From: Harriet Nash
To: "Jill Caverly" <JSC1@nrc.gov>,<IPNonPublicHearingFile@nrc.gov>
Date: 9/25/2007 11:19:45 AM
Subject: Fwd: 2000 BO - Incidental Take Permit for Roseton and DanskammerGenerating Stations (Hudson River).pdf

>>> "Larry Wilson" <lrwilson@gw.dec.state.ny.us> 09/25/2007 11:04 AM >>>
Attached is the permit issued to the owners of the two fossil fuel plants you visited for the incidental take of Shortnose sturgeon.

Hearing Identifier: IndianPointUnits2and3NonPublic
Email Number: 128

Mail Envelope Properties (47668F97.HQGWDO01.OWGWPO04.200.2000014.1.128E19.1)

Subject: Fwd: 2000 BO - Incidental Take Permit for Roseton and DanskammerGenerating Stations (Hudson River).pdf
Creation Date: 9/25/2007 11:19:45 AM
From: Harriet Nash

Created By: HLN@nrc.gov

Recipients
"Jill Caverly" <JSC1@nrc.gov>
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NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT SECTION 7 CONSULTATION
BIOLOGICAL OPINION

AGENCY: National Marine Fisheries Service

ACTIVITY CONSIDERED: Incidental Take Permit for Roseton and Danskammer Point Generating Stations [Consultation #F/FPR/2000/01023]

CONDUCTED BY: National Marine Fisheries Service Northeast Regional Office

DATE ISSUED: NOV 29 2000

APPROVED BY: Acting Deputy Dir. Office of Protected Resources

This constitutes the National Marine Fisheries Service's (NMFS) biological opinion on the effects of the issuance of a section 10(a)(1)(A) and section 10(a)(1)(B) incidental take permit to Central Hudson Gas & Electric Corporation (CHGE) / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. for the continued operation of the Roseton and Danskammer Point Generating Stations on the Hudson River, New York, on endangered shortnose sturgeon in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). Formal intra-service consultation on NMFS' proposed issuance of a section 10(a)(1)(A) permit was initiated on June 8, 2000. This consultation was amended on August 9, 2000, to include consideration of NMFS's proposed issuance of a section 10(a)(1)(B) permit.

This biological opinion is based on information provided in the April 18, 2000, Conservation Plan (CP) and the applications for a section 10(a)(1)(A) research and enhancement permit, and section 10(a)(1)(B) incidental take permit for CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C., the Environmental Assessment (EA) prepared by NMFS for the section 10(a)(1)(B) permit, correspondence with Mr. Martin Daley, CHGE, and the best available scientific and commercial data available. A complete administrative record of CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C., application for a section 10(a)(1)(A) permit is on file at NMFS' Office of Protected Resources, Endangered Species Division, Silver Spring, Maryland. A complete administrative record of the section 10(a)(1)(B) permit, and the consultation on both permits, is on file at NMFS' Northeast Regional Office, Office of Protected Resources, Gloucester, Massachusetts [Consultation #F/FPR/2000/01023].

CONSULTATION HISTORY

Section 10(a)(1)(B) permit. During the 1995 and 1996 annual meetings to review the section 6 cooperative agreement between the New York State Department of Environmental Conservation (NYSDEC) and NMFS, the NMFS raised the issue of unauthorized take in the Hudson River. In April 1998, NMFS contacted NYSDEC and suggested that they act as the permittee for a general incidental take permit authorizing the taking of shortnose sturgeon at state-regulated power plants (including Roseton and Danskammer) and within state-regulated fishery monitoring programs. NYSDEC declined and CHGE subsequently initiated an application for a permit under section 10(a)(1)(B) of the ESA.

During that same time period, NMFS contacted EPA to determine if they would file an application for an incidental take permit. EPA stated that since the NPDES program had been delegated to the state, it was their position that there was no federal action that would trigger section 7 consultation.

On May 4, 1998, the NMFS received a draft CP and application for an Incidental Take Permit from CHGE. However, on November 13, 1998, NMFS informed CHGE that additional information should be submitted before the CP could be considered complete and its processing could continue.
The application package included a final draft CP, Implementing Agreement (IA), and application for an Incidental Take Permit for shortnose sturgeon. The CP, dated April 18, 2000, included detailed site-specific conditions, including mitigation and monitoring, to ensure the conservation, and aid in the recovery, of the shortnose sturgeon. The details of the separate request by CHGE for a scientific research permit pursuant to section 10(a)(1)(A) were also provided in the CP. The IA established legally binding obligations concerning the requirements and responsibilities detailed in the CP.

On August 9, 2000, NMFS published a notice of availability of an draft Environmental Assessment and receipt of an application for incidental take under section 10(a)(1)(B) in the Federal Register (65 FR 48677). The draft EA was prepared to evaluate the potential significance of the issuance of the requested incidental take permits. At this time, NMFS initiated formal intra-service consultation under section 7 of the ESA.

The public comment period for the CP, EA, and the IA was completed on September 8, 2000. One response was received. The issues raised in this comment are summarized in the EA along with the response from the NMFS.

Section 10(a)(1)(A) permit. On May 15, 2000, NMFS' Office of Protected Resources received a separate application for a section 10(a)(1)(A) research and enhancement permit from Mr. Martin Daley of Central Hudson Gas& Electric Corporation (CHGE). CHGE requested that the section 10(a)(1)(A) research permit application be issued separately from the section 10(a)(1)(B) incidental take permit application. After making a preliminary determination that the application was complete and in compliance with section 10(a)(1)(A) issuance criteria, and as required by CFR 222.24 (a), NMFS published a notice of receipt in the Federal Register on June 8, 2000, (65 FR 39869). Formal intra-service section 7 consultation on NMFS' proposed issuance of this permit was initiated on June 8, 2000, and amended on August 9, 2000, to include NMFS' proposed issuance of the section 10(a)(1)(B) permit.

Central Hudson Gas & Electric Corporation (CHGE) has applied to the National Marine Fisheries Service (NMFS) for an incidental take permit and scientific research permit for the Hudson River population of shortnose sturgeon at the Roseton and Danskammer Point power plants on the Hudson River. NMFS staff has worked with CHGE during the development of the application. During these discussions, CHGE made NMFS staff aware that it was likely that the plants would be sold to a new owner. Following submission of the application materials, CHGE notified NMFS that it had entered into an agreement to sell Danskammer and Roseton Power Plants to a different company, Dynegy. The only commenter on the draft Conservation Plan (CP), Implementing Agreement (IA) and Environmental Assessment (EA) also was aware of the sale and in fact attached a copy of a press release from CHGE announcing the pending sale to Dynegy. The parties plan to complete the sale by the end of the year. NMFS has now been officially informed by CHGE that the buyer has been identified. The new owner will be Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C (Dynergy). Both CHGE and Dynegy have requested that Dynegy be added as a co-applicant and co-permittee in this permit issuance process, as provided for in NMFS' regulations. As explained in correspondence from CHGE and Dynegy, Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. are willing to agree to all of the terms and conditions included in the Conservation Plan submitted by CHGE, the Implementing Agreement, and Permit. CHGE will be responsible for carrying out all the terms and conditions in the

Conservation Plan, Implementing Agreement and permit until the sale is complete and then Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. will assume responsibility.

DESCRIPTION OF THE PROPOSED ACTION

The CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. have applied to NMFS for an Scientific Research Permit pursuant to section 10(a)(1)(A) of the ESA, and for an Incidental Take Permit pursuant to Section 10(a)(1)(B) of the ESA for incidental take of shortnose sturgeon by entrainment and impingement as a result of the operation of Roseton and Danskammer Point Generating Stations. The NMFS is conducting this consultation because the issuance of these permits to CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. constitutes a discretionary Federal action subject to Section 7(a)(2) of the ESA. The duration of the Incidental Take Permit and CP is 15 years from the signature date. The duration of the Research Permit is 5 years.

CHGE currently operates the Roseton and Danskammer Point power plants located along the Hudson River approximately 65 miles upriver (RM 65) from the southern tip of Manhattan (Figure 1). Danskammer Point is owned by CHGE, whereas Roseton is jointly owned by CHGE and two other utilities. When the sale is complete, Dynegy Danskammer, L.L.C. will assume ownership of Dynegy Power Plant and Dynegy Roseton, L.L.C. will assume ownership of Roseton power plant.

A. General Description of Power Plant Operations

The proposed action is NMFS' issuance of a section 10(a)(1)(A) research permit and a section 10(a)(1)(B) incidental take permit to CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. for the take of endangered shortnose sturgeon, either directly through the research proposed or incidental to operations of the Roseton and Danskammer Point power plants in the Hudson River. Details of the operations at these plants are contained in the CP submitted with the section 10(a)(1)(A) and section 10(a)(1)(B) applications. A general description of operations at these plants which may affect shortnose sturgeon follows.

Water from the Hudson River is supplied to the condenser cooling water and the service water systems of the power plants. Service water systems cool plant components (e.g., bearings, etc.) that require heat removal for proper functioning, provide water for washing the intake traveling screens, and provide water for supplemental fire protection purposes.

Each of the power plants employs a once-through condenser cooling water system in which water is directly withdrawn from the Hudson River through an intake structure. Typically, the cooling water first passes through trash racks that are fixed, fence-like structures with slot-openings typically 2-3 inches wide. These trash racks prevent large debris, such as logs and large ice floes, from entering the intake and damaging the finer mesh traveling screens. The cooling water then flows into the intake forebay and through vertically rotating traveling screens. These traveling screens prevent smaller material such as leaves, aquatic vegetation, and fish from entering the plant's cooling water system. The traveling screens are rotated vertically and all collected materials are washed from the screen into a sluiceway. This material (including both debris and fish) then rapidly flows back to the Hudson River along with the screen wash water. These screen washings are returned to the river approximately 200 to 1,000 ft. away from the intake.

After passing through the traveling screens, the water is pushed by circulating water pumps through the plant's cooling water system. Cooling water then passes through the condenser tubes where it is used to condense steam for plant operations. This passage through the condensers results in the heating of the water, typically in the range of 41° to 68° F above ambient water temperatures. This heated water then enters a discharge pipe or canal and is returned to the Hudson River away from the plant's intake in order to minimize the potential for recirculation of heated discharge water. The operation of the cooling water systems at each power plant is regulated under the State Pollution Discharge Elimination System (SPDES) permits or other agreements.

Roseton Generating Station

The Roseton Generating Station is located on the west shore of the Hudson River at RM 66 and approximately 4 mi north of the Newburgh-Beacon Bridge (Figure 1). The plant consists of two fossil-fueled, steam electric units, having a combined net generating capacity rating of 1,248 MWe. Roseton is located on property immediately adjacent to CHGE's Danskammer Point Generating Station. This plant is jointly owned by CHGE, Con Edison, and Niagara-Mohawk Power Corporation; however, all operations are directed by CHGE. Roseton Unit 1 began commercial operation in December 1974 and Unit 2 in September 1974.

The Hudson River in the vicinity of Roseton is about 4,000 ft wide and 50 ft deep on average. The plant is located in the northern portion of an area known as Newburgh Bay that is up to 1 mi wide just south of Roseton. Roseton is within the salt-intruded reach of the Hudson River only when the freshwater flow is low for extended time periods; salinity in the vicinity rarely exceeds 2 ppt (approximately 1/15 seawater).

Roseton has a shoreline intake structure that is shared by both units. There are 12 openings or portals on the front face of the intake structure with bar or trash racks located between the portals and the traveling screens. Of the eight traveling screens installed at the plant, six are conventional vertical-rotating, single-entry, band-type screens flush mounted to face the waterway and two are dual-flow (double entry/single exit), band-type screens mounted perpendicular to the waterway. When only one unit is operating, one or two circulating water pumps are typically used. When two units are operating, two, three, or four pumps are used depending on ambient temperature. When both units are in operation, normally three circulating water pumps will be operated for a combined flow of 561,000 gpm. From the condensers, the combined cooling water is discharged into the Hudson River perpendicular to the direction of river flow through a submerged, multi-port, high-velocity diffuser at a distance of approximately 120 ft offshore.

The design of Roseton requires that when neither of the two generating units are operating it is necessary to operate one of the four circulating water pumps to maintain supply to the service-water and fire-protection systems required for plant reliability and safety. Each of these pumps independently has a nominal flow rate of approximately 218,000 gpm. During the spring of 1997, subsequent to the NYSDEC approval, a low-capacity pump was installed at the Roseton intake for use during a two-unit outage. It has a designed capacity of approximately 12,000 to 14,000 gpm, depending on tidal levels and will be used instead of a circulating water pump to supply service-water during a two-unit outage.

Danskammer Point Generating Station
The Danskammer Point Generating Station is located on the west shore of the Hudson River at RM 66, adjacent to and approximately 0.5 mi north of the Roseton Generating Station (Figure 1). Danskammer Point is located on property immediately adjacent to CHGE's Roseton Generating Station. Hudson River conditions in the vicinity of Danskammer Point are expected to be identical to that described for Roseton. Danskammer Point presently consists of four fossil-fueled, steam electric units, having a net generating capacity rating per unit ranging from 480 to 491 MWe. This plant is owned and operated by CHGE. Unit 1 began commercial operation in 1951, Unit 2 in 1954, Unit 3 in 1959, and Unit 4 in 1967.

Each of the four units at the Danskammer Point Station has a separate once-through cooling water system. Cooling water is transported to the plant through an intake canal located along the Hudson River shoreline north of the plant. This 450 ft long and 34 ft wide canal, which is protected by a debris boom and trash rack at the Hudson River end, leads to a common intake bay from which water is diverted into the individual cooling systems through a series of conventional vertical traveling screens.

Units 1 and 2 each are equipped with two circulating water pumps. Each pump has a designed pumping rate of 21,000 gpm. Unit 3 has two circulating water pumps, each with a designed pumping rate of 41,000 gpm. Unit 4 has three circulating water pumps, each with a designed pumping rate of 50,000 gpm. During the winter, one circulating water pump at each of Units 1, 2, and 3 and two circulating pumps at Unit 4 are operated for a combined flow of 183,000 gpm. For normal operations during the summer, an additional pump per unit is also operated resulting in a combined flow of 316,000 gpm. From the condensers, cooling water is discharged to the river through three separate shoreline subsurface pipes on the south side of the plant.

B. Proposed Mitigation Measures
As part of the CP and application for an section 10(a)(1)(B) incidental take permit, CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. has proposed to minimize the potential entrainment and impingement of shortnose sturgeon at the Roseton and Danskammer Point power plants through various measures. Such minimization measures will help ensure that the operation of these two power plants will not appreciably reduce the likelihood of the survival and recovery of shortnose sturgeon in the wild.

The Roseton and Danskammer Point proposed minimization programs consist of the following:

(1) CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. will assure three "unit-days of outage" at Roseton between 15 May and 30 June of each year that may be satisfied, at the discretion of CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C., through any combination of outages, cross plant credits made available, or cooling water flow reductions. In addition, CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. will use best reasonable efforts to keep the volumes of cooling water drawn into the Roseton power plant at the minimum required for the efficient operation of the plant. Such volumes and average maximum river water temperature are approximated below:

Time Period	Average Maximum River Water Temperature	Volume of Cooling Water Withdrawal from Roseton
1 Jan-14 May	60° F	418,000 gpm
15 May-14 Jun	71° F	561,000 gpm
15 Jun-24 Sep	82° F	641,000 gpm
25 Sep-16 Oct	72° F	561,000 gpm
17 Oct-31 Dec	64° F	418,000 gpm

When one unit at Roseton is out of service during the above time periods, the approximated flow rates shall be 70 percent of those set forth above for the respective period. Because the flow rate for any given period is dependent upon ambient river water temperature, flow rates for precise periods cannot be specified. Also, the flow rates may differ from those set forth in the chart because of the need to meet water quality standards or other conditions of the SPDES permits.

Danskammer Point will generally be operated with reduced cooling water flows of 220,000 gpm from 17 October through 14 May of each year. Throughout the rest of the year, cooling water flows will be reduced when electrical loads permit.

(2) In addition, off-peak cycling of circulating water pumps will be used when feasible at Roseton and Danskammer Point. The objective of this program is to reduce the volume of cooling water withdrawal during off-peak (evenings and/or weekends) periods when electrical loads are low, or when power can be purchased more economically

elsewhere, therein reducing the number of organisms entrained through the power plants. This supplemental flow reduction program is designed to reduce cooling water flow beyond what is typically required for efficient plant operations. The operating mode of circulating water pumps will be adjusted to (1) ensure compliance with SPDES permit thermal effluent limitations, and (2) utilize threshold generating unit output criteria for off-peak cycling of circulating water pumps.

(3) Roseton and Danskammer Point intake screens and fish return systems will be operated in continuous mode when circulating water pumps, which they serve, are operational in order to minimize injury and mortality of fish returned to the Hudson River.

C. Proposed Monitoring Program

As part of the CP and Incidental Take Permit application, CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. proposed a monitoring program to assess three objectives: the periodic take of shortnose sturgeon, the status of the species in the project area, and the progress on the fulfillment of mitigation requirements. CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. have proposed to implement a specific monitoring program to meet these objectives.

(1) CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. propose to provide an annual count of the number shortnose sturgeon impinged at each facility based on sampling during one 24-hour period each week of operation. Sampling protocols will combine provisions for rapid sorting of each collection to ensure any shortnose sturgeon are quickly recovered and returned to the Hudson River with as little additional stress as possible. The actual count of shortnose sturgeon collected as well as the length, weight, condition, and disposition of each individual collected will be presented for each facility in a quarterly report that will be submitted to NMFS within 1 month following completion of the quarter.

CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. will conduct this monitoring as long as such monitoring is a requirement of the SPDES permit. Based on the expectation that the monitoring studies discussed in the CP will also be part of the SPDES permit issued by NYSDEC for each facility, any related correspondence will be provided to both NMFS and

NYSDEC. Should the SPDES permit for either facility no longer require routine impingement monitoring, CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. will, prior to ceasing such monitoring, request a meeting with NMFS to discuss the need for future monitoring at either Roseton or Danskammer Point. Monitoring changes will not be implemented until agreed to by the NMFS.

(2) CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. will ensure that a mark-recapture study designed to estimate the population size of adult shortnose sturgeon in the Hudson River is conducted twice during the 15-year term of the permit (permit years 7 and 14). The results of this study are expected to provide useful information on the long-term trends in the population of adult shortnose sturgeon in the Hudson River. The level of effort and general study methodology will be similar to the recently completed study by Cornell University (Bain et al. 1998). CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. may, in its discretion, combine this population study with any other studies, if appropriate, to maximize efficiencies towards achieving desired monitoring goals.

Should it become known that other researchers will be conducting mark-recapture studies of shortnose sturgeon during substantially similar time periods, then CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. will meet with NMFS to design other studies to address the overall health of the shortnose sturgeon population in the Hudson River or other mutually acceptable study(s). In that event, CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. will provide support funding up to a maximum of $200,000 for all such studies. CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. will provide NMFS with a study plan at least 3 months prior to initiating the study and provide study results, along with the data collected, no later than 3 months after completion of the study.

D. Adaptive Management

The CP submitted as part of the application for an incidental take permit included procedures to deal with changed circumstances through adaptive management strategies. "Changed circumstances" are defined as circumstances affecting a species or geographic area covered by the CP that can be reasonably anticipated and planned for by plan developers and the NMFS. An adaptive management strategy provides for changes in the minimization, mitigation, and/or monitoring requirements of the CP to address the changed circumstances.

Three types of potential changed circumstances are addressed below as well as CHGE/ Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C.'s proposed adaptive management approach.

(1) <u>Listing or delisting of species potentially affected by the operation of the Roseton or Danskammer Point cooling water system.</u> Should additional species be added to the list of protected species under the ESA, CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. will then apply for an amendment to the CP to address the newly listed species. Should the species addressed in the CP become delisted for the Hudson River, this permit would no longer be valid or necessary. Continued monitoring and/or mitigation would be covered under the SPDES permitting process managed by the NYSDEC.

(2) <u>Biologically significant increases in the take of shortnose sturgeon at the Roseton or Danskammer Point Generating Stations.</u> Should the 5-year running average of the estimated annual take of shortnose sturgeon exceed authorized take under the incidental take permit at either Roseton or Danskammer Point, then CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. will meet with NMFS to discuss the potential increase in take and to determine whether or not it poses a risk to the shortnose sturgeon population. Should there be indications that these increases may jeopardize the health, condition, or potential recovery of the shortnose sturgeon in the Hudson River, CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. and NMFS will then work jointly to determine what additional mitigative measures can be reasonably achieved to protect the species. Even if the increases are not at a level to pose jeopardy, CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. will discuss and may voluntarily adopt appropriate mitigative measures.

(3) <u>Biologically significant decrease in the population of shortnose sturgeon in the Hudson River.</u> Should the shortnose sturgeon population substantially decrease in the Hudson River, then CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. will meet with NMFS to discuss whether or not currently permitted takes are greater than can be sustained by the population. If there is clear evidence that such permitted takes are greater than can be sustained by the existing population, then CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. and NMFS will

work jointly to determine what additional mitigative measures can be reasonably achieved to protect this species.

E. Proposed section 10(a)(1)(A) research permit

The National Marine Fisheries Service proposes to issue a scientific research permit to CHGE/Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. pursuant to section 10(a)(1)(A) of the ESA. The research is required by the New York State Department of Environmental Conservation as part of the operation of CHGE/Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C.' s Hudson River power plants and their associated NPDES permits. CHGE/Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. is required by these permits to conduction biological monitoring of waters affected by the operation of the Hudson River power plants. The permit would authorize CHGE/Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. to capture larval, juvenile and adult shortnose sturgeon in a 1-meter Tucker trawl, 1-meter net mounted in an epibenthic sled and a 3-meter beam trawl in the Hudson River, New York. The applicant will be collecting larvae, juvenile, and adult shortnose sturgeon in various location in the Hudson River between the estuary and River mile 152. These studies will also aid in confirming the accuracy of estimates of take anticipated by both CHGE/Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. and NMFS during the operation of the Hudson River power plants. Issuance of this section 10(a)(1)(A) permit will authorize the take of shortnose sturgeon in biological monitoring studies which have been conducted by CHGE on the Hudson River since 1974.

After capture in a 1-meter net mounted in an epibenthic sled, up to 40 larvae a year will be preserved resulting in 100% mortality of all the larvae. They will be collected to monitor the distribution and abundance of fish larvae throughout the river. Tow times for these activities will not exceed five minutes against the prevailing tide.

After capture in either a Tucker or beam trawl, up to 13 small juvenile (yearling) and 82 adult and large juvenile sturgeon a year will have morphometric measurements collected, external tags attached and then be released at the collection site. Tow times for these activities will not exceed five minutes against the prevailing tide.

Table 1. Maximum annual take of shortnose sturgeon.

#	Life stage	Species/DPS Population/ ESU	Take Activity	Details
40	larvae	Shortnose sturgeon - Hudson River DPS	Lethal take	Ichthyoplankton survey
13	juvenile	Shortnose sturgeon - Hudson River DPS	capture, handle, collect measurements, externally tag and release	Ichthyoplankton , Fall Shoals and Beach Seine surveys
82	juvenile and adult	Shortnose sturgeon - Hudson River DPS	capture, handle, collect measurements, externally tag and release	Ichthyoplankton , Fall Shoals and Beach Seine surveys

NMFS proposes to authorize these activities for a five-year period beginning in November 2000. To minimize the effects of the anticipated take, NMFS has identified the following conservation measures to minimize the effect of the proposed take of shortnose sturgeon associated with this research. NMFS proposes to add these conservation recommendations to the permit as special conditions:

1. The Permit Holder must take all necessary precautions to ensure that sturgeon are not harmed during captures, including use of appropriate gill net mesh size and twine type that prevents shutting gill opercula, restricting gill netting activities and decreasing the time of net sets when water temperatures exceed 24°C. Efforts must be made to limit handling of fish, especially when water temperatures are high.

2. Total handling time of any one shortnose sturgeon must not exceed 15 minutes.

3. Total holding time of any one shortnose sturgeon, after removal from the net, must not exceed two hours.

4. If water temperature exceeds 27°C, sturgeon should never be held on board for longer than 30 minutes.

5. When fish are onboard the research vessel, they should be placed in flow-through tanks that allow for total replacement of water volume every 15-20 minutes.

6. Oxygenation of holding tanks is necessary during periods of high temperature and/or low dissolved oxygen.

7. Sturgeon should be held in floating net pens or live cars during processing.

8. Sturgeon are extremely sensitive to chlorine; thorough flushing of holding tanks sterilized with bleach is required between sampling periods.

9. Fish should be treated with an electrolyte bath to help reduce stress and restore slime coat.

10. Fish must be handled with care and kept in water to the maximum extent possible during sampling and processing procedures. To reduce stress, all fish handled out-of-water must be transferred using a sanctuary net that holds water during transfer, be anesthetized, and be allowed to recover before being released.

11. The Permit Holder must, to the extent practical, cooperate and coordinate with other researchers conducting similar studies in the area.

12. The Permit Holder must not intentionally kill or cause to be killed any shortnose sturgeon authorized to be taken.

13. The permit holder is required to submit annual reports and a final comprehensive report. Reports must include:

a. a detailed description of activities conducted under this permit, including the species and total number of ESA-listed animals taken, the manner of take, and the dates/locations of take;

b. any preliminary analyses of the data;

c. measures taken to minimize disturbances to ESA-listed species and the effectiveness of these measures, a description of any problems and/or unforeseen effects which may have arisen during the research activities, and a brief narrative of the circumstances surrounding ESA-listed species injuries or mortalities, when appropriate; and,

d. steps that have been and will be taken to coordinate the research with that of other researchers.

Action area
The action area for this consultation encompasses the immediate area adjacent to the Roseton and Danskammer Point power plants as well as the portion of the Hudson River that shortnose sturgeon inhabit. To ensure that the action area includes all of the direct and indirect effects of the two power projects, the action area also encompasses the entire range of the shortnose sturgeon in the Hudson River, which extends from the mouth at river mile 0 to Troy Federal Dam at river mile 152.

STATUS OF SPECIES OR CRITICAL HABITAT
The only endangered or threatened species under NMFS' jurisdiction in the action area is the endangered shortnose sturgeon (*Acipenser brevirostrum*). No critical habitat has been designated for shortnose sturgeon.

Status of Shortnose Sturgeon Rangewide
Shortnose sturgeon is a member of the sturgeon family, Acipenseridae, which occurs in the Northern Hemisphere and has extensive evolutionary history that dates back about 200 million years (Bemis and Kynard 1997). Shortnose sturgeon were listed as endangered on March 11, 1967 (32 FR 4001), and shortnose sturgeon remained on the endangered species list with enactment of the ESA in 1973. A Shortnose Sturgeon Recovery Plan was published in December 1998, to promote the conservation and recovery of the species.

Although the shortnose sturgeon was originally listed as endangered rangewide, in its final recovery plan for shortnose sturgeon, NMFS recognized 19 separate populations occurring in New Brunswick, Canada (1); Maine (2); Massachusetts (1); Connecticut (1); New York (1); New Jersey/Delaware (1); Maryland/Virginia (1); North Carolina (1); South Carolina (4); Georgia (4); and Florida (2). Because most shortnose sturgeon adults remain in their natal river or estuary, there is limited interchange between stocks suggesting that populations from the different river systems are substantially reproductively isolated

(Kynard 1997). As a result, NMFS has determined that the extinction of a single shortnose sturgeon population risks permanent loss of unique genetic information that is critical to the survival and recovery of the species as a whole. Although NMFS has not formally listed these populations separately, any actions that appreciably reduce the likelihood of one or more of these populations to survive and recover could appreciably reduce the likelihood of the listed shortnose sturgeon to survive and recover in the wild.

The Shortnose Sturgeon Recovery Plan (NMFS 1998) identifies habitat degradation or loss (resulting, for example, from dams, bridge construction, channel dredging, and pollutant discharges) and mortality (resulting, for example, from impingement on cooling water intake screens, dredging and incidental capture in other fisheries) as principal threats to the species' survival. The recovery goal is identified as delisting shortnose sturgeon populations throughout their range and the recovery objective is to ensure that a minimum population size is provided such that genetic diversity is maintained and extinction is avoided.

Shortnose sturgeon are long-lived, slow maturing fish and are the smallest species of sturgeon in North America. For example, the maximum length in the Hudson River is about 3.5 ft (Dovel et al. 1992). The oldest known shortnose sturgeon is a 67-year-old female from Saint John River, Canada; while in the Hudson River the maximum reported age for shortnose sturgeon is 37 years (Gilbert 1989). Age at maturity varies by geographic location. Shortnose sturgeon have similar lengths at maturity (18-22 in. fork length) throughout their range, but, because sturgeon in southern rivers grow faster than those in northern rivers, southern sturgeon mature at younger ages (Dadswell et al. 1984). In the Hudson River, male shortnose sturgeon reach sexual maturity at age 3-5 years and females at age 6-7 years (Dadswell et al. 1984). The first spawning, however, may follow maturation in males by 1-2 years, while in females spawning may be delayed for up to 5 years (Dadswell 1979). Spawning appears to be a non-annual event (Kynard 1997). Based on the percentage of fish examined in the St. John River from August to March that were developing sexually, Dadswell (1979) suggested that females spawn once every third year and males every other year. Other evidence (annuli of the pectoral ray) suggests a 5- to 11-year interval between spawnings (Dadswell 1979). However, annual spawning has been suggested by tagging studies on the Hudson River that tracked shortnose sturgeon to the spawning grounds in successive years (Dovel et al. 1992).

In populations that have free access to the total length of a river (e.g., no dams within the species' range in a river: Saint John, Kennebec, Altamaha, Savannah, Delaware and Merrimack Rivers), spawning areas are located at the farthest upstream reach of the river (NMFS 1998). Sturgeon spawn in upper, freshwater areas and feed and overwinter in both fresh and saline habitats. Shortnose sturgeon spawning migrations are characterized by rapid, directed and often extensive upstream movement (NMFS 1998) and shortnose sturgeon typically leave the spawning grounds soon after spawning. Non-spawning movements include rapid, directed post-spawning movements to downstream feeding areas in spring and localized, wandering movements in summer and winter (Dadswell et al. 1984; Buckley and Kynard 1985; O'Herron et al. 1993). Kieffer and Kynard (1993) reported that post-spawning migrations were correlated with increasing spring water temperature and river discharge. Spawning migrations within the Hudson River, which can occur in either, or both, the fall and the spring (Kynard 1997), move shortnose sturgeon upriver in deeper channel areas as far as accessible habitat permits, often exceeding 125 mi from the mouth of their natal estuaries. Depending on latitude, spawning occurs from late winter to mid-spring when river temperatures increase to about 48° F and spawning usually ceases at 54-59° F (Kynard 1997). The duration of spawning activity ranges from a few days to 2-3 weeks. River channels with gravel substrate and moderate bottom water velocities seem characteristic of spawning habitat preferred by shortnose sturgeon (NMFS 1998).

Shortnose sturgeon are broadcast spawners with external fertilization of eggs. Ripe eggs and fertilized eggs have diameters of 0.12-0.13 in. and 0.14 in., respectively (Dadswell et al. 1984; Buckley and Kynard 1981). The eggs are demersal and adhere to objects on the river bottom within minutes of fertilization. Eggs hatch 13 days after fertilization at temperatures between 46 and 54° F. At 63° F, hatching occurs in 8 days (Buckley and Kynard 1981). Upon hatching, larvae are 0.29-0.45 in. long (Taubert 1980; Anonymous 1981, cited in Dadswell et al. 1984; Buckley and Kynard 1981). Recent research on larval behavior indicates that hatchlings are photonegative and vigorously seek cover under any available structure immediately after hatching (Richmond and Kynard 1995).

During the first 1-2 days following hatching, larvae denied or dislodged from cover will exhibit "swim-up and drift" behavior, which in the wild allows them to move short distances to seek available cover. Yolk-sac larvae continue to seek bottom cover for about a week, but after 1-2 days post-hatch their movements are predominantly horizontal along the bottom (Richmond and Kynard 1995). At 8-12 days post-hatch, larvae have well-developed eyes, a mouth with teeth, and fins that enable them to swim normally (Kynard 1997). In laboratory tests, larvae of this age were photopositive, nocturnally active, and preferred the deepest water available (Richmond and Kynard 1995). Ten-day-old larvae reportedly attempted to remain on the bottom or place themselves under any available cover (Pottle and Dadswell 1979; Washburn and Gillis Associates 1980). At this age (9-12 days post hatch), larvae are 0.59 inches in total length (TL), the yolk sac is completely absorbed, and the fry are feeding on zooplankton (Buckley and Kynard 1981; Washburn and Gillis Associates 1980). By about 0.55-0.67 inches TL, shortnose sturgeon, resembling miniature adults, become photopositive and leave cover to swim in the water column, although remaining bottom oriented. In the wild, larvae of this size probably migrate downstream (Richmond and Kynard 1995).

Early growth is rapid. Shortnose sturgeon larvae average approximately 0.7 in. TL at the end of May and from 4.9 to 5.1 in. by the end of July. Young shortnose sturgeon typically grow to 11.5 in. TL by the end of their second summer (Dovel et al. 1992), feeding on amphipods and dipteran larvae. After about the third year of life, growth slows considerably. Dadswell et al. (1984) reported a maximum size of approximately 35 in. TL at age 40, but shortnose sturgeon over 39 in. have been captured in the Hudson River (Hoff and Klauda 1979).

Juvenile shortnose sturgeon generally move upstream in spring and summer and move back downstream in fall and winter; however, these movements usually occur in the region above the saltwater/freshwater interface (Dadswell *et al.* 1984; Hall *et al.* 1991). Shortnose sturgeon appear to spend virtually all of their adult life in deep-water areas of their natal river, and only rarely enter nearby coastal waters (Bemis and Kynard 1997). While shortnose sturgeon are occasionally collected near the mouths of rivers (i.e., shortnose sturgeon presumably from the Hudson River have been caught in Sandy Hook Bay, New Jersey [Dovel et al. 1992]), they are not known to participate in coastal migrations (Dadswell et al. 1984).

The species appears to be estuarine anadromous in the southern part of its range, but in some northern rivers, it is "freshwater amphidromous" (i.e., adults spawn in freshwater but regularly enter saltwater habitats during their life; Kieffer and Kynard 1993). Adult sturgeon occurring in freshwater or freshwater/tidal reaches of rivers in summer and winter often occupy only a few short reaches of the total length (Buckley and Kynard 1985). Summer concentration areas in southern rivers are cool, deep, thermal refugia, where adults and juveniles congregate (Flournoy *et al.* 1992; Rogers and Weber 1994; Rogers and Weber 1995; Weber 1996).

Shortnose sturgeon are benthic omnivores but have also been observed feeding off plant surfaces (Dadswell *et al.* 1984). Generally, shortnose sturgeon feed on crustaceans, insect larvae, worms and molluscs (NMFS, 1998). Feeding patterns vary seasonally between northern and southern river systems.

Status of Shortnose Sturgeon in the Hudson River
The distribution of shortnose sturgeon is widespread throughout the Hudson River. Shortnose sturgeon occupy the Hudson River estuary where habitats range from a freshwater river channel, a low salinity fjord, and a brackish water harbor (Coch and Bokunlelez, 1986 and Limburg *et al.*, 1989). This 246-km section of the Hudson River is tidal and extends from New York City to the Troy Dam (upstream of Albany, NY) where the Hudson is shallow, turbulent and rises above sea level. Monitoring of fish distributions since 1969 by the Hudson River electric utilities (Hoff *et al.*, 1988 and Geoghegan et al., 1992) has recorded shortnose from nearly all portions of the estuary.

Shortnose sturgeon move considerable distances within the Hudson River, but they rarely appear to migrate to the ocean or to neighboring systems. Within the Hudson River, shortnose sturgeon display complex migratory behavior with non-spawning and spawning adults using different habitats and displaying different migratory behavior (Bain 1997). From late spring through early fall, most adult shortnose sturgeon are distributed in deep, channel habitats of the freshwater and brackish reaches of the Hudson River. As water temperatures decline in the fall, adult shortnose sturgeon typically concentrate in a few deeper overwintering areas, particularly near Kingston (RM 87) for pre-spawning adults and near Haverstraw (RM 33-38) for non-spawning adults (Figure 1) (Dovel et al. 1992; Bain 1997).

As early as the first week of April, adult shortnose sturgeon reach the spawning grounds between Coxsackie and Troy (RM 118-148; Figure 1). Spawning occurs from late April to early May (Dovel et al. 1992). After spawning, adults move downriver to feed and disperse over the tidal portion of the Hudson River, but are primarily south of Kingston (Bain 1997). Non-spawning adults are also distributed in this portion of the Hudson River after migrating upstream from their overwintering areas in the spring.

From the available information, it seems that the distribution of juvenile shortnose sturgeon is not drastically different than the adults. By late fall and early winter, most occupy brackish water overwintering areas located downriver, with most shortnose sturgeon occupying the area between about RM 34-39 (Dovel et al. 1992). There is no evidence that juvenile shortnose sturgeon move out of the lower Hudson River into coastal marine waters (Bain 1997).

The population of shortnose sturgeon in the Hudson River has increased over the past few decades, with this system apparently containing the largest discrete population of shortnose sturgeon reported anywhere. Evidence for the apparent population increase comes from two different sources. First, the annual estuary-wide monitoring conducted in part by the CHGE provides a relative measure of population abundance. This program dates back to 1974 and encompasses the entire Hudson River from the Battery at the southern tip of Manhattan (RM 0) to the Federal Dam at Troy (RM 152). Data compiled from this monitoring program show that the catch rates of shortnose sturgeon have been increasing since 1985, especially in the beam trawl and epibenthic sled samples.

The second source of information suggesting population increases in the Hudson River population of shortnose sturgeon comes from mark-recapture studies that provide absolute population sizes within the Hudson River. In the late 1970s, Dovel (1979) estimated the shortnose sturgeon population in the Hudson River at 13,844 fish. In the 1990s, researchers from Cornell University conducted a similar mark-recapture study (Bain et al. 1995, 1998). Using techniques identical to that of Dovel, these researches provided a preliminary population estimate of 38,024 adults (Bain et al. 1995). Subsequently, this estimate was refined to 56,708 adults based on additional data suggesting a four-fold increase in population size since the 1970s (Bain et al. 1998). Further, refined analytical techniques indicate that the most appropriate population estimate based on the Cornell study is 61,057 fish, which includes adults and an estimated 4,439 juvenile fish (Bain et al. 1998). These estimates reflect those fish in the overwintering and spawning concentration areas and, thus are likely just a subset of the total adult population. Additionally, because shortnose sturgeon do not appear to spawn every year, the majority of the population may be non-spawners and, thus, not included in this population estimate.

ENVIRONMENTAL BASELINE

By regulation, environmental baselines for biological opinions include the past and present impacts of all State, Federal or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process (50 CFR §402.02). The environmental baseline for this biological opinion includes the effects of several activities that may have affected the survival and recovery of threatened and endangered species in the action area. The activities that shape the environmental baseline of this consultation include the operation of other power plants on the Hudson River, monitoring projects, the operation of the Troy Dam, pollutants, water quality, dredging, and fisheries.

Operation of Power Plants

Shortnose sturgeon entering coastal or inshore waters are susceptible to impingement on cooling water intake screens. Electric power and nuclear power generating plants can affect sturgeon by impinging larger fish on cooling water intake screens and entraining larval fish. The operation of power plants in the upper portions of rivers has the greatest potential for directly affecting sturgeon populations because of the increased incidence of entraining younger and more vulnerable life stages.

A number of power plants are located on the Hudson River. For example, four facilities are in the same approximate area as the Roseton and Danskammer Point power plants, between river miles 35 and 42. One of these facilities, Bowline Point, is located near a known shortnose sturgeon concentration area. However, Bowline Point withdraws water from a man-made embayment called Bowline Pond and the intakes are set back over 2,200 ft from the shoreline, well away from channel congregation areas. Bowline Point's intake is also protected by a barrier net during much of the year.

Furthermore, during entrainment monitoring studies conducted from 1972 to 1998, no shortnose sturgeon were found to be entrained at any of the four power plants in the mid-Hudson River (Table 1). It is important to note however, that entrainment sampling was not conducted each year for each power plant. Additionally, extensive impingement monitoring studies have been conducted at each of the power plants since the early 1970s. Only 40 shortnose sturgeon have been collected in impingement samples from all four power plants over the 26-year interval of available data (Table 2). Adjusting to account for periods not sampled, shortnose sturgeon impingement at the four power plants was found to be 86 shortnose sturgeon in 26 years, approximately 3 fish/year (Table 3). While the levels of entrainment and impingement at these four plants are relatively small considering the large sampling period and the concentration and spawning areas are not adjacent to the majority of these power plants, the fact remains that these (and other) power plants on the Hudson River have previously impinged shortnose sturgeon and may have impacted the Hudson River population.

Monitoring/Research Studies

Several monitoring programs have been conducted in the Hudson River since the early 1970s. For example, current monitoring of fish populations throughout the Hudson River is being performed in part by CHGE, pursuant to requirements contained in the SPDES permits issued by the NYSDEC and other agreements. The core portion of this Hudson River Monitoring Program was established in 1974 and has been conducted annually since then. The program employs several fishery techniques in four separate sampling programs to obtain comprehensive information on the abundance and distribution of larval, young-of-year, and post-juvenile fish of selected species throughout the Hudson River. All sampling is conducted under scientific collector's permits issued by the NYSDEC, which require return of all live shortnose sturgeon to the Hudson River with minimal handling stress. Nevertheless, these monitoring programs are involved in the capture, collection and, inevitably, harassment of shortnose sturgeon and thus, could have impacted the species' migration, reproduction, and foraging patterns.

The Longitudinal River Ichthyoplankton Survey was designed to monitor the distribution and abundance of fish eggs and larvae in the Hudson River during and immediately following the spring and early summer spawning seasons. The entire length of the Hudson River from RM 0 at the Battery in Manhattan to RM 152 at the Federal Dam in Troy is sampled. No shortnose sturgeon eggs have been documented from these surveys, but a total of 56 larvae identified as shortnose sturgeon were collected over the 25 years of available data. In addition, 126 sturgeon larvae were collected that were not identified to species and, thus, could have been either shortnose or Atlantic sturgeon. Over the 25-year period from 1974 through 1998, a total of 87 yearling and older shortnose sturgeon were also collected. Beginning 1989, the condition at release was recorded for all yearling and older shortnose sturgeon collected in this survey. These data indicate that all 60 individuals collected over this period were released alive.

The Fall Shoals Survey was designed to monitor the distribution and abundance of young fish in areas of the Hudson River deeper than 10 ft (from the Battery to the Troy Dam) during the summer and fall. A total of 466 shortnose sturgeon have been collected in the Fall Shoals Survey since 1974 for an average of just over 18 per year. Beginning 1989, the condition at release was recorded for all but one of the shortnose sturgeon collected in this survey. These data indicate that all 383 individuals for whom information exists were released alive.

The Beach Seine Survey was designed to monitor the distribution and abundance of young fish in the shallow (<10 ft) waters of the Hudson River (from the George Washington Bridget to the Troy Dam). Only one shortnose sturgeon was captured in the Beach Seine Survey over 25 years of sampling.

Operation of Troy Dam

The existence of the Troy Dam on the Hudson River likely restricts shortnose sturgeon spawning migration to the upper portions of the river. Hydroelectric dams such as the Troy Dam may affect shortnose sturgeon by altering water flows or temperatures necessary for successful spawning and or migration, restricting habitat, elevating turbidity levels as a result of erosion generated by abnormal flow fluctuations, and causing mortalities to fish that become entrained or impinged. Since sturgeon require adequate river flows and water temperatures for spawning, any alterations that dam operations pose on a river's natural flow pattern, including increased or reduced charges, can be detrimental to sturgeon reproductive success. The inability to move above dams and use potentially beneficial spawning habitats may restrict reproduction and sturgeon population growth. In populations that have free access to the total length of the river (e.g., no dam within the species range in the river) spawning areas are located at the most upstream reach of the river used by sturgeon (NMFS, 1998). The upstream migration of the shortnose sturgeons tracked on the Hudson River could be blocked by the Troy Dam.

Contaminants

Principal toxic chemicals in the Hudson River include pesticides and herbicides, heavy metals, and other organic contaminants such as polychlorinated aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs). Pesticides and herbicides are not believed to pose significant risk to the Hudson River from continued inputs, and sediment contaminant concentrations appear to have declined in the past few decades (CHGE et al. 1999). Areas of sediment contamination appear limited to urban areas near New York City. Likewise, concentrations of many heavy metals also appear to be in decline and remaining areas of concern are largely limited to those near urban or industrialized areas. With the exception of areas near New York City, there currently does not appear to be a major concern with respect to heavy metals in the Hudson River (CHGE et al. 1999), but metals could have previously affected shortnose sturgeon.

PAHs, which are products of incomplete combustion, most commonly enter the Hudson River as a result of urban runoff. As a result, areas of greatest concern are limited to urbanized areas, principally near New York City. The majority of individual PAHs of concern have declined during the past decade in the lower Hudson River and New York Harbor.

PCBs are the principal toxic chemicals of concern in the Hudson River. Primary inputs of PCBs in freshwater areas of the Hudson River are from the upper Hudson River near Fort Edward and Hudson Falls, New York. In the lower Hudson River, PCB observed concentrations observed are a result of both transport from upstream as well as direct inputs from adjacent urban areas. PCBs tend to be bound to sediments, and also bioaccumulate and biomagnify once they enter the food chain. This tendency to bioaccumulate and biomagnify results in the concentrations of PCBs in the tissue concentrations in aquatic-dependent organisms. These tissue levels can be many orders of magnitude higher than those observed in sediments and can approach or even exceed levels that pose concern over risks to the environment and to humans who might consume these organisms. Over the past two decades, PCB concentrations in the aquatic organisms from the Hudson River have been declining; however, concerns over potential human health and ecological risks remain.

Contaminants, including toxic metals, PAHs, pesticides, and PCBs can have substantial deleterious effects on aquatic life including production of acute lesions, growth retardation, and reproductive impairment. Ultimately, toxins introduced to the water column become associated with the benthos and can be particularly harmful to benthic organisms like sturgeon. Heavy metals and organochlorine compounds are known to accumulate in fat tissues of sturgeon, but their long term effects are not yet known. Available data suggest that early life stages of fish are more susceptible to environmental and pollutant stress than older life stages (NMFS 1998).

Although there have not been any studies to assess the impact of contaminants on shortnose sturgeon, elevated levels of environmental contaminants, including chlorinated hydrocarbons, in several other fish species are associated with reproductive impairment, reduced egg viability, and reduced survival of larval fish. Some researchers have speculated that PCBs may reduce the shortnose sturgeon's resistance to fin rot. Under a statewide toxics monitoring program, the NYSDEC analyzed tissues (i.e., fillet, liver, and gonad) from one shortnose sturgeon to determine PCB concentrations. In gonadal tissues, where lipid percentages are highest, the average PCB concentration was 29.55 ppm (NMFS 1998).

Several characteristics of shortnose sturgeon (i.e., long lifespan, extended residence in estuarine habitats, benthic predator) predispose the species to long-term and repeated exposure to environmental contamination and potential bioaccumulation of heavy metals and other toxicants. In the Connecticut River, coal tar leachate was suspected of impairing sturgeon reproductive success. Kocan et al. (1993) conducted a laboratory study to investigate the survival of sturgeon eggs and larvae exposed to PAHs, a by-product of coal distillation. Approximately 5% of sturgeon embryos and larvae survived after 18 days of exposure to Connecticut River coal-tar contaminated sand in a flow-through laboratory system. This study demonstrated that coal-tar contaminated sediment is toxic to shortnose sturgeon embryos and larvae under laboratory exposure conditions (NMFS 1998).

Although there is scant information available on levels of contaminants in shortnose sturgeon tissues, some research on other, related species indicates that concern about effects of contaminants on the health of sturgeon populations is warranted. Detectable levels of chlordane, DDE (1,1-dichloro-2, 2-bis(p-chlorophenyl)ethylene), DDT (dichlorodiphenyl-trichloroethane), and dieldrin, and elevated levels of PCBs, cadmium, mercury, and selenium were found in pallid sturgeon tissue from the Missouri River (Ruelle and Keenlyne 1993). These compounds may affect physiological processes and impede a fish's ability to withstand stress. PCBs are believed to adversely affect reproduction in pallid sturgeon.

Point-source discharges (i.e., municipal wastewater, paper mill effluent, industrial or power plant cooling water or waste water) affect water quality and may also contribute to impacts on shortnose sturgeon. Compounds associated with these discharges, including metals, dioxin, dissolved solids, phenols, and hydrocarbons, can alter the pH of receiving waters, which may lead to mortality, alterations in fish behavior, deformations, and reduced egg production and survival.

Water Quality
Heavy usage of the Hudson River and development along the waterfront (i.e., industrial parks, marine terminals, recreational real estate) could have affected shortnose sturgeon throughout the action area. Coastal development and/or construction sites often result in excessive water turbidity, which could influence sturgeon spawning and/or foraging ability. Industries along the Hudson River have likely impacted the water quality, as service industries, such as transportation, communication, public utilities, wholesale and retail trades, finance, insurance and real estate, repair, and others, have increased since 1985 in all nine counties in the lower Hudson Valley.

The Hudson River is used as a source of potable water, for waste disposal, transportation, and cooling by industry and municipalities. Rohman et al. (1987) identified 183 separate industrial and municipal discharges to the Hudson and Mohawk Rivers. The greatest number of users were in the chemical industry, followed by the oil industry, paper and textile manufacturers, sand, gravel, and rock processors, power plants, and cement companies. Approximately 20 publicly owned treatment works discharge sewage and wastewater into the Hudson River. Most of the municipal wastes receive primary and secondary treatment. A relatively small amount of sewage is attributed to discharges from recreational boats.

Federal Maintenance Dredging Projects
The construction and maintenance of Federal navigation channels has also been identified as a source of sturgeon mortality. Hopper dredges, which are frequently used in ocean bar channels and sometimes in harbor channels and offshore borrow areas, move relatively rapidly and can entrain and kill sturgeon, presumably as the drag-arm of the moving dredge overtakes the slower moving sturgeon. Dredging also has the potential to disrupt benthic habitat and affect shortnose sturgeon prey distribution. The Hudson River Federal Channel is maintained by the Army Corps of Engineers (ACOE), and the ACOE works in the Hudson River under the constraints of a general Environmental Impact Statement drafted in 1983.

Fisheries
Direct harvest of shortnose sturgeon is prohibited by the ESA. However, shortnose sturgeon are taken incidentally in other anadromous fisheries along the east coast and are probably targeted by poachers (NMFS 1998). Commercial shad fisheries and recreational hook and line fisheries operating in the Hudson River are known to incidentally capture shortnose sturgeon (Clancy 2000).

Integration and Synthesis of Status of Species and Environmental Baseline

In summary, several factors have adversely affected shortnose sturgeon within the action area, many of which are expected to continue contemporaneously with the proposed action. NMFS assumes that several activities which adversely affect shortnose sturgeon will continue at current levels, including:

- Continued operation of the Troy Dam.
- Contaminants, including toxic metals, polychlorinated aromatic hydrocarbons, pesticides, and polychlorinated biphyenlys will persist in habitats occupied by shortnose sturgeon.
- Operation of cooling water intakes will continue to impinge shortnose sturgeon on water intake screens.

The above adverse actions are expected to combine to either injure or kill an unquantified number of shortnose sturgeon within the action area during the life of this proposed permit.

EFFECTS OF THE PROPOSED ACTION
In this section of a biological opinion, as required by the ESA and interagency section 7 regulations, NMFS assesses the direct and indirect effects of the proposed action, and of interrelated and interdependent actions on threatened and endangered species and designated critical habitat (50 CFR §402.02). Indirect effects are those that are caused later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration (50 CFR §402.02).

The purpose of this assessment is to determine if it is reasonable to expect that NMFS' issuance of section 10(a)(1)(A) and section 10(a)(1)(B) permits is likely to directly or indirectly, reduce appreciably the likelihood of both the survival and recovery of endangered shortnose sturgeon in the wild by reducing their reproduction, numbers, or distribution [which is the "jeopardy" standard established by 50 CFR §402.02].

Section 10(a)(1)(B) incidental take permit

The operation of power plants, such as Roseton and Danskammer Point Generating Stations, requires the withdrawal of large quantities of water for cooling purposes, and the subsequent discharge of this cooling water, at an increased temperature, back to the source waterbody. The use of cooling water could affect shortnose sturgeon by entrainment and impingement at the cooling water intake, or by the elevated temperature of the discharge. The nature of these potential effects is described below.

Entrainment

Along with the water used for condenser cooling, organisms smaller than the intake screen openings (usually 0.25- to 0.5-in. mesh) can be drawn into the system, a process called entrainment. Planktonic organisms are susceptible to entrainment because their small size and limited swimming ability reduce the potential for escape from the entrained water mass and allow passage through the mesh of the traveling screens. Entrained fish are typically the younger life stages (eggs and larvae). Any entrained fish eggs and larvae pass through the circulating pumps and condenser tubes along with the cooling water. The cooling water and any entrained fish eggs and larvae then enter the discharge canal or conduit for return to the Hudson River. During their passage through the plant, entrained individuals experience a variety of stresses, some of which may cause death. Survival rates for fish eggs and larvae entrained by power plants depend on the species' hardiness as well as their responses to thermal stresses. Entrainment survival rates for relatively hardy species, such as striped bass, white perch, and Atlantic tomcod, at mid-Hudson River power plants generally exceed 70 percent (EA Engineering Science and Technology 1989).

Due to their life-history characteristics and spawning distribution, the Hudson River population likely has low vulnerability to entrainment effects from the operation of either of the two power plants. Shortnose sturgeon spawn in the northern most areas of the Hudson River at approximately RM 118-148. In addition, shortnose sturgeon eggs are demersal and adhesive and upon hatching, yolk-sac larvae and larvae seek cover on the bottom. As a result, the eggs and larvae of shortnose sturgeon are located primarily upstream of RM 110, well upriver of any of the two power plant intakes (RM 66). Consequently, few entrainable life stages of shortnose sturgeon occur in the vicinity of the power plants. The preference of shortnose sturgeon larvae for deeper waters and their benthic orientation, coupled with the fact that the intakes of these power plants are located along the shallow shore, additionally reduces the possibility of their entrainment at Roseton and Danskammer Point.

However, because of the concerns over the potential effects of entrainment mortality on fish populations in the Hudson River, entrainment-monitoring studies were conducted at each of the six power plants in the mid-Hudson River over the 16-year period from 1972 to 1987. Especially intensive monitoring for entrainment abundance was conducted from 1981 through 1987. This intensive monitoring entailed sampling nearly 24 hours per day, 4-7 days per week, over the 10- to 12-week long peak entrainment season (i.e., spring) each year.

Despite entrainment sampling of a magnitude not found anywhere else in the world, very few entrainable-size (i.e., small enough to fit through the wire mesh of the traveling screens) shortnose sturgeon were collected from any of the power plants (Table 1). Only at Danskammer Point were any (4) shortnose sturgeon larvae identified in entrainment samples, all in 1984. A small number (4) of sturgeon yolk-sac and post yolk-sac larvae (species unidentified) were also collected in entrainment samples, again all at Danskammer Point and in 1983 and 1984. However, definitive identifications of these individuals were not made and, thus, they could have been of either Atlantic or shortnose sturgeon. The occurrence of shortnose sturgeon larvae in 1984 might be explained by the fact that the highest single-day freshwater flows during both May and June (encompassing the larval period for shortnose sturgeon) since 1974 occurred that year. In these monitoring studies, the total number of shortnose sturgeon larvae collected at Roseton and Danskammer Point power plants over the entire 16-year study period was between 4 (assuming all unidentified sturgeon were Atlantic sturgeon) and 8 (assuming all unidentified sturgeon were shortnose sturgeon). Assuming that entrainment of shortnose sturgeon continues at these rates, NMFS does not believe that losses of shortnose sturgeon due to entrainment at the
Roseton and Danskammer Point power plants will reduce appreciably the numbers, distribution, or reproduction of shortnose sturgeon in the Hudson River in a way which will reduce their ability to survive and recover in the wild.

Impingement

To keep condensers from clogging with solid materials and biota, power plant cooling water intake systems oftentimes use a combination of large- and finer-mesh screens. Typically, the large-mesh screens or bar racks (2-3 in. slot width) are fixed in place while the finer-mesh screens can move to facilitate cleaning. These movable screens are called traveling screens. As the water passes through these screens, organisms larger than the mesh openings, such as larger invertebrates and fish, can be impinged against the screens. Owing to their more limited swimming abilities, most fish impinged are less than 1 year old.

Shortnose sturgeon have been impinged on the intake screens of other power plants besides those in the Hudson River. At the Salem and Hope Creek Nuclear Generating Station on the Delaware River, New Jersey, an average of 0.6 impinged shortnose sturgeon have been documented from 1979 to 1998. Over this time period, there have been at least five mortalities. Most of these shortnose sturgeon were found while cleaning the Circulating Water Intake Trash Racks. Furthermore, in May 2000, another dead shortnose sturgeon (33 in.) was found impinged on the trash racks of the Salem and Hope Creek Nuclear Generating Station.

At the Roseton and Danskammer Point Generating Stations, various screenwash systems are employed for periodically removing impinged fish from the screens and returning them to the Hudson River. Continuous rotation of traveling screens, as employed at each of the two Hudson River power plants, reduces the amount of time the fish are in contact with the screen and substantially increases post-impingement survival. The survival rate for impinged fish is species specific, varies with size and season, and depends on several other power plant-related factors, such as intake velocity, plant design, and operating conditions. For hardy species (e.g., striped bass and Atlantic tomcod), impingement survival is generally high (>50 percent and >90 percent, respectively, for conventional traveling screens [Muessig et al. 1988] and >90 percent and >80 percent, respectively, for modified Ristroph-type screens [Fletcher 1990]). At Roseton Generating Station, there are six conventional traveling screens and two dual-flow, band-type screens that are similar but not identical to modified Ristroph-type screens. All the traveling screens at Danskammer Point are of the conventional type.

A major concentration area has not been documented in the Hudson River around the two power plants (Bain et al. 1998). Further, juvenile shortnose sturgeon prefer the deeper waters of channel areas, where they are found on the bottom. This deep benthic orientation, coupled with the fact that the intakes of these power plants are located along the shallow shore, further reduces vulnerability to impingement at either of the power plants.

However, because of concerns over potential effects of power plant impingement on fish populations in the Hudson River, extensive impingement monitoring studies have been conducted at each of the six power plants in the mid-Hudson River since the early 1970s. In general, weekly, 24-hour sampling to examine the abundance and species composition of impinged organisms has occurred annually at Roseton and Danskammer Point.

Since the start of impingement monitoring in 1972, only 63 shortnose sturgeon have been collected in impingement samples from all six power plants over the 26-year interval of available data (Table 2). Of these, 29 were collected at Roseton or Danskammer Point. No strong seasonal pattern in the collection of this species is evident at any of the power plants. These counts represent the total number of shortnose sturgeon impinged at each power plant over all sampling periods.

Sampling procedures require that all sturgeon alive at the time of collection be carefully returned to the Hudson River after being measured. The condition of some of the individuals collected (i.e., degree of decay) demonstrates that at least some of those collected were dead prior to collection. Available length frequency data collected on these impinged individuals indicates that the majority were between 8-28 in. long and were likely between 2 and 15 years of age based on age-length plots presented by Bain et al. (1998).

To estimate the total number of shortnose sturgeon impinged at the six power plants in the mid-Hudson River, the impingement monitoring results were adjusted up to account for periods not sampled, as described in Appendix A. This adjustment yields an estimate of total shortnose sturgeon impingement of 275 individuals, or an average of just over 10 per year across all six power plants during the past 27 years (Table 3, 4). Estimated impingement rates of shortnose sturgeon have averaged 7.5 individuals per year from 1989 to 1998. Totals and yearly average rates for each power plant are:

Table 4. Estimated impingement of shortnose sturgeon at 6 mid-Hudson River power plants.

Power Plant	**1972-1998**		**1989-1998**	
	Total	**Average No. Impinged/Year**	**Total**	**Average No. Impinged/Year**
Bowline Point	23	0.9	0	0
Lovett	0	0	0	0
Indian Point Unit 2	37	1.4	8	0.8
Indian Point Unit 3	26	1.0	8	0.8
Roseton	**49**	**1.8**	**15**	**1.5**
Danskammer Point	**140**	**5.2**	**44**	**4.4**
TOTAL	275	10.2	75	7.5

Hardier species are likely to exhibit extremely high survival after impingement (Muessig et al. 1988; Fletcher 1990). Shortnose sturgeon have been considered to be relatively hardy and resistant to physical stresses similar to those encountered in power plant impingement (ASA 2000). While the degree of shortnose sturgeon "hardiness" has been subject to debate, during recent intensive trawling of the Hudson River to study shortnose sturgeon, the sampling team from Cornell University collected and handled more than 7,000 shortnose sturgeon without a single reported mortality. This program included capture by trawl, removal of the individuals from the water and the net, measurement and weighing of individuals, and insertion of a tag - the combined effect of which could be expected to induce similar stress on sturgeon as impingement and the subsequent return to the Hudson River. The lack of mortality associated with this trawling effort suggests that impingement mortality could be similarly low and the majority of those shortnose sturgeon impinged alive will be returned to the Hudson River unharmed with the proposed intake screen operation at each power plant.

Based on the results of past monitoring efforts described above, NMFS anticipates that an average of 8 shortnose sturgeon could be impinged each year at the Roseton and Danskammer Point power plants considered in this Opinion. Based on the demonstrated hardiness of this species, it is probably reasonable to assume that some of the impinged sturgeon may survive unharmed. However, assuming that all impinged sturgeon die, NMFS does not believe that the loss of 8 shortnose sturgeon a year at these facilities will reduce appreciably the numbers, reproduction, or distribution of shortnose sturgeon in the Hudson River.

Discharge of Heated Cooling Water

The discharge of heated cooling water has the potential to affect species of fish found within the Hudson River. At many power plants, various biocides, such as chlorine and bromine, are used to keep the cooling water system clean and free from biofouling, which could adversely affect plant performance. Some residual amounts of these biocides are then released back into the environment along with the cooling water. Discharged amounts of biocides and heat are limited by SPDES permits, which are established to protect aquatic life and enforced through discharge monitoring requirements.

While current SPDES permits allow the use of chlorine to prevent biofouling of the cooling water system at both Roseton and Danskammer Point, such biocides have not been used over the past 25 years, owing to the naturally high turbidity levels in the Hudson River. Consequently, there is no potential that any discharge of these chemicals from either Roseton or Danskammer Point will adversely affect shortnose sturgeon.

Exposure to heated effluent can adversely affect aquatic organisms in the source/receiving waterbody if their thermal tolerance levels are exceeded. The slightly heated water (typically 10-20° F above ambient) discharged from these operating power plants has a lower density than that of the ambient water. As a result, the thermal plumes produced by these discharges float and highest temperatures are limited to areas near the surface. Since shortnose sturgeon is a benthic species, it is reasonable to expect that the potential for exposure to elevated temperatures resulting from cooling water discharges would be minimal. Further, in general, fish are known to detect and avoid potentially lethal water temperatures (Meldrim et al. 1974; Neill and Magnuson 1974; Texas Instruments Incorporated 1976; EA Engineering Science and Technology 1978), suggesting that shortnose sturgeon will swim away in the unlikely event that they are exposed to potentially detrimental elevated water temperatures. Recent hydrothermal modeling for Roseton revealed that the thermal plume from this plant (as defined by a 4° F temperature increase) occupies 8 percent or less of the cross-sectional area of the Hudson River at this location (CHGE et al. 1999). Although not specifically modeled, it is reasonable to assume that the thermal plume from Danskammer Point (a smaller power plant) would occupy even a smaller area. Consequently, there is ample area for shortnose sturgeon to move up- and downstream without being significantly affected by elevated temperatures from either plant.

In addition, Roseton has a high velocity diffuser on their cooling water system at the point of discharge to maximize the rate of mixing of heated discharge waters with the ambient estuarine water. As a result, the heated effluent is rapidly diluted to minimize the exposure of aquatic organisms to elevated temperatures. Therefore, the risk of the cooling water discharges from either of the two power plants adversely affecting shortnose sturgeon in the Hudson River is low.

Based on the results of past monitoring efforts described above, NMFS does not anticipate that shortnose sturgeon will be exposed to thermal effluents from the Roseton and Danskammer Point power plants in a way or to a degree that adverse effects would be likely. Based on the ability of shortnose sturgeon to move about in the river, their preference for benthic environments which are likely to be relatively unaffected by thermal discharges, and demonstrated hardiness of this species, it is probably reasonable to assume that shortnose sturgeon are unlikely to be harmed by these discharges. As a result, NMFS does not believe that the thermal discharges from the Roseton and Danskammer Point power plants will reduce appreciably the numbers, reproduction, or distribution of shortnose sturgeon in the Hudson River.

2. Section 10(a)(1)(A) research permit.

Larval Collection. The applicant has requested the lethal capture of 40 larvae in a net on an epibenthic sled. Any larvae caught in this net would be used to confirm spawning in the Hudson River.

No information currently exists regarding the level of spawning or the success of shortnose sturgeon spawning in the Hudson River, although estimates are available from other rivers. C. Smith (1985) estimated that shortnose sturgeon produce between 40,000 and 200,000 eggs per fish. Dadswell *et al.* (1984) reported 27,000 to 208,000 eggs for fish from the St. John River, New Brunswick, Canada, and studies by Heidt and Gilbert (1978) report shortnose from the Altamaha River in Georgia producing between 79,000 and 90,000 eggs. Hatchling survival rates of 19.3% under laboratory conditions have been reported by Buckley and Kynard (1981).

Direct effects of the proposed research include the death, or permanent removal, of 200 larvae from the Hudson River shortnose sturgeon population over the life of the permit. Given the estimated population of shortnose sturgeon in the Hudson River, the likely numbers of spawning shortnose sturgeon, and the few larvae which are expected to be captured and killed during the proposed research (40 larvae per year for a five year period), NMFS believes that loss of these individual larvae would have minimal effects on this population. NMFS concludes that it is unlikely that the loss of larvae associated with the proposed research and monitoring would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the listed population of shortnose sturgeon in the wild by reducing the reproduction, numbers, or distribution of the shortnose sturgeon population in the Hudson River.

Capture, External Tagging and Release of 95 Adults and Juveniles annually

The applicant proposes to capture, externally tag and release up to 95 adult and juvenile shortnose sturgeon annually. The proposed method for capture of these sturgeon is capture in either a Tucker or beam trawl. The applicants have captured, handled, and released numerous shortnose sturgeon throughout the state of New York for more than twenty years, as required by New York state regulators. Trawl times will not exceed five minutes per trawl (CHGE, 2000). Potential indirect effects of capture in a trawl may include post-capture stress or delayed access to spawning grounds.

Potential direct effects to shortnose sturgeon due to the external placement of tags can include skin irritation, causing the sturgeon to rub the tag against submerged items in an effort to dislodge it. This rubbing can create external sores and open avenues for infection, increasing the possibility of post-tagging mortality. Shortnose sturgeon are hardy and, although possible, injuries have not been reported on wild fish tagged with these tags. In addition, the applicants have been conducting this study since 1974 and have not recorded any direct mortalities of a shortnose sturgeon associated with their research activities. Indirect mortalities and injuries may have occurred, but none have been detected in recaptures of tagged fish associated with this research. As a direct result of this record, NMFS is not authorizing any unintentional mortalities in the Section 10(a)(1)(A) permit.

Based on the above, NMFS does not believe that the proposed capture, handling and tagging of up to 95 juvenile and adult fish annually, is not expected to result in injuries which would be expected, directly or indirectly, to cause any long-term adverse effects to shortnose sturgeon. Both juvenile and adult shortnose sturgeon which will be handled and tagged during the research activity are expected to recover quickly from the procedures and resume normal activities without residual adverse effects. Short-term disorientation and minor disturbances to feeding and other activities such as spawning or migrating are likely but are expected to be short-term. Based on this expectation NMFS does not believe the proposed research activities on juvenile and adult shortnose sturgeon are likely to reduce appreciably the likelihood of both the survival and recovery of shortnose sturgeon in the wild by reducing the reproduction, numbers, or distribution of this population in the Hudson River.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur within the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Several features of the shortnose sturgeon's natural history, including delayed maturation, non-annual spawning (Dadswell et al. 1984; Boreman 1997), and long life-span, affect the rate at which recovery can proceed. The cumulative anthropogenic activities in the Hudson River that could impact shortnose sturgeon recovery are recreational and commercial fisheries, additional Hudson River power plants, monitoring and research projects, operation of Troy Dam, pollutants, water quality, and development and/or construction activities resulting in excessive water turbidity and habitat degradation.

Besides the impacts of the Roseton and Danskammer Point power plants, the shortnose sturgeon is currently and will continue to be threatened by other anthropogenic activities in the Hudson River. Shortnose sturgeon are protected from directed fisheries, but they are captured as bycatch in commercial and recreational fisheries, mainly the American shad gill net fishery. Poaching could also contribute to excessive shortnose sturgeon mortality.

A number of other power plants are located on the Hudson River. In particular, four facilities are in the same approximate area as the Roseton and Danskammer Point power plants, between river miles 35 and 42: Bowline Point, Lovett, Indian Point Unit 2 and Indian Point Unit 3. While these facilities have the potential to entrain and/or impinge shortnose sturgeon, the rates of entrainment and impingement over the last 28 years have been relatively low. This likely is partly attributable to the distribution of shortnose sturgeon in the Hudson River in relation to the location of the Bowline Point, Lovett, Indian Point Unit 2 and Indian Point Unit 3 power plants. While the previous levels of entrainment and impingement at these four plants are relatively small considering the large sampling period, the existence of these and other power plants on the Hudson River have the cumulative potential to adversely affect shortnose sturgeon survival and recovery.

Since the early 1970s, CHGE has funded several monitoring programs in the Hudson River to obtain comprehensive information on the abundance and distribution of larval, young-of-year, and post-juvenile fish of selected species throughout the Hudson River. All sampling is conducted under scientific collector's permits issued by the NYSDEC, which require return of all live shortnose sturgeon to the Hudson River with minimal handling stress. These four monitoring programs have the potential to take shortnose sturgeon and influence survival. The effects of monitoring and associated take at the Roseton and Danskammer Point power plants is currently being addressed under section 10(a)(1)(A) of the ESA in this Opinion. Monitoring and incidental take at the other power plants will be subject to separate review and future applications for section 10(a)(1)(A) and section 10(a)(1)(B) permits from these facilities.

The Hudson River contains toxic chemicals including pesticides and herbicides, heavy metals, and other organic contaminants such as PAHs and PCBs. Sources for these toxicants include point sources (e.g., wastewater discharges), non-point sources (e.g., urban and agricultural runoff), and accidental spills. These pollutants could affect shortnose sturgeon growth, health, spawning success, egg survival, and larval development.

Industries along the Hudson River also likely impact the water quality, as service industries, such as transportation, communication, public utilities, wholesale and retail trades, finance, insurance and real estate, repair, and others, have increased since 1985 in all nine counties in the lower Hudson Valley. Rohman et al. (1987) identified 183 separate industrial and municipal discharges to the Hudson and Mohawk Rivers. The greatest number of users were in the chemical industry, followed by the oil industry, paper and textile manufacturers, sand, gravel, and rock processors, power plants, and cement companies. Approximately 20 publicly owned treatment works discharge sewage and wastewater into the Hudson River. Most of the municipal wastes receive primary and secondary treatment. A relatively small amount of sewage is attributed to discharges from recreational boats.

Heavy usage of the Hudson River and development along the waterfront (i.e., industrial parks, marine terminals, recreational real estate) could affect shortnose sturgeon in the action area. Coastal development and/or construction sites often result in excessive water turbidity, which could influence sturgeon spawning and/or foraging ability. Shortnose sturgeon require a clean rock or cobble substrate to deposit their eggs and unfavorable substrates could make it impossible for eggs to adhere to critical interstitial areas. Additionally, excessive turbidity could impair sturgeon foraging by making it difficult to locate prey.

Integration and Synthesis of effects

Although the shortnose sturgeon is endangered throughout its entire range, it currently exists as 19 populations in separate river systems. NMFS has determined that each of these populations are substantially reproductively isolated and the extinction of one shortnose sturgeon population may risk the permanent loss of unique genetic information that is critical to the survival and recovery of the species as a whole. Although NMFS has not formally listed these species separately, any action that appreciably reduced the reproduction, numbers, or distribution of one or more of these populations in a way that reduced their ability to survive and recover could also appreciably reduce the species' likelihood of surviving and recovering in the wild.

The Hudson River shortnose sturgeon population form one of the 19 shortnose sturgeon populations. The operation of power plants and associated intake of cooling water have the potential to adversely affect shortnose sturgeon and their subsequent survival as a result of entrainment and impingement.

A total of 4, or possibly 8 including unidentified sturgeon larvae, shortnose sturgeon larvae were collected in extensive entrainment monitoring conducted at six Hudson River power plants (Roseton and Danskammer Point included) over a 16-year study period. As previously discussed, the low vulnerability of shortnose sturgeon larvae to entrainment may be attributed to their demersal behavior after hatching and the shoreline intake locations. Additionally, this species' spawning and larval nursery areas occur many miles north of Roseton and Danskammer Point, well outside the influence of their cooling water withdrawals. The low number of shortnose sturgeon larvae likely to be entrained at these two power plants, many of which have the potential to be returned to the Hudson River unharmed, is likely to have a minimal effect on the survival and recovery of the shortnose sturgeon population. While precise estimates of annual egg production for Hudson River shortnose sturgeon are not available, data from other systems suggest that it may be in the range of 100 thousand eggs per female (Dadswell 1979). The magnitude of entrainment of shortnose sturgeon projected for Roseton and Danskammer Point power plants is small compared to the annual production of young from even a single female. Likewise, the loss of 40 shortnose sturgeon larvae per year associated with the section 10(a)(1)(A) permit is not likely to have more than minimal effects on the survival and recovery of shortnose sturgeon in Hudson River. Overall, the continued operation of these power plants and the designated level of incidental take from both entrainment and research activities likely poses little risk to the health and continued recovery of the Hudson River population of shortnose sturgeon.

Based on extensive impingement monitoring data, it is estimated that the number of shortnose sturgeon collected as a result of impingement at Roseton and Danskammer Point should average less than 7 individuals per year and potentially reach as high as 30 in any single year. Evidence suggests that the vast majority of these impinged fish would be returned to the Hudson River unharmed. This projected annual collection is exceedingly small compared to a total population size of more than 60,000 shortnose sturgeon Age 1 and older estimated to be in the Hudson River at present. The actual incremental mortality imposed on the population by impingement at the two power plants likely poses little risk to the survival and continued recovery of the Hudson River population. Based on previous experience, NMFS also believes that research activities proposed by the applicants involving the capture and handling of up to 95 shortnose sturgeon per year can likewise be expected to result in little harm to individual fish.

The fact that the population has increased approximately four-fold in the Hudson River since the late 1970s and Roseton and Danskammer Point have documented some level of shortnose sturgeon impingement and entrainment during this time, suggests that the proposed actions are of little population-level consequence. During the time of prior impingement and entrainment, both Roseton and Danskammer Point were withdrawing cooling water at levels comparable to what is being proposed for the future. Despite this entrainment and impingement, the shortnose sturgeon population was able to increase to the point that it is now widely considered to be in good condition (Bain et al. 1998). Based on the above, NMFS does not believe that issuance of a section 10(a)(1)(B) permit for incidental take associated with operations of the Roseton and Danskammer Point power plants is likely to reduce the numbers, distribution, or reproduction of shortnose sturgeon in a way which is likely to reduce appreciably their ability to survive and recovery in the wild.

The proposed research in the section 10(a)(1)(A) application is very similar to other research permitted by NMFS on other Northeast rivers. Based on experience with those research activities, and the effects of the proposed activities, NMFS does not expect the proposed research activities to result in more than minor losses of individual larvae (40 per year for a five year period). The effects to shortnose sturgeon due to the loss of 40 larvae per year over a five year period is unlikely to be detectable within the Hudson River population or the rangewide population as listed. In addition, the proposed research activities are not expected to result in more than short-term and minor disturbances in normal behaviors such as feeding, spawning, and migrating, associated with the handling, capture, and tagging of up to 95 juvenile and adult shortnose sturgeon per year. These minor disturbances are not likely to have measurable or long-term effects. No mortalities of juvenile or adult shortnose sturgeon are expected. As a result, NMFS does not expected that issuance of the proposed section 10(a)(1)(A) permit to CHGE/Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. is likely to reduce appreciably the likelihood of both the survival and recovery of shortnose sturgeon in the wild by reducing their reproduction, numbers, or reproduction within the Hudson River population, or the larger population of shortnose sturgeon as listed.

The results of the proposed research will likely continue to contribute to our understanding of the habitat, foraging ecology, growth rate, and population dynamics of the species, with concentration on the Hudson River system. This information has been identified as a number one priority in the final shortnose sturgeon recovery plan (NMFS, 1998).

CONCLUSION

Based on the above, NMFS has determined that the take of shortnose sturgeon associated with activities of the Roseton and Danskammer Point power plants on the Hudson River addressed in the subject section 10(a)(1)(A) and section 10(a)(1)(B) permits are not likely to appreciably reduce the numbers, distribution, or reproduction of shortnose sturgeon in the Hudson River population in a way which appreciably reduces the ability of shortnose sturgeon to survive and recover in the wild.

After reviewing the current status of the species discussed herein, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the NMFS' biological opinion that NMFS issuance of a section 10(a)(1)(A) and section 10(a)(1)(B) permit to CHGE/Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. is not likely to jeopardize the continued existence of endangered shortnose sturgeon. No critical habitat has been designated, therefore, none will be affected.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined to include any act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The proposed CP and its associated documents, including this biological opinion, clearly identify anticipated impacts to affected species likely to result from the proposed taking and the measures that are necessary and appropriate to minimize those impacts. All conservation measures described in the proposed CP, together with the terms and conditions described in the associated Implementing Agreement and the Section 10(a)(1)(B) permit issued with respect to the proposed CP, are hereby incorporated by reference as reasonable and prudent measures and terms and conditions within this Incidental Take statement pursuant to 50 CFR §402.14(i). Such terms and conditions are non-discretionary and must be undertaken for the exemptions under section 10(a)(1)(B) and section 7(o)(2) of the ESA to apply. If the permittee fails to adhere to these terms and conditions, the protective coverage of the section 10(a)(1)(B) permit and section 7(o)(2) may lapse. The amount or extent of incidental take anticipated under the proposed CP and associated monitoring and reporting requirements are as described in the CP and its accompanying section 10(a)(1)(B) permit. CHGE is the holder of the permit until the sale of the plants is complete and then Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. will become the new owners and permit holders.

Based on impingement data collected from 1972 to 1998, NMFS anticipates the average annual incidental take by CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C.to be 2 shortnose sturgeon at Roseton and 4 at Danskammer Point. All levels of incidental take will be evaluated as a 5-year running average to account for the high inter-annual variation. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the potential for and impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, the level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. When the incidental take has been reached/exceeded, then CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. must immediately provide an explanation of the causes of the taking and review with the NMFS the need for possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. NMFS has determined that the level of incidental take as designated in the proposed CP is not likely to jeopardize the continued existence of endangered shortnose sturgeon located in the project area. To further reduce the adverse effects on listed species, NMFS recommends that the following conservation measures be implemented.

1. NMFS should provide technical assistance to CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. throughout the term of the permit and provide technical advice on monitoring and other biological issues associated with implementation of the CP.

2. NMFS should conduct regular and frequent compliance monitoring, including review of the quarterly reports for the monitoring program. This includes monitoring the terms of the IA and the CP in order to ensure compliance with the incidental take permit, the CP and the IA.

REINITIATON OF CONSULTATION

This concludes formal consultation on the issuance of a Section 10(a)(1)(B) incidental take permit to CHGE / Dynegy Danskammer, L.L.C. and Dynegy Roseton, L.L.C. for the Roseton and Danskammer Point Generating Stations. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in this biological opinion; or (4) a new species is listed or critical habitat designated that may be affected by the identified action. In instances where the amount or extent of incidental take is exceeded, NMFS must immediately request reinitiation of section 7 consultation.

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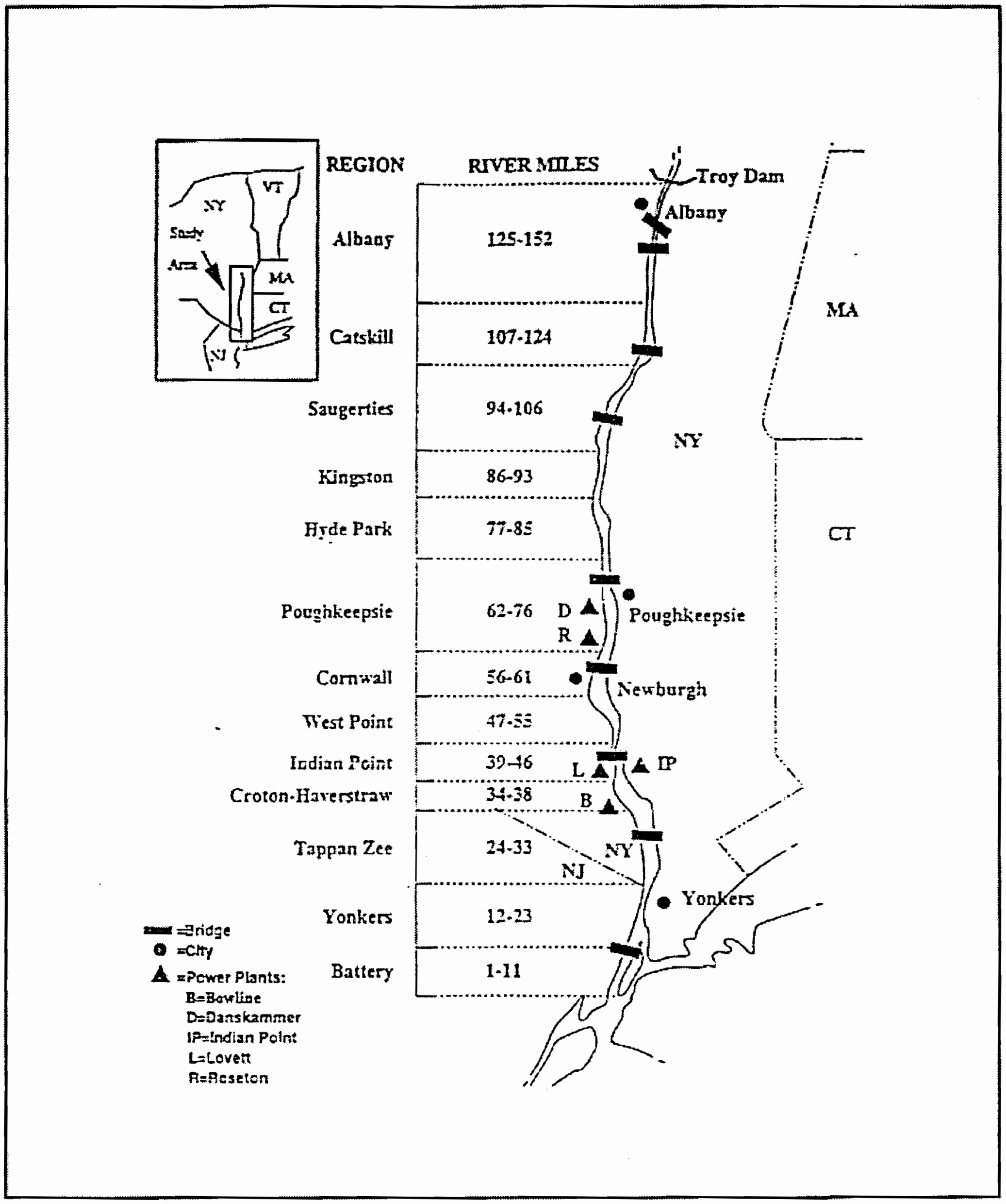

Figure 1-1. Locations of six existing power plants on the Hudson River estuary.

TABLE 1. ACTUAL NUMBER OF SHORTNOSE STURGEON (SNS) COLLECTED DURING ENTRAINMENT SAMPLING AT SIX HUDSON RIVER POWER PLANTS, 1972-1998

	Bowline	**Lovett**	**Indian Point Unit 2**	**Indian Point Unit 3**	**Roseton**	**Danskammer Point**	**Annual Total**
1972	NS	NS	NR	Not Operational	Not Operational	NS	---
1973	NS	NS	NR	Not Operational	NS	NS	---
1974	NS	NS	NR	Not	0	0	0

TABLE 1. ACTUAL NUMBER OF SHORTNOSE S..RGEON (SNS) COLLECTED DURING ENTRAINMENT SAMPLING AT SIX HUDSON RIVER POWER PLANTS, 1972-1998

	Bowline	**Lovett**	**Indian Point Unit 2**	**Indian Point Unit 3**	**Roseton**	**Danskammer Point**	**Annual Total**
1975	0	0	NR	Operational Not Operational	0	0	0
1976	0	0	NR	NR	0	0	0
1977	0	0	NC	NC	0	0	0
1978	0	NS	NC	NC	0	0	0
1979	0	NS	NC	NC	0	0	0
1980	0	NS	0	0	0	0	0
1981	0	NS	0	0	0	0	0
1982	0	NS	N	NS	0	0	0

TABLE 1. ACTUAL NUMBER OF SHORTNOSE STURGEON (SNS) COLLECTED DURING ENTRAINMENT SAMPLING AT SIX HUDSON RIVER POWER PLANTS, 1972-1998

	Bowline	Lovett	Indian Point Unit 2S	Indian Point Unit 3	Roseton	Danskammer Point	Annual Total
1983	NC	NS	0	0	0	2 *Acipenser*	2 *Acipenser*
1984	NC	NS	0	0	0	3 (1)[a] SNS, 1 (1) *Acipenser*	3 (1) SNS, 1 (1) *Ac*

TABLE 1. ACTUAL NUMBER OF SHORTNOSE S[illegible]RGEON (SNS) COLLECTED DURING ENTRAINMENT SAMPLING AT SIX HUDSON RIVER POWER PLANTS, 1972-1998

	Bowline	**Lovett**	**Indian Point Unit 2**	**Indian Point Unit 3**	**Roseton**	**Danskammer Point**	**Annual Total**
							ipenser
1985	NC	NS	0	0	0	0	0
1986	0	NS	0	0	0	0	0
1987	0	NS	0	0	0	0	0
1988	NS	NS	NS	NS	NS	NS	- - -
1989	NS	NS	NS	NS	NS	NS	- - -
1990	NS	NS	NS	NS	NS	NS	- - -
1991	NS	NS	NS	NS	NS	NS	- - -
1992	NS	NS	NS	NS	NS	NS	- - -

TABLE 1. ACTUAL NUMBER OF SHORTNOSE S. .GEON (SNS) COLLECTED DURING ENTRAINMENT SAMPLING AT SIX HUDSON RIVER POWER PLANTS, 1972-1998

	Bowline	Lovett	Indian Point Unit 2	Indian Point Unit 3	Roseton	Danskammer Point	Annual Total
1993	NS	NS	NS	NS	NS	NS	---
1994	NS	NS	NS	NS	NS	NS	---
1995	NS	NS	NS	NS	NS	NS	---
1996	NS	NS	NS	NS	NS	NS	---
1997	NS	0	NS	NS	NS	NS	0
1998	NS	0	NS	NS	NS	NS	0

TABLE 1. ACTUAL NUMBER OF SHORTNOSE STURGEON (SNS) COLLECTED DURING ENTRAINMENT SAMPLING AT SIX HUDSON RIVER POWER PLANTS, 1972-1998

	Bowline	Lovett	Indian Point Unit 2	Indian Point Unit 3	Roseton	Danskammer Point	Annual Total
Total	0	0	0	0	0	3 (1) SNS, 3 (1) *Acipenser*	3 (1) SNS, 3 (1) *Acipenser*

TABLE 1. ACTUAL NUMBER OF SHORTNOSE S[illegible]GEON (SNS) COLLECTED DURING ENTRAINMENT SAMPLING AT SIX HUDSON RIVER POWER PLANTS, 1972-1998

	Bowline	Lovett	Indian Point Unit 2	Indian Point Unit 3	Roseton	Danskammer Point	Annual Total

[a] Numbers in parenthesis indicate number collected during a special study of simultaneous sampling at Danskammer Point and Roseton.

Note: NS = No Sampling; NC = No Catch of SNS, samples were examined for only select species; NR = No Report for SNS, only data for select species reported.

Sources: Annual entrainment monitoring reports.

Acipenser = Species unidentified.

TABLE 2. ACTUAL NUMBER OF SHORTNOSE STURGEON COLLECTED DURING IMPINGEMENT SAMPLING AT SIX HUDSON RIVER POWER PLANTS, 1972-1998

	Bowline	**Lovett**	**Indian Point Unit 2**	**Indian Point Unit 3**	**Roseton**	**Danskammer Point**	**Annual Total**
1972	No Sampling	No Sampling	1	Not Operational	Not Operational	4	5
1973	1	0	2	Not Operatio	0	2	5

1974	1	0	3	nal Not Operational	1	0	5
1975	0	0	1	Not Operational	0	0	1
1976	1	0	2	0	0	0	3
1977	0	0	6	1	0	1	8
1978	0	0	2	3	0		5
1979	0	0	2	2	0	0	4
1980	0	0	0	1	0	0	1
1981	0	0		0	0	0	0
1982	0	0	0	0	0	3	3
1983	0	0	0	0	0	1	1
1984	0	0	1	1	2	3	7
1985	0	0	0	0	1	2	3
1986	0	0	0	0	0	0	0
1987	0	0	1 (1)	1	0	0	2 (1)
1988	0	0	0 (3)	1	1	0	2 (3)

1989	0	0	0	0 (1)	0	0	0 (1)
1990	0	0	0 (1)	0	0	2	2 (1)
1991	0	0	No Sampling	No Sampling	0	0	0
1992	0	0	No Sampling	No Sampling	0	1	1
1993	0	0	No Sampling	No Sampling	0	0	0
1994	0	0	No Sampling	No Sampling	1	0	1
1995	0	0	No Sampling	N	1	1	2

1996	0	0	No Sampling	No Sampling	0	0	0
1997	0	0	No Sampling	No Sampling	0	0	0
1998	0	0	No Sampling	No Sampling	0	2	2
Total	3	0	21 (5)	10 (1)	7	22	63 (6)

Note: Numbers in parenthesis indicate number of shortnose sturgeon taken on non-sample days.
Sources: Hoff & Klauda 1979; annual impingement monitoring reports.

TABLE 3. ESTIMATED ANNUAL IMPINGEMENT OF SHORTNOSE STURGEON AT SIX HUDSON RIVER POWER PLANTS, 1972 -1998

	Bowline	Lovett	Indian Point Unit 2	Indian Point Unit 3	Roseton	Danskammer	All Plants
1972	1[a]	0[a]	1[b]	Not Operational	Not Operational	14	16
1973	9	0[c]	2[b]	Not Operational	0	29[d]	40
1974	9	0[c]	3	Not Operational	7	0	19
1975	0	0	1	Not Operational	0	0	1
1976	4	0	2	0	0	0	6
1977	0[e]	0	6	1	0	6	13
1978	0	0	2	3	0	0	5
1979	0	0	2	2	0	0	4
1980	0	0	0	1	0	0	1
1981	0	0	0	0	0	0	0

						1	1
1982	0	0	0	0	0	6	6
1983	0[e]	0	0	0	0	5	5
					1	1	3
1984	0	0	4	4	3	5	6
						1	1
1985	0	0	0	0	7	1	8
1986	0	0	0	0	0	0	0
1987	0	0	6	3	0	0	9
							1
1988	0	0	0	4	7	0	1
1989	0	0	0	0	0	0	0
						1	1
1990	0	0	0	0	0	5	5
1991	0	0	1[f]	1[f]	0	0	2
							1
1992	0	0	1[f]	1[f]	0	8	0
1993	0	0	1[f]	1[f]	0	0	2
							1
1994	0	0	1[f]	1[f]	8	0	0
							1
1995	0	0	1[f]	1[f]	7	7	6
1996	0	0	1[f]	1[f]	0	0	2
1997	0	0	1[f]	1[f]	0	0	2
						1	1
1998	0	0	1[f]	1[f]	0	4	6
						1	2
					4	4	7
Total	23	0	37	26	9	0	5
							1
					1	5	0
					.	.	.
Per Year	0.9	0.0	1.4	1.0	8	2	2
Last 10					1	4	7
years	0	0	8	8	5	4	5
					1	4	7
					.	.	.
Per year	0	0	0.8	0.8	5	4	5

[a] Estimated impingement based on yearly average of following 5 years of sampling (1973-1977) and prorated to start of operation in September.

[b] Assumed 100 percent of flow sampled in accordance with applicable Standard Operating Procedures.

[c] Percent of annual flow sampled assumed same as 1975.

[d] Percent of annual flow sampled based on 26 sampling days (from sampling frequency) and 365 operating days.

[e] Percent of annual flow sampled assumed same as previous year.

[f]Estimated impingement based on yearly average of last 5 years of sampling (1986-1990).

APPENDIX A.

PROCEDURES FOR ESTIMATING TOTAL IMPINGEMENT OF SHORTNOSE STURGEON

A.1 INTRODUCTION

The six power plants (Bowline Point, Lovett, Indian Point Unit 2 and Unit 3, Roseton and Danskammer Point) located in the mid-Hudson River Estuary ("the Estuary") employ a once-through cooling water system to cool the condensers. The cooling systems withdraw large quantities of the Estuary water containing a variety of aquatic organisms of different species and sizes. The organisms found in the cooling water may pass through a plant's cooling system (entrainment) or may be entrapped on the debris screens installed at the intake to the cooling system (impingement). After passage through the plant's cooling system, the water and entrained organisms are discharged to the Estuary. Various screenwash systems are employed at the power plants for periodically removing impinged organisms from the debris screens and either disposing of them or returning them to the Estuary.

Sampling programs and studies concerned with the aquatic effects of impingement have been conducted at each of the power plants since the early 1970s. Weekly sampling for a 24-hour period for impingement abundance and species composition has generally been conducted at Bowline Point, Lovett, Roseton, and Danskammer Point since the start of commercial operation of each plant. At Indian Point, impingement abundance and species composition was monitored daily until July 1981 and thereafter for 110 days per year on a seasonally stratified, randomly selected schedule. Impingement sampling at Indian Point was discontinued in 1991 following the installation of modified Ristroph-type traveling screens.

In order to assess the impact of impingement on shortnose sturgeon, an estimate of the total number of shortnose sturgeon impinged should be determined. Because impingement sampling was not conducted daily at most of the power plants (except at Indian Point prior to 1981), the number of shortnose sturgeon collected during sampling reflects only a portion of the total impingement. These sampling numbers should be scaled by some factor to arrive at a total estimated impingement. Based on the assumption that impingement is directly proportional to flow, a scaling factor based on the percent of total plant flow sampled has typically been used. In support of this assumption, it stands to reason that if there were no flow there would be no impingement. Conversely, if all the water in the Estuary was used, then it stands to reason that all shortnose sturgeon would be impinged. Thus, at least over some range of flow, the number of shortnose sturgeon impinged is proportional to the amount of cooling water withdrawn from the Estuary.

A.2 ESTIMATION PROCEDURE

The total estimated impingement of shortnose sturgeon at each of the power plants for each year from 1972 through 1998 was derived from the number of shortnose sturgeon collected in impingement samples and the percent of total plant flow sampled as follows:

$$I_{py} = \frac{N_{py}}{F_{py}}$$

I_{py} = Total estimated impingement for power plant (p) in year (y)

N_{py} = Number of shortnose sturgeon collected in impingement samples at power plant (p) in year (y)

F_{py} = Percent of total plant flow sampled at power plant (p) in year (y).

The number of shortnose sturgeon collected in impingement samples and the percent of total plant flow sampled were obtained from the annual impingement reports produced by the impingement contractor at each of the power plants. If percent of flow sampled could not be determined from the annual reports, then either a value from the previous or following year or a value based on sampling frequency was substituted. If no sampling was conducted at a power plant for a year, then the total estimated impingement for that year was based on an annual average total estimated impingement from either the previous or following 5 years of sampling.

A.3 RESULTS

Estimates of the total annual impingement and supporting data for each year are presented for Roseton and Danskammer Point power plants in Table A-19. Similar data for four other Hudson River power plants is presented in Table A-20. These results demonstrate that shortnose sturgeon are impinged at the six power plants listed relatively infrequently. This infrequency is evidenced by the fact that during the 10 most recent years of impingement monitoring at all power plants (1981-1990), shortnose sturgeon were not even collected at any specific plant almost 80 percent of the time.

TABLE A-1 TOTAL ESTIMATED IMPINGEMENT OF SHORTNOSE STURGEON AT ROSETON AND DANSKAMMER POINT POWER PLANTS, 1972-1998

	Roseton			Danskammer Point			Both Power Plants	
	Number of Impinged SNS	Total Plant Flow Sampled (%)	Total Estimated Impingement	Number of Impinged SNS	Total Plant Flow Sampled (%)	Total Estimated Impingement	Number of Impinged SNS	Total Estimated Impingement
1972	Not Operational			4	30.55	14	4	14
1973	0	38.82	0	2	7.1[(a)]	29	2	29
1974	1	16.64	7	0	12.1	0	1	7
1975	0	13.09	0	0	13.91	0	0	0
1976	0	13.87	0	0	14.7	0	0	0
1977	0	17.2	0	1	17.1	6	1	6
1978	0	18.03	0	0	18.38	0	0	0
1979	0	18.2	0	0	17.0	0	0	0
1980	0	17.7	0	0	20.0	0	0	0
1981	0	19.3	0	0	19.7	0	0	0
1982	0	15.5	0	3	19.8	16	3	16
1983	0	16.7	0	1	22.2	5	1	5
1984	2	16.4	13	3	20.9	15	5	28
1985	1	15.8	7	2	19.7	11	3	18
1986	0	14.7	0	0	16.8	0	0	0
1987	0	17.3	0	0	20.0	0	0	0
1988	1	15.7	7	0	18.6	0	1	7
1989	0	14.3	0	0	14.1	0	0	0
1990	0	14.3	0	2	14.2	15	2	15
1991	0	14.4	0	0	14.0	0	0	0
1992	0	14.3	0	1	14.2	8	1	8
1993	0	14.7	0	0	13.7	0	0	0
1994	1	14.1	8	0	14.6	0	1	8
1995	1	14.9	7	1	14.7	7	2	14
1996	0	14.4	0	0	14.1	0	0	0
1997	0	14.4	0	0	14.6	0	0	0
1998	0	14.4	0	2	14.3	14	2	14
Total	7	--	49	22	--	140	29	189

(a) Percent flow sampled based on 26 sampling days (from sampling frequency) and 365 operational days.

(b)

TABLE A-2 TOTAL ESTIMATED IMPINGEMENT OF SHORTNOSE STURGEON AT BOWLINE POINT, LOVETT, AND INDIAN POINT UNIT 2 AND UNIT 3 POWER PLANTS, 1972-1998

Year	Bowline Point			Lovett			Indian Point Unit 2			Indian Point Unit 3		
	Number of Impinged SNS	Total Plant Flow Sampled (%)	Total Estimated Impingement	Number of Impinged SNS	Total Plant Flow Sampled (%)	Total Estimated Impingement	Number of Impinged SNS	Total Plant Flow Sampled (%)	Total Estimated Impingement	Number of Impinged SNS	Total Plant Flow Sampled (%)	Total Estimated Impingement
1972	No		1[a]	No		0[a]	1	100[c]	1	Not		
1973	1	11.44	9	0	13.9[b]	0	2	100[c]	2	Not		
1974	1	12.32	9	0	13.9[b]	0	3	100	3	Not		
1975	0	14.99	0	0	13.9	0	1	100	1	Not		
1976	1	26.72	4	0	13.9	0	2	100	2	0	100	0
1977	0	26.72[b]	0	0	10.7	0	6	100	6	1	100	1
1978	0	33.17	0	0	13.5	0	2	100	2	3	100	3
1979	0	30.4	0	0	12.2	0	2	100	2	2	100	2
1980	0	27.7	0	0	12.2[b]	0	0	100	0	1	100	1
1981	0	18.9	0	0	10.8	0	0	50.75	0	0	64.48	0
1982	0	16.6	0	0	13.4	0	0	17.64	0	0	30.0	0
1983	0	16.6[b]	0	0	16.1	0	0	26.54	0	0	49.83	0
1984	0	31.2	0	0	13.8	0	1	33.33	4	1	32.16	4
1985	0	29.3	0	0	10.4	0	0	83.3	0	0	41.33	0
1986	0	28.3	0	0	10.8	0	0	35.03	0	0	29.7	0
1987	0	26.6	0	0	8.9	0	1	17.73	6	1	40.4	3
1988	0	28.4	0	0	10.6	0	0	27.91	0	1	29.1	4
1989	0	27.3	0	0	11.1	0	0	30.52	0	0	28.62	0
1990	0	29.3	0	0	10.4	0	0	14.2	0	0	28.08	0
1991	0	13.8	0	0	14.4	0	No		1[d]	No		1[d]
1992	0	15.0	0	0	13.0	0	No		1[d]	No		1[d]
1993	0	15.1	0	0	12.6	0	No		1[d]	No		1[d]
1994	0	14.0	0	0	14.9	0	No		1[d]	No		1[d]
1995	0	15.4	0	0	15.5	0	No		1[d]	No		1[d]
1996	0	16.5	0	0	15.1	0	No		1[d]	No		1[d]
1997	0	14.1	0	0	15.0	0	No		1[d]	No		1[d]
1998	0	14.9	0	0	15.7	0	No		1[d]	No		1[d]
Tota	3	--	23	0	--	0	--		37	21	--	26

[a] Estimated impingement based on yearly average of following 5 years of sampling (1973-1977) and prorated to start of operation in September.

[b] Assumed percent flow sampled was same as previous or following year because actual percent flow data were not found.

[c] Percent flow sampled based on percent flow sampled at Indian Point Unit 1 by assuming the sampling schedule was the same.

[d] Estimated impingement based on yearly average of last 5 years of sampling (1986-1990).