NEW YORK STATE OF OPPORTUNITY. | NY Power Authority

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September 23, 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
Proposed Study Plan and Responses to Additional Information Requests

Dear Secretary Bose:

On May 3, 2019, the Power Authority of the State of New York (Power Authority), 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. On or before August 9, 2019, FERC, state and federal resource agencies, non-governmental organizations, and other stakeholders provided their comments on SD1 and requested certain resource studies. In addition, FERC requested certain additional information for the Projects.

In accordance with the Integrated Licensing Process (ILP) schedule included in SD1, the Power Authority hereby provides its Proposed Study Plan (PSP) and responses to FERC's additional information requests.

In response to stakeholder study requests, the Power Authority is proposing seven studies to be conducted as one-year studies in 2020 (the first study season), as follows:

- Water Quality Study
- Fish Entrainment/Impingement Study
- Blueback Herring Migration Study
- Fish Community Study
- Aquatic Mesohabitat Study
- Bald Eagle Study

- Recreation Study

Each of the proposed studies is described in detail in the PSP. Other studies that were requested are not being proposed by the Power Authority because the Power Authority believes that these studies do not meet specified FERC study plan criteria, as presented in SD1. In addition, two proposed studies are not being proposed as part of the PSP, but may be proposed for second season studies, depending on the results of the 2020 studies.

The Power Authority will hold a study plan meeting, open to state and federal resource agencies and the public, at 9:00 AM on Wednesday, October 23, 2019, at Hilton Garden Inn Albany Airport, 800 Albany Shaker Road, Latham, NY, 12211. At the meeting, the Power Authority will discuss the proposed study plans with stakeholders. FERC will also be in attendance at the study plan meeting.

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 enclosed PSP, please do not hesitate to contact me. Information regarding the relicensing of the Crescent and Vischer Ferry Projects can be found at the Power Authority's relicensing website at http://www.nypa.gov/cvf.

Sincerely,

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Enclosures:

Proposed Study Plan

cc: Distribution List (attached)

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PROPOSED STUDY PLAN
FOR THE

CRESCENT AND VISCHER FERRY HYDROELECTRIC PROJECTS
FERC NO. P-4678 AND P-4679

Prepared for:

NEW YORK STATE OF OPPORTUNITY. | NY Power Authority

Prepared by:

Kleinschmidt

SEPTEMBER 23, 2019

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LIST OF ABBREVIATIONS

ADCP	Acoustic Doppler Current Profiler
APE	Area of Potential Effect
BCD	Barge Canal Datum
CVF or Projects	Crescent and Vischer Ferry Projects
C.F.R.	Code of Federal Regulations
cfs	cubic feet per second
DO	dissolved oxygen
DOE	Department of Energy
EA	Environmental Assessment
EAP	Emergency Action Plan
ESA	Endangered Species Act
FERC or Commission	Federal Energy Regulatory Commission
FPA	Federal Power Act
FPC	Federal Power Commission
GIS	Geographic Information System
HEC	USACE Hydrologic Engineering Center
HEC-HMS	USACE Hydrologic Engineering Center's Hydrologic Modeling System
HEC-RAS	Hydrologic Engineering Center River Analysis System
ILP	Integrated Licensing Process
LiDAR	Light Detection and Ranging
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOI	Notice of Intent
NYSCC	New York State Canal Corporation
NYNHP	New York Natural Heritage Program
NYPA	New York Power Authority
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
OPRHP	New York State Office of Parks, Recreation, and Historic Preservation
O&M	operation and maintenance
PAD	Pre-Application Document
PME	Protection, Mitigation, and Enhancement
Power Authority	New York Power Authority

PSP	Proposed Study Plan
RSP	Revised Study Plan
RTE	Rare, Threatened, and Endangered
SAV	submerged aquatic vegetation
SCORP	State Comprehensive Outdoor Recreation Plan
STID	Supporting Technical Information Document
T & E Species	Threatened and Endangered Species
U.S.	United States
USACE	United States Army Corps of Engineers
USDOI	United States Department of Interior
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

1 INTRODUCTION

The Power Authority of the State of New York (Power Authority or NYPA) is relicensing the Crescent and Vischer Ferry Hydroelectric Projects (FERC Nos. 4678 and 4679) (Projects). The Projects are located on the Mohawk River, about 4 and 14 miles, respectively, upstream from its confluence with the Hudson River in New York. The Power Authority is using the Federal Energy Regulatory Commission's (FERC or Commission) Integrated Licensing Process (ILP) as outlined in 18 C.F.R. Part 5.

In accordance with 18 C.F.R. §§ 5.5 and 5.6, the Power Authority filed its Notice of Intent (NOI) and Pre-Application Document (PAD) on May 3, 2019, which included the Power Authority's preliminary issues and studies list for the Projects. These studies included: 1) a water quality study; and 2) a recreation site inventory and condition assessment.

The Commission issued its Scoping Document 1 (SD1) on June 10, 2019. On July 10, 2019 the Commission conducted environmental site visits to each of the Projects in conjunction with the public scoping meetings on July 10-11, 2019 in Clifton Park, New York, where potential issues were identified by agencies, stakeholders, and the public. Subsequently, the Power Authority received comments on the PAD and the study plans, as well as requests for additional studies and additional information. The Power Authority has reviewed these comments, study requests, and additional information requests and this Proposed Study Plan (PSP) addresses and responds to all comments and requests.

In addition to responding to comments received, the Power Authority proposes in this PSP to build on the studies that were initially proposed in the PAD. The Power Authority has enhanced the study plans for the water quality and recreation studies in response to comments received during the scoping process. Additionally, the Power Authority is proposing five additional first year, single season studies that were requested by stakeholders. These include: 1) a fish entrainment study, 2) a blueback herring migration study, 3) a fish community study, 4) an aquatic mesohabitat study, and 5) a bald eagle study. In total, the Power Authority is proposing to conduct seven first year, single season studies that it believes are relevant to the continued operation of the Projects and will better enable FERC to analyze the effects of continued operation of the Projects.

The Power Authority will hold a study plan meeting, open to state and federal resource agencies and the public, at 9:00 AM on Wednesday, October 23, 2019, at Hilton Garden Inn Albany Airport, 800 Albany Shaker Road, Latham, NY, 12211. At the meeting, the Power Authority will discuss the proposed study plans with stakeholders. FERC will also be in attendance at the study plan meeting.

Stakeholders may provide comments on the PSP within 90 days of this filing, the deadline of which is December 22, 2019. Written comments must be filed directly with the Commission using the eFiling system at http://www.ferc.gov/docs-filing/efiling.asp or by regular mail at Federal Energy Regulatory Commission, 888 First Street, N.E. Washington, DC 20426. On August 27, 2019, the Federal Energy Regulatory Commission (FERC or Commission) issued a rule amending its regulations concerning the process for delivering filings and submissions to the Commission. The rule, which will go into effect November 4, 2019, requires that filings and submissions to be delivered to the Commission, other than by the United States Postal Service (USPS), are to be sent to the Commission's off-site security screening facility at: 12225 Wilkins Avenue, Rockville, MD 20852.

The Power Authority will subsequently file a Revised Study Plan (RSP) with the Commission by January 21, 2020.

The PSP is divided into four sections:

1. Proposed study plans;
2. A discussion of additional study requests;
3. Responses to FERC additional information requests (AIRs); and
4. Appendices with a listing of study request letters and a matrix that summarizes study requests and comments received during scoping, along with a brief response to each item.

2 PROPOSED STUDIES

In the Projects' PAD, the Power Authority proposed two studies: a water quality study and a recreation inventory study. Based on comments received during scoping, the Power Authority has developed study plans for these studies to address the comments received. Further, commenting parties requested studies related to fish entrainment, blueback herring migration, the fish community and composition, American eel, freshwater mussels, aquatic mesohabitat and aquatic resources, bald eagle habitat, Project operations, and upstream flooding at Vischer Ferry. In response to these study requests, in addition to the two originally proposed studies, the Power Authority has developed study plans for five additional resource topics and has included them in the PSP.

2.1 Water Quality Study

2.1.1 General Description of Proposed Study

The Power Authority proposed a water quality study in the PAD. Subsequently, the New York State Department of Environmental Conservation (NYSDEC), the U.S. Fish and Wildlife Service (USFWS) and other stakeholders requested a water quality study to determine if the Projects meet minimum water quality standards for the preservation of beneficial uses at the Projects, including fish and wildlife habitat and recreation. The purpose of the water quality study is to collect certain water quality data and evaluate current water quality conditions at the Projects for those parameters potentially affected by operation of the Projects. The proposed study plan includes utilizing standard sampling methodologies such as in-situ water quality monitors to continuously record dissolved oxygen (DO) and water temperature data, and to conduct monthly sampling of other water quality parameters for the warm season period May through October 2020.

2.1.2 Geographic Scope

The geographic scope of this study encompasses the Projects' powerhouse tailwaters, as well as the lower end of the Project impoundments. To assess the effects of each Project on water quality, the study plan proposes sampling sites in each of the Project impoundments just upstream of the powerhouses, and in each of the powerhouse tailwaters.

2.1.3 Study Goals and Objectives

The goal of this study is to evaluate the effects, if any, of each Project on water quality and to determine compliance with State of New York water quality standards. The objectives of this study are to collect continuous DO and temperature data in the Projects' impoundments and tailwaters during the warm summer and early fall months (i.e., the period when elevated water temperature and low DO levels are most likely to occur in waters released through the Projects), and to collect additional water quality data for pH, conductivity, and turbidity in the Projects' impoundments, sufficient to characterize current water quality at each Project.

2.1.4 Relevant Resource Management Goals and Public Interest Considerations

The Mohawk River at the Crescent and Vischer Projects is classified by NYSDEC as Class A waters, except for the Barge Canal section associated with the Crescent Project, which is classified as Class C waters. The Barge Canal that is classified as Class C includes the Waterford Flight portion of the canal from Lock E-6 where it joins the Mohawk River at the Crescent Project down to Lock E-2, approximately 1.5 miles further down the canal.

Class A waters are described as a source of water supply for drinking, culinary or food processing purposes, primary and secondary contact recreation, and fishing. The waters shall be suitable for fish, shellfish and wildlife propagation and survival (6 NYCRR § 701.6).

Class C waters are described as suitable for fish, shellfish and wildlife propagation and survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes (6 NYCRR § 701.8). Applicable water quality standards for Crescent and Vischer Ferry Project waters are provided in the PAD (see Table 4.3-7).

2.1.5 Existing Information and Need for Additional Information

Existing water quality information for the Mohawk River in the vicinity of the Projects was gathered during PAD development. The USGS works collaboratively with NYSDEC to collect water quality data in the Mohawk River basin. There are two long term water quality monitoring stations within the vicinity of the Projects: Cohoes (located approximately 1.75 miles downstream of the Crescent Dam) and Latham (located approximately 4.5 miles downstream of the Vischer Ferry Dam and 5.75 miles upstream of the Crescent Dam). Table 4.3-8 in the PAD shows the results from these stations for years that data are available.

Additionally, water quality is monitored continuously along a portion of the Mohawk River as part of the Hudson River Environmental Conditions Observing System (HRECOS). There are three monitoring locations along the Mohawk River: at Ilion, New York; at Lock E-8; and at the Rexford Bridge. The Ilion monitoring location is approximately 60 miles upstream of the Vischer Ferry Dam and is above the Little Falls Project on the Mohawk River. Lock E-8 is located approximately 7 miles upstream of the Vischer Ferry Dam. The Rexford Bridge station is located approximately 3.9 miles (or 4.3 river miles) upstream of the Vischer Ferry Dam. Table 4.3-9 in the PAD shows the available data from the Rexford Bridge and Lock E-8 stations.

Although the water quality data collected in the lower Mohawk River does not suggest any adverse water quality conditions directly related to the operation of the Crescent and Vischer Ferry Projects, water quality immediately upstream and downstream of the dams and powerhouses has not been evaluated for many years. Because certain water quality parameters, particularly DO and temperature, can be affected by the operation of hydropower projects, updated information on DO and temperature conditions immediately upstream and downstream of the dams/powerhouses is needed to confirm that the Project operations are not having adverse effects on river water quality, and that Project discharges meet applicable water quality standards for these parameters.

2.1.6 Project Nexus

The operation of the Projects has the potential to affect certain water quality conditions, primarily temperature and DO, which are critical to aquatic habitat, particularly during the warmer, lower flow periods in the summer. The proposed water quality study will evaluate DO and temperature conditions in the Project impoundments and tailwaters and determine if the waters discharged from the Projects meet applicable New York State water quality standards for these parameters.

2.1.7 Methodology

Task 1. Consultation

The Power Authority will consult with NYSDEC water quality staff regarding the planned location of the impoundment and tailwater monitoring locations to be used for continuous DO and temperature monitoring. Selected locations will be chosen to be as representative of impoundment and tailwater conditions as possible, while ensuring the safety and security of the instruments and monitor operations/maintenance personnel.

Task 2. Field Work

The Power Authority will conduct a single season study to monitor DO and temperature in the lower impoundment and powerhouse tailwater of each Project using a continuous monitor such as a Hydrolab Datasonde or other self-contained monitor and data logger. DO and temperature data will be recorded in 30-minute intervals for the period May through October (six months), as weather and river flow conditions allow. The continuous monitors will be maintained approximately weekly. The maintenance schedule will be followed as closely as practicable but will consider weather and safety-related issues (e.g., high river flows). At each maintenance check, the monitors will be cleaned, and a spot check of DO and temperature will be collected using a hand-held device to confirm constant monitor data and to account for potential instrument drift and/or fouling. Instrument calibration and maintenance will follow manufacturers guidelines and the USGS 2006 “Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Station Operation, Record Computation, and Data Reporting” (Wagner, et.al., 2006)

In addition to the continuous monitoring, on a monthly basis for the same period (May-October), the Power Authority will collect other water quality parameters at each continuous monitoring location including pH, turbidity, and conductivity using a hand-held multiprobe. At the impoundment monitoring stations, monthly water quality measures will be taken using a hand-held device at 1-meter intervals from the surface to approximately just above the impoundment bottom.

The Power Authority will also collect river flow data from the downstream USGS Cohoes gage, as well as daily rainfall and air temperature data which will be used to evaluate changes in DO and temperature conditions in response to changes in river flow and weather conditions.

Task 3. Data Analysis

The Power Authority will download all data collected by the continuous monitors and create a water quality database for the Projects. All data will be reviewed following standard quality assurance/quality control protocols, and any anomalous or erroneous data will subsequently be removed from the final dataset. Removed data will be documented with the reasons for removal. Additional grab-sample data for pH, turbidity, and conductivity will also be entered into the database. Collected data will be analyzed along with information on river flow (from the USGS Cohoes gage), rainfall, and air temperature data to evaluate trends in DO and temperature conditions upstream and downstream of each Project, and to assess any observable changes in DO and temperature conditions that may be attributable to Project operations. DO and temperature data will also be compared to state water quality standards for these parameters to determine compliance with state standards. Other water quality parameters collected will also be evaluated with respect to applicable state water quality standards.

Task 4. Study Report

The Power Authority will prepare a comprehensive water quality study report. The final study report will be included in the Initial Study Report (ISR) which is scheduled to be filed with FERC in February 2021.

2.1.8 Proposed Deliverables and Schedule

The Power Authority proposes to perform this study in 2020. Study reporting will be conducted in accordance with the Process Plan and Schedule (18 C.F.R. § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

Task	Schedule
Task 1. Consultation	March-April 2020
Task 2. Field Work	May-October 2020
Task 3. Data Analysis	November-December 2020
Task 4. Final Study Report	February 2021 (as part of ISR)

2.1.9 Level of Effort and Cost

The estimated cost for the water quality study at the Crescent and Vischer Ferry Projects is approximately $80,000.

2.1.10 References

Hudson River Environmental Conditions Observing System (HRECOS). 2019a. Current Data. Website: http://hudson.dl.stevens-tech.edu/hrecos/d/index.shtml. Accessed March 25, 2019.

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United States Geological Survey (USGS). 2018c. National Water Information System: USGS 01356400 Mohawk River Near Latham, NY. Website: https://nwis.waterdata.usgs.gov/usa/nwis/qwdata/?site_no=01356400

United States Geological Survey (USGS). 2018d. National Water Information System: USGS 01357500 Mohawk River at Cohoes, NY. Website: https://waterdata.usgs.gov/nwis/inventory/?site_no=01357500

Wagner, R.J., Boulger, R.W., Jr., Oblinger, C.J., and Smith, B.A. 2006. Guidelines and standard procedures for continuous water-quality monitors—Station operation, record computation, and data reporting: U.S. Geological Survey Techniques and Methods 1–D3, 51 p. + 8 attachments; accessed April 10, 2006, at *http://pubs.water.usgs.gov/tm1d3*.

2.2 Fish Entrainment Study Plan

2.2.1 General Description of Proposed Study

The Power Authority proposes to conduct a study to evaluate the potential for fish entrainment and impingement at the Projects. FERC and other resource agencies and stakeholders requested a fish entrainment and impingement study to evaluate the potential for impingement, entrainment, and survival of migratory and resident game fish at the Projects. The proposed study will be conducted as a desktop study, utilizing existing databases and information to evaluate the potential for entrainment and impingement at the Projects, and to assess turbine survival rates for both resident and migratory fish.

2.2.2 Geographic Scope

The study area for this study includes the Crescent and Vischer Ferry Projects. The proposed study will evaluate conditions in and around the Projects' powerhouses and intake structures, as well as the downstream end of the Projects' impoundments, in the vicinity of the dams.

2.2.3 Study Goals and Objectives

The primary goals and objectives of this study are to provide a literature-based assessment of the potential for fish entrainment and impingement at the Projects, and to use existing databases, tools, and models to evaluate potential turbine survival rates for representative resident and migratory fish species/lifestages at the Projects.

2.2.4 Relevant Resource Management Goals and Public Interest Considerations

The NYSDEC manages the Mohawk River in the vicinity of the Projects as a mix of warm-water and cool-water species, which includes abundant game species such as smallmouth bass and walleye. The fish community is dominated by warm-water species and is used extensively by recreational anglers (NYSDEC, 2018). The river is also managed for diadromous species including, primarily, the anadromous blueback herring. NYSDEC's fishery management goals for the Mohawk River are multi-faceted and recognize that the fisheries of the Mohawk River watershed, like many inland waters, are in a state of transition (NYSDEC, 2018). Management of the Mohawk River fishery is complicated by the continuous influx of new species through the New York State Canal System and must balance the need to provide desirable fishing opportunities for sportfish while also trying to sustain native biodiversity (NYSDEC, 2018).

2.2.5 Existing Information and Need for Additional Information

During preparation of the PAD, existing information was compiled regarding the physical characteristics of the Crescent and Vischer Ferry Projects, including information on the Projects' powerhouses, intakes and turbines. The PAD provides information on the Projects' facilities in Sections 3 and 4.4.3, respectively. The PAD also provides a list of fish species known to occur in the Mohawk River in the vicinity of the Projects (see Table 4.4-1 in the PAD). In addition, the passage of juvenile blueback herring has been studied at the Project, as has the effectiveness of the existing acoustic deterrent systems operational at both Projects for reducing Project entrainment.

Although there is significant information on the fish species found in the lower Mohawk River and the effectiveness of the Projects' acoustic deterrent systems in reducing turbine passage by juvenile blueback herring, information on the potential for fish entrainment and impingement of other resident and migratory species at the Projects has not previously been assessed. An evaluation of the potential for fish entrainment and turbine passage survival at the Projects for both resident and migratory species will assist in understanding the potential impacts to the fish community.

2.2.6 Project Nexus

Hydropower projects have the potential to entrain and/or impinge both resident and migratory fish species. Although the Crescent and Vischer Ferry Projects are currently operated with seasonal deployment of a hydroacoustic deterrent system designed to route fish away from the Project powerhouses, there is still some potential for fish entrainment and/or turbine passage. This study will provide insight on the potential for fish entrainment and impingement at the Projects and will consider the potential effects of continued Project operation on the fisheries resources within the Project area.

2.2.7 Methodology

The Power Authority proposes to conduct a literature-based study of entrainment and impingement and turbine survival at the Projects using a review of relevant biological criteria, analysis of physical Project characteristics, and existing information on turbine survival rates developed from studies of other conventional hydropower projects. This is an approach that has been used throughout the U.S. and is a generally accepted method for evaluating entrainment and impingement.

Task 1. Describe Intake and Turbine Configurations

The first step in evaluating the potential for fish entrainment and survival is to consider the physical features of the Projects' impoundments, intake structures, and turbine units that may affect entrainment and turbine passage survival. Features and dimensions of the Projects will be obtained from the Power Authority, including engineering drawings and available bathymetric and/or physical surveys of the impoundments, including substrate information. This information will be used to examine important characteristics, including rack spacing and intake depths, and estimate intake velocities at various flow rates.

Task 2. Field Collection of Intake Velocities

The Power Authority will collect velocity, water depth, and substrate data from the impoundment, as needed to confirm the information calculated or determined from existing information in Task 1. Water velocity and depth measurements in the vicinity of the intake structures at both Projects will be collected using an Acoustic Doppler Current Profiler (ADCP). Substrate information will also be confirmed with the ADCP methodology. Velocity measurements will be collected along pre-determined transects in front of and adjacent to the intake structures during varying operational conditions. These data will then be used to verify the relative magnitude of calculated intake velocities and flow.

Task 3. Water Quality Data Analysis

Impoundment water quality data (DO and temperature) will be analyzed because the potential for fish entrainment, and subsequent potential turbine survival, can be affected by the vertical temperature profile and location of a thermocline and the dissolved oxygen (DO) concentration near the intake structures.

Water quality measurements, including DO and temperature, will be collected as part of the water quality study (see Section 2.1) and will include vertical profile data from the lower end of each impoundment. This data will be used to evaluate potential DO and thermal stratification near the intake structures and to consider how any observed stratification characteristics, such as the depth of the thermocline, might affect fish movement and use in the vicinity of the intake structures.

Task 4. Impingement Analysis

A summary of the existing fish assemblage in both impoundments appears in the PAD (see Table 4.4-1). Life history characteristics and habitat preferences of each species at different life stages will be reviewed in relation to reservoir intake configuration and water quality conditions. Based on these considerations, the fish species included in the entrainment analysis will be selected by determining which fish species, and at what life stages, are most likely to be present near the intake structures.

The potential for impingement on an intake trash rack depends on rack spacing and the size and swim characteristics of various fish species and lifestages. Not all fish species occurring in the impoundments are equally susceptible to impingement because of their habitat use, behavior and swimming abilities relative to the Project intake velocities. After determining which fish species have the potential to be present in the area of the intake structures, an analysis will be performed to estimate the body length and width of fish that would be physically excluded by the bar rack spacing at each intake structure, and, thus, at risk for potential impingement. The potential for involuntary impingement of these species will then be assessed by comparing swim speed thresholds to intake velocity.

Task 5. Entrainment Analysis

Using standard literature sources, the Power Authority will develop a summary of the life history traits and habitat requirements of fish species as they relate to affecting entrainment at the Projects. Habitat use, swimming performance, behavior, and life stages, for example, are factors affecting entrainment potential. This process will index species and life stages of resident fish across a range from “most” to “least” prone to involuntary entrainment. The potential for involuntary entrainment of the most susceptible species will be assessed by comparing swim speed thresholds to intake velocity.

Based on existing scientific literature and the information compiled in Tasks 1 through 3, comparable projects will be identified, and the results from studies of turbine survival at those projects will be applied, in conjunction with the broader analysis, to estimate the likelihood of fish entrainment and survival at the Crescent and Vischer Ferry Projects.

Task 6. Assessment of Turbine Passage Survival

Investigations of fish turbine passage survival have been independently conducted at numerous hydroelectric projects throughout the country, providing a considerable data set from which a reasonable estimate of turbine passage survival at the Projects can be made. Winchell et al. (2000) summarized turbine passage survival data reported in the EPRI (1997) database by turbine type, turbine characteristics, and fish size. Based on the consistency of results from numerous studies, it is apparent that fish size rather than species is the primary variable in determining the probability of survival through turbines, with smaller fish being more likely to survive turbine passage (Franke et al., 1997; Winchell et al., 2000). Species-specific estimates of fish mortality through various turbine types (EPRI, 1992) indicate that survival rates across species are generally uniform for each specific turbine type. To estimate survival of fish that may be entrained and passed through the turbines at the Projects, survival studies conducted at similar hydroelectric facilities with similar turbine types and hydraulic capacities to those at the Crescent and Vischer Ferry Projects will be examined and discussed.

Additionally, calculated estimates of turbine passage survival performed by the Department of Energy (DOE) (Franke et al., 1997) will be used to estimate the survival rate using a blade-strike model. The model uses various turbine, fish and operations characteristics to calculate a strike and mortality probability. The Franke blade-strike model will be applied to a subset of fish species/lifestages that are considered representative of other species/lifestages with similar physical characteristics.

Task 7. Study Report

Study results will be presented in a final entrainment study report. The study report will discuss the assessment of entrainment and impingement of various species and lifestages that are representative of Project fish communities. The report will also provide the results of turbine survival/mortality estimates. The final study report will be included in the Initial Study Report (ISR) which is scheduled to be filed with FERC in February 2021.

2.2.8 Proposed Deliverables and Schedule

The Power Authority proposes to perform this study in 2020. Study reporting will be conducted in accordance with the Process Plan and Schedule (18 C.F.R. § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

Task	**Schedule**
Tasks 1, 3-6. Literature Search and Analyses	March - September 2020
Task 2. Collection of Field Velocity Data	May - June 2020
Task 7. Final Study Report	February 2021(as part of ISR)

2.2.9 Level of Effort and Cost

The Power Authority believes the proposed level of effort will adequately assess fish entrainment, impingement and turbine survival at the Crescent and Vischer Ferry Projects. The proposed approach is consistent with methods accepted by FERC at numerous other hydroelectric projects. The estimated cost for this desktop study as proposed is approximately $65,000.

2.2.10 References

Carlson, D.M., Daniels, R.A., and Wright, J.J. 2016. Atlas of Inland Fishes of New York. New York State Museum Record 7. Website: http://www.nysm.nysed.gov/common/nysm/files/atlasofinlandfishes.pdf. Accessed December 12, 2018.

Electric Power Research Institute (EPRI). 1992. Fish entrainment and turbine mortality review and guidelines. Technical Report TR-101231, Project 2694-01. Electrical Power Research Institute, Palo Alto, California. 282 p.

Electric Power Research Institute (EPRI). 1997. Turbine entrainment and survival database-field tests. Technical Report TR-108630. Electric Power Research Institute, Palo Alto, California. 13 p.

Franke, G.F., D.R Webb, R.K. Fisher, Jr., D. Mathur, P.N. Hopping, P.A. March, M.R. Headrick, I.T. Laczo, Y. Ventikso, and F. Sotiropoulos. 1997. Development of environmentally advanced hydropower turbine system design concepts. Report 2677-0141. U.S. Department of Energy, Idaho Falls, Idaho. 456 p.

NYSDEC, 2018. Mohawk River Action Agenda 2018-2022 (DRAFT). NYSDEC Mohawk River Basin Program 625 Broadway Albany, New York 12233-3502.

Winchell, F., S. Amaral, and D. Dixon. 2000. Hydroelectric turbine entrainment and survival database: an alternative to field studies. Hydrovision 2000: New Realities, New Responses. HCI Publications, Kansas City, MO.

2.3 Blueback Herring Migration Study

2.3.1 General Description of Proposed Study

The Power Authority proposes a single-season blueback herring migration study to assess the timing, duration, and magnitude of adult blueback herring upstream migration through the canal locks that provide herring access to the Crescent and Vischer Ferry Projects. Because upstream migrating adult blueback herring access the lower Mohawk River and the Project waters via the Barge Canal and associated locks, relatively little is known about the timing and size of the adult herring run in the lower Mohawk River. Runs of downstream migrating juvenile herring are far better understood as a result of the Power Authority's provision of downstream passage facilities at the Crescent and Vischer Ferry Projects, the existing acoustic deterrent systems, and a number of previous studies of the effectiveness of those systems for routing and passing juvenile blueback herring. This study will use hydroacoustic methods to assess the abundance, timing, and routing of the upstream adult migration of blueback herring in relation to the canal and lock facilities which provide upstream passage for blueback herring at both the Crescent and Vischer Ferry Projects.

2.3.2 Geographic Scope

The geographic scope of this study includes certain Project waters in the vicinity of the canal/lock entrances where adult migrating blueback herring will be monitored, as well as waters in and around Lock E-6 and Lock E-7; the canal and lock facilities associated with each Project that provide upstream passage for blueback herring.

2.3.3 Study Goals and Objectives

The goals and objectives of this study are to use hydroacoustic methods to assess the timing, duration, and magnitude of the upstream adult migration of blueback herring via the canal and lock facilities (Locks E-6 and E-7) associated with each of the Crescent and Vischer Ferry Projects, respectively.

2.3.4 Relevant Resource Management Goals and Public Interest Considerations

Blueback herring are the primary anadromous fish species that utilize the Mohawk River. Blueback herring are native to the Hudson River basin, and have historically gained access to the Mohawk River via the Barge Canal and lock system. Blueback herring have been documented in the lower Mohawk River for many decades. The Mohawk River, in the vicinity of the Projects, is managed by the NYSDEC as a mixed cool-water and warm-water fishery. The fish community is dominated by warm-water species and is used extensively by recreational anglers (NYSDEC, 2018). The river is also managed for anadromous blueback herring. NYSDEC's fishery management goals for the Mohawk River are multi-faceted and recognize that the fisheries of the Mohawk River watershed, like many inland waters, are in a state of transition (NYSDEC, 2018). Management of the Mohawk River fishery is complicated by the continuous influx of new species through the New York State Canal System and must balance the need to provide desirable fishing opportunities for sportfish while also trying to sustain native biodiversity (NYSDEC, 2018). The NYSDEC also has an interest in the blueback herring run in the lower Mohawk River. The Atlantic States Marine Fisheries Commission (ASMFC) regulates river herring stocks in New York and has the stated goal to protect, enhance, and restore East Coast migratory spawning stocks of blueback herring in order to achieve stock restoration and maintain sustainable levels of spawning stock biomass.

2.3.5 Existing Information and Need for Additional Information

Existing information on blueback herring in the Mohawk River in the vicinity of the Projects was gathered during PAD development. Blueback herring are native to the Hudson River and migrate up the Hudson and various tributaries to spawn in the spring. Historically, blueback herring utilized the Barge Canal and its associated lock system to initially gain access to the Mohawk River. Today, herring continue to use the canal system for upstream migration. Spawning occurs in the Mohawk River and generally begins when water temperatures reach 10-15 ^{o}C. Over the past two decades the blueback herring runs have been in decline all along the eastern seaboard, including in the Mohawk River (Limburg and Ringler, 2012).

Because the canal and lock system provide upstream passage for blueback herring at the Projects, the Power Authority and resource agencies have focused attention on providing outmigrating herring with safe and effective downstream passage. Toward this end, the Power Authority has, for many years, installed and operated an acoustic deterrence system in combination with downstream passage facilities at both Projects to enhance downstream passage for both adult and juvenile herring, and to minimize turbine passage. As a result of studies that have been done on both turbine passage and the effectiveness of the acoustic deterrent system, far more is known about downstream migration of blueback herring than upstream. For example, the Power Authority studied juvenile blueback herring movements in relation to the hydroacoustic deterrence system at the Crescent Project in 2012 (Normandeau, 2013). As part of this study, the Power Authority obtained estimates of juvenile herring abundance and densities, the timing of the juvenile herring outmigration run, and the effectiveness of the hydroacoustic system in deterring juvenile herring away from the powerhouse (Normandeau, 2013).

Information on upstream migration of adult blueback herring is more limited. Recent studies of the fish community in the lower Mohawk River confirm that adult blueback herring utilize the canal/lock system to migrate up the Mohawk River, and that blueback herring spawn in the river between the Crescent Project and the Little Falls Project (Limburg and Ringler, 2012). For example, a study conducted by the Cornell Water Resources Institute in 2011-2012 found adult blueback herring utilizing canal Locks E-7, E-8, E-9, E-11 and E-15, as well as at Little Falls. During this study, fish were captured between May 22 and June 26, but were no longer present by July 2 (Limburg and Ringler, 2012). However, aside from this study, information on the timing and abundance of the adult blueback herring run in the lower Mohawk River is limited.

2.3.6 Project Nexus

The proposed blueback herring study will provide additional information on the status and timing of the adult blueback herring run in the lower Mohawk River, and provide information on the existing upstream migration route through the locks used by adult blueback herring at the Crescent and Vischer Ferry Projects.

2.3.7 Methodology

The proposed study will utilize hydroacoustic monitoring to assess the timing, duration, and magnitude of upstream migrating adult blueback herring. Monitoring will occur at the upstream portions of Locks E-6 and E-7. Monitoring will begin with the opening of the Canal System (typically in early to mid-May), and will continue through the end of the upstream migration season (early to mid-July).

Task 1. Consultation

The Power Authority will consult with the fisheries resource agencies to obtain existing information regarding adult blueback herring migration on the Mohawk River as well as movement of other fish species through the lock system. The Power Authority will also consult with the New York State Canal Corporation (NYSCC) to explain the purpose and scope of the study and identify feasible activities that will not interfere with navigation and lock operations.

Task 2. Field Work

The study will use hydroacoustic technology to monitor the upstream portion of Locks E-6 and E-7. This technology will consist of split beam transducer arrays deployed to provide sufficient coverage of the targeted areas. The exact location, orientation, and number of transducers will be determined during reconnaissance and test deployment prior to the commencement of the survey to optimize spatial coverage. To the extent possible, transducers will be mounted in areas of limited turbulence and ambient noise and away from eddies or other hydraulic conditions where fish congregation (i.e. "milling") could occur.

Monitoring upstream migrating fish to estimate magnitude (i.e. numbers) using hydroacoustics is challenging due to the likelihood of counting fish multiple times. Fish behavior is such that schools of fish may reside in an area for some period of time and not move in a consistent, laminar direction past the transducers. The ability to design a monitoring system that reduces this issue can be challenging and relies on site-specific conditions. Ideally, transducers will be mounted as close to the target area as possible but conflicting flow patterns associated with lock operation will need to be considered. The monitoring system will be configured to allow for identification acoustic targets corresponding to adult blueback herring, based on parameters such as movement direction, fish size and number.

Data will be recorded and archived continuously. Transducers will be inspected and serviced by a qualified technician and data reviewed at least once per week. Weekly data review will be qualitative in nature to evaluate trends, ensure the system is functioning properly, and determine when the upstream migration season is complete.

Task 3. Data Analysis

The Power Authority will analyze all collected data. During analysis, echo data will be analyzed using standard analytical tools such as Echoview ® software. The data will be analyzed with respect to the timing of observed fish movements relative to lock operations, water temperature, climatic conditions, and river flow. To the extent possible, the data will also be analyzed to obtain estimates of the number of fish utilizing the locks for passage. Data will be displayed in tabular and graphic format minimum including daily, monthly and full season passage estimates. A comparison of the estimates relative to magnitude and timing between the two monitoring locations (Locks E-6 and E-7) will also be made.

Task 4. Study Report

The Power Authority will prepare a blueback herring migration study report. The final study report will be included in the Initial Study Report (ISR) which is scheduled to be filed with FERC in February 2021.

2.3.8 Proposed Deliverables and Schedule

The Power Authority proposes to perform this study in 2020. Study reporting will be conducted in accordance with the Process Plan and Schedule (18 C.F.R. § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

Task	Schedule
Task 1. Consultation/Meetings	March 2020
Task 2. Field Work	April - July 2020
Task 3. Data Analysis	Fall 2020
Task 4. Final Study Report	February 2021 (as part of ISR)

2.3.9 Level of Effort and Cost

The estimated cost for the blueback herring migration study is approximately $250,000.

2.3.10 References

Dunning, D.J. and C.D. Gurshin. 2012. Downriver Passage of Juvenile Blueback Herring Near an Ultrasonic Field in the Mohawk River. *North American Journal of Fisheries Management*. 32:365-380.

Gurshin, C.W.D., M.P. Balge, M.M. Taylor, and B.E. Lenz. 2014a. *Importance of Ultrasonic Field Direction for Guiding Juvenile Blueback Herring Past Hydroelectric Turbines.* 144th American Fisheries Society Annual Meeting, Quebec, Canada. 21 August.

Gurshin, C.W.D., M.P. Balge, M.M. Taylor, and B.E. Lenz. 2014b. *Importance of Ultrasonic Field Direction for Guiding Juvenile Blueback Herring Past Hydroelectric Turbines*. North American Journal of Fisheries Management, 34:6, 1242-1258, OI:.1080/02755947.2014.963749.

Mathur, D., P.G. Heisey, K.J. McGrath, and T.R. Tatham. 1996. *Juvenile Blueback Herring (Alosa aestivalis) Survival via Turbine and Spillway.* Water Resources Bulletin of the American Water Resources Association. Vol. 21, No. 1. February.

Normandeau Associates. 2009. Hydroacoustic Studies of the Downstream Passage of Juvenile Blueback Herring in the Presence of Ultrasound at the Crescent Hydroelectric Project, Mohawk River, New York.

Normandeau Associates. 2012. Hydroacoustic Studies of the Downstream Passage of Juvenile Blueback Herring after Reconfiguration of the Ultrasound at the Crescent Hydroelectric Project, Mohawk River, New York. 2012.

2.4 Fish Community Study

2.4.1 General Description of Proposed Study

The Power Authority is proposing to conduct an assessment of the existing fish community in the lower Mohawk River in the vicinity of the Crescent and Vischer Ferry Projects. The purpose of the study is to evaluate the species composition and relative abundance of the fish community at the Projects using existing fisheries survey data that has been collected by NYSDEC and other agency or university researchers.

2.4.2 Geographic Scope

The geographic scope of this study is the lower Mohawk River in the vicinity of the Crescent and Vischer Ferry Projects. The Crescent impoundment is approximately 10 miles long and the upstream terminus of the impoundment is located at the Vischer Ferry dam. The Vischer Ferry impoundment is 10.3 miles long and the upstream terminus of the impoundment is located at Lock E-8 in Schenectady.

2.4.3 Study Goals and Objectives

The goal of the study is to utilize existing fisheries data for the lower Mohawk River to conduct a comprehensive desktop assessment of the fish community at the Crescent and Vischer Ferry Projects, including a determination of species composition and relative abundance.

2.4.4 Relevant Resource Management Goals and Public Interest Considerations

The NYSDEC manages the Mohawk River in the vicinity of the Projects as a mix of warm-water and cool-water species, which includes abundant game species such as smallmouth bass and walleye. The fish community is dominated by warm-water species and is used extensively by recreational anglers (NYSDEC, 2018). The river is also managed for diadromous species including, primarily, the anadromous blueback herring. NYSDEC's fishery management goals for the Mohawk River are multi-faceted and recognize that the fisheries of the Mohawk River watershed, like many inland waters, are in a state of transition (NYSDEC, 2018). Management of the Mohawk River fishery is complicated by the continuous influx of new species through the New York State Canal System and must balance the need to provide desirable fishing opportunities for sportfish while also trying to sustain native biodiversity (NYSDEC, 2018).

2.4.5 Existing Information and Need for Additional Information

There is existing information on the fish and the fish community in the lower Mohawk River in the vicinity of the Projects. Reports and studies of the Mohawk River fish community produced by NYSDEC, the U.S. Geological Survey (USGS) and other agency and university researchers were gathered during PAD development. Section 1.4 of the PAD gives an extensive description of the fish and aquatic habitat around the Project area, and the PAD also provides a list of fish species known to occur in the Mohawk River in the vicinity of the Projects (see Table 4.4-1 in the PAD). At least 62 fish species have been documented in the Mohawk River and the Canal System from Lock E-6 in Waterford to Lock E-20 in Rome, New York from 1934 through 1983 (McBride, 2009). Fish communities have been sampled several times between 1934-2016, using a variety of methods. Some of the more recent research and studies have been documented in the following reports and technical papers.

- Bureau of Fisheries. 2015 - 2016. Bureau of Fisheries Annual Report. New York State Department of Environmental Conservation.
- Bureau of Fisheries. 2014 - 2015. Bureau of Fisheries Annual Report. New York State Department of Environmental Conservation.
- Connelly, N.A. and Brown, T.L. 2009. New York Statewide Angler Survey, Report 1: Angler Effort and Expenditures. New York State Department of Environmental Conservation Bureau of Fisheries. Website: http://www.dec.ny.gov/docs/fish_marine_pdf/nyswarpt1.pdf. Accessed January 2019.
- George, S.D., Baldigo, B.P., and Wells, S.M. 2016. Effects of Seasonal Drawdowns on Fish Assemblages in Sections of an Impounded River–Canal System in Upstate New York, Transactions of the American Fisheries Society, 145:6, 1348-1357
- Hattala, K.A., A.W. Kahnle, and R.D. Adams. 2011. Sustainable Fishing Plan for New York River Herring Stocks. Bureau of Marine Resources, Hudson River Fisheries Unit, and Hudson River Estuary Program of New York State Department of Environmental Conservation. Website: http://www.asmfc.org/uploads/file/NY_RiverHerring_SFMP.pdf. Accessed January 2019.
- Limburg, Karin and R. Ringler. 2012. Final Report to Cornell Water Resources Institute for blueback herring research on the Mohawk River. **"**Relative Abundance of Blueback Herring (*Alosa aestivalis*) in Relation to Permanent and Removable Dams on the Mohawk River**".** Water Resources Institute, Cornell University. April 15, 2012.
- McBride, N.D. 2009. Lower Mohawk River Fisheries. New York State Department of Environmental Conservation, Stamford.
- McBride, N.D. 1994. A fisheries management plan for the lower Mohawk River. New York State Department of Environmental Conservation, Albany.

- McBride, N.D. 1985. Distribution and relative abundance of fish in the lower Mohawk River. New York State Department of Environmental Conservation, Stamford.
- Wells, S, Limburg, K. and D Legard, C. 2013. Tracking Blueback Herring in the lower Mohawk River. February 2013. Conference: NY Chapter AFS, At Watertown, NY
- Wells, S. 2018. New York State Department of Environmental Conservation (NYSDEC). Bureau of Fisheries Technical Brief #2018040. Crescent Lake (H-240) Black Bass Survey (Survey #: 418011).

Based on these surveys, the NYSDEC and others have provided general descriptions of the fish community in the lower Mohawk River, but more recently collected fisheries data has not been utilized to provide a recent comprehensive assessment of the fish community in the lower Mohawk River. Thus, although NYSDEC and others have been studying and sampling the fish community in the lower Mohawk River for many years, there has been no effort to use the collected fish data to conduct an overall assessment of the fish community since the work done by McBride in 2009. The Power Authority's proposed study will gather relevant fisheries data from various sources and will make an updated assessment of the fish community in the area of the Projects.

2.4.6 Project Nexus

Crescent and Vischer Ferry Project waters provide habitat for an array of native and non-native fish species, including both resident and migratory species. The proposed study will use existing data to develop an assessment of the fish community found at the Projects, which in turn can be used to consider how the existing fish community may be affected by Project operations.

2.4.7 Methodology

Task 1. Consultation

The Power Authority will meet with NYSDEC to discuss the availability and access to existing fish survey data that the agency has collected on its own, or in cooperation with other agencies and researchers, over the past 20 years. The meeting will also be used to discuss and identify other agencies and researchers that likely have additional fisheries data. It recognized that each dataset may have been collected for a specific research purpose, but the Power Authority believes that collectively the research data will contribute to a characterization of the fish assemblage in the vicinity of the Projects.

Task 2. Background Research

The Power Authority proposes to work with staff at NYSDEC and other identified researchers to obtain fisheries reports as well as any summary and raw data in their files regarding fishery surveys. The Power Authority will contact individuals and organizations identified by the NYSDEC to obtain the identified data and reports. This information may be available in hardcopy only or in a variety of electronic formats. All information will be converted to an appropriate electronic format which may consist of scanned versions of hardcopy reports. Once the data is obtained, an annotated bibliography of all studies will be created and to the extent practical, data from all sources will be assembled into a single electronic database.

Task 3. Data Analysis

The Power Authority will analyze all collected data to characterize the Mohawk River fishery in the vicinity of the Crescent and Vischer Ferry Projects. Depending on the data available, analysis may include species composition, relative abundance, fish condition factors, creel data, and temporal changes.

Task 4. Study Report

The Power Authority will prepare a final study report that characterizes the Crescent and Vischer Ferry fish community. The final study report will be included in the Initial Study Report (ISR) which is scheduled to be filed with FERC in February 2021.

2.4.8 Proposed Deliverables and Schedule

The Power Authority proposes to perform this study in 2020. Study reporting will be conducted in accordance with the Process Plan and Schedule (18 C.F.R. § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

Task	Schedule
Task 1. Consultation	March - May 2020
Task 2. Background Research	Spring and Summer 2020
Task 3. Data Analysis	Fall 2020
Task 4. Final Study Report	February 2021 (as part of ISR)

2.4.9 Level of Effort and Cost

The estimated cost for the Fish Community study is approximately $35,000.

2.4.10 References

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2.5 Aquatic Mesohabitat Study

2.5.1 General Description of Proposed Study

The Power Authority proposes to conduct an aquatic mesohabitat study at the Crescent and Vischer Ferry Projects. The study will be completed in a single field season. The purpose of the study is to identify and map aquatic habitats at the Projects including wetlands, riparian, and littoral vegetation communities, including submerged aquatic vegetation and open water habitats. The study will also identify and map areas of significant shoreline erosion. The study will be conducted using a combination of field observations and desktop evaluation.

2.5.2 Geographic Scope

The geographic scope of this study encompasses the FERC Project boundary for the Crescent and Vischer Ferry Projects. More specifically, this study will examine aquatic habitats that occur within the Projects' boundaries, including wetlands, riparian and littoral vegetation communities, and other significant aquatic habitat types.

2.5.3 Study Goals and Objectives

The goal of the study is to identify and characterize the key aquatic habitat types found at the Projects, including wetlands, SAV, and riparian habitats. Specific goals of this study are to identify, describe, and map aquatic mesohabitat within the study area, and to identify areas of significant shoreline erosion. The study will also consider the potential effects, if any, of the Projects' operations on these habitats.

2.5.4 Relevant Resource Management Goals and Public Interest Considerations

NYSDEC's mission is "to conserve, improve and protect New York's natural resources and environment and to prevent, abate and control water, land and air pollution, in order to enhance the health, safety and welfare of the people of the state and their overall economic and social well-being." NYSDEC's natural resource management goals within the Mohawk River Watershed are consistent with their mission while focusing on protecting and enhancing fish and wildlife habitat and improving public access. No essential fish habitat as defined by the National Marine Fisheries Service was identified in the Project area (National Oceanic and Atmospheric Administration, 2018).

2.5.5 Existing Information and Need for Additional Information

Existing information on wetlands in the lower Mohawk River in the vicinity of the Projects was gathered during PAD development. National Wetland Inventory (NWI) wetland maps for the two Projects are provided in Figures 4.6-1 through 4.6-5 in the PAD. Most of the aquatic habitat upstream and downstream of the Projects is comprised of open water lake (impoundment) habitat. The Crescent dam impounds an area of approximately 2,000 acres, and the impoundment extends upstream of the dam approximately 10 miles to the Vischer Ferry dam. The Vischer Ferry dam impounds an area of 1,050 acres and extends upstream 10.3 miles to the Lock E-8 dam. Downstream of the Crescent dam there is a short stretch of riverine habitat that continues to the impoundment created by Erie Boulevard's School Street Project. NWI data and digital orthophotography of the Project impoundments shows that there are some areas of vegetated wetlands within the Projects' boundaries, including some areas of aquatic beds. There are also aquatic bed, emergent and scrub-shrub wetlands along the margins of the impoundment and within the river's riparian zone, floodplain areas, and portions of the old canal system.

2.5.6 Project Nexus

The Crescent and Vischer Ferry impoundments encompass 2,000 acres and 1,050 acres of Project waters, respectively. The Projects' impoundments and tailwater areas support a variety of aquatic habitat types. A survey of wetlands and other aquatic mesohabitats within the Projects' boundaries will provide information on the type and quantity of habitat and associated vegetation and aquatic resources that have become established under the existing operation of the Projects. The proposed study will provide up-to-date mapping of wetlands, riparian and littoral vegetation cover types, and other important aquatic habitat types located within the boundaries of the Projects, which will help inform resource assessments associated with the license application.

2.5.7 Methodology

Task 1. Background Research

Wetland, riparian, and littoral habitats within the Projects' boundaries are associated with the margin and near shore areas of the impoundments. NWI data and aerial imagery of the Projects suggest that vegetated wetlands within the boundaries consist of areas of aquatic beds in the impoundment, palustrine emergent (PEM) and palustrine scrub-shrub (PSS) wetlands along the edges of the impoundments and in adjacent floodplain areas. As a first step, the Power

Authority will review existing NWI and other readily available satellite imagery to identify general cover types for the waters within or immediately adjacent to the Projects' boundaries.

Task 2. Field Work

Habitat mapping will involve three phases of work. The first two phases will identify general wetland, littoral, and riparian cover types through aerial imagery interpretation and field verification. The third phase will be the production of an aquatic habitat/cover type map for each of the Projects. The field verification is intended to fill in gaps in the database for the habitat type map. Vegetation types and land use classifications will also be assigned for all lands and waters within the Projects' boundaries. Additional data collected during the field verification will describe the characteristics of each mapped aquatic habitat type including species composition, habitat structure, habitat quality, and land use. Information collected during desktop analysis and field surveys will include:

- plant species composition, including the dominant and more prominent associated species in each wetland and riparian habitat type;
- vegetation community structure data, including estimates of aerial cover of the dominant cover types, including SAV;
- rare, unique, and particularly high quality submerged or emergent wetland, littoral, or riparian habitat;
- occurrence of freshwater mussels and observed fish nesting activity; and
- occurrence of exotic invasive species.

The field effort will be conducted by navigating around and through the Project by boat, by car or on foot. During the shoreline survey work, biologists will also attempt to observe and/or identify any RTE plant species that may be present but may not have been previously identified within the Projects' boundaries. Field crews will document plant RTE species observed and/or suitable habitats identified with a GPS unit. Significant habitats immediately adjacent to the Projects' shorelines (within 50 feet), will also be surveyed, quantified and identified via GPS.

Field crews will also note and record significant stands of invasive exotic species, with special attention paid to the aerial extent of invasive European water chestnut (*Trapa natans)*. The intent of the invasive species mapping is to document significant areas of invasives. Lesser areas containing only occasional invasive species will be characterized with a GPS center point and/or radius necessary to enclose the population. For areas where invasive species are ubiquitous or impractical to map, surveyors will characterize the invasive species population using estimates of aerial coverage and percent of species present. For areas where dense stands of invasive species have formed, infestations will be photo-documented and geo-referenced.

During field reconnaissance, impoundment shoreline and shallow water habitats will also be observed for the presence of freshwater mussels and other large or notable aquatic macroinvertebrates. Evidence of freshwater mussels including any observed relic shells or middens will be documented and marked with GPS coordinates. Observations will also be made of substrates in shallow and shoreline areas where substrates are readily observable either through aerial imagery or during field reconnaissance. Any notable areas of unique substrates such as ledge, gravel and cobble will be documented and located on the habitat maps with GPS coordinates. Field crews will also look for evidence of fish nesting in shallow and marginal shoreline areas. Again, any areas of observed fish redds or other signs of fish nesting will be documented and located on the habitat maps with GPS coordinates.

During field reconnaissance surveys, observed areas of erosion will be documented and located with GPS, and representative photographs will be obtained.

Task 3. Data Analysis

Imagery data will be processed and incorporated into a geographic information system (GIS) platform. The GIS will be used to quantify and map aquatic and riparian habitats within the study area by geolocating boundaries, as defined by the field metrics. These data will be transformed into tabular, graphs, and spatial mapping data to quantify the approximate amount and distribution of each habitat type. Aerial imagery delineations of habitat types will be verified through field reconnaissance and field verification data will be used to fill in gaps in the database for the habitat type map. Field observations of significant aquatic habitats, notable substrate types, significant stands of invasive species, and observations of freshwater mussels and fish nesting activities will all be added via GPS coordinates to the aquatic habitat maps. In addition, the report will include the general shoreline description and photographs of representative habitat types. The report will include biological characteristics consisting of readily observable aquatic fauna, invasive aquatic plant species, fish spawning beds, and observations of freshwater mussel beds or evidence of shell material, including locations. The report will also describe the Projects' operations and impoundment elevations during the field surveys. Data will be presented in concise tables, graphs, and maps, where appropriate.

Task 4. Study Report

The Power Authority will prepare a final report that details the results of the study including detailed aquatic habitat maps. The final report for the aquatic mesohabitat study will be provided in the Initial Study Report (ISR), which will be filed with FERC in February 2021.

2.5.8 Proposed Deliverables and Schedule

The Power Authority proposes to perform this study in 2020. Study reporting will be conducted in accordance with the Process Plan and Schedule (18 C.F.R. § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

Task	Schedule
Task 1. Background Research	Spring and Summer 2020
Task 2. Field Work	Summer and Fall 2020
Task 3. Data Analysis	Fall 2020
Task 4. Final Study Report	February 2021 (as part of ISR)

2.5.9 Level of Effort and Cost

The estimated cost for the aquatic mesohabitat study is approximately $80,000.

2.5.10 References

United States Fish and Wildlife Service (USFWS). 2018. National Wetlands Inventory (NWI). Website: https://www.fws.gov/wetlands/index.html Accessed: October 26, 2018.

Wolman, M.G., 1954. A Method of Sampling Coarse River-Bed Materials. Trans. Am. Geophys. Union, 35: 951-956.

2.6 Bald Eagle Study

2.6.1 General Description of Proposed Study

The Power Authority is proposing a single-season bald eagle study, as requested by FERC. The purpose of the bald eagle study is to survey existing and potential bald eagle nesting, foraging, and roosting locations and to monitor seasonal use and bald eagle activity in these habitat areas.

2.6.2 Geographic Scope

The geographic scope of this study is the FERC Project boundaries for the Crescent and Vischer Ferry Projects.

2.6.3 Study Goals and Objectives

The goal of the study is to identify and map areas of existing and potential bald eagle nesting, roosting, and foraging habitats at the Crescent and Vischer Ferry Projects, and to monitor and record bald eagle activities in those areas.

2.6.4 Relevant Resource Management Goals and Public Interest Considerations

The bald eagle is a New York State-Threatened species and is known to occur within and in the vicinity of both Projects. The NYSDEC Division of Fish, Wildlife and Marine Resources, Bureau of Wildlife, published a *Conservation Plan for Bald Eagles in New York State*. The goal of the plan is to "ensure the perpetuation of a healthy bald eagle population, including its essential habitat and the ecosystems upon which it depends, in a cost effective manner," (NYSDEC, 2016). Bald eagles are also protected by the federal Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act (72 FR 37345-37372).

2.6.5 Existing Information and Need for Additional Information

There is significant information on the distribution of nesting and over-wintering bald eagles within New York State (NYSDEC 2016). Over the past two decades, NYSDEC has compiled data and information on eagle use of the Upper Hudson River and eastern Mohawk River. Based on available information, bald eagles utilize the eastern Mohawk River (in the vicinity of the Projects) during the breeding season and also sometimes for overwintering.

The Project areas are known to support nesting bald eagles as well. As recently as July 2019, an eBird participant recorded their observation of two adult bald eagles circling the Mohawk

River, and two immature Bald Eagles displaying territorial defense toward each other at the Town of Colonie Boat Launch (eBird, 2019). Further review of eBird records indicate that observations of bald eagles in the lower Mohawk River valley are relatively common.

The NYSDEC reports that the eastern-most section of the Mohawk River might also be considered part of the Upper Hudson survey area, as it empties into the Hudson about nine miles north of Albany. Cohoes Falls, located along the Mohawk River approximately one mile west of the Hudson, annually attracts a few eagles, likely due to the open water found around the falls; however, during the 2010 NYSDEC survey, only a single adult eagle was observed at that location (NYSDEC, 2019).

2.6.6 Project Nexus

The Crescent and Vischer Ferry Projects encompass 2,000 acres and 1,050 acres of Project waters, respectively. The Projects' impoundments and tailwater areas are known to provide foraging habitat for bald eagles. In addition, lands in the vicinity of the Projects may support seasonal nesting and roosting habitat for bald eagles. The proposed study will determine if there are existing or potential bald eagle habitat areas within the Project boundaries and will consider the effect of Project operations on eagle use of these habitats.

2.6.7 Methodology

Task 1. Consultation

The Power Authority will consult with NYSDEC to determine the availability of bald eagle nesting activity at the Projects, and obtain up-to-date information on the location of active and historic bald eagle nests within the Projects' boundaries.

Task 2. Background Research

As described above, over the past 30 years, significant research and survey efforts associated with bald eagles in the Upper Hudson River and eastern Mohawk River systems have been performed and well documented, and these activities continue today. The Power Authority will work with USFWS, NYSDEC, and other sources, as applicable, to obtain existing information associated with bald eagles in the lower Mohawk River system in the vicinity of the Projects.

Task 3. Field Work

The Power Authority will conduct surveys of the Projects to determine the location and use of nesting, roosting and foraging habitat. Surveys will be conducted in early spring and summer to best evaluate seasonal use of the Projects for nesting, roosting and foraging. Overwintering use will be documented based on birding observations reported through eBird and other local birding sites. Surveys will be conducted by boat, vehicle or on foot, as appropriate to the season and to gain access to areas of potential habitat. The location of bald eagle nests, nesting trees (historic or current), roost locations, and foraging areas will be mapped. The survey will also include routine checks of eBird and other on-line documentation of bald eagle listings and sightings in the Project vicinity. Such sightings will be combined with survey data to provide a comprehensive assessment of bald eagle use of the Crescent and Vischer Ferry Projects.

Task 4. Data Analysis

The Power Authority will analyze all collected data and create GIS-based maps showing the location of observed eagle nesting and roosting habitats. Observations of eagle nesting and roosting activity will be discussed in the report. Eagle use of Project waters for foraging, including information on time of year, weather, and flow conditions will be assessed.

Task 5. Study Report

The Power Authority intends to conduct the bald eagle study, including field surveys, in the early spring and summer of 2020. The final report for the bald eagle study will be provided in the Initial Study Report, which will be filed with FERC in February 2021.

2.6.8 Proposed Deliverables and Schedule

The Power Authority proposes to perform this study in 2020. Study reporting will be conducted in accordance with the Process Plan and Schedule (18 C.F.R. § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

Task	Schedule
Task 1. Consultation	March - May 2020
Task 2. Background Research	Spring and Summer 2020
Task 3. Field Work	Spring and Summer 2020
Task 4. Data Analysis	Fall 2020
Task 5. Final Study Report	February 2021 (as part of ISR)

2.6.9 Level of Effort and Cost

The estimated cost for the bald eagle study as proposed is approximately $24,000.

2.6.10 References

American Bald Eagle Information for New York. 2019. Online [URL]: http://www.baldeagleinfo.com/eagle/directory/NY.html (Accessed: August 19, 2019).

eBird. 2019. Online [URL]: https://ebird.org/view/checklist/S53989382 (Accessed: August 19, 2019).

New York Hudson Online Bird News. 2019. http://birding.aba.org/mobiledigest/NY05. (Accessed: August 21, 2019).

Nye, P. 2010. New York State Bald Eagle Report: 2010. New York State Department of Environmental Conservation, Albany, NY. Online [URL]: http://www.dec.ny.gov/docs/wildlife_pdf/baea2010.pdf (Accessed: August 19, 2019).

NYSDEC. 2016. Conservation Plan for Bald Eagles in New York State. Division of Fish, Wildlife and Marine Resources: Bureau of Wildlife. March 2016.

NYSDEC. Undated. Bald Eagle Program, Bald Eagle Research. Online [URL]: http://www.dec.ny.gov/animals/9381.html. (Accessed: August 21, 2019).

2.7 Recreation Study

2.7.1 General Description of Proposed Study

The Power Authority proposes to conduct a single-season recreation study of the Crescent and Vischer Ferry Projects. The proposed study will inventory existing public recreation sites and provide information on recreation access, recreation use, and a consideration of effects of the Projects, if any, with respect to existing and future recreation use and capacity. The study will identify and describe formal and informal, non-commercial, public recreation sites, facilities and amenities that provide public access to the Projects, including the sites' relation to the Projects' boundaries. The study will also assess the condition of the public recreation sites and facilities within and adjacent to the Projects' boundaries, including any erosion that may exist due to recreational use. Finally, the study will utilize use counts and user surveys to determine the adequacy of the Project recreation sites and facilities and to evaluate if changes or upgrades to the sites are or will be needed to meet current or future recreation needs at the Projects.

2.7.2 Geographic Scope

The study area encompasses lands and waters within the Projects' boundaries as well as non-commercial public recreation sites immediately adjacent to the Projects that provide public recreational access to Crescent and Vischer Ferry Project lands and waters.

2.7.3 Study Goals and Objectives

The goal of the study is to inventory both formal and informal, non-commercial recreation sites that provide public recreational access to the Projects, and to evaluate current use and future needs through the conduct of use counts and user surveys at the Project recreation sites. The specific objectives of this study are to complete a recreation facility inventory and condition assessment, to evaluate recreation use at the Project recreation sites, and to conduct user surveys to help determine the adequacy of the existing Project recreation sites.

2.7.4 Relevant Resource Management Goals and Public Interest Considerations

Recreation has been identified as a Project purpose by the Commission. Identifying the effects of Project operations pertaining to recreation is relevant to the Commission's public interest determination in issuing new licenses for the continued operation of the Projects. In addition, the resource management goals of the agencies, such as NYSDEC and the New York State Office of Parks, Recreation, and Historic Preservation (OPRHP), are to maintain public recreational opportunities at and access to the Project.

2.7.5 Existing Information and Need for Additional Information

Existing information on public recreation sites (both Project and non-Project sites) and recreation use of those sites was gathered as part of the development of the PAD. In its study request, FERC noted that although the PAD provided a summary of recreation use based on its last three Form 80 (recreation report) filings, most data compiled for Form 80 filings are derived from informal surveys and estimates of use. FERC also stated that the PAD provided no project-specific information regarding visitor perceptions of recreation at the Projects. FERC concluded that a study that gathers information on visitor perceptions of the adequacy of public access and facilities, current use, and whether existing access facilities in the area are meeting recreation demand, in addition to the already proposed facility inventory, would inform future license conditions related to public access and recreation facilities. The proposed study will collect additional information with respect to current recreation use levels at the Project recreation sites and facilities; will obtain recreational users' perceptions regarding the adequacy of the existing Project recreation sites; and will inform a decision on whether existing Project recreation sites and facilities are meeting public recreation needs and demands.

2.7.6 Project Nexus

FERC regulations require that the license application include a statement of the existing recreation measures or facilities to be continued or maintained and the new measures or facilities proposed by the applicant for the purpose of creating, preserving, or enhancing recreational opportunities at the Projects and their vicinity, and for the purpose of ensuring public safety when using Project lands and waters. In addition, recreation is a recognized project purpose at FERC-licensed projects under section 10(a) of the Federal Power Act (FPA).

2.7.7 Methodology

Task 1. Background Research

The Power Authority will review existing information to consider Project recreation site locations and determine the appropriate survey routes and locations for trail camera placement to most effectively count site users. Existing and historic information on recreation use at the Project recreation sites will also be examined to determine its potential value for assessing recreation demand and site capacity at existing Project recreation sites.

Task 2. Field Work

The field work for this study will be conducted between the months of May 2020 and October 2020. Field data collection will involve a combination of inventory, condition assessment, use counts, and user surveys.

Recreation Facility Inventory

The Power Authority will update existing data on recreation resources adjacent to and within the Projects' boundaries through conduct of an inventory and recreation site assessment. For the site assessment, the Power Authority will utilize a standardized site inventory form to evaluate each formal and informal, non-commercial, public recreation site listed in the PAD (Tables 4.8-1, 4.8-2, 4.8-3 and 4.8-4). The inventory form will be used to document the facilities and amenities associated with each recreation site and determine the general condition of the site, facilities and amenities, including observations of erosion and impacts to vegetation caused by recreation use. The inventory will collect information on the owner and manager for each site; the number and types of facilities and amenities, including identifying Americans with Disabilities Act (ADA)-related amenities at formal recreation sites; signage at the site; the amount of available parking; observed recreation activities; and the general aesthetics of the site. Photos of the recreation sites will be taken and GPS datapoints will be recorded while in the field for each facility at the recreation site, which will be entered into a GIS format.

The inventory and condition assessment will be conducted at all non-commercial public recreation sites that provide recreational access to Project lands and waters. The inventory will not include privately-owned recreation sites within and abutting the Projects, such as commercial marinas, homeowner association facilities, or private individual facilities.

Project Recreation Site Use and User Survey

The Power Authority will conduct a recreation use and user survey at each of the Project recreation sites listed in Table 2.7-1. Project recreation site use will be evaluated with the use of trail cameras (where feasible), recreation site sign-in sheets, and/or spot counts. User surveys will be conducted via intercept surveys and/or voluntary survey boxes. The field work for this study will be conducted between the months of May 2020 through October 2020.

Table 2.7-1: Crescent and Vischer Ferry Project Recreation Sites

Crescent Project Recreation Site Name	Recreation Amenities
Tailrace Bank Fishing Area	Informal tailwater fishing area
Picnic Area	Small picnic area near powerhouse and tailwater
Vischer Ferry Project Recreation Site Name	**Recreation Amenities**
Project Forebay Scenic Overlook	Provides views of the impoundment and parking access to the shoreline for fishing and hiking
Tailrace Parking Facilities	Parking for fishing and hiking along the shoreline of the trailrace
Town of Niskayuna Boat Ramp (also known as Lock E-7 Boat Ramp)	Boat ramp and parking area that is integrated with the NYSCC Lock E-7 State Canal Park

Trail cameras will be employed, where feasible, to count recreation users at each of the Project recreation sites. The Power Authority believes that trail cameras can be successfully employed at the Crescent tailwater fishing and picnic sites, and at Vischer Ferry at the tailwater fishing and overlook sites. The Power Authority will investigate the feasibility of trail cameras to count visitors at the Town of Niskayuna Boat Ramp on the Vischer Ferry impoundment. However, if it is determined that the use of trail cameras at that site will not provide a good estimate of use, the Power Authority will work with NYSCC to determine another appropriate way to obtain use information for that site, including the possible use of traffic counters and/or visitor sign-in sheets.

If the Power Authority determines that trail cameras are not a feasible option for conducting use counts at the Project recreation sites, spot counts will be conducted at each of the five Project recreation sites. Spot counts are short duration counts which will be utilized as a snapshot of use at each survey location. Individuals conducting the count will collect data immediately upon arriving at the survey location. Once the spot count is completed, individuals conducting the count will administer a user survey as described below. Surveys will be administered for approximately two hours at each survey location.

If used, spot counts will be conducted at each survey location on two weekdays and two weekend days a month and on one day on the following holiday weekends between May through October: Memorial Day, Independence Day (weekend closest to July 4th), Labor Day, and Columbus Day. The number of vehicles parked at each site and any observed recreation use will be recorded on data forms to determine the time-of-day use patterns at the sites. The number of vehicles parked will be factored into the recreation use estimates for the Project recreation sites.

A recreation user survey will be administered either as a voluntary, self-administered, box survey or as an intercept survey. Among other things, the survey will ask recreationists to identify the recreational activities they are participating in at the Project recreation site that day, how often they visit the recreation site, and how they use the site in various seasons. This information will also be used to gain the opinion of the user with regard to the adequacy of the Project recreation sites and the amount and types of recreation opportunities offered at the Projects.

Task 3. Data Analysis

Inventory and condition assessment results will be compiled and maps of each of the Project recreation sites will be prepared showing the location of the Project boundary in relation to the site, facilities, and amenities. Use counts and user survey results will be compiled and analyzed. Trail camera counts and/or spot count data will be analyzed to estimate the amount of use occurring at each of the Project recreation sites. To the extent possible, recreation use data will be summarized by season and activity type for each site surveyed. User survey results will be compiled and analyzed to evaluate user perceptions of the existing recreation sites and opportunities at the Projects. Future recreation demand at the Projects under current Project operations will be evaluated using trend data from state, regional, and national resources, as applicable.

Task 4. Study Report

The Power Authority will prepare a study report summarizing the results of the recreation facilities inventory and the recreation use and user survey. The report will include a description of each public recreation site inventoried, including both formal and informal Project and non-Project public recreation sites that provide access to the Projects. The report will include information on the available facilities and amenities, ownership and management, general condition, and representative photos. Sketches and maps of the recreation sites will also be included. The report will also analyze user survey responses with respect to respondents' perceptions of the adequacy and condition of the Projects' recreation sites, including signage, parking, and access. Site inventory forms, user surveys, and spot count forms (if conducted) will be included in an appendix to the report. The final report for the recreation study will be provided in the ISR, which will be filed with FERC in February 2021.

2.7.8 Proposed Deliverables and Schedule

The Power Authority proposes to perform this study in 2020. Study reporting will be conducted in accordance with the Process Plan and Schedule (18 C.F.R. § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

Task	Schedule
Task 1. Background Research	March 2020 - May 2020
Task 2. Field Work	May 2020 - October 2020
Task 3. Data Analysis	November 2020 - December 2020
Task 4. Final Study Report	February 2021 (as part of ISR)

2.7.9 Level of Effort and Cost

The estimated cost of this recreation study as outlined in this plan is approximately $60,000.

2.7.10 References

Bowker et al. 2012. Outdoor Recreation Participation in the United States - Projections to 2060: A Technical Document Supporting the Forest Service 2010 RPA Assessment. Gen. Tech. Rep. SRS-160. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. Recreation Facility Inventory, Recreation Use and Needs Assessment, Section 11 and Reservoir Surface Area Assessment Study Plan.

Cordell et al. 1999. Outdoor Recreation in American Life: A National Assessment of Demand and Supply Trends. Champaign, IL: Sagamore Publishing.

Cordell, H. K. 2012. Outdoor recreation trends and futures: a technical document supporting the Forest Service 2010 RPA Assessment. Gen. Tech. Rep. SRS-150. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station.

Federal Energy Regulatory Commission (FERC). 1996. Recreation Development at Licensed Hydropower Projects. Washington, DC. March 1996.

FERC. 2014. Project Recreation Facilities Tables and As-Built Site Plan Drawing Guidance. Washington DC. July 2014.

FERC. 2017. Hydropower Primer: A Handbook of Hydropower Basics. Washington DC. February 2017.

U.S. Department of Agriculture Forest Service (USDA Forest Service). 2007 National Visitor Use Monitoring Program. USDA Forest Service. Washington D.C. July 2007. Web address: http://www.fs.fed.us/recreation/programs/nvum.

3 DISCUSSION OF ADDITIONAL STUDY REQUESTS

In addition to the study plans proposed by the Power Authority in Section 2.0, several stakeholders requested other studies. In accordance with FERC's criteria for study requests, which were presented in Scoping Document 1 (SD1), the Power Authority has concluded that the proposed studies presented in Section 3.1 are unnecessary because: 1) there is (or will be as a result of proposed studies) sufficient existing information concerning the subject of the requested study; 2) there is no nexus between Project operations and effects on the resource requested to be studied; and/or 3) these requested studies would not inform the development of license requirements. A discussion of each request for which the Power Authority has not proposed a specific study is provided in Section 3.1 below.

Section 3.2 identifies two studies, an American Eel study and freshwater mussel survey, which may be considered for second-season studies, depending on the results of the Fish Community Study and Aquatic Mesohabitat Study. The Power Authority's final proposal on these two studies will be included in the ISR, as provided in section 5.15(c) of FERC's ILP regulations.

3.1 Studies Not Proposed

3.1.1 Tailrace Net Fishing Study

Riverkeeper requested a tailrace net fishing study of the Crescent and Vischer Ferry Projects. The requested study is intended to evaluate turbine entrainment and mortality rates at the Projects using tailrace netting techniques.

The Power Authority proposes to conduct an assessment of fish entrainment at the Projects, as described in Section 2.2 of this PSP. Its proposed desktop approach to evaluating entrainment and turbine survival/mortality is a standard, cost effective method that is routinely used throughout the U.S. to evaluate fish entrainment, impingement, and turbine mortality potential at hydropower projects. It is a recognized and scientifically based approach that has significant advantages to tailrace netting which is difficult, costly, impactful to the fish, and fraught with safety concerns for those conducting the study. Additionally, there are several indicators that fish mortality through the Crescent and Vischer Ferry Project turbines is low based on turbine mortality studies that have been previously conducted at the Projects, as discussed in Section 4.4 of the PAD.

Overall, the proposed desktop approach to evaluating the potential for entrainment/impingement and turbine mortality is the best approach. Therefore, because the Power Authority's proposed method is a recognized and generally accepted approach to evaluating entrainment and impingement potential and effects (see Criteria 6; 18 C.F.R. §5.9(b)), and because the level of effort and cost associated with doing the requested tailrace netting study as a means of evaluating turbine entrainment and mortality is significantly greater (see Criteria 7; 18 C.F.R. §5.9(b)), the Power Authority is not proposing a tailrace net fishing study.

3.1.2 Otolith Microchemistry of Blueback Herring Study

Riverkeeper requested that the Power Authority conduct a study of otolith microchemistry in blueback herring. The primary stated purpose of the requested study is to evaluate blueback herring via otolith microchemistry to determine if blueback herring are repeat spawners and if the Mohawk River is a source or sink population for the fish.

The Power Authority is proposing a blueback herring migration and routing study, as described in Section 2.6 of this PSP. The proposed study will utilize appropriate methodologies to examine the upstream migration of adult blueback herring into Project waters via the canals and locks associated with the Crescent and Vischer Ferry Projects. Information collected from the proposed study will provide resource agencies with additional information on the timing of the upstream migration run for adult blueback herring and will also provide an assessment of canal/lock use by these fish as a means for accessing Project waters. Additional questions about whether migrating adult blueback herring are repeat spawners or whether the Mohawk River itself is a source or sink population of the species are unrelated, and therefore have no nexus, to the Crescent and Vischer Ferry Projects and their continued operation. Because the issues raised in this study request have no nexus to the continued operation of the Crescent and Vischer Ferry Projects and would not inform the development of license requirements (see Criteria 5; 18 C.F.R. § 5.9(b)), the Power Authority is not proposing an otolith microchemistry study at the Projects.

3.1.3 Vischer Ferry Flooding Study

Several stakeholders provided comments related to flooding upstream of the Vischer Ferry dam and the effects, if any, of the Vischer Ferry Project operations on localized flooding. More specifically, some stakeholders requested that the Power Authority conduct a study to evaluate the role of Vischer Ferry dam in upstream flooding and to consider alternative dam configuration or operation to help reduce flooding potential.

The Stockade District (an historic waterfront area) of Schenectady, New York has a long history of flooding. The Stockade District lies within the 100 year floodplain of the Mohawk River and has been flooded repeatedly both before and after the Crescent and Vischer Ferry dams were built during construction of the original canal system (Shumaker and Rock, 2018). Over the years, numerous studies have been conducted by various entities, including the State of New York, NYSDEC, the USGS, and the Power Authority to examine the frequency and causes of the Stockade District flooding, including the role of ice jams and the potential effects of existing dams in such flooding. In a recent filing to FERC on August 9, 2019, the Power Authority provided FERC with two of the more recent reports on this subject. The letter report dated April 17, 2018 prepared by Gomez and Sullivan found that operation of the Vischer Ferry dam has little effect on upstream flooding, and that reducing the dam crest and installing crest gates would have almost no effect on upstream water surface elevations in the Stockade District during 10-year and 100-year flood events (Gomez and Sullivan, 2017).

More comprehensive studies of the lower Mohawk River flooding have determined that ice jams are more frequently the cause of flooding in the Stockade District than high river flows or the operation of the river's dams. For this reason, the USGS, in partnership with other agencies and researchers, has conducted several studies to understand the nature and frequency of flood-causing ice jams and to develop modeling tools to predict the potential for ice jams and associated flooding on the lower Mohawk River. (USGS, 2019).

NYSDEC has made the issue of flooding and flood control strategies a significant component of its Mohawk River Basin Action Agenda and prepares regular reports and updates on cooperative initiatives being undertaken to better understand, predict and mitigate flooding on the lower Mohawk River (NYSDEC, 2018). In addition, in 2018, the U.S. Congress authorized $1.3 M in funds to assist the City of Schenectady with a study to evaluate options and develop flood mitigation plans for the Stockade District, and the Federal Emergency Management Agency (FEMA) has recently earmarked $7.5 M for implementation of Stockade District flood mitigation strategies (The Daily Gazette, 2019).

In short, the issue of flooding upstream of Vischer Ferry dam has been extensively studied and both ongoing and previous studies have repeatedly demonstrated that the existence and operation of the Vischer Ferry Project has little or no effect on upstream flooding of the Stockade District. Because the existing information is clearly sufficient to evaluate the flooding issue (see Criteria 4, 18 C.F.R. 5.9(b)), the Power Authority is not proposing a Vischer Ferry flooding study.

3.1.4 References

The Daily Gazette. 2019. "Stockade gets first look at flood mitigation options". The Daily Gazette. Thursday April 4, 2019.

Foster, J.A., Marsellos, A.E., and Garver, J.I. 2011. Predicting Trigger Level for Ice Jam Flooding of the Lower Mohawk River Using LiDAR and GIS. *In: Cockburn and Garver, Proceedings of the 2011 Mohawk Watershed Symposium, Union College, Schenectady, NY. March 18, 2011.*

Gomez and Sullivan Engineers. 2018. Evaluation of Variable Crest Control Apparatus at Vischer Ferry Dam. Letter Report to Mr. Sal Lamsal, New York Power Authority. April 17, 2018.

NYSDEC. 2018. Progress Report – Mohawk River Basin Action Agenda. New York State Department of Conservation. March 2018.

U.S. Geological Survey (USGS). 2019. Mohawk River Ice Jam Monitoring. https://www.usgs.gov/centers/ny-water/science/mohawk-river-lock-8-near-schenectady-01354330?qt-science_center_objects=0#qt-science_center_objects. Accessed August 21, 2019.

Woidt, J. and J. Rock. 2019. Stockade Flood Mitigation Project; Hydrologic, Hydraulic, and Ice Jam Assessment.

3.2 Study Requests to be Considered

3.2.1 American Eel Study

Some commenters requested that the Power Authority conduct an American eel study at the Projects. The USFWS, NYSDEC and Riverkeeper all requested a study to determine the distribution and relative abundance of American eels at the Projects. Riverkeeper also specifically requested a radio telemetry study of silver eels.

During its development of the PAD, the Power Authority utilized numerous reports, technical papers, and bulletins prepared by NYSDEC and others that reported the results of many fish surveys that have been conducted in the lower Mohawk River over the past 30 years. These reports demonstrate that NYSDEC and other affiliated agencies and organizations have already conducted numerous studies and surveys of fish, which should allow for a thorough assessment of the species composition of fish at the Projects, as well as some information on the abundance of various fish species, including American eel. All of the reports and information that the Power Authority has received and reviewed to date suggest that American eel occur rarely in the lower Mohawk River 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).

Although there appears to be an abundance of fish data available for the lower Mohawk River, it seems that this information has not recently been used to develop a clear picture of the composition and status of the fishery in the vicinity of the Projects. For this reason, the Power Authority is proposing a Fish Community Study that would utilize existing fish survey data to more comprehensively evaluate the composition of the fish community and the relative abundance of various species, including American eel.

The proposed Fish Community Study will help confirm the frequency with which American eel occur at the Projects; therefore, additional study of American eel is unnecessary. However, should the proposed fish composition study find that eels occur more frequently than currently thought, the Power Authority may propose any study or data collection for the second study season to describe the frequency with which American eel occur at the Projects.

References

Wells, S. 2018. Crescent Lake Black Bass Survey. New York State Department of Conservation. Technical Brief. #2018040. August 31, 2018.

3.2.2 Freshwater Mussel Survey

The USFWS and NYSDEC requested a freshwater mussel survey at the Projects. The intended purpose of the survey is to locate and identify freshwater mussels that may inhabit Project waters.

The Power Authority is proposing an Aquatic Mesohabitat Study that will include observations of any evidence of freshwater mussels. Such information, along with the aquatic habitat information and maps developed as part of this study, will additionally inform the need for further searches for freshwater mussels. Also, the Aquatic Mesohabitat Study will provide data that will allow the Power Authority to target searches for freshwater mussels in their preferred habitats. For this reason, the Power Authority is not proposing to conduct the requested freshwater mussel survey. Rather, the Power Authority is proposing to use the results of the Aquatic Mesohabitat Study to better inform whether or not to propose any mussel survey in the second study season.

4 FERC ADDITIONAL INFORMATION REQUESTS

In addition to study requests, FERC included several additional information requests (AIR) in its comments. The Power Authority's responses to the AIRs are provided below.

4.1 AIR 1 - Project Boundary - Lock E-6

Currently, the Crescent Hydroelectric Project (Crescent Project) does not include Lock E-6 as part of the project. However, it appears that Lock E-6 and the canal between the dam and the lock should be part of the project because Lock E-6 is needed for impounding the reservoir of the Crescent Project. Please explain why the lock and canal are not included in the project boundary. If it is determined that the lock and canal are needed for project purposes, both features should be enclosed within the project boundary when the draft license application or preliminary licensing proposal is filed.

The Power Authority has reviewed the Exhibit G map for the Crescent Project and has confirmed that Lock E-6 and the portion of the canal upstream of the lock, including the two canal guard gates, are within the Project Boundary. The current Exhibit G map for the Crescent Project is provided in Appendix C. The area circled in red shows the location of the Project Boundary that includes a small portion of the canal at Lock E-6 and above. The Power Authority plans to update its Exhibit G maps for Crescent and Vischer Ferry as part of the relicensing process and will evaluate whether Lock E-6 or any portions of the canal currently within the Project Boundary are necessary for project purposes. The Power Authority will propose any appropriate modifications to the existing Project Boundary and Project works in the draft license application.

4.2 AIR 2 - Dates of Flashboard Installation/Removal and Navigation Season

Staff needs additional information regarding the seasonal timing of the fish passage practices that are currently implemented at both projects (notches in the flashboards and navigation lockages) to support our analysis of the effectiveness of these practices for passing migratory blueback herring and American eel. Therefore, please provide the following information for the previous 20 years, to the extent such data are available: (1) the dates the flashboards were installed and removed each year at each project; and (2) the starting and ending dates for the navigation season in the Erie Canal each year. Please note any anomalies in the record, such as late installations of the flashboards or early closing of the navigation season, and if available, the reason for the anomaly.

The Power Authority has reviewed its records for the past 20 years, and has compiled the dates of flashboard installation and removal for the period 1999 - 2019. The Power Authority requested records of the navigation season start and end dates from NYSCC; that information is included in the table below.

Year	Crescent Flashboards In	Crescent Flashboards Out	Vischer Ferry Flashboards In	Vischer Ferry Flashboards Out	Barge Canal Open	Barge Canal Closed
2019	10-May		7-May		17-May	16-Oct
2018	25-May	4-Dec	22-May	14-Dec	15-May	10-Oct
2017	26-May	28-Nov	23-May	1-Dec	19-May	11-Oct
2016	13-May	29-Nov	10-May	2-Dec	27-Apr	22-Nov
2015	1-May	8-Dec	14-May	11-Dec	8-May	18-Nov
2014	16-May	9-Dec	13-May	5-Dec	5-May	19-Nov
2013	28-Jun	3-Dec	25-Jun	6-Dec	1-May	15-Nov
2012	25-May	27-Nov	22-May	30-Nov	28-Apr	15-Nov
2011	26-May	9-Dec	27-Apr	8-Nov	14-May	3-Dec
2010	6-May	9-Nov	3-May	16-Nov	1-May	15-Nov
2009	29-Apr	9-Nov	27-Apr	13-Nov	1-May	15-Nov
2008	1-May	17-Nov	28-Apr	18-Nov	1-May	15-Nov
2007	26-Apr	13-Nov	23-Apr	16-Nov	4-May	15-Nov
2006	4-May	16-Nov	1-May	22-Nov	1-May	15-Nov
2005	22-May	21-Nov	19-May	28-Nov	1-May	15-Nov
2004	22-Apr	16-Nov	19-Apr	19-Nov	1-May	15-Nov
2003	5-May	8-Nov	2-May	20-Nov	5-May	7-Nov
2002	25-Apr	12-Nov	24-Apr	9-Nov	6-May	3-Nov
2001	26-May	10-Nov	25-May	9-Nov	7-May	4-Nov
2000	4-May	15-Nov	3-May	19-Nov	1-May	19-Nov
1999	30-Apr	29-Nov	29-Apr	2-Dec	3-May	21-Nov

4.3 AIR 3 - Flow through Fish Passage Notches

At the environmental site review, New York Power Authority (NYPA) was uncertain as to the amount of flow provided through the two fish notches (the adult notch and juvenile notch) at the Vischer Ferry Hydroelectric Project (Vischer Ferry Project) and the dimensions of these notches. Therefore, please provide this information, as well as the depths and substrates of the plunge pools at both the Crescent Project and the Vischer Ferry Project.

At the Vischer Ferry Project, the two fish passage notches are both located on Dam F (see PAD Figure 4.4-3). Both fish passage notches release fish onto the dam apron which is 40 feet wide. The depth of the water downstream of the two fish passage notches is dependent upon the apron elevation and the elevation of the Crescent impoundment. The apron elevation is different for Dam D and Dam F, running from 177’ to 175’ and 179.5’ to 177.5’, respectively. In addition, the Vischer Ferry tailwater elevation varies with the Crescent headpond, which has an elevation of 184’ for non-navigation season and 185’ during the navigation season. Since the fish passage notches are open only during the navigation season when the flashboards are up., the tailwater depth below the fish passage notches would be between 5.5 and 7.5 feet deep along the apron.

At the Crescent Project, the fish passage notch is located on Dam A, and the centerline of the 80 foot wide fish passage notch is about 400 feet from the left abutment. The notch releases water onto the dam apron, which is approximately 40 feet wide. As at Vischer Ferry, water depth below the fish passage notch is dependent on both the elevation of the apron and the tailwater elevation that varies depending on the School Street Project impoundment elevation. During the navigation season when the flashboards are up at Crescent and the fish passage notch is open, the tailwater elevation is approximately 157'. The apron elevation runs from 147' to 145', which produces a water depth below the fish passage notch of between 10 and 12 feet.

4.4 AIR 4 - Minimum Hydraulic Capacity

At the environmental site review, NYPA stated the minimum hydraulic capacity was the same for all turbines—200 cubic feet per second (cfs) for the Kaplan and Francis units at each project. However, Table 3.3-1 of the Pre-Application Document (PAD) indicates the minimum hydraulic capacities of the Kaplan and Francis units are 350 cfs and 400 cfs, respectively. Please clarify this discrepancy.

The minimum hydraulic capacity of the units at the Crescent and Vischer Ferry Projects are as stated in the PAD. The Kaplan units have a minimum hydraulic capacity of 350 cfs and the Francis units a minimum hydraulic capacity of 400 cfs.

4.5 AIR 5 - Water Withdrawals from the Vischer Ferry Impoundment

As indicated in the PAD (Table 4.3-5) and confirmed at the site visit, water withdrawals in excess of 1 million gallons per day (MGD) are made from the Vischer Ferry impoundment at General Electric in Schenectady, New York (4.0 to 11.4 MGD) and the Knolls Atomic Power Laboratory (1.7 to 3.7 MGD). To support staff's analysis of water quantity resources at both projects, please provide additional information regarding these water withdrawals. Specifically, describe how the water that is withdrawn is used and whether it is released back into the impoundment and if so, how it is modified (e.g., increased temperature of the effluent).

The Power Authority provided an initial response to this question in its comments on SD1 filed on August 9, 2019. The Power Authority has re-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 available through the NYSDEC website is included in Table 4.3-5 of the PAD.

4.6 AIR 6 - Period of Record for Hydrology Data

Hydrology statistics presented in the PAD are based on an 8-year period of record (from 2011 through 2018, encompassing Hurricane Irene), which likely biases (upwards) flow estimates at the projects, especially given the short period of record (only 8 years). Therefore, in your draft license application or preliminary licensing proposal, please provide a description of the hydrology at both projects and updated flow statistics (tables 4.3-1 and 4.3-2 of the PAD) and flow duration curves (figures 4.3-1 and 4.3-2; Appendix D) that are based on a longer period of record—at least 30 years of pro-rated flow data from the nearby United States Geological Survey (USGS) gages at Little Falls (USGS Gage No. 01347000, data available from 1927 to present) or Cohoes Falls (USGS Gage No. 01357500, data available from 1917 to present).

The Power Authority provided an initial response to this question in its comments on SD1 filed on August 9, 2019. In the PAD, the Power Authority included flow data available electronically from the SCADA records (2010-2018). Additional flow records are available for the Project, but are not currently in an electronic format that makes them readily available for statistical analysis and graphing. The Power Authority will provide flow statistics and flow duration curves for both Projects for a longer period of record in the draft license application.

4.7 AIR 7 - Fisheries Reports

In section 4.4 of the PAD, you cite several fisheries reports that staff was not able to locate. Therefore, please file the following reports/references as supplemental information as part of the public record for the projects: Chas T. Main, Inc. (1984); Curtis and Associates (1987), McBride (1985), and McBride (1994). 17 to present).

The requested documents are provided in Appendix D. The Power Authority provided the other source documents that were used in the preparation of the fishery portion of the PAD in its comments on SD1 filed August 9, 2019.

4.8 AIR 8 - Project Facilities

In section 3.3 of the PAD, project facilities are identified as a dam, powerhouse, impoundment, and appurtenant facilities. In the existing license, switchyards, generator leads, and transformer banks are also mentioned as existing project facilities. Please describe in greater detail the switchyards, generator leads, transformer banks, and other appurtenant facilities not previously mentioned as part of the project facilities.

The Crescent Project includes a switchyard located approximately 100 feet from the powerhouse. Underground 2.4 kV generator leads for Units 1 and 2 are about 250 feet in length and are tied to a 2.4 kV bus. The 2.4 kV bus is tied to Transformer 1 (T1 34.5/2.4 kV); and T1 ties to a 34.5 kV bus. Underground 4.16 kV generator leads for Units 3 and 4 are about

300 feet in length and are tied to a 4.16 kV bus. The 4.16 kV bus is tied to Transformer 2 (T2 34.5/4.16 kV); and T2 ties to a 34.5 kV bus.

The Vischer Ferry Project includes a switchyard located about 100 feet from the powerhouse. Underground 2.4 kV generator leads for Units 1 and 2 are tied to a 2.4 kV bus. The 2.4 kV bus is tied to Transformer 1 (T1 34.5/2.4 kV); and T1 ties to a 34.5 KV bus. Underground 4.16 kV generator leads for Units 2 and 4 are about 300 feet in length and are tied to a 4.16 kV bus. The 4.16 kV bus is tied to Transformer 2 (T2 34.5/4.16 kV); and T2 ties to a 34.5 kV bus.

As part of this relicensing process, the Power Authority plans to analyze whether these facilities are needed for Project purposes. Any proposed changes to Project works, together with the Power Authority's rationale for any changes, will appear in the draft license application.

4.9 AIR 9 - Vegetation Management

In section 3.3 of the PAD, project facilities are identified, and section 3.4 references the scope of operations for those identified facilities. Also, in section 4.8.1.1, formal project recreation sites are identified for the Crescent and Vischer Ferry Projects; and section 4.8.2.1 states that, generally, project operations and maintenance, and recreation are the primary activities that occur on project lands. Please describe the details (e.g., frequency and method) of any vegetation management that occurs at either project, their formal recreation sites, and any appurtenant facilities to support operations and maintenance. Examples of vegetation management may include activities such as mowing, trimming, and turf management; hazard or risk tree removal; clearing to maintain overlooks; herbicide treatments; and others.

The Power Authority undertakes routine vegetation management at the Crescent and Vischer Ferry Projects on an as-needed basis following standard practices for Power Authority hydroelectric projects. Grassy areas around the powerhouses, switch yards and at the Project recreation sites are mowed routinely. Hand mowing, line-trimming, or spot applications of herbicides may also be used, as needed, to control weeds in driveways, parking areas, equipment, along guard rails, around signage, and around Project buildings and structures that are well away from the water. No herbicide applications are made in Project waters, drainage ways, or near the Project shorelines. All herbicide applications are made following manufacturer's specifications, and Power Authority staff and/or contractors follow standard environmental and safety protocols for handling, applying and disposing of herbicides. There are very few areas that support trees or woody vegetation within the Projects' boundaries. Where trees are present, if any tree or limb poses a safety hazard to any equipment, structures, Power Authority staff or the public, the Power Authority will remove them. To the extent feasible, tree-cutting and/or limb removal is limited to winter months (November to March), unless the tree and/or limb poses an imminent safety concern, in which case it will be removed as soon as is safe and practicable.

Vegetation management at one of the Project recreation sites, the Town of Niskayuna Boat Ramp associated with Lock E-7, is done by the NYSCC and the Town of Niskayuna.

APPENDICES

APPENDIX A: Comment and Study Request Letters

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D.C. 20426
August 9, 2019

OFFICE OF ENERGY PROJECTS

Project No. 4678-052–New York
Crescent Hydroelectric Project

Project No. 4679-049–New York
Vischer Ferry Hydroelectric Project

New York Power Authority

VIA Electronic Mail

Mr. Robert Daly
Licensing Manager
New York Power Authority
Robert.Daly@NYPA.gov

Reference: Requests for Additional Information and Study Requests

Dear Mr. Daly:

After reviewing the Pre-Application Document (PAD) for the Crescent Hydroelectric Project and the Vischer Ferry Hydroelectric Project, and participating in the July 10 and 11, 2019 scoping meetings, and the July 10, 2019 environmental site review, we have determined that additional information is needed to adequately assess potential effects of the projects on environmental resources. We provide comments on the PAD and our additional information requests in Schedule A, and three study requests in Schedule B. Unless otherwise specified, please file your responses to Schedule A with your proposed study plan, which must be filed by September 23, 2019.

Staff may determine a need for additional studies or information upon receipt and review of scoping comments, study requests, and your proposed study plan. As necessary, we will request additional information or studies or provide additional input on proposed or requested studies after you file the proposed study plan.

Please include a master schedule in your proposed study plan that includes the steps for conducting each proposed study (i.e., data collection, data analysis, consultation, and report preparation), the distribution of progress reports, and the filing date of the initial study report. If, based on the study results, you are likely to propose any plans or measures to address the effects of the projects, drafts of those plans should be filed with your draft license application (or preliminary licensing proposal).

If you have any questions, please contact Jody Callihan at (202) 502-8278 or jody.callihan@ferc.gov.

Sincerely,

John B. Smith, Chief
Mid-Atlantic Branch
Division of Hydropower Licensing

Enclosures: Schedule A
Schedule B

ADDITIONAL INFORMATION

Lock E-6

1. Currently, the Crescent Hydroelectric Project (Crescent Project) does not include Lock E-6 as part of the project. However, it appears that Lock E-6 and the canal between the dam and the lock should be part of the project because Lock E-6 is needed for impounding the reservoir of the Crescent Project. Please explain why the lock and canal are not included in the project boundary. If it is determined that the lock and canal are needed for project purposes, both features should be enclosed within the project boundary when the draft license application or preliminary licensing proposal is filed.

Dates of Flashboard Installation/Removal and Navigation Season

2. Staff needs additional information regarding the seasonal timing of the fish passage practices that are currently implemented at both projects (notches in the flashboards and navigation lockages) to support our analysis of the effectiveness of these practices for passing migratory blueback herring and American eel. Therefore, please provide the following information for the previous 20 years, to the extent such data are available: (1) the dates the flashboards were installed and removed each year at each project; and (2) the starting and ending dates for the navigation season in the Erie Canal each year. Please note any anomalies in the record, such as late installations of the flashboards or early closing of the navigation season, and if available, the reason for the anomaly.

Flow through Fish Passage Notches

3. At the environmental site review, New York Power Authority (NYPA) was uncertain as to the amount of flow provided through the two fish notches (the adult notch and juvenile notch) at the Vischer Ferry Hydroelectric Project (Vischer Ferry Project) and the dimensions of these notches. Therefore, please provide this information, as well as the depths and substrates of the plunge pools at both the Crescent Project and the Vischer Ferry Project.

Minimum Hydraulic Capacity

4. At the environmental site review, NYPA stated the minimum hydraulic capacity was the same for all turbines—200 cubic feet per second (cfs) for the Kaplan and Francis units at each project. However, Table 3.3-1 of the Pre-Application Document (PAD)

indicates the minimum hydraulic capacities of the Kaplan and Francis units are 350 cfs and 400 cfs, respectively. Please clarify this discrepancy.

Water Withdrawals from the Vischer Ferry Impoundment

5. As indicated in the PAD (Table 4.3-5) and confirmed at the site visit, water withdrawals in excess of 1 million gallons per day (MGD) are made from the Vischer Ferry impoundment at General Electric in Schenectady, New York (4.0 to 11.4 MGD) and the Knolls Atomic Power Laboratory (1.7 to 3.7 MGD). To support staff's analysis of water quantity resources at both projects, please provide additional information regarding these water withdrawals. Specifically, describe how the water that is withdrawn is used and whether it is released back into the impoundment and if so, how it is modified (e.g., increased temperature of the effluent).

Period of Record for Hydrology Data

6. Hydrology statistics presented in the PAD are based on an 8-year period of record (from 2011 through 2018, encompassing Hurricane Irene), which likely biases (upwards) flow estimates at the projects, especially given the short period of record (only 8 years). Therefore, in your draft license application or preliminary licensing proposal, please provide a description of the hydrology at both projects and updated flow statistics (tables 4.3-1 and 4.3-2 of the PAD) and flow duration curves (figures 4.3-1 and 4.3-2; Appendix D) that are based on a longer period of record—at least 30 years of pro-rated flow data from the nearby United States Geological Survey (USGS) gages at Little Falls (USGS Gage No. 01347000, data available from 1927 to present) or Cohoes Falls (USGS Gage No. 01357500, data available from 1917 to present).

Fisheries Reports

7. In section 4.4 of the PAD, you cite several fisheries reports that staff was not able to locate. Therefore, please file the following reports/references as supplemental information as part of the public record for the projects: Chas T. Main, Inc. (1984); Curtis and Associates (1987), McBride (1985), and McBride (1994).

Project Facilities

8. In section 3.3 of the PAD, project facilities are identified as a dam, powerhouse, impoundment, and appurtenant facilities. In the existing license, switchyards, generator

leads, and transformer banks are also mentioned as existing project facilities. Please describe in greater detail the switchyards, generator leads, transformer banks, and other appurtenant facilities not previously mentioned as part of the project facilities. Please include the approximate dimensions of the switchyard, length and voltage of the generator leads, and location of each facility, including the point of inter-connection with the grid.

Vegetation Management

9. In section 3.3 of the PAD, project facilities are identified, and section 3.4 references the scope of operations for those identified facilities. Also, in section 4.8.1.1, formal project recreation sites are identified for the Crescent and Vischer Ferry Projects; and section 4.8.2.1 states that, generally, project operations and maintenance, and recreation are the primary activities that occur on project lands. Please describe the details (e.g., frequency and method) of any vegetation management that occurs at either project, their formal recreation sites, and any appurtenant facilities to support operations and maintenance. Examples of vegetation management may include activities such as mowing, trimming, and turf management; hazard or risk tree removal; clearing to maintain overlooks; herbicide treatments; and others.

STUDY REQUESTS

After reviewing the information in the PAD, we have identified a gap between the information in the PAD and the information needed to assess project effects. As required in section 5.9 of the Commission's regulations, we have addressed the seven study request criteria for each of the study requests that follow.

Entrainment and Impingement Study

Criterion (1) – Describe the goals and objectives of each study proposal and the information to be obtained.

The goal of this study is to evaluate the potential for trash rack impingement, turbine entrainment, and related survival for migratory (blueback herring and American eel) and resident game fishes (smallmouth bass, walleye, and yellow perch) at the Crescent Project and Vischer Ferry Project in the Mohawk River. The objectives of this study, at a minimum, are to: (1) estimate the minimum sizes of each target species[1] that would be excluded from the trash racks at each project based on body size alone; (2) provide the burst speeds (with source information cited) for juveniles and adults of each target species;[2] (3) provide the expected intake approach velocities at the maximum hydraulic capacity of each project; and (4) use a blade strike model (e.g., Franke et al. 1997)[3] to estimate the turbine mortality of each target species. The blade strike models should be based on the specifications of the Kaplan and Francis turbines (rotational speed, blade spacing and number, etc.) installed at each project; separate mortality estimates (model runs) should be conducted for the Francis and Kaplan units, with

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[1] NYPA should consult with the United States Fish and Wildlife Service and New York State Department of Environmental Conservation to determine if there are species of interest other than the target species listed here; if so, include those additional species in its entrainment analysis.

[2] Surrogate fish species with a similar swimming mode and body shape may be used if lifestage- and/or species-specific information on burst speeds is not available for the target species.

[3] Franke, G.F., D.R. Webb, R.K. Fisher, Jr., D. Mathur, P.N. Hopping, P.A. March, M.R. Haedrick, I.T. Laczo, Y. Ventikos, and F. Sotiropoulos. 1997. Development of environmentally enhanced hydropower turbine system design concepts. Prepared for U.S. Department of Energy, Idaho Operations Office, Contract DE-AC07-94ID13223.

mortality estimates reported for each 1-inch size bin across the entire size range of fish used in the models.

Criterion (2) – If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resources to be studied.

Not applicable.

Criterion (3) – If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.

Sections 4(e) and 10(a) of the Federal Power Act require that the Commission give equal consideration to all uses of the waterway on which a project is located. When reviewing a proposed action, the Commission must consider the environmental, recreational, fish and wildlife, and other non-developmental values of the project, as well as power and developmental values.

Fish populations in the Mohawk River support a sustainable riverine ecosystem that is critical in providing public opportunities, including recreational fishing. Ensuring that the effect of the projects' operations pertaining to this resource are considered in a reasoned way is relevant to the Commission's public interest determination.

Criterion (4) – Describe existing information concerning the subject of the study proposal and the need for additional information.

Although a turbine mortality study (utilizing balloon tagging)[4] was previously conducted at the projects for juvenile blueback herring,[5] no entrainment or turbine mortality data are available for other species present in the vicinity of the projects, including American eel and resident gamefish such as smallmouth bass, walleye, and

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[4] In the balloon tagging study, juvenile blueback herring equipped with inflatable (balloon) tags were released into the penstock, passed through the Kaplan turbines at the Crescent Project, and were recovered downstream in the tailrace, thereby providing a field-based estimate of turbine mortality.

[5] RMC Environmental Services, Inc. 1992. Juvenile blueback herring (*Alosa aestivalis*) survival in powerhouse/turbine passage and spillage over the dam at the Crescent Hydroelectric Project, New York. Filed on July 28, 1992; Accession No. 19920729-0355.

yellow perch. Staff needs this information to assess project effects on important fishery resources occurring in the vicinity of the project.

Criterion (5) – Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

Fish utilizing this portion of the Mohawk River are susceptible to impingement on the projects' trash racks and entrainment through the projects' turbines when the projects are operating. Results from the study would provide insight into the magnitude of such project effects and inform the need for license measures to protect fishery resources.

Criterion (6) – Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

Desktop studies of impingement and entrainment, such as the study requested here, are commonly conducted to support the Commission's hydropower licensing proceedings. Sufficient literature should be available to describe the life history characteristics, swimming speeds, and avoidance behaviors of the target species. In addition, an extensive entrainment and survival database (EPRI, 1997)[6] is available to aid desktop entrainment studies.

Criterion (7) – Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

We expect the desktop study (literature review, analysis, and report writing) would take 1 to 2 months to complete and cost about $20,000, unless a day or two of fieldwork is necessary in order to obtain approach velocity measurements; in that case the cost would likely be higher. The specific methodology and scope of the study can be refined during the study planning phase and upcoming proposed study plan meeting.

Bald Eagle Study

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[6] Electric Power Research Institute (EPRI). 1997. Turbine survival and entrainment database – Field tests. EPRI Report No. TR-108630. Prepared by Alden Research Laboratory, Inc. Holden, MA.

Criterion (1) – Describe the goals and objectives of each study proposal and the information to be obtained.

The goal of the study is to verify existing and identify new bald eagle nest, foraging, and roost locations; and to monitor bald eagle activity levels at the identified locations at both projects. The study objective is to collect data and information to inform Commission staff's analysis of the effects of continued operation and maintenance of the projects on bald eagles and their habitat.

Criterion (2) – If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resources to be studied.

Not applicable.

Criterion (3) – If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.

Sections 4(e) and 10(a) of the Federal Power Act require that the Commission give equal consideration to all uses of the waterway on which a project is located. When reviewing a proposed action, the Commission must consider the environmental, recreational, fish and wildlife, and other non-developmental values of the project, as well as power and developmental values.

The bald eagle is federally protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. It is also classified as Threatened by the State of New York under the New York State Environmental Conservation Law and State of New York regulations. Additionally, detailed State of New York resource management goals can be found in the *Conservation Plan for Bald Eagles in New York State*.[7]

Criterion (4) – Describe existing information concerning the subject of the study proposal and the need for additional information.

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[7] New York Department of Environmental Conservation (New York DEC). 2016. Conservation Plan for Bald Eagles in New York State. Available: https://www.dec.ny.gov/docs/wildlife_pdf/nybaldeagleplan.pdf. Accessed: August 1, 2019.

The PAD identified the bald eagle as having the potential to occur at both projects, and Scoping Document 1 preliminarily identified the bald eagle as a resource issue in need of analysis under the National Environmental Policy Act. Staff found that an active nest was documented within the Crescent Project boundary and other bald eagle activity was documented at and adjacent to both projects.[8]

Applicable guidelines and planning documents[9, 10] recommend activity restrictions, or other measures, based on knowing the locations of bald eagle nests, foraging, and roost locations. The information would assist staff in analyzing possible resource affects by project activities and determine the need for resource protection measures, if any.

Criterion (5) – Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

Project operation and maintenance have the potential to directly affect bald eagle nesting, foraging, and roosting. Study results would inform the need for and location(s) of resource protection measures, if needed.

Criterion (6) – Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with

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[8] Morgan, C. 2019. eBird Checklist: http://ebird.org/ebird/view/checklist?subID=S57453805. eBird: An online database of bird distribution and abundance [web application]. eBird, Ithaca, New York. Available: http://www.ebird.org. Accessed: August 1, 2019.

[9] U.S. Fish and Wildlife Service (FWS). 2007. National Bald Eagle Management Guidelines. Available: https://www.fws.gov/northeast/ecologicalservices/pdf/NationalBaldEagleManagementGuidelines.pdf. Accessed: August 1, 2019.

[10] New York DEC, 2016.

generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

The proposed study methodology should include an existing literature and data review, field surveys, and a study report. The study should be conducted at both projects and be completed in 1 year.

Bald eagle use studies are commonly conducted to support the Commission's hydropower licensing proceedings. Sufficient information to inform study design is available in the *National Bald Eagle Management Guidelines*[11] and the *Conservation Plan for Bald Eagles in New York State*.[12] Additional information is also available on applicable U.S. Fish and Wildlife Service[13] and New York Department of Environmental Conservation[14] websites.

Criterion (7) – Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

The proposed study should take about 1 year to complete with an estimated cost of about $20,000. No alternative studies have been proposed at this time.

Recreation Study

Criterion (1) – Describe the goals and objectives of each study proposal and the information to be obtained.

The goal of this study is to gather information on recreation use, recreation access, and potential project effects to determine existing and future recreation use and capacity at the projects.

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[11] FWS, 2007.

[12] New York DEC, 2016.

[13] FWS. 2016. Bald Eagle Management Guidelines and Conservation Measures. Available: https://www.fws.gov/northeast/ecologicalservices/eagle.html. Accessed: August 1, 2019.

[14] New York DEC. 2019. Bald Eagle Management. Available: https://www.dec.ny.gov/animals/7068.html. Accessed: August 1, 2019.

The objectives of the study are to, at a minimum: (1) identify and describe each formal and informal recreation site and facility at the project in relation to the projects' boundaries; (2) identify the condition of all formal and informal recreation sites and facilities within and adjacent to the projects' boundaries, including any erosion that may exist due to recreational use; and (3) conduct visitor surveys during the recreation season to determine the adequacy of project recreation facilities and if changes or upgrades to the sites would be needed to meet current or future recreation needs.

Criterion (2) – If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.

Not applicable.

Criterion (3) – If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.

Sections 4(e) and 10(a) of the Federal Power Act require that the Commission give equal consideration to all uses of the waterway on which a project is located. When reviewing a proposed action, the Commission must consider the environmental, recreational, fish and wildlife, and other non-developmental values of the project, as well as power and developmental values.

There are a number of public recreational opportunities within and adjacent to the Crescent and Vischer Ferry Projects. Understanding the condition of the existing project recreation sites and facilities, the amount of current and projected future use, and how these sites and facilities are managed is essential in determining the adequacy of project recreation facilities to meet current and future recreation needs; and therefore, is relevant to the Commission's public interest determination.

Criterion (4) – Describe existing information concerning the subject of the study proposal, and the need for additional information.

Section 4.8 of the PAD (pages 4-80 – 4-88) provides a general discussion of recreation demand in the region and a summary of recreation at each project. It also includes a brief discussion of recreation use estimates compiled every 6 years as part of the Licensed Hydropower Recreation Report Form 80 (Form 80) required by the projects' current FERC licenses. However, while NYPA proposes to conduct a project recreation site facility inventory at both projects,[15] it does not propose to gather any recreation use data. Although NYPA provides a brief summary of recreation use based on its last three Form 80 filings, most data compiled for Form 80 filings are derived from informal surveys and estimates of use. The PAD also provides no project-specific information regarding visitor perceptions of recreation at the projects. A study that gathers information on visitor perceptions of the adequacy of public access and facilities, current use, and whether existing access facilities in the area are meeting recreation demand, in addition to the already proposed facility inventory, would inform future license conditions related to public access and recreation facilities.

Criterion (5) – Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

Each project includes a reservoir that provides boating and fishing opportunities and a tailrace that provides informal fishing access. Continued operation of the projects could affect recreational resources through disruption or displacement of activities, changes to the recreational experience, increased use, changes in the types of recreation activities in the area, or by other means. The results of the study would inventory existing recreation facilities and activities, detect current use patterns, and help to determine recreational demand and the potential need for new recreation facilities.

Criterion (6) – Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

The specific methodology and scope of the recreation study can be refined during the study planning phase and upcoming proposed study plan meeting, but the study should include, at a minimum, the following provisions:

1. Inventory all formal and informal public and private recreational sites/facilities within and adjacent to each project's boundary.

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[15] In the PAD, NYPA identifies two project recreation sites at the Crescent Project (a picnic area near the powerhouse and an informal tailrace bank fishing area) and three project recreation sites at the Vischer Ferry Project (a scenic overlook at the project forebay, a tailrace parking area, and a boat ramp at Lock E-7 also known as the Town of Niskayuna Boat Ramp).

2. Administer a recreation use survey that addresses all recreation activity types known to occur or potentially occur at each project. Specific methods should include visitor observations and on-site visitor intercept surveys at formal and informal public recreation areas at each projects' reservoir and tailrace, as well as spot counts.

   - Visitor observations should capture information such as location, date, time, weather, number of vehicles, watercraft (if any), number of recreation users or party size, and recreation activity.
   - The visitor survey sampling should be based on a stratified random sample that includes all seasons, various locations, and various times of week and day to enable representative responses from the visitors, while ensuring interview coverage during key times (e.g., holiday and weekend days, shoulder seasons, fishing and hunting seasons).
   - The survey instrument should include items to assess visitor perceptions of crowding, recreational conflict, conflicts between the public and adjacent property owner(s), adequacy and placement of signage, adequacy of recreation facilities and access to the projects, and effects of project operation and management on recreation and recreation opportunities at the projects (e.g., fluctuating reservoir levels).
   - Spot counts should be conducted on survey days. The spot counts represent short-term counts (approximately 5 minutes per site) and should record the number of vehicles parked at a site/facility and the number of users observed. This information should be statistically analyzed to develop the recreational use figures for each project. Final recreation use for the recreation facilities and sites at each project should be summarized by season and activity type for each site.

3. Prepare a report that includes information on the number of recreation days spent at project recreation sites, average number of persons per party, and a determination of the percent of the each facility's capacity that is currently being utilized. The above information should be entered into spreadsheets for statistical analysis. The collected information should be used to project changes to project recreation demand over the term of any new license that may be issued. The report also should include: (1) identification of all project and non-project recreation sites at each project, including informal recreation sites, and who owns each site; (2) the location of the recreation sites in relation to the project boundary, including facilities/amenities that may straddle the project boundary; (3) the types

and number of amenities provided at each site; (4) the condition of the facility/amenities; (5) identification of any erosion at each recreation site; (6) entities responsible for the operation and maintenance of the sites; (7) hours/seasons of operation, if applicable; (8) photographs of each site; (9) use figures for each recreation site, overall recreational use figures, and projected use figures; and (10) a compilation of responses to the recreation use survey.

Two or three technicians would be needed to review existing data sources, survey sites in the field from the end of May through the beginning of October (or through the Erie Canal navigation season, whichever is longer), develop the inventory, evaluate past and current use, evaluate potential effects of the project on area recreation resources, and draft and finalize maps and reports.

Criterion (7) – Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

The estimated cost of the Recreation Study at both projects is $100,000, including study plan development, field data collection, reservoir surface area modeling and mapping, and study report preparation. One field season should be sufficient to collect the required data and prepare the study report.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

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August 9, 2019

New York Power Authority
Attn: Mark E. Slade, Licensing Director
123 Main Street
White Plains, NY 10601

RE: Pre-Application Document and
Study Requests Comments
Crescent Hydroelectric Project (FERC No. 4678)
Vischer Ferry Hydroelectric Project (FERC No. 4679)
Albany, Saratoga and Schenectady Counties

Dear Mr. Slade:

The New York State Department of Environmental Conservation ("NYSDEC" or "Department") is providing the following comments on the May 2019 Pre-Application Document (PAD) submitted by the Power Authority of the State of New York ("Power Authority", "NYPA" or "Applicant") for relicensing the existing Crescent Hydroelectric Project (FERC No. 4678) and Vischer Ferry Hydroelectric Project (FERC No. 4679). Study requests comments are also provided.

Overview of Projects

The two projects, collectively referred to as the "NYPA Projects", are located on the Mohawk River adjacent to one another at river miles 4 and 14, respectively. The Crescent Project is an 11.8 MW conventional hydroelectric facility located in Albany, Saratoga and Schenectady Counties, New York in the Towns of Colonie, Clifton Park, Halfmoon, Waterford and Niskayuna. The Vischer Ferry Project is an 11.8 MW conventional hydroelectric facility located in Saratoga and Schenectady Counties, New York, in the Towns of Clifton Park, Niskayuna and the City of Schenectady.

Comments on the Pre-Application Document

The PAD is generally well-organized and addresses many of the necessary key issues for the NYPA Projects. NYSDEC staff have no specific comments on the PAD.

Comments on Scoping Document 1

Scoping Document 1 (SD1) is generally well-organized and addresses most of necessary the key issues for the NYPA Projects. NYSDEC staff have no specific comments on SD1.

Study Requests

The New York State Department of Environmental Conservation requests that the Applicant conduct the following studies:

I. Water Quality Monitoring Study

The Water Quality Monitoring Study should include: continuous water temperature and dissolved oxygen (DO) data collection for 1 year and discrete measurements (i.e. temperature, DO, pH, and conductivity) monthly from April 1 through November 30. Baseline water quality studies are needed to ensure compliance with NYS water quality standards, (the Clean Water Act § 401 Water Quality Certification) and identify potential NYPA Projects impacts to the fish community, particularly impacts to blueback herring (*Alosa aestivalis*) during upstream and downstream migrations (e.g., juvenile outmigration, adult immigration). An additional year of monitoring may be needed based on a review of the first year's study results to ensure impacts on aquatic resources and that the goals and objectives of the Study are addressed. Data should be collected from the impoundments, the by-passed reaches and tailrace. Water quality information collected should be summarized in a manner that will allow appropriate analysis of the current flow regime. Methods for mitigating water quality problems (i.e. modifications to infrastructure, or changes to existing operations) should be fully explored and modeled as to their potential effectiveness.

1. *Goals and Objectives*

   The goals and objectives of this study are to provide baseline water quality information.

2. *Resource Management Goals*

   NYSDEC's mission is "to conserve, improve and protect New York's natural resources and environment and to prevent, abate and control water, land and air pollution, in order to enhance the health, safety and welfare of the people of the state and their overall economic and social well-being." The natural resource management goals within the Mohawk River Watershed will be consistent with the Department's mission while focusing on protecting and enhancing fish and wildlife habitat and improving public access.

3. *Public Interest*

   The requestor is a state resource agency.

4. *Existing Information*

   The NYSDEC conducts statewide monitoring programs for determining the overall quality of waters, trends in water quality, and the identification of water quality issues achieved through the Rotating Integrated Basin Studies (RIBS) program, which occur on 5-year cycles. The Mohawk River's next anticipated sampling will occur in 2020. Data from the RIBS program cannot be used to quantify the direct impacts of either hydro facility, but rather can be used to expand the assessment.

5. *Nexus to Projects Operations and Effects*

   The existing NYPA Projects impound water from the Mohawk River. These impoundments and releases have the potential to impact such water quality factors as temperature and dissolved oxygen (DO), which are critical to the quality of the aquatic habitat, especially during low flow summer periods.

6. *Methodology Consistent with Accepted Practice*

   The recommended study uses standard water quality sampling techniques commonly used in most hydropower licensing activities.

7. *Level of Effort, Cost, and Why Alternative Studies Will Not Suffice*

The level of effort would be low and would involve monitoring with continuous measurement devices and collecting monthly samples while undertaking other work such as fisheries or macroinvertebrate surveys. In addition, temperature and DO instruments would need to be installed, with data being periodically downloaded. The actual cost is unknown but would be relatively low.

I. Freshwater Mussel Survey

The freshwater mussel survey should be completed by an individual who is properly licensed and is familiar with the species in the watershed of the NYPA Projects. Reporting should include species-specific results. An additional year of study may be needed based on a review of the first year's study results to ensure impacts on aquatic resources and that the goals and objectives of the Study are addressed. Throughout the state and in the local geographic area freshwater mussels have been poorly documented and assessed in the past and many are in peril of extirpation and extinction due to habitat loss and alteration, overharvest, and competition with invasive species. It is unknown what species may be present in the NYPA Projects areas barring the invasive Zebra Mussel (*Dreissena polymorpha*).

1. *Goals and Objectives*

The goals and objectives of this study are to provide information on the existing freshwater mussel populations upstream and downstream of the facilities that are impacted by NYPA Projects operations.

2. *Resource Management Goals*

NYSDEC's mission is "to conserve, improve and protect New York's natural resources and environment and to prevent, abate and control water, land and air pollution, in order to enhance the health, safety and welfare of the people of the state and their overall economic and social well-being." The natural resource management goals within the Mohawk River Watershed will be consistent with the Department's mission while focusing on protecting and enhancing fish and wildlife habitat and improving public access.

3. *Public Interest*

The requestor is a state resource agency.

4. *Existing Information*

Historical references make mention of native freshwater mussels within the Mohawk River Watershed as well as within tributaries flowing into the river. The Mohawk River and associated Erie Barge Canal is an S1/S2[1] river for freshwater mussels as designated by the New York Natural Heritage Program.

[1] S1 is indicative of critically imperiled, 5 or fewer occurrences, few remaining individuals or habitat, or otherwise highly vulnerable species and S2 is indicative of statewide imperiled, 6-20 occurrences, few remaining individuals or habitat, otherwise greatly vulnerable species.

5. *Nexus to Projects Operations and Effects*

The NYPA Projects alter the natural flows upstream and downstream. These areas are important for mussel propagation and survival. Freshwater mussels depend on fish host species and the NYPA Projects' dams block fish movement both upstream and downstream. Additionally, the turbine intakes may impinge or entrain fish, resulting in mortality. The NYPA Projects may also affect the amount of habitat available for mussels within the NYPA Projects boundaries in the impoundment.

6. *Methodology Consistent with Accepted Practice*

The NYSDEC requests that the Applicant survey populations of freshwater mussels carried out in impoundments, stream habitats and bypass reaches of the NYPA Projects boundaries. The full areal extent of the survey should include:

- All areas of direct disturbance by hydropower project maintenance and improvement;
- Anywhere there will be alteration of stream banks or the stream bed related to the NYPA Projects;
- Areas with permanent or temporary changes to flow, sedimentation, intake of waters or discharge of effluent, chemical discharge, or potential chemical spill discharge;
- Equipment in-stream or other disturbance; and
- All areas hydrologically influenced by the hydropower project.

All bivalve species encountered, including invasive species, should be identified and noted in survey reports. The discovery of species listed as NYS Endangered or Threatened may require additional, more detailed surveys (Smith et al 2001). Initial surveys, and possible additional and more detailed surveys, should be timed area surveys consistent with one or both protocols listed as follows:

- Smith, D.R., R.F. Villella, and D.P. Lemarie. 2001. Survey protocol for assessment of endangered freshwater mussels in the Allegheny River. J. N. Am. Benthol. Soc. 20(1):118-132.
- West Virginia Mussel Survey Protocols (March 2018 version) by West Virginia DNR. http://www.wvdnr.gov/Mussels/Main.shtm

Contractors and/or surveyors conducting surveys should have a relevant degree and experience sampling and identifying freshwater mussels in New York State. A curriculum vitae (CV) and resume should be provided to describe past experience and support selection.

Completed reports should be sent in full to the NYSDEC for review unaltered, as well as included in the Study Report.

7. *Level of Effort, Cost, and Why Alternative Studies Will Not Suffice*

The level of effort would involve one field crew sampling on a seasonal basis. The study would take approximately one year but depending on the area covered and the river conditions could case the study to take more than one year. The actual cost is unknown and would depend upon the gear types used, number of sampling locations, local labor costs, the ability to combine multiple studies (e.g., fisheries, macroinvertebrates, and water quality) into one task, etc. The existing literature provided in the PAD (Section 4.4.7) is inadequate to fully address Projects impacts, and there are no alternatives to conducting a mussel survey. However, the Applicant has flexibility to design the most cost-effective way to acquire the necessary data.

II. Fish Protection and Downstream Passage Studies

The NYPA Projects dams serve as a barrier to upstream and downstream fish migration. Fish moving downstream are subjected to potential mortality from impingement and entrainment. Recently issued licenses issued for projects on similar rivers throughout New York State, have incorporated 1"-clear spaced trash racks to physically exclude most adult fish from the turbines, alternate downstream passage routes, and other features (e.g. reduced approach velocities, adequate plunge pools, etc.) to encourage safe downstream fish passage.

The Applicant should explore alternatives to keep all fish species out of the turbines, and any other species found in abundance during fishery surveys. Alternatives also need to be developed to effectively allow the passage of fish downstream around the dam. These alternatives may include modifying any existing trash sluices located close to the intakes and provide notches in the flashboards.

This study should include a literature search of available passage designs for the species of concern, as well as information on the relative effectiveness of each design. Existing facilities at other dams should be investigated. Careful attention should be paid to attraction flows, guidance mechanisms and velocities. Fish moving downriver must be diverted away from the turbines and guided to the downstream passage facility. Adequate attraction and conveyance flows must be provided. The passage facility should not create a bottleneck that would delay downstream movement or expose the fish to excessive predation. All passage facilities should be designed to prevent blockage from ice and debris, should be as maintenance-free as is feasible and be able to operate under all flow conditions experienced in the Mohawk River Basin.

In addition to literature review and on-site investigations of existing facilities, the Applicant should collect site-specific data from the Projects to aid in the design of protection and passage facilities. This information should include flows, velocities, water depths, and substrates.

The Applicant should also collect information on the passage requirements of the fish species found in the Mohawk River Basin. This information should include: swimming speeds (including burst speeds); where in the water column these fish are likely to be moving and different forms of attractants or repellents (e.g. sound, light, etc.) that may help guide each species.

For fish that have been drawn into the turbines, the probability of survival for fish passage through the NYPA Projects turbines should also be assessed for both the Francis and Kaplan turbines. The Applicant should consider both adult and juvenile life stages of fish species found in the Mohawk River Basin.

1. *Goals and Objectives*

The goals and objectives of this study are to collect site-specific information and conduct a literature review of fish passage alternatives to evaluate options for improving fish protection and downstream fish passage at the NYPA Projects facilities. The information obtained will allow NYSDEC aquatic biologists and USFWS's fishway engineers to evaluate the potential effectiveness of various options.

2. *Resource Management Goals*

NYSDEC's mission is "to conserve, improve and protect New York's natural resources and environment and to prevent, abate and control water, land and air pollution, in order to enhance the health, safety and welfare of the people of the state and their overall economic and social well-being." The natural resource management goals within the Mohawk River Watershed will be consistent with the Department's mission while focusing on protecting and enhancing fish and wildlife habitat and improving public access.

3. *Public Interest*

The requestor is a state resource agency.

4. *Existing Information*

Some survival studies have already been conducted for the Kaplan turbines, but are limited to juvenile blueback herring. Both NYPA Projects have 3-7/8" clear-spaced trash racks at intake. Downstream fish passage is provided as a space in the flashboards, however these are targeted to protecting blueback herring.

5. *Nexus to Projects Operations and Effects*

Dams block fish movements both upstream and downstream. The turbine intakes may impinge or entrain fish, resulting in mortality. The existing minimum flow/downstream fish passage structures may not be adequate for the downstream passage of fish.

6. *Methodology Consistent with Accepted Practice*

The recommended study uses standard literature reviews and site-specific data collection techniques common to most hydropower licensing activities and satisfactory to meeting the informational needs of the USFWS.

7. *Level of Effort, Cost, and Why Alternative Studies Will Not Suffice*

The level of effort would involve moderate literature review, discussions with fisheries biologists and fishway engineers, and site-specific data collection. The study could be completed in 1 year but may require more time. The actual cost is unknown and would depend upon the number of alternatives examined.

III. Fish Community Study

The Applicant should conduct comprehensive fisheries surveys within the vicinity of the Projects to inform how the Projects impact fish populations and species composition and inform the Fish Protection and Downstream Passage Study. The Applicant should use a variety of gear types during different seasons because the ability of any particular gear type to capture fish is affected by fish species, size and behavior, the in-water physical and hydrological conditions of the sampling site and other seasonal variables. No single gear type is effective for sampling all potential species that may be found in lake or riverine systems; however, multiple gear types used in combination used throughout the season can effectively sample the majority of fish species present.

Comprehensive sampling for fisheries data collection should include some combination of the use of electrofishing, gill netting, trap netting, minnow traps, seining, and angling. The survey work should be done for at least 1 full year; with an option for a second year of study should the data collected be deemed inadequate upon review. The survey should cover at least three seasons (spring, summer, and fall), and all four seasons, if possible. The information collected should include species identification, size, age, sex, and condition, as well as movement patterns and habitat utilization. Standard water quality data (e.g. water temperature, dissolved oxygen, pH, and conductivity) should also be collected in conjunction with these surveys. These studies should focus on the general fishery resources, not only sportfish.

1. *Goals and Objectives*

   The goals and objectives of this study are to provide information on the existing fishery and resources in the vicinity of the NYPA Projects, including areas upstream and downstream of the dam, to aid in the determination of what the impacts of the Projects may be. The information to be collected should include both temporal and spatial aspects of species distribution; age, size, sex and condition data; habitat utilization; and fish movement patterns.

2. *Resource Management Goals*

   NYSDEC's mission is "to conserve, improve and protect New York's natural resources and environment and to prevent, abate and control water, land and air pollution, in order to enhance the health, safety and welfare of the people of the state and their overall economic and social well-being." The natural resource management goals within the Mohawk River Watershed will be consistent with the Department's mission while focusing on protecting and enhancing fish and wildlife habitat and improving public access.

3. *Public Interest*

   The requestor is a state resource agency.

4. *Existing Information*

   Fish surveys have been conducted in the vicinity of the NYPA Projects as documented in the PAD, but the majority have focused on the collection of a select few species, namely sportfish, blueback herring and American eel, and have used limited gear types (boat electrofishing, shore seining) and have a bias for and against specific fish species and therefore do not give a full view of the fish community.

5. *Nexus to Projects Operations and Effects*
   Freshwater fish and their habitat are among the aquatic resources affected by NYPA Projects operations. Knowledge of the fish community currently present, fish size, and age structure throughout the NYPA Projects is essential to adequately evaluate how the operations impact habitat and in turn impacts the fish community; how the fish populations are impacted by entrainment, impingement and passage through turbines; and is essential to inform the Applicant of what actions can minimize negative impacts or enhance benefits to fish and other aquatic resources, should they exist.

6. *Methodology Consistent with Accepted Practice*

   The recommended study uses standard scientific collecting techniques used in most hydropower licensing activities. The Applicant should use a variety of gear types during different seasons because the ability of any particular gear type to capture fish is affected by fish species, size and behavior, the in-water physical and hydrological conditions of the sampling site, and other seasonal variables. No single gear type is effective for sampling all potential species that may be found in lake or riverine systems; however, multiple gear types used in combination used throughout the season can effectively sample the majority of fish species present. Standard water quality data (e.g. water temperature, dissolved oxygen, pH, and conductivity) should also be collected in conjunction with these surveys.

7. *Level of Effort, Cost, and Why Alternative Studies Will Not Suffice*

   The level of effort would involve one field crew sampling on a seasonal basis. The study would last for 1-2 years. The actual cost is unknown and would depend upon the gear types used, number of sampling locations, local labor costs, the ability to combine multiple studies (e.g., fisheries, macroinvertebrates and water quality) into one task, etc. The existing literature provided in the PAD (Section 4.4.2.1) is inadequate to fully address project impacts as they have focused primarily on the collection of sportfish with the last extensive studies completed 30 years ago. In addition, there are no alternatives to conducting standard fishery surveys, however, the Applicant does have flexibility to design the most cost-effective way to acquire the necessary data.

IV. <u>American Eel Study</u>

American eel (*Anguilla rostrata*) has a wide range across the Eastern United States and New York State where it is native in 17 of the 18 watersheds in the state. Eel runs, in which young-of-year juvenile eels (elvers) migrate into freshwater habitat, have long occurred with elvers scaling waterfalls and the faces of dams to access more habitat further inland. Despite their robust nature, the American eel population has been steadily in decline and the construction of dams and the operation of hydropower projects are some of the contributing factors. American eels are not known to travel well through the canal lock system and may even show a preference for dam sites during their upstream migration in the spring. As the American eel has been documented in surveys to inhabit the Mohawk River Watershed, a study is needed to ascertain the presence and abundance of eels and the need to provide them a better mode of upstream and downstream passage.

1. *Goals and Objectives*

   The goals and objectives of this study are to investigate the presence, distribution, and relative abundance of American eel in the NYPA Projects area and assess the need for eel ladders to improve successful and safe upstream passage.

2. *Resource Management Goals*

   NYSDEC's mission is "to conserve, improve and protect New York's natural resources and environment and to prevent, abate and control water, land and air pollution, in order to enhance the health, safety and welfare of the people of the state and their overall economic and social well-being." The natural resource management goals within the Mohawk River Watershed will be consistent with the Department's mission while focusing on protecting and enhancing fish and wildlife habitat and improving public access.

3. *Public Interest*

The requestor is a state resource agency.

4. *Existing Information*

Although caught in low numbers in the past decade, fishery surveys have collected American eels while sampling. There are also historical records of American eel caught in the Mohawk River and adjacent tributaries.

5. *Nexus to Projects Operations and Effects*

Both NYPA Projects have constructed dam structures which pose a migratory hurdle for the American eel in their upstream migration as elvers. While elvers may be able to ascend the dam face, they are also put at a higher risk of predation and will have to expend additional energy to do so. The ability of the American eel to move upstream, and downstream, is of special interest. Additionally, there is concern over the potential of American eel to be entrained by the NYPA Projects resulting in mortalities of out-migrating adults.

6. *Methodology Consistent with Accepted Practice*

The detection of American eel DNA is a less intensive method for detecting simple presence/absence of eel in the NYPA Projects areas. The methods provided by Cornell University's "Tracking Fish with eDNA" (https://fishtracker.vet.cornell.edu/) program should be followed as detailed in Cornell's protocols.

The collection of eels through the deployment of eel pots and eel traps should be employed at the NYPA Projects dams to determine staging of upstream migration and relative abundance of elvers. These sampling efforts are more intensive but would facilitate assessment of both presence and numbers of eels and would be suitable for both the first and second phase of the study. In addition to traps and mops, sampling efforts should include surveying benthic habitat preferred by American eel with nets and/or electrofishing. This would allow for determining relative abundance of all eels, although mainly adults. The recommended study uses standard sampling techniques commonly used in most hydropower licensing activities for an American eel study.

7. Level of Effort, Cost, and Why Alternative Studies Will Not Suffice

The level of effort would involve one field crew. The study would last for 1-2 years. The actual cost is unknown and would depend upon the methods used, number of sampling locations, local labor costs, the ability to combine multiple studies (e.g., fisheries, macroinvertebrates, and water quality) into one task, etc. The existing literature provided in the PAD (Section 4.4.2.3) is inadequate to fully address Projects impacts, however, the Applicant has flexibility to design the most cost-effective way to acquire the necessary data and may combine efforts with other study efforts.

V. Aquatic Mesohabitat Study

The Applicant should conduct a mesohabitat study of all fluvial parts of the NYPA Projects area including mapping of these areas. The study should identify both mapped and unmapped wetlands, as well as aquatic vegetation and substrate within the Project area. This study may help with other studies, such as the freshwater mussel survey. Understanding the available aquatic habitat is beneficial to developing management plans for sportfish species which may utilize different habitats for different purposes, such as wetlands, flooded shoreline, and shallow vegetated areas as nurseries and rocky outcrops for protection from flows. Similar information may also be useful in identifying where certain species may be localized based on their habitat preferences.

1. *Goals and Objectives*

   The goals and objectives of this study are to map the distribution and abundance of aquatic mesohabitat within the NYPA Projects area, evaluate the types of aquatic habitats that occur there, and identify potential effects of the NYPA Projects operations on this habitat and its quality.

2. *Resource Management Goals*

   NYSDEC's mission is "to conserve, improve and protect New York's natural resources and environment and to prevent, abate and control water, land and air pollution, in order to enhance the health, safety and welfare of the people of the state and their overall economic and social well-being." The natural resource management goals within the Mohawk River Watershed will be consistent with the Department’s mission while focusing on protecting and enhancing fish and wildlife habitat and improving public access.

3. *Public Interest*

   The requestor is a state resource agency.

4. *Existing Information*

   State regulated freshwater wetlands and regulated adjacent areas are located within the NYPA Projects area. General classification of the habitat has been assigned, such as impoundment or pool, but are lacking in descriptors (e.g. bottom type, substrate size, vegetation, etc.).

5. *Nexus to Projects Operations and Effects*

   Freshwater fish and their habitat are among the aquatic resources affected by NYPA Projects operations. Knowledge of the aquatic habitats throughout the NYPA Projects is essential to adequately evaluate how the operations impact habitat and, in turn, impacts the fish community. It is important to know what actions can minimize negative impacts or enhance benefits to fish and other aquatic resources, should they exist.

6. *Methodology Consistent with Accepted Practice*

   The recommended study uses standard sampling techniques commonly used in most hydropower licensing activities. This may involve a combination of desktop studies and on-site field work.

7. *Level of Effort, Cost, and Why Alternative Studies Will Not Suffice*

   The level of effort would be low and would likely involve a small crew for field work and be able to be completed in 1-year's effort. The actual cost is unknown but is anticipated to be relatively low, particularly if combined with other study efforts.

VI. Project Operations Study

The Applicant should conduct a study on the operations of the NYPA Projects. Data of interest would include impoundment elevation, power generation, flows (through the turbines, downstream fish passage, and minimum flows), and leakage measurements. A demonstration of the ramping rates both up and down would also be of interest. This will provide supporting evidence that the NYPA Projects are operating in run-of-river mode[2] and demonstrate what actions are being taken to avoid impoundment drawdowns, varied downstream flows, and are meeting the necessary conservation and downstream fish passage flows.

1. *Goals and Objectives*

   The goals and objectives of this study are to provide insight to how the NYPA Projects operate and follow a run-of-river operations scheme. In addition, the leakages through the flashboards are merely an estimation and are meant to contribute towards the minimum flows, having a more accurate measurement of the leakages would be meaningful both for the Department and the Applicant.

2. *Resource Management Goals*

   NYSDEC's mission is "to conserve, improve and protect New York's natural resources and environment and to prevent, abate and control water, land and air pollution, in order to enhance the health, safety and welfare of the people of the state and their overall economic and social well-being." The natural resource management goals within the Mohawk River Watershed will be consistent with the Department's mission while focusing on protecting and enhancing fish and wildlife habitat and improving public access.

3. *Public Interest*

   The requestor is a state resource agency.

4. *Existing Information*

   The nearest USGS gages are 01356000, located 180' upstream of the Vischer Ferry Project (FERC No. 4679) and monitors gage height, and 01357500, located at the School Street Project hydroelectric plant and monitors both discharge and gage height.

5. *Nexus to Projects Operations and Effects*

   The mode of operation for a hydropower project can have a variety of effects on the riverine system that it inhabits. The least impactful mode is run-of-river, which not only is

[2] Run-of-river operational mode is when a hydropower project operates using the natural flow of the river, not stored pondage, and does not create modified or varied flows (peaks and pulses) in the downstream reaches of the waterway it operates on.

of greater benefit to the riverine ecosystem, but also limits impacts to other hydropower projects, and their operations, which may be located downstream. The NYPA Projects have several other hydropower projects located downstream, including the School Street Project (FERC No. 2539), whose operations could be affected by the operations of the NYPA Projects.

6. *Methodology Consistent with Accepted Practice*

   The recommended study uses standard techniques commonly used in most hydropower licensing activities, typically in the form of desktop analysis.

7. *Level of Effort, Cost, and Why Alternative Studies Will Not Suffice*

   The level of effort is estimated to be low and would likely involve a majority of desktop analysis, keeping costs low as well. A single year's worth of effort would be needed to complete this study, providing no anomalous conditions arise.

We appreciate the opportunity to comment. If you have any questions or would like to discuss further, please feel free to contact me at 518-402-9179 or michael.higgins@dec.ny.gov.

Sincerely,

Michael T. Higgins
Project Manager
Major Projects Management

CC: Nicole Cain, NYSDEC, Bureau of Ecosystem Health
Chris VanMaaren, NYSDEC, Region 4
Mary Anne Bonilla, Office of General Counsel

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
3817 Luker Road
Cortland, New York 13045

(ER 19/0251)
FERC Nos. 4678-052 and 4679-049

August 8, 2019

Ms. Tara Groom
New York Power Authority
30 South Pearl St.
Albany, NY 12207

RE: Crescent and Vischer Ferry Hydroelectric Projects (FERC Nos. 4678 and 4679) Comments on Pre-Application Document, Scoping Document 1, and Study Requests

Dear Ms. Groom:

The U.S. Fish and Wildlife Service (Service) has reviewed the May 3, 2019, Pre-Application Document (PAD) filed by the Power Authority of the State of New York (Applicant) for the Crescent and Vischer Ferry Hydroelectric Projects (Project or Projects) (FERC Nos. 4678 and 4679), located on the Mohawk River in Schenectady, Albany, and Saratoga Counties, New York. We have also reviewed the June 10, 2019, Scoping Document 1 issued by the Federal Energy Regulatory Commission (FERC). The Service is submitting our study requests herein.

Existing Project Description

The Crescent Project is located at the upstream end of the Waterford Flight on the New York State Barge Canal at Lock E-6 and consists of two main concrete gravity dams (Dams A and B) that are curved, have a total length of 1,435 feet, and link each bank to a rock island in the middle of the Mohawk River. The Project impoundment extends upstream 10 miles to the Vischer Ferry Project, has a surface area of 2,000 acres, and holds 50,000 acre-feet of water at the normal pool elevation of 184 feet. The 1 foot high wooden flashboards are installed seasonally during the canal navigation season (generally May through October). A third, smaller dam (Dam C), provides added structural stability for Dam B by impounding water to approximately 4.5 feet deep against the downstream toe of Dam B. Two regulating structures, a 30-foot-wide Tainter gate and an 8 foot wide ice/trash sluice gate, are located on the western side of Dam B. The powerhouse is 180 feet long and 73 feet wide, integral with Dam B, and has four turbine-generator units: two vertical Kaplan turbines (with a rated capacity of 3.0 megawatts

[MW] each) and two vertical Francis turbines (with a rated capacity of 2.8 MW each). The Project also contains a switchyard, generator leads, transformer banks, and appurtenant facilities.

The Vischer Ferry Project is located at the New York State Barge Canal Lock E-7 and consists of three connected concrete gravity dams (Dams D, E, and F) having a total length of 1,919 feet. Dams D and F are 30 feet high, while Dam E varies in height from 1 to 3 feet above Goat Island, located in the middle of the river. The Project impoundment extends 10.3 miles upstream to Lock E-8 in Schenectady, New York, and has a surface area of 1,050 acres and holds 25,000 acre-feet of water at the normal pool elevation of 211 feet. The 27 inch high wooden flashboards are seasonally installed during the canal navigation season (generally May through October). Regulating structures are present along the Project's headrace and include seven sluice gates. Six of these gates have openings that are 14 feet high by 8 feet wide with sill elevations of 202.1 feet; the seventh opening is used as a trash sluice and is 12 feet high and 8 feet wide with a sill elevation of 190 feet. The powerhouse is 186 feet long and 73 feet wide, integral with Dam F, and similar to the Crescent Project, has four turbine-generator units: two vertical Kaplan turbines (with a rated capacity of 3.0 MW each) and two vertical Francis turbines (with a rated capacity of 2.8 MW each). The Project also contains a switchyard, generator leads, transformer banks, and appurtenant facilities.

Both Projects are operated as run-of-river (ROR) hydroelectric facilities. The Crescent Project has a required minimum flow downstream of 100 cubic feet per second (cfs), which is increased to 250 cfs during the navigation season. The Vischer Ferry Project has a required minimum flow downstream of 200 cfs, year-round. Both Projects utilize an acoustic deterrent system to guide blueback herring (*Alosa aestivalis*) away from the Projects' intakes and toward flashboard openings for downstream passage. At the Crescent Project, the flashboard opening is located on Dam A and is designed to release 250 cfs. At the Vischer Ferry Project, two flashboard openings are utilized at different distances from the intakes. An opening at the river right end of the Dam F is provided from May through July for adult blueback herring and an opening near the center of Dam F is provided from September through November for juvenile blueback herring. Both openings are designed to release approximately 90 cfs. Each Project has four turbine-generating units and a total authorized installed capacity of 11.8 MW. The average annual generation of the Crescent Project and the Vischer Ferry Project from 2009 through 2018 was 58,456 megawatt-hours (MWh) and 50,601 MWh, respectively.

Study Requests

The Service requests that the Applicant conduct the following studies to address information gaps in the PAD and provide the information necessary to assess the effects of the Projects and determine appropriate Protection, Mitigation, and Enhancement (PME) measures.

I. Blueback Herring Migration and Routing Study

The Applicant currently utilizes a hydroacoustic deterrent system to direct downstream migrating blueback herring away from each Project's intake to limit entrainment. The Service will be evaluating the efficacy of this method during relicensing to inform our Section 18 Fishway Prescription conditions for the Projects. Of note, the difficulty in installing this system in the spring prior to the start of the navigation season was problematic this year and has been an issue in the past. The cumulative impacts of entrainment through the six hydroelectric projects in the lower Mohawk and Hudson Rivers require particularly low entrainment rates[1] at each project in order to maintain a high escapement rate. This issue has become increasingly important in light of the decline in blueback herring in the system, and the Atlantic Coast more broadly.

The Service recommends that the Applicant conduct a detailed, 2 year, fisheries study utilizing a variety of hydroacoustic, tagging, netting, and general fisheries methods to determine the abundance, timing, and routing of the upstream adult and downstream adult and juvenile migration of blueback herring in relation to the dam, powerhouse, fish bypass, and lock facilities at the Project.

1. *Goals and Objectives*

The goals and objectives of this study are to determine the abundance, timing, and routing of the upstream adult and downstream adult and juvenile migration of blueback herring in relation to the dam, powerhouse, fish bypass, and lock facilities at the Project.

2. *Resource Management Goals*

The Mohawk River, in the vicinity of the Projects, is managed by the New York State Department of Environmental Conservation (NYSDEC) as a mixed coolwater/warmwater fishery. The NYSDEC's fishery management goals include sustaining and enhancing all existing viable fisheries resources of the Mohawk River, especially for blueback herring, smallmouth bass, (*Micropterus dolomieu*), northern pike (*Esox lucius*), chain pickerel (*E. niger*), walleye (*Sander vitreus*), yellow perch (*Perca flavescens*), and sunfish (Family: *Centrarchidae*). The Atlantic States Marine Fisheries Commission (ASMFC) regulates river herring stocks in New York and has the stated goal to protect, enhance, and restore East Coast migratory spawning stocks of blueback herring in order to achieve stock restoration and maintain sustainable levels of spawning stock biomass.[2]

3. *Public Interest*

The requestor is a resource agency.

4. *Existing Information*

The Projects currently provide downstream passage for adult and juvenile blueback herring during the navigation season. Recent changes in the navigation season have shortened this period from ending in November to ending in October. The Applicant currently utilizes a hydroacoustic deterrent system to direct downstream migrating blueback herring away from the Projects' intakes to limit entrainment. At the Crescent Project, a flashboard opening is provided

[1] Even a 90% survival rate through each Project would result in the loss of approximately one-half of the total run.
[2] ASMFC. 2010. Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management). 158pp.

during the navigation season in Dam A with a 250 cfs attraction flow.[3] At the Vischer Ferry Project, a flashboard opening releasing approximately 90 cfs is provided from May through July for adult blueback herring and from September through November at a location closer to the intakes for juvenile blueback herring. Both Projects have 3-7/8 inch clear-spaced trashracks.

Section 4.4.3.3 of the PAD describes the fish passage studies that have been conducted at the Projects. Entrainment mortality for juvenile blueback herring was evaluated in a 1996 study that estimated a 96 ± 7% survival through the Kaplan turbines. While the data were not provided in the PAD, it is our understanding that the estimated survival through the Francis turbines was approximately 70%. Survival of adult blueback herring was not studied. The PAD states that the fish bypass rates for the Vischer Ferry and Crescent Projects are approximately 90% and 77%, respectively. No information is provided regarding the proportion of fish passing through the adjacent locks or over the spillway, or the delay associated with the current methods of downstream passage, especially as it pertains to movement through both Projects sequentially.

Canal operations have changed considerably in the previous several decades. Other studies[4] in the Mohawk River have found that a lower number of lockages run each day can notably increase the proportion of fish passing through a project's intake. Conservatively, there has been a 70% decline in the number of lockages due to decreased usage of the canal system.[5] Additionally, climate changes have resulted in significant increases in early season water temperatures in the Hudson River Basin since the early 1990s and increases in late season discharges that are key drivers of blueback herring migration periods.

Particularly notable for juvenile out-migration is the change in the operating season of the canal locks since 2017. The navigation season during all of the previous studies at the Projects extended until roughly mid-November each year, while it now ends on or around October 10. Out-migration can occur in late October to early November, which is now outside of the navigation period. Additionally, with the general decrease in available lockages, there are currently many fewer opportunities for all blueback herring to pass through the locks, even during the navigation season.

While a variety of studies related to blueback herring migration and passage have been conducted at the Projects, there are no studies that provide data on the routing and timing of the migration of the species through both Projects under the current license conditions (i.e., ROR operations), fish passage design, lockage frequency, and restricted navigation period. The fish passage requirements at the Vischer Ferry Project are also inconsistent with current requirements at downstream projects on the Mohawk River that initiate juvenile downstream protection measures as early as August 1, in contrast to the September date at the Project, and hydroacoustic

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[3] We note that at the July 10, 2019, site visit, the Applicant indicated that they generally hold the reservoir elevation between 0.1 and 0.2 feet below the crest of the flashboards, which only provides an attraction flow of approximately 185 to 220 cfs.

[4] Barnes-Williams Environmental Consultants. 1989. Report on the 1988 Juvenile Blueback Herring Emigration at the Little Falls Hydroelectric Station. 23 pp.

[5] The canal system has evolved from a commercial waterway to one primarily utilized for recreational purposes. The New York State Canal Corporation (NYSCC) noted that 1989 was the peak year for recreational lockages with 159,141 (NYSCC 2008 Annual Report). The total number of recreational lockages in 2015 was noted as 47,083 (NYSCC 2015 Annual Report).

data at the New York State Dam (FERC No. 7481) suggests that out-migration may start sooner than August 1.

The Service is concerned with the lack of current information regarding blueback herring movement at the Projects. Repeated entrainment through hydroelectric projects in the Mohawk and Hudson Rivers can dramatically reduce the number of out-migrating young-of-year and repeat-spawners from the Mohawk River, which are a component of the East Coast population of blueback herring as managed by the ASMFC. The Projects may contribute to a net loss of individuals in the coastal population by reducing the success of out-migrating individuals compared to the population without access to the additional habitat in the Mohawk River.

5. *Nexus to Project Operations and Effects*

The Projects' dams serve as barriers to upstream and downstream fish migration. Fish moving downstream are subjected to potential mortality from impingement and entrainment. The Projects divert the majority of the flows from the river channel into the turbines, except during high flow spillage events.

6. *Methodology Consistent with Accepted Practice*

The Service recommends a thorough fisheries study targeted at the timing and routing of blueback herring at the Projects. This study should be developed in consultation with, and approved by, the Service and the NYSDEC. The Applicant should use a variety of hydroacoustic, tagging, and netting techniques to assess the timing and population size of the migration of blueback herring at the Projects. Additionally, this study should determine the routing of blueback herring during both upstream and downstream migration. The study should assess the degree to which the species moves upstream through the locks or stages below the Projects' tailraces. This study should cover the entire migration period, both upstream and downstream for adults and downstream for juveniles, as determined by the Service and the NYSDEC. The study should focus on movement into the Projects' area, targeting the canal locks, the intakes, the fish bypasses, the turbines, and upstream from the canal and Projects' dams. Due to highly variable migration numbers and periods from year-to-year, this study should be conducted for 2 years. The study should be supplemented with general fisheries information as needed to determine the proportion of any acoustically monitored targets that are blueback herring. We recommend that a variety of sampling gear, including gill nets, trap nets, seines, and electroshocking, be used as appropriate for site conditions. This study should use standard scientific collecting techniques used in many hydroelectric licensing studies related to river herring movement. Information normally collected includes species, size, age, sex, and condition, as well as any specific habitat information (i.e. substrate, water depth, velocity conditions). Standard water quality data (i.e., water temperature, dissolved oxygen [DO], pH, and conductivity) are usually collected in conjunction with these surveys.

7. *Level of Effort, Cost, and Why Alternative Studies Will Not Suffice*

The level of effort would involve a field crew sampling the migration period for 2 years. The actual cost is unknown and would depend upon the gear types used, number of sampling locations, local labor costs, the ability to combine multiple studies (e.g., fisheries and water quality) into one task, etc. No alternative studies have been proposed, and there are no known alternatives to conducting these surveys. However, the Applicant has flexibility to design the most effective way to acquire the necessary data as approved by the Service and the NYSDEC.

II. American Eel Study

The Service is requesting a study of American eel (*Anguilla rostrata*) occurrence in the vicinity of the Projects. American eel are known to occur in the lower Mohawk River; however, the actual abundance and distribution in the vicinity of the Projects is unknown as downstream dams and canal lockages (i.e., eel generally move at night and lockages are during the day) may limit the abundance of eel above Cohoes Falls and above and below the Projects. This information will inform our Section 18 Fishway Prescription conditions.

1. *Goals and Objectives*

The goals and objectives of this study are to determine the distribution and relative abundance of American eel in the Project boundary. The Service may recommend additional upstream and downstream study efforts pertaining to passage for this species depending on the outcome of this study.

2. *Resource Management Goals*

The Mohawk River, in the vicinity of the Project, is managed by the NYSDEC as a mixed coolwater/warmwater fishery. The NYSDEC's fishery management goals include sustaining and enhancing all existing viable fisheries resources of the Mohawk River, especially for blueback herring, smallmouth bass, northern pike, chain pickerel, walleye, yellow perch, and sunfish. The ASMFC regulates coastal American eel stocks and has the stated goal to conserve and protect the American eel resource to ensure its continued role in its ecosystems while providing the opportunity for commercial, recreational, scientific, and educational uses.[6]

3. *Public Interest*

The requestor is a resource agency.

4. *Existing Information*

Section 4.4.2.3 of the PAD provides information regarding American eel in the Mohawk River watershed; however, no detailed survey or distribution information is provided.

5. *Nexus to Projects Operations and Effects*

The Projects' dams impound the Mohawk River and restrict the movement of aquatic species, including American eel. The Project intakes can entrain fish and cause mortality of adult out-migrating silver eel, limiting their reproduction potential.

[6] ASMFC. 2000. Interstate Fishery Management Plan for American Eel (*Anguilla rostrata*). 79 pp.

6. *Methodology Consistent with Accepted Practice*

The Applicant should utilize standard fishery practices including nighttime electrofishing and eel traps/eel pots. The level of effort would involve one field crew sampling on a seasonal basis with a focus on upstream and downstream migration and location of adult eels. The study would last for 1-2 years. It could be conducted along with other fisheries sampling activities as requested by the NYSDEC. The actual cost is unknown and would depend upon the gear type used, number of sampling locations, local labor costs, the ability to combine multiple studies (e.g., fisheries and water quality) into one task, etc. The provided literature is currently inadequate to fully address Project impacts, and there are no alternatives to conducting eel surveys. However, the Applicant has flexibility to design the most cost-effective way to acquire the necessary data.

7. *Level of Effort, Cost, and Why Alternative Studies Will Not Suffice*

The level of effort would involve one field crew. The study would last for 1-2 years. The actual cost is unknown and would depend upon the method used, number of sampling locations, local labor costs, the ability to combine multiple studies (e.g., fisheries, mussels, and water quality) into one task, etc. The existing literature is inadequate to fully address the Projects impacts; however, the Applicant has flexibility to design the most cost-effective way to acquire the necessary data.

III. Fish Protection and Downstream Passage Studies

The Service recommends that the Applicant prepare an assessment of entrainment and mortality at the Projects and explore potential alternative methods to exclude fish from the Projects' turbines and safely pass fish downstream. This study should collect site-specific data and reference available literature regarding target fish species and impacts at similar hydroelectric sites.

1. *Goals and Objectives*

The goals and objectives of this study are to provide information on impacts due to fish entrainment and mortality and potential fish passage and protection structures that could be utilized at the Projects. The information obtained will allow the Service's fishway engineers to evaluate the potential effectiveness of various options.

2. *Resource Management Goals*

The Mohawk River, in the vicinity of the Projects, is managed by the NYSDEC as a mixed coolwater/warmwater fishery. The NYSDEC's fishery management goals include sustaining and enhancing all existing viable fisheries resources of the Mohawk River, especially for blueback herring, smallmouth bass, northern pike, chain pickerel, walleye, yellow perch, and sunfish. The ASMFC regulates river herring stocks in New York and has the stated goal to protect, enhance, and restore East Coast migratory spawning stocks of blueback herring in order to achieve stock restoration and maintain sustainable levels of spawning stock biomass. The ASMFC regulates coastal American eel stocks and has the stated goal to conserve and protect the American eel resource to ensure its continued role in its ecosystems while providing the opportunity for commercial, recreational, scientific, and educational uses.

3. *Public Interest*

The requestor is a resource agency.

4. *Existing Information*

Section 4.4.3.3 in the PAD indicates that the Projects have 3-7/8-inch-clear-spaced trashracks and describes the downstream fish passage and protection measures at the Projects, as identified above. This section also describes entrainment studies focused on juvenile blueback herring; however, there is no information in the PAD regarding fish entrainment or mortality at the Projects for adult blueback herring or other species.

5. *Nexus to Project Operations and Effects*

The Projects' dams serve as barriers to fish migration. Fish moving downstream are subjected to potential mortality from impingement and entrainment. New licenses issued for projects throughout New York and the northeast have incorporated 1 inch clear spaced trashracks (3/4" clear-spaced trashracks for American eel) to physically exclude most adult fish from the turbines, alternate downstream passage routes, and other features (e.g., reduced approach velocities, adequate plunge pools, etc.) to encourage safe downstream fish passage.

6. *Methodology Consistent with Accepted Practice*

The recommended study uses standard literature reviews and site-specific data collection techniques common to most hydroelectric licensing activities. The Service recommends that the Applicant explore alternatives to keep all fish species out of the turbines. We also recommend that alternatives to effectively pass fish downstream around the dams be developed. These alternatives may include any existing trash sluices located close to the intakes.

A good starting point would be a literature search of available passage designs for the species of concern, as well as information on the relative effectiveness of each design. Existing facilities on the Mohawk River and at other similar dams can be investigated. Attraction flows, guidance mechanisms, and velocities are important components of an effective fish protection and downstream passage system. An effective system also diverts fish away from the turbines and guides them to the downstream passage facility. Adequate attraction and conveyance flows are critical to the proper functioning of the fishway. A passage facility that creates a bottleneck could delay downstream movement or expose the fish to excessive predation. The Service recommends that all passage facilities be designed to prevent blockage from ice and debris and be as maintenance-free as is feasible. Effective systems must be able to operate under all flow conditions experienced in the Mohawk River.

Currently, each project on the Mohawk River uses a unique protection/passage design. The pros and cons of each system and their applicability to Crescent and Vischer Ferry should be explored. Little Falls (FERC #3509) uses a punch-plate overlay and passage sluice system. School Street (FERC #2539) uses a 1'-clear-spaced angled trashrack (with solid bottom plate to guide American eel) and bypass pipe. New York State Dam (FERC #7481) utilizes a hydroacoustic warning system with incremental passage flows and unit shutdowns to guide fish through a bypass. Green Island (FERC #13), located on the Hudson River just downstream from the mouth of the Mohawk River, is installing a promising, but still experimental, proprietary passive exclusion screen and fish bypass system.

The Service recommends, in addition to literature review and on-site investigations of existing facilities, that the Applicant collect site-specific data from the Projects to aid in the design of protection and passage facilities. This information would include flows, velocities, water depths, and substrates.

We also recommend that the Applicant collect information on the passage requirements of the fish species found in the Mohawk River. This information includes swimming speeds (including burst speeds), where in the water column these fish are likely to be moving, different forms of attractants or repellents (e.g., sound, light, etc.) that may help guide each species, etc.

7. *Level of Effort, Cost, and Why Alternative Studies Will Not Suffice*

The level of effort would involve moderate literature review, discussions with fishway engineers, and site-specific data collection. The study could be completed in less than 1 year, but may require more time to design effective facilities. The actual cost is unknown and would depend upon the number of alternatives examined. No alternative studies have been proposed.

IV. Freshwater Mussel Surveys

The Service recommends that the Applicant conduct a thorough freshwater mussel survey at the Projects. The study should use a variety of shallow and deep-water techniques approved by the NYSDEC.

1. *Goals and Objectives*

The goals and objectives of this study are to provide information on the existing freshwater mussel communities that may be impacted by Project operations. This information will be used to document the current mussel communities to determine potential impacts from the operation of the Projects.

2. *Resource Management Goals*

The Mohawk River, in the vicinity of the Projects, is managed by the NYSDEC as a mixed coolwater/warmwater fishery. The NYSDEC's fishery management goals include sustaining and enhancing all existing viable fisheries resources of the Mohawk River, especially for blueback herring, smallmouth bass, northern pike, chain pickerel, walleye, yellow perch, and sunfish. The

Mohawk River, along with the Erie Barge Canal, is listed as an S1/S2[7] river for freshwater mussels by the New York Natural Heritage Program.

3. *Public Interest*

The requestor is a resource agency.

4. *Existing Information*

In Section 4.4.7, the PAD provides a table of possible freshwater mussel species that may occur in the vicinity of the Projects. Additional information is needed to determine their actual abundance and distribution.

5. *Nexus to Project Operations and Effects*

Freshwater mussels and other aquatic macroinvertebrates are important components of the ecosystem in the Mohawk River. The Projects affect water levels in the impoundments and flows downstream from the dams. Mussel communities can be impacted by these water level and flow fluctuations. The dams block fish movements both upstream and downstream. Mussels rely on fish for the movement of their progeny and reproductive success.

6. *Methodology Consistent with Accepted Practice*

The recommended study uses standard scientific collecting techniques common to most hydroelectric licensing activities. Standard sampling techniques targeting mussel populations should be utilized. The Applicant should follow specific study guidelines as recommended by the NYSDEC for freshwater mussels.

7. *Level of Effort, Cost, and Why Alternative Studies Will Not Suffice*

The level of effort would involve one field crew sampling on a seasonal basis. The study would last for 1-2 years. The actual cost is unknown and would depend upon the gear types used, number of sampling locations, local labor costs, the ability to combine multiple studies (e.g., fisheries and water quality) into one task, etc.

V. Aquatic Mesohabitat Study

The Service recommends that the Applicant verify all key aquatic habitats at the Projects, including wetlands and submerged aquatic vegetation. This study will involve verification of existing data and mapping of occurrence to update the information on these habitats for the Projects.

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[7] S1: Critically imperiled, typically 5 or fewer occurrences, very few remaining individuals, acres, or miles of stream, or some factor of its biology making it especially vulnerable in New York State. S2: Imperiled statewide because of rarity, typically 6 to 20 occurrences, few remaining individuals, acres, or miles of stream, or factors demonstrably making it very vulnerable in New York State.

1. *Goals and Objectives*

The goals and objectives of this study are to identify key aquatic habitat areas that may be affected by Project operations. The study will provide information on the extent and quality of aquatic habitats and the wildlife they support.

2. *Resource Management Goals*

The Mohawk River, in the vicinity of the Projects, is managed by the NYSDEC as a mixed coolwater/warmwater fishery. The NYSDEC's fishery management goals include sustaining and enhancing all existing viable fisheries resources of the Mohawk River, especially for blueback herring, smallmouth bass, northern pike, chain pickerel, walleye, yellow perch, and sunfish. The Mohawk River, along with the Erie Barge Canal, is listed as an S1/S2 river for freshwater mussels by the New York Natural Heritage Program.

3. *Public Interest*

The requestor is a resource agency.

4. *Existing Information*

In Section 4.6, the PAD summarizes the Service's National Wetlands Inventory (NWI) and the NYSDEC delineations of wetlands that may be affected by Project operations; however, these surveys are not precise enough to capture all regulated wetlands, thus there is a need for confirmation of wetland vegetation in the vicinity of the Projects. Little specific information is included in the PAD regarding aquatic vegetation or shoreline habitats.

5. *Nexus to Project Operations and Effects*

The Projects are currently authorized to use 1-foot (Crescent) and 3-foot (Vischer Ferry) flashboards that seasonally raise and lower the Projects' impoundments, which can impact shoreline and aquatic habitats that are important habitats for fish and wildlife. The information will be used to determine what, if any, impacts the Projects are having on these resources and what the appropriate PME measures might be.

6. *Methodology Consistent with Accepted Practice*

The Service recommends that the Applicant document all wetlands and other aquatic vegetation that may be affected by Project operations. The NWI maps are frequently used as the starting point in identifying wetlands. The Applicant should confirm the boundaries of any wetlands identified in the PAD and conduct an additional search for any wetland areas at the Projects. Submerged aquatic vegetation in the impoundments should be mapped and identified. Shoreline areas of erosion, fish nesting, and mussel beds or middens should also be mapped. The Service is not requesting detailed delineation of wetlands at the Projects.

7. *Level of Effort, Cost, and Why Alternative Studies Will Not Suffice*

The level of effort and cost are relatively low. We recommend this study to ensure that there are no gaps in the aquatic mesohabitat information and to provide spatial data for important aquatic mesohabitats at the Projects. No alternative studies have been proposed.

VI. Water Quality

The Service recommends that the Applicant conduct a thorough water quality assessment at the Projects. The study should provide relevant water quality information to determine if the Projects meet minimum water quality standards for the preservation of beneficial uses at the Projects including fish and wildlife habitat and recreation.

1. *Goals and Objectives*

The goals and objectives of this study are to provide baseline water quality information to allow a proper determination of the potential impacts at the Projects. These data are necessary to evaluate how water quality may influence the current condition of the fishery.

2. *Resource Management Goals*

The Mohawk River, in the vicinity of the Projects, is managed by the NYSDEC as a mixed coolwater/warmwater fishery. The NYSDEC's fishery management goals include sustaining and enhancing all existing viable fisheries resources of the Mohawk River, especially for blueback herring, smallmouth bass, northern pike, chain pickerel, walleye, yellow perch, and sunfish. The Mohawk River, along with the Erie Barge Canal, is listed as an S1/S2 river for freshwater mussels by the New York Natural Heritage Program.

3. *Public Interest*

The requestor is a resource agency.

4. *Existing Information*

In Section 4.3.2.4, the PAD indicates that while there is extensive water quality data for the Mohawk River, there is no known water quality data collected in the vicinity of the Projects.

5. *Nexus to Project Operations and Effects*

The Projects release water downstream from their impoundments, which could impact such water quality factors as temperature and DO, which are critical to the quality of the aquatic habitat.

6. *Methodology Consistent with Accepted Practice*

The recommended study uses standard scientific water quality sampling techniques used in most hydroelectric licensing activities. These studies should include water temperature and DO monitoring on a continuous basis for at least 1 year, along with monthly sampling of other parameters such as chlorophyll content, pH, turbidity, and conductivity. An additional year of monitoring may be requested based on a review of the first year's results. This information will be used to document baseline water quality conditions and to determine potential impacts from Project operations. We recommend that water quality data be collected from vertical profiles in the impoundments and below the powerhouses at the Projects. As the Projects' dams are wide, distal portions of the downstream reach below the dam may not be adequately watered by current spillage. The Applicant should record continuous water quality data below the dams near the canal locks. The data should be presented in conjunction with generation at the Projects, noting which units were operating and any unit trips, as well as flows in the bypassed reaches. Data from the downstream U.S. Geological Survey (USGS) Cohoes gauge should also be provided, along with daily rainfall and temperature data.

7. *Level of Effort, Cost, and Why Alternative Studies Will Not Suffice*

The level of effort would be moderate and could involve a crew monitoring continuous measurement devices and collecting monthly samples while undertaking other work such as fisheries or macroinvertebrate surveys. In addition, temperature and DO loggers could be installed, with data being periodically downloaded. The actual cost is unknown but would be relatively low. In Section 5.2 of the PAD, the Applicant has proposed to conduct a water quality study in consultation with the Service and the NYSDEC.

VII. Run-of-River Compliance Study

The Service recommends that the Applicant conduct a ROR compliance study to evaluate Project operations and the influence they may have on downstream flows. Project operations, including unit trips, unit start-ups, and flashboard condition can have notable impacts on downstream flows and the aquatic communities in the Mohawk River.

1. Goals and Objectives

The goal of this study is to evaluate ROR compliance at the Projects and to determine what impacts the Projects may have on downstream flows. The objectives of this study are to: 1) record generation, operations, impoundment levels, and flows at the Projects; and 2) produce figures of these Projects and flow data for evaluation of ROR compliance.

2. Resource Management Goals

The Mohawk River, in the vicinity of the Projects, is managed by the NYSDEC as a mixed coolwater/warmwater fishery. The NYSDEC's fishery management goals include sustaining and enhancing all existing viable fisheries resources of the Mohawk River, especially for blueback herring, smallmouth bass, northern pike, chain pickerel, walleye, yellow perch, and sunfish. The

ASMFC regulates river herring stocks in New York and has the stated goal to protect, enhance, and restore East Coast migratory spawning stocks of blueback herring in order to achieve stock restoration and maintain sustainable levels of spawning stock biomass. The Mohawk River, along with the Erie Barge Canal, is listed as an S1/S2 river for freshwater mussels by the New York Natural Heritage Program.

3. Public Interest

The requestor is a resource agency.

4. Existing Information

The PAD provides no information regarding fluctuations at the USGS Cohoes gauge or whether the fluctuations may be a result of the operations of the Projects. The Projects' operations are described as ROR; however, the methods utilized to achieve ROR are not defined in the PAD. The Francis turbines at the Projects, in particular, are generally operated at full gate and the ramping up and down of these units may dramatically affect downstream flows.

5. Nexus to Project Operations and Effects

The Projects are licensed to operate in a ROR mode. However, downstream fluctuations are occurring on the Mohawk River that do not appear to be solely the cause of the operation of upstream projects. Project operations need to be evaluated to determine the source of these fluctuations. In rivers with multiple hydroelectric projects attempting to operate in a ROR fashion, there is often a difficulty in maintaining river flows depending on how each project is operated. Fluctuations downstream decrease the value of the habitat for fish and other aquatic organisms.

6. Methodology Consistent with Accepted Practice

The Service recommends that the Applicant provide a narrative in the Proposed Study Plan (PSP) of how the Applicant operates the Project to maintain ROR flows. This narrative would be most effective if it is described as follows: 1) how the units come on and off line in relation to headpond elevations and river flows and ramping rates for the units; 2) how often the units are operated in a manual mode and how ROR operations are maintained when these situations occur; and, 3) how the system is adjusted to accommodate circumstances when the flashboards are partially tripped, as was observed during the site visit.

In order to evaluate ROR compliance, the Service recommends that the Applicant install real-time monitors to record generation for each turbine and water-level sensors that should record: 1) headpond elevations; 2) incoming flows from upstream of the impoundments; and 3) downstream flows below the Projects. One additional monitor should be placed in the vicinity of the Cohoes USGS gauge to verify the accuracy of the methods employed against a known source of reliable flow data. A sensor should also be placed at the Projects to record barometric pressure, such that the depths recorded by the water-level sensors can be adjusted for pressure changes. The sensors should record data at 15-minute intervals, and be in place from May 1 through October 31. The Applicant should utilize flow-metering devices to measure flows at the monitored stream locations over a range of low to high flows to develop rating curves for discharge at these sites.

Flows, water levels, and generation data should be presented in bi-weekly intervals on a scale that allows for interpretation of low-flow periods. Times when the Projects are operated in a manual mode, when there are unit trips, start-ups or shut-downs, and when the flashboards are repaired, fail, or are partially breached, should be indicated. The programmable logic control settings for the Project should be provided and clearly noted whenever they are changed throughout the study period. Any deviations from these protocols provided in the PSP should be explained in the Study Report.

7. Level of Effort, Cost, and Why Alternative Studies Will Not Suffice

The recommended study uses standard monitoring and flow observation techniques that have been used in many hydro licensing activities. The level of effort would be relatively low and involve installation of monitoring equipment, regular downloading of data, and the measurement of discharge-rating curve flows. Quality assessment and control and data presentation will require a moderate level of effort to ensure accurate and interpretable results from the study.

* * * * *

The Service recommends that the PSP developed by the Applicant incorporate all of the above-listed studies. We also recommend that the study proposals incorporated into the PSP be as detailed as possible so that all parties know exactly what is being agreed to when the study plan is approved.

Thank you for the opportunity to provide study requests for the Projects. If you have any questions or desire additional information, please contact John Wiley at 607-753-9334.

Sincerely,

David A. Stilwell
Field Supervisor

cc: NYSDEC, Stamford, NY (C. VanMaaren, S. Wells)
NYSDEC, Albany, NY (N. Cain)
FERC e-file
OEPC, Washington, DC (S. Alam)
FWS, BER (ERT), Falls Church, VA (S. Nash)
FWS, Hadley, MA (S. Simon)

Document Content(s)

Assemblymember Phil Steck, Albany, NY.
August 8, 2019

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First St. NE
Washington, DC 20426

RE: Docket # P-4678 and P-4679

Dear Secretary Bose:

On behalf of my constituents in the 110th Assembly District, I am writing regarding the relicensing of Crescent and Vischer Ferry Dams on the Mohawk River. The Crescent and Vischer Ferry dams affect water flow and quality along more than 20 miles of the Mohawk River. Before any existing licenses are to be renewed, a full analysis of the following environmental impacts must be considered:

- Drinking water: Recent work by the USGS and NYSDEC has shown elevated phosphorous, chlorophyll-a, and fecal coliform bacteria in the lower Mohawk that exceed guidance values and these concerning levels may be driven in part by impoundments (Smith and Nystrom, 2017). Water quality in these impoundments affects algal growth, which in turn can affect drinking water quality and/or treatment costs by increasing the risk of formation of disinfection byproducts or harmful algal blooms (HABs). More than 100,000 people in Colonie and Cohoes rely on the Mohawk River as a drinking water source, and more than 120,000 people in Niskayuna, Schenectady, Scotia, Glenville, Rotterdam and Ballston rely at least in part on aquifers under the influence of Mohawk River water. We need to fully evaluate the roll that the dams play in affecting water quality in the lower Mohawk and implement strategies for source water protection.
- Fish: Studies are needed to better understand native, non-native, and migratory fish in the lower Mohawk. Migratory fish, including blueback herring and American eel, are present in the Mohawk River, and are known to suffer injury and mortality when passing both upstream and downstream through dams.
- Studies are needed to better understand the roll that the Vischer Ferry dam plays in causing ice jams and subsequent flooding. The Schenectady Stockade is a historical area in the 110th Assembly District. This area has been subject to significant flooding that has become increasingly worse over time. The source of the flooding is the Mohawk River. It is likely that the current dam structures on the river contribute to or cause flooding in the historic Stockade. It is critical that before any relicensing of these man made structures is allowed, there must be a comprehensive study or modeling on the formation of ice, flow of ice jams, and points were ice gets obstructed.

Thank you for your kind consideration of this request.

Sincerely,

Phil Steck
110th Assembly District

encl: Enhanced Water Quality Monitoring in Support of Modeling Efforts in the Mohawk River Watershed

Cockburn, J.M.H. and Garver, J.I., Proceedings of the 2017 Mohawk Watershed Symposium,
Union College, Schenectady, NY, March 17, 2017
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Enhanced Water Quality Monitoring in Support of Modeling Efforts in the Mohawk River Watershed

Alexander J. Smith[1] and Elizabeth Nystrom[2]
[1]NYS-DEC, Division of Water, Mohawk River Basin Program, Albany, NY
[2]US Geological Survey, New York Water Science Center, Troy, NY

The quality of surface water has important effects on human and ecological health. In the Mohawk River watershed, surface water is an important drinking water source and is used for swimming, fishing, and recreation. The New York State Department of Environmental Conservation (NYSDEC) is tasked by the U.S. Environmental Protection Agency (USEPA) to monitor ambient water quality of the State. The NYSDEC is also tasked to develop Total Maximum Daily Loads (TMDLs) for state waters that fail to meet their intended uses. Water-quality impacts on designated uses in the Mohawk River watershed are well documented by the NYSDEC. These impacts include eutrophication from phosphorus, which degrades the quality of water supplies, and the presence of bacteriological pathogens, which limits contact recreational opportunities. In 2015 the NYSDEC conducted a “TMDL - Lite” analysis to better understand the sources and loads of pollutants in the Mohawk River watershed. The results of this analysis indicated approximately 60% of the phosphorus in the Mohawk River watershed is the result of point source discharges, such as sewage treatment facilities. A lesser, but still significant portion (21%) of phosphorus in the watershed is from non-point source agricultural practices. The remaining (19%) phosphorus load in the Mohawk River watershed was estimated to be from developed land, septic fields, and natural sources collectively. As a result of this analysis demonstrating the high proportion of phosphorus load originating from point source discharges and the current assessments of water quality conditions, the NYSDEC began to set in motion the process for developing a phosphorus TMDL for the Mohawk River. This process includes the development of enhanced water quality monitoring data from throughout the watershed and the development of a detailed water-quality model.

During 2016 the NYSDEC and United States Geological Survey’s NY Water Science Center (USGS) partnered in the collection of a comprehensive water-quality dataset suitable for calibrating future waterquality models in support of a TMDL for the Mohawk River. Beginning in April 2016, surface-water quality samples were collected from 30 different sites throughout the Mohawk River watershed from upstream of Rome to Cohoes, including both main-stem (n=10) and tributary (n=20) locations. Samples were collected six times (Spring-Fall) from each location with an additional six collections for bacterial analysis. Sampling parameters included river and stream discharge, nutrients, suspended sediment, minerals, trace elements, organic carbon, chlorophyll-a, oxygen demand, and pathogens (coliforms). Preliminary results indicate water quality in several areas in the Mohawk River watershed exceed NYSDEC’s water quality guidance values for phosphorus, chlorophyll-a, and New York State’s (NYS) water-quality standards for bacteria. Although NYS does not have official water-quality standards for phosphorus and chlorophyll-a, guidance values that are protective of both drinking water supplies (25 µg/L TP, 6 µg /L Chl-a) and aquatic life (30µg/L TP, 6µg/L Chl-a) have been established and are available in the literature (Callinan 2010, Smith et al. 2015, Smith et al. 2013, Smith and Tran 2010). Using these guidance values in review of water-quality data at the 30 sites sampled in 2016, 12 tributary and 7 main-stem sites exceeded the phosphorus guidance. For chlorophyll-a, 7 tributary and 6 main-stem sites exceeded guidance values. NYS does have water quality standards for both total (2,400 colonies/100mL) and fecal (200 colonies/100mL) coliforms for surface waters for the protection of human health. These standards are based on average conditions calculated from a minimum of 5 water-quality samples in a 30-day period. Results of our investigation, which followed these sample collection criteria, indicate 5 tributaries and 1 main-stem site exceeded the standard for total coliform and 7 tributaries and 2 main-stem sites exceeded the standard for fecal coliform. However, one-time exceedances from the 30-day period of sampling were more than double the number of average exceedances and were widespread. Phosphorus concentrations and the levels of coliform standard exceedances in several tributaries including Nail, Reall, and Ballou Creeks near Utica suggest these smaller watersheds may be significant sources of pollutants. However, chlorophyll-a exceedance of guidance values does not appear to become an issue until further downstream on the main-stem Mohawk River in the area of Amsterdam – Cohoes. These results may suggest a complex interaction between nutrient concentrations, altered flow regime

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due to the canal system, and the build-up of suspended algae in downstream impoundments. Instantaneous load calculations provide a slightly different perspective on targeting specific tributaries for nutrient controls when compared with concentration only. For example, some larger tributaries, although lower in phosphorus concentration, contribute greater overall loads of phosphorus to the Mohawk River simply due to their size and average discharge.

Next steps in the process of developing a TMDL for the Mohawk River include developing a sophisticated water-quality model that builds off of the New York State Canal Corporation's (Canal Corp.) newly completed hydraulic and hydrologic models for the Mohawk River watershed. The Canal Corp. built these advanced models for the watershed to support their flood warning system for the Mohawk River. Prior to the development of Canal Corp.'s flood warning system, developing a water-quality model would have required significantly more effort. Building off of their advances in this area will dramatically improve efficiencies in NYSDEC's water quality model. A modeling team from the NYSDEC, USGS, and Canal Corp. are presently working to begin development of the Mohawk River water-quality model. The water-quality data collected during 2016 from the Mohawk River watershed will be used to calibrate this model. Once completed, the model will allow water-quality managers to estimate improvements in water quality through various scenarios of pollutant limitations within the watershed, further protecting drinking water supplies, recreational opportunities, and aquatic life.

Literature Cited

Callinan, C.W. (2010) River Disinfection By-Product/Algal Toxin Study. New York State Department of Environmental Conservation, Division of Water. Albany, NY. pp. 75

Smith, A.J., Duffy, B.T. and Novak, M.A. (2015) Observer rating of recreational use in wadeable streams of New York State, USA: Implications for nutrient criteria development. Water Research 69, 195-209.

Smith, A.J., Thomas, R.L., Nolan, J.K., Velinsky, D.J., Klein, S. and Duffy, B.T. (2013) Regional nutrient thresholds in wadeable streams of New York State protective of aquatic life. Ecological Indicators 29, 455-467.

Smith, A.J. and Tran, C.P. (2010) A weight-of-evidence approach to define nutrient criteria protective of aquatic life in large rivers. Journal of the North American Benthological Society 29(3), 875-891.

Invited Oral Presentation

Document Content(s)

RIVERKEEPER.
NY's clean water advocate

August 9, 2019

Via Electronic Filing

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First St. NE
Washington, DC 20426

Re: Comments of Riverkeeper, Inc. on the Scope of Environmental Review and Study Requests for the Crescent Hydroelectric Project (P-4678-052) and/or Vischer Ferry Hydroelectric Project (P-4679-049)

Dear Secretary Bose,

Riverkeeper appreciates this opportunity to comment on the environmental review scoping document and to request relicensing studies as part of the relicensing applications for the Crescent and Vischer Ferry Dams (FERC Nos. 4678 & 4679, respectively), located on the Mohawk River in Saratoga, Albany, and Schenectady Counties, New York.

Riverkeeper is requesting the following changes to the scope of the environmental review, based on the evidence presented below:

1. the scope of the cumulative impacts analysis must be expanded;
2. the scope of the analysis must include a "hard look" at the decommissioning alternative;
3. the environmental analysis must properly define the primary uses and address use impairments of the Mohawk River in the project areas;
4. the environmental analysis must accurately account for wastewater discharges in the project areas;
5. the environmental analysis must accurately account for drinking water intakes and drinking source water impacts in the project areas; and,
6. the environmental analysis must consider environmental justice communities.

www.riverkeeper.org • 20 Secor Road • Ossining, New York 10562 • t 914.478.4501 • f 914.478.4527

In addition, Riverkeeper requests specific studies related to fish and water quality. Towards the goal of protecting and restoring diadromous, native, and sport fishes, Riverkeeper calls for thorough studies of:

1. fish fauna community composition including multiple dimensions of biodiversity indices;
2. American eel out-migration;
3. adult blueback herring provenance and iteroparity; and
4. fish mortality in and around the hydropower facilities.

Currently, water quality in the project areas threatens primary uses, including drinking water and recreation. Water quality studies that address the connections between these dams and documented water quality threats, including nutrient over-enrichment and harmful algal blooms, are needed to ensure that license requirements protect and restore water quality.

A. Relevant public interest considerations

Our mission at Riverkeeper, Inc. ("Riverkeeper"), a non-profit 501(c)(3) organization, is to protect and restore the Hudson River and its tributaries. The Mohawk River is the largest tributary to the Hudson River, accounting for approximately 25% of the Hudson River Watershed area.[1]

Riverkeeper has patrolled from Waterford to Rome on the Mohawk River in our vessel, the *R. Ian Fletcher*, since 2014. Riverkeeper has partnered with scientists at SUNY Cobleskill and SUNY Polytechnic Institute to monitor recreational water quality in the Mohawk River since 2015, utilizing Environmental Protection Agency (EPA)'s recommended fecal indicator bacteria and Recreational Water Quality Criteria. Riverkeeper has also been a supporter and/or participant of the Mohawk Watershed Symposium since 2014, and a member of the steering committee for the New York State Department of Environmental Conservation's Mohawk Basin Program since 2018.

New York State has made specific and measurable commitments to improving water quality in the Mohawk River to assure that water is safe for drinking and recreation, that fish populations are healthy, and that communities are resilient to flooding and other impacts from climate change. These goals are expressed in a draft five-year Mohawk River Basin Action Agenda,[2] produced by the Mohawk River Basin Program, which was established in 2010.

The Mohawk River Watershed Management Plan, published in 2015 by the Mohawk River Watershed Coalition, which is made up of Soil and Water Conservation Districts in the

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[1] Mohawk River Watershed Coalition, Mohawk River Watershed Management Plan § 1.2 (2015),http://mohawkriver.org/management-plan/ (hereinafter Mohawk Management Plan).
[2] NYSDEC, Mohawk River Basin Action Agenda: 2018-2022 (2018), https://www.dec.ny.gov/docs/water_pdf/mohawkactionag.pdf.

watershed, identified these two top priorities: 1) protect and restore the quality and ecological functions of water resources; and 2) protect and enhance natural hydrologic processes.[3]

B. Changes to Scope of Environmental Review

1. The Scope of the Cumulative Impacts Analysis Must be Expanded

As required by the National Environmental Policy Act (NEPA), the Commission must analyze the cumulative impacts of the proposed action. See 40 C.F.R. § 1508.7 ("Cumulative impact is . . . the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions."). As such, the Commission must take into account all damage created as a consequence of building and operating the dams from the 1900s through the present moment. Failure to adequately examine all past effects will leave the NEPA requirements unsatisfied, "fatally infect[ing]" the Commission's analysis.[4]

In the scoping document, the Commission does acknowledge the need to study past impacts, but qualifies that, "The historical discussion will, by necessity, be limited to the amount of available information for each resource. The quality and quantity of information, however, diminishes as we analyze resources further away in time from the present."[5] It is this qualification that concerns Riverkeeper, as it falls short of the "hard look" at the environmental consequences required by NEPA.[6] While historic data is not always robust, the Commission has the ability to use modern modelling techniques to bolster their understanding of past conditions. Simply relying on limited historic data does not satisfy NEPA's purpose of informed decision-making, in light of the available techniques. Therefore, the Commission must remove that qualification and expand the scope of its cumulative impacts analysis to include a thorough comparison of conditions before and after dam construction.

This is especially critical because the cumulative impacts analysis is the only portion of the NEPA analysis where the environmental costs of the dams can be truly be captured. As required by NEPA, the Commission must analyze a minimum of three alternatives: 1) the no-action alternative, 2) the applicant's proposed action, and 3) all feasible alternatives to the proposed action.[7] The no-action alternative forms the baseline against which all other alternatives are assessed.[8]

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[3] Mohawk Management Plan, at v.
[4] *Am. Rivers & Ala. Rivers Alliance v. FERC*, 895 F.3d 32, 39 (D.C. Cir. 2018).
[5] FERC, Scoping Document: Crescent and Vischer Ferry Hydroelectric Projects § 4.1.3, No. 4678-052 & 4679-049 (*hereinafter* Scoping Document).
[6] *New York v. Kleppe*, 429 U.S. 1307, 1311 (1976) ("the essential requirement of the NEPA is that before an agency takes major action, it must have taken "a 'hard look' at environmental consequences") (internal citations omitted).
[7] 40 CFR § 1502.14.
[8] *See generally Conservation Law Foundation v. FERC*, 216 F.3d 41, 45 (D.C. Cir. 2000).

In the Crescent and Vischer Ferry scoping document, the Commission identifies five possible alternatives. It summarily dismisses three of these alternatives, federal government takeover, non-power license, and project decommissioning. This leaves only the no-action alternative of continued operation under the current license, and the Commission's proposed alternative of continued operation under the existing license requirements. The scoping proposal makes it clear that the proposed alternative entails "[n]o new or upgraded facilities, structural changes, or operational changes to the projects."[9] As such, the proposed alternative and the no-action "baseline" are actually the same, which essentially guarantees that no significant environmental impact will be found, and largely subverts the primary purpose of the NEPA analysis.

Thus, the Commission must conduct the most thorough cumulative impacts analysis possible, examining all past and present impacts to the maximum extent, to fulfill the purpose of NEPA.

2. The Scope of the Analysis Must Include a "Hard Look" at the Decommissioning Alternative

In addition, Riverkeeper maintains that the Commission must perform a study of the decommissioning alternative, to determine the environmental conditions if the dams were to be removed. The purpose of NEPA is to provide for informed decision-making where "the Commission has fully examined options calling for greater or lesser environmental protection."[10] To fulfill NEPA's requirements, the courts have consistently required some consideration of the decommissioning alternative.[11]

In the scoping document, the Commission claims that it has no basis for recommending decommissioning, such that it is not a reasonable alternative and does not warrant further study because: 1) decommissioning has significant costs, 2) the projects provide safe, renewable energy, 3) no party has suggested project decommissioning would be appropriate.[12]

While in some other cases, the Commission was able to satisfy its NEPA obligation with such conclusory explanations, the Mohawk Dams situation is materially different because Riverkeeper might support the decommissioning alternative if the NEPA study shows a positive environmental impacts.[13] Decommissioning could restore free-flowing river conditions to over 20 miles of the river, providing benefits to water quality, wildlife and habitat. It is inappropriate

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[9] Scoping Document § 3.2.1.
[10] *Conservation Law Foundation v. FERC*, 216 F.3d 41, 46 (D.C. Cir. 2000); 42 U.S.C. § 4332.
[11] *Am. Rivers v. FERC*, 201 F.3d 1186, 1201 (9th Cir. 1999); *Conservation Law Foundation*, 216 F.3d, at 46.
[12] Scoping Document § 3.5.3.
[13] *See Am. Rivers v. FERC*, 201 F.3d 1186, 1201 (9th Cir. 1999) (court accepting the Commission's explanation that decommissioning is not considered a reasonable alternative by anyone); *cf. Conservation Law Foundation v. FERC*, 216 F.3d 41, 46 (D.C. Cir. 2000) (stating that the Commission does not need to imagine the time before the dam existed, "at least when no one advocates [for] decommissioning.").

to pre-judge whether decommissioning is appropriate before it has been studied. Therefore, the reasoning provided in the scoping document does not satisfy the Commission's NEPA obligations. In addition, such study would have significant overlap with the required cumulative impacts analysis, such that it would not be overly burdensome for the Commission to complete.

Therefore, the Commission must amend the scoping document to include a full study of the decommissioning alternative in order to assess whether any of the above impacts are present to satisfy NEPA's call for informed decision-making. Riverkeeper may recommend the decommissioning alternative if the results of that study show an overall benefit to the water quality or nearby wildlife populations.

3. The Environmental Analysis Must Properly Define the Primary Uses and Address Use Impairments of the Mohawk River in the Project Areas

To fulfill NEPA's requirements, the environmental analysis must consider "[w]hether the action threatens a violation of Federal, State, or local law or requirements imposed for the protection of the environment."[14] Therefore, the scope of the environmental analysis must encompass an examination of the project's compatibility with the Mohawk River's use designation and other state and local requirements. The Commission's current proposed EA outline places the discussion on "Consistency with Comprehensive Plans" under the "Conclusions and Recommendations" section.[15] Riverkeeper asks that this section be expanded to include all other related federal, state, and local requirements--as discussed below--pertaining to the Mohawk River and that it be placed within the environmental analysis section such that it is considered prior to choosing an alternative.

NYPA's pre-application document for the two projects lists many uses for the Mohawk River, including hydroelectric generation, agricultural water supply, drinking water, industrial development, recreation, and navigation.[16] This list excludes one of the river's most important functions, which is to support aquatic life.

The scoping document discusses aquatic resources and specifically lists aquatic resources as a focus, but does not mention drinking water uses or impacts. The aquatic resources section of the environmental assessment should be expanded to include drinking water as an aquatic resource. The analysis of the Mohawk's use as a drinking water supply must be included in the scope, as

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[14] 40 C.F.R. § 1508.27(10).
[15] Scoping Document, at § 8.0.
[16] NYPA, Crescent and Vischer Ferry Hydroelectric Projects Pre-Application Document FERC No. P-4678 & P-4679 §§ 4.1.1, 4.1.2 (2019) (*hereinafter* Crescent and Vischer Ferry Projects PAD).

NEPA also requires consideration of "[t]he degree to which the proposed action affects public health or safety," which clearly applies to safe drinking water.[17]

Under the Clean Water Act, the NYS Department of Environmental Conservation (NYSDEC) is responsible for designating the best uses of the state's waters, and setting water quality standards that correspond to these uses. According to NYSDEC's Waterbody Inventory/Priority Waterbody List (WI/PWL), the Mohawk River from the Crescent Dam to Schenectady (upstream of the Vischer Ferry Dam) is designated as Class A.[18] The best uses of Class A waters include drinking, swimming and fishing, and the water quality must also support "fish, shellfish and wildlife propagation and survival."[19]

The environmental review must acknowledge that aquatic life, human consumption and swimming are among the primary uses of these waters. The environmental impacts of the dams must be evaluated in light of these uses, and not only in light of navigational uses, which are less dependent on water quality and flow conditions.

NYSDEC's WI/PWL notes threats or impacts to water supply, aquatic life and recreational uses in the Mohawk River in the project areas.[20] Nutrients, silt/sediment and pathogens are listed as pollutants of concern. Stormwater runoff, agriculture, and combined sewer overflows are listed as sources. Both hydromodification and flow diversions are recognized as impacting uses.[21]

NYSDEC has made specific commitments to improve water quality to support these uses as part of Mohawk Basin Program Action Agendas. The aquatic resources section of the environmental assessment should be expanded to include water quality parameters relevant to documented threats, including nutrients, silt/sediment, and algae.

The uses of the river, the relevant goals of watershed management plans, and the dams' contributions to suspected use impairments, should be the subject of comprehensive environmental impact analysis.

4. The Environmental Analysis Must Accurately Account for Wastewater Discharges in the Project Areas

The Pre-Application Document (PAD) does not account for municipal and private wastewater treatment facilities that discharge to the Mohawk River or its tributaries in the vicinity of the

[17] 40 C.F.R. § 1508.27(2).
[18] *Mohawk River WI/PWL*, DEC, https://www.dec.ny.gov/chemical/36739.html (last visited Aug. 8, 2019).
[19] 6 CRR-NY 701.6
[20] NYSDEC, WI/PWL Fact Sheets - Mohawk/Alplaus Kill Watershed (0202000411), https://www.dec.ny.gov/docs/water_pdf/wimohawkalplauskill.pdf.
[21] Id.

dams.[22] This is extremely concerning since the PAD informs the Commission in defining the scope of analysis, and this critical information does not appear to have been accounted for in the scoping document. In response to the Commission's request for information on water treatment facilities, Riverkeeper is providing the following information, and we call on the Commission to specifically include analysis of the below wastewater discharges within the scope of the project's environmental assessment.

Discharges from these facilities contain nutrients that promote the growth of algae and bacteria, particularly in slow-moving waters. These plants also have the potential to release pathogens, either by design with adherence to SPDES permit requirements, or due to malfunction or infrastructure failure. Wastewater treatment plants also release an array of unregulated micropollutants, such as pharmaceuticals, personal care products, industrial chemicals, and pesticides. Wastewater treatment plants in the project area include industrial facilities, and several municipal facilities receiving industrial wastewater, which may contain unregulated pollutants.[23] The Mohawk River is a significant contributor of micropollutants to the Hudson River Watershed, and the contaminant profile of samples collected from the Mohawk River carries the signature of wastewater treatment facilities.[24]

Movement of nutrients, pathogens, and other contaminants through the environment is fundamentally connected to hydrologic conditions.Therefore, any flow alterations associated with these dams and their operations have the potential to impact ecological processes involving these pollutants. The environmental assessment must properly account for the composition and timing of wastewater effluent releases in order to evaluate the potential impacts of dam operations.

In addition, the PAD omits facilities that are cumulatively permitted to discharge over 4.5 MGD of wastewater effluent into the waters in the project vicinity:

- Town of Rotterdam Sewer District #2 (SPDES ID NY0020141);
- Town of Niskayuna Sewer District #6 WWTP (SPDES ID NY0023973);
- Von Roll USA (SPDES ID NY0074489);
- Viaport Rotterdam Mall (SPDES ID NY0109614);
- Mohawk River Country Club & Chateau (SPDES ID NY0130826); and
- Riverview Landing STP (SPDES ID NY0131768).

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[22] *DEC InfoLocator*, NYSDEC, https://www.dec.ny.gov/pubs/109457.html (last visited Aug. 8, 2019).
[23] SPDES permits for Rotterdam (T) Sewer District #2 WWTP (ID NY0020141), Schenectady Sewage Treatment Plant (NY0020516), Mohawk View Water Pollution Control Plant (NY0027758)
[24] C. Carpenter, D. Helbling,*Widespread Micropollutant Monitoring in the Hudson River Estuary Reveals Spatiotemporal Micropollutant Clusters and Their Sources*, 52 Envtl.l Sci. & Tech. 11, 6187-6196 (2018) doi.org/10.1021/acs.est.8b00945.

The NYSDEC Mohawk River Basin Program is implementing a Source Water Protection Program for the Mohawk Watershed that is focused on these and other SPDES-permitted facilities. Riverkeeper recommends that the Commission take this program into account during the assessment of the Crescent and Vischer Ferry Dams.

5. The Environmental Analysis Must Accurately Account for Drinking Water Intakes and Drinking Source Water Impacts in the Project Areas

NEPA requires that the environmental assessment examine the potential impacts on public health and safety.[25] It is undisputed that drinking water is critical to public health. As such, the scope of environmental analysis must account for the following drinking water intakes and source water impacts, which are not included within the PAD.

Table 4.3-4 of the PAD incorrectly characterizes the Mohawk View Water Treatment Plant (SPDES ID NY0102148) as an "industrial wastewater treatment facility."[26] While this facility does have a discharge permit, more importantly it is drinking water treatment facility that serves 82,000 residents of the Town of Colonie (Public Water Supply (PWS) ID NY0100198).[27] This facility draws raw surface water from the Mohawk River and raw groundwater from wells located near the Crescent Dam impoundment.

Table 4.3-5, "Water Withdrawals Within or Near the Boundaries of the Crescent and Vischer Ferry Projects," and Figure 4.3-4, "Water Withdrawals and Discharges Within or Near the Boundaries of the Crescent and Vischer Ferry Projects" do not include the raw surface water intakes for the Mohawk View Water Treatment Plant (SPDES ID NY0102148, PWS ID NY0100198).[28] These intakes must be properly mapped, and the use of surface water as a drinking water supply must be addressed in the environmental assessment.

In addition, the PAD fails to identify five additional public drinking water supplies located in the project vicinity:

- Town of Rotterdam (WWR0001334 / PWS NY4600067 and PWS NY4600069);
- City of Schenectady (WWR0001387 / PWS NY4600070);
- Village of Scotia (WWR0001403 / PWS NY4600071);
- Town of Glenville (WWR0000601 / PWS NY4600091), which also serves Town of Ballston (PWS NY4505658); and

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[25] 40 C.F.R.§ 1508.27(2)
[26] Crescent and Vischer Ferry Projects PAD, at § 4.3.1.3 tbl. 4.3-4.
[27] *Public Works - Division of Latham Water*, Town of Colonie, https://www.colonie.org/departments/lathamwater/ (last visited Aug. 8, 2019).
[28] Crescent and Vischer Ferry Projects PAD, at § 4.3.1.3 tbls. 4.3-5, fig. 4.3-4.

- Town of Niskayuna (WWR0001104 / PWS NY4600073).

Cumulatively, these systems supply drinking water to nearly 150,000 residents. These five intakes are located in the Great Flats Aquifer (also known as the Schenectady Aquifer), which underlies and exchanges water with the Mohawk River.[29] Due to the geology and soils of the aquifer and surroundings, the NYS Department of Health's Source Water Assessments for these wells indicate that they are highly susceptible to contamination from surface pollution sources.[30] The aquifer recharge area overlaps with the project area.[31] In the Schenectady and Rotterdam well fields, aquifer water levels and drawdown are dependent on river level, and vary between navigational and non-navigational seasons.[32]

The groundwater-surface water connection between the Great Flats Aquifer and the Mohawk River means that surface water quality in the Vischer Ferry project area may have the potential to impact drinking water sources. The nature of groundwater-surface water connections, and the potential impacts of surface water quality on groundwater, must be evaluated in the environmental assessment.

Finally, the City of Cohoes operates a surface drinking water intake less than 2 miles downstream of the Crescent Dam (PWS NY0100192).[33] This system is a source of drinking water to more than 20,000 residents of Cohoes and Green Island. Because of its proximity to the project areas, water quality at this intake is directly impacted by dam operations and impoundments. This intake needs to be included in the environmental assessment.

Collectively, these surface and groundwater sources are the largest regional supply of drinking water, serving nearly 225,000 people in three counties. The influence of these dams on water quality for the region must be thoroughly studied as part of the environmental review.

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[29] *Great Flats Aquifer*, Schenectady County, https://www.schenectadycounty.com/node/224 (last visited Aug. 8, 2019).

[30] Town of Glenville, Annual Drinking Water Quality Report for 2018, https://www.townofglenville.org/sites/glenvilleny/files/uploads/2018_annual_water_quality_report_003.pdf; Town of Niskayuna, Annual Drinking Water Quality Report for 2018, https://www.niskayuna.org/sites/niskayunany/files/uploads/niskayuna_awqr_2018_final.pdf; Town of Rotterdam, Annual Drinking Water Quality Report for 2018,https://rotterdamny.org/departments.aspx?DepartmentID=2; Village of Scotia, Annual Drinking Water Quality Report for 2018, https://r9b3h3p8.stackpathcdn.com/wp-content/uploads/2019/05/Water-Quality-Report-for-2018.pdf.

[31] Town of Glenville, Glenville Well-Field Protection Committee,Advisory Report on Protection of the Glenville Well-Field (2013).

[32] Thomas M. Johnson, *Responsible Planning For Future Ground Water Use From The Great Flats Aquifer: Two Case Studies: The Gep Energy Project And The Si Green Fuels Boiler Project* in Proceedings from the 2009 Mohawk Watershed Symposium, Union College, Schenectady NY (J.M.H. Cockburn & J.I. Garver eds., 2009) (*hereinafter* 2009 Mohawk Watershed Symposium).

[33] City of Cohoes, Annual Drinking Water Quality Report for 2018, https://www.ci.cohoes.ny.us/ArchiveCenter/ViewFile/Item/148.

6. The Environmental Analysis Must Consider Environmental Justice Communities

In accordance with the Commission's guidance[34] and Executive Order 12898,[35] the scope of NEPA must include a study of environmental justice communities.

NYSDEC has identified Potential Environmental Justice Areas (PEJAs) within the project areas, based on U.S. Census data.[36] Two PEJAs are located directly adjacent to the Mohawk River shoreline in Schenectady in the project areas. According to EPA environmental exposure indicators, exposure to major wastewater discharges is high in these areas, ranging from the 73rd to the 78th percentile compared to other communities in NYS and nationwide.[37] The environmental assessment should address the historical circumstances and impacts of these dams and their operations on communities in these PEJAs; the potential ongoing impacts of these dams and their operations; and the potential for increased vulnerabilities in these areas due to multiple environmental impacts, including the dams and their operations.

7. The Environmental Analysis Must Consider a Broader Range of Issues Related to Native, Migratory and Recreational Fish, and Other Aquatic Life

The scoping document identifies aquatic resources issues to be addressed, including the need for minimum flows to protect aquatic resources downstream of each project; and the effects of continued operation and maintenance of the projects on aquatic resources, including entrainment and impingement mortality of resident fishes, and entrainment mortality and downstream passage of blueback herring and American eel.

The scope should include a broader range of issues related to these fish, including upstream passage of juvenile American eels; movements of native and sport fishes; dam-associated mortality for blueback herring and American eel; effects of lighting on eel migration; and comparisons of impact to historic baseline populations, not only status quo operation and

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[34] *See* FERC, Guidance Manual for Environmental Report Preparation 4-82 (2017) (in reference to NEPA requirements within the Natural Gas Act context). See also CEQ, A Citizen's Guide to the NEPA 5 (2007) (discussing the applicability of Executive Order 12898 to the NEPA analysis).

[35] 59 Fed. Reg. 7629 (Feb. 16, 1994). *See also Summary of Executive Order 12898 - Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, EPA.gov, https://www.epa.gov/laws-regulations/summary-executive-order-12898-federal-actions-address-environmental-justice (last updated Sept. 17, 2018).

[36] Maps & Geospatial Information System (GIS) Tools for Environmental Justice, NYSDEC, http://www.dec.ny.gov/public/911.html (select "Schenectady") (last visited Aug. 8, 2019).

[37] *EJSCREEN: Environmental Justice Screening and Mapping Tool*, EPA.gov, https://www.epa.gov/ejscreen (select census block areas "360930202001" and "360930203001") (last visited Aug. 8, 2019).

maintenance. In addition, impacts on freshwater mussels as well as the eggs and larvae of native and high-value recreational fishes should be considered.

Safe passage to and from rivers, and protection of freshwater habitats are critical for the conservation of native and diadromous fishes. Hydroelectric dams have been constructed in many rivers that historically had high densities of eels and other species, and these fish have been severely impacted by these in-water structures. The dams in general disconnect habitat and fragment rivers and represent one of the largest problems facing freshwater species.

Hydropower dams are a particular concern to diadromous fishes, blocking access to significant portions of critical habitat. In addition, the machinery associated with electricity generation (turbines), and the water intake systems can cause significant mortality. Injury or mortality to fish are often the result of passage at hydroelectric facilities from the following: (1) turbines and mechanical components; (2) entrainment; (3) impingement of fish, larvae, or eggs against screens/trash racks; (4) falling from spillways; (5) turbulence and shear forces; (6) hyper-oxygenated water; (7) extreme pressure changes; (8) disorientation leading delayed migrations patterns. For diadromous fishes there is a critical temporal period to reach the spawning ground before eggs will be resorbed.

Fish in general are vulnerable to injury from a variety of causes in and around hydroelectric dams. When no water spills over the dam owing to low water levels, migrant fish can be attracted to the turbine intake tunnels, which is often the only source of downstream flow present in the forebay area of the dam. Fish attempting to pass downstream of a hydroelectric dam readily incur physical injury or mortality. A survey of fish sampled in tailraces showed tears in the fins (63% of all fish) and scale loss (60%) were the most frequently observed injury types, followed by hemorrhages (44%), dermal lesions (43%), partial amputations of fins (31%), pigment anomalies (24%) and bruises (11%).[29] Emboli in the eyes (7%) and amputations of body parts (2%) occurred less frequently.[38] Other studies have shown that eels mortality is 100% when eels are entrained in turbines.[39] Injury and mortality can also occur to fish, larvae, and eggs through impingement against screens or trash racks that are intended to prevent debris, or in some cases, from being drawn into water intakes. The cumulative effect of the series of hydroelectric dams on the Mohawk River represents a particularly serious obstacle to diadromous fishes. In addition to diadromous fishes, these dams also inhibit the free mobility and potentially cause genetic isolation to the native and recreational species, all of which potentially impacts freshwater mussels.

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[38] M. Mueller, J. Pander & J. Geist,*Evaluation of External Fish Injury Caused by Hydropower Plants Based on a Novel Field-based Protocol,* 24 Fisheries Mgmt. and Ecology , 240 (2017), https://doi.org/10.1111/fme.12229.

[39] JW Carr & FG Whoriskey *Migration of Silver American Eels Past a Hydroelectric Dam and Through a Coastal Zone*. 15 Fisheries Mgmt. and Ecology, 393 (2008), https://doi.org/10.1111/j.1365-2400.2008.00627.x.

Research is needed to determine the best ways to mitigate these obstacles and provide safe passage around turbines for eels and other migrating fish. Brown et al. (2013) clearly stated that "half-way technologies" have done little to restore diadromous fishes to sustainable levels.[40] The impact of these dams on downstream passage of migratory, native and sport fishes in the Mohawk River must therefore be within the scope of this environmental review.

a. American Eels

American eels (*Anguilla rostrata*), as a catadromous species, spawn in the Sargasso Sea, and return to coastal estuaries and their tributaries as glass eels in the spring. They move upstream to freshwater habitat and will continue to migrate as immature yellow eels. The sex of the species is determined by density dependent relationships and environmental cues. Females tend to live in low density regions, growing large and deferring reproduction for often twenty years or more, whereas males tend to live in high density conditions and mature much sooner. At maturity, eels return to the Sargasso Sea to spawn once, and die. These life history patterns have allowed the species to flourish for millions of years and are adaptive across both southern and northern hemispheres of the western Atlantic.

American eels have a historic presence in the Mohawk River, despite the presence of the Falls at Cohoes. Ample research has shown that American eels have the wherewithal and an uncanny ability to surmount natural obstacles during their upstream migrations, even ones as imposing as Cohoes. Immature eels driven by evolutionary imperatives will migrate upstream and can scale 100-foot vertical walls if the conditions are right favorable..

At one time eels accounted for the highest biomass in Hudson River tributaries and it is likely that Mohawk River tributaries were no different. Alplaus, a Schenectady County hamlet almost five miles upstream of the Vischer Ferry dam, derives its name from the Dutch Aal Plaats, or "place of eels,"[41] suggesting that American eels were once highly abundant. Hence, the precipitous decline of eels in the Mohawk River is likely to have had a cascading impact to the ecosystem because of their primary roles as both predator and prey and as a host species to freshwater mussels, which are also in decline across North America for the same suite of problems that diadromous fish are facing.

Dams impede the upstream migration of immature eels while downstream passage at hydroelectric dams is known to be a significant source of mortality to out-migrating silver eels owing to the machinery associated with the generation of electricity from water intake systems and turbines. Eels are semelparous creatures (they spawn only once in their lifetimes) and therefore all anthropogenically induced mortality occurs prior to spawning. For large females

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[40] JJ Brown et al., *Fish and Hydropower on the U.S. Atlantic Coast: Failed Fisheries Policies from Half-way Technologies,* 6 Conserservation Letters 280(2013), https://doi.org/10.1111/conl.12000.
[41] Always Alplaus, https://www.alplaus.org/ (last visited Aug. 8, 2019).

that have deferred spawning, the cumulative impact from hydropower production is considered to be significant to the metapopulation.

Population densities of American eels in the Mohawk River watershed and elsewhere throughout their range are much reduced from historical levels largely due to migration barriers, habitat alterations, and a variety of other anthropogenic influences.[42] In a telemetry study attempting to determine the impact of hydropower dams to eels, Carr and Whoriskey (2008) revealed that eels of all life-stages will attempt to move downstream through the turbines in preference to the spillway and every eel that passed through the turbines was killed.[43] For eels, the dam itself and/or exterior lighting on the dam structure can become disorienting and delay the timing of their downstream migration. Eels that initially approached the dam and have difficulty finding an exit and would often withdraw to return on multiple occasions before they eventually found a way out of the reservoir or into the turbines.[44]

To understand the dams' impacts on American eels, the scope of the review should be expanded to include upstream migration, impact of exterior lighting, and injury and mortality. As described in the first two sections of this letter, the impact of the dams on American eel must be considered as compared to a baseline "no action" alternative of decommissioning and dam removal.

b. Blueback Herring

Blueback herring (*Alosa aestivalis*), are a species of diadromous fish that are present in the Mohawk River and represent an important fishery, both in the Hudson River Estuary and on the east coast of the United States. The species plays a pivotal role in the food-web as a foundational forage species in freshwater, estuarine, and marine ecosystems. With such a prominent position in the ecosystem, forage species such as blueback herring need to exist in high abundances. However, blueback herring, like American eels and most other diadromous fishes, are now in severe decline.[45] Restoration efforts throughout their range have been underway for decades to ensure continued stability and vitality of the population. Towards this aim, taxpayers have spent millions of dollars restoring river herring - of which bluebacks are a composite species - and other species of diadromous fishes because of their vital roles in the ecosystem and the human economy.

Blueback herring were historically isolated from the Mohawk river by the Cohoes Falls. However, with the development of the Erie Canal and the attendant lock system, blueback

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[42] Dittman, D.E., Machut, L.S., and Johnson, J.H. (2010) American Eel History, Status, and Management Options: Overview. Final Report for C005548, Comprehensive Study of the American Eel. State Wildlife Grant NYSDEC, Bureau of Wildlife, Albany, NY. 37 pp.

[43] JW Carr & FG Whoriskey, *supra* note 39.

[44] *Id.*

[45] Atlantic States Marine Fisheries Commission, 2017 River Herring Stock Assessment Update, Volume 1: Coastwide Summary (2017) (*hereinafter* ASMFC 2017).

herring gained access into the Mohawk basin. While blueback herring in the Mohawk could be viewed as an invasive species, they are an important native forage fish in the Hudson River Estuary and ocean ecosystem. It is quite possible that the expansion of the bluebacks into the Mohawk River represents an important habitat expansion population if downstream passage past the hydroelectric dams can be assured. Immature blueback herring may also form a significant forage base for resident sportfish like smallmouth bass and walleye in the Mohawk River as well.

To understand the dams' impacts on blueback herring, the scope of the review should be expanded to include mortality. As described in the first two sections of this letter, the impact of the dams on blueback herring must be considered as compared to a baseline "no action" alternative of decommissioning and dam removal.

c. Native and Gamefish

A robust recreational fishery exists in the Mohawk River for smallmouth bass (*Micropterus dolomieu*) and walleye (*Sander vitreus*) and other gamefish species that are highly attractive to sportsmen. While these fish don't migrate out of the Mohawk River, they move within it to find forage and spawning habitats. Therefore dams typically have a similar, if less profound, impact on native and resident species of fish, as compared to anadromous and catadromous fishes.

To understand the dams' impacts on native and gamefish, the scope of the review should be expanded to include analysis of upstream and downstream migration of native and gamefish. As described in the first two sections of this letter, the impact of the dams on resident gamefish must be considered as compared to a baseline "no action" alternative of decommissioning and dam removal.

d. Freshwater mussels

The free mobility of fish within the Mohawk River and its watershed also impacts freshwater mussels since fish are important vectors for freshwater mussels. Freshwater mussels are among the most endangered faunal groups on the planet for the same reasons as most other imperiled aquatic species, dams and habitat alteration.[46]

The scope of the review should be expanded to include impacts to freshwater mussels in relation to environmental flows, compared to baseline "no action" alternative of decommissioning and dam removal.

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[46] D. Strayer et al., *Changing Perspectives on Pearly Mussels, North America's Most Imperiled Animals*, 54 BioScience 429 (2004).

C. Study Requests

Based on the information available, Riuhverkeeper requests the following studies, according to the study request criteria outlined in the scoping document. In addition, we request that the project owner consult with regulatory agencies, Riverkeeper, and other stakeholders to develop detailed study plans, and we request that the results be used to develop permit conditions that will mitigate this dam's impact on the ecology and water quality of the Mohawk River.

1. Acoustic Telemetry Study of Out-migrating Silver Eels

a. Describe the Goals and Objectives of Each Study Proposal and the Information to be Obtained

The goal of this study is to determine the out-migration patterns of American eels in the Mohawk River and to determine if the Vischer Ferry and Crescent Dam are preventing or delaying eels from returning to the Sargasso Sea to spawn. Riverkeeper requests that acoustic telemetry be used to accurately track the movements of silver eels in and around the dams, especially in the fall when they begin their return migrations. In order to conduct this study, silver eels should be captured in late summer and their movements and behavior patterns should be monitored for at least one migration season. As in all science, more sampling and data collection is better.

b. Explain the Relevant Resource Management Goals of the Agencies or Indian Tribes with Jurisdiction over the Resource to be Studied

This criterion is not applicable.

c. Explain Any Relevant Public Interest Considerations in Regard to the Proposed Study

Relevant public interest considerations are outlined in the first section of this letter.

d. Describe Existing Information Concerning the Subject of the Study Proposal, and the Need for Additional Information

Very little is known about the various life-stages of American eels and their habitat requirements.[47] Carr and Whoriskey (2008) showed that despite a newly constructed bypass at a hydropower dam, mature silver eels were delayed in their downstream migration at the face of the dam.[48] Seventy six percent of the tagged eels entered the turbines and received fatal injuries

[47] Atlantic States Marine Fisheries Commission, American Eel Benchmark Stock Assessment: Stock Assessment, Report No. 12-01 (2012) (see comments).
[48] JW Carr & FG Whoriskey, *supra* note 39.

despite the bypass system in place. An acoustic survey would help determine the mortality rate of silver eels and other eel life-stages due to the Vischer Ferry and Crescent dams and is necessary in licensing the aforementioned dams and other hydropower dams.

The knowledge gained from these studies would not only be useful in determining how the Vischer Ferry and Crescent hydropower dams impact American eels, but would also help provide measures to improve fish survival at these and other facilities in the Mohawk River, and at other hydropower project where eels are present. Lastly, if there is a low-level outlet a study such as this would be able to determine if out-migrating eels could move downstream without high levels or injury or mortality or if they are able to use the spillway.

There is a lack of knowledge specifically related to the silver eel life-stage, and this study would have applications beyond the Mohawk River. American eels are considered depleted in United States waters[49], and information gained in these types of studies could help fishery managers better protect the species.

e. Explain Any Nexus Between Project Operations and Effects (Direct, Indirect, and/or Cumulative) on the Resource to be Studied, and How the Study Results Would Inform the Development of License Requirements

This study could help determine if the lights on the structures confuse or disorient out-migrating eels or if eels are deterred from entering water intakes by bubble curtains. It would also be determined if eels are attracted to the water in-takes and subsequently entrained into the turbines. This information would inform the development of license requirements that pertain to lighting, intake design, and fish protection measures.

The information gained could be used to determine the time of day and weather patterns that eel choose to migrate. Based on the information gained from this study, license requirements could be developed to optimize project operations during the autumn when silver eels are most likely to migrate, without causing harm to eels.

American eels are native inhabitants to the Mohawk River and their populations have been seriously impacted by the dams throughout their range. Attempts should be undertaken to restore American eels to a level which would occur if the Vischer Ferry and Crescent Dams were nonexistent. Towards this goal actions should be taken to facilitate upstream passage. The Vischer Ferry and Crescent Dams do not have upstream fish passage. Riverkeeper recommends that eel passage be provided at both dams.

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[49] Atlantic States Marine Fisheries Commission, American Eel Benchmark Stock Assessment: Stock Assessment, Report No. 12-01 (2012) (see comments).

f. Explain How Any Proposed Study Methodology (Including Any Preferred Data Collection and Analysis Techniques, or Objectively Quantified Information, and a Schedule Including Appropriate Filed Season(s) and the Duration) is Consistent with Generally Accepted Practice in the Scientific Community or, as Appropriate, Considers Relevant Tribal Values and Knowledge

Silver eels would be captured during an electroshock survey and coded transmitters (e.g., Vemco V9) would be surgically implanted into their peritoneal cavities. Coded tags of this nature were specifically developed to provide researchers with the means to track and determine the behavior patterns of fish. These types of telemetry tags can function as a simple pinger giving location only, or can be equipped with depth and/or temperature sensors. For applications such as site residency studies and automated monitoring of migrations, coded transmissions are desirable because of significantly increased battery life and the large number of unique IDs available on a single frequency.

g. Describe Considerations of Level of Effort and Cost, as Applicable, and Why Proposed Alternative Studies Would Not be Sufficient to Meet the Stated Information Needs

NYPA has not proposed any fish studies despite the information needs that we have outlined in section 7 of this letter.

2. Otolith Microchemistry Study of Blueback Herring

a. Describe the Goals and Objectives of Each Study Proposal and the Information to be Obtained

Otoliths are considered one of the most valuable tools in fisheries science because they can be used to accurately determine the age and specific habitat usage of fish.

The goal of this study is to utilize otolith microchemistry on blueback herring captured in the impoundments behind the Vischer Ferry and Crescent hydroelectric dams to determine age, life history traits, and migration patterns.

The objectives of this study are to: determine the provenance of fish captured in the impoundment; determine if the blueback herring are repeat spawners within the Mohawk River; and determine if the Mohawk River is a source or a sink population for these fishes.

b. Explain the Relevant Resource Management Goals of the Agencies or Indian Tribes with Jurisdiction over the Resource to be Studied

This criterion is not applicable.

c. Explain Any Relevant Public Interest Considerations in Regard to the Proposed Study

Relevant public interest considerations are outlined in the first section of this letter.

d. Describe Existing Information Concerning the Subject of the Study Proposal, and the Need for Additional Information

Because the otoliths growth occur on a regular basis in response to endogenous and exogenous signals, the otoliths are considered one of the most accurate chronometric structures animal world. Hence, temporal and spatial incorporation of environmentally derived elements form the ambient environment occurs in a systematic fashion that allows interpretation of a fish's life-history patterns.

For instance, by comparing Strontium (Sr)/Barium (Ba) ratios in the otoliths of blueback herring, researchers would be able to determine the provenance of fish captured in the impoundment. Since Ba is found in higher levels in freshwater environments and Sr is found in higher levels in marine environments, otoliths could be used to determine if the blueback herring are repeat spawners within the Mohawk River, which would mean they were able to complete normal migrational movements to and from the ocean. In addition, the adult blueback herring could be analyzed to show if they exhibit natal fidelity to the Mohawk River or if they are vagrants that have gotten lost. Another question that could be answered by using a robust otolith microchemistry study with blueback herring is to determine if the Mohawk River is a source or a sink population for these fishes. Otoliths as natural tags will answer many unresolved questions.

e. Explain Any Nexus Between Project Operations and Effects (Direct, Indirect, and/or Cumulative) on the Resource to be Studied, and How the Study Results Would Inform the Development of License Requirements

There is major concern when anadromous fish must pass through multiple dams, creating the potential for significant cumulative impacts. Passage of adult repeat spawners is also a major concern for most Atlantic Coast species.

The results of this study will improve understanding of the cumulative impacts of these dams on blueback herring, and inform the development of license requirements for fish passage and protection.

f. Explain How Any Proposed Study Methodology (Including Any Preferred Data Collection and Analysis Techniques, or Objectively Quantified Information, and a Schedule Including Appropriate Filed Season(s) and the Duration) is Consistent with Generally Accepted Practice in the Scientific Community or, as Appropriate, Considers Relevant Tribal Values and Knowledge

Otolith microchemistry is a standard methodology utilized in fisheries science that has received widespread acceptance. Otoliths are calcium carbonate ear bones that are possessed by all teleost fishes. Because all teleosts possess otoliths, they can be used as natural tags that record their movements from environmental signals. Otolith accrete layers of calcium carbonate on a daily basis and divalent chemicals are randomly substituted for Ca^{2+} or are inserted in the interstitial spaces of the calcium carbonate lattice during formation of the aragonitic crystal. The benefit of otolith microchemistry is that environmental history of fishes can be reconstructed by determining the chemical ratios of divalent elements incorporated in the otoliths using laser ablation inductively coupled mass spectroscopy (LA ICPMS).

Fish should be sampled for at least one to two spawning seasons and the resultant data could provide powerful data about the life histories of blueback herring in the Mohawk River and how the Vischer Ferry and Crescent dam impact their populations.

g. Describe Considerations of Level of Effort and Cost, as Applicable, and Why Proposed Alternative Studies Would Not be Sufficient to Meet the Stated Information Needs

NYPA has not proposed any fish studies despite the information needs that we have outlined in section 7 of this letter.

3. Fish Fauna Composition Study

a. Describe the Goals and Objectives of Each Study Proposal and the Information to be Obtained

The first goal of study is to utilize eDNA, boat electrofishing, and sampling with nets to assess fish fauna composition in the vicinity of the Vischer Ferry and Crescent dam areas. The objective is to determine the different dimensions of species diversity (species abundance, species richness, and species evenness) upstream and downstream of the hydropower facilities. The species sampled during these surveys would likely represent the species that are most impacted by the dams.

In addition, the routine sampling would help determine how abundant American eels and blueback herring are in the vicinity of the Vischer Ferry and Crescent Dams. These surveys would help determine the density of eels in the impoundments. Determining the density of eels and blueback herring as well as other species in the impoundments in the vicinity of the Vischer Ferry and Crescent dams would help show how many species are impacted by the dams and their hydropower operations.

b. Explain the Relevant Resource Management Goals of the Agencies or Indian Tribes with Jurisdiction over the Resource to be Studied

This criterion is not applicable.

c. Explain Any Relevant Public Interest Considerations in Regard to the Proposed Study

Relevant public interest considerations are outlined in the first section of this letter.

d. Describe Existing Information Concerning the Subject of the Study Proposal, and the Need for Additional Information

There has been a noticeable decline in the runs of blueback herring in the Mohawk River and the status of the smallmouth bass appears to be in decline as well. Maturing blueback herring provide an optimal forage for smallmouth bass. Thus, the decline in the blueback herring could be tied to other changes in the fish assemblage within the Mohawk River. The largest question is whether the hydroelectric dams are associated with the loss to the blueback herring that enter the system.

e. Explain Any Nexus Between Project Operations and Effects (Direct, Indirect, and/or Cumulative) on the Resource to be Studied, and How the Study Results Would Inform the Development of License Requirements

The cumulative effect of the series of hydroelectric dams on the Mohawk River represents a serious obstacle to diadromous fishes, if not all species of fishes. These dams also inhibit the free mobility and potentially cause genetic isolation to the native and recreational species.

Information on fish community composition by hydropower plants is an important aspect for development of license requirements. The gathering of information from these types of sampling methods would help determine the true impact to all the fishes that inhabit the Mohawk River and are affected by the generation of electricity by the Vischer Ferry and Crescent dams.

f. Explain How Any Proposed Study Methodology (Including Any Preferred Data Collection and Analysis Techniques, or Objectively Quantified Information, and a Schedule Including Appropriate Filed Season(s) and the Duration) is Consistent with Generally Accepted Practice in the Scientific Community or, as Appropriate, Considers Relevant Tribal Values and Knowledge

The combined benefits of both methods in these studies would yield a cost-effective, efficient, non-destructive sampling regime.

The use of eDNA is sensitive enough to detect newly introduced species, rare species or species that escape traditional sampling methods. Ample evidence has shown that eDNA yields a more detailed results for species richness, electrofishing yields better results for species evenness and sampling fishing is outperformed by eDNA and electrofishing alike. Both electrofishing and sampling fishing may be used to collect data for diversity analysis, however electrofishing outperforms sampling fishing with regards to amount of species caught, making electrofishing a more suitable data collection method. Two years of electroshocking and eDNA should be conducted.

Sampling with nets and should complement the above described methods. Sampling for fish with nets should be conducted in accordance with a standardized procedure (e.g. with regards to depth, temperature, time of year etc) in order to collect data on what species are caught. This methodology has 3 steps: (1) planning of how many nets should be used and where they should be placed; (2) placing nets, and (3) collecting nets, identifying, measuring sampled fish; (4) determining injuries to fish from entrainment, impingement, or from other factors caused by hydropower dams and the generation of electricity.

In order to judge how to place nets some background research needs to be conducted. When placing out the nets and collecting them again, the water temperature, the transparency of the water, wind direction, wind speed, air temperature and cloudiness should be recorded. When sorting through the nets during collections. It would be beneficial to record, length weight, and take scale samples. One to two seasons of net sampling should be conducted in and around the Vischer Ferry and Crescent dams to obtain a true representation of the species that are present.

g. Describe Considerations of Level of Effort and Cost, as Applicable, and Why Proposed Alternative Studies Would Not be Sufficient to Meet the Stated Information Needs

NYPA has not proposed any fish studies despite the information needs that we have outlined in section 7 of this letter.

4. Tailrace Net Fishing Study

a. Describe the Goals and Objectives of Each Study Proposal and the Information to be Obtained

The goal of the study is to place nets at tailraces of the hydropower facilities to determine the injury and mortality to the variety of fishes in the impoundments. The objectives are to assess the impacts of these dams and turbines on native fishes and high value sport fishes in order to evaluate the effectiveness of current fish deterrents.

4.2 Explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied

This criterion is not applicable.

c. Explain Any Relevant Public Interest Considerations in Regard to the Proposed Study

Relevant public interest considerations are outlined in the first section of this letter.

d. Describe Existing Information Concerning the Subject of the Study Proposal, and the Need for Additional Information

Riverine fish are entrained to some extent at virtually every site tested. Entrainment rates are variable among hydropower production sites. Entrainment rates for different species and sizes of fish change daily and seasonally. Most importantly, entrainment rates of different turbines at a site can be significant. The tailraces should be studied to determine if eels and other fishes are suffering injury and mortality.

The Vischer Ferry and Crescent Dams do not have downstream protections on the turbines. In addition, there are no screens on either dam, only three-inch trash screens. Consequently, fish would be readily entrained into the turbines and severely injured if not killed. At these dams, it is not known whether the existing bubble curtains actually deter blueback herring from entrainment; whether other species of fishes are being entrained into the turbines; and whether eggs and larvae of fish are susceptible to entrainment and impingement. Consideration should be given to the downstream passage of blueback herring and American eels.

e. Explain Any Nexus Between Project Operations and Effects (Direct, Indirect, and/or Cumulative) on the Resource to be Studied, and How the Study Results Would Inform the Development of License Requirements

Riverkeeper recommends that protective measures be employed and additional studies be performed to ensure the health and population stability, if not restoration, of resident native fishes, migratory fishes, and high value recreational fishes and fisheries in the Mohawk River.

The information from this study would inform whether screens would protect eels and other species from entering the turbines; how screens could be employed to protect all stages of aquatic life from eggs and larvae to adult stages; and what the optimal area is for screens that would sufficiently reduce the water velocity to prevent impingement of aquatic life.

f. Explain How Any Proposed Study Methodology (Including Any Preferred Data Collection and Analysis Techniques, or Objectively Quantified Information, and a Schedule Including Appropriate Filed Season(s) and the Duration) is Consistent with Generally Accepted Practice in the Scientific Community or, as Appropriate, Considers Relevant Tribal Values and Knowledge

Two seasons of tailrace net sampling should be conducted to ensure that harm to aquatic organisms is accurately assessed.

g. Describe Considerations of Level of Effort and Cost, as Applicable, and Why Proposed Alternative Studies Would Not be Sufficient to Meet the Stated Information Needs

NYPA has not proposed any fish studies despite the information needs that we have outlined in section 7 of this letter.

Since downstream migrants are not often observed, far less consideration has been given to the study of downstream fish passage at hydroelectric facilities. It is time to consider the downstream passage of fish in systems where hydroelectric power is being generated.

5. Water Quality Study

a. Describe the Goals and Objectives of Each Study Proposal and the Information to be Obtained

The goal of this study is to characterize impacts of the Vischer Ferry and Crescent Dams on water quality in the Mohawk River by measuring water quality upstream, within and downstream of the Crescent and Vischer Ferry impoundments. The study objectives are to characterize any effects of the dams and/or their operations on fecal-indicator bacteria, nutrients, silt/sediment, and algal/cyanobacterial abundance in the Mohawk River, with a focus on drinking water and recreational (swimming) uses of the water. This will be done by obtaining the following information:

- Temperature, dissolved oxygen and chlorophyll *a* depth profiles upstream of the Vischer Ferry impoundment (baseline conditions) and at multiple locations within the impoundments;
- Nutrient (nitrogen and phosphorus) and turbidity measurements upstream of the Vischer Ferry impoundment (baseline conditions) and at multiple locations within the impoundments;
- Streamgage or instantaneous flow measurements sufficient to relate water quality, flow and dam operations;
- Data near drinking water intakes; and
- Frequent measurements throughout the year, to capture the broadest possible range of conditions.

b. Explain the Relevant Resource Management Goals of the Agencies or Indian Tribes with Jurisdiction over the Resource to be Studied

This criterion is not applicable.

c. Explain Any Relevant Public Interest Considerations in Regard to the Proposed Study

Relevant public interest considerations are outlined in the first section of this letter.

d. Describe Existing Information Concerning the Subject of the Study Proposal, and the Need for Additional Information

NYSDEC's Waterbody Inventory/Priority Waterbodies List notes threats or impacts to water supply, aquatic life and recreational uses in the Mohawk River in the project areas.[50] Nutrients, silt/sediment and pathogens are listed as pollutants, and stormwater runoff, agriculture, and combined sewer overflows are listed as sources. Hydromodification and flow diversions are also noted for impacting uses. The assessments were last revised in 2010, based on undated monitoring. More recent monitoring studies by NYSDEC are not reflected in the WI/PWL.

Riverkeeper partners with scientists at SUNY Cobleskill to monitor the Mohawk River for *Enterococcus*, an EPA-recommended bacterial indicator of fecal contamination. Within the

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[50] NYSDEC, WI/PWL Fact Sheets - Mohawk/Alplaus Kill Watershed (0202000411), https://www.dec.ny.gov/docs/water_pdf/wimohawkalplauskill.pdf.

project areas, we have sampled seven locations approximately once per month, from May to October, since 2015.

Based on geometric means of all samples collected at each site, four of our seven sampling locations met EPA-recommended Recreational Water Quality Criteria (RWQC).[51] At three sites, the geometric means slightly exceeded the EPA-recommended threshold of 30 cells/100 mL. These are Mohawk Harbor (41 cells/100 mL), Schenectady STP (34 cells/100 mL), and I-87 Crossing near Vischer Ferry (31 cells/100 mL).[52]

Water quality at these three sites was poorer in wet weather, a pattern that we commonly observe in throughout the Hudson River Watershed.[53] (For the purposes of our monitoring studies, we define wet weather as 0.25" or greater precipitation in the three days leading up to sampling.) Comparing geometric means of samples collected in wet versus dry weather shows that, at these three sites, wet weather drove the RWQC exceedances observed. *Enterococcus* counts were also notably elevated at the Aqueduct Rowing Docks, downstream of the Schenectady STP, during wet weather.

Periods of intense rainfall and snowmelt are associated with wastewater overflows and spills throughout the Hudson River Watershed, due to insufficient wastewater treatment plant capacity and aging infrastructure. Three of the WWTPs in the project vicinity (Town of Rotterdam, Town of Niskayuna, and Town of Colonie) have reported discharges of untreated or partially treated sewage between May 2016 and June 2019.[54] In this area, permitted sanitary sewer bypasses are also a factor: the SPDES permit for the Schenectady STP allows discharges of untreated sewage when necessary, which may include periods of wet weather. The City of Schenectady STP reported five sewage discharges between May 2016 and June 2019.[55]

Fecal-indicator bacteria such as *Enterococcus* are the most commonly used indicator of wastewater pollution, and they are closely related to pathogen presence. However, wastewater effluent also contains high concentrations of nutrients, which are a noted pollutant in this area of the Mohawk River, and unregulated contaminants such as industrial chemicals and pharmaceuticals.

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[51] Recreational Water Quality Criteria and Methods, EPA.gov, https://www.epa.gov/wqc/recreational-water-quality-criteria-and-methods (select "2012 Recreational Water Quality Criteria") (last visited Aug. 8, 2019).
[52] Riverkeeper, Mohawk River Water Quality Monitoring Results 2015-2018 (2019), https://www.riverkeeper.org/wp-content/uploads/2019/03/2018-Entero-Report-MOHAWK-Final.pdf.
[53] Riverkeeper, How's the Water? 2015: Fecal Contamination in the Hudson River and its Tributaries (2015), https://www.riverkeeper.org/wp-content/uploads/2015/06/Riverkeeper_WQReport_2015_Final.pdf.
[54] Sewage Discharge Notifications, NYSDEC, https://www.dec.ny.gov/chemical/101187.html (last visited July 10, 2019) (select "Sewage Discharge Reports").
[55] *Id.*

Excessive nutrients and slow-moving water promote algal growth, which may intensify into Harmful Algal Blooms (HABs) in extreme cases. HABs are becoming increasingly common in New York State.[56] The NYSDEC's Mohawk River Basin Action Agenda reports that fourteen HABs have been documented in the Mohawk Watershed between 2012-2017, three of which had documented high algal toxins present.[57]

Recent NYSDEC monitoring, which is not reflected in current WI/PWL assessments, shows that chlorophyll *a* begins to exceed guidance values in the Amsterdam-Cohoes reach of the river, but not further upstream, and suggests that flow alterations and nutrient concentrations allow build-up of suspended algae in impoundments.[58]

HAB-forming algae may produce toxins that are harmful to humans and other animals. Toxins are potentially fatal when ingested, but negative impacts can occur through any contact with affected water. Drinking water affected by HABs requires special monitoring, and if toxins are present, additional treatment is required before consumption. Excessive algal growth can also detrimentally affect aquatic ecosystems by reducing light penetration, altering the nutritional value of phytoplankton for consumers, and depleting dissolved oxygen in the benthic through decomposition.

In addition to the direct negative impacts of HABs on recreational and drinking water quality, treatment of raw water containing large amounts of organic matter may result in disinfection byproducts that are harmful to human health.[59]

The impacts noted in NYSDEC's waterbody assessment are based on a relatively small amount of monitoring data collected nearly a decade ago. Data gathered more recently by NYSDEC has not been used to update the PWL. It is important to collect up-to-date water quality information that is comprehensive enough to assess the dynamics of this system, to protect the health and wellbeing of drinking water consumers, recreational users of the river, and aquatic life.

e. Explain Any Nexus Between Project Operations and Effects (Direct, Indirect, and/or Cumulative) on the Resource to be Studied, and How the Study Results Would Inform the Development of License Requirements

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[56] Harmful Blue-green Algae Bloom Beach Trends, NYS DOH, https://www.health.ny.gov/environmental/water/drinking/bluegreenalgae/beachsurveillance.htm (last visited Aug. 8, 2019).
[57] NYSDEC, Mohawk River Basin Action Agenda: 2018-2022 (2018), https://www.dec.ny.gov/docs/water_pdf/mohawkactionag.pdf.
[58] Alexander J. Smith & Elizabeth Nystrom, *Enhanced Water Quality Monitoring in Support of Modeling Efforts in the Mohawk River Watershed*, in 2009 Mohawk Watershed Symposium, *supra* note 28.
[59] EPA, EPA 816-R-01-014, Stage 1 Disinfectants and Disinfection Byproducts Rule: What Does it Mean to You? (2001),https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=200025FL.txt.

Flow is a fundamental feature of riverine ecosystems, affecting many physical conditions such as temperature, dissolved oxygen, and stratification; sediment regimes; and a wide range of ecological processes including nutrient uptake and primary production.

Dams restrict water movement to certain flowpaths and create reaches of slow-moving or still water. Periods of intense rainfall or snowmelt are associated with higher instream flows and sewage overflows. Depending on water levels prior to rainfall and the intensity and duration of rainfall (or snowmelt), dams may either hold water back, pass it through the project turbines, or pass it over the crest of the dam, and this may differ depending on whether flashboards are installed.

Disinfection byproducts are highly variable, requiring water treatment plant operators to monitor closely and adjust plant processes carefully. Hydropower operations at these dams alter water levels and flow, and therefore may affect raw drinking water quality.

The Crescent and Vischer Ferry project areas include multiple significant point and nonpoint pollution sources, and several drinking water intakes, all of which have been assessed as being highly susceptible to contamination. The conjunction of these inputs and uses makes it extremely important to understand the roles these two dams play, individually and cumulatively, in the ecosystem.

The Crescent and Vischer Ferry dams are part of a complex system that includes other permanent dams (permanent and temporary), locks and bypasses. Each of these components has the potential to alter water level and flow. Results of this water quality study would help to inform the development of license requirements including but not limited to: monitoring status of upstream components in the system to anticipate changes to water levels or flow; operational responses to changes in water levels or flow caused by upstream components of the system; operating restrictions related to seasonal conditions such as water temperature and snowmelt; water quality monitoring and notification requirements to drinking water plant operators; monitoring of sewage overflow reports; and minimum bypass flows and bypass flow routes.

f. Explain How Any Proposed Study Methodology (Including Any Preferred Data Collection and Analysis Techniques, or Objectively Quantified Information, and a Schedule Including Appropriate Filed Season(s) and the Duration) is Consistent with Generally Accepted Practice in the Scientific Community or, as Appropriate, Considers Relevant Tribal Values and Knowledge

Riverkeeper proposes that studies be conducted according to NYSDEC monitoring protocols, including ELAP certification requirements, so that data are consistent with regulatory practices in NYS.

g. Describe Considerations of Level of Effort and Cost, as Applicable, and Why Proposed Alternative Studies Would Not be Sufficient to Meet the Stated Information Needs

The requested studies involve standard water quality measurements, and therefore do not require unreasonable levels of effort or cost. The requested studies may utilize autosamplers and/or sondes, reducing the level of effort involved.

The water quality studies proposed in the scoping document are limited to dissolved oxygen and water temperature. While these are relevant parameters, NYSDEC assessment data show that additional parameters are important and may be directly related to dams, particularly parameters related to HABs. The water quality studies already proposed do not mention information that would be used to relate water quality to flow and dam operations, and do not recognize drinking water uses in the project areas, and therefore would not be sufficient to completely evaluate the impacts of these dams on resources in the project area.

D. Conclusion

Riverkeeper appreciates the opportunity to comment. If you have any questions about these comments, please contact Jennifer Epstein at jepstein@riverkeeper.org or (914) 478-4501 x248.

Sincerely,

Dan Shapley

Water Quality Program Director

ORIGINAL

31 Van Voast Lane

Glenville, New York 12302

July 20, 2019

Kimberly D. Bose

Secretary, FERC

888 First Street, NE

Washington, DC 20426

Vischer Ferry Dam Project # 4679 – 049

Dear Secretary Bose:

I wish to suggest an environmental/cultural study that should be addressed prior to re-licensing the NY Vischer Ferry Hydroelectric Project.

I was a licensed engineer, in the Flood Protection Bureau of the New York State Department of Environmental Conservation (NYSDEC) for almost 30 years. I was involved in the planning, design, construction, operation and maintenance of flood control projects constructed by the five Corps OF Engineer (COE) districts serving New York.

The Vischer Ferry Dam, producing the eleven mile Niskayuna Pool, has caused flooding problems to the unique cultural historic Stockade District of Schenectady, since constructed in 1914. State investigations of flooding problems from this dam date back to the 1920's. In an effort to address the flooding problems, the New York District of the COE identified a feasible local protection project, involving a proposed levee project for the Stockade District in the late 1960's. This project was rejected by the City, as the levee would compromise the extensively used park of the Stockade District.

Prior to re-licensing the hydroelectric plant, I ask that (1) gate modification installation and (2) operation of the gated dam be investigated to protect Stockade District and nearby cultural resources.

The New York Power Authority (NYPA) has recently begun investigating the feasibility of installing gates in a modified dam. Constructing a 400 to 600 foot gated weir would allow the pool to be partly evacuated PRIOR to the arrival of a flood wave.(Reference: A recently constructed recreational dam on the Salt River in the City of Tempe, AZ, has ten hydraulic operated gates , each gate being approximately 100 feet wide and 16 feet high.) This would substantially reduce flood damages to the historic and cultural Stockade District and the Village of Scotia area. Such a study is necessary prior to re-licensing the hydroelectric plant at Vischer Ferry Dam.

A gated weir in Vischer Ferry Dam would allow a winter draw down of the Niskayuna Pool. Ice jam modeling is too complex for reliability projections. The thickness of the ice sheet, depth of the snowpack, air temperature, duration and rate of rise, the intensity and amount of rain, all contribute in a river system ice run. However, if the Niskayuna Pool could be drawn down several feet the probability of ice jam flooding is greatly reduced. The fact that the Niskayuna Pool can't be drawn down is a major design deficiency that must be addressed prior to re-licensing the hydroelectric plant.

Sincerely,

Russell Wege, PE

Retired Engineer

Document Content(s)

James L Woidt, Scarborough, ME.
As part of the existing conditions analysis in support of the Mitigation Measures to Reduce Flooding the Historic Stockade Project led by the City of Schenectady with support from the New York State Department and Homeland Security and Emergency Services (DHSES) and Federal Emergency Management Agency (FEMA), Shumaker Consulting Engineering and Land Surveying, DPC (Shumaker) completed a hydrologic, hydraulic, and ice jam analysis of the Mohawk River at the Schenectady Stockade Historic District (Stockade; Shumaker, 2019). In this report, Shumaker reviewed existing literature and stream gage records to identify a total of 20 flood events that caused flood damage in the Stockade since the construction of Vischer Ferry Dam in 1913. Of these 20 events, 11 were identified to be caused by ice jams. Shumaker’s calculation of the flood risk in the Stockade due to ice jamming yielded that ice-jam induced flood risk was greater than that of unobstructed free-flow conditions and including the joint probability of ice-jam induced flood risk with the unobstructed free-flow flood risk increased the Base Flood Elevation approximately 1.2 feet from what is currently shown on the FEMA Flood Insurance Rate Maps and 1.8 feet from free-flow conditions alone based on Shumaker’s (2019) revised hydraulic analyses. Therefore, ignoring ice jams would underestimate the Schenectady reach of of the Mohawk River.

Extensive published research by Dr. Garver of Union College and the USGS have identified the Rexford Knolls, between the Rexford Bridge and Vischer Ferry Dam, as a frequent location of ice jams affecting the Stockade. The operation of Vischer Ferry Dam affects the hydraulics of the Mohawk River in this location which may also affect the formation of ice jams; whether this impact is beneficial or detrimental is unknown. Although technical analyses of the impact of Vischer Ferry Dam on ice jamming do not yet exist, numerous Stockade residents have penned letters to the editor and spoken publicly claiming that Vischer Ferry Dam is responsible for flooding of the Stockade and that is must be modified. These claims are to date unfounded in science and a brief hydraulic analysis performed by Shumaker found that Vischer Ferry had less than a six-inch impact on the base flood elevation in the Stockade. However, no known studies have been completed to quantify the impacts (positive or negative) of the operation of Vischer Ferry dam on upstream or downstream ice jamming. Therefore, I recommend that flood damage be included as a potential impact of Vischer Ferry Dam and that as part of the re-licensing process, a study be conducted that quantifies the frequency and magnitude of ice jamming on the Mohawk River upstream and downstream of Vischer Ferry Dam and quantifies the impact of Vischer Ferry Dam on the frequency and magnitude of flooding upstream and downstream of the dam.

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Document Content(s)

John I. Garver, Schenectady, NY.
Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First St. NE
Washington, DC 20426

Docket Number P-4678 and P-4679.– Vischer Ferry and Crescent Hydroelectric Projects

Dear Secretary Bose,

This is a comment on the environmental review scoping document (Docket Number P-4679 and P-4678), and this letter requests relicensing studies related to fish populations and fish passage.

The Visher Ferry Dam (VFD) and the Crescent Dam on the lower Mohawk River are permanent impoundments, and published data clearly show that they affect the overall fishery in the watershed. Piscivorous birds (Comorants and Mergansers) have high population densities below the VFD, which may reflect limited fish passage and thus an ecological bottleneck related to poor opportunities for passage.

The Mohawk River has strongly asymmetric fish populations that vary in species and abundance between permanently impounded sections (i.e. Vischer and Crescent dams, herein “the Dams”), and those sections of the River that are seasonally impounded. A primary finding from recent surveys shows that the seasonally impounded sections of the river (i.e. those up river from the Project) support a higher diversity and larger percentage of native species.

We need more data to fully understand the nature of the fishery in the Lower Mohawk River. Specifically surveys are needed to quantify: 1) the distribution asymmetry of native versus non-native fish in the impounded sections of the river; 2) the affect that permanent impoundments has on overall fish recruitment and migration; 3) population dynamics of herring and eel; 4) the overall effect of the dams (and turbines) on both up-river and down-river fish passage; 5) the current and potential threat from invasive fish.

Limited survey data show that the lower impounded section has a diverse fishery that appears to be dominated by non-native species (McBride, 2009; George et al., 2016). While recent surveys are based on standard electrofishing, the method and timing of surveys apparently are not sufficient to fully capture the population dynamics of Herring (i.e. Alosa aestivalis) and Eel (i.e. Anguilla rostrata), thus we have almost no data on the health of these cornerstone fish.

Birds eat fish. Cormorants and Mergansers are diving birds that prey on fish and other freshwater macrofauna. There have been 162 reports of Double-Crested Cormorant (Phalacrocorax auritus) at the Vischer Ferry Dam reported on eBird since 2009 (2009 to May 2019), and combined, these reports account for 1642 birds. Likewise, there have been 229 reports of Common Merganser (Mergus merganser) at the same site since 2009 with a total of 2442 birds being reported. Note that eBird is volunteered reported data, and obviously this represents a minimum possible number of birds at this site: this region has moderate participation in this form of data collection.

There is no other site on the Mohawk River in Schenectady County that has this reported density of these piscivores (Phalacrocorax auritus and Mergus merganser). There are no locations on the River in this area that are even close to the bird density. The eBird database is an online record of bird observations launched in 2002 by the Cornell Lab of Ornithology at Cornell University and the National Audubon Society. Thus for the Mohawk River in Schenectady County, these data show the highest occurrence of these piscivores occurs at the Vischer Ferry Dam.

Both Phalacrocorax auritus and Mergus merganser are a voracious predators of fish (Dorr et al., 2014; Pearce et al., 2015), and there have been a number of management issues in the United States associated with these birds, especially Cormorants (Dorr and Fielder, 2017a,b). Research has shown that cormorants tend to feed on smaller fish, including young fish, and they may be responsible for a mortality bottleneck (see Dorr and Fielder, 2017a). The appearance of Phalacrocorax sp. into river environments, due to a displacement from marine foraging area, has been shown to have resulted in a massive decline of fish (Jepsen et al., 2018). Cormorants feed on fishes that are readily available and the birds are common and abundant where fish are easily caught (see Dorr et al. 2014). Thus the common occurrence of these birds at the dam would suggest that there maybe some question about the efficiency of fish passage at the Dam.

Summary. We need studies and detailed data on fish populations and fish passage in the context of the Vischer and Crescent dams. The abundance of Piscivorous diving birds at the VFD may indicate that the dam is a major bottleneck caused by limited fish passage opportunities. Current data sets are insufficient for making informed management decisions.

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George, S.D., Baldigo, B.P. and Wells, S.M., 2016. Effects of Seasonal Drawdowns on Fish Assemblages in Sections of an Impounded River–Canal System in Upstate NY. Transactions of the Am Fisheries Soc, 145(6), pp.1348-1357.

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Document Content(s)

Christopher Cook, Saratoga Springs, NY.
Hello,

Hydroelectric dams provide clean energy but not without negative environmental impacts. As part of this relicensing process, please conduct a full environmental impact analysis to understand the impacts these dams have on migratory fish and water quality.

Thank you,

Chris Cook

Document Content(s)

APPENDIX B: Response to Comments and Study Requests

No.	Agency/Stakeholder	Study Request/Comment/AIR	Power Authority Response
	STUDY REQUESTS		
		WATER QUALITY	
1	USFWS 8/8/2019	**Water Quality Study** - The Service recommends that the Applicant conduct a thorough water quality assessment at the Projects. The study should provide relevant water quality information to determine if the Projects meet minimum water quality standards for the preservation of beneficial uses at the Projects including fish and wildlife habitat and recreation. The goals and objectives of this study are to provide baseline water quality information to allow a proper determination of the potential impacts at the Projects. These data are necessary to evaluate how water quality may influence the current condition of the fishery. The recommended study uses standard scientific water quality sampling techniques used in most hydroelectric licensing activities. These studies should include water temperature and DO monitoring on a continuous basis for at least 1 year, along with monthly sampling of other parameters such as chlorophyll content, pH, turbidity, and conductivity. An additional year of monitoring may be requested based on a review of the first year's results. This information will be used to document baseline water quality conditions and to determine potential impacts from Project operations. We recommend that water quality data be collected from vertical profiles in the impoundments and below the powerhouses at the Projects. As the Projects' dams are wide, distal portions of the downstream reach below the dam may not be adequately watered by current spillage. The Applicant should record continuous water quality data below the dams near the canal locks. The data should be presented in conjunction with generation at the Projects, noting which units were operating and any unit trips, as well as flows in the bypassed reaches. Data from the downstream u.s. Geological Survey (USGS) Cohoes gauge should also be provided, along with daily rainfall and temperature data.	The Power Authority is proposing to conduct a water quality study at the Crescent and Vischer Ferry Projects. The study will be conducted during the 2020 study season, and will include continuous DO and temperature monitoring at four locations (impoundment and tailwater of each Project) for the warm weather period May through October. The study report will be included in the Initial Study Report (ISR) expected to be filed with FERC in February 2021.
2	NYSDEC 8/9/2019	**Water Quality Monitoring Study** The Water Quality Monitoring Study should include: continuous water temperature and dissolved oxygen (DO) data collection for 1 year and discrete measurements (i.e. temperature, DO, pH, and conductivity) monthly from April 1 through November 30. Baseline water quality studies are needed to ensure compliance with NYS water quality standards, (the	See response to USFWS in 1.

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		Clean Water Act § 401 Water Quality Certification) and identify potential NYPA Projects impacts to the fish community, particularly impacts to blueback herring (*Alosa aestivalis*) during upstream and downstream migrations (e.g., juvenile outmigration, adult immigration). An additional year of monitoring may be needed based on a review of the first year's study results to ensure impacts on aquatic resources and that the goals and objectives of the Study are addressed. Data should be collected from the impoundments, the by-passed reaches and tailrace. Water quality information collected should be summarized in a manner that will allow appropriate analysis of the current flow regime. Methods for mitigating water quality problems (i.e. modifications to infrastructure, or changes to existing operations) should be fully explored and modeled as to their potential effectiveness. The goals and objectives of this study are to provide baseline water quality information. The recommended study uses standard water quality sampling techniques commonly used in most hydropower licensing activities.	
3	Riverkeeper 8/9/2019	**Water Quality Study** The goal of this study is to characterize impacts of the Vischer Ferry and Crescent Dams on water quality in the Mohawk River by measuring water quality upstream, within and downstream of the Crescent and Vischer Ferry impoundments. The study objectives are to characterize any effects of the dams and/or their operations on fecal-indicator bacteria, nutrients, silt/sediment, and algal/cyanobacterial abundance in the Mohawk River, with a focus on drinking water and recreational (swimming) uses of the water. This will be done by obtaining the following information: • Temperature, dissolved oxygen and chlorophyll a depth profiles upstream of the Vischer Ferry impoundment (baseline conditions) and at multiple locations within the impoundments; • Nutrient (nitrogen and phosphorus) and turbidity measurements upstream of the Vischer Ferry impoundment (baseline conditions) and at multiple locations within the impoundments; • Streamgage or instantaneous flow measurements sufficient to relate water quality, flow and dam operations; • Data near drinking water intakes; and	See response to USFWS in 1. However, the focus of the Power Authority's proposed water quality study is DO and temperature and does not include the collection of bacteria, chlorophyll-a, nutrients, etc., as these water quality parameters are not related to Project operations.

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		• Frequent measurements throughout the year, to capture the broadest possible range of conditions. Riverkeeper proposes that studies be conducted according to NYSDEC monitoring protocols, including ELAP certification requirements, so that data are consistent with regulatory practices in NYS.	
4	Assemblyman Steck 8/8/2019	Drinking water: Recent work by the USGS and NYSDEC has shown elevated phosphorous, chlorophyll-a, and fecal coliform bacteria in the lower Mohawk that exceed guidance values and these concerning levels may be driven in part by impoundments (Smith and Nystrom, 2017). Water quality in these impoundments affects algal growth, which in turn can affect drinking water quality and/or treatment costs by increasing the risk of formation of disinfection byproducts or harmful algal blooms (HABs). More than 100,000 people in Colonie and Cohoes rely on the Mohawk River as a drinking water source, and more than 120,000 people in Niskayuna, Schenectady, Scotia, Glenville, Rotterdam and Ballston rely at least in part on aquifers under the influence of Mohawk River water. We need to fully evaluate the roll that the dams play in affecting water quality in the lower Mohawk and implement strategies for source water protection.	See response to USFWS in 1. However, the focus of the Power Authority's proposed water quality study is DO and temperature and does not include the collection of bacteria, chlorophyll-a, nutrients, etc., as these water quality parameters are not related to Project operations.
		FISH AND AQUATICS	
5	FERC 8/9/2019	**Entrainment and Impingement Study** - The goal of this study is to evaluate the potential for trash rack impingement, turbine entrainment, and related survival for migratory (blueback herring and American eel) and resident game fishes (smallmouth bass, walleye, and yellow perch) at the Crescent Project and Vischer Ferry Project in the Mohawk River. The objectives of this study, at a minimum, are to: (1) estimate the minimum sizes of each target species**1** that would be excluded from the trash racks at each project based on body size alone; (2) provide the burst speeds (with source information cited) for juveniles and adults of each target species;**2** (3) provide the expected intake approach velocities at the maximum hydraulic capacity of each project; and (4) use a blade strike model (e.g., Franke et al. 1997)**3** to estimate the turbine mortality of each target species. The blade strike models should be based on the specifications of the Kaplan and Francis turbines (rotational speed, blade spacing and number, etc.) installed at each project; separate mortality estimates (model runs) should be conducted for the Francis and Kaplan	The Power Authority is proposing to conduct an industry standard desktop entrainment/impingement study for the Crescent and Vischer Ferry Projects. The study will be conducted during the 2020 study season. The proposed study will examine the potential for entrainment of both resident and migratory species, and will estimate turbine survival/mortality for representative species/lifestages found at the Projects.

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		units, with mortality estimates reported for each 1-inch size bin across the entire size range of fish used in the models.	
6	USFWS 8/8/2019	**Fish Protection and Downstream Passage Studies** The Service recommends that the Applicant prepare an assessment of entrainment and mortality at the Projects and explore potential alternative methods to exclude fish from the Projects' turbines and safely pass fish downstream. This study should collect site-specific data and reference available literature regarding target fish species and impacts at similar hydroelectric sites. The goals and objectives of this study are to provide information on impacts due to fish entrainment and mortality and potential fish passage and protection structures that could be utilized at the Projects. The information obtained will allow the Service's fishway engineers to evaluate the potential effectiveness of various options. The recommended study uses standard literature reviews and site-specific data collection techniques common to most hydroelectric licensing activities. The Service recommends that the Applicant explore alternatives to keep all fish species out of the turbines. We also recommend that alternatives to effectively pass fish downstream around the dams be developed. These alternatives may include any existing trash sluices located close to the intakes.	See response to FERC in 5.
7	NYSDEC 8/9/2019	**Fish Protection and Downstream Passage Studies** The NYPA Projects dams serve as a barrier to upstream and downstream fish migration. Fish moving downstream are subjected to potential mortality from impingement and entrainment. Recently issued licenses issued for projects on similar rivers throughout New York State, have incorporated 1"-clear spaced trash racks to physically exclude most adult fish from the turbines, alternate downstream passage routes, and other features (e.g. reduced approach velocities, adequate plunge pools, etc.) to encourage safe downstream fish passage. The Applicant should explore alternatives to keep all fish species out of the turbines, and any other species found in abundance during fishery surveys. Alternatives also need to be developed to effectively allow the passage of fish downstream around the dam. These alternatives may include modifying any existing trash sluices located close to the intakes and provide notches in the flashboards.	See response to USFWS in 6.

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		This study should include a literature search of available passage designs for the species of concern, as well as information on the relative effectiveness of each design. Existing facilities at other dams should be investigated. Careful attention should be paid to attraction flows, guidance mechanisms and velocities. Fish moving downriver must be diverted away from the turbines and guided to the downstream passage facility. Adequate attraction and conveyance flows must be provided. The passage facility should not create a bottleneck that would delay downstream movement or expose the fish to excessive predation. All passage facilities should be designed to prevent blockage from ice and debris, should be as maintenance-free as is feasible and be able to operate under all flow conditions experienced in the Mohawk River Basin. In addition to literature review and on-site investigations of existing facilities, the Applicant should collect site-specific data from the Projects to aid in the design of protection and passage facilities. This information should include flows, velocities, water depths, and substrates. The Applicant should also collect information on the passage requirements of the fish species found in the Mohawk River Basin. This information should include: swimming speeds (including burst speeds); where in the water column these fish are likely to be moving and different forms of attractants or repellents (e.g. sound, light, etc.) that may help guide each species. For fish that have been drawn into the turbines, the probability of survival for fish passage through the NYPA Projects turbines should also be assessed for both the Francis and Kaplan turbines. The Applicant should consider both adult and juvenile life stages of fish species found in the Mohawk River Basin. The goals and objectives of this study are to collect site-specific information and conduct a literature review of fish passage alternatives to evaluate options for improving fish protection and downstream fish passage at the NYPA Projects facilities. The information obtained will allow NYSDEC aquatic biologists and USFWS's fishway engineers to evaluate the potential effectiveness of various options. The recommended study uses standard literature reviews and site-specific data collection techniques common to most hydropower licensing	

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		activities and satisfactory to meeting the informational needs of the USFWS.	
8	USFWS 8/8/2019	**Blueback Herring Migration and Routing Study** The Applicant currently utilizes a hydroacoustic deterrent system to direct downstream migrating blueback herring away from each Project's intake to limit entrainment. The Service will be evaluating the efficacy of this method during relicensing to inform our Section 18 Fishway Prescription conditions for the Projects. Of note, the difficulty in installing this system in the spring prior to the start of the navigation season was problematic this year and has been an issue in the past. The cumulative impacts of entrainment through the six hydroelectric projects in the lower Mohawk and Hudson Rivers require particularly low entrainment rates' at each project in order to maintain a high escapement rate. This issue has become increasingly important in light of the decline in blueback herring in the system, and the Atlantic Coast more broadly. The Service recommends that the Applicant conduct a detailed, 2 year, fisheries study utilizing a variety of hydroacoustic, tagging, netting, and general fisheries methods to determine the abundance, timing, and routing of the upstream adult and downstream adult and juvenile migration of blueback herring in relation to the dam, powerhouse, fish bypass, and lock facilities at the Project. The goals and objectives of this study are to determine the abundance, timing, and routing of the upstream adult and downstream adult and juvenile migration of blueback herring in relation to the dam, powerhouse, fish bypass, and lock facilities at the Project. The Service recommends a thorough fisheries study targeted at the timing and routing of blueback herring at the Projects. This study should be developed in consultation with, and approved by, the Service and the NYSDEC. The Applicant should use a variety of hydroacoustic, tagging, and netting techniques to assess the timing and population size of the migration of blueback herring at the Projects. Additionally, this study should determine the routing of blueback herring during both upstream and downstream migration. The study should assess the degree to which the species moves upstream through the locks or stages below the Projects' tailraces. This study should cover the entire migration period, both upstream and downstream for adults and downstream for juveniles, as determined by the Service and the NYSDEC. The study should focus on movement into the Projects' area, targeting the canal locks, the	The Power Authority is proposing a blueback herring migration study that focuses on upstream migrating adult herring. The proposed study will be conducted in 2020 during the herring migration season (May through July). The focus on upstream migration is proposed since much more is already known about downstream migration of blueback herring juveniles (and adults) based on studies that have been conducted over the years to test the effectiveness of the Power Authority's acoustic deterrence and fish passage systems at both Crescent and Vischer Ferry. The proposed study will focus on evaluating the movement of adult herring through Locks E-6 and E-7, which provide upstream passage for blueback herring at the Crescent and Vischer Ferry Projects, respectively. The proposed study will use hydroaccoustics to gather information on the timing and magnitude of the adult herring run, and the routes the fish use to move upstream of the dams.

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		intakes, the fish bypasses, the turbines, and upstream from the canal and Projects' dams. Due to highly variable migration numbers and periods from year-to-year, this study should be conducted for 2 years. The study should be supplemented with general fisheries information as needed to determine the proportion of any acoustically monitored targets that are blueback herring. We recommend that a variety of sampling gear, including gill nets, trap nets, seines, and electroshocking, be used as appropriate for site conditions. This study should use standard scientific collecting techniques used in many hydroelectric licensing studies related to river herring movement. Information normally collected includes species, size, age, sex, and condition, as well as any specific habitat information (i.e. substrate, water depth, velocity conditions). Standard water quality data (i.e., water temperature, dissolved oxygen [DO], pH, and conductivity) are usually collected in conjunction with these surveys.	
9	Riverkeeper 8/9/2019	**Otolith Microchemistry Study of Blueback Herring** Otoliths are considered one of the most valuable tools in fisheries science because they can be used to accurately determine the age and specific habitat usage of fish. The goal of this study is to utilize otolith microchemistry on blueback herring captured in the impoundments behind the Vischer Ferry and Crescent hydroelectric dams to determine age, life history traits, and migration patterns. The objectives of this study are to: determine the provenance of fish captured in the impoundment; determine if the blueback herring are repeat spawners within the Mohawk River; and determine if the Mohawk River is a source or a sink population for these fishes. Otolith microchemistry is a standard methodology utilized in fisheries science that has received widespread acceptance. Otoliths are calcium carbonate ear bones that are possessed by all teleost fishes. Because all teleosts possess otoliths, they can be used as natural tags that record their movements from environmental signals. Otolith accrete layers of calcium carbonate on a daily basis and divalent chemicals are randomly substituted for Ca 2+ or are inserted in the interstitial spaces of the calcium carbonate lattice during formation of the aragonitic crystal. The benefit of otolith microchemistry is that environmental history of fishes can be reconstructed by determining the chemical ratios of divalent elements incorporated in the otoliths using laser ablation inductively coupled mass spectroscopy (LA ICPMS). Fish should be sampled for at least one to two	See PSP section 3.1.2.

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		spawning seasons and the resultant data could provide powerful data about the life histories of blueback herring in the Mohawk River and how the Vischer Ferry and Crescent dam impact their populations.	
10	NYSDEC 8/9/2019	**Fish Community Study** The Applicant should conduct comprehensive fisheries surveys within the vicinity of the Projects to inform how the Projects impact fish populations and species composition and inform the Fish Protection and Downstream Passage Study. The Applicant should use a variety of gear types during different seasons because the ability of any particular gear type to capture fish is affected by fish species, size and behavior, the in-water physical and hydrological conditions of the sampling site and other seasonal variables. No single gear type is effective for sampling all potential species that may be found in lake or riverine systems; however, multiple gear types used in combination used throughout the season can effectively sample the majority of fish species present. Comprehensive sampling for fisheries data collection should include some combination of the use of electrofishing, gill netting, trap netting, minnow traps, seining, and angling. The survey work should be done for at least 1 full year; with an option for a second year of study should the data collected be deemed inadequate upon review. The survey should cover at least three seasons (spring, summer, and fall), and all four seasons, if possible. The information collected should include species identification, size, age, sex, and condition, as well as movement patterns and habitat utilization. Standard water quality data (e.g. water temperature, dissolved oxygen, pH, and conductivity) should also be collected in conjunction with these surveys. These studies should focus on the general fishery resources, not only sportfish. The goals and objectives of this study are to provide information on the existing fishery and resources in the vicinity of the NYPA Projects, including areas upstream and downstream of the dam, to aid in the determination of what the impacts of the Projects may be. The information to be collected should include both temporal and spatial aspects of species distribution; age, size, sex and condition data; habitat utilization; and fish movement patterns. The recommended study uses standard scientific collecting techniques used in most hydropower licensing activities. The Applicant should use a	The Power Authority is proposing a desktop, literature-based study to evaluate the fish community found at the Crescent and Vischer Ferry Projects. The study will be conducted in 2020 and will utilize existing fisheries data that has been collected by NYSDEC, USGS, and other researchers. Numerous studies and surveys of fish have been conducted in the lower Mohawk River in the vicinity of the Projects over the past several decades. When examined comprehensively, the Power Authority believes that existing survey data will provide a complete picture of the fish community, including both resident and migratory species, found in the Crescent and Vischer Ferry Project waters.

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		variety of gear types during different seasons because the ability of any particular gear type to capture fish is affected by fish species, size and behavior, the in-water physical and hydrological conditions of the sampling site, and other seasonal variables. No single gear type is effective for sampling all potential species that may be found in lake or riverine systems; however, multiple gear types used in combination used throughout the season can effectively sample the majority of fish species present. Standard water quality data (e.g. water temperature, dissolved oxygen, pH, and conductivity) should also be collected in conjunction with these surveys.	
11	Riverkeeper 8/9/2019	**Fish Fauna Composition Study** The first goal of study is to utilize eDNA, boat electrofishing, and sampling with nets to assess fish fauna composition in the vicinity of the Vischer Ferry and Crescent dam areas. The objective is to determine the different dimensions of species diversity (species abundance, species richness, and species evenness) upstream and downstream of the hydropower facilities. The species sampled during these surveys would likely represent the species that are most impacted by the dams. In addition, the routine sampling would help determine how abundant American eels and blueback herring are in the vicinity of the Vischer Ferry and Crescent Dams. These surveys would help determine the density of eels in the impoundments. Determining the density of eels and blueback herring as well as other species in the impoundments in the vicinity of the Vischer Ferry and Crescent dams would help show how many species are impacted by the dams and their hydropower operations. The combined benefits of both methods in these studies would yield a cost-effective, efficient, non-destructive sampling regime. The use of eDNA is sensitive enough to detect newly introduced species, rare species or species that escape traditional sampling methods. Ample evidence has shown that eDNA yields a more detailed results for species richness, electrofishing yields better results for species evenness and sampling fishing is outperformed by eDNA and electrofishing alike. Both electrofishing and sampling fishing may be used to collect data for diversity analysis, however electrofishing outperforms sampling fishing with regards to amount of species caught, making electrofishing a more suitable data collection method. Two years of electroshocking and eDNA should be conducted. Sampling with nets and should complement the	See responses to FERC in 5 and NYSDEC in 10.

No.	Agency/Stakeholder	Study Request/Comment/AIR	Power Authority Response
		above described methods. Sampling for fish with nets should be conducted in accordance with a standardized procedure (e.g. with regards to depth, temperature, time of year etc) in order to collect data on what species are caught. This methodology has 3 steps: (1) planning of how many nets should be used and where they should be placed; (2) placing nets, and (3) collecting nets, identifying, measuring sampled fish; (4) determining injuries to fish from entrainment, impingement, or from other factors caused by hydropower dams and the generation of electricity. In order to judge how to place nets some background research needs to be conducted. When placing out the nets and collecting them again, the water temperature, the transparency of the water, wind direction, wind speed, air temperature and cloudiness should be recorded. When sorting through the nets during collections. It would be beneficial to record, length weight, and take scale samples. One to two seasons of net sampling should be conducted in and around the Vischer Ferry and Crescent dams to obtain a true representation of the species that are present.	
12	Assemblyman Steck 8/8/2019	Fish: Studies are needed to better understand native, non-native, and migratory fish in the lower Mohawk. Migratory fish, including blueback herring and American eel, are present in the Mohawk River, and are known to suffer injury and mortality when passing both upstream and downstream through dams.	See responses to FERC in 5 and NYSDEC in 10.
13	Garver 8/8/2019	We need studies and detailed data on fish populations and fish passage in the context of the Vischer and Crescent dams. The abundance of Piscivorous diving birds at the VFD may indicate that the dam is a major bottleneck caused by limited fish passage opportunities. Current data sets are insufficient for making informed management decisions.	See responses to FERC in 5 and NYSDEC in 10.
14	Riverkeeper 8/9/2019	**Tailrace Net Fishing Study** The goal of the study is to place nets at tailraces of the hydropower facilities to determine the injury and mortality to the variety of fishes in the impoundments. The objectives are to assess the impacts of these dams and turbines on native fishes and high value sport fishes in order to evaluate the effectiveness of current fish deterrents. Riverine fish are entrained to some extent at virtually every site tested. Entrainment rates are variable among hydropower production sites. Entrainment rates for different species and sizes of fish change daily and seasonally. Most importantly, entrainment rates of different turbines at a site can be significant. The tailraces should be studied to determine if eels and other	The Power Authority is not proposing to conduct the requested tailrace net fishing study. See PSP section 3.1.1. See also response to FERC in 5.

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		fishes are suffering injury and mortality. The Vischer Ferry and Crescent Dams do not have downstream protections on the turbines. In addition, there are no screens on either dam, only three-inch trash screens. Consequently, fish would be readily entrained into the turbines and severely injured if not killed. At these dams, it is not known whether the existing bubble curtains actually deter blueback herring from entrainment; whether other species of fishes are being entrained into the turbines; and whether eggs and larvae of fish are susceptible to entrainment and impingement. Consideration should be given to the downstream passage of blueback herring and American eels. Two seasons of tailrace net sampling should be conducted to ensure that harm to aquatic organisms is accurately assessed.	
15	USFWS 8/8/2019	**American Eel Study** The Service is requesting a study of American eel *(Anguilla rostrata)* occurrence in the vicinity of the Projects. American eel are known to occur in the lower Mohawk River; however, the actual abundance and distribution in the vicinity of the Projects is unknown as downstream dams and canal lockages (i.e., eel generally move at night and lockages are during the day) may limit the abundance of eel above Cohoes Falls and above and below the Projects. This information will inform our Section 18 Fishway Prescription conditions. The goals and objectives of this study are to determine the distribution and relative abundance of American eel in the Project boundary. The Service may recommend additional upstream and downstream study efforts pertaining to passage for this species depending on the outcome of this study. The Applicant should utilize standard fishery practices including nighttime electrofishing and eel traps/eel pots. The level of effort would involve one field crew sampling on a seasonal basis with a focus on upstream and downstream migration and location of adult eels. The study would last for 1-2 years. It could be conducted along with other fisheries sampling activities as requested by the NYSDEC. The actual cost is unknown and would depend upon the gear type used, number of sampling locations, local labor costs, the ability to combine multiple studies (e.g., fisheries and water quality) into one task, etc. The provided literature is currently inadequate to fully address Project impacts, and there are no alternatives to conducting eel surveys. However, the Applicant has flexibility to design the most cost-effective way to acquire the necessary data.	See PSP section 3.2.1.

No.	Agency/Stakeholder	Study Request/Comment/AIR	Power Authority Response
16	NYSDEC 8/9/2019	**American Eel Study** American eel (*Anguilla rostrata*) has a wide range across the Eastern United States and New York State where it is native in 17 of the 18 watersheds in the state. Eel runs, in which young-of-year juvenile eels (elvers) migrate into freshwater habitat, have long occurred with elvers scaling waterfalls and the faces of dams to access more habitat further inland. Despite their robust nature, the American eel population has been steadily in decline and the construction of dams and the operation of hydropower projects are some of the contributing factors. American eels are not known to travel well through the canal lock system and may even show a preference for dam sites during their upstream migration in the spring. As the American eel has been documented in surveys to inhabit the Mohawk River Watershed, a study is needed to ascertain the presence and abundance of eels and the need to provide them a better mode of upstream and downstream passage. The goals and objectives of this study are to investigate the presence, distribution, and relative abundance of American eel in the NYPA Projects area and assess the need for eel ladders to improve successful and safe upstream passage. The detection of American eel DNA is a less intensive method for detecting simple presence/absence of eel in the NYPA Projects areas. The methods provided by Cornell University's "Tracking Fish with eDNA" (https://fishtracker.vet.cornell.edu/) program should be followed as detailed in Cornell's protocols. The collection of eels through the deployment of eel pots and eel traps should be employed at the NYPA Projects dams to determine staging of upstream migration and relative abundance of elvers. These sampling efforts are more intensive but would facilitate assessment of both presence and numbers of eels and would be suitable for both the first and second phase of the study. In addition to traps and mops, sampling efforts should include surveying benthic habitat preferred by American eel with nets and/or electrofishing. This would allow for determining relative abundance of all eels, although mainly adults. The recommended study uses standard sampling techniques commonly used in most hydropower licensing activities for an American eel study.	See response to USFWS in 15.

No.	Agency/Stakeholder	Study Request/Comment/AIR	Power Authority Response
17	Riverkeeper 8/9/2019	**Acoustic Telemetry Study of Out-migrating Silver Eels** The goal of this study is to determine the out-migration patterns of American eels in the Mohawk River and to determine if the Vischer Ferry and Crescent Dam are preventing or delaying eels from returning to the Sargasso Sea to spawn. Riverkeeper requests that acoustic telemetry be used to accurately track the movements of silver eels in and around the dams, especially in the fall when they begin their return migrations. In order to conduct this study, silver eels should be captured in late summer and their movements and behavior patterns should be monitored for at least one migration season. As in all science, more sampling and data collection is better. Silver eels would be captured during an electroshock survey and coded transmitters (e.g., Vemco V9) would be surgically implanted into their peritoneal cavities. Coded tags of this nature were specifically developed to provide researchers with the means to track and determine the behavior patterns of fish. These types of telemetry tags can function as a simple pinger giving location only, or can be equipped with depth and/or temperature sensors. For applications such as site residency studies and automated monitoring of migrations, coded transmissions are desirable because of significantly increased battery life and the large number of unique IDs available on a single frequency.	See response to USFWS in 15.
18	USFWS 8/8/2019	**Freshwater Mussel Surveys** The Service recommends that the Applicant conduct a thorough freshwater mussel survey at the Projects. The study should use a variety of shallow and deep-water techniques approved by the NYSDEC. The goals and objectives of this study are to provide information on the existing freshwater mussel communities that may be impacted by Project operations. This information will be used to document the current mussel communities to determine potential impacts from the operation of the Projects. The recommended study uses standard scientific collecting techniques common to most hydroelectric licensing activities. Standard sampling techniques targeting mussel populations should be utilized. The Applicant should follow specific study guidelines as recommended by the NYSDEC for freshwater mussels.	See PSP section 3.2.2.

No.	Agency/Stakeholder	Study Request/Comment/AIR	Power Authority Response
19	NYSDEC 8/9/2019	**Freshwater Mussel Survey** The freshwater mussel survey should be completed by an individual who is properly licensed and is familiar with the species in the watershed of the NYPA Projects. Reporting should include species-specific results. An additional year of study may be needed based on a review of the first year's study results to ensure impacts on aquatic resources and that the goals and objectives of the Study are addressed. Throughout the state and in the local geographic area freshwater mussels have been poorly documented and assessed in the past and many are in peril of extirpation and extinction due to habitat loss and alteration, overharvest, and competition with invasive species. It is unknown what species may be present in the NYPA Projects areas barring the invasive Zebra Mussel (*Dreissena polymorpha*). The goals and objectives of this study are to provide information on the existing freshwater mussel populations upstream and downstream of the facilities that are impacted by NYPA Projects operations. The NYSDEC requests that the Applicant survey populations of freshwater mussels carried out in impoundments, stream habitats and bypass reaches of the NYPA Projects boundaries. The full areal extent of the survey should include: • All areas of direct disturbance by hydropower project maintenance and improvement; • Anywhere there will be alteration of stream banks or the stream bed related to the NYPA Projects; • Areas with permanent or temporary changes to flow, sedimentation, intake of waters or discharge of effluent, chemical discharge, or potential chemical spill discharge; • Equipment in-stream or other disturbance; and • All areas hydrologically influenced by the hydropower project. All bivalve species encountered, including invasive species, should be identified and noted in survey reports. The discovery of species listed as NYS Endangered or Threatened may require additional, more detailed surveys (Smith et al 2001). Initial surveys, and possible additional and more detailed surveys, should be timed area surveys consistent with one or both protocols listed.	See response to USFWS in 18.

No.	Agency/Stakeholder	Study Request/Comment/AIR	Power Authority Response
		WETLANDS/WILDLIFE/BOTANICAL	
20	USFWS 8/8/2019	**Aquatic Mesohabitat Study** The Service recommends that the Applicant verify all key aquatic habitats at the Projects, including wetlands and submerged aquatic vegetation. This study will involve verification of existing data and mapping of occurrence to update the information on these habitats for the Projects. The goals and objectives of this study are to identify key aquatic habitat areas that may be affected by Project operations. The study will provide information on the extent and quality of aquatic habitats and the wildlife they support. The Service recommends that the Applicant document all wetlands and other aquatic vegetation that may be affected by Project operations. The NWI maps are frequently used as the starting point in identifying wetlands. The Applicant should confirm the boundaries of any wetlands identified in the PAD and conduct an additional search for any wetland areas at the Projects. Submerged aquatic vegetation in the impoundments should be mapped and identified. Shoreline areas of erosion, fish nesting, and mussel beds or middens should also be mapped. The Service is not requesting detailed delineation of wetlands at the Projects.	The Power Authority is proposing to conduct an aquatic mesohabitat study at the Crescent and Vischer Ferry Projects. The proposed study will use a combination of existing aerial imagery and field reconnaissance to develop habitat maps showing the location and extent of various aquatic habitats including littoral and riparian wetlands and SAV. The resulting habitat maps will describe the vegetative composition of the various habitats and will also note the location and extent of observed RTE species, invasive species, freshwater mussels, and areas of shoreline erosion. To the extent possible, information on substrate types will also be observed and documented. The study will be conducted during the 2020 study season.
21	NYSDEC 8/9/2019	**Aquatic Mesohabitat Study** The Applicant should conduct a mesohabitat study of all fluvial parts of the NYPA Projects area including mapping of these areas. The study should identify both mapped and unmapped wetlands, as well as aquatic vegetation and substrate within the Project area. This study may help with other studies, such as the freshwater mussel survey. Understanding the available aquatic habitat is beneficial to developing management plans for sportfish species which may utilize different habitats for different purposes, such as wetlands, flooded shoreline, and shallow vegetated areas as nurseries and rocky outcrops for protection from flows. Similar information may also be useful in identifying where certain species may be localized based on their habitat preferences. The goals and objectives of this study are to map the distribution and abundance of aquatic mesohabitat within the NYPA Projects area,	See response to USFWS in 20.

No.	Agency/Stakeholder	Study Request/Comment/AIR	Power Authority Response
		evaluate the types of aquatic habitats that occur there, and identify potential effects of the NYPA Projects operations on this habitat and its quality. The recommended study uses standard sampling techniques commonly used in most hydropower licensing activities. This may involve a combination of desktop studies and on-site field work.	
22	FERC 8/9/2019	**Bald Eagle Study** - The goal of the study is to verify existing and identify new bald eagle nest, foraging, and roost locations; and to monitor bald eagle activity levels at the identified locations at both projects. The study objective is to collect data and information to inform Commission staff's analysis of the effects of continued operation and maintenance of the projects on bald eagles and their habitat. The proposed study methodology should include an existing literature and data review, field surveys, and a study report. The study should be conducted at both projects and be completed in 1 year.	The Power Authority is proposing to conduct a bald eagle study at the Crescent and Vischer Ferry Projects. The proposed study will be conducted as a combination desktop and reconnaissance level study of bald eagle habitats and use at the Projects. The proposed study will be conducted during the 2020 field season with a focus on surveys in the early spring (nesting) and summer (roosting and foraging).
		RECREATION/LAND USE	
23	FERC 8/9/2019	**Recreation Study** - The goal of this study is to gather information on recreation use, recreation access, and potential project effects to determine existing and future recreation use and capacity at the projects. The objectives of the study are to, at a minimum: (1) identify and describe each formal and informal recreation site and facility at the project in relation to the projects' boundaries; (2) identify the condition of all formal and informal recreation sites and facilities within and adjacent to the projects' boundaries, including any erosion that may exist due to recreational use; and (3) conduct visitor surveys during the recreation season to determine the adequacy of project recreation facilities and if changes or upgrades to the sites would be needed to meet current or future recreation needs. The specific methodology and scope of the recreation study can be refined during the study planning phase and upcoming proposed study plan meeting, but the study should include, at a minimum, the following provisions:	The Power Authority is proposing to conduct a recreation study at the Crescent and Vischer Ferry Projects. The proposed study will be conducted during the 2020 recreation season (May through October), and will include both a recreation site inventory and recreation use/user survey. The Power Authority is proposing to conduct an inventory of all non-commercial public recreation sites that provide access to Project lands and waters. The study will also gather information on Project recreation site use. Project recreation site use will be evaluated using trail cameras, where feasible. Recreation user surveys will be made via survey

No.	Agency/Stakeholder	Study Request/Comment/AIR	Power Authority Response
		1. Inventory all formal and informal public and private recreational sites/facilities within and adjacent to each project's boundary. 2. Administer a recreation use survey that addresses all recreation activity types known to occur or potentially occur at each project. Specific methods should include visitor observations and on-site visitor intercept surveys at formal and informal public recreation areas at each projects' reservoir and tailrace, as well as spot counts. • Visitor observations should capture information such as location, date, time, weather, number of vehicles, watercraft (if any), number of recreation users or party size, and recreation activity. • The visitor survey sampling should be based on a stratified random sample that includes all seasons, various locations, and various times of week and day to enable representative responses from the visitors, while ensuring interview coverage during key times (e.g., holiday and weekend days, shoulder seasons, fishing and hunting seasons). • The survey instrument should include items to assess visitor perceptions of crowding, recreational conflict, conflicts between the public and adjacent property owner(s), adequacy and placement of signage, adequacy of recreation facilities and access to the projects, and effects of project operation and management on recreation and recreation opportunities at the projects (e.g., fluctuating reservoir levels). • Spot counts should be conducted on survey days. The spot counts represent short-term counts (approximately 5 minutes per site) and should record the number of vehicles parked at a site/facility and the number of users observed. This information should be statistically analyzed to develop the recreational use figures for each project. Final recreation use for the recreation facilities and sites at each project should be summarized by season and activity type for each site. 3. Prepare a report that includes information on the number of recreation days spent at project recreation sites, average number of persons per party, and a determination of the percent of each facility's capacity that is currently being utilized. The above information should be entered into spreadsheets for statistical analysis. The collected information should be used to project changes to project recreation demand over the term	boxes and voluntary survey responses. The resulting study report will be included in the Initial Study Report.

No.	Agency/Stakeholder	Study Request/Comment/AIR	Power Authority Response
		of any new license that may be issued. The report also should include: (1) identification of all project and non-project recreation sites at each project, including informal recreation sites, and who owns each site; (2) the location of the recreation sites in relation to the project boundary, including facilities/amenities that may straddle the project boundary; (3) the types and number of amenities provided at each site; (4) the condition of the facility/amenities; (5) identification of any erosion at each recreation site; (6) entities responsible for the operation and maintenance of the sites; (7) hours/seasons of operation, if applicable; (8) photographs of each site; (9) use figures for each recreation site, overall recreational use figures, and projected use figures; and (10) a compilation of responses to the recreation use survey. Two or three technicians would be needed to review existing data sources, survey sites in the field from the end of May through the beginning of October (or through the Erie Canal navigation season, whichever is longer), develop the inventory, evaluate past and current use, evaluate potential effects of the project on area recreation resources, and draft and finalize maps and reports.	
		PROJECT OPERATIONS/FLOODING	
24	USFWS 8/8/2019	**Run-of-River Compliance Study** The Service recommends that the Applicant conduct a ROR compliance study to evaluate Project operations and the influence they may have on downstream flows. Project operations, including unit trips, unit start-ups, and flashboard condition can have notable impacts on downstream flows and the aquatic communities in the Mohawk River. The goal of this study is to evaluate ROR compliance at the Projects and to determine what impacts the Projects may have on downstream flows. The objectives of this study are to: 1) record generation, operations, impoundment levels, and flows at the Projects; and 2) produce figures of these Projects and flow data for evaluation of ROR compliance. The Service recommends that the Applicant provide a narrative in the Proposed Study Plan (PSP) of how the Applicant operates the Project to maintain ROR flows. This narrative would be most effective if it is described as follows: 1) how the units come on and off line in relation to headpond elevations and river flows and ramping rates for the units; 2) how often the units are operated in a manual mode and how ROR	The Power Authority is not proposing a study of Project operations or run-of-river compliance. However, NYPA will prepare an information package that includes additional flow and impoundment level data for both Projects, sufficient to demonstrate run-or-river operations at the Projects. The information will be included in the Draft License application (DLA).

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		operations are maintained when these situations occur; and, 3) how the system is adjusted to accommodate circumstances when the flashboards are partially tripped, as was observed during the site visit. In order to evaluate ROR compliance, the Service recommends that the Applicant install realtime monitors to record generation for each turbine and water-level sensors that should record: 1) headpond elevations; 2) incoming flows from upstream of the impoundments; and 3) downstream flows below the Projects. One additional monitor should be placed in the vicinity of the Cohoes USGS gauge to verify the accuracy of the methods employed against a known source of reliable flow data. A sensor should also be placed at the Projects to record barometric pressure, such that the depths recorded by the water-level sensors can be adjusted for pressure changes. The sensors should record data at I5-minute intervals, and be in place from May 1 through October 31. The Applicant should utilize flow-metering devices to measure flows at the monitored stream locations over a range of low to high flows to develop rating curves for discharge at these sites. Flows, water levels, and generation data should be presented in bi-weekly intervals on a scale that allows for interpretation of low-flow periods. Times when the Projects are operated in a manual mode, when there are unit trips, start-ups or shut-downs, and when the flashboards are repaired, fail, or are partially breached, should be indicated. The programmable logic control settings for the Project should be provided and clearly noted whenever they are changed throughout the study period. Any deviations from these protocols provided in the PSP should be explained in the Study Report.	
25	NYSDEC 8/9/2019	**Project Operations Study** The Applicant should conduct a study on the operations of the NYPA Projects. Data of interest would include impoundment elevation, power generation, flows (through the turbines, downstream fish passage, and minimum flows), and leakage measurements. A demonstration of the ramping rates both up and down would also be of interest. This will provide supporting evidence that the NYPA Projects are operating in run-of-river mode2 and demonstrate what actions are being taken to avoid impoundment drawdowns, varied downstream flows, and are meeting the necessary conservation and downstream fish passage flows.	See response to USFWS in 24.

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		The goals and objectives of this study are to provide insight to how the NYPA Projects operate and follow a run-of-river operations scheme. In addition, the leakages through the flashboards are merely an estimation and are meant to contribute towards the minimum flows, having a more accurate measurement of the leakages would be meaningful both for the Department and the Applicant. The recommended study uses standard techniques commonly used in most hydropower licensing activities, typically in the form of desktop analysis.	
26	Assemblyman Steck 8/8/2019	**Flooding** Studies are needed to better understand the roll that the Vischer Ferry dam plays in causing ice jams and subsequent flooding. The Schenectady Stockade is a historical area in the 110th Assembly District. This area has been subject to significant flooding that has become increasingly worse over time. The source of the flooding is the Mohawk River. It is likely that the current dam structures on the river contribute to or cause flooding in the historic Stockade. It is critical that before any relicensing of these man made structures is allowed, there must be a comprehensive study or modeling on the formation of ice, flow of ice jams, and points were ice gets obstructed.	See PSP section 3.1.3.
27	Wege 7/20/2019	The Vischer Ferry Dam, producing the eleven mile Niskayuna Pool, has caused flooding problems to the unique cultural historic Stockade District of Schenectady, since constructed in 1914. State investigations of flooding problems from this dam date back to the 1920's. In an effort to address the flooding problems, the New York District of the COE identified a feasible local protection project, involving a proposed levee project for the Stockade District in the late 196(ys. This project was rejected by the City, as the levee would compromise the extensively used park of the Stockade District. Prior to re-licensing the hydroelectric plant, I ask that (1) gate modification installation and (2) operation of the gated dam be investigated to protect Stockade District and nearby cultural resources. The New York Power Authority (NYPA) has recently begun investigating the feasibility of installing gates in a modified dam. Constructing a 400 to 600 foot gated weir would allow the pool to be partly evacuated PRIOR to the arrival of a flood wave.(Reference: A recently constructed recreational dam on the Salt River in the City of Tempe, AZ, has ten hydraulic	See response to Assemblyman Steck in 26.

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		operated gates, each gate being approximately 100 feet wide and 16 feet high.) This would substantially reduce flood damages to the historic and cultural Stockade District and the Village of Scotia area. Such a study is necessary prior to re-licensing the hydroelectric plant at Vischer Ferry Dam. A gated weir in Vischer Ferry Dam would allow a winter draw down of the Niskayuna Pool. Ice jam modeling is too complex for reliability projections. The thickness of the ice sheet, depth of the snowpack, air temperature, duration and rate of rise, the intensity and amount of rain, all contribute in a river system ice run. However, if the Niskayuna Pool could be drawn down several feet the probability of ice jam flooding is greatly reduced. The fact that the Niskayuna pool can't be drawn down is a major design deficiency that must be addressed prior to re-licensing the hydroelectric plant.	
28	Woidt 8/9/2019	Extensive published research by Dr. Garver of Union College and the USGS have identified the Rexford Knolls, between the Rexford Bridge and Vischer Ferry Dam, as a frequent location of ice jams affecting the Stockade. The operation of Vischer Ferry Dam affects the hydraulics of the Mohawk River in this location which may also affect the formation of ice jams; whether this impact is beneficial or detrimental is unknown. Although technical analyses of the impact of Vischer Ferry Dam on ice jamming do not yet exist, numerous Stockade residents have penned letters to the editor and spoken publicly claiming that Vischer Ferry Dam is responsible for flooding of the Stockade and that is must be modified. These claims are to date unfounded in science and a brief hydraulic analysis performed by Shumaker found that Vischer Ferry had less than a six-inch impact on the base flood elevation in the Stockade. However, no known studies have been completed to quantify the impacts (positive or negative) of the operation of Vischer Ferry dam on upstream or downstream ice jamming. Therefore, I recommend that flood damage be included as a potential impact of Vischer Ferry Dam and that as part of the relicensing process, a study be conducted that quantifies the frequency and magnitude of ice jamming on the Mohawk River upstream and downstream of Vischer Ferry Dam and quantifies the impact of Vischer Ferry Dam on the frequency and magnitude of flooding upstream and downstream of the dam.	See response to Assemblyman Steck in 26.

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	OTHER COMMENTS		
	Riverkeeper 8/9/2019	Riverkeeper commented that the scope of the Commission’s environmental analysis must include a “hard look” at the decommissioning alternative.	No federal or state resource agency has suggested Project decommissioning would be appropriate for the Crescent and Vischer Ferry Projects and there is no basis for recommending it. The Projects utilize dams that were constructed as part of the canal system and provide a viable, safe, and clean renewable source of power to the region. If the Projects were decommissioned, the dams would remain in place and the Projects’ contribution to renewable energy generation would be irreplaceable. Thus, Project decommissioning is not a reasonable alternative to relicensing the Projects with appropriate PME measures, and should not be considered as an alternative in the Commission’s environmental analysis.
	ADDITIONAL INFORMATION REQUESTS		
AIR 1	FERC 8/9/2019	**Project Boundary - Lock E-6** Currently, the Crescent Hydroelectric Project (Crescent Project) does not include Lock E-6 as part of the project. However, it appears that Lock E-6 and the canal between the dam and the lock should be part of the project because Lock E-6 is needed for impounding the reservoir of the Crescent Project. Please explain why the lock and canal are not included in the project boundary. If it is determined that the lock and canal are needed for project purposes, both features should be enclosed within the project boundary when the draft license application or preliminary licensing proposal is filed.	In response to this AIR, as part of its PSP, the Power Authority is filing corrected Project boundary maps that show the portion of Lock E-6 that is within the Project boundary.

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AIR 2	FERC 8/9/2019	**Dates of Flashboard Installation/Removal and Navigation Season** Staff needs additional information regarding the seasonal timing of the fish passage practices that are currently implemented at both projects (notches in the flashboards and navigation lockages) to support our analysis of the effectiveness of these practices for passing migratory blueback herring and American eel. Therefore, please provide the following information for the previous 20 years, to the extent such data are available: (1) the dates the flashboards were installed and removed each year at each project; and (2) the starting and ending dates for the navigation season in the Erie Canal each year. Please note any anomalies in the record, such as late installations of the flashboards or early closing of the navigation season, and if available, the reason for the anomaly.	In response to this AIR, the PSP includes a table of dates for flashboard installation/removal and opening/closing of canal navigation season for the past twenty years.
AIR 3	FERC 8/9/2019	**Flow through Fish Passage Notches** At the environmental site review, New York Power Authority (NYPA) was uncertain as to the amount of flow provided through the two fish notches (the adult notch and juvenile notch) at the Vischer Ferry Hydroelectric Project (Vischer Ferry Project) and the dimensions of these notches. Therefore, please provide this information, as well as the depths and substrates of the plunge pools at both the Crescent Project and the Vischer Ferry Project.	Additional information on fish passage notch flows was previously provided to the Commission in the Power Authority's Scoping Document 1 comments filed 8/9/2019. Additional information on depths and substrates below the fish passage notches is provided in the PSP.
AIR 4	FERC 8/9/2019	**Minimum Hydraulic Capacity** At the environmental site review, NYPA stated the minimum hydraulic capacity was the same for all turbines—200 cubic feet per second (cfs) for the Kaplan and Francis units at each project. However, Table 3.3-1 of the Pre-Application Document (PAD) indicates the minimum hydraulic capacities of the Kaplan and Francis units are 350 cfs and 400 cfs, respectively. Please clarify this discrepancy.	Clarification on minimum operating flows for each of the Crescent and Vischer Ferry units is provided in the PSP.
AIR 5	FERC 8/9/2019	**Water Withdrawals from the Vischer Ferry Impoundment** 1. As indicated in the PAD (Table 4.3-5) and confirmed at the site visit, water withdrawals in excess of 1 million gallons per day (MGD) are made from the Vischer Ferry impoundment at General Electric in Schenectady, New York (4.0 to 11.4 MGD) and the Knolls Atomic Power Laboratory (1.7 to 3.7 MGD). To support staff's analysis of water quantity resources at both projects, please provide additional information regarding these water withdrawals. Specifically, describe how the water that is withdrawn is used and whether it is released back	The Power Authority responded to a similar question from FERC about water withdrawals in its 8/9/19 comments. Readily available public information on water withdrawals was provided in the PAD. No additional details are readily available.

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		into the impoundment and if so, how it is modified (e.g., increased temperature of the effluent).	
AIR 6	FERC 8/9/2019	**Period of Record for Hydrology Data** 1. Hydrology statistics presented in the PAD are based on an 8-year period of record (from 2011 through 2018, encompassing Hurricane Irene), which likely biases (upwards) flow estimates at the projects, especially given the short period of record (only 8 years). Therefore, in your draft license application or preliminary licensing proposal, please provide a description of the hydrology at both projects and updated flow statistics (tables 4.3-1 and 4.3-2 of the PAD) and flow duration curves (figures 4.3-1 and 4.3-2; Appendix D) that are based on a longer period of record—at least 30 years of pro-rated flow data from the nearby United States Geological Survey (USGS) gages at Little Falls (USGS Gage No. 01347000, data available from 1927 to present) or Cohoes Falls (USGS Gage No. 01357500, data available from 1917 to present).	The Power Authority responded to this question in its 8/9/19 comments.
AIR 7	FERC 8/9/2019	**Fisheries Reports** 1. In section 4.4 of the PAD, you cite several fisheries reports that staff was not able to locate. Therefore, please file the following reports/references as supplemental information as part of the public record for the projects: Chas T. Main, Inc. (1984); Curtis and Associates (1987), McBride (1985), and McBride (1994).	The Power Authority responded to this question in its 8/9/19 comments.
AIR 8	FERC 8/9/2019	**Project Facilities** 1. In section 3.3 of the PAD, project facilities are identified as a dam, powerhouse, impoundment, and appurtenant facilities. In the existing license, switchyards, generator leads, and transformer banks are also mentioned as existing project facilities. Please describe in greater detail the switchyards, generator leads, transformer banks, and other appurtenant facilities not previously mentioned as part of the project facilities. Please include the approximate dimensions of the switchyard, length and voltage of the generator leads, and location of each facility, including the point of inter-connection with the grid.	The Power Authority has provided additional detail about switchyards, generator leads, and transformers in the PSP.

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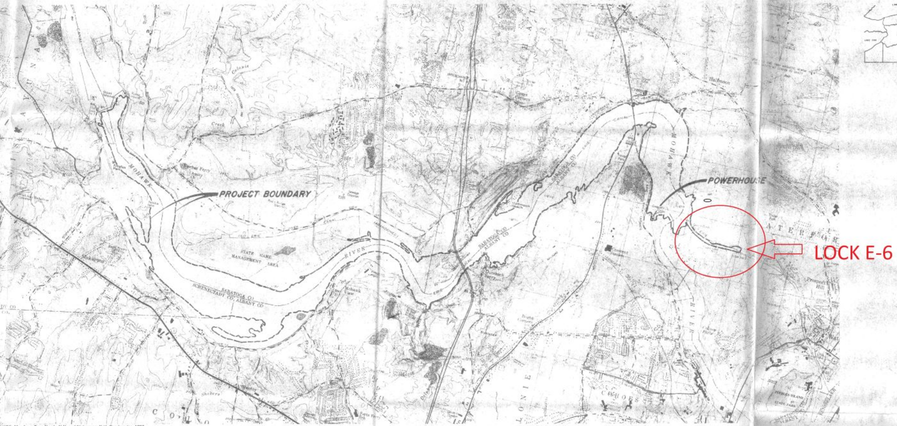
AIR 9	FERC 8/9/2019	**Vegetation Management** 1. In section 3.3 of the PAD, project facilities are identified, and section 3.4 references the scope of operations for those identified facilities. Also, in section 4.8.1.1, formal project recreation sites are identified for the Crescent and Vischer Ferry Projects; and section 4.8.2.1 states that, generally, project operations and maintenance, and recreation are the primary activities that occur on project lands. Please describe the details (e.g., frequency and method) of any vegetation management that occurs at either project, their formal recreation sites, and any appurtenant facilities to support operations and maintenance. Examples of vegetation management may include activities such as mowing, trimming, and turf management; hazard or risk tree removal; clearing to maintain overlooks; herbicide treatments; and others.	The Power Authority has provided additional information regarding routine vegetation management practices at the Crescent and Vischer Ferry Projects in the PSP.

APPENDIX C: Crescent Project Exhibit G Map



NOTE: Map from Troy North, N.Y. and Niskayuna, N.Y. Quadrangles, 1980.

CRESCENT HYDROELECTRIC PROJECT

This drawing is a part of the ap[illegible] for license made by the undersigned.

This 10th day of Februa[illegible] 1982.

POWER AUTHORITY OF TH[illegible] STATE OF NEW YORK

By B P Cu[illegible]

POWER AUTHORITY OF THE STATE OF NEW YORK

CRESCENT HYDROELECTRIC PROJECT

PROJECT LOCATION MAP

SCALE: AS INDICATED

FIGURE G

APPENDIX D: Requested Mohawk River Fisheries Studies

Appendix D. Fisheries Documents for the Crescent and Vischer Ferry Projects

Chas. T. Main, Inc. 1984. Studies of the migration of juvenile blueback herring in the lower Mohawk River. Prepared for the NY Power Authority, New York, NY.

Curtis and Associates. 1987. Vischer Ferry hydroacoustic study of blueback herring outmigration in the lower Mohawk River. Prepared for the NY Power Authority, New York, NY.

McBride, N.D. 1985. Distribution and relative abundance of fish in the lower Mohawk River. NYS Department of Environmental Conservation, Stamford.

McBride, N.D. 1994. A fisheries management plan for the lower Mohawk River. NYS Department of Environmental Conservation, Stamford.

STUDIES OF JUVENILE BLUEBACK HERRING DOWNSTREAM MIGRATION IN THE LOWER MOHAWK RIVER SEPTEMBER-NOVEMBER 1983

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INTRODUCTION

The New York Power Authority has applied to the Federal Energy Regulatory Commission (FERC) for a license for the Vischer Ferry Hydroelectric Project (FERC Project No. 4679) and for the Crescent Hydroelectric Project (FERC Project No. 4678) on the lower Mohawk River. Pursuant to these license applications, the Power Authority met with local, state and Federal agencies to discuss their environmental concerns. Potential project effects on upstream and downstream migration of blueback herring were specifically mentioned by the New York State Department of Environmental Conservation (NYS DEC), the U.S. Department of the Interior Fish and Wildlife Service (US FWS) and Office of Environmental Project Review, and the U.S. Army Corps of Engineers.

The operation of the project will not affect the upstream passage of blueback herring because anadromous adults utilize the adjacent locks of the NYS Barge Canal for access to the Mohawk River (N. McBride, NYS DEC; personal communication), and project operation will not alter the historical operation of the locks nor the surrounding environment. The potential effect of the hydroelectric stations on the downstream migration of blueback herring was examined in studies conducted by the Power Authority during autumn 1982. These studies were developed and conducted in consultation with NYS DEC, and sampling was done in the lower portion of the river near the Crescent Hydroelectric Station.

Studies in 1982 provided data on the downstream movement of juvenile blueback herring. Substantial numbers of young herring apparently outmigrated from late October into mid-November. Many of these fish appeared to be utilizing the locks of the NYS Barge Canal. However, it was not possible to determine the relative abundance of herring which passed over Crescent Dam or through Crescent Hydroelectric Station because access to the river below these facilities was difficult and only limited sampling could be conducted in this area. Juvenile herring displayed diel spatial distribution; herring apparently moved into shore areas during the day and into offshore waters at night. Of the six sampling gear evaluated, four gear effectively sampled juvenile herring, but the electrofisher was judged to be the most effective gear for future studies because it provided comparable samples from a variety of habitats.

Following review of the results of the 1982 sampling program by NYS DEC and US FWS, the Power Authority met with these agencies to determine the scope of additional studies in 1983. Because of the desire to determine the relative abundance of herring passing through the locks and powerhouse or over the dam and because of the difficult access to the river below Crescent Dam, the Power Authority proposed to conduct the 1983 sampling at Vischer Ferry Dam where access below the dam to each of the three potential avenues of outmigration was easy. Studies at Vischer Ferry Dam are also applicable to the Crescent Hydroelectric Station because the relationship of the powerhouse, dam and lock is similar at both locations.

In light of the 1982 data, the objectives of the second year of study were to determine (1) the relative effectiveness of the electrofisher and the Cobb trawl in the currents below the lock and powerhouse, (2) the timing of annual outmigration, (3) the usage of each of the three potential avenues of outmigration by juvenile herring and (4) the relative abundance of juvenile herring using each of the three possible avenues.

MATERIALS AND METHODS

Study Area

Fisheries samples were regularly taken in the impoundments immediately above and below Vischer Ferry Dam. Four stations (Sta. A-1 through A-4) were sampled above the dam (Vischer Ferry Pool); one station was just above Lock E-7, two stations were above the spillway sections of the dam and one station was just above the entrance of the headrace of the hydroelectric station (Table 1, Figure 1). Sampling above the spillways and powerhouse was conducted as close as safely possible to these structures. At the spillway, this safe distance varied from approximately 5 feet above the dam when the pool level was below the flashboards and no spillage occurred to approximately 150 feet above the dam when spillage occurred. The presence of swift, unpredictable currents in the headrace canal dictated that sampling be conducted in the pool immediately above the entrance to the headrace.

Four stations (Sta. B-1 through B-4) were sampled below the dam (Crescent Pool), and these four stations were comparable in location to the four stations above the dam (Table 1, Figure 1). These downstream stations were selected to sample herring after these fish had passed through the lock, over the dam or through the powerhouse. To ensure that sampling at these stations collected primarily fish which were utilizing each of the three potential avenues of outmigration, sampling was conducted directly in the flows from the lock, powerhouse or spillway. Every effort was made to sample these areas when flow from the outmigration pathway was present.

Below the lock, most sampling was conducted approximately 100 to 200 feet below the gate of the lock (Station B-1b) although some collections were also made in the area nearer to the gate (Station B-1a). Sampling at Station B-1b occurred during the 10-minute period of lock discharge and usually began when the water released from the lock reached the sampling area (approximately 1 minute after lock discharge began). Since the outlet ports are located near the bottom of the lock chamber, the velocity and volume of the discharge flow varied throughout the release period because these parameters of flow depended on the height of the water column over the outlet ports. Therefore, the flow was greatest at the beginning of the discharge period when the lock was full and diminished during the remainder of the discharge period as the lock emptied.

Below the spillways, sampling was conducted near the base of the dam. Sampling was conducted from 5 to 10 feet from the base of the dam when there was no spillage and from 10 to 25 feet from the dam when spillage occurred. The area sampled below Dam F (Sta. B-3) was near a broken flashboard, and therefore, some spillage usually occurred at this station.

Below the powerhouse, sampling was conducted in the discharge of the turbines. The exact location of the sampling area varied with the number and location of the turbines in operation, but sampling was usually conducted from 25 to 125 feet below the powerhouse. Data from a digital flowmeter suspended either in the mouth of the trawl or from the boat indicated that the average current in the area sampled below the hydroelectric station (1.00 m/s, n = 13) was similar to the average flow at Station B-1b approximately 150 feet below the lock (0.86 m/s, n = 11).

In addition to sampling above and below Vischer Ferry Dam, samples were periodically collected at the open lock gate and within the lock chamber (Table 1, Figure 1). All areas of the lock chamber between the upstream and downstream gates were sampled.

Sampling Dates

Studies were conducted from September 5 through November 17, 1983, to identify the annual peak of outmigration, to examine the relative proportion of herring using each of the three potential avenues of outmigration, and to determine the immediate physical condition of these fish (Table 2). Sampling conducted from September 20 through November 9 provided comparable data from the electrofisher and the Cobb trawl (Table 2). The usage of each of the possible avenues of outmigration by herring was examined by sampling above and below the dam from October 28 through November 17 (Table 2).

Sampling Gear

A boat-mounted electrofishing unit was used to sample herring at all locations. The electrofisher was a Coffelt Variable Voltage Pulsator which was used at an output voltage (D.C.) of 200 to 230 volts and a pulse frequency of 65 pulses per second. Because the sampling areas below the dam were relatively small and because the boat was drifting downstream while sampling, it was necessary to frequently move the boat back into the discharge area to accomplish 2-minutes of pulse generation. With the need to reposition the boat, sampling for a 2-minute collection usually required 5 to 10 minutes, depending on the number of herring collected. Above the dam, sampling areas were generally larger and strong currents were absent; therefore, the time required for 2-minutes of electrofishing was approximately 5 to 7 minutes. The actual time of pulse generation was determined either by an electric clock plugged into the electrofishing unit or a hand-held stopwatch used by the boat operator.

As suggested by NYS DEC, a stationary net - a 1.5 x 1.5 m Cobb trawl (1.2 cm mesh) - was also used to collect juvenile herring at stations below the dam. The trawl was fished at the surface approximately 10 meters behind the boat. Below the lock and powerhouse the trawl fished passively in that the boat maintained a relatively stationary position in the discharge. Below the spillway, the velocity of flow was relatively low and the trawl could not be fished passively. At this station, the trawl was towed parallel to the dam for 2 minutes. The fishing speed of the trawl was estimated with a digital flowmeter suspended either in the mouth of the trawl or from the boat. After the trawl had been maintained in position for 2 minutes, it was retrieved by hand.

The net was deployed approximately 75 feet downstream of the turbulent area below the lock and powerhouse and then towed into position (Table 2). However, the 2-minute sampling period did not begin until the trawl was positioned in the discharge. The net was not deployed directly in the discharge of the lock and powerhouse because the turbulent flow made safe and proper deployment of the gear difficult.

All collected fish were processed in the same manner regardless of the means of collection. Fish were placed in ambient-temperature water in a 20-gallon tub; the individuals of other species were quickly returned to the water. All blueback herring were identified and counted. Samples of herring collected below the powerhouse, dam and lock were examined 3 minutes after the end of the collection, and their physical condition was recorded as live, dead or stunned (Appendix Tables A-D). Stunned fish were alive but displayed erratic swimming. Live herring were returned to the water, but dead and stunned herring were discarded into a plastic bag which was later disposed at an appropriate site.

Sampling Programs

The 1983 sampling program consisted of three studies: an evaluation of two sampling gear, a determination of the annual outmigration period and an identification of the avenues of outmigration. Sampling began in the first week of September and was scheduled to conclude during the last week in October. It was anticipated that the peak of the herring outmigration would occur during this 8-week period, and 3 weeks of intensive efforts were to be implemented when this peak of the herring migration occurred. However, this peak period for migration was not apparent during the original 8-week period, and sampling was extended into mid-November in an effort to identify and sample the peak of the run. This extension of the sampling period resulted in revision of the original sampling frequencies for each of the three studies; these revisions were made in consultation with NYS DEC. Alteration of sampling frequencies for each study are discussed below in the description of these elements of the sampling program.

1. Gear Evaluation

In studies conducted at Crescent Dam in 1982, MAIN (1983) reported that both the electrofisher and Cobb trawl were effective gear for collecting juvenile herring in open water. MAIN concluded that electrofishing was the most suitable gear for future studies because it provided comparable samples for a variety of diverse habitats. For this reason, the Power Authority proposed to utilize the electrofisher for collections at Vischer Ferry Dam in 1983. However, during consultation with NYS DEC and US FWS, these agencies stated that a stationary net-type of sampler may be preferable for sampling below Vischer Ferry dam. To evaluate the relative efficiencies of these two gears below the dam, a study was undertaken from September 20 through November 9 to collect comparable data with the electrofisher and the Cobb trawl (Table 2).

Comparable series of 2-minute collections were taken with each gear below the powerhouse, spillway and lock (Sta. B-1b, B-2, B-4) as part of the sampling for annual migration. Typically, a set of collections was made at all stations with one gear, and then a set of collections was immediately made with the second gear. It usually required approximately 45 minutes to collect the two comparable sets of data.

2. Annual Outmigration

The timing of the annual period of outmigration was determined by 2-minute electrofishing collections taken below the lock (Sta. B-1b), spillway (Sta. B-2) and powerhouse (Sta. B-4) from September 5 through November 15 (Table 2). Initially, samples were collected in the evening, but on two of the first five sampling dates the powerhouse was not in operation during the evening sampling period. Therefore, in order to ensure sampling during periods of powerhouse operation, collections were switched from night to day (afternoon) beginning on September 29.

Initially, a total of three electrofishing collections were taken at each of the three locations; in addition, three, 2-minute collections were also taken at each location with the Cobb trawl to evaluate the relative effectiveness of the two gears (see sampling program for Gear Evaluation). However, it became apparent by the end of September that spillage was occurring infrequently and therefore it was inappropriate to sample below the spillway for outmigrating herring when spillage did not occur. In consultation with NYS DEC, the sampling scheme was modified to shift sampling from below the spillway when there was no spillage to the stations below the lock and powerhouse. Beginning in October, only one sample was taken below the spillway on dates when no spillage occurred, and a total of four collectons were collected below the powerhouse and lock. However, when spillage occurred, three collections were still made at each of the three locations.

Sampling was conducted on 2 days each week during September and was reduced to 1 day each week during the first 3 weeks of October and the first week in November. This reduction in weekly sampling permitted the reallocation of sampling efforts to extend the overall program for an additional 3 weeks.

3. Avenues of Outmigration

a. Relative abundance: In addition to data collected during the annual migration study, information on the relative proportion of juvenile herring passing through the lock and powerhouse and over the dam were also collected during the last week of October and the second and third weeks in November. Based on data from 1982 (MAIN 1983) and available data on herring abundance, water temperature and river flow in fall 1983, these 3 weeks were selected for this additional work because they were judged by MAIN and the Power Authority in consultation with NYS DEC, to be the weeks when the peak migration of herring was most likely. During these 3 weeks 2-minute electrofishing collections were taken at these three locations on two dates per week in the last week of October and the second week in November and one date per week in the third week in November.

The number of samples taken at each location during the intensive sampling depended upon the occurrence of spillage at Vischer Ferry Dam. When spillage occurred, four collections were taken at each of the three locations during the day and again at night. When there was no spillage, however, data from below the spillway were not collected because this potential avenue of outmigration was unavailable to migrating herring. Therefore, when spillage did not occur, one collection was taken at the base of the spillway and five collections were taken below the lock and powerhouse. As during periods of spillage, samples were taken during the day and also at night.

b. Usage: During the 3-week period of peak outmigration, 2-minute electrofishing collections also were taken above and below Vischer Ferry Dam to examine the usage of the three potential avenues of outmigration by juvenile herring; this program was suggested by NYS DEC. Four simultaneous (within 15 minutes) samples were taken with two boats above and below the lock, two sections of the spillway, and the powerhouse (Table 1, Figure 1) throughout an approximately 8-hour period. For each sampling date, one of the three potential avenues was selected for study based on the projected operation of that structure and sampling focused on that avenue.

The sampling design included 4 hours of sampling before the selected avenue of outmigration was in operation, and these data were intended to document the pre-operational abundance of herring above and below that avenue. The second 4 hours were conducted when that avenue was in operation, and these data were intended to document any changes in abundance that might be attributed to movement along this avenue. Samples taken below the lock included a separate collection in the lock chamber to provide data on the number of herring remaining in the lock chamber after water was released during a lockage.

Two types of sampling schemes suggested by NYS DEC were implemented during each of the 4-hour periods before and during operation. A transect of the four stations above the dam and a comparable transect of four stations below the dam were sampled simultaneously by a second crew. One hour was allocated for sampling each transect, and these transects were sampled twice during each 4-hour period. During each of the other 2 hours of each 4-hour period, four simultaneous samples were taken above and below the avenue of outmigration under investigation. Sampling was designed so that sampling the transect alternated with the more intensive sampling effort at the one particular avenue of outmigration.

Although every effort was made to collect pre-operational and operational data for each of the three potential avenues of outmigration, it was not possible to obtain these data for the powerhouse. Several efforts were scheduled, based on anticipated shutdown and subsequent startup of the powerhouse, but on both occasions the powerhouse was in operation at the beginning of the scheduled sampling period.

In contrast to the powerhouse, it was easier to schedule sampling at the lock because this facility was shut down every day from approximately 2300 hours to 0700 hours the next morning. Furthermore, if the lock did not operate by approximately 0730 in response to river traffic, the lock operator would, at our request, operate the lock to simulate passage of a vessel. After this initial operation, the lock generally operated two to four times during the next 4 hours either in response to river traffic and/or additional requests for simulated lock operation.

It was not always possible to conduct the sampling at the lock exactly according to the designed sampling scheme. On November 10, sampling at the lock was scheduled to begin at approximately 0300 hours, but fog prevented the crews from initiating the collection of pre-operational data until approximately 0930 hours. However, it became apparent that river traffic would be traversing the lock by noon, 2.5 hours after pre-operational sampling began. Therefore, to ensure that as much pre-operational data as possible were collected, the sampling design was revised by compressing sampling into the time available and by modifying the alternating sequence of transect and intensive local sampling.

Sampling in response to spillage was also difficult to schedule. Although it takes approximately 36 hours for precipitation within the watershed to result in increased flow at Vischer Ferry Dam (D. Wein, Niagara Mohawk Power Corporation, personal communication), the occurrence and timing of spillage also depends on the capacity of the turbines to pass this increase flow. When river flow rises, both turbines are operated at full capacity to utilize these flows and if all of the river flow can be passed through turbines, spillage will not occur. Spillage begins only when river flow exceeds the capacity of the turbines, but the timing of this event and, therefore, the scheduling of sampling according to the sample design, was difficult to predict. As a result, sampling during spillage on November 16 was unevenly divided into 5 hours of pre-operational sampling and 3 hours of sampling during spillage. On November 17, sampling focused on the spillway even though spillage occurred at the beginning of the sampling period. Since spillage was already occurring, sampling in this manner did not allow for the collection of pre-operational data. This avenue was selected nonetheless because the powerhouse was in operation and because sampling at the lock had already been conducted on three dates.

RESULTS AND DISCUSSION

Gear Evaluation

In order to compare the relative efficiencies of the electrofisher and the surface Cobb trawl, the catch data from 2-minute collections were directly compared. This direct comparison was reasonable because both gear sampled herring in the moving surface waters below the lock and powerhouse, and differences between catch of the two gear should be attributable to the relative efficiencies of the two gear and methodologies.

Based on a total of 66 comparisons between the catch of the two gear, the electrofisher caught almost twice as many herring as the Cobb trawl (770 vs 426; Table 3). Disregarding nine comparisons where both gear collected the same number of herring, more fish were taken with the electrofisher in 42 of the 57 comparisons (74%); the catch with the Cobb trawl exceeded that of the electrofisher in 15 of the 57 comparisons (26%).

When the efficiency of the two gear was examined in relation to the sampling station, differences between the gear were still apparent. Below the powerhouse, the electrofisher consistently (19 of 22 comparisons) caught more herring than the Cobb trawl (Table 3), and the total number of herring collected with the electrofisher, disregarding one large catch with the electrofisher* was about six times greater than the number taken with the Cobb trawl (319 vs 49). Similarly, the electrofisher consistently (10 or 12 comparisons) collected more fish below the spillway (Sta. B-2); the number collected with the electrofisher was approximately four times greater than that taken by the Cobb trawl (115 vs 29). Below the lock, however, the efficiency of the Cobb trawl was similar to that of the electrofisher. Neither gear consistently caught more herring at the lock, and the number collected by the two gear was similar (137 vs 117), disregarding the one large catch made with the Cobb trawl.

Initially, NYS DEC and US FWS expressed reservations about the suitability of the electrofisher as a sampling gear below Vischer Ferry Dam. On October 19, representatives of NYS DEC reviewed preliminary data comparing the catch of the Cobb trawl and the electrofisher from September 20 through October 11. After reviewing the 33 available comparisons between two gears, these NYS DEC personnel concluded that the electrofisher consistently caught more fish with less variability in catch and that the

* Individual large catches with either the electrofisher or the Cobb trawl were disregarded for comparative purposes because these catches represented the rare encounter with a large group of herring rather than a difference in catch efficiency between the two gear. These infrequent collections greatly increased the catch of one gear and therefore biased the comparison of the more typical catch of the two gear.

electrofisher could not be discounted as a sampling gear for this study. Based on this discussion, the electrofisher remained the prime sampling gear for the study although additional trawl data were also collected at the request of NYS DEC.

Data collected in 1983, demonstrated that dead fish were collected during electrofishing samples below the powerhouse, spillway and lock throughout the sampling period (see Appendix Tables B-D). Although comparable data between catches with the Cobb trawl and electrofisher were limited to collections below the lock, the number of dead fish collected during electrofishing (16 of 137 fish, 12%) were greater than the number of dead fish in Cobb trawl collections (5 of 348, 1.4%). Live fish were returned to the water after sorting and counting, and no attempt was made to test for latent survival of blueback herring.

Annual Outmigration

In examining the catch of juvenile herring below Vischer Ferry Dam to identify the annual period of outmigration, data from the stations below the lock and powerhouse were combined to yield a single mean catch for each day. Generally, data from these stations were highly variable from day to day (Table 4, Figure 2), and the single daily mean value tended to make general trends more apparent by reducing this intra- and interstation variability. Data collected below the powerhouse during periods of non-operation were excluded from the daily mean catch because these data were unrelated to the abundance of outmigrating herring. Data were collected below the spillway on each date (Appendix Table E), but spillage rarely occurred (2 of 21 dates). Therefore, spillway data were not used to calculate daily mean catch because these data did not reflect the abundance of outmigrating herring.

Sampling below the potential avenues of outmigration assumed that increases in catch rate at these locations indicated the movement of juvenile herring through these avenues. Juvenile blueback herring appeared to emigrate through the study area from approximately late September through early November (Table 4, Figure 3). During most of September, the mean daily catch was relatively low (seven herring or less, Table 4). In late September, the abundance of herring collected below the lock and powerhouse began to increase, and maximum numbers of herring were collected in mid- to late October. The mean daily catch declined quickly after late October with mean values of 11 herring or less by the first full week in November (Table 4). Comparable data collected in late October and mid November during the Avenues of Outmigration sampling program further substantiated the movement of herring from the area (Figure 3). No consistent diel trend of herring abundance was observed (Figure 3).

Water temperature and river flow are two factors which are believed to influence blueback herring outmigration. Declining water temperatures and increasing river flows are reportedly correlated to movement of juvenile blueback herring in the Hudson River (Texas Instruments 1981) and the emigration of juvenile alewife and American shad, two other anadromous clupeids, in the Connecticut and Hudson rivers (Kissil

1974, Leggett and Whitney 1972, Marcy 1976 and Texas Instruments 1981). MAIN (1983) reported that the greatest movement of juvenile herring from the lower Mohawk River in 1982 occurred in late October and early November and that this movement may have been delayed somewhat by the below average river-flows in September and October.

In 1983, the temperature measured during fisheries sampling ranged from nearly 25°C on September 5 to approximately 5°C on November 17 (Figure 4). During the apparent period of outmigration, the temperature ranged from 19°C in late September to approximately 8°C by early November, and it was between 15°C and 11°C during maximum outmigration. Water temperatures during the apparent peak of outmigration in 1982 were similar, approximately 13°C to 9°C (MAIN 1983). In the Hudson River, mass outmigration of juvenile blueback herring occurred below 14°C (Texas Instruments 1981).

River flows during most of the period of outmigration were relatively low (usually less than 1,500 cfs, provisional USGS data; Figure 4) compared to historical monthly mean flows for September (2,517 cfs), October (3,433 cfs) and November (5,175 cfs). The highest river flows during 1983 were approximately 3,000 cfs, and these flows were recorded on September 23 and November 6-8 (Figure 4). The increased river flow on September 23 occurred several days before the apparent beginning of outmigration and the increased river flow on November 6-8 corresponded with the last few days of the outmigration period. Peak herring outmigration during mid- to late October occurred during the

:elatively low, stable flows that prevailed throughout October.
ıerring outmigration apparently began in mid-October during
.y low flow and peaked in early November when river flows increased
) cfs (MAIN 1983).

The 2 years of fisheries data suggest that no single factor
mines the timing of juvenile blueback herring migration from the
wk River in the fall. River flow may influence herring movement,
its observed relationship to herring emigration was variable.
vement during 1983 apparently was preceded by increased river flow and
eaked during low flow, whereas movement during 1982 began during low
flow conditions and peaked during higher flow conditions. A relationship
between water temperature and the period of maximum outmigration, as
determined by Power-Authority sponsored studies, was observed during the
2 years; water temperature during peak abundance ranged between approximately
15°C and 9°C during both 1982 and 1983. However, it is not clear whether
water temperature directly influences outmigration, or whether other
factors, such as photoperiod or availability of food and suitable habitat,
may also influence outmigration in addition to water temperature. Because
of the sampling variability inherent in collecting schooling fish such
as blueback herring and the limited number of years examined, it is
difficult to identify the combination of factors which control the onset
of herring outmigration in the lower Mohawk River.

Avenues of Outmigration

At Vischer Ferry Dam, emigrating juvenile herring have three potential avenues of outmigration: through Lock E-7, over the dam spillway or through the Vischer Ferry Hydroelectric Station. During 1983, the data demonstrated that herring emigrated through the lock and powerhouse. However, there was little opportunity for outmigration over the dam spillway because river flows were low during the outmigration period and spillage over the dam rarely occurred. Spillage conditions occurred on two dates that the sampling was conducted above and below the dam, but the abundance of herring was too low to provide meaningful data (Tables 5 and 6).

During the 3 weeks of intensive sampling in 1983 (Table 2) it was not possible to obtain pre- and post-operational samples at the powerhouse because the powerhouse did not shut down in a predictable manner during this period (see Materials and Methods section). However, data from other elements of the 1983 sampling program provided some evidence that fish utilized this pathway for outmigration. The increased catch below the powerhouse during October suggests that outmigrating herring utilized this pathway. This usage was not surprising because numerous researchers have reported that outmigrating fishes pass through powerhouse turbines (Bell 1981, Turbak et al. 1981).

Data collected above and below the lock prior to and after lock operation demonstrated that the lock was used by outmigrating herring. On October 28, the density of juvenile herring immediately above the lock in the last pre-operational sample (0635 hours) decreased sharply after lock operation began while the density of herring below the lock in the first operational period (0805 hours) showed a general increase immediately after the lock began to operate (Table 7, Figure 5). The November 11 survey suggested a slight decrease in abundance of herring above the lock after lock operation began but no corresponding increase in abundance downstream of the lock was observed (Table 8). Too few herring were collected on November 10 survey to draw any conclusions about lock usage (Table 9). Collections made during another element of the sampling program (see Annual Outmigration section) also showed some increases in abundance of herring below the lock during October, and these data also suggest that this pathway was used by emigrating herring (Table 4).

Sampling in the lock chamber suggested that many herring remained in the lock chamber following the discharge of the lock and the opening of the downstream lock gate. On almost every sampling date when data were systematically collected in and below the lock, more herring were collected within the lock chamber after it was emptied than were collected downstream of the lock during its discharge and after the gate was opened (Table 10). The abundance of herring in the lock was consistently higher than that taken anywhere else in the study area. Although sampling conditions in the confined, quiescent water in the lock were more favorable than conditions in the unconfined turbulent discharge below the lock, the abundance of herring collected from quiet water above and below the lock rarely approached the abundance of herring in the lock chamber.

The large number of herring remaining in the lock after it was emptied demonstrated that lowering the lock does not induce all fish in the lock to leave. Lowering the water level in the lock represents the discharge of approximately 65% of the water in the lock. The outlet valves which are located near the bottom of the lock, and unless herring near the surface actively seek this discharge flow, only herring in the lower portion of the water column are most likely to be carried from the lock in this discharge. Furthermore, the brief (approximately 5-10 minute) period that the gate was open following the lowering of the lock presents a limited opportunity for fish near the open gate to emigrate. Sampling just downstream of the open gate did not indicate large numbers of herring in that area; the abundance of herring in these samples was similar to the abundance of herring in collections from the lock discharge (Table 10). Herring may remain in the lock during a number of lockages before passing to the Crescent Pool.

In addition to coordinated sampling above and below specific avenues of outmigration, samples were also taken below each of the potential avenues of outmigration to provide data on the relative number of herring passing through each avenue. These data, coupled with data collected below Vischer Ferry Dam during another element of the sampling program (Annual Outmigration Studies), provided a view of the relative number of herring using each pathway for emigration in 1983 (Tables 4 and 7). Since spillage over the dam occurred infrequently (approximately 4 of 42 dates) during the outmigration period, this potential avenue of outmigration was essentially unavailable to emigrating herring.

As noted earlier, the catch of juvenile herring below the lock and powerhouse before the onset of the outmigration was similar (see Annual Outmigration section). However, during the period of outmigration, the catch of herring below the powerhouse was larger than the corresponding catch of young herring below the lock. From September 26 through November 7, the mean catch of 17.4 juvenile herring below the powerhouse (855 herring in 49 collections, Table 4) was approximately 1.8 times greater than the mean catch of 9.8 herring below the lock (491 herring in 50 collections, Table 4). Comparable data collected during sampling below the dam on October 28 revealed a similar trend with 26 fish (two collections) taken below the lock and 39 fish (two collections) taken below the powerhouse when both avenues were in operation (Table 7).

CONCLUSIONS

1. In comparable collections, the electrofisher caught almost twice as many juvenile herring as the Cobb trawl; the electrofisher caught more fish than the Cobb trawl in 74% of the collections. The electrofishing methodology was at least as effective as the Cobb trawl in capturing dead fish in the water column.

2. Juvenile blueback herring appeared to emigrate from approximately late September through early November with maximum numbers of herring collected below the lock and powerhouse in mid- to late October.

3. Of the three potential avenues of outmigration (through the lock and powerhouse or over the dam), only two potential pathways were available to emigrating herring because spillage over the dam did not occur during the outmigration period. It appears that outmigration herring pass through both the lock and the powerhouse.

4. During outmigration, more herring were generally collected below the powerhouse than the lock.

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Table 1. Description of Fisheries Sampling Stations in the Impoundments Above and Below Vischer Ferry Dam

Station	Location
A-1	Vischer Ferry Pool immediately above Lock E-7: navigation channel from upstream gate of lock to end of bulkhead on western side of channel
A-2	Vischer Ferry Pool from 25 to 150 feet above westernmost portion (Dam D) of Vischer Ferry Dam
A-3	Vischer Ferry Pool from 25 to 150 feet above easternmost portion (Dam F) of Vischer Ferry Dam
A-4	Vischer Ferry Pool immediately above headrace of hydroelectric station to area approximately 150 feet beyond the entrance to the headrace
B-1a	Crescent Pool immediately below Lock E-7: portion of navigation channel from downstream gate of lock to approximately 100 feet below the lock gate
B-1b	Crescent Pool immediately below Lock E-7: portion of navigation channel approximately 100-200 feet below the downstream gate of lock
B-2	Crescent Pool from base of spillway of westernmost section of dam (Dam D) to distance of approximately 25 feet from spillway
B-3	Crescent Pool from base of spillway of easternmost section of dam (Dam F) to distance of approximately 25 feet from spillway. Station located in area of spillage through broken flashboard
B-4	Crescent Pool in discharge of the hydroelectric station; area from 25 to 125 feet below southernmost wall of powerhouse although the exact area sampled varied with the number and location of generating units in operation
Lock	The chamber of Lock E-7; i.e., the area bounded by the upstream and downstream gates of the lock and subject to water level fluctuations associated with lock operation

Table 2. Description of 1983 Fisheries Sampling Program

	Gear Evaluation	Annual Outmigration	Avenues of Outmigraton		Condition of Herring
			Relative Abundance	Usage	
Gear:	Electrofisher Cobb Trawl	Electrofisher	Electrofisher	Electro- fisher	Electrofisher
Stations[a]:	B-1b, B-2, B-4	B-1b, B-2, B-4	B-1b, B-2, B-4	A-1 thru A-4 B-1 thru B-4	B-1 thru B-4
Time of Day[b]:	Afternoon Evening	Afternoon Evening	Morning Afternoon Evening	Post-midnight Morning Afternoon	Morning Afternoon Evening Post-midnight
Sampling Dates:					
September	20, 22, 29	5, 8, 13, 15, 20, 22, 26, 29			All dates sampled
October	4, 11, 19, 25, 26, 27	4, 11, 19	25, 26, 27	28	All dates sampled
November	1, 2, 8, 9		1, 2, 7, 8, 9, 14	10, 11, 16, 17	All dates sampled

NOTES:

a. See Table 1 and Figure 1 for locations.
b. Morning = 0800 to approximately 1200 hours
Afternoon = approximately 1200 hours to sundown
Evening = sundown to approximately 2400 hours
Post-midnight = approximately 2400 hours to dawn

Table 3. Comparison of Number of Juvenile Blueback Herring Taken in Comparable 2-Minute Collections with the Electrofisher (EF) and Surface Cobb Trawl (CT) Below E-7, Vischer Ferry Dam, and Vischer Ferry Powerhouse in 1983

Collection Date	Lock		Spillway[a]		Powerhouse[b]	
	EF	CT	EF	CT	EF	CT
September 20	2	0	3	1	1	0
22	0	7	5	0	1	5
29	0	5	0	0	77	0
	0	3	6	0	2	0
	1	1	10	11	7	27
	1	9	16	11	86	27
October 4	1	5	25	1	62	0
	0	1	-	-	22	0
	1	0	-	-	21	0
	14	0	-	-	10	2
	16	6			115	2
11	1	0	-	-	13	0
	3	0	5	0	2	0
	11	231	-	-	4	0
	6	3	-	-	2	2
	21	256			21	2
19	3	8	25	1	47	0
	15	10	-	-	199	0
	18	5	-	-	1	0
	15	27	-	-	8	11
	51	50			255	11
25	22	32	7	2	3	0
26	4	2	1	4	0	0
	2	7	20	9	18	0
	6	9	21	13	18	0
27	0	0	6	0	10	0

Table 3 (Cont)

Collection Date	Lock		Spillway[a]		Powerhouse[b]	
	EF	CT	EF	CT	EF	CT
November 1	7	0	2	0	6	2
2	2	0	0	0	1	0
8	8	1	0	0	1	0
9	1	0	0	0	0	0
TOTAL	137	348	115	29	518	49

GRAND TOTAL - Electrofisher: 770
Cobb Trawl: 426

NOTES:

a. No spillage occurred over the spillway on any date except September 22.
b. The powerhouse was in operation on all dates except September 20.

Table 4. Number of Juvenile Blueback Herring Collected Below Lock E-7 and the Vischer Ferry Hydroelectric Station in 2-Minute Electrofishing Collections in 1983

		LOCK E-7			POWERHOUSE[b]			TOTAL		
		Catch	N[a]	Catch/N	Catch	N	Catch/N	Catch	N	Catch/N
Sept.	5	39	5	8	20	5	4	59	10	6
	8	24	5	5	32	5	6	56	10	6
	13	35	5	7	77	5	15	35[c]	5	7
	15	55	5	11	4	5	1	59	10	6
	20	15	4	4	103	4	26	15[c]	4	4
	22	1	4	<1	3	4	1	4	8	1
	26	10	4	3	18	4	5	28	8	4
	29	1	3	<1	86	3	29	87	6	14
Oct.	4	16	4	4	116	4	29	132	8	16
	11	21	4	5	21	4	5	42	8	5
	19	51	4	13	255	4	64	306	8	38
	25	257	5	51	16	3	4	265[c]	7	38
	26	18	10	2	152	10	15	170	20	8
	27	26	5	5	173	5	35	199	10	20
Nov.	1	51	5	10	11	5	2	62	10	6
	2	12	5	2	1	5	<1	13	10	1
	7	28	1	28	6	2	3	34	3	11
	8	58	9	6	41	9	5	99	18	6
	9	16	4	4	4	4	1	20	8	2
	14	0	4	0	1	4	<1	1	8	<1
	15	1	5	<1	0	5	0	1	10	<1
		735	100	7	952[c]	89	11	1687	189	9

NOTES:

(a) N = Number of electrofishing collections
(b) Except for collections on Sept. 13 and 20 and one collection on Oct. 25, all collections below powerhouse taken during periods of powerhouse discharge
(c) Collections below powerhouse excluded from data summary when powerhouse was not in operation.

Table 5. Abundance of Juvenile Blueback Herring Collected Above and Below Vischer Ferry Dam Before and After Spillage over the Dam on November 16, 1983

	Starting Time	Area	Abundance[a] Lock E-7	Dam D	Dam F	Powerhouse
PRE-SPILLAGE	1005	Above Dam	0	26	0	0
		Below Dam	0	0	0	0
	1130	Above Dam		2[b]		
		Below Dam		0[b]		
	1205	Above Dam	0	0	0	0
		Below Dam	0	0	0	0
	1345	Above Dam		0[b]		
		Below Dam		0[b]		
	1430	Above Dam		0[b]		
		Below Dam		0[b]		
SPILLAGE	1500	Above Dam	0	0	0	0
		Below Dam	0	0	0	0
	1600	Above Dam		2[b]		
		Below Dam		0[b]		
	1630	Above Dam	0	0	2	0
		Below Dam	3	0	0	0

NOTES:

a. Unless otherwise noted, all values are number of herring in a two minute electrofishing collection

b. Mean values of four samples; individual values for each mean are reported below.

	1130 Hours	1345 Hours	1430 Hours	1600 Hours
Above Dam	0,0,0,7	0,1,0,0	0,0,0,0	0,10,0,0
Below Dam	0,0,0,0	0,0,0,0	0,0,0,0	0,0,0,0

Table 6. Abundance of Juvenile Blueback Herring Collected Above and Below Vischer Ferry Dam During Spillage over the Dam on November 17, 1983

Starting Time	Area	Abundance[a] Lock E-7	Dam D	Dam F	Powerhouse
0700	Above Dam	0	0	0	0
	Below Dam	1	0	0	0
0800	Above Dam		0[b]		
	Below Dam		0[b]		
0900	Above Dam	0	0	0	0
	Below Dam	0	0	0	0
1000	Above Dam		0[b]		
	Below Dam		0[b]		
1205	Above Dam		0[b]		
	Below Dam		0[b]		
1245	Above Dam	0	0	0	0
	Below Dam	9	0	0	0
1310	Above Dam		1[b]		
	Below Dam		0[b]		
1400	Above Dam	0	0	0	0
	Below Dam	0	0	0	0

NOTES:

a. Unless otherwise noted, all values are number of herring in a two minute electrofishing collection.

b. Mean values of four samples; individual values for each mean are reported below.

	0800 Hours	1000 Hours	1205 Hours	1310 Hours
Above Dam	0,0,0,0	0,0,0,0	0,0,0,0	5,0,0,0
Below Dam	0,0,0,0	0,0,0,0	0,0,0,0	0,0,0,0

Table 7. Abundance of Juvenile Blueback Herring Collected Above and Below Vischer Ferry Dam Before and After Operation of Lock E-7 on October 28, 1983

	Starting Time	Area	Abundance[a] Lock E-7	Dam D	Dam F	Powerhouse
PRE-OPERATION	0330	Above Dam	17	0	1	2
		Below Dam	18	2	12	4
	0430	Above Dam	113[b]			
		Below Dam	22[b]			
	0540	Above Dam	43	3	1	8
		Below Dam	154	4	9	19
	0635	Above Dam	39[b]			
		Below Dam	20[b]			
OPERATION	0805	Above Dam	8[b]			
		Below Dam	40[b]			
	0900	Above Dam	19	22	0	0
		Below Dam	26	0	2	26
	1000	Above Dam	8[b]			
		Below Dam	3[b]			
	1100	Above Dam	36	234	16	0
		Below Dam	0	3	2	13

NOTES:

a. Unless otherwise noted, all values are number of herring in a two minute electrofishing collection

b. Mean values of four samples; individual values for each mean are reported below.

	0430 Hours	0635 Hours	0805 Hours	1000 Hours
Above Dam	56,375,20,1	87,50,5,15	2,19,8,1	4,22,5,0
Below Dam	14,51,18,6	29,5,24,23	29,27,6,97	0,1,5,7

Table 8. Abundance of Juvenile Blueback Herring Collected Above and Below Vischer Ferry Dam Before and After Operation of Lock E-7 on November 11, 1983

	Starting Time	Area	Abundance[(a)] Lock E-7	Dam D	Dam F	Powerhouse
PRE-OPERATION	0400	Above Dam	19	1	1	0
		Below Dam	31	0	0	1
	0500	Above Dam	8[(b)]			
		Below Dam	8[(b)]			
	0535	Above Dam	11	0	6	1
		Below Dam	19	0	0	1
	0615	Above Dam	27[(b)]			
		Below Dam	13[(b)]			
OPERATION	0800	Above Dam	19[(b)]			
		Below Dam	6[(b)]			
	0835	Above Dam	0	1	3	0
		Below Dam	0	0	0	1
	0945	Above Dam	6[(b)]			
		Below Dam	4[(b)]			
	1005	Above Dam	0	0	2	0
		Below Dam	0	0	0	1

NOTES:

a. Unless otherwise noted, all values are number of herring in a two minute electrofishing collection

b. Mean values of four samples; individual values for each mean are reported below.

	0500 Hours	0615 Hours	0800 Hours	0945 Hours
Above Dam	6,7,9,10	5,30,22,50	6,49,0,22	1,16,0,8
Below Dam	21,0,6,4	2,6,5,39	8,10,6,1	0,12,3,0

Table 9. Abundance of Juvenile Blueback Herring Collected Above and Below Vischer Ferry Dam Before and After Operation of Lock E-7 on November 10, 1983

	Starting Time	Area	Abundance[a] Lock E-7	Dam D	Dam F	Powerhouse
PRE-OPERATION	1015	Above Dam	0	0	0	0
		Below Dam	2	1	1	0
	1115	Above Dam	1[b]			
		Below Dam	2[b]			
	1214	Above Dam	2	0	0	0
		Below Dam	0	0	0	0
OPERATION	1350	Above Dam	5[b]			
		Below Dam	3[b]			
	1407	Above Dam	10	0	0	0
		Below Dam	1	0	0	0
	1455	Above Dam	6[b]			
		Below Dam	1[b]			
	1510	Above Dam				
		Below Dam	1	0	0	0

NOTES:

a. Unless otherwise noted, all values are number of herring in a two minute electrofishing collection

b. Mean values of numerous samples; individual values for each mean are reported below.

	1115 Hours	1350 Hours	1455 Hours
Above Dam	1,0,0,3,0,1,0,0	1,18,0,1	1,23,0,0
Below Dam	1,4,2,13,0,0,0,0,0	4,7,0,1	0,1,0,2

Table 10. Number of Juvenile Blueback Herring Collected Below Lock E-7 During and Following Lock Discharge and Within Lock E-7, Mohawk River, 1983

Date	Below Lock;[a,b] During Discharge (Station B-1b)	Below Lock; Approach to Open Gate (Station B-1a)[b]	Within Lock; After Discharge with Gate Open[b]	Within Lock;[b] After Discharge Prior to Gate Opening
October 19 (day)	3	-	81	-
25 (night)	-	-	-	15
	25	-	61	-
	3	-	227	-
	163	-	562	-
26 (day)	-	-	-	55
	0	-	24	-
	1	-	1	-
	0	-	0	-
(night)	-	-	-	2
	0	-	8	-
	4	-	0	-
	3	-	31	-
27 (day)	-	-	-	121
	16	-	11	-
	2	-	39	-
	2	-	71	-
November 1 (night)	-	-	-	5
	5	-	168	-
	18	-	83	-
	15	-	258	-
2 (day)	-	-	-	91
	0	-	101	-
	9	-	238	-
	1	-	109	-

Table 10 (Cont)

Date	Below Lock;[a,b] During Discharge (Station B-1b)	Below Lock; Approach to Open Gate (Station B-1a)[b]	Within Lock; After Discharge with Gate Open[b]	Within Lock;[b] After Discharge Prior to Gate Opening
November 7 (day)	28	9	140	-
8 (night)	0	0	145	-
	8	24	109	-
	0	0	45	-
	1	0	10	-
(night)	11	0	5	-
	4	4	25	-
	3	1	38	-
	14	2	63	-
	17	1	47	-
9 (day)	1	2	39	-
	14	13	129	-
	0	0	59	-
	1	0	5	-
14 (night)	0	0	0	-
	0	0	7	-
	0	1	37	-
	0	1	10	-
15 (day)	0	0	52	-
	0	1	3	-
	1	0	12	-
	0	0	1	-
	0	0	0	-

NOTE:

a. Only those collections taken in conjunction with collections at lock approach and/or within lock are included.

b. Values reported as number of herring collected in electrofishing collections of 0.8 to 4 minutes.

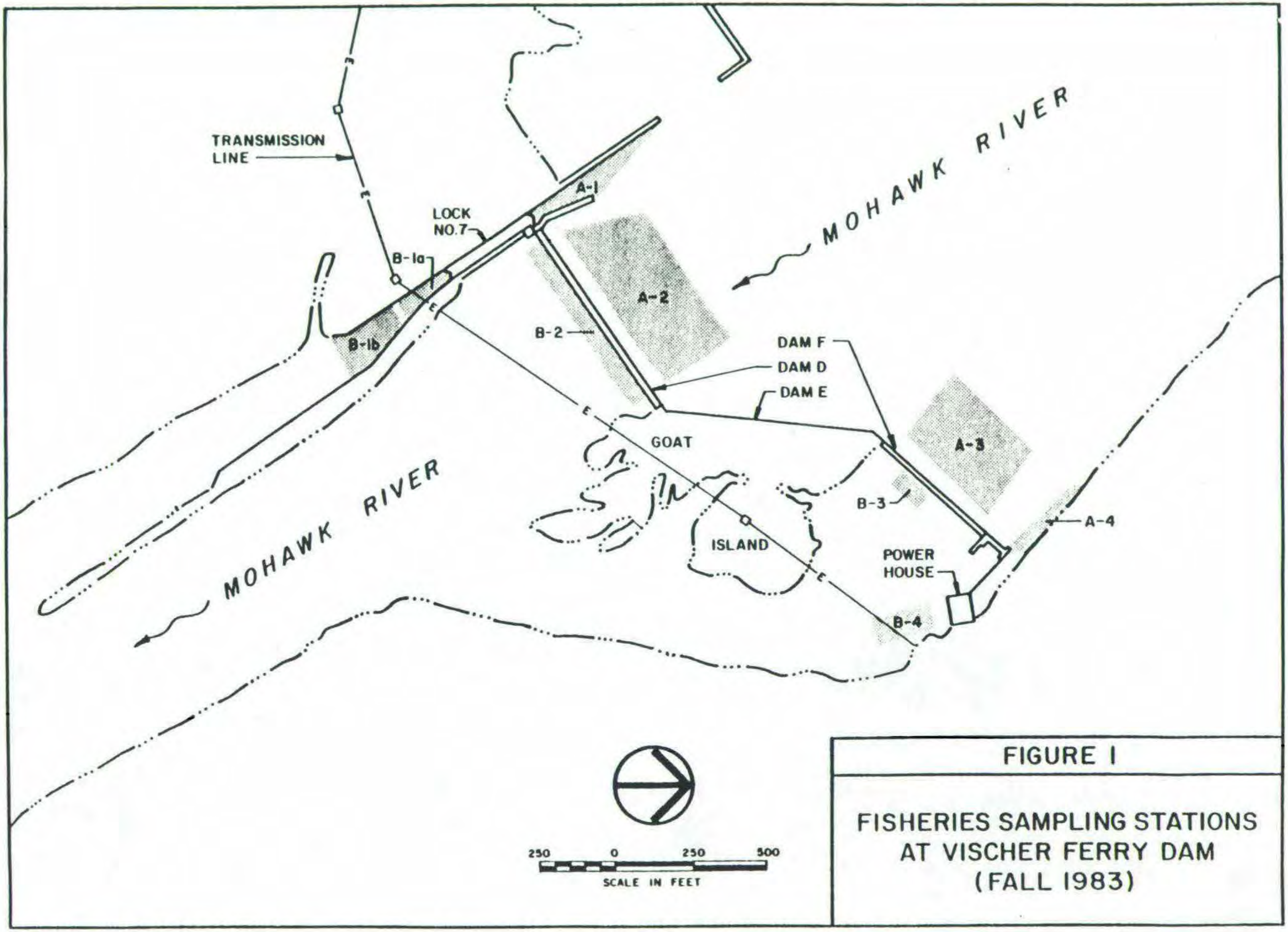


FIGURE 1

FISHERIES SAMPLING STATIONS AT VISCHER FERRY DAM (FALL 1983)

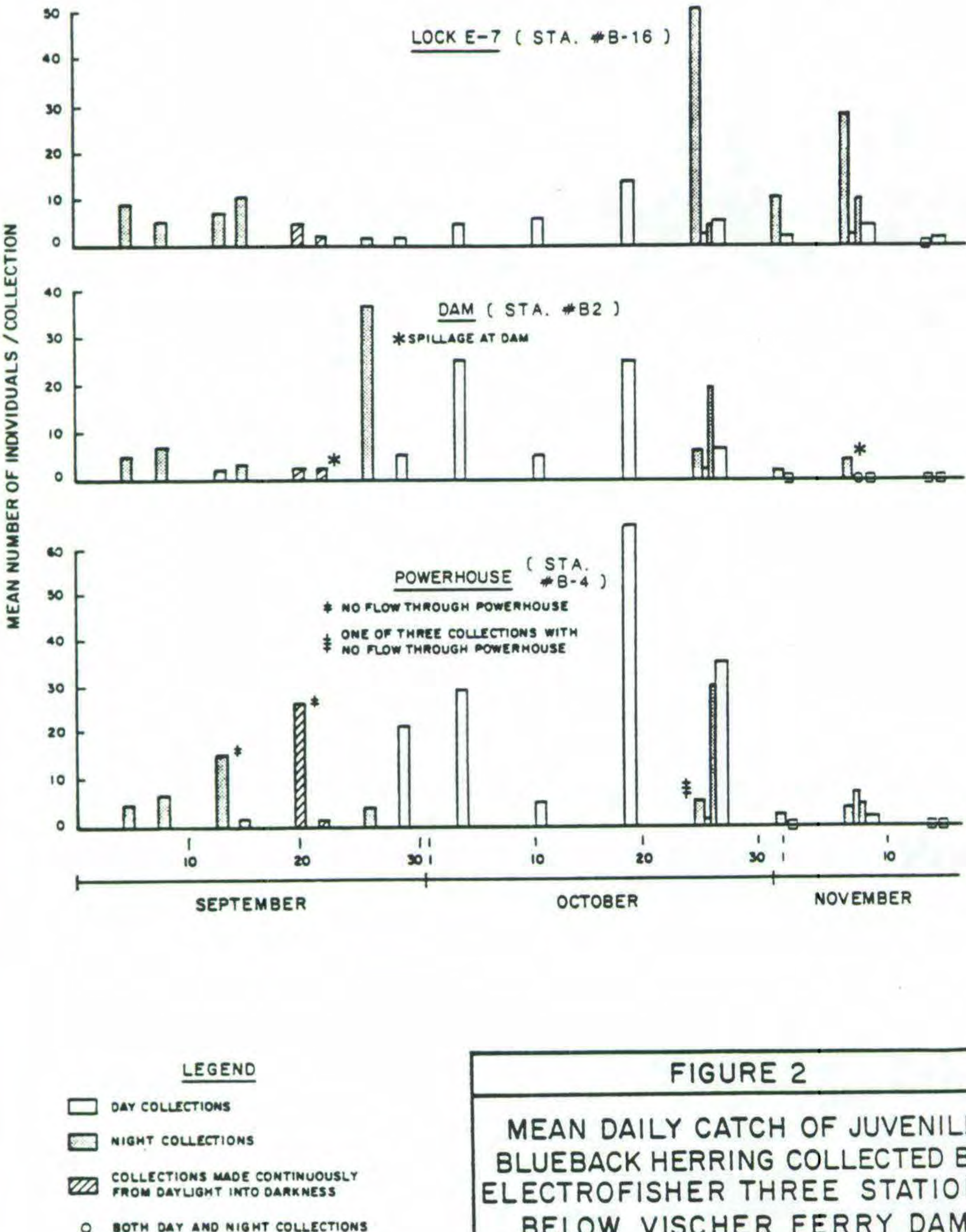


FIGURE 2

MEAN DAILY CATCH OF JUVENILE BLUEBACK HERRING COLLECTED BY ELECTROFISHER THREE STATIONS BELOW VISCHER FERRY DAM MOHAWK RIVER (FALL 1983)

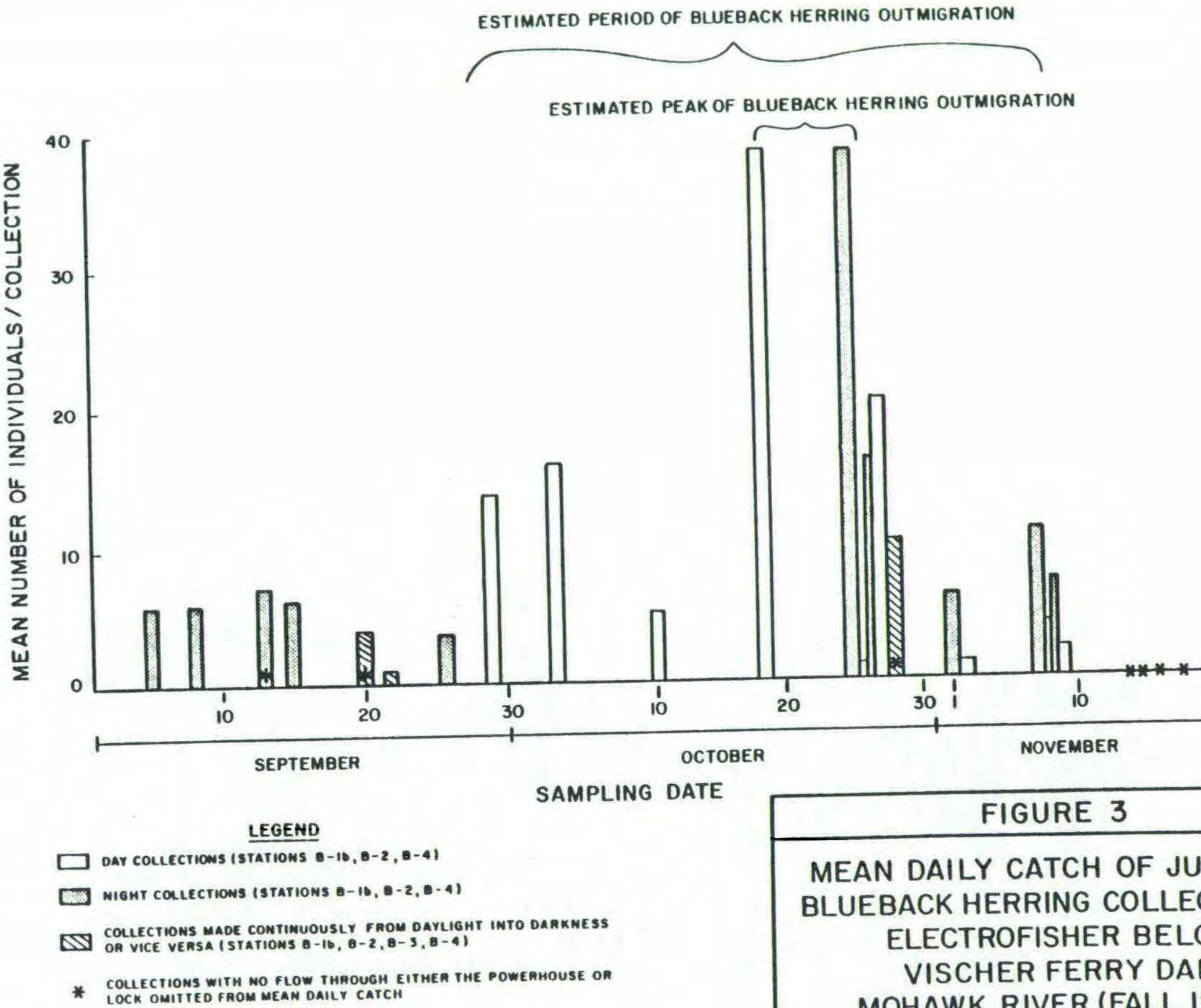


FIGURE 3

MEAN DAILY CATCH OF JUVENILE BLUEBACK HERRING COLLECTED BY ELECTROFISHER BELOW VISCHER FERRY DAM MOHAWK RIVER (FALL 1983)

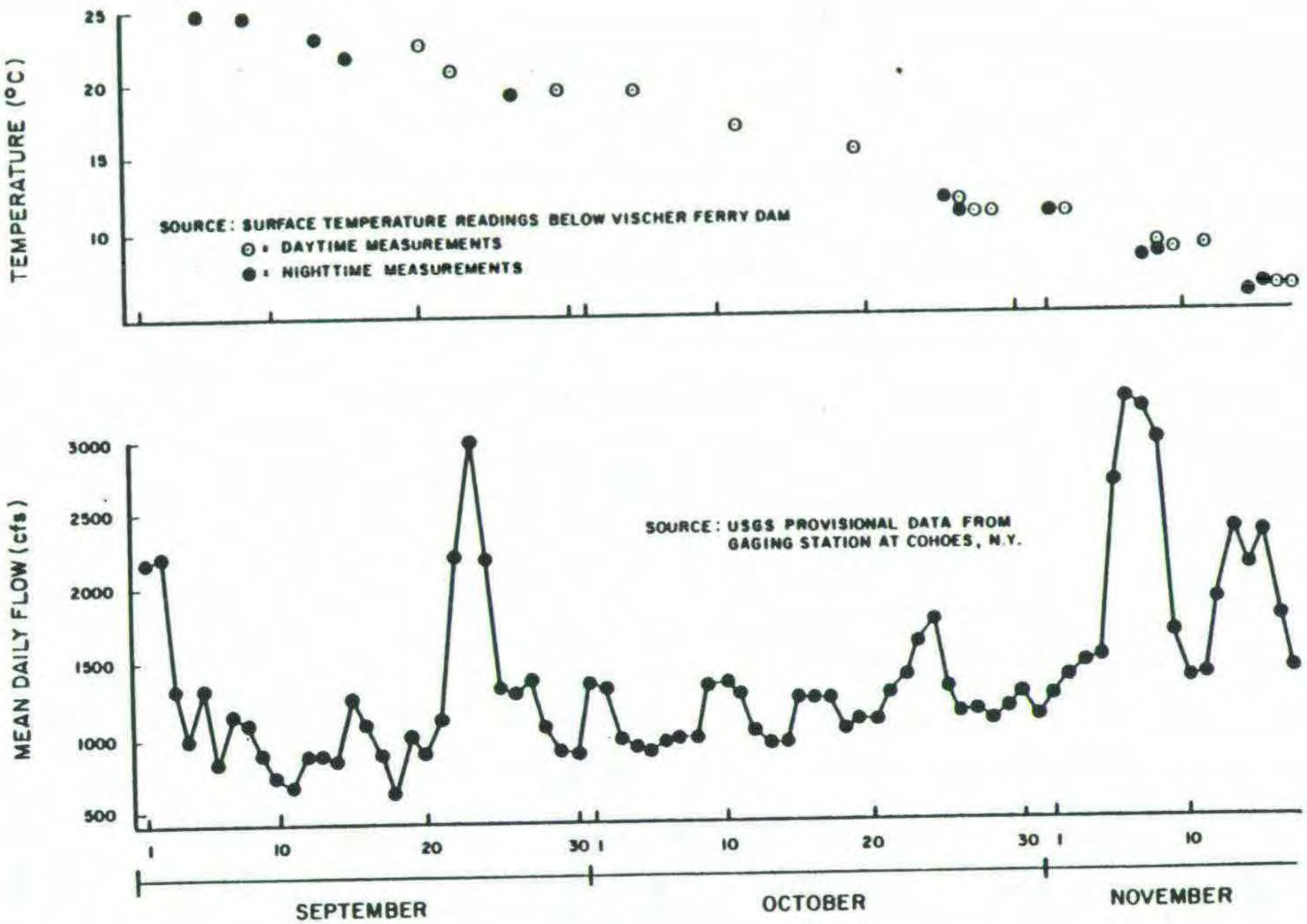
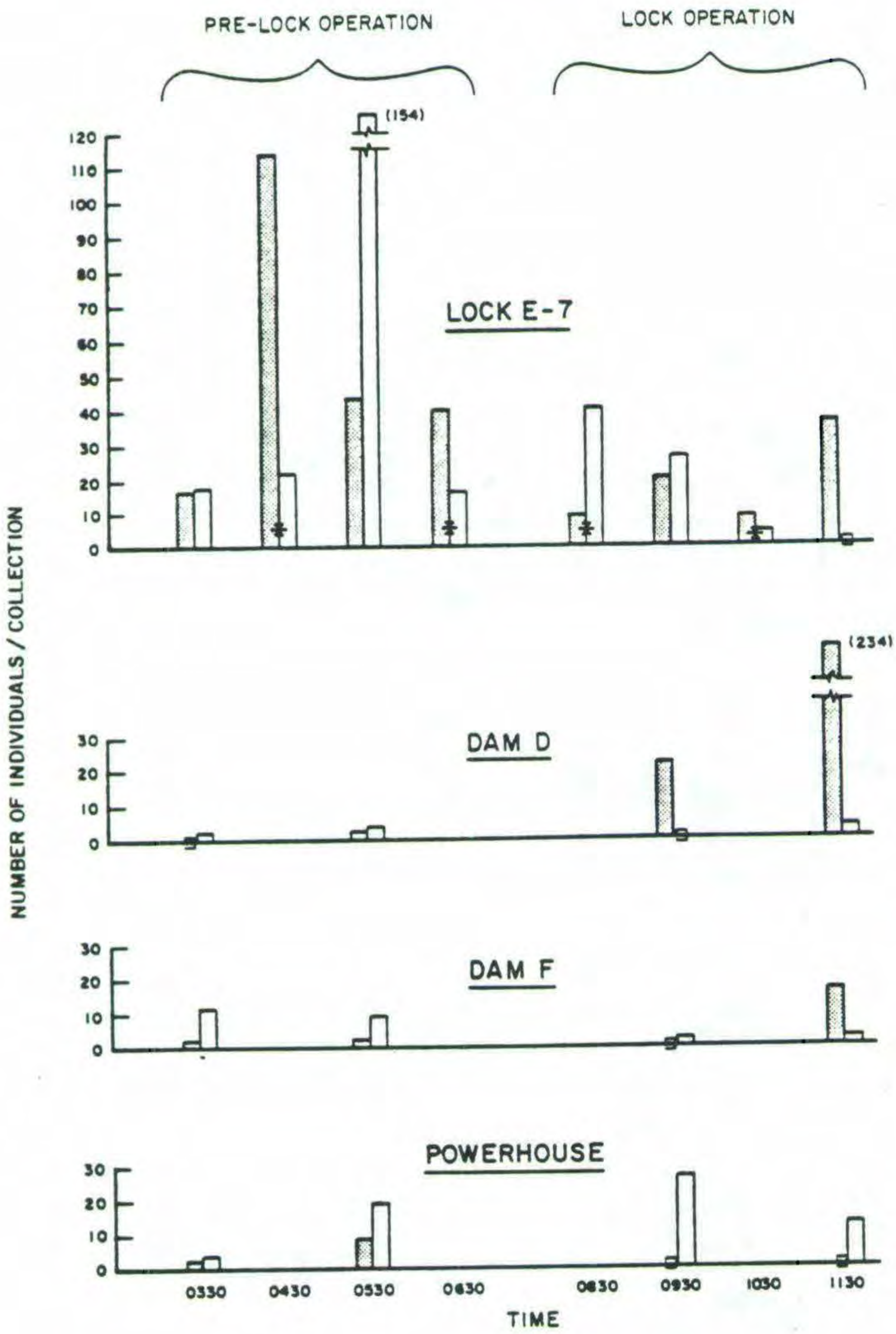


FIGURE 4

TEMPERATURE AND MEAN DAILY FLOW IN THE MOHAWK RIVER AT VISCHER FERRY DAM (FALL 1983)



LEGEND

- * MEAN VALUE OF FOUR COLLECTIONS
- COLLECTIONS ABOVE POTENTIAL AVENUE OF OUTMIGRATION
- COLLECTIONS BELOW POTENTIAL AVENUE OF OUTMIGRATION

FIGURE 5

ABUNDANCE OF JUVENILE BLUEBACK HERRING ABOVE AND BELOW POTENTIAL AVENUES OF OUTMIGRATION AT VISCHER FERRY DAM MOHAWK RIVER, OCTOBER 28, 1983

Appendix Table A. Summary of Immediate Condition of Juvenile Blueback Herring Collected at Vischer Ferry Dam in 1983

LOCATION	Station [a]	Number Examined	Condition [b]		
			Live	Stunned	Dead
Below Spillway	B-2	348	96%	2%	2%
Lock E-7					
Lock Chamber	Lock	850	86%	7%	7%
Below lock during lock discharge	B-1b	588	90	4	6
Below lock after lock discharge	B-1a	23	91	4	5
Below Powerhouse	B-4				
Powerhouse operating		937	95%	3%	2%
Powerhouse not operating		187	97	2	1

NOTES:

a. Stations described in Table 1 and shown on Figure 1
b. Data for individual collections are presented in Appendix Tables A-C

Appendix Table B. Number and Immediate Condition of Juvenile Blueback Herring Collected Below the Spillway of Vischer Ferry Dam (Sta. B-2) from September 5 through November 7, 1983

Date	Live	Stunned	Dead
September			
5	25	0	1
8	31	1	2
13	7	0	0
15	14	0	0
20	4	0	0
22	6	0	0
26	149	0	0
29	16	0	0
October			
4	23	0	2
11	5	0	0
19	25	0	0
26	17	4	0
27	5	0	1
November			
1	2	0	0
7	6	1	1
TOTAL	335	6	7

NOTE: Data are summarized in Appendix Table A.

Appendix Table C. Number and Immediate Condition of Juvenile Blueback Herring Collected at Lock E-7 from September 5 through November 15, 1983

Date	Below Lock During Lock Discharge (Station B-1b)			Below Lock After Lock Discharge (Station B-1a)			Lock Chamber		
	Live	Stunned	Dead	Live	Stunned	Dead	Live	Stunned	Dead
September									
5	39	0	0	-	-	-	-	-	-
8	11	1	0	-	-	-	-	-	-
13	35	0	0	-	-	-	-	-	-
15	55	0	0	-	-	-	-	-	-
20	15	0	0	-	-	-	-	-	-
22	0	0	1	-	-	-	-	-	-
26	9	0	1	-	-	-	-	-	-
29	1	0	0	-	-	-	-	-	-
October									
4	15	0	1	-	-	-	-	-	-
11	20	0	1	-	-	-	-	-	-
19	40	0	11	-	-	-	-	-	-
25	69	0	0	-	-	-	203	28	11
26	16	0	2	-	-	-	30	5	7
27	85	3	9	-	-	-	142	8	21
November									
1	31	11	0	-	-	-	153	15	5
2	2	1	0	-	-	-	86	5	0
7	21	3	4	-	-	-	-	-	-
8	50	4	4	5	0	0	29	1	0
9	15	0	1	14	1	0	38	1	0
14	-	-	-	0	0	2	35	-	12
15	1	0	0	1	0	0	15	0	0
TOTAL	530	23	35	20	1	2	731	63	56

NOTE: Data are summarized in Appendix Table A.

Appendix Table D. Number and Immediate Condition of Juvenile Blueback Herring Collected Below the Vischer Ferry Hydroelectric Station from September 5 through November 14, 1983.

	Powerhouse Operating			Powerhouse not Operating		
Date	Live	Stunned	Dead	Live	Stunned	Dead
September						
5	20	0	0	-	-	-
8	27	0	1	-	-	-
13	-	-	-	76	0	1
15	4	0	0	-	-	-
20	-	-	-	100	2	0
22	3	0	0	-	-	-
26	18	0	0	-	-	-
29	84	0	2	-	-	-
October						
4	111	1	3	-	-	-
11	20	0	1	-	-	-
19	252	0	2	-	-	-
25	4	1	0	5	2	1
26	145	2	2	-	-	-
27	155	18	0	-	-	-
November						
1	8	0	1	-	-	-
2	1	0	0	-	-	-
7	4	0	2	-	-	-
8	32	5	3	-	-	-
9	3	1	0	-	-	-
14	1	0	0	-	-	-
TOTAL	892	28	17	181	4	2

NOTE: Data are summarized in Appendix Table A.

Appendix Table E. Number of Juvenile Blueback Herring Collected Below the Spillway of Vischer Ferry Dam in 2-Minute Electrofishing Collections in 1983*

	Catch	Number of Collections (N)	Catch/N
September			
5	26	5	5
8	36	5	7
13	7	5	1
15	14	5	3
20	4	4	1
22	6	4	1*
26	149	4	37
29	16	3	5
October			
4	25	1	25
11	5	1	5
19	25	1	25
25	7	1	7
26	21	2	10
27	6	1	6
November			
1	2	1	2
2	0	1	0
7	8	2	4*
8	0	2	0
9	0	1	0
14	0	1	0
15	0	1	0
TOTAL	357	51	7

* Except for collections on Sept. 22 and Nov. 7, all collections below spillway taken during periods of leakage through the flashboards but not spillage

Vischer Ferry Hydroacoustic Study of Blueback Herring Outmigration In the Lower Mohawk River

September - November 1985

Prepared for:

The New York Power Authority

Prepared by:

Curtis and Associates

June, 1987

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Introduction

In June 1984, the New York Power Authority received major licenses for the Crescent and Vischer Ferry Hydroelectric projects. The Authority proposed in the license applications to expand the existing powerplants from 5.6 MW to 11.6 MW. The licenses contained articles requiring the Authority to conduct studies to evaluate measures to mitigate the potential impact of project operation on outmigrating juvenile blueback herring. The Authority, in consultation with the New York State Department of Environmental Conservation, the U. S. Fish and Wildlife Serivce, and the U. S. Army Corps of Engineers, conducted studies of the potential effect of the powerplants on outmigrating herring during 1982 and 1983. These studies employed traditional fisheries gear to evaluate the powerhouse and navigation lock as avenues of outmigration.

The Power Authority utilized hydroacoustic techniques during the 1985 fall study. The objectives of this study were to: 1) determine spatial and diel movement patterns of herring during the peak outmigration period, 2) obtain quantitative data on outmigrants at potential migration sites including the powerhouse headrace, the entrance to Lock E-7 of the New York Department of Transportation Barge Canal, the sluice gate entrance, and the Vischer Ferry Dam spillway if spillage occurred, and 3) determine the effectiveness of artificial light as an attractant on dusk or nighttime diversions of fish through the sluice gate and navigation lock.

Materials and Methods

Study Area

Outmigrations of juvenile blueback herring were hydroacoustically monitored in the headrace of the Vischer Ferry Powerhouse, the entrance to Lock E-7, the entrance to the northernmost sluice gate, the north and south ends of the spillway, and the Vischer Ferry pool from the dam extending upstream 2000 feet (Figures 1 and 5).

Sampling Gear

Bendix long-range side-scanning sonar fish counters were utilized throughout the Vischer Ferry hydroacoustic study. The counters were electronically calibrated and tested on juvenile herring in a one acre pond before installation. Final on-site adjustments were made with a dual-trace oscilloscope. Each counter used two, 512-KHW, dual-beam (2^{o} and 4^{o}) transducers to provide counts of individual fish. The transducers were mounted vertically on the guide wall and the two conical shaped sonar beams aimed perpendicular to the direction of herring migration (Figure 2). In this manner, the fish were ensonified from the side providing the optimum sonar target. Depth of the transducers from the surface was selected based on vertical distribution of outmigrating herring in the Vischer Ferry headrace as discussed on page 12.

In all tasks except for the mobile survey of the Vischer Ferry pool and the survey of lock E-7, the counters were programmed to provide on paper tapes an hourly print-out of fish counts during the previous hour. During the mobile study, fish counts were recorded instantaneously so their location on the survey map could be determined and a print-out of total counts was produced at the end of each transect. At lock E-7, print-outs were provided for the total number of fish entering the upstream lock approach when the valves were open during lock fill and when the upstream gates were open.

Task 1 - Data Collection at Powerhouse

Hydroacoustic equipment was first deployed in the Vischer Ferry headrace on September 24, 1985. The electronics were housed inside the powerhouse and the two dual-beam transducers were installed on the south guide wall approximately 70 feet upstream from the powerhouse. Initially, to obtain the vertical distribution of migrating blueback herring, the transducers were floated at the surface and aimed toward the bottom (Figure 3). The counting range was electronically adjusted so that fish passing between the transducers and the headrace bottom were counted. This distance (approximately 22 feet) was electronically divided into seventeen strata. Counts of the numbers of fish passing through the ensonified area of each stratum were recorded each hour. Counts were made in this manner for 19 hours (1600 hours September 24 - 1000 hours September 25). The scheduled 24-hour vertical distribution sample was cut short to monitor passage of a major outmigration peak. A second period of vertical distribution counts (0100 hours October 25 - 2400 hours October 26) was utilized to compare the vertical distribution pattern determined in the September periods (Table 1). Adjustment of transducer location was not necessary since vertical distribution varied little between the September and October samples.

After 19 hours of vertical counts (September 24-25), the transducers were mounted one below the other on the guide wall and aimed horizontally across the headrace (Figure 2). This placement provided an ensonified screen perpendicular to the wall and to the migration of fish through the headrace. Fish detection and counts from the side provided the most advantageous hydroacoustical aspect. Depth of the transducers from the surface was arranged to coincide with the highest density of fish as revealed during the vertical distribution study (see pages 12 and 13). All fish within the ensonified area were individually counted. Fish counts were made continuously 24 hours a day and recorded hourly on a paper tape print-out.

Task 2 - Data Collection at the Sluice Gate

To evaluate the sluice gate as a potential avenue of outmigration, the northernmost sluice gate at the Vischer Ferry Powerhouse was partially opened during part of the study period and passing herring hydroacoustically enumerated. This gate was selected because of its proximity to concentrations of fish at the powerhouse and because it opened from the top. This configuration simulated water passage through an opening in the flashboards.

On the first day of sampling (October 6), the sluice gate was opened 30 percent as indicated by the gauge attached to the gate. During the rest of the study, the gate was opened to 40 percent which corresponded to a depth of approximately three feet below pool level. When the water surface was at the top of the flashboards (el. 213.25 feet), the corresponding discharge through the sluice gate was approximately 200 CFS at 40 percent gate opening.

The electronics were housed in a weather-tight box on the guide wall deck near the sluice gate. The sonar transducer was attached to the end of a boom which was clamped to the deck of the walkway at the sluice gate (Figure 4). The transducer was directed to ensonify that part of the upper water column just upstream from the sluice gate opening. Since the gate opened from the top, the transducer was mounted just below the water surface. Fish entering the gate opening passed through the ensonified area.

Attractant lighting was provided by two 1,000 watt mercury vapor flood lights mounted approximately four feet above the water and directed toward the gate opening.

Task 3 - Data Collection at Lock E-7

Hydroacoustic equipment was installed at navigation Lock E-7 approximately 60 feet upstream from the upstream lock gates (Figure 1). Ensonification of this area allowed counts of fish immediately before they entered the lock via the lock gates or the valves used for filling the lock. Two transducers were attached to the south guide-wall approximately four feet below the water surface. Depth of the transducers was determined from vertical distribution data collected at the powerhouse (discussed on page 12) and from data collected between the two upstream guide-walls at the lock with a Fish Ray fish locator (Model FR-100). The transducer beams were directed across the lock toward the north guide-wall. Fish counts were made when the lock was filling prior to opening the lock gate and when the upstream gates were open. In general, boat traffic was not allowed to enter or depart the lock until the fish counts were terminated. However, in the case of small boats, the counter was turned off momentarily as the boat passed the ensonified area. Since the boats were moving slowly, entrained air caused no false counts.

An attractant light source was provided for selected lockages by two 1,000-watt mercury vapor flood lights. These lights were clamped to the lock chamber guard rail approximately eight feet above the water and directed from within the lock to shine through the open lock doors. The lights were directed to illuminate the upstream lock entrance and a portion of the lock-approach immediately upstream of the gates. As the fish approached the lock, light intensity increased.

Two sample t-test of means was utilized to determine the difference between the number of fish entering the lock with and without attractant lights. This difference was examined with the powerhouse in operation and not in operation. Significance level for all statistical tests was alpha = 0.05.

Task 4 - Mobile Study

The hydroacoustic equipment was fitted to an outboard powered john boat. The two transducers were mounted on the gunnel of the boat approximately six feet from the stern. In this location, no interference from motor noise or entrained air was detected.

The mobile study was to determine the spatial pattern of blueback herring movement toward the dam, lock, and powerhouse (Figure 6). This study consisted of surveys throughout the pool from the dam upstream approximately 0.4 miles. The survey pattern started at the guide wall at the powerhouse and proceded to the upstream end of the southern lock wall. The pattern turned upstream for approximately 200 foot and then transversed the river to the north side. Transect lines continued at approximately 200 foot intervals to a point 2,000 feet upstream from the powerhouse. After the transect was run in the upstream direction, the order was reversed and the transect was performed in the downstream direction ending at the powerhouse. A single survey was comprised of both the upstream and downstream sampling runs.

On the first survey, the two transducers were aimed at the bottom to determine the bathymetry of the study area. On this survey an additional transect line was located approximately 20 feet and parallel to the dam (Figure 5). During the rest of the mobile surveys, the transducers were aimed horizontally and a counting range of 100 feet was utilized. By counting fish from the side, a larger area of water could be ensonified and the fish next to the dam could be safely counted from a distance.

Sampling was initiated on November 1 and continued until November 14. Although high winds prevented sampling on three days during that period, eleven day and two night surveys were conducted.

In addition to the normal survey pattern, two random surveys were conducted within the sampling area. On the random surveys, schools of fish were located and followed as they migrated through the study area.

Task 5 - Data Collection During Spillage

Hydroacoustic equipment was utilized at the north and south ends of the Vischer Ferry Dam to monitor fish passage over the flashboards when spillage occurred. The electronics were housed in a weather-tight box attached to the sluice gate deck. The two dual-beam transducers were mounted to a boom attached to the sluice gate structure adjacent to the northern most flashboards. When counts were made at the south end of the spillway, the transducers were attached to the outside of the lock wall. The transducers were aimed horizontally just upstream from the flashboards. The fish passed through the ensonified area and were counted as they were passed over the flashboards.

Spillage occurred on only two occasions during the sampling period. Counts were made at the north end of the spillway during the first period of spillage (September 27-30) and at the south end during the second period of spillage (October 16 and 17).

Results and Discussion

Task 1 - Data Collection at Powerhouse

Vertical distribution of outmigrating herring was determined in order to place the transducers at the most advantageous depth. Horizontal sweeps with the transducers at various depths from the surface revealed no fish in the upper two feet and few fish in the lower ten feet of the water column. Quantitative data confirmed these findings when the transducers were floated on the surface and aimed toward the bottom. Data were collected in this manner during September 24 (1600-2400 hours) and September 25 (0000-1000 hours). The number and percentage of fish recorded in each 1.25 foot stratum of the water column are presented in Table 1. Although no fish were detected in the upper two feet of the water column, 97.3 percent of the herring counted were migrating between 2.0 and 9.5 feet from the surface. Some 89.3 percent of the fish were counted in the five-foot interval between 2.0 and 7.0 feet. Based on this information, the transducers were located 4.5 feet below the water surface and aimed across the forebay (Figure 2).

Additional vertical distribution counts made from 0000 hours October 25 to 2400 hours October 26 verified the previous sampling in September (Table 1). Since the October counts accounted for 7.0 percent of all vertical distribution counts, the October data were used for confirmation and the placement of the transducers was not altered. Since only a small section of the headrace area was ensonified during the vertical distribution sampling, the counts collected during that period were not included in the total count so as not to bias daily comparisons.

Monitoring of outmigration at Vischer Ferry Powerhouse was initiated at 1800 hours on September 26 and continued until 2400 hours on November 15. During the 49 days of outmigration monitoring, 1,578,613 fish were counted in the headrace area (Table 2).

Daily abundance of blueback herring at the powerhouse and daily percentages of the total count are presented in Table 2. Daily herring counts varied from a high of 109,709 fish on October 1 to a low of 4,681 on October 24. These counts represented 7.0 percent and 0.3 percent, respectively, of the total counts at the headrace. The mean number of fish counted per day was 32,217 and the mean number per hour was 1,342.

Three major peaks of outmigration were detected during the study period. The first peak occurred on September 27 through October 1. During that period, 417,481 fish were counted representing 26.5 percent of the run. Heavy rainfall from Hurricane Gloria resulted in a mean daily river flow at

Cohoes Gage Station of 7,142 CFS while the mean daily flow for the entire sampling period (September 24 - November 15) was 3,511 CFS. Spillage over the Vischer Ferry Dam occurred during most of the first peak outmigration period (September 27-30). A water temperature drop of 3.0°C (20.0° - 17.0°C) accompanied this five-day crest and was the most pronounced temperature decline during the study period.

Although increased river flow from Hurricane Gloria coincided with the first outmigration peak, the second and third peaks occurred during periods when river flows were below the mean river flow throughout the sampling period. The second peak occurred during October 6 and 7 when 172,750 herring were counted representing 11.0 percent of the total run. During this 2-day period, water temperature dropped 0.8°C (15.5° to 14.7°C) and the mean daily river flow (at Cohoes Gage) of 2,670 CFS was 23.9 percent below the study period mean flow of 3,511 CFS (Table 3). No spillage over the dam occurred during the second period of outmigration.

The last period of peak outmigration occurred on November 8 through 10. Counts of 171,948 fish, represented 10.9 percent of the total counts. A continual drop in water temperature (8.5° to 7.8°C) accompanied this period of peak outmigration. River flow (2,780 CFS) during this period was 20.8 percent below the study period mean flow. No spillage over the dam occurred during this period of outmigration.

The ten days included in these three peaks accounted for 762,179 fish and 48.3 percent of the total run. The mean number of fish counted daily during these peaks was 76,218 whereas the daily mean for non-peak days was 19,913.

Heavy rainfall from Hurricane Gloria produced high river flows and prompted increased powerhouse discharges. The mean daily powerhouse discharge of 2,542 CFS during the first outmigration peak was 14.8 percent greater than the study period mean discharge of 2,166 CFS. The second period mean daily powerhouse discharge of 2,229 CFS was only 2.8 percent greater than the study period mean and the mean daily powerhouse discharge of 2,517 CFS during the third outmigration period was 16.2 percent greater than the mean discharge for the study period. Although the three major outmigration peaks occurred during above average powerhouse discharge rates, similar above average discharges on several occasions during the study period were not accompanied by peak outmigrations. Therefore, increased powerhouse discharge was not the sole prerequisite for peak herring outmigration.

Herring outmigration in 1985 apparently occurred from late September through mid-November. The hydroacoustic sampling gear was not deployed until September 24th but circumstantial evidence suggested that substantial outmigration did not occur during mid-September. During a preliminary site inspection on September 17, no herring were observed in the ice chute in the powerhouse forbay. However, herring were observed and collected from the chute on September 24. Therefore, outmigration of substantial numbers of fish apparently started between September 17 and 24. Termination of outmigration apparently occurred shortly after mid-November as evidenced by decreasing water temperature and the low daily counts on five consecutive days from November 11 through 15, the last five sampling dates. Timing of the 1985 juvenile herring outmigration was apparently similar to the previous years (Charles T. Main, Inc., 1984).

Variation in diel abundance was detected at the Vischer Ferry Powerhouse. Table 4 presents the combined (peak and non-peak) hourly counts and the hourly percentages for days with 24 hourly counts. Days devoted to vertical distribution counts and partial counts on initial start-up days were not included in Table 4. Most of the fish, 74,997 per hour (67.3 percent), were counted during daylight hours (0700-1900 hours). Daily peaks of outmigration at 0800 and 1900 hours accounted for 13.7 percent of the fish counts. Times of greatest migration (5 percent or more of the daily total) occurred during 0700-1200 hours, 1500 hours, and 1800-1900 hours daily. The first period (0700-1200 hours) yielded

84,814 fish per hour while the last peak period (1800 - 1900 hours) averaged 88,922 fish per hour. These nine hours of peak outmigration accounted for 52.4 percent of the fish counted.

During days of peak outmigration, the pattern of diel abundance varied little when compared to the total migration (Table 5). Time of the peak morning movement (0700-1200 hours) remained unchanged although the percentage increased from 35.0 to 39.6 percent of the total count. The 1500 hour peak increased 1.0 percent during peak days. The afternoon peak period decreased in magnitude and duration to 7.4 percent between 1800 and 1900 hours as compared to the 12.3 percent between 1700 and 1900 hours for the entire period.

Diel herring abundance during each of the three peak periods of outmigration are presented in Table 6. Herring movement was generally similar in magnitude and timing among these three periods and with the run in general. During each of the three periods, 34.0 to 42.8 percent of the fish were counted between 0700-1200 hours. The mid-afternoon peak was also noted during all three periods although it was smaller than the 0700-1200 hour peak. The 1800-1900 hour peak which was noted in the combined data (Table 4) occurred only in the first migration peak (September 17 - October 2).

Periods of greatest movement during the non-peak days were less pronounced than during the peak periods but the hours of greatest movement remained similar (Table 7). The greatest periods of movement occurred in the morning (0800-1200 hours) and evening (1700-1900 hours). The mid-afternoon peak was not noticeable during the non-peak days.

Task 2 - Data Collection at the Sluice Gate

Hydroacoustic sampling was conducted at the sluice gate during October 6-15, October 23, and October 28-November 2. On these dates, 5,812 fish were counted during 133 hours of sampling (Table 8). The mean number of fish per hour was 44 compared to a mean at the powerhouse of 1,276 fish during the same 133 hours. Since the hydroacoustic equipment was under constant supervision, the higher counts on October 28 and 29 apparently did not result from equipment malfunction or the accumulation of trash on the transducer. These counts did not correspond with high counts at the powerhouse or navigation lock E-7.

Based on a two sample t-test, herring abundance at the sluice gate significantly increased when the powerhouse was in operation (Table 9). During power production, juveniles apparently responded to the flow through the powerhouse and moved to the north side of the river where they were subject to passage through the sluice gate. When the powerhouse was not operating, the herring remained near the navigation channel on the south side of the river (see Mobile Study, Task 4).

Diurnal abundance of herring at the sluice gate is presented in Table 10. The mean counts per hour varied from 0 at 0400 hours and 2400 hours to 319 at 1500 hours, but two periods of increased abundance were noted. During mid-afternoon (1400-1600 hours), the greatest counts (78-319 herring per hour) were observed. A second period of abundance (137 fish per hour) was counted at 2100 hours. Neither of these periods corresponded exactly with times of peak abundance at other sample sites although the mid-afternoon period was similar to the small peak noted in counts at the powerhouse (Tables 4-6). Most noticeably, the morning period of movement so pronounced in the powerhouse counts was not recorded at the sluice gate.

Flood lights were utilized at night (1800-2400 hours) at the sluice gate during five days of October 7-11 (Table 8). In the 14 hours that lights were used during this period, 404 fish (29 fish/hour) were counted. In comparison, 14 hours of lights-off counts on October 6, 12, 13, and 15 yielded 1,385 fish with an average of 99 fish per hour. Lights-off data from throughout the study period indicated 1,666 fish (44 fish per hour) were counted in 38 hours. The lights demonstrated no apparent positive influence on fish abundance.

The limited effectiveness of the sluice gate may be, in part, due to the paucity of herring in the upper two feet of the water column and the fact that the sluice gate opens from the top. Although the sluice gate was opened 40 percent (approximately three feet depending on pool level), vertical distribution data indicated that only 19.7 percent of the herring migrated in this area of the water column. Also, the volume of water (200 CFS) and flow generated by opening the sluice gate was small (approximately 11 percent) compared to the mean volume of water 1,782 CFS and flow in the headrace at the same time.

Task 3 - Data Collection at Lock E-7

A total of 115 locking operations were monitored between 1830 hours on October 8 and 2057 hours on October 30. Some 68,292 fish were counted in 2,848 minutes of lock operation yielding a mean of 24 fish per minute or 1,440 fish per hour. Since 19 locking operations during the period were not monitored, the total number of herring passed via lock E-7 during October 8-30 was not determined.

The time required to fill the locks (valves open), the time the lock gates were open and the fish counts during these times are presented in Table 11. Times ranged from 3 to 18 minutes for the lock fill time and from 2 to 57 minutes for the gates open.

Based on counts per minute, several distinct periods of diel abundance were evident. From 0500 hours to 1100 hours, the mean number of fish counted per minute was 29 (1,740 fish per hour). The counts per minute dropped to 8 (480 fish per hour) during mid-day (1200-1600 hours). Between 1700 and 2100 hours the counts returned to morning levels with 31 fish per minute (1,860 fish per hour). It should be noted that these data include various operational modes at the powerhouse.

Diurnal fish counts per minute at lock E-7 were correlated with the operational mode at Vischer Ferry Powerhouse. A two sample t-test of means of total counts at the lock with the powerhouse in operation verses total counts at the lock without the powerhouse in operation revealed a significant difference between the means at the 0.05 level (Table 12). With the powerhouse on, 20 fish were counted per minute at lock E-7 while the mean increased to 39 with the powerhouse off. When just the daylight (0700-1800 hours) lockings were considered, a significant difference was again detected between the mean counts with powerhouse on (17 fish per minute) and off (62 fish per minute, Table 13). However, no significant difference was discovered between night counts with powerhouse on (27 fish per minute) and night counts with powerhouse off (29 fish per minute, Table 14). Flow at the powerhouse appeared to be an important attraction to outmigrating herring. Assuming a 12 minute filling, the intermittent flow into Lock E-7 during filling was approximately 550 CFS compared to a mean discharge of 2,184 CFS from the powerhouse between September 24 and November 15.

Attractant flood lights were used during 42 of 64 locking operations conducted at night between October 16 and 30 (Tables 11 and 15). Based on the 64 night locking counts, the use of attractant lights did not significantly increase the fish counts at lock E-7 (Table 16).

Task 4 - Mobile Survey

During the fifteen mobile surveys conducted during November 1-14, 27,387 fish counts were recorded. Blueback herring generally were detected in relatively low density schools (less than 200 fish per school). These schools were small in size (usually less than 50 feet in diameter). No differences were detected in school size and density relative to abundance of fish at the powerhouse or the lock. Likewise, no school and density differences were noted between November 1-6 (non-peak counts at the powerhouse) and November 7-11 (one of three periods of peak counts).

However, the mean number of schools detected per survey did increase from 3 to 7 during the major migration period in November.

When the powerhouse was in operation, fish were detected on the north side of the river often in the relatively small channel leading into the headrace (Figure 6). Without the powerhouse operating, that side of the river was generally void of herring schools (Figure 7). On two occasions (November 5 and 8), herring located approximately two hundred yards upstream from the headrace were followed as they migrated into the headrace. Prior to this movement both schools had been stationary for up to an hour. Rapid movement by both schools toward the tailrace occurred between 1700 and 1800 hours. On both of these dates powerhouse operation was not altered between 1200 and 1800 hours. Therefore, alterations in flow did not alone stimulate movement of these schools into the headrace on those two days. Herring movement appeared crepuscular in nature and not totally correlated to powerhouse operation.

When the powerhouse was not in operation, the majority of the fish detected were found in the navigation channel on the south side of the river (Figure 7). Schools were frequently detected throughout the length of the channel between the lock and the upstream end of study area.

Material from dredging the navigation channel has been deposited in mid-river. The area along the dam between the powerhouse and the lock was shallow (4-5 feet) and heavily vegetated. No large schools of herring were detected in this area of the river (Figures 6-7). Multiple target signals were identified as submergent vegetation and individual isolated targets were suspected to be resident fish species. Although the mobile survey was not conducted during spillage over the flashboards, extensive utilization of the spillway as a migration route was not suggested by non-spillage migration patterns (see Task 5).

Task 5 - Data Collection During Spillage

The fish counter was operated at the northern end of the spillway from 1700 hours on September 27 until 1600 hours on September 30 (Table 17). The counting range started at the northern end of the flashboards and extended 150 feet southward. During these 72 hours of monitoring, 13,806 fish were counted. On the south end, counts were made on October 16 (2000-2200 hours) and October 17 (0700-1800 hours). The counting range of 50 feet extended from the north side of lock E-7 to a larger tree resting against the flashboard. During this 15 hour period, 1,126 fish were counted (Table 18).

Combining data from the northern and southern ends, 87 hours of counts were made and 14,932 fish were counted. The mean of 172 fish per hour is considerably less than the mean counts from the headrace or from the navigation lock. However, the spillway mean did exceed the mean of 44 fish per hour from the sluice gate study.

The first spillage monitoring period (September 27-30) coincided with a period of peak outmigration (Table 2). However, neither of the last two peak outmigration periods occurred during the October 16 and 17 period of spillage when fish passage over the spillway was again monitored.

Data were collected only at the two ends of the dam but these locations were the most likely portions of the spillway for fish passage. Water depths at the ends of the dam was greater than the shallow depths along the middle of the dam and herring were more typically found in deeper water during outmigration. During the mobile study, few herring were detected along the spillway. Therefore, caution should be exercised in expanding data collected at the ends of the spillway to the entire length of the structure.

Conclusions

Task 1 - Data Collection at the Powerhouse

1. Few, if any, juvenile blueback herring migrated in the upper two feet of the water column of the Vischer Ferry headrace during outmigration.
2. Approximately 97.3 percent of the herring migrated in water depths between 2.0 and 9.5 feet.
3. Of the 1,578,613 herring counted at the powerhouse, 842,578 fish (53.4 percent) were counted during three migration periods totaling 14 days.
4. Diel migration peaks regularly occurred at 0600-1200 hours and at 1700-1900 hours.

Task 2 - Data Collection at the Sluice Gate

1. Compared to counts at the headrace, the sluice gate did not pass a substantial number of fish.
2. Herring abundance at the sluice gate was positively correlated to flow in the powerhouse headrace.
3. Attractant lights did not measurably increase herring abundance at the sluice gate.

Task 3 - Data Collection at Lock E-7

1. Substantial numbers (68,292) of juvenile blueback herring utilized Lock E-7 as an outmigration route during the 22 days of lock counts.
2. Herring were more abundant at the lock during morning and evening periods than during mid-day.
3. Abundance of juvenile herring in the lock significantly increased from 20 fish per minute to a mean of 39 fish per minute when the powerhouse was not in operation.
4. The use of attractant lights at the lock did not significantly increase herring abundance at Lock E-7.

Task 4 - Mobile Study

1. Outmigrating herring congregated in low density schools in the pool above Vischer Ferry. Some schools remained stationary for up to an hour before migrating into the powerhouse headrace.
2. Deep water headrace and lock channels were preferred habitat while the shallow mid-river areas were void of herring schools.

3. Flow created by powerhouse operation attracted fish to channel upstream of the powerhouse. When the powerhouse was off, schools of herring were more abundant in the river near the lock.

4. Observations of movement of herring schools suggested that time of day was important in triggering fish movement through the powerhouse.

Task 5 - Data Collection During Spillage

1. Fish were passed over the flashboards when water spilled over Vischer Ferry Dam.

References Cited

Chas. T. Main, Inc. 1984. Studies of the Migration of Juvenile Blueback Herring in the Lower Mohawk River. Prepared for The New York Power Authority.

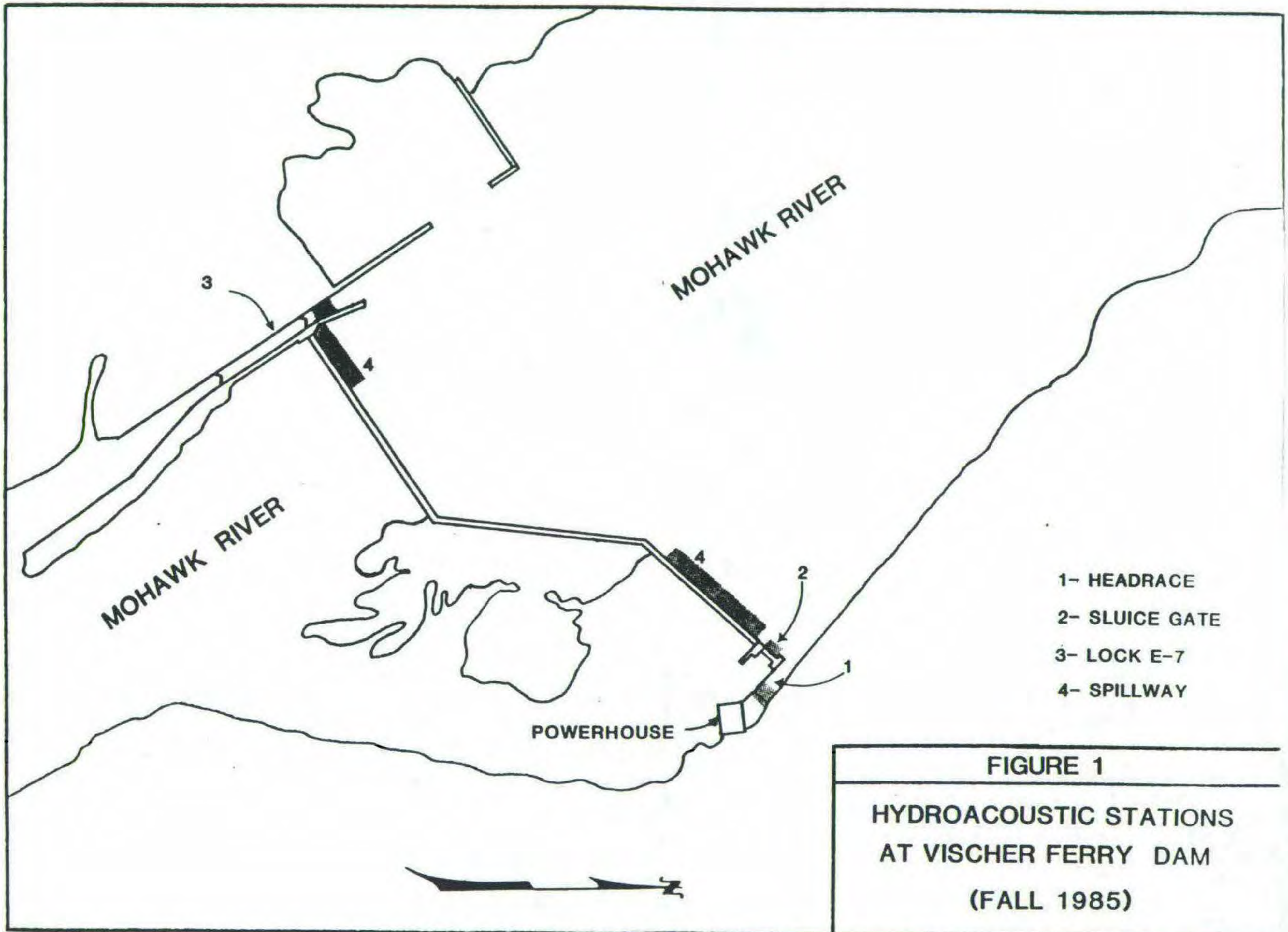


FIGURE 1

HYDROACOUSTIC STATIONS AT VISCHER FERRY DAM (FALL 1985)

FIGURE 2

TRANSDUCER LOCATION FOR BLUEBACK HERRING COUNTS AT VISCHER FERRY FOREBAY FALL 1985

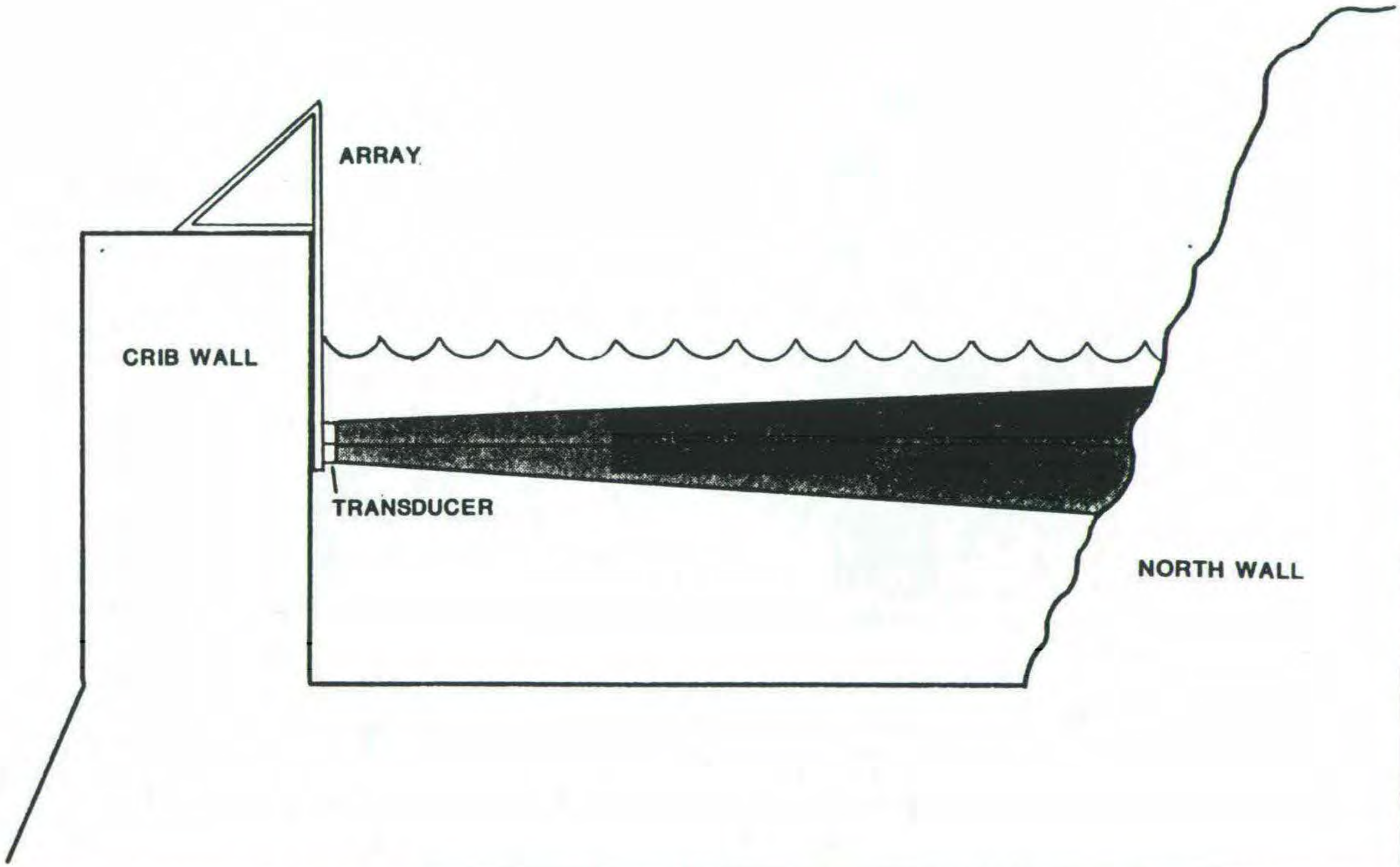
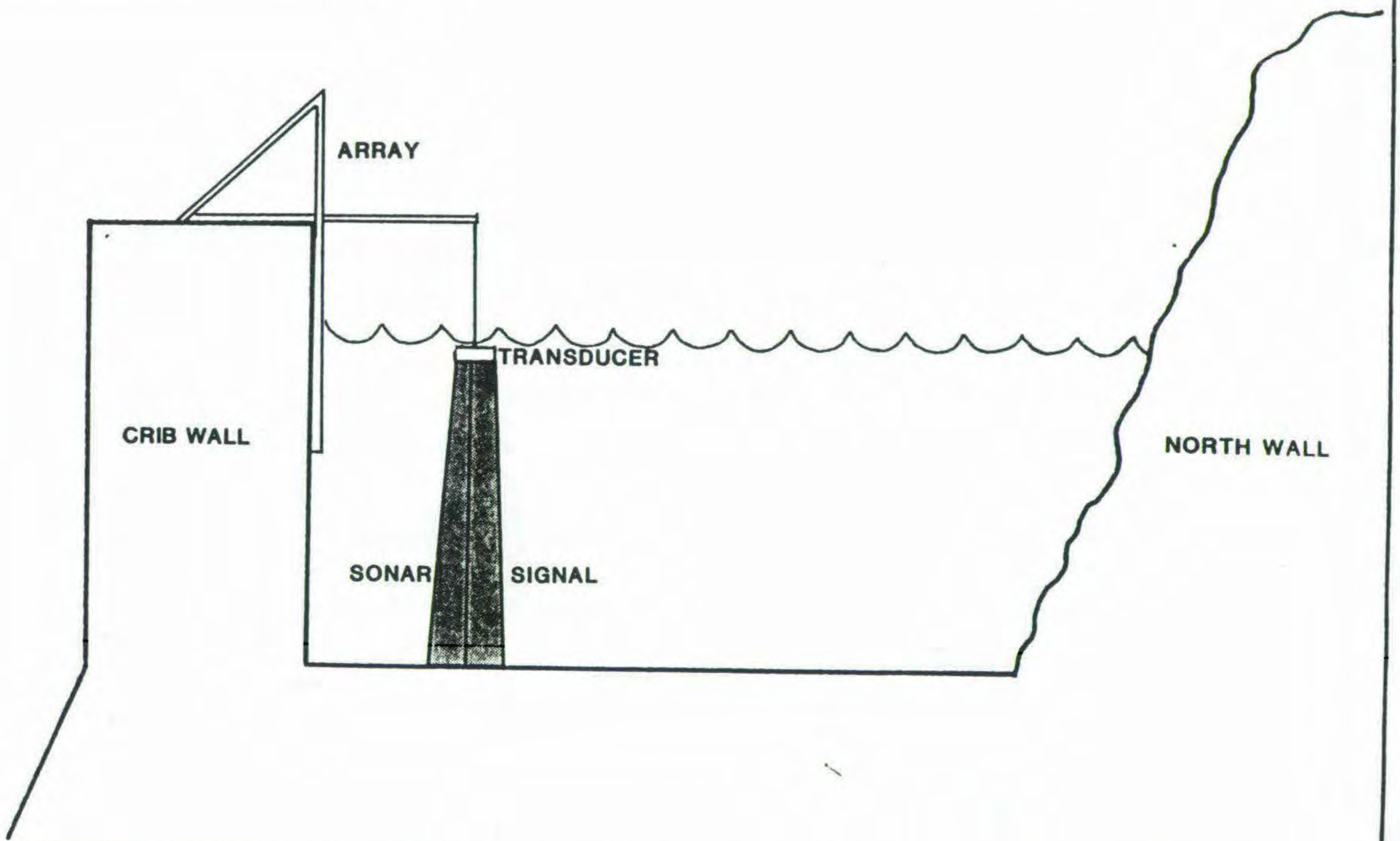


FIGURE 3

TRANSDUCER LOCATION FOR VERTICAL COUNTS AT VISCHER FERRY FOREBAY (FALL 1985)



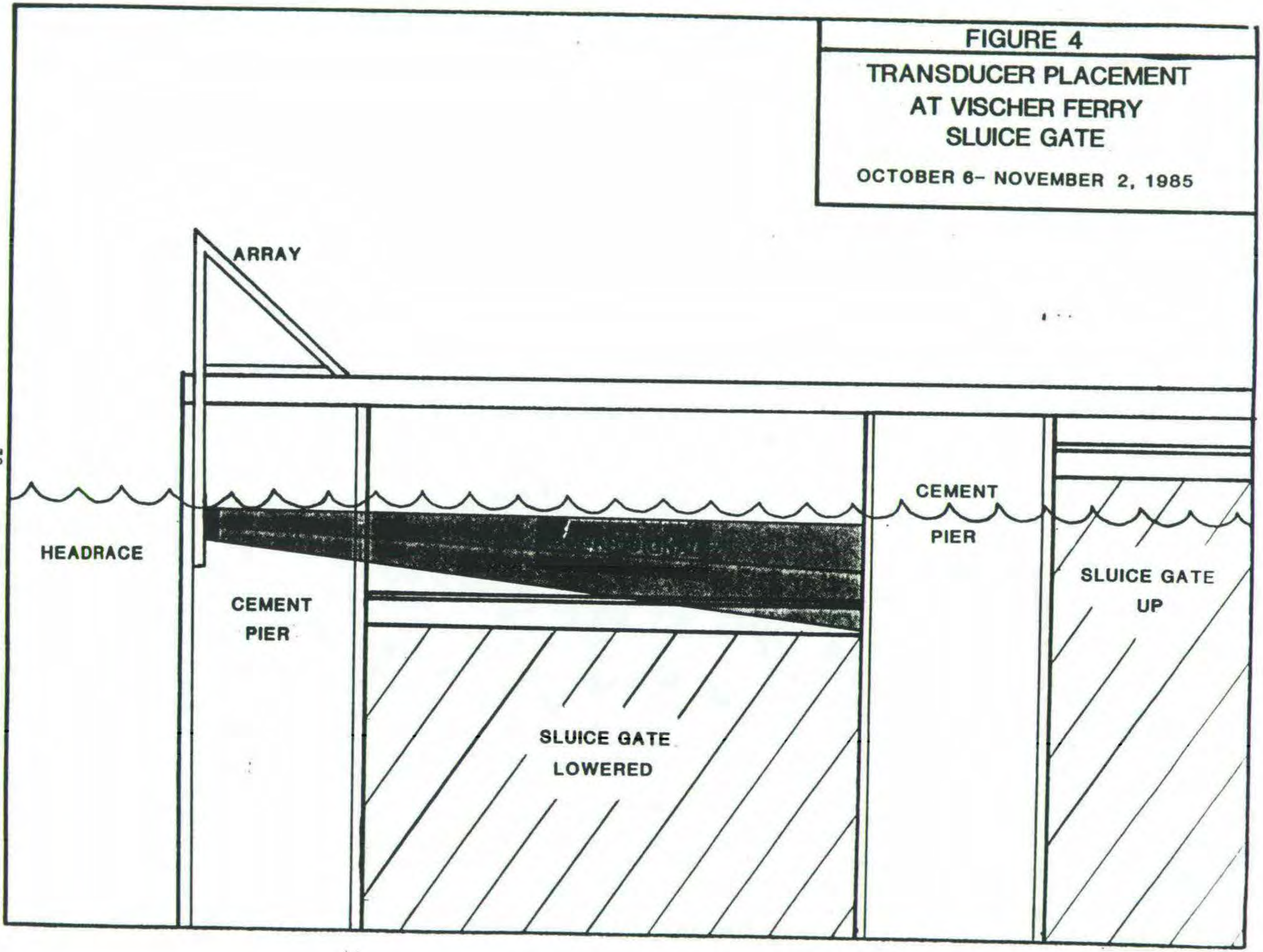


FIGURE 4
TRANSDUCER PLACEMENT AT VISCHER FERRY SLUICE GATE
OCTOBER 6– NOVEMBER 2, 1985

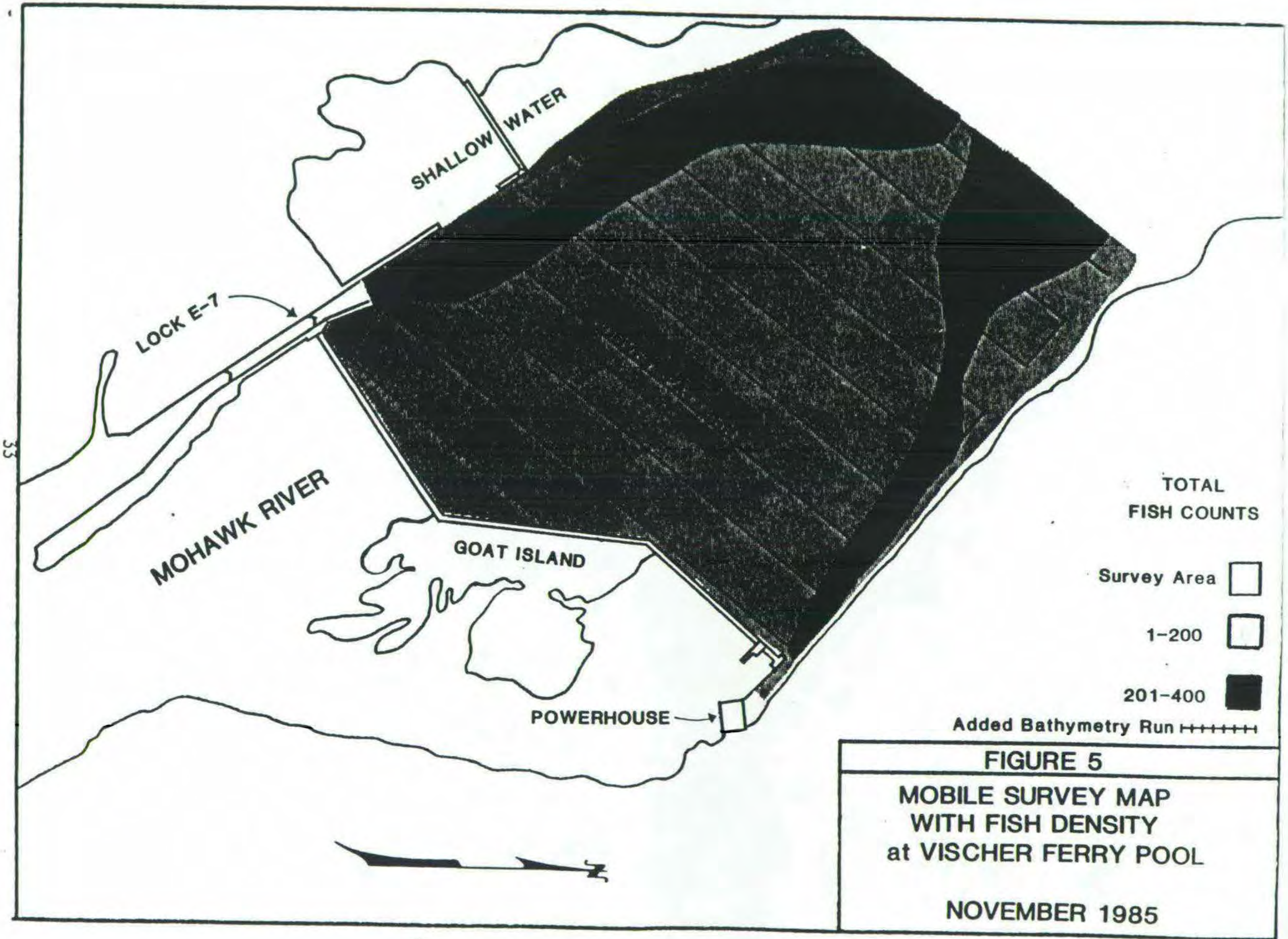


FIGURE 5
MOBILE SURVEY MAP
WITH FISH DENSITY
at VISCHER FERRY POOL

NOVEMBER 1985

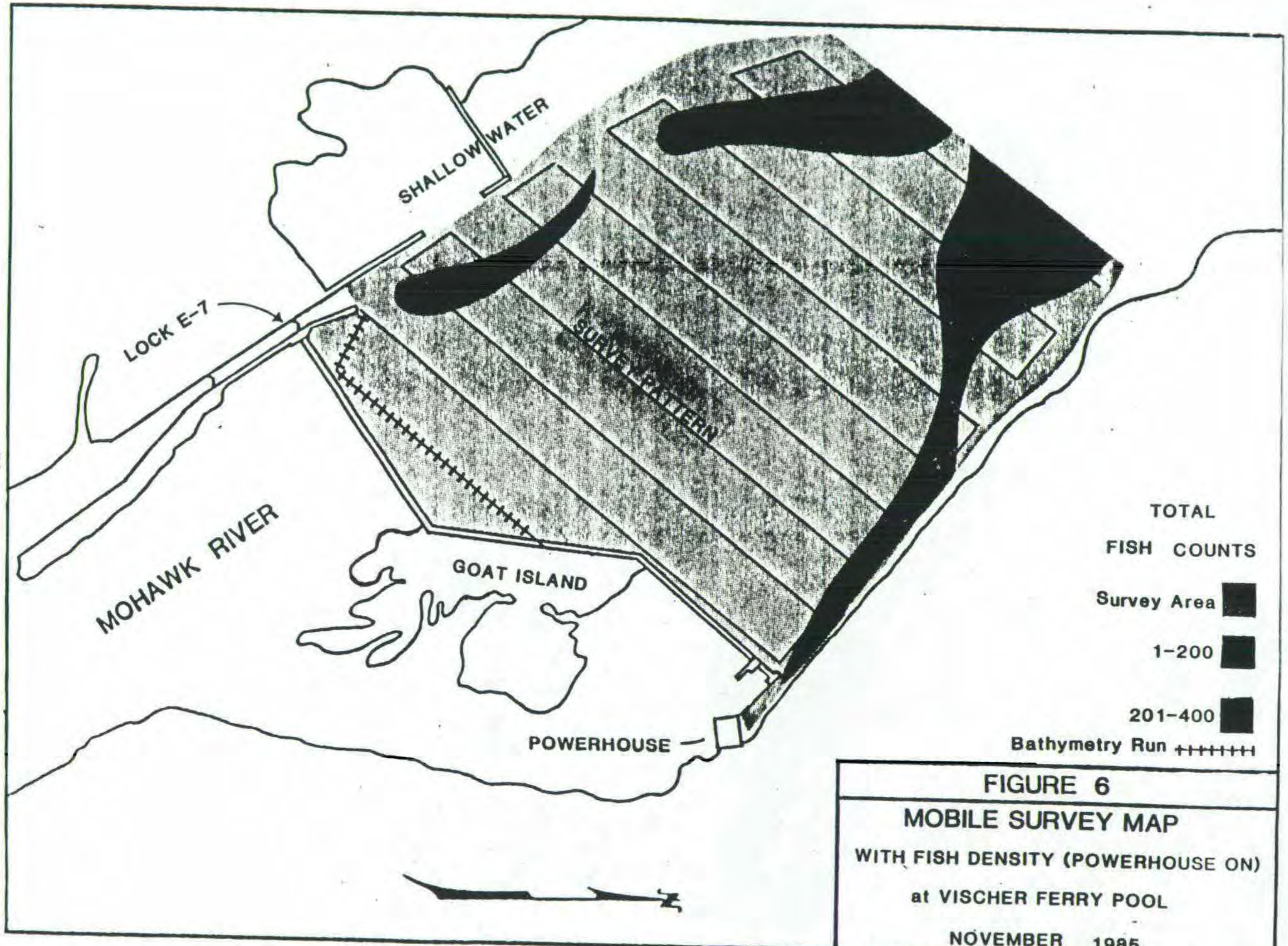


FIGURE 6

MOBILE SURVEY MAP

WITH FISH DENSITY (POWERHOUSE ON)

at VISCHER FERRY POOL

NOVEMBER 1985

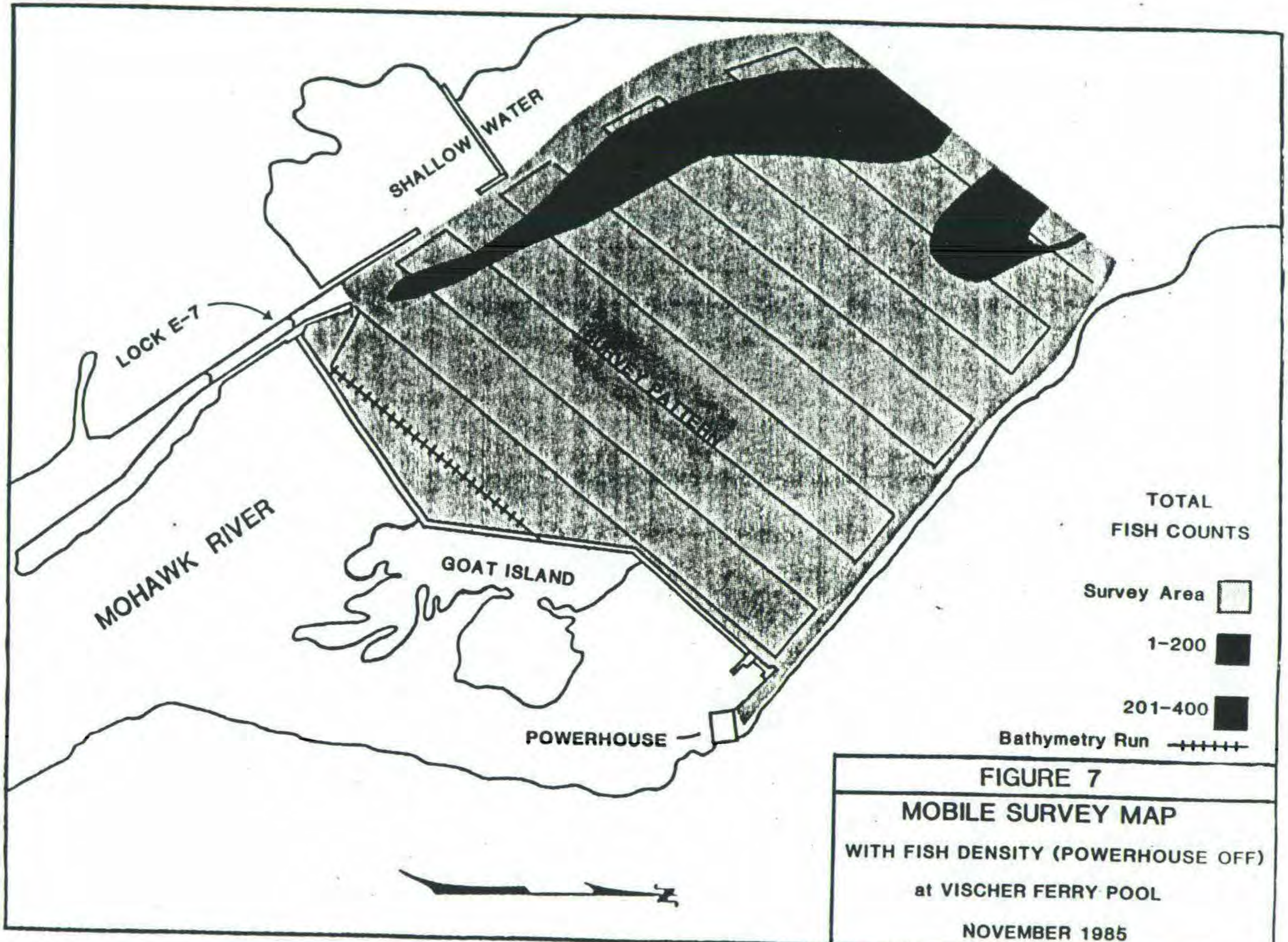


FIGURE 7

MOBILE SURVEY MAP

WITH FISH DENSITY (POWERHOUSE OFF)

at VISCHER FERRY POOL

NOVEMBER 1985

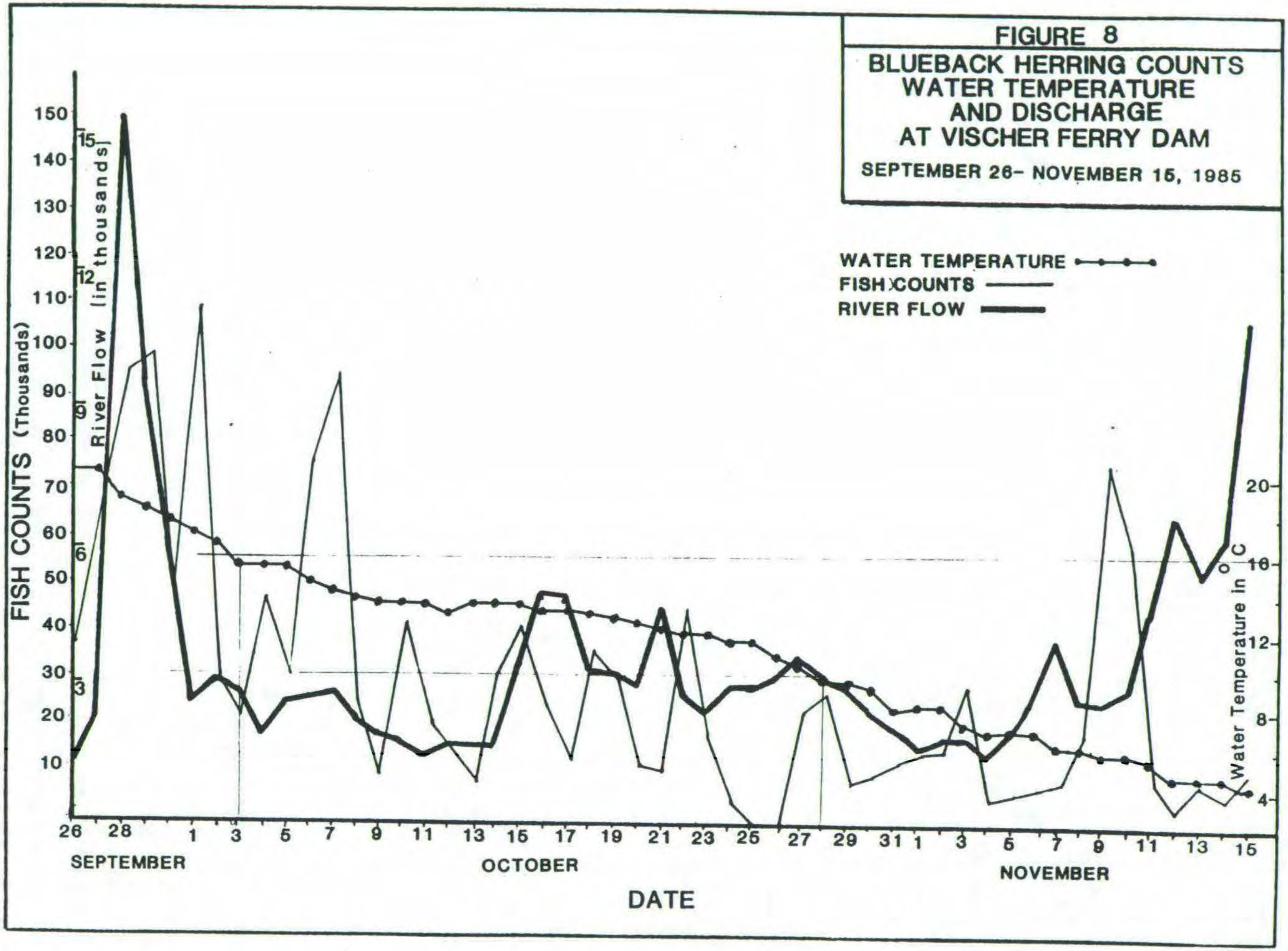


FIGURE 8
BLUEBACK HERRING COUNTS
WATER TEMPERATURE
AND DISCHARGE
AT VISCHER FERRY DAM
SEPTEMBER 26- NOVEMBER 15, 1985
WATER TEMPERATURE
FISH COUNTS
RIVER FLOW
FISH COUNTS (Thousands)
River Flow (in thousands)
Water Temperature in °C
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
15
12
9
6
3
20
16
12
8
4
26 28 1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 1 3 5 7 9 11 13 15
SEPTEMBER
OCTOBER
NOVEMBER
DATE

Table 1. Vertical Distribution of Outmigrating Juvenile Blueback Herring at Vischer Ferry Powerhouse, Mohawk River, 1985.

Depth	Fish Counts			Percent		
	Sept. 24-25*	Oct. 25-26*	Total	Sept. 24-25	Oct. 25-26	Total
2.00	0	0	0	0.0	0.0	0.0
3.25	4,296	209	4,505	19.7	12.9	19.3
4.50	8,544	691	9,235	39.3	42.7	39.5
5.75	4,340	473	4,813	19.9	29.2	20.6
7.00	2,260	67	2,327	10.4	4.1	9.9
8.25	1,266	101	1,367	5.8	6.2	5.8
9.50	475	18	493	2.2	1.1	2.1
10.75	120	12	132	0.6	0.7	0.6
12.00	116	26	142	0.5	1.6	0.6
13.25	119	14	133	0.5	0.9	0.6
14.50	62	8	70	0.3	0.5	0.3
15.75	60	0	60	0.3	0.0	0.2
17.00	36	1	37	0.2	0.1	0.2
18.25	27	0	27	0.1	0.0	0.1
19.50	20	0	20	0.1	0.0	0.1
20.75	15	0	15	0.0	0.0	0.0
21.00	19	0	19	0.1	0.0	0.1
Totals	21,775	1,620	23,395	100.0	100.0	100.0

* Denotes 1600 hours September 24 -1000 hours September 25 and 0100 hours October 25 - 2400 hours October 26, 1985

Table 2. Daily Abundance of Juvenile Blueback Herring at Vischer Ferry Powerhouse, Mohawk River, September 26 - November 15, 1985.

Date	Fish Counts Daily	Percentages of Total Counts	
		Daily	Cumulative
09/26/85	37,278	2.4	2.4
09/27/85	63,266	4.0	6.4
09/28/85	95,794	6.0	12.4
09/29/85	99,645	6.3	18.7
09/30/85	49,067	3.1	21.8
10/01/85	109,709	7.0	28.8
10/02/85	30,241	1.9	30.7
10/03/85	20,339	1.3	32.0
10/04/85	49,439	3.1	35.1
10/05/85	30,798	1.9	37.0
10/06/85	76,717	4.9	41.9
10/07/85	96,033	6.1	48.0
10/08/85	28,331	1.8	49.8
10/09/85	11,210	0.7	50.5
10/10/85	43,756	2.8	53.3
10/11/85	21,296	1.4	54.7
10/12/85	15,893	1.0	55.7
10/13/85	8,122	0.5	56.2
10/14/85	32,997	2.1	58.3
10/15/85	42,713	2.7	61.0
10/16/85	24,890	1.6	62.6
10/17/85	13,278	0.8	63.4
10/18/85	37,615	2.4	65.8
10/19/85	31,951	2.0	67.8
10/20/85	12,547	0.8	68.8
10/21/85	11,511	0.7	69.3
10/22/85	47,884	3.0	72.3
10/23/85	18,267	1.2	73.5
10/24/85	4,681	0.3	73.8
*10/25/85	0	—	73.8
*10/26/85	0	—	73.8
10/27/85	23,835	1.5	75.3
10/28/85	28,604	1.8	77.1
10/29/85	8,999	0.6	77.7
10/30/85	11,394	0.7	78.4
10/31/85	14,466	0.9	79.3
11/01/85	15,691	1.0	80.3
11/02/85	16,473	1.0	81.3
11/03/85	40,645	2.6	83.9
11/04/85	6,093	0.4	84.3
11/05/85	7,546	0.5	84.8
11/06/85	9,452	0.6	85.4
11/07/85	10,660	0.7	86.1
11/08/87	31,183	2.0	88.1

*Days devoted to vertical distribution counts

Table 2 continued.

Date	Fish Counts Daily	Percentages of Total Counts	
		Daily	Cumulative
11/09/85	78,617	5.0	93.1
11/10/85	62,148	3.9	97.0
11/11/85	11,107	0.7	97.7
11/12/85	5,945	0.4	98.1
11/13/85	10,294	0.6	98.7
11/14/85	7,504	0.5	99.2
11/15/85	12,700	0.8	100.0
Total	1,578,613	100.0	

Table 3. Discharge at Vischer Ferry Powerhouse[1] and River Flow at Cohoes Gage Station[2], Mohawk River, November 15, 1985.

Date	Powerhouse CFS	River Flow CFS	Date	Powerhouse CFS	River Flow CFS
Sept. 24	625	763	Oct. 24	2,500	2,940
25	792	951	25	2,417	2,980
26	1,500	1,290	26	3,000	3,160
27	1,938	2,280	27	2,750	3,550
28	3,000	15,500	28	2,104	3,270
29	3,000	9,410	29	2,188	3,000
30	2,896	5,960	30	1,646	2,470
Oct. 01	1,875	2,560	31	1,646	2,140
02	2,750	3,090	Nov. 01	1,438	1,590
03	1,896	2,750	02	1,625	1,820
04	2,021	1,870	03	1,688	1,830
05	2,146	2,490	04	1,500	1,480
06	2,542	2,640	05	1,833	1,990
07	1,917	2,700	06	2,458	2,610
08	1,896	2,230	07	2,667	4,020
09	1,583	1,880	08	2,583	2,780
10	1,292	1,660	09	2,521	2,640
11	1,104	1,450	10	2,446	2,920
12	1,500	1,630	11	2,625	4,640
13	1,146	1,570	12	3,000	6,750
14	1,500	1,620	13	3,000	5,530
15	2,583	3,360	14	3,000	6,190
16	2,958	5,070	15	2,458	16,600
17	3,000	4,970			
18	2,542	3,290			
19	2,313	3,250			
20	2,396	3,010			
21	2,625	4,680			
22	2,479	2,870			
23	1,875	2,410			

1 - Data provided by Niagara Mohawk Power Company
2 - Data provided by United States Geological Survey (Preliminary)

Table 4. Diel Abundance of Outmigrating Juvenile Herring and Mean Hourly Discharge at Vischer Ferry Powerhouse, Mohawk River, September 26 - November 15, 1985.

Hours	Days Powerhouse On	Mean Hourly Discharge CFS x 100	Fish Counts*	Percent of Total Fish Counts
0100	48	19.4	40,562	2.8
0200	48	20.1	57,903	4.0
0300	47	19.6	34.735	2.4
0400	47	19.6	46,226	3.2
0500	47	19.4	33,227	2.3
0600	38	15.3	45,858	3.2
0700	40	15.7	90,101	6.2
0800	50	20.8	98,190	6.8
0900	51	21.9	90,213	6.2
1000	51	22.9	75,348	5.2
1100	51	23.3	75,872	5.2
1200	51	23.2	79,158	5.4
1300	51	23.6	54,680	3.8
1400	51	24.2	48,918	3.4
1500	51	24.4	73,698	5.1
1600	51	24.9	61,464	4.2
1700	40	24.4	49,473	3.4
1800	41	20.4	77,975	5.4
1900	41	20.8	99,869	6.9
2000	47	23.8	52,475	3.6
2100	48	24.6	42,405	2.9
2200	48	21.9	44,157	3.0
2300	48	21.7	40,842	2.8
2400	48	20.4	36,328	2.5
Total			1,449,677	100.0

*Only days with 24 one-hour counts were included.

Table 5. Diel Abundance of Outmigrating Juvenile Blueback Herring During the Three Peak Periods Combined at Vischer Ferry Powerhouse, Mohawk River, September 27-October 1, October 6-7, and November 8-10, 1985.

Hours	Fish Counts	Percent
0100	18,854	2.2
0200	26,511	3.2
0300	12,935	1.5
0400	23,582	2.8
0500	21,073	2.5
0600	32,739	3.9
0700	71,018	8.4
0800	64,424	7.7
0900	61,461	7.3
1000	43,556	5.2
1100	50,798	6.0
1200	42,214	5.0
1300	25,508	3.0
1400	26,594	3.2
1500	51,641	6.1
1600	38,389	4.6
1700	29,389	3.5
1800	31,917	3.8
1900	62,451	7.4
2000	30,568	3.6
2100	21,100	2.5
2200	19,495	2.3
2300	21,405	2.5
2400	14,896	1.8
Total	842,518	100.0

Table 6. Diel Abundance of Juvenile Blueback Herring During Three Periods of Peak Outmigration at Vischer Ferry Powerhouse, Mohawk River, 1985.

	Sept. 27-Oct. 2		Oct. 6-8		Nov. 7-11	
Time	Fish Counts	Percent	Fish Counts	Percent	Fish Counts	Percent
0100	7,314	1.6	7,232	3.6	4,308	2.2
0200	14,014	3.1	7,054	3.5	5,443	2.8
0300	5,555	1.2	4,839	2.4	2,541	1.3
0400	6,387	1.4	11,513	5.7	5,682	2.9
0500	10,170	2.3	6,582	3.3	4,321	2.2
0600	12,917	2.9	8,534	4.2	11,288	5.8
0700	37,157	8.3	20,964	10.4	12,897	6.7
0800	28,728	6.4	12,130	6.0	23,566	12.2
0900	42,124	9.4	10,066	5.0	9,271	4.8
1000	20,465	4.6	8,401	4.2	14,690	7.6
1100	22,541	5.0	16,839	8.4	11,418	5.9
1200	23,458	5.2	7,950	4.0	10,806	5.6
1300	10,801	2.4	7,710	3.8	6,997	3.6
1400	13,863	3.1	8,860	4.4	3,871	2.0
1500	25,491	5.7	12,956	6.4	13,194	6.8
1600	14,367	3.2	10,606	5.3	13,416	6.9
1700	19,646	4.4	5,735	2.9	4,008	2.1
1800	22,692	5.1	3,909	1.9	5,316	2.7
1900	49,577	11.1	7,219	3.6	5,655	2.9
2000	22,627	5.1	3,130	1.6	4,811	2.5
2100	10,526	2.4	4,660	2.3	5,914	3.1
2200	10,635	2.4	3,382	1.7	5,478	2.8
2300	9,552	2.1	7,840	3.9	4,013	2.1
2400	7,115	1.6	2,970	1.5	4,811	2.5
Total	447,772	100.0	201,081	100.0	193,715	100.0

Table 7. Diel Abundance of Outmigrating Juvenile Blueback Herring, During Non-Peak Days at Vischer Ferry Powerhouse, Mohawk River, September 26 - November 15, 9185.

Hours	Fish Counts	Percent
0100	21,708	3.6
0200	31,392	5.2
0300	21,800	3.6
0400	22,644	3.7
0500	12,154	2.0
0600	13,119	2.2
0700	19,083	3.1
0800	33,766	5.6
0900	28,752	4.7
1000	31,792	5.2
1100	25,074	4.1
1200	36,944	6.1
1300	29,172	4.8
1400	22,324	3.7
1500	22,057	3.6
1600	23,075	3.8
1700	20,084	3.3
1800	46,058	7.6
1900	37,418	6.2
2000	21,907	3.6
2100	21,305	3.5
2200	24,662	4.1
2300	19,437	3.2
2400	21,432	3.5
Total	607,159	100.0

Table 8. Relative Abundance of Blueback Herring at the Vischer Ferry Powerhouse, Mohawk River, and Sluice Gate During Selected Days in October and November, 1985.

Date	Time	Sluice Gate Lights	Sluice Gate Fish Counts	Powerhouse Discharge (cfs)	Powerhouse Fish Counts
Oct. 6	1400	*	2	3,000	5,675
	1500	*	4	3,000	9,686
	1600	*	3	3,000	7,983
	1700	*	0	3,000	2,805
	1800	off	1	3,000	2,081
	1900	off	11	3,000	2,992
	2000	off	0	3,000	829
	2100	off	2	3,000	1,485
	2200	off	4	3,000	1,582
	2300	off	1	3,000	7,049
	2400	off	0	1,000	2,113
Oct. 7	1700	*	0	2,500	1,491
	1800	on	3	2,500	821
	1900	on	0	2,500	1,892
Oct. 8	0700	*	3	1,500	1,159
	0800	*	14	1,500	834
	0900	*	0	2,500	333
	1000	*	21	2,500	372
	1100	*	17	2,500	4,470
	1200	*	3	2,500	1,519
	1300	*	5	2,500	892
	1400	*	7	2,500	1,990
	1500	*	15	2,500	1,748
	1600	*	0	2,500	1,243
	1700	*	18	2,500	1,439
	1800	on	8	2,500	1,007
	1900	on	8	2,500	2,335
	2000	on	5	2,500	1,657
Oct. 9	0700	*	17	1,500	1,005
	0800	*	6	1,500	1,006
	0900	*	0	1,500	639
	1600	*	3	1,500	466
	1700	*	0	1,500	582
	1800	on	2	2,000	909
	1900	on	0	3,000	477
	2000	on	3	3,000	215

* Daylight samples

Table 8 continued.

Date	Time	Sluice Gate Lights	Sluice Gate Fish Counts	Powerhouse Discharge (cfs)	Powerhouse Fish Counts
Oct. 10	1700	*	91	1,500	3,331
	1800	on	0	1,500	1,721
	1900	on	103	1,500	654
	2000	on	137	1,500	798
	2100	on	143	1,500	586
Oct. 11	0500	*	0	1,000	457
	0600	*	0	0	959
	0700	*	0	0	1,146
	0800	*	12	500	2,309
	0900	*	5	1,500	1,266
	1000	*	0	1,500	388
	1700	*	0	1,500	400
	1800	on	0	0	4,570
	1900	on	0	0	2,578
Oct. 12	1700	*	8	1,500	1,914
	1800	off	0	1,500	6,481
	1900	off	31	1,500	4,030
	2000	off	7	1,500	0
Oct. 13	0600	*	2	+0	0
	0700	*	6	+0	0
	0800	*	27	1,500	2,701
	0900	*	0	1,500	778
	1700	*	0	1,500	97
	1800	off	1	+0	855
	1900	off	0	0	1,416
Oct. 15	0500	*	1	3,000	449
	0600	*	4	3,000	736
	0700	*	4	3,000	412
	0800	*	8	3,000	451
	0900	*	10	3,000	813
	1800	off	31	0	11,354
	1900	off	10	0	8,523
Oct. 23	0600	*	0	0	138
	0700	*	0	0	138
	0800	*	0	1,500	494
	0900	*	11	2,500	332
	1000	*	21	2,500	149
	1100	*	10	2,000	202
	1200	*	0	1,500	99
	1300	*	7	1,500	169
	1400	*	11	1,500	1,199
	1800	off	51	0	2,220
	1900	off	17	0	52

Table 8 continued.

		Sluice Gate		Powerhouse	
Date	Time	Lights	Fish Counts	Discharge (cfs)	Fish Counts
Oct. 28	1400	*	191	2,000	1,965
	1500	*	1461	2,000	1,612
	1600	*	531	2,000	1,264
	1700	*	4	2,000	811
	1800	off	200	2,000	624
	1900	off	203	2,000	876
	2000	off	293	2,000	878
	2100	off	541	2,000	396
	2200	off	166	2,000	695
	2300	off	28	2,000	841
Oct. 29	1300	*	87	2,500	423
	1400	*	260	2,500	162
	1500	*	113	2,500	266
	1600	*	220	2,500	239
	1700	*	207	2,500	243
	1800	off	32	2,500	236
	1900	off	178	2,500	273
	2000	off	74	2,500	346
	2100	off	0	2,500	233
	2200	off	0	1,500	172
Oct. 30	1300	*	0	2,500	281
	1400	*	0	2,500	285
	1500	*	3	2,500	155
	1600	*	2	2,500	182
	1700	*	2	2,500	221
	1800	off	2	2,500	184
	1900	off	0	2,500	649
	2000	off	0	2,500	862
	2100	off	0	2,500	770
	2200	off	0	1,500	584
Oct. 31	0400	off	0	0	147
	0500	off	0	0	866
	0600	*	0	0	314
	0700	*	0	0	1,091
	0800	*	0	2,500	351
	0900	*	0	2,500	276
	1000	*	1	2,500	218
	1100	*	0	2,500	288

Table 8 continued.

Date	Time	Sluice Gate		Powerhouse	
		Lights	Fish Counts	Discharge (cfs)	Fish Counts
Nov. 1	0400	off	0	0	523
	0500	off	0	0	46
	0600	*	0	0	206
	0700	*	0	0	720
	0800	*	5	2,500	513
	0900	*	7	2,500	455
	1000	*	7	2,500	1,761
	1100	*	21	2,500	717
Nov. 2	0400	off	0	0	367
	0500	off	0	0	69
	0600	*	0	0	145
	0700	*	0	0	482
	0800	*	4	2,500	499
	0900	*	2	2,500	355
	1000	*	6	2,500	215
	1100	*	6	2,500	243
Total			5,812		169,761

Table 9. Comparison of Juvenile Blueback Herring Counts at the Vischer Ferry Sluice Gate with Powerhouse in Operation verses Powerhouse not in Operation, Mohawk River, October, 1985.

	ON	OFF
Mean	53.21	4.53
Median	0	0
Variance	27,542.05	138.25
Standard Deviation	165.95	11.75
Range	1461	51
Minimum Value	0	0
Maximum Value	1461	51
Sample Size	107	26

Table 10. Diurnal Blueback Herring Abundance at Vischer Ferry Sluice Gate, Mohawk River, October and November, 1985.

Time	No. of Hours	Fish Counts	Fish/hr.
0100	0	0	0
0200	0	0	0
0300	0	0	0
0400	3	0	0
0500	5	1	0.2
0600	7	6	0.9
0700	9	30	3.3
0800	9	76	8.4
0900	9	35	3.9
1000	6	56	9.3
1100	5	54	10.8
1200	2	3	1.5
1300	4	99	24.8
1400	6	471	78.5
1500	5	1596	319.2
1600	6	767	127.8
1700	11	330	10.0
1800	13	331	25.5
1900	13	553	42.5
2000	8	519	64.9
2100	5	686	137.2
2200	4	170	42.5
2300	2	29	14.5
2400	1	0	0
Total	133	5812	

Table 11. Juvenile Blueback Herring Counts at Lock E-7, Mohawk River, October 8-30, 1985

Date	Time	Counting Time (min.)			Fish Counts			Lights	Powerhouse Discharge CFS x 100
		Lock Filling	Gates Open	Total	Lock Filling	Gates Open	Total		
Oct. 8	1830	-	6	6	-	207	207	off	25
9	1013	-	5	5	-	35	35	off	15
9	1457	-	9	9	-	60	60	off	15
9	1539	-	12	12	-	50	50	off	15
9	1904	11	2	13	237	17	254	off	30
10	0710	-	8	8	-	150	150	off	15
10	0833	7	6	13	197	228	425	off	15
10	0902	7	22	29	-	383	383	off	15
10	0945	7	3	10	13	74	87	off	15
10	1010	8	24	32	0	210	210	off	15
10	1408	7	6	13	60	264	324	off	15
10	1700	7	27	34	126	598	724	off	15
11	0742	7	46	53	238	2,811	3,049	off	0
11	0848	9	6	15	-	4,025	4,025	off	0
11	1000	11	2	13	635	372	1,007	off	15
11	1126	11	21	32	2,527	968	3,495	off	15
11	1231	10	3	13	-	105	105	off	15
11	1522	18	2	20	878	55	933	off	15
11	1729	8	21	29	95	58	153	off	15
11	1807	10	24	34	92	385	477	off	0
12	0803	7	4	11	343	68	411	off	15
12	0824	6	-	6	88	0	88	off	15
12	1108	9	35	44	7	2	9	off	15
12	1216	7	-	7	53	0	53	off	15
12	1358	7	3	10	22	60	82	off	15
12	1447	9	-	9	15	0	15	off	15
12	1559	11	5	16	38	43	81	off	15
12	1653	6	5	11	13	30	43	off	15
12	1717	9	20	29	66	66	132	off	15
12	1753	7	4	11	1,330	48	1,378	off	15
12	1816	9	9	18	1,493	135	1,628	off	15

Table 11 continued.

Date	Time	Counting Time (min.) Lock Filling	Counting Time (min.) Gates Open	Counting Time (min.) Total	Fish Counts Lock Filling	Fish Counts Gates Open	Fish Counts Total	Lights	Powerhouse Discharge CFS x 100
Oct. 13	0825	7	7	14	22	285	307	off	0
13	0900	8	30	38	10	60	70	off	0
13	1015	-	9	9	-	3	3	off	15
13	1112	8	4	12	70	0	70	off	15
13	1139	7	4	11	2	2	4	off	15
13	1447	8	9	17	18	22	40	off	15
13	1520	8	4	12	10	2	12	off	15
13	1756	10	25	35	63	268	331	off	15
14	0731	8	20	28	3	3	6	off	15
14	0831	9	4	13	20	0	20	off	15
14	1440	10	10	20	5	58	63	off	15
14	1551	8	35	43	8	53	61	off	15
14	1721	8	15	23	18	23	41	off	15
15	0741	8	10	18	42	50	92	off	30
15	0935	6	6	12	676	-	676	off	30
15	1501	9	4	13	5	0	5	off	30
15	1732	7	41	48	10	325	335	off	30
16	0759	11	20	31	492	183	675	off	15
16	1900	15	-	15	77	-	77	on	30
16	1924	9	27	36	55	463	518	on	30
16	2012	8	35	43	268	443	711	on	30
16	2109	12	29	41	292	87	379	on	30
17	0812	8	38	46	668	3,468	4,136	off	30
17	0954	7	2	9	115	25	140	off	30
17	1507	9	6	15	53	3	56	off	30
17	1809	7	3	10	13	13	26	off	30
17	-	-	5	5	-	182	182	off	30
Oct. 18	0938	11	3	14	10	0	10	off	25
18	1635	8	4	12	0	0	0	off	25
19	0857	9	36	45	33	157	190	off	30
19	0957	3	3	6	0	0	0	off	30
19	1731	-	9	9	0	88	88	off	30

Table 11 continued.

Date	Time	Counting Time (min.)			Fish Counts			Lights	Powerhouse Discharge CFS x 100
		Lock Filling	Gates Open	Total	Lock Filling	Gates Open	Total		
Oct. 21	0522	8	20	28	350	2,538	2,888	off	0
21	0624	10	-	10	490	0	490	off	0
21	0654	9	30	39	132	1,003	1,135	off	0
21	1017	7	3	10	40	147	187	off	30
21	1718	5	20	25	0	0	0	off	30
21	1754	7	14	21	0	16	16	off	30
21	1827	9	-	9	33	0	33	off	15
22	0533	11	27	38	260	470	730	on	30
22	0623	9	32	41	238	483	721	on	30
22	0716	8	38	46	100	75	175	off	30
22	1725	8	3	11	0	0	0	off	20
22	1748	8	7	15	0	0	0	off	20
22	1816	7	28	35	93	192	285	on	25
23	0531	10	34	44	673	325	998	on	25
23	0627	10	30	40	128	307	435	on	0
23	0717	10	36	46	130	902	1,032	off	0
23	1705	16	20	36	23	20	43	off	25
23	1755	8	45	53	12	157	169	on	25
24	0523	8	32	40	98	266	364	on	25
24	0614	9	41	50	373	1,158	1,531	on	25
24	0717	7	41	48	67	346	413	off	25
24	1753	9	22	31	10	80	90	on	25
24	1834	15	30	45	118	67	185	on	25
25	0521	7	22	29	282	148	430	on	25
25	0603	12	28	40	607	413	1,020	on	0
25	0655	8	57	65	638	223	861	on	0
25	1749	6	22	28	142	368	510	off	30
25	1829	7	22	29	60	1,028	1,088	on	0
27	1707	6	12	18	67	27	94	on	25
27	1735	8	11	19	73	18	91	on	25

Table 11 continued.

Date	Time	Counting Time (min.) Lock Filling	Counting Time (min.) Gates Open	Counting Time (min.) Total	Fish Counts Lock Filling	Fish Counts Gates Open	Fish Counts Total	Lights	Powerhouse Discharge CFS x 100
Oct. 28	1712	12	10	22	1,395	2,393	3,788	on	20
28	1747	9	12	21	531	788	1,314	on	20
28	1820	8	13	21	585	138	723	on	20
28	1855	8	22	30	158	790	948	on	20
28	1939	9	25	34	988	298	1,286	on	20
28	2026	8	26	34	1,286	1,095	2,381	on	20
28	2112	8	24	32	115	4,582	4,697	on	20
29	1605	-	11	11	0	177	177	on	25
29	1737	8	15	23	302	20	322	on	25
29	1813	8	19	27	492	67	559	on	25
29	1854	8	15	23	192	47	239	on	25
29	1930	7	22	29	208	315	523	on	25
29	2013	8	30	38	1,288	550	1,838	on	0
29	2104	8	30	38	255	138	363	on	25
30	1712	8	14	22	593	37	630	on	0
30	1748	8	13	21	535	128	663	on	0
30	1823	7	4	11	35	60	95	on	0
30	1846	8	6	14	82	275	357	on	0
30	1915	7	10	17	65	10	75	on	0
30	1939	8	15	23	478	103	581	on	0
30	2018	8	15	23	601	53	654	on	0
30	2057	4	30	34	490	178	668	on	0

Table 12. Comparison of Total Juvenile Blueback Herring Counts at Lock E-7 with Powerhouse in Operation verses Powerhouse not in Operation, Mohawk River, October, 1985.

	ON	OFF
Mean	20.55	39.22
Variance	1007.65	2943.63
Standard Deviation	31.92	55.53
Range	172.18	266.49
Minimum Value	0.00	1.84
Maximum Value	172.18	268.33
Sample Size	93	22

Table 13. Comparison of Daylight Juvenile Blueback Herring Counts at Lock E-7 with Powerhouse in Operation verses Powerhouse not in Operation, Mohawk River, 1985.

	ON	OFF
Mean	17.78	61.75
Median	-	-
Variance	1013.85	7345.87
Standard Deviation	32.08	92.58
Range	172.18	266.49
Minimum Value	0.00	1.84
Maximum Value	172.18	268.33
Sample Size	66	7

Table 14. Comparison of Nighttime Juvenile Blueback Herring Counts at Lock E-7 with Powerhouse in Operation verses Powerhouse not in Operation, Mohawk River, October, 1985.

	ON	OFF
Mean	27.33	29.51
Median	-	-
Variance	927.63	552.44
Standard Deviation	31.04	24.33
Range	144.18	98.73
Minimum Value	2.60	4.41
Maximum Value	146.78	103.14
Sample Size	27	15

Table 15. Abundance of Blueback Herring at Lock E-7, Mohawk River, with Flood Lights On, 1985.

Date	Time	Minutes Counted	Total Fish Counts
Oct. 16	1900	15	77
16	1924	36	518
16	2012	43	711
16	2109	41	379
22	0533	38	730
22	0623	41	721
22	1816	35	285
23	0531	44	998
23	0627	40	435
23	1755	53	169
24	0523	40	364
24	0614	50	1531
24	1753	31	90
24	1834	45	185
25	0521	29	430
25	0603	40	1020
25	0655	65	861
25	1829	29	1088
27	1707	18	94
27	1735	19	91
28	1712	22	3788
28	1747	21	1314
28	1820	21	723
28	1855	30	948
28	1939	34	1286
28	2026	34	2381
28	2112	32	4697
29	1605	11	177
29	1737	23	322
29	1813	27	559
29	1854	23	239
29	1930	29	523
29	2013	38	1838
29	2104	38	363
30	1712	22	630
30	1748	21	663
30	1823	11	95
30	1846	14	357
30	1915	17	75
30	1939	23	581
30	2018	23	654
30	2057	34	668
Total		1,300	33,658

Table 16. Comparison of Nightime Juvenile Blueback Herring Counts with Attractant Lighting and with No Attractant Lighting at Lock E-7, Mohawk River, October, 1985

	ON	OFF
Mean	27.14	23.95
Median	17.8	6.15
Variance	1131.61	1311.49
Standard Deviation	33.64	36.21
Range	169.3	125.3
Minimum Value	2.9	0
Maximum Value	172.2	125.3
Sample Size	42	22

Table 17. Juvenile Blueback Herring Counts at the Northside of the Vischer Ferry Spillway, Mohawk River, September 27-30, 1985.

Date	Time	Fish Counts
Sept. 27	1700	410
	1800	214
	1900	391
	2000	187
	2100	103
	2200	87
	2300	180
	2400	90
Sept. 28	0100	138
	0200	51
	0300	97
	0400	115
	0500	111
	0600	73
	0700	195
	0800	499
	0900	243
	1000	392
	1100	270
	1200	497
	1300	18
	1400	201
	1500	143
	1600	192
	1700	236
	1800	269
	1900	380
	2000	97
	2100	173
	2200	39
	2300	33
	2400	91
Sept. 29	0100	95
	0200	110
	0300	87
	0400	14
	0500	129
	0600	281
	0700	193
	0800	323
	0900	598
	1000	418
	1100	401
	1200	407

Table 17 continued.

Date	Time	Fish Counts
Sept. 29	1300	218
	1400	193
	1500	189
	1600	171
	1700	79
	1800	485
	1900	561
	2000	378
	2100	221
	2200	418
	2300	149
	2400	222
Sept. 30	0100	141
	0200	89
	0300	201
	0400	114
	0500	121
	0600	98
	0700	195
	0800	50
	0900	13
	1000	5
	1100	49
	1200	108
	1300	0
	1400	21
	1500	41
	1600	5
Total		13,806

Table 18. Juvenile Blueback Herring Counts at the Southside of the Vischer Ferry Spillway, Mohawk River, October, 1985.

Date	Time	Fish Counts
October 16	2000	152
	2100	57
	2200	0
October 17	0700	5
	0800	21
	0900	91
	1000	124
	1100	21
	1200	44
	1300	111
	1400	173
	1500	291
	1600	23
	1700	7
	1800	6
Total		1126

Mohawk-Hudson Watershed: H240
Watershed File #625

Distribution and Relative Abundance of Fish in the Lower Mohawk River

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Abstract

The results of a fisheries survey of the 123 km (76.3 mi) lower Mohawk River from Five Mile Dam downstream to its confluence with the Hudson River are presented. The survey was conducted from 1979 to 1983 with the objectives of assessing the river's fisheries and determining management needs. The lower Mohawk River supports abundant and diverse warmwater fish populations. Fifty-six fish species were collected including 12 species that were not collected during the 1934 fisheries survey. Three primary habitat types were identified including power pool impoundments, river canal impoundments, and natural river segments. Species composition of the fish populations associated with these habitat types were different. Sport fish populations in the power pool impoundments were dominated by panfish, whereas game fish outnumbered panfish in river canal impoundments and natural river segments. Five indices of relative abundance and size distribution were used to assess the quality of fish populations. All indices showed that the lower Mohawk River supports large numbers of sport fish species of sizes considered desirable by most New York anglers. The data show that the lower Mohawk River contains a very large population of smallmouth bass, which may well support one of the best fisheries in New York for that species.

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INTRODUCTION

The Mohawk River is the second longest river in New York State. Recent census data show that approximately 825,000 people live within a 32 km (20 mi.) corridor of the Department of Environmental Conservation (DEC) Region 4 portion of the river; and the lower 47 km (29 mi) is located within the Capital District (Albany-Schenectady-Troy) area, the fourth largest metropolitan area in New York State. The river is also part of the New York State Barge Canal system. Proposals to modernize the system are under review. Studies are also underway to determine the feasibility of expanding the hydropower potential of the Mohawk River.

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 Mohawk River. In 1979, the DEC Region 4 Fisheries Unit began a study of the lower Mohawk River to better understand its fisheries potential and management needs. This report is the second of a series and summarizes fish distribution, abundance, and sport fishing quality of the Mohawk River from the Hudson River to Five Mile Dam. A previous report (McBride 1983) describes angler use and harvest. These findings and those from forthcoming reports (significant habitats, age and growth, food habits, and walleye and smallmouth bass tagging efforts) will be used to develop a Mohawk River fishery management plan.

EFFECTS OF ERIE AND BARGE CANAL CONSTRUCTION

The Mohawk River Valley has always been an important transportation corridor across eastern New York State. Opening of the Erie Canal in 1825 contributed significantly to the westward expansion of the United States throughout the East and Great Lakes region (Finch 1925; Drago 1972). In 1918, the Erie Canal was replaced by the Erie Barge Canal. Although the economic impacts of the two canal systems are well documented (Salmon 1951; Goodrich 1962; Miller 1962), few people are aware of their ecological consequences.

Prior to the construction of the Erie Canal, the Mohawk River watershed was geographically isolated from all other New York watersheds because of the 24 m (80 ft) high Cohoes Falls. It limited fish movement from the Hudson River to only the lower 5.5 km (3.4 mi) of the Mohawk River. However, completion of the Erie Canal and the Erie Barge Canal created a bypass around the falls resulting in a direct waterway link between the Hudson River and Great Lakes (Figure 1). Fish could now move east or west through the canal to establish populations in other watersheds or the Mohawk River itself. Fish moving west through the canal system include the sea lamprey, *Petromyzon marinus*, (Aron and Smith 1971), alewife, *Alosa pseudoharengus*

(Smith 1970), and white perch, Morone americana (Scott and Christie 1963). Fish moving eastward include smallmouth bass, Micropterus dolomieui (Hubbs and Baily 1938), and gizzard shad, Dorosoma cepedianum (George 1983). Significant anadromous and catadromous species using the Mohawk River are blueback herring, Alosa aestivalis, and American eel, Anguilla rostrata. An occasional striped bass, Morone saxatilis, have been reportedly caught by anglers.

Unlike the Erie Canal which was a landcut canal throughout its length, the Erie Barge Canal involved canalization of the Mohawk River and other natural water bodies. Canalization resulted in the obliteration of the succession of riffles, pools, and still waters that characterized the natural Mohawk River (Bishop 1935). Approximately 135 km (84 mi) of the 257 km (160 mi) river was changed from a free flowing stream to a series of permanent and seasonal impoundments. Water levels in these impoundments are regulated by both permanent and movable dams. The movable dams are composed of steel uprights and plates called gates. In the winter (December through April), the gates and uprights are entirely removed and the river upstream from Lock 8 becomes free flowing. The canalized river contains a 61 m (200 ft) wide x 4.3 m (14 ft) deep shipping channel. Maintenance dredging is required annually to maintain the shipping channel at its proper width and depth. Much of the dredged spoil is redeposited within the river outside the shipping channel in so-called wet dump areas.

STUDY AREA

When all dams are in place, the study section covers 2,806 hectares (6,934 acres) from Five Mile Dam downstream 123 km (76.3 mi) to its confluence with the Hudson River (Figure 2). This section encompasses the DEC Region 4 portion of the Mohawk River. The river has a total drainage area of 8,951 km^2 (3,456 mi^2) and a yearly average daily flow, measured at a gaging station below Cohoes Falls, of 161.5 cms (5,701 cfs). In 1980, the minimum and maximum flows recorded were 17 and 2,240 cms (604 and 79,100 cfs), respectively (USGS 1982). The 123 km (76.3 mi) of river contains 15 dams, nine locks, and three operational hydropower facilities. All but 10.3 km (6.4 mi) of the study length is canalized.

The river occupies the same channel as the barge canal in all but two sections. At Five Mile Dam, the Erie Barge Canal and Mohawk River separate for 7.1 km (4.4 mi) and rejoin about 0.2 km (0.1 mi) below Lock 16. This 7.1 km (4.4 mi) section of uncanalized river is a remnant of what the lower Mohawk River was prior to canalization and is characterized by numerous shallow pools and riffles. From Lock 16 downstream to Crescent Dam, the river consists of two permanent and eight seasonal impoundments (Table 1) ranging in size from 74 to 771 hectares (182 to 1,904 acres). The percentage of river bottom in each pool occupied by the shipping channel ranges from 12.1 to 45.3% (Table 1).

The Erie Barge Canal and Mohawk River separate for the second time at Crescent Dam (Figure 3). The canal drops 15.5 m (169 ft) in 3.7 km (2.3 mi) before entering the mouth of the Mohawk River. This 3.7 km (2.3 mi) land cut canal, which includes five locks and two guard gates, is called the Waterford Flight. During the navigation season, the mean monthly daily diversion to the Waterford Flight ranged from 2.9 to 3.9 cms (104 to 137 cfs). The remaining flows of the Mohawk River spills over Crescent Dam and/or passes through the Crescent Dam hydroelectric facility. A 4.9 m (16 ft) diversion dam, which creates a 32.4 hectare (80 acre) impoundment is located 1.4 km (0.8 mi) downstream from Crescent Dam. The Diversion Dam diverts all flows up to 246 cms (8,700 cfs) into the headrace or intake channel of the School Street hydropower station (Robert Fulton, Niagara Mohawk, personal communication) and is discharged below Cohoes Falls. When flows are less than 246 cms (8,700 cfs) which is much of time during the summer and fall, flows in the 1.3 km (0.8 mi) stretch of river from the Diversion Dam to Cohoes Falls is dependent upon leakage at the Diversion Dam which is minimal. Downstream 1.5 km (0.9 mi) from Cohoes Falls, the river is impounded by the 4.9 m (16 ft) Champlain Street Dam. Below the Champlain Street Dam, the Mohawk River splits into three branches before entering the Hudson River (Figure 3). From south to north, they are known as the Fifth, Third and Fourth Branch, respectively. There is a 2.1 and 2.7 m (7 and 9 ft) high dam on the Fourth Branch. The Hudson River floods the lower section of each branch due to the ponding effect from the Federal Dam at Troy located 1.0 km (0.6 mi) downstream of the Fifth Branch of the Mohawk River. The Fifth, Third, and Fourth Branches are flooded for a distance of approximately 0.7, 1.1, and 0.7 km (0.4, 0.7 and 0.4 mi), respectively. Above the flooded reach, the river is a broad expanse of exposed bedrock, shallow water, many riffles, and a few deeper pools (Bishop 1935).

Shindel (1969) classified the Mohawk River into three channel basin types based on shape and use. They are the natural river, the river canal, and the powerpool section. These three channel types are also appropriate in describing the primary habitat types.

The natural river section comprises a total of 10.3 km (6.4 mi) in the study area 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 Champlain Street Dam. The river canal section extends 76.3 km (47.4 mi) from Lock 8 to Lock 16. This section of river has been straightened and dredged to accommodate canal traffic. The dams at Locks 8-15 are movable and in place only during the navigation season which typically runs from May 1 through November 30. These dams are entirely removed during the winter and the river becomes free flowing. The 36.2 km (22.5 mi) power pool section extends from Lock 8 downstream to the Diversion Dam, Cohoes Falls to the Champlain Street Dam and the flooded stream sections at the mouth. These impoundments are permanent and flows are influenced by hydropower operation.

Recent summer water chemistry surveys (unpublished DEC Region 4 data) between 1979 and 1982 show that the lower Mohawk River is homothermous and moderately fertile. Total alkalinity, expressed as calcium carbonate, ranged from 85.5 to 119.7 ppm. The pH ranged from 7.6 to 8.8 Secchi disk transparency ranged from 0.6 to 1.2 m (2-4 ft). Dissolved oxygen (DO) levels ranged from 7.0 to 14.0 ppm at all depths in all pools sampled. However, late summer DO stratification in Crescent Lake and the Lock 7 Pool with DO values less than 5.0 ppm at depths greater than 3.0 m (10.0 ft) was reported in 1983 (C.T. Main, Inc. 1984).

HISTORICAL BACKGROUND

Water Quality

The Mohawk River has been well studied relative to pollution and water quality. At the turn of the century, considerable municipal and industrial pollution was reported in the vicinity of the cities and villages along the Mohawk (Anon 1952). Many tributaries were similarly polluted. No improvement was noted at the time of the 1934 biological survey (Faigenbaum 1935). Moore (1935) characterized the Barge Canal and uncanalized Mohawk River as grossly polluted. Untreated discharges of municipal and industrial wastes were still commonplace in 1951 (Anon 1952). By 1966-67, water quality had improved but discharges of untreated sanitary and industrial waste were still occurring (O'Conner 1968) and low dissolved oxygen levels were reported downstream of Schenectady. Implementation of a strong water pollution abatement program from 1966-1976 significantly reduced the pollution level of the Mohawk River (Anon 1976). By 1983, most gross industrial and domestic discharges have been controlled by construction of pollution control facilities funded in large measure by DEC's Pure Water Program. The primary exception is Cayadutta Creek which empties into the Mohawk River at Fonda and is considered to be one of the most polluted streams in the state. Its effect on the Mohawk River is curently being investigated (Dr. Edward Kuzia, DEC, personal communication). Analysis of fish collected from various locations on the Mohawk River in 1977 and 1980 indicate that environmental contaminants (i.e. PCB's, heavy metals, etc.) are present (NYSDEC 1978, 1981). Due to the adoption of the final actionable level of 2.0 ppm PCB's by the Federal Food and Drug Administration in May 1984, health advisories for the Mohawk River downstream of the Lock 7 Dam (Figure 2) are under consideration. Studies are currently underway to identify potential PCB sources and the extent of the problem.

Fish Stocking

Fish were first stocked in two sections of the lower Mohawk River in 1924: Crescent Dam to Lock 8 and Lock 14 to Lock 16. Stocking records show that at least 21.8 million walleye fry, 29,400 smallmouth bass fingerlings, 544 adult bullhead, 1,000 largemouth bass, and 29 crappie were stocked from 1924 to 1934.

Following the 1934 biological survey, the following stocking policies were formulated:

Section Location	SPECIES	NUMBER	SIZE
Crescent Dam - Lock 7	Walleye	800,000	Fry
	Largemouth bass	2,700	Fry
	Bullhead	80	Adult
Lock 7 - Schenectady County Line	Walleye	1,000,000	Fry
	Smallmouth bass	2,000	Fry
	Largemouth bass	500	Fry
	Bullhead	400	Fingerling
Schenectady County Line-Lock 10	Walleye	250,000	Fry
	Smallmouth bass	2,000	Fry
Lock 15 - Lock 16	Walleye	800,000	Fry
	Largemouth bass	2,700	Fry
	Bullhead	80	Adult

Stocking was terminated in 1947 in the section from Lock 7 to the Schenectady County line, in 1961 for the sections from the Schenectady County line to Lock 10 and Lock 15 to Lock 16, and in 1967 for the Crescent Dam to Lock 7 section. From the available stocking records, at least 35 million walleye, 7,000 largemouth bass, 640 bullhead, 3,000 smallmouth bass and 100 crappie were stocked from 1935 to 1967.

Beginning in 1980, approximately 18,000 hybrid tiger muskellunge (Esox lucius x E. masquinongy) fingerlings were stocked annually at the rate of 15 fish per hectare (6 fish per acre) in the 32.7 km (20.3 mi) section of river between Crescent Dam and Lock 8. The purpose of the stocking was to develop a trophy fishery for fish weighing more than 4.5 kg (10 lb) in the Capital District metropolitan area. No tiger musky fingerlings were produced in New York in 1983 so no stocking was possible; and none will be produced in 1984 due to hatchery reconstruction. The stocking program will be resumed in 1985 once production facilities at DEC's South Otselic fish hatchery are completed. Some legal (76.2 cm or 30 in) tiger muskies were caught in 1983.

Previous Fish Surveys

The first biological survey of the entire Mohawk River was in 1934 (Moore 1935) and established a landmark data base for fisheries information. Sampling downstream of Five Mile Dam was done primarily with 1.8, 3.7, 4.6, and 9.1 m (6, 12, 15, and 30 ft) seines but gill nets and fyke nets were also used. Net specifications other than seine lengths were not described. Seining was done at 56 locations but the number of seine hauls per site is unknown. Seine hauls were made in tributaries up to 1.6 km (1 mi) upstream of the Mohawk River. Gill and fyke nets were fished overnight at 27 and 10 locations, respectively. However, 19 of the 27 gill nets were fished in the 32.7 km (20.3 mi) section between Crescent Dam and Lock 8. Thus, only eight gill nets were fished in the remaining 90.3 km (56.0 mi) of river. Gill nets were fished at depths up to 9.1 m (30 ft). Fyke nets and seines were typically fished in water less than 0.9 m (3 ft) deep.

The 1934 survey (Bishop 1935) resulted in the capture of 48 species of fish (Table 2) from the lower Mohawk River. Walleye were the predominant game species followed by largemouth bass and smallmouth bass. Only three chain pickerel were recorded. Brown bullhead, pumpkinseed, rock bass, and yellow perch were the predominant Mohawk River panfish. Other panfish species collected were black crappie, white crappie, white perch, and yellow bullhead. The remaining 36 species collected included suckers, carp, herring, alewife, and a variety of minnows and darters. The overall fishing quality in the Mohawk River during 1934 was probably poor due to pollution impacts. According to Bishop (1935) fishing for game species (including panfish) throughout the greater length of the river was largely limited to the aerated fast water below the dams.

The next fisheries survey in the lower river was carried out in 1970 and 1971 by the DEC Region 4 Fisheries Unit. Its purpose was to update information on the quality of the sport fishery between Crescent Dam and Lock 16 (Figure 2). Fish sampling was done with a 220 v DC electrofishing boat powered by a 1000 watt generator. Fish collections in June, 1970 and 1971, included 26 species (Table 2). Smallmouth bass were the predominant game species encountered throughout the lower river. Walleye and largemouth bass were also collected. Largemouth bass appeared to be more common between Crescent Dam and Lock 12 while walleye were more common between Lock 12 and Lock 16. Brown bullhead, pumpkinseed, and rock bass were the most common Mohawk River panfish. Bluegill, black crappie, and yellow perch were also collected. The remaining 17 species included minnows, suckers, carp and herring. As a result of the surveys, it was recommended that the special fishing regulations (no season, size, or creel limits) then in effect for the Mohawk River downstream of Canajoharie (Figure 2) be changed to conform to the general statewide fishing regulations. This recommendation became effective in 1976.

Fish Salvage

From 1945 to 1962, the New York State Conservation Department, now known as the New York State Department of Environmental Conservation, conducted a statewide fish salvage program. During the 18 year program, the lower Mohawk River was frequently netted as a source of fish for transfer elsewhere. Fish were removed from waters where they were considered over abundant or unavailable for public fishing. Game and panfish species were transferred to other waters, particularly park ponds; and some fish, such as carp, were destroyed. In 1959 and 1962, fish salvage records show that a total of 282,509 fish weighing 57,856 kg (127,436 lb) were removed from the Crescent Dam to Lock 7 section of the river. Bullhead (73%) and crappie (12%) represented 85% of the total fish removed.

Weed Control

From 1946 to 1976, the New York State Conservation Department conducted a water chestnut (Trapa natans) eradication program on the Mohawk River and other infested New York waters. According to Muenscher (1935), water chestnut infestations totaling 405 to 486 hectares (1,000 to 1,200 acres) were limited to the Mohawk River, primarily between Crescent Dam and Lock 7. By 1952, the known infestations had spread to about 1,376 hectares (3,400 acres) in the Mohawk and Hudson Rivers (Wich 1968) and infestations had spread throughout the lower Mohawk River. Control efforts using handpicking and spraying of the herbicide 2,4-D (2,4-Dichlorophenoxyacetic acid) at a rate of 8.9 kg acid equivalent of active ingredient per hectare had reduced total infestations to about 546 hectares (1,350 acres) in the Hudson-Mohawk system by 1976.

In the Mohawk River, control efforts had reduced known water chestnut infestations to 308 hectares (761 acres) by 1966 and 170 hectares (420 acres) by 1976. The eradication program was terminated statewide in 1976 when continued use of 2,4-D at the rate needed for water chestnut control was not permitted by 2,4-D label restrictions. Hand pulling alone was not considered an economically feasible solution. Observations since termination of the water chestnut control program indicate that the extent of infestations in the Mohawk River had increased substantially. Although the extent of increase is unknown, many areas have become heavily infested that were weed free or controllable by handpulling in the past.

Angler Use

Presently, the lower Mohawk River provides a popular, high quality warmwater fishery. In 1982, a creel survey was conducted on the 109 km (67.7 mi) reach of Mohawk River from Crescent Dam upstream to Lock 16 (McBride 1983). An estimated 115,245 anglers fished the Mohawk River between May 1 and October 31, 1982 for 389,033 hours or 155.2 hours per hectare (62.7 hours/acre). Shore and boat anglers fished an estimated 160,979 hours (64.2 hours per hectare or 26.0 hours per acre) and 228,054 hours (91.0 hours per hectare or 36.8 hours per acre), respectively. No other large warmwater system in New York is known to support fishing pressure exceeding the 155.2 hours per hectare (62.7 hours per acre) recorded from the lower Mohawk River. Shore and boat anglers each caught (creeled and released) about 0.9 fish per hour; however, shore anglers creeled 0.29 fish per hour compared to 0.15 fish per hour for boat anglers. The estimated harvest was 77,626 fish (31.0 fish per hectare or 12.5 fish per acre) weighing 25,953 kg (10.4 kg per hectare or 9.2 lb per acre). Smallmouth bass were the most frequently harvested fish followed by rock bass, bullhead, yellow perch, and walleye. The harvest of 9.6 smallmouth bass per hectare (3.9 fish per acre) was the highest recorded for a New York water with a 12 in (30.5 cm) size limit (McBride 1983).

METHODS

Fish populations in the Mohawk River from the Hudson River to Five Mile Dam 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. Oneida Lake trap nets, of either 12.7 or 19.1 mm (½ or 3/4 in) bar measure nylon mesh, were fished for 51.4 net nights. Swedish multifilament gill nets were fished for 55 net nights. Each gill net was 45.7 m (150 ft) long, 1.5 m (5.0 ft) deep and contained six 7.6 m (25 ft) panels of 38, 51, 57, 64, 76, and 89 mm (1½, 2, 2¼, 2½, 3 and 3½ in) stretch mesh.

Electofishing was conducted for a total of 25.1 hours along sections of the shoreline on both sides of the river. Except for 2.3 hours, all electrofishing was done with a 220v DC electrofishing boat powered by a 3500 watt generator. A car top electrofishing boat with a 220v AC, 500 watt generator was used in areas that were inaccessible to the larger boat for the remaining 2.3 hours. Fifty-three seine hauls were made with a 22.9 m (75 ft) bag seine with 6.4 mm (1/4 in) bar measure nylon mesh. Sixteen trawl hauls were made with either a 3.9 or 7.6 m (16 or 25 ft) otter trawl with a 3.2 mm (1/8 in) bar mesh cod end. Additional trawling was not done because of the rocky substrate which resulted in extensive net damage. Total sampling effort by pool for all gear types is summarized in Table 3.

In 1982 and 1983, all fish except blueback herring taken by trap net were individually measured for total length to the nearest 0.1 in (2.5 mm) and generally weighed to the nearest ounce (28 g). Some fish were weighed to the nearest 0.01 lb (0.4 g). Trap net catches of blueback herring were counted and individual measurements were often made on a subsample because of large catches. Scale samples were taken from 10 fish per 2.5 cm (1.0 in) group for game and panfish species, suckers, common carp, and from 25 to 30 blueback herring per pool. Prior to 1982, data on size and scale samples were collected differently for non-game fish species. Panfish of each species were separated into "desirable" and "undesirable" size categories, counted, and weighed collectively. Crappie, yellow perch, bullhead, white perch, and white bass over 20.3 cm (8.0 in) and bluegill, pumpkinseed, and rock bass over 16.5 cm (6.5 in) were considered to be a size desirable to anglers. Scale samples were taken from six fish per inch (2.5 cm) group of each panfish species. All other fish were counted and weighed collectively by species.

Fishes collected by bag seine and trawls were counted separately by species except when large catches necessitated estimation within species groups. Lengths, weights, and scale samples were not routinely taken. Seining and trawling efforts were primarily used to identify potential significant habitats and to collect minnows and other small fish species generally not susceptible to capture by trap net, gill net, and electrofishing.

Five indices were used, based on June sampling with trap net, electrofishing, and gill net only, to assess the quality of the sport fishery in the lower Mohawk River: non-game fish/game fish biomass ratio, electrofishing catch rates, percentage "desirable size" panfish, growth rates and proportional stock density (PSD). In this report, PSD was calculated for game species only using the methodology and size boundaries recommended by Anderson (1980).

RESULTS AND DISCUSSION

Fifty-six fish species have been recorded from the lower Mohawk River in recent years compared to 48 in the 1934 survey (Table 2). Forty-nine species were collected during the 1979-1983 fisheries survey; four additional species from an ongoing significant habitat study which included the flooded mouth and lower 61 m (200 ft) of stream in selected tributaries, and three species found by other fisheries scientists (Dr. Carl George, Union College; Dr. Lavett Smith; American Museum of Natural History; Dr. Thomas Tatham, C. T. Main, personal communication). Twelve species collected in recent years have not been previously recorded, and six species collected in 1934 were not found during recent sampling efforts.

Fish Species Changes since 1934

The 12 fish species not previously collected included American shad, brindled madtom, brown trout, central stone-roller, channel catfish, gizzard shad, northern pike, red-breast sunfish, striped bass, tiger musky, white bass and white catfish. American shad is an anadromous species that enters the Mohawk River from the Hudson River where they are abundant (McFadden 1973). At least one juvenile American shad was collected by a consultant group at Lock 7 in 1983; however, none were collected in a similar study by the same group at Crescent Dam in 1982 (Dr. Thomas Tatham, C.T. Main, personal communication). It is likely that the American shad occurs infrequently although it is possible that we are observing in the Mohawk the beginning of a developing shad run. It is believed that the brindled madtom, central stoneroller, gizzard shad, and white bass are moving or have moved eastward through the Erie Barge Canal since they were captured previously in adjacent watersheds to the west. During the 1927 biological survey of the Oswego River System, brindled madtom and white bass were collected in Oneida Lake or its tributaries; the central stoneroller and gizzard shad were collected from the Clyde River in Wayne County (Greeley 1928). Although northern pike were not collected in the 1934 survey, they were considered present but rare (Bishop 1935). Northern pike are still rare. Tiger muskies are present as a result of a stocking program to develop a trophy sport fishery in Crescent Lake and the Lock 7 Pool. Brown trout were collected in three tributaries (Evas Kill, Knauderack Creek, and Zimmerman Creek) at or near their confluence with the Mohawk River. Improved water quality apparently has resulted in a downstream extension of the trout inhabited zones in some streams. The remaining four species - striped bass, redbreast sunfish, channel catfish, and white catfish - are common or abundant in the Hudson River and/or Champlain Barge Canal (McFadden 1973; Makarewicz 1983) which accounts for their presence in the mouth of the Mohawk. It appears that only an occasional striped bass moves upriver via the Waterford Flight.

No bluegills were collected during the 1934 survey; however, they had become established by the late 1950's. Bluegill were the fifth most abundant species removed during the 1959 and 1962 fish salvage operations. They are currently common to abundant in the power pool impoundments but sparse in the remainder of the river. Bluegills may have moved eastward or westward through the Erie Barge Canal because they were collected in adjacent watersheds during 1927 and 1934 biological surveys (Greeley 1928, 1935); or existing populations may be a result of widespread stocking throughout New York in the 1950's.

Alewife (two specimens) were collected only in the mouth of the Mohawk River. In 1934, alewives were considered to be more abundant than blueback herring in Crescent Lake which reportedly supported landlocked populations (Greeley 1935; Bishop 1935). Although anadromous alewives are abundant in the Hudson River (McFadden 1973), they apparently do not migrate through the Waterford Flight into the Mohawk River above Crescent Dam.

The reason for the disappearance of landlocked alewife populations is not known. The absence of a significant run of anadromous alewife into the lower Mohawk may be a result of delayed opening of the Erie Barge Canal. Currently, the barge canal becomes operational around May 1. Past operating records show that the Erie Barge Canal typically opened mid-April and occasionally as early as April 1. Since alewives spawn earlier than blueback herring (Scott and Crossman 1973), the two to four week delay may be enough to prevent a significant anadromous run of alewife into the Mohawk River. It could also be that alewives do not migrate upstream of the Troy Dam in the Hudson River in significant numbers because Makarewicz (1983) collected numerous blueback herring but no alewives in areas of the Hudson above the dam. The Troy Dam lock traditionally opens up a week earlier than the State's Barge Canal system.

The six species of fish collected in 1934 but not during the current survey include brook silverside, brook stickleback, hornyhead chub, lake chub, longnose sucker, and tadpole madtom. All of these species except the longnose sucker were considered rare in 1934 (Greeley 1935). Of the six species, only brook stickleback have been recently collected in the lower Mohawk River drainage. The author has collected brook stickleback in the Poentic Kill approximately 1.8 km (1.1 mi) upstream of the Mohawk River. Longnose sucker and tadpole madtom have been collected from the Mohawk River upstream of Five Mile Dam (Jack Hasse, DEC, personal communication) and are probably present but rare in the lower Mohawk River. The brook silverside, hornyhead chub, and lake chub have not been recently found anywhere in the Mohawk River watershed (Jack Hasse, DEC; Dr. Lavett Smith, American Museum of Natural History; and Dr. Carl George, Union College, personal communication).

Current Relative Species Abundance

During the June sampling with electrofishing gear, gill net and trap net, blueback herring were the most abundant fish collected from the lower Mohawk River followed by smallmouth bass, white sucker, yellow perch, brown bullhead, and rock bass. Numerically, game species represent 12.1% of the total fish collected compared to 25.4% for panfish and 62.6% for all others. Total gill net, electrofishing, and trap net collections are summarized by pool in Table 4.

The most numerous species collected by seine (Table 5) were young-of-year blueback herring, emerald shiner, spottail shiner, and bluntnose minnow. In trawl collections (Table 6) young-of-year blueback herring, spottail shiner, and trout perch were the most numerous species taken.

Game Fishes

The smallmouth bass is the dominant piscivore in the Mohawk River and was the second most abundant species collected. Electrofishing catch rates ranged from 17.3 fish per hour in Crescent Lake to 155.1 fish per hour in the Lock 10 Pool (Table 7) and averaged 70.7 fish per hour for the entire lower river. Except for the Lock 15 Pool, smallmouth bass catch rates were highest in the seasonal impoundments of the river canal section. The electrofishing catch rates of smallmouth bass (Table 7) were very high and indicative of a dense population. Comparable data for other New York warmwater rivers are not available. However, spring electrofishing catch rates for 8 New York lakes surveyed by Green (1984) from 1978 to 1980 averaged 8.9 smallmouth bass per hour with individual collections ranging up to 43.2 smallmouth bass per hour.

Variability in bass abundance between pools as reflected by electrofishing catch rates is likely related to such factors as habitat and forage availability. Behavioral characteristics may also be involved and there may be distinct populations between pools. Smallmouth bass inhabiting rivers appear to occupy distinct home areas (Paragamian and Cole 1975). Similar home areas are reported in lakes (Pflug and Pauley 1983; Forney

1961). Tagging studies would be needed to determine whether such strong territorial behavior is exhibited by smallmouth bass in the Mohawk River.

Walleye are common throughout the Mohawk River but far less abundant than smallmouth bass. They were about 12% as abundant as smallmouth bass in June fish collections. Anglers catch one walleye for every 20-25 smallmouth bass caught (McBride 1983). Gill net catch rates range from 0 to 3.6 fish per net (Table 8) and averaged 1.5 compared to 7.5 fish per net recorded for Oneida Lake (Dr. John Forney, Cornell University, personal communication) which is considered New York's premier walleye fishery. Electrofishing (Table 7) and trap net (Table 9) catch rates were highest in the Lock 11 Pool but catch rates for all gear types (Tables 7-9) indicate that walleye abundance between all other pools, were similar. In the natural river section between Five Mile Dam and Lock 16, walleye slightly outnumbered smallmouth bass in the fish collections (Table 4). Fish collections suggest that walleye are not abundant in the lower Mohawk River. This is supported by the low angler catch rates of 0.02-0.03 fish per hour (McBride 1983).

Electrofishing data (Table 7) indicate that largemouth bass are rare throughout much of the river. They are most abundant in Crescent Lake, declining in numbers both upriver and downriver. Similar electrofishing catch rates of largemouth and smallmouth bass in Crescent Lake indicate the two species are co-dominant in this area (Table 7).

Panfishes

Pumpkinseed, bluegill, white perch, black crappie, yellow perch, and white crappie are abundant in the power pool impoundments. Rock bass, brown bullhead, and yellow perch are the most abundant panfish species in the river canal pools.

More panfish species were present in the four permanent power pool impoundments than in other areas of the river. Power pools contained an average of 10 species compared to six species in the river canal pools. Density of panfish populations was also higher in the power pools than in the river canal section. Total catch rate by gear type was typically higher in the four permanent impoundments than that found in the Lock 8-15 Pools (Tables 7-9).

Other Fish

Adult blueback herring are the most abundant species in all areas of the lower Mohawk River during the June sampling period; however, their abundance is seasonal. They migrate annually into the Mohawk River from the Atlantic Ocean in late spring and early summer. The upstream limit of herring runs into the Mohawk River recorded to date is Nine Mile Creek near Marcy, New York which is approximately 179 km (111 mi) upstream of the Mohawk's confluence with the Hudson River (Jack Hasse, DEC, personal communication). Spawning apparently occurs in tributaries and below dams throughout the lower river during May and June. Spent fish surviving spawning, typically return to sea shortly after spawning (Scott and Crossman 1973); however, some adult blueback herring have been observed by the author in the Mohawk River as late as November 5.

Herring eggs hatch in two to three days at temperatures of 72-75°F (Scott and Crossman 1973). Typically juvenile herring grow rapidly and return to sea about a month after hatching (Scott and Crossman 1973) when they attain lengths of 30 to 50 mm (1.2-2.0 in); however, peak outmigration in the Mohawk River occurs in the fall. In 1982, peak outmigration occurred in November (Dr. Thomas Tatham, C. T. MAIN, personal communication) and has been observed in the Waterford Flight as late as December (William Rohr, Dept. of Transportation, personal communication). During their freshwater residency, juvenile herring appear to prefer vegetated areas and can attain lengths approaching 102 mm (4.0 in) by the time of their fall outmigration. To date, there is no evidence of a landlocked form of blueback herring in the Mohawk River.

The annual influx of blueback herring is believed to be largely responsible for the abundance of piscivores in the lower Mohawk River. Since annual mortalities of adult clupeids (herring and/or alewives) is high, ranging from 30 to 90% and varying significantly among river systems (Richkus and DiNardo 1984), decomposition of the carcasses of dead spawners may contribute to nutrient levels in the lower Mohawk River. The carcasses also serve as an additional food source for benthic invertebrates, including crayfish, and enhance benthic production. Although the large size of adult bluebacks (mean length of 500 fish was 27.7 cm or 10.9 in) makes them relatively unavailable as forage for most piscivores, juvenile herring contribute greatly to the forage base. Food habit studies conducted in 1983 indicate that juvenile herring are preyed upon by smallmouth bass, largemouth bass, walleye, and yellow perch (unpublished DEC Region 4 data). Juvenile herring may buffer smallmouth bass eggs and fry against panfish depredation. Kesler (1974) implies that juvenile anadromous alewives increased survival of young of the year largemouth bass because of reduced predation by bluegills at the egg, fry, and fingerling stage.

Historical Changes in Fish Community Structure

Gill net collections in 1934 and during the current study indicate that major changes have occurred in the community structure of the fish population in the lower Mohawk River. Abundance of game and panfish species has increased significantly since 1934 and is believed largely due to improvement in dissolved oxygen levels associated with overall improvement in water quality. These differences were analyzed by segment because sampling effort in 1934 was more intense between Crescent Dam and Lock 8. Nineteen of the 27 gill net sets in 1934 were between Crescent Dam and Lock 8 compared to only eight sets throughout the remaining study section.

In the Crescent Dam to Lock 8 reach, the relative abundance of game species remained fairly constant between 1934 and 1980 while panfish populations increased and the other fishes declined (Table 10). Although the percentage of game species in the catch remained relatively constant, 6.9% in 1934 compared to 7.3% in 1979-80, a major shift between walleye and smallmouth bass occurred. Walleye declined from 6.4 to 1.9% of the fishes collected while smallmouth bass increased from 0.3 to 5.3% (Table 10). The reason for the decline in walleye abundance is unknown. Relative abundance of panfishes increased from 31.4% to 42.4% of the fishes collected while other fish declined from 61.8 to 50.3% (Table 10). Pumpkinseed, rock bass, white perch, and yellow bullhead showed major gains while brown bullhead showed a major decline. Blueback herring, common carp, and shorthead redhorse showed major gains while alewife, golden shiner and white sucker showed major declines (Table 10).

Only major changes in the community structure upstream of Lock 8 were identified because of the small sample size in 1934. Game species increased from 7.9 to 13.0% of the fishes collected while panfish increased from 2.1 to 23.4%, and the other fish category declined from 89.9% to 63.5% (Table 11).

Differences in Fish Community Structure by Habitat Type

The June sampling data suggest major differences in fish communities in permanent impoundments of the power pool section and the seasonal impoundments of the river canal section. Comparisons of the relative percentage of the three categories -- game fishes, panfishes, 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. Panfish and game species represented 35.9 and 5.2% respectively, of the fish collected in the four permanent power pool impoundments studied compared to 13.0 and 19.8% in the eight seasonal river canal impoundments (Table 12). This shift is even more apparent when only resident species were examined and the anadromous blueback herring excluded. In the power pool impoundments, game and panfish species represented 9.4 and 65.2% of the fishes collected compared to 36.3 and 23.8% in the river canal impoundments (Table 12). In the uncanalized river between Five Mile Dam and Lock 16, game species outnumber panfish 13.3 to 1.

Seasonal water level fluctuations that increase water velocities in the river canal section may be responsible for the differences observed in fish community structure in the power pools and river canal impoundments. Extreme water level fluctuations, ranging from 0.3 to 4.9 m (1 to 16 ft), occur in the Lock 8-15 pools because of the removal or installation of the movable dams. This is contrasted to the relatively stable water levels in the permanent impoundments which varies from 0 to 0.7 m (2.3 ft) due to the removal of flashboards from Crescent Dam and the Lock 7 Dam. The winter drawdown results in increased water velocities and significant dewatering of shallow water areas in the river canal section.

Fish Population Quality

The lower Mohawk River supports abundant populations of warm and cool water fish species. Five indices were used to assess the quality of the sport fish populations and results demonstrate that the river supports a high quality fishery.

The non-game/game fish biomass ratio of fish collected in June ranged from 18.0/1 to 2.0/1 with the permanent impoundments of the power pool section having the higher or less favorable ratios (Table 13). A low non-game/game fish biomass ratio generally indicates a high quality fishery. Other DEC Region 4 waters with non-game/game fish biomass ratios ranging from 2.7/1 to 6.2/1 support good sport fisheries.

The electrofishing catch rate of legal (12 inches or larger) smallmouth bass ranged from 3.1 to 52.8 fish per hour (Table 13) and averaged 17.3 fish per hour for the entire lower river. Spring electofishing catch rates for 8 New York lakes surveyed by Green (1984) from 1978 to 1980 averaged 2.2 legal smallmouth bass per hour with individual collections ranging up to 12.1 legal smallmouth bass per hour. Catch rates above 10 legal fish per hour are considered very good for New York waters (Dr. David Green, Cornell University, personal communication). Catch rates of legal bass in the Mohawk River were 2.2 to 40.6 times higher in the river canal impoundments compared to the power pool impoundments. Catch rates peaked in the Lock 11 Pool and then declined rapidly upstream of Lock 11. The high percentage of legal bass in the catch when combined with the very high electrofishing catch rates for all size bass indicates that the lower Mohawk River supports a very abundant and high quality smallmouth bass population.

Proportional stock density (PSD) of largemouth bass was 59.5% in Crescent Lake. Sample size of largemouth bass in the remaining pools, walleyes in all pools, and smallmouth bass below Crescent Dam were too small to calculate meaningful PSD's. Smallmouth bass PSD's upstream of Crescent Dam (Figure 2) ranged from 17.1 to 84.4% (Table 13) and averaged 46.2% in the lower Mohawk River. On the basis of modeling studies, Anderson and Weithman (1978) suggest that smallmouth bass exhibit satisfactory or favorable size structure, i.e. balance, when PSD is near or within a range of 30 to 60%. PSD's of 45-65% may be adequate for largemouth bass. Seven of the 12 pools surveyed had smallmouth bass PSD's within the desirable range. The length frequency distribution of smallmouth bass are summarized by pool in Table 14.

Diary cooperators on the Mohawk River in 1982 averaged 1.32 smallmouth bass (all sizes) and 0.64 legal (30.5 cm+) fish per hour (unpublished data, DEC, Region 4). The mean size of all bass and legal bass caught was 30.0 cm (11.8 in) and 34.3 cm (13.5 in), respectively. In the St. Lawrence River, which has long been recognized as one of the premiere smallmouth bass fisheries in New York, diary cooperators from 1978 to 1980 recorded catch rates only half as high as that found in the lower Mohawk River in 1982. St. Lawrence River catch rates for legal smallmouth bass was about 0.3 fish per hour and the mean size was about 35 cm (Green 1984). The catch per hour for bass of all sizes was about 0.5 fish per hour and they averaged 31 cm (12.2 in). Thus, the smallmouth bass fishery in the lower Mohawk River must be ranked among the best in New York.

Preliminary age and growth information for game and panfish species from Crescent Lake (Table 15) and the Lock 9 Pool (Table 16) indicate that Mohawk River fish grow rapidly. Bass begin attaining legal size (12 in or 30.5 cm) during their fourth summer at age 3+ and all bass attain legal size by age 4+. Walleyes attain legal size (15 in or 38.1 cm) at age 2+. Panfish typically attain desirable size at age 2+ or 3+.

Almost two thirds (65.4%) of all panfish collected were of desirable size. The percentage of desirable size panfish is high in all pools (Table 13) and considered excellent. Other Region 4 waters supporting high quality panfish fisheries include Tomhannock and Watervliet Reservoirs. The percentage of desirable size panfish in Tomhannock Reservoir (Elliot 1970) and W-tervliet Reservoir (McBride 1978) was 43.4% and 78.2%, respectively.

CONCLUSIONS

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 as evidenced by the presence of 12 new species and the apparent disappearance of six species since the 1934 biological survey. Because the State's barge canal sysem provides a direct waterway link between several New York watersheds, further species addition to the Mohawk River are likely. Development of the Mohawk River fishery management plan will outline future management directions including survey and study needs.

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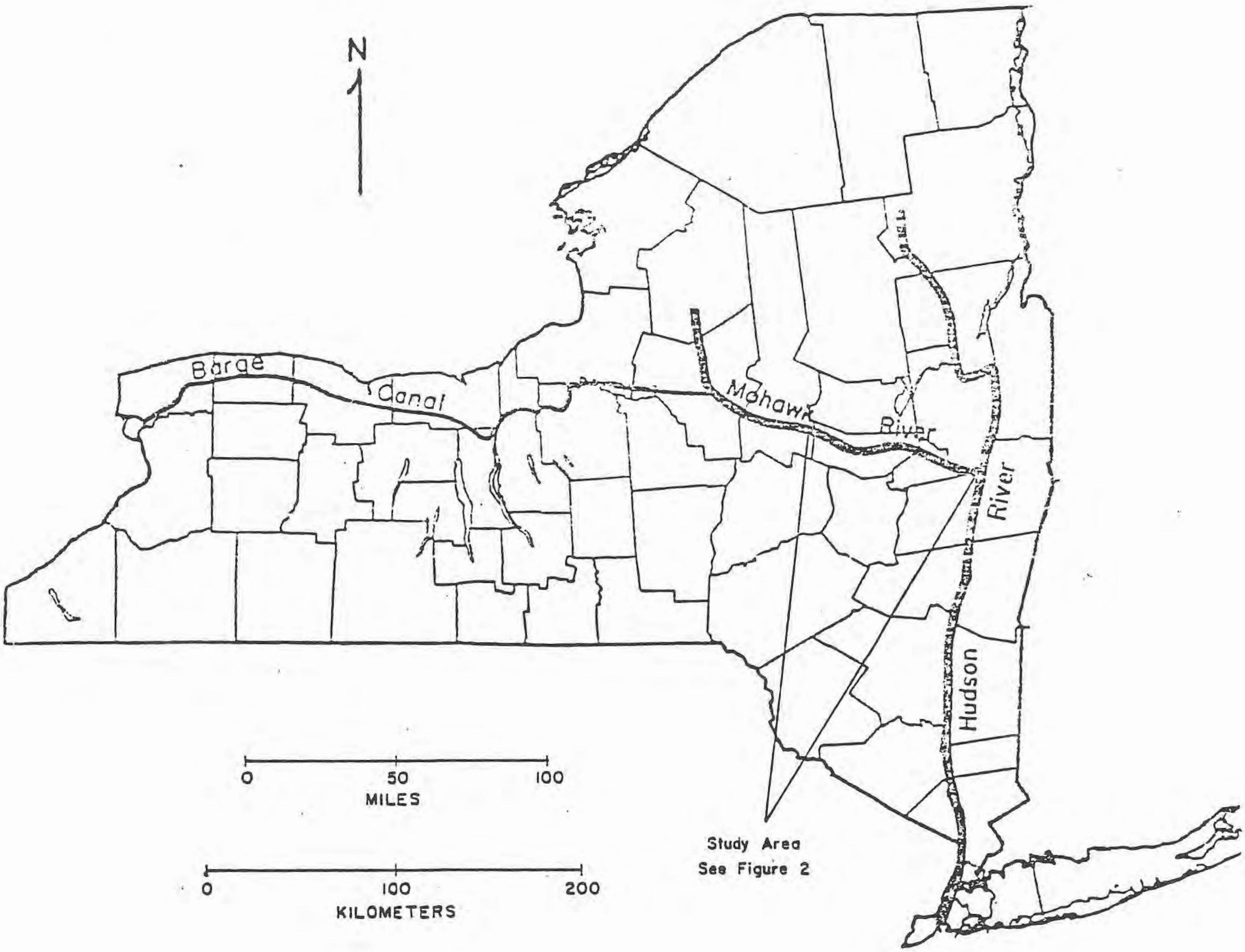

Figure 1: New York State showing the Hudson River, Mohawk River and Barge Canal.

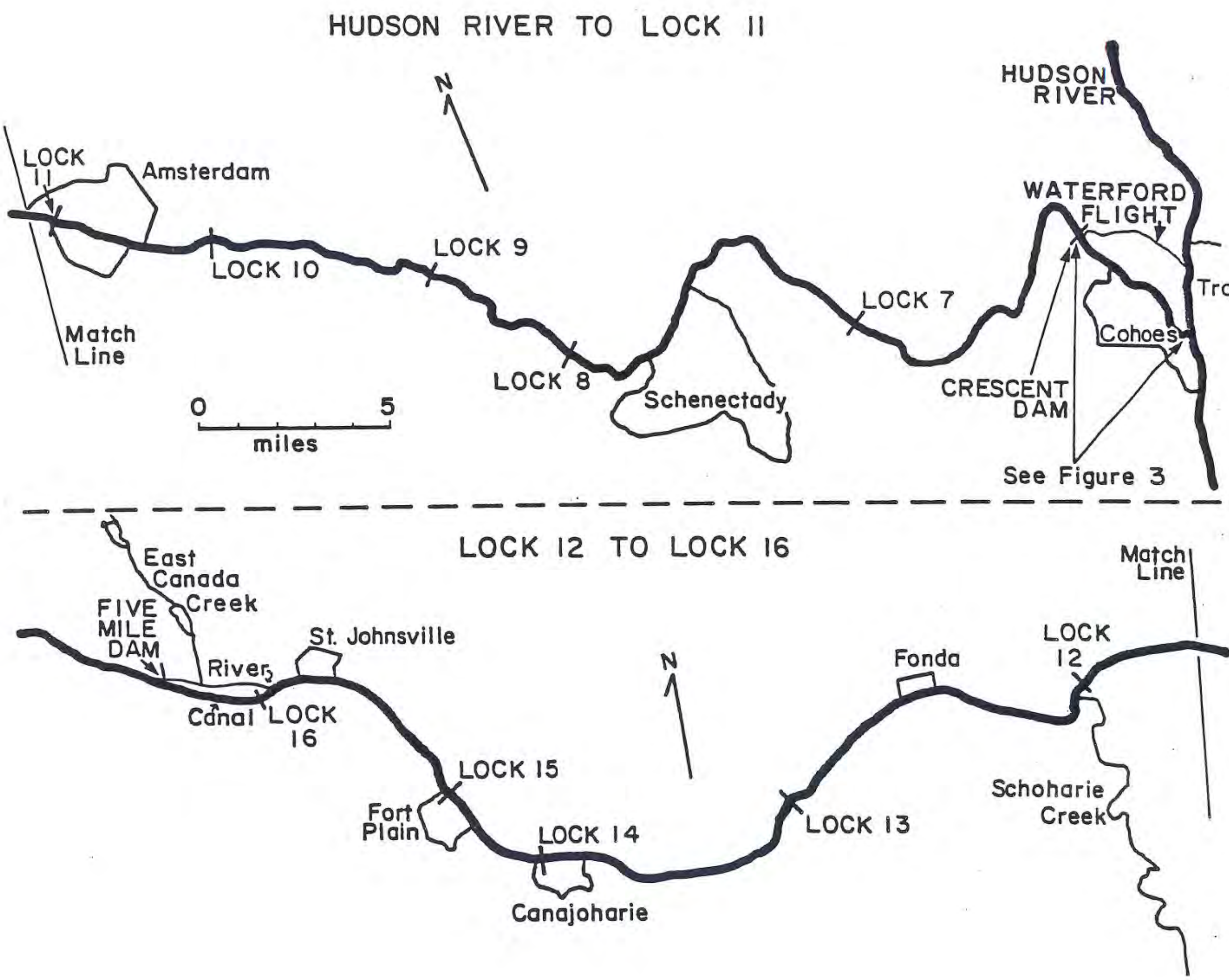

Figure 2: The lower Mohawk River from Five Mile Dam to the Hudson River.

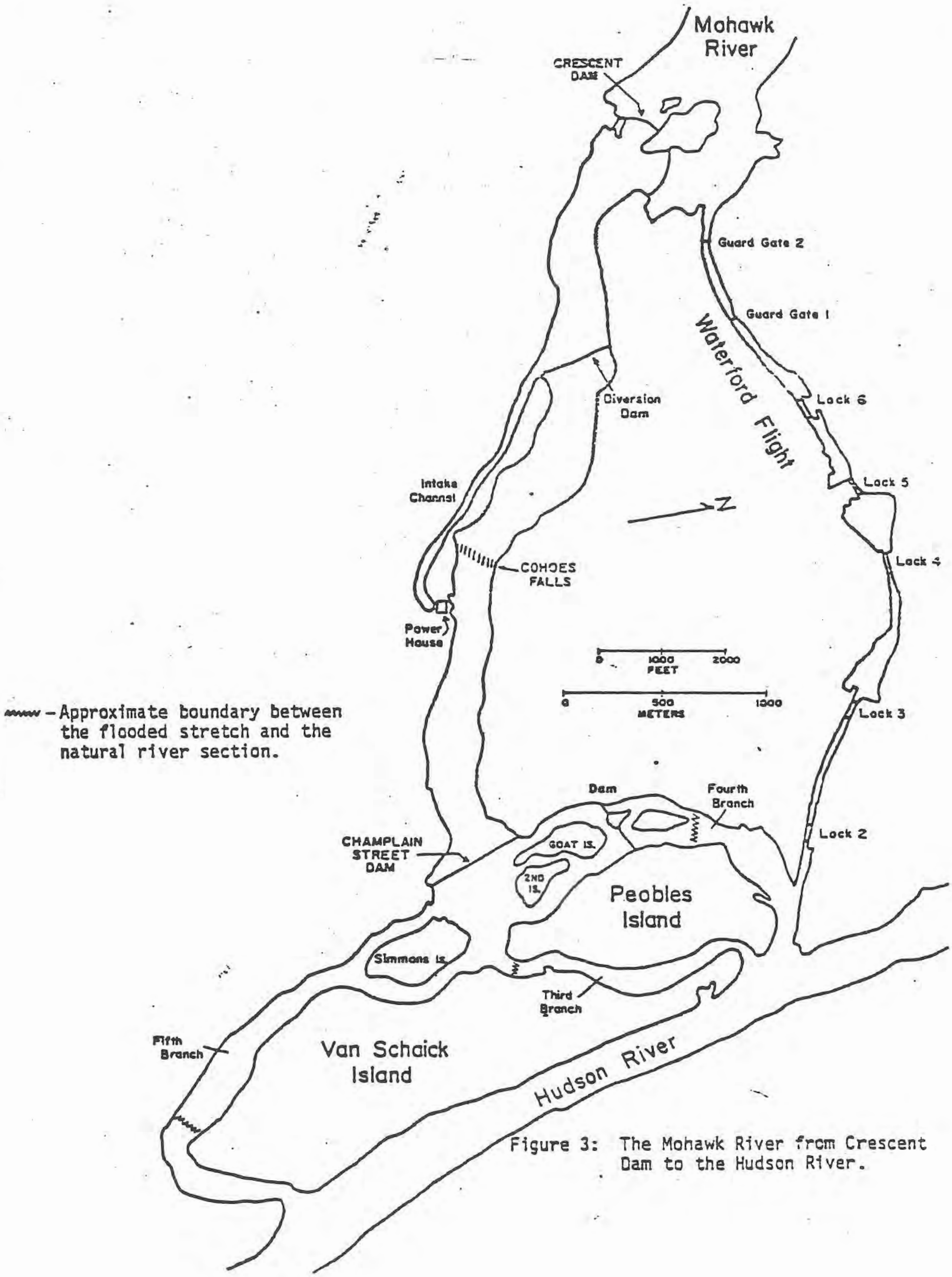

Figure 3: The Mohawk River from Crescent Dam to the Hudson River.

Table 1: Summary of physical characteristics of pools on the Mohawk River from its confluence with the Hudson River to Five Mile Dam

Name	Location Description	Habitat Type[1/]	Acres	Length (miles)	Mean Width (ft)	% Shipping Channel
Mouth	Hudson River to Champlain Street Dam	NRS/PPS	252	1.7	1,223	3.6
Champlain St. Pool	Champlain Street Dam to Cohoes Falls	PPS	92	0.9	843	0
Cohoes Falls Pool	Cohoes Falls to Diversion Dam	NRS	82	0.8	846	0
School Street Pool	Diversion Dam to Crescent Dam	PPS	80	0.8	825	0
Crescent Lake	Crescent Dam to Lock 7	PPS	1,904	9.5	1,653	12.1
Lock 7 Pool	Lock 7 to Lock 8	PPS	1,072	10.8	819	24.4
Lock 8 Pool	Lock 8 to Lock 9	RCS	337	4.8	579	34.5
Lock 9 Pool	Lock 9 to Lock 10	RCS	438	6.2	583	34.3
Lock 10 Pool	Lock 10 to Lock 11	RCS	378	4.1	761	26.3
Lock 11 Pool	Lock 11 to Lock 12	RCS	444	4.6	796	25.1
Lock 12 Pool	Lock 12 to Lock 13	RCS	614	9.7	522	38.2
Lock 13 Pool	Lock 13 to Lock 14	RCS	445	7.9	465	43.0
Lock 14 Pool	Lock 14 to Lock 15	RCS	182	3.4	442	45.3
Lock 15 Pool	Lock 15 to Lock 16	RCS	388	6.7	478	41.9
Lock 16 to Five Mile Dam		NRS	226	4.4	424	0
			6,934	76.3		

1/ Key to habitat type

NRS - Natural river section, PPS - Power pool section, RCS - River canal section

Table 2: Common and scientific names of fishes collected in the Mohawk River from its confluence with the Hudson River to Five Mile Dam

		1934	1970-1971	1979-1983
FRESHWATER EELS				
American eel	*Anguilla rostrata*	x	x	x
HERRINGS				
Blueback herring	*Alosa aestivalis*	x	x	x
Alewife	*Alosa pseudoharengus*	x		x
American shad	*Alosa sapidissima*			x 1/
Gizzard shad	*Dorosoma cepedianum*			x
TROUTS				
Brown trout	*Salmo trutta*			x 2/
MUDMINNOWS				
Central mudminnow	*Umbra limi*	x		x 1/
PIKES				
Northern pike	*Esox lucius*			x
Tiger Muskellunge	*Esox lucius* x *E. masquinongy*			x
Chain pickerel	*Esox niger*	x		x
MINNOWS AND CARPS				
Central stoneroller	*Campostoma anomalum*			x
Goldfish	*Carassius auratus*	x	x	x
Lake chub	*Couesius plumbeus*	x		
Common carp	*Cyprinus carpio*	x	x	x
Cutlips minnow	*Exoglossum maxillingua*	x		x
Eastern silvery minnow	*Hybognathus regius*	x		x
Hornyhead chub	*Nocomis biguttatus*	x		
Golden shiner	*Notemigonus crysoleucas*	x	x	x
Satinfin shiner	*Notropis analostanus*	x	x	x
Emerald shiner	*Notropis atherinoides*	x	x	x
Common shiner	*Notropis cornutus*	x	x	x
Spottail shiner	*Notropis hudsonius*	x	x	x
Rosyface shiner	*Notropis rubellus*	x		x
Spotfin shiner	*Notropis spilopterus*	x		x
Bluntnose minnow	*Pimephales notatus*	x	x	x
Fathead minnow	*Pimephales promelas*	x	x	x
Blacknose dace	*Rhinichthys atratulus*	x		x 2/
Longnose dace	*Rhinichthys cataractae*			x 2/
Creek chub	*Semotilus atromaculatus*	x		x
Fallfish	*Semotilus corporalis*	x	x	x

Table 2: Cont'd.

		1934	1970-1971	1979-1983
SUCKERS				
Longnose sucker	*Catostomus catostomus*	x		
White sucker	*Catostomus commersoni*	x	x	x
Northern hog sucker	*Hypentilium nigricans*	x	x	x
Shorthead redhorse	*Moxostoma macrolepidotum*	x	x	x
FRESHWATER CATFISHES				
White catfish	*Ictalurus catus*			x
Yellow bullhead	*Ictalurus natalis*	x		x
Brown bullhead	*Ictalurus nebulosus*	x	x	x
Channel catfish	*Ictalurus punctatus*			x
Stonecat	*Noturus flavus*	x		x
Tadpole madtom	*Noturus gyrinus*	x		
Brindled madtom	*Noturus miurus*			x
TROUT-PERCHES				
Trout perch	*Percopsis omiscomaycus*	x	x	x
KILLIFISHES				
Banded killifish	*Fundulus diaphanus*	x		x
SILVERSIDES				
Brook silverside	*Labidesthes sicculus*	x		
STICKLEBACKS				
Brook stickleback	*Culaea inconstans*	x		
TEMPERATE BASSES				
White perch	*Morone americana*	x		x
White bass	*Morone chrysops*			x
Striped bass	*Morone saxatilis*			x
SUNFISHES				
Rock bass	*Ambloplites rupestris*	x	x	x
Redbreast sunfish	*Lepomis auritus*			x
Pumpkinseed	*Lepomis gibbosus*	x	x	x
Bluegill	*Lepomis macrochirus*		x	x
Smallmouth bass	*Micropterus dolomieui*	x	x	x
Largemouth bass	*Micropterus salmoides*	x	x	x
White crappie	*Pomoxis annularis*	x		x
Black crappie	*Pomoxis nigromaculatus*	x	x	x

Table 2: Cont'd.

		1934	1970-1971	1979-1983
PERCHES				
Greenside darter	Etheostoma blennoides	x		x 2/
Fantail darter	Etheostoma flabellare	x		x 1/
Tessellated darter	Etheostoma olmstedi	x	x	x
Yellow perch	Perca flavescens	x	x	x
Log perch	Percina caprodes	x		x
Walleye	Stizostedion vitreum vitreum	x	x	x

1/ Collected by non-DEC agencies.

2/ Collected during significant habitat inventory of selected tributaries.

Table 3: Sampling effort on the Mohawk River from the mouth to Five Mile Dam, 1979-1983.

	TRAP NET SETS	GILL NET SETS	BOAT ELECTRO-FISHING (HOURS)	BAG SEINE HAULS	OTTER TRAWL HAULS
Mouth	1.4[1]	1[2]	1.02	--	--
Champlain St. Pool		NOT SAMPLED			
Cohoes Falls Pool		NOT SAMPELD			
School St. Pool	1	2	0.75[3]	--	--
Crescent Lake	13	7	3.60[4]	13	6
Lock 7 Pool	7	8	3.27	7	8
Lock 8 Pool	3	4	1.90	4	2
Lock 9 Pool	4[5]	5	1.45	4	--
Lock 10 Pool	3	3	1.87	4	--
Lock 11 Pool	3	4	1.25	4	--
Lock 12 Pool	5	7	2.90	8	--
Lock 13 Pool	5	5	2.18	4	--
Lock 14 Pool	3	3	1.28	--	--
Lock 15 Pool	3[6]	6	3.58[7]	5	--
TOTALS	51.4	55	25.05	53	16

1/ One trap net set vandalized. Net caught fish but netting efficiency unknown. Net was presumed to have been vandalized the same evening it was set. Data from the two nets treated as 1.4 nets.

2/ Another gill net destroyed by vandalism. Fish in net were not processed.

3/ Time estimated because cartop boat shocker lacked an elapsed time meter.

4/ 1.0 hours were for game fish only.

5/ Two trap net sets vandalized. Both nets had fish but netting efficiency unknown. Data from the two nets treated as one net.

6/ Two trap nets twisted because of rapidly rising water. Both nets had fish but netting efficiency unknown. Data from the two nets treated as one net.

7/ Includes an estimated 1.5 hours of shocking time between Five Mile Dam and Lock 16. The cartop boat shocker lacked an elapsed time meter.

Table 4: Total number of fishes collected by gill net, boat shocker and trap nets on the lower Mohawk River between 1979 and 1983.

	Mouth	School Street Pool	Crescent Lake 1/	Lock 7 Pool	Lock 8 Pool	Lock 9 Pool	Lock 10 Pool	Lock 11 Pool	Lock 12 Pool	Lock 13 Pool	Lock 14 Pool	Lock 15 Pool 2/	Lock 16 to Five Mile Dam
Game Fishes													
Chain pickerel			1				1						
Largemouth bass	2	5	48	38	11	4	3						1
Northern pike			1										1
Smallmouth bass	30	23	63	216	122	155	303	103	288	148	133	104	24
Striped bass	3		1										
Tiger musky	2												
Walleye	1	2	17	18	8	11	20	42	33	16	6	10	27
Pan Fishes													
Black crappie	32	16	243	16		1						3	
Bluegill	61	12	257	148	1	1	2	1	2	1			
Brown bullhead	30	42	278	134	13	31	60	48	62	23	11	6	3
Channel catfish	1												
Pumpkinseed	54	42	93	252		2				2			*3/
Redbreast sunfish	9												
Rock bass	38	60	47	136	36	83	71	21	79	68	33	20	
White bass			7	9			1	1	1	1		2	
White catfish	1												
White crappie	1	4	331	6									
White perch	203	5	117	46	15		1	1	3	8	3		
Yellow bullhead		3	17	6	1				1			1	
Yellow perch	50	165	73	252	43	34	73	37	43	21	17	15	1
Other Fishes													
Alewife	2												
American eel	2	3	2	12	1	5	2	3	5	4	3	4	*
Blueback herring	457	286	1996	1386	783	592	240	691	492	126	226	347	
Bluntnose minnow			1		1			2	9				
Brindled madtom					1				1				
Common carp	5	4	225	123	28	28	16	20	17	21	5	4	*

Table 4: Cont'd.

	Mouth	School Street Pool	Crescent Lake 1/	Lock 7 Pool	Lock 8 Pool	Lock 9 Pool	Lock 10 Pool	Lock 11 Pool	Lock 12 Pool	Lock 13 Pool	Lock 14 Pool	Lock 15 Pool	Lock 16 to Five Mile Dam
Other Fishes													
Common shiner				2									
Emerald shiner			1		3			2	4	8	3		*
Fallfish			4	83	111	96	32	16	5	2	1	1	*
Fathead minnow					1	3							
Gizzard shad		1		14	1				2				
Goldfish	1		14	12									
Golden shiner	16	10	93	129	4	17	4	2	2	2	3	1	*
Logperch							4	1	1	5			*
Northern hog sucker					3	2	7	10	1	2	5		*
Satinfin shiner				1									
Shorthead redhorse		2	44	15	20	41	31	45	55	71	16	1	*
Silvery minnow			2										
Spotfin shiner			11	1									
Spottail shiner			3		5	54	45	3	6				
Stonecat					12	9			2	3	2	1	
Trout perch			1				1	3					
White sucker	34	1	101	308	139	70	115	113	84	87	45	65	*

1/ Excludes one hour of electrofishing for game fish only in which 54 smallmouth bass, 8 largemouth bass, and 2 walleye were collected.

2/ Excludes fish collected during the estimated 1.5 hours of electrofishing from Five Mile Dam to Lock 16 because only game and panfish species were collected.

3/ * observed but not collected. Only game and panfish species collected. Survey done in October by electrofishing only.

Table 5: Total number of fishes collected by bag seine on the Crescent Dam to Five Mile Dam portion of the Mohawk River in 1982 and 1983.

	Crescent Lake	Lock 7 Pool	Lock 8 Pool	Lock 9 Pool	Lock 10 Pool	Lock 11 Pool	Lock 12 Pool	Lock 13 Pool	Lock 14 Pool	Lock 15 Pool
Game Fishes									NOT SAMPLED	
Largemouth bass	28	10	1	2	4	3	1			
Smallmouth bass	12	36	160	372	414	173	284	15		56
Tiger musky	1	1								
Walleye							5			
Panfishes										
Black crappie		1			1					
Bluegill	8	1	4	1	20		1	44		1
Brown bullhead						19	11			
Crappie[1/]							1			
Pumpkinseed	35	519	4	1		2	6			
Rock bass	1	17	130	276	76	68	150	11		1
Sunfish[2/]	691									
White crappie	3		1							
White perch	14	1					1			
Yellow perch	37	80	2	17	1	2	30	5		3

1/ Returned to water before positive identification was made.

2/ Includes both bluegill and pumpkinseed. All fish were young of year.

Table 5: Cont'd

Other Fishes	Crescent Lake	Lock 7 Pool	Lock 8 Pool	Lock 9 Pool	Lock 10 Pool	Lock 11 Pool	Lock 12 Pool	Lock 13 Pool	Lock 14 Pool	Lock 15 Pool
Banded killifish				1						3
Blueback herring	2,438	3,500	1,460	616	3,250	6,275	5,395	22		
Bluntnose minnow	92	200	195	441	65	35	441	16		1
Brindled madtom	1								N	
Central stoneroller				1					O	
Common carp	6			4		9	14		T	
Common shiner	2	1			25		1			
Creek chub								1		
Cutlips minnow			1						S	
Emerald shiner	1,381	340	2,105	270	1,153	366	1,625	1,610	A	2
Fallfish		50	40	75	75	56	78		M	5
Fathead minnow				1					P	
Golden shiner	48	85	15	13	50		80		L	
Gizzard shad	31						9	46	E	27
Log perch	35	2		3	1				D	
Rosyface shiner		6		1	25					
Shorthead redhorse	2			1		5	2	4		1
Spotfin shiner	2	5	51	3	4		11	1		
Spottail shiner	701	800	310	464	340	27	260	108		
Tesselated darter	53	70	2			11	38	12		9
Trout perch				1				1		
White sucker	26	11	75	23		73	197	24		30

Table 6: Total number of fishes collected by trawling on the Crescent Dam to Lock 9 portion of the Mohawk River in 1982 and 1983.

	Crescent Lake	Lock 7 Pool	Lock 8 Pool
GAME FISHES			
Smallmouth bass		1	1
Walleye	1		
PANFISHES			
Black crappie	2	2	
Bluegill	2		
Brown bullhead	4	2	
Crappie	49		
Pumpkinseed	10	3	
Rock bass	1	1	
Sunfish[1/]	82		
White crappie		1	
White perch		1	
Yellow perch	60	5	
OTHER FISHES			
Blueback herring	1997	117	2
Bluntnose minnow	2		
Common carp	6		
Emerald shiner	2	18	
Fallfish			1
Golden shiner	35	4	
Gizzard shad	2		
Spottail shiner	297	196	6
Tesselated darter	3		2
Trout perch	155	26	4
White sucker	4	1	

1/ Young of year bluegill and pumpkinseed.

Table 7: Electrofishing index of abundance (number of fish/hour) of Mohawk River fishes collected between the Hudson River and Five Mile Dam.

	Mouth	School Street Pool	Crescent Lake[1/]	Lock 7 Pool	Lock 8 Pool	Lock 9 Pool	Lock 10 Pool	Lock 11 Pool	Lock 12 Pool	Lock 13 Pool	Lock 14 Pool	Lock 15 Pool[2/]
Game Fishes												
Chain pickerel												
Largemouth bass	2.0	5.3	13.9	10.4	5.3	2.8	1.6					
Northern pike												
Smallmouth bass	25.5	24.0	17.3	51.1	56.3	89.0	155.1	78.4	92.1	62.4	99.2	43.8
Striped bass	2.9											
Tiger musky	2.0											
Walleye			0.4	0.6	1.1	1.4	2.7	12.0	0.3	0.5	1.6	
Panfishes												
Black crappie		1.3	1.5									
Bluegill	2.0	1.3	31.9	6.1	0.5	0.7			0.7	0.5		
Brown bullhead	2.0	1.3	1.5	3.7		2.8	1.1	1.6	2.4		0.8	0.5
Channel catfish												
Pumpkinseed	15.7	17.3	12.7	16.5								
Redbreast sunfish	2.0											
Rock bass	25.5	10.7	9.2	19.3	6.8	16.6	21.4	7.2	10.7	12.4	17.2	4.3
White bass												
White catfish												
White crappie		1.3	9.6	0.3								
White perch	18.6		3.9	0.3					0.7			
Yellow bullhead				0.3					0.3			
Yellow perch	18.6	40.0	5.8	20.5	5.8	12.4	13.9	9.6	5.5	1.8	6.3	

Table 7: Cont'd

Other Fishes	Mouth	School Street Pool	Crescent Lake[1/]	Lock 7 Pool	Lock 8 Pool	Lock 9 Pool	Lock 10 Pool	Lock 11 Pool	Lock 12 Pool	Lock 13 Pool	Lock 14 Pool	Lock 15 Pool[2/]
American eel				2.5	0.5	2.8		1.6	1.4	1.8	2.3	1.9
Blueback herring	13.7	14.7	1.9	10.7	2.6	10.3	9.6	12.8	3.1	11.9	3.9	
Common carp	2.9		19.2	9.8	9.5	1.4	3.7	9.6	1.4	1.8	2.3	1.0
Fallfish			1.5	18.0	46.3	35.9	11.2	9.6	1.4		0.8	
Gizzard shad		1.3		0.3	0.5				0.7			
Goldfish	1.0			0.6								
Golden shiner	1.0	4.0	2.7	5.5		4.1	0.5	0.8	0.3		0.8	
Northern hog sucker					1.1	0.7	2.2	8.0		0.9	3.9	
Shorthead redhorse		1.3	0.4		1.6		11.8	27.2	10.3	21.6	2.3	
Stonecat												
White sucker	17.6		10.4	31.5	31.6	18.6	24.6	57.6	10.0	12.9	15.6	10.6

1/ Game fish only collections excluded.
2/ Excludes 1.5 hours of estimated shocking from Five Mile Dam to Lock 16.

Table 8: Gill net index of abundance (number of fish/gill net) of Mohawk River fishes collected between the Hudson River and Five Mile Dam.

	Mouth	School Street Pool	Crescent Lake	Lock 7 Pool	Lock 8 Pool	Lock 9 Pool	Lock 10 Pool	Lock 11 Pool	Lock 12 Pool	Lock 13 Pool	Lock 14 Pool	Lock 15 Pool
Game Fishes												
Chain pickerel												
Largemouth bass			0.1									
Northern pike												
Smallmouth bass	3.0	1.5	1.6	4.3	3.5	4.6	2.7	1.0	1.7	1.0	1.7	1.7
Striped bass												
Tiger musky												
Walleye			1.4	0.8	0.8	1.0	2.3	1.5	3.6	2.0	1.0	1.7
Panfishes												
Black crappie			0.7			0.2						0.5
Bluegill	2.0		0.1				0.3					
Brown bullhead	7.0	0.5	2.9	1.4	0.5	0.8	3.0	0.3	1.1	1.0	1.7	
Channel catfish												
Pumpkinseed	6.0	2.5	1.3	4.3								
Redbreast sunfish												
Rock bass	3.0	19.0	1.6	7.8	4.0	5.2	4.3	1.5	3.3	5.2	1.7	1.3
White bass			0.1									0.2
White catfish	1.0											
White crappie			1.6									
White perch	30.0		6.1	0.8	1.0					0.7	1.0	
Yellow bullhead			1.1	0.5								0.2
Yellow perch	16.0	18.0	4.1	11.5	6.3	1.0	8.0	1.8	2.6	1.0	2.0	1.7

Table 8: Cont'd

	Mouth	School Street Pool	Crescent Lake	Lock 7 Pool	Lock 8 Pool	Lock 9 Pool	Lock 10 Pool	Lock 11 Pool	Lock 12 Pool	Lock 13 Pool	Lock 14 Pool	Lock 15 Pool
Other Fishes												
American eel												
Blueback herring	3.0	5.5	10.7	9.3	11.0	11.4	7.7	0.8	2.3	17.0	6.3	6.0
Common carp		1.0	7.4		0.8	0.6	0.3		0.1	1.0		
Fallfish				1.0	2.2	3.8	2.0	0.3	0.1	0.4		
Gizzard shad				0.4								
Goldfish			0.3									
Golden shiner	4.0		2.1	5.6		1.0	0.7			0.2	0.7	
Northern hog sucker					0.3		1.0		0.1			
Shorthead redhorse		0.5	3.4	1.8	4.3	8.2	2.7	1.5	2.9	3.8	4.0	0.2
Stonecat					3.0	1.8			0.3	0.6	0.7	0.2
White sucker	3.0	0.5	4.9	10.6	14.0	6.8	10.7	5.5	2.7	5.4	6.0	5.2

Table 9: Trap net index of abundance (number of fish/trap net) of Mohawk River fishes collected between the Hudson River and Five Mile Dam.

	Mouth	School Street Pool	Crescent Lake	Lock 7 Pool	Lock 8 Pool	Lock 9 Pool	Lock 10 Pool	Lock 11 Pool	Lock 12 Pool	Lock 13 Pool	Lock 14 Pool	Lock 15 Pool
Game Fishes												
Chain pickerel			0.1				0.3					
Largemouth bass		1.0	0.8	0.7	0.3		0.3					
Northern pike			0.1									
Smallmouth bass	0.7	2.0	0.5	2.4	0.3	0.8	1.7	0.3	1.5	1.4	0.3	1.0
Striped bass			0.1									
Tiger musky												
Walleye	0.7	2.0	0.5	1.4	1.0	1.0	2.7	7.0	1.2	1.0	0.3	
Panfishes												
Black crappie	22.9	15.0	18.1	2.3								
Bluegill	40.7	11.0	13.3	17.4			0.3	0.3				
Brown bullhead	15.0	41.0	19.5	15.9	3.7	5.8	17.0	15.0	6.3	3.6	1.7	1.3
Channel catfish	0.7											
Pumpkinseed	22.9	24.0	4.0	23.4		0.5				0.4		
Redbreast sunfish	5.0											
Rock bass	6.4	16.0	0.8	1.7	2.3	8.3	6.0	2.0	4.2	3.0	2.0	1.0
White bass			0.5	1.3			0.3	0.3	0.2	0.2		0.3
White catfish												
White crappie	0.7	3.0	22.5	0.7								
White perch	110.0		5.7	5.4	3.7		0.3	0.3	0.2	1.4	0.3	
Yellow bullhead		2.0	0.1	0.3								
Yellow perch	10.7	99.0	2.2	13.3	2.3	3.5	7.7	6.0	1.5	2.4	1.0	1.7

Table 9: Cont'd

	Mouth	School Street Pool	Crescent Lake	Lock 7 Pool	Lock 8 Pool	Lock 9 Pool	Lock 10 Pool	Lock 11 Pool	Lock 12 Pool	Lock 13 Pool	Lock 14 Pool	Lock 15 Pool
Other Fishes												
Alewife	1.4											
American eel	1.4	3.0	0.2	0.6		0.3	0.7	0.3	0.2	0.2		
Blueback herring	314.3	264.0	147.3	182.4	244.7	132.5	66.3	224.0	77.8	2.0	67.3	104.3
Common carp	1.4	2.0	9.5	13.0	2.3	5.8	2.7	2.7	2.0	2.4	0.7	0.7
Fallfish				2.3	4.7	6.3	1.7	1.0				0.3
Gizzard shad				1.4								
Goldfish			0.9	1.4								
Golden shiner	7.9	7.0	5.5	9.4	1.3	1.5	0.3	0.3	0.2			0.3
Northern hog sucker						0.1						
Shorthead redhorse			1.5				0.3	1.7	1.0	1.0	0.3	
Stonecat												
White sucker	9.3		3.2	17.1	7.7	2.3	12.3	13.0	5.8	6.4	2.3	4.0

Table 10: Comparisons of relative abundance (%) of fishes collected in 1934 and 1979-80 by gill nets in the Mohawk River between Crescent Dam and Lock 8.

	1934	1979-80
GAME FISHES	6.9	7.3
Largemouth bass	0.1	0.1
Smallmouth bass	0.3	5.3
Walleye	6.4	1.9
PANFISHES	31.4	42.4
Black crappie	0.5	0.6
Bluegill	-	0.2
Brown bullhead	14.2	3.7
Pumpkinseed	2.0	5.1
Rock bass	3.5	9.5
White bass	-	0.1
White crappie	0.8	1.3
White perch	1.6	5.9
Yellow bullhead	0.1	1.4
Yellow perch	11.9	14.5
OTHER FISHES	61.8	50.3
Alewife	7.6	-
American eel	0.1	-
Blueback herring	4.5	17.8
Common carp	1.3	6.2
Common shiner	0.4	-
Fallfish	0.4	1.0
Gizzard shad	-	0.2
Goldfish	-	0.2
Golden shiner	19.6	6.0
Shorthead redhorse	1.6	4.6
Spottail shiner	0.1	-
Stonecat	0.1	-
White sucker	26.3	14.3

Table 11: Comparisons of relative abundance (%) of fishes collected in 1934 and 1981-82 by gill nets in the Mohawk River between Lock 8 and Lock 16.

	1934	1981-82
GAME FISHES	7.9	13.0
Smallmouth bass	0.5	7.0
Walleye	7.4	6.0
PANFISHES	2.1	23.4
Black crappie	-	0.4
Bluegill	-	0.1
Brown bullhead	1.6	3.0
Rock bass	0.5	10.7
White bass	-	0.1
White perch	-	0.6
Yellow bullhead	-	0.1
Yellow perch	-	8.5
OTHER FISHES	89.9	63.5
Blueback herring	5.3	23.3
Brindled madtom	-	0.1
Common carp	2.1	1.1
Fallfish	1.6	3.4
Golden shiner	20.1	0.9
Northern hog sucker	-	0.4
Shorthead redhorse	11.1	10.9
Stonecat	0.5	2.6
White sucker	49.7	20.8

Table 12: Numerical composition of fish collections, with and without blueback herring, from each pool in the lower Mohawk River.

	Impoundment[1/]	Game fish/ panfish/other (includes blue-back herring)	Game fish/ panfish/other (excludes blue-back herring)
Mouth	P	3.7/46.4/50.0	6.6/83.0/10.4
School Street Pool	P	4.4/50.9/44.8	7.5/87.3/5.3
Crescent Lake	P	3.2/35.8/61.0	6.3/69.8/24.0
Lock 7 Pool	P	8.1/29.8/62.1	13.8/50.7/35.5
Lock 8 Pool	S	10.1/8.0/81.7	24.3/18.8/56.9
Lock 9 Pool	S	13.7/12.3/74.0	26.3/23.5/50.2
Lock 10 Pool	S	31.7/20.2/48.2	41.3/26.3/32.4
Lock 11 Pool	S	12.4/9.4/78.2	30.6/23.0/46.4
Lock 12 Pool	S	26.8/15.9/57.3	45.5/27.1/27.5
Lock 13 Pool	S	26.5/20.0/53.5	33.3/25.2/41.6
Lock 14 Pool	S	27.1/12.5/60.4	48.6/22.4/29.0
Lock 15 Pool [2/]	S	20.8/7.9/71.3	50.0/19.0/31.0

1/ P = Permanent

S = Seasonal

2/ Does not include the fish collected by electrofishing between Lock 16 and Five Mile Dam because only game and panfish species were collected.

Table 13: Fish indices summary of the Mohawk River by pool from the Hudson River to Five Mile Dam.

	Mouth	School Street Pool	Crescent Lake	Lock 7 Pool	Lock 8 Pool	Lock 9 Pool	Lock 10 Pool	Lock 11 Pool	Lock 12 Pool	Lock 13 Pool	Lock 14 Pool	Lock 15 Pool 2/
Smallmouth bass PSD	__1/	__1/	58.4%	17.1%	65.5%	73.6%	48.0%	84.4%	37.4%	46.4%	26.0%	38.3%
Legal SMB/HR. 3/	3.9	1.3	3.1	3.7	27.9	44.8	52.4	52.8	20.0	13.8	10.9	8.7
Non-game/gamefish (by weight)	16.0/1	16.4/1	18.0/1	11.2/1	6.4/1	3.9/1	2.0/1	4.3/1	2.5/1	3.2/1	3.1/1	3.0/1
% desirable panfish (by number)	60.1	82.3	68.9	53.6	74.3	69.1	62.5	78.9	82.7	71.0	68.8	78.7

1/ Sample size to small.

2/ Excludes the estimated 1.5 hours of electrofishing between Five Mile Dam and Lock 16.

3/ SMB = smallmouth bass: Electrofishing only.

Legal size = 30.5 cm+ (12"+)

Table 14: Length-frequency distribution of smallmouth bass collected by boat shocker, gill net, and trap net from the lower Mohawk River between 1979-1983.

Size Group (in)	Mouth	School Street Pool	Crescent Lake[1/]	Lock 7 Pool	Lock 8 Pool	Lock 9 Pool	Lock 10 Pool	Lock 11 Pool	Lock 12 Pool	Lock 13 Pool	Lock 14 Pool	Lock 15 Pool[2/]
3.0-3.9	-	-	2	6	1	4	2	-	-	-	-	-
4.0-4.9	-	-	8	10	2	2	8	4	5	-	1	2
5.0-5.9	-	1	5	11	6	11	3	6	8	1	1	-
6.0-6.9	3	-	2	10	3	9	17	3	11	9	8	3
7.0-7.9	-	2	4	47	4	4	47	4	21	15	14	9
8.0-8.9	4	3	14	41	16	12	52	2	27	17	26	12
9.0-9.9	5	3	15	29	6	6	16	3	46	20	23	27
10.0-10.9	10	10	8	22	12	12	27	5	54	22	28	14
11.0-11.9	4	2	25	18	15	20	26	7	48	28	15	11
12.0-12.9	1	1	23	9	29	29	55	11	43	20	9	15
13.0-13.9	2	-	6	5	14	22	33	31	13	8	4	8
14.0-14.9	-	1	5	5	5	11	13	16	6	6	1	3
15.0-15.9	-	-	-	3	7	6	3	9	3	2	1	-
16.0-16.9	1	-	-	-	2	7	1	2	3	-	2	-
TOTALS	30	23	117	216	122	155	303	103	288	148	133	104

1/ Includes game fish only collections.

2/ Excludes bass collected between Five Mile Dam and Lock 16 because collections were made in October.

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

	AGE				
SPECIES	1+	2+	3+	4+	5+
GAME FISHES					
Largemouth bass	6.3 (14)	10.0 (11)	12.0 (14)	13.1 (3)	15.7 (3)
Smallmouth bass	5.3 (9)	8.9 (21)	11.1 (21)	12.2 (19)	13.0 (8)
Walleye	11.1 (11)	15.5 (3)	16.8 (1)	19.0 (3)	-
PANFISHES					
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)
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)
Yellow perch	-	6.6 (20)	8.8 (3)	9.9 (10)	-

Table 16: Age and average total length (inches) at capture of game and panfish collected in the Lock 9 Pool during June 10-12 and 15-16, 1981 (Sample size in parenthesis).

	AGE					
SPECIES	1+	2+	3+	4+	5+	6+
GAME FISHES						
Largemouth bass	-	-	10.6 (1)	13.3 (2)	-	17.4 (1)
Smallmouth bass	5.4 (13)	8.5 (22)	11.1 (27)	13.2 (29)	15.1 (6)	16.1 (5)
Walleye	8.3 (1)	14.7 (7)	17.0 (3)	-	-	-
PANFISHES						
Black crappie	5.8 (1)	-	-	-	-	-
Bluegill	-	-	6.5 (1)	-	-	-
Pumpkinseed	-	6.5 (1)	-	-	-	-
Rock bass	3.1 (2)	5.5 (18)	7.4 (14)	8.5 (7)	8.9 (2)	9.5 (1)
Yellow perch	4.9 (9)	7.8 (7)	9.2 (12)	10.2 (6)	11.2 (3)	-

Mohawk River Watershed:H240
Watershed Filed #625

A FISHERIES MANAGEMENT PLAN FOR THE LOWER MOHAWK RIVER

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October, 1994

EXECUTIVE SUMMARY

The lower Mohawk River extends for 76 miles from its confluence with the Hudson River upstream to Five Mile Dam. This highly developed river, which is part of the New York State Barge Canal system, contains five permanent dams, nine movable dams, nine locks, and five operational hydropower facilities. A 200 ft wide x 14 ft deep shipping channel is maintained in approximately 69 miles of river. During the five month non-navigation season, the movable dams are lifted entirely out of the water and 47 miles of impounded river becomes free flowing.

The lower Mohawk supports an exceptional warmwater fishery noted primarily for its smallmouth bass fishing. Bass are abundant and fast growing because of abundant, high quality forage provided primarily by anadromous blueback herring.

The magnitude and quality of the resource, its close proximity to large numbers of people, and needs for environmental assessment relating to commercial development necessitated the development of a management plan to provide direction in managing the fisheries resource of the lower Mohawk River. The FISHERIES MANAGEMENT PLAN FOR THE LOWER MOHAWK RIVER describes the management history and current status of the resource and presents strategies and recommendations for achieving the long term goal of maintaining the lower Mohawk River as one of the premiere smallmouth bass fisheries in New York.

Management objectives are to

. Provide a quality warmwater fishery for up to 150,000 angler trips/year.

. Provide smallmouth bass catch rates (creeled plus release) of 1.0 fish (all sizes) and 0.5 legal (≥ 12 in) fish/h for anglers targeting bass.

. Provide walleye catch rates (creeled plus release) of 0.35 fish (all sizes) and 0.20 legal (≥ 15 in) fish/h for anglers targeting walleye.

. Provide panfish catch rates (creeled plus release) of 1.0 fish/h anglers targeting panfish.

. Preserve and maintain the anadromous blueback herring run throughout the lower Mohawk.

To accomplish the goal and objectives outlined in the plan, the following recommendations should be implemented.

Hydropower Development

1. Oppose new dam construction in the lower Mohawk River.

2. Continue the December through April drawdown of the Lock 8-16 reach on the lower Mohawk River that results from the removal of the gates and uprights. Replacement of movable dams with permanent dams should be opposed.

3. Oppose hydropower development at Lock 16 to preserve the 4.4 mi natural river reach downstream of Five Mile Dam.

4. Recommend installation of downstream fish passage facilities for juvenile and adult herring utilizing the best available technology. If these facilities are ineffective in protecting outmigrating adult and juvenile herring, plant shutdown during the outmigration period may be required. Downstream fish passage facilities should reduce site specific and cummulative impacts of turbine mortality.

5. Recommend installation of downstream fish passage facilities for resident fish species utilizing the best available technology.

6. Recommend to the Federal Energy Regulatory Commission (FERC) that hydropower developers be required to construct or provide fishermen parking and shoreline access to the tailwater discharge area. The need for boat access will be determined individually for each site.

7. Recommend to FERC that the School Street hydropower developer be required to provide shoreline access to the tailwater discharge below Cohoes Fall and to the bypass reach between the Diversion Dam and Cohoes Fall. They should also be required by FERC to construct a cartop launch to the impoundment upstream of the Diversion Dam.

Hydropower Operation

1. Recommend to FERC that all new and relicensed hydropower facilities be required to operate in a run of river mode. The change in operational mode will stabilize streamflows in the 2.6 mi of river downstream of Cohoes Falls.

2. Recommend to FERC that the operator of the Crescent hydropower facility evaluate the required 100 ft^3/s and 300 ft^3/s voluntary minimum flow to the Mohawk River downstream of Cohoes Falls. Article 36 and 40 of the FERC license for Crescent states that the effectiveness of the minimum flow requirement for the protection and enhancement of aquatic resources in the Mohawk River must be evaluated.

3. Recommend to FERC that the School Street hydropower operator be required to provide a 400 ft^3/s minimum base flow with channel modification to the 0.8 mi bypass reach between the Diversion Dam and Cohoes Fall. Niagra Mohawk Power Corporation (NMPC) proposed 60 ft^3/s minimum flow requirement is inadequate.

4. Recommend to FERC that the Mohawk Mill hydropower operator be required to evaluate the 200 ft^3/s minimum flow release to the 250 and 1400 ft bypass reaches. As part of his license exemption, the Mohawk Mills operator agreed to undertake all studies, modelling, surveys, etc necessary to assess the significance of the minimum flow requirements.

5. Recommend to FERC that all new hydropower facilities be required to evaluate their impact on the upstream fish passage of adult blueback herring through the navigation lock. Mitigation may be required.

Angler Access (also see Hydropower Development)

1. Construct a DEC trailered boat launch near Cayadutta Creek if the Village of Fonda agrees to it and agrees to assume routine maintenance responsibilities. Construction of this launch site will complete DEC's formal boat access program for the lower Mohawk River. DEC's future role will be to maintain existing boat launch sites and to provide technical assistance to local governmental agencies interested in increasing or improving shore and boat fishing access.

2. Develop car top access to the 4.4 mi natural river reach between Five Mile Dam and Lock 16. This also requires improvement to the access road to Five Mile Dam. Development responsibility should be determined upon completion of statewide Canal Development Master Plan by the New York Thruway Authority (NYTA).

Cooperative Studies

1. Develop cooperatively with affected parties measures to control the non-biological impacts of zebra mussels on man made structures. The Region 4 Fisheries Office will participate in biological studies as required.

2. Participate in the NYTA preparation of the statewide canal master plan. The Region 4 Fisheries Office will provide information and other assistance as needed and/or required.

Fisheries

1. Collect fish for contaminant analysis as required. DEC's Bureau of Environmental Protection would carry out the laboratory analysis of the fish collected.

2. Initiate fish studies that focus on specific needs as they may arise such as overexploitation of walleye or the status of emerald shiners. Intensive riverwide sampling is not needed in the forseeable future.

3. Stock approximately 9-12,000 fall fingerling tiger muskies annually in the 20.3 mi reach between Crescent Dam and Lock 8. The stocking rate will be 3-4 fish/acre effective in 1994. The Region 4 Fisheries Office will stock the fish by boat to assure adequate distribution of fish throughout the stocked reach.

4. Continue existing statewide angling regulations throughout the Mohawk River since they are adequate to maintain the existing high quality fishery. If overexploitation of walleye should occur, an 18 in minimum size and 3 fish creel limit will be implemented riverwide. Exploitation rates of 50% or higher for smallmouth bass may require implementation of an experimental 14 in minimum size limit on two adjacent lock pools.

5. Develop a blueback herring study plan outlining the informational needs required to assess the status of herring in the river. Implementing a study of this scope is beyond the current capabilities and resources of the Region 4 Fisheries Office.

6. Increase lockages at the Troy Dam and Waterford Flight during May to facilitate upstream movement of adult blueback herring. Develop a plan for NYTA and Army Corp of Engineers (COE) review and implementation.

7. Meet with the Department of Health (DOH) to evaluate the need to continue the ban on fishing in the Hudson River upstream of the Troy Dam.

8. Continue to work with the Region 4 Law Enforcement Office in an effort to resolve angler complaints about the lack of enforcement of fishing regulations on the river.

9. Develop an annual news release on the purpose and importance of angling regulations.

10. Investigate potential fishing tournament impacts as staff resources allow and rectify any problems through communication and discussion with appropriate bass fishing organizations.

11. Seek legislative authority that will allow DEC to prohibit the commercial sale of hook and line caught panfish.

12. Implement two year smallmouth bass and walleye angler diary programs and a creel check of panfish anglers in 1996 to monitor catch (creel plus release) rates. These programs should be repeated as necessary to determine if catch rate objectives for these species are being met.

13. Promotion of fishing opportunities on the Mohawk River is not needed due to existing high fishing pressure and the promotional efforts of the private sector. The Mohawk River fishing brochure should be updated and reprinted as necessary.

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INTRODUCTION

The lower Mohawk River supports a popular high quality fishery noted primarily for its smallmouth bass[a] fishing (McBride 1987a). At 160 mi in length, the Mohawk River is the second longest river in New York State. The lower 29 mi is located within the Capital District (Albany-Schenectady-Troy) area with its 403,000 residents, the fourth largest metropolitan area in New York State. The river is also part of the New York State Barge Canal system.

In 1979, the Department of Environmental Conservation (DEC) Region 4 Fisheries Office began a major effort to better understand the fisheries potential and management needs of the lower Mohawk River. Studies that have been completed include a fish distribution survey (McBride 1985a), creel survey of fishing pressure and catch rates (McBride 1983), food habits of black bass (1985b), fish age and growth (McBride 1986), five year smallmouth bass angler diary program (McBride 1989), aerial mapping of exposed substrate types (McBride 1987b), status of walleye (McBride 1988), and smallmouth bass population dynamics (McBride 1993).

The magnitude and quality of the resource, its close proximity to large numbers of people, and needs for environmental assessment relating to commercial development necessitated the development of a management plan to provide direction in managing the fisheries resource of the lower Mohawk River. An interim plan

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[a]See Table 1 for scientific names of fishes reported in the lower Mohawk River.

was developed in 1987 (McBride 1987a). This report updates the 1987 plan, summarizes the fishery management history and includes recommendations for the future management of the lower river.

EFFECTS OF ERIE AND BARGE CANAL CONSTRUCTION

The Mohawk River valley has always been an important transpor- tation corridor across eastern New York State. Opening of the Erie Canal in 1825 contributed significantly to the westward expansion of the United States throughout the East and Great Lakes region (Finch 1925; Drago 1972). In 1918, the Erie Canal was replaced by the present day Erie Barge Canal. Although the economic impacts of the two canal systems are well documented (Salmon 1951; Goodrich 1962; Miller 1962), few people are aware of their ecological consequences.

Prior to the construction of the Erie Canal, the Mohawk River watershed was geographically isolated from all other New York watersheds because of the 80 ft high Cohoes Falls. It limited fish movement from the Hudson River to only the lower 2.6 mi of the Mohawk River. However, completion of the Erie Canal in 1825 and the Erie Barge Canal in 1918 created a bypass around the falls resulting in a direct waterway link between the Hudson River and Great Lakes (Figure 1). Fish could now move east or west through the canal to establish populations in other watersheds or the Mohawk River itself. Fish moving west through the canal system include the sea lamprey, Petromyzon marinus, (Aron and Smith 1971), alewife (Smith 1970), and white perch (Scott and Christie 1963). Fish moving eastward include smallmouth bass (Hubbs and Baily 1938) and gizzard shad, (George 1983). Significant anadromous and catadromous species using the Mohawk River are blueback herring and American eel. Striped bass and American shad have been collected downstream of Lock 7 (McBride 1985).

Unlike the Erie Canal which was a landcut canal throughout its length, the Erie Barge Canal involved canalization of the Mohawk River and other natural water bodies. Canalization resulted in the obliteration of the succession of riffles, pools, and still waters that characterized the natural Mohawk River (Bishop 1935). Approximately 84 mi of the 160 mi river was changed from a free flowing stream to a series of permanent and seasonal impoundments. Water levels in these impoundments are regulated by both permanent and movable dams. The movable dams are composed of steel uprights and plates called gates. In the winter (December through April), the gates and uprights are entirely removed and the river upstream from Lock 8 becomes free flowing. Surface area drawdown of the seasonal impoundments from summer to winter range from 36% to 56% (McBride 1987b). The canalized river contains a 200 ft wide x 14 ft deep shipping channel. Maintenance dredging is required annually to maintain the shipping channel at its proper width and depth.

DESCRIPTION

With all dams in place, the lower Mohawk River from Five Mile Dam downstream 76.3 mi to its confluence with the Hudson River (Figure 2), covers 6,934 acres. This section encompasses the DEC Region 4 portion of the Mohawk River in Montgomery, Schenectady, and Albany Counties. Portions of the river are located in the Region 5 and 6 counties of Saratoga and Herkimer, respectively. The river has a total drainage area of 3,456 mi^2 and an average annual flow, measured at a gaging station below Cohoes Falls, of 5,666 ft^3/s. In 1988, the minimum and maximum flows recorded were 149 and 40,000 ft^3/s, respectively (Firda et al 1989). This 76 mi of river contains five permanent dams, nine movable dams, nine locks, and five operational hydropower facilities. All but 6.9 mi of the lower river is canalized.

The river occupies the same channel as the barge canal in all but two sections. At Five Mile Dam, the Erie Barge Canal and Mohawk River separate for 4.4 mi and rejoin about 0.1 mi downstream of Lock 16. This 4.4 mi section of uncanalized river is a remnant of what the lower Mohawk River was prior to canalization and is characterized by numerous shallow pools and riffles. From Lock 16 downstream to Crescent Dam, the river consists of two permanent and eight seasonal impoundments ranging in size from 182 to 1,904 acres (Table 2). The percentage of river bottom in each pool occupied by the shipping channel ranges from 12.1 to 45.3% (Table 2).

The Erie Barge Canal and Mohawk River separate for the second time at Crescent Dam (Figure 3). The canal drops 169 ft in 2.3 mi before entering the mouth of the Mohawk River. This 2.3 mi land cut canal, which includes five locks and two guard gates, is called the Waterford Flight (Figure 3). During the navigation season, the mean daily diversion to the Waterford Flight ranged from 104 to 137 ft^3/s. The remaining river spills over Crescent Dam or passes through the Crescent Dam hydroelectric facility. A 16 ft high diversion dam, which creates an 80 acre impoundment is located 0.8 mi downstream of Crescent Dam. The Diversion Dam diverts all flows up to 5,910 ft^3/s into the headrace or intake channel of the School Street hydropower station and is discharged downstream of Cohoes Falls. When flows are less than 5,910 ft^3/s, which is about 70% of the time, flows in the 0.8 mi stretch of river from the Diversion Dam to Cohoes Falls are dependent upon leakage at the Diversion Dam which is minimal. Downstream 0.9 mi from Cohoes Falls, the river is impounded by the 22 ft high New York State Dam. Downstream of the New York State Dam, the Mohawk River splits into three branches with a total length of 3.6 mi before entering the Hudson River (Figure 3). From south to north, they are known as the Fifth, Third and Fourth Branch, respectively. The dam on the Fourth Branch is bisected by an island (Figure 4) resulting in the east and west dams being 7 and 9 ft high, respectively. The Hudson River floods the lower section of each branch due to the ponding effect from the Federal Dam at Troy located 0.6 mi downstream of the Fifth Branch of the Mohawk River. The Fifth, Third, and Fourth Branches are flooded for a distance of approximately 0.4, 0.7 and 0.4 mi, respectively. Above the flooded reach, the river is a broad expanse of exposed bedrock, shallow water, many riffles, and a few deeper pools (Bishop 1935).

Shindel (1969) classified the Mohawk River into three channel basin types based on shape and use. They are the natural river, the river canal, and the powerpool section. These three channel types are also appropriate in describing the primary aquatic habitat types.

The natural river section comprises a total of 6.9 mi of the lower river and is found in three reaches: Five Mile Dam to Lock 16, the Diversion Dam to the head of the New York State Dam impoundment, and at the mouth above the flooded branch sections to the New York State Dam (Figures 2 and 3). The river canal section extends 47.4 mi from Lock 8 to Lock 16. This section of river has been straightened and dredged to accomodate canal traffic. The dams at Locks 8-15 are movable and in place only during the navigation season which typically runs from May 1 through November 30. These dams are entirely removed during the winter and the river becomes free flowing. The 22.0 mi power pool section extends from Lock 8 downstream to the Diversion Dam, and the flooded stream sections at the mouth. These impoundments are permanent with flows and impoundment levels influenced by hydropower operation.

HISTORICAL BACKGROUND

Water Quality

The Mohawk River has been well studied relative to pollution and water quality. At the turn of the century, considerable municipal and industrial pollution was reported in the vicinity of the cities and villages along the Mohawk (Anon 1952). Many tributaries were similarly polluted. No improvement was noted at the time of the 1934 biological survey (Faigenbaum 1935). Moore (1935) characterized the Barge Canal and uncanalized Mohawk River as grossly polluted. Untreated discharges of municipal and industrial wastes were still commonplace in 1951 (Anon 1952). By 1966-67, water quality had improved but discharges of untreated sanitary and industrial waste were still occurring (O'Conner 1968) and low dissolved oxygen levels were reported downstream of Schenectady. Implementation of a strong water pollution abatement program from 1966-1976 significantly reduced the pollution level of the Mohawk River (Anon 1976). By 1983, most gross industrial and domestic discharges have been controlled by construction of pollution control facilities funded in large measure by DEC's Pure Water's Program. The primary exception is Cayadutta Creek which empties into the Mohawk River at Fonda and is considered to be one of the more polluted streams in the state.

Early summer water chemistry surveys (unpublished DEC Region 4 data) between 1979 and 1982 indicated that the lower Mohawk River was homothermous and moderately fertile. Total alkalinity, expressed as calcium carbonate, ranged from 85.5 to 119.7 ppm; pH ranged from 7.6 to 8.8; and secchi disk transparencies ranged from 2 to 4 ft. Dissolved oxygen (DO) levels ranged from 7.0 to 14.0 ppm at all depths in all pools sampled. However, late summer DO stratification in Crescent Lake and the Lock 7 Pool with DO values less than 5.0 ppm at depths greater than 10 ft and approaching 0.1 ppm at the bottom were reported in August, 1983 (C.T. Main, Inc. 1984). In 1988, DEC's Division of Water studied the DO stratification in the Crescent Dam to Lock 8 reach. Late summer water temperature decreased as much as 12°F with depth but there was no thermal stratification. Bottom water temperatures ranged from 73 to 80°F. DO stratification similar to that observed by C. T. Main, Inc (1984) in 1983 was found (Unpublished DEC Division of Water data). The cause of the DO stratification remains unknown (Jim Dalton, Division of Water, personal communication).

Analysis of fish collected from various locations on the Mohawk River in 1977 indicated that contaminants (PCB's, heavy metals, etc) were present (NYSDEC 1978, 1981). Health advisories were in effect from 1984 through April, 1994, for the consumption of white perch and smallmouth bass downstream of Lock 7 to the Hudson River because of elevated PCB levels in these two species.

Contaminants

Fish throughout the lower Mohawk River have been collected periodically since 1977 for contaminant analysis as part of the statewide toxic substances monitoring program. PCB's are the primary contaminant of concern; other contaminants such as heavy metals and organochlorines are present but at concentrations below current federal Food and Drug Administration (FDA) tolerance levels for consumption as food. Results of the analysis of the PCB levels in fish collected since 1977 are summarized in Table 3. In general, PCB levels are higher at downstream sites than upstream sites (Table 3). In 1983, FDA lowered the tolerance levels for PCB's from 5 ppm to 2 ppm.

A health advisory was issued in 1984 recommending that white perch caught in the 13.7 mi reach of Mohawk River downstream of Lock 7 not be eaten because of elevated PCB levels. DEC initiated a study to locate the source of PCB contamination in the Vischer Ferry area (Crescent Dam to Lock 7). Soil, aquatic invertebrates, and young-of-year smallmouth samples were collected from various locations between Crescent Dam and Lock 9. Soil and invertebrate results were negative. Fish samples were lost at the laboratory. At the time, the source of PCB contamination in the Vischer Ferry area was unknown (Ronald Sloan, DEC, personal communication). Recently, evidence was found to indicate that the General Electric facility in Schenectady may be the source of PCB's in the lower riverine reaches. Additional studies are underway to determine the magnitude of the problem.

In 1987, ten species of fish were collected from the Vischer Ferry area to determine the extent and magnitude of the PCB problem. White perch and smallmouth bass were the only two species with PCB levels $\geq$2 ppm; white crappie averaged 1.7 ppm of PCB's and the remaining seven species had PCB levels < 1 ppm (Table 3). White perch PCB levels were 3.4 ppm compared to 7.3 ppm in 1983. Smallmouth bass PCB levels averaged 2.1 ppm which is within the 1.9 to 3.7 ppm range recorded from earlier samples for legal ($\geq$ 12 in) size fish (Table 3). By 1992 smallmouth bass and white perch, collected below the Lock 7 Dam, had PCB levels averaging 0.8 and 1.3 ppm, respectively. Because of the low PCB levels in the white perch and smallmouth bass, the special health advisories in effect for these two species since 1984 were discontinued in April, 1994.

The mouth of the Mohawk River, comprising about 252 acres, is closed to fishing because of the fishing ban on the Hudson River from the Troy Dam to Fort Edward. The fishing ban, in effect since 1976, is due to generally high levels of PCB contamination in Hudson River fish. The closure includes all Hudson River tributraries to the first impassible barrier which encompasses the Mohawk River from its mouth upstream to the New York State Dam (Figure 3). Fish in the five mile Hudson River reach between the Troy Dam and Lock 1, which includes the Mohawk River, were first sampled for PCB's in 1988 and again in 1991 and 1992. PCB levels for the six fish species collected in 1988 ranged from 2.3 to 5.2 ppm and from 0.4 to 11.9 ppm for the 12 fish species collected in 1991 (Table 4). Ten of the 12 fish species collected in 1991 had PCB levels under the 2 ppm tolerance level established by the FDA. An eat none health advisory is issued when PCB levels $\geq$ 6 ppm (Ronald Sloan, DEC, personal communication) and only common carp had PCB levels that exceeded 6 ppm. Additional fish samples were collected in 1992 to provide added support for modifying the no fishing ban. Unexpectedly, PCB levels were significantly higher with six of the 9 species collected having PCB levels greater than 2 ppm (Table 4) but only two species (common carp and white perch) had PCB levels $\geq$ 6 ppm.

Maintenance Dredging

Annual maintenance dredging of the Barge Canal is needed to maintain the 200 ft wide x 14 ft deep shipping channel at its proper width and depth. The size and number of areas which need to be dredged varies from year to year. In 1991, approximately 39,000 cubic yards of material were dredged compared to 3,600 cubic yards in 1990 and none in 1989 (Al Kosinski, Division of Regulatory Affairs, DEC, personal communication).

Maintenance of the canal system through the 1992 dredging season was the responsibility of the New York State Department of Transportation (DOT). Beginning in 1993, the New York Thruway Authority (NYTA) assumed jurisdiction of canal operations including maintenance dredging responsibilities. Since 1918 until about six years ago, dredged spoiled was frequently redeposited within the river outside the shipping channel in so called "wet dump" areas. As wet dump locations were filled, which often took years, the material was then hydraulically dredged to a nearby upland disposal area. The primary problem with this method, from a fisheries point of view, was the erosion of sediment from the spoil mound(s) to downstream areas especially in the river canal impoundments (McBride 1987a). In 1988 DOT modified their dredged disposal procedures. All dredged spoils are now transported to sites and dumped where a hydraulic dredge is operating. If no hydraulic dredge is operating within reasonable travel distance, dredged spoil is then deposited in the river at a site scheduled to be hydraulically dredged later that year. No longer does dredged spoil remain in the river beyond the navigation season in which it was dredged.

A draft environmental impact statement which addresses maintenance dredging of the New York State barge canal was prepared in 1984 by the Army Corp of Engineers (COE) for a proposed 10 year dredging program. The 1984 draft environmental impact statement (DEIS) was never officially released. The Region 4 Fisheries Office found significant deficiencies in the DEIS including a failure to recognize significant ecological differences between the canalized river and landcut sections of the canal/river and a lack of commitment to eventual employment of more modern and less environmentally damaging dredging methodologies. Further work on the DEIS was terminated shortly thereafter due to lack of financial resources (Al Kosinski, Division of Regulatory Affairs, DEC, personal communication).

Hydropower

Mohawk River hydropower facilities include Mohawk Mills (Fourth Branch Associates), New York State Dam (Adirondack Hydro Development Corporation), School Street (Niagara Mohawk Power Corporation), Crescent (New York Power Authority), and Vischer Ferry (New York Power Authority) (Figures 2 and 3). A sixth facility is located at Lock 17 (Little Falls Hydro Associates) on the Region 6 portion of the Mohawk River. Since the early 1980's, an additional 11 facilities have been proposed for development at the remaining dams throughout the 76 mi reach of river between the mouth and Five Mile Dam. However, development proposals have been dropped at all sites. Currently, no undeveloped site is under consideration for hydropower development.

Hydroelectric facilities are licensed by the Federal Energy Regulatory Commission (FERC) which is responsible for the license conditions under which these facilities operate. Crescent and Visher Ferry were relicensed in 1984. Mohawk Mills and the New York State Dam facilities were licensed in 1983 and 1987, respectively. The School Street facility is currently in the process of renewing its hydropower license which expired December 31, 1993. Until relicensing issues are resolved at School Street, FERC will issue an annual license which will allow the School Street facility to continue its operation.

The Vischer Ferry and Crescent hydropower stations operate in a storage and release mode and regulate flows to the 2.6 mi of Mohawk River downstream of Cohoes Falls whenever Mohawk River flows are less than 3,250 ft^3/s. Flows less than 3,250 ft^3/s occur about 45% of the time annually and 80% of the time from June through October (NMPC 1991). When the Crescent and Vischer Ferry facilities are in a storage mode and not spilling, the only flows to the river are due to leakage through the dam and/or turbines plus the conservation flow release. The FERC conservation flow requirements, released as leakage through the flashboards, at Vischer Ferry and Crescent are 200 and 100 ft^3/s, respectively. The New York Power Authority (NYPA), however, is voluntarily releasing 300 ft^3/s at both these facilities. Summer flows as low as 149 ft^3/s were recorded in 1987 at the USGS gage below Cohoes Falls (Unpublished data, USGS). The frequency of occurrence of minimal flows are unknown. When river flows exceed 3,250 ft^3/s, these two facilities operate in a run-of-river mode so that the instantaneous outflow from the impoundment is equal to the inflow.

When water is discharged to generate hydroelectric power, downstream river flows can increase dramatically. Summer stream flows below Crescent can fluctuate 15 fold between the storage and release phases with low flows 8% of peak flows. Daily minimum, mean, and maximum river flows at the Cohoes gaging station from June through September, 1987, are graphically illustrated in Figures 5, 6, 7 and 8, respectively. Minimum flows often represent about 10% of the average daily summer flow (Table 5). The minimum average 7 consecutive day flow at recurrence interval of 10 years (MA7CD10) is 754 ft^3/s (NMPC 1991).

Water levels in the Vischer Ferry impoundment may fluctuate up to 13.5 in daily from the top of the 27 in high flashboards or the crest of the concrete dam when the flashboards are out. Water levels in the Crescent impoundment may fluctuate up to 12 in daily from the top of the 12 in high flashboards or the crest of the concrete dam when the flashboards are out. In the School Street impoundment immediately downstream of Crescent Dam, water levels may fluctuate 12 in daily from the crest of the Diversion Dam (Figure 3). Prior to 1992, the School Street impoundment was lowered up to 3 ft during the generating phase.

Hydropower operations have also resulted in two bypassed river sections. There is a 0.8 mi bypass reach from the base of the Diversion Dam downstream to Cohoes Falls (Figure 4). Except during spillage events which occurs about 33% of the time, flows in this reach are entirely dependent upon leakage at the Diversion Dam. There is currently no minimum flow requirement for this 0.8

mi reach; thus, Cohoes Falls, one of the larger natural falls in New York, is practically dry two thirds of the year. At the Mohawk Mills dam on the Fourth Branch (Figure 4), a minimum interim flow of 200 ft^3/s is required; 40 ft^3/s is spilled over the West Dam to a 250 ft bypass reach and 160 ft^3/s is spilled over the East Dam to a 1,400 ft bypass reach.

Hydropower facilities can provide a barrier to the upstream and downstream movement of fish. Upstream fish passage from the Hudson River through the Mohawk River is provided by the navigation locks at the dams. Fish moving downriver are subject to entrainment and mortality of unknown magnitude because stream flows are typically diverted through the turbines much of the time.

Weed Control

The New York State Conservation Department conducted a water chestnut (Trapa natans) eradication program on the Mohawk River and other infested New York waters from 1946 to 1976. According to Muenscher (1935), water chestnut infestations in 1934 totalling 1,000 to 1,200 acres were limited to the Mohawk River, primarily between Crescent Dam and Lock 7. By 1952, the known infestations had spread to about 3,400 acres in the Mohawk and Hudson Rivers (Wich 1968) and infestations had spread throughout the lower Mohawk River. Control efforts, using handpicking and spraying of the herbicide 2,4-D (2,4-Dichlorophenoxyacetic acid) at a rate of 7.9 lb acid equivalent of active ingredient per acre, had reduced total infestations to about 1,350 acres in the Hudson-Mohawk system by 1976.

In the Mohawk River, control efforts had reduced known water chestnut infestations to 761 acres by 1966 and 420 acres by 1976. The eradication program was terminated statewide in 1976 when continued use of 2,4-D at the rate needed for water chestnut control was not permitted by 2,4-D label restrictions. Hand pulling alone was not considered an economically feasible solution. Observations since termination of the water chestnut control program indicate that the extent of infestations in the Mohawk River have increased substantially. Although the extent of increase has not been quantified, many areas have become heavily infested that were weed free or controllable by handpulling in the past.

Canal Lands Development

New York voters in November, 1991, authorized the state to charge tolls for lockages throughout the statewide canal system, which includes the Erie Barge Canal, and permitted long term lease arrangements of state owned land along the canal. The enabling legislation passed the state legislature in 1992. As a result, operational responsibility for the New York State Barge Canal system was transferred from DOT to NYTA in late 1992. In 1993, an inventory of natural and man-made features located within and along the New York State canal system was completed. The NYTA is now in the process of developing a canal master plan to establish a framework for fostering recreational, tourism, economic development, and preservation of the canal system. This draft plan, being prepared by the Canal Recreationway Commission, is due to be completed in September, 1994 with public meeting and hearings to follow. The target date for completion of the final plan is January 1, 1995.

LOWER MOHAWK RIVER FISHERY

The lower Mohawk River supports one of the better smallmouth bass fisheries in New York. Angler cooperators targeting smallmouth bass averaged 1.17 bass/h and 0.56 legal (≥ 12 in) bass/h from 1982 through 1986 (McBride 1989). These catch rates are very high. In the St. Lawrence River, long recognized as one of the premiere smallmouth bass fisheries in New York, diary cooperators from 1978 to 1980 recorded catch rates only half as high as that found in the lower Mohawk River from 1982 to 1986. St. Lawrence River cooperator catch rates for smallmouth bass averaged 0.60 fish and 0.32 legal (≥ 12 in) fish/h (Green et al 1986).

Walleye fishing is also excellent in the Mohawk River. Angler cooperators targeting walleye averaged 0.54 fish/h and 0.43 legal (≥ 15 in) fish/h from 1983 through 1986 (McBride 1988). Catch rates exceeding 0.20 fish/h are above average and rates approaching 0.50 fish/h are excellent for anglers fishing specifically for walleye (Festa et al 1987).

Panfish angling opportunities are best in the permanent impoundments. These impoundments generally support abundant populations of black crappie, bluegill, brown bullhead, pumpkinseed, rock bass, white crappie, white perch, and yellow perch. Brown bullhead, rock bass, and yellow perch are the most abundant panfish in the river canal impoundments upstream of Lock 8.

Previous Fish Surveys

The first biological survey of the entire Mohawk River occurred in 1934 and resulted in the capture of 48 fish species (Table 1) from the lower Mohawk River (Bishop 1935). Walleye were the predominant game species followed by largemouth bass and smallmouth bass. Only three chain pickerel were recorded. Brown bullhead, pumpkinseed, rock bass, and yellow perch were the predominant Mohawk River panfish. Other panfish species collected were black crappie, white crappie, white perch, and yellow bullhead. The remaining 36 species collected included suckers, carp, herring, alewife, and a variety of minnows and darters. The overall fishing quality in the Mohawk River during 1934 was probably poor due to pollution impacts. According to Bishop (1935) fishing for game species (including panfish) throughout the greater length of the river was largely limited to the aerated fast water below the dams.

The next fisheries survey of the lower river was carried out in 1970 and 1971 by the DEC Region 4 Fisheries Unit. Its purpose was to update information on the quality of the sport fishery between Crescent Dam and Lock 16 (Figure 2). Fish sampling was done with a 220 v DC electrofishing boat powered by a 1000 watt generator. Fish collections in June, 1970 and 1971, included 26 species (Table 1). Smallmouth bass were the predominant game species encountered throughout the lower river. Walleye and largemouth bass were also collected. Largemouth bass appeared to be more common between Crescent Dam and Lock 12 while walleye were more common between Lock 12 and Lock 16. Brown bullhead, pumpkinseed, and rock bass were the most common Mohawk River panfish. Bluegill, black crappie, and yellow perch were also collected. The remaining 17 species included minnows, suckers, carp and herring.

The most comprehensive survey of the lower Mohawk River occurred from 1979 to 1983 in an effort to assess the river's fish populations and management needs. Sampling effort included 51 trap net sets, 55 gill net sets, 25.1 h of boat electrofishing, 53 bag seine hauls, and 16 otter trawl hauls (McBride 1985). Fifty-six fish species were recorded including 12 species not collected during the 1934 survey (Table 1). Six species collected in 1934 were not collected during this effort. The anadromous blueback herring was the most abundant fish collected followed by smallmouth bass, white sucker, yellow perch, brown bullhead, and rock bass (McBride 1985). Sport fish populations in the permanent impoundments were dominated by panfish whereas game fish outnumbered panfish in the seasonal impoundments. All indices showed that the lower Mohawk River supported large numbers of sport fish species of sizes considered desirable by most New York anglers. Smallmouth bass and walleye are the most important game fish species and blueback herring are the most important forage species. For a more complete description and summary of the 1979-83 survey, see McBride (1985).

Historical Changes in Fish Community Structure

Gill net collections in 1934 and from 1979 to 1983 indicate that major changes have occurred in the community structure of the fish population in the lower Mohawk River. Abundance of game and panfish species has increased significantly since 1934 and is believed largely due to improvement in dissolved oxygen levels associated with the overall improvement in water quality (McBride 1985).

In the Crescent Dam to Lock 8 reach, the relative abundance of game species remained relatively constant between 1934 and 1980 while panfish populations increased and the other fish (carp, suckers, etc) declined (McBride 1985). Although the percentage of game species in the catch remained relatively constant, 6.9% in 1934 compared to 7.3% in 1979-80, a major shift between walleye and smallmouth bass occurred. Walleye declined from 6.4% to 1.9% of the fish collected while smallmouth bass increased from 0.3% to 5.3%. Relative abundance of panfish species increased from 31.4% to 42.4% of the fish collected while other fish declined from 61.8% to 50.3%. Upstream of Lock 8, game fish species increased from 7.9% to 13.0% of the fish collected while panfish increased from 2.1% to 23.4%, and the other fish category declined from 89.9% to 63.5% (McBride 1985).

Differences in Fish Community Structure by Habitat Type

The 1979-83 fisheries survey found major differences in fish communities between the permanent impoundments of the power pool section and the seasonal impoundments of the river canal section. Comparisons of the relative percentage of the three fish categories (gamefish, panfish, and other fish) showed that the lower Mohawk River fish community changes from panfish dominance in the power pool impoundments to game fish dominance in the river canal impoundments (McBride 1985). Panfish and gamefish species averaged 40.7% and 4.9% of the fish collected in the four permanent power pool impoundments studied compared to 13.3% and 21.1% in the eight seasonal river canal impoundments (Table 6). The shift is even more apparent when only resident species were examined and the anadromous blueback herring excluded. In the power pool impoundments, game and panfish species averaged 8.6% and 72.7% of the fish collected compared to 37.5% and 23.2% in the river canal impoundments (Table 6).

Seasonal water level fluctuations and increased water velocities in the river canal section may be responsible for the differences observed in fish community structure between the power pool and river canal impoundments (McBride 1985) because it apparently precludes establishment of abundant lentic panfish populations. Extreme water level fluctuations, ranging from 1 to 16 ft, occur in the Lock 8-15 pools because of the annual removal or installation of the movable dams. This is in contrast to the relatively stable water levels in the permanent impoundments which varies from 0 to 2.3 ft due to the removal of flashboards from Crescent Dam and the Lock 7 Dam. The winter drawdown, which can reduce the surface area of summer pools by 36% to 56% (McBride 1987), results in increased water velocities and significant dewatering of shallow water areas in the river canal section. In short, the river becomes a free flowing river from December through April instead of 47 mi of ponded water. Seasonal drawdown of the canal appears to be a given from the standpoint of canal operation.

Fish Stocking

Fish were first stocked by New York in 1924 into two sections of the lower Mohawk River: Crescent Dam to Lock 8 and Lock 14 to Lock 16. Stocking records show that at least 21.8 million walleye fry, 29,400 smallmouth bass fingerlings, 544 adult bullhead, 1,000 largemouth bass, and 29 crappie were stocked from 1924 to 1934.

Following the 1934 biological survey, the following stocking policies were formulated:

Section Location	SPECIES	Number	Size
Crescent Dam-Lock 7	Walleye	800,000	Fry
	Largemouth bass	2,700	Fry
	Bullhead	80	Adult
Lock 7-Schenectady County Line	Walleye	1,000,000	Fry
	Smallmouth bass	2,000	Fry
	Largemouth bass	500	Fry
	Bullhead	400	Fingerling
Schenectady County Line- Lock 10	Walleye	250,000	Fry
	Smallmouth bass	2,000	Fry
Lock 15 - Lock 16	Walleye	800,000	Fry
	Largemouth bass	2,700	Fry
	Bullhead	80	Adult

Stocking was terminated in 1947 for the section from Lock 7 to the Schenectady County line, in 1961 for the sections from the Schenectady County line to Lock 10 and Lock 15 to Lock 16, and in 1967 for the Crescent Dam to Lock 7 section. From the available stocking records, at least 35 million walleye, 7,000 largemouth bass, 640 bullhead, 3,000 smallmouth bass and 100 crappie were stocked from 1935 to 1967. Reasons for terminating the stocking programs were probably related to advances in fishery science which by that time had demonstrated that the stocking of warmwater species was often of little value or unnecessary.

Hybrid tiger muskellunge (northern pike x muskellunge) have been stocked in the Mohawk River to develop a trophy fishery for fish weighing more than 8 lb. From 1980 to 1982, approximately 18,000 fall fingerling tiger musky were stocked annually at a rate of six fish per acre in the 20.3 mi reach of river between Crescent Dam and Lock 8 (Table 7). None were stocked upstream of Lock 8 because game fish populations were abundant there. No fish were stocked in 1983 and 1984 because the tiger musky hatchery was being renovated. Stocking was resumed in September, 1985, at the 6 fish/ acre rate. Since 1989, tiger muskies have been stocked at about half the recommended rate or 8,800 fish because of hatchery production cutbacks needed to meet fingerling walleye productions needs. However, some surplus fish have been available for additional stocking.

Legal ($\geq$ 30 in) tiger muskies were first reported caught in 1983 and fish up to 41 in long and 18 1/2 lb were recorded in 1985. Twenty pound fish have been reported since then. Tiger muskies have been documented in the Hudson River as far south as the Port of Albany which is 13 mi downstream of the stocked section. Tiger muskies have been reported upstream of Lock 8 but these reports have not been verified. Because of downstream movement, the tiger musky stocking program between Crescent Dam and Lock 8 also provides a limited fishery in the 4.2 mi reach of Mohawk River below Crescent Dam.

Fish Salvage

From 1945 to 1962, the New York State Conservation Department, now known as the New York State Department of Environmental Conservation, conducted a statewide fish salvage program. During the 18 year program, the lower Mohawk River was frequently netted as a source of fish for transfer elsewhere. Fish were removed from waters where they were considered over abundant or unavailable for public fishing. Game and panfish species were transferred to other waters, particularly park ponds; and some fish, such as carp, were destroyed. In 1959 and 1962, fish salvage records show that a total of 282,509 fish weighing 127,436 lb were removed from the Crescent Dam to Lock 7 section of the river. Bullhead (73%) and crappie (12%) represented 85% of the total fish removed.

Angler Use

The lower Mohawk River supports a popular, warmwater fishery. In 1982 on the Crescent Dam to Lock 16 reach (Figure 2), the estimated total fishing pressure was 115,245 trips or 389,033 h which is equivalent to 18.6 trips/acre or 62.7 h/acre (McBride 1983). Shore and boat anglers made an estimated 59,622 and 55;623 trips, respectively. No other large (>1000 acres) warmwater system in New York at the time was known to support fishing pressure exceeding the 62.7 h/acre recorded from the lower Mohawk River.

During 1982, angler use in the vicinity of locks and lift bridges throughout most of the NYS Barge Canal system was determined through daily counts made by lock operators of DOT's Waterways Maintenance Division. A minimum of 66,316 angler trips (89% shore and 11% boat) at a rate of 243 trips/acre occurred in the vicinity of the 15 locks and one guard gate on the lower Mohawk River and Waterford Flight during the May through October study period (Festa 1984). This amounted to 47% of the total lock associated fishing effort recorded during the 1982 Barge Canal survey (Festa 1984).

Fishing pressure, based on aerial angler count data, for the Region 4 portion of the Mohawk River increased 874% between 1973 and 1983 (Table 8). Since then, however, fishing pressure has declined almost 18%. The number of anglers observed per flight averaged 13.4 in 1973 compared to 117.1 and 96.5 in 1983 and 1990, respectively (Table 8). The decline in angler use since 1983 is due to fewer shore anglers which averaged 64.5 anglers/flight in 1983 compared to 33.3 anglers/flight in 1990. The almost 50% decline in shore fishing use cannot be explained. In contrast, boat angler use has increased every year for the period of record but the rate of increase has slowed dramatically in recent years. From 1973 to 1983, boat angler use increased 535% from 4.1 to 52.6 anglers/flight; however, boat angler use only increased 20% to 63.3 anglers/flight since 1983 (Table 8).

Estimates of total fishing pressure, derived from expansion of aerial angler counts are summarized in Table 9. The 1982 use estimates based on aerial angler counts (67,588 trips) for the Crescent Dam to Lock 16 reach are 41% lower than estimates derived from the 1982 creel survey (115,245 trips). Since the lock tenders in 1982 observed almost 60,000 angler trips on the Lock 7 to Lock 16 reach (Festa 1984), it is believed that aerial angler counts underestimate total fishing pressure. However, the similarity in fishing pressure as measured by aerial angler counts for the periods 1972-73, 1982-83, and 1988-1990 indicates that aerial angler counts are reasonably precise and useful in monitoring long term trends.

Angler catch and harvest

Lower Mohawk River shore and boat anglers each caught (creeled plus release) about 0.9 fish/h in 1982; however, shore anglers creeled 0.29 fish/h compared to 0.15 fish/h for boat anglers (McBride 1983). Smallmouth bass, the dominant species caught by both shore and boat anglers between May 1 and September 30 were caught at a rate of 0.36 and 0.73 fish/h, respectively. During the bass season, shore and boat anglers each creeled 0.09 smallmouth bass/h. 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 57,165 lb from the Crescent Dam to Lock 16 reach during May through September, 1982 (McBride 1983). The per acre yield was 12.5 fish and 9.2 lb. For shore and boat anglers combined, smallmouth bass were the most frequently harvested fish followed by rock bass, bullhead, yellow perch, and walleye. The smallmouth bass harvest represented 31% of the total fish creeled and 42% of the total pounds removed. The per acre harvest of 3.9 smallmouth bass weighing 3.9 lb was the highest recorded for a New York water with a 12 in size limit (McBride 1983).

Fishing regulations

Statewide angling regulations (Table 10) apply throughout the Mohawk River. The bass season opens the 3rd Saturday in June and ends November 30; the walleye and tiger muskellunge season opens the 1st Saturday in May and ends March 15. Anglers may creel 5 bass, 5 walleye, and 1 tiger muskellunge per day. Minimum size limits for bass, walleye, and tiger muskellunge are 12, 15 and 30 in, respectively. There are no seasons, minimum size restrictions, or creel limits on panfish (bullhead, bluegill, perch, etc) or other fish (i.e. suckers, carp, herring etc) species except for crappie. Effective October 1, 1992, the statewide regulation for crappie became 25 fish daily with a minimum size limit of 6 in.

Prior to 1975, there were no seasons, size or creel limit restrictions for game fish species in the Mohawk River downstream of Canajoharie (Figure 2). When water quality and fish populations improved, statewide regulations were applied to the lower 62 mi of river.

The theoretical effects of a 10, 12 and 14 in minimum size limit on the yield of smallmouth bass in the lower Mohawk River was modelled by McBride (1993). He found that the maximum yield of smallmouth bass would be achieved under a 10 in minimum size limit because the predicted yield decreases with higher size limits. Although a 10 in minimum size limit results in the highest predicted yield, fishing quality would decline because the increased exploitation of 10 to 12 in bass would result in fewer bass ≥ 12 in. Increasing the size limit on bass to 14 in would substantially increase the percentage of 14 in and larger smallmouth bass in the creel but the increase in actual numbers of larger fish (≥15 in) would be less dramatic and the theoretical increase may not be noticable or measureable. McBride (1993) recommended that the 12 in minimum size limit currently in effect for the lower Mohawk River be continued as the most appropriate regulation. Existing catch rates are high and further improvement through changes in management strategy seems unlikely under the present condition which includes relatively low fishing mortality and high natural mortality.

Access

Access to the lower Mohawk River is good for both boat and shore anglers. There are 17 formal trailer launch sites of which eight are publicly owned (Table 11) including four by DEC and two by the Office of Parks, Recreation and Historical Preservation (OPRHP). DEC launch sites are at Nelliston (completed in 1982), Amsterdam (completed in 1984), Glenville (completed in 1986) and Canajoharie (completed in 1990), OPRHP launch sites are at Crescent Dam and the mouth of Schoharie Creek. The Lock 9-10 and Lock 11-12 reaches, which are 6.2 and 4.6 mi long respectively, are the only two lock pools without trailered boat access. There are two formal car top launch sites on the lower river (Table 11). In addition there are many informal launch sites including some suitable for launching trailered boats.

Two additional trailered boat launch sites have been proposed. DEC has offered to construct a launch site near the mouth of Cayudutta Creek which is about midway between Locks 12 and 13 (Figure 2) if the Village of Fonda would assume maintenance responsibility (policing, mowing, litter pickup, etc) for the site. The Village is not interested in assuming this responsibility at the present time. The City of Amsterdam has proposed a launch site in the Lock 11-12 reach but this has been delayed indefinitely due to funding difficulties.

Shore fishing is largely limited to the lock areas. They are generally near population centers, have good road access, plentiful parking, and offer good fishing. From Lock 8 upstream to Lock 16, the best access to the river is at the locks. Between Lock 8 and Crescent Dam, a distance of about 20 mi, numerous shore fishing opportunities are available. Access to the river from Crescent Dam downstream to the NYS Dam is limited and in some areas potentially dangerous. The mouth of the Mohawk River is accessible to wading anglers; however fishing is not allowed because of the fishing ban on the Hudson River which includes tributaries to the first impassible barrier.

FISHERIES ISSUES

There are a number of issues that have or may have the potential for negatively impacting angling quality in the lower Mohawk River. These issues can be categorized as physical (i.e. hydropower impacts), biological (i.e. zebra mussel infestation), perceptual (i.e. fishing tournament impacts) and social (i.e. fishing ban) and are discussed in greater detail below.

Hydropower Development

There are currently five operational hydropower facilities (Mohawk Mills, New York State Dam, School Street, Crescent, and Vischer Ferry) on the lower Mohawk River (Figures 2 and 3). A sixth facility is located at Lock 17 on the Region 6 portion of the river. Only three hydropower facilities (School Street, Crescent and Vischer Ferry) existed in 1985. Since then, facilities were constructed at New York State Dam and Mohawk Mills and the generating capacities of the Crescent and Vischer Ferry facilities were doubled through the installation of new turbines. The generating capacity of the School Street facility is proposed to increase by 50% (NMPC 1991). Although an additional 11 facilities have been proposed for development at the remaining dams and other potential sites on the 76 mi of river between the mouth and Five Mile Dam, none of these are currently being pursued because they are economically unfeasible. Riverwide concerns are fish passage and habitat alteration. There are also site specific concerns such as stream flow fluctuations that are discussed separately.

Entrainment: The species of primary concern is the anadromous blueback herring. Adult herring migrate up the Mohawk River as far as Rome, approximately 120 mi upriver from the Hudson River, and spawn throughout the river. Spent fish typically attempt to return to sea shortly after spawning (Scott and Crossman 1973); however, some adult herring have been observed into the fall (McBride 1985a). Juvenile herring outmigrate in the fall.

Hydropower development and operation has the potential to adversely affect the magnitude of the blueback herring run. At existing dams with no hydropower facility, spillage over the dam is presumed to be the major exit route for adult fish and the fall outmigration (mid-August through November) of juvenile herring. Where there is a hydropower facility, most of the river flow is diverted through the turbines which results in the entrainment and mortality of herring. In a 1985 hydroacoustic study at Vischer Ferry from October 8-30, approximately 88% of the juvenile herring outmigrated through the powerhouse compared to 12% through the lock (Curtis and Associates 1987).

In the early 1980's, it was reported that turbine related mortalities to juvenile clupeids could be as high as 83% (Kynard et al. 1982). In retrospect, much of the mortality could have been associated with the study methodology. Recent studies suggest that turbine morality of juvenile clupeids may be in the range of 0 to 15% (Mathur et al 1994). In a 1991 study at the Mohawk River Crescent hydropower facility (Figure 3), RMC (1992) reported a 4%

mortality (95% confidence interval 88 to 100%) to juvenile herring passing through a Kaplan turbine operating at maximum efficiency. Although the DEC's Division of Fish and Wildlife and the U.S. Fish and Wildlife Service found the Cresent Study to be deficient because of biases in the design and execution of the study, FERC stated that the study results were acceptable. DEC's primary objections to the 1991 study were lack of replication, non-randomized induction points, and failure to test both Kaplan turbines. There is no information on turbine mortality of adult herring.

Maintenance of the blueback herring run throughout the lower river is essential for continuance of the river's high quality sport fishery (McBride 1985b). Large numbers of adult herring die annually in the Mohawk River. According to Richkus and DiNardo (1984), annual mortality rates can vary from 30 to 90% among river systems. The mortality rate in the Mohawk River is unknown. It is believed that the carcasses of dead spawners in the Mohawk serve as an abundant food source for benthic invertebrates including crayfish. Although the large size of adult bluebacks (mean length of 500 fish was 10.9 in) makes them relatively unavailable as forage for most piscivores (McBride 1985a), juvenile herring contribute greatly to the river's forage base. Food habit studies conducted in 1983 indicate that juvenile herring are preyed upon extensively by smallmouth and largemouth bass (McBride 1985b) and to a lesser extent by walleye.

Only the New York State Dam project in the lower Mohawk River has a fish bypass system which is in the process of being evaluated for its effectiveness. A bypass facility at Mohawk Mills proved ineffective and is in the process of being redesigned. There are no fish bypass facilities at School Street, Crescent, and Vischer Ferry. A fish bypass has been recommended for School Street as part of the relicensing review. Because of the supposed low turbine mortality of juvenile herring at Crescent, FERC made an interim decision to allow NYPA to pass herring preferentially through their new Kaplan turbines at both the Crescent and Vischer Ferry hydropower projects. However, NYPA was required by FERC to address gull predation and adult blueback herring fish passage impacts.

Since the lower Mohawk River has the potential to support up to 16 hydropower facilities (5 existing, 11 proposed), entrainment mortality particularly cumulative mortalities must be addressed and mitigated by the hydropower developer/operator. Cumulative turbine mortality impacts of both adult and juvenile herring could greatly reduce and possibly eliminate the spawning run of blueback herring to upstream reaches of the Mohawk River. For example, if a cohort of 1,000 juvenile herring upstream of Lock 16 suffered 10% turbine mortality at each hydropower facility (proposed and existing) from Lock 16 downstream to the Hudson River, only 185 fish (82% mortality) would survive. At the five existing facilities on the lower Mohawk River,a 10% mortality at each site yields a cumulative mortality of 37% or 63% survival. Survival would be even lower at higher entrainment mortalities.

Turbine mortality of resident fish species is also of concern but the magnitude of the problem is not known. Tagging studies of smallmouth bass and walleye on the lower Mohawk River have shown that movement between lock pools occurs and that most of the movement is downstream. First year tag returns of legal size (≥ 12 in) smallmouth bass showed that 14% were caught downstream and 4% upstream of the lock pool tagged (McBride 1993). Walleye demonstrated even more movement. First year tag returns of legal size (≥ 15 in) walleye showed that 39% were caught downstream and 9% upstream of the lock pool tagged (McBride 1988). Needed are on-site studies assessing the amount of downstream movement through a given powerplant by resident fish species and the resulting turbine mortalities.

Habitat Alteration: The dams from Lock 8 through Lock 15 are movable and in place only during the navigation season (typically May 1 - November 30). In the winter when these dams are entirely removed, 47 mi of seasonal impoundments become free flowing river compared to the permanent impoundments downstream of Lock 8. The surface area of the river with seasonal impoundments is reduced by 36 to 56% during winter low flow periods (McBride 1987b). Sportfish populations are dominated by panfish in the permanent impoundments and game fish in the seasonal impoundments. See section entitled "Differences in fish community structure by habitat type" for more information on this subject.

Walleye may also be affected by migration barriers related to replacement of the existing movable dams with permanent dams. Placement of permanent dams could interfere with the walleye spawning run. Primary spawning areas in the Mohawk River appear to be located in the shallow fast water areas below the movable dam sites at Lock 10, 12, 14, 15 and probably below Locks 8, 9 and 11 (McBride 1988). Currently, these dams are out of the river from about December 1 through the end of April. Some walleye move upriver through several lock pools to spawn. Many potential spawning areas may become unsuitable if permanent impoundments are established because the shallow riffle areas at most of the movable dam sites will be permanently lost because of ponding. Installation of the movable dams earlier in the spring may also adversely affect walleye spawning success by blocking access to upriver spawning sites.

Stream Flow Fluctuations

Stream flows in the 2.6 mi of river below the Cohoes Falls, at river flows $\leq$ 3,250 ft^3/s, may fluctuate daily from about 150 to 3,250 ft^3/s because of hydropower operation at the Crescent and Vischer Ferry hydropower stations. Many riverine fish and invertebrate species have a limited range of conditions to which they are adapted and daily fluctuation in flows is not a condition to which most aquatic species are adapted (Cushman 1985). Such conditions can reduce the abundance, diversity, and productivity of these riverine organisms. Altering the volume of discharge changes the characteristics of a stream, including water depth, wetted perimeter, and current velocity. Hildebrand (1980) summarized the adverse impacts of water level fluctuations which are highlighted in the following paragraphs.

Current velocity is an important factor regulating the occurrence and microdistribution of stream dwelling invertebrates and all fish life stages (Wright and Szluha 1980). Feeding adaptations and respiratory structures of stream invertebrates are specifically adapted for currents, and some species are confined to fairly definite ranges of current speed and depth (Hynes 1970; Ward 1976). Thus one obvious effect of radically changing current velocities is that those species limited to narrow ranges will be unable to tolerate periods of unsuitable current velocity and only those organisms that can tolerate wide velocity variations will remain (Wright and Szluha 1980).

Reduced population numbers, biomass, and diversity of fish and benthic organisms are often reported in streams where fluctuating conditions result in considerable habitat exposure (Wright and Szluha 1980). In circumstances of extremely rapid reductions, stranding and dessication of both invertebrates and fish may occur; and frequently, extreme fluctuations will prohibit development of an adapted community (Wright and Szluha 1980).

Downstream displacement via drift in response to low flows appears to be an important mechanism contributing to reductions of benthic fauna in fluctuating systems (Wright and Szluha 1980). Once in the drift, invertebrates are considerably more vulnerable to predation. MacPhee and Bruscen (1976) stated that extreme reductions in flow significantly increased the amount of insect drift and the rate of ingestion of drifting organisms by salmon in an experimental diversion channel. Minshall and Winger (1968) found that virtually all bottom dwelling forms were affected by reductions in stream discharge. They also noted that periodic reduction of water levels during daylight could increase the drift of invertebrates during periods when fish are actively feeding.

Fish populations in streams are also affected by fluctuating discharges. Experimental studies by MacPhee and Bruscen (1976) demonstrated that both decreases and rapid increases in flow displaced fish from test sections. Fish were displaced more rapidly at night than during the day. Such reductions in carrying capacity and resultant displacement of fish were caused by loss of shelter, food and available space. Habitat is assumed to be the primary factor limiting population size (Loar and Scale 1981) and each species has different habitat requirements for each life stage (spawning, incubation, fry, juvenile, and adult).

Frazer (1972) argues that although shelter is an important determinant of fish carrying capacity, carrying capacity can be affected by changes in current velocity alone. In support of his argument, Frazer (1972) cited studies by Kalleberg (1958) who reported a decrease in the size of territories for juvenile salmon and brown trout as a result of increased current velocity. Conversely, reduced velocities caused individuals to enlarge the area of their territories; and the smaller and less agressive fish were often displaced in the process. With reduced flows, more fish were forced to select less desirable feeding stations because of the expanded territories of the more agressive individuals. Thus, the competition for space becomes competition for food. The less agressive individuals remain in the smaller territories over longer periods of time and are thus exposed to more predators.

Based on the above discussion, it is likely that the drastic fluctuation in stream flows occurring on the Mohawk River downstream of Cohoes Falls are adversely impacting the aquatic community. The 150 ft^3/s flow that may be present during the storage phase represents about 2.6% of the 5,666 ft^3/s annual average flow and 20% of the 754 ft^3/s MA7CD10 flows. Mean summer flows (June-August, July-September, and June-September) at Cohoes averaged 1,950 to 2,278 ft^3/s from 1979 to 1988 (Table 5). In 1987, daily low and mean flows at Cohoes were less than MA7CD10 flows (754 ft^3/s) on 43 (47%) and 4 (4%) days, respectively, between June 1 and August 31, (unpublished data, USGS files). Thus, the storage and release operations at Crescent and Vischer Ferry results in frequent drought flows on a daily basis to the 2.6 mi of river downstream of Cohoes Falls whenever river flows are less than 3,250 ft^3/s which is approximately 45% of the time. According to Tennant (1976), 30% of the average annual flow is recommended as a base flow to sustaing good survival conditions for most aquatic life forms and general recreation. Thirty percent of the average stream flow at Cohoes is 1700 ft^3/s. Another methodology for determining base flows requires a 0.5 ft^3/s flow for each square mile of drainage area (USFWS 1981). Since the

Mohawk River drainage area is 3,456 mi^2, a base flow of 1728 ft^3/s is indicated. Elimination of frequent large daily flow fluctuations by changing the operational mode of Crescent and Vischer Ferry hydropower facilities to run of river should result in increased density and diversity of benthic invertebrates. Sport fish populations should also respond positively to a return of seasonal flow patterns.

Stream Diversion

Hydropower operations have resulted in two bypassed river sections. There is a 0.8 mi bypass reach between the Diversion Dam and Cohoes Falls (Figure 4). At the Mohawk Mills dam, there is a 250 ft bypass reach below the West Dam and a 1,400 ft bypass reach below the East Dam (Figure 4).

Flows to the 0.8 mi bypass reach between the Diversion Dam and Cohoes Falls are currently entirely dependent upon leakage at the Diversion Dam. Spillage occurs about 33% of the time whenever stream flows at the dam exceed about 6000 ft^3/s. If the generating capacity of the School Street hydropower station is increased to 9,000 ft^3/s as proposed, spillage over the dam would be reduced to only 18% of the time. The average flow at the Cohoes gaging station is 5,666 ft^3/s. According to Tennant (1976), a flow of 1,700 ft^3/s would be required to provide good conditions for aquatic life. NMPC is proposing a 60 ft^3/s flow to the bypass reach as part of its hydropower relicensing effort. Tennant (1976) states that 10% of the average flow, which is equivalent to 567 ft^3/s at Cohoes, is the minimum instantaneous flow needed to sustain short term survival habitat for aquatic life. Instream flow studies conducted by NMPC suggests that a 400 ft^3/s flow with channel modifications would provide minimal habitat suitability. The 60 ft^3/s flow proposed by NYPA represents 1% of the average flow. This minuscule flow would represent the only flows spilling over Cohoes Falls, one of the larger natural falls in New York, for 82% of the year. The proposed 60 ft^3/s bypass flow also appears esthetically inadequate.

At the Mohawk Mills dam, the FERC license exemption requires the hydropower operator to provide a minimum interim flow 200 ft^3/s; a 40 ft^3/s flow is spilled over the West Dam to the 250 ft bypass reach and 160 ft^3/s is spilled over the East Dam to the 1,400 ft bypass reach (Figure 4). DEC had determined this minimum flow was required to maintain the waste assimilative capacity of the river. However, the adequacy of this minimum flow to the aquatic community in the bypass reach was never evaluated. Since the Fourth Branch of the Mohawk River (Figure 3) receives about 45% of the total river flow, 30% of the average flow (Tennant method) for the bypass reaches would be 765 ft^3/s (5,666 ft^3/s x 0.45 x 0.30). Thus, it is clear that the interim 200 ft^3/s conservation flow, which is equivalent to about 8% of the average flow, is inadequate. According to Tennant (1976), 10% of the average flow is the minimum flow needed to sustain only short term survival habitat for aquatic life.

Zebra Mussels

Zebra mussels (Dreissena polymorpha) are small freshwater bivalve mollusks averaging 1 to 1 1/2 in long that can form extremely dense colonies of more than 9,000 individuals per square foot. Native to Europe, zebra mussels were first found in North America in 1988 at Lake St. Clair which connects Lake Huron to Lake Erie. Since then, mussels have rapidly spread throughout the Great Lakes and eastward into the canal system of New York. In the spring of 1991, zebra mussels were found In Oneida Lake and the Hudson River. During the summer, zebra mussels were found in the Mohawk River between Crescent Dam and Lock 7. The magnitude of infestation in the Mohawk River is unknown but the rocky substrate appears to provide ideal habitat for zebra mussel colonization. By the end of 1993, zebra mussels were reported abundant everywhere there was suitable habitat.

These mussels have the potential to biofoul municipal and industrial water intake facilities, to disrupt food webs and ecosystem balances, and interfere with sport and commercial fishing, navigation, and recreational boating and beach use (O'Neill and MacNeill 1989).

Fisheries related impacts could result from zebra mussel filtration activity (O'Neill and MacNeill 1989). An adult mussel can filter about one quart of water per day. Excessive removal of phyto- plankton from the water could cause a decline in zooplankton species which feed upon phytoplankton. As a result, populations of zooplankton feeding fish such as blueback herring could also decline and ultimately affect gamefish populations such as bass and walleye. The potential impact on the aquatic community of the Mohawk River is not known at the present time. During 1993, many anglers commented on the dramatic increases in water clarity. It is not known if the increased water clarity was related to zebra mussels.

Non-biological impacts are the more immediate concern. Water intake structures (intake cribs and trash racks) serve as excellent habitat for mussel colonization. The main impacts, associated with colonization are loss of intake head; obstruction of valves; obnoxious or dangerous methane gas production; and electro-corrosion of steel and cast iron pipelines (O'Neill nad MacNeill 1989). Major problems on the Mohawk River can be expected to occur during the coming years with one of the biggest potential threats being to operation of the navigation locks.

Contaminants

Many long time residents in the Mohawk River corridor remember when the Mohawk River was a virtual open sewer. Although this is no longer the situation and water quality is generally good, many of these residents still consider Mohawk River fish unfit to eat. The current health advisory on consumption of white perch and smallmouth bass, due to elevated PCB levels, reinforces the continued misconception that all fish from the river are unsafe to eat. The health advisory for these two species applies only to the 12 mi of river open to fishing downstream of Lock 7 and recommends that white perch should not be eaten and smallmouth bass consumption should be limited to one meal per month. White perch PCB levels declined from 7.3 ppm in 1983 to 3.4 ppm in 1987 to 1.3 ppm in 1992 (Table 3). Smallmouth bass PCB levels averaged 2.1 ppm in 1987 and 0.8 ppm in 1992 (Table 3). As the result of the declining PCB levels in smallmouth bass and white perch, the special health advisories were terminated April, 1994. The seven other species in this reach tested in 1987 and elsewhere generally had PCB levels < 1 ppm (Table 3).

Fishing Ban

Fishing has been prohibited in the mouth of the Mohawk River, which comprises about 250 acres, downstream of the New York State Dam (Figure 3) since 1976. This closure is a spin off of the fishing ban on the Hudson River from the Troy Dam to Hudson Falls which includes all tributaries to the first impossible barrier because of high levels of PCB contamination in fish. "No fishing" signs have been posted throughout the fishing prohibited section. In 1988 fish were collected from the 5 mi Hudson River reach between the Troy Dam and Lock 1 and for the first time were analyzed for contaminants. This analysis indicated that a reexamination of the ban might be warranted for this reach of river. The six fish species tested had PCB levels averaging 2.3 to 5.2 ppm (Table 4). Additional fish samples were collected from the reach in 1991 and PCB levels were lower than those recorded in 1988. PCB levels in the 12 fish species collected in 1991 ranged from 0.4 to 11.9 ppm (Table 4). Ten of the 12 fish species collected in 1991 had PCB levels under the 2 ppm tolerance level established by the FDA. Unfortunately, fish collected in 1992 showed dramatic increases in PCB levels with only three of the nine species collected having PCB levels $\leq$ 2 ppm (Table 4). Two species (common carp and white perch) had PCB levels $\geq$ 6 ppm, a level where an eat none health advisory has generally been applied. The observed increase from 1991 to 1992 was presumably from recent inputs of PCB's from the General Electric plant site in Hudson Falls (Ron Sloan, DEC, personal communication).

The fishing ban is not generally enforced. A total of 1,122 anglers fished a 2.75 acre counting area immediately below Lock 2, which is entirely within the fishing prohibited area, from May 1 through October 31, 1982 (unpublished data, Region 4 Fisheries files). Approximately 115 boat and 1,200 shore angler trips per year were made throughout the mouth of the Mohawk in 1988, 1989, and 1990 (Unpublished data, Region 4 Fisheries Office). Anglers are routinely seen during site visits to the area. When laws are not enforced, people tend to lose respect for them because it fosters the attitude that if one can get away with violating the law in one situation than its probable he can in another.

<u>Law Enforcement</u>

The most frequent complaint from anglers about the Mohawk River concerns the lack of law enforcement. Primary concerns are the harvest of bass and walleye during the closed season and the harvest of sublegal (< 12 in) bass. The impact of illegal harvest is unknown. There is only one environmental conservation officer (ECO) each in all of Montgomery and Schenectady counties.

The extent of illegal harvest in a recreational fishery may very well be the fisheries manager's greatest unknown and could easily be the one factor blocking attainment of management objectives for a fishery (Paragamian 1984). Gigliotti and Taylor (1990) used a yield per recruit simulation model to evaluate the effect of poaching on legal harvest in sport fisheries. They found that, depending on the extent of illegal harvest and instanteous catch rates used, the reduction in the number of legal size fish caught per 1,000 recruits ranged from 2% to 72%. In one example, the reduction in legal harvest of northern pike ranged from 10% at 10% illegal harvest to 41% at 50% illegal harvest (Gigliotti and Taylor 1990). The importance of angler compliance with fishing regulations is obvious.

Commercial Fisheries

Commercial fishing along the Mohawk River is apparently limited to the taking and selling of bait fish and the sale of hook and line caught panfish species. The magnitude of these activities is unknown.

Emerald shiner, the primary species of interest for many bait fishermen, were the most abundant minnow species collected from the Mohawk River in 1982-83 (McBride 1985). In recent years licensed commercial bait fishermen have been complaining that emerald shiner abundance has declined to low levels and are no longer catchable in commercial quanities. This observation has not been verified.

In recent years, large numbers of black and white crappie were being caught and sold from the Crescent Dam to Lock 7 reach of the Mohawk River in early spring. There was an unconfirmed report that one dealer bought 5,000 angler caught crappies. In October, 1992, a 6 in minimum size and 25 fish/day creel limit on crappie was imposed. Current fishing regulations allow the sale of all fish for which there is no closed season and no minimum size limit. Other popular species involved in the sale of hook and line caught panfish are yellow perch and bluegill. Commercial sale of angler caught panfish can result in inequitable benefits from a public resource because it allows certain anglers to harvest a disproportionate share of the resource for personal financial gain. For example, 5 to 10 anglers harvested about three tons of bluegill through the ice of the 370 acre Goodyear Lake during the winter of 1989-90 (Kay Sanford, DEC, personal communication).

Fishing Tournaments

Tournament bass fishing is popular on the Mohawk River. Although large numbers of fish are caught and weighed in during the course of a season, tournament anglers release their catch. Mortality associated with handling and stress is generally not considered a problem. In the St. Lawrence River, post-release mortality was 3.4% (Klindt and Schiavone 1991). A potential downside of tournament bass fishing, especially on riverine systems, involves the capture of bass over a wide stretch of river and their subsequent release at a central weigh in site. In the St. Lawrence River, studies showed that tournament caught and released largemouth and smallmouth bass did not show significant post-tournament movement or return to their capture sites (Klindt and Schiavone 1991).

Relocation of bass is not considered to be a signficant problem in the Mohawk River at the present time. Numerous tournaments with many different weigh in locations are held on the Mohawk River each year. Any stockpiling of fish that occurs at any one location would tend to be offset by relocation of bass to other weigh in sites. In addition, the dams from Lock 8 to Lock 15 are not permanent barriers to fish movement. During the navigation season, fish can and do utilize the locks. During the non-navigation season, the eight movable dams are lifted from the river and 47 miles of seasonal impoundments become a free flowing river.

MANAGEMENT GOAL AND OBJECTIVES

The Mohawk River currently provides a high quality warmwater fishery noted primarily for its smallmouth bass fishing. It is our intention to manage the resource so that this high quality fishery is maintained.

The goal of this plan is to:

MAINTAIN THE LOWER MOHAWK RIVER

AS ONE OF THE PREMIERE SMALLMOUTH BASS FISHERIES

IN NEW YORK

Objectives

Provide a quality warmwater fishery for up to 150,000 angler trips/year on the lower Mohawk River.

Provide smallmouth bass catch rates (creeled plus release) of 1.0 fish (all sizes) and 0.5 legal ($\geq$ 12 in) fish/h for anglers targeting bass in the lower Mohawk River.

Provide walleye catch rates (creeled plus release) of 0.35 fish (all sizes) and 0.20 legal ($\geq$ 15 in) fish/h for anglers targeting walleye in the lower Mohawk River.

Provide panfish catch rates (creeled plus release) of 1.0 fish/h for anglers targeting panfish in the lower Mohawk River.

Preserve and maintain the anadromous blueback herring run throughout the lower Mohawk River.

Needs

Major requirements which need to meet to attain fisheries management objectives for the lower Mohawk River include:

1. Mitigate the fishing ban at the mouth of the Mohawk River.

2. Protect outmigrating adult and juvenile blueback herring.

3. Monitor the status of adult blueback herring to determine population trends.

4. Stabilize stream flows in the Mohawk River downstream of Cohoes Falls.

5. Continue the seasonal fluctuation in water level resulting from the installation and removal of the movable dams from Lock 8 to Five Mile Dam.

FISHERIES MANAGEMENT STRATEGIES

To achieve the management goal, the following strategies should be implemented.

Hydropower development

The Mohawk Mills, New York State Dam, School Street, Crescent and Vischer Ferry hydropower facilities are each associated with a permanent dam. However, new hydropower facilities proposed for development at Locks 8 through 15 would be built at movable dam sites. These dams are currently in place during the May 1 through December 1 navigation season and are entirely lifted from the water during the five month non-navigation season. When these dams are lifted from the water, 47 mi of seasonal impoundments become a free flowing river. None of the 11 proposed facilities for the lower Mohawk River are currently active because of poor economics.

Hydropower developers have proposed replacing existing movable dams with permanent dams which would have a severe impact on the existing high quality smallmouth bass fishery. Currently, fish populations in the permanent impoundment are dominated by panfish and by game fish in the seasonal impoundments. Panfish and game fish represented 41% and 5%, respectively, of the fish collected in the permanent impoundments compared to 13% and 21% in the seasonal impoundments (Table 6). Thus, replacing a movable dam with a permanent dam would result in increased panfish populations at the expense of gamefish populations. The winter dewatering that now occurs from December 1 through May 1 should be continued to preserve the high quality smallmouth bass fishery. Placement of permanent dams could also interfere with the walleye spawning run.

Hydropower Operation

There are six hydropower facilities on the Mohawk River from the mouth upstream to Lock 17. The three new facilities (Mohawk Mills, NYS Dam, and Lock 17) built since 1983 operate in a run of river mode. The School Street facility operating license expires December 31, 1993. As part of its relicensing effort for School Street, NMPC is proposing to operate in a run of river mode with pondage (maximum 1 ft drawdown of their 80 acre impoundment). The Crescent and Vischer Ferry facilities operate in a storage and release mode whenever river flows are less than 3,250 ft^3/s which is about 45% of the year. At flows above 3,250 ft^3/s, these two facilities operate in a run of river mode.

Crescent and Vischer Ferry were relicensed by FERC in 1984 with an expiration date of 2024. The relicensing project reviews for Crescent and Vischer Ferry were limited by FERC hydropower licensing policy to the project boundaries which excluded the lower river downstream of the Diversion Dam. Consequently, the adverse impact of fluctuating river flows downriver could not be addressed or mitigated. A conservation flow of 100 ft^3/s is currently required at Crescent but NYPA has voluntarily increased this flow to 300 ft^3/s. The required and voluntary conservation flows are inadequate to mitigate the existing adverse fisheries impact of fluctuating river flows in the 2.6 mi of river downstream of Cohoes Falls and are also inadequate as base flows when Crescent is in the storage phase of the generating cycle. Article 36 and 40 of the FERC license for Crescent states that the effectiveness of the minimum flow requirement for the protection and enhancement of aquatic resources in the Mohawk River must be evaluated. NYPA should be required by FERC to initiate these evaluation studies downstream of Cohoes Falls and to determine what the appropriate flow should be. Higher flows should result in a more productive fishery. FERC, however, has rejected DEC's position.

Ideally, NYPA should be required to change the storage and release operation at Vischer Ferry and Crescent to run of river. In the event that this effort fails, a higher minimum flow release at Crescent than the voluntary 300 ft^3/s currently being released should be obtained. This would help mitigate but not eliminate the adverse impacts of fluctuating stream flows downstream of Cohoes Falls. When Crescent and Vischer Ferry are up for relicensing in 2024, the operating mode should be changed to run of river. All new and relicensed facilities on the Mohawk River should be required to operate in a run of river mode. The base flow requirement in the event we cannot achieve run of river should be 1,712 ft^3/s (30% of average annual flow).

Stream Bypass

NMPC should be required by FERC to provide a minimum base flow to the 0.8 mi bypass reach from the Diversion Dam downstream to Cohoes Falls (Figure 4). As part of their relicensing effort for the School Street project, NMPC completed an instream flow incremental methodology (IFIM) study. As a result of IFIM modelling, NMPC is proposing a 60 ft^3/s bypass flow to improve aquatic habitat and aesthetic flows over Cohoes Falls. DEC and the USFWS have reviewed this study and determined the proposed flow was inadequate. The IFIM study suggests that a 400 ft^3/s flow would provide minimum habitat suitability. The proposed 60 ft^3/s bypass flow is equivalent to approximately 8% of the 754 ft^3/s MA7CD10 flow and 1% of the average annual flow. At Barberville Falls, approximately 12 mi to the southeast, FERC staff recommended that a minor hydropower project not be licensed largely for aesthetic reasons even though the developer agreed to a minimum flow almost four times higher than the MA7CD10 flow. Negotiations are ongoing between DEC, USFWS, and NMPC. When the School Street project is relicensed, a bypass flow requirement should be a license condition. It is possible, however, that the FERC required flow may not be adequate to protect the aquatic resource in the bypass reach.

Fourth Branch Associates (FBA), owner/operator of the Mohawk Mills hydropower project is currently required by their FERC license exemption to provide a minimum base flow of 200 ft^3/s downstream which is equivalent to 8% of the average flow. A 40 ft^3/s flow is spilled over the West Dam to the 250 ft bypass reach and 160 ft^3/s is spilled over the East Dam to the 1,400 ft bypass reach (Figure 4). The existing conservation flow is believed inadequate to maintain the fisheries resource in the bypass reaches downstream of the East and West Dam because the flow only provides for short term survival. As part of the license exemption, FBA agreed to undertake all studies, modeling, surveys, etc. necessary to assess the significance of the dewatered area and to adjust the minimum spillage requirements as deemed necessary by DEC. DEC should ask FERC to require FBA to initiate these studies.

Although none is proposed at the present time, development of a hydropower facility in the landcut canal upstream of Lock 16 could significantly reduce flows to the 4.4 mi long natural channel downstream of Five Mile Dam (Figure 2). This largest remaining segment of undisturbed natural river in the lower 80 mi of Mohawk River would be adversely impacted because river flows would be diverted from the natural river channel to the landcut canal. This river reach is a remnant of what the lower Mohawk River was and consists of numerous shallow pools and riffles. This 4.4 mi segment should be treated as unique and any proposals to alter flows should be viewed with extreme caution. Hydropower development in the landcut canal downstream of Five Mile Dam should be opposed. This recommendation will be forwarded to the NYTA for inclusion in the Canal Master Plan that will be developed for the statewide barge canal system.

Fish Passage

Entrainment impacts of hydroelectric plant operation on anadromous fish species moving downriver must be addressed. The species of primary concern is the anadromous blueback herring, both adults and juveniles. At existing hydropower facilities, virtually all river flows are diverted through the generating plant. As a result, turbine mortality has the potential to adversely affect the magnitude of the blueback herring run. Also, reduced flows in the bypass reaches may result in hazardous conditions for passage, including increased predation. Since 1985, the Crescent and Vischer Ferry facilities have doubled their generating capacity and the New York State Dam and Mohawk Mills facilities were built. School Street is proposing to increase its generating capacity by 50%. Another 11 hydropower projects have been proposed, but all have been dropped primarily for economic reasons. Ultimately, there could be as many as 16 hydropower projects throughout the lower Mohawk River. Not all the proposed power plants may be built but there are no guarantees that none will be built. The cumulative impacts of these projects on downstream migration of adult and juvenile herring must be addressed including those by the existing five projects on the lower Mohawk.

Site specific turbine mortality of outmigrating herring may not be an issue but the cumulative impact may be significant. For example, a cohort of 1,000 juvenile herring upstream of Lock 16 could someday pass through as many as 16 hydropower facilities before reaching the Hudson River. If the turbine mortality at each facility was 5, 10, 15, 20, and 25, and 30%, total mortality of the 1000 fish would be 58, 81, 92, 97, 99, and 100%, respectively. For existing facilities (5) on the lower Mohawk, a 10% turbine mortality at each site would result in a cumulative mortality of 37%. Thus, cumulative turbine mortality impacts could greatly reduce and possibly eliminate the spawning run of blueback herring to upstream reaches of the Mohawk River. Therefore, hydropower developers must be required to provide an effective bypass system for adult and juvenile herring at each facility. Plant shutdown during the outmigration period should be required if no other mitigative measures are deemed adequate.

Currently only the New York State Dam and Mohawk Mills projects have fish bypass systems which are in the process of being evaluated for their effectiveness. The Mohawk Mills fish bypass was found to be ineffective and a new bypass facility will be built and evaluated. The School Street facility should be required to provide a fish bypass facility as part of its relicensing effort (license expired December 31, 1993). NMPC is proposing to pass herring preferentially through their proposed Kaplan turbines since studies at the Crescent facility immediately upstream suggested that outmigrating juvenile herring turbine mortality was only 4%. DEC and the USFWS do not agree with NMPC position since the head at School Street is almost three times higher than at Crescent. The Crescent study was also flawed.

The magnitude of entrainment and turbine mortality of resident fish species passing through lower Mohawk River hydropower facilities are unknown. Ongoing entrainment studies conducted throughout New York show that entrainment rates are highly variable and that turbine mortalities are species specific and size related (Mark Woythal, DEC, personal communication). Variabilities in entrainment and mortality rates between turbines at the same site and projects on the same river can be quite different. In the absence of site specific studies on the lower Mohoawk River, downstream fish passage facilities should be provided for resident fish species at all hydropower facilities.

Upstream fish passage for existing hydropower facilities is not an issue at the present time. Fish can and do utilize the navigation locks to move upriver as evidenced by the presence of blueback herring throughout the lower Mohawk River. The locks will continue to be operated by the NYTA as navigation locks for both commercial and recreational boat traffic. Lockages are for boats only. When boat traffic is absent or light, upriver herring movement may be delayed. These delays can be mitigated by operating the locks for passing herring upriver especially in the Waterford Flight connecting the Hudson and Mohawk Rivers. Discharges from new hydropower facilities could have an adverse impact on the potential upstream passage of adult fish by diverting fish way from the lock entrance. This potential impact should be evaluated and mitigated if necessary.

<u>Contaminants</u>

PCB's are present in Mohawk River fish but at levels less than the FDA tolerance level of 2.0 ppm. THe current health advisories for the consumption of white perch (eat none) and smallmouth bass (one meal/month) caught downstream of Lock 7 were terminated April, 1994. White perch PCB levels had declined from 7.3 ppm in 1983 to 3.4 ppm in 1987 to 1.3 ppm in 1992 and smallmouth bass PCB levels of legal size bass ($\geq$ 12 in) over the same time period declined from 2.6 to 2.1 ppm to 0.8 ppm in 1992 (Table 3).

Blueback Herring

The lower Mohawk River supports a major spawning run of anadromous blueback herring with fish migrating as far as Rome, approximately 120 mi upriver. Juvenile herring are an important forage species (McBride 1985). Maintenance of the blueback herring run throughout the lower Mohawk River is essential for continuance of the river's high quality sportfishery (McBride 1985). Unfortunately, there is little information on the status of blueback herring in the Mohawk River. What is known is that the population probably has great year to year variability. Limited sampling below Lock 9 found that 4% of the adult herring collected in 1993 were Age 3 compared to 27% in 1990 (unpublished data, Region 4 Fisheries files). However, the limited information (age and growth; percentage repeat spawners) available may not be representative of the entire run.

Annual monitoring of the adult run is needed to determine the status of the herring population. Over time, it could then be possible to determine population trends (up, down, or holding its own). If the trend line is downward, than causitive factors for the decline would be more readily identifiable and corrective measures implemented. Implementing a monitoring program of this scope is beyond the current capabilities and resources of the Region 4 Fisheries Office. Such an undertaking would be appropriately funded through a consortium of Mohawk River hydropower developers upon development of a plan of study for blueback herring. This study proposal would involve DEC, USFWS and other resource agencies with an interest in Mohawk River blueback herring.

Zebra Mussel

Zebra mussel, an introduced exotic mollusk from Europe, were found in the Crescent Dam to Lock 7 reach of the Mohawk River in 1991. By 1993, these mussels formed dense colonies on natural substrates and man-made structures throughout the lower river. The ecological and non-biological impacts could be significant. Measures to control zebra mussels are under development. Chemicals are effective but may be toxic to non-target organisms. DEC and affected parties (individuals, industries, other governmental agencies, etc) must work cooperatively to evaluate the impact of zebra mussels and to develop effective control measures.

Fish Surveys

Fish populations throughout the lower Mohawk River were sampled extensively from 1979 through 1983 (McBride 1983). In addition, there have been special studies focusing on smallmouth bass and walleye. Additional intensive riverwide sampling is not needed in the forseeable future. How- ever, this could change if there is a need to assess the impact of zebra mussels infestions or the demise of the blueback herring run on riverwide fish populations. Until such time, fish studies should focus on specific needs as they may arise.

Fish Stocking

Tiger musky have been stocked in the Mohawk River since 1980 to develop a trophy fishery for fish weighing more than 8 lb.

Approximately 18,000 fall fingerling tiger musky are stocked annually at a rate of 6 fish/acre in the 20.3 mi reach of river between Crescent Dam and Lock 8. Fish are currently being stocked at about one half the recommended rate. Beginning in 1994, the stocking rate will be reduced to 3-4 fish/acre or 9-12,000 fish total because the average size of tiger musky fingerlings will be 9 in and result in higher survival. Tiger muskies are not stocked upstream of Lock 8 because of abundant game fish populations. Downstream movement has resulted in a limited tiger musky fishery in the 4.2 mi reach of river below Crescent Dam.

Fishing Regulations

Existing statewide angling regulations for the Mohawk River are still appropriate and should be continued. Statewide regulations adequately protect the warmwater fisheries resource while providing good catch rates. However, situations may change and special regulations may become appropriate at some future time.

Walleye exploitation may be as high as 44% but the age and size distribution suggests that over exploitation was not a problem affecting angling quality in 1984 and 1985 (McBride 1988). If overexploitation should become a problem, an 18 in minimum size limit and 3 fish/day creel limit regulation should be implemented riverwide. Smallmouth bass exploitation is currently less than 20% which is considered low (McBride 1993). Modelling studies predict that the abundance of bass $\geq$ 14 in will decline as exploitation exceeds 50% (McBride 1993). If exploitation should increase to a high level, an experimental 14 in minimum size limit regulation should be implemented on at least two adjacent lock pools to assess the impact of a higher size limit on bass abundance, biomass, growth, and the age and size structure.

Except for crappie, panfish catch is not currently regulated and they can be taken at any time in any number or size. Recent studies outside New York have shown that panfish angling quality can be improved through creel and minimum size limit regulations in overexploited fisheries. However, panfish exploitation is not known to be a problem in the Mohawk River. There is, however, a commercial hook and line fishery of unknown magnitude for panfish on the river.

Fishing Ban

Fishing is currently prohibited at the mouth of the Mohawk River even though contaminant levels in fish are at levels which, elsewhere, would permit fishing with appropriate health advisories. The New York State Department of Health (DOH) has a general advisory that recreational anglers should eat no more than one meal (0.5 lb) per week of fish from any water in the state. Special restrictive advice for sport fishing are issued when contaminant analysis reveal levels which exceed FDA tolerance levels. For PCB's, the following guidelines are in effect (Ronald Sloan, DEC, personal communication):

$\geq$ 2.0 ppm - eat no more than one meal per month

$\geq$ 6.0 ppm - eat none

PCB levels in 12 fish species collected in 1991 from the 5 mi Hudson River reach between the Troy Dam and Lock 1, which includes the Mohawk River, ranged from 0.4 to 11.9 ppm (Table 4). Ten of the 12 species collected had PCB levels under 2 ppm compared to 8 of 13 species collected downstream of the Troy Dam where fishing is allowed (Table 4). Unfortunately, PCB levels in fish collected in 1992 increased significantly over 1991 levels. Between the Troy Dam and Lock 1, only three of nine species collected had PCB levels under 2 ppm but only two species (common carp and white perch) had PCB levels over 6 ppm (Table 4). Below the Troy Dam, three of the 15 resident species collected had PCB levels under 2 ppm and five species (common carp, goldfish, smallmouth bass, walleye, and white perch) had PCB levels over 6 ppm. Although closed to fishing, the river mouth is a popular fishing area. The fishing ban should be enforced or the regulation changed to at least allow fishing on a catch and release basis. Opening this reach of Mohawk River downstream of the NYS Dam to fishing would create 252 acres of additional fishing opportunity in the metropolitan Capital District area. DEC and DOH should evaluate the need to continue the fishing ban at the mouth of the Mohawk River.

Access

Public access throughout the Mohawk River is generally good. All lock pools except the Lock 9 and 11 Pools have trailered boat launch facilities. Shore fishing is generally available at both sides of all dams.

Hydropower development has the potential to reduce shoreline access for anglers fishing at the many dams. In 1982, approximately 86% of the shorefishing effort occurred at the locks and dams (McBride 1983). Therefore, all hydropower developers should be required to provide a fishermen parking area for 10-12 cars and safe shore fishing access to the tailwater discharge area as part of its FERC license. The need for boat access must be determined individually for each hydropower site.

Cartop boat access should be provided to the 4.4 mi natural river reach between Five Mile Dam and Lock 16. Launch sites at Five Mile Dam and Lock 16 should be constructed. This recommendation should be incorporated into the statewide Canal Development Master Plan which is to be prepared by the NYTA. DEC could construct the access site if the NYTA improved the access road to Five Mile Dam.

Construction of a trailered boat launch near the mouth of Cayadutta Creek in Fonda midway between Locks 12 and 13 would complete DEC's formal boat access program for the lower Mohawk River. This will not be possible unless the Village of Fonda agrees to it and agrees to assume routine maintenance (mowing, trash pick-up, etc).

DEC will continue to address access problems and take advantage of access opportunities that may arise. DEC's future role will be to maintain existing boat launch sites and to provide technical assistance to local governmental agencies interested in increasing or improving shore and boat fishing access.

Canal Lands Development

New York voters in November, 1991, authorized tolls on the statewide canal system, which includes the Erie Barge Canal, and long term leasing of state owned land along the canal. A canal master plan will be completed by January 1, 1995, to maximize the recreational and tourism potential of the canal system. DEC should be a member of the planning team responsible for preparation of the canal master plan. The Region 4 Fisheries Office will provide information and other assistance as needed and/or required for the lower Mohawk River.

Publicity

The Mohawk River has received extensive publicity, including numerous articles in area newspapers and articles in a variety of outdoor magazines, on the excellent fishing that the river offers. In 1986, DEC developed a fishing guide to the lower Mohawk River. The Capital District Fishing Brochure, released in 1992, is expected to generate increased attention to the lower river. Since fishing pressure on the river is relatively high by New York standards, additional publicity is not needed. The Mohawk River fishing brochure, however, should be updated and reprinted as needed as a service to anglers.

Angler Use Surveys

Angler use averaged 18.6 trips/acre on the Mohawk River in 1982 and the estimated total angler use was 115,245 trips (McBride 1983). Based on aerial angler count data fishing pressure has decline about 18% since 1983 (Table 8). Reasons for the decline are not known. Near term monitoring of angler use on the Mohawk River is not necessary.

Law Enforcement

Anglers frequently complain about the lack of law enforcement along the Mohawk River, specifically the harvest of bass and walleye during the closed season and the harvest of sublegal fish. The extent of the problem is unknown but there is no evidence to suggest that the illegal harvest is adversely impacting angling quality. There is a need, however, to curb the perception of illegal activity. The Region 4 Fisheries Office should prepare an annual news release for regional distribution on the purpose and importance of angling regulations. Anglers should be encouraged to report violators of fishing regulations. They should include vehicle description, license number, boat description and registration number and description of the individual(s). Although tickets may not be issued, a visit by an ECO will at least put the alleged violator on notice which may make the individual less likely to violate fish and wildlife laws in the future.

Fishing Tournaments

Tournament bass fishing is popular on the Mohawk river. Although large numbers of fish are caught and weighed in during the course of a season, tournament anglers release their catch and help foster the catch and release concept which has helped maintain good fisheries in many waters. A potential downside of tournament bass fishing, especially on riverine systems, involves the capture of bass over a wide stretch of river and their subsequent release at a central weigh in site. In the St. Lawrence River, studies showed that tournament caught and released largemouth and smallmouth bass did not show significant post-tournament movement or return to their capture sites (Klindt and Schiavone 1991).

If a given site should become the primary tournament headquarters for the Mohawk River, tournament related relocation of bass would be of more concern. At the present time, DEC lacks authority to regulate this fishing activity. DEC will continue to investigate potential tournament impacts as staff resources allow. If problems are documented we will first attempt to rectify such problems through communication and discussion with apporpriate bass fishing organizations. As circumstances dictate, regulations to provide time and space limitations on tournaments and insure that all tournaments meet the standards of the better run events will be given consideration.

Commercial Fisheries

There is a limited commercial fishery of unknown magnitude on the Mohawk River for the taking of bait fish and the sale of hook and line caught panfish. Emerald shiner, the primary target of bait fishermen, has reportedly declined to low levels of abundance and are not catchable in commercial quantities. Black and white crappie were reportedly the primary target for the hook and line commercial fishery. With the imposition of statewide size and creel limit on crappie in October, 1992, the emphasis has shifted to yellow perch and bluegill.

The commercial bait fishery is probably very small. The cause of a decline in emerald shiner abundance may never be determined. It would be desirable to determine the current level of emerald shiner abundance. The seining portion (4-13 hauls/pool) of the 1982-83 fisheries survey in the Crescent Dam to Lock 16 reach should be repeated when time and priorities allow such an effort.

The impact of the commercial hook and line fishery for yellow perch, bluegill and other unregulated panfish is unknown. There is, however, something inherently wrong with potential over utilization of a public resource for personal financial gain. Commercial fishing can also result in an inequitable distribution of a the resource, particularly for larger, quality size fish. New York is only one of four states that allows the unregulated sale of panfish with 41 states prohibiting the sale of angler caught panfish (P. Festa, DEC, personal communication). Commercial sale of panfish caught in the Mohawk River is probably not appropriate in the interest of optimal resource allocation. If legislation necessary to regulate this activity is not supported, creel limits for panfish over a certain size may need to be implemented to assure an equitable distribution of panfish.

Management Plan Evaluation

Mohawk River management objectives are based on target species catch rates. Smallmouth bass and walleye catch rates will be evaluated simultaneously through the use of angler diary cooperators. The diary program will be similar in design and scope to the 1982-86 effort. However, the diary program will run two years and possibly three years instead of five as done earlier.

The evaluation should be done at 10 year intervals beginning in 1996. The last riverwide diary program ended in 1986. If catch rates should be lower than the targets, tagging programs should be implemented on selected lock pools to determine if overexploitation is a problem. Panfish catch rates will be monitored through creel checks that focus primarily on the permanent impoundments downstream of Lock 8. This should be a one year effort conducted every 10 years beginning in 1996.

MANAGEMENT RECOMMENDATIONS

The following recommendations should be implemented to help achieve the plan's objectives.

Hydropower Development

1. Oppose new dam construction in the lower Mohawk River.

2. Continue the December through April drawdown of the Lock 8-16 reach on the lower Mohawk River that results from the removal of the gates and uprights. Replacement of movable dams with permanent dams should be opposed.

3. Oppose hydropower development at Lock 16 to preserve the 4.4 mi natural river reach downstream of Five Mile Dam.

4. Recommend installation of downstream fish passage facilities for juvenile and adult herring utilizing the best available technology. If these facilities are ineffective in protecting outmigrating adult and juvenile herring, plant shutdown during the outmigration period may be required. Downstream fish passage facilities should reduce site specific and cummulative impacts of turbine mortality.

5. Recommend installation of downstream fish passage facilities for resident fish species utilizing the best available technology.

6. Recommend to FERC that hydropower developers be required to construct or provide fishermen parking and shoreline access to the tailwater discharge area. The need for boat access will be determined individually for each site.

7. Recommend to FERC that the School Street hydropower developer be required to provide shoreline access to the tailwater discharge below Cohoes Fall and to the bypass reach between the Diversion Dam and Cohoes Fall. They should also be required by FERC to construct a cartop launch to the impoundment upstream of the Diversion Dam.

Hydropower Operation

1. Recommend to FERC that all new and relicensed hydropower facilities be required to operate in a run of river mode. The change in operational mode will stabilize streamflows in the 2.6 mi of river downstream of Cohoes Falls.

2. Recommend to FERC that the operator of the Crescent hydropower facility evaluate the required 100 ft^3/s and 300 ft^3/s voluntary minimum flow to the Mohawk River downstream of Cohoes Falls. Article 36 and 40 of the FERC license for Crescent states that the effectiveness of the minimum flow requirement for the protection and enhancement of aquatic resources in the Mohawk River must be evaluated.

3. Recommend to FERC that the School Street hydropower operator be required to provide a 400 ft^3/s minimum base flow with channel modification to the 0.8 mi bypass reach between the Diversion Dam and Cohoes Fall. NMPC proposed 60 ft^3/s minimum flow requirement is inadequate.

4. Recommend to FERC that the Mohawk Mill hydropower operator be required to evaluate the 200 ft^3/s minimum flow release to the 250 and 1400 ft bypass reaches. As part of his license exemption, the Mohawk Mills operator agreed to undertake all studies, modelling, surveys, etc necessary to assess the significance of the minimum flow requirements.

5. Recommend to FERC that all new hydropower facilities be required to evaluate their impact on the upstream fish passage of adult blueback herring through the navigation lock. Mitigation may be required.

Angler Access

1. Construct a DEC trailered boat launch near Cayadutta Creek if the Village of Fonda agrees to it and agrees to assume routine maintenance responsibilities. Construction of this launch site will complete DEC's formal boat access program for the lower Mohawk River. DEC's future role will be to maintain existing boat launch sites and to provide technical assistance to local governmental agencies interested in increasing or improving shore and boat fishing access.

2. Recommend to FERC that all hydropower developers be required to construct or provide fishermen parking and shoreline

access to the tailwater discharge area. The need for boat access will be determined individually for each site.

3. Recommend to FERC that the School Street hydropower developer be required to provide shoreline access to the tailwater discharge below Cohoes Falls and to the bypass reach between the Diversion Dam and Cohoes Falls. They should also be required by FERC to construct a cartop launch to the 80 acre impoundment upstream of the Diversion Dam.

4. Develop car top access to the 4.4 mi natural river reach between Five Mile Dam and Lock 16. This also requires improvement to the access road to Five Mile Dam. Development responsibility should be determined upon completion of the statewide Canal Development Master Plan by the NYTA.

<u>Cooperative Studies</u>

1. Develop cooperatively with affected parties measures to control the non-biological impacts of zebra mussels on man made structures. The Region 4 Fisheries Office will participate in biological studies as required.

2. Participate in the NYTA preparation of the statewide canal master plan. The Region 4 Fisheries Office will provide information and other assistance as needed and/or required.

<u>Fisheries</u>

1. Collect fish for contaminant analysis as required. DEC's Bureau of Environmental Protection would carry out the laboratory analysis of the fish collected.

2. Initiate fish studies that focus on specific needs as they may arise such as overexploitation of walleye or the status of emerald shiners. Intensive riverwide sampling is not needed in the forseeable future.

3. Stock approximately 9-12,000 fall fingerling tiger muskies annually in the 20.3 mi reach between Crescent Dam and Lock 8. The stocking rate will be 3-4 fish/acre effective in 1994. The Region 4 Fisheries Office will stock the fish by boat to assure adequate distribution of fish throughout the stocked reach.

4. Continue existing statewide angling regulations throughout the Mohawk River since they are adequate to maintain the existing high quality fishery. If overexploitation of walleye should occur, an 18 in minimum size and 3 fish creel limit will be implemented riverwide. Exploitation rates of 50% or higher for smallmouth bass may require implementation of an experimental 14 in minimum size limit on two adjacent lock pools.

5. Develop a blueback herring study plan outlining the informational needs required to assess the status of herring in the river. Implementing a study of this scope is beyond the current capabilities and resources of the Region 4 Fisheries Office.

6. Increase lockages at the Troy Dam and Waterford Flight during May to facilitate upstream movement of adult blueback herring. Develop a plan for NYTA and COE review and implementation.

7. Meet with the DOH to evaluate the need to continue the ban on fishing in the Hudson River upstream of the Troy Dam.

8. Continue to work with the Region 4 Law Enforcement Office in an effort to resolve angler complaints about the lack of enforcement of fishing regulations on the river.

9. Develop an annual news release on the purpose and importance of angling regulations.

10. Investigate potential fishing tournament impacts as staff resources allow and rectify any problems through communication and discussion with appropriate bass fishing organizations.

11. Seek legislative authority that will allow DEC to prohibit the commercial sale of hook and line caught panfish.

12. Implement two year smallmouth bass and walleye angler diary programs and a creel check of panfish anglers in 1996 to monitor catch (creel plus release) rates. These programs should be repeated as necessary to determine if catch rate objectives for these species are being met.

13. Promotion of fishing opportunities on the Mohawk River is not needed due to existing high fishing pressure and the promotional efforts of the private sector. The Mohawk River fishing brochure should be updated and reprinted as necessary.

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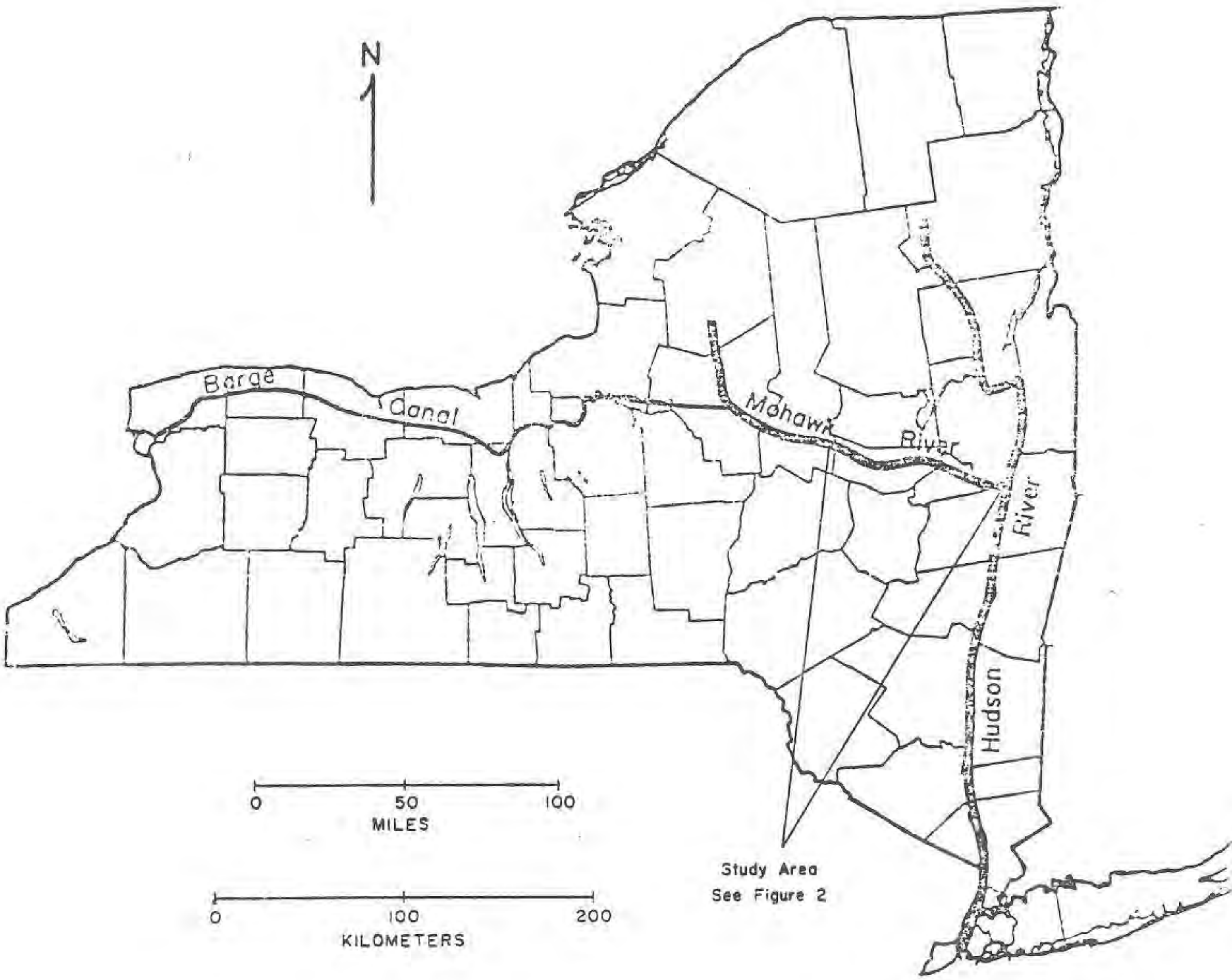


Figure 1: New York State showing the Hudson River, Mohawk River, and Barge Canal.

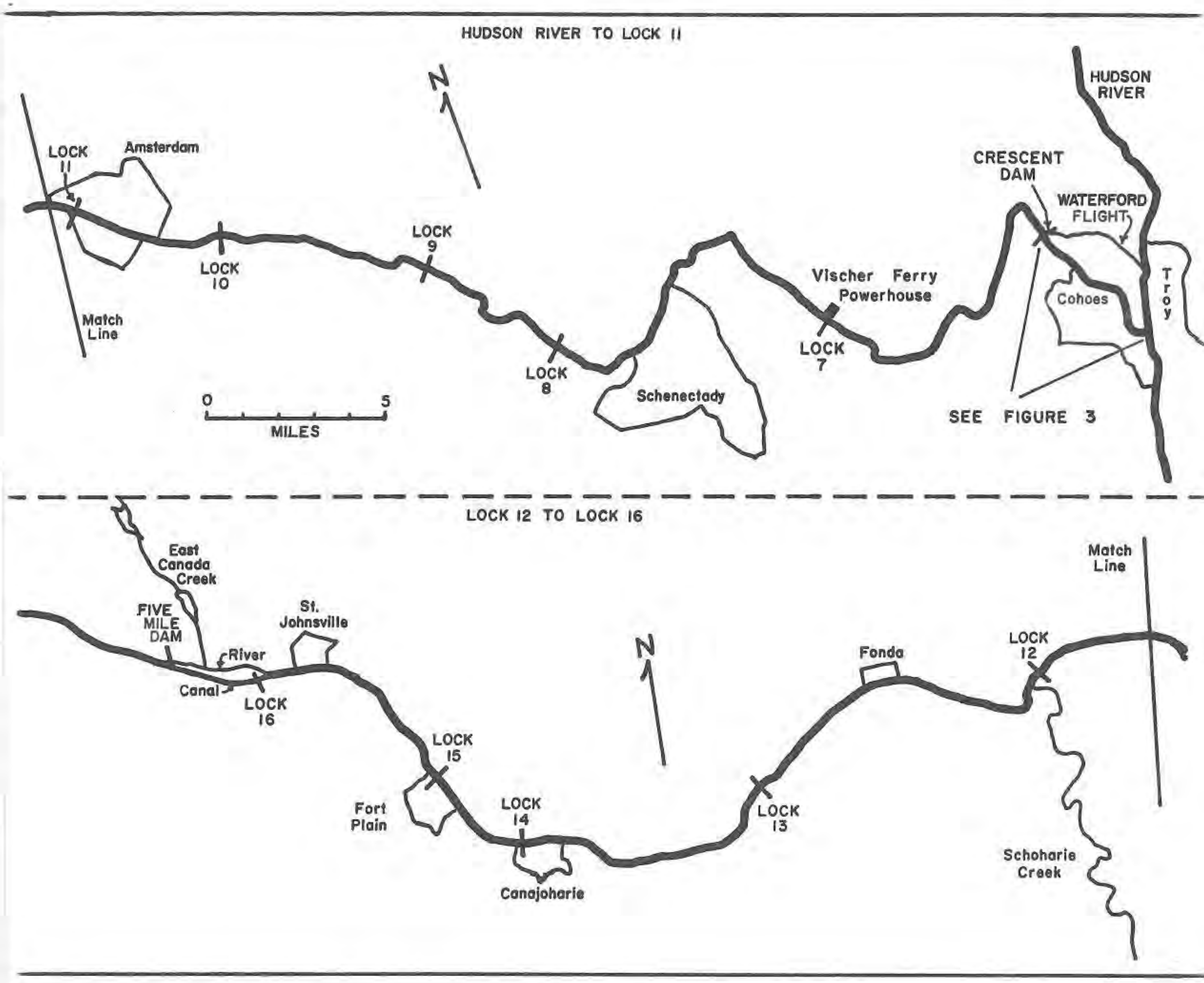
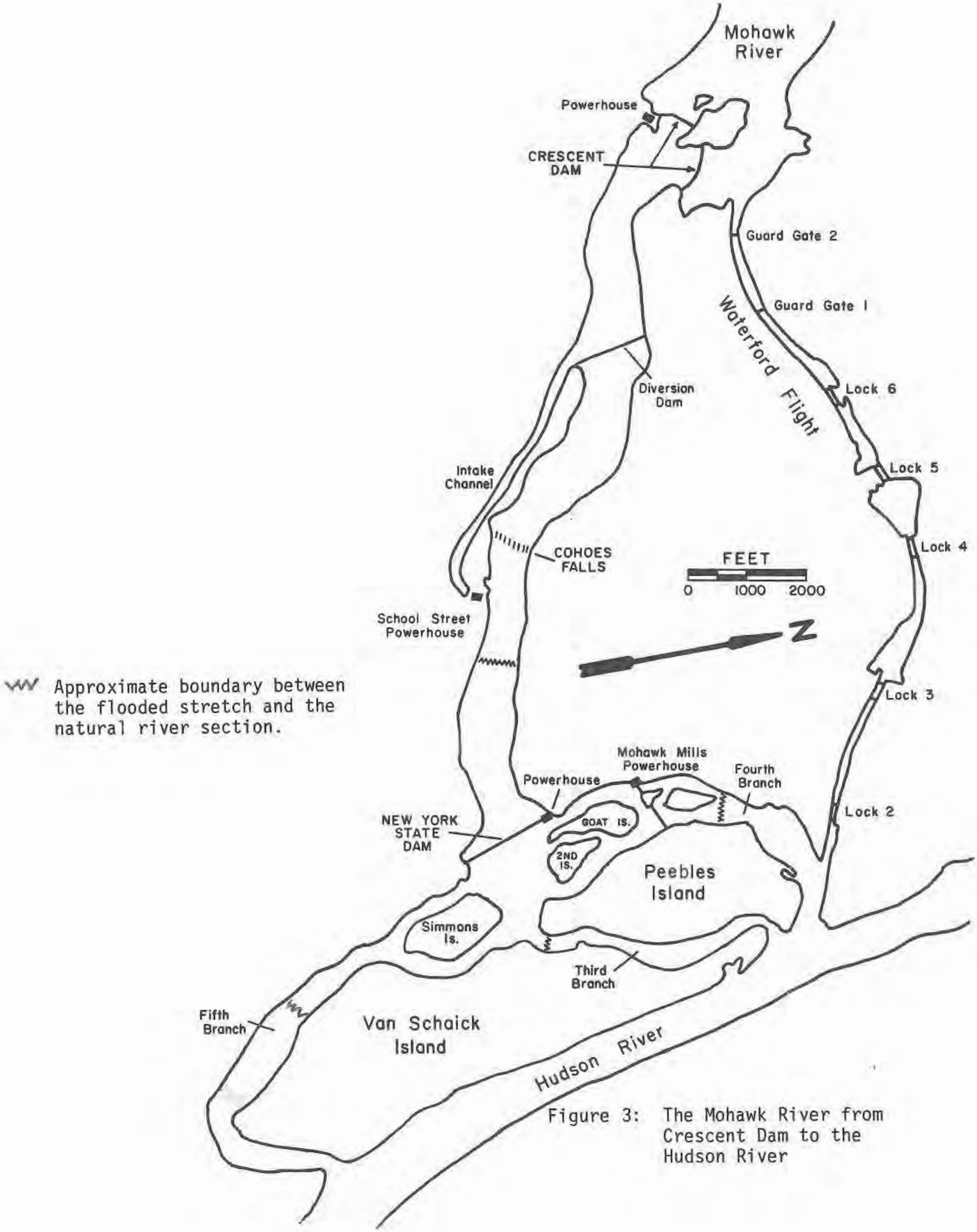


Figure 2: The lower Mohawk River from Five Mile Dam downstream to the Hudson River.



Approximate boundary between the flooded stretch and the natural river section.

Figure 3: The Mohawk River from Crescent Dam to the Hudson River

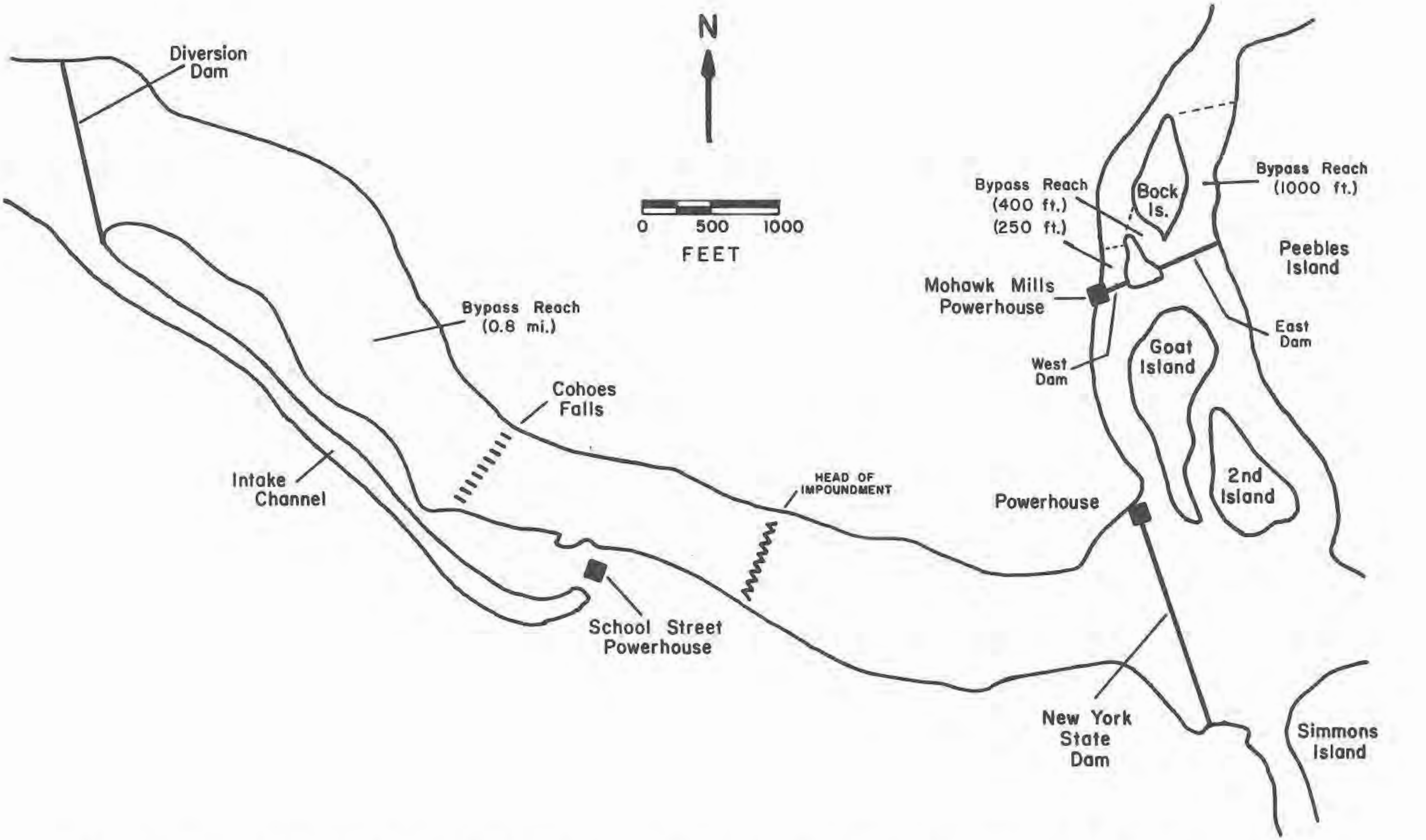


Figure 4: The lower Mohawk River downstream of the Diversion Dam showing the location of the two bypass reaches.

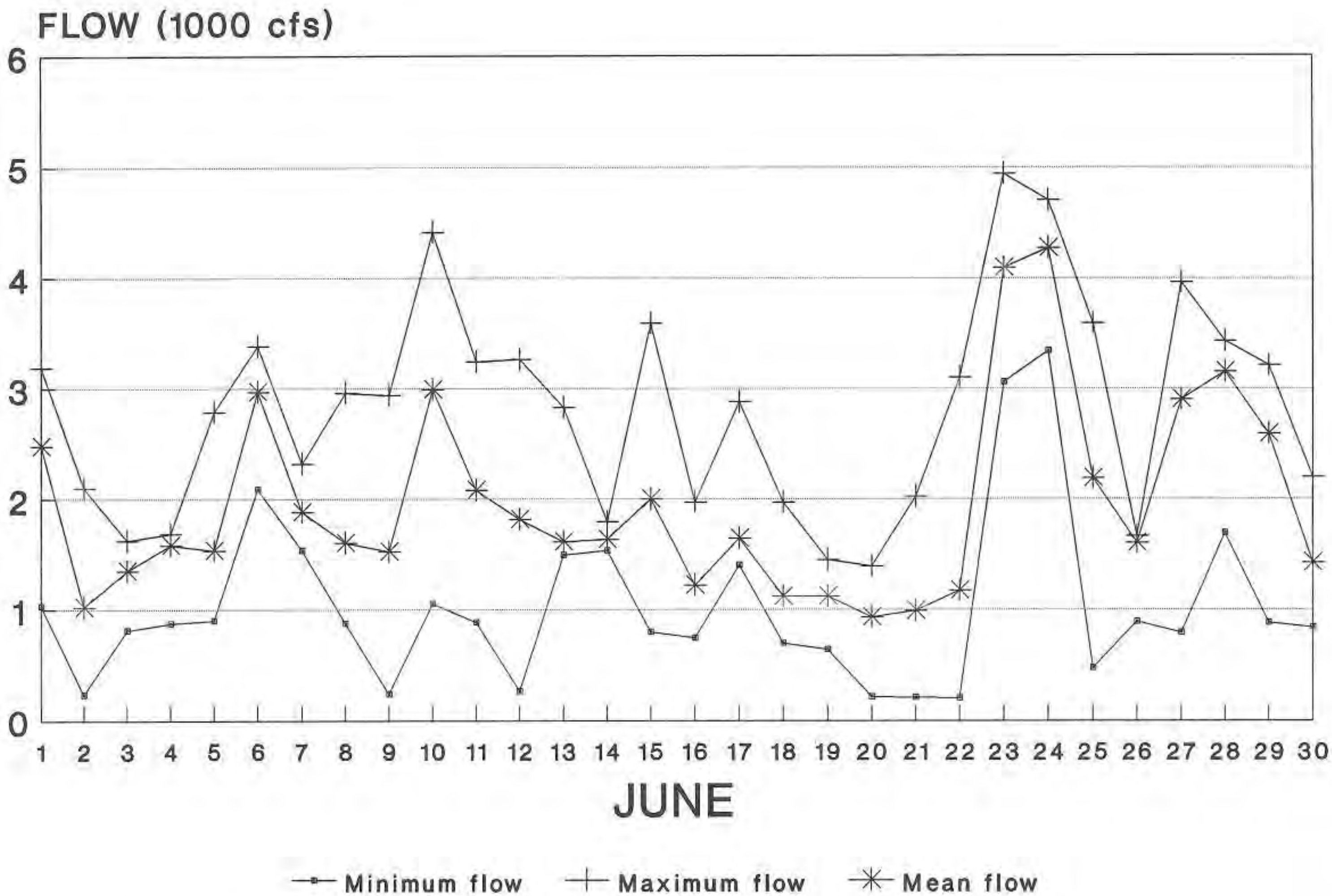


Figure 5: Low, mean, and maximum daily June, 1987, flows in the Mohawk River at the USGS gauging station located approximately 0.2 mi downstream of the Cohoes Falls.

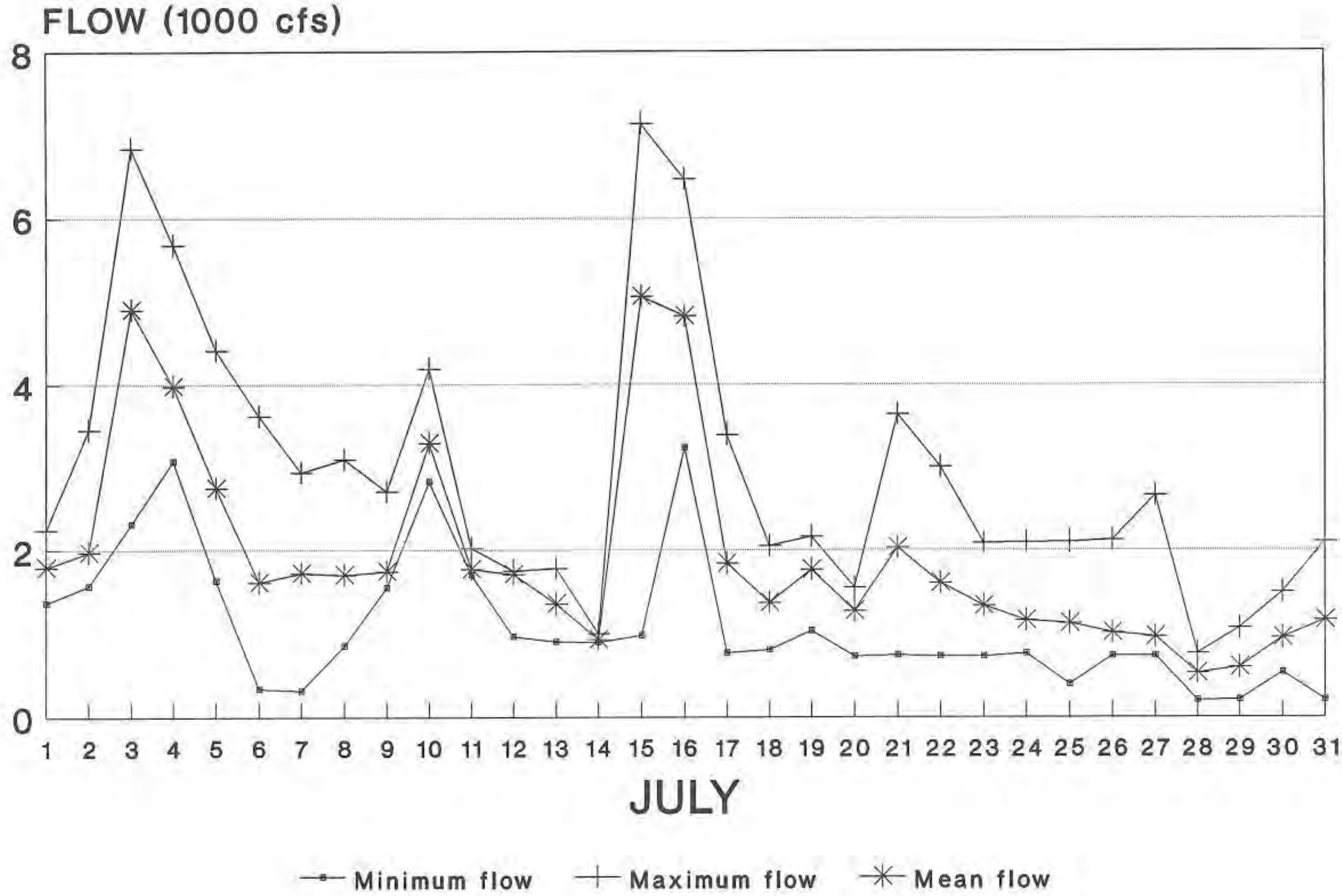


Figure 6: Low, mean, and maximum daily July, 1987, flows in the Mohawk River at the USGS gauging station located approximately 0.2 mi downstream of the Cohoes Falls.

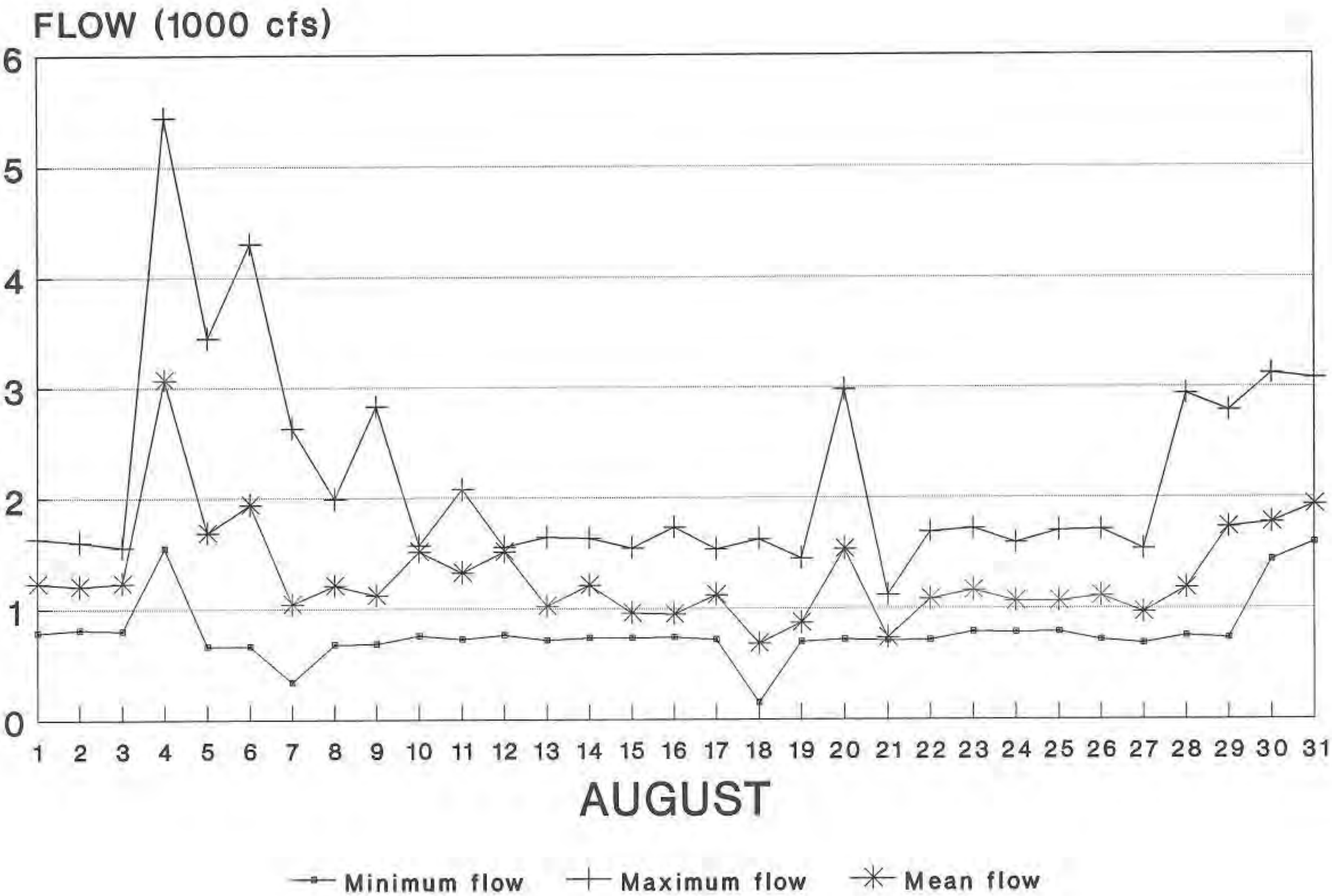


Figure 7: Low, mean, and maximum daily August, 1987, flows in the Mohawk River at the USGS gauging station located approximately 0.2 mi downstream of the Cohoes Falls.

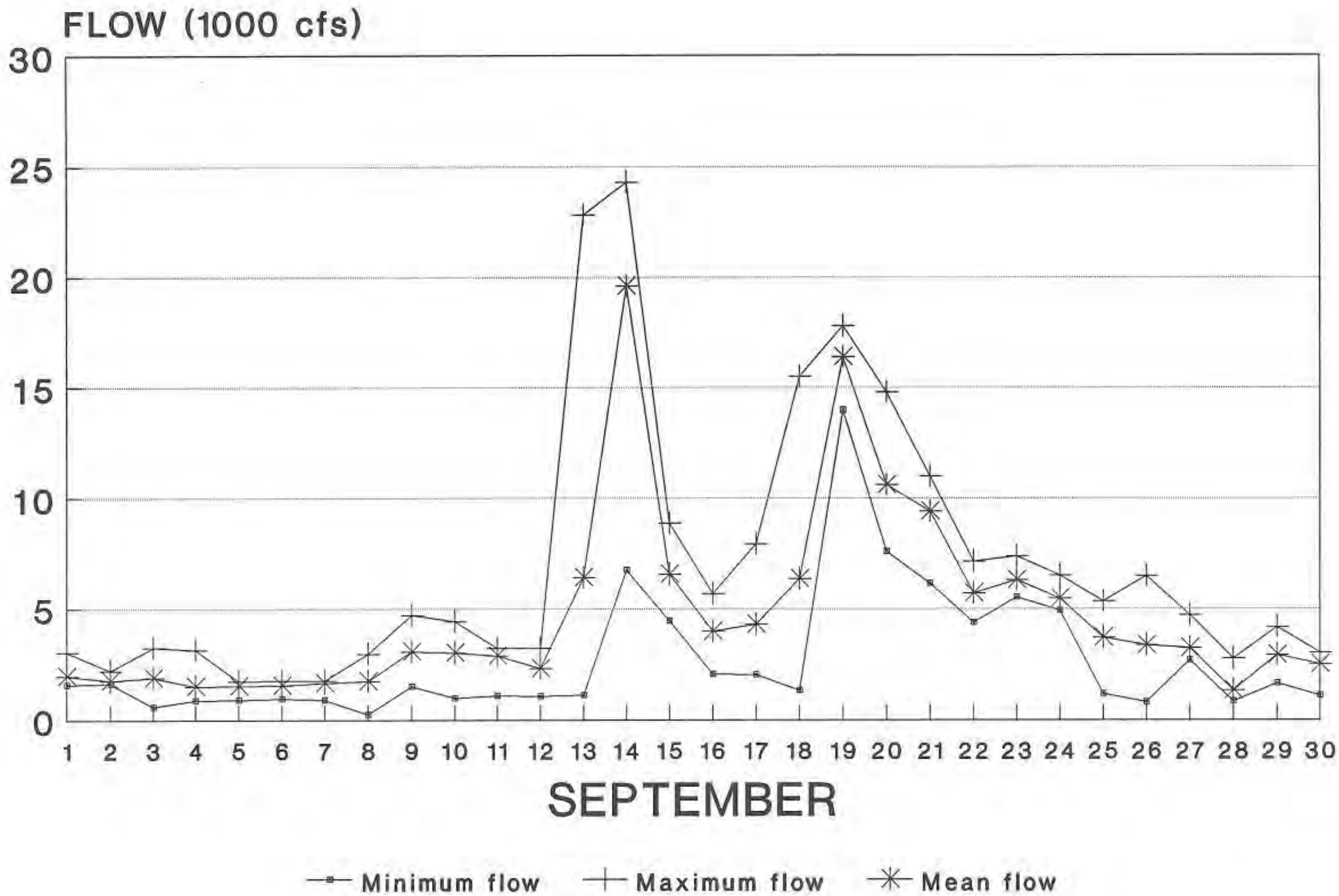


Figure 8: Low, mean, and maximum daily September, 1987, flows in the Mohawk River at the USGS gauging station located approximately 0.2 mi downstream of the Cohoes Falls.

Table 1: Common and scientific names of fishes collected in the Mohawk River from its confluence with the Hudson River to Five Mile Dam

		1934	1970-1971	1979-1983
FRESHWATER EELS				
American eel	Anguilla rostrata	X	X	X
HERRINGS				
Blueback herring	Alosa aestivalis	X	X	X
Alewife	Alosa pseudoharengus	X		X
American shad	Alosa sapidissima			X[a]
Gizzard shad	Dorosoma cepedianum			X
MINNOWS AND CARPS				
Central stoneroller	Campostoma anomalum			X
Goldfish	Carassius auratus	X	X	X
Lake chub	Couesius plumbeus	X		
Satinfin shiner	Cyprinella analostanus	X	X	X
Spotfin shiner	Cyprinella spiloptera	X		X
Common carp	Cyprinus carpio	X	X	X
Cutlips minnow	Exoglossum maxillingua	X		X
Eastern silvery minnow	Hybognathus regius	X		X
Common shiner	Luxilus cornutus	X	X	X
Hornyhead chub	Nocomis biguttatus	X		
Golden shiner	Notemigonus crysoleucas	X	X	X
Emerald shiner	Notropis atherinoides	X	X	X
Spottail shiner	Notropis hudsonius	X	X	X
Rosyface shiner	Notropis rubellus	X		X
Bluntnose minnow	Pimephales notatus	X	X	X
Fathead minnow	Pimephales promelas	X	X	X
Blacknose dace	Rhinichthys atratulus	X		X[b]
Longnose dace	Rhinichthys cataractae	X		X[b]
Creek chub	Semotilus atromaculatus	X		X
Fallfish	Semotilus corporalis	X	X	X
SUCKERS				
Longnose sucker	Catostomus catostomus	X		
White sucker	Catostomus commersoni	X	X	X
Northern hog sucker	Hypentilium nigricans	X	X	X
Shorthead redhorse	Moxostoma macrolepidotum	X	X	X
FRESHWATER CATFISHES				
White catfish	Ameiurus catus			X
Yellow bullhead	Ameiurus natalis	X		X
Brown bullhead	Ameiurus nebulosus	X	X	X
Channel catfish	Ictalurus punctatus			X
Stonecat	Noturus flavus	X		X
Tadpole madtom	Noturus gyrinus	X		
Brindled madtom	Noturus miurus			X

Table 1: Cont'd.

		1934	1970-1971	1979-1983
PIKES				
Northern pike	*Esox lucius*			X
Tiger Muskellunge	*Esox lucius* x *E. masquinongy*			X
Chain pickerel	*Esox niger*	X		X
MUDMINNOWS				
Central mudminnow	*Umbra limi*	X		X[a]
TROUTS				
Brown trout	*Salmo trutta*			X[b]
TROUT-PERCHES				
Trout perch	*Percopsis omiscomaycus*	X	X	X
KILLIFISHES				
Banded killifish	*Fundulus diaphanus*	X		X
SILVERSIDES				
Brook silverside	*Labidesthes sicculus*	X		
STICKLEBACKS				
Brook stickleback	*Culaea inconstans*	X		
TEMPERATE BASSES				
White perch	*Morone americana*	X		X
White bass	*Morone chrysops*			X
Striped bass	*Morone saxatilis*			X
SUNFISHES				
Rock bass	*Ambloplites rupestris*	X	X	X
Redbreast sunfish	*Lepomis auritus*			X
Pumpkinseed	*Lepomis gibbosus*	X	X	X
Bluegill	*Lepomis macrochirus*		X	X
Smallmouth bass	*Micropterus dolomieu*	X	X	X
Largemouth bass	*Micropterus salmoides*	X	X	X
White crappie	*Pomoxis annularis*	X		X
Black crappie	*Pomoxis nigromaculatus*	X	X	X

Table 1: Cont'd.

		1934	1970-1971	1979-1983
PERCHES				
Greenside darter	*Etheostoma blennoides*	X		X[b]
Fantail darter	*Etheostoma flabellare*	X		X[a]
Tessellated darter	*Etheostoma olmstedi*	X	X	X
Yellow perch	*Perca flavescens*	X	X	X
Log perch	*Percina caprodes*	X		X
Walleye	*Stizostedion vitreum*	X	X	X

[a] Collected by non-DEC agenies.

[b] Collected during stream surveys of selected tributaries near the mouth.

Table 2: Summary of physical characteristics of pools on the Mohawk River from its confluence with the Hudson River to Five Mile Dam.

Name	Location Description	Habitat Type[a]	Acres	Length (mi)	Mean Width (ft)	Shipping Channel
Mouth	Hudson River to New York State Dam	NRS/PPS	252	1.7	1,223	3.6
NYS Dam Pool	New York State Dam to Cohoes Falls	NRS/PPS	92	0.9	843	0
Cohoes Falls Reach	Cohoes Falls to Diversion Dam	NRS	82	0.8	846	0
School Street Pool	Diversion Dam to Crescent Dam	PPS	80	0.8	825	0
Crescent Lake	Crescent Dam to Lock 7	PPS	1,904	9.5	1,653	12.1
Lock 7 Pool	Lock 7 to Lock 8	PPS	1,072	10.8	819	24.4
Lock 8 Pool	Lock 8 to Lock 9	RCS	337	4.8	579	34.5
Lock 9 Pool	Lock 9 to Lock 10	RCS	438	6.2	583	34.3
Lock 10 Pool	Lock 10 to Lock 11	RCS	378	4.1	761	26.3
Lock 11 Pool	Lock 11 to Lock 12	RCS	444	4.6	796	25.1
Lock 12 Pool	Lock 12 to Lock 13	RCS	614	9.7	522	38.2
Lock 13 Pool	Lock 13 to Lock 14	RCS	445	7.9	465	43.0
Lock 14 Pool	Lock 14 to Lock 15	RCS	182	3.4	442	45.3
Lock 15 Pool	Lock 15 to Lock 16	RCS	388	6.7	478	41.9
Lock 16 to Five Mile Dam		NRS	226	4.4	424	0
			6,934	76.3		

[a] Key to habitat type

NRS - Natural river section, PPS - Power pool section, RCS - River canal section

Table 3: PCB concentrations in fish collected from the Fonda, Hoffmans, Vischer Ferry and the NYS Dam areas of the Mohawk River in 1977, 1980, 1983, 1987, and 1992.

FONDA (Locks 12-13)

Species	Date	No Analyzed	Mean length(in)	Average PCB's (ppm)
Smallmouth bass	1977	10	10.9	0.4
Smallmouth bass	1980	16	11.0	1.4
Smallmouth bass	1980	14	14.4	0.5
Smallmouth bass	1983	9	10.8	0.6
Smallmouth bass	1983	10	12.0	0.4
Smallmouth bass	1983	1	13.1	2.8
White sucker	1977	10	11.6	0.4
White sucker	1977	7	15.0	0.7
Yellow perch	1983	4	7.7	0.6
Walleye	1983	2	16.8	1.2
Rock bass	1983	5	7.3	0.3
HOFFMANS (Locks 9-10)				
Smallmouth bass	1977	10	10.7	0.6
Smallmouth bass	1980	18	11.2	1.2
Smallmouth bass	1980	12	15.0	0.8
White sucker	1977	7	11.4	0.5
White sucker	1977	10	12.8	0.6
VISCHER FERRY (Crescent Dam - Lock 7)				
Smallmouth bass	1977	10	10.7	0.7
Smallmouth bass	1980	15	10.7	1.9
Smallmouth bass	1980	15	13.8	1.9
Smallmouth bass	1983	8	11.2	2.2
Smallmouth bass	1983	6	12.0	2.6
Smallmouth bass	1983	4	13.1	2.1
Smallmouth bass	1983	2	15.4	3.7
Smallmouth bass	1987	7	14.2	2.1
Smallmouth bass	1992	20	13.6	0.8
Largemouth bass	1977	6	11.4	0.5
Largemouth bass	1987	22	13.4	0.8
White perch	1983	17	9.0	5.5
White perch	1983	6	10.4	12.4
White perch	1987	13	9.6	3.4
White perch	1992	21	9.0	1.3
White sucker	1977	10	10.7	0.5
White sucker	1977	9	15.4	1.7
Tiger musky	1987	1	23.4	0.4
Rock bass	1987	12	8.6	0.4
Pumpkinseed	1987	7	6.7	0.3
Bluegill	1987	6	7.1	0.5
Yellow perch	1987	15	8.8	0.6
White crappie	1987	5	11.0	1.7
Brown bullhead	1987	6	11.0	0.8

Table 3: Cont'd.

Species	Date	No Analyzed	Mean length(in)	Average PCB's (ppm)
		NYS DAM (Dam - Cohoes Falls)		
Smallmouth bass	1985	5	14.0	1.6
Pumpkinseed	1985	10	8.0	0.6
Rock bass	1985	4	9.2	0.8
Yellow perch	1985	9	11.1	0.6

Table 4: PCB concentrations[a] in fish collected from the Troy Dam to Lock 1 reach of the Hudson River in 1988, 1991, and 1992 and downstream of the Troy Dam in 1991 and 1992.

TROY DAM TO LOCK 1 (Fishing prohibited)

Species	Year Sampled	Number Analyzed	Mean Length(in)	Average PCB's (ppm)
Black crappie	1991	4	10.7	0.4
Bluegill	1992	10	7.0	1.7
Bluegill	1991	10	7.6	1.9
Brown bullhead	1991	2	12.1	1.0
Brown bullhead	1988	15	13.2	2.7
Common carp	1992	4	22.6	23.1
Common carp	1991	7	22.1	11.9
Largemouth bass	1992	12	14.9	2.9
Largemouth bass	1991	12	14.8	1.5
Largemouth bass	1988	8	14.8	3.0
Northern pike	1992	5	25.9	3.4
Pumpkinseed	1992	8	6.4	2.6
Pumpkinseed	1991	11	6.1	0.4
Pumpkinseed	1988	14	7.2	4.0
Redbreast sunfish	1988	15	7.2	2.3
Rock bass	1992	3	7.8	1.9
Rock bass	1991	11	7.0	0.5
Smallmouth bass	1992	12	14.0	4.5
Smallmouth bass	1991	19	11.9	1.2
Smallmouth bass	1988	7	12.6	5.2
Tiger musky	1991	1	30.2	0.6
Walleye	1991	5	18.8	0.8
White perch	1992	21	7.7	6.3
White perch	1991	20	7.6	4.1
White perch	1988	14	9.7	4.8
Yellow perch	1992	10	9.3	1.7
Yellow perch	1991	3	9.3	0.5
BELOW TROY DAM (Fishing allowed)				
American eel	1992	10	18.2	9.1
American shad	1992	6	19.4	1.1
Black crappie	1991	5	9.4	0.5
Blueback herring	1992	10	10.4	1.5
Bluegill	1992	11	6.8	1.5
Bluegill	1991	9	6.1	0.7
Brown bullhead	1992	2	12.5	3.1
Brown bullhead	1991	4	11.2	0.4
Common carp	1992	5	21.3	9.3
Common carp	1991	3	23.2	7.1
Goldfish	1992	1	12.7	8.8
Goldfish	1991	1	13.0	3.3
Largemouth bass	1992	9	13.3	2.3
Largemouth bass	1991	5	12.6	0.5
Northern pike	1992	5	26.7	5.5
Pumpkinseed	1992	10	7.7	1.7
Pumpkinseed	1991	10	6.5	0.5
Redbreast sunfish	1992	9	6.0	2.8
Redbreast sunfish	1991	10	7.5	0.7

Table 4: Continued

	Year Sampled	Number Analyzed	Mean Length(in)	Average PCB's (ppm)
Rock bass	1992	2	6.7	1.1
Rock bass	1991	8	7.6	0.6
Smallmouth bass	1992	15	16.4	6.3
Smallmouth bass	1991	16	14.3	2.7
White catfish	1992	3	15.7	5.4
White perch	1992	20	7.2	7.1
White perch	1991	20	7.2	3.3
Yellow perch	1992	10	8.7	2.8
Yellow perch	1991	7	8.7	0.5
Walleye	1992	2	19.6	6.3
Walleye	1991	2	16.1	2.7

[a]Unpublished data from DEC's Bureau of Environmental Protection

Table 5: Summer (June-August, July-September, and June-September) mean flows (ft^3/S) in the Mohawk River at the USGS gauging station in Cohoes, 1979-1988.

	June-Aug	July-Sept	June-Sept
1988	1397	1506	1468
1987	1724	2662	2483
1986	4650	3488	4241
1985	1020	1271	1274
1984	3063	2243	2764
1983	1985	1182	1788
1982	3568	1539	2942
1981	1758	2346	2314
1980	1680	1473	1631
1979	1931	1788	2002
AVERAGE	2278	1950	2191

Table 6: Summary of Mohawk River fish indices by pool from the Hudson River to Lock 16. Mouth to Lock 7 Pool are permant impoundments. Lock 8 to 15 Pools are seasonal impoundments. Data from 1979-83 fish collections summarized by McBride (1985).

	Electrofish Fish/h All LmB[a]	Electrofish Fish/h LmB ≥ 12 in	Electrofish Fish/h All SmB[b]	Electrofish Fish/h SmB ≥ 12 in	SmB[c] PSD	SmB[c] RSD_{12}	SmB[c] RSD_{14}	Non-game/gamefish (by weight)	GF/PF/OF[d] (includes herring)	GF/PF/OF[d] (excludes herring)
Mouth	2.0	0	25.5	3.9	30%	15%	4%	16.0/1	3.7/46.4/50.0	6.6/83.0/10.4
School Street Pool	5.3	0	24.0	1.3	18%	9%	5%	16.4/1	4.4/50.9/44.8	7.5/87.3/5.3
Crescent Lake	13.9	5.3	17.3	3.1	59%	34%	5%	18.0/1	3.2/35.8/61.0	6.3/69.8/24.0
Lock 7 Pool	10.4	2.8	51.1	3.7	22%	12%	4%	11.2/1	8.1/29.8/62.1	13.8/50.7/35.5
Average	7.9	2.0	29.5	3.0	32%	18%	5%	15.4/1	4.9/40.7/54.5	8.6/72.7/18.8
Lock 8 Pool	5.3	2.6	56.3	27.9	65%	52%	13%	6.4/1	10.0/8.0/81.7	24.3/18.8/56.9
Lock 9 Pool	2.8	2.1	89.0	44.8	74%	58%	19%	3.9/1	13.7/12.3/74.0	26.3/23.5/50.2
Lock 10 Pool	1.6	0.5	155.1	52.4	48%	38%	6%	2.0/1	31.7/20.2/48.2	41.3/26.3/32.4
Lock 11 Pool	0	0	78.4	52.8	67%	59%	30%	4.3/1	12.4/9.4/78.2	30.6/23.0/46.4
Average	2.4	1.3	94.7	44.5	64%	52%	17%	4.2/1	17.0/12.5/70.5	30.6/22.9/46.5
Lock 12 Pool	0	0	92.1	20.0	44%	26%	5%	2.5/1	26.8/15.9/57.3	45.5/27.1/27.5
Lock 13 Pool	0	0	62.4	13.8	46%	26%	6%	3.2/1	26.5/20.0/53.5	33.3/25.2/41.6
Lock 14 Pool	0	0	99.2	10.9	26%	14%	3%	3.1/1	27.1/12.5/60.4	48.6/22.4/29.0
Lock 15 Pool	0	0	43.8	8.7	37%	26%	3%	3.0/1	20.8/7.9/71.3	50.0/19.0/31.0
Average	0	0	74.4	13.4	38%	23%	4%	3.0/1	25.3/14.1/60.6	44.4/23.4/32.3
Lock 8-15 Pool Average	1.2	0.7	84.5	28.9	51%	37%	11%	3.6/1	21.1/13.3/65.6	37.5/23.2/39.4

[a] LmB = largemouth bass

[b] SmB = Smallmouth bass

[c] Includes bass collected by all gear types (electrofishing, gill net, and trap net)

[d] GF = gamefish (bass, walleye, etc) PF = panfish (bluegill, bullhead, crappie, etc) OF = Other fish (carp, sucker, fallfish, etc)

Table 7: Fingerling tiger musky stocked in the Crescent Dam to Lock 8 reach of the lower Mohawk River.

	Crescent Dam-Lock 7	Lock 7-Lock 8	Total
1980	11,500	6,500	18,000
1981	11,423	6,500	17,923
1982	11,423	6,500	17,923
1983	-	-	0
1984	-	-	0
1985	11,423	6,500	17,923
1986	11,423	6,500	17,923
1987	11,400	6,500	17,900
1988	11,400	6,500	17,900
1989	10,500	3,300	13,800
1990	5,500	3,300	8,800
1991	9,660	5,440	15,100
1992	5,500	3,300	8,800
1993	7,070	4,030	11,100

Table 8: Comparison of aerial angler count data for the Region 4 portion of the Mohawk River between April 1 and October 31, 1973 - 1990.

AVERAGE NUMBER/FLIGHT

	1973	1977	1982	1983	1988	1989	1990[a]
Cohoes to Lock 7							
Total Anglers	5.4	20.8	31.4	42.5	31.8	30.7	36.9
Shore Anglers	3.8	15.6	18.0	22.7	15.0	12.4	13.9
Boat Anglers1.6	5.1	13.4	19.8	16.8	18.3	23.0	
Boats	0.8	2.6	7.0	9.7	8.9	8.7	12.2
Lock 7 to Amsterdam							
Total Anglers	3.8	13.3	58.9	49.6	40.9	41.4	39.0
Shore Anglers	2.9	11.3	31.9	29.3	18.9	15.8	12.7
Boat Anglers	0.9	2.1	27.0	20.2	22.0	25.6	26.3
Boats	0.4	1.1	13.4	10.4	11.7	13.3	14.1
Amsterdam to St. Johnsville							
Total Anglers	4.2	13.8	21.0	25.0	28.4	22.1	20.6
Shore Anglers	2.7	11.4	9.9	12.4	9.0	6.8	6.7
Boat Anglers	1.6	2.4	11.0	12.6	19.4	15.3	13.9
Boats	0.7	1.2	5.6	6.6	10.0	8.0	7.4
GRAND TOTALS							
Total Anglers	13.4	47.9	111.3	117.1	101.0	94.2	96.5
Shore Anglers	9.4	38.3	59.8	64.5	42.8	35.1	33.3
Boat Anglers	4.1	9.6	51.4	52.6	58.2	59.1	63.3
Boats	1.9	4.9	26.0	26.7	30.6	30.0	33.7

[a] October not flown

Table 9: Comparison of expanded aerial count data for the Region 4 portion of the Mohawk River between April 1 and October 31, 1973-1990.

Year	Shore fishing trips	Boat fishing trips	Totals
1990	26652	30259	56911[a]
1989	32922	29781	62703
1988	34061	26057	60118
1983	59291	25969	85260
1982	53185	27166	80351
1977	33345	4812	38157
1973	7876	2283	10159
1972	6370	2003	8373

[a] October not flown.

Table 10: Summary of 1991 angling regulations pertaining to the Mohawk River.

STATEWIDE REGULATIONS[a]

Species	Open Season	Minimum Length	Daily Limit
Largemouth and smallmouth bass	3rd Saturday in June through November 30	12 in	5
Northern pike	1st Saturday in May through March 15	18 in	5
Pickerel		15 in	5
Tiger muskellunge		30 in	1
Walleye		15 in	5
Bullheads, carp, catfish, crappies, rock bass, suckers sunfish, white bass, white perch and yellow perch	All Year	Any Size	Any Number

a/ For species not listed, see the current New York State fishing regulations guide.

Table 11: Summary of available boat launch sites on the lower Mohawk River.

NYS Dam to Cohoes Falls	Ownership	Trailer Launch	Comments
NYS Dam	Private	No	cartop launch only
Crescent Dam to Lock 7			
Waterford Flight Recreation Area	Public	Yes	
Albany Marine Service	Private	Yes-fee	
Sanford's Boat Livery	Private	Yes-fee	
Colonie Town Park	Public	Yes-fee	Colonie residents only
Halfmoon Beach	Private	Yes-fee	
Blains Bay Marina	Private	Yes-fee	
Lock 7 to Lock 8			
Lock 7 Park	Public	Yes	
The Boat House	Private	No	cartop launch only
Freemans Bridge Launch	Public	Yes	
Mohawk River Marina	Private	Yes-fee	
Lock 8 to Lock 9			
Arrowhead Marina	Private	Yes-fee	
Kiwanis Park	Public	Yes	
Lock 9 to Lock 10			
Lock 10 Launch	Public	No	cartop launch only
Lock 10 to Lock 11			
Amsterdam Launch	Public	Yes	
Lock 12 to Lock 13			
Schoharie Crossing	Public	Yes	
Poplars Restaurant	Private	Yes-fee	
Lock 13 to Lock 14			
Canajoharie Launch	Public	Yes	
Lock 14 to Lock 15			
Nelliston Launch	Public	Yes	
Lock 15 to Lock 16			
St. Johnsville Marina	Private	Yes-fee	

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