UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
One Blackburn Drive
Gloucester, MA 01930-2298

OCT 24 2007

Ms. Christine A. Godfrey
Regulatory Division
U.S. Army Corps of Engineers
New England District
696 Virginia Road
Concord, Massachusetts 01742-2751

RE: Endangered Species Act Section 7 Formal Consultation for Cianbro Constructors, LLC Brewer Module Facility

Dear Ms. Godfrey:

Enclosed is NOAA's National Marine Fisheries Service (NMFS) biological opinion (BO), issued under Section 7(a)(2) of the Endangered Species Act (ESA), for dredging and construction activities by Cianbro Constructors, LLC (Cianbro) for the proposed Brewer Module Facility in Brewer, Maine. The US Army Corps of Engineers (ACOE) is proposing to provide a Clean Water Act Section 404 Permit and Rivers and Harbor Act Section 10 Permit to Cianbro that authorizes activities occurring below the ordinary high water mark in the Penobscot River. This BO is based on the ACOE's August 24, 2007 Biological Assessment (BA), Cianbro's July 19, 2007 permit application to the ACOE, correspondence between Cianbro, ACOE, and NMFS, and other sources of information. The BO concludes that dredging and other construction activities in the Penobscot River proposed by Cianbro, may adversely affect, but are not likely to jeopardize the continued existence of endangered shortnose sturgeon (*Acipenser brevirostrum*) or Atlantic salmon (*Salmo salar*).

As required by Section 7(b)(4) of the ESA, an incidental take statement (ITS) prepared by NMFS is provided with the BO. The ITS exempts the incidental taking of three (3) shortnose sturgeon from interactions with dredging and other in-water activities associated with construction of the Brewer Module Facility, while specifying reasonable and prudent measures and implementing terms and conditions necessary to minimize the impact of these activities on shortnose sturgeon. This level of take accounts for shortnose sturgeon injured or killed during in-water work and shortnose sturgeon that may be captured by the dredge bucket but released unharmed. This take level was estimated based on the likelihood of the presence of shortnose sturgeon in the action area during the time period proposed for dredging and other construction activities and previous interactions between dredging projects and sturgeon. No take of Atlantic salmon is exempted in this BO. Monitoring that is required by the ITS will continue to supply information on the level of take resulting from the proposed action.

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. To further reduce adverse effects of the proposed project, NMFS recommends several conservation recommendations for endangered shortnose sturgeon and Atlantic sturgeon (an ESA candidate species). While these recommendations are discretionary, NMFS strongly urges the ACOE to carry out these programs.

This BO concludes consultation under Section 7 of the ESA for construction of the Brewer Module Facility. Please send a final copy of the permit for our records. If project plans change or new information becomes available that changes the basis for this determination, consultation should be reinitiated. Consultation will need to be reinitiated in any maintenance dredging occurs at the Brewer Module Facility. Please contact Jeff Murphy of my staff at (207) 866-7379 or Jeff.Murphy@noaa.gov for any questions involving this consultation.

Sincerely,

for Patricia A. Kurkul
Regional Administrator

Cc: Jeff Murphy, NMFS
Marcy Scott, NMFS
Wende Mahaney, USFWS
Norm Dube, MASC
Shawn Mahaney, ACOE

NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT
BIOLOGICAL OPINION

Agency: Army Corps of Engineers (ACOE), New England District

Activity Considered: Issuance of permit under the Rivers and Harbors Act by the ACOE to Cianbro Constructors, LLC for associated dredging and construction of the Brewer Module Facility
F/NER/2007/05867

Conducted by: National Marine Fisheries Service
Northeast Region

Date Issued: 10/23/07

Approved by: Chris Mantzaris for Patricia Kurkul

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INTRODUCTION

This constitutes the biological opinion (Opinion) of NOAA's National Marine Fisheries Service (NMFS) under the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531-1543) on the effects of the US Army Corps of Engineers (ACOE) issuance of a permit to Cianbro Constructors, LLC and Penobscot River Holdings, LLC (collectively, "Cianbro") for dredging and constructions activities associated with the proposed Brewer Module Facility in Brewer, Maine. This Opinion is based on the following: information provided by the ACOE in the Biological Assessment (BA) submitted to NMFS on August 24, 2007, the July 19, 2007 permit application to the ACOE under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act, correspondence between Cianbro, ACOE, and NMFS, and other available sources of information. ACOE's request for formal consultation was received on August 24, 2007 and formal consultation was initiated on August 29, 2007. A complete administrative record of this consultation will be kept on file at the NMFS Northeast Regional Office.

CONSULTATION HISTORY

May 18, 2007 – On behalf of Cianbro, Woodlot Alternatives, Inc. (Woodlot) requested information from NMFS concerning Essential Fish Habitat (EFH) and Significant Wildlife Resources relevant to the proposed project area.

June 4, 2007 –NMFS responded to the information request by Cianbro in an email stating that the Penobscot River is EFH for Atlantic salmon, and endangered Atlantic salmon and shortnose sturgeon may be present in the project area.

Week of June 4, 2007 – In a telephone conversation with Cianbro and Woodlot, NMFS confirmed that the proposed project would require Section 7 consultation under the ESA regarding potential effects on shortnose sturgeon and Atlantic salmon.

June 14, 2007 – NMFS hosted a meeting with Cianbro and Woodlot at NMFS's Maine Field Station in Orono, Maine to discuss the proposed Brewer Module Facility. During the meeting, NMFS indicated that formal Section 7 consultation under the ESA would be required as preliminary information indicated that the proposed project may adversely affect Atlantic salmon and shortnose sturgeon. NMFS suggested that Cianbro work with the ACOE to prepare a Biological Assessment (BA) on the effects of the proposed project on listed species.

July 2, 2007 – NMFS, US Fish and Wildlife Service (USFWS), Maine Department of Environmental Protection (MDEP), Maine Department of Marine Resources (MDMR) Bureau of Sea Run Fisheries and Habitat (formerly the Maine Atlantic Salmon Commission), Cianbro, and Woodlot met at the project site. During the meeting the proposed mitigation plan for the project was discussed. The on-site mitigation involves restoration activities on Sedgeunkedunk Stream. NMFS, USFWS, and MDMR agreed that the mitigation plan would add value to aquatic habitat in Sedgeunkedunk Stream including Atlantic salmon habitat. Bulkhead installation and riprap impact areas related to the project were also discussed.

July 2, 2007 – NMFS, Cianbro, and Woodlot met with researchers at the University of Maine to discuss the ongoing shortnose sturgeon study in the Penobscot River. NMFS provided Cianbro and Woodlot with a draft report of sturgeon studies conducted by the University of Maine.

July 19, 2007 – Cianbro filed an application with the ACOE under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act to construct the Brewer Module Facility in Brewer, Maine.

August 24, 2007 – NMFS receives letter from ACOE dated August 24, 2007 requesting initiation of formal Section 7 consultation for construction of the proposed Brewer Module Facility. As the submission from ACOE contained all of the information necessary to conduct a consultation, the date that the letter was received serves as the date of initiation of consultation. NMFS received additional information on the proposed project in submissions dated September 13, September 21, and September 28, 2007.

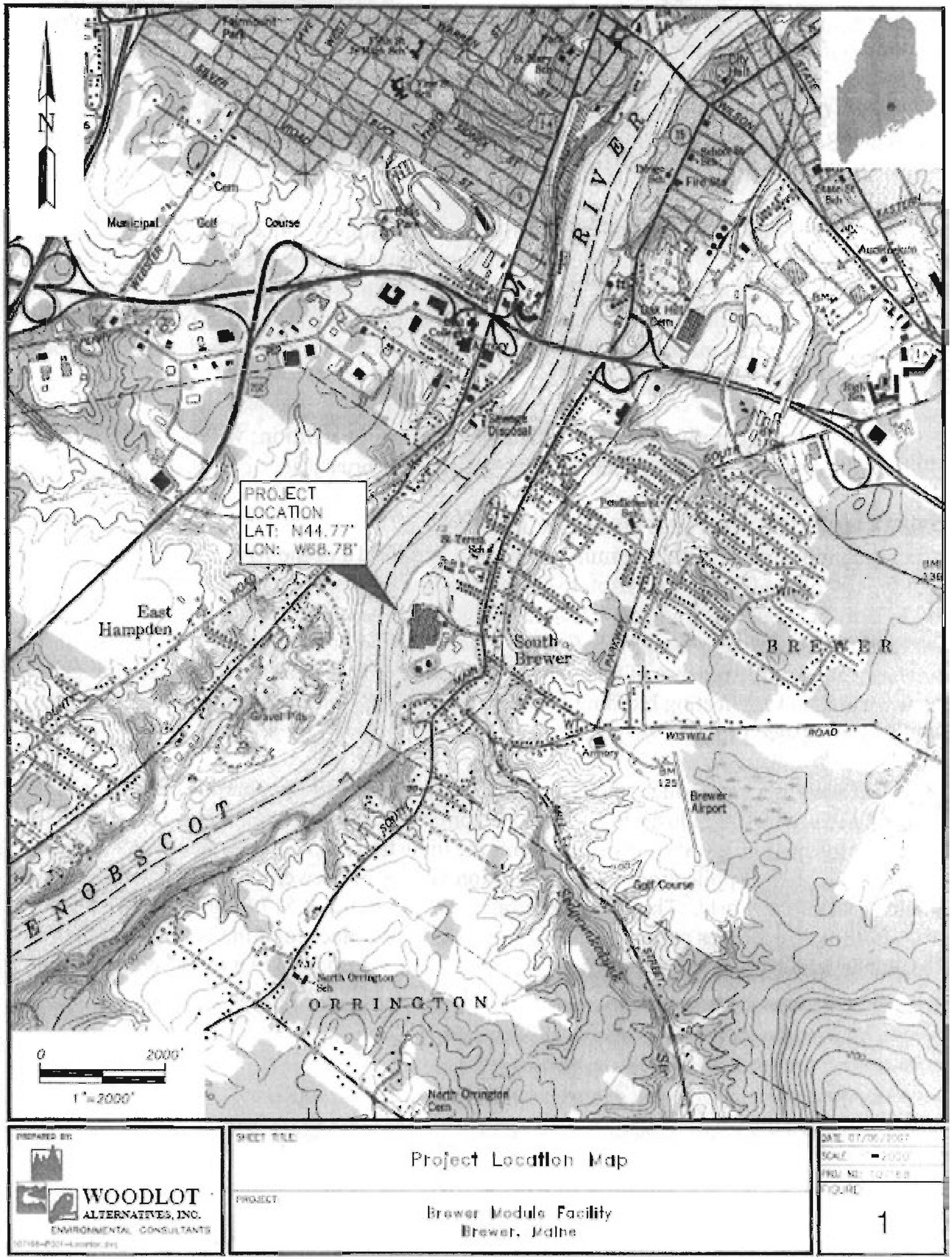
October 5, 2007 – ACOE notifies NMFS that Cianbro's permit conditions will be modified such that all dredging and disposal shall occur from August 1 to February 28, of any given year.

DESCRIPTION OF THE PROPOSED ACTION

The ACOE is proposing to issue a permit, pursuant to Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act, to Cianbro for the construction of the Brewer Module Facility in Brewer, Maine (see Figure 1 for project location). Cianbro intends to construct the module fabrication facility at the former Eastern Fine Paper facility along the Penobscot River. Module fabrication is the process of taking unfinished materials such as steel girders, piping, and electrical wiring, and fabricating building components that can readily be shipped and then assembled to a finished project.

Module fabrication is a common method of construction for facilities in pharmaceutical, paper making, and petrochemical industries. It is also becoming increasingly common in smaller scale construction projects in the transportation and marine industries, as well as typical commercial and residential building applications. The fabrication facility in Brewer would provide modules for projects around the world. The proposed project site is located at 517 South Main Street, Brewer, Maine, and occupies approximately 39 acres at the confluence of the Penobscot River and Sedgeunkedunk Stream. Completed modules would be transported to a bulkhead and rolled onto barges for shipment. Construction is expected to begin in November of 2007.

Figure 1. Project location map.



Existing Site Conditions
The property is currently occupied by three buildings: the former main mill, an administration building, and a small storage building in which hazardous waste was temporarily stored before being shipped off site. The mill and administration buildings are currently vacant and are being cleared of machinery, furniture, and other remnants. The storage building is currently being used for general equipment storage by the City of Brewer.

An existing bulkhead area protrudes into the Penobscot River west of the mill site, and a timber cribbing wall forms the shoreline of the river running north of the mill. Photographs of past mill operations indicate that this area was used for coal and pulp wood loading. This area is in poor condition, exhibiting signs of erosion with areas of failed cribbing and sinkhole formation. Environmental studies conducted at the site indicate that the land up-gradient of the existing timber cribbing wall is prone to erosion.

The existing conditions at the site since the mill closure have been extensively documented through environmental assessments and through interactions with Maine's Voluntary Response Action Plan (VRAP) program. This program provides that parties who identify and clean up known contaminations at the time they take possession are protected from future liability for past contamination. The latest investigation report available is the "Draft Supplemental Phase II Investigation, Eastern Fine Paper" dated February 28, 2007, prepared by Edwards and Kelsey for South Brewer Redevelopment, LLC. This report identifies numerous soil and site contamination areas of concern.

ACOE Permit Conditions
The ACOE has proposed the following special conditions for any permit issued to Cianbro for construction of the Brewer Module Facility: 1) All dredging and disposal shall occur from August 1 to February 28 of any given year; 2) For all activities excluding dredging, all excavation and backfilling shall occur when the tide is below the work area; and 3) Adequate sedimentation and erosion control devices such as geo-textile silt fences or other devices capable of filtering the fines involved, shall be installed and properly maintained to minimize impacts on waters and wetlands during construction. These devices must be removed upon completion of work and stabilization of disturbed areas. The sediment collected by these devices must also be removed and placed upland, in a manner that will prevent its later erosion and transport to a waterway or wetland. The August 1 to February 28 work window for dredging and disposal operations is designed to minimize adverse effects to listed species in the action area.

Onshore Construction
The central feature of the module fabrication facility development is the construction of a structural pad in the center of the site approximately 250,000 ft^2 (5.7 acres) in size. The pad is surrounded by haul roads and gravel-surfaced laydown areas for raw materials handling, sorting, and temporary storage. Raw materials would be brought to the pad on an as-needed basis during construction of modules. This fabrication site will include subsurface utility and drainage systems.

In order to utilize the Eastern Fine Paper site, Cianbro proposes to raze the existing mill structures and re-grade the site. Demolition debris will be separated and recycled, used as fill, or disposed of, as appropriate. Three existing mill buildings are planned to remain in place on the site. The existing administration building (approximately 4,295 ft^2) will be renovated for administrative support. This renovation will include providing utility infrastructure (water, sewer, electrical, telecommunications) for job site trailers, which will be installed from time to time to suit ongoing fabrication operations. A warehouse portion of an existing mill building approximately 29,900 ft^2 in size will be renovated for reuse as a warehouse and storage facility with loading dock access. A boiler building will initially remain in place and will not be utilized. This building may be remediated and removed in the future. Areas of the onshore facilities that will be disturbed by construction activities will be stabilized with temporary erosion controls, which will be maintained until construction is complete. A haul road system for use in transporting constructed modules from the fabrication site(s) to the barge bulkhead and onsite parking will be expanded to support up to 600 employees. Support facilities, including restrooms, wash stations, and a cafeteria, may be also be constructed. The site development will be served by public water, sewer, electrical power, telecommunications, and natural gas infrastructure abutting the site.

Cellular Bulkhead Installation
The existing bulkhead will be re-constructed for barge access to the site for the purpose of shipping completed module structures. The existing timber cribbing retaining wall that wraps around the bulkhead will be re-built with a cellular sheet pile retaining wall and riprap to stabilize the shoreline in this area. A total of nine 35-foot diameter cells consisting of 68 sheet piles each will be used to construct the bulkhead (for a total of 712 total sheet piles). These cells will be located in upland and intertidal areas. Installation of the bulkhead and supporting cellular piles will begin with pre-excavation of about 500 cubic yards of existing riprap and old timber cribbing to allow the sheets to penetrate obstructions on or in the existing ground. In the areas that are overlaying the existing timber crib pier, the timbers will need to be removed by utilizing a land-based crawler crane equipped with a clam shell bucket. A debris curtain will be deployed to catch any loose detritus not captured by the clam bucket. In the areas of existing riprap overlay, a conventional excavator will be utilized to remove the riprap. All excavation and filling associated with installation of the cellular bulkhead must occur when the tide is below the work area pursuant to the ACOE's proposed permit conditions.

Once the bulkhead area is prepared for piling installation, a two-level pre-assembled circular frame will be placed on location for each cell using a land-based crawler crane and/or a water-borne crawler crane on a barge. The frame is a template to accurately guide the installation of the interlocking steel sheet piles. To facilitate the frame installation, temporary pilings are driven into the ground to support the frame on elevation and location. The pre-assembled frame is then swung out over the piles, lowered to the desired elevation, and fastened to the piles.

The sheeting operation begins by hanging a single sheet pile (19.7 inches wide by 40 feet long) on the frame and clamping it off in a plumb position. The crawler crane then picks up a vibratory hammer that is swung onto the top of the sheet. Through vibratory motion and weight, it drives the sheet to refusal or a prescribed elevation. This process is repeated to encircle the frame and ultimately close it off in a full circle. Access to the cell frame is provided by boats and temporary gang ways. The vibratory hammer will utilize biodegradable vegetable oil in lieu of hydraulic oil in the event of a hose break between the shore-mounted diesel-powered power pack and the hammer. Arcs between the full cells are then installed in the same manner.

Once a cell is driven into place, clean granular borrow is utilized to fill and backfill the cells. The material will be delivered and stockpiled on shore, with suitable erosion control measures in place. The material will be placed utilizing a crawler crane with a clam bucket into the cell and the fill elevation brought up to the bottom frame of the two-level preassembled frame to gain stability. The pre-assembled frame is then removed and set aside for the next installation. The cell will continue to be backfilled to the top of sheets at final elevation.

After completing the cells and adjoining arcs to retain the existing river bank, the crawler crane will place riprap scour protection and bank protection along the bulkhead. Approximately 21,760 square feet of intertidal habitat will be impacted by construction of the bulkhead and placement of riprap for scour and band protection. After completing the cells and adjoining arcs to retain the existing river bank, additional backfill will be dozed into place, compacted, and ultimately brought up to final design elevation using conventional construction equipment. Shore side backfill stock piles will have suitable erosion protection measures in place.

Fender Pile Installation

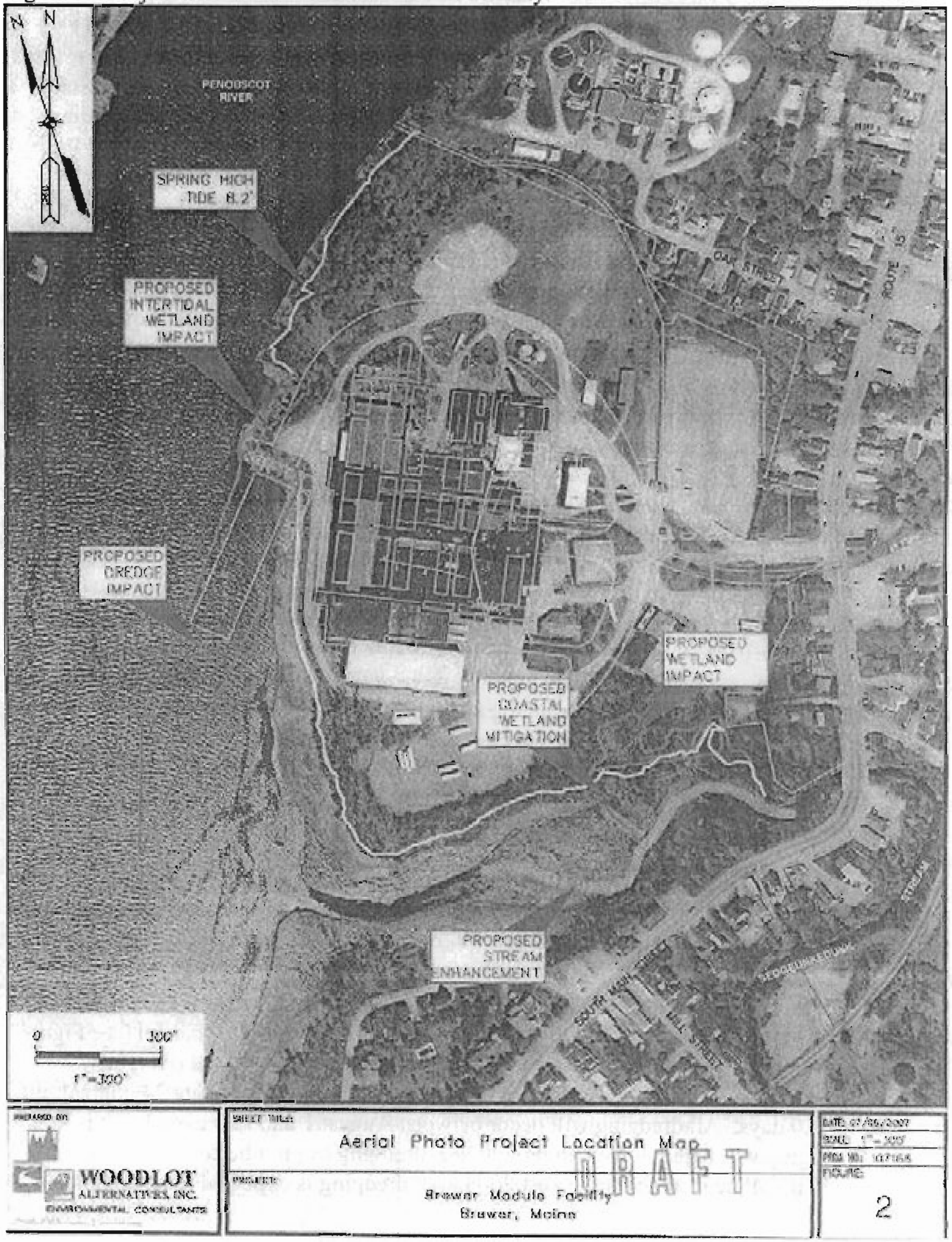
Berthing and mooring dolphins will be constructed using marine equipment. The dolphins will be comprised of multiple steel pipe piles (one 36-inch and two 24-inch diameter) supporting a large concrete cap. The piles will be advanced/driven through any surficial soils at the seabed until the top of rock is encountered. Depending upon final detailed design considerations, the piles may be seated and affixed to the rock using drilled rock sockets, if necessary. A precast concrete form would be used to contain the cast-in-place concrete used for the remainder of the pile cap. Work practices would be employed that will prevent discharge of uncured concrete to the river. Once the loading platform and breasting and mooring dolphins are in-place, fabricated steel truss walkways and other equipment will be erected by the marine equipment to interconnect the structures for personnel access and operations. All of the precast concrete elements and the steel pipe piles will be fabricated off-site.

Dredging

Cianbro is proposing to dredge approximately 33,000 cubic yards of sediment from the Penobscot River in an area east of the proposed bulkhead to allow barges to reach the bulkhead of the Brewer Module Facility. The dredge area will be approximately 700 feet long and will extend 100 feet from the shoreline. Dominant substrate types within the dredge area vary from fine silt, sand, and saw dust to coarse cobble and gravel. The proposed dredge area is skewed outward from its landward (upstream) limit at the proposed bulkhead into the channel (see Figure 2). The maximum lateral extent of the dredge is approximately 230 feet into the river, or approximately 30 percent of the channel width. The dredge is expected to operate 24 hours/day over a period of 120 days. All dredging will occur between August 1 and February 28. It is expected that dredging will begin in November 2007. If dredging can not be completed by February 28, 2008 it will be resumed in August 2008. All dredging is expected to be completed at the end of 2008.

Dredging operations will occur in the barge berth area utilizing a barge mounted excavator or crane equipped with a clamshell bucket. The positioning of the crane barge and dump scow will

Figure 2. Project detail at the Brewer Module Facility.



be controlled by spuds and/or anchors. Dredge spoils will be disposed at the Rockland Disposal Site (RSD) and upland. It has been estimated that 1/3 of all spoils will be disposed at RSD while the remaining 2/3 will be disposed at an approved upland area. Dredge spoils destined for RSD will be loaded into a dump scow rafted alongside the crane barge. After the dump scow is loaded to capacity, it will be towed down the Penobscot River and deposited at the RDS.

The RDS covers a 0.25 square nautical mile (nmi^2) (0.87 km^2) area of seafloor within West Penobscot Bay. It is located approximately 3.1 nmi (5.7 km) east-southeast of Brewster Point, Glen Cove, Maine. Sediments deposited at RDS have originated from dredging projects in Rockland, Camden, and Castine Harbors, as well as Bangor, Belfast, and Searsport. Since 1982, approximately 1,118,000 cubic yards of dredged material have been deposited at the site. The routing of the barge will be as determined by the MDMR to protect commercial fisheries resources. Upon discharging the scow's cargo, the barge will return upstream to the project area for subsequent loads. Depending on the scow's capacity, this cycle will be repeated approximately 15 times.

While maintenance dredging may be necessary in the future, no application for authorization for maintenance dredging has been made and the ACOE is not currently proposing to authorize maintenance dredging. As such, the effects of maintenance dredging will not be considered in this Opinion.

Riprap Installation for Road Widening

Cianbro proposes to construct a haul road system for use in transporting constructed modules from the fabrication site(s) to the barge bulkhead. The fill slope of the haul road behind the bulkhead will be constructed as a rock fill embankment in areas below the high tide line. Cianbro proposes to use clean rock fill material to prevent leaching of fine materials into the Penobscot River during construction. The rock fill is comprised of well-graded durable crushed stone riprap material, meeting the requirements for Maine Department of Transportation (MDOT) 703.26, Plain and Hand Laid Riprap.

During low tide, brush debris and existing riprap fill will be removed from the footprint of the fill slope to create a clean base for placement of fill materials. A conventional excavator will be utilized to remove this material. Following clearing, rock fill (approximately 1,800 cubic yards) will be placed with conventional excavation equipment or a land-based crawler crane with a clamshell bucket. Fill will be placed in layers and compacted with conventional construction equipment. The rock fill material can be placed in the dry with minimal compaction, lessening the duration of construction disturbance adjacent to the river. All excavation and filling associated with the proposed road widening will occur when the tide is below the work area pursuant to the ACOE's proposed permit conditions.

Wetland Mitigation Activities

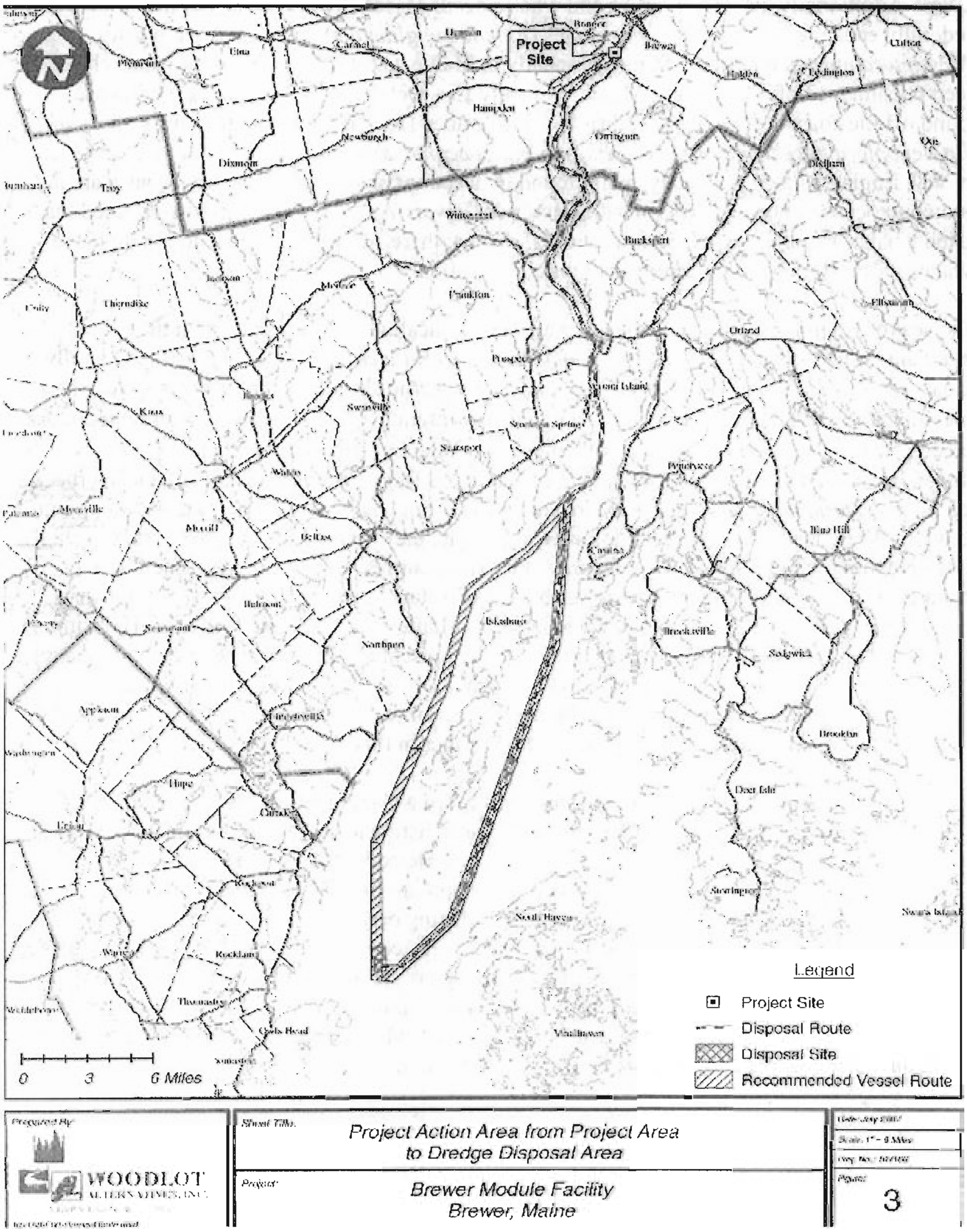
The proposed on-site wetland mitigation measures required by the ACOE and the MDEP for the Brewer Module Facility are intended to compensate for the approximately 21,780 ft^2 (0.5 ac) of freshwater tidal wetland/river impacts from the project. The proposed mitigation will involve activities at the confluence of the Penobscot River and Sedgeunkedunk Stream including: 1) stabilizing approximately 540 linear feet of shoreline to contain existing contaminants; 2) planting a shoreline buffer; and 3) removing debris and some large water pipes from the tidal stream channel to facilitate passage of anadromous fish species. The work may also involve deepening the tidal stream channel of Sedgeunkedunk Stream to create a more defined thalweg to enhance fish passage. The work is designed to enhance freshwater intertidal wetlands and will enhance functions and values related to water quality, shoreline stabilization, fish and shellfish habitat, and wildlife habitat. The restoration/enhancement measures are designed to replace the impacted intertidal wetlands at a ratio of more than 2:1 (a 2:1 ratio is required by MDEP under their wetland regulations), whereby 44,341 ft^2 (1.1 ac) of intertidal habitat will be restored/enhanced to compensate for 21,780 ft^2 (0.5 ac) of intertidal and subtidal impacts at the proposed bulkhead site

The proposed wetland mitigation will be integrated with clean-up of contaminated materials in a cove area along the southern edge of the development site at the inlet of Sedgeunkedunk Stream. The contaminated materials will be removed as part of the VRAP to be authorized by MDEP, allowing for the restoration of former tidal wetland habitat. Cianbro will be responsible for planning, implementing, and monitoring the on-site mitigation work. All excavation and filling associated with the proposed mitigation plan will occur when the tide is below the work area pursuant to the ACOE's proposed permit conditions.

Action Area

The action area is defined in 50 CFR 402.02 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The action area for this project includes areas of bulkhead construction and dredging (including areas with increased suspended sediment concentrations resulting from the dredge operations) in the Penobscot River, wetland mitigation in Sedgeunkedunk Stream, the Rockland Disposal Site in West Penobscot Bay and the route used by project vessels to transport material from the dredge site to the disposal site (see Figure 3).

Figure 3. Action area of Section 7 consultation.



LISTED SPECIES IN THE GULF OF MAINE

Several species listed under NMFS' jurisdiction occur in Maine waters. Endangered shortnose sturgeon and the Gulf of Maine DPS of Atlantic salmon have been documented in the Penobscot River. Additionally, listed sea turtles and whales occur seasonally in the Gulf of Maine (GOM). Federally endangered Northern right whales (*Eubalaena glacialis*) and humpback whales (*Megaptera novaeangliae*) are found seasonally in Maine waters. Northern right whales have been documented off the coast of Maine from July 15 – October 15. Humpback whales are found off the coast of Maine from April 15 – November 15. Fin (*Balaenoptera physalus*), Sei (*Balaenoptera borealis*) and Sperm (*Physter macrocephalus*) whales are also seasonally present in New England waters but are typically found in deeper offshore waters. Listed whales are not known to occur in Penobscot Bay or the Penobscot River. As such, NMFS has determined that listed whales are not likely to occur in the action area; therefore, effects of the action on listed whales will not be considered further in this consultation.

The sea turtles in northeastern nearshore waters are typically small juveniles with the most abundant being the federally threatened loggerhead (*Caretta caretta*) followed by the federally endangered Kemp's ridley (*Lepidochelys kempi*). Loggerheads and Kemp's ridleys have been documented in waters as cold as 11°C, but generally migrate northward when water temperatures exceed 16°C. These species are typically present in New England waters from June 1 – November 30 and are most common south of Cape Cod Bay. Federally endangered leatherback sea turtles (*Dermochelys coriacea*) are located in New England waters during the warmer months as well. While leatherbacks are predominantly pelagic, they may occur close to shore, especially when pursuing their preferred jellyfish prey. Green sea turtles (*Chelonia mydas*) may also occur sporadically as far north as Massachusetts, but those instances are rare and are typically storm related. Green sea turtles are not known to occur in Maine waters. While loggerheads, Kemp's ridleys and leatherback sea turtles may be seasonally present in the Gulf of Maine, these species are not known to occur in Penobscot Bay or the Penobscot River. As such, NMFS has determined that listed sea turtles are not likely to occur in the action area; therefore, effects of the action on listed sea turtles will not be considered further in this consultation.

Atlantic sturgeon (*Acipenser oxyrinchus*) are considered a Candidate Species as NMFS has initiated a status review for this species to determine if listing as threatened or endangered under the ESA is warranted. A status review report was completed by the status review team in February 2007. NMFS is currently reviewing the report and other available information to determine if listing under the ESA is warranted. A listing determination, and, if listing is warranted, any accompanying proposed rule(s), are expected to be published by NMFS in 2008. If it is determined that listing is warranted, a listing determination and final rule listing the species could be published within a year from the date of publication of the listing determination or proposed rule. As effects to candidate species are not subject to Section 7 consultation, effects to Atlantic sturgeon will not be considered in this Opinion.

STATUS OF AFFECTED SPECIES

This section will focus on the status of listed species within the action area, summarizing information necessary to establish the environmental baseline and to assess the effects of the proposed action on listed species.

Gulf of Maine DPS of Atlantic salmon (*Salmo salar*)	Endangered
Shortnose sturgeon (*Acipenser brevirostrum*)	Endangered

Gulf of Maine DPS of Atlantic salmon

The GOM DPS of anadromous Atlantic salmon was listed by the USFWS and NMFS (collectively, the Services) as an endangered species on November 17, 2000 (65 FR 69459). The GOM DPS encompasses all naturally reproducing remnant populations of Atlantic salmon downstream of the former Edwards Dam site on the Kennebec River northward to the mouth of the St. Croix River. To date, the Services have determined that these populations are found in the Dennys, East Machias, Machias, Pleasant, Narraguagus, Ducktrap, and Sheepscot Rivers, Kenduskeag Stream, and Cove Brook. The GOM DPS includes naturally reproducing Atlantic salmon in the Penobscot River downstream of the former Bangor Dam. The USFWS' GOM DPS river-specific hatchery-reared fish are also included as part of the listed entity. Critical habitat has not been designated for this species.

In the final rule listing the GOM DPS of Atlantic salmon, the Services deferred a determination of inclusion of fish that inhabit the main stem and tributaries of the Penobscot River above the site of the former Bangor Dam (65 FR 69464). The deferred decision reflected a need for further analysis of scientific information, including a detailed genetic characterization of the Penobscot population. In June, 2006, a new status review of additional Atlantic salmon populations, including the upper Penobscot River population, was completed by a Biological Review Team led by NMFS. Although the 2000 listing of Atlantic salmon did not include populations in the Penobscot River above the former site of the Bangor Dam, the recently completed status review of additional Atlantic salmon populations indicates that the mainstem Penobscot River population of Atlantic salmon are closely related to the GOM DPS (Faye *et al.* 2006). The BRT also concluded that Atlantic salmon populations in Kennebec River upstream of the former Edwards Dam and Androscoggin River are also closely related to GOM DPS. NMFS is currently considering the information presented in the new Status Review to determine whether action under the ESA is warranted.

Atlantic salmon life history

The Atlantic salmon is an anadromous fish species that spends most of its adult life in the ocean but returns to freshwater to reproduce. The Atlantic salmon is native to the basin of the North Atlantic Ocean, from the Arctic Circle to Portugal in the eastern Atlantic, from Iceland and southern Greenland, and from the Ungava region of northern Quebec south to the Connecticut River (Scott and Crossman 1973). In the United States, Atlantic salmon historically ranged from Maine south to Long Island Sound. However, the Central New England and Long Island Sound DPSs have been extirpated (65 FR 69459, Nov. 17, 2000).

Adult Atlantic salmon ascend the rivers of New England beginning in the spring and continuing into the fall, with the peak occurring in June. Once an adult salmon enters a river, rising river temperatures and water flows stimulate upstream migration. When a salmon returns to its home river after two years at sea (referred to as 2-sea-winter or 2SW fish), it is approximately 75 cm long and weighs approximately 4.5 kg. A minority (10-20%) of Maine salmon return as smaller fish, or grilse, after only one winter at sea (1SW) and still fewer return as larger 3-sea-winter (3SW) fish. A spawning run of salmon with representation of several age groups ensures some level of genetic exchange among generations. Once in freshwater, adult salmon cease to feed during their up-river migration. Spawning occurs in late October through November.

Approximately 20% of Maine Atlantic salmon return to the sea immediately after spawning, but the majority overwinter in the river until the following spring before leaving (Baum 1997). Upon returning to salt water, the spawned salmon or kelt resumes feeding. If the salmon survives another one or two years at sea, it will return to its home river as a repeat spawner.

The salmon's preferred spawning habitat is coarse gravel or rubble substrate (up to 8.5 cm in diameter) with adequate water circulation to keep the buried eggs well oxygenated (Peterson 1978). Water depth at spawning sites is typically between 30 and 61 cm, and water velocity averages 60 cm per second (Beland 1984). Spawning sites are often located at the downstream end of riffles where water percolates through the gravel or where upwellings of groundwater occur (Danie *et al.* 1984). Redds, the depressions where eggs are deposited, average 2.4 m long and 1.4 m wide (Baum 1997). An average of 240 eggs is deposited per 100 m^2, or one unit of habitat (Baum 1997). Beland (1984) reported that the total original Atlantic salmon spawning and nursery habitat in Maine rivers was 398,466 units.

In late March or April, the eggs hatch into larval alevins or sac fry. Alevins remain in the redd for about six weeks and are nourished by their yolk sac. Alevins emerge from the gravel about mid-May, generally at night, and begin actively feeding. The survival rate of these fry is affected by stream gradient, overwintering temperatures and water flows, and the level of predation and competition (Bley and Moring 1988).

Within days, the free-swimming fry enter the parr stage. Parr prefer areas with adequate cover (rocks, aquatic vegetation, overhanging streambanks, and woody debris), water depths ranging from approximately 10 to 60 cm, velocities between 30 and 92 cm per second, and temperature near 16°C (Beland 1984). Parr actively defend territories (Allen 1940; Danie *et al.* 1984; Kalleberg 1958; Mills 1964). Some male parr become sexually mature and can successfully spawn with sea-run adult females. Water temperature (Elliot 1991), parr density (Randall 1982), photoperiod (Lundqvist 1980), the level of competition and predation (Fausch 1988; Hearn 1987), and the food supply, all influence the growth rate of parr. Maine Atlantic salmon produce from five to ten parr per unit of habitat (Baum 1997). Parr feed on larvae of mayflies and stoneflies, chironomids, caddisflies and blackflies, aquatic annelids and mollusks, as well as numerous terrestrial invertebrates that fall into the river (Scott and Crossman 1973).

In a parr's second or third spring, when it has grown to 12.5-15 cm in length, physiological, morphological and behavioral changes occur (Schaffer and Elson 1975). This process, called smoltification, prepares the parr for migration to the ocean and life in salt water. In Maine, the majority of parr (80%) remain in fresh water for two years, while the balance remains for three years (Baum 1997). The biochemical and physiological modifications that occur during smoltification prepare the fish for the dramatic change in osmoregulatory needs that comes with the transition from a freshwater to a saltwater habitat (Bley 1987; Farmer *et al.* 1977; Hoar 1976; Ruggles 1980; USFWS 1989). As smolts migrate from the rivers between April and June, they tend to travel near the water surface, where they must contend with changes in water temperature, pH, dissolved oxygen, pollution levels, and predation. Most smolts in New England rivers enter the sea during May and June to begin their ocean migration. It is estimated that Maine salmon rivers produce 19 fry per unit of habitat, resulting in five to ten parr per unit and ultimately three smolts per unit (Baum 1997).

Atlantic salmon of U.S. origin are highly migratory, undertaking long marine migrations from the mouths of U.S. rivers into the northwest Atlantic Ocean, where they are distributed seasonally over much of the region (Reddin 1985). The marine phase starts with smoltification and subsequent migration through the estuary of the natal river. Upon completion of the physiological transition to salt water, the post-smolt grows rapidly and has been documented to move in small schools loosely aggregated close to the surface (Dutil and Coutu 1988). After entering the nearshore waters of Canada, the U.S. post-smolts become part of a mixture of stocks of Atlantic salmon from various North American streams. Upon entry into the marine environment, post-smolts appear to feed opportunistically, primarily in the neuston (near the surface). Their diet includes invertebrates, amphipods, euphausiids, and fish (Fraser 1987; Hislop and Shelton 1993; Hislop and Youngson 1984; Jutila and Toivonen 1985).

Most of the GOM DPS-origin salmon spend two winters in the ocean before returning to Maine streams for spawning. Aggregations of Atlantic salmon may still occur after the first winter at sea, but most evidence indicates that they travel individually (Reddin 1985). At this stage, Atlantic salmon primarily eat fish, feeding upon capelin, herring, and sand lance (Hansen and Pethon 1985; Reddin 1985; Hislop and Shelton 1993).

Status and Trends of Atlantic salmon Rangewide

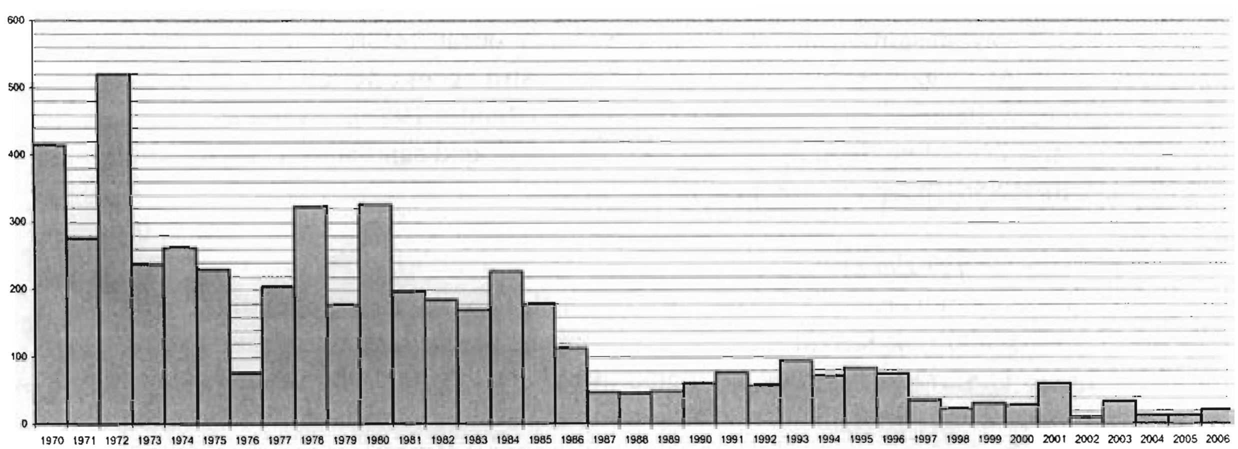
Anadromous Atlantic salmon were native to nearly every major coastal river north of the Hudson River in New York (Atkins 1874; Kendall 1935). The annual historic Atlantic salmon adult population returning to U.S. rivers has been estimated to be between 300,000 (Stolte 1981) and 500,000 (Beland 1984). The largest historical salmon runs in New England were likely in the Connecticut, Merrimack, Androscoggin, Kennebec, and Penobscot Rivers.

By the early 1800s, Atlantic salmon runs in New England had been severely depleted due to the construction of dams, over fishing, and water pollution, all of which greatly reduced the species' distribution in the southern half of its range. Restoration efforts were initiated in the mid-1800s, but there was little success due to the presence of dams and the inefficiency of early fishways (Stolte 1981). There was a brief period in the late nineteenth century when limited runs were reestablished in the Merrimack and Connecticut Rivers by artificial propagation, but these runs were extirpated by the end of the century (USFWS 1989). By the end of the nineteenth century, three of the five largest salmon populations in New England (in the Connecticut, Merrimack, and Androscoggin Rivers) had been eliminated. As with most anadromous species, Atlantic salmon can exhibit temporal changes in abundance. Angler catch and trapping data from 1970 to 1998 provide the best available composite index of recent adult Atlantic salmon population trends within the GOM DPS rivers. These indices indicate that there was a dramatic decline in the mid-

1980s, and that populations have remained at low levels ever since. Figure 4 below demonstrates this trend.

Total documented natural (wild and conservation hatchery) GOM DPS spawner returns for 1995 through 2004 are as follows: 1995 (85); 1996 (82); 1997 (38); 1998 (23); 1999 (32); 2000 (28); 2001 (60); 2002 (16); 2003 (33); 2004 (13); 2005 (13); and 2006 (21) (USASAC 2007). These counts (as well as the counts shown in Figure 4) represent minimal estimates of the wild adult returns, because not all GOM DPS rivers have trapping facilities (*e.g.*, weirs) to document spawner returns in all years. The counts of redds conducted annually by the MDMR demonstrate that salmon do return to those rivers for which no adult counts are possible. Since 2001, scientists have estimated the total number of salmon returning to the GOM DPS with a linear regression model. This estimate is calculated using capture data on GOM DPS rivers with trapping facilities (Dennys, Pleasant, and Narraguagus Rivers), combined with redd count data from the other five GOM DPS rivers. Total return estimates based on these redd counts and trap data are 99 adults in 2001, 33 adults in 2002, 72 adults in 2003, and 82 adults in 2004, 71 adults in 2005, and 79 adults in 2006 (at 90% probability).

Figure 4. Total documented natural (wild and conservation hatchery) spawner returns from USASAC (2005) data (minimal estimates) for the GOM DPS 1970-2004.



Densities of young-of-the-year salmon (0+) and parr (1+ and 2+) generally remain low relative to potential carrying capacity. This depressed juvenile abundance is a direct result of low adult returns in recent years. Survival from the parr to the smolt stage has previously been estimated to range from 35-55% (Baum 1997). Research in the Narraguagus River, however, demonstrated at the 99% probability level that survival was less than 30% (Kocik *et al.* 1999). Survival from fry to smolt, based on results from hatchery fry stocking, is reported by Bley and Moring (1988) to range from about 1-12%; and survival from egg to smolt stage is reported by Baum (1997) to be approximately 1.25%.

In summary, naturally-producing Atlantic salmon populations in the GOM DPS are at extremely low levels of abundance. This conclusion is based principally on the fact that: 1) spawner abundance is below 10% of the number required to maximize juvenile production; 2) juvenile abundance indices are lower than historical counts; and 3) smolt production is less than one-third of what would be expected based on the amount of habitat available. Counts of adults and redds in all rivers continue to show a downward trend from these already low abundance levels. Given recent estimates of spawner-recruitment dynamics, some researchers suggest that adult populations may not be able to replace themselves, and that populations would be expected to decline further (Beland and Friedland 1997).

Threats to Atlantic salmon recovery

The Services listed the GOM DPS as endangered because of the danger of extinction created by inadequate regulation of agricultural water withdrawals, disease, aquaculture, and low marine survival (65 FR 69476, Nov. 17, 2000). At this time, the Services consider the Atlantic salmon an endangered species that is faced with a variety of threats including acidified water and associated aluminum toxicity, Atlantic salmon aquaculture off the coast of Maine, poaching of adults in DPS rivers, incidental capture of adults and parr by recreational fishermen, predation, sedimentation of habitat, depletion of diadromous fish communities, and water withdrawals. The 2006 status review of Atlantic salmon populations in Maine identified obstructed fish passage and degraded habitats caused by dams as one of the greatest impediments to self-sustaining Atlantic salmon populations in Maine (Faye *et al.* 2006). No single factor can be pinpointed as the cause of the continuing decline of the DPS. Rather, all threats that were key factors in the listing determination, in combination with other recently identified threats, have the potential to adversely affect Atlantic salmon and their habitat. Continued research and assessment is needed to understand the impacts of and interactions among all the threats faced by the DPS. Not all threats are pervasive throughout the DPS rivers, and not all threats would be expected to adversely affect the DPS if populations were stable (*e.g.*, predation and competition). Despite a wide variety of conservation activities already completed or currently in progress, the GOM DPS has not shown any recent signs of population recovery.

GOM DPS of Atlantic salmon in the action area

The Action Area for this consultation encompasses areas of bulkhead construction, dredging (including areas with increased suspended sediment concentrations resulting from the dredge operations), wetland mitigation in Sedgeunkedunk Stream, vessel route, and the Rockland Disposal Site. This area is expected to encompass all of the direct and indirect effects of the proposed dredging project. Naturally reproducing Atlantic salmon in the Penobscot River and its tributaries downstream of the former Bangor Dam are listed as endangered as part of the GOM DPS. Atlantic salmon originating from above the former Bangor Dam are not presently included in the GOM DPS but also occur in the action area.

Given the life history of Atlantic salmon, only migrating adults, moving upstream and downstream, and smolts, moving downstream, will occur in the action area. Because the action area is located in a tidal reach of the Penobscot River and Sedgeunkedunk Stream, the proposed project is not expected to affect salmon fry and parr which only occur in freshwater. Adult salmon would pass by the project area on their way to spawning areas in upstream waters any time between April and November. Similarly, post-spawn adults (*i.e.*, kelts) can be found in the lower river during the same time period. Smolts are likely to be found in the vicinity of the project area any time between April and June as they make their way downriver to the marine environment.

To date, the Services have determined that endangered populations of Atlantic salmon are found in the Dennys, East Machias, Machias, Pleasant, Narraguagus, Ducktrap, and Sheepscot Rivers, Kenduskeag Stream, and Cove Brook. Unpublished data collected by the MDMR and NMFS also suggests that Atlantic salmon are also naturally reproducing in Sedgeunkedunk Stream. The Ducktrap River, Kenduskeag Stream, Cove Brook, and Sedgeunkedunk Stream are located in the Penobscot River watershed and therefore Atlantic salmon originating from these waterbodies have the potential to be affected by construction of the Brewer Module Facility.

Cove Brook is a small tributary to the Penobscot River estuary located approximately 13 miles below the Veazie Dam (head of tide). Cove Brook flows approximately 16.5 km from its headwaters and drains an area approximately 24.6 square km. MDMR has conducted baseline monitoring of Atlantic salmon populations in Cove Brook since 1996 (MDMR unpublished data). Due to its small size, MDMR surveys of the brook provide comprehensive data concerning Atlantic salmon population status. From 1996-2001, MDMR documented low numbers of spawning Atlantic salmon in Cove Brook (less than 1 redd per year). No Atlantic salmon (juvenile or adult) or spawning redds have been documented in the brook since 2002. Considering Atlantic salmon in Maine typically complete their life cycle in four years, some researchers have suggested that the population of Atlantic salmon in Cove Brook is functionally extinct. At the very least, numbers of Atlantic salmon in Cove Brook are too small to reasonably quantify.

Recent data collected by the MDMR indicate that Kenduskeag Stream also contains a population of naturally reproducing Atlantic salmon. Kenduskeag Stream, which drains an area approximately 557 square km, is one of the largest tributaries to the Penobscot River estuary. The stream flows approximately 58 km from its headwaters and empties into the Penobscot River about 7 km downstream of the Veazie Dam in Bangor, Maine. In 2002, MDMR conducted a basin-wide electrofishing survey of wadeable habitat in Kenduskeag Stream and French Stream (a small tributary of Kenduskeag Stream) and collected 85 wild juvenile Atlantic salmon. In 2003, MDMR performed a spawning survey in the area of French stream confluence and the mainstem Kenduskeag stream and one Atlantic salmon redd was documented. Estimated (median) juvenile Atlantic salmon densities (fish/100 m^2) in Kenduskeag Stream in 2005 were 0 (young-of-year) and 0.2 (parr). Due to limited data for the entire watershed, the number of adult salmon and smolts emigrating annually from Kenduskeag Stream is not presently known.

The Ducktrap River is a small tributary to Penobscot Bay, located approximately 48 km downstream of the Veazie Dam. The Ducktrap River runs from its source in Tilden Pond for approximately 17 km to Penobscot Bay. The Ducktrap River watershed drains an area of about 93 square km. Redd count surveys conducted by MDMR from 1997 to 2004 have documented 0 (2001 and 2002) to 29 (1999) redds (USASAC 2005). In 2004, 9 redds were found in the Ducktrap River. Estimated adult returns in the Ducktrap River based upon redd counts were 15 in 2004. One redd and four test digs were observed in the Ducktrap River in the fall of 2005. No redds were observed in 2006. Juvenile Atlantic salmon have been documented at several electrofishing sites in the river during 2000-2006. Estimated (median) juvenile Atlantic salmon densities (fish/100 m^2) in the Ducktrap River from 2004 to 2006 ranged from 4.7 (2004) to 11.2

(2006) for young-of-year fish and 0 (2004) to 6.5 (2005) for parr (USASAC 2005; USASAC 2006; USASAC 2007). Due to limited data for the entire watershed, the number of adult salmon and smolts emigrating annually from the Ducktrap River is not currently known.

The MDMR has conducted electrofishing surveys in Sedgeunkedunk Stream since 1970. Samples were not collected annually during this period nor were population estimates or densities generated from these data. Electrofishing sampling, however, indicates that juvenile Atlantic salmon routinely occur in Sedgeunkedunk Stream (Table 1). From 1970 to 2006, the number of young-of-year salmon captured ranged from 0 (multiple years) to 138 (1980). Parr collected during sampling ranged from 0 (2006) to 132 (1979). Several adult salmon have also been observed by MDMR and others in the stream during this period. Based upon stocking records maintained by the USFWS' Craig Brook National Fish Hatchery, it does not appear any Atlantic salmon have been stocked in Sedgeunkedunk Stream for the period of record. Therefore, NMFS has concluded that these fish were naturally reproduced.

Table 1. Electrofishing results from Sedgeunkedunk Stream during 1970-2006 (Unpublished data MDMR).

	Number of Atlantic Salmon Captured	
Year	Young-of-Year	Parr
1970	0	7
1971	0	3
1975	3	9
1976	0	10
1977	6	8
1978	69	10
1979	0	132
1980	138	2
1981	73	91
1983	3	8
2000	2	10
2001	0	19
2002	0	2
2003	0	1
2005	0	4
2006	0	0

Based upon the above information, the number of listed adult GOM DPS Atlantic salmon migrating through the Penobscot watershed is likely less than 20 fish annually. The number of migrating GOM DPS smolts in the watershed cannot be determined with available information. As noted above, non-listed Atlantic salmon originating above the former Bangor Dam also occur in the action area for this consultation. Since 1997, the number of adult returns to the upper Penobscot River (*i.e.*, non GOM DPS salmon) has averaged about 1,000 fish annually. However, considering the number of GOM DPS salmon in the lower Penobscot River represent only a fraction of the Atlantic salmon that occur in the Penobscot River watershed it is likely that most of the Atlantic salmon occurring within the action area of the Brewer Module Facility would be non-GOM DPS Atlantic salmon (*i.e.*, naturally reared in the upper Penobscot River or hatchery reared from upper Penobscot River broodstock). The effects of this action on upper Penobscot

River Atlantic salmon are not be considered within the context of this Opinion as these fish are not listed under the ESA.

Shortnose sturgeon

On March 11, 1967, shortnose sturgeon were listed as endangered throughout its range. NMFS assumed jurisdiction for shortnose sturgeon under a 1974 government reorganization plan (38 FR 41370). As noted in NMFS' 1998 Recovery Plan for shortnose sturgeon, a population of this federally endangered fish is recognized to exist in the Penobscot River.

Shortnose sturgeon life history

Shortnose sturgeon are benthic fish that are primarily found in the deep channel sections of large rivers. They feed on a variety of benthic and epibenthic invertebrates including molluscs, crustaceans (amphipods, chironomids, isopods), and oligochaete worms (Vladykov and Greeley 1963; Dadswell 1979 in NMFS 1998). Shortnose sturgeon have similar lengths at maturity (45-55 cm fork length) throughout their range, but, because sturgeon in southern rivers grow faster than those in northern rivers, southern sturgeon mature at younger ages (Dadswell *et al.* 1984). Shortnose sturgeon are long-lived (30-40 years) and, particularly in the northern extent of their range, mature at late ages. In the north, males reach maturity at 5 to 10 years, while females mature between 7 and 13 years. Based on limited data, females spawn every three to five years while males spawn approximately every two years. The spawning period is estimated to last from a few days to several weeks. Spawning begins from late winter/early spring (southern rivers) to mid to late spring (northern rivers) when the freshwater temperatures increase to 8-9°C. Several published reports have presented the problems facing long-lived species that delay sexual maturity (Crouse *et al.* 1987; Crowder *et al.* 1994; Crouse 1999). In general, these reports concluded that animals that delay sexual maturity and reproduction must have high annual survival as juveniles through adults to ensure that enough juveniles survive to reproductive maturity and then reproduce enough times to maintain stable population sizes.

Total instantaneous mortality rates (Z) are available for the Saint John River (0.12 - 0.15; ages 14-55; Dadswell 1979), Upper Connecticut River (0.12; Taubert 1980b), and Pee Dee-Winyah River (0.08-0.12; Dadswell *et al.* 1984). Total instantaneous natural mortality (M) for shortnose sturgeon in the lower Connecticut River was estimated to be 0.13 (T. Savoy, Connecticut Department of Environmental Protection, personal communication). There is no recruitment information available for shortnose sturgeon because there are no commercial fisheries for the species. Estimates of annual egg production for this species are difficult to calculate because females do not spawn every year (Dadswell *et al.* 1984). Further, females may abort spawning attempts, possibly due to interrupted migrations or unsuitable environmental conditions (NMFS 1998). Thus, annual egg production is likely to vary greatly in this species. Fecundity estimates have been made and range from 27,000 to 208,000 eggs/female (Dadswell *et al.* 1984).

At hatching, shortnose sturgeon are blackish-colored, 7-11mm long and resemble tadpoles (Buckley and Kynard 1981). In 9-12 days, the yolk sac is absorbed and the sturgeon develop into larvae which are about 15mm total length (TL; Buckley and Kynard 1981). Sturgeon larvae are believed to begin downstream migrations at about 20mm TL. Laboratory studies suggest that young sturgeon move downstream in a 2-step migration: a 2 to 3-day migration by larvae followed by a residency period by young of the year (YOY), then a resumption of migration by yearlings in the second summer of life (Kynard 1997). Juvenile shortnose sturgeon (3-10 years old) reside in the interface between saltwater and freshwater in most rivers (NMFS 1998).

In populations that have free access to the total length of a river (*e.g.*, no dams within the species' range in a river: Saint John, Kennebec, Altamaha, Savannah, Delaware and Merrimack Rivers), spawning areas are located at the farthest upstream reach of the river (NMFS 1998). In the northern extent of their range, shortnose sturgeon exhibit three distinct movement patterns. These migratory movements are associated with spawning, feeding, and overwintering activities. In spring, as water temperatures rise above 8°C, pre-spawning shortnose sturgeon move from overwintering grounds to spawning areas. Spawning occurs from mid/late March to mid/late May depending upon location and water temperature. Sturgeon spawn in upper, freshwater areas and feed and overwinter in both fresh and saline habitats. Shortnose sturgeon spawning migrations are characterized by rapid, directed and often extensive upstream movement (NMFS 1998).

Shortnose sturgeon are believed to spawn at discrete sites within a river (Kieffer and Kynard 1993). In the Merrimack River, males returned to only one reach during a four year telemetry study (Kieffer and Kynard 1993). Squiers *et al.* (1982) found that during the three years of the study in the Androscoggin River, adults returned to a 1-km reach below the Brunswick Dam and Kieffer and Kynard (1993) found that adults spawned within a 2-km reach in the Connecticut River for three consecutive years. Spawning occurs over channel habitats containing gravel, rubble, or rock-cobble substrates (Dadswell *et al.* 1984; NMFS 1998). Additional environmental conditions associated with spawning activity include decreasing river discharge following the peak spring freshet, water temperatures ranging from 8-12° C, and bottom water velocities of 0.4 to 0.7 m/sec (Dadswell *et al.* 1984; NMFS 1998). For northern shortnose sturgeon, the temperature range for spawning is 6.5-18.0°C (Kieffer and Kynard in press). The eggs are separate when spawned but become adhesive within approximately 20 minutes of fertilization (Dadswell *et al.* 1984). Between 8° and 12°C, eggs generally hatch after approximately 13 days. The larvae are photonegative, remaining on the bottom for several days. Buckley and Kynard (1981) found week-old larvae to be photonegative and form aggregations with other larvae in concealment.

Adult shortnose sturgeon typically leave the spawning grounds soon after spawning. Non-spawning movements include rapid, directed post-spawning movements to downstream feeding areas in spring and localized, wandering movements in summer and winter (Dadswell *et al.* 1984; Buckley and Kynard 1985; O'Herron *et al.* 1993). Kieffer and Kynard (1993) reported that post-spawning migrations were correlated with increasing spring water temperature and river discharge. Young-of-the-year shortnose sturgeon are believed to move downstream after hatching (Dovel 1981) but remain within freshwater habitats. Older juveniles tend to move downstream in fall and winter as water temperatures decline and the salt wedge recedes. Juveniles move upstream in spring and feed mostly in freshwater reaches during summer.

Juvenile shortnose sturgeon generally move upstream in spring and summer and move back downstream in fall and winter; however, these movements usually occur in the region above the saltwater/freshwater interface (Dadswell *et al.* 1984; Hall *et al.* 1991). Adult sturgeon occurring in freshwater or freshwater/tidal reaches of rivers in summer and winter often occupy only a few short reaches of the total length (Buckley and Kynard 1985). Summer concentration areas in southern rivers are cool, deep, thermal refugia, where adult and juvenile shortnose sturgeon congregate (Flourney *et al.* 1992; Rogers and Weber 1994; Rogers and Weber 1995; Weber 1996). While shortnose sturgeon are occasionally collected near the mouths of rivers and often spend time in estuaries, they are not known to participate in coastal migrations and are rarely documented in their non-natal river.

The temperature preference for shortnose sturgeon is not known (Dadswell *et al.* 1984) but shortnose sturgeon have been found in waters with temperatures as low as 2 to 3°C (Dadswell *et al.* 1984) and as high as 34°C (Heidt and Gilbert 1978). However, temperatures above 28°C are thought to adversely affect shortnose sturgeon. In the Altamaha River, temperatures of 28-30°C during summer months create unsuitable conditions and shortnose sturgeon are found in deep cool water refuges.

Shortnose sturgeon are known to occur at a wide range of depths. A minimum depth of 0.6m is necessary for the unimpeded swimming by adults. Shortnose sturgeon are known to occur at depths of up to 30m but are generally found in waters less than 20m (Dadswell *et al.* 1984; Dadswell 1979). Shortnose sturgeon have also demonstrated tolerance to a wide range of salinities. Shortnose sturgeon have been documented in freshwater (Taubert 1980; Taubert and Dadswell 1980) and in waters with salinity of 30 parts-per-thousand (ppt) (Holland and Yeverton 1973; Saunders and Smith 1978). Mcleave *et al.* (1977) reported adults moving freely through a wide range of salinities, crossing waters with differences of up to 10ppt within a two hour period. The tolerance of shortnose sturgeon to increasing salinity is thought to increase with age (Kynard 1996). Shortnose sturgeon typically occur in the deepest parts of rivers or estuaries where suitable oxygen and salinity are present (Gilbert 1989).

Status and Trends of Shortnose Sturgeon Rangewide

Shortnose sturgeon were listed as endangered on March 11, 1967 (32 FR 4001), and the species remained on the endangered species list with the enactment of the ESA in 1973. Although the original listing notice did not cite reasons for listing the species, a 1973 Resource Publication, issued by the US Department of the Interior, stated that shortnose sturgeon were "in peril…gone in most of the rivers of its former range [but] probably not as yet extinct" (USDOI 1973). Pollution and overfishing, including bycatch in the shad fishery, were listed as principal reasons for the species' decline. In the late nineteenth and early twentieth centuries, shortnose sturgeon commonly were taken in a commercial fishery for the closely related and commercially valuable Atlantic sturgeon. More than a century of extensive fishing for sturgeon contributed to the decline of shortnose sturgeon along the east coast. Heavy industrial development during the twentieth century in rivers inhabited by sturgeon impaired water quality and impeded these species' recovery; possibly resulting in substantially reduced abundance of shortnose sturgeon populations within portions of the species' ranges (e.g., southernmost rivers of the species range: Santilla, St. Marys and St. Johns Rivers). A shortnose sturgeon recovery plan was published in December 1998 to promote the conservation and recovery of the species (see NMFS 1998). Shortnose sturgeon are listed as "vulnerable" on the IUCN Red List.

Although shortnose sturgeon are listed as endangered range-wide, the final recovery plan recognizes 19 separate populations occurring throughout the range of the species. These populations are in New Brunswick Canada (1); Maine (2); Massachusetts (1); Connecticut (1); New York (1); New Jersey/Delaware (1); Maryland and Virginia (1); North Carolina (1); South Carolina (4); Georgia (4); and Florida (2). NMFS has not formally recognized distinct population segments (DPS)[1] of shortnose sturgeon under the ESA. Although genetic information within and among shortnose sturgeon occurring in different river systems is largely unknown, life history studies indicate that shortnose sturgeon populations from different river systems are substantially reproductively isolated (Kynard 1998) and, therefore, should be considered discrete. The 1998 Recovery Plan indicates that while genetic information may reveal that interbreeding does not occur between rivers that drain into a common estuary, at this time, such river systems are considered a single population compromised of breeding subpopulations (NMFS 1998).

Studies conducted since the issuance of the Recovery Plan have provided evidence that suggests that years of isolation between populations of shortnose sturgeon have led to morphological and genetic variation. Walsh et al. (2001) examined morphological and genetic variation of shortnose sturgeon in three rivers (Kennebec, Androscoggin, and Hudson). The study found that the Hudson River shortnose sturgeon population differed markedly from the other two rivers for most morphological features (total length, fork length, head and snout length, mouth width, interorbital width and dorsal scute count, left lateral scute count, right ventral scute count). Significant differences were found between fish from Androscoggin and Kennebec rivers for interorbital width and lateral scute counts which suggests that even though the Androscoggin and Kennebec rivers drain into a common estuary, these rivers support largely discrete populations of shortnose sturgeon. The study also found significant genetic differences among all three populations indicating substantial reproductive isolation among them and that the observed morphological differences may be partly or wholly genetic.

Grunwald et al. (2002) examined mitochondrial DNA (mtDNA) from shortnose sturgeon in eleven river populations. The analysis demonstrated that all shortnose sturgeon populations examined showed moderate to high levels of genetic diversity as measured by haplotypic diversity indices. The limited sharing of haplotypes and the high number of private haplotypes are indicative of high homing fidelity and low gene flow. The researchers determined that glaciation in the Pleistocene Era was likely the most significant factor in shaping the phylogeographic pattern of mtDNA diversity and population structure of shortnose sturgeon. The Northern glaciated region extended south to the Hudson River while the southern non-glaciated region begins with the Delaware River. There is a high prevalence of haplotypes restricted to either of these two regions and relatively few are shared; this represents a historical subdivision that is tied to an important geological phenomenon that reflects historical isolation. Analyses of haplotype frequencies at the level of individual rivers showed significant differences among all systems in which reproduction is known to occur. This implies that although higher level genetic stock relationships exist (i.e., southern vs. northern and other regional subdivisions), shortnose sturgeon appear to be discrete stocks, and low gene flow exists between the majority of populations.

1 The definition of species under the ESA includes any subspecies of fish, wildlife, or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature. To be considered a DPS, a population segment must meet two criteria under NMFS policy. First, it must be discrete, or separated, from other populations of its species or subspecies. Second, it must be significant, or essential, to the long-term conservation status of its species or subspecies. This formal legal procedure to designate DPSs for shortnose sturgeon has not been undertaken.

Waldman et al. (2002) also conducted mtDNA analysis on shortnose sturgeon from 11 river systems and identified 29 haplotypes. Of these haplotypes, 11 were unique to northern, glaciated systems and 13 were unique to the southern non-glaciated systems. Only 5 were shared between them. This analysis suggests that shortnose sturgeon show high structuring and discreteness and that low gene flow rates indicated strong homing fidelity.

Wirgin et al. (2005) also conducted mtDNA analysis on shortnose sturgeon from 12 rivers (St. John, Kennebec, Androscoggin, Upper Connecticut, Lower Connecticut, Hudson, Delaware, Chesapeake Bay, Cooper, Peedee, Savannah, Ogeechee and Altamaha). This analysis suggested that most population segments are independent and that genetic variation among groups was high.

The best available information demonstrates differences in life history and habitat preferences between northern and southern river systems and given the species' anadromous breeding habits, the rare occurrence of migration between river systems, and the documented genetic differences between river populations, it is unlikely that populations in adjacent river systems interbreed with any regularity. This likely accounts for the failure of shortnose sturgeon to repopulate river systems from which they have been extirpated, despite the geographic closeness of persisting populations. This characteristic of shortnose sturgeon also complicates recovery and persistence of this species in the future because, if a river population is extirpated in the future, it is unlikely that this river will be recolonized. Consequently, this Opinion will treat the Penobscot River population of shortnose sturgeon separately from the other eighteen identified populations of shortnose sturgeon with their range for the purposes of this analysis.

Historically, shortnose sturgeon are believed to have inhabited nearly all major rivers and estuaries along nearly the entire east coast of North America. The range extended from the St John River in New Brunswick, Canada to the Indian River in Florida. Today, only 19 populations remain ranging from the St. Johns River, Florida (possibly extirpated from this system) to the Saint John River in New Brunswick, Canada. Shortnose sturgeon are large, long lived fish species. The present range of shortnose sturgeon is disjunct, with northern populations separated from southern populations by a distance of about 400 km. The species is anadromous in the southern portion of its range (i.e., south of Chesapeake Bay), while northern populations are amphidromous (fish move between fresh and salt water during some part of life cycle, but not for breeding)(NMFS 1998). Population sizes vary across the species' range. From available estimates, the smallest populations occur in the Cape Fear (~8 adults; Moser and Ross 1995) and Merrimack Rivers (~100 adults; M. Kieffer, United States Geological Survey, personal communication), while the largest populations are found in the St John (~100,000; Dadswell 1979) and Hudson Rivers (~61,000; Bain et al. 1998). As indicated in Kynard 1998, adult abundance is less than the minimum estimated viable population abundance of 1000 adults for 5 of 11 surveyed northern populations and all natural southern populations. Kynard 1998 indicates that all aspects of the species' life history indicate that shortnose sturgeon should be abundant in most rivers. As such, the expected abundance of adults in northern and north-central populations should be thousands to tens of thousands of adults. Expected abundance in southern rivers is uncertain, but large rivers should likely have thousands of adults. The only river systems likely supporting populations of these sizes are the St John, Hudson and possibly the Delaware and the

Kennebec, making the continued success of shortnose sturgeon in these rivers critical to the species as a whole. While no reliable estimate of the size of either the total species or the shortnose sturgeon population in the Northeastern United States exists, it is clearly below the size that could be supported if the threats to shortnose sturgeon were removed.

Threats to shortnose sturgeon recovery

The Shortnose Sturgeon Recovery Plan (NMFS 1998) identifies habitat degradation or loss (resulting, for example, from dams, bridge construction, channel dredging, and pollutant discharges) and mortality (resulting, for example, from impingement on cooling water intake screens, dredging and incidental capture in other fisheries) as principal threats to the species' survival.

Several natural and anthropogenic factors continue to threaten the recovery of shortnose sturgeon. Shortnose sturgeon continue to be taken incidentally in fisheries along the east coast and are probably targeted by poachers throughout their range (Dadswell 1979; Dovel *et al.* 1992; Collins *et al.* 1996). Bridge construction and demolition projects may interfere with normal shortnose sturgeon migratory movements and disturb sturgeon concentration areas. Unless appropriate precautions are made, internal damage and/or death may result from blasting projects with powerful explosives. Hydroelectric dams may affect shortnose sturgeon by restricting habitat, altering river flows or temperatures necessary for successful spawning and/or migration and causing mortalities to fish that become entrained in turbines. Maintenance dredging of Federal navigation channels and other areas can adversely affect shortnose sturgeon populations. Hydraulic dredges can lethally take sturgeon by entraining sturgeon in dredge dragarms and impeller pumps. Mechanical dredges have also been documented to lethally take shortnose sturgeon. In addition to direct effects, dredging operations may also impact shortnose sturgeon by destroying benthic feeding areas, disrupting spawning migrations, and filling spawning habitat with resuspended fine sediments. Shortnose sturgeon are susceptible to impingement on cooling water intake screens at power plants. Electric power and nuclear power generating plants can affect sturgeon by impinging larger fish on cooling water intake screens and entraining larval fish. The operation of power plants can have unforeseen and extremely detrimental impacts to water quality which can affect shortnose sturgeon. For example, the St. Stephen Power Plant near Lake Moultrie, South Carolina was shut down for several days in June 1991 when large mats of aquatic plants entered the plant's intake canal and clogged the cooling water intake gates. Decomposing plant material in the tailrace canal coupled with the turbine shut down (allowing no flow of water) triggered a low dissolved oxygen water condition downstream and a subsequent fish kill. The South Carolina Wildlife and Marine Resources Department reported that twenty shortnose sturgeon were killed during this low dissolved oxygen event.

Contaminants, including toxic metals, polychlorinated aromatic hydrocarbons (PAHs), pesticides, and polychlorinated biphenyls (PCBs) can have substantial deleterious effects on aquatic life including production of acute lesions, growth retardation, and reproductive impairment (Cooper 1989; Sinderman 1994). Ultimately, toxins introduced to the water column become associated with the benthos and can be particularly harmful to benthic organisms (Johnson *et al.* 1992) like sturgeon. Heavy metals and organochlorine compounds are known to accumulate in fat tissues of sturgeon, but their long term effects are not yet known (Ruelle and Henry 1992; Ruelle and Kennlyne 1993). Available data suggests that early life stages of fish are more susceptible to environmental and pollutant stress than older life stages (Rosenthal and Alderdice 1976).

Several characteristics of shortnose sturgeon life history including long life span, extended residence in estuarine habitats, and being a benthic omnivore, predispose this species to long term, repeated exposure to environmental contaminants and bioaccumulation of toxicants (Dadswell 1979). In the Connecticut River, coal tar leachate was suspected of impairing sturgeon reproductive success. Kocan (1993) conducted a laboratory study to investigate the survival of sturgeon eggs and larvae exposed to PAHs, a by-product of coal distillation. Only approximately 5% of sturgeon embryos and larvae survived after 18 days of exposure to Connecticut River coal-tar (i.e., PAH) demonstrating that contaminated sediment is toxic to shortnose sturgeon embryos and larvae under laboratory exposure conditions (NOAA Fisheries 1998).

Although there is scant information available on the levels of contaminants in shortnose sturgeon tissues, some research on other related species indicates that concern about the effects of contaminants on the health of sturgeon populations is warranted. Detectible levels of chlordane, DDE (1,1-dichloro-2, 2-bis(p-chlorophenyl)ethylene), DDT (dichlorodiphenyl-trichloroethane), and dieldrin, and elevated levels of PCBs, cadmium, mercury, and selenium were found in pallid sturgeon tissue from the Missouri River (Ruelle and Henry 1994). These compounds were found in high enough levels to suggest they may be causing reproductive failure and/or increased physiological stress (Ruelle and Henry 1994). In addition to compiling data on contaminant levels, Ruelle and Henry also determined that heavy metals and organochlorine compounds (*i.e.* PCBs) accumulate in fat tissues. Although the long term effects of the accumulation of contaminants in fat tissues is not yet known, some speculate that lipophilic toxins could be transferred to eggs and potentially inhibit egg viability. In other fish species, reproductive impairment, reduced egg viability, and reduced survival of larval fish are associated with elevated levels of environmental contaminants including chlorinated hydrocarbons. A strong correlation that has been made between fish weight, fish fork length, and DDE concentration in pallid sturgeon livers indicates that DDE increases proportionally with fish size (NMFS 1998).

During summer months, especially in southern areas, shortnose sturgeon must cope with the physiological stress of water temperatures that may exceed 28°C. Flourney *et al.* (1992) suspected that, during these periods, shortnose sturgeon congregate in river regions which support conditions that relieve physiological stress (*i.e.*, in cool deep thermal refuges). In southern rivers where sturgeon movements have been tracked, sturgeon refrain from moving during warm water conditions and are often captured at release locations during these periods (Flourney *et al.*1992; Rogers and Weber 1994; Weber 1996). The loss and/or manipulation of these discrete refuge habitats may limit or be limiting population survival, especially in southern river systems.

Pulp mill, silvicultural, agricultural, and sewer discharges, as well as a combination of non-point source discharges, which contain elevated temperatures or high biological demand, can reduce dissolved oxygen levels. According to the Recovery Plan for shortnose sturgeon (NMFS 1998) low oxygen levels (below 5 mg/L) are known to be stressful to aquatic life, and presumably, sturgeon would be adversely affected by levels below this limit. Shortnose sturgeon may be less tolerant of low dissolved oxygen levels in high ambient water temperatures and show signs of stress in water temperatures higher than 28°C (Flourney *et al.* 1992). At these temperatures, concomitant low levels of dissolved oxygen may be lethal.

Status of Shortnose Sturgeon in the Action Area
On June 30, 1978, one shortnose sturgeon was captured in Penobscot Bay during finfish sampling conducted by the MDMR (Squiers and Smith 1979). As shortnose sturgeon rarely participate in coastal migrations and are known to complete their entire life history in their natal river, researchers concluded that this sturgeon was a member of a previously undocumented Penobscot River population of shortnose sturgeon. The river had long been suspected of supporting a shortnose sturgeon population based on anecdotal evidence of shortnose sturgeon capture and observation in combination with archeological data which suggested that sturgeon from the Penobscot River were used by native peoples (Knight 1985 and Petersen and Sanger 1986 in NMFS 1998).

In 1994 and 1995, researchers attempted to document the use of the Penobscot River by shortnose sturgeon. Nets were set near the head of tide in both years with the goal of capturing spawning adults. This was the only area of the river targeted by the researchers. Researchers fished for approximately 409 net hours. No shortnose sturgeon were captured. However, even in rivers with relatively large populations with intense sampling programs (*i.e.*, the Connecticut River), it is not uncommon for there to be a year when no migration to the spawning grounds and subsequently no spawning occurs.

The 1978 capture in conjunction with historical and anecdotal evidence and the habitat characteristics of the river have led NMFS to conclude that it is reasonably likely that there is a small persistent population of shortnose sturgeon in the Penobscot River (NMFS 1998). In the spring of 2004, NMFS biologists observed two approximately 36"-long sturgeon leaping out of the river near Bangor. Water temperatures at the time of this observation were consistent with the preferred temperatures for shortnose sturgeon spawning and this is the area of the river where spawning likely occurs (*i.e.*, 8-15°C). Also in the spring of 2004, NMFS biologists reported that three small sturgeon were observed by others working in the river in the Bangor area. One Atlantic sturgeon was captured by an angler in the river in the spring of 2005 which indicates that the river may also support a population of Atlantic sturgeon; however, adult Atlantic sturgeon are much larger than adult shortnose sturgeon and the size of the other observed fish is consistent with the size of adult shortnose sturgeon. Additionally, the location of the observed sturgeon was upstream of where juvenile Atlantic sturgeon (which may be the same size as adult shortnose sturgeon) are likely to be found in the river. Based on these captures and observations, NMFS concluded it was reasonably likely that there were at least several adult shortnose sturgeon in the Penobscot River.

In May 2006, the University of Maine (UM), in conjunction with NMFS and U.S. Geological Survey (USGS), began a study of the distribution, abundance, and movements of adult and sub-adult Atlantic sturgeon in the Penobscot River. These research efforts confirmed the presence of shortnose sturgeon in the river. In 2006, 62 individual shortnose sturgeon were captured by UM in the Penobscot River from Frankfort upstream to Bangor. Between May 21, 2007 and September 10, 2007, an additional 61 individual shortnose sturgeon were captured and tagged in the river. Most sturgeon captured during the study were adults. The type of gear used for sampling (large mesh gill nets of 6" and 12" stretch) is not designed to capture sturgeon less than 2 feet in length. No sampling targeting early life stages or juvenile shortnose sturgeon has been conducted to date.

UM researchers captured 17 shortnose sturgeon the reach of the Penobscot River between Sedgeunkedunk Stream (river mile 36.4) and an asphalt plant in Bangor (river mile 38.5) from September 28 to October 19, 2006. Additionally, in 2006, 12 of 14 (86%) shortnose sturgeon tagged with hydroacoustic transmitters were detected during the winter months in an approximately 7,500 foot section of the Penobscot River from the confluence of Sedgeunkedunk Stream upstream to the City of Bangor's waste water treatment facility. Tracking data indicate that sturgeon begin moving into this reach of the Penobscot River in October and depart in early spring (April). Some adults start moving back into the vicinity of this area in June. This information indicates that the area between the Bangor water treatment facility and Sedgeunkedunk Stream is likely used as an overwintering area for shortnose sturgeon. These movements are consistent with movements of shortnose sturgeon in other river systems, including the Delaware and Kennebec Rivers. In these river systems, the majority of shortnose sturgeon have moved to the overwintering area by the time water temperatures reach 10°C in the fall, although some move to the overwintering area much sooner and others do not appear to move to the main overwintering area at all. The proposed Brewer Module Facility will be located in the area of the river identified by tracking studies to be used by over-wintering fish.

The preliminary telemetry data collected by UM suggests that sub-adult and adult shortnose sturgeon move extensively within the river system during spring and early summer and often can be found over mudflats outside the main river channel (Fernandes *et al.* 2006). Spawning areas have not yet been identified. Researchers suspect that based on the literature, spawning likely occurs as far upriver as sturgeon can migrate. This allows larvae and juveniles the most freshwater habitat downriver before they enter estuarine conditions.

Based on life history information from other rivers, adult shortnose sturgeon in the Penobscot River likely to spawn in deep water areas near the base of the Veazie Dam (located about 4 miles upstream of the proposed Brewer Module Facility) when water temperatures are between 8 and 15°C. Adults are known to rapidly leave the area after spawning and move to downstream foraging areas. Adults may also briefly visit more saline reaches of the estuary as is seen in the Connecticut and Merrimack Rivers. When water temperatures drop to 10°C shortnose sturgeon move to upstream overwintering areas. In some river systems (Hudson, Connecticut), overwintering areas are segregated between spawners and non-spawners. In the Penobscot River, the distance to be traveled to the spawning grounds is relatively short and there may only be one overwintering area as is seen in other rivers with small amounts of available habitat (*e.g.*, the Merrimack River). Eggs and larvae are likely concentrated near the spawning area for up to 4 weeks post-spawning, after which larvae disperse into the tidal river. As juvenile sturgeon are believed to remain upstream of the salt wedge until they are about 45 cm long (Crance 1986), it is likely that juvenile sturgeon occur in the Penobscot River from the Veazie Dam downstream to the Town of Hampden. The proposed Brewer Module Facility is located in this section of river.

Based on the number of shortnose sturgeon captured to date, there are at least 123 adult shortnose sturgeon in the Penobscot River. While there is currently not enough information available to calculate a reliable population estimate, data presently available suggest that the river likely supports a population of 300 to 2,000 adult and sub-adult shortnose sturgeon (personal communication, Dr. Michael T. Kinnison, University of Maine, September 15, 2007). As most fish captured during the study have been relatively large adults (>70 cm total length), it is clear that the population contains individuals that are several decades old. This is consistent with the structure of other stable shortnose sturgeon populations (i.e., Hudson, Kennebec) where the majority of fish are older adults and juveniles make up only a small percentage of the population.

While specific habitat preferences or feeding areas in the Penobscot River have not been identified to date, the available information, as well as what is known about sturgeon in other river systems, allows NMFS to determine when and where shortnose sturgeon are likely to occur in the Penobscot River system. Based upon data collected by UM, known life history characteristics of shortnose sturgeon, and habitat availability in the Penobscot River, larvae, young-of-year, juvenile, and adult shortnose sturgeon have the potential to occur in the action area at various times of the year. NMFS does not anticipate any spawning adults or shortnose sturgeon eggs to occur in the action area as suitable spawning habitat does not occur in this section of the Penobscot River. Based on historic water temperatures and residency time, larval sturgeon are expected to occur in the action area from April through June. Juvenile and adult sturgeon likely occur near the proposed Brewer Module Facility year round while foraging and/or overwintering in the action area. Shortnose sturgeon are likely to occur in the lower portion of the action area (i.e., the area between the proposed facility and the RDS) primarily during the summer months. Based upon data collected by UM, over-wintering sturgeon are likely to occur near the Brewer Module Facility from October to April. Based on the habitat characteristics of the area to be dredged, the potential for ice buildup, and information concerning known sturgeon overwintering areas in other river systems, it is likely that most overwintering fish occur in the deeper areas of the main river channel rather than in the shallows near the shoreline.

ENVIRONMENTAL BASELINE

Environmental baselines for biological opinions include the past and present impacts of all state, federal or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR 402.02). The environmental baseline for this biological opinion includes the effects of several activities that may affect the survival and recovery of the endangered species in the action area. The activities that shape the environmental baseline in the action area of this consultation generally include: dredging operations, water quality impacts, scientific research, commercial and recreational fisheries, and recovery activities associated with reducing those impacts.

Effects of Federal Actions that have Undergone Formal or Early Section 7 Consultation

NMFS has undertaken two formal ESA section 7 consultations in the action area. One formal Section 7 consultation was undertaken to address the effects of Atlantic sturgeon research in the Penobscot River on listed Atlantic salmon and shortnose sturgeon. On April 20, 2006, NMFS issued an intra-Service Opinion on the effects of distributing funds to the USGS and UM as part of an interagency agreement to investigate the distribution and abundance of Atlantic sturgeon in the Penobscot River, Maine. Although the Opinion concluded that the issuance of funds to USGS for the proposed Atlantic sturgeon study was not likely to jeopardize the continued existence of any ESA-listed species under NMFS jurisdiction, takes of Atlantic salmon and shortnose sturgeon were expected to occur. NMFS issued an Incidental Take Statement (ITS) to USGS exempting the take of no more than 9 shortnose sturgeon (one lethally) that were likely to be captured incidentally in gill nets set for the project. NMFS also exempted the lethal take of up to 1 listed Atlantic salmon during the study. On June 13, 2006, NMFS reinitiated formal section 7 consultation on the Atlantic sturgeon study since the level of take exempted in the April 2006 Opinion was exceed and the action resulted in effects to Atlantic salmon and shortnose sturgeon not previously considered. On October 4, 2006, NMFS issued a new Opinion for the Atlantic sturgeon study. The October 2006 Opinion also concluded that the proposed action was not likely to jeopardize the continued existence of any ESA-listed species under NMFS jurisdiction, but exempted that take of up to 215 shortnose sturgeon (10 lethally) and 1 Atlantic salmon (lethally).

On March 27, 2007, NMFS issued an Opinion on the effects of issuing a scientific research permit (No. 1595) to Michael Hastings at UM for the capture of shortnose sturgeon for research purposes. This study is part of the ongoing Atlantic sturgeon and shortnose sturgeon studies funded by NMFS described above. In the March 2007 Opinion, NMFS concluded that the issuance of Permit No. 1595 was not was not likely to jeopardize the continued existence of any ESA-listed species under NMFS jurisdiction and the take of up to four Atlantic salmon was likely to occur.

Other Potential Sources of Impacts in the Action Area

Non-Federally Regulated Fishery Operations
Unauthorized take of shortnose sturgeon and Atlantic salmon is prohibited by the ESA. However, shortnose sturgeon are taken incidentally in anadromous fisheries along the East Coast and may be targeted by poachers (NMFS 1998). The Penobscot River is an important corridor for migratory movements of various species including alewife (*Alosa pseudohernegus*), American eel (*Anguilla rostrata*), blueback herring (*Alosa aestivalis*), American shad (*Alosa sapidissima*), rainbow smelt (*Osmerus mordax*), striped bass (*Morone saxatilis*) and lobster (*Homarus americanus*). It has been estimated that approximately 20 shortnose sturgeon are killed each year in the commercial shad fishery operating in the Northeast and an additional number are also likely taken in recreational fisheries (T. Savoy pers. comm. in NMFS 1998). However, the incidental take of shortnose sturgeon in the Penobscot River has not been documented due to confusion over distinguishing between Atlantic sturgeon and shortnose sturgeon and likely apprehension to report illegal bycatch to authorities. Due to a lack of reporting, no information on the number of listed shortnose sturgeon or Atlantic salmon caught and released or killed in commercial or recreational fisheries on the Penobscot River is available.

In 2007, the MDMR authorized a limited catch-and-release fall fishery (September 15 to October 15) for Atlantic salmon in the Penobscot River upstream of the former Bangor Dam. Angling is limited to 150 feet downstream of the Veazie Dam to the Bangor Dam. Considering the low numbers of GOM DPS origin Atlantic salmon in this area of the Penobscot, this fishery is not expected to significantly affect listed Atlantic salmon.

Contaminants and Water Quality
Point source discharges (*i.e.*, municipal wastewater, paper mill effluent, industrial or power plant cooling water or waste water) and compounds associated with discharges (*i.e.*, metals, dioxins, dissolved solids, phenols, and hydrocarbons) contribute to poor water quality and may also impact the health of sturgeon and salmon populations. The compounds associated with discharges can alter the chemistry and temperature of receiving waters, which may lead to mortality, changes in fish behavior, deformations, and reduced egg production and survival. Contaminants including heavy metals, polychlorinated aromatic hydrocarbons (PAHs), pesticides, and polychlorinated biphenyls (PCBs), can have serious, deleterious effects on aquatic life and are associated with the production of acute lesions, growth retardation, and reproductive impairment (Ruelle and Keenlyne 1993). Contaminants introduced into the water column or through the food chain eventually become associated with the benthos where bottom dwelling species like shortnose sturgeon are particularly vulnerable. In 2000, the US Environmental Protection Agency (EPA) delegated authority for the National Pollutant Discharge Elimination System (NPDES) permit program to the State of Maine. NMFS comments on all NPDES issued for discharges to the Penobscot River.

Several characteristics of shortnose sturgeon life history including long life span, extended residence in estuarine habitats, and being a benthic omnivore, predispose this species to long term, repeated exposure to environmental contaminants and bioaccumulation of toxicants (Dadswell 1979). Contaminant analysis of tissues from a shortnose sturgeon from the Kennebec River (which supports similar industries, such as paper mills, as the Penobscot River) revealed the presence of fourteen metals, one semivolatile compound, one PCB Aroclor, Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) in one or more of the tissue samples. Of these chemicals, cadmium and zinc were detected at concentrations above an adverse effect concentration reported for fish in the literature (ERC 2003). Thomas and Khan (1997) demonstrated that exposure to cadmium at concentrations well below the concentration detected in the shortnose sturgeon significantly increased ovarian production of estradiol and testosterone which can adversely affect reproductive function. The concentration of zinc detected in the shortnose sturgeon liver tissue was slightly less than the effect concentration for reduced egg hatchability reported by Holcombe *et al.* (1979) and exceeded the effect concentration for reduced survival cited in Flos *et al.* (1979).

Ruelle and Henry (1994) determined that heavy metals and organochlorine compounds (*i.e.*, PCBs) accumulate in fat tissues. Although the long term effects of the accumulation of contaminants in fat tissues are not yet known, some speculate that lipophilic toxins could be transferred to eggs and potentially inhibit egg viability. PCBs may also contribute to a decreased immunity to fin rot. In other fish species, reproductive impairment, reduced egg viability, and reduced survival of larval fish are associated with elevated levels of environmental contaminants including chlorinated hydrocarbons. A strong correlation that has been made between fish weight, fish fork length, and DDE (dichlorodiphenyldichloroethylene) concentration in pallid sturgeon livers indicates that DDE increase proportionally with fish size (NMFS 1998).

Despite improvements to water quality in the Penobscot River, discharges to this system contribute various chemical contaminants as well as heated effluent to the river. While individual discharges likely have only minor detrimental effects on listed species and their habitats, the cumulative effects of these discharges is unknown and may be negatively impacting or delaying the potential for shortnose sturgeon and Atlantic salmon to recover in this system.

Scientific Studies
There have only been two studies targeting shortnose sturgeon in the Penobscot River. The MDMR study conducted in 1994 and 1995, as described above, did not result in the capture of any shortnose sturgeon.

UM was issued a scientific research permit (No. 1595) by NMFS in 2007 which authorizes them to capture up to 100 shortnose sturgeon annually in the Penobscot from 2007-2012 using gill nets and trammel nets. Shortnose sturgeon are captured, handled, measured, weighed, Passive Integrated Transponder (PIT) tagged, Carlin tagged, ultrasonic tagged, scanned for tags, tissue sampled, anesthetized, boroscoped, and released. Permit No. 1595 also authorizes UM to collect and preserve thirty shortnose sturgeon eggs to verify spawning in the Penobscot River. Only two adult or juvenile lethal takes are authorized by Permit No. 1595. The information gained from UM's research will be used by NMFS to further sturgeon conservation actions in the Penobscot River.

MDMR is authorized under the USFWS' endangered species blanket permit (No. 697823) to conduct monitoring, assessment, and habitat restoration activities for listed Atlantic salmon populations in Maine. The extent of take from MDMR activities during any given year is not expected to exceed 2% of any life stage being impacted, except that for adults, it would be less than 1%. MDMR will continue to conduct Atlantic salmon research and management activities in Cove Brook, Ducktrap River, Penobscot River, and the Kenduskeag Stream watershed. Although these activities will result in some take of Atlantic salmon, adverse impacts are expected to be minor and such take is authorized by an existing ESA permit. The information gained from these activities will be used to further salmon conservation actions in the GOM DPS of Atlantic salmon.

Hydroelectric facilities
The Penobscot River Basin has been extensively developed for hydroelectric power production. There are 113 dams in the Penobscot River watershed. Twenty of these dams are associated with generating facilities. While the effects of these facilities are largely unknown, they all have the potential to affect flow in the river and may affect shortnose sturgeon and Atlantic salmon habitat and/or migration patterns. The first impediment to upstream passage on the mainstem of the Penobscot River is currently the Veazie Dam. This dam restricts the available habitat for shortnose sturgeon. In rivers where shortnose sturgeon have free access (*i.e.*, there are no dams), the species typically has a 100-200km range. In the Penobscot River, this range is restricted to only 25 miles of mainstem river, with an additional 20 miles of estuary available below the mouth of the river. The Veazie Dam prevents shortnose sturgeon from accessing the majority of their historically available habitat and has likely prevented the species from spawning at their preferred spawning habitat, which is likely located upstream of the Veazie Dam. The lack of availability to their full range has likely had a significant negative effect on shortnose sturgeon in

this river system and will continue to delay recovery of this species in the Penobscot River. As the geographic range of the GOM DPS is located downstream of all hydroelectric facilities in the Penobscot River, any effects of hydroelectric operations to listed salmon are likely limited to minor habitat alterations related to river flow fluctuations.

Conservation and Recovery Actions Reducing Threats to Listed Species
In November 2005, NMFS and the USFWS issued the Final Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic salmon (NMFS and USFWS 2005). The major areas of action in the recovery plan are designed to stop and reverse the downward population trends of the remnant eight wild Atlantic salmon populations and minimize the potential for human activities to result in the degradation or destruction of Atlantic salmon habitat essential to survival and recovery. A recovery team has been appointed to coordinate implementation of recovery actions, and to assess and integrate ongoing recovery efforts.

In 1998, NMFS issued the Final Recovery Plan for shortnose sturgeon (NMFS 1998). The long-term recovery objective for shortnose sturgeon is to recover all discrete population segments to levels of abundance at which they no longer require protection under the ESA. To achieve and preserve minimum population sizes for each population segment, the final recovery plan recommends identifying and preserving essential habitats and monitoring and minimizing mortality. Other key recovery tasks are to define essential habitat characteristics, assess mortality factors, and protect shortnose sturgeon through applicable federal and state regulations.

Summary and Synthesis of the Status of the Species and Environmental Baseline
Impacts from actions occurring in the Environmental Baseline for the Penobscot River have the potential to impact shortnose sturgeon and Atlantic salmon. Despite improvements in water quality and the elimination of directed fishing for these species, shortnose sturgeon and Atlantic salmon still face numerous threats in this river system. As noted above, the effect of hydroelectric facilities in the Penobscot River Basin is largely unknown; however, it is likely that they affect flow in the River which may affect the habitat and/or migration patterns of shortnose sturgeon and Atlantic salmon.

Summary of the status of Atlantic salmon
The number of listed GOM DPS Atlantic salmon in the Penobscot River watershed is small. Recent information collected by the MDMR indicates that the number of listed adult Atlantic salmon returning to the Ducktrap River, Cove Brook, Sedgeunkedunk Stream, and the Kenduskeag River is likely less than 20 fish annually. The number of juvenile Atlantic salmon in each river is also small. No active river-specific conservation hatchery program exists for these rivers. NMFS assumes that the population of listed Atlantic salmon in the Penobscot River watershed is at best stable (but at a critically low level) and at worst decreasing.

Summary of the status of shortnose sturgeon
There are at least 120 adult shortnose sturgeon in the Penobscot River with preliminary population estimates ranging from 300 to 2000 adults. The particulars of population dynamics and habitat use of the Penobscot River population are currently being studied. Without information on historical abundance it is difficult to make determinations with a high level of confidence regarding the stability of the population or about the long term survival and recovery

of this population. As it is likely a relatively small population and nothing is known about the level of genetic diversity, it is difficult to predict how likely the population is to rebound from catastrophic events (*e.g.*, oil or chemical spill, weather event etc.) that affect habitat quality, prey availability or result in direct mortality of a number of individuals. However, as there are likely several hundred adults in this population and the adults captured so far are likely several decades old, the available information indicates that this population is long lived and relatively unexploited by fisheries. As such, NMFS believes that this population is likely stable but low when compared to historic population levels in the Penobscot River.

While no estimate that has a high level of certainty regarding the size of either the shortnose sturgeon population in the Northeastern US or of the species throughout its range exists, it is clearly below the size that could be supported if the threats to shortnose sturgeon were removed. Based on the number of adults in population for which estimates are available, there are at least 104,662 adult shortnose sturgeon, including 18,000 in the Saint John River in Canada. Based on the best available information, NMFS believes that the status of shortnose sturgeon throughout their range is at best stable (with gains in populations such as the Hudson, Delaware and Kennebec offsetting the continued decline of southern river populations) and at worst declining. The lack of information on the status of certain populations such as that in the Chesapeake Bay and Penobscot River add uncertainty to determination on the status of this species as a whole.

EFFECTS OF THE ACTION

This section of an Opinion assesses the direct and indirect effects of the proposed action on threatened and endangered species or critical habitat, together with the effects of other activities that are interrelated or interdependent (50 CFR 402.02). Indirect effects are those that are caused later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration (50 CFR 402.02). This Opinion examines the likely effects (direct and indirect) of the proposed action on shortnose sturgeon and Atlantic salmon in the Penobscot River and Penobscot Bay and their habitat within the context of each species' current status, the environmental baseline and cumulative effects.

Given the life history of Atlantic salmon, only migrating adults, moving upstream and downstream, and smolts, moving downstream, will occur in the action area. Because it is located in a tidal reach of the river, the project is not expected to affect salmon fry and parr. Juvenile Atlantic salmon remain in non-tidal waters until the smolt stage. Adult salmon could migrate pass the action area on their way to spawning areas in upstream waters any time between the months of April and November. Similarly, post-spawn adults (*i.e.*, kelts) can be found in the lower river any time between the months of April through November. Smolts are likely to be found in the vicinity of the project area any time between April and June as they make their way downriver to the marine environment.

Based upon the life history requirements and available habitat in the Penobscot River, it is possible that all lifestages of shortnose sturgeon except spawning adults and eggs could occur in the action area of this consultation.

Dredging and Disposal Operations
A mechanical clamshell bucket dredge will be used to perform the dredging at the Brewer Module Facility. Dredging will remove approximately 33,000 cubic yards of sediment from an area approximately 700 feet long and 100 feet wide within the Penobscot River. Based on the ACOE's proposed permit conditions, dredging operations will occur between August 1 and February 28 of any given year. Dredging will be performed 24 hours/day for approximately 120 days. Dredging in late December, January, and February will not likely occur due to ice on the river. Based on the current project schedule, dredging is expected to begin on November 1, 2007 and continue through late December, 2007. Dredging not completed during this time will resume on August 1, 2008 and is expected to be completed by the end of 2008.

Dredging and disposal can pose risks of direct and long-term biological effects to aquatic communities (Nightingale and Simenstad 2001). Potential impacts to fish resulting from dredging operations can include burial, entrainment/entrapment, turbidity and resuspension of sediments and contaminants, alterations of habitat and food base, and behavioral changes (Nightingale and Simenstad 2001). Shortnose sturgeon and Atlantic salmon could be injured or killed from entrapment in the bucket or burial in sediment during dredging and/or when sediment is deposited into the dredge scow. Sturgeon or salmon captured and emptied out of the bucket could suffer severe stress or injury, which could also lead to mortality.

Interactions between shortnose sturgeon and dredge operations have been fairly well documented. In the Northeast, lethal takes of shortnose sturgeon have been documented in dredge operations in the Delaware and Kennebec Rivers. A mechanical bucket dredge will be used to perform the proposed dredging project. While the impacts to shortnose sturgeon from mechanical dredging are expected to be less than those from other types of dredges (e.g., hopper and hydraulic pipeline), the potential for taking shortnose sturgeon with this type of dredge exists. On April 30, 2003, a clam-shell bucket dredge operating at the Bath Iron Works (BIW) sinking basin captured a 105cm female shortnose sturgeon. The fish was recovered from the dredge bucket alive but suffered from a severe laceration that nearly cut the fish in half. The fish died on board the barge. In addition, an Atlantic sturgeon was killed in the Cape Fear River, North Carolina in a bucket and barge operation (NMFS 1998) and an Atlantic sturgeon was captured in a clamshell bucket, deposited in the dredge scow, and released apparently unharmed during dredging operations at BIW in 2001 (Maine DMR 2002). It is possible for sturgeon to survive entrapment in bucket dredges. During dredging operations at BIW in June 2002, one Atlantic sturgeon was recovered from the dredge bucket and released apparently unharmed. While Atlantic sturgeon and shortnose sturgeon are not the same species, they are of similar body type and juvenile and smaller adult Atlantic sturgeon can be the same approximate size as shortnose sturgeon. Therefore, effects from dredging on the two species are comparable.

The ACOE has been performing maintenance dredging at the Doubling Point and Popham Beach reaches in the Kennebec River Federal navigation channel since 1950 at approximately three-year intervals. Dredging of the Federal Navigation Channel at Doubling Point in the Kennebec River occurred from October 6-10, 2003 with a hopper dredge with dredging occurring 24 hours a day. Four shortnose sturgeon were entrained on October 6 and one was entrained on October 8. Three of the sturgeon died and two were released alive. Approximately 10,000 cubic yards of material were removed from the deepwater navigation channel over the course of the five days. These sturgeon were presumably completing their upstream migration to overwintering areas.

Due to the nature of interactions between shortnose sturgeon and dredge operations, it is difficult to predict the number of interactions that are likely to occur from a particular dredging operation. Projects that occur in an identical location with the same equipment year after year may result in interactions in some years and none in other years. For example, dredging in the BIW sinking basin prior to 2003 resulted in no interactions with shortnose sturgeon but one shortnose sturgeon was killed by the clamshell dredge in the last hour of the last day of dredging on April 30, 2003. Due to permit restrictions, dredging at BIW has typically occurred from November through April when concentrations of shortnose sturgeon are thought to be the lowest in the Bath area. In contrast, dredging using a hydraulic cutterhead in an area of the Delaware River with known concentrations of shortnose sturgeon did not entrain any shortnose sturgeon in 1983 (Hastings 1983) while at least two shortnose sturgeon were entrained during maintenance dredging activities in the same area in both 1995 and 1996. Base upon this information, it is evident that entrainment rates during dredging are high variable and largely unpredictable.

As noted in the description of the action, dredging and disposal will occur between August 1 and February 28. As indicated in the Status of the Species section, the youngest life stage of shortnose sturgeon likely to occur at the project site are larvae. At the time dredging commences in August, larval sturgeon will have grown to young-of-year fish. Therefore, the youngest life stage of shortnose sturgeon potentially affected by dredging at the proposed Brewer Module Facility will be young-of-year fish. Information on the distribution of juvenile sturgeon in the Penobscot River is lacking as no studies on juvenile sturgeon have been undertaken in the Penobscot River. Studies on other rivers indicate that juveniles most commonly occur in deep water (greater than 10 meters) near the saltwater/freshwater interface. As the proposed Brewer Module Facility will be located just upstream of the salt wedge in the Penobscot River and deep water habitat is available, it is likely that juveniles are present in action area throughout much of the year. No sturgeon are expected to occur in the vicinity of the RDS, thus disposal is expected to have no effect on this species. In addition, an August 1 to February 28 work window will protect pre-spawning and spawning shortnose sturgeon in the Penobscot River.

Adult shortnose sturgeon have been documented by UM in the area where dredging will occur throughout much of the year with the highest concentration occurring during late fall and winter months. The available information suggests that adults are using the area for foraging and overwintering. During winter, it appears this section of the Penobscot River is concentrated with overwintering individuals. In 2006, 12 of 14 tagged shortnose sturgeon tagged by UM overwintered in this section of the Penobscot River. In April of 2006, most sturgeon moved out of the overwintering area to downstream areas apparently in response to high river flows during spring thaw. By May 2006, sturgeon moved back into the proposed dredging area where they were documented periodically throughout the summer. During summer months, shortnose sturgeon in the Penobscot River appear to use both shallow and deep water habitat during foraging. During winter, shortnose sturgeon are typically found in deep water near the bottom. As the area to be dredged is currently located in depths ranging from 0 to 20 ft, it is likely to be occupied by juvenile and adult shortnose sturgeon throughout much of the year.

The number of interactions between dredge equipment and shortnose sturgeon seems to be associated with the length of time dredging takes, with a greater number of interactions associated with a longer duration of dredging. The number of interactions is also heavily influenced by the time of year dredging occurs (with more interactions correlated to times of year when more shortnose sturgeon are present in the action area) and the type of dredge gear used. Shortnose sturgeon seem better able to avoid a mechanical dredge than a hopper or cutterhead dredge, likely due to the hydraulic suction associated with these dredge types which makes avoidance more difficult. Interactions are also greater in places where fish are concentrated (such as on the overwintering grounds, within a heavily used migratory pathway or on summer foraging grounds) and may also be higher during the winter months when fish are less active.
As both small and large fish seem to be entrained during dredging at comparable rates (ACOE 1998), the risks of entrapping either juvenile or adult sturgeon would be similar at the Brewer Module Facility.

As noted above, the somewhat unpredictable nature of dredging interactions makes it difficult to determine an actual number of interactions that are likely to occur. The proposed dredging is expected to take approximately 120 days with work occurring 24 hours a day. This work will be permitted to occur between August 1 and February 28; however, as noted above it is likely that dredging will occur between November 1, 2007 and December 31, 2007 and again between August 1, 2008 and the end of 2008. As noted above, the available tracking information indicates that a large percentage of the Penobscot River shortnose sturgeon is likely to be in the overwintering area during this time period. For example, in 2006, 12 of 14 tagged fish were detected within about one mile of the proposed dredge area. From October 4 to October 21, 2006, UM captured 15 shortnose sturgeon directly west of the proposed dredge area. Additionally, shortnose sturgeon have been documented in this region of the Penobscot River nearly year round. These fish are likely using this region of the river, including the area to be dredged as a travel corridor to and from the upstream spawning site, as a foraging area and as an overwintering area.

Dredging with a bucket dredge at various BIW facilities occurs on a fairly routine basis, with at least 9 dredge events occurring since 1997, and only 1 interaction with a shortnose sturgeon observed. The Kennebec River in the vicinity of BIW is a known summer foraging area for shortnose sturgeon.

Dredging has occurred in the past in areas within the Delaware River where shortnose sturgeon are known to overwinter. In March 1996, three shortnose sturgeon were found in a dredge spoil near Newbold Island where a cutterhead pipeline dredge was discharging material. A necropsy indicated that the sturgeon were likely alive and in good condition when they were entrained in the dredge. In January 1998, three shortnose sturgeon were found in a dredge spoil for that year's maintenance dredging of the Delaware River. Both dredge operations occurred in the Kinkora-Trenton range of the Delaware River where dense, sedentary aggregations of sturgeon occur in the winter months.

Based on the best available information, NMFS believes that the dredging proposed at the Brewer Module Facility will not effect more sturgeon than the number affected during dredging projects in the Kennebec or Delaware River. This determination is based on the preliminary determination that the Penobscot River population of shortnose sturgeon is significantly smaller than that in the Kennebec or Delaware River.

As noted above, over the course of 9 dredge events at BIW occurring since 1997, with over 571,000 cubic yards of material removed, only 1 interaction with a shortnose sturgeon has been observed. While the majority of dredging projects have occurred between November and April when the fewest number of shortnose sturgeon are present in the Bath area, dredging has occurred during the summer months when shortnose sturgeon are known to be concentrated in the Bath area. Additionally, tracking data indicate that, depending on the year, up to 20% of the shortnose sturgeon population may at least be transient in the Bath area throughout the winter months when dredging traditionally occurs. The small number of interactions between shortnose sturgeon and dredge equipment in the Kennebec River is likely due to the highly mobile and transient nature of shortnose sturgeon in the areas that have been dredged as well as the use of a bucket dredge which greatly reduces the potential for interactions between shortnose sturgeon and dredge gear. The likelihood of a dropping dredge bucket interacting with an individual shortnose sturgeon is low due to the slow speed at which the bucket moves and the relatively small area of the bottom it interacts with at any one time.

The likelihood of an interaction is increased based on the number of the shortnose sturgeon likely to be in the area to be dredged, the length of time of dredging, and the cold water temperatures which cause shortnose sturgeon to be less reactive to stimuli, such as an oncoming dredge. As noted above, dredging in the Delaware River has occurred within an overwintering area. Dredging at the Brewer facility may be more comparable to these dredging operations due to the time of year when dredging occurred and the known concentration of sturgeon in the area to be dredged. However, as shortnose sturgeon are more likely to be able to avoid a clamshell bucket than a cutterhead dredge and there are likely significantly fewer shortnose sturgeon overwintering in the Penobscot River than in the Delaware River, fewer shortnose sturgeon are likely to be affected by the Brewer dredging.

It is likely that the effects of the proposed dredging fall between the level of effects seen at the Kennebec River and Delaware River projects noted above. Based on the dredge type to be used, the time of year proposed for dredging, and the likely number of shortnose sturgeon in the area to be dredged, NMFS believes that between 1 and 3 shortnose sturgeon are likely to interact with the dredge gear operating at the proposed Brewer Module Facility. This will account for shortnose sturgeon injured and/or killed during dredging operations and/or captured in the dredge bucket and released apparently unharmed.

Dredging operations are not expected to entrap any juvenile or adult Atlantic salmon in the Penobscot River. Dredging operations at the Brewer Module Facility will occur after smolts have migrated downstream in the Penobscot River and its tributaries (including Sedgeunkedunk Stream). Although migrating adult salmon could be present in the action area, adult salmon are capable of high burst swimming speeds (over 13 ft/sec)(Colavecchia *et al.* 1998) which would protect them from becoming entrapped in a bucket dredge. Larson and Moehl (1990) found that the most fish entrained during dredging operations were demersal (fish living close to the bottom) such as shortnose sturgeon. Larson and Moehl (1990) concluded that it is unlikely anadromous fishes are entrained significantly by dredges. Some studies suggest that pressure waves created as a bucket dredge descends through the water column warns salmonids and gives them time to avoid the bucket (Larson and Moehl 1990). Disposal activities at RSD are also not expected to entrap or bury any adult Atlantic salmon.

In addition to the direct interaction impacts as discussed above, there is the potential for dredging activities to affect the species by disrupting normal behavior patterns. As noted previously, the majority of tagged shortnose sturgeon were detected overwintering in the vicinity of the proposed project. While we have very limited data on the population of shortnose sturgeon in the Penobscot River, we do know from other systems that overwintering aggregations are an important portion of the life cycle for the species. If we assume that the movement and behavior of the tagged sturgeon is indicative of the overall population, then we would assume that the majority of the shortnose sturgeon population in the Penobscot River would be in the vicinity of the proposed project while dredging is occurring. It is reasonable to assume that dredging activity could disturb shortnose sturgeon and cause some movement. We assume that this movement will be short in duration and relatively local in range such that shortnose sturgeon will move within the overwintering area. It is not anticipated that such localized movement will result in significant disruption of normal behavior patterns or significantly modify habitat such that it actually kills or injures shortnose sturgeon. Therefore, we do not believe that any quantifiable harm or harassment will occur. Monitoring data collected during this project will be used to assess the degree and magnitude of sturgeon movement and the relationship of such movement to dredging activity. It should be noted, however, that baseline data for shortnose sturgeon in the Penobscot River is very limited and also that monitoring activity, as required in the reasonable and prudent measures, is limited in scope and duration.

Interactions with the Sediment Plume

Dredging and disposal operations cause sediment to be suspended in the water column. This results in a sediment plume in the waterbody, typically present from the dredge or disposal site and decreasing in concentration as sediment falls out of the water column as distance increases from the site. Levels of turbidity at any one site are affected by a combination of factors including substrates, currents, and operational parameters (Nightingale and Simenstad 2001). The ACOE's BA for the project presents results from the DREDGE model used to estimate the extent of the sediment plume associated with the proposed dredging. Based upon this information, increased sediment levels are likely to be present for no more than 3,300-feet downstream of the dredge area in the Penobscot River. The direction of the sediment plume will change based on the tides. The ACOE estimates that sediment concentrations within the 3,300 foot area of impact to range from less than 6 mg/l up to 100 mg/l. Sediment levels at RSD are also expected to increase significantly during disposal operations.

Suspended sediments released into the water column during dredging and disposal activities can affect fish through interference with breathing, feeding, and predator-prey relationships (Nightingale and Simenstad 2001). Turbidity is a natural characteristic of estuarine habitats and many fish species can thrive in rivers and estuaries with naturally high concentrations of suspended sediments (Nightingale and Simenstad 2001). Studies of the effects of turbid waters on fish suggest that concentrations of suspended solids can reach thousands of milligrams per liter before an acute toxic reaction is expected (Burton 1993). The studies reviewed by Burton (1993) demonstrated lethal effects to fish at concentrations of 580mg/L to 700,000mg/L depending on species. Sublethal effects have been observed at substantially lower turbidity levels. For example, prey consumption was significantly lower for striped bass larvae tested at concentrations of 200 and 500 mg/L compared to larvae exposed to 0 and 75 mg/L (Breitburg 1988 in Burton 1993). The following section discusses the potential effects of sediments released at the proposed dredge site in the Penobscot River and disposal site at Rockland on listed shortnose sturgeon and Atlantic salmon.

While there have been no directed studies on the effects of Total Suspended Solids (TSS) on shortnose sturgeon, shortnose sturgeon juveniles and adults are often documented in turbid water and Dadswell (1984) reports that shortnose sturgeon are more active under lowered light conditions, such as those in turbid waters. As such, shortnose sturgeon are assumed to be as least as tolerant to suspended sediment as other estuarine fish such as striped bass. Laboratory studies (Niklitschek 2001; Secor and Niklitschek 2001) have demonstrated shortnose sturgeon are able to actively avoid areas with unfavorable water quality conditions and that they will seek out more favorable conditions when available. The life stages of shortnose sturgeon most vulnerable to increased sediment are eggs and larvae, which are subject to burial and suffocation. As noted above, no eggs and/or larvae will be present in the action area at the time of dredging or disposal activities. Dredging with a mechanical dredge of the size to be used for the Brewer Module Facility is a slow process, likely to take up to 120 days, with dredging likely occurring during both daylight and nighttime hours. The speed of the operation combined with the relatively small amount of material removed with each drop of the dredge makes it less likely that there will be a sediment plume strong enough to deter shortnose sturgeon from the area.

Monitoring of twelve mechanical dredge operations in the Delaware River (Burton 1993) in 1992 indicated that sediment plumes fully dissipated within 3,300-feet from the dredge area. This is consistent with an assessment done by the ACOE which indicated that the disposal of dredge spoils in the Kennebec River at an in-river disposal site resulted in a 3,000-foot sediment plume. The Delaware River study also indicated that mechanical dredging does not alter turbidity or dissolved oxygen to a biologically significant degree and analysis did not reveal a consistent trend of higher turbidity and lower dissolved oxygen within the sediment plume. In addition, the average downstream turbidity was no more than 30 NTUs which is well below the toxic concentrations of suspended sediments reported in the literature. While the increase in suspended sediments may cause shortnose sturgeon to alter their normal movements, any change in behavior is likely to be insignificant as it will only involve movement further up in the water column. Based on this information, any increase in suspended sediment is not likely to affect the movement of shortnose sturgeon between foraging areas and/or concentration areas during any phase of dredging or otherwise negatively affect shortnose sturgeon in the action area. As shortnose sturgeon are unlikely to occur at the RSD, no effects from disposal operations are expected on the species.

Suspended sediments can have lethal and sublethal effects on Atlantic salmon. Sublethal effects of suspended sediments can include impairment of swimming activity, respiration, and predator avoidance. Sedimentation has been identified as a threat particularly to early life stages of Atlantic salmon. However, no juvenile Atlantic salmon are expected to occur in the action area at the time of dredging or disposal activities. Atlantic salmon adults rely on olfactory sense to identify and navigate their natal river. Large amounts of sediment in the Penobscot River or

Penobscot Bay could negatively impact adult migratory behavior through disruption of olfactory senses. In a review of the effects of sediment loads and turbidity on fish, Newcomb and Jensen (1996) concluded that more than 6 days exposure to total suspended solids (TSS) greater than 10 mg/l is a moderate stress for juvenile and adult salmonids. A single day exposure to TSS in excess of 50 mg/l is also a moderate stress to salmonids. Based upon analysis by the ACOE, sediment concentrations within the 3,300 area of impact are likely to range from less than 6 mg/l up to 100 mg/l. Sediment concentrations of 100 mg/l are expected to occur only within 100 meters of the dredging operation for short periods of time. Atlantic salmon movement through estuaries is rapid (LeBar *et al.* 1978, Tytler *et al.* 1978). As adult Atlantic salmon are actively migrating through Penobscot River/Bay, NMFS expects only a single day exposure to any adults affected by dredging or disposal operations by the applicant. Based on this information, NMFS does not expect any injury or mortality to adult Atlantic salmon as a result of dredging operations in the Penobscot River. In addition, Atlantic salmon are not likely to be buried during disposal activities at RSD as they tend to migrate in the upper water column (Holbrook, unpublished data). However, it is likely that dredging and disposal operations will result in short-term behavioral changes to adult Atlantic salmon. These behavior changes will likely result in adult salmon actively avoiding areas of elevated suspended sediments by moving horizontally or vertically in the water column. A complete disruption of migration is not expected as a result of dredging or disposal. In addition, very few listed Atlantic salmon are likely to occur within the area of dredging operations.

Alteration of habitat
Since dredging involves removing the bottom material down to a specified depth, aquatic habitat will be impacted by dredging operations. As noted above, the Penobscot River in the vicinity of the proposed Brewer Module Facility or RSD does not contain foraging habitat for Atlantic salmon. Rather, these areas serve solely as a migratory pathway for the species. Habitat alterations associated with dredging, bulkhead construction, and wetland mitigation are not expected to create any impediments to Atlantic salmon migrations in the action area. Removing bottom sediments will also not change the suitability of Atlantic salmon migration habitat in the river. Therefore, the proposed issuance of a permit by the ACOE is not expected to have any significant effects on habitat of Atlantic salmon.

Disposal operations can bury important benthic resources thus resulting in significant impacts to foraging habitat for shortnose sturgeon. The proposed dredge area in the Penobscot River contains potential foraging areas for shortnose sturgeon. A dense freshwater mussel bed is located in the proposed dredge area dominated by eastern elliptio with scattered alewife floaters. This mussel bed extends down river from the dredge operation and is in an area outside the main channel flows. This area will be highly susceptible to sedimentation from the dredge operation. Eastern elliptio are a documented prey item for shortnose sturgeon and potentially an important food resource in the fresh water intertidal portion of the Penobscot River. Approximately 13,253 ft^2 of this mussel bed will be removed by the dredge operation. This direct impact area is less than half of the total mussel bed area mapped by Cianbro in the summer of 2007. As the remaining half of this mussel bed is located just downstream of the proposed dredge area, it will also be impacted from sedimentation resulting from the dredge operations.

Data collected by UM in 2006 show that shortnose sturgeon frequently move upstream and downstream throughout much of the lower Penobscot River from Bangor downstream to near Bucksport during spring and summer. During this period, sturgeon were presumably foraging. Although tagged sturgeon in 2006 did frequent the Penobscot River in the vicinity of proposed Brewer Module Facility, their presence was not persistent until late fall and winter.

Scuba surveys conducted by Cianbro in 2007 documented other areas containing freshwater mussels upstream and downstream of the proposed berthing area. Even assuming that all of the mussel bed in the action area would be impacted by the proposed dredge operation, its relatively small size in relationship to the entire lower Penobscot River suggests that shortnose sturgeon are not likely to be more attracted to the berthing area than to other foraging areas in the river and should be able to find sufficient prey. Recolonization by benthic organisms is expected to occur within the dredge area in approximately 12 months after completion. As extensive areas of suitable foraging habitat occur elsewhere in the Penobscot River, NMFS anticipates that the dredging activities are not likely to disrupt normal feeding behaviors for shortnose sturgeon and are not likely to remove critical amounts of prey resources from the river. In addition, the dredging activities are not likely to alter the habitat in any way that prevents sturgeon from using the area as a migratory pathway.

Activities associated with wetland mitigation plans for Sedgeunkedunk Stream are not expected to impact any shortnose sturgeon or Atlantic salmon habitat. The confluence of Sedgeunkedunk Stream is not known to support either shortnose sturgeon or Atlantic salmon foraging habitat. In fact, the intertidal wetland restoration actions are designed to enhance habitat for fisheries resources including anadromous fish species. As all excavation and filling work associated with the wetland mitigation area must be accomplished when the tide is below the work area and sedimentation control will be utilized, no significant sedimentation of aquatic habitat is expected to occur during the work.

Release of Contaminated Sediments
Sediment cores taken from the proposed dredge area were analyzed for the presence of contaminants. Results of this analysis indicate that sediments in the dredge area contained copper and mercury. Semi-Volatile Organic Compounds (SVOC) including pyrene, phenanthrene, flouranthene, and chrysene were also detected in the sediment cores. Pyrene, phenanthrene, flouranthene, and chrysene are classified as Polycyclic Aromatic Hydrocarbons (PAHs). PAHs are created when products like coal, oil, gas, and garbage are burned but the burning process is not complete. The entire Penobscot River estuary has been identified by the MDEP as impaired by mercury from industrial point sources and Combined Sewer Overflows (MDEP 2004).

It is difficult to predict the concentrations of contaminants that would be mobilized into the water column during dredge operations. The US Environmental Protection Agency (EPA) has set both Criteria Maximum Concentration (CMC or acute criteria defined as the highest concentration of a pollutant to which aquatic life can be exposed for a short period of time (1-4 hours) without deleterious effects) and Criteria Chronic Concentration (CCC or chronic criteria defined as the highest concentration of a pollutant to which aquatic life can be exposed for an extended period of time (4 days) with deleterious effects) for priority toxic pollutants in freshwater and saltwater.

CMC and CCC limits for mercury in freshwater have been established at 1.4 μg/l and 0.77 μg/l, respectively. CMC and CCC limits for copper in saltwater have been established at 13.0 μg/l and 9.0μg/l, respectively. CMC and CCC limits have not been established by EPA for the various PAHs detected in sediment cores at the Brewer Module Facility. Based upon high flushing rates in the Penobscot River, NMFS does not anticipate either mercury or copper concentrations to exceed these levels in the vicinity of the proposed dredge operations at the Brewer Module Facility.

For Atlantic salmon, only adults are likely to occur in the action area at the time of dredging. As adults are actively migrating through the action area, exposure to any contaminants is expected to be short (less than one day). Adult and juvenile shortnose sturgeon could potentially be exposed to high levels of mercury, copper, and PAHs for longer periods if fish are present in the sediment plume during dredging operations. In most fish species, larvae are the most sensitive life stage. However, no eggs or larvae of shortnose sturgeon are expected to occur in the action area at the time of dredging. As any exposure to these increased levels of contaminants is expected to be less than 120 days and rapid dilution is expected, any effects to shortnose sturgeon from the re-suspension of contaminants are expected to be non-lethal. Additionally, removal of these contaminated sediments from the Penobscot River is expected to have long-term, beneficial effects to shortnose sturgeon. While possible, it is extremely unlikely that any contaminated sediments will be disposed at RSD. Therefore, no lethal take of Atlantic salmon or shortnose sturgeon is expected as a result of contaminants released during dredge operations at the Brewer Module Facility.

Impacts of berthing area construction
In-water work at the proposed Brewer Module Facility will include installation of two cellular piles associated with the bulkhead, installation of two mooring dolphins and dredging of the barge berth area. All other work will be done above the low water line. The dolphins will be comprised of multiple steel pipe piles (one 36-inch and two 24-inch diameter) supporting a large concrete cap. Pipe piles will be driven using primarily an impact hammer. For the construction of the cellular piles, a two-level preassembled circular frame will be put in place to serve as a guide for the interlocking steel sheet piles. A total of nine (9), 35-foot diameter cells consisting of 68 sheet piles each will be used to construct the bulkhead (712 total sheet piles). Sheet piles will be driven using a vibratory hammer. Each pile will take approximately one-half hour to install with 15 minutes of actual driving time per pile. The pile driving operation of the in-water cellular piles will occur over 18 weeks. Approximately 500 yards of excavation to remove existing riprap and old timber cribbing will need to be performed before the cells can be installed. This excavation will occur in the dry when the tide is below the work area. The mooring dolphins will be installed using both a vibratory hammer and impact hammer following completion of cellular pile installation and excavation. These moorings are typically driven into place from a barge mounted crane using both a vibratory hammer and impact hammer. Measured noise levels associated with installation of various sized steel piles range from 175 to 206 dB rms (WSDOT 2006). Driving tubular steel piles with an impact hammer has been shown to generate sound levels of 190 decibels as far as 190 feet from a steel pile and sound levels of 155 decibels as far as 1,860 feet from a steel pile once water transmission loss rates are applied (FERC 2006). Vibratory driving sound levels are generally 10 to 20 dB lower than impact hammer driving (WSDOT 2006). Based upon this information, the use of either an impact hammer or vibratory

hammer at the proposed Brewer Module Facility is not expected to generated noise levels in excess of 190 decibels.

The driving of steel piles produces sound waves that may affect fish. Research specifically related to the effects of noise and vibration associated with pile driving activities found that a number of factors influenced the degree of harm experienced by fish. These factors included the size and force of the hammer, distance from the activity, water depth, bottom substrate and the species, size, and physical condition of the fish (Illingworth and Rodin 2001 as cited in Washington State Department of Transportation 2006). The effects of noise on fish also appear to be related to the physiology of the fish and the degree to which it relies on hearing. The effects of noises on fish have included changes in behavior, temporary and permanent hearing loss, physical damage and death (Popper and Clark 1976 as cited in Nightingale and Simenstad 2001, Fiest *et al.* 1992 as cited in Nightingale and Simenstad 2001, Hawkins 2006).

Very little research is available on the effects of anthropogenic noise on Atlantic salmon or shortnose sturgeon. Generally, small fish are more prone to injury by intense sound waves than are larger fish. A study conducted in Scotland investigated the effect that pile driving activity using impact and vibratory hammers might have on migrating Atlantic salmon (Hawkins 2006). Background-noise levels within the project area were 118-149 dB re 1µPa rms (root mean square) and sound-pressure levels generated by pile driving ranged from 142-176 dB re 1µPa peak, with sound expose levels (SELs) of between 133-145 dB re 1µPa2-s. Because noise from the activity was high enough to be detected by the salmon it was presumed that the activity may have delayed or prevented upstream migration although no direct observations of fish were made. The conclusions of this study seem to contradict other opinions that suggest that salmonids would have low behavioral sensitivity to sound pressure because their inner ear is not in proximity to the swim bladder (Washington State Department of Transportation 2006). Studies conducted on the Columbia River in Washington concluded salmonids would have to be very close (within 10 feet) to be disturbed and express an avoidance response (Carrasquero 2006).

In regard to shortnose sturgeon, Hastings and Popper (2005) state that the hearing capability of sturgeon is unknown. One study conducted using shortnose sturgeon to investigate the effects of underwater blasting on fish found that fish, including shortnose sturgeon, held in cages more than 140 feet from the blast site were unaffected by the noise (USACE 1999). While no studies have been conducted on the effects of pile driving on shortnose sturgeon, two studies have been conducted on the effects of blasting on this species. Both activities produce sound waves that would act similarly in the water column, making effects comparable. Moser (1999) studied the effects of rock blasting in Wilmington Harbor on caged hatchery reared shortnose sturgeon. In this study, blasts measured had a maximum sound level of 234dB. Fifty shortnose sturgeon were placed at locations 35, 70, 140, 280 and 560 feet upstream and downstream from the blast. Additionally, a control group of 200 individuals were held 0.5 miles from the test blast area. A small number of sturgeon mortalities were recorded during this testing in the cages nearest to the blasts. This study indicated that among the species tested (which included mullet, cyprinodontids and striped bass), mortality rates were lowest for shortnose sturgeon. Injuries noted in fish caged closest to the blast included loss of equilibrium, distended swim bladder and hemorrhaging. Dead fish were generally negatively buoyant, indicating that they would not be noted in surface evaluations of fish mortality following a blast. A study done in the Cooper River, South

Carolina, by Collins and Post (2001) tested the use of blasting caps to possibly repel shortnose sturgeon from a blasting site. Recorded sound levels were between 196-229 dB. Shortnose sturgeon located within 50 feet of the blast were temporarily stunned. No mortalities were reported.

Observations indicate that vibratory hammers are the preferred method for driving piles to reduce impacts to fisheries resources. A vibratory pile driving hammer has a set of jaws that clamp onto the top of the pile (WSDOT 2006). The pile is held steady while the hammer vibrates the pile to the desired depth. Because vibratory hammers are not impact tools, noise levels are not as high as with impact pile drivers. With vibratory hammers, the energy level rises more slowly and is spread out over a longer period of time as compared to air-, diesel-, or hydraulic-driven hammers (WSDOT 2006). Impacts on fish have not been observed in association with vibratory hammers (WSDOT 2006). This is because of the slower rise time and the fact that the energy produced is spread out over the time it takes to drive the pile. Carrasquero (2001) reports that vibratory hammers are unlikely to have a significant impact on migrating salmonid behavior at ranges over 20 to 30 feet from the pile being driven.

The best available information suggests that sound pressure levels greater than 190-194 decibels (dB) have the potential to physically injure fish (Hastings 2002; Hastings and Popper 2005). Sound pressure levels greater than 155dB often illicit avoidance behaviors and can stun small fish (NMFS 2003). The best available information for salmon suggests that thresholds between 180 dB peak and 150 dB rms will protect fish from harm (Hastings 2002 as cited in Washington State Department of Transportation 2006).

Based on these studies, shortnose sturgeon and Atlantic salmon are not likely to be killed due to exposure to sound waves in the range likely to result from the pile driving required for this project (*i.e.*, less than 190dB). This conclusion is based on the studies noted above which only noted mortality at levels of 234dB. Shortnose sturgeon and Atlantic salmon may be temporarily stunned if they were close enough to the piles being driven. Injury and mortality are not likely due to exposure to sound waves associated with the pile driving (Moser 1999, Collins and Post 2001) as sound waves will be lower than 234dB.

It is difficult to predict the number of shortnose sturgeon or Atlantic salmon that will likely be exposed to sound waves greater than 155dB. As noted above, sound waves above the no effect threshold (*i.e.*, 155dB) are likely to be experienced as far as 1,860 feet from a steel pile. Pile driving operations at the Brewer Module Facility will occur over 18 weeks. A vibratory hammer will be used to install all sheet piles while an impact hammer will be used only for pipe pile installation. For effects to be likely, a shortnose sturgeon and Atlantic salmon would need to be within 1,860 feet of the pile driving operations. As the Penobscot River in the vicinity of the proposed Brewer Module Facility is about 650 feet wide, it is likely that shortnose sturgeon and Atlantic salmon could detect noises generated by pile driving. NMFS believes it is unlikely that any Atlantic salmon would be adversely affected by the pile driving given that: a) peak sound waves for most of the river will be 155 db or less; b) the best available information for salmon suggests that thresholds between 180 dB peak and 150 dB rms will protect fish from harm (WSDOT 2006), and c) a vibratory hammer will be used to drive all but 8 piles.

During winter months when sturgeon may be over-wintering in the action area, the effects of noise may be much greater. Any sturgeon dislocated from the construction area during winter as a result of pile driving may experience reduced overwintering survival. Shortnose sturgeon exposed to the sound waves greater than 155dB may experience temporary stunning or otherwise be temporarily diverted from normal behaviors. Based upon data collected by UM in 2006 and 2007, the area of the Penobscot River used by overwintering shortnose sturgeon is approximately 7,500 feet in length. As a significant portion of this area is expected to experience little or no impact from pile driving noise, it is reasonable to expect any sturgeon affected by noise to relocate within the overwintering area itself. Therefore, the effects of pile driving on overwintering sturgeon are expected to be insignificant.

CUMULATIVE EFFECTS

Cumulative effects are defined in 50 CFR §402.02 as those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation. The following section discusses potential cumulative effects that are reasonably certain to occur to shortnose sturgeon and Atlantic salmon with the action area of this consultation.

The effects of future state and private activities in the action area that are reasonably certain to occur during construction activities associated with the Brewer Module Facility are recreational fisheries, pollutants, and development and/or construction activities resulting in excessive water turbidity and habitat degradation. Research activities on shortnose sturgeon by UM could also continue during the proposed project. UM has been granted a Scientific Research Permit (Permit No. 1595) by NMFS to capture 100 shortnose sturgeon annually in the Penobscot River for a five year period (2007-2011). No more than two shortnose sturgeon may be sampled lethally as part of Permit 1595. Permit 1595 does not authorize any lethal take of listed Atlantic salmon in the Penobscot River during research activities.

Impacts to shortnose sturgeon and Atlantic salmon from non-federal activities are largely unknown in this river. It is possible that occasional recreational fishing for anadromous fish species may result in incidental takes of shortnose sturgeon and Atlantic salmon. There have been no documented takes of shortnose sturgeon in the action area. One Atlantic sturgeon was captured by an angler in 2005. Thus, the operation of these hook and line fisheries and other fisheries could result in future shortnose sturgeon or Atlantic salmon mortality and/or injury.

In December 1999, the State of Maine adopted regulations prohibiting all angling for sea-run salmon statewide. A limited catch-and-release fall fishery (September 15 to October 15) for Atlantic salmon in the Penobscot River was recently authorized by the MASC for 2007. Angling is limited to 150 feet downstream of the Veazie Dam to the Bangor Dam. Considering the low numbers of GOM DPS origin Atlantic salmon in this area of the Penobscot, this fishery is not expected to significantly affect listed Atlantic salmon. Despite strict state and federal regulations, both juvenile and Atlantic salmon remain vulnerable to injury and mortality due to incidental capture by recreational anglers and as bycatch in commercial fisheries. The best available information indicates that Atlantic salmon are still incidentally caught by recreational anglers. Evidence suggests that Atlantic salmon are also targeted by poachers (NMFS 2005). Commercial fisheries for elvers (juvenile eels) and alewives may also capture Atlantic salmon as bycatch. No estimate of the numbers of Atlantic salmon caught incidentally in recreational or commercial fisheries exists.

Pollution from point and non-point sources has been a major problem in this river system, which continues to receive discharges from sewer treatment facilities and paper production facilities (metals, dioxin, dissolved solids, phenols, and hydrocarbons). Contaminants introduced into the water column or through the food chain, eventually become associated with the benthos where bottom dwelling species like shortnose sturgeon are particularly vulnerable. Atlantic salmon are also vulnerable to impacts from pollution and are also likely to continue to be impacted by water quality impairments in the Penobscot River and its tributaries.

Contaminants associated with the action area are directly linked to industrial development along the waterfront. PCBs, heavy metals, and waste associated with point source discharges and refineries are likely to be present in the future due to continued operation of industrial facilities. In addition many contaminants such as PCBs remain present in the environment for prolonged periods of time and thus would not disappear even if contaminant input were to decrease. It is likely that shortnose sturgeon and Atlantic salmon will continue to be affected by contaminants in the action area in the future.

Industrialized waterfront development will continue to impact the water quality in and around the action area. Sewage treatment facilities, manufacturing plants, and other facilities present in the action area are likely to continue to operate. Excessive water turbidity, water temperature variations and increased shipping traffic are likely with continued future operation of these facilities. As a result, shortnose sturgeon foraging and/or distribution in the action area may be adversely affected.

Sources of contamination in the action area include atmospheric loading of pollutants, stormwater runoff from development, groundwater discharges, and industrial development. Chemical contamination may have an effect on listed species reproduction and survival.

As noted above, impacts to listed species from all of these activities are largely unknown. However, NMFS has no information to suggest that the effects of future activities in the action area will be any different from effects of activities that have occurred in the past.

INTEGRATION AND SYNTHESIS OF EFFECTS

Shortnose sturgeon

Shortnose sturgeon are endangered throughout their entire range. This species exists as nineteen separate populations that show no evidence of interbreeding. The shortnose sturgeon residing in the Penobscot River form one of these nineteen populations.

NMFS has estimated that the proposed action, the issuance of a permit by the ACOE to Cianbro for associated dredging, piling driving, and other instream activities for the proposed Brewer Module Facility, will result in the mortality of no more than 3 shortnose sturgeon. As explained in the "Effects of the Action" section, all other effects on shortnose sturgeon and their habitat are likely to be insignificant or discountable. Furthermore, the project is not likely to alter the

Penobscot River in a way that would make the action area unsuitable for use as a migratory pathway for any life stage of shortnose sturgeon.

NMFS believes that the authorization of the proposed action would not reduce the reproduction or distribution of shortnose sturgeon in the Penobscot River. This action is not likely to reduce reproduction because it is not likely to affect spawning activity and the action will not affect suitable spawning habitat or prevent shortnose sturgeon from attempting or completing spawning. It is not likely to reduce distribution because the action will not impede shortnose sturgeon from accessing foraging, overwintering or spawning grounds in the Penobscot River. Nor is it expected that the action would reduce the river by river distribution of shortnose sturgeon. While the dredging is likely to kill up to three shortnose sturgeon, this number represents a small percentage of the shortnose sturgeon population in the Penobscot River, which is believed to be stable and consist of at least 120 adults, and an even smaller percentage of the total population of shortnose sturgeon rangewide. The best available population estimates indicate that there are at least 120 adult shortnose sturgeon in the Penobscot River and that the population size likely ranges between 300 and 2,000 adult and sub-adult shortnose sturgeon in the Penobscot River and an unknown number of juveniles. While the loss of three juvenile or adult shortnose sturgeon will have a small effect on the number of shortnose sturgeon in the Penobscot River, it is not likely that this effect will be detectable at a population level; therefore, the loss of three shortnose sturgeon will not have a detectable effect on the species as a whole.

While the loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers, reproduction and distribution of the species, in general this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of shortnose sturgeon because: 1) the species is widely geographically distributed; 2) it is not known to have low levels of genetic diversity; and 3) in the case of the Penobscot River population, there may be hundreds of spawning adults.

For these reasons, NMFS believes that there is not likely to be any reduction in reproduction and distribution and only a small and likely undetectable decrease in the numbers of shortnose sturgeon in the Penobscot River population and an undetectable decrease in the species as a whole. As such, there is not likely to be an appreciable reduction in the likelihood of survival and recovery in the wild of the Penobscot River population or the species as a whole.

Atlantic salmon

Atlantic salmon in the GOM DPS currently exhibit critically low spawner abundance, poor marine survival, and are still confronted with a variety of threats. Numbers of endangered adult Atlantic salmon returning to the GOM DPS are extremely low, with only 79 adults in 2006, with less than 20 returning annually to the Penobscot system. Based upon the best available scientific information, NMFS has determined that interactions between project operations and any listed adult Atlantic salmon would be insignificant. Additionally, there are no likely effects on foraging Atlantic salmon. The action is also not likely to significantly alter migratory or resting behavior of Atlantic salmon. As the proposed action will not affect the numbers, reproduction or distribution of Atlantic salmon, it will not affect the likelihood of survival and recovery of the GOM DPS.

CONCLUSION

After reviewing the best available information on the status of endangered and threatened species under NMFS jurisdiction, the environmental baseline for the action area, the effects of the action, and the cumulative effects, it is NMFS' biological opinion that the proposed action may adversely affect but is not likely to jeopardize the continued existence of shortnose sturgeon or Atlantic salmon. Because no critical habitat is designated in the action area, none will be affected by the proposed action.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. NMFS interprets the term "harm" as an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering (50 CFR §222.102). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

Amount or Extent of Incidental Take

The proposed project has the potential to directly affect shortnose sturgeon by causing them to become entrapped in the dredge. These interactions are likely to cause mortality to the affected shortnose sturgeon. Based on the known seasonal distribution of shortnose sturgeon in the Penobscot River and information available on historic interactions between shortnose sturgeon and dredging operations, NMFS anticipates that no more than 3 shortnose sturgeon are likely to be directly affected by this action. This number will account for shortnose sturgeon injured or killed during dredging operations as well as shortnose sturgeon captured in the dredge bucket and released apparently unharmed. Shortnose sturgeon are also likely be affected by pile driving and sediment plumes in the action area but these effects are not likely to injure or kill any shortnose sturgeon.

The proposed project is likely to adversely affect shortnose sturgeon through disturbance in and near the overwintering area. However, these effects are not likely to injure or kill any shortnose sturgeon in the action area. Therefore, the following ITS does not exempt any take from harm or harassment of shortnose sturgeon.

The proposed project is also likely to adversely affect adult Atlantic salmon through increased sediment loads and pile driving in the Penobscot River. However, these effects are not likely to injure or kill any Atlantic salmon in the action area. Therefore, the following ITS does not exempt any lethal take of Atlantic salmon associated with issuance of a Corps permit to Cianbro.

NMFS believes this level of incidental take is reasonable given the seasonal distribution and abundance of shortnose sturgeon in the action area and the level of take of shortnose sturgeon at other dredging projects. In the accompanying biological opinion, NMFS determined that this level of anticipated take is not likely to result in jeopardy to the species.

Reasonable and prudent measures
NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize and monitor impacts of incidental take of the Penobscot River population of shortnose sturgeon:

1. NMFS must be contacted before dredging commences and again upon completion of the dredging activity.
2. A NMFS-approved observer must be present on board the dredge barge for the duration of the project.
3. The ACOE shall ensure that the dredge is equipped and operated in a manner that provides the endangered species observer with a reasonable opportunity for detecting interactions with listed species and that provides for handling and collection of shortnose sturgeon during project activity.
4. All interactions with shortnose sturgeon must be promptly reported to NMFS.

Terms and conditions
In order to be exempt from prohibitions of section 9 of the ESA, ACOE and Cianbro must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and which outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. To implement RPM #1, the ACOE must require Cianbro to contact NMFS (Jeff Murphy: by email (Jeff.Murphy@noaa.gov) or phone (207) 866- 7379 within 24-hours of the commencement of dredging and again within 24-hours of the completion of dredging activity.

2. To implement RPM #2, during all dredging operations, a trained NMFS-approved observer must be present and conduct monitoring duties in accordance with the attached "Observer Protocol" and "Observer Criteria" (see Appendix A).

3. To implement RPM #2, observer coverage must be sufficient for 100% monitoring of dredging operations. All biological material observed in the dredge bucket or the scow must be documented by the observer.

4. To implement RPM #3, the ACOE must ensure that Cianbro and the dredge contractor adhere to the attached "Monitoring Specifications for Mechanical Dredges" (see Appendix A).

5. To implement RPM #3, the ACOE must require Cianbro to contact NMFS within 24 hours of any interactions with shortnose sturgeon, including non-lethal and lethal takes (Jeff Murphy: by email (Jeff.Murphy@noaa.gov) or phone (207) 866- 7379 or the Endangered Species Coordinator by phone (978)281-9208 or fax 978-281-9394).

6. To implement RPM #3, the ACOE must require the NMFS- approved observer to photograph and measure any shortnose sturgeon observed during project operations (including whole sturgeon or body parts observed at the disposal location) and the corresponding form (Appendix B) must be completed and submitted to NMFS **within 24 hours** by fax (978-281-9394).

7. To implement RPM #3, the ACOE must require the NMFS-approved observer in the event of any lethal takes, any dead specimens or body parts must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with NMFS. The form included as Appendix B must be completed and submitted to NMFS as noted above.

8. To implement RPM #4, the ACOE must require of Cianbro that if any lethal take occurs, the NMFS-approved observer must take fin clips (according to the procedure outlined in Appendix C) to be returned to NMFS for ongoing analysis of the genetic composition of the Penobscot River shortnose sturgeon population.

9. To implement RPM #3, the ACOE must require Cianbro to submit a final report at the end of each calendar year summarizing the results of dredging activities and any takes of listed species to NMFS by mail (to the attention of the Endangered Species Coordinator, NMFS Protected Resources Division, One Blackburn Drive, Gloucester, MA 01930).

10. To implement RPM #4, the ACOE must require Cianbro to monitor shortnose sturgeon presence and movements in the Bangor/Brewer overwinter area during dredging and pile driving operations. Specifically, hydrophones and radio telemetry receivers must be used to detect and document the presence and movements of any acoustically or radio-tagged sturgeon in this area of the Penobscot River semi-weekly (twice a week) throughout all dredging and pile driving activities in the river. The results of this monitoring effort must be provided in a monthly report to Jeff Murphy, NMFS, 17 Godfrey Drive, Orono, Maine, 04967.

11. To implement RPM #4, the ACOE must measure ambient TSS, mercury, and copper concentrations in the Penobscot River before, during, and after dredging operations in the action area. This information will be used to determine any acute or chronic effects of water quality on listed shortnose sturgeon.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize and monitor the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, the level of incidental take is exceeded, reinitiation of consultation and review of the reasonable and prudent measures are required. ACOE must immediately provide an explanation of the causes of the taking and review with NMFS the need for possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

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

(1) Population information on certain life stages of shortnose sturgeon is still sparse for this river system. The ACOE should continue to support studies to evaluate habitat and the use of the river, in general, by shortnose sturgeon in the Penobscot River. For example, shortnose sturgeon population surveys using DIDSON sonar during and after dredging operations in the Penobscot River will yield valuable data concerning species interactions.

(2) If any lethal take occurs, ACOE should require or encourage Cianbro to arrange for contaminant analysis of the specimen. If this recommendation is to be implemented, the fish should be immediately frozen and NMFS should be contacted within 24 hours to provide instructions on shipping and preparation

(3) If any interactions with Atlantic sturgeon occur, the endangered species observer should document the interaction with photographs and a written report. This report should be submitted to NMFS, to the attention of Kim Damon-Randall (by fax 978-281-9394 or e-mail Kimberly.Damon-Randall@Noaa.gov). If any Atlantic sturgeon are killed during dredging operations, the specimen should be refrigerated or frozen until disposal procedures are discussed with NMFS.

REINITIATION OF CONSULTATION

This concludes formal consultation on the issuance of permits by the ACOE for associated dredging and construction activities at the Brewer Module Facility. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may not have been previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species; or (4) a new species is listed or critical habitat designated that may be affected by the identified action. In instances where the amount or extent of incidental take is exceeded, Section 7 consultation must be reinitiated immediately.

LITERATURE CITED

ACOE. 1991. Biological Assessment for shortnose sturgeon, Connecticut River below Hartford, Connecticut. Prepared by: Impacts Analysis Division, USACOE, Waltham, MA.

ACOE. 1997. Biological assessment for shortnose sturgeon (Acipenser brevirostrum) in the Kennebec River, Bath, Maine. Prepared by: USACOE, Waltham, MA.

ACOE. 1998. Entrainment by hydraulic dredges – A review of potential impacts. Dredging Operations and Environmental Research. Technical Note DOER-E1.

Allen, R. 1940. Studies on the biology of the early stages of the salmon (Salmo salar): growth in the river Eden. J. Animal Ecol. 9(1):1-23.

Ashbrook, C.E., K.W. Yi, and J. Arterburn. Tangle nets and gill nets as a live capture selective method to collect fall Chinook salmon broodstock in the Okanogan River: 2004. Washington Dept. of Fish and Wildlife. Olympia, WA.

Atkins, C.G. 1874. On the salmon of eastern North America, and its artificial culture. Pages 227-335 in United States Commission of Fish and Fisheries Report of the Commissioner for 1872 and 1973, part II. Washington.

Bain, M.B., D.L. Peterson, and K.K. Arend. 1998. Population status of shortnose sturgeon in the Hudson River. Final Report to the National Marine Fisheries Service. U.S. ACE Agreement # NYD 95-38.

Baum, E.T. 1997. Maine Atlantic Salmon - A National Treasure. Atlantic Salmon Unlimited, Hermon, Maine.

Beland, K. 1984. Strategic plan for management of Atlantic salmon in the state of Maine. Atlantic Sea Run Salmon Commission, Bangor, Maine.

Beland, K. and K. Friedland. 1997. Estimating freshwater and marine survival for Atlantic salmon cohorts spawned in 1989-1991, Narraguagus River, Maine. American Fisheries.

Bley, P.W. 1987. Age, growth, and mortality of juvenile Atlantic salmon in streams: a review. Biological Report 87(4). U.S. Fish and Wildlife Service, Washington, D.C.

Bley, P.W. and J.R. Moring. 1988. Freshwater and ocean survival of Atlantic salmon and steelhead: a synopsis. Biological Report 88(9). Maine Cooperative Fish and Wildlife Research Unit, Orono.

Buckley, J. and B. Kynard. 1985. Habitat use and behavior of pre-spawning and spawning shortnose sturgeon, Acipenser brevirostrum, in the Connecticut River. North American Sturgeons: 111-117.

Burton, W. 1993. Effects of bucket dredging on water quality in the Delaware River and the potential for effects on fisheries resources. Prepared by Versar, Inc. for the Delaware Basin Fish and Wildlife Management Cooperative, unpublished report. 30 pp.

Carrasquero, J. 2001. Over-water structures: Freshwater issues. White Paper. Submitted to Washington Dept. Fish and Wildlife; Washington Dept. of Ecology; Washington Dept. of Transportation.

Colavecchia, M., C. Katapodis, R. Goosney, D. Goosney, D. Scruton, and R. McKinley. Measurement of burst swimming performance in wild Atlantic salmon using digital telemetry. Regulated Rivers Research & Management. 14: 41-51.

Collins, M.R. et al. 1996. Bycatch of sturgeons along the southern Atlantic coast of the USA. North American Journal of Fisheries Management 16:24-29.

Collins, M.R. and W.C. Post. 2003. Research and management of endangered species in South Carolina, part 2: shortnose sturgeon in the Winyah Bay system, South Carolina. Final Report to NMFS, Project No. NA17FL1541. SCDNR. Charleston, South Carolina. 40 pp.

Cooper, K. 1989. Effects of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans on aquatic organisms. Reviews in Aquatic Sciences 1(2):227-242.

Crance, J. H. 1986. Habitat suitability index model and instream flow suitability curves: shortnose sturgeon. US Fish Wildl. Serv. Biol. Rep. 82(10.129). 31pp.

Crouse, D.T. 1999. The consequences of delayed maturity in a human-dominated world. American Fisheries Society Symposium. 23:195-202.

Crouse, D.T., L.B. Crowder, and H. Caswell. 1987. A stage-based population model for loggerhead sea turtles and implications for conservation. Ecol. 68:1412-1423.

Crowder, L.B., D.T. Crouse, S.S. Heppell. and T.H. Martin. 1994. Predicting the impact of turtle excluder devices on loggerhead sea turtle populations. Ecol. Applic. 4:437-445.

Crowder, L.B., S.R. Hopkins-Murphy, and A. Royle. 1995. Estimated effect of turtle excluder devices (TEDs) on loggerhead sea turtle strandings with implications for conservation. Copeia. 1995:773-779.

Dadswell, M.J. 1979. Biology and population characteristics of the shortnose sturgeon, *Acipenser brevirostrum* LeSueur 1818 (Osteichthyes: Acipenseridae), in the Saint John River estuary, New Brunswick, Canada. Can. J. Zool. 57: 2186-2210.

Dadswell, M.J., B.D. Taubert, T.S. Squiers, D. Marchette, and J. Buckley. 1984. Synopsis of biological data on shortnose sturgeon, *Acipenser brevirostrum* LeSueur 1818. National Oceanic and Atmospheric Administration Technical Report NMFS 14, Washington, D.C.

Danie, D.S., J.G. Trial, and J.G. Stanley. 1984. Species profiles: life histories and environmental requirements of coastal fish and invertebrates (North Atlantic) – Atlantic salmon. U.S. Fish Wildl. Serv. FW/OBS-82/11.22. U.S. Army Corps of Engineers, TR EL-82-4. 19 pp.

Dovel, W.L. 1981. The endangered shortnose sturgeon of the Hudson estuary: its life history and vulnerability to the activities of man. Final Report to the Federal Energy Regulatory Commission, Washington, D.C.

Dutil, J.-D. and J.-M. Coutu. 1988. Early marine life of Atlantic salmon, Salmo salar, postsmolts in the northern Gulf of St. Lawrence. Fish. Bull. 86(2):197-211.

Elliot, J.M. 1991. Tolerance and resistance to thermal stress in juvenile Atlantic salmon, Salmo salar. Fresh. Biol. 25:61-70.

Environmental Research and Consulting, Inc. 2003. Contaminant Analysis of Tissues from a Shortnose Sturgeon from the Kennebec River, Maine. Unpublished report submitted to the National Marine Fisheries Service Protected Resources Division. 8p.

Fay, C., M. Bartron, S. Craig, A. Hecht, J. Pruden, R. Saunders, T. Sheehan, and J. Trial. 2006. Status Review for Anadromous Atlantic Salmon (Salmo salar) in the United States. Report to the National Marine Fisheries Service and U.S. Fish and Wildlife Service. 294 pp.

Farmer, G.J., D. Ashfield and J.A. Ritter. 1977. Seawater acclimation and parr-smolt transformation of juvenile Atlantic salmon, Salmo salar. Freshwater and Anadromous Division, Resourc. Branch, Fish. Mar. Serv., Tech. Rep. Serv. MAR/T-77-3

Fausch, K.D. 1988. Tests of competition between native and introduced salmonids in streams: what have we learned? Can. J. Fish. Aquat. Sci. 45(12):2238-2246.

Federal Energy Regulatory Commission (FERC). 2006. FERC staff issues Final Environmental Impact Statement on the Crown Landing LNG and Logan Lateral Projects (Docket Nos. CP04-411-000 and CP04-416-000). Issued: April 28, 2006

Fernandes, S.J., M.T. Kinnison, and G.B. Zydlewski. 2006. *Draft* Investigation into the distribution and abundance of Atlantic sturgeon and other diadromous species in the Penobscot River. Report in progress.

Flos, R., A. Caritat, and J. Balasch. 1979. Zinc content in organs of dogfish subject to sublethal experimental aquatic zinc pollution. Comparative Biochemistry and Physiology 64C: 77-81.

Flournoy, P.H., S.G. Rogers, and P.S. Crawford. 1992. Restoration of shortnose sturgeon in the Altamaha River, Georgia. Final Report to the U.S. Fish and Wildlife Service, Atlanta, Georgia.

Fraser, P.J. 1987. Atlantic salmon, Salmo salar L., feed in Scottish coastal waters. Aquaculture Fish. Manage. 18(2):243-247.

Grunwald, C., J. Stabile, J.R. Waldman, R. Gross, and I.I. Wirgin. 2002. Population genetics of shortnose sturgeon, Acipenser brevirostrum, based on sequencing of the mitochondrial DNA control region. Molecular Ecology 11:1885-1898Hall, W.J., T.I.J. Smith, and S.D. Lamprecht. 1991. Movements and habitats of shortnose sturgeon Acipenser brevirostrum in the Savannah River. Copeia 3:695-702.

Hansen, L.P. and P. Pethon. 1985. The food of Atlantic salmon, Salmo salar L., caught by long-line in northern Norwegian waters. J. Fish Biol. 26:553-562.

Hastings, R.W. 1983. A study of the shortnose sturgeon population in the upper tidal Delaware River: assessment of impacts of maintenance dredging. Prepared for the US Army Corps of Engineers. Philadelphia District.

Hastings, M C. and A. N. Popper. 2005. Effects of Sound on Fish. <http://www.dot.ca.gov/hq/env/bio/files/Effects_of_Sound_on_Fish23Aug05.pdf>. Accessed on 20 July 2007.

Hawkins, A. 2006. Assessing the impact of pile driving upon fish. Page 22 *in* C.L. Irwin, P. Garrett, K.P. McDermott, eds. Center for Transportation and the Environment, North Carolina State University, Raleigh, North Carolina.

Hearn, W.E. 1987. Interspecific competition and habitat segregation among stream-dwelling trout and salmon: a review. Fisheries 12(5):24-21.

Hislop, J.R.G. and A.F. Youngson. 1984. A note on the stomach contents of salmon caught by longline north of the Faroe Island in March 1983. ICES C.M. 1984/M:17.

Hislop, J.R.G. and R.G.J. Shelton. 1993. Marine predators and prey of Atlantic salmon (Salmo salar L.). Pages 104-118 in D. Mills, editor. Salmon in the sea and new enhancement strategies. Fishing News Books, Oxford.

Hoar, W. S. 1976. Smolt transformation: evaluation, behavior, and physiology. J. Fish. Res. Board of Canada. 33(5):1233-1252.

Holcombe, GW, DA Benoit and EN Leonard. 1979. Long-term effects of zinc exposures in brook trout. Transactions of the American Fisheries Society 108: 76-87.

Johnson, L. L., E. Casillas, J. E. Stein, T. K. Collier, U. Varanasi. 1992. Contaminant effects on reproductive effects on reproductive success in selected benthic fish species. Marine Environmental Research, 35:165-170.

Jutila, E. and J. Toivonen. 1985. Food composition of salmon post-smolts (Salmo salar L.) in the Northern part of the Gulf of Bothnia. ICES C.M. 1985/M:21.

Kalleberg, H. 1958. Observations in a stream tank of territoriality and competition in juvenile salmon and trout (Salmo salar L. and S. trutta L.). Report/Institute of Fresh-Water Research, Drottningholm 39:55-98.

Kendall, W. C. 1935. The fishes of New England: the salmon family. Part 2 – the salmons. Memoirs of the Boston Society of Natural History: monographs on the natural history of New England, Boston, MA. 90 pp.

Kieffer, M.C. and B. Kynard. 1993. Annual movements of shortnose and Atlantic sturgeons in the Merrimack River, Massachusetts. Transactions of the American Fisheries Society 1221: 1088-1103.

Kieffer, M.C. and B. Kynard. In press. Pre-spawning migration and spawning of Connecticut River shortnose sturgeon. American Fisheries Society. 86 pages.

Knight, J. A. 1985. Differential preservation of calcined bone at the Hirundo site, Alton, Maine. Master's Thesis, Institute for Quaternary Studies, University of Maine, Orono, Maine.

Kocan, R.M., M.B. Matta, and S. Salazar. 1993. A laboratory evaluation of Connecticut River coal tar toxicity to shortnose sturgeon (Acipenser brevirostrum) embryos and larvae. Final Report to the National Oceanic and Atmospheric Administration, Seattle, Washington.

Kocik, J.F., K.F. Beland and T.F. Sheehan. 1999. Atlantic salmon overwinter survival and smolt production in the Narraguagus River. O-99-NEC-1. Woods Hole, Massachusetts.

Kynard, B. 1998. Twenty-two years of passing shortnose sturgeon in fish lifts on the Connecticut River: What has been learned? In: Fish migration and fish bypasses, M. Jungwirth, S. Schmutz, and S. Weiss, Editors. pp. 255-264.

Larson, K. and K. Moehl. 1990. Fish entrainment by dredges in Grays Harbor, Washington. In Effects of dredging on anadromous Pacific Coast fishes. C.A. Simenstad, ed. Washington Sea Grant Program, University of Washington, Seattle, pp 102□112.

LeBar, G.W., J.D. McCleave, and S.M. Fried. 1978. Seaward migration of hatchery-reared Atlantic salmon smolts in the Penobscot River estuary, Maine: open-water movements. Journal du Conseil. International Council for the Exploration of the Sea 38(2): 257-269.

Lundqvist, H. 1980. Influence of photoperiod on growth of Baltic salmon parr (Salmo salar L.) with specific reference to the effect of precocious sexual maturation. Can. J. Zool. 58(5):940-944.

Maine Department of Environmental Protection. 2004. 2004 Integrated Water Quality and Assessment Report. Augusta, Maine.

Maine Department of Marine Resources (MDMR). 2003. Completion Report Kennebec River Shortnose Sturgeon Population Study 1998-2001. Prepared by Thomas S. Squiers, Maine Department of Marine Resources, unpublished report submitted to NMFS. 19 pp.

McCleave, J. D., S. M. Fried and A. K. Towt. 1977. Daily movements of the shortnose sturgeon, *Acipenser brevirostrum*, in a Maine Estuary. Copeia 1977:149-157.

MDMR. 2006. WWW Page: http://www.maine.gov/dmr/recreational/fishes/salmon.htm. Accessed July 7, 2006.

Mills, D. H. 1964. The ecology of young stages of Atlantic salmon in the River Bran, Rosshire. Dept. Agric. Fish. Of Scotland, Freshwater Salmon Fish. Res.

Moser, M.L. and S.W. Ross. 1995. Habitat use and movements of shortnose and Atlantic sturgeons in the lower Cape Fear River, North Carolina. Transactions of the American Fisheries Society 124:225-234.

Moser, M. L., and S. W. Ross. 1995. Habitat use and movements of shortnose and Atlantic sturgeons in the lower Cape Fear River, North Carolina. Transaction of the American Fisheries Society 124: 225-234.

NMFS. 1996. Status Review of shortnose sturgeon in the Androscoggin and Kennebec Rivers. Northeast Regional Office, National Marine Fisheries Service, unpublished report. 26 pp.

NMFS. 1998. Recovery plan for the shortnose sturgeon (Acipenser brevirostrum). Prepared by the Shortnose Sturgeon Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland 104 pp.

NMFS 2000. Protocol for Use of Shortnose and Atlantic Sturgeons. Prepared by Mary Moser *et al.* NOAA Technical Memorandum NMFS-OPR-18.

NMFS (National Marine Fisheries Service). 2003. Final Biological Opinion to the Corps of Engineers on the Proposed Modification of Existing Permits Authorizing the Installation and Maintenance of Aquaculture Fish Pens Within the State of Maine. Gloucester, MA.

NMFS. 2003. Final Biological Opinion on the issuance of a section 10(a)(1)(a) scientific research permit for take of endangered Sacramento River winter-run Chinook salmon, threatened Central Valley spring-run Chinook salmon, and threatened Central Valley steelhead. Sacramento, CA.

NMFS (National Marine Fisheries Service) and USFWS (U.S. Fish and Wildlife Service). 2005. Final Recovery Plan for the Gulf of Maine Distinct Population Segment of the Atlantic Salmon (Salmo salar). National Marine Fisheries Service, Silver Spring, MD.

NMFS. 2006. Endangered Species Act Section 7 consultation on research on Atlantic sturgeon in the Penobscot River, Maine, to be funded by NMFS and carried out by USGS. Gloucester, MA. Biological Opinion, April 20.

Niklitschek, E. J. 2001. Bioenergetics Modeling and Assessment of Suitable Habitat for Juvenile Atlantic And Shortnose Sturgeons in the Chesapeake Bay. Ph.D. thesis, University of Maryland, College Park, MD.

Nightingale, B. and C. A. Simenstad. 2001. Dredging activities: Marine issues. Washington State Transportation Center.

Normandeau Associates. 2001. Bath Iron Works dredge monitoring results. Prepared by Normandeau Associates, Inc. Yarmouth, Maine, unpublished report. 11 pp.

Normandeau Associates. 2003. Bath Iron Works dredge monitoring results -- 2003. Prepared by Normandeau Associates, Inc. Yarmouth, Maine, unpublished report. 5 pp.

O'Herron, J.C., K.W. Able, and R.W. Hastings. 1993. Movements of shortnose sturgeon (Acipenser brevirostrum) in the Delaware River. Estuaries 16:235-240.

Peterson, R.H. 1978. Physical characteristics of Atlantic salmon spawning gravel in some New Brunswick, Canada streams. Can. Fish. Mar. Serv. Tech. Rep. No. 785:1-28.

Peterson, J.B., and D. Sanger. 1986. Archeological Phase II Testing at the Eddington Bend site (74-8), Penobscot County, Maine. Final Report to Bangor Hydro-Electric Company, University of Maine, Orono, Maine.

Randall, R.G. 1982. Emergence, population densities, and growth of salmon and trout fry in two New Brunswick streams. Can. J. Zool. 60(10):2239-2244.

Reddin, D.G. 1985. Atlantic salmon (Salmo salar) on and east of the Grand Bank. J. Northwest Atl. Fish. Soc. 6(2):157-164.

Rogers, S.G. and W. Weber. 1994. Occurrence of shortnose sturgeon (*Acipenser brevirostrum*) in the Ogeechee-Canoochee river system, Georgia, during the summer of 1993. Final Report of the United States Army to the Nature Conservancy of Georgia.

Rogers, S.G. and W. Weber. 1995. Status and restoration of Atlantic and shortnose sturgeons in Georgia. Final Report to the National Marine Fisheries Service, Southeast Regional Office, St. Petersburg, Florida.

Rosenthal H, Alderdice DF (1976) Sublethal effects of environmental stressors, natural and pollutional, on marine fish eggs and larvae. J Fish Res Board Can 33:2047–2065

Ruelle, R., and K.D. Keenlyne. 1993. Contaminants in Missouri River pallid sturgeon. Bull. Environ. Contam. Toxicol. 50: 898-906.

Ruelle, R. and C. Henry. 1994. Life history observations and contaminant evaluation of pallid sturgeon. Final Report U.S. Fish and Wildlife Service, Fish and Wildlife Enhancement, South Dakota Field Office, 420 South Garfield Avenue, Suite 400, Pierre, South Dakota 57501-5408.

Ruggles, C.P. 1980. A review of downstream migration of Atlantic salmon. Canadian Technical Report of Fisheries and Aquatic Sciences. Freshwater and Anadromous Division.

Schaffer, W.M. and P.F. Elson. 1975. The adaptive significance of variations in life history among local populations of Atlantic salmon. Ecology 56:577-590.

Secor and Niklitschek, 2001. Hypoxia and Sturgeon oxyrinchus released into the Chesapeake Bay. Fish. Bull. 98(4): 800-810.

Scott, W.B. and E.J. Crossman. 1973. Atlantic salmon. Pages 192-197 in Freshwater Fishes of Canada (Bulletin 184). Department of Fisheries and Oceans, Scientific Information and Publications Branch, Ottawa.

Sindermann, C. J. 1994. Quantitative effects of pollution on arine and anadromous fish populations. National Oceanic and Atmospheric Administration Technical Memorandum NMFS-F/NEC104. Woods Hole, Massachusetts.

Squiers, T., L. Flagg, and M. Smith. 1982. American shad enhancement and status of sturgeon stocks in selected Maine waters. Completion report, Project AFC-20

Squiers, T. and M. Robillard. 1997. Preliminary report on the location of overwintering sites for shortnose sturgeon in the estuarial complex of the Kennebec River during the winter of 1996/1997. Unpublished report, submitted to the Maine Department of Transportation.

Stolte, L. 1981. The forgotten salmon of the Merrimack. Department of the Interior, Northeast Region, Washington, D.C.

Taubert, B.D. 1980. Reproduction of shortnose sturgeon, *Acipenser brevirostrum*, in the Holyoke Pool, Connecticut River, Massachusetts, USA, and the Saint John River, New Brunswick, Canada. Can. J. Zool. 58: 1125-1128.

Taubert, B.D. 1980. Biology of shortnose sturgeon (*Acipenser brevirostrum*) in the Holyoke Pool, Connecticut River, Massachusetts. Unpublished dissertation report prepared for the University of Massachusetts, Amherst, Massachusetts.

Thomas, P. and I.A. Khan. 1997. Mechanisms of chemical interference with reproductive endocrine function in sciaenid fishes. In: *Chemically Induced Alterations in Functional Development and Reproduction of Fishes*. R.M. Rolland, M. Gilbertson and R.E. Peterson (eds.). pp. 29-51. SETAC Technical Publications Series.

Tytler, P., Thorpe, J. E. & Shearer, W. M. (1978). Ultrasonic tracking of the movements of Atlantic salmon smolts (Salmo salar) in the estuaries of two Scottish rivers. Journal of Fish Biology 12, 575–586.

US Army Corps of Engineers. 1999. Appendix C - Rock Blasting in Wilmington Harbor, NC. <http://www.fws.gov/nc-es/pubs/fwca/wilmington/App_C_blast.pdf> Accessed 20 July, 2007.

U.S. Atlantic Salmon Assessment Committee. 2005. Annual Report of the U.S. Atlantic Salmon Assessment Committee: Report No. 17- 2004 Activities. 2005/17. Concord, New Hampshire.

U.S. Atlantic Salmon Assessment Committee. 2006. Annual Report of the U.S. Atlantic Salmon Assessment Committee: Report No. 18- 2005 Activities. 2005/18. Gloucester, MA.

U.S. Atlantic Salmon Assessment Committee. 2007. Annual Report of the U.S. Atlantic Salmon Assessment Committee: Report No. 19- 2006 Activities. 2006/19. Concord, New Hampshire. Gloucester, MA.

USDOI. 1973. Threatened Wildlife of the United States. Resource Publication 114. March 1973.

USFWS (U.S. Fish and Wildlife Service). 1989. Final environmental impact statement 1989-2021: restoration of Atlantic salmon to New England rivers. Department of the Interior, U.S. Fish and Wildlife Service, Newton Corner, MA.

USFWS (U.S. Fish and Wildlife Service) and NMFS (National Marine Fisheries Service). 2000. Endangered and threatened species; final endangered status for a distinct population segment of anadromous Atlantic salmon (Salmo salar) in the Gulf of Maine. Federal Register 65 (223): 69459-69483.

Vander Haegen, G.E., K.W. Yi, C.E. Ashbrook, E.W. White and L.L. LeClair. 2002. Evaluate Live Capture Selective Harvest Methods. BPA Contract 2001-007-00 36p. {Macdonald, 1984 #1496}

Vladykov, V.D., and J.R. Greeley. 1963. Order Acipenseroidei. Pages 24-60 *In*: Fishes of the western North Atlantic. Part III. Memoirs of the Sears Foundation for Marine Research 1.

Waldman, J.R., C. Grunwald, J. Stabile, and I. Wirgin. 2002. Impacts of life history and biogeography on the genetic stock structure of Atlantic sturgeon Acipenser oxyrinchus oxyrinchus, Gulf sturgeon A. oxyrinchus desotoi, and shortnose sturgeon A. brevirostrum. J. Appl. Icthyol. 18:509-518.

Walsh, M.J., M. Bain, T. Squires, J. Waldman, and I. Wirgin. 2001. Morphological and Genetic Variation among Shortnose Sturgeon Acipenser brevirostrum from Adjacent and Distant Rivers. Estuaries 24: 41-48.

Washington State Department of Transportation. 2006. Noise Impact Assessment. <http://www.wsdot.wa.gov/TA/Operations/Environmental/NoiseChapter011906.pdf> Accessed on 20 July 2007.

Weber, W. 1996. Population size and habitat use of shortnose sturgeon, *Acipenser brevirostrum*, in the Ogeechee River system, Georgia. Unpublished Master Thesis, University of Georgia, Athens, Georgia.

Wirgin, I., C. Grunwald, E. Carlson, J. Stabile, and J. Waldman. Range-wide population structure of shortnose sturgeon (*Acipenser brevirostrum*) using mitochondrial DNA control region sequence analysis. Fisheries Bulletin.

APPENDIX A

MONITORING SPECIFICATIONS FOR MECHANICAL DREDGES

I. EQUIPMENT SPECIFICATIONS

A. Floodlights

Floodlights must be installed to allow the NMFS-approved observer to safely observe and monitor dredge bucket and scow.

B. Intervals between dredging

Sufficient time must be allotted between each dredging cycle for the NMFS-approved observer to inspect the dredge bucket and scow for shortnose sturgeon and/or sturgeon parts and document the findings.

II. OBSERVER PROTOCOL

A. Basic Requirement

A NMFS-approved observer with demonstrated ability to identify shortnose sturgeon must be placed aboard the dredge(s) being used starting immediately upon project commencement to monitor for the presence of listed species and/or parts being taken or present in the vicinity of dredge operations.

B. Duty Cycle

A NMFS-approved observer must be onboard during dredging until the project is completed. While onboard, observers shall provide the required inspection coverage to provide 100% coverage of all dredge-cycles.

C. Inspection of Dredge Spoils

During the required inspection coverage, the NMFS-approved observer shall observe the bucket as it comes out of the water and as the load is deposited into the scow during each dredge cycle for evidence of shortnose sturgeon. If any whole shortnose sturgeon (alive or dead) or shortnose sturgeon parts are taken incidental to the project(s), Jeff Murphy (207) 866-7379 or Pat Scida (978) 281-9208 must be contacted **within 24 hours** of the take. An incident report for shortnose sturgeon take (Appendix C) shall also be completed by the observer and sent to Jeff Murphy via FAX (207) 866-7342 within 24 hours of the take. Incident reports shall be completed for every take regardless of the state of decomposition. Every incidental take (alive or dead, decomposed or fresh) should be photographed. A final report including all completed load sheets, photographs, and relevant incident reports are to be submitted to the attention of Jeff Murphy, NMFS, Maine Field Station, 17 Godfrey Drive, Orono, Maine 04473.

D. Inspection of Disposal

The NMFS-approved observer shall observe all disposal operations to inspect for any whole shortnose sturgeon or sturgeon parts that may have been missed when the load was deposited into the scow. If any whole shortnose sturgeon (alive or dead) or shortnose sturgeon parts are observed during disposal operation, the procedure for notification and documentation outlined above should be completed.

E. Disposition of Parts

If any whole shortnose sturgeon (alive or dead, decomposed or fresh) or shortnose sturgeon parts are taken incidental to the project(s), Jeff Murphy (207) 866-7379 or Pat Scida (978) 281-9208 must be contacted within 24 hours of the take. All whole dead shortnose sturgeon, or shortnose sturgeon parts should be photographed and described in detail on the Incident Report of Shortnose Sturgeon Take (Appendix C). The photographs and reports should be submitted to Jeff Murphy, NMFS, Maine Field Station, 17 Godfrey Drive, Orono, Maine 04473. All whole dead shortnose sturgeon or shortnose sturgeon parts should be refrigerated or frozen. Disposition of dead shortnose sturgeon will be determined by NMFS.

III. OBSERVER REQUIREMENTS

Submission of resumes of endangered species observer candidates to NMFS for final approval ensures that the observers placed onboard the dredges are qualified to document takes of endangered and threatened species, to confirm that incidental take levels are not exceeded, and to provide expert advice on ways to avoid impacting endangered and threatened species. NMFS does not offer certificates of approval for observers, but approves observers on a case-by-case basis.

A. Qualifications

Observers must be able to:

1) differentiate between shortnose (*Acipenser brevirostrum*) and Atlantic (*Acipenser oxyrinchus oxyrinchus*) sturgeon and their parts;
2) handle live sturgeon;
3) correctly measure the total length and width of live and whole dead sturgeon species;

B. Training

Ideally, the applicant will have educational background in biology, general experience aboard dredges, and hands-on field experience with the species of concern. For observer candidates who do not have sufficient experience or educational background to gain immediate approval as endangered species observers, we note below the observer training necessary to be considered admissible by NMFS. We can assist the ACOE by identifying groups or individuals capable of providing acceptable observer training. Therefore, at a minimum, observer training must include:

1) instruction on how to identify sturgeon and their parts;

2) instruction on appropriate screening on hopper dredges for the monitoring of sturgeon(whole or parts);

3) demonstration of the proper handling of live sturgeon incidentally captured during project operations;

4) instruction on standardized measurement methods for sturgeon lengths and widths; and
5) instruction on dredging operations and procedures, including safety precautions onboard.

APPENDIX B

Incident Report of Shortnose Sturgeon Take

SHORTNOSE STURGEON SALVAGE FORM

Version 05-21-2007 for documenting dredge interactions

INVESTIGATORS'S CONTACT INFORMATION
Name: First ______________ Last ____________________
Agency Affiliation ______________________________________
Address ____
____
Area code/Phone number __________________________________

UNIQUE IDENTIFIER (Assigned by NMFS)

DATE REPORTED:
Month ☐☐ Day☐☐ Year 20☐☐
DATE EXAMINED:
Month ☐☐ Day☐☐ Year 20☐☐

SPECIES: (check one)
- ☐ shortnose sturgeon
- ☐ Atlantic sturgeon
- ☐ Unidentified Acipenser species

Check "Unidentified" if uncertain. See reverse side of this form for aid in identification.

LOCATION FOUND: ☐Offshore (Atlantic or Gulf beach) ☐Inshore (bay, river, sound, inlet, etc)
River/Body of Water_____________ City____________________ State ____
Descriptive location (be specific)_________________________________
____
____
Latitude ____________N (Dec. Degrees) Longitude ____________W (Dec. Degrees)

CARCASS CONDITION at time examined: (check one)
- ☐ 1 = Fresh dead
- ☐ 2 = Moderately decomposed
- ☐ 3 = Severely decomposed
- ☐ 4 = Dried carcass
- ☐ 5 = Skeletal, scutes & cartilage

SEX:
- ☐ Undetermined
- ☐ Female ☐ Male

How was sex determined?
- ☐ Necropsy
- ☐ Eggs/milt present when pressed
- ☐ Borescope

MEASUREMENTS: Circle unit
Fork length ________ cm / in
Total length ________ cm / in
Length ☐ actual ☐ estimate
Mouth width (inside lips, see reverse side) ________ cm / in
Interorbital width (see reverse side) ________ cm / in
Weight ☐ actual ☐ estimate ________ kg / lb

TAGS PRESENT? Examined for external tags including fin clips? ☐ Yes ☐ No Scanned for PIT tags? ☐ Yes ☐ No

Tag #	Tag Type	Location of tag on carcass

CARCASS DISPOSITION: (check one or more)
- ☐ 1 = Left where found
- ☐ 2 = Buried
- ☐ 3 = Collected for necropsy/salvage
- ☐ 4 = Frozen for later examination
- ☐ 5 = Other (describe) ____________________

Carcass Necropsied?
☐Yes ☐No
Date Necropsied:__________
Necropsy Lead:
____

PHOTODOCUMENTATION:
Photos/vide taken? ☐ Yes ☐ No
Disposition of Photos:__________
____
____

SAMPLES COLLECTED? ☐ Yes ☐ No

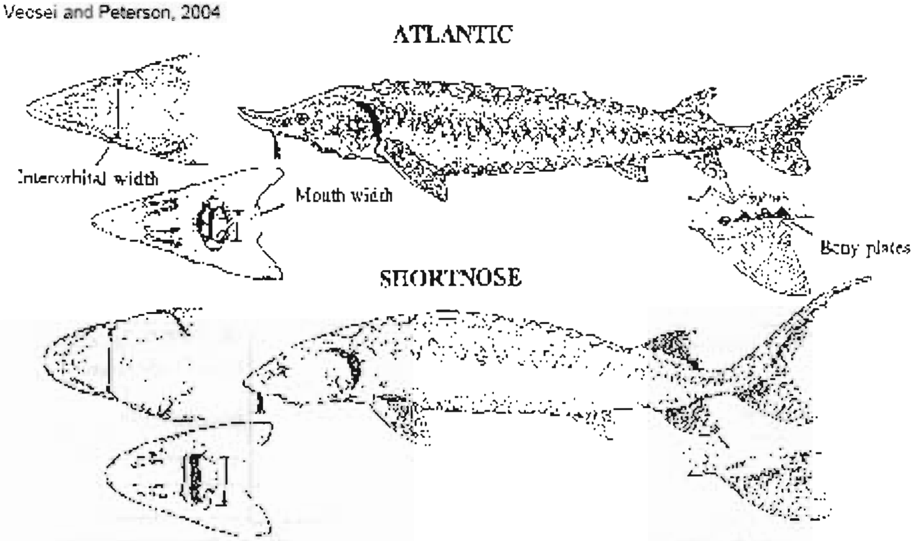
Sample	How preserved	Disposition (person, affiliation, use)

Comments:
____
____
____

Distinguishing Characteristics of Atlantic and Shortnose Sturgeon

Characteristic	Atlantic Sturgeon, *Acipenser oxyrinchus*	Shortnose Sturgeon, *Acipenser brevirostrum*
Maximum length	> 9 feet/ 274 cm	4 feet/ 122 cm
Mouth	Football shaped and small. Width inside lips < 55% of bony interorbital width	Wide and oval in shape. Width inside lips > 62% of bony interorbital width
*Pre-anal plates posterior to rectum	Large paired pre-anal plates, often followed by a second pair of plates and another, larger single plate	1-3 pre-anal plates, never paired
Plates along the anal fin	Large rhombic plates found along the lateral base of the anal fin	No plates along the base of anal fin
Habitat/Range	Anadromous; spawn in freshwater but primarily lead a marine existence	Freshwater amphidromous; aside from seasonal migrations to estuary, rarely occurs in the marine environment

* From Vecsei and Peterson, 2004



Describe any wounds / abnormalities (note tar or oil, gear or debris entanglement, propeller damage, etc.). Please note if no wounds / abnormalities are found.

Data Access Policy: Upon written request, information submitted to National Marine Fisheries Service (NOAA Fisheries) on this form will be released to the requestor provided that the requestor credit the collector of the information and NOAA Fisheries. NOAA Fisheries will notify the collector that these data have been requested and the intent of their use.

Fax completed for within 24 days of date of the interaction to: Dana Hartley, Shortnose Sturgeon Recovery Coordinator, NOAA Fisheries Northeast Region, One Blackburn Drive, Gloucester, MA 01930
Phone: 978-281-9300 x6514; Fax: 978-281-9394; E-Mail Dana.Hartley@noaa.gov

APPENDIX C

Procedure for obtaining fin clips from shortnose sturgeon for genetic analysis

Obtaining Sample

1. For any dead shortnose sturgeon, after the specimen has been measured and photographed, two one-inch clips from the caudal fin shall be taken.

2. Each fin clip should be placed into a vial of 95% ethanol and the vial should be labeled with the species name, date, name of project and the fork length and total length of the fish along with a note identifying the fish to the appropriate observer report.

Storage of Sample

1. If it is not possible to immediately send the sample to NMFS, the sample should be refrigerated or frozen.

Sending of Sample

1. All vials should be sealed with a lid and further secured with tape. Vials should be placed into Ziploc or similar resealable plastic bags. Vials should be then wrapped in bubble wrap or newspaper (to prevent breakage) and sent to:

   NMFS
   Northeast Regional Office
   Protected Resources Division
   Attn: Endangered Species Coordinator
   One Blackburn Drive
   Gloucester, MA 01930

2. Upon sending a sample, contact Dana Hartley at (207) 866-7379 or Pat Scida at (978) 281-9208 to inform NMFS to expect a sample.