UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

# Environmental Assessment (EA)

On the Issuance of a Scientific Research Permit (Permit No. 16549) to the S.O. Conte Anadromous Fish Research Center (CAFRC) to Conduct Research Activities on Endangered Wild and Captive Shortnose Sturgeon

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**Abstract**: The S.O. Conte Anadromous Fish Research Center; USGS, Box 796 (One Migratory Way, Turners Falls, Massachusetts 01376), is requesting authorization for a scientific research permit for takes of shortnose sturgeon (*Acipenser brevirostrum*) in the wild and captivity pursuant to the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. §§ 1531 *et seq.*). The applicant proposes to determine up and downstream migrations, habitat use, spawning periodicity, and seasonal movements of shortnose sturgeon in the Connecticut River (from Agawam, MA to Montague, MA). The applicant also proposes short-term captive animal research of wild origin shortnose sturgeon in laboratory tests of up- and downstream fish passage studies, swimming performance tests, tagging studies, anesthesiology, behavior, physiology, and contaminant studies. Furthermore, the applicant requests authorization for collecting fertilized embryo from the Merrimack River (MA), Kennebec River, and Androscoggin River (ME), to produce non-releasable progeny for larval research in the laboratory. The permit would be valid for five years upon issuance.

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# CHAPTER 1: PURPOSE AND NEED FOR ACTION

## *1.1 DESCRIPTION OF ACTION*

The National Marine Fisheries Service (NMFS), Office of Protected Resources (NMFS PR) proposes to issue a ESA Permit (File No. 16549 to the S.O. Conte Anadromous Fish Research Center, USGS (hereinafter, Permit Holder) and Barnaby Watten (Responsible Party), under Section 10(a)(1)(A) of the Endangered Species Act (ESA) of 1973 as amended (16 U.S.C. §§ 1531 *et seq*.), and the regulations governing the taking, importing, and exporting of endangered and threatened species (50 C.F.R. §§ 222-226).

### 1.1.1 *Purpose and Need*:

The purpose of the scientific research would be to gather information used to help inform conservation management decisions to recover shortnose sturgeon in the wild. Section 10(a)(1)(A) of the ESA allows NMFS to issue permits and permit modifications to take ESA-listed shortnose sturgeon. The applicant requires a permit to conduct the proposed research.

The primary purpose of the permit would be to therefore provide an exemption from the take prohibitions under the ESA to allow "takes" of shortnose sturgeon for bona fide scientific research. The need for issuance of the permit is related to NMFS's mandates under the ESA. Specifically, NMFS has a responsibility to implement the ESA to protect, conserve, and recover threatened and endangered species under its jurisdiction. The ESA prohibits takes of threatened and endangered species, with only a few very specific exceptions, including for scientific research and enhancement purposes. Permit issuance criteria require that research activities are consistent with the purposes and policies of these federal laws and would not have a significant adverse impact on the species.

### 1.1.2 *Background*

In response to the receipt of an application for a permit from the S.O. Conte Anadromous Fish Research Center, USGS [File No. 16549], NMFS proposes to issue a scientific research permit for "takes"[1] of shortnose sturgeon (*Acipenser brevirostrum*) pursuant to the statute and regulations listed above.

The current permit application succeeds expired Permit No. 1549-01 authorizing similar study of shortnose sturgeon on the Connecticut River and elsewhere in the Gulf of Maine (GOM). The original permit (Permit No. 1549) was supported by a February 2007 environmental assessment (EA) entitled "*Environmental Assessment of Issuance of a Scientific Research Permit to Dr. Boyd Kynard, S.O. Conte Anadromous Fish Research Center, to Conduct Research Activities on Endangered Shortnose Sturgeon (File 1549)* (NMFS 2007a)" analyzing the effects of shortnose sturgeon research on the environment in multiple rivers (including the Connecticut and Merrimack Rivers (MA), and the Androscoggin River (ME). Subsequently, a supplemental environmental assessment (SEA) was produced analyzing the environmental effects of issuing a permit modification entitled, "*Supplemental Environmental Assessment on the Issuance of a Modification to Scientific Research Permit No. 1549 [Boyd Kynard, S.O. Conte Anadromous Fish Research Center] to Conduct Research Activities on Endangered Shortnose Sturgeon*" (NMFS 2009) increasing the authorized take and capture methods in the Merrimack River. Each of these analyzes resulted in a finding of no significant impact (FONSI)

1 The ESA defines "take" as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." The term "harm" is further defined by regulations (50 C.F.R. § 222.102) as "an act which actually kills or injures fish or wildlife."

determination under the National Environmental Policy Act (NEPA), and each of these actions were determined to be non-controversial.

#### 1.1.3 *General Research Objectives*

The objectives of this project would include studies of shortnose sturgeon life history, migration, physiology, and passage in the Connecticut River. The applicant also proposes captive animal research in laboratory tests of up- and downstream fish passage studies, swimming performance tests, tagging studies, anesthesiology, behavior, physiology and contaminant studies, as well as producing progeny for further larval research characterizing early life stage history in the Merrimack, Kennebec and Androscoggin Rivers .

### *1.2 SCOPE OF ENVIRONMENTAL ASSESSMENT (EA):*

This assessment is an analysis serving as an EA for File No. 16549 focusing primarily on effects of issuing an ESA permit to study endangered shortnose sturgeon, the target species of the applicant's research.

The National Oceanic and Atmospheric Administration (NOAA) has, in NOAA Administrative Order 216-6 (NAO 216-6; 1999), listed issuance of permits for research on protected species as categories of actions that "do not individually or cumulatively have a significant effect on the human environment…" and which therefore do not require preparation of an environmental assessment (EA) or environmental impact statement (EIS). A possible exception to the use of these categorical exclusions is when the action may adversely affect species listed as threatened or endangered under the ESA (NAO 216-6 Section 5.05c).

There is no evidence from prior analyses of the effects of permit issuance, or from monitoring reports submitted by permit holders[2,] that issuance of research permits for take of shortnose sturgeon listed under the ESA results in adverse effects on stocks or species. Since 2005, NMFS has prepared over 100 EAs for issuance of permits under the Marine Mammal Protection Act and ESA, with 14 currently active shortnose sturgeon permits under NMFS management jurisdictions (See Appendix 1). In every case, the EA supported a finding of no significant impact regardless of the nature of the permitted take or the status of the species that were the subject of the permit. These EAs were accompanied by Biological Opinions prepared pursuant to interagency consultation under Section 7 of the ESA and further document that such permits are not likely to adversely affect listed species. Nevertheless, NMFS has prepared this EA containing the more detailed analysis to determine the potential for adverse impacts on threatened or endangered species resulting from takes of the target shortnose sturgeon to assist in making the decision about permit issuance under the ESA.

A *Federal Register* notice of Receipt of the application (77 Fed. Reg. 21750) was published on April 11, 2012, allowing other agencies and the public to comment on the action. All agency comments were appropriately addressed and are reviewable in the record for File No. 16549. None of the comments were controversial and none addressed the proposal's potential effects on the quality of the human environment. No comments from the public were received on the application.

2 All NMFS permits for research on protected species require submission of annual reports, which include information on responses of animals to the permitted takes.

## CHAPTER 2 ALTERNATIVES INCLUDING THE PROPOSED ACTION

***2.1 ALTERNATIVE 1 - NO ACTION*:** Under the No Action alternative, the requested permit would not be issued and the applicant would not receive an exemption from the ESA prohibition against take.

***2.2. ALTERNATIVE 2 - PROPOSED PERMIT*:** Under the Proposed Permit alternative, a permit would be issued to exempt the applicant from the ESA take prohibition during conduct of research consistent with the purposes and policies of the ESA and applicable permit issuance criteria.

### *2.3 DESCRIPTION OF THE PROPOSED ACTION*

#### 2.3.1 *Action Area*

The applicant proposes capturing adults, sub-adults, juveniles and early life stages (ELS) of shortnose sturgeon in the Connecticut River beginning at Agawam, MA and extending to Turner Falls, MA. Additionally fertilized embryo are requested to be collected from the Merrimack River (MA), Androscoggin River (ME) and the, Kennebec (ME) Rivers in the action area described in File No. 16306 (NMFS 2012). The captive research component of the action area is proposed for the Conte Anadromous Fisheries Research Center ("Conte Lab") located at Turner Falls, MA. The maps of the action area are illustrated in Figures 1–4 of Appendix 1.

#### 2.3.2 *Research Goals:*

The applicant's study objectives (1-15) are discussed in detail within the applicant's application. Specifically these goals are categorized by location and specimen type as follows:

- ***Above Holyoke Dam Connecticut River (Wild Adult/sub-adult & Juvenile Specimens)***: (1) Compare population abundance techniques; (2) Monitor natural spawning success of shortnose sturgeon in the Connecticut River at the Montague spawning site; (3) Determine seasonal habitat use and movements of Connecticut River shortnose sturgeon yearlings and juveniles during summer-fall foraging and over-wintering periods using tagging and telemetry studies.

- ***Below Holyoke Dam Connecticut River (Wild Adult/sub-adult & Juvenile Specimens)*:** (4) Study the significance of the Agawam site on the Connecticut River; (5) Study the movement and behavior of upstream migrant adults approaching Holyoke Dam; and (6) Evaluate fish passage structures; (7) Model upstream swimming performance for fish passage; (8) Determine the physiological effects of electro-narcosis.

- ***Gulf of Maine Rivers (Cultured from ELS Non-releasable Animals)*:** (9) Model downstream larval dispersal behavior of Gulf of Maine progeny in the laboratory at CARFC; (10) Test salinity and thermal tolerances of ELS in the laboratory; (11) Evaluate endocrine disruption in multiple life-stages of shortnose sturgeon in the laboratory;

- ***Captive, (Cultured Non-releasable Animals)*:** (13) Adult/sub-adult fish remaining from prior permits to be used in calibrating physiology and performance tests (e.g., electro-narcosis) on wild specimens; (14) authorization to receive up to 20 captive brood stock of shortnose sturgeon for producing progeny for experimental research; and (15) authorization to import up to 40,000 shortnose sturgeon ELS from international sources over five years for experimental research.[3]

3 Import of shortnose sturgeon would require CITES I permit authorization secured through the U.S. Fish and Wildlife Service.

### 2.3.3 *Takes of Wild Shortnose Sturgeon from the Connecticut River*

*2.3.3.1.* *Takes of Wild Shortnose Sturgeon Above the Holyoke Dam (RM 87-121)*: Table 1 (line 1) summarizes proposed directed take north of the Holyoke Dam on the Connecticut River, authorizing annual capture of up to 100 wild adult and sub-adult shortnose sturgeon (≥550mm) with gill nets. A sub-set (line 1.a.) of 85 animals would be captured in mark/recapture comparative sampling; and a sub-set of 15 animals (line 1.b) would be captured and either internally radio tagged, under anesthesia, or externally tagged, depending on sex and stage of spawning, to determine life history and spawning incidence.. Additionally, up to 100 juvenile shortnose sturgeon (<550mm) (line 2. b) would be captured with gill nets, seines and/or trawls; of these, a subset of 25 juveniles (>300mm) would be externally telemetry tagged and tracked to determine life history and passage of juvenile shortnose sturgeon. Lastly, to verify spawning success, D-nets would be deployed for capturing up to 150 early life stages (ELS) downstream of identified spawning sites (line 3).

Table 1. Authorized take of wild shortnose sturgeon in the Connecticut River upstream of Holyoke Dam by number, life stage, location, method, and by research activity.*

| Task | No. Fish | Subset | Life Stage | River Location and Capture Method | Take Activity | Details |
|---|---|---|---|---|---|---|
| *1.* | *100* | | *Adults &sub-adults (≥550 mm)* | *Wild CT River (Upstream of Holyoke Dam); Gill-net, beach seine, and/or trawl* | *Directed Take* | |
| | *a.* | *85* | *Adults & sub-adults* | | *Capture, PIT tag (#1b), tissue sample, measure, weigh, borescope (≥690mm), release immediately* | *Comparison of methods of Upstream CT River: mark/recapture count estimate (2 of 5 years)* |
| | *b* | *15* | *Adults* | | *Capture, PIT tag (#1b), tissue sample, measure; weigh; borescope (≥690mm); external tag (#2 = late-stage females), internal tag (#3=males and early-stage females); anesthesia,); release immediately, track* | *Upstream CT River: Montague spawning success; life history* |
| *2.* | *100* | | *Juveniles (<550 mm)* | | *Directed Take* | |
| | *a.* | *75* | | | *Capture, PIT tag (#1a); only fish ≥ 300 mm TL), tissue sample, measure, weigh, release immediately* | *Upstream CT River: juvenile life history, ecology, and passage* |
| | *b.* | *25* | | | *Capture, PIT tag (#1a; only fish ≥ 300 mm TL), tissue sample, measure, weigh, external tag (#2); release immediately & track* | *Upstream CT River: juvenile life history, ecology, and passage* |
| *3.* | *150* | | *Eggs/Larvae* | *D-nets: maximum set duration of 14 hours* | *Intentional Directed Mortality* | *Upstream CT River: Montague spawning success* |

* Tag types are described in application and Table 9 in this EA.

#### 2.3.3.2 *Takes of Wild Shortnose Sturgeon Below the Holyoke Dam (River Mile 71-87)*

Table 2 (line 1) summarizes the proposed annual takes of 100 wild shortnose sturgeon adult and sub-adults (>550mm) below Holyoke Dam with gill nets. A sub-set of 30 (line 1.a.) would be captured and tracked with either external telemetry tags for late stage females, or internally under anesthesia for early stage females or males, documenting approach routes from downstream to the Holyoke Dam; a sub-set of 40 adults/sub-adults (line 1.b) of either sex would be captured in two of five years and transported to the lab for swimming performance tests in flumes; a sub-set of 30 animals (line 1.c) of either sex would be captured in two of five years and transported to the lab for electronarcosis testing.

Table 2. Authorized take of wild shortnose sturgeon in the Connecticut River downstream of Holyoke Dam by number, life stage, location, method, and by research activity.*

| Task | No. Fish | Subset No. | Life Stage | River Location and Capture Method | Take Activity | Details |
|---|---|---|---|---|---|---|
| *1* | *100* | | *Adults & Sub-adults (>550mm)* | *Lower River with gill nets* | *Directed Take* | |
| *a* | | *30* | *Adults & Sub-adults (>550mm)* | *Lower River with gill nets* | *Capture, PIT tag (#1b), tissue sample, weigh measure, borescope (≥690mm), external tag (#2 = late-stage females), internal tag (#3=males and early-stage females); anesthesia,), treat prophylactic, released immediately & track* | *Study of approach routes Holyoke Dam (5of 5 years)* |
| *b* | | *40* | *Adults & Sub-adults (>550mm)* | *Lower River at Agawam with gill nets* | *Capture, PIT (#1b), tissue sample, measure, borescope (>690mm), weigh, transport to lab, externally tagged (#2) fish passage and swimming performance tests (held for 72-hrs & up to 2 mo), treat prophylactic, & release* | *Laboratory swimming performance tests (2 of 5 years)* |
| *c* | | *30* | *Adults & Sub-adults (>550mm)* | *Lower River at Agawam with gill nets* | *Capture, PIT (#1b), tissue sample, measure, borescope (>690mm), weigh, transport to and from lab, physiology tests; blood; (held for 72-hrs & up to 2 mo), treat prophylactic; and released* | *Physiology, endocrinology and other tests including electro-narcosis (2 of 5 years)* |

* Tag types are described in the application and in Table 9.

#### 2.3.3.3 *Unintended Lethal Takes of Wild Fish (Above and below the Holyoke Dam)*:

As indicated in Table 3, three wild shortnose sturgeon would be authorized annually to be unintentionally lethally taken as a result of research activity, including up to one adult or sub-adult.

Table 3. Authorized incidental lethal take of wild shortnose sturgeon in the Connecticut River.

| Line No. | No. Fish | Life Stage | River Location and Capture Method | Take Activity | Details |
|---|---|---|---|---|---|
| *1.* | *3* | *All stages* | *Wild CT River above or below Holyoke Dam; all methods* | *Unintentional Lethal Take* | *Total of 3 mortalities or serious injury, including up to 1 adult or sub-adult annually (>550mm)* |

### 2.3.4 *Takes of Captive, Cultured, Non-releasable Shortnose Sturgeon*

#### *2.3.4.1 Takes of Fertilized Embryo from Gulf of Maine Rivers:*

Table 4 (line 1.a, b & c) summarizes proposed take of 6,000 fertilized embryo from three Gulf of Maine rivers collected in any two (2) permitted years for laboratory studies. The capture of running adults providing gametes from the Kennebec, Androscoggin, or the Merrimack Rivers would be authorized in Permit No. 16306. The fertilized embryo would be transferred to the Permit Holder's laboratory where they would be hatched and properly quarantined, eliminating the potential for escape.

Table 4. Authorized take of fertilized embryo from GOM shortnose sturgeon to conduct captive research with cultured animals.[1]

| Line No. | No. Fish | Subset | Life Stage | River Location | Take Activity | Notes |
|---|---|---|---|---|---|---|
| *1.[2]* | *6,000* | | *Fertilized Embryo (F-0 Generation)*<br><br>*GOM Rivers Endangered* | *Fertilized embryo produced by free spawning ripe animals captured in the following Gulf of Maine spawning locations.* | *Directed Lethal Take:* | *( 2 of 5 years; no more than once per location from Gulf of Main Rivers over 5 years)* |
| | *a.* | *2,000* | | *Merrimack River, MA (Haverhill spawning site)* | *Lethal Take: removal, transport eggs, hatching, laboratory testing* | *Lab studies: larval dispersal; genetics salinity/temperature tolerance; endocrine disruptor effects, behavior, toxicology, and contaminants* |
| | *b.* | *2,000* | | *Androscoggin River, ME (Brunswick Dam site)* | *Lethal Take: removal, transport eggs, hatching, laboratory testing* | *Lab studies: larval dispersal; genetics salinity/temperature tolerance; endocrine disruptor effects, behavior, toxicology, and contaminants* |
| | *c.* | *2,000* | | *Kennebec River, ME (Hallowell or Lockwood Dam sites)* | *Lethal Take: removal, transport egg, hatch, laboratory testing* | *Lab studies: larval dispersal; genetics salinity/temperature tolerance; endocrine disruptor effects, behavior, toxicology, and contaminants* |

1. Research objectives for producing cultured animals from fertilized embryo may include studies devoted to: physiology, anesthesiology/neurology (MS-222 and electro-narcosis trials), fish passage, fish behavior, technology (e.g., tagging); toxicology, contaminants, immunology, life history (e.g., downstream dispersal), water quality, and endocrinology.
2. Fertilized embryos would be produced from the gametes obtained from adult animals spawned in the field, but captured under authority of permit 16306; however, the take of the fertilized embryos would be authorized under the current permit, during 2 of 5 years of the permit and no more than once per location from any of the Gulf of Main Rivers. Progeny would be humanely euthanized after lab studies are completed.

#### *2.3.4.2 Takes of Fertilized Embryo Imported from the St. John River, Canada.*

A total of up to 40,000 fertilized embryos of shortnose sturgeon of St. John River ancestry would be legally collected and imported into the United States from New Brunswick, CA, authorized under the Convention on International Trade in Endangered Species (CITES I). Table 5 below summarizes the proposed take activity.

Table 5. Shortnose sturgeon proposed to be imported from the St. John River, Canada, and the activities authorized performed.

| No. Imported | Life Stage/Sex | Species/ Population River Origin | Take Action | Location | Notes |
|---|---|---|---|---|---|
| 40,000 (5 yrs) | Early life stages: Eggs & Larvae (either sex) | Captive: Shortnose sturgeon Saint John River New Brunswick, CA (F-0 Generation) | Contaminant, toxicology, physiology, endocrinology, behavior research, environmental tolerance. | S.O. Conte Anadromous Fisheries Research Center | Directed lethal research of captive animals CITES Import Permit (when issued) |

*2.3.4.3 Takes of Shortnose Sturgeon Adults and Sub-adults Held at the Conte Research Laboratory Prior to this Action under Permit No. 1549:*
Table 5 below presents the holding of 11 (F-1) shortnose sturgeon originating from Connecticut River parents (authorized under Permit No. 1549). These fish are remaining from the CAFRC Physiology Section and are valued for calibration design of further experimental studies. They could potentially also serve as brood animals in the future for producing non-releasable progeny for further research.

Table 6. Authorized maintenance of captive, non-releasable shortnose sturgeon originating from Connecticut River parents held over from prior Permit No. 1549.

| No. Fish | Life Stage | River Origin and Status | Take Activity | Notes |
|---|---|---|---|---|
| 11 | Adult Sub-adults | Captive Non-releasable Animals Connecticut River (F-1 Generation) | Holding, handling, feeding, rearing, tagging, tissue sampling, biopsy, anesthetizing, therapeutic, & prophylactic treatment, transporting, photographing, lethal research, or euthanizing, as required in scientific studies | Maintain 11 captive, non-releasable shortnose sturgeon for use in designing physiology experiments (e.g., electronarcosis; salinity testing; temperature tolerance; or endocrine response). Animals could be euthanized when no longer useful for further research. |

*2.3.4.4 Shortnose Sturgeon Adults and Sub-adults Acquired from the University of Georgia, Originating from the Connecticut River:* The shortnose sturgeon under consideration in this application are non-releasable shortnose sturgeon originally propagated at the USGS Conte Fisheries Research Center from Connecticut River parents under prior expired Permit No. 1549. Subsequently, these animals were transferred to the University of Georgia for testing under Permit No. 14364 and they would upon issuance of Permit under File 16549, be transported by live carrier back to the Conte Laboratory for testing indicated in Table 7 below.

Table 7. Authorized transport and maintenance of captive, non-releasable shortnose sturgeon originating from Connecticut River parents held under Permit No. 1549.

| No. Fish | Life stage/Sex<br>Year Class | Species/ Population<br>River Origin | Take Activity | Location | Notes |
|---|---|---|---|---|---|
| 20 | Adult/Sub-Adult<br>(Male/Female)<br>2005 YC | Captive: Connecticut River[1]<br>(F-1 Generation) | Transport, holding, handling, feeding, rearing, tagging, tissue sampling, biopsy, anesthetizing, propagation, therapeutic, & prophylactic treatment, transporting, photographing, lethal research, and euthanizing, as required in scientific studies | S.O. Conte Anadromous Fisheries Research Center) | Scientific studies including nutrition, tagging, physiology, environmental tolerance tests, contaminants, fish health, behavioral, tagging, genetics, fish culture techniques, fish passage, swimming performance and propagation |

1. *Test animals would be acquired from the University of Georgia currently maintained under ESA Permit No. 14634.*

2.3.5 *Research Activities and Methods for Wild Animals Captured in the Connecticut River:* A review of the techniques and equipment used to take (capture, hold, handle, tag, anesthetize, borescope, sample and perform further research and released) on all life stages of wild shortnose sturgeon taken from the Connecticut River is briefly summarized as follows:

*2.3.5.1 Capture of Wild Adults and Sub-adults (gill-nets):*

Standard gill-net sampling as stated in the application and outlined in Table 6 is proposed throughout the year; durations of net deployment would vary based on specific research objectives and environmental conditions present. Drift or encirclement nets (Kynard et al. 2012) would be used when targeting specific winter aggregations or tagged individuals, and would be deployed for no longer than 30 minutes. Reduced emphasis would occur when sampling during the spring spawning migration.

Capture of adult and large juvenile SNS would be conducted in accordance with NMFS protocols (Kahn and Mohead 2010). Gill-net sampling would use multi-filament bottom set nets anchored roughly parallel to water flow in areas protected from strong flows. Stretched mesh-sizes used for capturing adults would be between 15.2–20.3 cm and for juveniles between 7.6–12.7 cm. The net-set protocol summarized in Table 6 would be adhered to. Gill nets would be deployed in waters having minimum D.O. concentrations of 4.5 mg/L. No netting activity would take place below 0°C or above 28°C; and if water temperature were below 7°C or above 27°C, sturgeon would only be measured, weighed, photographed, PIT tagged and genetic tissue sampled before being recovered and released within 30 minutes of capture.

Table 8. Summary of general netting conditions

| | Water Temperature (°C) | Minimum DO (mg/L) | Net Set Duration (hr) |
|---|---|---|---|
| 1 | < 15 | 4.5 | 14[1] |
| 2 | 15 ≤ 20 | 4.5 | 4 |
| 3 | 20 ≤ 25 | 4.5 | 2 |
| 4 | 25 ≤ 28 | 4.5 | 1 |

1. Nets may be set overnight while unattended at the environmental tolerances indicated.

*2.3.5.2 Capture of Small Juveniles (small mesh gill-nets, beach seine and trawls):* Small juveniles would be sampled using a variety of techniques including anchored gill-nets 2.5 x 5.1 cm stretched-mesh, adhering to methods described above, small mesh 100-m long beach seines used over shallow sand or gravel substrates in areas suspected of being used by small juveniles (Benson et al. 2005), and epibenthic trawls referred to as Missouri trawls (Herzog et al. 2005). More detailed methods and descriptions of gear are described in the researcher's permit application.

*2.3.5.3 Capture of Early-life stages (D-nets) in Upper Connecticut River:* A maximum of 150 early life stages (ELS) (Table 1; line 3) annually would be sampled at the Montague spawning area using D-nets described by Kieffer and Kynard (2012a). D-nets would have openings measuring between 0.4–0.2 $m^3$. Net body would be constructed of nylon mesh measuring between 2.0–0.5 mm square. D-nets would be deployed for a maximum of 14 hours and would be fitted with a mechanical water flow meter to calculate volume of water sampled. Nets would be held in place with river anchors designed to hold rock-rubble substrate with a recovery line and float tied to the anchor line just before the net mouth. Where conditions permit, a smaller D-net would be pulled by hand during a wading kick-sample in suspected spawning shoals, a (Kieffer and Kynard et al 2012a). Netting would be avoided during high-flow conditions, or pulled early if debris load is high. ELS specimens would be preserved in 95% alcohol for later developmental staging and genetics evaluations. Excess ELS would be returned to substrate in the river to hatch, but all ELS would be accounted for as directed mortality (Table 1: line 3).

*2.3.5.4 Handling and Holding Methods of Wild Shortnose Sturgeon in the Field:* Captured sturgeon would be held under several conditions. Sturgeon scheduled for immediate release at the capture site, such as most fish captured on wintering aggregations or fish receiving telemetry tags downstream of Holyoke, would be held for up to 2 hours in boat-side net pens capable of holding up to 20 individuals. Additional boat side net pens would be provided for excess animals. Fish brought onto the boat for examination/tagging would be held in an aerated 250 L fiberglass examination tank for a maximum of 15 minutes with no more than 5 individuals in the tank at any one time. During extremes of heat and cold, examination water would be aerated or routinely exchanged as needed to prevent significant temperature changes; and all fish captured below 7°C or above 27°C would be measured, weighed, photographed, PIT tagged and genetic tissue sampled before being recovered and released within 30 minutes of capture. Sturgeon held in the examination tank onboard would receive a treatment of mucous-restoring electrolyte to reduce stress. Fish with net abrasions during gill-netting, would receive an anti-fungal treatment such as an iodine-based fungicide used by the aquaculture industry.

#### 2.3.5.5 *Borescope Examination:*

Because shortnose sturgeon are not sexually dimorphic, the researcher proposes using a fiber-optic borescope according to the method used by Kynard and Kieffer (2002) for confirming the sex of adult shortnose sturgeon (>69 cm TL) as well as staging the maturity of female sturgeons' eggs. During the exam, the fish's head and most of the body would remain in water under relaxed condition during the exam taking one to two minutes whereupon the probe would be inserted gently through the genital pore into the genital tract (Kynard and Kieffer 2002). Males would also be positively identified in spring when they are ripe and running with milt. The probe would be inserted gently through the genital opening and genital tract. Eggs, if present, would be viewed through the wall of the genital track and staged as early stage or late stage individuals and potential spawners.

#### 2.3.5.6 *Tissue Sampling:*

A small tissue sample (2-$cm^2$ soft pectoral fin clip) would be taken from each newly captured sturgeon for genetic analysis in order to archive genetic samples from the Connecticut River. The tissue would be kept frozen for the first 24 hours, and then stored in 95% ethanol. Because the lab does have the expertise to conduct genetic analysis of tissue sample taken, it will retain one-half of individual samples and make available the remainder to the NOAA's National Ocean Service (NOS) Charleston Lab for archival.

#### 2.3.5.7 *PIT Tags and Telemetry Tags*:

Table 9 describes the PIT and telemetry tags proposed for individual animal identification or tracking. Radio and acoustic tagging techniques would be used to document upstream and downstream migrations, habitat use, spawning periodicity, and seasonal movements. Telemetry tags selected would depend on the specific life stage and/or sexual maturity of the sturgeon captured. For example, radio or acoustic transmitter tags would be attached externally by perforating the dorsal fin base or dorsal scute with strands of nylon monofilament line joined with a corrodible metal crimp (Kieffer and Kynard 2012b).

Table 9. Internal and external telemetry tags used to tag wild shortnose sturgeon in the Connecticut River.*

| Tag No. | Tag Type | Mfg | Length/Width Weight | Battery life | Life Stage Identified (TL) | Details |
|---|---|---|---|---|---|---|
| 1.a. | PIT | Biomark | 8 mm x 2mm<br>11 mm x 2mm | RFID Long-term | Juveniles 300<550mm | Implanted near dorsal fin |
| 1.b. | PIT | Biomark | 23mm x 4mm | RFID Long-term | Adult &sub-adult ≥550mm | Sutures used to secure tag |
| 2. | External radio or sonic tags | Lotek or Vemco | 12g | 800-d | Adult &sub-adult ≥550 mm | Tags externally attached by perforating the dorsal fin base or dorsal scute with strands of nylon monofilament line joined with a corrodible metal crimp. |
| | | | 10g | 800-d | Juveniles <500mm | |
| | | | 8g | 700-d | Juveniles <400mm | |
| | | | 4g | 400-d | Juveniles ≥300mm | |
| 3. | Internal radio | Lotek | 73mm x 16mm (25g) | 4-yr | Adult &sub-adult ≥550 mm | Surgically implanted inside body cavity |
| 4. | Internal/ external radio tag | Lotek | 73mm x 16mm (25g) | 4-yr | Adult &sub-adult ≥550 mm | Surgically implanted internal tag having trailing external antennae outside body cavity |

* No tag would exceed 2% of body weight excepting authorized research designed to measure impacts of tag weight.

***PIT Tags:*** Captured yearlings, small juveniles, large juveniles, and adult sturgeons would be scanned along the entire dorsal surface with a PIT tag reader. If PIT tags are not detected, appropriate sized PIT tags would then be inserted into the animals' dorsal musculature with a sterile hypodermic needle posterior to the dorsal fin. Sturgeon measuring between 300 and 550 mm TL would be marked with either an 8 or 11 mm x 2mm Biomark tags; however, larger sturgeon adults and sub-adults (>550mm) would be marked with a 23 x 2 mm, 0.5g PIT tags) inserted through a small 5mm long incision created 3-5 cm anterior to the insertion of the dorsal fin in the thickest dorsal musculature, and then closed with a single cross-stitched suture. When inserting the 23 mm PIT tags, the scalpel is used only to open the surface of the skin as the larger hypodermic needle for injecting the larger tags become dull when penetrating rough skin. After the skin is opened, the hypodermic needle is used to seat the tag properly into the muscle.

The rationale for using the larger 23 mm tags on larger animals is that the use of the automated tag reader at the bypass tube at Holyoke Dam requires a greater read-range more effectively instrumented by the larger tags. Movement and passage through the dam is also a NOAA study objective requested for FERC re-licensing.

***External Telemetry Tags****:* Both acoustic and radio external tags would be attached to the dorsal fin of animals following techniques described by Kieffer and Kynard (2012b). Researchers would follow the current 2% rule in Kahn and Mohead (2010) for selecting tag sized relative to body weight. Due to the lack of surgery, external tags would be mounted throughout the year without using anesthesia. Only external tags would be used on young juveniles as highlighted in Table 2. Tags would be fitted with two 100-lb test monofilament leaders (one at each end of the tag) and secured with a copper crimp. Leaders would be firmly attached to tags with an epoxy-style adhesive. The tag would be positioned along the fish's dorsal fin base so it sits in the roughly 45° angle made by the dorsal fin and body. Needles would be used to perforate the dorsal-fin base below the row of pterygiophores bones supporting the fin and guide the leaders through the fin base, and would be gauged just large enough to accept the diameter of the monofilament leader (resulting in the smallest perforation possible). Each tag would be fitted with a pair of custom-sized neoprene pads (roughly 1-mm thick) to be placed between the tag and fish to minimize chafe. The tag would then be fixed to the fish using a crimp constructed of dissimilar metals (copper and aluminum) on each leader after the tag is pulled against the fish body. Dissimilar metals used in the crimp would facilitate a more rapid corrosion of the crimp, allowing the tag to eventually fall free.

***Internal Telemetry Tags:*** Internal telemetry tags would be implanted using a 3-cm surgical incision in the ventral body wall as described by Kieffer and Kynard (2012b). Disinfection would be practiced in the field, including cleaning surgical instruments with alcohol and using new scalpels and needles between each surgery. Internal tags would follow the same 2% tag/body weight rule for maximum tag size selection, and would be coated with an inert elastomer providing a cushioned tag surface to minimize irritation of the peritoneum and internal organs. Absorbable gut or synthetic sutures would be used for deep sutures penetrating the peritoneum, and non-absorbable silk would be used for shallow sutures that do not penetrate the body cavity. Cutting-tipped surgical needles would be used to penetrate sturgeon skin with diameters ranging between 2-0 to 3-0, depending on fish size and skin thickness. Surgery would be conducted when river temperature conditions are between 7.0–25.0°C (spring-summer) and above 12.0°C (fall and winter).

*2.3.5.8 Anesthesia:*

The primary method proposed for immobilizing shortnose sturgeon when conducting surgical procedures (and when relaxing animals for minor examinations) would be electro-narcosis. The applicant would also use MS-222 as an alternate means of inducing narcosis.

***Electro-narcosis***: Using the method, described by Henyey et al. (2002), the researcher would use non-pulsed DC voltage (0.3-0.5 V/cm, 0.01 amp) to immobilize animals. In this procedure, fish would be placed in a tank with a screen anode at one end of the tank and a cathode screen at the other end. As voltage is applied quickly to the anode (1-2 sec), the subject fish would lose equilibrium and would relax and sink to the bottom. Voltage would then be adjusted downward until the fish became immobilized except for strong opercula movement. Fish would be supported with netting so only their back or ventral surface emerged from the water before work is conducted.

***MS-222***: An alternative method proposed for inducing anesthesia would be the use of MS-222 (tricaine methane sulfonate) described by Summerfelt and Smith (1990). Individual fish would be anesthetized by placing it in a water bath with an pre-determined dosage. The dosage would vary depending on the type of procedure and the water temperature. For non-invasive procedures (e.g., tissue sampling, etc.), a 50 mg/L solution of MS-222 would be used as a light sedative for calming sturgeon when handled. When using surgical procedures, such as implanting radio transponders, narcosis would be induced and maintained at concentrations up to 150 mg/L. Sturgeon would be recovered from narcosis after surgery (usually within 5 to 7 minutes) in a floating net pen in the river prior to being returned to the river.

*2.3.5.9 Unintentional Mortality or Harm of Wild Shortnose Sturgeon*:

The researcher has requested up to three annually unintended mortalities or serious injuries resulting from research in the Connecticut River, including up to one incidence involving an adult or sub-adult sturgeon (≥550 mm) annually (Table 3), and up to two juvenile animals per year. This request was based on the cumulative stress anticipated from the volume of research activity required to sample sturgeon and meet the researcher's objectives.

2.3.6 *Laboratory Research Activities with Wild Shortnose Sturgeon (short-term; releasable) and Captive, Cultured Shortnose Sturgeon (permanent; non-releasable):*

*2.3.6.1 Laboratory Research with Wild (short-term; releasable) Shortnose Sturgeon:*

A review of the take (capture, transport, hold short-term, mark, tag, sample, hold and perform further research as described in the application) of wild shortnose sturgeon captured from the Connecticut River and transported to the Conte Laboratory are summarized in Table 2 (line 1b, c) of this EA. All wild animals transported and held at the Conte Laboratory for short-term experimental studies would be secured and quarantined separately from other animals. They would be releasable to the environment immediately after the lab procedures are completed. These animals would be not be fed during laboratory confinement, but they would be maintained properly, given daily care, treated humanely, and provided medical care as necessary.

The research objectives on wild animals held for short-term lab procedures would include:

- Evaluating fish passage structures with wild shortnose sturgeon;
- Swimming performance and flume testing with wild shortnose sturgeon; and
- Determining the physiological effects of electro-narcosis with wild shortnose sturgeon.

*2.3.6.2* *Laboratory Research with (Permanent; Non-releasable) Shortnose Sturgeon:*
The applicant proposes sources for acquiring permanent, non-releasable shortnose sturgeon for laboratory research, including: (a) collecting fertilized embryo from GOM River adults (Table 4); (b) importing fertilized embryo from a commercial producer on the St. John River, Canada (Table 5); (c) continuing maintenance of captive, non-releasable shortnose sturgeon held over from prior Permit No. 1549 (Table 6); and (d) transporting captive, non-releasable shortnose sturgeon authorized under Permit No. 14634 (Table 7).
Immediate study proposals included in the permit application were the following initiatives

- Determining downstream larval dispersal behavior of GOM shortnose sturgeon progeny;
- Determining the salinity and thermal tolerances of early life stages of shortnose sturgeon;
- Evaluating endocrine disruption in multiple life-stages of shortnose sturgeon;
- Determining the physiological effects of electro-narcosis on shortnose sturgeon;
- Determining exposure impacts on shortnose sturgeon ELS to pulp and paper-mill effluent; and
- Producing research specimens for further research at the Conte Lab and other permitted facilities.

All captive animals acquired or produced for experimental studies at the Conte Center Lab would be secured and quarantined separate from other study animals and would be non-releasable to the environment. Intentional mortality would be anticipated with some of these cultured animals as part of the proposed research described in the application; however, all animals would be fed and maintained properly, given daily care, treated humanely, and provided medical care as necessary.

*2.3.6.3* *Transport of Shortnose Sturgeon to and from the Conte Center*:

***Transport of Older Life Stages (Adults, Sub-adults, and Juveniles):*** Sturgeon would be transported in tanks affixed to a truck. Transport tanks would be filled to capacity and fitted with tight-fitting lids. Redundant sources of aeration from electric air pumps and compressed oxygen would be provided. During transport, fish would be checked hourly, or more often, to ensure a healthy, non-stressed condition. Fish transportation would also be avoided during weather extremes of heat or cold. Transporting equipment and dip nets would be sterilized with chlorine bleach and neutralized prior to moving sturgeon with sodium bi-sulfite and rinsed with water. Transport water would be treated with electrolyte to reduce stress and maintain osmoregulation. Upon arrival at the lab, sturgeon would be acclimated slowly to receiving waters (2°C per 15 minutes) and given a static 30-min prophylactic water bath treatment of hydrogen peroxide. Animals held for short-term testing at the lab, would be returned to the same river location where captured after studies are completed. Receiving waters would gradually be introduced with pumps into the transport tanks at the river release point until both waters have identical temperatures and chemistries.

***Transport of Early Life Stages (ELS: Embryos and Larvae)***: Fertilized embryo or hatched larvae would be packed into 5 to 8 gallon shipping containers of styrofoam boxes, double bagged with food-grade clear plastic bags. ELS would be placed into the inner bag containing 2–3 gallons of clear river or well water taking up one-third of the packing boxes volume. In turn, the bag would be inflated pure oxygen from a field emergency oxygen kit. The inflated bag would then be sealed, providing eggs with an oxygen rich environment and a large flat surface to keep eggs evenly distributed, preventing clumping during the transport. Ice would be placed under the bag with an insulation pad to keep the eggs from over-heating during a transport (e.g., air or flight). Hatching jars would be prepared to

receive the ELS for incubation at the Conte Lab and would be transferred from transport containers once tempered to a similar water chemistry and temperature.

*2.3.6.4* *Holding and Quarantine of Shortnose Sturgeon at the Laboratory*:
All life stages of shortnose sturgeon transported to the facility would be acclimated slowly to the receiving water (approximately a 2$^{o}$C change per 15 minutes) allowing shipping and receiving waters to equilibrate with similar water chemistries and temperatures. Each animal would be placed in isolation tanks and initially treated with a standard prophylactic treatment of hydrogen peroxide. In turn, sturgeon would be separated into labeled 5–6 foot diameter fiberglass tanks outfitted with aeration stones and flow-through river water with net-mesh covers to limit light penetration and escape. Separate sampling equipment would be assigned to different treatments of fish, or, if not separate, sanitized prior to use. Also, prior to moving sturgeon to new holding tanks, equipment and holding facilities would be properly sanitized and thoroughly rinsed. The air supply to holding tanks would be redundant forced air blower systems, designed to maintain optimal dissolved oxygen concentrations above 4.5 mg/L and water exchange rates for holding tanks would be maintained between 15 to 20 volumes per day. Effluent from all tanks would be sterilized by lethal exposure to ultra-violet light to pathogen releases downstream and directed by drains through a gravel sink trap eliminating the potential for animals to escape to the downstream watershed.

During holding, fish activity and health would be visually examined daily. The applicant has voluntarily agreed to hold all specimens in accordance with the Institutional Animal Care and Use Committee (IACUC) animal welfare protocols on file with the permit application. Necessary therapeutic or prophylactic treatments would be administered by qualified biologists or technicians throughout the time animals are held at the facility.

*2.3.6.5* *Research and Final Disposition of Long-term, Non-releasable Animals:*
The researcher would be authorized to conduct lethal research and other experimental procedures on non-releasable animals where surviving animals would routinely be euthanized after research is completed or there is no foreseeable future research need anticipated for the animals. All research activities, however, including lethal research, would be consistent with standard husbandry care routinely occurring at fisheries research facilities. Permanent captive sturgeon would be fed and maintained properly, given daily care, treated humanely, and provided medical care as necessary. At the conclusion of yearly studies, researchers would be required to account for all surviving animals. As described in the application, the applicant would also supply research specimens for further research to other permitted facilities. In this effort, the numbers and sizes of animals requested annually for further research, would be required to be submitted to NMFS PR at between six and eight months in advance of transferring the specimens to another research or educational facility. Preserved specimens would also be authorized for documenting research and other educational or forensic purposes.

2.3.7 *Mitigation Measures:*
In addition to the applicant's stated methods, conditions in the attached permit would be implemented for minimizing impacts to the target and non-target animals.

# CHAPTER 3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

## *3.1 PHYSICAL ENVIRONMENT*[4]

For the action of issuing a research permit for the take of wild and captive shortnose sturgeon, the appropriate physical environment evaluated in this EA consists of: (1) the main stem of the middle Connecticut River between Agawam and Montague, MA (RM 71 to 121); and (2) the laboratory facilities of the Conte Anadromous Fish Research Center (Turner Falls, MA).

### 3.1.1 *Description of the Connecticut River:*

The Connecticut River is the longest river in New England, originating 2,625 feet above sea level in the Fourth Connecticut Lake accumulating water from several major tributaries as it flows south at a slope of about six feet per mile. The waterway serves as the boundary between New Hampshire and Vermont flowing south through Massachusetts and Connecticut before emptying into Long Island Sound (LIS) over 400 miles from its source. An area of about 8,309 square miles is drained by the river at the Holyoke Dam. Although the Connecticut River is tidally influenced up to the Enfield Rapids (River kilometer (rkm) 110) at the Connecticut state line, the maximum extent of the salt wedge is 0.1 ppt occurring in Haddam, CT (rkm 26). During times of high discharge the entire salt wedge and zone of mixing can be displaced into the LIS. The Connecticut River is also the largest source of sediment and freshwater for LIS (Horne and Patton, 1989).

### 3.1.2 *Description of the Conte Center Laboratory*:

The Conte Laboratory would be used to culture captive animals and perform further research on captive animals. The center is one of four facilities currently authorized by NMFS to hold cultured and wild stocks of shortnose sturgeon for research studying the physiology, behavior, and ecology of anadromous fishes and to design and test experimental fish passages and hydraulic structures. It includes a 2,400 square - foot fish - rearing facility; hydraulics lab with 120 ft. x 40 ft. x 20 ft. experimental flumes with direct flow of 200 cfs for design and testing of fish - passage structures; and modern equipment for studies of fish physiology, biochemistry, endocrinology, bioenergetics, microscopy, and telemetry.

The Conte Lab holds sturgeon in covered, circular 5-ft foot diameter holding tanks away from bright lights or noises. Water supply at the facility is river water provided by a gravity fed flow-through system (minimum, 5 gal/min). Effluent drain water from the lab is directed to a gravel sink providing a barrier to any escaped fish held at the facility and the Connecticut River. For a more detailed description of the facility, please refer to the researcher's application for permit and the USGS's website: http://www.lsc.usgs.gov/?q=conte-anadromous-fish-branch.

### 3.1.3 *Biodiversity and Ecosystem Function*

The proposed permit for scientific research on wild shortnose sturgeon in the Connecticut River would not interfere with benthic productivity, predator-prey interactions or other biodiversity or ecosystem functions. With the exception of directed lethal take of ELS during the permit, and the incidental lethal take of three wild shortnose sturgeon annually, the research activities would not result in the removal of the target species from the ecosystem (See Chapter 4 for analysis of lethal take). Nor would the

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4 Although the applicant would be authorized to obtain fertilized embryo from ripe running adults in the Merrimack River (MA), Kennebec River (ME) and Androscoggin River (ME), the capture of the adult animals providing the gametes would be authorized by Permit No. 16306 (NMFS 2012) wherein the physical environments of these river systems would be analyzed.

permitted research affect the diet or foraging patterns of wild shortnose sturgeon. Further, the proposed action does not involve activities known or likely to result in the introduction or spread of aquatic nuisance species, such as ballast water exchange. Take of captive animals permanently held, would not impact the wild population; thus, effects of issuing the permit on biodiversity and ecosystem function will not be considered further in this EA.

#### 3.1.4 *Ocean and Coastal Habitats and Unique Areas*

The proposed permit is directed at targeting shortnose sturgeon in the Connecticut River (MA) above the salt zone, and thus would not significantly affect habitat in ocean and coastal habitat. Further, as also noted in the EA for the applicant's previous actions (NMFS 2007; File No. 1549), protected areas, critical habitat, sediment, bottom habitat or EFH would not likely be significantly impacted by the proposed action. Thus, effects on such areas will not be considered further in this EA.

#### 3.1.5 *Historic Places, Scientific, Cultural, and Historical Resources:*

If the permit is issued, the research would not take place at any sanctuaries, reserves or conservation areas. No park lands, prime farmlands, wetlands, or wild and scenic rivers are found within the action area.

#### 3.1.6 *Social and Economic Resources:*

The proposed action does not affect distribution of environmental burdens, access to natural or depletable resources or other social or economic concerns. It does not affect traffic and transportation patterns, risk of exposure to hazardous materials or wastes, risk of contracting disease, risk of damages from natural disasters, food safety, or other aspects of public health and safety. Thus, effects on such resources will not be considered further.

## *3.2* BIOLOGICAL ENVIRONMENT

### 3.2.1 *ESA Target Species under NMFS Jurisdiction*

| | | |
|---|---|---|
| Shortnose sturgeon | (*Acipenser brevirostrum)* | *Endangered* |

The following is a summary of the status and occurrence of the targeted shortnose sturgeon range-wide and the proposed action area. Further descriptions of the status of this species may be found in the Biological Opinion accompanying this document, as well as NMFS Recovery Plans and other documents referenced at http://www.nmfs.noaa.gov/pr/publications/.

#### *3.2.1.1*: *Occurrence of Shortnose Sturgeon Range-wide*

Shortnose sturgeon occur along the Atlantic Coast of North America, from the Saint John River in Canada to the Saint Johns River in Florida. The Shortnose Sturgeon Recovery Plan (NMFS 1998) describes a single shortnose sturgeon population segment that exists in the wild, but is managed in 19 separate rivers independently. Two additional geographically managed populations occur behind dams in the Connecticut River (above the Holyoke Dam) and above the Wilson and Pinopolis Dams on the upper Santee-Cooper River system in South Carolina.

Although the Shortnose Sturgeon Recovery Plan (NMFS 1998) suggests the species range-wide is largely endemic to natal rivers, recent information indicates that at the northern and southern end of the species' distribution, there is a high rate of gene flow (suggesting migration) is occurring between rivers (King *in press*). Seasonal migration between the Kennebec, Androscoggin, and Penobscot

Rivers in Maine, has recently been tracked (Fernandes 2008 and T. Squires pers. comm. 2008). At the southern end of the species' distribution, populations appear to exchange between 1 and 10 individuals per generation, with the highest rates of exchange between the Ogeechee and Altamaha Rivers (Wirgin *et al.* 2005).

However, Wirgin (2005) concluded that rivers separated by more than 400 kilometers were connected by very little migration while rivers separated by no more than 20 kilometers (such as the rivers flowing into coastal South Carolina) would experience high migration rates. Important to note in this regard, at the geographic center of the shortnose sturgeon range, there is a 400 kilometer stretch of river with no known populations occurring from the Delaware River, New Jersey to the Cape Fear River, North Carolina (Kynard 1997). Shortnose sturgeon are known, however, to occur in the Chesapeake Bay, but they may be transients from the Delaware River via the Chesapeake and Delaware Canal (Skjeveland *et al.* 2000, Welsh *et al.* 2002) or remnants of a population in the Potomac River.

#### *3.2.1.2 Shortnose Sturgeon in Action Area Rivers:*

All life stages of shortnose sturgeon taken from the Connecticut River would be part of the biological environment affected by the proposed action. Proposed research activities involving collections of gametes from ripe "running" adult shortnose sturgeon captured in the Merrimack River (MA), Kennebec River (ME) and Androscoggin River (ME), would also affect the biological environment of the target species in each of these rivers. Thus the biological environment of these rivers are discussed in the following segment of this EA.

***Connecticut River*:**

- *Abundance Estimates:* The Connecticut River shortnose sturgeon population was stable for 20 years from the mid-1970s to mid-1990s (Kynard, 1997), but it has more recently been cited as slightly increasing (B. Kynard, T. Savoy; pers. comm.; 2012; Savoy, 2004). Population estimates have been completed for shortnose sturgeon occurring both upstream and downstream of the dam in the Connecticut River. Taubert (1980) conducted the earliest population estimate: a Peterson mark-recapture model for sturgeon upstream the dam resulted in an estimate of 370–714 adults. More recently, a Schnabel mark-recapture estimate upstream the dam during the summer-fall foraging period of 1994 indicated an abundance estimate of 328 adults (CI = 188–1,264 adults; Kynard et al. 2012a) in the upper Connecticut River. Further, during studies of spawning ecology upstream the dam at the Montague spawning site, abundance of pre-spawning adults was estimated each spring between 1994–2001 at a mean of 142.5 spawning adults (CI = 14–360 spawning adults; Kynard et al. 2012a). Downstream of the dam (rkm 100–0), researchers conducted annual estimates of foraging and wintering adults using the Schnabel mark-recapture technique during 1989–2002: mean abundance was 1,042 adults, with the average estimates almost doubling between the sampling periods of 1989–1994 at 788 adults and 1996–2002 at 1,297 adults (Savoy 2004).

Long-term field and laboratory research on migrations and spawning on the Connecticut River population, initially reported in Kynard *et al.* (1999), continued through 2005. Although these populations are geographically isolated, genetic analyses suggest that the shortnose sturgeon living downstream of the dams are identical to those living upstream (Quattro et al. 2002, and Wirgin et al. 2005), representing one population segmented by the Holyoke Dam Project constructed in 1849. Other genetic evidence also supports the conclusion of one population between the up- and downstream segments (Wirgin *et al.*, unpublished manuscript).

- *Spawning*: The spawning of shortnose sturgeon in the Connecticut River was first documented by Taubert (1980) who captured reproductively mature shortnose sturgeon in the Holyoke Pool above the Holyoke Dam, and also collected 13 shortnose sturgeon larvae below the Cabot Station electrical generator facility (rkm 179). Spawning habitat was characterized as dominated by gravel, rubble, and large boulders.

The Holyoke Dam Project (rkm 140), dividing Connecticut River shortnose sturgeon into two groups— one upstream group and one downstream group in relation to the dam— blocks the downstream sturgeon group from migrating above the dam to known spawning grounds at Montague (rkm 193–194). Studies conducted between 1990 and 2002, examining spawning behavior of upstream and downstream groups of sturgeon, documented the behavior of adults in relation to the Holyoke Dam and the spawning site at Montague. Both sites were found to have similar optimal spawning habitat available to the spawning fish; however, tracking of 46 radio-tagged adults (29 ripe females) and intensive drift netting for early life stages at Holyoke found a rare spawning of only one downstream group female, while extensive spawning was documented in 4 of the 7 years of the study by adults at Montague. Tracked adults below the dam moved upstream as far as possible to the Holyoke Project, indicating a drive to continue moving upstream. Large groups of animals were found congregated at the dam site in multiple years of the study. However, the study concluded that spawning below Holyoke could not support the abundance of the downstream population, and that spawning at the Montague site must sustain both groups (Kynard et al 2012b).

- *Foraging*: To document foraging habits of sturgeon, Savoy and Benway (2004) examined stomach contents of fish collected in the upper river and estuarine regions of the Connecticut River. Shortnose sturgeon in the estuary preyed upon gammarid amphipods, chironomids, and polycheates, whereas in the upriver area, sturgeon fed on clams, chironomids, and insects. Since shortnose sturgeon in the estuary foraged on a broader variety and greater amount of taxa than sturgeon in the upper river (Savoy and Benway 2004), the authors placed a high importance on unrestricted access to the estuary so that fish could maintain the high condition factors observed by Savoy (2004)

- *Over-wintering/Migration*: Researchers have observed shortnose sturgeon use of the Connecticut River estuary in spring during times of high freshwater outflow, particularly in the form of rapid (up to 40km/day) and directed movement to this area post-spawning (Savoy and Shake 1992, Savoy 2004). In another study, most (21 out of 23) shortnose sturgeon fitted with ultra-sonic transmitters in the Connecticut River moved into the estuary each spring (Savoy 2004). Buckley and Kynard (1985a) also documented downstream movement in the spring from Holyoke Dam to the lower river in post-spawning shortnose sturgeon. Extensive use of the estuary over winter was not observed, rather, adult shortnose sturgeon remained in the upriver, freshwater sites (Savoy 2004). During sampling efforts from October to March, researchers were successful in collecting only a single shortnose sturgeon in the estuary (Savoy and Benway 2004).

***Merrimack River:*** The Merrimack River in the 1990s provided an initial population estimate of less than 100 shortnose sturgeon (Kynard 1997) with verification of spawning animals. Sampling of pre-spawning adults, utilizing a total of 2,357 net hours during a 3-year effort, yielded 24 captured individuals (Kieffer and Kynard 1996). However, sampling in May of 2008 yielded 22 ripe pre-spawning males which were captured in a total of 76 net hours of effort. Spawning was also verified with the capture of ELS in the D-net sampling. These updated findings represented the potential for a significant change in shortnose sturgeon population abundance. In winter aggregate sampling during 2009, over 200 animals were captured leading to and a preliminary mark-recapture estimate of greater

than 2,000 animals. Efforts in 2008, 2009, and 2010 also documented spawning of shortnose sturgeon in the Merrimack River (rkm 33) near Haverhill, Massachusetts (NMFS 2011; Permit No. 1549-01).

However, in April 2010, USGS researchers reported 4 of 6 telemetry tagged late-stage females had migrated from the Merrimack River (MA) to known or suspected spawning sites in the Kennebec River (a distance of 285km) (M. Kieffer pers. comm. 2010). Some animals were also found using the Saco River during their transit. This previously unknown migration indicates a much larger coastal migration of the endangered shortnose than previously understood, emphasizing the importance of Maine's southern rivers in terms of stock connectivity and demographic correspondence.

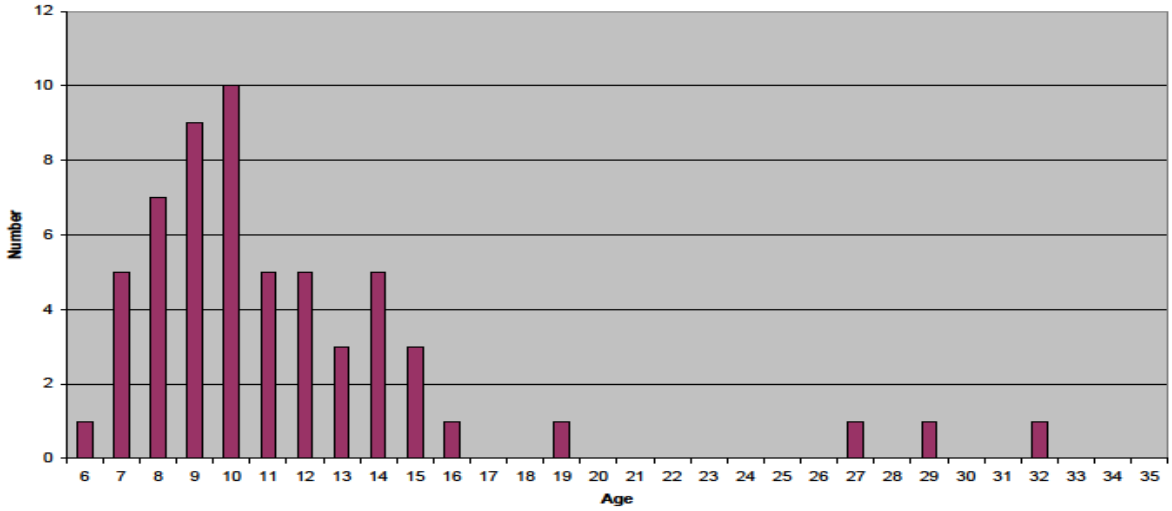
***Kennebec River Complex***:

- *Abundance Estimates*: The Maine Division of Marine Resources (MDMR) has conducted studies determining distribution and abundance of shortnose sturgeon in the estuarine complex of the Kennebec, Androscoggin and Sheepscot rivers (Squiers and Smith, 1979, Squiers et al. 1982). Additional studies were conducted determining the timing of spawning run and location of spawning areas in the tidal section of the Androscoggin River (Squiers et al. 1982; Squiers 1983; Squiers et al., 1993). The estimated size of the adult population (>50cm TL), based on a tagging and recapture study done from 1977 through 1981, was 7,200 with a 95% C.I. of 5,000 - 10,800 (Squiers et al., 1982). The average density of shortnose sturgeon in the estuarine complex of the Kennebec River was the second highest of any population studied through 1983 (Dadswell et al., 1984). Another population study was conducted from 1998 through 2000. The Schnabel estimate using the tagging and recapture data from 1998, 1999, and 2000 was 9,488 with a 95% confidence interval of 6,942 to 13,358 (Squiers 2003).

According to Squires (1983) large catches of shortnose sturgeon were made on the Androscoggin River about 400 m downstream of the Route 201 bridge between Brunswick and Topsham from late April through mid-May. This site is approximately 44 km upriver from the mouth of the Kennebec River in the direction of Brunswick through Merrymeeting Bay. Temperatures ranged from 8.5°C to 14.5°C during the time of these large catches. Many of the male sturgeon captured each year were freely expressing milt. During 1983, a few female sturgeon were so ripe that eggs were extruded as they were retrieved from the nets Squires (1983). The substrate at the sampling site graduated from ledge, boulders, cobbles, pebbles, and gravel on the Brunswick shore to sand in the middle to silt on the Topsham shore. The maximum depth at low tide was 6.7 m, with an average depth of 3 m. Water velocities measured along a transect from the Brunswick shore to the Topsham shore during an outgoing tide ranged from 32cm/sec. to 60cm/sec. A follow-up study (Squires et al., 1993) was conducted in 1993 using radio telemetry, artificial substrate, and bottom set plankton nets. Ripe shortnose sturgeon were concentrated for a distance of about 500 m below the Brunswick Hydroelectric dam approximately 100 m upriver of the Route 201 bridge (rkm 44). Shortnose sturgeon eggs were collected using artificial substrate and plankton nets. The spawning migration extended from the end of April to the last week in May. Spawning occurred from at least May 7 through May 19 based on the presence of eggs on the artificial substrate. The temperature from late April through the end of May ranged from 7°C to 17°C. Gillnet catches and radio telemetry indicated that the peak spawning occurred from May 8 to May 10 at a water temperature of 14°C.

Figure 2 below illustrates a mean age of 12 years (median 10 yr.) determined for 58 shortnose sturgeon adults collected on the spawning run in the Androscoggin River in 1981 (Squiers et al. 1982). The lengths ranged rom 52.5 cm FL to 90.0 cm FL with the average fork length of 68.9; however, sex was undetermined.

**Figure 2: Age of shortnose sturgeon captured in the Androscoggin River, ME during the 1981 spawning run.**




*Spawning*: Spawning site(s) on the Kennebec River are not as well delineated as the site(s) on the Androscoggin River (T. Squires, pers. comm.2008). Squiers et al. (1982) suspected a site to occur 11 km below the former Edwards Dam (rkm 59) where males extruding milt were collected in 1980 and 1981. In additional sampling (May 11, 1999) 10 km below the former Edwards Dam (rkm 60) to collect tissue samples, 135 adults were captured in an overnight set. The water temperature was 14 °C and it is assumed that these sturgeon were on their spawning run (Squires 2003).

MDMR also conducted an ichthyoplankton survey from 1997 through 2001 monitoring the recolonization of the habitat above the Edwards Dam removed in 1999. In the results summarized by Squires (2003), 12 sampling sites were established above the former dam site and thirteen sites were established below the former dam site. Surface tows with one-meter plankton nets (800 microns) or stationary sets of one-half meter D-shaped plankton nets (1600 microns) were made at each station. Small numbers of shortnose sturgeon eggs and/or larvae were collected at sites located in the first nine kilometers below the former Edwards Dam each year (rkm 61-70). However, no shortnose sturgeon eggs or larvae were collected above the former Edwards Dam site in 2000 or 2001 (Squires, 2003). The latest collection of ELS on the Kennebec River occurred in 2009 when 23 larvae were captured at rkm 64 with D-nets (G. Wippelhauser, pers. comm. 2010).

While there have not been any directed studies determining if shortnose sturgeon are utilizing potential spawning habitat above the former Edwards Dam, several shortnose sturgeon have been captured incidental to other studies in Waterville, 27 km above the former Edwards Dam, since its removal (G. Wippelhauser, pers. comm. 2009).

- *Foraging:* Tracking data and gillnet studies indicate the majority of shortnose sturgeon feed in the Bath region of the Kennebec River (rkm 16 – rkm 29) from mid April through early December, then migrate upriver to overwinter in Merrymeeting Bay (T. Squires pers. comm.,2008). Although the major concentrations of shortnose sturgeon are found in the Bath region, including the Sasanoa River, shortnose sturgeon are also found in Monstweag Bay in the lower Sheepscot River and in Merrymeeting Bay (rkm 29 to rkm 42). Based on limited gillnetting and telemetry data it appears shortnose sturgeon occasionally make forays upriver to the Augusta/Gardiner (rkm 59-70) area during summer months (T. Squires pers. comm.,2008).

Salinities in the main foraging area in the Bath Region range from 0 to 21ppt from May through November. There is very little stratification during most of this time period and the difference in salinities from the surface to the bottom are usually less than 1 ppt. The temperature ranges from 4°C in April to over 24°C in July, to around 5°C in late November. Dissolved oxygen levels are almost always near 100% saturation (T. Squires pers. comm., 2008). Some shortnose sturgeon also utilize Montsweag Bay, a part of the Sheepscot River, as a foraging area. The Sheepscot is interconnected with the Kennebec River through the Sasanoa River and Hockomock Bay. Salinities ranged from 12 to 28 ppt and temperatures ranged from 12 to 22°C in June and July in Montsweag Bay during an ultrasonic telemetry study (McCleave et. al. 1977).

Stomach contents of shortnose sturgeon captured in Montsweag Bay were examined by McCleave et al. (1977). The most common food items were crangon shrimp (*Crangon septemspinosous*); clams (*Mya arenaria*); and small winter flounder (*Pseudopleuronectes americanus*). No food habit studies have been conducted for shortnose sturgeon in the Kennebec River (T. Squires pers. comm.,2008). Tracking studies indicate shortnose sturgeon make use of two large marshes in the Bath area; Hanson Bay (Pleasant Cove; rkm 21) in the Sasanoa River and Winnegance Cove (rkm 17) in the Kennebec River. A Wetland Functional Assessment was conducted by Bath Iron Works (BIW) as part of the review of impacts of the proposed expansion of the shipyard into wetlands habitat (Normandeau 1998). The benthic community in Winnegance Creek was assessed as part of this study and the benthic assemblage in Winnegance Creek (rkm 17) contained no mollusks, a preferred food of adult shortnose sturgeon in other rivers (Dadswell, 1979, Dadswell et. al., 1984). One of the dominant available species in Winnegance Creek, however, was the sabellid polychaete (*Maranzariella viridis),* found in stomachs of shortnose sturgeon in the Saint John River, but not preferred there.

No sampling for epibenthic invertebrates was done in the BIW Wetland Functional Assessment. On numerous occasions, however, gammarid amphipods were observed on the nets when sampling for sturgeon in the summer foraging area (T. Squires pers. comm., 2008). In an earlier study on the food habits of smelt in the lower reaches of the Kennebec River, the dominant food item was gammarids, particularly *Gammarus oceanicus* (Flagg, 1974). Although, the stomach contents of shortnose sturgeon were not sampled in this part of the Kennebec complex, shortnose sturgeon consumed gammarid amphipods and polychaete worms in the estuary of the Connecticut River (Savoy and Benway, 2004), in the Hudson River (Haley, 1999), and on the Edisto and Savannah River (Collins 2008); and it is thus likely, shortnose sturgeon in the Kennebec complex would also prefer the same food item.

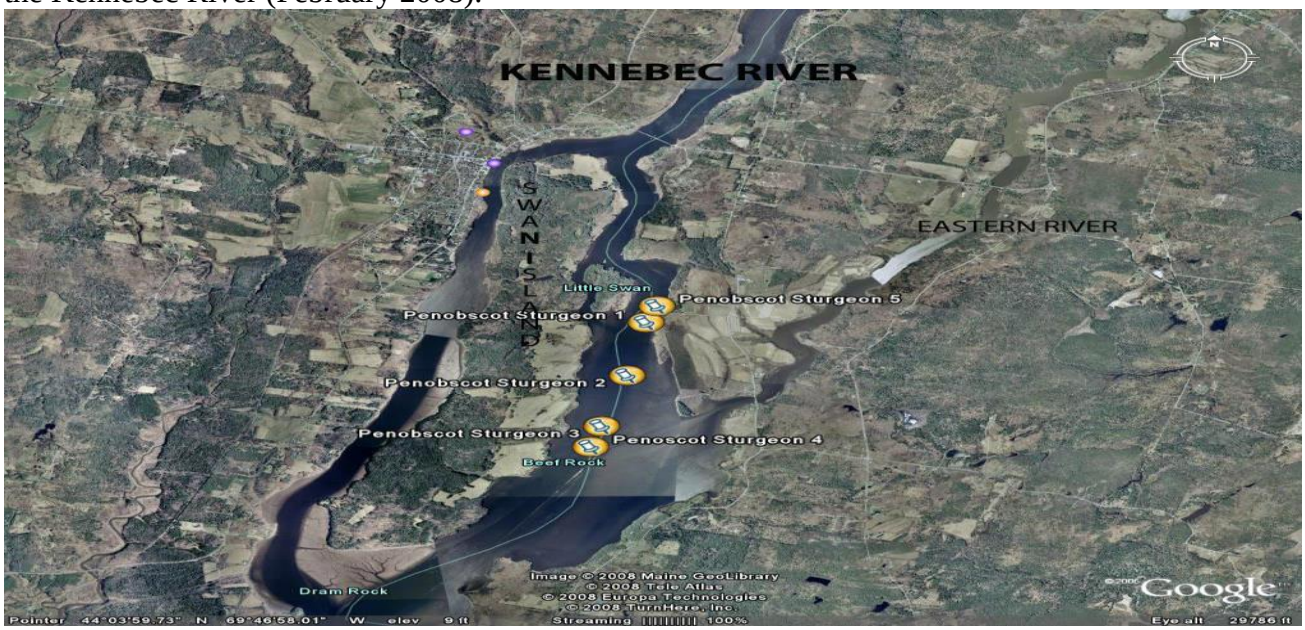
- *Overwintering/Resting Areas*: No studies had been done to locate the overwintering sites of adult shortnose sturgeon in the Kennebec River prior to 1996. Based on catch per unit effort from gillnet sets in the lower Kennebec River, it was thought the likely overwintering sites in the estuarial complex was in the deep saline region of the lower river (below Bluff Head, rkm 15) and possibly in the adjacent

estuary of the Sheepscot River (Squiers et al. 1982). It was also known some shortnose sturgeon overwintered in the tidal freshwater sections of the Eastern and Cathance rivers; both are tributaries to Merrymeeting Bay (Squiers et al. 1982). MDMR attempted to identify shortnose sturgeon overwintering sites in the Kennebec in 1996. A total of fifteen shortnose sturgeon were outfitted with sonic transmitters in October and November 1996 in order to track them to their overwintering habitat. Initial capture locations of the sturgeon varied within the Kennebec System. Eight individuals were captured, tagged and released in Pleasant Cove (rkm 21) on the Sasanoa River which joins the Kennebec River in Bath just a short distance downriver of the Carlton bridge; five were captured, tagged and released in Winnegance Cove (rkm 17), located approximately 2700 m below the Carlton Bridge on the Kennebec River, and two were captured in Merrymeeting Bay (rkm 38) and released at the Richmond town landing in channel west of Swan Island (rkm 40.5) (T. Squires, pers. comm. 2008).

The eight shortnose sturgeon captured in Pleasant Cove and the five captured in Winnegance Cove were all relocated. Eleven of the thirteen were relocated in Merrymeeting Bay. The first two sturgeon tagged in Pleasant Cove (code #338 and 356) were never found in Merrymeeting Bay. Sturgeon # 338 did move from Pleasant Cove to Winnegance Cove and back, and sturgeon # 356 moved to Days Ferry (rkm 24) and back. (T. Squires, pers. comm., 2008). Both sturgeons were last found in Pleasant Cove (rkm 21) on November 13, 1996. After November 13, 1996 sturgeon with transmitters were only found in upper Merrymeeting Bay on the east side of Swan Island (rkm 38). Eleven individual sturgeon were identified in this area. It became impossible to separate signals as the sturgeon grouped together. Multiple signals were found at the suspected overwintering site near Swan Island in Merrymeeting Bay on every occasion it was checked. Poor ice conditions made it difficult to cover large areas in Merrymeeting Bay and its tributaries so it was possible that not all sturgeon overwintered at the suspected overwintering site but no other signals were received at other sites which included smelt camp colonies on the Kennebec, Eastern, Cathance and Abagadasset rivers (T. Squires, pers. comm. 2008).

- *Movement and Migration*: Additionally, in October and November of 2007, MDMR using its passive array of receivers, detected five pre-spawning adult shortnose sturgeon overwintering in the Kennebec River having been initially captured and ultrasonically tagged in the Bangor/Brewer overwintering area of the Penobscot River in late September 2007 (Fernandes et. al. 2008) Four of these individuals were subsequently relocated in the Kennebec River overwintering area (Merrymeeting Bay) near rkm 38 in February 2008. These sturgeon were located between rkm 37.25 to 39.25. This stretch of river is tidally influenced freshwater and the depths are approximately 4.5 to 6.0 m with a predominant sand substrate.

Figure 3: Location of shortnose sturgeon captured from the Penobscot River in 2007, overwintering in the Kennebec River (February 2008).




### 3.2.2 *Non Target Protected Species*

#### *3.2.2.1*: *ESA Protected Species Potentially Affected by the Proposed Action*

- Dwarf wedgemussel *(Alasmidonta heterodon)* Endangered

Dwarf wedgemussel[5] are invertebrate mollusks that have experienced significant declines in the last twenty years, including regional extirpations of the last remaining populations in Canada. Moreover, the long-term viability of the small number of extant occurrences remaining in the United States is questionable given continuing declines and difficult-to-manage threats to the species. Decline has continued, especially over the last 10 years, and currently the species occupies only 20-25% of the sites it once occupied, with populations severely fragmented. The species continues to face significant threats from habitat loss primarily due to human encroachment throughout its range and, without intervention, may decline to the point of critical imperilment soon. In Massachusetts, it was historically known from the mainstem Connecticut River, several of its tributaries, and four other rivers in the southeastern and northeastern parts of the state. It is now believed extirpated from most of these sites (USFWS 2012). Although the applicant and it's researchers are able to identify the presence of the dwarf wedgemussel, the species has not been encountered by any of the applicant's researchers associated with his study in the last twenty years. Therefore, it is highly unlikely that the researchers will interact with this species.

- Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus)* *Endangered*

While research efforts have not specifically investigated the occurrence of Atlantic sturgeon in the upper Connecticut River, the species has rarely been collected incidentally in this region during

5. For a discussion of the dwarf wedgemussel, see http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=F029

extensive sampling for shortnose sturgeon (T. Savoy; 2012; pers. com.). Occasional reports, sightings, and capture of large Atlantic sturgeon (150-300 cm) are made, but most Atlantic sturgeon captured within tidal waters or freshwater in Connecticut are consistent with the size and seasonal locations of immature Atlantic sturgeon from the Hudson River (Savoy 1996). Based on the lack of evidence of spawning adults, stocks of Atlantic sturgeon native to Connecticut waters are believed to be extirpated (Savoy 1996, NMFS 2007).

Also, although, Atlantic sturgeon and shortnose sturgeon coexist in GOM waters where the proposed taking of gametes from shortnose sturgeon adults would result, the capture of the parents in the proposed action would be authorized under Permit No. 16306. Thus, only the take of the gametes from five pairs of adults would take place under the current proposed action; and any interaction or negative impacts to Atlantic sturgeon in GOM waters from the proposed research in File 16549 would be accounted for. Therefore, NMFS discounts the potential of the proposed shortnose sturgeon research to interact with this species in the action area described in the Connecticut River or the GOM Rivers. .

# CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

This chapter represents the scientific and analytic basis for comparison of the direct, indirect, and cumulative effects of the alternatives. Regulations for implementing the provisions of NEPA require consideration of both the context and intensity of a proposed action (40 C.F.R. §§ 1500-08).

## *4.1 EFFECTS OF THE NO ACTION ALTERNATIVE*

If the No Action alternative was selected, the opportunity to collect valuable information about the biology and ecology of the species potentially would be lost. There are no direct or indirect effects on the environment of not issuing the permits. The take of shortnose sturgeon resulting from the applicant's research under this alternative would not be exempted.

## *4.2 EFFECTS OF THE PROPOSED PERMIT ALTERNATIVE*

Any impacts of the proposed action would be limited primarily to the biological environment, specifically the animals studied or affected by the research. The type of actions proposed in the permit request would minimally affect the physical environment and would be highly unlikely to affect the socioeconomic environment or pose a risk to public health and safety. Effects would occur at the time when the applicant's research results in takes of the target shortnose sturgeon.

### 4.2.1. *Environmental Consequences to the Biological Environment — Shortnose Sturgeon:*

#### *4.2.1.1. <u>Impacts to Wild Shortnose Sturgeon Captured in Rivers:</u>*

Authorization has been requested by the .O. Conte Anadromous Fish Research Center to take shortnose sturgeon in the Connecticut River and GOM rivers as described in the application and summarized in Chapter 2. The analyses conducted for issuance of prior permits (File No 1549; NMFS 2007 and 1549-01; NMFS 2009) for similar shortnose sturgeon research activities in the same action area, demonstrated that although individual animals potentially could experience low levels of mortality or serious harm, most impacts would be short-lived stress or minimal injury during procedures, with recovery anticipated within the course of a day. Three incidental mortalities or serious injury from activities in the permit are proposed, as well as the directed mortality of ELS in the Connecticut River and GOM Rivers. The following discussion summarizes the effects on individual wild sturgeon taken in the proposed permit.

***Effects of Capturing Wild Sturgeon***:

- *Gill nets, Trammel Nets, Trawls and Beach Seines*: The applicant proposes to use gill nets, trammel nets, and trawls to capture wild shortnose sturgeon. Entanglement in nets can result in injury and mortality, reduced fecundity, and delayed or aborted spawning migrations of sturgeon (Moser and Ross 1995; Collins et al. 2000; Moser et al. 2000 and Kahn and Mohead, 2010). Historically, the majority of shortnose sturgeon mortality during scientific research has been directly related to capture, as a function of numerous factors including water temperature, low dissolved oxygen concentration, soak time, mesh size, net composition, and netting experience.

To illustrate, of 5,911 shortnose sturgeon captured by gill nets or trammel nets during research authorized by 6 permits (during years 1997-2004), only 23 died, yielding an incidental mortality rate of 0.39%. All of these mortalities were due to high water temperature and low dissolved oxygen (DO) concentrations. Moser and Ross (1995) reported gill net mortalities approached 25% when water temperatures exceeded 28ºC even though soak times were often less than 4 hours. NMFS revised netting protocol based on guidance from researchers (Moser et al. 2000; Kahn and Mohead 2010) and these procedures were implemented in the permit conditions. From 2005-2010, 4,826 shortnose sturgeon were captured during research activities conducted by 17 permits; there were 2 mortalities (0.04% mortality rate). The low mortality rate of more recent research is due to mitigation measures implemented by permit holders (Moser et al. 2000; Kahn and Mohead 2010), such as reduced soak times at warmer temperatures or lower DO levels; as a result, the effects of capture on shortnose sturgeon have been reduced.

To limit stress and mortality of sturgeon due to capture by gill nets or trammel nets, the applicant would adhere to the net set protocols as stated by NMFS PR and conditioned in the permit. Specifically, during lower water temperatures (<15°C), soak times of nets would not exceed 14 hours; at water temperatures between 15°C and 20°C, net sets would not exceed 4 hours; at water temperatures between 20°C and 25°C, net sets would not exceed 2 hours; and netting activities between 25 and 28°C, nets would be deployed for one hour. Gear would be deployed only in waters where dissolved oxygen concentrations are at least 4.5 mg/l at the deepest depth sampled for the duration of deployment; and no netting activity would take place below 0°C or above 28°C. Additionally, no surgical procedures would take place below 7°C or above 27°C. If water temperature were outside of these limits, sturgeon would only be measured, weighed, photographed, PIT tagged, and genetic tissue sampled before being recovered and released as soon as possible.

Trawl nets would be used in such a manner as to limit potential impacts to shortnose sturgeon. According to the applicant and in accordance with NMFS recommendations, the gear would be set and hauled by hand (Kahn and Mohead 2010). The trawl will be towed along the bottom at a slow speed (about 2.5 knots) for a short time (5-15 minutes). Other permit holders have utilized trawl nets to capture shortnose sturgeon in the past, and had no mortality or injuries (e.g., File No. 1516). Beach seine use would be limited to the winter in the Merrimack River along sand and gravel shoals, and fish would be handled in the same manner as sturgeon captured using other methods.

Efforts to minimize impacts with beach seines would include conditions such as: (1) when drawing the seine's lead line close to shore, animals would not be crowded, and would be pooled in clear waters with minimal turbidity or mud bottoms; (2) all animals would be handled and released within 15 minutes after pooled along the shore; (3) bycatch would be released unharmed and minimally handled;

and (4) areas sampled would not be seined more than once in a 24 hour period; and (5) habitats seined would be characterized by sandy bottoms free of bottom snags.

Based on the applicant's experience and past history, as well as the mitigation measures contained in the permit, NMFS does not anticipate exceeding the long-term adverse effects on shortnose sturgeon by methods of capture proposed in the application.

- *D-Net Collection of Eggs or Larvae (ELS) in the Connecticut River*: A maximum of 150 ELS would be sampled at the Montague spawning area using D-net techniques described by Kieffer and Kynard (1996). Due to their relatively small size, neither D-frame nets nor egg mats would disrupt water flow or habitat. Therefore, no adverse impacts to the physical environment are anticipated. Drifting or dislodged embryos and larvae would be captured in the nets, identified, and preserved; excess of the authorized take would immediately be returned to the river. Depending on water flow and debris in the river, researchers would check nets at up to 14 hours. Sampling seasons would occur at the discretion of the applicant, but typically from April through May, corresponding with known spawning periods in the Connecticut River. D-nets would be removed from the river once the water temperature exceeds 25°C or once the amount of authorized shortnose sturgeon eggs and/or larvae has been collected, whichever comes first. Since shortnose sturgeon are broadcast spawners and lay tens of thousands of eggs at a time (Dadswell, 1979), it is believed that the relatively small number requested would not have an adverse effect on the population's viability.

***Effects of Handling and Holding***: Routine handling and holding can result in raised levels of stressor hormones in shortnose sturgeon. Sturgeon are a hardy species, but sensitive to handling stress when water temperatures are high or dissolved oxygen is low. Additionally, sturgeon tend to inflate their swim bladder when stressed or handled in air (Moser et al. 2000). If they are not returned to neutral buoyancy prior to release, they tend to float and would be susceptible to sunburn and bird attacks. In some cases, if pre-spawning adults are captured and handled, it is possible that they would interrupt or abandon their spawning migrations (Moser and Ross 1995).

To minimize capture and handling stress, researchers would hold shortnose sturgeon in nets pens or in holding tanks, provide fish with a continuous flow of water, and minimize the amount of time the fish would be handled and held. While total water volume in the tanks would not be critical, water flow, adequate control of temperature and oxygen levels is considered essential. When fish would be held onboard in flow-through tanks, water replacement would be accomplished every 15-20 minutes. When water temperature exceeds 27$^{o}$C, sturgeon would not be held onboard more than 30 minutes. Additionally, DO concentration would not be less than 5 ppm. Following processing, sturgeon would be returned to the net pen or holding tank for observation to ensure full recovery just prior to release. Shortnose sturgeon would be checked for buoyancy problems and treated with a slimecoat restorant prior to release, as well as monitored for proper swimming behavior after release. Total holding time would be no longer than 60 minutes from capture until release.

***Effects of Boroscopy:*** Boroscopy is minimally invasive allowing researchers to identify the sex of a sturgeon without engaging in riskier surgical procedures that would typically include greater stress, invasive surgery, anesthesia, and increased handling and holding times. Researchers have demonstrated that no damage is caused while examining sturgeon using a borescope (Kynard and Kieffer 2002). The procedure as a whole only lasts approximately 1-4 minutes. Therefore borescopic examinations would not be expected to cause harmful effects to sturgeon because of the speed, safety,

and minimally invasive nature of the procedure. For these reasons, NMFS does not expect adverse impacts, other than discomfort to individual sturgeon.

***Effects of Tissue Sampling***: The applicant proposes to take a small (2 $cm^2$), non-deleterious tissue sample, clipped with surgical scissors from a section of soft fin rays of captured sturgeon. Tissue sampling does not impair the sturgeon's ability to swim and is not thought to have any long-term adverse impact (Kahn and Mohead 2010). Many researchers, including the applicant, have removed tissue samples according to this same protocol with no adverse effects (Wydoski and Emery 1983); therefore, NMFS does not anticipate any long-term adverse effects to the sturgeon from this activity.

***Effects of Tagging***:

- *PIT Tags*: As described in Section 2.3.6.7, sturgeon between 300 and 550 mm TL would be PIT tagged with 8 and 11mm x 2mm Biomark tags; however, larger adult and sub-adult sturgeon (>550mm) would be marked with a PIT tag measuring 23 x 4 mm x 0.5g, inserted through a small 5mm long incision created in the hard skin with a scalpel 3-5 cm anterior to the insertion of the dorsal fin in the thickest dorsal musculature, and then closed with a single cross-stitched suture. To avoid duplicate tagging, all sturgeon would be scanned with a PIT tag reader prior to the insertion of a PIT tag. Tagging implanting and minor surgical procedures described previously, could result in stress during restraint and minor wounds when healing.

The smaller PIT tags have not known to have any other direct or indirect effects on shortnose sturgeon when appropriately sized and implanted correctly. Although, there has been one report of shortnose sturgeon mortality as a result of 14 mm PIT tags inserted too deeply in smaller sturgeon in the cranial area. Henne et al. (2003) found that 14mm tags inserted into shortnose sturgeon <330 mm total length (TL) (range: 180-270mm) caused 40% mortality after 48 hours. However, no mortality was documented in sturgeon measuring 250- 330 mm TL after 28 days using 11.5mm PIT tags. Therefore, to address these concerns, the applicant would not PIT tag smaller sturgeon <300mm TL, and all sturgeon measuring between 300 and 550 mm would be tagged with 8 and 11 mm x 2 mm PIT tags. Also, in these smaller animals, where the girth is narrow at the dorsal fin position, PIT tag insertion could be located at the widest dorsal location of the animal, typically at the $4^{th}$ scute position.

The researcher also proposes to use larger 23 mm PIT tags secured with a suture as described in the application and highlighted in this EA in Section 2.3.6.7. The applicant has been authorized to use such tags in two other ESA permits studying shortnose sturgeon with no adverse impacts reported (Permit Nos. 1549 and 1239). PIT tagging in the past with 23 mm PIT tags was used with the suturing technique described in the application, especially in winter in cooler water to promote healing and tag retention. However, the rational for using the larger 23 mm long tag on larger animals arises from use of the automated fish tag reader capability at the bypass tube at Holyoke Dam requiring the greater tag-read range of this tag larger tag essential for detection by the automated system. Movement and passage through the dam is also part of a NOAA study objective for FERC re-licensing of the Holyoke Dam.

When inserting the 23 mm PIT tags, the scalpel is used only to open the surface of the skin, as the larger hypodermic needle used for injecting the larger tags tends to become dull when penetrating rough skin. After the skin is opened minimally, the hypodermic needle in turn is used to seat the tag properly into the muscle; the skin is then closed with a cross-stitch suture. Although the procedure

incorporates the additional steps of opening the skin and then suturing the opening after the tag is seated, NMFS does not expect the procedure to cause additional duress or significant impact, especially when weighed against the benefits of long-term retention and increased tag performance required.

- *External Telemetry Tags*: The research would authorize the attachment of external telemetry tags, a minimally invasive procedure having several advantages over surgical implantation of telemetry tags. Since surgery or anesthesia is not necessary for attachment, external telemetry tags can be used on late-stage females without risk of destroying eggs. Thus, attaching external acoustic tags would be a minimally intrusive method for tagging pre-spawning female sturgeon, reducing the likelihood of aborted spawning runs (Kahn and Mohead 2010). This method also allows researchers more flexibility since external tags can be attached throughout the year, in contrast to internal tags, where surgery can only be performed when water temperatures are appropriate. Further, the external tag is not thought to have adverse effects on sturgeon when installed with neoprene buffer pads which reduces irritation to the animal and increases tag retention. The reported adverse effects using external tags have been related to the tag size. Collins et al. (2002) reported very rapid loss of large transmitters attached externally on the dorsal fin due to the sturgeon rubbing on substrate; and 100% retention through day 60 of smaller telemetry tags. Consequently, adult through juvenile shortnose sturgeon would be fitted with external acoustic tags appropriate to their size (see Table 7) using approved methods recommended by NMFS protocols lasting approximately 2-3 minutes (Kahn and Mohead 2010).

- *Internal Telemetry Tags*: Surgery for inserting internal acoustic tags would cause stress during capture and restraint, discomfort to the fish, as well as minor wounds from surgery carrying a future risk of infection. To address these concerns, the applicant proposes to use the best management practices as endorsed by NMFS (Kahn and Mohead 2010). These practices would minimize or eliminate potential short-term adverse effects and reduce the risk of injury and mortality. The fish would also be monitored for infection and treated as needed.

The experience of other researchers using the same methods suggests that these procedures are conducted in a manner minimizing or eliminating mortality to the fish. Buckley and Kynard (1985) tagged 91 shortnose sturgeon with internal radio tags. Tracking of 82 of these fish in 1,442 locations were obtained with no observed mortality. Studies have also shown that radio-tagged fish appear to recover quickly, showing no long-term effects from handling. Additionally, O'Herron et al. (1993) radio-tagged 28 fish, and relocated 26 as many as 35 times. Additionally, Kieffer and Kynard (2012b) report irritation and expulsion of internal tags is reduced by coating tags with an inert elastomer. Tags surgically implanted into the body cavity were usually retained for the tag's operational life, and in most cases, for much longer (mean: 1,370.7 day). Further, poor incision healing was rare (Kieffer and Kynard 2012b).

To guard against adverse effects associated with internal acoustic tags, the applicant proposes to use the best management practices as endorsed by NMFS in the sturgeon protocol (Moser et al. 2000; Kahn and Mohead 2010). Surgery would only occur when water temperatures were between 7-25°C in spring and summer, and at temperatures ≥12°C in fall and winter. Additionally, researchers would seal the tags with an inert elastomer polymer to prevent tag rejection. In general, by using proper sanitized surgical techniques, tagging with internal sonic tags is not expected to have significant impact on the normal behavior, reproduction, or survival of shortnose sturgeon.

***Effects of Anesthesia**:*

- *Electronarcosis*: Electronarcosis is a non-chemical method of anesthetization using a low voltage constant direct current (CDC) producing muscle relaxation and immobility. Electronarcosis has been used successfully by researchers at the Conte Center since the 1970s (Kynard and Lonsdale 1975; Curry and Kynard 1978; and Henyey et al 2002 ) to anesthetize research animals including shortnose sturgeon. Since 2004, USFWS researchers in Maryland have also followed the Henyey et al. (2002) protocol anesthetizing Atlantic and shortnose sturgeon on the Potomac River and Chesapeake Bay with no adverse effects (Mike Mangold, USFWS, pers. comm., 2010; USGS 2007b). Researchers in South America using these methods have reported similar success (Alves et al. 2007). Henyey et al. (2002) used low voltage CDC to induce electronarcosis in shortnose sturgeon and observed no changes in swimming or feeding behavior, no ill effects, and no mortality after six weeks.

The evidence summarized in Kahn and Mohead (2010) indicates electronarcosis induced by the method described is similar to the condition induced by chemical anesthetics and does not cause adverse effects on sturgeon. Preliminary research (Matthew Balazik; pers. comm. July 2012) supports this claim, finding that cortisol concentrations measured one hour after animals were treated with no anesthesia, was almost two times greater than concentrations measured for either electronarcosis or MS222, each of which had similar cortisol concentrations. However, after 24 hours, cortisol levels for controls and both treatment animals were the same. Nevertheless, more research is needed on the physiological mechanisms by which electronarcosis works.
To evaluate these mechanisms, the applicant will report to NMFS descriptions of field use of electronarcosis with observations of fish reactions. Additionally formalized laboratory research is described in the application for determining physiological stress responses. If incidence of mortality or serious injury should occur as a result of the use of electro-narcosis; or if it is found that stress responses from electro-narcosis is affecting sturgeon adversely, research would temporarily cease, and NMFS would need to be consulted to discuss any remedial changes in methods before a decision could be made to resume its future use.

- MS-222: The proposed anesthetic concentration of up to 150 mg/L MS-222 is commonly used by sturgeon biologists to induce light to deep planes of anesthesia for invasive procedures (e.g., internal acoustic tagging) (D. Peterson, D. Fox, M. Collins, T. Savoy, *pers. comm*. Nov. 2009) and is the only chemical anesthetic recommended by NMFS (Kahn and Mohead 2010). The induction varies with dosage, temperature and water chemistry; however, typical induction times are from 5-8 minutes. Complete recovery time from the anesthetic averages 4-6 minutes (Brown 1988).

Risks associated with anesthetizing with MS-222 would include hypoxia from overexposure (Coyle et al. 2004), and injury from thrashing during the excited phase of induction. Furthermore, anesthetizing fish in poor health or stressed condition could result in injury or mortality. To reduce such risks, only properly trained staff would use this technique, and only non-stressed animals in good health would be anesthetized. To avoid injury while being anesthetized, sturgeon would be restrained with netting to prevent animals from jumping or falling out the anesthetic bath. Fish would be monitored closely during induction to reach the proper level of anesthesia prior to surgery, and would be observed to ensure proper recovery from anesthetic narcosis prior to release. Also, because MS-222 is an acidifying solution, potentially extending the induction time for narcosis, bath solutions would be buffered to a neutral pH with sodium bicarbonate and oxygenated prior to use. MS-222 has been found to be excreted in fish urine within 24 hours and tissue levels decline to near zero in the same amount of

time (Coyle et al. 2004). Consequently, a sturgeon released after treatment with MS-222 would not present a sizable risk to the environment should a predator consume that sturgeon. Therefore, NMFS considers the anesthetizing protocol with MS-222 to be well established with known risks minimized, producing limited effects on shortnose sturgeon and the environment.

***Effects of Unintentional Mortality or Harm of Wild Shortnose Sturgeon During Field Research in the Connecticut River***: The PI has of the permit has reported no mortalities and has reduced disturbances resulting in stress while working under more conservative sampling effort since 2007 (Permit 1549; NMFS 2007). The current proposal contains similar proven measures and research methods as in past reduce injury, stress, or mortality; however, based on the volume of the authorized activities requested, the researcher applied for three incidental mortalities annually in the Connecticut River, including one incidence involving an adult or sub-adult sturgeon (>550 mm) and up to two incidences of juvenile harm or mortality, to meet the researchers objectives.

However, based on the biological opinion prepared for this action, NMFS does not expect the proposed research activities would appreciably reduce wild shortnose sturgeon's likelihood of survival and recovery in the Connecticut River by adversely affecting the number of animals born in a particular year; the reproductive success of adult female sturgeon; the survival of young sturgeon; or the number of young sturgeon that annually recruit into the adult, breeding population of shortnose sturgeon of the Connecticut River.

The results of the proposed research will also likely continue to contribute to our understanding of the habitat, foraging ecology, growth rate, population dynamics, and approaches and passage to river structures characterizing the species in the Connecticut River. This information has also been identified as high priorities in the final shortnose sturgeon recovery plan for the Connecticut River (NMFS, 1998), and thus, as such, far outweighs the potential for harm resulting from research activities.

***Effects of Stress Upon Handling Adult Shortnose Sturgeon in GOM Rivers Selected for Free-Spawning in the Field:*** The incidental netting of up to two "running" female sturgeon and a complement of up to five ripe males in GOM Rivers, would be accomplished in two of five years of the permit by the previous authorization in File No. 16306. The applicant has proposed to attempt to use these candidate animals for collecting gametes during field spawning.

To reduce stress on selected male sturgeon, only "running" healthy animals would be selected which would be released immediately after its sperm was collected, pooled in a vial, and iced for later use (up to 72 hours) in anticipation of running female(s) collected. To minimize stress on females, only one ovulation of the eggs from one or two females per location would be taken; and the animals would then be returned to the river immediately after conditions were evaluated. Further, the netting would take place in water temperatures between 7 and 15$^{o}$C to minimize stress; and also, only animals in good health with robust activity would be selected. All processed fish would be held in flow-through tanks or pens and be given treatments of electrolyte restorative prior to release. Gametes would be collected as quickly as possible when fish are held waiting for final processing. These animals would be monitored regularly in tanks, and subsequent handling of reproductive adults would conform to standard NMFS protocols; specifically, animals could only be held for up to two hours after capture, else released immediately.

Because the proposed, targeted capture of shortnose sturgeon is already authorized in Permit 16306, further handling of animals incidentally captured while in spawning condition, would be limited to collecting the running gametes. NMFS believes if animals opportunistically selected are healthy specimens when captured, and the above mitigation are followed, any additional impacts from free spawning would be minimal and short-lived.

***Effects of Removing ELS from the Merrimack River (MA), Kennebec River and Androscoggin Rivers (ME):*** NMFS has previously analyzed the potential of sampled populations of shortnose sturgeon adversely affected by authorizing collection of fertilized embryo in the action area by free-spawning reproductively mature adults in the field (File 1549; NMFS 2007). In the current permit application, 2,000 fertilized embryo from each of three Gulf of Maine rivers [Merrimack River (MA); Kennebec River (ME); and Androscoggin River (ME)] would result in authorizing a total of 12,000 fertilized embryos collected and these would collected during any two of the five years of the permit.

The potential to reduce the recruitment viability of targeted shortnose sturgeon in the GOM system is estimated by evaluating the proposed numbers of ELS taken against the total numbers produced by broadcast spawning sturgeon. The adult population of shortnose sturgeon in the GOM is estimated at 12,000 (Squiers 2003; 6,800 – 13,358) adults; however, these animals are considered a part of a meta-population (Fernandes 2008) split between the known spawning rivers in the GOM consisting of the Kennebec, Androscoggin, and Merrimack River. It is also considered one of the healthiest of all the shortnose sturgeon populations with respect to population size verses the threats faced by the population (Squires. Pers. Comm. 2008)

Although the survival from egg to juvenile is likely the most critical aspect in determining the strength of the year class (COSEWIC, 2005), by using the following assumptions based on each adult female sturgeon spawning every three years and each female producing between 94,000 and 200,000 each (COSEWIC 2005), a conservative estimate of 94 million ELS produced annually in the system is estimated.

[i.e., assuming]
(1) female adult sturgeon comprising 50% of the population will reproduce every 3years;
(2) 1,000 adult females will spawn in the GOM annually; and
(3) the minimal number of eggs produced per female is 94,000.

If the total of 12,000 fertilized eggs were lost to the system over the five-year permit life, which is a conservative estimate, the result would largely be a discountable fraction of the annual egg production. And even if the entire egg production of up to four females were lost over the five years of the permit, which is a non-conservative estimate, the resulting take would likely have an insignificant impact on the overall ability of GOM's shortnose sturgeon population to recruit early life stages into the system.

*4.2.1.2. Impacts on Wild Shortnose Sturgeon Captured from Below the Holyoke Dam, Transported and Held Short-term at the Conte Lab and then Released:*

In the current application, the applicant requests to capture and transport 40 adults/sub-adults from south of the Holyoke Dam (Table 2; line 1.b) in two of five years for swimming performance tests, releasing the animals within 72 hours. The applicant also proposes to capture and transport up to 30 animals from south of the Holyoke Dam (Table 2; line 1.c) in two of five years of the permit to the lab for other longer term tests lasting up to two months. Potential adverse effects associated with such

captive holding and subsequent return of wild animals would potentially include the risk of additional stress or injury resulting from proposed testing or the potential failure of life support systems, low dissolved oxygen, or disease incidence. Additionally, there would also be potential for accidental cross-contamination of wild stocks with long-term cultured stocks held at the lab, which could result in more genetic homogeneity in fish stocks if cultured animals were released accidently into the river. Other potential negative impacts could be the potential altered behavior after returned to the wild in terms of migration, foraging, use of habitat or loss of desire to return to spawning areas in the river. Additionally, NMFS recognizes that poorer condition or weight loss could result from sturgeon held at the facility for up to two months before returned to the river. Potential for each of these negative impacts, as well as proposed mitigations, are therefore discussed in the following sections.

***Risks of Incidental Mortality, Disease or Harm to Wild Sturgeon Held Short-term at the Conte Lab***: By the nature of holding wild sturgeon in an artificial environment, and also of conducting short-term experimental procedures described in the application, the potential exists for stress, small abrasions, slow healing from tagging, exposure to pathogens, mortality through system failure, or animals suffering mortality or injury through unrestrained jumping from tanks.

To address such concerns, researchers at Conte Lab facility would maintain animals with redundant water and power supplies in case of power or source water loss. Further, water quality would be monitored on- and off-site using remote sensing employed overnight. Also, the identities of all separate stocks of animals held at the holding facility would be clearly and uniquely marked on tanks located at opposite ends of the facility in order to eliminate mixing between releasable and non-releasable sturgeon. Animals would also be given appropriate prophylactic or prescriptive care as highlighted in the veterinary health policy of the Conte Lab[6]. The following conditions would also be included in the permit to help eliminate the potential for adverse effects to these wild animals held temporarily at the facility.

- Holding tanks at the research facility must be covered to prevent escape and located away from disturbances, such as bright lights or loud sounds. Water exchange rates in holding tanks must average at least 10 to 15 volumes per day and at least five gallons per minute flow. Additionally, a primary and backup forced air supply must be provided, maintaining dissolved oxygen at a minimum 5 mg/l concentration.
- Sampling equipment must be assigned to each stock separately, or, if shared, it must be sanitized prior to use.
- Prior to moving or handling fish, holding tanks, equipment must be sanitized properly.
- Wild stocks may be held and returned to their natural habitat within three months of capture, and they must not be fed artificial diets.
- Separate flow-through (or closed-system) water must be used for each stock which must be treated separately or separately quarantined.
- Gross health screenings should be performed and recorded when wild stocks enter and leave the facility, as well as daily observations recorded.
- Standard therapeutic and prophylactic treatments, if used, must be administered by qualified biologists.
- Personnel allowed to handle and examine fish must be specifically trained to recognize changes in sturgeon behavior and fish health, and must record all pertinent data daily.

6 Described in the S.O. Conte Anadromous Fish Research Center Animal Welfare and Animal Care Guidelines (IACUC) attached to the permit application for File 16549.

Although NMFS does believe individual animals would experience levels of additional stress during short-term captivity and testing, past research experience at the Conte lab has shown that these risks are minimized by utilizing the mitigation measures highlighted above and in the permit. Wild shortnose sturgeon have been held for up to eight months at the Conte Lab and subsequently returned to the Connecticut River with no apparent adverse impacts found for the population or the species (File No. 1239, NMFS 2000; and File No. 1549 (NMFS 2007a). Consequently, NMFS does not anticipate mortality, disease, or harm from the additional risks of holding wild fish temporarily while conducting planned short-term experimentation.

***Risk of Conditioning and Weight Loss of Wild Shortnose Sturgeon Held Short-term***:
The applicant stated that because past efforts have been unsuccessful in conditioning overwintered wild fish in captivity to accept commercial food or natural items, such as river mussels or earth worms (M. Kieffer, unpublished information), these animals would not receive supplemental feeds while held at the facility for up to two months. NMFS addresses the potential for the loss of conditioning in wild shortnose sturgeon while held in captivity in the following section.

In regard to loss of conditioning, the applicant commented (M. Kieffer; pers. comm.; 2012) that while wild fish may consume some food items when overwintering in their natural river environment —in the same period sturgeon are to be held at the Conte Center Lab—the literature suggests that foraging in the winter months by wild sturgeon is already greatly reduced; and thus, comparable minor losses in conditioning of wild sturgeon while held short-term in the Conte lab would be a similar common occurrence in the wild. Other researchers have also confirmed that in the Connecticut River (Savoy and Benway 2004), the Saint John River (Dadswell 1979 and Litvak 2007), the Penobscot River (Fernandes et al. 2010) and in the Hudson River (Dovel et al. 1992), there is a significantly reduced quantity or absence of food in stomachs of overwintering shortnose sturgeon, as well as reduced activity and movement. Further, other empirical evidence provided by the applicant, documented the overwintering weight loss of three Connecticut River shortnose sturgeon, captured and released at Agawam in late-October and then later recaptured again in the spring, varied between 3.7–4.3% (mean 4.1%) (M. Kieffer; pers. comm.; email September 2012).

In research authorized by Permit Nos. 1239 and 1549, the applicant also provided data in Table 8 below (M. Kieffer; pers. comm., 2012) documenting the weight loss of three groups of sturgeon overwintered at the Conte Laboratory. Where animals were captured in the fall and released in the spring, weight loss is shown to be related to the duration of captivity and also the time of year taken into captivity. For example, for the shortest average length of time in over-wintered in captivity, weight-loss was minimized by Group 3 animals. Similarly, the weight-loss observations for Group 2 animals were close to that of Group 3, even though the eight animals in Group 2 were held an average of 4.1 months longer. Analyzed as a group, 61 percent of both Group 2 and 3 animals showed no weight loss.

It is significant, however, that Group 1 animals experienced markedly higher weight losses than both Group 2 and 3 animals due to the longer period of captivity while not being fed, but also due, according to Kieffer et al (2012), to the time when the animals were removed from the wild between mid-September and early-October. In this regard, the time of capture in the fall is seen as an important

Table 8. Weight loss documented for wild shortnose sturgeon held captive beginning in the fall and overwintered at the Conte Lab for various time intervals.

| Group No. | No. of Animals | Beginning Time of Captivity[1] | Length of Captivity (Months)[2] | Range of Weight Loss (%) | Mean Weight Loss (%) |
|---|---|---|---|---|---|
| 1 | 9 | Sept 15 – Oct 9 | 7.5—8.3 | 8.7—19.8 | 13.8 |
| 2 | 8 | Oct 10 –Dec 7 | 5.0—6.9 | 0—7.8 | 1.7 |
| 3 | 10 | Oct 24 – Nov 8 | 1.6—2.1 | 0—5.8 | 1.9 |

1 Animals captured in the fall over the range of dates indicated.
2 Animals released in the spring after held for varying time intervals.

contributor for loss of weight and condition in shortnose sturgeon removed from the wild prior to overwintering because the months of September and October represent the last period of intensive, active foraging spent by shortnose sturgeon when water temperatures are relatively warmer prior to overwintering (M. Kieffer; pers. comm. 2012).

Kynard et al. (2011) also documented another additional weight loss observation of a single post-spawned female sturgeon overwintered for six months at the Conte Lab. As a result of being overwintered and artificially spawned at the lab prior to her release in May, this animal lost approximately 2.5 kg of its beginning weight. When recaptured 12 weeks later in the summer, however, the female had already regained 1.9 kg of her body weight, indicating empirically that sturgeon weight loss as a result of overwintering is predictable, and that the recovery of condition is fairly rapid after returned to the river.

As indicated, the applicant has proposed capturing and transporting to the Conte lab in late fall and conducting planned tests and releasing the animals as soon as testing is completed. Forty adults/sub-adults from south of the Holyoke Dam (Table 2; line 1.b) in two of five years for swimming performance tests, releasing the animals within two months, typically within 72 hours. The applicant also proposes capturing and transport up to 30 animals from south of the Holyoke Dam (Table 2; line 1.c) in two of five years of the permit to the lab for other short-term testing lasting up to two months. Based on evidence presented by the applicant on the impacts of weight loss influenced by the length of captive holding and the timing of capture, NMFS believes that the act of holding these animals for a maximum of two months in the Conte Lab would not lessen their conditioning or fitness in the wild greater than that experienced by wild animals.

***Risks of Altered Behavior in Short-term Captive Shortnose Sturgeon Returned to the Wild***: Although there is little published information documenting altered behavior among shortnose sturgeon held captive for extended periods, NMFS recognizes that there could be potential risks for altered behavior when wild sturgeon are returned to their natural environment after being held captive. These altered behaviors could include changes in an animal's spawning, foraging, seasonal movements, and abilities to react to changes in its environment.

To empirically document possible altered behavior patterns, Kieffer and Kynard (2012a) (Permit No 1549; NMFS 2007) tracked eight captive sturgeon returned to the Connecticut River in the spring after having been held in captivity two to eight months. Five of these radio-tagged males were successfully tracked, behaving as typical spawning adults after returned the same year, moving to and remaining at the spawning location until late May. One of the animals was released 10 km downstream of the

Montague spawning area and four days later was detected at the spawning area. Additionally, four male and one female shortnose sturgeon of the same group were observed returning to the spawning area the following spring, indicating that their reproductively was in sync with other animals not experiencing captivity. Further, separate tracking data revealed that all eight of these animals occupied the known winter aggregation areas prior to migrating to the spawning area. Also, as previously noted from Kynard et al (2011), a post-spawning female released from the Conte Lab, after having lost 2.5 kg of egg mass, was recaptured in the wild 12 weeks later after she had gained 1.9 kg of her weight, indicating that this animal's foraging behavior was not altered.

Other evidence was presented by Isley et al. (2003) publishing results (Permit No. 1261; NMFS 2000) addressing potential changes in behavior of wild Savannah River shortnose sturgeon after held for six months in captivity and then returned to their natural environment. The study concluded that migration behaviors of the tagged animals were similar to that of controls never held in artificial environments. In the study it was shown that animals returned to the river beginning in December and January, and also in the spring beginning in mid-February, displayed typical upriver movements coinciding with increases in water temperature (Isley et al. 2003). Also documented were normal movements between estuarine fresh and brackish water during late spring, typical of normal sturgeon foraging activity. Experimental and control fish also displayed similar fall movements from summering areas to the upper reaches of the estuary coinciding with decreases in water temperature.

These observations of sturgeon response to environmental cues, overwintering behavior, spawning periodicity, and foraging activity, are evidences that shortnose sturgeon readapt rapidly to their natural environment after being held and returned. Thus, NMFS does not anticipate significantly altered behavior when shortnose sturgeon captured from the lower population segment of the Connecticut River are held short-term for up to two months and are later released.

***Conclusions on Impacts to Wild Adult/Sub-Shortnose Sturgeon Used in Short-term Research:*** The applicant has suggested because surrogate captive sturgeon are not fit for rigorous testing, the use of wild shortnose sturgeon is necessary for appropriate modeling .performance of wild fish to mitigate measures for dam passage with respect to water flow tested under various conditions (M. Kieffer; pers. comm. 2012). Similarly, other tests using wild shortnose sturgeon measuring the physiology and endocrinology responses are necessary because testing with captive surrogate shortnose sturgeon does not measure comparable responses. The potential information gained from the proposed experimental research on wild Connecticut River shortnose sturgeon has been identified as objectives by NMFS for FERC re-licensing of the Holyoke Dam and in the final shortnose sturgeon recovery plan (NMFS, 1998). Although NMFS recognizes risks described above to wild animals held for short-term research at the Conte Lab, these risks have been shown to be minimal as mitigated in this EA. Further, because the information in the proposed objectives is critical to species recovery and is not obtainable otherwise, NMFS supports use of wild adult and sub-adult animals as proposed.

#### *4.2.1.3. Impacts of Maintaining Captive Shortnose Sturgeon Raised from Early Life Stages at the Conte Lab (long-term; non-releasable Animals):*

The captive, non-releasable shortnose sturgeon held permanently under quarantine conditions at the Conte Lab would require takes of fertilized embryos originating from wild animals originating from the Merrimack, Kennebec and Androscoggin Rivers. Sources of shortnose sturgeon progeny would also include those imported from Canada as fertilized embryo and/or produced in the future by spawning Connecticut River brood animals obtained from the University of Georgia. These stocks would be used

as test animals at the Conte Lab and other permitted facilities for upstream and downstream fish passage studies, physiology tests and contaminant research and also as distributed to other permitted researchers at other facilities and educational display aquaria when requested. Such takes of wild ELS and or captive progeny are critical for gaining scientific information necessary for managing recovery of the species and cannot be reliably obtained elsewhere.

However, potential primary threats from culturing shortnose sturgeon at the Conte Lab could result from escapement into the Connecticut River watershed, resulting genetic alterations to native populations, as well as competition for space and resources between hatchery-reared and wild fish. Further, since most sturgeon diseases have been documented in captive-reared fish, there is also potential for escapees to spread pathogens if released unintentionally.

Because the permit would not authorize any release of long-term captive, cultured sturgeon into the wild, progeny cultured at the Conte Lab would be required to be properly quarantined, eliminating the potential for escape. The researcher would also be required to minimize the potential for pathogens spread from the facility. Disease and proper quarantine measures would be addressed by properly treating sampling gear prior to sampling animals, identifying all separate stocks held at the holding facility with prominent labels on holding tanks and off-site master records. Tanks would be covered with fitted lids and drains preventing escape. Additionally, all holding tank effluents would be passed through a lethal ultra-violet sterilization unit and a downstream gravel sink pit, preventing introduction of any live progeny or pathogens into the river. Further, to maintain the health of research animals at the facility, gross health screenings would be performed with standard therapeutic and prophylactic treatments administered by qualified biologists as necessary. Personnel authorized in the permit to handle and examine fish would be required to record all pertinent data daily and be specifically trained to recognize changes in sturgeon behavior and fish health.

The permit would also be conditioned so that all captive shortnose sturgeon, gametes or biological samples at the facility would remain in the possession of the Permit Holder, and that the Permit Holder could not transfer live fish, gametes, or biological samples to anyone not listed in the permit without obtaining prior written approval from NMFS. Additionally, commercial aquaculture would be forbidden in the permit.

***Conclusions on Impacts to Culturing (long-term, non-releasable) Captive Shortnose Sturgeon*:** The primary benefit of culturing captive stocks of shortnose sturgeon as proposed by the applicant would be that the animals would serve as surrogates for wild stocks where testing with captive animals could be verified as representative test animals. That is, where hatching and culturing embryos to various desired life stages for experimental purposes could provide valuable specimens for research possessing identical characteristics to wild fish; it would eliminate the need for further specimen collection from the wild. Further, such research would provide conservation measures for recovery of the species which could not be determined otherwise by using wild stocks because of the lethal nature of the research.

To date, for a period of 20 years under successive ESA permits, there have been no reports of escapees from the facility or incidences of disease attributed to animals held in the facility. Lastly, although animals are labeled as long-term test animals, all progeny produced and tested at the lab would be euthanized at the end of annual studies, excepting those animals reasonably anticipated for further research, or those requested by other permitted laboratories or educational facilities. Therefore, NMFS

considers the impacts of the proposed action would be limited to the laboratory facility and to the individual sturgeon tested in research.

#### *4.1.2.4 Impacts of Transporting Animals*

***Transport of Wild Animals within the Connecticut River Basin to the Conte Lab***: Requests to transport adult and sub-adult shortnose sturgeon to the laboratory holding facility for further research activities could result in potential adverse effects including discomfort, stress, injury and/or mortality resulting from activation of latent disease organisms, osmoregulatory problems, poor water quality, overcrowding, equipment breakdown, or improper tempering (Jensen, 1990).

Wild shortnose sturgeon captured in the Connecticut River have been transported to the Conte Lab without reported mortalities for over 30 years, excepting one incident in 2004 (Permit No. 1239; NMFS 2004) where researchers experienced a failure of an air pump on equipment used for transporting five animals to the lab from the Agawam site. Animals became severely stressed and died after 48 hours in the lab. The researchers took immediate corrective action modifying the transport vehicle, incorporating redundant air supplies to each transport tank.

To address these problems, the applicant provided the following transport protocol which NMFS determines would minimize further stress and mortality of sturgeon in the proposed action.

- Only healthy candidate animals can be selected for transport.
- Water quality must be maintained properly with a liquid oxygen system and redundant aeration from the electric air pumps.
- Sturgeon must not be overcrowded in transport tanks and must be filled to capacity and fitted with tight-fitting secured lids to prevent water surge and scarring of animals.
- For transport trips, fish and equipment must be checked routinely to insure a healthy condition.
- Transport must be avoided during weather extremes of heat and cold and water temperature must be maintained between 20$^{o}$C and 7$^{o}$C.
- River water must be collected from the river at the capture site and must be treated with an electrolyte in order to reduce stress and maintain osmoregulation.
- Upon arrival at the holding facility, transported animals must be transferred to temporary holding facilities and tempered to the receiving water in order to avoid abrupt water temperature or chemistry changes.
- Animals would also receive a treatment of hydrogen peroxide as prescribed in USGS document HFA-305 (USGS 2007a).

***Transport of Fertilized Embryo from GOM Rivers***: Fertilized embryo from the Merrimack, Kennebec, or Androscoggin rivers would be driven by automobile to the Conte Lab using standard transport methods described in the application necessary to maintain water quality and dissolved oxygen levels in sealed bags for up to 72 hours. Upon arrival to the holding facility, the embryo would be transferred to hatching jars using standard hatchery methods for avoiding abrupt water chemistry changes. The methods proposed for transporting the fertilized embryo should not detrimental to embryo causing failure in their hatchability and further development.

*4.2.2 Controversy:*

Federal agencies are required to consider "the degree to which effects on the quality of the human environment are likely to be highly controversial" when evaluating potential impacts of a proposed action [40 CFR §1508.27]. All agency comments were appropriately addressed and none of the comments indicated the proposed action was controversial, and none addressed the proposal's potential effects on the quality of the human environment. The applications for the proposed permits were made available for public review and comment; however, no public comments were received.

*4.2.3. Cumulative Impacts*

*4.2.3.1 Summary of Cumulative Impacts on Wild Fish Captured in Rivers and Released Immediately:*

In general, takes of shortnose sturgeon by harassment during permitted research using the proposed methodologies have not been shown to result in long-term or permanent adverse effects on individuals regardless of the number of times the harassment occurs. The frequency and duration of the disturbance under the proposed permit would allow adequate time for animals to recover from adverse effects such that additive or cumulative effects of the action on its own are not expected.

No measurable effects on population demographics are anticipated because any sub-lethal (disturbance) effects are expected to be short-term, with the animals recovering within a day. The proposed action contains authorization for unintentional annual mortality of up to three animals in the Connecticut River component of the study. Such mortality would affect the individual animals; however, the action would not be anticipated to have impacts to shortnose sturgeon at the population or the species level. If a greater incidence of mortality or serious injury should occur, however, researchers would be required to cease the study and consult with the Permits Division to determine the cause of mortality and to discuss any remedial changes in research methods. The Permits Division could grant authorization to resume permitted activities based on review of the incident depending on the circumstances, or else suspend activities indefinitely.

As stated previously, there is planned directed lethal take of a total of 12,000 fertilized shortnose sturgeon embryo from GOM rivers over a two-year period of the permit, and also 150 ELS annually from the Connecticut River above the Holyoke Dam. However, even if the total egg production of four or five female fish proposed to be taken in GOM rivers were lost due to aborted spawning runs, the potential negative impact to the system would be discounted because the total is considered a small fraction of the total egg production annually in the GOM, considered a meta-population, having documented migration between known primary spawning rivers—the Kennebec, Androscoggin, and Merrimack Rivers.

In terms of corresponding research contributing to cumulative impacts in the action area, there is one shortnose sturgeon permit potentially overlapping from authorized shortnose sturgeon research in the in the state of Connecticut (File No. 15614), and one Atlantic sturgeon research permit (Permit No. 16526) taking place concurrently with shortnose research in GOM rivers (Permit No. 16306). Even if the proposed permit were able to target the same individual animals as other permit holder in the region, however, NMFS would not expect significant cumulative impacts because effects of research activities would typically dissipate within a day as previously discussed. Moreover, researchers working under NMFS permits are required to notify the appropriate NMFS Regional Office in advance of field work. The Northeast Regional Office would be tasked with coordinating activities under multiple permits for the action area to ensure there is not unnecessary duplication of research.

***Other Cumulative Impacts on Wild Fish***: The target shortnose sturgeon population may be exposed to other human activities including: water quality and contaminants, by-catch in commercial and recreational fishing gear, poaching, habitat alteration (e.g., dredging and blasting), ship strikes, artificial propagation, and dams. Related to this action, the effects of past and ongoing human and natural factors (fisheries, existing NMFS research permits and other activities) occurring in or near the action area that have contributed to the current status of the species, are described in detail in the baseline section of the attached biological opinion produced for the ESA Section 7 consultation for this permit. The general threats facing shortnose sturgeon range-wide were also referenced and discussed in the opinion. These activities and threats are expected to continue into the future.

*4.2.3.2 Summary of Cumulative Impacts from Culturing Captive Shortnose Sturgeon (long-term, non-releasable):*

NMFS believes that negative impacts of maintaining non-releasable shortnose sturgeon progeny produced and cultured at research facilities are limited to the facilities; that is, there are no significant impacts recognized to native populations from these captive shortnose sturgeons. Individually, animals at the facility would be fed and maintained properly under quarantine conditions, and would be given daily care, treated humanely, and provided with medical care as necessary. Further, NMFS has made the determination that these captive-bred shortnose sturgeons would be non-releasable to the wild unless conditions have been met and are specifically authorized for restoration of extirpated or severely impacted rivers. Therefore, NMFS regards such research activities involving captive, cultured shortnose sturgeon would not reduce the shortnose sturgeon's likelihood for survival or recovery in the wild.

Further, NMFS authorizes and encourages some lethal testing of hatchery raised individuals to gain information otherwise unobtainable, directly benefiting this endangered species in the wild. However, because NMFS recognizes similar genetic, physical, physiological, ecological, and behavioral characteristics are shared by shortnose sturgeon produced in a hatchery and the natural populations from which they are derived, these animals can serve as valuable surrogate resource specimens for recovery goals, contributing in ways not obtainable otherwise. Depending on specific research objectives, results are often directly comparable to wild animals in experimental research, but without the risk associated with lethally taking wild animals.

*4.2.3.3 Summary of Cumulative Impacts on Wild Shortnose Sturgeon Transported to the Lab Facility and Held and Released (short-term, releasable):*

In the current action, mature animals from the downstream segment of the Holyoke Dam Project on the Connecticut River would be captured, transported to Conte Lab and returned to the river safely after proposed experimental research is completed. Because the permit application proposes to hold shortnose sturgeon for short-term periods in an artificial environment, it was necessary to establish specific conditions in the permit defining the manner by which animals could be held under quarantine conditions at the laboratory. Although, there would be the added potential for stress and mortality due transporting and holding sturgeon for short periods of time, these mitigations would be expected to reduce or eliminate the potential adverse effects of transporting and holding sturgeon.

The applicant is highly qualified in sturgeon biology and culture. Researchers at the USGS facility have been performing similar permitted research on shortnose sturgeon held captive for short-term holding periods for over 30 years. Further, all proposed research procedures would follow standard protocols serving to mitigate unforeseen impacts when capturing, transporting and holding animals in captivity for up to two months. Also, because there is little evidence animal behavior or conditioning

would be altered significantly while holding the animals prior to release, NMFS believes utilizing these wild animals would further recovery efforts for the species.

#### *4.2. 4 Conclusions*:

The biological opinion completed for the ESA section 7 consultation for this permit provides an integration and synthesis of the information about the status of the species, past and present activities affecting the species, possible future actions that might affect the species, and effects of the proposed action in order to provide a basis for determining the additive effects of the take authorized in this permit on ESA listed shortnose sturgeon, in light of their present and anticipated future status. Thus the conclusion of the biological opinion was that the proposed action would not likely jeopardize the continued existence of any of the wild or species, nor would it likely destroy or adversely modify designated critical habitat for any listed species. NMFS expects the proposed research activities, including the culture of captive stock and the release of wild stock held for short-term periods, would not appreciably reduce the likelihood of survival and recovery of shortnose sturgeon in the wild by adversely affecting their birth, death, or recruitment rates.

Furthermore, there is no individually insignificant but cumulatively significant impact associated with the overall proposed action. Therefore, NMFS believes that the issuance of Permit No. 16549 would have only negligible impacts to shortnose sturgeon, and that the proposed action would not likely jeopardize the continued existence of the species.

## CHAPTER 5 LIST OF PREPARERS AND PERSONS/AGENCIES CONSULTED

This EA was prepared by the National Marine Fisheries Service, Office of Protected Resources in Silver Spring, Maryland. Additionally, the NMFS Northeast Regional Office of Protected Resources in Gloucester, Massachusetts was consulted and their comments were incorporated into the document.

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# Appendix No. 1:

| Table 1: Listing of similar shortnose sturgeon ESA permits affecting the scope of the Proposed Action | | | |
|---|---|---|---|
| ***Permit No.*** | **Location** | ***Authorized Take*** | ***Research Activity*** |
| 10115<br>Expires: 8/3/2013 | Saltilla & Saint Marys River, GA/FL | 85 adult/juv<br>(20 ELS) | Capture, handle, measure, weigh, PIT tag, tissue sample, collect ELS |
| **ENVIRONMENTAL ASSESSMENT** ON THE EFFECTS OF THE ISSUANCE OF A SCIENTIFIC RESEARCH PERMIT TO CONDUCT RESEARCH ON SHORTNOSE STURGEON IN THE SAINT MARYS RIVER AND SATILLA RIVERS, GEORGIA AND FLORIDA | | | |
| 14394<br>Expires: 9/30/14 | Altamaha River and Estuary, GA | 500 adult/juv.<br>(1 lethal &<br>100 ELS) | Capture, handle, weigh, measure, PIT tag, transmitter tag, tissue sample, anesthetize, laparoscopy, blood collection, fin ray section, collect ELS |
| **ENVIRONMENTAL ASSESSMENT** ON THE EFFECTS OF THE ISSUANCE OF A SCIENTIFIC RESEARCH PERMIT (File No. 14394) TO CONDUCT RESEARCH ON SHORTNOSE STURGEON IN THE ALTAMAHA RIVER, GEORGIA | | | |
| 10037<br>Expires: 4/30/2013 | Ogeechee River and Estuary, GA | 150 adult/juv.<br>(2 lethal &<br>40 ELS) | Capture, handle, measure, weigh, PIT tag, tissue sample, fin-ray section, anesthetize, laparoscopy, blood collection, radio tag, collect ELS |
| **Environmental Assessment** of Issuance of a Scientific Research Permit to Dr. Douglas Peterson, University of Georgia, (File No.10037) to Conduct Research on Endangered Shortnose Sturgeon | | | |
| 15677<br>Expires: 5/31/2016 | S. Carolina Rivers and Estuaries | 154 adult/juv<br>(100 ELS) | Capture with gill & trammel net or trawl, measure, weigh, photograph/video, dart tag, PIT tag, genetic tissue sample, anesthetize, laparoscopy, gonadal biopsy, blood sample; collect ELS |
| **ENVIRONMENTAL ASSESSMENT** ON THE EFFECTS OF THE ISSUANCE OF A SCIENTIFIC RESEARCH PERMIT (File No. 15677) TO CONDUCT SCIENTIFIC RESEARCH ON SHORTNOSE STURGEON IN SOUTH CAROLINA RIVERS | | | |
| 14759<br>Expires: 8/19/2015 | North Carolina Rivers | 70 adult/juv. | Capture, handle, weigh measure, Floy tag, PIT tag, genetic tissue sample; anesthetize acoustic tag |
| **ENVIRONMENTAL ASSESSMENT** ON THE EFFECTS OF THE ISSUANCE OF A SCIENTIFIC RESEARCH PERMIT (File No. 14759) TO CONDUCT SCIENTIFIC RESEARCH ON SHORTNOSE STURGEON IN NORTH CAROLINA RIVERS | | | |
| 14176<br>Expires: 9/30/2015 | Potomac River | 30 adult/juv.<br>(20 ELS) | Capture, handle, weigh, measure, Floy PIT tag, genetic tissue sample; anesthetize w/ electronarcosis; & internal acoustic tag |
| **ENVIRONMENTAL ASSESSMENT** ON THE EFFECTS OF THE ISSUANCE OF A SCIENTIFIC RESEARCH PERMIT FILE NO. 14176 TO CONDUCT RESEARCH ON SHORTNOSE STURGEON IN THE POTOMAC RIVER, MARYLAND AND VIRGINIA | | | |
| 14604<br>Expires: 4/19/2015 | Delaware River and Estuary NJ & DE | 1,000 adult/juv.<br>(1 lethal &,<br>300 ELS) | Capture, handle, measure, weigh, Floy tag, PIT tag, tissue sample, anesthetize, ultrasonic tag, laparoscopy, blood collection, collect ELS |
| **ENVIRONMENTAL ASSESSMENT** ON THE EFFECTS OF THE ISSUANCE OF A SCIENTIFIC RESEARCH PERMIT (File No. 14604) TO CONDUCT SCIENTIFIC RESEARCH ON SHORTNOSE STURGEON IN THE DELAWARE RIVER | | | |
| 14396<br>Expires: 12/31/2014 | Delaware River and Estuary NJ & DE | 100 adult/juv | Capture, handle, measure, weigh, Floy tag, PIT tag, genetic tissue sample, anesthetize, and sonic tag |

| | | | |
|---|---|---|---|
| **ENVIRONMENTAL ASSESSMENT** ON THE EFFECTS OF THE ISSUANCE OF A SCIENTIFIC RESEARCH PERMIT (File No. 14396) TO CONDUCT SCIENTIFIC RESEARCH ON SHORTNOSE STURGEON IN THE DELAWARE RIVER | | | |
| 16439<br>Expires:10/31/2016 | Hudson River, | 240 and 2,340 shortnose sturgeon in year 1-3 and year 4-5, | Capture, handle, weigh, measure, PIT & Carlin tag, genetic tissue sample, and gastric lavage |
| **ENVIRONMENTAL ASSESSMENT** (SEA) OF THE ISSUANCE OF A SCIENTIFIC RESEARCH PERMIT MODIFICATION (FILE NO. 16439) TO NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (NYSDEC) FOR CONDUCTING RESEARCH ON ENDANGERED SHORTNOSE STRUGEON | | | |
| 17095<br>Expires: 8/28/17 | Hudson River and Estuary, NY | 82 Shortnose sturgeon adult/ juv; (40 ELS)<br>82 Atlantic sturgeon adult/juv;(40 ELS) | Capture, handle, measure, weigh, PIT tag, Carlin tag, photograph, tissue sample, collect ELS |
| **ENVIRONMENTAL ASSESSMENT** Of Issuance of a Scientific Research Permit (File No. 17095) to Entergy nuclear Generation, Inc. to Conduct Research on Endangered Shortnose and Atlantic Sturgeon | | | |
| **16549**<br>**Proposed Permit** | **Upper Conn. River, MA** | **200adult/juv Ct River. (3 lethal & 150 els Upper CT River/5000 ELS lower CT River) 12,000 ELS from GOM Rivers for 2 years)** | **capture, handle, measure, weigh, anesthetize, pit tag, Telemetry tag, tissue sample, borescope, laboratory tests, collect els** |
| **SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT** ON THE ISSUANCE OF A MODIFICATION TO SCIENTIFIC RESEARCH PERMIT NO. 1549 [BOYD KYNARD, S.O. CONTE ANADROMOUS FISH RESEARCH CENTER] TO CONDUCT RESEARCH ACTIVITIES ON ENDANGERED SHORTNOSE STRUGEON | | | |
| 15614<br>Expires: 5/23/2016 | Lower Conn. River & Estuary., CT | 500 adult/juv (2 lethal &; 300 ELS) | Capture, handle, measure, weigh, PIT & Floy tag acoustic tag, gastric lavage, fin ray section, collect ELS |
| **Environmental Assessment** ON THE EFFECTS OF THE ISSUANCE OF SCIENTIFIC RESEARCH PERMIT FILE NO. 15614 TO CONDUCT RESEARCH ON SHORTNOSE STURGEON IN CONNECTICUT WATERS | | | |
| 16306<br>Expires 5/21/2017 | Kennebec Complex and Estuary, ME | 500 adult/juv.; (30 ELS) | Capture, handle, measure, weigh, tissue sample, PIT tag, acoustic tag, lavage, anesthetize, collect ELS |
| **ENVIRONMENTAL ASSESSMENT** For Issuance of Scientific Research Permits Nos. 16306 to Conduct Scientific Research on Protected Shortnose Sturgeon in the Gulf of Maine | | | |

**Appendix 2: Maps of Action Area**

Figure 1: Map of GOM Rivers and Connecticut River

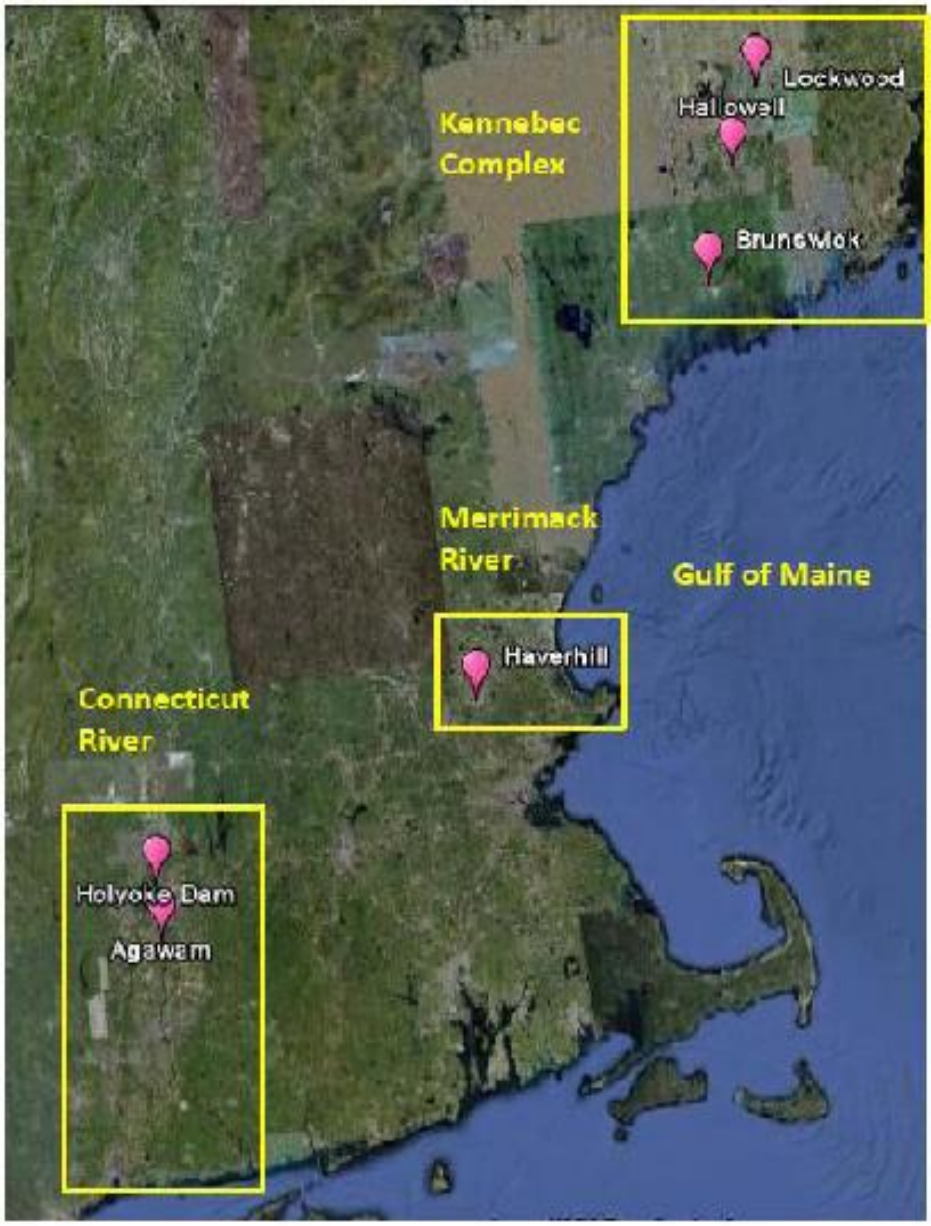

Figure 2: Upper Connecticut River above Holyoke Dam

Figure 3 Map of Connecticut River Downstream of Holyoke Dam
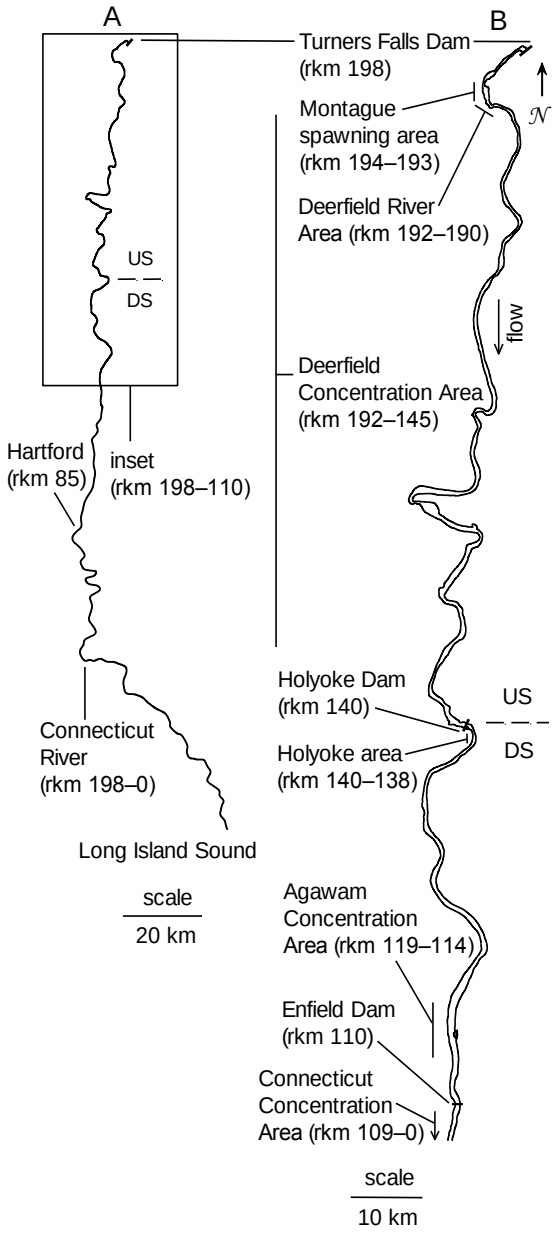
**Figure 4: Detailed Map of Connecticut River Action Area**