surveys. At Rio Reservoir, in 2.65 hours of electrofishing only two older walleye up to age 4+ were captured. At Swinging Bridge, only one adult walleye was captured estimated to be 4+ in age. No white perch were collected during the survey.

Rio Reservoir was stocked with walleye advanced fingerlings in late summer 2012 as the first stocking in a five-year experimental stocking program, with the objective of establishing a population there. Swinging Bridge Reservoir had a native walleye population which appears to be declining following the introduction of alewife and more recently, white perch.

Swinging Bridge Reservoir Creel Survey

In response to concerns about a declining walleye fishery, a full open water season (May 1 – November 30) creel survey was conducted on Swinging Bridge Reservoir. Additionally, a cold winter with corresponding good ice conditions allowed for the winter ice fishery to exist, and an additional two months of creel survey data were collected during February and March 2015 when ice conditions were safe.

The final report contains the following summary of this creel survey:

- The open water (boat) fishery accounted for 1.5 times the fishing pressure noted for shore anglers.
- Total open-water season fishing pressure was estimated to be approximately 25 hours/acre. The estimated total winter (February – March 2015) ice fishing season pressure was 0.9 hr/ac, or approximately 3.5% of the estimated total open water season.
- A total of 1566 fish were observed by or reported to the creel agent, with the highest proportion (45%) being comprised of black bass (primarily smallmouth), followed by black crappie (26%). Walleye only comprised 5% of the open water season catch. Total ice fishing catch (all species) was estimated to be only 2.2% of the total open season catch.
- Overall, 58% of the anglers interviewed were shore anglers, and of these 28% were targeting common carp. This was the second most fished for shore angling category, following those shore anglers fishing for “anything” (60%).
- The length frequency distribution of angler-caught walleye indicates that young-of-year or age 1 walleye were likely present in the catch, which are both year classes which failed to show up in 2013 and 2014 fall boat electrofishing surveys. It appears, therefore, that some walleye recruitment is occurring despite the presence of alewife and white perch.

Crystal Lake (Sullivan County) Brook Trout Survey

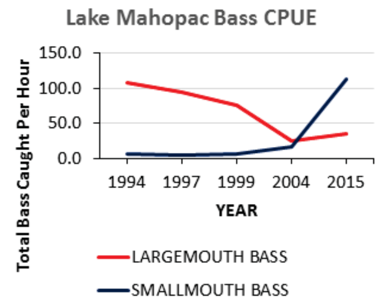
Crystal Lake is a 35 acre lake located within the Crystal Lake Wild Forest Unit. This lake was reclaimed twice (1975 and 1987), followed by introduction of wild brook trout fingerlings. In both cases, an excellent wild brook trout fishery resulted, which continued until warmwater species became reestablished via bait bucket or other intentional reintroduction by the public. Since 1987, alewife, brown bullhead, golden shiner, and pumpkinseed have been documented in Crystal Lake, in addition to brook trout. Brook trout catch/effort in fall trap net sets has declined throughout the period, stabilizing at lower numbers than those documented in the period right after the 1987 reclamation.

Three trap nets were set overnight in mid-October 2015 to document the current condition of the brook trout population, and to determine if the condition of the population had deteriorated enough to consider another reclamation. Forty five brook trout were collected, representing ages 1+ through 3+. Additionally, brown bullhead, golden shiner, and pumpkinseed were collected.

These results indicate a somewhat improved brook trout collection when compared to results from other recent trap net surveys. The results from this survey, along with some other inherent difficulties in conducting a reclamation here (including the easy accessibility of this lake to the public and what seems to be the inevitable likelihood of future non-brook trout reintroductions) has caused us to postpone any reclamation plans for the near future.

Lake Mahopac Electrofishing Survey

A boat electrofishing survey was conducted on May 18, 2015 to assess the status of the fish population following the introduction of triploid grass carp in 1994. The permitted 1994 introduction of triploid grass carp by the Lake Mahopac Park District resulted in a near elimination of all submerged aquatic vegetation, and the lake’s ecology underwent some major changes. When the lake was heavily vegetated, largemouth bass were the dominant gamefish. After a period of nearly 20 years with very little vegetation, the dominant gamefish has shifted to smallmouth bass. In 2015, 113 smallmouth bass were collected per hour compared to 35.4 largemouth bass per hour. Now that the triploid grass carp numbers are much reduced, the aquatic vegetation has rebounded, and the Park District would like to stock additional triploid grass carp.



HABITAT CONSERVATION

Tappan Zee Bridge Replacement

Region 3 fisheries staff continued to provide onsite monitoring during 2015 and 2016 for the $3.9 billion Tappan Zee Bridge Replacement Project. Fisheries staff conducted approximately one to three visits per week overseeing various construction activities. Activities with the greatest potential for impact to aquatic habitat and organisms were monitored closely. Some of these activities included concrete placement of the new road deck, dredging, and armoring. As of Spring 2016, concrete has been poured forming all columns and piers on the approach spans of the bridge. Only the main span columns have yet to be completed, but are currently about 300 feet tall and will have a final height of just over 400 feet. Fisheries staff also participated in monthly progress meetings held between DEC, Thruway Authority and the contractors, Tappan Zee Constructors.

PUBLIC SERVICE AND CONSTITUENT SUPPORT

I FISH NY Efforts

The Region 3 I FISH NY program conducted 15 fishing festivals reaching 1,079 people, 9 fishing clinics reaching 556 people (these events ranged from working with people with disabilities, adult day care centers and inner city youth programs) and four summer camp programs reaching 160 campers. A total of 30 programs were delivered with over 1,668 people going fishing or receiving fishing information this year from the Region 3 I FISH NY Program.

Staff also conducted 7 “train the trainer” programs teaching 33 camp counselors how to fish and providing the camps with fishing equipment, so they can teach the kids during camp.

World Hunting and Fishing Exposition

Region 3 Fisheries staff set up and staffed a booth at the World Hunting and Fishing Exposition at Rockland Community College in Rockland County. From February 27 through March 2, 2015, thousands of anglers attended the show. People who visited the booth were able to talk fishing with our staff, receive literature, and view mounts of our state record fish. The kids were entertained by playing Velcro-fishing.

2015-16 Region 3 Fisheries Staff	
Mike Flaherty	Biologist 2 (Aquatic)
Bob Angyal	Biologist 1 (Aquatic)
Ryan Coulter	Biologist 1 (Aquatic)
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REGION 4
BUREAU OF FISHERIES

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SPECIES CONSERVATION & MANAGEMENT

Mohawk River Fishery Assessment

NYSDEC and USGS completed a second spring daytime boat electrofishing survey as part of a three-year cooperative study (2014-2016) to assess fish communities in the NYS Barge Canal. The survey took place in sections of the Canal from Crescent Lake in Waterford upriver to Rome, NY between Canal Locks E6—E21 (about 123 river miles). The Canal is made up of permanent (reservoir) and seasonal (drawdown/riverine) sections along this stretch. A total of 39 species were documented in 2015 via daytime boat electrofishing comprising 3,927 individuals. Popular river gamefish such as smallmouth bass and walleye were more abundant in the reservoir-type habitats, while smaller fishes (e.g. river minnows/shiners) were more common in the seasonal (riverine) habitats. Catch rates ranged from 47-132 fish/hr in the seasonally impounded section and 90 - 342 fish/hr in the permanently impounded sections. The winter drawdowns in the seasonally impounded sections appear to reduce the relative abundance of fish and may adversely affect angling opportunities, but may also create more natural riverine conditions that favor some native fishes. No round goby were found in the survey but are expected to spread east from Oneida Lake soon.

Lake Taghkanic Fishery Survey

In June 2015, a survey using trap nets, gill nets, seines and boat electrofishing was conducted on Lake Taghkanic. The purpose of this survey was to assess the status of the lake's fishery, determine if cisco still inhabit the lake, and investigate a recent report that Alewife have invaded the lake. The lake is located entirely within Lake Taghkanic State Park and was last sampled in 2006. A total of 570 fish and 9 species were captured, including American eel, alewife, chain pickerel, brown bullhead, banded killifish, rock bass, pumpkinseed, bluegill, and largemouth bass. Bluegill dominated the catch (53%), but only about 7% were more than 6.5 inches long. Chain pickerel and largemouth bass were the next two most abundant species comprising almost 13% and 10% of the catch, respectively. Only about 12% of the chain pickerel were of legal size (15 inches) and just over 25% of the largemouth bass were of legal size (12 inches). Alewife were confirmed in the lake with the capture of 56 yearling fish. Brown bullhead comprised just over 8% of the catch and most (>83%) were more than 10 inches long. Adult American Eel seemed to prefer nearshore vegetation and were a surprise catch in the survey. The absence of cisco from both the 2015 and 2006 surveys and the lack of current reports of the presence of the cisco would indicate that they are no longer present. The forage base in Lake Taghkanic appears to be adequate for establishing a walleye fishery, thus a 5-year stocking policy to establish walleye in the lake will commence in 2017.

East Sidney Reservoir Fishery Survey

A fall boat electrofishing survey of East Sidney Reservoir was conducted to assess the status of the fish community and determine survival and growth of walleye fingerlings that were stocked in June as part of a new 5 year stocking program (2015-2019). A total of 535 fish representing 15 species were captured, including brown trout, common carp, golden shiner, emerald shiner, common shiner, spottail shiner, bluntnose minnow, white sucker, brown bullhead, rock bass, pumpkinseed, bluegill, smallmouth bass, largemouth bass, and yellow perch. The catch was predominantly forage and immature fishes; no stocked walleye were found. Common shiner were the most abundant species (33% of the catch), followed by white sucker (18%) and smallmouth bass (11%). All brown trout were found near the inlet area and were large (>15 inches) adults; one appeared to be a stocked fish (worn fins). Very few pumpkinseed or rock bass captured were of desirable size (≥ 6.5 inches). The same was true for the yellow perch, with only 9% of the catch ≥ 8 inches. Brown bullhead were uncommon but most (86%) were >10 inches. Black bass were the most common gamefish collected, but only 7% of the largemouth bass and 20% of the smallmouth bass were of legal size (12 inches). There were, however, some large fish captured, with four smallmouth bass and seven largemouth bass over 15 inches. The largest smallmouth bass was just over 18 inches and the largest largemouth bass was over 19 inches.

Otsego Lake Lake Whitefish Assessment

In support of the management goal of reestablishing the predator-prey relationship between lake trout and lake whitefish in Otsego lake, extensive habitat assessment and biological survey work was completed during the 2015 field season. As the locally adapted native prey for lake trout, lake whitefish have the potential to provide a more reliable food resource for lake trout than non-native alewives. However, the spawning population of lake whitefish is currently very low and little is known about where successful reproduction is happening in the lake. To gain this knowledge, gill nets and trap nets were deployed from late November through early December of 2015. Electrofishing was also conducted. Students, faculty and staff from SUNY Cobleskill, SUNY Oneonta and Hartwick College provided extensive assistance in the operation of this gear. These efforts documented that most of the Lake Whitefish were spawning south of Sunken Island in the upper northwest corner of the lake. On two different nights in early December 2015, a total of 18 adult ripe Lake Whitefish were captured measuring 521-629 mm total length and weighing 1.7-2.9 kg. These fish were later aged at 6-13 y using scale samples. To assess the potential for hatchery propagation of lake whitefish at SUNY Cobleskill, three female and 10 male lake whitefish were field spawned to produce approximately 71,000 eggs. Success rates varied for egg fertilization ~80%, eye-up ~60%, and hatching ~35%, respectively. While this experiment is not expected to yield fry for stocking in 2016 it has provided an opportunity for SUNY Cobleskill to gain experience in rearing this species. In addition to the above described work, summer snorkeling surveys were also completed to assess salmonid spawning habitat.

Pepacton Reservoir Brown Trout Survey

To assess the status of the brown trout population in Pepacton Reservoir a gill net survey was completed in June 2015. Standardized methods were used to allow comparison with earlier surveys. Gill net gangs were set overnight at 11 standardized locations throughout the reservoir at depths ranging from the surface to 120 ft. A total of 46 brown trout (7.5-27.1 in), 1 rainbow trout (20.8 in), 3 alewife (3.8-4.5 in), 11 rainbow smelt (7.5-9.6 in), 1 longnose sucker 10.9 in), 153 white sucker (8.2-19.9 in), 8 brown bullhead (8.9-16.1 in), 13 channel catfish (5.6-15.4 in), 2 margined madtom (4.7-5.2 in), 130 rock bass (3.9-7.6 in), 3 smallmouth bass (16.5-17.3 in), and 78 yellow perch (3.9-11.2 in) were collected. Brown trout ranged in weights from 0.13 to 7.1 lbs. In the eleven previous surveys conducted between 1969 and 2008, the number of brown trout collected ranged from 32 to 66 for an average of 48.8 fish/survey. The 2015 catch of 46 brown trout was unchanged from the longterm average which indicates that brown trout abundance in Pepacton Reservoir is stable. A total of 21 brown trout were sent to USFWS in Lamar, Pa for fish health testing. Ten brown trout and 11 smallmouth bass were sent to the NYSDEC Hale Creek for mercury testing. Results from the fish health testing showed no known fish health issues in the brown trout. Mercury testing has not yet been completed, but currently there is a recommended health advisory of 1 meal/month for brown trout over 24" and smallmouth bass over 15".

Thompsons Lake Fishery Assessment

Thompsons Lake is a 128 acre waterbody in Albany County that supports both warmwater and coldwater sportfish. To assess the status of the coldwater and warmwater fishery a gill net survey was conducted on 8/3/15. A total of 116 fish were collected including 18 rainbow trout (12.6-18.7 in), 1 brown trout (12 in), 7 chain pickerel (12-22 in), 43 golden shiner (6.5-10.3 in), 7 white sucker (9.3-20.7 in), 1 rock bass (6.5 in), 3 pumpkinseed (8-8.8 in), 8 bluegill (8.3- 9.7 in), 2 largemouth bass (12-13 in) and 26 yellow perch (8.1-12.7 in). Of the nineteen trout collected, 3 rainbow trout were considered holdover fish measuring 17.6, 17.7 and 18.7 in. The average condition factor for rainbow trout was 0.99, 1.07 for brown trout which is equivalent to the typical wild brown trout found in a stream. As a result of this survey it was recommended that the existing stocking policy for Thompsons Lake be continued at 1,700 rainbow trout and 500 brown trout yearlings annually. A total of 13 rainbow trout were sent to the NYSDEC Hale Creek field station for mercury testing but have not yet been analyzed. Currently there is no specific health advisory for consuming fish from Thompsons Lake.

Glass Lake Fishery Assessment

Glass Lake is a 126 acre pond in Rensselaer County that supports both warmwater and coldwater sportfish. To assess the status of the coldwater fishery, a gill net survey was conducted on 8/27/15. A total of 199 fish were collected including 5 rainbow trout (12.4-13.7 in), 5 chain pickerel (16.6-23.5 in), 25 golden shiner (8-12.1 in), 26 brown bullhead (9-13.4 in), 3 pumpkinseed (7.8-8.3 in), 91 bluegill (6.6-9 in), 2 largemouth bass (9.1-9.2 in), 3 black crappie (9.4-11.3) and 38 yellow perch (8.5-12.1 in). The catch of 5 rainbow trout was surprisingly low and there is no explanation why so few trout were collected. The existing stocking policy for Glass Lake will continue at 1,800 rainbow trout yearlings annually, but will be reevaluated again in the near future to determine if a different salmonid species would be better suited for the lake. A total of 5 rainbow trout and 10 yellow perch were sent to the NYSDEC Hale Creek field station for mercury testing but have not yet been analyzed. Currently there is no specific health advisory for consuming fish from Glass Lake.

PUBLIC SERVICE AND CONSTITUENT SUPPORT

Improvements to Goodyear Lake Access

Major upgrades to the hand carry boat access site on Goodyear Lake were completed, all of which are universally accessible. Upgrades included a ½ mile long trail through the woods with resting benches, a fishing platform which cantilevers over the water, a picnic area with a fireplace and picnic tables, and improved traffic flow and increased parking. New interpretive signage, a canoe/kayak launch, porta-potty as well as a path for pulling ice fishing sleds onto the lake are also provided.

Region 4 Outreach Events

Region 4 Fisheries collaborated with fellow DEC staff from other offices and various state and local agencies/groups on six public outreach events on four different inland waters during 2015-2016. Three of the six events were registered free fishing clinics focusing on introducing newcomers to the sport of angling, while the other three events were more relevant to showcasing the resident fishes from their respective waterbodies.

Starting in June, staff teamed up with other Fisheries staff from Albany to conduct a free fishing day for families at Pepacton Reservoir sponsored by the NYCDEP. Relatively low attendance and a slow bite that day resulted in only a few rock and smallmouth bass being caught. The NYCDEP continues to expand recreational opportunities for the public on their large reservoirs by promoting more of these free fishing days. In July, staff teamed up with OPRHP staff at Glimmerglass SP for the semi-annual Otsego Lake Appreciation Day in cooperation with other local groups like OCCA (Otsego Co. Conservation Association) to educate the public on local aquatic resources. A trap net and angling produced various lake fishes including one nice walleye and largemouth bass that were fan favorites in our aquaria display at the beach house. We had a moderate turnout for the event and many folks learned much about the lake ecology and other topics discussed.

In August, staff teamed up with the Hudson River Estuary Society, NYS Museum, and region 5 fisheries staff for the Great Hudson River Estuary fish count. For this event, a variety of Hudson/Mohawk River fishes were collected by electrofishing and displayed along the beach in tubs for the public to observe and touch as desired. An adult bowfin captured off Peebles Island just before the event began was particularly noteworthy as it was the first of this species to be recorded in the upper Hudson River. Later in October, staff participated in the Day in the Life of the Hudson River Estuary by night shocking the local rivers to collect and hold adult fishes for local grade school science classes the next day. The range of this effort was extended to cover five sites along the Hudson River from Peebles Island in Cohoes down to the Corning Preserve in Albany. Live adult river fishes were provided to each site including some nice striped bass, walleye, channel catfish and shorthead redhorse. This riverside event has become the most well-attended and successful youth outreach programs in the watershed.

2015-16 Region 4 Fisheries Staff	
Chris VanMaaren	Biologist 2 (Aquatic)
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Tim Pokorny	Biologist 1 (Aquatic) Trainee 2
Dennis Wischman	Fish and Wildlife Technician 3
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Anthony Bruno	Seasonal Fish & Wildlife Technician

SPECIES CONSERVATION & MANAGEMENT

Brook Trout Pond Surveys

Snag Lake

Snag Lake was last surveyed in 1976 and brook trout stocking was stopped due to the level of acidity found in that survey. In 2008 an experimental brook trout stocking policy was started using the Horn Lake strain of brook trout. This most recent survey revealed that there is currently a brook trout monoculture in Snag Lake. Twenty-six brook trout were captured from several year classes, and nine of the fish captured were unmarked, indicating that some natural reproduction is taking place. The stocking rate was reduced from 600 fingerlings to 300 fall fingerlings to improve the current mediocre growth.

Falls Pond

Stocking of Falls Pond was suspended in 1985 following a survey that collected only one brook trout and showed unsuitable acidity levels. Improvements in pH of certain Adirondack waters, including waters in this area, prompted a fisheries and chemistry survey of this pond. The fish survey resulted in a catch of 32 brook trout from this 37 acre water. The brook trout ranged from 14”-16”, and the water chemistry showed marked improvement from historical levels. In addition, there is a natural fish barrier that protects this water from the upstream migration of non-native fish species. A new stocking policy was initiated for 2016 calling for 1,000 Horn Lake strain brook trout fingerlings to be stocked each year.

Round and Twin Ponds

Round Pond is a 17 acre pond in the Dix Mountain Wilderness, and Twin Pond is a small, connected pond immediately downstream of Round Pond. The ponds were successfully reclaimed in 2005 and later stocked with Windfall strain brook trout. The stocking rate was reduced after a 2010 survey in which 47% of the captured brook trout were wild. The current survey was the first since that stocking rate reduction, and wild fish now comprise 78% of captured fish. While the number of brook trout captured dropped from the last survey, the catch rate is still twice the pre-reclamation value and the average length is unchanged from 2010. Unfortunately, a few blacknose dace were also caught, the first species other than brook trout to be documented since the reclamation. Because of the extent of natural reproduction, the pond no longer requires stocking. The pond will be revisited in a few years to assess the brook trout population and the pond’s species composition.

Bloody Pond

Bloody Pond is a 5 acre pond in the Hammond Pond Wild Forest that was reclaimed in 1992 and subsequently stocked with brook trout. The reclamation successfully eradicated golden shiner, creek chub, brown bullhead and yellow perch and the pond remains a brook trout monoculture. The pond appears to be in good shape and the current survey produced the highest average length since the reclamation. Bloody Pond will continue to be managed as a brook trout water, and no adjustment to its stocking rate is needed at this time.

Horseshoe Pond

Horseshoe Pond is a four acre pond in the Pharaoh Lake Wilderness that was reclaimed in 1995 and later stocked with Little Tupper strain brook trout. The primary targets of the reclamation were brown bullhead and golden shiner. Brook trout were the only species present in the initial post-reclamation survey in 1997, but small numbers of bullhead were captured in 2003 and again in this survey. The purpose of this survey was to assess the brook trout fishery and check for natural reproduction. The brook trout catch rate was considerably higher than in previous post-reclamation surveys, but the average length was down slightly, and only stocked fish were captured. The pond continues to provide a reliable backcountry fishing destination, but in the absence of natural reproduction, stocking will be necessary to maintain the fishery.

Round Pond

Round Pond is a small (22 acres) and very deep (100 feet), high elevation pond in Lake George Wild Forest. The pond is accessible by trail from Lily Pond. This survey was conducted as an update since the pond had not been surveyed since 2006. Rainbow trout have been stocked in Round Pond since 1937 producing large fish. Rainbow trout caught ranged from 14” to 21”. Other species captured included brown bullhead, numerous golden shiners, bluntnose minnows and redbreast sunfish. Round Pond will continue to be stocked with rainbow trout at its current stocking rate.

Lixard Pond

Lixard Pond, reclaimed in 1973, is a unique pond in that it sustains a brook trout fishery despite being very shallow (maximum depth 10 ft). Experimental gill nets captured 20 brook trout ranging from 9” to 17”. A minnow net and minnow trap captured no fish, though newts were noted to be very abundant. Despite the fact the pond was reclaimed several decades ago, it remains a brook trout monoculture. Lixard Pond will continue to be managed to maintain the current brook trout population, and no adjustment to its stocking policy is needed at this time.

Icehouse Pond

This easily accessible water in the Moose River Plains was reclaimed in 1999 and has been limed twice, the last time in 1996. Icehouse Pond is sampled annually as part of the Region 5 limed waters program. The last fisheries survey was performed in 2004. As of 2015, the pond remains a brook trout monoculture. Nine brook trout were collected and multiple year classes were represented in the sample. The growth rate of the brook trout appears to be good in this small 6 acre water, and the pH is still quite suitable. Sufficient dissolved oxygen is present to a depth of about 20 feet and the temperature at this depth was about 41° F. There are signs of relatively heavy angling pressure and the current stocking rate of Temiscamie x Domestic hybrid brook trout will be maintained.

Round Whitefish Egg Take

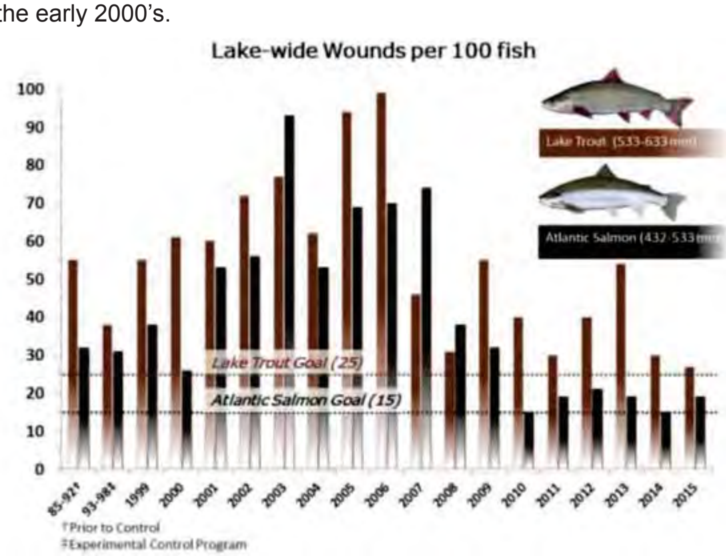
Region 5 Fisheries staff, along with staff from the Oneida Hatchery, conducted an egg take for round whitefish in Lower Cascade Lake in late November. Lower Cascade Lake is an important broodstock water for this species which is endangered in New York State. Because of the unusually warm weather, ice-cover was less of an issue than usual. A total of 240 round whitefish were captured, and the timing of the run was good, as the majority of the females were ripe. Forty-five pairs were stripped, resulting in about 12,500 eggs, which were immediately transported to the Oneida Hatchery to be raised as part of the ongoing effort to support this rare native species.

Lake Champlain Trout and Salmon Restoration

Sea Lamprey Control

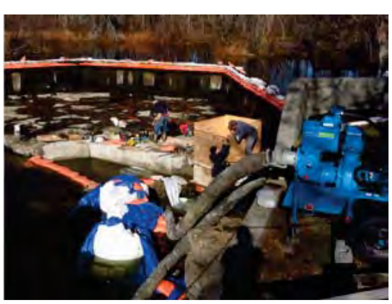
The Ausable River's south mouth, Mount Hope Brook, and the Poultney River were all treated to reduce the number of parasitic sea lamprey in Lake Champlain. Three treatments in Vermont (the Hubbardton River, Winooski River and Lewis Creek) were also completed. These treatments are part of an integrated management program to restore trout and salmon populations and their associated fisheries to Lake Champlain and its tributaries. While the U.S. Fish and Wildlife Service has now taken the lead, DEC staff also assisted with these treatments. All the treatments appeared to be successful, though two (Beaver Brook and Putnam Creek) were rescheduled to 2016 because of too-low flows.

Sea lamprey wounding rates on lake trout and landlocked Atlantic salmon through time are presented in the figure below. The trend for both landlocked Atlantic salmon and lake trout is positive, with substantial decreases in wounding rates for both species compared to the early 2000's.



Chazy River Sea Lamprey Barrier Repaired

For over 20 years the sea lamprey barrier dam on the Great Chazy River, located just upstream of the village of Champlain, has had a leak in fissures under the bedrock on which the dam sits. Sea lamprey were able to take this subterranean flow and bypass the dam during their springtime spawning run, requiring the treatment of an additional 13 miles of river. Last fall in cooperation with the USFWS, a contractor was hired to do some concrete work to plug the leak under the dam. The work appears to have been successful at stopping the water flow and should make the dam impassable to spawning sea lamprey.



Willsboro Dam (Boquet River) Removal

The Willsboro Dam, site of the Willsboro Fishway, has been removed. As part of the removal process, a large portion of the fish ladder was removed, and the remainder was filled in with soil to provide for a public viewing area. Removal of this dam opens a large portion of the Boquet River to spawning landlocked Atlantic salmon from Lake Champlain. Previous studies by the US Fish and Wildlife Service have indicated that the bedrock cascades below the dam site serve as an effective sea lamprey barrier, so spawning by sea lamprey above the dam is not expected. Nonetheless, the USFWS will conduct periodic monitoring above the dam to verify that larval sea lamprey are not utilizing the area above the dam site. The dam removal was conducted by the Town of Willsboro with assistance from the USFWS and DEC.

BEFORE

AFTER

2015-16 Region 5 Fisheries Staff

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Jim Pinheiro	Biologist 1 (Ecology)
Rob Fiorentino	Biologist 1 (Aquatic)
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Brett D'Arco	Seasonal Fish and Wildlife Technician
Chris Swamp	Seasonal Fish and Wildlife Technician
Ethan Ladouceur	Seasonal Fish and Wildlife Technician
Jason Smith	Seasonal Fish and Wildlife Technician

REGION 6

BUREAU OF FISHERIES

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SPECIES CONSERVATION & MANAGEMENT

Eastern Lake Ontario/St. Lawrence River Warmwater Fish Stock Assessment

Over one-third of fishing effort in Region 6 occurs on eastern Lake Ontario or the St. Lawrence River. Warm/coolwater fish stock assessments are conducted by Region 6 on the St. Lawrence River and by both regional and Lake Ontario units on eastern Lake Ontario. The assessments track condition of fish stocks in these waters. In the St. Lawrence River Thousand Islands area abundance of legal size smallmouth increased from record lows in 1996-2004 and varied at moderate levels after 2006. This increase was due to faster growth and earlier recruitment of young fish (largely due to availability of round goby forage) rather than improved recruitment or increases in the total number of individuals in the population. After 2013 smallmouth bass abundance in standard sampling nets declined rapidly and was at near record low levels in 2014 and 2015. Northern pike abundance in the Thousand Islands remains depressed largely due to habitat changes resulting from water level regulation. For Lake St. Lawrence, walleye numbers continue to decline from a peak abundance in 2010 and are now below the long term average. Smallmouth bass in Lake St. Lawrence were collected at the long term average and have shown relative stability since 2010. Abundance of legal size smallmouth bass in eastern Lake Ontario increased after 2005 from record lows in 2000-2004 although it remained low relative to the levels of the 1970s, 1980s and early 1990s. Small increases in harvestable size bass since 2005 have been attributed to increased growth and vulnerability of young fish to capture. No strong year classes have been detected in recent years. In 2015, abundance appeared to be at a level comparable to the record lows of the early 2000s.

Brook Trout Management

Good water quality is vital to a thriving fish population. Many fish, including brook trout (*Salvelinus fontinalis*) cannot tolerate acidic conditions. In an effort to counterbalance the effects of acidification NYSDEC conducts a pond liming program which includes monitoring water quality in vulnerable waters. During the 2015 field season, Region 6 monitored water quality in 38 Adirondack lakes and ponds. Lime is typically spread on the pond's frozen surface and mixes into the water once the ice melts in the spring. The warm weather experienced in the winter of 2015-16 precluded efforts to lime any ponds because ice conditions were not safe. Generally speaking, the levels of pH in Adirondack ponds are slowly improving thanks to the Clean Air Act (1970) which addresses emissions of hazardous air pollutants. NYSDEC will continue to monitor water quality in Adirondack ponds to ensure brook trout have suitable habitat.

Heritage strains of brook trout are genetically distinguishable from other brook trout and this makes them important to New York's biodiversity. Their unique adaptations also make them valuable tools in fisheries management. For a number of years, Region 6 has conducted annual heritage strain egg takes in order to further the propagation and distribution of these unique strains of brook trout. In fall 2015, egg takes for the Little Tupper strain were conducted on Boottree Pond. Wild male Little Tupper brook trout were collected from South Twin Lake and their milt was used to fertilize some of the eggs collected from Boottree Pond. This was an attempt to bring wild selected genes into the gene pool. Fertilized eggs were transferred to the NYSDEC hatchery system where they will be raised and stocked in the fall as fingerlings. This is the eighth year that an egg take has been conducted on Boottree Pond.

Two strains of brook trout which include the Horn Lake strain and the Temiscamie-Hybrid strain, have been stocked into Lyon Lake and Hawk Pond which are located in the Five Ponds Wilderness Area. The two strains were stocked together in the same water to create a "head to head" competition. Future surveys will be conducted in an attempt to determine which strain may be better suited for survival in Adirondack waters.

Walleye Assessments

Black Lake

From 2009 through 2015 Region 6 fisheries conducted five electrofishing surveys and two gill net surveys at Black Lake (St. Lawrence County) in order to evaluate the success of the 2008-2013 experimental 50-day fingerling (sometimes called fryling) stockings. These fish were marked with oxytetracycline which produces a mark that can be detected for one or two years. No fish young enough to read the marks were captured although 11 of the 84 walleye sampled during the surveys were in the age range that could have been from the experimental stockings (they could also have been from natural reproduction). The group of walleye most commonly sampled originated from years in which no stocking, or only fry stocking, along with natural reproduction occurred. Based on these findings, walleye management in Black Lake has now moved toward fry stocking.

Red Lake

Red Lake (Jefferson Co.) was sampled in 2015 as part of a full "Percid Plan" study with both gill nets and boat electrofishing. The lake has been managed primarily for walleye although it has healthy populations of largemouth and smallmouth bass, northern pike, and panfish. Yellow perch, smallmouth bass, and black crappie were the three most abundant species collected in gill nets at 33%, 17%, and 14% respectively. Catch per Unit Effort in electrofishing samples (CPUE= fish/hour) was highly variable for walleye, smallmouth bass, and northern pike primarily due to the variety of habitats sampled. Walleye abundance was considered low with CPUE's for gill nets and electrofishing at 1 fish/net night and 2 fish/hour respectively. Largemouth bass were collected with greater regularity at all sites with an average CPUE of 21.5 fish/hour. Regional records show that walleye (fry, 50 day, and fingerling) have been stocked from 1990-2013. Due to a direct connection to the Indian River, fish movement in and out of the lake likely has a large impact on fish community composition, and makes evaluation of stocking success problematic.

Yellow Lake Fish Community Assessment

Yellow Lake, in St. Lawrence County (364 acres), was surveyed in June of 2015 as a precursor to a complete community assessment in 2016. The lake is a narrow, shallow, eutrophic water body with a maximum depth of <20 feet. A total of four days of sampling effort utilizing experimental gill nets, fyke nets, and daytime boat electrofishing was completed. A total of 673 fish representing 13 species were collected and processed during the week of survey. Bluegill, Pumpkinseed, and Golden Shiner comprised the top three species at 33%, 16% and 13% respectively. Predators were dominated by Northern Pike at 9.4% of the catch. Largemouth Bass were not collected in large numbers although they are the most sought after sportfish in the lake. Total bass, which included juvenile fish, were collected at an average rate of 17.1 fish/hr by boat electrofishing.

HABITAT CONSERVATION

Fish Passage

Region 6 Fisheries personnel have been involved with reviewing downstream fish passage designs for the Upper and Lower Beaver Falls hydroelectric projects on the Beaver River. Re-licensing efforts continue for the Upper and Lower Beaver Falls Hydropower Plants. The Village of Gouverneur Hydroelectric facility began the licensing process in December of 2014 and will continue for the next couple of years. Region 6 Bureau of Fisheries and Division of Environmental Permits personnel are currently working with the U.S. Fish and Wildlife Service on a basinwide approach to streamline the upcoming plethora of hydroelectric projects due for relicensing in the Black River Basin. The use of 'nature-like' fishways, such as the rock ramp, which are often less expensive and more effective at passing a range of fish species than conventional fishways is being encouraged.

PUBLIC SERVICE & CONSTITUENT SUPPORT

New/Upgraded Access Facilities

Providing public access to natural resources is a key regional program. During 2015-16 two new access sites were constructed using the principals of Universal Access Design and five sites were rehabilitated. The Yellow Lake Fishing Access Site is a Universal Access, hand carry canoe/kayak/car-top boat launch in St. Lawrence County. The Cpt. Herman J. Bendfeldt Memorial Fishing Access Site provides shore fishing access to the West Branch of Fish Creek in Oneida County. In Lewis County, three Fishermen's Parking Areas on Fish Creek (tributary of the Black River) were resurfaced. The Glenfield Fishing Access Site, also in Lewis County, was rehabilitated to include Universal Access Parking and the Accessible Observation Deck overlooking a nearby marsh was repaired. The Cranberry Lake Boat Launch Site in St. Lawrence County was rehabilitated by widening the entrance road to accommodate two-way traffic and both the upper and lower parking lots were regraded and re-graveled to correct drainage issues.

Outreach and Education

Regional outreach efforts reached anglers and families at fishing clinics and Earth Day events. Fisheries staff participated in the Earth Day celebration at the New York State Zoo at Thompson Park, Watertown. Over 2500 people attended the event, many of them families with young children. Attendees were presented with information on Northern New York stream ecosystems as well as a variety of other environmental topics. Hands-on activities with aquatic invertebrates were met with interest and excitement by attendees of all ages. Elementary school students were reacheed at conservation field days, environmental awareness days and local events such as the Thousand Islands Land Trust Bug Bonanza. At Jefferson County Environmental Awareness Days staff worked with Cooperative Extension and the Fort Drum Natural Resources Division, among others, to present hundreds of area sixth graders with interesting information and activities relating to local resources including area fishes and fishery issues. Staff participated in the "Bug Bonanza" by setting up a station dedicated to teaching children about "water bugs" (aquatic macroinvertebrates). This year's theme concentrated on how aquatic macro-invertebrates find their food and what functional feeding group they belong to. A lesson plan called "Macroinvertebrate Simon Says" that was developed by Utah State University Water Quality Extension provided a fun and educational experience for all who participated. High school students were reached at Envirothon competitions which included elements on aquatic systems and fishery management. Together thousands of anglers, students and families throughout the region were provided to information about fish, fishing and aquatic systems.

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REGION 7

BUREAU OF FISHERIES

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

SPECIES CONSERVATION & MANAGEMENT

2015 Cormorant Management at Oneida Lake

For the sixth consecutive year DEC Fish and Wildlife staff from both Regions 6 and 7 conducted a cormorant management program on Oneida Lake. The primary goal of the program is to reduce the number of cormorants on the lake in order to limit their impact on the lake's sportfish populations. Effort was increased again in 2015 to address the recent trend of increased cormorant numbers in the spring and summer months and also to limit cormorant nesting activity. Department staff began hazing and egg oiling in late April and continued hazing and culling activities through the end of September. Counts and/or hazing took place from April 29th through October 7th on a total of 30 days. The highest count of the early season occurred on April 29 when a total of 279 cormorants were observed. Cormorant numbers declined during the month of May (average 175 birds: range 122-249) and remained near the target population level of 100 birds during June (86 birds: range 74-103) and July (116 birds: range 94-142). Cormorant numbers from August through October increased dramatically relative to 2014. Despite a similar level of hazing effort, the August average count of 408 was over a third higher than August 2014 while the September 2015 average count of 650 cormorants was more than double the September 2014 average. Cormorant hazing efforts ceased with the onset of duck season in October.

To reinforce the hazing efforts and to collect data on diets, a total of 179 cormorants were culled. Of these, 160 were submitted to Cornell researchers for diet analysis. Diets consisted of a mix of species which included gizzard shad, yellow perch, emerald shiners, and walleye, among others. Recently established round goby accounted for 12% (by number) of the cormorant's diet but much of this came later in the year as the goby population increased. Yellow perch and walleye again comprised a significant portion of the diets, particularly when considered by total volume. Without doubt, Department hazing efforts in 2015 once again saved large numbers of Oneida Lake sportfish from cormorant predation.

Spring 2015 Cayuga Inlet Fishway Operations

Fishway operations continued in spring 2015. For the season, a total of 681 rainbow trout were handled which was nearly 140 more than the previous spring. Region 7 Fisheries staff also assisted with the annual collection of approximately 250,000 "Finger Lakes Wild" strain rainbow trout eggs conducted by Bath Hatchery. The rainbow trout produced from this collection are used to augment wild rainbow trout populations in Cayuga, Skaneateles, Owasco, and Keuka Lakes.

The number of adult sea lamprey in the lake has declined, as evidenced by the number captured at the Fishway in spring 2015. A total of 398 adult sea lamprey were trapped and killed at the Fishway - down dramatically from the past few years when approximately 4,000 to 6,000 were captured/killed annually. Lamprey wounding of rainbow trout is monitored at the Cayuga Inlet Fishway using fish in the 500-549 mm (19.7–21.6 in.) target index size range. The wounding rate for rainbow trout in the spring 2015 was 0.24 active wounds/fish which was down from 2014's rate of 0.34 wounds/fish. The 2015 rate was only slightly above the target rate of < 0.23 wounds/rainbow trout but is expected to continue dropping as the number of adult lamprey in Cayuga Lake continues to decline as a result of the August 2014 lampricide treatment of Cayuga Inlet.

Cayuga Lake Summer Gillnet Survey

During late July and early August 2015, Region 7 Fisheries staff sampled the lake trout population of Cayuga Lake using Finger Lakes Standard Gang gill nets at 32 standard netting sites. This was the fourteenth time the lake was surveyed using this technique since 1976. The primary objectives of the survey are to determine the relative abundance of adult lake trout, the incidence of sea lamprey attacks on lake trout, and to monitor the relative contributions of wild and stocked lake trout to the population. In addition, 50 lake trout were collected for chemical residue assessment. Overall, the gear adjusted lake trout catch likely represents a medium to medium-high density population relative to past surveys. The observed sea lamprey wounding rate (0.03 wounds/lake trout) was exceptionally low. Of the 847 lake trout collected, 92 (15%) did not have a hatchery fin clip. Since all stocked lake trout in Cayuga Lake are supposed to have a fin clip, the unclipped fish are presumably wild. This level of wild contribution to the lake trout population of Cayuga Lake is one of the highest observed in the time series. Of particular note is the apparent wild contribution of younger lake trout (11 to 15 inch size range). Of the 158 lake trout from this size category that were captured, 52 (33%) were unclipped. In comparison just 6% of the rest of the lake trout sample (40 out of 689) were unclipped. Although unlikely, the results may be biased by a 2012 stocking of 5,000 small (3-inch), unclipped, surplus lake trout. By 2015, these unmarked fish should have been approximately 11 to 15 inches long. However, these 5,000 unclipped fish represent less than 8% of the 65,000 lake trout stocked that particular year and it's highly unlikely that they would have recruited at such a disproportionately greater rate. The high percentage of hatchery fish in the adult lake trout population of Cayuga Lake indicates that the fishery is still primarily maintained by stocking but future monitoring will be necessary to determine whether the wild contribution is indeed increasing.

Old Chenango Canal Trout Sampling

The Old Chenango Canal in Madison County was electrofished on August 20, 2015. The survey was conducted to evaluate whether recent angler concerns about poor trout fishing are a result of changes in the canal's trout abundance and/or size structure. Also, no fishery surveys have been conducted at the canal by the Department since 1991. Two sites were electrofished and the total of 167 brown trout collected provided a catch per unit effort (CPUE) of 125/trout hour. This CPUE was greater than the 1991 CPUE of 53/trout hour (n=137 brown trout). However, the 2015 mean brown trout length was only 129 mm compared to the 1991 mean of 213 mm. It does appear that there is currently a good year class of wild young-of-year (YOY) brown trout in the stream, but larger older-aged trout appear to be underrepresented. Of the 167 trout captured, only two were ≥12 inches (1.2%) while in 1991, 33 (24%) of the brown trout sampled were ≥12 inches. The Old Chenango Canal is managed under special trout fishing regulations with an all year open season, a minimum length of 12 inches, a two trout daily limit, and "artificial lures only" policy. Additional survey work will be conducted in

2016 before making any recommendations or changes to the current regulations or stocking policy of 1,000 one year-old brown trout.

2015 Finger Lakes Angler Diary Cooperator Program

Angler catch data for the 2015 fishing season on the four eastern Finger Lakes were summarized and letters sent to participating cooperators in early April 2016. Data from this program provides DEC with information on growth rates, stocked fish recruitment, and angler success rates which help guide our management efforts. A brief summary of each lake follows but the full summaries are available on the DEC website at *http://www.dec.ny.gov/outdoor/27875.html*. Highlights from the 2015 summaries include:

- Continued, but slow improvement in the brown and rainbow trout fisheries of Owasco Lake;
- The highest overall trout/salmon catch rate (catch per trip) in Cayuga Lake dating back to 1984;
- Targeted catch rates of bass in Skaneateles Lake continue to indicate the lake now supports an outstanding smallmouth bass fishery;
- Combined targeted catch rates for smallmouth and largemouth bass in Otisco Lake were also indicative of an exceptional black bass fishery.

Brook Trout Stream Surveys

Six Eastern Brook Trout Joint Venture (EBTJV) surveys were conducted by Region 7 Fisheries staff in 2015. Two of the surveys took place on unnamed tributaries to Wylie Brook (Chenango County) and were selected because they are candidates for use of the Culvert Replacement Funds available from the United States Fish and Wildlife Service (USFWS). The USFWS Cortland office has some funding to purchase larger culverts in an effort to reconnect brook trout habitat in central New York. Region 7 and USFWS staff evaluated two culverts in the Wylie Brook watershed. Brook trout had been observed during previous surveys on both unnamed tributaries. Brook trout presence in these streams was reconfirmed in 2015 when two brook trout were collected in one tributary and 19 in the other. Culvert replacement was deemed necessary at the Seymour Hill Road tributary to facilitate upstream fish passage. Culvert replacement is scheduled for 2016. Analysis of the second problem culvert on the other unnamed tributary at Wylie-Horton Road, revealed that upstream fish passage could be reestablished by installing two grade control "steps" immediately downstream of the culvert. This configuration should provide conditions to allow fish passage under low to moderate flow conditions. This project is expected to be completed in 2016 as well.

Factory Brook (Cortland County), Handsome Brook (Chenango County), Unnamed Stream (Chenango County) and Wylie Brook (Broome and Chenango counties) were electrofished to obtain brook trout genetic samples as part of the EBJV. These streams were selected as they also contained brown trout, as samples needed to come from a population that was mixed with brown trout. Brook trout were collected in 3 of the 4 streams; no brook trout were caught in Handsome Brook. Overall, a total of 30 brook trout were caught. Fin clips were taken from each of these brook trout and submitted to the principle investigator of the study. Beside the brook trout, 48 brown trout and 7 burbot were also collected.

2015 Jamesville Reservoir Fall Walleye Assessment

Walleye (6,600 pond fingerlings) are scheduled to be stocked every other year in Jamesville Reservoir. In 2005, surplus walleye were available, so a total of 7,800 were stocked rather than the normal allotment. Night-time boat electrofishing was conducted on September 30, 2015 to assess the current status of the walleye population in the reservoir as well as to attempt to assess the tiger muskellunge population. The entire perimeter of the lake was sampled, and 67 walleye were collected, along with one tiger muskellunge. The catch rate of walleye was 40.6 fish per hour, a substantial improvement over both the 2013 survey at 13.7 fish per hour, and 2011 at 4.7 fish per hour. Walleyes ranged in size from 7.1 to 24.4 inches and ranged in age from 0 to 9+ years. Sixty-one of the captured walleye were age 0, presumably from the spring 2015 stocking as very little natural reproduction is known to occur in this lake. The lone 10-inch tiger muskellunge captured was obviously one of the 1,700 recently stocked fish put in by DEC in late September 2015.

Leland Ponds 2015 Fish Community Survey

Upper and Lower Leland Ponds, 46 and 55 acres respectively, located in the Town of Eaton, Madison County were surveyed with a boat electrofisher and gill and fyke nets in June and July. Upper Leland Pond is stocked yearly by DEC with 1,400 yearling brown trout. Lower Leland Pond is stocked annually with 200 tiger musky fingerlings. The purpose of the survey was to evaluate age, growth, abundance, and predator/prey balance of the reservoir's sportfish community and to determine if stocked brown trout and tiger musky are recruiting to the fishery.

Upper and Lower Leland Ponds are connected via a culvert pipe and, for the purpose of this survey data collected on each water was pooled. Overall, 545 fish were caught representing 18 species. Yellow perch were the most numerous with 162 caught (30% of catch). The next most numerous species was alewives (n=81, 15% of catch), followed by largemouth bass (n= 72, 13% of catch), rock bass (n=41, 8% of catch), and pumpkinseed sunfish (n=37, 7% of catch). Other gamefish caught were chain pickerel (n=30, 6% of catch) and smallmouth bass (n=2, 0.4% of catch). Current stocking strategies on these waters may need to be reassessed given the catch of only one stocked brown trout and tiger musky.

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REGION 8

BUREAU OF FISHERIES

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

SPECIES CONSERVATION & MANAGEMENT

Lamprey Control Seneca Lake - Catharine Creek

During the week of September 8th, a total of 28 staff from 5 different regions, Caledonia Fish Hatchery, Rome Pathology Lab, the US Fish and Wildlife Service, and SUNY Brockport treated Catharine Creek to control sea lamprey larvae. TFM, a highly selective lampricide, was applied to various sections of Catharine Creek and its tributaries for a period of 33 h. TFM in-stream concentrations were monitored round the clock during the application to ensure that only sea lamprey larvae, which live in the stream sediments, were impacted. Non target mortality was very light with only 12 non-lamprey impacted. Although observed/estimated mortality of sea lamprey larvae was good, it is likely that mortality was not 100%. Stream flow at the time of treatment was the lowest ever for a treatment since they began in 1982. This resulted in an extended treatment duration along with levels of dilution/attenuation of TFM concentrations nearing 40% in downstream areas. Therefore, minimum lethal concentrations of TFM for sea lamprey larvae were typically not achieved for the recommended 9 hours. Based on the results of the Catharine Creek TFM treatment it is recommended that future treatments be avoided at flow rates <8.0 cfs due to the problems associated with dilution/attenuation and treatment duration.

Catharine Creek Rainbow Trout Production Survey

A total of 9 index sites in Catharine Creek and 2 index sites in Sleepers Creek, a tributary of Catharine Creek, were sampled with backpack electrofishing gear August 17-20, 2015 to estimate density of age 0 and age 1 and older rainbow trout. The estimated density of young-of-year (YOY) rainbow trout collected at the nine sites in Catharine Creek ranged from 0 to 1,739 YOY rainbow trout/acre and averaged 937 YOY/acre. The estimated density of age 1+ and older rainbow trout collected at the nine sites in Catharine Creek ranged from 0 to 190 age 1+ fish/acre and averaged 64/acre. Although densities fall within historic ranges, they are generally skewed toward the lower end of the range. Similar results were found in Sleepers Creek. The relatively low numbers of Age 1+ rainbow trout may have been the result of a couple of significant spring rain events that may have negatively impacted the 2014 year class in western Finger Lakes tributaries.

Seneca Lake Fish Community Survey

Seneca Lake, located within Ontario, Yates, Seneca, and Schuyler counties, is the largest of the Central New York Finger Lakes (43,343 acres). During the summer and fall of 2014 and 2015, the fish community of Seneca Lake's shallow nearshore habitats was sampled using 35 fyke net sets, 32 gill net sets, and 32 bag seine pulls. Thirty shoreline night boat electroshocking sites and eight backpack electroshocking sites at tributary mouths were sampled. The purpose of the survey was to develop a picture of the overall fish community of the lake.

A total of 10,628 individual fish of 40 species were collected. This represents 83% of the species detected within the last 44 years and 65% of all species known historically from Seneca Lake. Thirty species were recorded both in early records (late 1800s and early 1900s) and current surveys, indicating that these species have a long history in Seneca Lake. Eighteen species were recorded from Seneca Lake for the first time after 1965, while 14 historic species have not been detected in at least 44 years.

Of note, for the first time since 1927, walleye (n=1) were collected in Seneca Lake. Alewife were the most numerous species captured with 4,368 caught (41% of catch) followed by brown bullhead (n= 1,785, 17% of catch), banded killifish (n=596, 6% of catch), rudd (n=561, 5% of catch), yellow perch (n=534, 5% of catch), pumpkinseed (n=290, 3% of catch), smallmouth bass (n=237, 2% of catch), and largemouth bass (n=139, 1% of catch). Data analysis is ongoing, and a report is expected in late 2016.

Finger Lakes Rainbow Trout Spawning Run Surveys

Spring rainbow trout sampling occurred on three major Finger Lake tributaries in March: Naples Creek (Canandaigua Lake), Cold Brook (Keuka Lake), and Catharine Creek (Seneca Lake). Results of the surveys were similar on all three streams, with rainbow trout spread throughout the entire length of the tributaries. Total number of trout collected ranged from 19 in Cold Brook to 110 in Catharine Creek. The largest fish collected was a 9.2 pound female collected from Catharine Creek. In general, all trout collected appeared to be in good condition. Many of the female trout in each tributary had already spawned. Relatively warm temperatures during March led to many adult rainbow trout spawning before the beginning of the season on April 1. Despite the warm weather in March, angler reports and results from fishing derbies indicated that there were some rainbows remaining in the streams during early April.

Stream	Total #	Max. Length (in)	Max. Wt. (lbs)
Naples Creek	57	26.7	8.2
Cold Brook	19	25.3	5.9
Catharine Creek	110	29.5	9.2

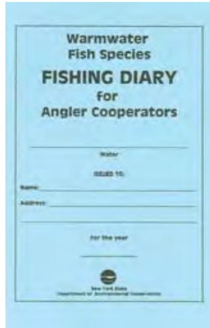
Wild Trout Surveys

Electrofishing surveys were completed on 81 streams in 2015. Over a five year period (2010 through 2012, 2014 and 2015), 861 sites from 699 streams were sampled with trout collected from 194 streams. The numbers of streams with each trout species combination collected are listed below. Wild trout were documented for the first time in 108 streams. These streams will be added to a list of streams that qualify for reclassification as wild trout streams.

Species	# Streams
Brook Trout Only	67
Brown Trout Only	55
Brook Trout and Brown Trout	30
Rainbow Trout Only	19
Rainbow Trout and Brown Trout	6
Rainbow Trout and Brook Trout	1
Rainbow Trout, Brook Trout, Brown Trout	1
Total	**179**

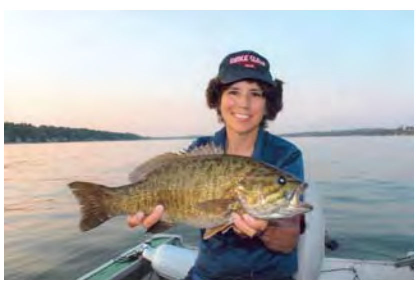
Angler Diary Cooperator Programs

Coldwater Program (Seneca, Keuka, Canandaigua Lakes)



The 40+ year old program continued in 2015 on Canandaigua, Seneca and Keuka Lakes. Total number of angler trips were 371, 696 (all time low), and 678 respectively for the 3 lakes. In both Seneca and Keuka took anglers 2.5 hours to catch a legal trout. Although lower than what anglers have come to expect, these catch rates are similar to or better than catch rates experienced in the mid 1970's and 80's when angling effort was much higher. In Canandaigua, anglers averaged 2.1 hours to catch a legal trout, a big improvement from last year. This catch rate is better than the target of 2.5 hours per legal trout. Salmonine catch composition continues to remain at more desirable levels than in the early 2000's in Canandaigua with lake trout accounting for about 73% of trout caught. However, in both Seneca and Keuka Lakes, lake trout once again dominated, accounting for 89% and 98% of the catch respectively. This indicates very little contribution to the fishery from brown trout, rainbow trout and Atlantic salmon. The lake trout population in Keuka Lake continues to be sustained entirely by naturally reproduced fish, whereas the other lakes have variable natural recruitment rates that require supplemental stockings to maintain the lake trout fishery. Canandaigua Lake continues to be the one western Finger Lake with a significant contribution of both rainbow and brown trout. Regulations were recently enacted to improve the overall trout fishing experience in the western Finger Lakes. The diary program remains an integral part in the evaluation of these new regulations.

Conesus Lake



Fishing effort by angler diary keepers in 2015-16 was similar to the prior year. Overall, fishing on Conesus Lake was on par with past years, as it took diary-keeping anglers 3.62 hours to catch one legal game fish (0.28 legal gamefish per hour). However, this number was significantly influenced by one diary keeper, as most took between 1.0 and 8.3 hours to catch a legal gamefish. For anglers targeting largemouth bass, the catch rate was 0.46 legal bass/hour. Largemouth bass comprised 28% of the total game species caught. Eighty seven percent of the largemouth bass catch was composed of legal sized (>12 inches) fish. All but 8 were released. Although most of the bass were less than 14 inches, anglers caught 9 memorable fish greater than 18 inches. Smallmouth bass comprised 11% of the total game fish catch; 90% were legal size and all were released. Seven of the smallmouth exceeded 18 inches. Northern pike made up 45% of the total game fish catch. Ninety five percent were legal size, with fish averaging 28 inches in total length. One fish greater than 36 inches was caught and the overall catch rate was 0.33 legal pike/hour. Fifteen tiger muskies were caught, the largest 41.5 inches in length. Seventeen walleyes were caught, all by anglers specifically targeting walleyes, for a catch rate of 0.17 legal fish/hr. Average walleye length was 23 inches and 15 fish were harvested.

Honoeye Lake

During the 2015-2016 fishing season, 17 diary cooperators reported 1,649 hours of fishing effort during 662 fishing trips. This is a similar amount of fishing effort compared to previous years. A total of 2,783 game fish and 194 panfish were reported caught. On average, anglers took 0.70 hours to catch one legal game fish (1.4 per hour). This is a very good catch and is similar to last year. The high catch rate for game fish continues to be primarily due to excellent largemouth bass fishing.

Twenty-seven walleye averaging 19.2 inches were caught with 21 harvested. Anglers who were specifically targeting walleye had a catch rate of 0.16 walleye/hour. Total catch and catch rate were both down compared to last year. Similar to last year, most of the walleye reported were 18 inches or larger with little evidence of recruitment of the walleye fry stocked each year. Diary results also indicated quality fishing for chain pickerel, bluegills, pumpkinseeds, and black crappie.

Chemung River Creel Survey

The Chemung River, flowing through the southern tier of New York near Corning and Elmira, supports an important warmwater fishery. Fishing access to the Chemung River has been expanded over the last two decades with a total of 10 boat launch sites located within this area. These boat launching facilities, in addition to the bank access available at bridge crossings and within the flood control project area within the Cities of Elmira and Corning, provide fishing accessibility to anglers. A modified-access creel survey was conducted from 1 May 2015 – 31 October 2015 to determine angler effort, catch, and characteristics. A total of 445 angler parties were interviewed during the survey, with anglers fishing an estimated 27,948 angler-h. Most anglers targeted bass and channel catfish, with walleye and carp being other somewhat common targets. Anglers caught an estimated 6,595 gamefish, with black bass, almost entirely smallmouth bass, comprising 94% of the total gamefish catch. Anglers also caught an estimated 417 walleye. An estimated total of 5,190 non-gamefish were caught with channel catfish comprising 17% of the catch. Sixty-five percent of all anglers interviewed responded that they never keep bass, with only <1% regularly keeping bass, indicating the Chemung bass fishery is largely a catch and release fishery. Nearly 44% of channel catfish were harvested, indicating that catfish fishery is largely consumptive. Overall, the Chemung River provides mostly local anglers with good warmwater fishing opportunities, primarily for smallmouth bass, channel catfish, and walleye.

PUBLIC SERVICE & CONSTITUENT SUPPORT

Fishing Pole Lending program

Six libraries were actively involved in the Region 8 Library Fishing Pole Program in 2015: Dansville, Wood, Pulteney, Honeoye, Woodward Memorial and Modeste Bedient (Branchport). In addition, Lyndonville Public School received poles from the program for defined fishing classes. The number of poles loaned ranged from 28 at Woodward Memorial Library to 6 at Dansville Public Library. Regardless of the number of users, all the Librarians report that the program generates many positive comments.

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SPECIES CONSERVATION & MANAGEMENT

Chautauqua Lake Fisheries Management

Muskellunge Egg Take

In April and May 2015 a trap net survey was conducted on Chautauqua Lake to collect muskellunge eggs for the New York State hatchery system, and to assess the status of the muskellunge population in the Chautauqua Lake. A total of 151 adult muskellunge were collected and 32 mated pairs were spawned. Offspring from all 32 pairs will be equally represented in our hatchery product to maintain a high level of genetic diversity within the muskellunge population. The catch rate in 2015 was 1.8 fish/net night. This catch rate is lower than the catch rates observed in 2013 and 2014 but is similar to the average of previous years. The total length of female muskellunge ranged from 28 inches to 48 inches with an average of 38 inches. The total length of male muskellunge ranged from 24 inches to 40 inches with an average of 31 inches.

Fall Walleye Survey

The walleye population in Chautauqua Lake was surveyed in late September by boat electrofishing. This assessment has been done every year since the early 1990's and serves as an index of abundance for the walleye population. A total of 261 walleye were caught for a catch rate of 34.8 fish per hour. The catch in 2015 was similar to last year and above the long term average of 19.7 fish per hour. The last two years have shown two of the largest year classes of walleye ever documented in Chautauqua Lake. In 2014 267 young-of-year walleye were caught and in 2015 183 young-of-year walleye were caught. The 2014 year class was well represented as one year olds in 2015, which indicates good survival through their first winter. Walleye in Chautauqua Lake typically reach legal size of 18" by age 6 so anglers won't see these fish for a few years, but there should be some excellent walleye fishing in the years ahead.

Rushford Lake Fish Community Survey

Rushford Lake's fish community was surveyed throughout the spring, summer and fall of 2015 following standardized protocol. In mid-May, fyke nets were deployed to sample pre-spawning and spawning fish species within the littoral zone. In mid-August, bag seining was completed throughout the near shore habitat to capture cyprinid minnows and age-0 fish. In mid-September, gill nets were deployed in order to sample fish species at deeper water depths. In late September, electrofishing was completed to sample all fish species within the littoral zone.

In total, 23 different species were collected from Rushford Lake (species richness=23). The predominant fish captured was yellow perch, representing 27% of the total catch. Smallmouth bass were the second most abundant fish, representing 16% of the total catch. Walleye and rock bass were also collected, but each represented less than 1% of the total catch. All but one species, the black redhorse, had been collected in Rushford Lake prior to the 2015 survey. Currently, black redhorse are listed as a species of special concern in New York. In addition to Rushford Lake, black redhorse have only been recently documented in the Allegheny River basin and Buffalo River.

Shannon's diversity index was 2.4, suggesting Rushford Lake had a moderately diverse fish community. Shannon based evenness was 0.8, suggesting that all fish species within the community were roughly equal in abundance. Although not much else can be interpreted from these current values, they may serve as a baseline of comparison for future surveys. This baseline can then be used to better document dramatic changes within Rushford Lake's fish community, helping fisheries staff better identify potential causes of those changes. By identifying potential causes, more informed and appropriate management decisions can be made.

Genesee River Angler Diary Program

The Genesee River angler diary program covers the entire river in Region 9 from the Pennsylvania state line downstream to Letchworth State Park. The river is managed as a stocked trout fishery from the PA line downstream to Belmont. The river also has a substantial population of smallmouth bass throughout its length. Diary programs have also been used on the river in 1988, 1989 and 2010.

A total of 19 diarists reported a large number of trips made (237) and hours fished (749) in 2014. The majority of diarist trips were made by anglers targeting trout (84%) and occurred in the months of April, May and June (61% of total trips). A total of 450 yearling brown trout (91% released), 179 two-year-old or older brown trout (80% released), 120 rainbow trout (90% released), 13 brook trout (92% released) and 222 smallmouth bass (all released) were reportedly caught by diarists.

The combined average catch rate for brown trout and rainbow trout in 2014 of 1.17 fish/hour was well above the management objective of 0.5 fish/hour. Although only 39 trips targeted bass, the average catch rate for smallmouth bass in the diary program was very high at 2.01 fish/hour. The diarist's average catch rate for brown and rainbow trout combined in 2014 (1.17 fish/hour) was very similar to the 2010 (1.33 fish/hour) and 1988 (1.38 fish/hour) diary programs, but lower than the rate found in the 1989 program (2.40 fish/hour).

Lower Niagara River Warmwater Fisheries Survey

An electrofishing survey of the lower Niagara River from Lewiston to the mouth of the river was completed in June – July 2015. A total of 1034 fish representing 21 species were collected during 3.75 hours of electrofishing. Smallmouth bass were the most abundant game fish with 291 collected for an average catch rate of 76 fish/hour - one of the highest catch rates ever recorded in New York. The catch rate of Smallmouth Bass is truly exceptional when compared to the statewide average of 4 fish/hour. Total length of Smallmouth Bass ranged from 4.5 inches to 19.2 inches with an average of 14.1 inches. Smallmouth Bass reached legal size of 12 inches during their third growing season in the lower Niagara River. Other notable catches include several large walleye, four species of sucker, freshwater drum and American eel. One of the most interesting findings of this survey was the abundance of American eel in the lower Niagara River. Twelve eels were caught and 13 others observed for an average catch rate of 3.1 fish per hour and an average observation rate of 6.2 fish per hour. American Eel ranged in size from 20 inches to 34.2 inches with an average length of 25.2 inches. American eel are listed as a species of greatest conservation need and the lower Niagara River is one of the few places in the Great Lakes where they can be reliably caught.

Stream Habitat Enhancement Monitoring

Wiscoy Creek watershed wild trout monitoring surveys

Wiscoy Creek, a popular wild brown trout fishery in Wyoming and Allegany Counties, and two major tributaries (North Branch Wiscoy Creek and Trout Brook) were sampled in 2015 to monitor trout populations and angler diary cooperator catch rates on the main stream. The same 15 sites had been sampled in 2006, 2009 and 2012, with some sites on Wiscoy Creek also sampled from 1978-2001. Average adult (yearling and older) brown trout abundance for Wiscoy Creek in 2015 was 496/mile, half of that found in 2009 and 2012, and only one third of what was found in 2006. Declines in adult trout abundance over time were statistically significant at 8 of 10 individual sites. An increase was seen in the abundance of larger wild brown trout (>15 inches) beginning in the 2009 survey and this became especially apparent in 2012 and 2015. Total catch of young-of-year brown trout was low in 2015 opposed to 2012 when it had been high the highest ever measured.

Considerable declines in adult brown trout abundance were also observed for the North Branch Wiscoy Creek and Trout Brook from 2006-2015. Additionally, the catch of young-of-year brown trout in both creeks was variable depending on the site, which followed the same pattern we saw in Wiscoy Creek itself. A high number of adult and young-of-year wild brook trout were found at one site on Trout Brook.

The angler diary program in 2015 duplicated ones done along with electrofishing in 1997, 2001, 2006, 2009 and 2012. The catch rate in 2015 was 0.54 fish/hour (±0.14). This was a lower catch rate than any of the past diary programs and corresponded well with the electrofishing finding of reduced adult brown trout abundance. Angler diary program participation in 2015 was reduced from earlier programs. This limited the ability to statistically evaluate the fishery by month and by stream section.

Clear Creek (Ellington) wild trout population monitoring

Using assistance from USFWS staff and angler volunteers, an electrofishing survey of Clear Creek, which flows through Cattaraugus and Chautauqua Counties, was conducted to monitor the wild brown trout and rainbow trout populations. Five sites were sampled which duplicated ones done in 1995, 2005 and 2010. Due to a high wild trout population, stocking of hatchery brown trout ceased on this creek after 2005. For all sites, abundance of yearling and older (adult) wild brown trout in 2015 (935 fish/mile) was higher than in 2010 (689 fish/mile), near that found in 2005 (940 fish/mile) and much higher than found in 1995 (393 fish/mile). However, changes in trout abundance were not consistent between sites in 2015. At the lower two sites, where adult trout habitat was similar to 2010 and 2005, lower numbers of trout were found this year. At the upper three sites, adult trout habitat increased substantially from 2010 and 2005, as did the abundance of adult brown trout. It appears the overall increased abundance for adult brown trout was primarily a result of improved habitat (new, deep pools) at three of the sampling sites. Biomass of adult wild brown trout in 2015 (83 pounds/acre) was very similar to 2010 and 2005, but substantially higher than in 1995 (39 pounds/acre). Abundance of larger trout has increased steadily from 1995 to 2015 with the values for trout >12" (148/mile) (16% of the total adults captured), >14" (58/mile) and >16" (25/mile) being found this year. Of the 385 adult wild brown trout captured in 2015, eight of them (2%) were >16", with four over 18" and the largest at 19.4".

Wild rainbow trout (probably from illegal transfers by anglers) were found in Clear Creek for the first time in 2005 and were again found at two sampling sites in 2010 (25 adult fish/mile). However, in 2015 no adult or young-of-year rainbow trout were captured. It is unknown if they still exist in the creek, nor what caused them to be absent from sites where they appeared to be increasing in abundance from 2005 to 2010. The abundance of young-of-year brown trout in 2015 was the lowest we have measured in the four sampling years (183/mile) and is consistent with low abundance of young brown trout seen in other western NY streams this year.

PUBLIC SERVICE & CONSTITUENT SUPPORT

Angler Education

Region 9 fishing education efforts included coordination and involvement in 5 youth and family free fishing clinics, reaching 411 youth anglers and their families. Two exceptionally strong free fishing day events offered to the public in the greater Buffalo area at Tifft Nature Preserve and Chestnut Ridge County Park were provided in cooperation with the Erie County Federation of Sportsmen's Clubs.

Summer Camp Programs

Fisheries staff provided 5 fishing education programs for youth campers at DEC Rushford Environmental Camp, covering fishing education and instruction for a total of 237 campers. In an effort to offer fishing education to more youth summer camps than DEC staff can actually visit, the Train-the-Trainer program was provided for 4 water-based summer camps. The goal is to teach fishing education to the camp counselors who will in turn provide the training to their many campers throughout the summer. A total of 39 camp counselors received fishing education training from DEC staff. Fishing equipment and fishing education lesson plans were also provided to the camps.

Fishing Hotlines

Fishing extension was provided via the Lake Erie Fishing Hotline and Western New York Fishing Hotline. The hotlines are updated each Friday to provide western New York anglers with current info on productive fishing locations, baits, tips and techniques. Each hotline is available on the DEC website at *http://www.dec.ny.gov/outdoor/fish-hotlines.html* or can be heard at (716) 855-FISH. During the report period, anglers visited the Lake Erie hotline page 102,126 times, Western New York hotline page 89,307 times and the automated phone lines 22,097 times. In all, these popular angler resources were visited an average of 585 times per day.

2015-16 Region 9 Fisheries Staff	
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INLAND FISHERIES SECTION

BUREAU OF FISHERIES

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Fishery Surveys Entered Into Statewide Database

Data from 581 fishery surveys were received by the Biological Survey Unit during 2015-16. This total included 124 Eastern Brook Trout Joint Venture (EBTJV) surveys. A total of 430 surveys were finalized and added to the Bureau's Statewide Database (SWDB) during 2015-16. Updated copies of the SWDB containing newly entered data were generated during the year, one in November (2015) and one in March (2016). These were distributed to Central Office and Regional Bureau of Fisheries Staff as well as Cornell University, the NY Cooperative Fish & Wildlife Research Unit, USGS, SUNY ESF, the Natural Heritage Program and Penn State University.

The statewide database was used during the period in the production of the Atlas of Inland Fishes of New York (Carlson et al. 2016), as well as the creation of Unit Management Plans that document management goals for both aquatic and terrestrial resources on public holdings and easements. Data contained in the database was also used as part of an assessment of river and stream populations of black bass in New York State. It is also being used as part of a revision of the Bureau of Fisheries' primary warmwater inland lake sampling protocol, the Centrarchid Sampling Manual. The New York portion of the rangewide brook trout habitat patch layer, derived primarily from SWDB survey data, was also added to the NYSDEC master habitat data selector where it can be readily accessed and compared to other data selector layers by agency biologists and environmental permits staff.

Considerations for Freshwater Sportfish Regulation Changes

Changes are routinely made to the freshwater sportfish regulations every two years. As a start to this process modifications initially being considered were made public including being made available on the DEC website in February and March of 2016. Utilizing the input received thus far, a collection of proposed changes will now be advanced forward in accordance with New York State's rule making process. A formal Proposed Rule Making is expected to be in place this summer (2016). This will include a formal 45 day public comment period. Upon completion of the entire rule making process the regulation changes would take effect on April 1, 2017 and be incorporated in that year's Fishing Guide.

Warmwater Fisheries Management

Ecology and Management of the Fish Communities in Oneida and Canadarago Lakes

Researchers at the Cornell Biological Field Station at Oneida Lake completed their annual assessment of the fish communities in Oneida and Canadarago Lakes. Funded by a Federal Aid in Sportfish Restoration grant, these monitoring projects are the longest running warmwater fishery assessments in New York State and continue to provide valuable insight on the complex dynamics associated with warmwater fish populations in large northern lakes.

Oneida Lake

Long term fish community changes in Oneida Lake are measured by assessing standard gill net catches. There were 1,343 fish caught in the standard gill nets in 2015, the 4th lowest observed since 2000. White perch represented 33% of the total gill net catch, higher than walleye (26%) and yellow perch (32%). This is the 5th year since 2000 that white perch were the most common species in the gill nets. These three species represent over 80% of the catch in most years.

The estimated adult (age 4 and older) walleye population was 425,000 in 2015, which was a slight decrease from the 2014 estimate of 442,000. Approximately 30% of the adult population are from a large 2010 year class, which is the largest year class since 1987. Over the full course of the 58 year data series the adult walleye population has experienced a significant decrease, but has shown a significant increase since 2000.

The adult (age 3 and older) yellow perch population was estimated to be 923,000 fish, an increase from the 2014 estimate of 596,000. Long term trends show a significant population decline, but no trend is detectable over the last decade, suggesting a more or less stable, but much smaller population than was present in the lake in the 1960s – 1980s.

Round gobies have become established in Oneida Lake. By late July 2014, round gobies began to show up in standard trawl samples and by mid-August were encountered regularly throughout the lake. Trawl catches in 2015 indicated that the round goby population is expanding. After a peak catch of 10 round goby in a trawl sample from 2014, catches exceeded 600 in September 2015, and round goby were the most abundant fish in trawl samples throughout September.

Nearshore fyke net and boat electrofishing surveys were recently added to the monitoring program to account for the anticipated changes in the littoral fish community associated with increases in water clarity attributed to filter feeding dreissenid mussels. In 2014, 25 species were caught in the fyke nets, many of which were littoral species that are not typically caught with the traditional gears used in the long term studies. The fyke net survey has provided an index of young-of-year black bass production and also shows potential as an index for sunfish and chain pickerel. It also will provide valuable data on production of nesting bass and sunfish to assess potential impacts of round goby.

Spring boat electrofishing survey sportfish catches were dominated by walleye (12/hour), largemouth bass (10/hour), chain pickerel (9/hour), smallmouth bass (4/hour), and longnose gar (3/hour). Emerald shiner, yellow perch, brown bullhead, and pumpkinseed made up the majority of the panfish and non-sportfish catch. Spring electrofishing provides a good complement to fyke nets for assessing the nearshore fish community and provides the only index for adult largemouth bass and best index for chain pickerel.

Seining in 2015 collected 21 species, similar to the diversity represented in fyke net samples. Seine samples were dominated by young-of-year yellow perch in all months, with catches of 1759/haul in July declining to 158/haul in September. Other common species included banded killifish, emerald shiner, logperch, white sucker, and white perch. Seine surveys will be useful in assessing potential shifts in habitat use by young-of-year yellow perch from offshore areas, where they have been indexed by our trawl samples, to inshore areas.

Estimated angler effort in 2015 was 232,928 boat hours, which continued a trend of increasing effort since 2002, with 2015 effort the highest yet recorded. The total number of access interviews conducted during June and July was 320. Of these anglers, 173 (54%) strictly sought walleye, while 93 (29%) sought only black bass. Anglers who sought some combination of walleye, bass, yellow perch and panfish comprised the rest of the sample. Of anglers seeking black bass, 26 (30% of bass anglers) indicated they were fishing in a tournament. The estimated catch rate for walleye was 0.23/hr in both June and July. The smallmouth bass catch rate was 0.16/hr in June and 0.23/hr in July. Walleye catch rates were comparable to recent years while bass catch rates showed a modest decline. The estimated total harvest of walleye for the 2015 open water season was 57,230 fish.

Canadarago Lake

NYSDEC Region 4 Fisheries staff conducted a fall boat electrofishing survey of Canadarago Lake to assess the status of the walleye population and other warmwater sportfish. A total of 346 fish representing 15 species were captured. Species captured included alewife, chain pickerel, tiger muskellunge, common carp, golden shiner, spottail shiner, rudd, white sucker, brown bullhead, rock bass, pumpkinseed, bluegill, largemouth bass, yellow perch, and walleye. Yellow perch were the most commonly caught species (42% of the sample), followed by white sucker (15%), largemouth bass (12%), and pumpkinseed (10%). Only eight walleye were captured and all but one were legal size (15 inches) or larger, an indication that recruitment continues to be a problem due to fry predation by an abundant alewife population. A walleye stocking program was initiated in 2011 to maintain this popular fishery, but few young-of-year walleye have been captured in annual fall surveys, which suggests that the success of this program has been limited so far. Region 4 Fisheries will continue to annually assess the walleye population to track the status of stocked fish and other components of the fish community. In addition, a report summarizing Canadarago Lake fisheries surveys from 1974 – 2014 was completed by Cornell Biological Field Station staff in January 2016.

Stocking Evaluation of 50 Day Old Walleye Fingerlings

An experimental walleye stocking program, initiated in 2009 in 9 lakes in central and western regions of the state, was continued using approximately 50 day old tank raised fingerlings from Oneida Hatchery. These 9 lakes (Upper, Middle, and Lower Cassadaga Lakes, Redhouse Lake, Payne Lake, Otisco Lake, Loon Lake, Black Lake and Red Lake) were stocked for 5 consecutive years with about 250,000 1.5 inch long fingerlings and assessed every fall for young of year survival. Stocking ended for these lakes in 2013 and full walleye population assessments were conducted on the Cassadaga Lakes, Redhouse Lake, Payne Lake, Loon Lake and Otisco Lake in 2014 and Black and Red Lake in 2015 to assess the success of the program. No walleye were collected from the Cassadaga Lakes, and few walleye were collected from Redhouse, Red, Black and Payne lakes, indicating that the stocking experiments in these waters were unsuccessful in establishing walleye fisheries. Walleye were commonly captured from Loon and Otisco lakes, indicating that the program can be successful in certain waters. Other lakes, including Chautauqua Lake, East Sidney Reservoir, Rio Resevoir and Cazenovia Lake were included in the stocking program after 2009 and were evaluated for young of year stocked walleye survival in 2015. No stocked walleye were found in East Sidney and Rio reservoirs or Cazenovia Lake. Stocked walleye were commonly caught from Chautauqua Lake.

Statewide Fisheries Database Black Bass Assessment

Largemouth bass and smallmouth bass population data (length, weight, ages) from the NYSDEC Statewide Fisheries Database (SWFD) from 2004-2013 were summarized and key population metrics (catch rates, condition, growth) were assessed and compared among statewide stream/river, lake/pond and St. Lawrence River populations. For both species, there were over twice the number of surveys, fish collected and waterbodies sampled for lakes than there were for streams. Mean lengths, weights, and ages for both species were smaller in streams than lakes. Lake surveys were more likely to be designed for warmwater sportfish population assessments (i.e., Centrarchid and Percid surveys) than stream surveys, which likely influenced the size and age structure of fish collected from each waterbody type. Grand mean smallmouth bass catch rates were similar for lakes (10/h±6) and streams (8/h±2), whereas grand mean largemouth bass catch rates were higher in lakes (19/h±5) than streams (11/h±8). Condition, as measured by relative weights (Wr) derived from species-specific equations, of each black bass species in streams and lakes was similar, but largemouth bass tended to be in better condition than smallmouth bass and condition tended to increase from spring through fall within species/waterbody type groups. Small sample sizes of aged bass limited age distribution and growth assessments, particularly for streams. The limited data suggested that both species typically reach 10 inches by age 3 and 12 inches by age 4 in all waterbody types, and that lake and St. Lawrence River smallmouth bass mean lengths were slightly higher than those for stream smallmouth bass for ages 3-6. Mean lengths at ages for smallmouth bass from the St. Lawrence River and lakes are indicative of fast growth through age 5, and average growth thereafter.

This project highlighted the extent and limitations of stream black bass population data in the SWFD. Few stream surveys provided the data necessary for a comprehensive assessment of bass populations, which limited the assessment of statewide population metrics and stream/lake comparisons. Establishment of standard warmwater stream sampling and assessment methods would allow for a more uniform and comprehensive assessment approach, which would greatly enhance the ability to reliably assess individual bass populations and make comparisons among streams throughout the state.

Coldwater Fisheries Management

Brook Trout Management

Since the completion of the catchment level brook trout assessment in the spring of 2015, the resulting statewide map of habitat patches where brook trout were found or predicted was incorporated into two additional tools for conservation planning. First, the data was provided to the New York Natural Heritage Program resulting in the inclusion of brook trout status as a criterion in its Great Lake Riparian Opportunity Assessment; a geographic information tool designed to help identify watersheds in the Great Lakes basin where reestablishing streamside forest would have the greatest conservation benefit. It was also added to the master habitat data selector enabling DEC staff to easily overlay the brook trout habitat patches with any of the other maps already in the data selector. The catchment level brook trout information is available to the general public at the following URL:

http://ecosheds.org:8080/geoserver/www/Web_Map_Viewer.html.

In 2015, the Bureau participated in two new multi-agency research projects applying genetic analyses to brook trout management questions. The primary objective of the first project was to identify western NY brook trout populations that would most benefit from removing barriers to fish passage. A secondary objective was to determine the extent to which the genetic structure of certain wild brook trout populations had been influenced by stocked brook trout. To answer these questions, Bureau staff conducted non-lethal collections of adipose fin tissue from brook trout from 18 streams in Region 9 and 20 streams in Region 8. The samples were submitted to a U.S. Fish and Wildlife Service lab where analysis is in progress. USFWS staff completed similar collections on an additional 19 waters in western New York. The second project is an experimental approach to brook trout monitoring in the Chesapeake Bay watershed. The technique being tested uses genetic markers from adipose fin tissue from young-of-the-year brook trout to characterize the population structure and genetic health of a brook trout population. A relatively small sample can be used to estimate the number of breeding adults within a self-contained population. This can then be used to infer whether that population is stable or declining with considerably less effort than would be required to conduct traditional population estimates. In 2015, tissue collections were completed on six streams in NYSDEC Regions 4, 7, and 8. Other states conducted parallel sampling in their portions of the Chesapeake Bay watershed.

Taking advantage of recent advances in the science, information, and technology available to manage this species, a new statewide brook trout management plan is being drafted. The original brook trout plan, completed in 1979, has been a successful blueprint for managing this species in New York State but it is clearly due for an update. The rewrite committee, chaired by the Coldwater Unit Leader, met in December 2015 to review the components written by the members. A complete first draft is planned for 2016.

Landlocked Atlantic Salmon Management

Since 2007, the Bureau obtained landlocked Atlantic salmon eggs (Sebago strain) from the state of Maine to stock Little Clear Pond; the brood stock source for the entire NYSDEC Atlantic salmon propagation program. The objective was to gradually replace the Little Clear Pond strain with the Sebago strain which showed superior performance in a study completed on Lake Champlain. In 2015, analysis of the 2014 netting data showed that all captured fish were Sebago strain progeny. Therefore, the eggs taken from Little Clear Pond in the fall of 2015 could be confidently classified as pure Sebago strain. With this transition successfully completed, eggs from Maine are no longer needed and Atlantic salmon propagation can continue based on a self-sufficient Sebago strain brood stock in Little Clear Pond.

Coldwater Habitat Management and Monitoring in the New York City Watershed

The upper reaches and tributaries of the Delaware River support one of most productive trout fisheries east of the Mississippi River. The fishery depends upon releases of cold water from three water supply reservoirs operated by New York City under a Flexible Flow Management Plan (FFMP) that is negotiated between New York City and the states of New York, New Jersey, Pennsylvania and Delaware. The FFMP is, in turn, based on the outcome of legal proceedings among the above parties which culminated in 1954 in a United States Supreme Court decree. In this management context, NYSDEC's habitat protection objectives are contained in recommendations set forth on January 12, 2010 in concurrence with the Pennsylvania Fish and Boat Commission. Both the FFMP and the joint fisheries recommendations can be found on the website of the Delaware Rivermaster:
http://water.usgs.gov/osw/odrm/index.html.

In order to assure the availability of flow and temperature data essential to coldwater fisheries management in the tailwaters of New York City's Delaware and Catskill reservoirs, a total of $54,510 was committed in 2015 to support the operation of U.S. Geological Survey stream gages at the following locations:

- Diversion from Schoharie Reservoir
- Esopus Creek at Coldbrook
- East Branch Delaware River at Harvard
- West Branch Delaware River at Hale Eddy
- West Branch Delaware River at Hancock
- Delaware River at Lordville
- Delaware River at Callicoon
- Neversink River at Bridgeville

These instruments, which transmit flow and temperature measurements in real time, would not otherwise be operated. The data they collect are available to the public at the following website:
http://waterdata.usgs.gov/ny/nwis/current/?type=sw&group_key=basin_cd.

Beyond supporting the operation of the USGS gages, Bureau of Fisheries staff from Regions 3 and 4 deploy an array of temperature recording sensors at strategic locations downstream of the three Delaware reservoirs on an annual basis to provide additional information to evaluate the performance of the FFMP with respect to the habitat protection objectives described above. A report summarizing the data collected from this monitoring effort for the period from June 2011 through May 2015 was completed in 2016 and is available on the Delaware Rivermaster website.

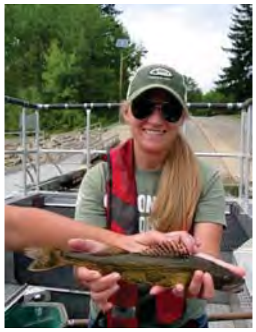
Between July 8th and August 5th of 2015 Cannonsville Reservoir was rapidly drawn down as a public safety precaution following a soil boring accident. The additional volume of cold water released during this period shifted the zone of optimal trout temperatures downstream from its typical summer location under the FFMP. Had the drawdown continued however, the volume of cold water would have been exhausted by August 17th leaving the trout populations in both the reservoir and the river vulnerable to thermal stress and fish kills. NYSDEC and Pennsylvania Fish and Boat Commission staff met regularly during the drawdown to discuss risk scenarios and management options. Fortunately, repair work at the dam was completed ahead of schedule and the remaining reservoir storage was sufficient to sustain the fishery through the rest of the summer.

Inland Trout Stocking Research

In 2015, the Coldwater Unit continued to consider the management implications of Cornell University's evaluation of the methods currently used by the Bureau to calculate stocking rates for inland trout streams. The Cornell report, finalized in early 2015, showed that, while catch rate objectives were generally met under the current stocking rates for the streams included in the study, several important parameters including angler effort, angler harvest rates and natural mortality rates had changed substantially since the catch rate oriented trout stocking (CROTS) method was adopted in 1990. Because the CROTS method is working reasonably well, no systematic changes are currently proposed. However, based on the study findings, the Bureau will pursue further research and investigate management options that may offer opportunity to provide greater fishing opportunity with the trout produced by the hatchery system.

Management of Rare & Endangered Fishes

Sauger Restoration



Sauger are one of the most critically imperiled fish species in New York State and a Conservation Management Plan was recently adopted to aid its recovery. The goal of this plan is to establish and maintain self-sustaining sauger populations in all suitable waters of native watersheds, including the Allegheny River watershed. A stocking program was developed and implemented to establish a population in this watershed. Sauger fry from the Ohio River were provided by the West Virginia Division of Natural Resources in 2014 and 2015. These fry were raised in ponds at the Chautauqua Hatchery until being stocked in the upper Allegheny Reservoir in early June of each year. Electrified trawl and boat electrofishing surveys were conducted in late summer of each year to check the status of stocked fish. A total of 6 young of year sauger were collected during trawl surveys. Sixty-seven young of year and 17 age 1 sauger were collected during boat electrofishing surveys. Sauger are staying near the area where they were stocked, a relatively high percentage of them are surviving, and growth appears to be quite high. The prevalence of a variety of fish species in the trawl surveys suggests that the forage base in the upper reservoir is more than adequate to support a sauger population. Annual late summer surveys in stocked areas will continue for each year sauger are stocked and a survey will be conducted throughout the watershed in 2020 to determine if the objective of establishing a self-sustaining population was met.

Lake Sturgeon Recovery Efforts

Restoration effort for lake sturgeon (*Acipenser fulvescens*), a Threatened species in New York State, began in 1991. Since that time DEC has sought to enhance natural recovery in several locations via propagation and stocking through 2024.

Lake sturgeon eggs (100,000) were taken in early June at the Robert Moses Power Project, Massena NY with 4 egg bearing females providing eggs. A cooperative effort between NYS DEC and the Genoa National Fish Hatchery (USFWS, Wisconsin) was successful in rearing approximately 20,500 fish. Hatchery capacity at both facilities was exceeded so stocking was split into two increments; 10,000 summer fingerlings and 10,500 fall fingerlings. Approximately 13,000 fish were stocked in the St. Lawrence, Raquette River, St. Regis River, Oswegatchie River, Black Lake, Cayuga Lake, Genesee River and Salmon River (Franklin County). The remainder (≈7,500) were stocked into bays along the eastern basin of Lake Ontario. All fingerlings received Coded Wire Tags (CWT) prior to stocking for year class survival assessments in the future.

Region 6 staff began a tagging study in 2010 to acquire biological data and provide the basis for movement studies throughout Lake Ontario and the St. Lawrence River. A total of 169 sturgeon were collected in 2015 from the eastern basin of Lake Ontario, and the St. Lawrence River downstream to just below the Robert Moses Power Project. Most of the fish (145) were new captures and were tagged with Passive Integrated Transponders (PIT tags).

The Region 9 fisheries unit and the Lake Erie Fisheries Research Unit sampled the lake sturgeon spawning population in Buffalo Harbor during May and June 2015. Buffalo Harbor is a historic spawning area for lake sturgeon and the area supported a major commercial fishery in the late 1800's. However, overfishing and habitat loss reduced the Lake Erie sturgeon population to very low levels and they are currently listed as threatened by New York State. In recent years the lake sturgeon population in Lake Erie has been increasing and fish once again began returning to Buffalo Harbor to spawn in detectable numbers. Lake sturgeon spawning aggregations in Buffalo Harbor have been surveyed since 2012. Over the last four years 131 lake sturgeon have been caught and tagged. The majority of the fish captured are less than 20 years old but older fish are also present, including one fish that was estimated to be 84 years old. The average total length of all lake sturgeon caught from 2012 – 2015 was 4' 9" and the average weight was 58 pounds. The largest fish caught during the survey was a 6' 2", 143 pound female caught in 2015. All fish caught during the survey were tagged with external FLOY tags and internal PIT tags. In 2015 we began working with U. S. Fish and Wildlife Service from Lamar, PA and 19 fish were tagged with acoustic telemetry tags that will be used to track lake sturgeon movements throughout Lake Erie with the goal of identifying seasonal habitat use and spawning locations.

Region 6 Rare Fish Management Update

Summer Sucker

Life history studies about time of spawning, sizes, growth and genetics of summer sucker and the eastern variant of summer sucker were advanced. Late spawning suckers from Squaw Lake and South Pond (Raquette watershed) were successfully sampled in an attempt to examine gene expression using RNA analysis of fish at time of spawning. The eastern variant of late spawning sucker surveys were sampled a second year in Fish Pond and Thirty-five Outlet, but late spawning was not able to be documented like in 2014. Suckers were not able to be caught in Minnow Pond, the spot where the earliest summer suckers were described, in 1886. It appears that suckers previously known here may have been replaced by the many coolwater species that became established in the last several decades. Genetic analysis of these samples will likely be completed in spring 2016.

Pugnose Shiner

Planning continued for a pugnose shiner recovery program to include stocking in Chaumont Bay of Lake Ontario in 2016. Efforts were extended in 2015-16 as: 1) guiding a study by SUNY Brockport on habitat associations in the St. Lawrence and 2) assisting in the hatchery propagation at SUNY Cobleskill such that brood stock were satisfactorily delivered so there was spawning and reproduction in 2015. Stocking could occur in September 2016.

Native Mussel Distribution in the Upper Susqhehanna Watershed

Region 8 Fish and Wildlife staff completed the second year of a five-year project to determine distribution, density, and status of native freshwater pearly mussel species in six major sub-basins of the Susquehanna, Lake Erie, and Allegheny Watersheds. Mussels stabilize streambeds, diversify stream habitat, provide nutrients to other benthic invertebrates, filter suspended solids and pollutants from water, and are considered indicators of ecosystem health. In spite of the ecological importance of freshwater pearly mussels, they are among the most imperiled groups of animals in North America.

Between 2014 and 2015, 87 sites along 24 streams in the Susquehanna watershed's Chemung sub-basin were surveyed. Evidence of native mussels (live animals or shells) was found in 12 of the surveyed waterbodies. Live mussels were found in eight of the surveyed streams, while live Species of Greatest Conservation Need (SGCN) mussels were found in six of the streams.

A total of 13 species were detected in these surveys, including five SGCN. SGCN species included brook floater, elktoe, green floater, paper pondshell, and yellow lampmussel. We documented both threatened species, brook floater and green floater, at sites where they were not previously detected two decades ago during the last watershed survey. This may indicate that these species, green floater in particular, have expanded their range in this sub-basin.

Lake Ontario Cisco Restoration

Re-establishing self-sustaining populations of native whitefishes in Lake Ontario is the focus of cooperative efforts between the Department, the United States Geological Survey (USGS), the Ontario Ministry of Natural Resources (OMNR), the U.S. Fish and Wildlife Service (USFWS), and the Great Lakes Fishery Commission (GLFC). For the third consecutive year, DEC region 8 staff assisted USGS staff with a fall stocking of ciscoes, or lake herring, in Irondequoit Bay. Lake herring were once an important prey fish in Lake Ontario, and supported important commercial fisheries that collapsed in the early 1950s largely due to over-harvest. On November 30 and December 7 and 9, 2015 Region 8 staff assisted USGS staff with a trap net survey aimed at capturing ciscoes stocked in 2015 and previous years. None were collected during this effort.

2015-16 Inland Section Staff

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LAKE ONTARIO RESEARCH UNIT

BUREAU OF FISHERIES

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

The Bureau of Fisheries Lake Ontario Unit (LOU), based in Cape Vincent, is primarily responsible for delivering a lake-wide fisheries assessment and research program. The mainstay of the program is the Department's 60 ton Research Vessel Seth Green. Lake Ontario's sportfisheries have been valued at over $112 million annually, and successful management requires that fisheries assessments and research be executed collaboratively. Delivery of this comprehensive program requires active partnerships with a number of institutions, including DEC Regions 6, 7, 8 and 9, the U.S. Geological Survey (USGS), the Ontario Ministry of Natural Resources and Forestry (OMNRF), the U.S. Fish and Wildlife Service (USFWS), the Great Lakes Fishery Commission (GLFC), Canada Fisheries and Oceans (DFO), Cornell University, and the SUNY College of Environmental Science and Forestry. The complete annual report can be accessed at:
www.dec.ny.gov/outdoor/27068.html.

SPECIES CONSERVATION & MANAGEMENT

Sportfishery Monitoring

Each year from April through September, the LOU conducts the Lake Ontario fishing boat survey at 30 access channels from the Niagara River in the west to the Association Island cut in the east. The survey tracks a multitude of trends in the open lake sportfishery, including angler effort, catch and catch rates, harvest and harvest rates, performance of stocked fish, and fish growth/condition. Lake Ontario fishing quality is best characterized by the number of trout and salmon caught per fishing boat trip (catch rate). In 2015, there were periods and locations of excellent fishing quality and periods and locations of poor fishing quality. With the variety of trout and salmon species present in Lake Ontario, anglers were able to target another species when catch rates for their preferred target declined. This resulted in a good catch rate for all trout and salmon combined in 2015; however, this relatively high rate is largely attributed to the high catch rate of lake trout (Figure 1). Reduced fishing success and overall angler effort (i.e. total number of days spent fishing by anglers) relative to recent years is thought to have been influenced by abnormally cool water temperatures, as well as atypical wind patterns in 2015.

Preyfish Monitoring and Predator Growth/Condition

With over 5 million trout and salmon stocked annually into Lake Ontario by New York State and the Province of Ontario, it is important to monitor the abundance of bait or preyfish that trout and salmon predators feed on, as well as growth rates and condition of predators (also see Sportfishery Research). Partnering with USGS and OMNRF, the LOU monitors relative abundance of alewife, rainbow smelt, sculpins, and round gobies. Alewife populations are of particular concern, as they are the primary food for Chinook salmon, the top predator in the lake. The adult alewife abundance index in 2015 was similar to the previous four years (Figure 2). Catches of age-1 alewife in 2014 and 2015 were very low (Figure 3). The relatively severe winters of 2013/2014 and 2014/2015 likely contributed to lower survival of young alewife produced in 2013 and 2014. Given low numbers of age-1 alewife in both 2014 and 2015, the adult alewife population is expected to decline in 2016.

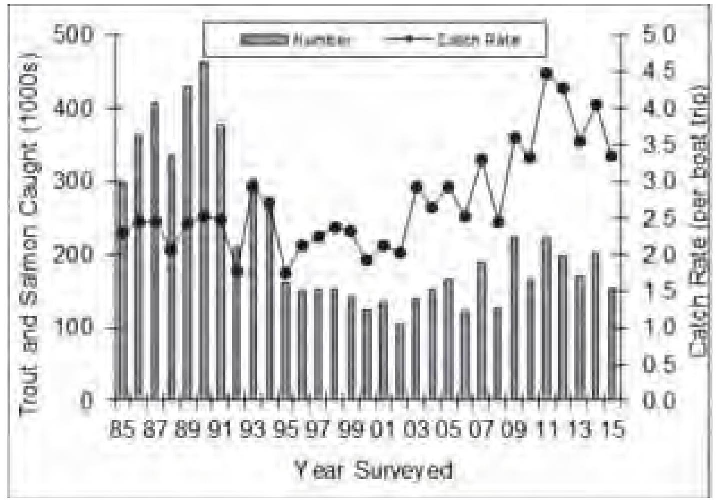

Figure 1. Total trout and salmon catch (bars) and catch rate (line/dots; top graph) and harvest (bars) and harvest rate (lines/diamonds; bottom graph) for boats seeking trout and salmon, 1985-2015.

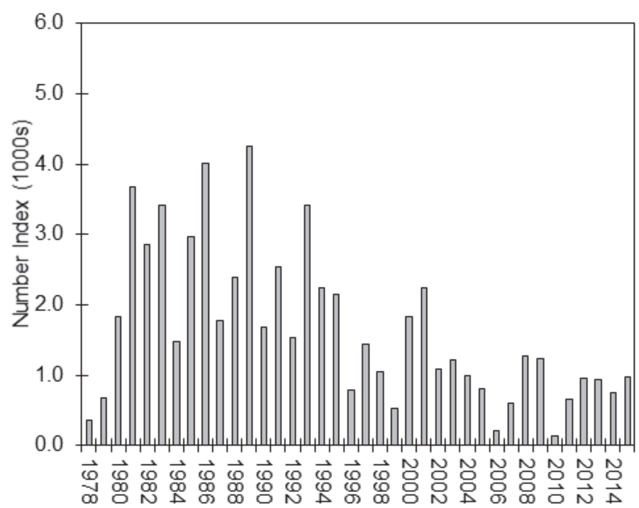

Figure 2. Abundance indices for adult (age-2 and older) alewife in the U.S. waters of Lake Ontario during late April-Early May, 1978-2014. (1 kg = 2.205 lbs)

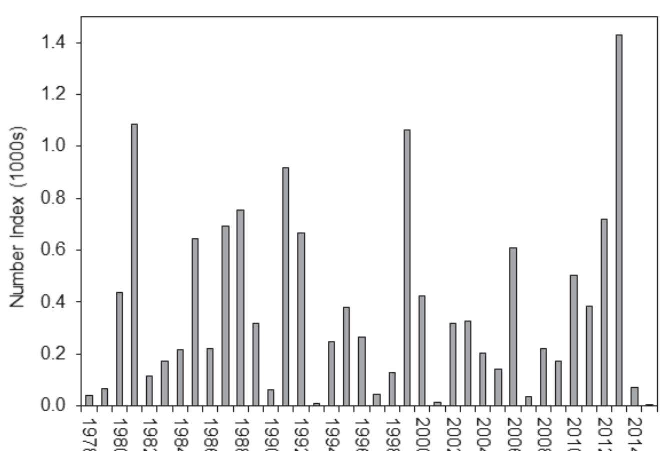

Figure 3. Abundance indices for age-1 alewife in the U.S. waters of Lake Ontario during late April-Early May, 1978-2015.

Sportfishery Research

Using Lake Ontario Natural Resources Damages funds, the Bureau of Fisheries purchased a $1.3 million automated fish marking trailer ("AutoFish") in 2008. The AutoFish system is capable of removing a fish's adipose fin and/or inserting a coded wire tag into the snout of the fish automatically at a high rate of speed and accuracy. Fin clipping and tagging gives researchers tools to answer a variety of questions regarding the relative performance of stocked and wild fish. From 2008-2011, the Department and the OMNRF "mass-marked" all Chinook salmon stocked into Lake Ontario with an adipose fin clip to determine the relative contributions of naturally reproduced ("wild") and hatchery stocked Chinook salmon to open lake and tributary fisheries. Knowing the relative roles of hatchery and wild salmon in the lake is very important for fisheries managers to better understand how stocking decisions can influence Chinook salmon population dynamics and predator/prey balance in Lake Ontario. High numbers of wild Chinook salmon in addition to stocked fish are thought to have contributed to an imbalance between predators and alewife in Lake Huron, greatly reducing growth and condition of Chinook salmon and negatively impacting sportfisheries. The relative contribution (%) of wild Chinook salmon in the open Lake Ontario sport fishery averaged approximately 47% from 2010-2015. These results indicate that although wild fish are an important component of the Lake Ontario Chinook sport fishery, stocking remains essential for sustaining the sport fishery and managing the lake ecosystem.

DEC's Salmon River Hatchery aims to stock Chinook salmon at sizes which promote good survival and imprinting to stocking sites. Tagging of Chinook salmon by LOU has also provided valuable information to managers regarding the effectiveness of hatchery stocking methods. Preliminary results of another LOU stocking strategy evaluation indicate that stocking and holding salmon in pens for a period of a few weeks prior to release ("pen rearing") results in about 2X better relative survival than stocking salmon directly into the lake. Since Lake Ontario angler groups pen rear about 500,000 Chinooks each year, the "effective" result of this stocking is the same as 1 million Chinook stocked by traditional mentods.

Native Species Restoration

An international program to restore a naturally reproducing population of lake trout in Lake Ontario is ongoing. To measure progress, cooperative DEC/USGS bottom trawl (juveniles; July) and gill net (adults; Sept.) surveys are conducted annually at 14 sites from the Niagara Bar to Charity Shoal in the Eastern Basin. Adult lake trout abundance increased each year from 2008-2014, following historic lows observed during 2005-2007. In 2015, 24 age-1 and 48 age-2 naturally produced lake trout were collected in trawl surveys, the 2nd largest catch of naturally produced lake trout in nearly 41 years of surveys.

Three species of deepwater coregonids (members of the whitefish family) are considered extirpated from Lake Ontario, and the LOU has been collaborating with the OMNRF, USFWS, and the GLFC to reintroduce bloater into the lake. In 2014, bloater eggs were collected from Lake Michigan and reared at OMNRF's White Lake Fish Culture Station and the USGS Tunison Laboratory of Aquatic Sciences in Cortland. For a fourth consecutive year, bloaters were stocked into Lake Ontario via this international partnership. Stocking numbers have increased each year, highlighting great advances made in bloater culture techniques at these facilities. Stocking of bloaters is expected to continue annually, with the goal of restoring a self-sustaining population within 25 years.

In addition, the USGS Tunison Laboratory of Aquatic Sciences, in partnership with DEC, is rearing and stocking another coregonid, lake herring. In 2015, a combined total of 100,000 lake herring were stocked into Irondequoit and Chaumont bays on Lake Ontario

Sea Lamprey Control

In an ongoing battle to combat the damaging impacts of sea lamprey on Lake Ontario sport fisheries, the GLFC and their sea lamprey control agents, the Department of Fisheries and Oceans Canada and the USFWS, conducted comprehensive control and assessment activities in Lake Ontario tributaries in 2015. In the adult phase, a single parasitic sea lamprey is capable of killing as much as 40 pounds of fish. Treatments to kill larval lamprey using lampricides were completed in 19 tributaries (10 in Canada, 9 in NY). Treatments in New York included Black River, Altmar Creek, Snake Creek, Catfish Creek, Owasco Outlet, Eightmile Creek, Sterling Creek, Red Creek, and Sodus Creek. A total of 4,184 sea lampreys were trapped in eight tributaries, five of which are index locations. Assessments were conducted on 96 tributaries (65 in Canada, 31 in NY).

Warmwater Fisheries Assessment

Each year the LOU conducts index gill netting to assess the status of warmwater fish populations in Lake Ontario's Eastern Basin. In 2015, smallmouth bass abundance declined to the lowest level observed since 2004 and among the lowest in 39 years of netting. Walleye abundance also decreased. However, with the evidence of moderate to strong reproduction in recent years, the fishery is expected to remain relatively stable for the next few years. In 2015, yellow perch catch declined to the lowest level in the time series. This decrease may be partly attributable to water temperature patterns and catch variability; however, angler reports also suggested lower yellow perch abundance in 2015. At least one lake sturgeon has been collected in 15 of the last 21 years, suggesting an increase in sturgeon abundance.

St. Lawrence River Research

Muskellunge Research

Muskellunge are the focus of a popular and economically important fishery in the Thousand Islands region of the St. Lawrence River, where the NYS record 69 pound 15 ounce muskellunge was caught in 1958. In the late 1970s, muskellunge guides raised concerns that the quality of the muskellunge sport fishery had declined dramatically. In response, the Department conducted preliminary research leading to an increase in the muskellunge minimum size limit from 32 inches to 36 inches. Using Federal Aid in Sport Fish Restoration program funding, the Department contracted with the SUNY College of Environmental Science and Forestry (ESF) beginning in 1987 to conduct St. Lawrence River muskellunge studies. In the ensuing years, studies have identified over 80 muskie spawning and nursery areas that have been afforded additional levels of protection from habitat alteration. Research documenting first spawning of females at approximately 36 inches in length (6 years old) led to increases in the minimum size limit first to 44 inches, and then to 48 inches. A muskellunge release program was instituted that rewards anglers who release a legal-size muskie with a limited edition muskie print created by a renowned local artist. By the mid-1990s, these management actions contributed to a substantial increase in muskellunge angler catch rates, which achieved the management plan catch rate target in 1999.

Large-scale mortalities of pre-spawn female muskellunge caused by the newly introduced Viral Hemorrhagic Septicemia virus (VHSv) were documented in 2005 and 2006. Spring trapnet surveys at index sites sampled each year indicated declining spawning adult abundance since 2008, with marginally improved catches in 2013 and 2014. (Figure 1). Catches of young-of-the-year (YOY) muskellunge in index seine hauls also declined since 2004, but improved slightly in 2013 and 2014 (Figure 2). An angler diary program, which indexes the relative quality of muskie fishing through angler catches, also indicates that angling success remains well below the target of 1 fish caught per 10 hours of fishing. A number of potential causes may be contributing to the apparent muskellunge decline, including habitat changes (vegetative and fish communities on nursery grounds), VHSv mortality, and the presence of round goby in spawning/nursery habitats. Investigations into the cause(s) for these declines are ongoing.

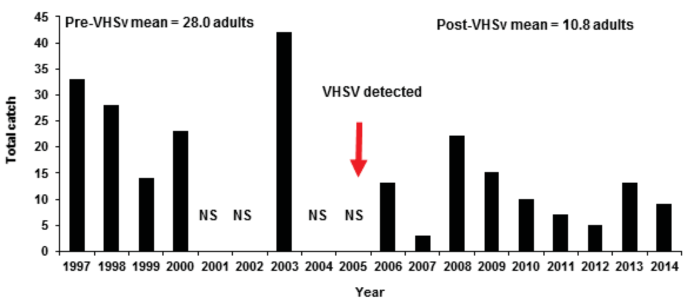

Figure 1. Total catch of muskellunge during spring trapnet sampling during 1997- 2014. Sites and effort are approximately equal over the series. Samples were not collected in 2001-02 and 2004-05 (NS) because of a decision of the Esocid Working Group to monitor muskellunge every third year. Following VHSV outbreak it was decided to resume annual monitoring.

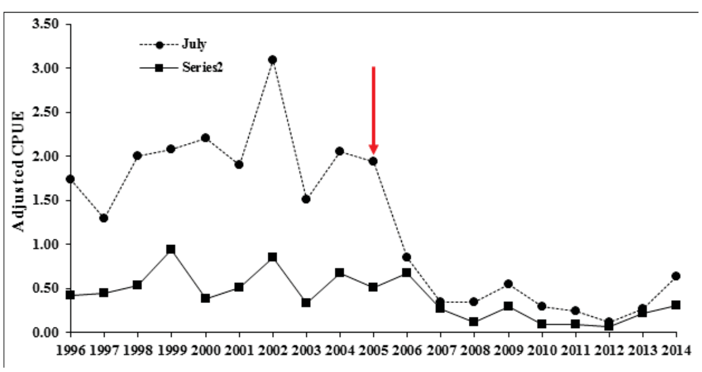

Figure 2. Catch per unit effort of YOY muskellunge captured in standardized seine hauls in eleven upper St. Lawrence River nursery sites from 1996 to 2014 (July= 30' seine series; Series 2= 60' seine). The arrow indicates the year VHSv (2005) was detected resulting in widespread mortality of adult muskellunge in the upper River.

Northern Pike Research

Northern pike spawn about one month earlier in the spring than muskellunge, and are more dependent upon the presence of submerged vegetation for spawning habitat. Long-term regulation of Lake Ontario and St. Lawrence River water levels by the International Joint Commission has reduced the natural range of water levels in the system, resulting in degradation of wetland habitats required by northern pike. Similar to muskellunge studies, ESF researchers have chronicled declines in the abundance of spawning adult and YOY northern pike in the Thousand Islands region. Ongoing research has focused on developing a better understanding of water level regulation impacts on wetland habitats, and conducting experimental habitat manipulations designed to improve natural reproduction of pike. Habitat manipulations include water level control structures used to restore more natural water level regimes in managed spawning marshes, and excavation of channels and pools in cattail mats.

Production of YOY northern pike in managed marshes was initially high, but has declined significantly since 2007. Low numbers of spawning adults, as well as a predominance of female pike, appear to contribute to low reproductive success. Seine hauls at Delaney Bay, downstream of a managed spawning marsh, resulted in a catch of only 12 YOY pike in 2014. The YOY muskellunge seining survey at eleven index sites caught 5 northern pike YOY in the 30' seine series in 92 hauls and 16 in the 60' seine series in 90 hauls. Eight upper St. Lawrence River bays were sampled by seining and 27 YOY pike were captured (N=57 hauls). Assessment of the efficacy of excavated channels in increasing northern pike reproduction is ongoing.

More detailed information on muskellunge and northern pike studies can be found in the Lake Ontario Unit annual report which can be accessed at *www.dec.ny.gov/outdoor/27068.html*.

2015-16 Lake Ontario Research Unit Staff

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Russell Moore	Fish & Wildlife Technician 1
Robert Partridge	Fish & Wildlife Technician 1

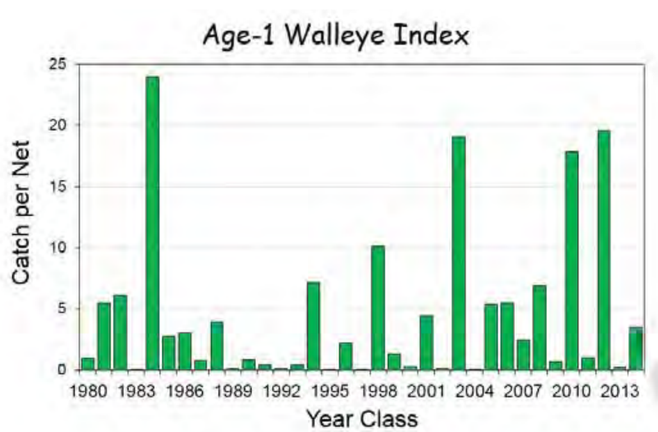
The New York State Department of Environmental Conservation's Lake Erie Fisheries Research Unit is responsible for research, assessment and fisheries management activities for one of New York's largest and most diverse freshwater fishery resources. A variety of annual programs are designed to improve our understanding of the Lake Erie fish community to guide fisheries management, and safeguard this valuable resource for current and future generations. The Lake Erie Unit annual report is available on DEC's website at *www.dec.ny.gov/outdoor/32286.html*.

SPECIES CONSERVATION & MANAGEMENT

Warmwater Fisheries Management

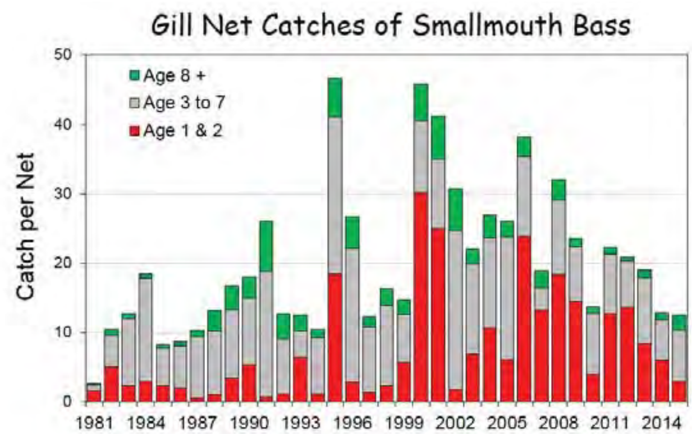
Walleye

Lake Erie's eastern basin walleye resource is composed of local spawning stocks as well as contributions from summertime movements of west basin spawning stocks. Walleye fishing in recent years has generally been very good and largely attributable to excellent spawning success observed in 2003, 2010, and 2012. Measures of walleye fishing quality in 2015 were the fifth highest recorded in the 28 year survey. New York's most recent juvenile walleye survey indicates a moderate spawning year in 2014. Overall good recruitment through recent years, especially from 2010 and 2012, suggests adult walleye abundance in the east basin will remain satisfactory for the next several years. The west basin of Lake Erie experienced a high walleye recruitment event in 2015, which should also help to support New York's walleye fishery in the future. A new research initiative that began in 2015 uses acoustic telemetry to study walleye movement and assess the contribution of west basin migrants to the New York walleye fishery. A $100 reward is associated with the return of each tagged fish along with the internal acoustic tag.



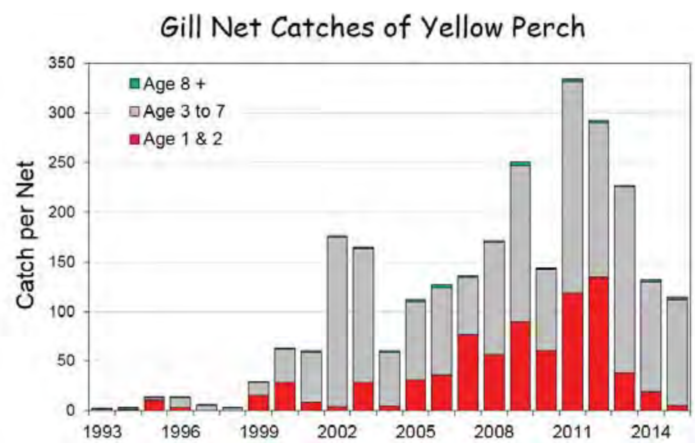
Smallmouth Bass

Lake Erie supports New York's, and perhaps the country's, finest smallmouth bass fishery. Bass fishing quality in 2015 was the fourth highest observed in the 28 year series of monitoring, with the peak observed in 2013. Generally stable spawning success, coupled with very high growth rates and acceptable survival, produce high angler catch rates and frequent encounters with trophy-sized fish. Most recent data indicate a very gradual decline of abundance to near long term average measures. Juvenile abundance measures suggest 2013 produced a below average smallmouth bass year class.



Yellow Perch

Lake Erie yellow perch populations have experienced wide oscillations in abundance over the last 30 years, from extreme lows in the mid-1990's to an extended recovery that's now lasted well over a decade. A large adult population continues to produce good angler catch rates, especially during spring and fall. Declining levels of juvenile yellow perch have resulted in an overall decline in the population over the past three years. Spawning success from 2011 through 2013 was average to poor. This decrease has yet to influence yellow perch angler quality which was the highest in the 27 year series in 2014.

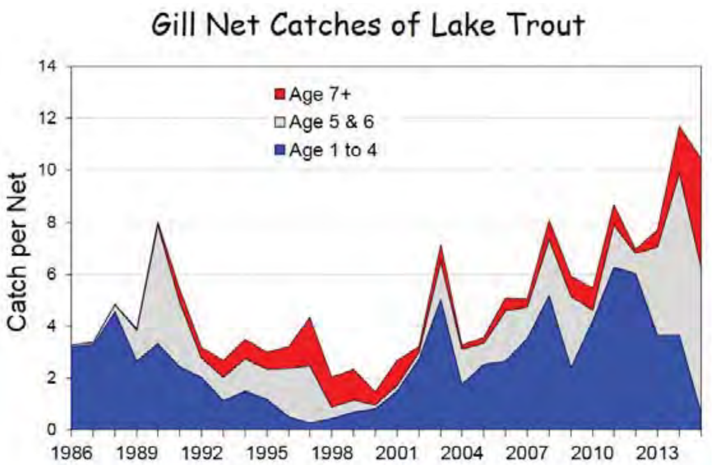


Coldwater Fisheries Management

Lake Trout Restoration

Re-establishing a self-sustaining lake trout population in Lake Erie continues to be a major goal of Lake Erie's coldwater program. Lake trout have been stocked since 1978 and annual assessments monitor progress towards restoration objectives. A revised lake trout rehabilitation plan was completed in 2008 and guides current recovery efforts. The overall index of abundance of lake trout in the New York waters of Lake Erie during 2015 was the second highest observed in 30 years. The majority of the catch was comprised of young adult lake trout ages 5-7. All adult fish (age 5 +) were observed at their highest abundance in 2015, but older fish (age 10+) remain scarce.

Basinwide estimates surpassed targets for adult abundance for the second consecutive year. However, adult survival for some lake trout strains remains low, mainly due to high sea lamprey predation. Natural reproduction has not yet been detected in Lake Erie, and significant stocking and sea lamprey control efforts must be continued to build and maintain the adult population to levels where natural production is viable. Beginning in 2016 an acoustic telemetry study will help locate spawning habitats used by stocked lake trout.



Sea Lamprey

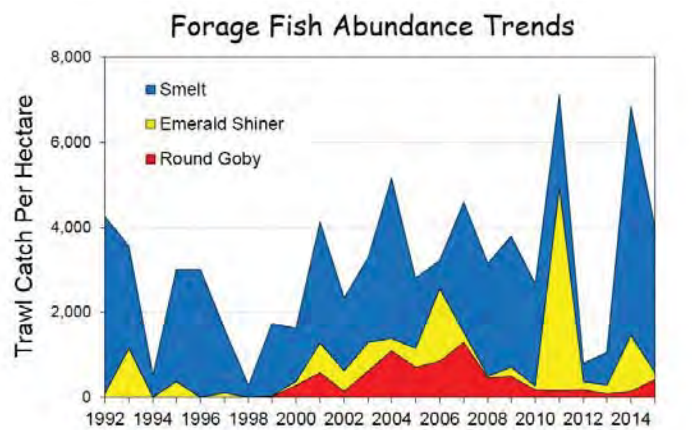
Sea lamprey invaded Lake Erie and the Upper Great Lakes in the 1920s and have played an integral role in the demise of many native cold-water fish populations. Great Lakes Fishery Commission (GLFC) coordinated sea lamprey control in Lake Erie began in 1986 in support of lake trout rehabilitation efforts, and regular treatments are conducted to reduce sea lamprey populations. Annual monitoring undertaken by NYSDEC includes observations of sea lamprey wounds on lake trout and other fish species, and lamprey nest counts on stream sections. Wounding rates on lake trout decreased in 2015 but remain well above targets. Inspections of sportfish species documented sea lamprey wounding on warmwater species as well. GLFC surveys conducted in recent years indicate the largest source of Lake Erie's sea lamprey production may be the St. Clair River rather than traditionally monitored and treated Lake Erie streams.

Salmonid Management

New York annually stocks approximately 255,000 steelhead and 35,000 brown trout into Lake Erie and its tributaries to provide recreational opportunities for anglers. Wild reproduction of steelhead also occurs in some tributaries but remains a minor contributor to the overall fishery. A long term annual angler diary program continues to monitor characteristics of the tributary steelhead fishery. Steelhead stocking was below target in 2015 due to a hatchery mortality event. Surplus steelhead were provided by PA and VT to mitigate this shortage. A tributary angler survey conducted in 2014-15 found steelhead catch rates were 0.32 fish/hour, which was similar to the previous 2011-12 survey. A study utilizing two different stocking sizes of steelhead and two different stocking strategies began in 2015, and will to continue through 2018. This research will provide insights on the role of stocking size and location on adult returns.

Prey Fish

The Lake Erie Unit conducts a number of surveys to assess forage fishes and components of the lake's lower trophic levels that further our understanding of factors shaping the fish community. Current surveys include trawling, predator diet studies, and lower food web monitoring. A variety of prey fish surveys beginning over 20 years ago identified rainbow smelt as the dominant component of the open lake forage fish community. Beginning in 2000, there was a notable increase in prey species diversity accompanied by somewhat lower smelt abundance, and in some year's especially high abundances of round gobies and emerald shiners. In recent years overall prey fish abundance has become highly variable with a notable decline in goby abundance in trawl surveys. Overall abundance of forage-sized fishes declined in 2015 but remained at average levels compared to the previous decade. Rainbow smelt were the dominant prey species, especially the young-of-the-year life stage. Trawl catches of round gobies increased for the first time in five years and many sources of information suggest emerald shiners were especially scarce in 2015. Lower trophic monitoring indicates near shore waters are a slightly less productive environment than typically favored by yellow perch and walleye populations.



2015-16 Lake Erie Research Unit Staff	
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Kyle Keys	Fish & Wildlife Technician 1
Ann Wilcox-Swanson	Fish & Wildlife Technician 1
Robert Lichorat	Fish & Wildlife Technician 1

PUBLIC SERVICE & CONSTITUENT SUPPORT

I FISH NY Angler Recruitment Efforts

Angler education through the I FISH NY initiative continued in 2015/16. Although most DEC regions conduct some outreach efforts aimed at beginning anglers, these efforts are most prominent in the downstate region (DEC Regions 1 and 2) and the other DEC Regions with dedicated outreach staff (DEC Regions 3, 7 and 9). Staff in DEC Central Office also conducted programs around the Capital District and the Adirondack Region.

In-School Fishing Education Programs

One hundred thirty-two formal education programs were conducted between April 1, 2015 and March 31, 2016 in DEC Regions 1, 2, 7 and 9. These included 124 in-school programs and 8 County Conservation days (schools come to go through environmental programs in a round robin fashion). Most of these programs (95) were conducted in DEC Region 2 (NYC). A total of 8,403 contacts with school aged kids were generated from these programs, including 5,916 in-school contacts and 2,487 contacts at County Conservation Days. Fifty-one formal education programs were conducted within one mile of an Environmental Justice Area, generating 8,949 contacts.

Fishing Clinics/Festivals

One hundred forty-five programs were conducted reaching 14,950 people, including 6,559 at fishing festivals, 4,136 at fishing clinics, 4,170 at summer camps and 85 at DEC campgrounds. Thirty-nine of these programs were conducted within 1 miles of an Environmental Justice Area, reaching 4,609 people. People attending fishing festivals generally received little to no fishing education, although seminars were generally available to those who desired to learn more about fishing. People attending fishing clinics generally received 30 to 60 minutes of fishing education followed by an opportunity to fish.

Train the Trainer Initiative

The I FISH NY program continues to expand its train the trainer efforts. Providing fishing education training to summer camp counselors and State Park's staff so that they can teach a fishing program to their campers allows DEC to reach many more children than they would otherwise be able to. Each 2+ hour training session covers topics on sportfish identification, fishing regulations, safety, knot tying, basic tackle and techniques, places to fish, and advanced lure techniques. Overall, Fisheries Staff from Regions 1, 2, 3, 7, 9 and Central Office collectively covered 40 camps and 16 State Parks and taught 464 counselors. An estimated 6,640 campers were taught fishing by counselors that went through the program.

Free Sportfishing Clinics

In 2013 legislation passed allowing for an unlimited number of Free Sportfishing Clinics to be held in New York State. This was a change from the traditional 4 free fishing clinics that used to be allowed for each DEC region. Compared to the 39 events that were held in 2013, the number of approved free sportfishing clinics has grown exponentially. During the 2015/2016 fiscal year DEC approved 134 free sportfishing clinics, with an estimated 18,000 participants! Even though a little more than half of the total were DEC sponsored, 59 non-DEC events were held, suggesting a big interest in outside groups to conduct free fishing clinics. As has been seen in previous years, the majority of fishing clinics were held in the Capital District and parts south (including Long Island and New York City).

I FISH NY Beginners' Guide to Freshwater Fishing

The *I FISH NY Beginners' Guide to Freshwater Fishing* is an upgrade of the popular *Getting Started: A beginners guide to freshwater fishing* manual (first produced in 1992). The new manual will be a complete re-write and designed in full color. The previous manual was produced in black and white. Six chapters have been completed, including "The Fishes of New York," "Basic Fishing Tackle and Techniques," "Care of Your Catch," "Safe and Responsible Angling," "Intermediate Fishing: Tackle and Techniques," and "Fisheries Management." These chapters have been posted on the DEC website at *www.dec.ny.gov/outdoor/98506.html*. The remaining three chapters are in the process of being finalized and should be available by summer 2016.

Social Media

Staff expanded use of Facebook and Twitter to promote fishing in NY and to provide fishing education/information on fishing education opportunities. All of our events are promoted by social media. Gov Delivery list serve service (termed DEC Delivers by DEC) was also used to produce 4 seasonal newsletters and selective other messaging. These emails generally get a 30 to 37 percent open rate which is very good by industry standards.

2015 Angler Achievement Awards

The Angler Achievement Awards Program received a total of 142 entries in 2015, a slight decline compared to 2014. Seventy-five percent of the entries received qualified under the Catch and Release Category, demonstrating the sound stewardship of participating anglers. Sixteen entries were entered into the Annual Award Category (kept fish). A new state record was established when Joshua Wegner caught a 5lb. 8 oz. white sucker from Cold Brook, Steuben County on April 14, 2015.

Interpretative Signage at Boat Launches

During 2015-2016 interpretive signage was designed and installed at the Isthmus @ Point Peninsula (Lake Ontario), Lake Placid, Lower Saranac Lake (Second Pond) and Forge Pond boat launches. Each panel series has helpful information directed towards anglers and boaters. Content provided includes: fish species present, contour map of the water body, invasive species disinfection procedures, fishing and boating regulations and angling advice.

Boat Launch Upgrades

Lake George Beach

Construction of a new boat launch at the Lake George Beach day use area was completed. The new site replaces the degraded ramp that was located in the middle of the bathing beach limiting access to the non-beach season. The new two-lane launch ramp is located at the southeast corner of the beach property. A 25 car and trailer parking area will remain open throughout the boating season. Additional parking will be provided during the non-beach season in the adjoining lot.

Upper Saranac Lake

This popular boat launch in Franklin County was completed upgraded. Improvements include asphalt paved parking for 26 cars and trailers and 12 vehicles, new boarding docks and a 2 lane concrete ramp. A boat flushing station was also provided fot boaters to flush waterholding compartments prior to launching to prevent the spread of microscopic aquatic invasive species such as spiny waterflea.

Forge Pond

At Forge Pond (Suffolk County), a former hand carry boat launch was transformed into a modern trailered boat launch. Improvements include a new gravel parking area for 10 cars and trailers and 5 cars, a concrete launch ramp, floating boarding docks, informational kiosk and a separate kayak launch.

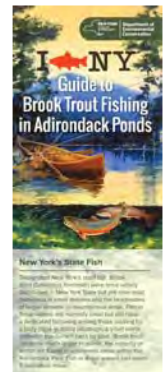
Fishing License Renewal Reminder Program

In an effort to address the continuing decline in fishing license sales, the Bureau of Fisheries initiated a license renewal email campaign in 2015 that expanded upon the spring 2015 Recreation Boating and Fishing Foundation (RBFF) effort. Unlike previous direct mail postcard reminder programs, this effort relied entirely on e-mail. A total of 96,071 emails were delivered in three batches (June 18, June 29 and July 24, 2015). License renewal emails were sent either to people who had previously received a renewal email from RBFF or people who had an email address on record in the license sales system but had not renewed their fishing license since September 30, 2014. People receiving those emails purchased 4,582 fishing licenses within 30 days of receiving a license renewal email, generating $134,959 in revenue to the Conservation Fund. Response rate ranged between 3.6 and 4.8 percent. Emails were delivered through the GovDelivery email system already in place with the DEC and did not cost anything to use. As an additional incentive to renew on-line, those that renewed were included in a drawing for five $100 Bass Pro Shops Gift cards.

DEC Freshwater Fisheries Insider

In a continuing effort to provide better and more convenient information to NY anglers, the Bureau of Fisheries launched the Freshwater Fisheries Insider e-news letter. This quarterly newsletter mailed to subscribers to the Freshwater Fishing e-mail group is designed to keep anglers current on issues associated with freshwater fishing in New York State. Those interested in receiving the Insider can sign up at *www.dec.ny.gov/outdoor/fishing.html*.

Adirondack Brook Trout Fishing Brochure



A new brochure entitled " I FISH NY Guide to Brook Trout Fishing in Adirondack Ponds" has been produced. This brochure, which is part of the I FISH NY series of publications designed to provide better information about fishing in New York State, provides suggested fishing locations and how-to information concerning NY's state fish, the brook trout. Information on DEC's brook trout management and restoration efforts are also included in the brochure.

New York National Boat Show

Central Office Public Use Section staff with assistance from Region 2 staff, once again staffed an exhibit at the New York National Boat Show held at the Jacob Javitts Center in Manhattan, January 6-10, 2016. The display highlighted methods boaters can employ to prevent the spread of aquatic invasive species. New fishing promotion banner-ups in Spanish and English were also unveiled at the show.

2015-16 Public Use and Outreach Staff	
Edward Woltmann	Biologist 3
Gregory Kozlowski	Biologist 2
Joelle Ernst	Biologist 1
Scott Cornwell	Fish and Widlife Technician 1

Public Access Projects

Region	County	Waterbody	Description of Project
1	Suffolk	Forge Pond (Peconic River)	Convert 10 car parking with hand launch to 10 car & trailer and 5 car parking with concrete ramp and boarding dock and separate canoe and kayak launch. Construction begun 9/14. Expected completion 6/15.
4	Otsego	Looking Glass Pond	2- ADA trails, 2 ADA fishing platforms, ADA picnic table, ADA hand launch (gravel to water line), ADA porta potty, 2 additional parking lots (NYWorks 3 project).
4	Rensselaer	Queechy Lake	Rebuild dock damaged during winter.
4	Delaware	Various waters with PFR	Reposted 95% of county. Only water with potential issues remain.
4	Otsego	Various waters with PFR	Repost 90% of PFR holdings.
4	Various	Various	Install 15-20 line recycling stations. Maintained by Audubon Society of the Capital District.
4	Otsego	Goodyear Lake	½ mile ADA trail, ADA fishing platforms, ADA picnic table, ADA grill/fire pit, ADA hand launch, ADA Porta-Potty, increased parking lot size, improved traffic flow pattern.
5	Franklin	Upper Saranac Lake	$475,000 in upgrades funded by NY Works; hard surface ramp with parking for 26 cars and trailers; includes a boat rinse station to flush out bilges, live wells and areas containing water to prevent spread of AIS.
5	Warren	Lake George	2- ADA trails, 2 ADA fishing platforms, ADA picnic table, ADA hand launch (gravel to water line), ADA porta potty, 2 additional parking lots (works 3 project completed).
6	St. Lawrence	Yellow Lake FAS	4 car parking with one Universal Access Parking space and aisle. Hand Carry canoe/kayak/car-top boat launch. Approximately 75% completed with anticipated completion in the spring/early summer 2016.
6	Oneida	West Branch of Fish Creek	50ft. x 100ft. gravel parking area constructed with an ADA parking space and aisle, along with a 20ft. wide entrance road. Allows public fishing on the West Branch of Fish Creek. Approximately 75% completed with anticipated completion in the spring/early summer 2016.
6	Lewis	Fish Creek (tributary to the Black River)	Rehabilitated three (3) separate Fishermen's Parking Areas
6	Lewis	Black River (Glenfield FAS)	Rehabilitated the Accessible Observation Deck and Bench, rehabilitated the FAS parking area to include an Accessible Parking Space and associated Access Aisle.
6	St. Lawrence	Cranberry Lake (Cranberry Lake BLS)	Widened the entrance road to accommodate two-way traffic. Rehabilitated and resurfaced the lower parking area back to its original size. Rehabilitated and resurfaced the upper parking area to its original size and fixed a drainage issue.
7	Oswego	West Branch Fish Creek	Constructed a 5 car parking area
7	Oswego	Little Sandy Creek	Constructed a 10 car parking area
9	Wyoming	Wiscoy Creek	Accessible fishing platform with one parking spot
9	Erie	Cattaraugus Creek	Angler parking lot with 10 parking spots

Public Access Acquisitions

Region	County	Name of Water/Site	Type of Acquistion	Acres/Miles	Intended Use of Property
7	Cayuga	Dutch Hollow Brook	Land Purchase	0.78	PFR
7	Cayuga	Grout Brook	Land Purchase	0.1	PFR Parking Area
7	Tompkins	Fall Creek	Land Purchase		PFR

Habitat Improvement Projects

Region	Name of Water	Project	Cooperator Name	Comments
1	Massapequa Creek/ Reservoir	Water Chestnut AIS removal	Nassau County	
1	Peconic River	Ludwigia AIS removal	Peconic Estuary Program	
4	Looking Glass Pond	Create Bass spawning beds in pond		
4	Horse Brook	Stream Continuity Aquatic Restoration Project	Trout Unlimited	
4	Pork Island Hollow Brook	Move stream from damaged channel to historic channel and add habitat features	NYSDOT	A team effort with DOT staff. The project is complete and the site has been sampled. In 2011 the old channel was surveyed and 2 trout were collected, one brown and one brook. After the project the new (historic) channel was surveyed and 38 trout were collected, 3 brown, 15 rainbow and 20 brook.
5	Boquet River	Willsboro Dam removal	Town of Willsboro	The Willsboro Dam, site of the Willsboro Fishway, has been removed. As part of the removal process, a large portion of the fish ladder was removed, and the remainder was filled in with soil to provide for a public viewing area. Removal of this dam opens a large portion of the Boquet River to Lake Champlain's spawning landlocked Atlantic salmon. Previous studies by the US Fish and Wildlife Service have indicated that the bedrock cascades below the dam site serve as an effective sea lamprey barrier, so spawning by sea lamprey above the dam is not expected. Nonetheless, the USFWS will conduct periodic monitoring above the dam to verify that larval sea lamprey are not utilizing the area above the dam site. The dam removal was conducted by the Town of Willsboro with assistance from the USFWS and DEC.
5	Great Chazy River	Sea lamprey barrier dam repair	USFWS	For over 20 years the sea lamprey barrier dam on the Great Chazy, located just upstream of the village of Champlain, has had a leak in fissures under the bedrock on which the dam sits. Sea lamprey were able to take this subterranean flow and bypass the dam during their springtime spawning run, requiring the treatment of an additional 13 miles of river. Last fall in cooperation with the USFWS, a contractor was hired to do some concrete work to plug the leak under the dam. The work appears to have been successful at stopping the water flow and should make the dam impassable to spawning sea lamprey.

Habitat Improvement Projects

Region	Name of Water	Project	Cooperator Name	Comments
6	Big Creek	Repair Pool Digger	DOT	
7	VanBuskirk Creek	Bank Stabilization and Habitat Improvement	US Fish and Wildlife Service	Stabilized and improved fish habitat in more than 650 feet of highly eroded stream
7	Cayuga Inlet	Bank Stabilization and Habitat Improvement	US Fish and Wildlife Service	Stabilized and improved fish habitat in more than 1,000 feet of highly eroded stream
9	Various waters	Shade tree and willow planting	Local TU chapters	4,000 trees and shrubs planted along trout streams by TU Chapter volunteers.

Hatchery Infrastructure Improvements

Work continued in 2015 to replace or repair aging hatchery infrastructure. The majority of these projects were funded with Governor Cuomo's NY Works program. Water supply work at Salmon River was funded with a Natural Resources Damages Account. Supplemental funding was provided by the Conservation Fund. Major projects included:

Bath Hatchery

Preliminary work has been completed for the installation of a new feed and equipment storage building. Ground was broken in the fall of 2015 and the project is scheduled to be completed in the summer of 2017. The present building is being used for storage and is old and inadequately sized for the storage needs of the hatchery. A new loading dock will also be built so feed deliveries can be unloaded efficiently with a forklift instead of by hand.

Chateaugay Hatchery

Thirteen outside fiberglass raceways were replaced in the summer of 2016 due to the existing 50-year-old cement raceways leaking excessively due to many cracks that had developed over the years. Demolition of the concrete raceways and installation of the new raceways, including new PVC piping, valves, and a new head pipe, was completed in-house by the crew at Chateaugay and two crew members from the Rome Hatchery. The pouring of the new pad and retaining walls was completed by contractors.

Chautauqua Hatchery

A new ultraviolet water disinfection system was installed during the winter of 2016. The new system will be able to kill pathogens in the hatchery's water supply much more efficiently than the old antiquated system. Disease prevention will be increased and this will benefit the walleye and muskellunge that are raised at the hatchery.

Two new high efficiency water boilers were also installed in the fall of 2015. They will be used to heat the building and to heat the production water for raising walleye and muskellunge. The original boilers were inefficient and prone to constant repairs. These new boilers will increase fish production and save on heating costs.

Oneida Hatchery

The installation of two new high efficiency boilers and associated piping was completed in the fall of 2015. The boilers are used for heating the building and to heat the production water that is used to raise walleye. The original boilers had become inefficient due to their age – they were the original boilers installed when the hatchery was built in 1992. A new traveling screen was also installed in the winter of 2016. The traveling screen is used to remove debris in the production water as it enters the hatchery so that screens and assorted piping and valves will not become clogged and to improve fish health. The original traveling screen was deteriorating and replacement parts had become difficult to find.

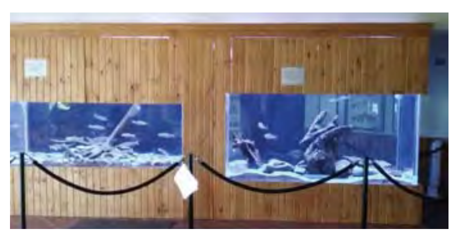
Rome Fish Hatchery

Work was completed in the fall of 2015 on a new concrete wall for the natural spring that is the source for all the spring water at the hatchery. A few years ago leaks developed in the old spring wall. A temporary repair was made several years ago but the leaks had redeveloped. Miscellaneous new piping and valves were also installed throughout the hatchery, as well as a new flow meter in the reservoir water line – the hatchery's largest source of production water for the fish. This flow meter will help regulate the amount of water going to the fish production ponds and Rome Fish Disease Control Center.

Salmon River Hatchery

A roof replacement project for the main hatchery building was completed in October 2015. The project included the removal of the old roof, removal of skylights, asbestos abatement, installation of new insulation and flashing, and the construction of the new roof. The original roof had been in place for decades and had developed leaks in many places, and had been repaired numerous times. The new roof is energy efficient and will provide employees with dry working and storage areas.

The flow through the pipeline from a nearby reservoir, which supplies the majority of fish culture water to the hatchery, has been declining for a number of years. Organic debris had accumulated in the line, restricting the flow of water and reducing the number of fish that can be raised at the hatchery. New valves were installed to replace many of the existing valves in the reservoir line and ports were installed to allow the "pigging", or cleaning, of the pipeline. After the cleaning the pipeline was producing over 10,000 gallons of water per minute, compared to less than 5,000 gallons of water per minute before the cleaning. The increased water flow will help to achieve target fish production numbers in the coming years.



Three new, large aquaria have been installed in the visitor center. These aquaria will display an assortment of fish and their different habitats stretching from the headwaters of the Salmon River to Lake Ontario. Visitors will now be able to gain further insight into the various fish species and habitats in the area.

Van Hornesville Hatchery

Phase I of the installation of drainage lines and new pathways was completed in the fall of 2014. Phase II was completed in November 2015. Phase II included additional drainage lines and pathways around the pond areas and as well as repaving the parking lot and portions of the hatchery access road. Poor drainage and old gravel pathways led to poor walking conditions for visitors. Visitors will now have a more enjoyable visit since walking conditions have greatly improved throughout the hatchery.

Fall Egg Collections

Lake Trout from Cayuga Lake

The annual Cayuga Lake collection of lake trout eggs (Finger Lake strain) began October 5, 2015 at Taughannock Point on Cayuga Lake. In four days of effort a total of 392,000 green eggs were collected. Of this total, 328,000 eggs were used for lake trout production while 64,000 eggs were fertilized with brook trout from Randolph hatchery to produce splake eggs. The eggs were transported each day to Bath Hatchery. The egg collection was completed using personnel from South Otselic Fish Hatchery, Rome Fish Hatchery, and Bath Fish Hatchery. The lake trout hatched from these eggs will be stocked throughout the state and the hatched splake will be released in the Adirondack Mountain region.

Lake Trout from Raquette Lake

The annual Raquette Lake collection of lake trout eggs (Adirondack strain) began on October 13, 2015 at North Point on Raquette Lake. A total of 188,000 green eggs were collected in 6 days of effort. The eggs were transported each day to Chateaugay Fish Hatchery. The egg collection was completed using personnel from Chateaugay Fish Hatchery, Rome Fish Hatchery, Adirondack Fish Hatchery, and the Region 5 Fisheries Management Unit.

Salmon River Hatchery- Chinook and Coho Salmon

The annual Salmon River Fish Hatchery's Chinook and coho salmon egg collection began on October 13 and October 20, 2015, respectively. The Chinook egg collection took seven days to complete with a total of 3.7 million eggs taken. Eggs were collected from 746 ripe females. For the coho egg collection, 2.4 million green eggs were taken on five days. Eggs were collected from 842 ripe females. Target numbers were reached for both species of fish. The egg collection was completed using personnel from Salmon River Fish Hatchery and the Salmon River Steward's Program. The salmon hatched from these eggs will be used for the DEC's Lake Ontario fish stocking program.

Adirondack Hatchery – Landlocked Salmon Egg Collection

The egg collection began on November 12 and ended on November 18, 2015. A total of 1.2 million eggs were collected – 187,000 from wild brood stock in Little Clear Pond and 1,005,000 from captive brood stock at the hatchery. Of the 1.2 million eggs collected, 130,000 were transferred to Tunison Laboratory in Cortland, NY for a research project that will investigate ways to improve the return of stocked salmon smolts. In addition, 63,000 eggs were transferred to the Eisenhower Federal Hatchery in Vermont to supplement future stocking in Lake Champlain. Target numbers of eggs were collected and it is anticipated that there will be enough landlocked salmon to meet future target numbers. Landlocked salmon are stocked into many Adirondack waters, Lake Champlain, Lake Ontario, as well as the Finger Lakes and other selected waters throughout the state.

Windfall Heritage Strain Brook Trout

The annual egg collection for the Windfall strain of brook trout took place at Mountain Pond in Franklin County (DEC Region 5) on October 28 and October 29, 2015. There were 20,600 green eggs collected from Mountain Pond. On November 3, 2015 we collected 7,700 eggs from Black Pond (also in Franklin County, DEC Region 5). This resulted in a total of 28,300 green eggs. The egg collection was completed using personnel from South Otselic Hatchery, Rome Hatchery, and the Region 5 Fisheries Management Unit.

Windfall X Domestic Brook Trout

Milt was collected from male Windfall strain brook trout from Black Pond in Franklin County (DEC Region 5) and crossed with "domestic" brook trout eggs on November 3 and 4, 2015. Milt from 13 males was used in the fertilization process along with 20 domestic females from Chateaugay Hatchery for a total collection of 25,000 eyed eggs. The egg collection was completed using personnel from South Otselic, Rome, and Chateaugay hatcheries.

Spring Wild Fish Egg Collections

Salmon River Hatchery – Steelhead

Salmon River Hatchery's annual steelhead rainbow trout egg collection began on March 16 and ended on March 21, 2016 with a total of 4 days spent collecting eggs. A total of 2.37 million Washington strain and 208,000 Skamania strain eggs were collected. Target numbers were reached. The fish hatched from these eggs will be stocked in tributary waters of Lake Ontario and Lake Erie.

Bath Hatchery – Wild and Hybrid Rainbow Trout

Collection of wild rainbow trout eggs from the Cayuga Inlet Fishway was conducted on March 11 and March 24, 2016. A total of 226,000 wild rainbow trout eggs were collected. There were also 22,000 hybrid (wild rainbows x domestic rainbows) rainbow trout eggs taken. Target numbers were reached and should be adequate to meet future stocking targets.

Oneida Hatchery – Walleye

Oneida Fish Hatchery staff, with assistance from other NYS hatcheries and regional fisheries staff, conducted trap netting operations for spawning walleye between March 30 and April 7, 2016. Captured fish were transferred back to the facility where eggs were collected and fertilized. Stripped walleye were released back into Scriba Creek. The staff captured 18,407 walleye and collected 284.4 million eggs. A total of 5,654 females were stripped, averaging 50,300 eggs per female. A male to female ratio of 2:1 was used for fertilizing the eggs. The eye up percentage was 61% resulting in 173,169,000 fry. The fry were transferred to two other NYS DEC hatcheries and stocked into 13 water bodies across New York State.

Chautauqua Hatchery – Muskellunge

Chautauqua Fish Hatchery's muskellunge egg take took place between April 22 and April 25, 2016. During that period, six trap nets were set in Chautauqua Lake at standard index net locations. Water temperature ranged from 45 to 52 degrees Fahrenheit during the netting period. A total of 146 adult muskellunge were captured, from which 26 pairs were mated and 1,127,000 eggs were collected.

Fish Disease Control

Statewide Fish Health

Two separate pathogen surveillance programs are conducted annually in New York. The first is an ongoing statewide survey to identify waters where regulated pathogens may be present in fish populations. Cornell University Aquatic Animal Health Program performs the second survey through a program to investigate diseases in wild fish.

Wild Fish Pathogen Surveillance Program

For the statewide survey, a wide range of fish species were collected from 30 locations (1,991 fish) and clinical testing was performed at the USFWS Fish Health Center in Lamar, PA. Pathogens of interest isolated from fish in New York waters in 2015 included Namaycush Herpes Virus (NaHV), Epizootic Epitheliotropic Disease Virus (EEDV), Largemouth Bass Virus (LMBV), and *Myxobolus articus*. NaHV was isolated from Lake Ontario lake trout in sampling events in April (5 out of 27) and September (5 out of 40). EEDV was isolated from lake trout in Seneca Lake where it had been isolated previously. LMBV was isolated from smallmouth bass in the Susquehanna River and Rushford Lake and from largemouth bass in Chautauqua Lake. *Myxobolus articus* was isolated from brook trout in Bay Pond (Franklin County) and again in the Connetquot River (Suffolk County). *M. articus* is not considered a risk at this time. Bay Pond will soon be stocked with heritage strain brook trout for use in future egg propagation projects.

Wild Fish Disease Investigations

Cornell University conducted 20 fish disease investigations in 2015. Viral Hemorrhagic Septicemia was isolated from Round Gobies (8 of 66) in the St. Lawrence River near Clayton New York in June as part of a routine monitoring program. VHS was detected from Lake Erie and Gizzard Shad in Dunkirk Harbor in 2014, so VHS continues to be routinely isolated from New York waters. In the largest investigation of the year, a massive Atlantic Menhaden kill was reported in May from many locations on the eastern U.S. coast from New Jersey to Maine. In New York, kills were evident all around Long Island and far up the Hudson River. Fish were collected from Upper Nyack on the Hudson, the mouth of Peconic Bay on the far eastern end of Long Island, and Port Washington on the western end of Long Island Sound. An unidentified virus was isolated from all fish tested and identification is still pending. Hypoxia due to oxygen depletion contributed to the kill in both Long Island locations.

Other cases included sturgeon injury by boat propellers at two locations on the Hudson River. Several springtime cases of common spawning-related Saprolegnia were investigated in Round Gobies and various centrarchid species at many locations.

Thiamine deficiency was problematic in Steelhead migrating up the Salmon River near Pulaski in 2014, as guides and anglers reported seeing hundreds of dead fish from November through January. But 2015 was very different as only a few lethargic fish were reported. The FDCU, Lake Ontario Unit, Region 7 fisheries and the Salmon River SFH staff, along with Federal, Provincial and academic researchers continue to monitor and investigate the situation.

Hatchery Fish Health and INAD Projects

The overall health of fish in our hatchery system has been good for several years. Many diseases routinely encountered in previous years, such as prominent *Saprolegnia* in our trout brood stock, *Gyrodactylus* infestations in our brook trout, and the furunculosis epizootic at Rome in 2012 have been mostly resolved. Also, our hatchery system has been free of program viruses, such as IPN, for decades. We do have recurring common bacterial disease issues that are addressed routinely.

Progress of Furunculosis Abatement at Rome SFH

In the summer of 2012, a serious epizootic of furunculosis occurred at the Rome hatchery and was linked to the importation of a very susceptible brown trout lot from Virginia. By September, an abatement plan was developed that included (1) destroying 800,000 still infected fish, (2) bi-annual inspections of all lots at 2% prevalence interval for two years, and (3) only Rome strain trout could be cultured on site. Rome strain brook and brown trout on site during the event were spared because they were largely unharmed during the epizootic. *Aeromonas salmonicida* was not detected in 2013 or 2014 inspections, so the hatchery classification was upgraded to ‘A’ in September. However, during spawning activities at Rome Field Station in November, clinical furunculosis was evident in a few dozen adult Rome Strain brown trout. In 2015, clinical furunculosis reappeared in about a dozen spawning brown trout, but losses were minimal and subsequent testing of all production lots at Rome Hatchery and other Rome Lab lots were negative. Rome Hatchery continues to be classified ‘As’, but there has been no sign of the pathogen other than the spawning activities taking place at Rome Lab in the late fall. Because the hatchery and lab are on a shared property with no biosecure boundary between them, the downgrade is necessary. It appears that the metabolic demands of spawning over the last few years have allowed latent furunculosis to become lytic. This phenomenon was not seen in our brood stock prior to the 2012 furunculosis epizootic and may be related to the introduction of the Virginia strain of *A. salmonicida*.

Flavobacterial Diseases

In 2015, the usual epizootics of bacterial gill disease, bacterial cold water disease, and columnaris disease appeared throughout our hatchery system, along with other undescribed, yet very similar Flavobacteria. These comprise the majority of the clinical hatchery work. In the quest to reduce Terramycin use in 2014, the use of Perox-Aid and Chloramine T proved successful in combatting columnaris disease and bacterial coldwater disease on several occasions. This approach was continued in 2015 with success. The key was early detection and early drug administration.

Investigational New Animal Drug (INAD) Work

2015 INAD projects included Chloramine T (INAD 9321) and Aqui-S (11-741). Oxytetracycline will be added to our 2016 work. With the Chloramine T approval being limited to certain fish species and diseases, staff collaborated with the AADAP group to study Chloramine T efficacy against *F. columnare* in Tiger Muskellunge at our South Otselic Fish Hatchery. In 2014, we conducted a study whereby naturally infected fish were treated with Chloramine T (20 mg/L). A control group was untreated. After 17 days, the treated group had a cumulative mortality of 12.6% versus 81.8% for the control group. The study report was submitted to the FDA for review and the results accepted in 2015 as part of a mission to eventually expand the drug label to include ‘all fish’. In 2015, we intended to conduct trials to evaluate OTC-343 efficacy at South Otselic against *F. columnare*, but the bacterial strain was resistant to the drug so the trial was aborted.

Hatchery Inspection Program

The DEC’s Fish Disease Control Unit (FDCU) annually inspects all lots of fish in DEC culture programs, from both domestic and wild sources. In 2015, inspections included domestic trout cultured in DEC hatcheries, plus various species of wild fish used in egg collections intended for hatchery propagation. In all, 55 inspections totaling 4,209 fish were conducted. *Aeromonas salmonicida* was isolated from adult coho salmon (1/60) during egg collections at the Salmon River, but not Chinook. In 2014, an atypical variant of *Yersinia ruckeri* was isolated from wild brook trout from Big and Little Hill Ponds in the Adirondacks, but was not detected from the same population in 2015 These fish are used as gamete sources for the heritage brook trout program and the fish are never removed from the site. No other program pathogens were detected in DEC hatcheries.

2015-16 Fish Culture Staff

CENTRAL OFFICE

Jim Daley	Fish Culturist 6
Dave Armstrong	Fish Culturist 5
Mary LaBoissiere	Secretary 1

ADIRONDACK

Matt Jackson	Fish Culturist 3
Kenneth Klubek	Fish Culturist 1
Aaron Day	Fish Culturist 1
Doug Peck	Fish Culturist 1

BATH

Ken Osika	Fish Culturist 3
Kelly Raab	Fish Culturist 1
Robert Sweet	Fish Culturist 2
Stephen Galbreth	Fish Culturist 1
Adam Haley	Fish Culturist 1

CALEDONIA

Alan Mack	Fish Culturist 4
Kevin Hayden	Fish Culturist 2
Mark Krause	Fish Culturist 3
Jason Schirmer	Fish Culturist 1
Robert Stein	Fish Culturist 2
Brian Ward	Fish Culturist 1
Stephen Zenzen	Fish Culturist 1
Steven Robb	Fish Culturist 1

CATSKILL

John Anderson	Fish Culturist 4
Tim Anstey	Fish Culturist 1
Joseph Gennarino	Fish Culturist 2
James Judson	Fish Culturist 1
Nathan Snyder	Fish Culturist 1
Michele Zeigler	Fish Culturist 1
Robert Poprawski	Fish Culturist 1

CHATEAUGAY

Neal McCarthy	Fish Culturist 2
Anthony Bruno	Fish Culturist (Trainee I)
Logan Grishaber	Fish Culturist (Trainee I)
Mike Sicley	Fish Culturist
Nicole Vogt	Fish Culturist

CHAUTAUQUA

Larry King	Fish Culturist 3
Eric Defries	Fish Culturist 2
Bradley Gruber	Fish Culturist 1
Ron Preston	Fish Culturist 1

ONEIDA

Bill Evans	Fish Culturist 4
Erika Stoddard	Fish Culturist (Trainee1)

RANDOLPH

Richard Borner	Fish Culturist 3
Trevor Brady	Fish Culturist 1
Barry Hohmann	Fish Culturist 1
Raymond Hulings	Maintenance Assistant
Jim Rambuski	Fish Culturist 2
Derek Weishan	Fish Culturist 1

ROME

Scott Wanner	Fish Culturist 4
John Gray	Fish Culturist 1
John Draper	Fish Culturist 1
Steven Grabowski	Fish Culturist 2
Zach Goodale	Fish Culturist 1
William R. Hajdasz	Maintenance Supervisor
Kimberly Matt	Keyboard Specialist
William Woodworth	Fish Culturist 2
Tobias Widger	Fish Culturist (Trainee 1)

FISH DISEASE CONTROL

Andrew Noyes	Pathologist 2 (Aquatic)
Geofrey Eckerlin	Biologist 1 (Ecology)
Mark Batur	Fish Culturist 1

SALMON RIVER

Thomas Kielbasinski	Fish Culturist 4
Stephen Dolan	Fish Culturist 3
David Domachowske	Fish Culturist 2
Brian Edmonds	Fish Culturist 1
Karen Hurd	Keyboard Specialist
Robert Nelson	Fish Culturist 2
Leslie Resseguie	Fish Culturist 1
Kevin Healy	Fish Culturist (Trainee 1)
Joseph Hentges	Fish Culturist 1

SOUTH OTSELIC

Pat Emerson	Fish Culturist 3
Bruce Ryan	Fish Culturist 2
Mike Speziale	Fish Culturist 1

VAN HORNESVILLE

Larry Kroon	Fish Culturist 3
Craig DuBois	Fish Culturist 2
Peter Kinney	Fish Culturist (Trainee 1)

Annual Fish Production

ANNUAL STOCKING REPORT - BY SPECIES
January 1, 2015 - December 31, 2015

		LESS THAN 1"		1" - 4.24"		4.25" - 5.74"		5.75" - 6.74"		6.75" - 7.74"		7.75" Plus		TOTAL	
SPECIES		NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT
Cold Water	**Cold Water**														
	Brook Trout	3,050	50	315,042	5,890	223,698	7,826	9,276	785	7,600		179,497	41,284	**697,459**	**60,105**
	Brown Trout					53,600	3,351	8,000	640	176,120	28,177	1,678,218	450,440	**2,017,997**	**511,253**
	Rainbow Trout			73,958	746	50,800	2,772	76,260	7,252	3,500	472	408,685	102,549	**475,671**	**85,674**
	Steelhead			180,810	1,116	494,340	23,982	27,160	1,994	8,900	1,213			**776,350**	**33,095**
	Lake Trout			122,942	2,150	331,723	7,632	594,450	38,079	82,350	9,265	110,940	17,066	**1,286,974**	**74,252**
	Splake											20,480	4,793	**21,040**	**4,848**
	Landlocked Salmon	45,300	4,693	521,900	819			182,230	17,914	155,380	19,232	3,452	1,443	**804,404**	**41,326**
	Coho					140,760	4,823	90,000	7,328					**130,000**	**8,125**
	Chinook			1,769,600	19,230									**1,969,790**	**22,607**
	Cold Water Total	**48,350**	**4,743**	**2,984,252**	**29,951**	**1,294,921**	**50,386**	**987,376**	**73,992**	**433,850**	**58,359**	**2,401,272**	**617,575**	**8,179,685**	**841,285**
Warm Water	**Warm Water**														
	Walleye	205,335,264	2,754	900,600	922									**212,254,052**	**4,381**
	Muskellunge	202,000	7									25,320	2,164	**479,060**	**2,397**
	Tiger Muskellunge									25,000	1,311	83,700	10,268	**135,460**	**9,076**
	Panfish											1,000	200	**500**	**100**
	Sauger			5,810	7										
	Warm Water Total	**205,537,264**	**2,761**	**906,410**	**929**	**-**	**-**	-	-	**25,000**	**1,311**	**110,020**	**12,632**	**212,869,072**	**15,954**
RTE	**Rare\Threatened\Endangered**														
	Lake Sturgeon	4,000	169							2,800	118			**12,000**	**139**
	Paddlefish	330	55									685	114		
	Round Whitefish	625	-											**10,500**	**4**
	Lake Herring					69,240	1,473							**144,670**	**2,824**
	RTE Total	**4,955**	**224**	-	-	**69,240**	**1,473**	-	-	**2,800**	**118**	685	114	**167,170**	**2,967**
Grand Total		**205,590,569**	**7,728**	**3,890,662**	**30,880**	**1,364,161**	**51,859**	**987,376**	**73,992**	**461,650**	**59,788**	**2,511,977**	**630,321**	**221,215,927**	**860,206**

Summary of Fisheries, Creel & Angler Surveys

Survey Name	Purpose
Region 1	
Little River	Alewife spawning survey
Peconic River	Alewife spawning survey
Beaver Brook	Alewife trap and transfer
10 small streams in Suffolk County	EBTJV Survey to document brook trout presence
Peconic Lake	Centrarchid/ Community survey
South Pond	Centrarchid Survey
Smith Pond, Roosevelt	Centrarchid Survey
Plum Island Main Pond	General Biological Survey
Lake Ronkonkoma	Threatened Species
Razor Pond	Threatened Species
Peconic River	Threatened Species
Connetquot River	Disease Monitoring
Muelleners Pond	Centrarchid Survey
Hards Lake	Alewife Spawning Survey
Fresh Pond, Hither Hills	Centrarchid Survey
Beaver Brook	EBTJV Survey
Region 2	
Meadow Lake, Queens	Disease/Invasive fish monitoring
Willow Lake, Queens	Disease/Invasive fish monitoring
Harlem Meer, Central Park	Centrarchid survey
100th St. Pool, Central Park	Centrarchid survey
Kissena Lake, Queens	Centrarchid survey
Meadow Lake, Queens	Invasive fish monitoring
Willow Lake, Queens	Invasive fish monitoring
Central Park Lake & Harlem Meer	Creel surveys
Region 3	
Crystal Lake	Brook Trout Spawning Assessment (trap netting)
Ashokan Reservoir	Walleye and Rainbow Trout assessment (boat electrofishing)
Lake Mahopac	Centrarchid Plan Survey (boat electrofishing)
Lake Stahahe	Community Fish Assessment (multiple methods)
Ridgebury Lake	Invasive Species Eradication follow-up (boat electrofishing)
Lake Minnewaska	Assessment of new introduction (bass and shiners)
Walton Lake	Water Chemistry profile
Wassaic Creek	Trout population assessment (electrofishing)
Neversink River	Trout population assessment (boat electrofishing)
Esopus Creek	Evaluation of water release from Ashokan Res. (boat electofishing)
Swinging Bridge Reservoir	Percid Plan Walleye evaluation (boat electrofishing)
Rio Reservoir	Percid Plan Walleye evaluation (boat electrofishing)
Titicus Reservoir	Percid Plan Walleye evaluation (boat electrofishing)
White Lake	Water Chemistry profile
Cross River Reservoir	Trout population assessment (gill netting)
Sterling Lake	Trout population assessment (gill netting)

Region 4	
Catskill Creek	Hudson River Walleye Tagging Study and TSMP collection
Little Delaware River Tributary	Culvert Assessment
Poeston Kill @ Hudson River	Fish Community and TSMP collection
Hudson River @ Wynants Kill	Fish Community
Mill Creek @ Hudson River	Fish Community
Stockport Creek	Fish Community
Murderers Creek	Fish Community
T16 Manor Kill	Invasive Fish Monitoring (O. weatherfish)
Wilber Lake	General Biological Survey
Mohawk River (with USGS) - contract	General Biological Survey
Pepacton Reservoir	Salmonid Netting, Fish Health and TSMP Collection
Copake Lake	Fish Kill Investigation
Taghkanic Lake	General Biological Survey
Shingle Kill	CROTS Survey
Manor Kill	CROTS Survey
Holiday Brook	Culvert Assessment
Carrs Creek tributary	Culvert Assessment
Goodyear Lake	General Biological Survey
Thompsons Lake	General Biological Survey and TSMP Collection
Susquehanna River	Fish Health Survey
Gilbert Lake	General Biological Survey and TSMP Collection
Colgate Lake	General Biological Survey and TSMP Collection
Mud Pond	General Biological Survey and TSMP Collection
Mohawk River	General Biological Survey
Long Pond	General Biological Survey and TSMP Collection
Second Pond	General Biological Survey and TSMP Collection
Shaver Pond	General Biological Survey and TSMP Collection
Glass Lake	General Biological Survey and TSMP Collection
West Branch Delaware River	Juvenile Salmonid Survey
Quacken Kill	Stream Temperature Survey
Otsego Lake	General Biological Survey
Schenevus Lake	General Biological Survey
Fly Creek and Tributaries	Brook Trout Genetics Monitoring Surveys
Carrs Creek and Tributaries	Brook Trout Genetics Monitoring Surveys
Schoharie Reservoir	Walleye Stocking Evaluation
East Sidney Reservoir	Walleye Stocking Evaluation
Green Brook	Culvert Assessment
Canadarago Lake	Percid Sampling
Line Creek	General Biological Survey
8 small stream surveys	Trout Presence/Absence
Region 5	
Lower Sargent Pond	Post-reclamation survey
Embody and Lost ponds	Bathymetries in preparation for reclamations
English Brook	Brook trout/Public Fishing Rights survey
Arnold Pond	Pre-reclamation survey

Round Pond	Trout survey
Saratoga Lake	Walleye and bass assessments
Loon Lake	Walleye assessment
Cossayuna Lake	Bass assessment
8 brook trout ponds	Long-term temperature and dissolved oxygen monitoring
14 ponds	Brook trout pond surveys
7 ponds/lakes	Egg-takes (brook trout, lake trout, round whitefish, landlocked salmon)
15 ponds	Advanced water chemistry sampling (acid rain recovery)
4 ponds	General surveys
Region 6	
Bear Pond	Limed Waters Program
Big Hill Pond	Fish Disease Monitoring
Black Lake	Walleye Evaluation (2 surveys)
Black River	Bass in Rivers Study
Black River	Lake Sturgeon Survey
Black River	Lake-Run Salmonid Monitoring
Boottree Pond	Brook Trout Egg Take
Boottree Pond	Limed Waters Program
Brewer Lake	Limed Waters Program
Buck Pond	Limed Waters Program
Clear Lake	Limed Waters Program
Clear Pond	Limed Waters Program
Cleveland Lake	Limed Waters Program
Curtis Pond	Limed Waters Program
Deer Pond	Fish Disease Investigation
Deer Pond	Brook Trout Egg Take
Delta Lake	Fish Disease Monitoring
Delta Lake	Walleye Evaluation
Evergreen Lake	Limed Waters Program
First Lake	Fish Community Survey
Hawk Pond	Limed Waters Program
Hedgehog Pond	Limed Waters Program
Hidden Lake	Limed Waters Program
Horn Lake	Limed Waters Program
Horseshoe Pond	Limed Waters Program
Indian River	Bass in Rivers Study
Lake Ontario	Lake Sturgeon Survey
Lake Ontario	Warmwater Fish Stock Assessment
Lake Ontario	Lower Trophic Level Study (12 surveys)
Lake St. Lawrence	Warmwater Fish Stock Assessment
Little Hill Pond	Fish Disease Monitoring
Little Otter Lake	Limed Waters Program
Long Lake	Limed Waters Program
Lyon Lake	Limed Waters Program
Mohawk River	Contaminant Collection
Nicks Pond	Limed Waters Program

North Twin Lake	Fish Disease Monitoring
Oswegatchie River	Bass in Rivers Study
Oswegatchie River	Walleye Egg Take
Payne Lake (Lewis County)	Limed Waters Program
Peaked Mountain Lake	Limed Waters Program
Pine Pond	Limed Waters Program
Pitcher Pond	Limed Waters Program
Quiver Pond	Limed Waters Program
Raven Lake	Acidified Waters Survey
Red Lake	Walleye Evaluation
Round Pond (St. Lawrence County)	Limed Waters Program
Round Pond (Oneida County)	Limed Waters Program
Second Lake	Fish Community Survey
Slender Pond	Limed Waters Program
Soda Pond	Limed Waters Program
South Lake	Water Chemistry Survey
South Twin Lake	Brook Trout Egg Take
St. Lawrence River	Lake Sturgeon Egg Take
St. Lawrence River	Lake Sturgeon Evaluation
St. Lawrence River	Esocid Monitoring
St. Lawrence River Thousand Islands	Warmwater Fish Stock Assessment
Stark Falls Reservoir	Contaminant Sampling
Summit Pond	Limed Waters Program
Sunshine Pond	Limed Waters Program
Tamarack Pond	Limed Waters Program
Third Lake	Fish Community Survey
Tooley Pond	Bass Survey
Townline Pond	Limed Waters Program
Twitchell Lake	Lake Trout Evaluation
Yellow Lake	Fish Community Survey
Region 7	
Huckleberry Pond	Winter Dissolved Oxygen check
Papish Pond	Winter Dissolved Oxygen check
Cayuga Inlet	Lake Sturgeon Assessment
Onondaga Lake	TSMP Collection
Upper Lelands Pond	Centrarchid Sampling
Lower Lelands Pond	Centrarchid Sampling
Salmon River Fish Hatchery	Steelhead Egg Take
Long Pond	Centrarchid Sampling
Whitney Point Reservoir	Percid Sampling
Emerson Gulf	General Biological Survey
Unnamed Trib to Onondaga Creek	Trout Assessment
Old Chenango Canal	Trout Assessment
T8 of Wylie Brook	Eastern Brook Trout Joint Venture Sampling
T7 of Wylie Brook	Eastern Brook Trout Joint Venture Sampling

Upper Lelands Pond	General Biological Survey
Lower Lelands Pond	General Biological Survey
Factory Brook	Eastern Brook Trout Joint Venture Sampling
Wylie Brook	Eastern Brook Trout Joint Venture Sampling
Handsome Brook	Eastern Brook Trout Joint Venture Sampling
Unnamed Water	Eastern Brook Trout Joint Venture Sampling
Cayuga Inlet Fishway	Finger lakes strain Rainbow Trout egg take, fish passage, Sea Lamprey removal trapping
Salmon River	Investigation of Algae Bloom in River
Salmon River Fish Hatchery	Salmon Egg Take
Cayuga Lake	Lake Trout Assessment
Ninemile Creek	Trout Assessment
Susquehanna River	TSMP Collection
Seneca River	Percid Sampling
Jamesville Reservoir	Percid Sampling
Whitney Point Reservoir	Percid Sampling
Cayuga Lake	Lake Trout Egg Take
Cazenovia Lake	Percid Sampling
Otisco Lake	Percid Sampling
DeRuyter Reservoir	Percid Sampling
Region 8	
Seneca Lake	Monitor Fishing Tournament for lamprey wounds
Spring Creek	Investigate effects on stream trout population from external forces.
Oatka Creek	Investigate effects on stream trout population from external forces.
Seneca Lake	Fish Kill Investigation
Seneca Lake	Fish Community Study
Catherine Creek	Rainbow Trout Production Study
Sleepers Creek	Rainbow Trout Production Study
Irondequoit Bay	Warmwater Fishery Survey
Chemung River	Warmwater Fishery Creel Survey
Seneca Lake	Fish Disease Monitoring
Springwater Creek	Rainbow Trout spawning run evaluation
Naples Creek	Rainbow Trout spawning run evaluation
Cold Brook	Rainbow Trout spawning run evaluation
Catherine Creek	Rainbow Trout spawning run and lamprey wounding rate evaluation
Sleepers Creek	Rainbow Trout spawning run and lamprey wounding rate evaluation
Seneca Lake (Catherine Creek)	Sea lamprey control via TFM
Fish die offs (12)	Investigate reports of fish die offs
116 small streams in Region 8	EBTJV survey to document brook trout presence
Region 9	
Allen Lake	Centrarchid sampling
Chautauqua Lake	Esocid sampling
Rushford Lake	Fish community sampling
Chautauqua Lake	Percid sampling
Lake Erie	Lake Sturgeon sampling
Alma Pond	Centrarchid sampling

Allegheny Reservoir	Sauger sampling
Niagara River	Fish community sampling
North Branch Wiscoy Creek	Fourth year post-habitat enhancement evaluation of trout population
Clear Creek - Arcade	Wild trout population estimate
Wiscoy Creek	Wild trout population estimate
Trout Brook	Wild trout population estimate
23 wild brook trout streams	Collect fin clips for genetic analysis with USFWS
Lake Ontario Research Unit	
Lake Ontario Alewife Bottom Trawl Survey	Assess yearling and adult alewife in Lake Ontario
Lake Ontario Juvenile Lake Trout Trawl Survey	Assess juvenile lake trout in Lake Ontario
Lake Ontario Warmwater Fisheries Assessment	Assess warmwater fish populations in the Eastern Basin
Status of Lake Ontario's Lower Trophic Levels	Monitor trends in Lake Ontario productivity, including nutrients, chlorophyll a, and zooplankton populations
Lake Ontario Adult Lake Trout Assessment	Assess adult lake trout populations in Lake Ontario
Lake Ontario Fishing Boat Survey	Monitor trends in angler effort/catch/harvest in the open waters of Lake Ontario
Lake Ontario Chinook Salmon Mass Marking Program	Determine contribution of wild Chinook salmon to Lake Ontario sportfisheries and evaluate success of pen-rearing projects
Northern Pike and Muskellunge Monitoring in the Thousand Islands Region of the St. Lawrence River	Monitor northern pike and muskellunge spawning and nursery areas to assess reproductive success and influence habitat changes
Lake Ontario Hydroacoustic Preyfish Assessment	Use hydroacoustic technology to develop lakewide estimates of alewife numbers and biomass
Lake Ontario Tributary Creel Survey	Monitor trends in salmonid angler effort/catch/harvest in Lake Ontario tributaries
Lake Ontario Benthic Preyfish Bottom Trawl Survey	Assess populations of sculpins and members of the whitefish family that live on or near the lake bottom
Lake Erie Research Unit	
Lake Erie Commercial Fishery Assessment	Sampling to characterize harvest & age composition of Lake Erie's commercial yellow perch fishery
Lake Erie Lower Trophic Monitoring Program	Index of lower trophic indicators seasonally, including zooplankton, nutrient concentrations, temperature and water transparency
Lake Erie Open Lake Sport Fishing Survey	Creel survey measure of sport fishing catch and effort from Lake Erie's boat fisheries for walleye, smallmouth bass and yellow perch
Lake Erie Steelhead Smolt Out-migration Study	Sampling to assess size specific out-migration patterns of newly stocked steelhead in selected Lake Erie tributaries
Lake Erie Tributary Angler Diary Program	Diary index of fishing quality for Lake Erie's tributary steelhead fishery
Lake Erie Tributary Sea Lamprey Nest Density	Annual nest counts to index the concentration of sea lamprey nests in selected Lake Erie tributaries
Lake Erie Fish Cleaning Station Monitoring	Annual examination of angler caught walleye processed at cleaning stations to characterize size, age composition and stomach contents
Lake Erie Acoustic Telemetry Study	Examine seasonal movements of Lake Erie walleye and lake trout
Lake Erie Coldwater Community Assessment	Gill net index of abundance, age composition, growth, and diet of lake trout, burbot and lake whitefish
Lake Erie Warmwater Community Assessment	Gill net index of abundance, age composition, growth, and diet of walleye, yellow perch and smallmouth bass
Lake Erie Forage and Juvenile Fish Assessment	Bottom Trawl index of abundance, age composition and growth, of juvenile yellow perch and an array of forage fish species
Lake Erie Tributary Angler Survey	Creel survey measure of sport fishing catch and effort from Lake Erie's tributary fisheries for steelhead

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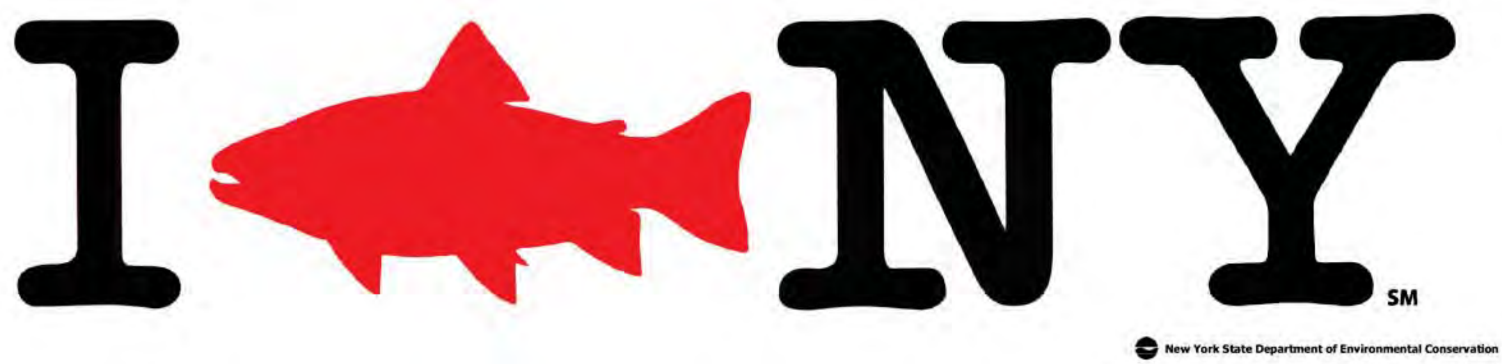

Permits & Licenses

A summary of licenses and permits reviewed or issued by the Bureau of Fisheries

DEC REGION

Permit Name	1	2	3	4	5	6	7	8	9	CO	Total
Farm Fish Pond			15	*144/146	3	14	156	110	74		518
Stocking	8		144	30	80	25	49	22	17		375
Triploid Grass Carp	2		274	219/296	42	37	276	492/502	664		2093
Overland Transport of Bait			9	13		6	3	16	7		54
Fish Possession (over daily limit)					1		3		1		5
Piranha		1				1	1		1		4
Baitfish	6	2	74	57	56	80	84	93	115		567
Temporary Revocable Permit (TRP)			1	2	23	6	22	19	4		77
Article 15 Issued/Reviewed		1	450	279	404		15	124	738		2011
Article 24 Issued/Reviewed	15		235	59	15	*472/667	1				992
Pesticide Permit Review	30		22	10/30+	7	4	16	10	12		111
Bass Hatchery Permits (C.O)										28	28
Trout Hatchery Permits (C.O)										35	35
License to Collect and Possess										138	138
Free Fishing Clinic										134	134
U.S. Armed Forces Free Fish Program										7	7
Other:											
Trout/Salmon in the Classroom			42	23							65
Hydropower Relicensing					1	0/3					1
Adopt A Natural Resource											
Fish Removal			1			2					3
Commercial Fishing (Great Lakes)										5	5

**Issued/Reviewed*

RETIREMENTS

The Bureau of Fisheries would like to acknowledge the following recent retiree for his years of service to the Bureau and his contribution to the effective management of the freshwater fisheries of New York State.

Jeff Robins
Region 7 Fisheries

Transactions of the American Fisheries Society

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Effects of Seasonal Drawdowns on Fish Assemblages in Sections of an Impounded River–Canal System in Upstate New York

Scott D. George, Barry P. Baldigo & Scott M. Wells

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ARTICLE

Effects of Seasonal Drawdowns on Fish Assemblages in Sections of an Impounded River–Canal System in Upstate New York

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Abstract
The Mohawk River and New York State Barge Canal run together as a series of permanent and temporary impoundments for most of the distance between Rome and Albany, New York. The downstream or lower section is composed of two permanent impoundments, the middle section of a series of temporary (seasonal) impoundments, and the upper section of a series of permanent impoundments. In the middle section, movable dams are lifted from the water during winter and the wetted surface area decreases by 36–56%. We used boat electrofishing during spring 2014 and 2015 to compare the relative abundance of fish populations and the composition of fish assemblages between the permanently and seasonally impounded sections of the Barge Canal and to infer the effects of the two flow management practices. A total of 3,264 individuals from 38 species were captured, and total catch per unit effort (CPUE) ranged from 46.0 to 134.7 fish/h at sites in the seasonally impounded section, compared with 140.0–342.0 fish/h in the permanent lower section and 89.0–282.0 fish/h in the permanent upper section. The amount of drawdown explained 55% of the variation in total CPUE and was a highly significant predictor variable. Mean total CPUE in the seasonally impounded section was significantly lower (by about 50%) than that in either permanently impounded section, and the assemblage composition differed significantly between sections. The relative abundance of many lentic species was markedly lower in the seasonally impounded section, while the relative abundance of several native cyprinids and the percentage of individuals belonging to species that are native to the watershed was greater in this section. Overall, these findings suggest that winter dam removal in impounded rivers may reduce the abundance of fish but may also create more natural riverine conditions that favor some native species.

Riverine ecosystems in developed regions are threatened by many anthropogenic stressors. Of these, damming and the resulting hydrologic modification arguably constitute the single greatest disturbance (Bunn and Arthington 2002; Dynesius and Nilsson 1994; Limburg and Waldman 2009). In North America, the era of constructing large (>15-m-high) dams for flood control, hydropower, and navigation dates back to the New Deal in the 1930s, but the rate of dam development exploded in the 1960s to meet increasing demands for hydropower (Pringle et al. 2000; Haxton and Findlay 2009). In the United States, more than 85% (by area) of inland waterways are artificially controlled (NRC 1992; Poff et al. 1997), and the hydrologic regime of most large rivers has been extensively altered (Benke 1990). The effects of these habitat alterations on fish assemblages include the proliferation of nonnative lentic species and the extirpation of migratory and riverine species that depend on specific lotic habitats (Bunn and Arthington 2002; Poff et al. 1997; Pringle et al. 2000; Haxton and Findlay 2009; Limburg and Waldman 2009).

Although the ecological impacts of permanently impounding large rivers have received ample attention in the literature,

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the effects of temporarily (seasonally) impounding rivers have not been thoroughly documented. Water levels in impoundments are often drawn down in the winter to maximize power generation and to minimize spring flooding (Karchesky and Bennett 2004; Haxton and Findlay 2009). These drawdowns can cause a contraction in the area and volume of habitat available to fish and may adversely affect the quality of off-channel overwintering habitats for some species (Karchesky and Bennett 2004; Haxton and Findlay 2009). For example, Raibley et al. (1997) observed a large winterkill of warmwater fishes in the Illinois River that resulted because declining water levels stranded fish in a backwater. Similarly, Largemouth Bass *Micropterus salmoides* experienced unusually high winter mortality when low water levels prevented access to suitable winter habitat on the upper Mississippi River (Pitlo 1992). Long-term changes to fish assemblages from repeated winter drawdowns may also occur, although such effects have seldom been documented. In one of the few studies to investigate the chronic effects of drawdowns, Haxton and Findlay (2009) noted that populations of littoral benthivores such as Pumpkinseed *Lepomis gibbosus* and Brown Bullhead *Ameiurus nebulosus* were adversely affected by annual winter drawdowns in the Ottawa River. These results were largely attributed to reductions in prey, but the availability of winter refuge to warmwater fishes in riverine environments is also critical. Comparable, but unknown effects may occur in parts of the Mohawk River that were incorporated into the New York State Canal System in 1918 and that experience substantial drawdowns each winter. Historically shallow and free flowing, the river exists today as a series of small impoundments in which water levels are controlled by a series of dams (McBride 1994, 2009). Determining the effects of these alterations on the historical fish assemblage would require precanal baseline data and is beyond the scope of this investigation. Instead, we assessed fish assemblages in temporary (seasonally drawn down) and permanent impoundments of this system during 2014–2015 to determine the current status of these assemblages and to infer the effects of the different flow management practices on the relative abundance of fish populations and the composition of fish assemblages. We also compiled information on the physical characteristics of each impoundment and explored the relationships between these data and the relative abundance of fish to identify confounding factors that might complicate an assessment of drawdown effects.

METHODS

Study area.—The Mohawk River is approximately 257 km long (McBride 1994) and flows south from its headwaters near Boonville to Rome, New York, where it turns and flows eastward, joining the Hudson River just north of Albany. The completion of the Erie Canal (a land cut that ran through the Mohawk River valley) in 1825 created a water linkage between the Great Lakes and Hudson River drainages and enabled the movement of migratory and resident species into the Mohawk River watershed (Mills et al. 1996; Carlson and Daniels 2004; Pimentel 2005). Due to its limited capacity, the Erie Canal was replaced by the New York State Barge Canal in 1918, a canalized river system which transformed most of the east–west portion of the Mohawk River into a series of permanent and seasonal impoundments (McBride 1994, 2009). The focus of this study is the 181.6-km section of the Barge Canal between Waterford (at Lock 6) and Rome (upstream of Lock 20), where the canal, crossing the drainage divide with the Oswego River basin, joins the Mohawk River (Figure 1). The 35.2-km section between Locks 6 and 8 is permanently impounded, the 75.6-km section between Locks 8 and 16 is seasonally impounded, and the 70.8-km section between Lock 16 and Rome is permanently impounded (hereafter referred to as the permanent lower, seasonal, and permanent upper sections, respectively). In the seasonal section, movable dams composed of steel uprights and horizontal plates are lifted after the navigation season (approximately May through early November). When this occurs, water levels drop 1.5–5.8 m and the river becomes free flowing from mid-November to April (McBride 1987, 1994, 2009). The surface area of these impoundments is reduced 36–56% when the dams are lifted, and large areas of the littoral zone are dewatered (McBride 1987). In contrast, water levels generally decrease by less than 1 m in the permanent lower section (McBride 1994) and by 0–2.5 m in the permanent upper section (J. Savoie, New York State Canal Corporation, personal communication) during the nonnavigation season. Although parts of the permanent upper section experience a small to moderate winter drawdown, the habitat remains fairly lentic and little habitat is dewatered.

The physical characteristics of the impoundments vary across a downstream–upstream gradient from larger, wider impoundments in the permanent lower section to smaller, narrower impoundments in the permanent upper section (see Supplementary Table S.1 in the online version of this article). A navigation channel with a minimum depth of 4.3 m is maintained throughout each impoundment, and the percent of the total habitat comprised by the shipping channel increases moving upstream (Table S.1). In some parts of the permanent upper section the Barge Canal and Mohawk River are separate parallel channels, and dam use on the separated sections of the Mohawk River largely controls water levels on adjacent parts of the Barge Canal. Given all of these characteristics, the impoundments in the permanent lower and permanent upper sections are relatively different, their chief similarity being the limited degree of drawdown. The permanent upper section, therefore, serves as a control to separate the confounding effects of differing impoundment characteristics (and natural differences based on watershed position) from those of drawdown.

The Barge Canal supports a diverse fish assemblage that is used extensively by recreational anglers. Historical estimates of fishing pressure between Locks 6 and 16 reached 155 h/ha over a 6-month period in 1982, which caused the study area to rank as one of the most heavily fished waters in New York

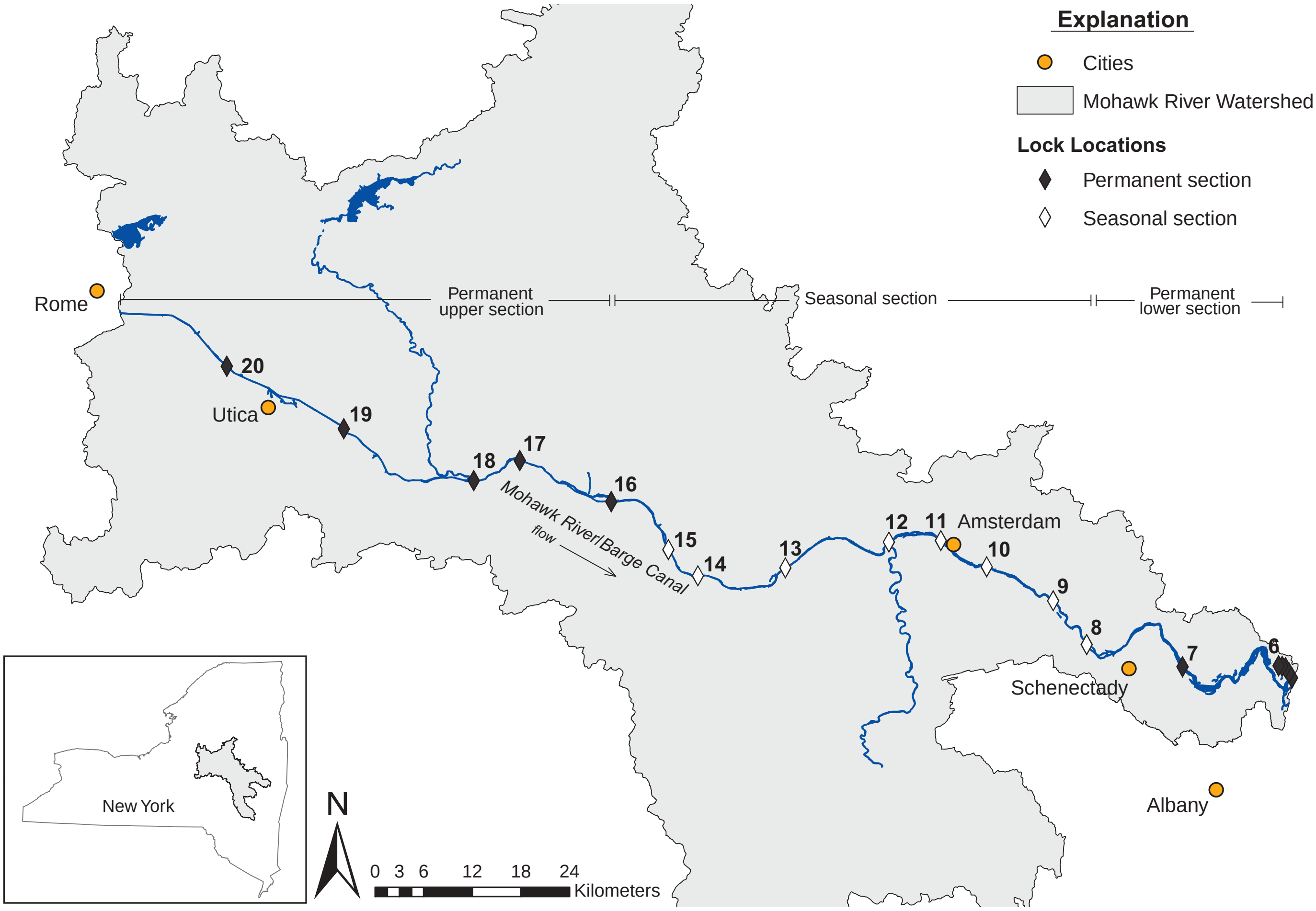

FIGURE 1. Map of the Mohawk River watershed showing the locations of the locks within the three sections of the Barge Canal, New York.

State (McBride 1983). Smallmouth Bass *Micropterus dolomieu* and Walleye *Sander vitreus* are the most popular game fishes among anglers (McBride 1983), but past biological surveys have documented at least 56 fish species within the immediate study area (McBride 1985, 1994, 2009) and as many as 71 fish species may inhabit the greater river–canal system (Carlson 2015). The study area receives annual spawning runs of anadromous Blueback Herring *Alosa aestivalis* during late spring, and their young of the year have been identified as a key component of the forage base for many piscivorous species (McBride 1985). Round Goby *Neogobius melanostomus* are invading the canal system from the Great Lakes drainage, although only one specimen has been captured in the study area to date (New York State Museum, catalog 71439, September 2014). Round Goby populations have had profound impacts on fish assemblages in the Great Lakes drainage and other areas (Corkum et al. 2004), although it is unlikely that they have substantially affected fish assemblages in the study area at this time.

Fish sampling.—Fish assemblages were sampled using daytime boat electrofishing of nearshore habitats during a 2-week period in late May and early June and generally followed the methods described in Miranda and Boxrucker (2009) and Moulton et al. (2002). All surveys used a 4.9-m (16-ft) Smith-Root electrofishing boat applying pulsed direct current at a frequency of 60 Hz. The study area was divided into 24 sites (reaches of river denoted by river kilometers), such that 8 sites were located in each of the three sections (permanent upper, seasonal, and permanent lower), thereby achieving a balanced study design with comparable effort between river sections (Table 1). Identification codes were generated for each site using the first 1–2 letters of the section name (PU, S, or PL) and the numbers of the lower and upper bounding locks (e.g., S8–9). Within each site, generally 2–3 subreaches (sections of shoreline) were sampled to account for the patchiness that is commonly present in fish distributions. Target shocking time at each subreach was 1,200 s but ranged from 900 to 1,800 s in an effort to collect a representative sample while minimizing fish stress during holding and processing (Miranda and Boxrucker 2009). All fish were identified to species and released, with the exception of some individuals that were kept for tissue analysis as part of the New York State Toxic Substances Monitoring Program.

TABLE 1. Site identification code, date sampled, range of river kilometers (measured from downstream to upstream starting at the confluence with the Hudson River), and estimates of total (all species) catch per unit effort (CPUE) and standard errors (SEs) for 24 sites sampled on the Barge Canal, 2014–2015, by river section.

Site ID	Date sampled	River kilometers	CPUE (fish/h)	SE (fish/h)
		Permanent lower section		
PL6-7a	May 27, 2014	3.5–7.9	304.0	8.0
PL6-7b	May 27, 2014	7.9–12.2	342.0	na
PL6-7c	May 26, 2015	12.2–16.6	152.6	2.0
PL6-7d	May 26, 2015	16.6–21.0	208.0	3.6
PL7-8a	May 28, 2014	21.0–25.4	217.3	8.9
PL7-8b	May 28, 2014	25.4–29.9	140.0	5.3
PL7-8c	May 27, 2015	29.9–34.3	262.5	68.3
PL7-8d	May 27, 2015	34.3–38.7	175.5	15.8
		Seasonal section		
S8-9	May 29, 2014	38.7–46.8	134.7	3.6
S9-10	May 29, 2014	46.8–56.4	128.0	11.5
S10-11	May 28, 2015	56.4–63.2	46.0	3.7
S11-12	May 28, 2015	63.2–70.0	101.0	15.7
S12-13	May 30, 2014	70.0–85.5	88.0	9.1
S13-14	May 29, 2015	85.5–98.1	79.0	2.7
S14-15	Jun 2, 2014	98.1–103.5	95.0	2.3
S15-16	Jun 2, 2014	103.5–114.3	67.0	5.2
		Permanent upper section		
PU16-17a	Jun 2, 2015	114.3–120.7	213.0	32.5
PU16-17b	Jun 2, 2015	120.7–127.1	132.0	0.6
PU17-18	Jun 2, 2015	127.1–133.9	89.0	3.0
PU18-19a	Jun 3, 2014	133.9–143.4	218.0	21.0
PU18-19b	Jun 3, 2014	143.4–153.0	154.8	3.7
PU19-20	Jun 3, 2015	153.0–169.5	93.0	6.4
PU20-21a	Jun 3, 2015	169.5–177.3	282.0	7.0
PU20-21b	Jun 4, 2014	177.3–185.1	240.0	16.0

Data analysis.—Ratio estimation was used across subreaches to calculate catch per unit effort (CPUE) and standard errors (Hansen et al. 2007) as fish per hour for each species and the entire assemblage for each site, impoundment, and river section. As a precursor to comparing fish assemblages among the three sections, simple linear regression was used to (1) determine whether there was a significant relationship between drawdown amount and total CPUE and (2) identify other physical impoundment characteristics affecting total CPUE that might confound an analysis of the effects of drawdowns. Analysis of variance (ANOVA) was then used to test for differences in mean CPUE for key species, groups, and the entire assemblage between the three sections, and Tukey's test was used to make pairwise comparisons when significant differences were identified. Additionally, the percentage of individuals that were native to the Mohawk River watershed was determined for each section using the species list in Carlson et al. (2016).

The composition of fish assemblages was evaluated using multivariate techniques with PRIMER-E version 7 software (Clarke and Gorley 2015). Square-root transformed species CPUE data were used to form a resemblance matrix of Bray–Curtis similarities comparing all 24 sites. A nonmetric multidimensional scaling ordination and analysis of similarities (ANOSIM) were used to test the null hypothesis that species assemblages did not differ between the three sections (Clarke et al. 2014; Clarke and Gorley 2015). Although the ANOSIM test produces a P-value, the value of the R-statistic is considered more important for assessing differences between groups (Clarke and Gorley 2015). An R-value of >0.75 indicates well-separated groups, whereas an R-value of 0.50–0.75 indicates separate but abutting or slightly overlapping groups and an R-value of 0.25–0.50 indicates distinguishable but overlapping groups (K. R. Clarke, Plymouth Marine Laboratory, personal communication; Ramette 2007). When the ANOSIM test found significant differences among sections, the similarity percentages (SIMPER) technique was used to identify the species that contributed most strongly to the observed differences (Clarke and Gorley 2015). Blueback

Herring (662 adults and 1 juvenile) were excluded from all analyses because they are a migratory species that were sporadically encountered in large schools and their inclusion would bias an assessment of resident assemblages. The results for all statistical tests were considered significant at $\alpha = 0.05$.

RESULTS

Electrofishing surveys collected a total of 3,264 individuals from 38 species; Smallmouth Bass was the only species captured at all 24 sites. Approximately 49% of the individuals captured were species native to the Mohawk River watershed. Total CPUE (all species) was 165.7 fish/h during the 2014 surveys and 150.1 fish/h during the 2015 surveys. Because the annual catch rates were similar, all data from both years were analyzed together.

Simple linear regressions between total CPUE (calculated for each impoundment) and physical impoundment characteristics indicated that the amount of drawdown was the primary driver of total CPUE (Table 2). Drawdown was a highly significant predictor variable ($F = 15.6$, $P = 0.002$) and explained 55% of the variation in total CPUE. Impoundment area approached significance ($F = 3.8$, $P = 0.074$) but only explained 23% of the variation in total CPUE, while elevation change at the lower bounding lock (approximate dam height), percent shipping channel, and river kilometer were not significant predictor variables and explained little of the variation in total CPUE.

Catch per Unit Effort by River Section

Total CPUE ranged from 46.0 to 134.7 fish/h at sites in the seasonal section, compared with 140.0–342.0 fish/h in the permanent lower section and 89.0–282.0 fish/h in the permanent upper section (Table 1; Figure 2). The differences in mean total CPUE between river sections were highly significant (ANOVA; $F = 9.8$, $P = 0.001$), and mean CPUE at the sites in the seasonal section (92.3 fish/h) was significantly lower (Tukey's test; $P < 0.05$) than at the sites in the permanently impounded lower section (225.2 fish/h) and permanently impounded upper section (177.7 fish/h; Table 3). Of the 38 species captured, only 5 had their greatest CPUE in the seasonal section (Table S.2). The remaining 33 species were captured at an equal or greater rate in one of the two permanently impounded sections and included lentic fishes like Pumpkinseed, Bluegill *Lepomis macrochirus*, Largemouth Bass, Rock Bass *Ambloplites rupestris*, and Yellow Perch *Perca flavescens* as well as a number of species that are well adapted to large riverine habitats, such as Smallmouth Bass and Walleyes. The low relative abundance of Yellow Perch and "other centrarchids" (members of the family Centrarchidae excluding Smallmouth Bass) at sites in the seasonal section is particularly noteworthy. The CPUE for many species (even within a particular river section) was highly variable, however, which reduced the power of the statistical comparisons. Despite this, mean CPUE for several species and groups differed significantly between river sections (Table 3).

TABLE 2. Results of simple linear regressions between five predictor variables and total catch per unit effort (CPUE) for each impoundment. Significant *P*-values are shown in bold italics.

Predictor variable	*F*-value	*P*-value	R^2
Drawdown amount (m)	15.6	***0.002***	0.5455
Impoundment area (km^2)	3.8	0.074	0.2256
Elevation change at lower bounding lock (m)	2.4	0.148	0.1543
Percent shipping channel	0.3	0.577	0.0246
River kilometer at lower bounding lock	0.0	0.960	0.0002

Assemblage Composition by River Section

Fish assemblages from sites in the seasonally impounded section grouped separately in the ordination, while sites from the two permanently impounded sections exhibited some overlap (Figure 3). A one-way ANOSIM test confirmed that fish assemblages differed significantly by river section ($R = 0.463$, $P = 0.001$). Pairwise comparisons showed that fish assemblages from the two permanently impounded sections differed more from the seasonal section than from one another. The relatively large *R*-values between the seasonal section and each of the permanently impounded sections indicate substantial differences in fish assemblages. In contrast, the small *R*-value comparing the two permanently impounded sections suggests that fish assemblages differed minimally between these sections (Figure 3). The SIMPER analysis indicated that Brown Bullhead, Rosyface Shiners *Notropis rubellus*, and Bluegills were the species that most discriminated between the permanent lower and seasonal sections, contributing 20.3% of the overall dissimilarity. The relative abundance of Brown Bullhead and Bluegills was greater in the permanent lower section, while the relative abundance of Rosyface Shiners was greater in the seasonal section. Yellow Perch, Rock Bass, and Spotfin Shiners *Cyprinella spiloptera* were the most discriminating species between the permanent upper and seasonal sections, contributing 23.9% of the overall dissimilarity. The relative abundances of Yellow Perch and Rock Bass were greater in the permanent upper section, while the relative abundance of Spotfin Shiners was greater in the seasonal section.

Approximately 44% of the individuals captured in the permanent lower section were species native to the Mohawk River watershed, compared with 57% in the seasonal section and 48% in the permanent upper section. High relative abundances of a number of native cyprinids in the seasonal section, such as Fallfish *Semotilus corporalis*, Rosyface Shiners, and Spotfin Shiners were largely responsible for this finding (Table S.2).

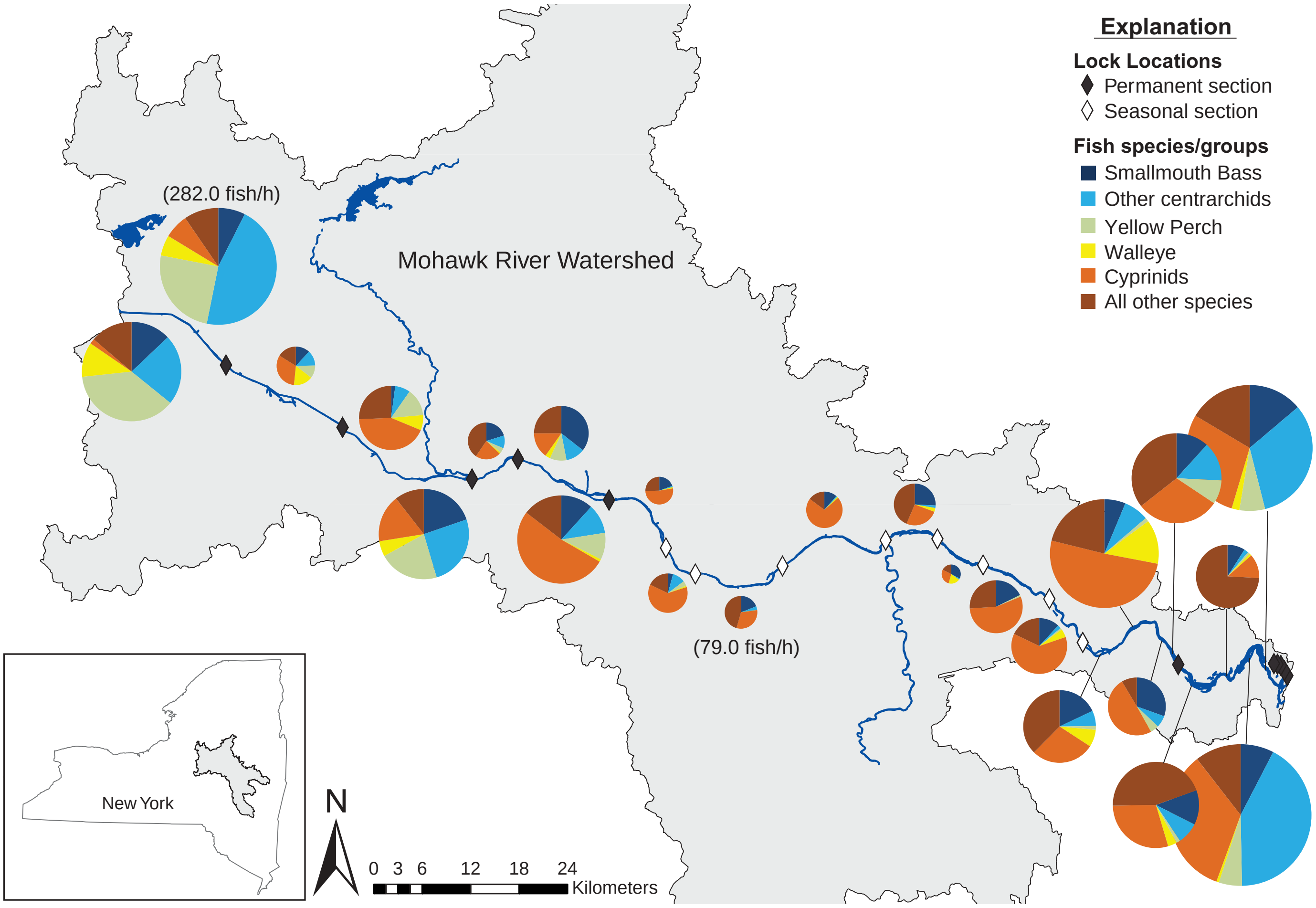

FIGURE 2. Composition of fish assemblages sampled from 24 sites on the Barge Canal, 2014–2015. Chart size reflects the total (all species) catch per unit effort.

DISCUSSION

The primary purpose of this investigation was to determine whether and how the drawdown resulting from removing temporary dams during the winter on a section of the Barge Canal affects fish assemblages. This was evaluated by first identifying a significant relationship between the relative abundance of fish and the drawdown amount in each impoundment and then by comparing fish assemblages at sites in the seasonally impounded section with those from sites in adjacent assemblages at sites in adjacent (bracketing) permanently impounded

TABLE 3. Mean, standard deviation, and ANOVA results for catch per unit effort (fish/h) of key species and groups (shown in Figure 2) by river section. Significant *P*-values are shown in bold italics; different lowercase letters denote significant differences among groups as determined from Tukey's test.

	Permanent upper		Seasonal		Permanent lower			
Species	Mean	SD	Mean	SD	Mean	SD	*F*-value	*P*-value
Smallmouth Bass	24.9	15.0	15.2	6.9	28.1	10.5	2.8	0.082
Other centrarchids	39.0	41.0	2.6	3.2	41.7	51.1	2.7	0.093
Yellow Perch	34.6 z	31.3	0.8 y	1.4	9.3 y	8.1	7.1	***0.004***
Walleye	11.1	8.7	2.7	3.4	8.1	11.6	2.0	0.165
Cyprinids	38.5	34.6	47.0	25.5	75.2	36.6	2.8	0.085
All other species	29.7 y	7.9	24.0 y	12.6	62.9 z	32.0	8.5	***0.002***
All species	177.7 z	71.0	92.3 y	29.6	225.2 z	72.3	9.8	***0.001***

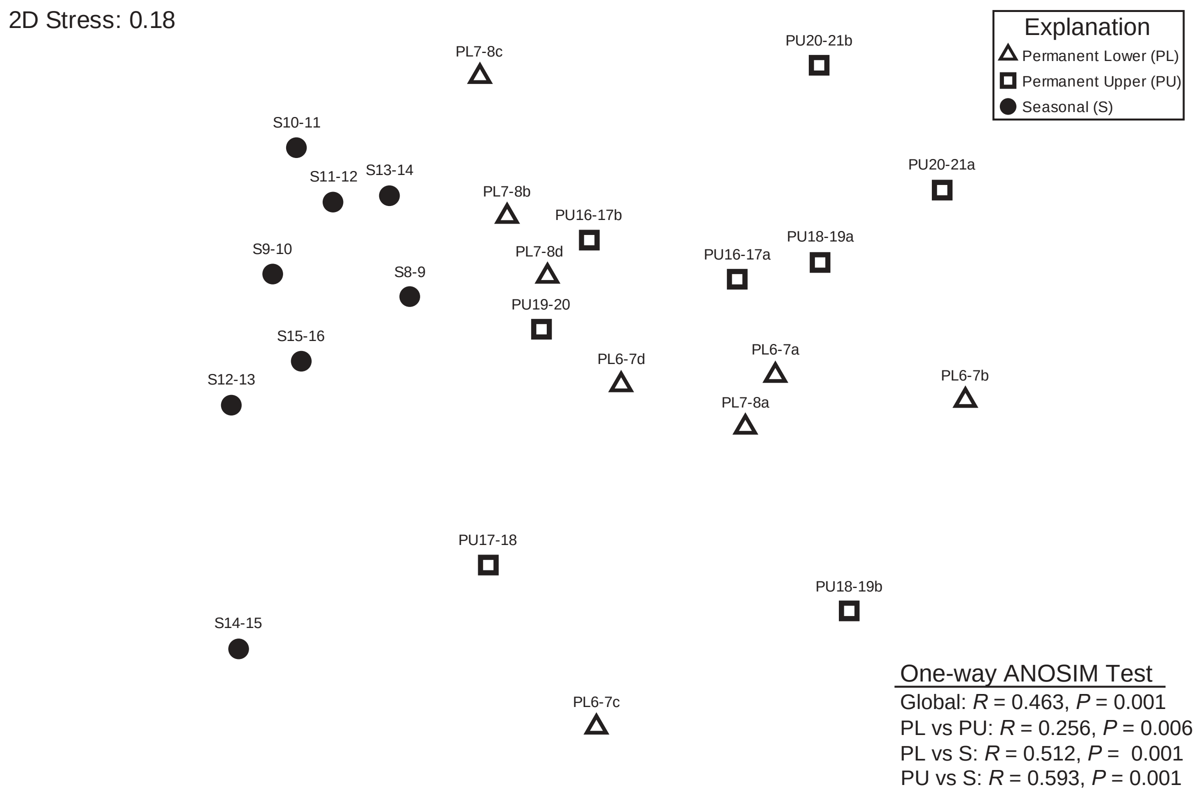

FIGURE 3. Nonmetric multidimensional scaling ordination and analysis of similarities (ANOSIM) results comparing fish assemblages between sections of the Barge Canal surveyed in 2014–2015.

sections. Our results indicate that the overall relative abundance of fish was lower in the seasonal section and that the composition of fish assemblages differed at those sites. Mean total CPUE at sites in the seasonal section was significantly lower than at sites in either of the permanently impounded sections, and the CPUE of many lentic species was markedly lower. These findings are consistent with those of McBride (1985), who found that the proportion of panfish was approximately one-third as great in the seasonal section of the Barge Canal as in the permanent lower section. In a similar vein, a recent study on the Ottawa River showed that littoral benthivores such as Pumpkinseed and Brown Bullhead were less abundant in or absent from impoundments that experienced an extensive winter drawdown (Haxton and Findlay 2009). An ongoing companion study to ours that is assessing macroinvertebrate communities in the Barge Canal (S. Johnson, Onondaga Environmental Institute, personal communication) should provide additional information as to how the abundance and composition of benthic prey available to insectivorous fishes varies by river section.

The data from the permanent upper section serve as a control against the possible confounding effects of watershed characteristics that change naturally across an upstream-to-downstream continuum unrelated to hydrologic manipulation. For example, the natural gradient in elevation, discharge, and productivity (Vannote et al. 1980) could conceivably cause differences in fish assemblages between the permanent lower and seasonal sections based simply on their positions in the watershed, thereby complicating the assessment of differing flow management practices. However, the results from the linear regressions indicate that differences in impoundment characteristics as well as river kilometer (which may serve as a surrogate for many changing characteristics along a gradient of watershed position) were not significant predictor variables of total CPUE. Furthermore, the similar fish assemblages at sites in the permanent lower and permanent upper sections suggest that the effects of natural longitudinal differences were minimal at the scale of our study area and are not primarily responsible for the observed differences in fish assemblages between the permanently and seasonally impounded sections. The high total CPUE and greater relative abundance of many lentic species (which were rare in the seasonal section) in the permanent upper section therefore provide a critical perspective for evaluating the effects of the winter drawdown.

Extreme drawdowns and the resulting differences in available winter habitat are the most logical explanation for the differences in fish assemblages among the three river sections. A number of studies have found that populations of warmwater fishes in large rivers are often limited by the quality and accessibility of winter habitat (Raibley et al. 1997; Karchesky and Bennett 2004).

At cold temperatures, many warmwater species are unable to forage or even swim effectively and generally seek refuge in bays or backwaters that are protected from currents and that stratify thermally, providing water temperatures around 4°C (Sheehan et al. 1990). Such areas allow fish to expend less energy to maintain their position while providing more favorable temperatures for performing basic physiological functions. Carlson (1992) estimated that five wintering areas supported 59% of the Largemouth Bass over the entire 166-km freshwater portion of the Hudson River estuary. A similar study on the Mississippi River indicated that three wintering areas supported nearly all of the Largemouth Bass in a 29-km river section (Pitlo 1992). When water levels are drawn down in the winter, fish may lose access to vital refuges and face adverse conditions in the remaining habitat or become stranded in backwaters and experience winterkill (Pitlo 1992; Raibley et al. 1997). For example, although a winter drawdown of 2.9 m on the Pend Oreille River in Idaho reduced the wetted surface area by only 11%, this may have been sufficient to prevent the use of backwater habitats by Largemouth Bass (Karchesky and Bennett 2004). On the seasonally impounded section of the Barge Canal, water levels are not traditionally drawn down; instead, the uprights and gates that comprise the movable dams are lifted from the riverbed, resulting in a 1.5–5.8-m drop in water levels, a 36–56% reduction of the wetted surface area, and an abrupt transition from impounded to riverine habit (McBride 1987). This may eliminate many possible winter refuges and expose fish to shallower, flowing waters with temperatures near 0°C and extensive ice formation. Thus, it is likely that the differences in fish assemblages observed between river sections are due primarily to the reduction of winter habitat available in the seasonal section after the drawdown.

Native fish species may be better adapted to the riverine conditions in the seasonally impounded section and appear to compete less successfully with nonnative species in the permanently impounded sections of the Barge Canal. Although the CPUE of many lentic centrarchids and other game fishes was lower in the seasonal section, the percentage of individuals from species that are native to the Mohawk River watershed was greater in this section. This is not surprising, since the native fish assemblage evolved under preimpoundment conditions in which the Mohawk River flowed freely with shallower and more typical riverine habitat (McBride 1994). Consequently, winter conditions in the seasonal section after the dams are lifted may resemble the natural riverine environment more closely and could provide a competitive advantage to native cyprinids and other riverine fishes, at least relative to the sections in which water levels are impounded year-round. This idea is consistent with the body of literature indicating that the changes in habitat resulting from the impoundment of free-flowing rivers generally favor nonnative, lentic fishes (Poff et al. 1997; Pringle et al. 2000; Bunn and Arthington 2002). Nonnative species, whether introduced intentionally to provide a sport fishery or by accident, can reduce or extirpate native riverine species in impoundments (Poff et al. 1997). Furthermore, the habitat in impoundments may not be adequate for native riverine species that depend on shallow, moving water for critical parts of their life history (Bunn and Arthington 2002). The seasonal section, therefore, may support a greater percentage of native individuals because they are better adapted to the riverine winter conditions, depend on specific riverine habitats that are maintained by the drawdown, or face less predation or competition from nonnative lentic species which are disadvantaged by the winter conditions.

The results presented here suggest that seasonal dam use on the Barge Canal has measurable effects on fish assemblages and that these effects should be interpreted within the context of the management objectives for the watershed. A key goal of the 2012–2016 Mohawk River Basin Action Agenda is the conservation of fish, wildlife, and their habitats while giving people the opportunity to enjoy the basin's natural resources (NYSDEC 2012). From an angling perspective, the seasonal section appears to offer poorer opportunities to catch many species, including Smallmouth Bass and Walleyes, which were identified as the most popular targets among anglers on the Barge Canal (McBride 1983). Similarly, the lower relative abundance of Largemouth Bass, Yellow Perch, Bluegills, Pumpkinseeds, and Rock Bass in the seasonal section should also adversely affect angling opportunities. From the perspective of conserving native biodiversity, however, the greater percentage of native individuals in the seasonal section suggests that it serves as a refuge from nonnative competitors and predators or provides critical riverine habitats. Although none of the species captured in the study are listed as endangered, threatened, or of special concern by the New York State Department of Environmental Conservation, the fish assemblages in the seasonal section may be more similar to the assemblage that prevailed prior to canalization. Ultimately, natural resource managers will have to determine which fish assemblage—and therefore which drawdown practice—is most desirable and consistent with management objectives while balancing the system's use for transportation and recreation, the generation of hydropower, and flood mitigation.

Although significant differences in fish assemblages were noted between the permanently and seasonally impounded sections of the Barge Canal, the present study has several limitations that should be considered. First, our fish surveys were conducted exclusively by means of boat electrofishing. Although this is generally viewed as the single most effective method for assessing lotic fish assemblages (Moulton et al. 2002), it is biased toward the capture of larger individuals (Dolan and Miranda 2003; Reynolds and Kolz 2012) and likely led to underestimates of the abundance of small species and the early life stages of many species. Additionally, by only sampling nearshore habitats we likely underestimated the abundance of certain benthic and pelagic species that use open water or deeper habitats (Miranda and Boxrucker 2009). This could explain why no Round Goby were captured despite being first identified in the western edge of the study area in September 2014. Second, although CPUE data are frequently used as a surrogate for abundance in large freshwater habitats where quantitative surveys are impractical, this approximation assumes that the number of fish captured is proportional to the effort expended and that capture probabilities are similar between sites and species (Hubert and Fabrizio 2007; Hayes et al. 2012; Hubert et al. 2012). While these assumptions may not always be met in practice, the relationship between CPUE and abundance can be improved through standardization of survey methods (Hubert and Fabrizio 2007). We attempted to do this by sampling only nearshore habitats during the same 2-week period each year and by using multiple subreaches within sites to further reduce the variance caused by random differences in the surveyed habitats. Despite this, unknown bias is inevitably introduced when CPUE is used to approximate abundance and capture probabilities are unknown (Hubert and Fabrizio 2007). Finally, the results described above are correlative or observational; they do not describe findings from a manipulative study. It would only be possible to truly establish a causal relationship by manipulating the current drawdown regime over some time period and investigating the effects.

Despite these limitations, the investigation presented here provides important information that can inform decisions by natural resource managers and policymakers and provide an impetus for further research on the Mohawk River and Barge Canal system. Our findings have regional implications for areas like the Hudson River portion of the Champlain Canal (parts of which experience an extensive annual winter drawdown), but they are also relevant on a broader scale because the effects of water-level manipulation in reservoirs is a topic of great concern (Ploskey 1986; Wlosinski and Koljord 1996). However, typical reservoir drawdowns do not transform aquatic habitats from lentic to lotic, and thus the unique nature of our study area makes an important contribution to the field of water-level management. Additionally, the data collected during this study will serve as a baseline to identify future changes to fish assemblages in the Mohawk River and Barge Canal system. Climate change, as well as recent improvements to the movable dams enabling them to be quickly lifted during the navigation season in anticipation of major storms, may alter the frequency, timing, and magnitude of low- and high-flow events and water temperatures in the Mohawk River watershed in the future (Rosenzweig et al. 2011; Peterson et al. 2013). Therefore, the baseline data provided by this study will not only help identify future changes to fish assemblages but also determine whether such changes are attributable to specific factors such as invasive species (e.g., Round Goby) or changes in flow management practices. It would be prudent, therefore, to conduct similar fish surveys in the future in order to make valid temporal comparisons with this data set while employing additional sampling techniques to obtain more information on the populations of benthic and pelagic fishes in this river–canal system.

ACKNOWLEDGMENTS

This research was funded by the Mohawk River Basin Program and the U.S. Geological Survey with logistical and field support from the New York State Department of Environmental Conservation. The authors extend appreciation to the fisheries staff from Regions 4 and 6, Alexander Smith, and Walter Keller (retired), all of the New York State Department of Environmental Conservation; Jeremy Wright and Bryan Weatherwax of the New York State Museum Ichthyology Lab; Noel Deyette and Luis Rodriguez of the U.S. Geological Survey; several student volunteers from the State University of New York at Cobleskill; and the New York State Canal Corporation. Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

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Bureau of Fisheries Technical Brief #2018040

Crescent Lake (H-240) Black Bass Survey (Survey #: 418011)

Scott Wells, Region 4 Fisheries August 31, 2018

Crescent Lake is a 1,904-acre permanent impoundment of the Lower Mohawk River spanning Schenectady, Saratoga, and Albany counties in NYS. Located at the top of the Waterford Flight of Locks, the reservoir is eutrophic, perennially infested with water chestnut, and supports a diverse assemblage of warmwater sportfishes. Smallmouth and largemouth (i.e., black) bass, walleye, northern pike, chain pickerel, channel catfish, and the occasional (stocked) tiger muskellunge make this a popular water for anglers. Migratory blueback herring, plus spottail, spotfin and other shiners are the common forage species. Blueback herring likely populated the river soon after the original bypass step-canal was completed around Cohoes Falls in 1823. Thereafter, this new marine-derived food source crafted the lower Mohawk into one of most productive rivers in the state (McBride 1994). Many river fishes including numerous non-natives move about the main stem river and connected waters (i.e., Hudson River) via canal locks and high flow events.

A survey using DEC's revised black bass and sunfish sampling manual (Brooking et al. 2018) was conducted over six nights covering much of the reservoir shoreline between June 18-27, 2018. The primary purpose was to assess the status of black bass, with a secondary focus on walleye. Effort included 27 individual boat shocking runs (14 all-fish, 13 sportfish) at night for a total of 8.9 hours of on-time. A total of 27 fish species were identified with 1,038 fish captured. The most numerous sportfish captured was smallmouth bass (198), with 11 fish >16 in. (maximum 18.7 in., Fig. 1), and a maximum weight of 2.8 lbs. The catch rate of smallmouth bass was 22/h followed by walleye at 15/h (Table 1). However, the catch rate for quality or legal (≥12 in.) size smallmouth bass was only 7/h, or one-half the statewide average for spring surveys on lakes >1000 acres in NYS. Largemouth bass were much less numerous (27), but ~60% were of legal size (≥12 in.), with a maximum length of 19.4 in. and a maximum weight of 4 lbs. The largemouth bass catch rate was a meager 3/h (all sizes), decreasing to 2/h for quality size fish (Table 1). Interestingly, over one-half of the smallmouth bass collected were immature (<9 in.), yet few juvenile largemouth bass were captured/observed. Walleye were also common but only 16 of 130 collected were of legal size (≥15 in.) with a catch rate of only 2/h (Table 1), with a maximum size of 24.8 in. and 5.4 lbs.

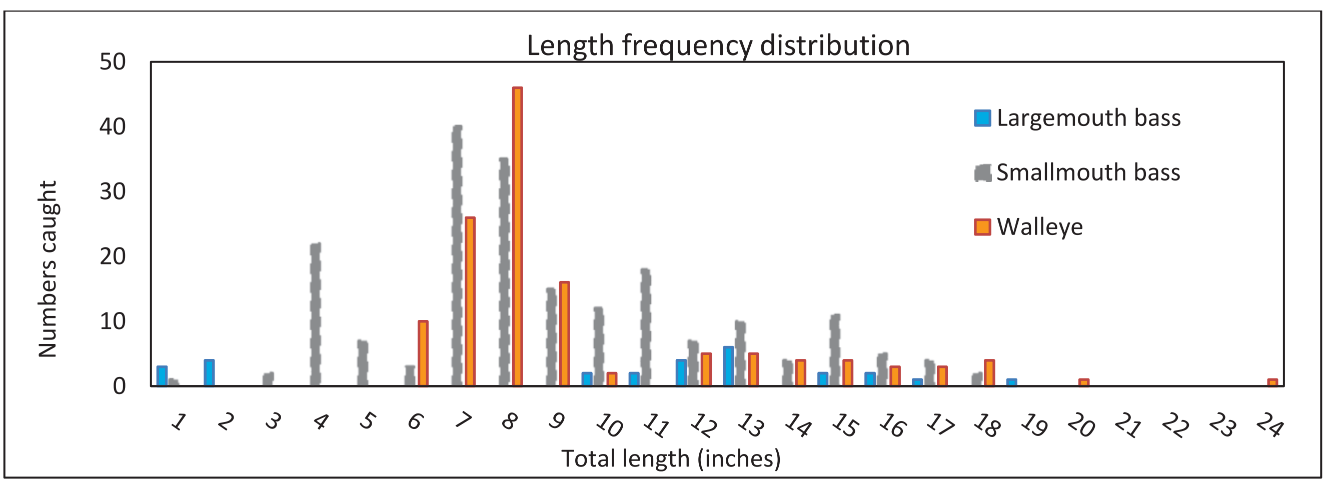

Figure 1. Results for three sport fishes captured in Crescent Lake, NY between June 18-27, 2018.

Only six northern pike and 11 chain pickerel were collected. No tiger muskellunge were collected or observed. Pumpkinseed and rock bass were the most common panfish captured, followed by bluegill, yellow perch, and brown bullhead (Table 1). Other notable collections included 12 channel catfish and three black crappie.

Table 1. Results from night electrofishing in Crescent Lake, NY between June 18-27, 2018.

Fish Species	N[2]	Effort[3] (h)	All sizes	YY/SY[4]	Length category[1] catch rate ≥Stock	≥Quality	≥Preferred
Brown bullhead	49	2.4	20.7	0.0	20.7	20.7	18.6
Rock bass	95	2.4	40.1	1.3	37.6	7.2	0.0
Pumpkinseed	129	2.4	54.4	0.8	53.6	34.6	3.8
Bluegill	62	2.4	26.6	8.9	16.0	13.1	0.0
Yellow perch	41	2.4	17.3	0.4	16.9	4.2	0.0
Largemouth bass	27	8.9	3.0	0.8	1.8	0.7	0.0
Smallmouth bass	198	8.9	22.3	3.6	18.0	6.8	3.2
Walleye	130	8.9	14.7	1.6	3.6	1.8	0.2

[1]Total length categories for various fish species

	Rock bass	Yellow perch / Brown bullhead	Bluegill / Pumpkinseed	Smallmouth bass	Largemouth bass	Walleye / Chain pickerel
Stock	≥ 4 in	≥ 5 in	≥ 3 in	≥ 7 in	≥ 8 in	≥ 10 in
Quality	≥ 7 in	≥8 in	≥ 6 in	≥11 in	≥12 in	≥ 15 in
Preferred	≥ 9 in	≥10/11 in	≥ 8 in	≥14 in	≥15 in	≥ 20 in

[2]N—numbers captured, [3]Effort—fishper h—hour, [4]YY—young of year and SY—spring yearling (age-1) fish

Large schools of forage fishes (likely young blueback herring, spottail and spotfin shiner) were observed during the survey, an indication of the lower river's productivity. Fish passage improvements at both ends of the reservoir (hydro-dams) would likely reduce mortality of migratory species such as American eel (only one adult collected in upper tailwater) and blueback herring (five adults collected at the tail of their spring run) resulting in a more productive (forage input) and balanced warmwater ecosystem.

Smallmouth bass and walleye populations appear to be recruiting well in Crescent Lake (Fig. 1). A lack of larger walleye and esocids in the survey was likely due to rising water temperatures in early summer when adult fishes tend to move deeper seeking cooler water. Shocking runs along dense water chestnut beds often resulted in very few fish collected. This scenario indicates a general avoidance displayed by many river fishes and likely caused our catch rates in general to be lower than expected. The presence of multiple public access points and a menu of quality sized sportfish, mostly in areas relatively devoid of water chestnut (better habitat), contribute to existing angler pressure that can be high due to close proximity of the Capital District and likely fluctuates by season. The productive black bass and walleye fishery of the lower river will continue to be managed under the statewide fishing regulations. In addition to smallmouth bass, the primary sportfish, good numbers of large panfish should also contribute to quality fishing opportunities for many years to come.

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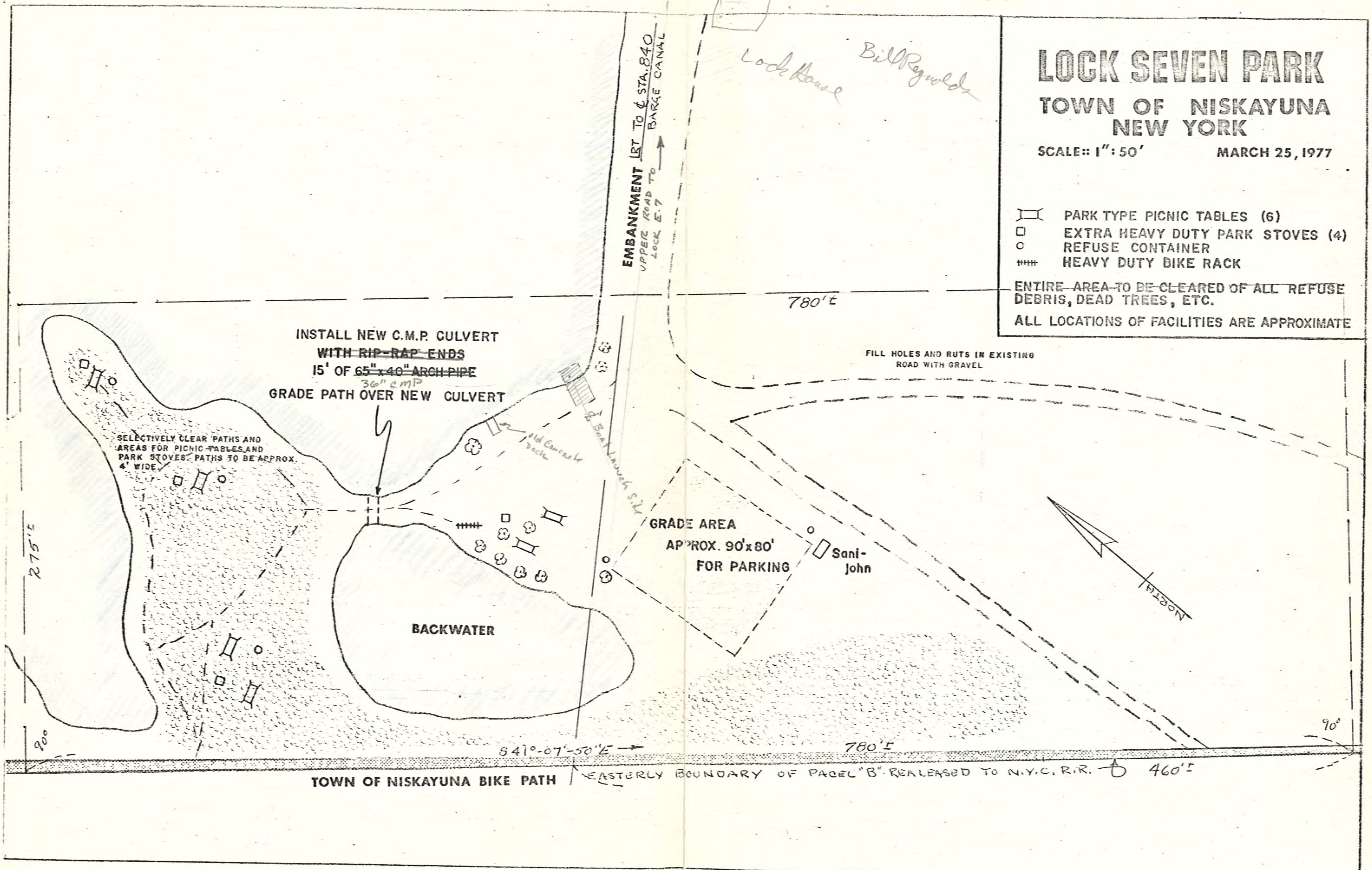
ATTACHMENT F

TOWN OF NISKAYUNA LOCK 7 PARK MAP AND MAINTENANCE AGREEMENT


LOCK SEVEN PARK
TOWN OF NISKAYUNA
NEW YORK
SCALE:: 1": 50'
MARCH 25, 1977
PARK TYPE PICNIC TABLES (6)
EXTRA HEAVY DUTY PARK STOVES (4)
REFUSE CONTAINER
HEAVY DUTY BIKE RACK
ENTIRE AREA TO BE CLEARED OF ALL REFUSE DEBRIS, DEAD TREES, ETC.
ALL LOCATIONS OF FACILITIES ARE APPROXIMATE
Lock House
Bill Reynolds
EMBANKMENT LRT TO ℄ STA. 840 BARGE CANAL
UPPER ROAD TO LOCK E.7
780'±
INSTALL NEW C.M.P. CULVERT
WITH RIP-RAP ENDS
15' OF 65"x40" ARCH PIPE
36" CMP
GRADE PATH OVER NEW CULVERT
FILL HOLES AND RUTS IN EXISTING ROAD WITH GRAVEL
SELECTIVELY CLEAR PATHS AND AREAS FOR PICNIC TABLES AND PARK STOVES. PATHS TO BE APPROX. 4' WIDE.
Old Concrete Dock
GRADE AREA
APPROX. 90'x80'
FOR PARKING
Sani-John
North
BACKWATER
275'±
90°
S41°-07'-50"E
780'±
90°
TOWN OF NISKAYUNA BIKE PATH
EASTERLY BOUNDARY OF PACEL "B" REALEASED TO N.Y.C. R.R.
460'±

Permit No. 77-05-35

NEW YORK STATE DEPARTMENT OF TRANSPORTATION
WATERWAYS MAINTENANCE SUBDIVISION

Permit for Use and Occupancy of N.Y. State Canal Lands
In accordance with Article X of the Canal Law

Property Identification PORTIONS OF PARCEL NOS. 732, 679-1, 679-2, B.C. CONT. NO. 14 AT LOCK NO. 7, ERIE BARGE CANAL

PERMISSION IS HEREBY GRANTED

To Town of Niskayuna (Dept. of Parks) (hereinafter referred to as permittee)

Address 1335 Balltown Road, Schenectady, New York 12309

to use and occupy the State owned property at the particular location described above or as the case may be in accordance with the map and plan hereto attached and pursuant to the conditions and regulations whether general or special, which are hereinafter set forth all forming a part hereof, to wit:

CONDITIONS AND REGULATIONS

1. The property covered by this permit shall be used only for the purposes of developing a picnic and fishing area adjacent to the southwesterly side of Lock #7, Erie Barge Canal area approx. 780 feet ± in length and 275 feet ± in width as shown on the attached print titled, "Lock Seven Park, Town of Niskayuna, N.Y." dated March 25, 1977. and for no other purpose whatsoever. This permit shall not be assigned or transferred. Any attempt to assign, transfer or convey any right, title or interest to the land will be considered an automatic revocation of this permit.

2. Initial Fee to be charged $ 25.00 and annually thereafter Fees waived

3. Permittee is responsible for any repairs, improvements or maintenance work of any kind on the property. It is the responsibility of the permittee to notify the State immediately of any unsafe or hazardous conditions or conditions that would affect continued occupation of the subject property.

4. The Commissioner, his agents, employees and contractors, shall at all times have the right of entry upon the property defined by this permit to perform whatever duties are deemed necessary.

5. It is understood and agreed that during the period which this permit is in effect the permittee shall maintain the land, buildings, and/or other structures in a neat, clean and sanitary conditions and shall comply with all State and local building, zoning and health rules and regulations.

6. It is understood by permittee that no liability of any kind shall attach to or rest upon the State for any damage on account of the granting or revocation of any permit. Permittee therefore undertakes and agrees to indemnify and save harmless the State, its officers or employees from any and all liability, claims, demands and recoveries arising out of the use and occupancy of the property.

7. This permit may be cancelled by either party on 30 days written notice whereupon it shall be the duty of the permittee to remove all the structures and works at his own expense from the property. Upon failure of the permittee to remove such works and structures, the Commissioner may without further notice summarily enter upon and remove from said premises any and all encroachments and property of the permittee at the permittee's own cost and expense. In the event of such a cancellation, no refund will be made for any unexpired term.

8. Except insofar as they are specifically modified herein, the rules and regulations governing navigation and use of the New York State Barge Canal System, are hereby made a part of this permit.

9. This permit is automatically cancelled within 60 days of the anniversary date for non-payment of the annual fee.

10. Special Provisions:

(a) As indicated on the attached map, the Town of Niskayuna agrees to develop during the year 1977 the area covered by this permit by construction of the parking area; picnic area; culvert installation, approach road repairs and sani-john installation.

(b) The park area will be policed by the Town law enforcement personnel and the park will be closed to the public at dusk each day.

(c) The general policing and clean-up of the area will be the direct responsibility of the Town of Niskayuna.

(d) There will be no interference by users of the park with the daily operation of the lock and requests to patrons by Department personnel shall be obeyed as they concern such operations.

(e) No additional structures shall be permitted without first receiving the written consent of the Commissioner of Transportation.

(f) The sign installation and location will be approved by Department personnal.

(g) The licensee is required to furnish this department with a Certificate of Public Liability Insurance in accordance with Form CAN-26.

RECOMMENDED J. Hulchanski Date 4-28-77

Regional Waterways Maintenance Engineer

ACCEPTANCE:

In consideration of the granting of the within permit, the undersigned ____________________ hereby accepts the same subject to the conditions and regulations herein prescribed.

Dated this ________ day of ____________________, 19 ______

____
Signature of Permittee

BY ____________________
(Add title, if signed by representative)

CORPORATE SEAL
(if any)

WITNESS – Signature ____________________ Date ____________________

APPROVED:

Commissioner of Transportation
For The People of the State of New York

ORIGINAL SIGNED BY
W. R. STELLATO

BY ____________________ Date ____________________

Director, Waterways Maintenance Subdivision

CAN 36a (1/76)
REVERSE

JEH

March 25, 1981

PERMIT NO. 77-05-35
TOWN OF NISKAYUNA

J. Hulchanski, Waterways, Region 1 ORIGINAL SIGNED BY J. HULCHANSKI

J. R. Stellato, Waterways, Bldg 5 Rm 216

Attached find a copy of the above mentioned permit and a copy of the March 20, 1981 letter from Richard E. Northcraft of DEC along with a sketch of the area.

The existing launch ramp mentioned in the letter is just the sloping gravel bank that has existed for some time. The proposed plan is to pave a portion of it for better access of boat trailers.

We have reviewed the plan and have no objection. We believe the proper way to handle this is to issue an amendment to the town permit.

JH:ep

Attachment

Rec 3/23/81 [illegible]

New York State Department of Environmental Conservation
Region 4
Fish and Wildlife Office
Stamford, New York 12167

Robert F. Flacke
Commissioner

March 20, 1981

Mr. John Hulchanski
Resident Engineer
DOT Waterways
84 Holland Avenue
Albany, New York

Dear Sir:

Ref our phone conversation of this date, the following are Dept. Environmental Conservation plans for the Lock 7 area:

The department is in the process of working out an agreement with the Town of Niskayuna to develop a Fishing access site on land leased from N.Y.S. DOT at Lock 7 (Permit 77-05-35).

The present plans are to improve the existing launch ramp with the installation of a concrete ramp 20 feet wide by 40 feet long. At the same time, the existing parking area will be expanded to accommodate 15-20 cars and trailers. All future maintenance of the area will be assumed by the Town of Niskayuna.

If there are any questions concerning this proposal feel free to contact me at this office at any time.

Sincerely,

Richard E. Northcraft
Prin. Fish & Wildlife Tech.

REN:klc

JEH

March 31, 1981

Town of Niskayuna
Department of Parks
1335 Balltown Road
Schenectady, New York 12309

Gentlemen:

Amendment No. 1 to Revocable Permit No. 77-05-35

WHEREAS, Revocable Permit No. 77-05-35 was issued to you on July 8, 1977 granting you permission to develop a picnic and fishing area adjacent to the southwesterly side of Lock #7,

WHEREAS, you have requested permission to improve the existing launch ramp with the installation of a concrete ramp 20 feet wide by 40 feet long, and to expand the existing parking area to accommodate 15-20 cars and trailers,

WHEREAS, this office has approved your request,

THEREFORE, Amendment No. 1 to Revocable Permit No. 77-05-35 is hereby granted giving permission to improve the existing launch ramp with the installation of a concrete ramp 20 feet wide by 40 feet long and to expand the existing parking area to accommodate 15-20 cars and trailers. All conditions and restrictions of the original permit shall apply.

Please submit the amendment fee of $5.00 to this office.

Sincerely yours,

ORIGINAL SIGNED BY
J. R. STELLATO

JOSEPH R. STELLATO
Director of Waterways Maintenance Division

cc: C. E. Carlson, Regional Director, Region 1
J. Hulchanski, Regional Waterways Engineer, Region 1
S. D. McConnell, Revenue Section, Bldg. 5, Room 422

JRS:WJS:COC

APR 1 1981