UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
55 Great Republic Drive
Gloucester, MA 01930-2276

NOV - 7 2012

Steven M. Howell, Lieutenant Colonel
District Engineer
New England District, Corps of Engineers
696 Virginia Road
Concord, Massachusetts 01742-2751

Re: Bath Iron Works Facility Wide Dredging and Brake Wheel Project

Dear Lt. Col. Howell,

Our Biological Opinion on the effects of continued maintenance dredging at the Bath Iron Works (BIW) facility and the proposed brake wheel scour protection project is enclosed. This Opinion considers effects of activities to be carried out by BIW and authorized by you under Permit NAE-2007-02528 and NAE-2012-01393. This Opinion also considers the use of the brake wheel system to conduct testing of DDG 1000 by BIW in cooperation with the U.S. Navy. In the Opinion, we conclude that the proposed actions are likely to adversely affect but is not likely to jeopardize the continued existence of shortnose sturgeon, the Gulf of Maine Distinct Population Segment (GOM DPS) of Atlantic sturgeon or the New York Bight DPS of Atlantic sturgeon. Additionally, we conclude that the proposed actions are not likely to adversely affect the GOM DPS of Atlantic salmon or critical habitat designated for Atlantic salmon. By issuing this Opinion, we withdraw the Opinion issued by us on November 4, 2009 regarding the effects of activities authorized under NAE-2007-02528.

As required by Section 7(b)(4) of the ESA, an incidental take statement (ITS) is provided with the Opinion. The ITS exempts the incidental taking of five shortnose sturgeon (three lethal) and two Atlantic sturgeon (one lethal) as a result of interactions with the mechanical dredge. These takes will occur between now and the time the dredging permit expires in November 2019. The Atlantic sturgeon captured or killed could originate from the GOM or New York Bight DPS. We do not anticipate the take of any Atlantic salmon. The ITS also specifies Reasonable and Prudent Measures (RPMs) and implementing Terms and Conditions necessary to minimize the impact of these activities on Atlantic salmon.

The RPM and implementing Terms and Conditions outlined in the ITS are non-discretionary, and must be undertaken so that they become binding conditions for the exemption in section 7(o)(2) to apply. Failure to implement the terms and conditions through enforceable measures may result in a lapse of the protective coverage of section 7(o)(2). If you have any questions regarding these requirements, please let us know.

This Opinion concludes consultation. Reinitiation of consultation is required and shall be requested by you or by us, where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (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.

We look forward to continuing to work cooperatively with your office to minimize the effects of dredging projects in the New England District on listed species. For further information regarding any consultation requirements, please contact Julie Crocker of my staff at (978)282-8480 or by e-mail (Julie.Crocker@noaa.gov). Thank you for working cooperatively with my staff throughout this consultation process.

Sincerely,

for John K. Bullard
Regional Administrator

Ec: Crocker, Murphy - F/NER3
Chiarella – F/NER4
Clement, ACOE (ME Office)

File Code: Section 7 ACOE Maine Bath Iron Works 10 Year Maintenance Permit 2012(Kennebec)
PCTS: F/NER/2012/03995

NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT
BIOLOGICAL OPINION

Agency: U.S. Army Corps of Engineers – New England District
U.S. Navy

Activity Considered: Maintenance Dredging and Brake Wheel Project at Bath Iron Works' Facility along the Kennebec River at Bath, Maine
F/NER/2012/03995

Conducted by: National Marine Fisheries Service
Northeast Region

Date Issued: 11/7/12

Approved by: for John Bullard

Table of Contents

1.0 INTRODUCTION

This constitutes the biological opinion (Opinion) of NOAA's National Marine Fisheries Service (NMFS) issued pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, as amended, on the effects of the Army Corps of Engineers, New England District (USACE) authorization of activities conducted by Bath Iron Works (BIW) at their facility along the Kennebec River, Maine. The activities considered in this Opinion include dredging as authorized by the USACE under Permit NAE-2007-02528 and BIW's Brake Wheel Scour Protection Project, which is proposed for authorization under Permit NAE-2012-01393.

This Opinion is based on information provided in the Biological Assessment (BA) dated August 2012, past consultations with the USACE, and scientific papers and other sources of information as cited in this Opinion. We will keep a complete administrative record of this consultation at our Northeast Regional Office. By issuing this Opinion, we withdraw the Opinion issued by us on November 4, 2009 regarding the effects of activities authorized under NAE-2007-02528.

2.0 CONSULTATION HISTORY

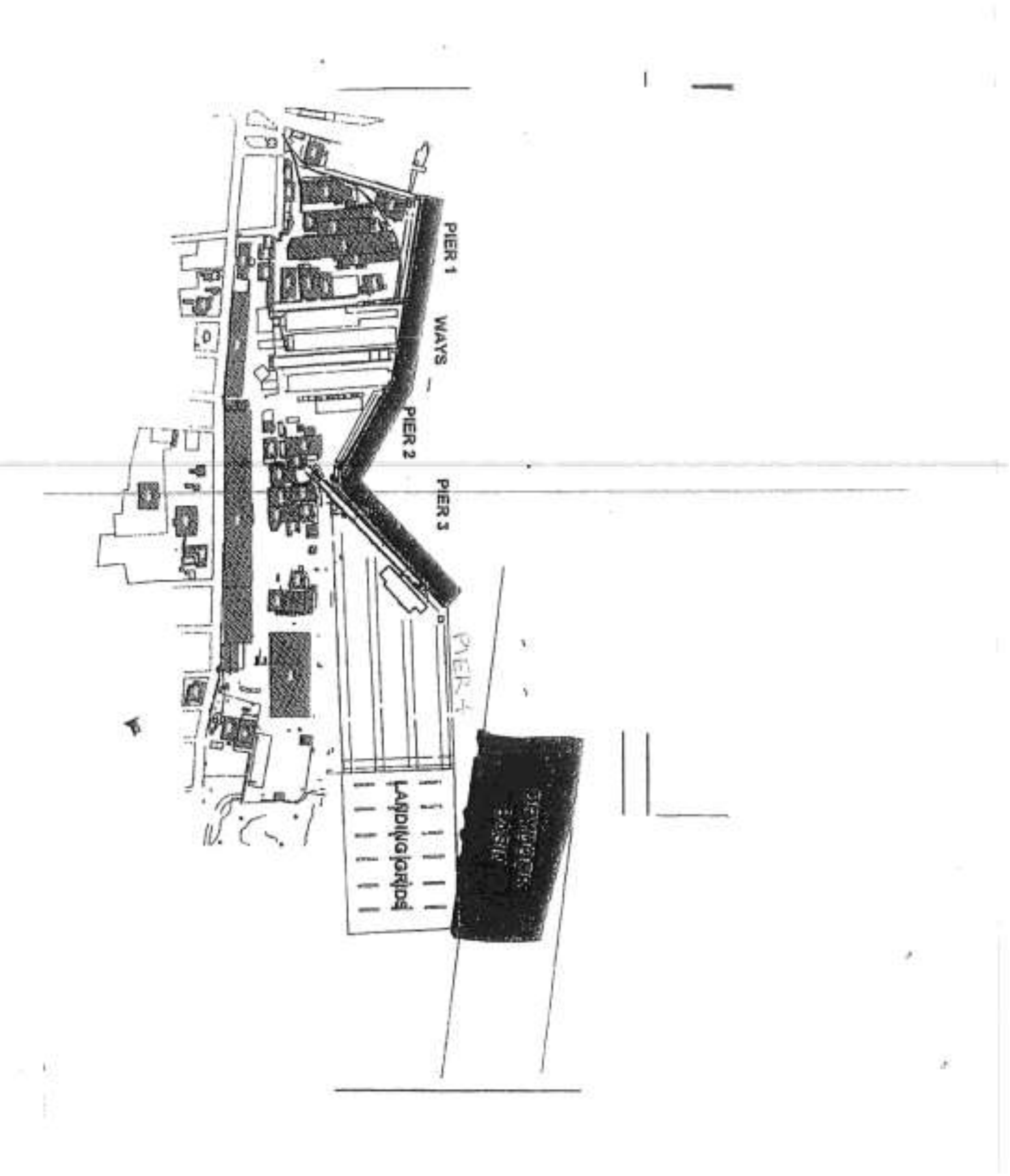
In 1997, BIW began a project to construct a land level transfer facility (LLTF). The work proposed involved dredging the "inboard deck" and creation of a deep sinking basin for the dry dock, pile driving for "outboard deck", drilling/blasting/excavation in the landing grid and construction of landing grid blocks, dolphins, and anchor pads, in addition to shoreline improvements. In a June 10, 1998 letter, we concurred with the USACE's determination that the proposed project was not likely to adversely affect shortnose sturgeon in the Kennebec River.

The USACE, BIW and NMFS began discussing a longterm approach to managing dredging activities at BIW in 2005. BIW routinely dredges three locations at their facility, the dry dock sinking basin, the landing grid, and the berth area (Piers 1, 2 and 3 (see Figure 1)) and authorization for this dredging has occurred under a variety of permits issued by the USACE and subject to consultation with us. In a letter dated July 9, 2009, the USACE requested initiation of consultation with us on their proposed issuance of a permit to authorize ten years of maintenance dredging at the BIW facility. We completed this consultation with the issuance of a Biological Opinion on November 4, 2009. The Opinion considered the effects of ten years of maintenance dredging on shortnose sturgeon, the Gulf of Maine Distinct Population Segment (GOM DPS) of Atlantic salmon and critical habitat designated for Atlantic salmon. In the Opinion, we concluded that the proposed action is likely to adversely affect but is not likely to jeopardize the continued existence of shortnose sturgeon. Additionally, we concluded that the proposed action is not likely to adversely affect the GOM DPS of Atlantic salmon or critical habitat designated for Atlantic salmon.

During the spring of 2012, USACE determined that reinitiation of the 2009 Opinion was necessary due to the listing of five DPSs of Atlantic sturgeon. Additionally, in the spring of 2012, BIW submitted an application to USACE for authorization to place stone rip rap on the river bottom near Pier 4 in anticipation of testing of a new U.S. Navy destroyer with a brake wheel system. On August 17, 2012, USACE requested reinitiation of the 2009 Opinion to consider effects of dredging on Atlantic sturgeon. Additionally, USACE requested that we consider effects of BIW's Brake Wheel Project, which is proposed for authorization under Permit NAE-2012-01393. This consultation was initiated on August 17, 2012. Supplemental information on underwater noise associated with brake wheel operations was provided to us by the Navy and BIW on October 18, 2012.

A brief history of previous consultations conducted between USACE and us regarding dredging activities at the BIW facility is provided below.

Figure 1. BIW Facilities



Dry Dock Sinking Basin

One component of the LLTF was the dry dock. Vessels on the dry dock are brought to the sinking basin where the dry dock is sunk so that the vessels are able to float off the dry dock. Construction of the sinking basin involved the removal of 500,000 cubic yards of material from the Kennebec River. The sinking basin is a 12.6 acre area adjacent to the BIW shipbuilding facility designed to have a depth of 70 feet below mean low water. The original dredging for the construction of the dry dock was completed between November 7, 1998 and January 5, 2000.

When originally constructed, BIW anticipated the sinking basin hole would be self-scouring and would not require frequent dredging. In September 2001, the dry dock was not able to sink to design depths (-70' mean low water (MLW)). At that time it was not clear if sand came from a slump of the side walls or from infilling. Also in September 2001, dredging of the sinking basin to restore the 70' depth was completed under the terms of the permit issued by the USACE in 1998 for the recently constructed LLTF.

In January 2002, BIW submitted an application to the USACE for annual maintenance dredging of the sinking basin. The permit authorized the dredging of approximately 10,000 cubic yards (cy) of sandy sediment annually over a ten-year period. Material was to be removed by a clam-shell bucket dredge mounted on a barge and would be disposed of in an established disposal area in the Kennebec River, north of Bluff Head in approximately 98 feet of water. The USACE intended to include a permit condition allowing dredging to occur from November 1 – April 30 of each year.

In March 2002, the USACE contacted us regarding the proposed permit for maintenance dredging of the sinking basin. At this time, we told the USACE that shortnose sturgeon are known to be in the vicinity of the BIW facility year-round but that concentrations of shortnose sturgeon would be largest from the late spring to early fall. At this time there was no evidence that shortnose sturgeon would be adversely affected by mechanical dredging. The USACE implemented a condition in the permit that restricted dredging to occur only from November 1 – April 30 of any year. In a letter dated May 24, 2002, we concurred with the USACE's determination that shortnose sturgeon were not likely to be adversely affected by the dredging activities in the sinking basin.

Dredging next occurred at the sinking basin between April 7 and April 30, 2003, with approximately 7,870 cubic yards of material removed. On April 30, 2003 the USACE contacted us to report that a shortnose sturgeon was killed by the mechanical dredge being used to dredge the sinking basin. This was the first evidence of lethal interactions between shortnose sturgeon and mechanical dredges. When the interaction occurred, we told USACE that any future dredging of the sinking basin with a mechanical dredge would require that the March 2002 consultation on this action be reinitiated as the take represented new information on the effects of the action.

In a conference call on September 5, 2003 between BIW staff, Jay Clement of the USACE and Julie Crocker of NMFS, BIW indicated that it would be necessary to dredge the sinking basin before February 2004 as there was a U.S. Navy destroyer scheduled for launching from the dry dock at that time and that recent sounding data had indicated that the sinking basin did not have adequate depth for the ship to float off the dry dock. BIW staff indicated that the dredging of 10-20,000cy of material would provide enough depth for the launch of this destroyer. The dredging of 79,300cy of material would bring the sinking basin back to its design depth of 70 feet below MLW and ensure that no maintenance dredging would be required before 2007. Consultation on the effects of the maintenance dredging of the sinking basin in the fall of 2003 was completed with the issuance of a Biological Opinion dated December 1, 2003. Approximately 44,000 cubic yards of material were removed with dredging occurring 24 hours a day between December 14 and December 24. No interactions with shortnose sturgeon were observed.

Dredging of the sinking basin occurred in December 2007. Approximately 70,000 cubic yards of silt were removed. Dredging took approximately 25 days to complete with dredging occurring 24 hours a day. Consultation with us on the effects of this dredging was completed with the issuance of an Opinion dated October 5, 2007. Consultation was reinitiated in December 2007 due to a modification to the proposed action. A new Opinion was issued on January 16, 2008. The sinking basin was last dredged in November-December 2009. At that time, 18,170cy of material was removed. No interactions with shortnose sturgeon were observed during the 2007 or 2009 dredging.

Berthing Piers

In 1997, BIW applied for USACE and Maine Department of Environmental Protection (DEP) authorization to conduct maintenance dredging activities at their facility. The USACE subsequently issued a permit (No. 199702110) for dredging along the various wharves and berthing areas located on the west bank of the Kennebec River. All dredging was to be done with a mechanical dredge with upland disposal. Ten years of maintenance dredging was also authorized by the permit. No consultation pursuant to section 7 of the ESA was conducted between USACE and us on the issuance of this permit by the USACE. The permit issued by the DEP required that an endangered species observer be present on the dredge barge if dredging occurred from April 2 through October 31 of any year. Dredging occurred in 1997 and no interactions with endangered species were recorded.

In April 2005, BIW informed the USACE that they would be dredging the Pier 3 berthing area (also referred to as the outfitting pier) in June 2005 as there were not adequate depths present at the berthing area for a US Navy Destroyer to be moved to Pier 3. Design depths at Pier 3 are 32 feet below mean low water. At that time, the USACE contacted us and inquired as to what steps were necessary to ensure that consultation was complete for the proposed dredging. In correspondence between Jay Clement of the USACE and Sara McNulty of NMFS, we indicated that as shortnose sturgeon are known to be present in the area to be dredged during the time of year proposed for dredging and shortnose sturgeon have been documented to be killed by mechanical dredge operations, section 7 consultation was necessary. We indicated and USACE agreed that formal consultation was necessary for the action proposed by USACE.

In a letter dated May 2, 2005 the USACE requested formal consultation for the proposed dredging of approximately 2,000 cubic yards (cy) of silt material from the BIW pier 3 berthing area so that adequate depths would be present for the docking of a US Navy Destroyer on June 6, 2005. However, subsequent soundings conducted by BIW indicated that natural scouring had removed enough silt for the ship to dock safely. Soundings conducted throughout the summer of 2005 indicated that dredging would be necessary to deberth the ship in October. As such, BIW sought approval from the USACE to conduct the required dredging in September 2005. In an e-mail dated August 29, 2005 USACE informed us that BIW had requested to dredge an additional 9,000 cy of material from the pier 3 berthing area beginning November 1, 2005. USACE indicated to us that they intended to approve this request. Approximately 2,000 cy of silt was removed over a 10 day period beginning on September 19, 2005. An additional 9,000 cy of material was removed over approximately 6 weeks between November and December 2005. No interactions with listed species occurred during these dredging operations.

Pier 3 was dredged three times in 2009 (March, June and November). In May 2009, BIW requested authorization from the USACE to conduct maintenance dredging sufficient to remove approximately 1,260 cubic yards of sand and silt from an 8,000 square foot area within the Pier 3 berthing area along the shoreline of the Kennebec River. Consultation with us was completed with the issuance of letter dated May 26, 2009 in which we concurred with the USACE's determination that the proposed action was not likely to adversely affect any listed species. This conclusion was based on the small volume of material to be removed, the short duration of the project, and the inclusion of a requirement that dredging cease should total suspended solids levels rise to 50mg/L above background. Dredging began on June 1, 2009 and was expected to last five to ten days. However, on the afternoon of June 1, the endangered species observer saw a 75cm shortnose sturgeon in the scow where dredged material was being deposited. The fish was not submerged underwater but resting on top of a pile of woody debris. The fish was retrieved from the scow and returned to the river without injury. Dredging ceased and was not resumed until November. At that time, 6,704cy of material was removed; no interactions with sturgeon were observed.

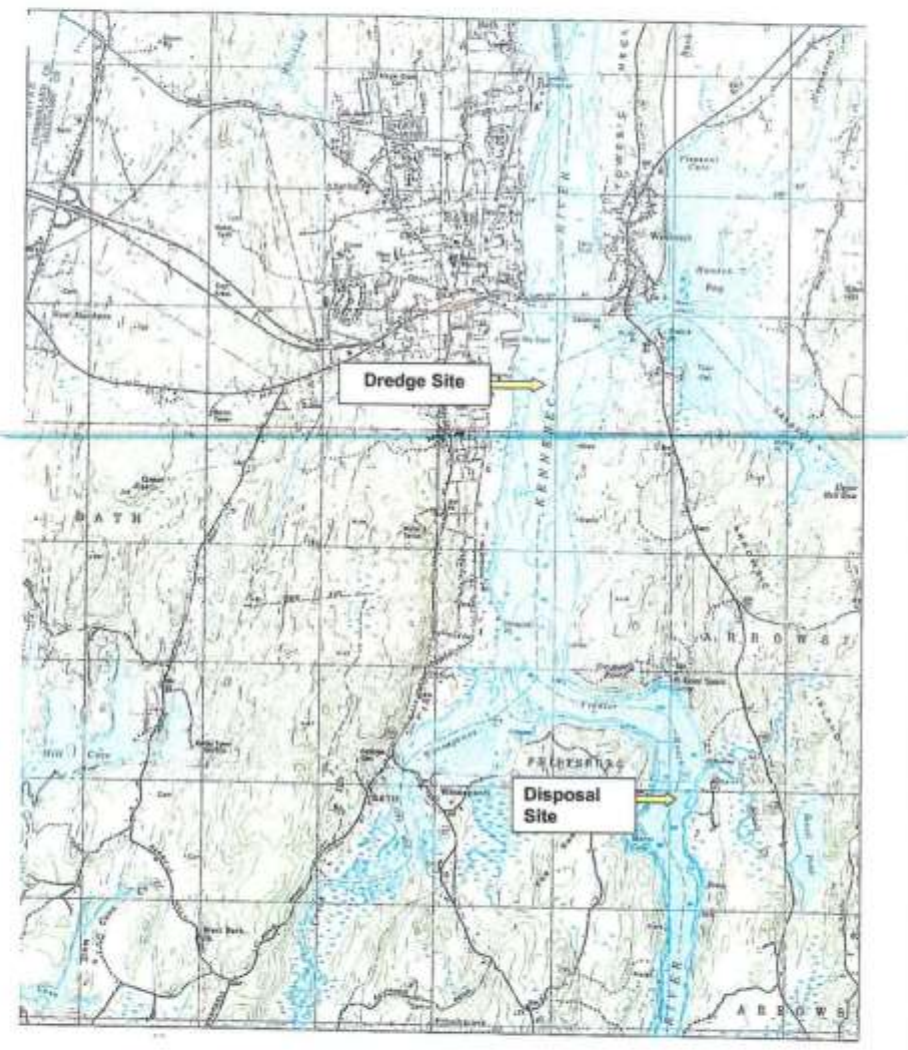
Landing Grid

BIW's dry dock is kept on Landing Grid 1 when not in use. Landing Grid 1 was last dredged in 2004 as permitted by USACE in the 10 year maintenance dredging condition in the LLTF construction permit. Approximately 2,000 to 4,000 cy of material was removed during this dredging event. No shortnose sturgeon interactions were recorded during this event. Dredging at the landing grid was last completed in January 2008, with approximately 1200 cy removed from the grid area. No interactions with listed species were recorded during this event. Consideration of the effects of the dredging of the landing grid was included in the Opinion issued by NMFS to USACE dated January 16, 2008 referenced above. The landing grid was last dredged in December 2009 with 3,808cy of material removed. No interactions with sturgeon were observed.

3.0 DESCRIPTION OF THE PROPOSED ACTION

The proposed action consists of two parts: (1) maintenance dredging of several areas within the Kennebec River over the remaining duration of the ten-year permit issued in November 2009, and (2) the brake wheel project, which will involve the one-time armoring of the river bottom at Pier 4. The project location is illustrated in Figure 2.

Figure 2. Project Location



3.1 Maintenance Dredging

Maintenance dredging at the BIW facility is necessary to accommodate the launching, berthing, and maintenance of deep draft vessels. There are several areas which are routinely dredged; these include the landing grid, sinking basin, and berthing piers (see Figure 3). The permit issued by USACE in November 2009 authorizes BIW to dredge each of these areas with a clamshell bucket controlled by a barge mounted crane. The permit authorizes maintenance dredging between October 1 and May 31 of any year. The permit will expire 10 years from its issuance (November 2019). BIW and USACE have proposed the following schedule for maintenance dredging:

- Dry Dock Sinking Basin: Remove up to 70,000 cy occurring every three years; dredging is next proposed to begin in February 2013. Dredging is also expected to occur in 2016 and 2019 for a total of three dredge events over the remaining life of the permit;

- Landing Grid: Remove approximately 3,500 cy of material from the Landing Grid every four years. Dredging is next proposed to begin in November 2012. Dredging is also expected to occur in 2016, for two dredge events over the remaining life of the permit.
- Berthing Piers: Remove up to 4,000 cy of material from the pier area every four years. Dredging is anticipated to occur in 2013 and 2017, for two dredge events over the remaining life of the permit.

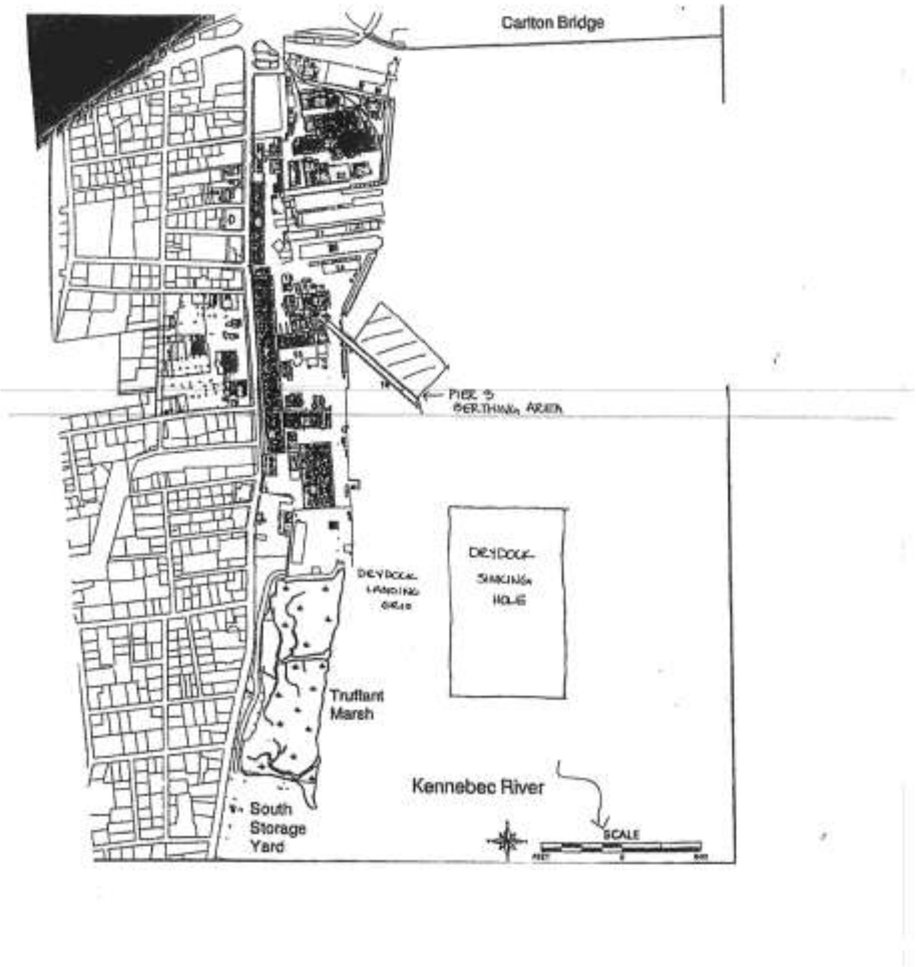


Figure 3. Location of Areas to be dredged

All dredging will occur with a mechanical clamshell dredge between October 1 and May 31. Dredging at the sinking basin could take up to 6 weeks with dredging at the landing grid and berthing piers expected to take 2-3 weeks each. In the past, there have been times when all three locations were dredged. However, this is not expected to occur in the future. Also in future years, simultaneous dredging of multiple sites is not expected to occur. Dredging at the sinking basin may occur 24 hours a day. Dredging at the landing grid and berthing piers will be restricted to daylight hours, and depending on the time of year, may occur 8-12 hours a day. The following maintenance dredging events are currently predicted: 2012 (landing grid); 2013 (sinking basin (February) and berthing piers (Fall)); 2016 (sinking basin and landing grid); 2017 (berthing piers); and, 2019 (sinking basin).

The USACE implements a special permit condition requiring that for any dredging occurring at the time of year when Atlantic salmon are likely to be present in the action area (i.e., April 10 – November 7), total suspended solids (TSS) levels must be monitored throughout dredging. The monitoring location must be located 50 meters up- and down-stream from the dredge with monitoring alternating hourly between the up and down stream location. Further, the USACE require that should TSS levels of 50mg/L above background be detected at the monitoring location, dredging must cease until TSS levels return to background levels. At this time, no dredging is scheduled to occur between April 10-May 31 or October 1-November 7.

Disposal of Dredged Material

The location at which dredged material will be disposed is dependent on the location of the dredging activity. Historic sampling and testing has shown that the material to be removed is clean sand suitable for in-river or nearshore disposal. Material dredged from the sinking basin will be disposed of at the existing in-river disposal area north of Bluff Head in approximately 95-100 feet of water (see Figure 4). Disposal at this site has been recommended by the Maine Geological Survey to help maintain the sand balance in the Kennebec River system. Material dredged from the other locations will be disposed of at an upland location. For these dredging operations, material will be loaded into scows then towed to a nearby dock where it will be offloaded into dump trucks and trucked to a disposal facility. The USACE implements a permit condition requiring that should in-water disposal be carried out between April 10 – May 31 or October 1 – November 7 (*i.e.*, the time of year when Atlantic salmon would be present in the action area), a dredged material management plan must be developed. This plan would be developed by BIW in coordination with USACE and us and would require monitoring of disposal operations and restrictions on disposal such that disposal would cease should TSS levels greater than 50mg/L above background be recorded. Disposal could only resume once TSS levels returned to background. At this time, no in-water disposal is scheduled to occur between April 10-May 31 or October 1-November 7.

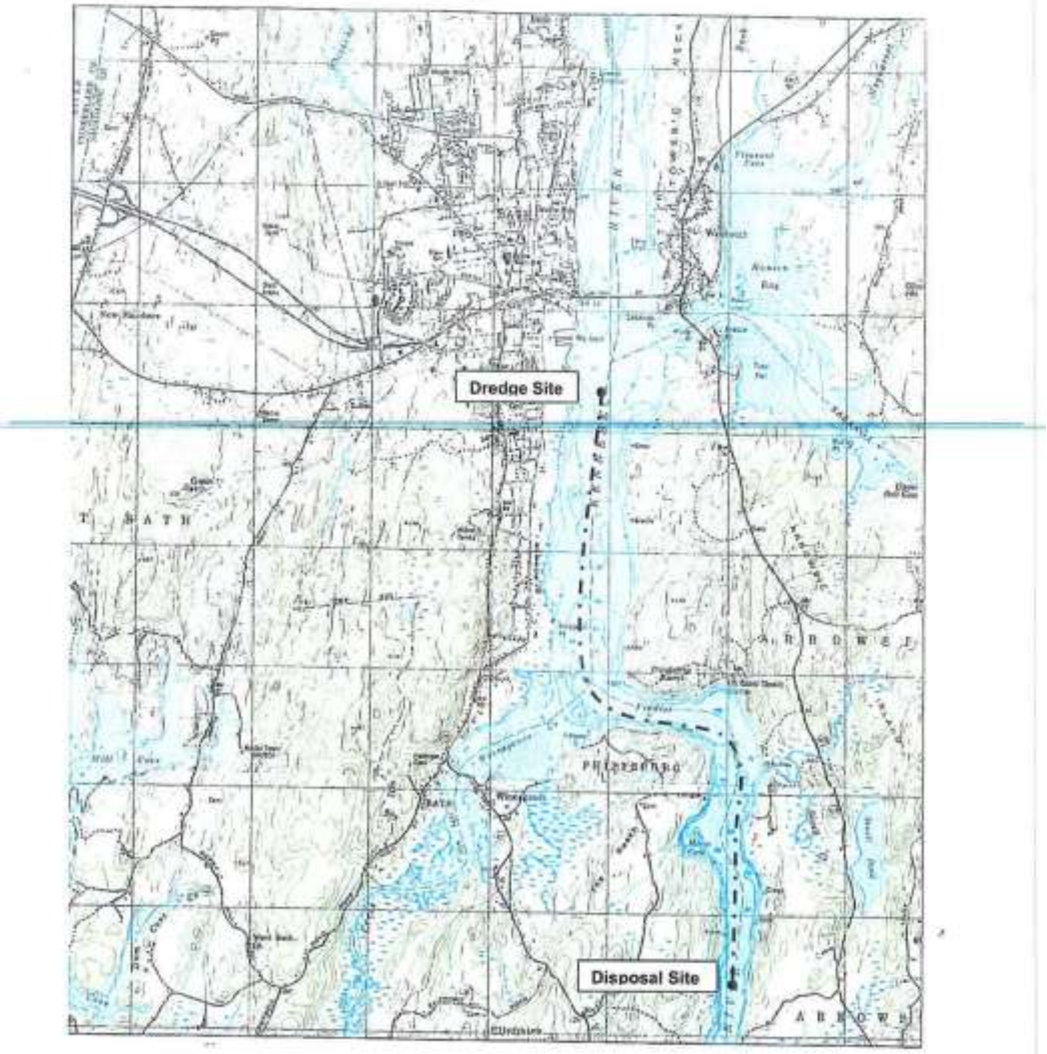


Figure 4. In-river disposal site and vessel transit route

3.2 Brake Wheel Project

BIW is proposing to install stone on the bottom of the river near Pier 4 to provide scour protection to the bottom and to the substructure of the pier during the testing of ship propulsion systems (see Figure 3). BIW is shifting design and construction from the U.S. Navy's DDG 51 Arleigh Burke class destroyer to the DDG 1000 Zumwalt-Class destroyer. Of significant difference is the new propulsion system. The DDG 51 was powered by four main gas turbine engines. The two shafts are each equipped with a Controllable Pitch Propeller (CPP) system which allows for propulsion control and the ability to run the engines without thrust during dockside propulsion testing. The DDG 1000 has an Integrated Power System (IPS), which generates electrical power for all ship systems, including propulsion. The DDG 1000 will be outfitted at Pier 4 with two brake wheels, one on each shaft, in place of the hub and propeller system. The DDG 1000 has a fixed pitch propeller that cannot be aligned to produce no thrust during propulsion testing. The use of the brake wheels will provide a mechanical load to commission and test the electrical system (for both generating and propulsion) without the thrust of a fixed pitch propeller system.

Small scale testing of the brake wheel system was completed at the Naval Surface Warfare Center Carderock Division – David Taylor Model Basin, Bethesda, Maryland. These tests indicate that scour will occur under various conditions within the proposed test sequence. The impact area from the turbulent jet of water created by the full power brake wheel is calculated to be 60-feet by 117-feet, including a 60-foot by 12-foot area directly under Pier 4. Located in this area are two rows of piles. BIW is concerned that sand will be scoured from the base of the piles resulting in a decrease in structural integrity. Additionally, suspended solids could overburden water intake filters on the ship, causing system failure.

To prevent scour, it was determined that the placement of rip rap within the impact area was necessary. This will not only maintain the structural integrity of the pier structure but will eliminate the suspension of sediments during operation of the brake wheels. During testing, the ships will be outfitted with specialized ‘brake wheels’ which enable propulsion testing without thrust (full thrust testing would rip the ship off its mooring at the pier). While full thrust is not generated and the ship does not move from the pier, sufficient power, cavitation, and turbulence is generated that BIW expects scouring of the river bottom. They also anticipate that without scour protection in place, the brake wheel testing would further expose the support pilings of the pier and increased turbidity would threaten water intakes, fire protection systems, ship systems’ intakes, and general water quality.

To protect the river bottom from scouring during brake wheel testing, up to 3.5’ of crushed stone and riprap will be placed on the river bottom within a 60’x 117’ area (0.16 acres) adjacent to and beneath BIW’s Pier 4. The stone will be placed by barge mounted crane with a clamshell bucket and by a backhoe on the pier. Stone will not be dumped, it will be placed bucket load by bucket load to achieve the desired grade and thickness. Rip-rap will be placed between November 7 and December 31, 2012, during daylight hours. Propulsion testing and operation of the brake wheels could potentially occur at any time of the year depending on BIW’s ship construction schedule.

USACE intends to incorporate the following conditions into the permit for the brake wheel project:

1. During the first full length test of the brake wheel system, when the wheel system is in operation, the permittee shall monitor Total Suspended Solids (“TSS”). The monitoring results shall be provided to the Corps and NMFS within sixty days of conclusion of the test. Point of contacts shall be Jay Clement (Corps) and Julie Crocker (NMFS).

2. During the first full length test of the brake wheel system, when the wheel system is in operation, the permittee shall continuously monitor noise levels in the project area. The monitoring results shall be provided to the Corps and NMFS within sixty days of conclusion of the test. Point of contacts shall be Jay Clement (Corps) and Julie Crocker (NMFS).

Once the scour protection is in place, the DDG-1000 may be moved to Pier 4. Brake wheel testing is accomplished by running one motor at a time. On the DDG 1000 there are two shafts, each driven by two motors. Testing will be completed on one motor at a time utilizing the base brake wheel (shorter spoke lengths; allows testing to be performed up to half power). Once a motor is tested, the crew will move to the second motor. The process will be conducted on each shaft. There may be times in which the shafts are required to run simultaneously. This independent shaft testing will take approximately 12 weeks per shaft to complete, with an overlap of several weeks during the testing phase.

An additional five weeks of testing, referred to as the Dock Trial Phase, will begin once both motors on each shaft have been tested. This phase of testing will focus on specific tests, often times with both shafts in operation. This period may be accomplished with the base brake wheel or with the extension tips (allowing for testing up to full power). The total operational test period is estimated to take seventeen to eighteen weeks. The plan is to work up to 10 hours per day, five days per week. On average, each shaft would run between two to four hours per day.

3.3 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 consultation includes the area to be dredged (i.e., the 12.6 acre sinking basin, the adjacent landing grid, and the berthing area) as well as the area of the Kennebec River where increased suspended sediment will be present due to the removal of silt. Additionally, the action area includes the area where scour will be placed for the brake wheel project at Pier 4 and the underwater area where underwater noise will be increased due to testing of ship propulsion systems at Pier 4. Based on analysis of other mechanical dredging activities (Burton 1993; Normandeau 2001; U. Washington 2001), increased suspended sediment levels are likely to be present for no more than 3,300-feet downstream of the dredge area. The direction of the sediment plume will change based on the tides. As such, the action area includes that area of the Kennebec River located within a 3,300-foot radius from the area to be dredged. Additionally, the action area includes the area of the river which will be armored for the brake wheel project. The action area also includes the Bluffs Head disposal site and the transit route to and from the disposal site as well as an area extending 3,000-feet from the disposal area where increased levels of suspended sediment are likely to be experienced. The action area also includes the transit route to the nearby dock where material from the berthing area and landing grid will be towed and then removed by truck. This area is expected to encompass all of the direct and indirect effects of the proposed dredging project (see Figure 1).

4.0 LISTED SPECIES AND CRITICAL HABITAT IN THE ACTION AREA

Several species listed under NMFS’ jurisdiction occur in the action area for this consultation. The action area has been designated as critical habitat for Gulf of Maine (GOM) DPS Atlantic salmon. In addition, we have determined that the action being considered in this biological opinion may affect the following endangered or threatened species and critical habitat under our jurisdiction:

GOM DPS of Atlantic salmon (*Salmo salar*)	Endangered
Shortnose sturgeon (*Acipenser brevirostrum*)	Endangered
GOM DPS of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*)	Threatened
New York Bight DPS of Atlantic sturgeon	Endangered
Chesapeake Bay DPS of Atlantic sturgeon	Endangered

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

4.1 GOM DPS of Atlantic salmon

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 DPS and Long Island Sound DPS have both been extirpated (65 FR 69459; Nov. 17, 2000).

The GOM DPS of anadromous Atlantic salmon was initially listed by the USFWS and NMFS (collectively, the Services) as an endangered species on November 17, 2000 (65 FR 69459). A subsequent re-listing as an endangered species by the Services (74 FR 29344; June 19, 2009), included an expanded range for the GOM DPS of Atlantic salmon. The decision to expand the geographic range of the GOM DPS was largely based on the results of a Status Review (Fay *et al.* 2006) completed by a Biological Review Team consisting of federal and state agencies and Tribal interests. Fay *et al.* (2006) concluded that the DPS delineation in the 2000 listing designation was largely appropriate, except in the case of large rivers that were excluded in the 2000 listing determination. Fay *et al.* (2006) concluded that the salmon currently inhabiting the larger rivers (Androscoggin, Kennebec, and Penobscot) are genetically similar to the rivers included in the GOM DPS as listed in 2000, have similar life history characteristics, and/or occur in the same zoogeographic region. Further, the salmon populations inhabiting the large and small rivers from the Androscoggin River northward to the Dennys River differ genetically and in important life history characteristics from Atlantic salmon in adjacent portions of Canada (Spidle *et al.* 2003; Fay *et al.* 2006). Thus, Fay *et al.* (2006) concluded that this group of populations (a “distinct population segment”) met both the discreteness and significance criteria of the Services’ DPS Policy (61 FR 4722; Feb. 7, 1996) and, therefore, recommended the geographic range included in the new expanded GOM DPS.

The newly listed GOM DPS includes all anadromous Atlantic salmon whose freshwater range occurs in the watersheds from the Androscoggin River northward along the Maine coast to the Dennys River, and wherever these fish occur in the estuarine and marine environment. The following impassable falls delimit the upstream extent of the freshwater range: Rumford Falls in the town of Rumford on the Androscoggin River; Snow Falls in the town of West Paris on the Little Androscoggin River; Grand Falls in Township 3 Range 4 BKP WKR on the Dead River in the Kennebec Basin; the un-named falls (impounded by Indian Pond Dam) immediately above the Kennebec River Gorge in the town of Indian Stream Township on the Kennebec River; Big Niagara Falls on Nesowadnehunk Stream in Township 3 Range 10 WELS in the Penobscot Basin; Grand Pitch on Webster Brook in Trout Brook Township in the Penobscot Basin; and Grand Falls on the Passadumkeag River in Grand Falls Township in the Penobscot Basin. The marine range of the GOM DPS extends from the Gulf of Maine, throughout the Northwest Atlantic Ocean, to the coast of Greenland.

Included in the GOM DPS are all associated conservation hatchery populations used to supplement these natural populations; currently, such conservation hatchery populations are maintained at Green Lake National Fish Hatchery (GLNFH) and Craig Brook National Fish Hatcheries (CBNFH), both operated by the USFWS. Excluded from the GOM DPS are landlocked Atlantic salmon and those salmon raised in commercial hatcheries for the aquaculture industry (74 FR 29344; June 19, 2009).

Species Description

Atlantic salmon have a complex life history that includes territorial rearing in rivers to extensive feeding migrations on the high seas. During their life cycle, Atlantic salmon go through several distinct phases that are identified by specific changes in behavior, physiology, morphology, and habitat requirements.

Adult Atlantic salmon return to rivers from the sea and migrate to their natal stream to spawn. Adults ascend the rivers within the GOM DPS beginning in the spring. The ascent of adult salmon continues into the fall. Although spawning does not occur until late fall, the majority of Atlantic salmon in Maine enter freshwater between May and mid-July (Meister 1958; Baum 1997). Early migration is an adaptive trait that ensures adults have sufficient time to effectively reach spawning areas despite the occurrence of temporarily unfavorable conditions that naturally occur within rivers (Bjornn and Reiser 1991). Salmon that return in early spring spend nearly 5 months in the river before spawning, often seeking cool water refuge (e.g., deep pools, springs, and mouths of smaller tributaries) during the summer months.

In the fall, female Atlantic salmon select sites for spawning. Spawning sites are positioned within flowing water, particularly where upwelling of groundwater occurs, allowing for percolation of water through the gravel (Danie et al. 1984). These sites are most often positioned at the head of a riffle (Beland et al. 1982); the tail of a pool; or the upstream edge of a gravel bar where water depth is decreasing, water velocity is increasing (McLaughlin and Knight 1987; White 1942), and hydraulic head allows for permeation of water through the redd (a gravel depression where eggs are deposited). Female salmon use their caudal fin to scour or dig redds. The digging behavior also serves to clean the substrate of fine sediments that can embed the cobble/gravel substrate needed for spawning and consequently reduce egg survival (Gibson 1993). As the female deposits eggs in the redd, one or more males fertilize the eggs (Jordan and Beland 1981). The female then continues digging upstream of the last deposition site, burying the fertilized eggs with clean gravel.

A single female may create several redds before depositing all of her eggs. Female anadromous Atlantic salmon produce a total of 1,500 to 1,800 eggs per kilogram of body weight, yielding an average of 7,500 eggs per 2 sea-winter (SW) female (an adult female that has spent two winters at sea before returning to spawn) (Baum and Meister 1971). After spawning, Atlantic salmon may either return to sea immediately or remain in freshwater until the following spring before returning to the sea (Fay et al. 2006). From 1967 to 2003, approximately 3 percent of the wild and naturally reared adults that returned to rivers where adult returns are monitored--mainly the Penobscot River--were repeat spawners (USASAC 2004).

Embryos develop in the redd for a period of 175 to 195 days, hatching in late March or April (Danie et al. 1984). Newly hatched salmon referred, to as larval fry, alevin, or sac fry, remain in the redd for approximately 6 weeks after hatching and are nourished by their yolk sac (Gustafson-Greenwood and Moring 1991). Survival from the egg to fry stage in Maine is estimated to range from 15 to 35 percent (Jordan and Beland 1981). Survival rates of eggs and larvae are a function of stream gradient, overwinter temperatures, interstitial flow, predation, disease, and competition (Bley and Moring 1988). Once larval fry emerge from the gravel and begin active feeding they are referred to as fry. The majority of fry (>95 percent) emerge from redds at night (Gustafson-Marjanen and Dowse 1983).

When fry reach approximately 4 cm in length, the young salmon are termed parr (Danie et al., 1984). Parr have eight to eleven pigmented vertical bands on their sides that are believed to serve as camouflage (Baum 1997). A territorial behavior, first apparent during the fry stage, grows more pronounced during the parr stage, as the parr actively defend territories (Allen 1940; Kalleberg 1958; Danie et al. 1984). Most parr remain in the river for 2 to 3 years before undergoing smoltification, the process in which parr go through physiological changes in order to transition from a freshwater environment to a saltwater marine environment. Some male parr may not go through smoltification and will become sexually mature and participate in spawning with sea-run adult females. These males are referred to as “precocious parr.”

First year parr are often characterized as being small parr or 0+ parr (4 to 7 cm long), whereas second and third year parr are characterized as large parr (greater than 7 cm long) (Haines 1992). Parr growth is a function of water temperature (Elliott 1991); parr density (Randall 1982); photoperiod (Lundqvist 1980); interaction with other fish, birds, and mammals (Bjornn and Resier 1991); and food supply (Swansburg et al. 2002). Parr movement may be quite limited in the winter (Cunjak 1988; Heggenes 1990); however, movement in the winter does occur (Hiscock et al. 2002) and is often necessary, as ice formation reduces total habitat availability (Whalen et al. 1999). Parr have been documented using riverine, lake, and estuarine habitats; incorporating opportunistic and active feeding strategies; defending territories from competitors including other parr; and working together in small schools to actively pursue prey (Gibson 1993; Marschall et al. 1998; Pepper 1976; Pepper et al. 1984; Hutchings 1986; Erkinaro et al. 1998; Halvorsen and Svenning 2000; Hutchings 1986; O’Connell and Ash 1993; Erkinaro et al. 1995; Dempson et al. 1996; Halvorsen and Svenning 2000; Klemetsen et al. 2003).

In a parr’s second or third spring (age 1 or age 2 respectively), when it has grown to 12.5 to 15 cm in length, a series of 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 vast majority of naturally reared parr remain in freshwater for 2 years (90 percent or more) with the balance remaining for either 1 or 3 years (USASAC 2005). In order for parr to undergo smoltification, they must reach a critical size of 10 cm total length at the end of the previous growing season (Hoar 1988). During the smoltification process, parr markings fade and the body becomes streamlined and silvery with a pronounced fork in the tail. Naturally reared smolts in Maine range in size from 13 to 17 cm, and most smolts enter the sea during May to begin their first ocean migration (USASAC 2004). During this migration, smolts must contend with changes in salinity, water temperature, pH, dissolved oxygen, pollution levels, and predator assemblages. The physiological changes that occur during smoltification prepare the fish for the dramatic change in osmoregulatory needs that come with the transition from a fresh to a salt water habitat (Ruggles 1980; Bley 1987; McCormick and Saunders 1987; McCormick et al. 1998). The transition of smolts into seawater is usually gradual as they pass through a zone of fresh and saltwater mixing that typically occurs in a river's estuary. Given that smolts undergo smoltification while they are still in the river, they are pre-adapted to make a direct entry into seawater with minimal acclimation (McCormick et al. 1998). This pre-adaptation to seawater is necessary under some circumstances where there is very little transition zone between freshwater and the marine environment.

The spring migration of post-smolts out of the coastal environment is generally rapid, within several tidal cycles, and follows a direct route (Hyvarinen et al. 2006; Lacroix and McCurdy 1996; Lacroix et al. 2004, 2005). Post-smolts generally travel out of coastal systems on the ebb tide and may be delayed by flood tides (Hyvarinen et al. 2006; Lacroix and McCurdy 1996; Lacroix et al. 2004, 2005). Lacroix and McCurdy (1996), however, found that post-smolts exhibit active, directed swimming in areas with strong tidal currents. Studies in the Bay of Fundy and Passamaquoddy Bay suggest that post-smolts aggregate together and move near the coast in "common corridors" and that post-smolt movement is closely related to surface currents in the bay (Hyvarinen et al. 2006; Lacroix and McCurdy 1996; Lacroix et al. 2004). European post-smolts tend to use the open ocean for a nursery zone, while North American post-smolts appear to have a more near-shore distribution (Friedland et al. 2003). Post-smolt distribution may reflect water temperatures (Reddin and Shearer 1987) and/or the major surface-current vectors (Lacroix and Knox 2005). Post-smolts live mainly on the surface of the water column and form shoals, possibly of fish from the same river (Shelton et al. 1997).

During the late summer and autumn of the first year, North American post-smolts are concentrated in the Labrador Sea and off of the west coast of Greenland, with the highest concentrations between 56 ^{o}N. and 58^{o}N. (Reddin 1985; Reddin and Short 1991; Reddin and Friedland 1993). The salmon located off Greenland are composed of both 1SW fish and fish that have spent multiple years at sea (multi-sea winter fish, or MSW) and includes immature salmon from both North American and European stocks (Reddin 1988; Reddin et al. 1988). The first winter at sea regulates annual recruitment, and the distribution of winter habitat in the Labrador Sea and Denmark Strait may be critical for North American populations (Friedland et al. 1993). In the spring, North American post-smolts are generally located in the Gulf of St. Lawrence, off the coast of Newfoundland, and on the east coast of the Grand Banks (Reddin 1985; Dutil and Coutu 1988; Ritter 1989; Reddin and Friedland 1993; and Friedland et al. 1999).

Some salmon may remain at sea for another year or more before maturing. After their second winter at sea, the salmon over-winter in the area of the Grand Banks before returning to their natal rivers to spawn (Reddin and Shearer 1987). Reddin and Friedland (1993) found non-maturing adults located along the coasts of Newfoundland, Labrador, and Greenland, and in the Labrador and Irminger Sea in the later summer and autumn.

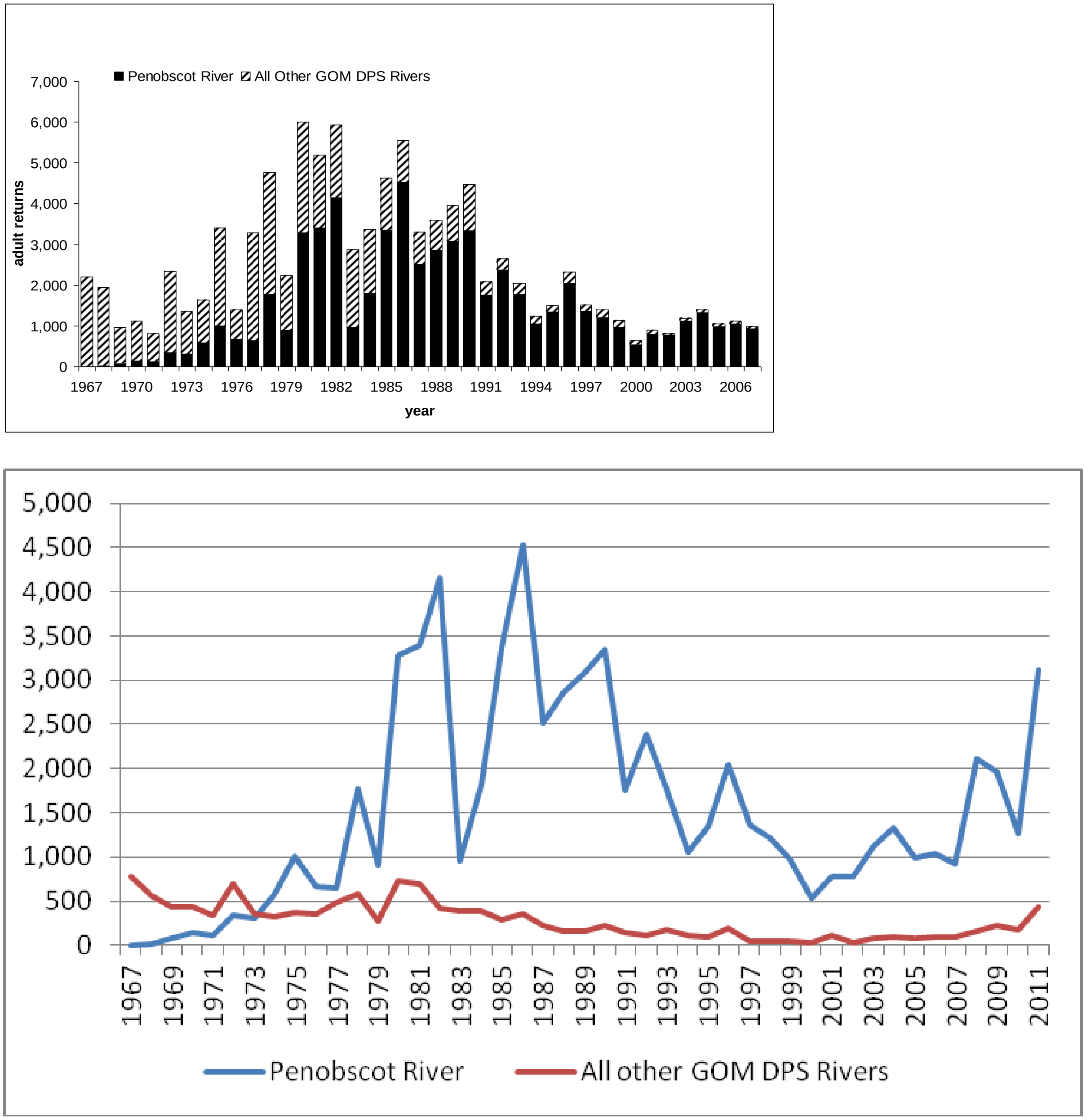
Status and Trends of the GOM DPS of Atlantic Salmon

The abundance of Atlantic salmon within the range of the GOM DPS has been generally declining since the 1800s (Fay *et al.* 2006). Data sets tracking adult abundance are not available throughout this entire time period; however, Fay *et al.* (2006) present a comprehensive time series of adult returns to the GOM DPS dating back to 1967. It is important to note that contemporary abundance levels of Atlantic salmon within the GOM DPS are several orders of magnitude lower than historical abundance estimates. For example, Foster and Atkins (1869) estimated that roughly 100,000 adult salmon returned to the Penobscot River alone before the river was dammed, whereas contemporary estimates of abundance for the entire GOM DPS have rarely exceeded 5,000 individuals in any given year since 1967 (Fay et al. 2006).

Contemporary abundance estimates are informative in considering the conservation status of the GOM DPS today. After a period of population growth in the 1970s, adult returns of salmon in the GOM DPS declined steadily between the early 1980s and the early 2000s but have been increasing again over the last few years. The population growth observed in the 1970s is likely attributable to favorable marine survival and increases in hatchery capacity, particularly from GLNFH that was constructed in 1974. Marine survival remained relatively high throughout the 1980s, and salmon populations in the GOM DPS remained relatively stable until the early 1990s. In the early 1990s marine survival rates decreased, leading to the declining trend in adult abundance observed throughout 1990s and early 2000s. The increase in the abundance of returning adult salmon observed between 2008 and 2011 may be an indication of improving marine survival.

Adult returns to the GOM DPS have been very low for many years and remain extremely low in terms of adult abundance in the wild. Further, the majority of all adults in the GOM DPS return to a single river, the Penobscot, which accounted for 91 percent of all adult returns to the GOM DPS between 2000 and 2011. Of the 3,125 adult returns to the Penobscot in 2011, the vast majority are the result of smolt stocking; and only a small portion were naturally-reared. The term naturally-reared includes fish originating from both natural spawning and from stocked hatchery fry (USASAC 2012). Hatchery fry are included as naturally-reared because hatchery fry are not marked and, therefore, cannot be distinguished from fish produced through natural spawning. Because of the extensive amount of fry stocking that takes place in an effort to recover the GOM DPS, it is possible that a substantial number of fish counted as naturally-reared were actually hatchery fry.

Figure 5. Adult returns to the GOM DPS 1967-2007.



Low abundances of both hatchery-origin and naturally-reared adult salmon returns to Maine demonstrate continued poor marine survival. Declines in hatchery-origin adult returns are less sharp because of the ongoing effects of hatcheries. In short, hatchery production over this time period has been relatively constant, generally fluctuating around 550,000 smolts per year (USASAC 2008). In contrast, the number of naturally reared smolts emigrating each year is likely to decline following poor returns of adults (three years prior). Although it is impossible to distinguish truly wild salmon from those stocked as fry, it is likely that some portion of naturally reared adults are in fact wild. Thus, wild smolt production would suffer three years after a year with low adult returns, because the progeny of adult returns typically emigrate three years after their parents return. The relatively constant inputs from smolt stocking, coupled with the declining trend of naturally reared adults, result in the apparent stabilization of hatchery-origin salmon and the continuing decline of naturally reared components of the GOM DPS observed over the last two decades.

Adult returns for the GOM DPS remain well below conservation spawning escapement (CSE) goals that are widely used (ICES 2005) to describe the status of individual Atlantic salmon populations. When CSE goals are met, Atlantic salmon populations are generally self-sustaining. When CSE goals are not met (i.e., less than 100 percent), populations are not reaching full potential; and this can be indicative of a population decline. For all GOM DPS rivers in Maine, current Atlantic salmon populations (including hatchery contributions) are well below CSE levels required to sustain themselves (Fay *et al.* 2006), which is further indication of their poor population status.

In conclusion, the abundance of Atlantic salmon in the GOM DPS has been low and either stable or declining over the past several decades. The proportion of fish that are of natural origin is very small (approximately 10%) and is continuing to decline. The conservation hatchery program has assisted in slowing the decline and helping to stabilize populations at low levels, but has not contributed to an increase in the overall abundance of salmon and has not been able to halt the decline of the naturally reared component of the GOM DPS.

4.1.1 Critical Habitat for Atlantic Salmon in the GOM DPS

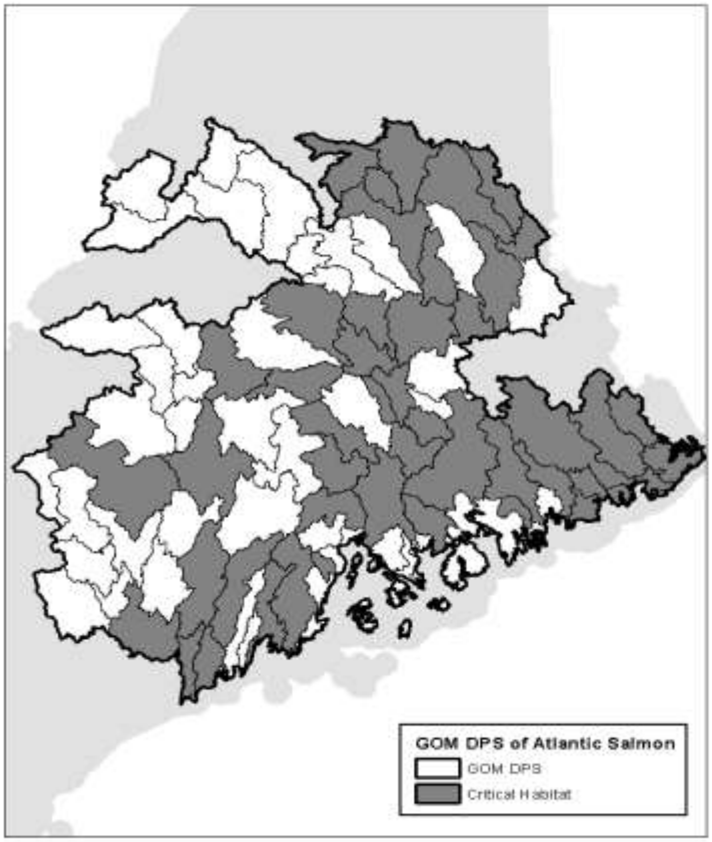
Coincident with the June 19, 2009 endangered listing, NMFS designated critical habitat for the GOM DPS of Atlantic salmon (74 FR 29300; June 19, 2009) (Figure 6). The final rule was revised on August 10, 2009. In this revision, designated critical habitat for the expanded GOM DPS of Atlantic salmon was reduced to exclude trust and fee holdings of the Penobscot Indian Nation and a table was corrected (74 FR 39003; August 10, 2009).

The status of Atlantic salmon critical habitat in the GOM DPS is important for two reasons: a) because it affects the viability of the listed species within the action area at the time of the consultation; and b) because those habitat areas designated "critical" provide PCEs essential for the conservation (i.e., recovery) of the species. The complex life cycles exhibited by Atlantic salmon give rise to complex habitat needs, particularly during the freshwater phase (Fay *et al.* 2006). Spawning gravels must be a certain size and free of sediment to allow successful incubation of the eggs. Eggs also require cool, clean, and well-oxygenated waters for proper development. Juveniles need abundant food sources, including insects, crustaceans, and other small fish. They need places to hide from predators (mostly birds and bigger fish), such as under logs, root wads, and boulders in the stream, as well as beneath overhanging vegetation. They also need places to seek refuge from periodic high flows (side channels and off-channel areas) and from warm summer water temperatures (coldwater springs and deep pools). Returning adults generally do not feed in fresh water but instead rely on limited energy stores to migrate, mature, and spawn. Like juveniles, they also require cool water and places to rest and hide from predators. During all life stages, Atlantic salmon require cool water that is free of contaminants. They also need migratory corridors with adequate passage conditions (timing, water quality, and water quantity) to allow access to the various habitats required to complete their life cycle.

Primary Constituent Elements of Atlantic Salmon Critical Habitat

Designation of critical habitat is focused on the known primary constituent elements (PCEs), within the occupied areas of a listed species, that are deemed essential to the conservation of the species. Within the GOM DPS, the PCEs for Atlantic salmon are: 1) sites for spawning and rearing, and 2) sites for migration (excluding marine migration[1]). NMFS chose not to separate spawning and rearing habitat into distinct PCEs, although each habitat does have distinct features, because of the GIS-based habitat prediction model approach that was used to designate critical habitat (74 FR 29300; June 19, 2009). This model cannot consistently distinguish between spawning and rearing habitat across the entire range of the GOM DPS.

Figure 6. HUC-10 Watersheds Designated as Atlantic Salmon Critical Habitat within the GOM DPS.



The physical and biological features of the two PCEs for Atlantic salmon critical habitat are as follows:

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[1] Although successful marine migration is essential to Atlantic salmon, NMFS was not able to identify the essential features of marine migration and feeding habitat or their specific locations at the time critical habitat was designated.

Physical and Biological Features of the Spawning and Rearing PCE

1. Deep, oxygenated pools and cover (*e.g.*, boulders, woody debris, vegetation, etc.), near freshwater spawning sites, necessary to support adult migrants during the summer while they await spawning in the fall.
2. Freshwater spawning sites that contain clean, permeable gravel and cobble substrate with oxygenated water and cool water temperatures to support spawning activity, egg incubation, and larval development.
3. Freshwater spawning and rearing sites with clean, permeable gravel and cobble substrate with oxygenated water and cool water temperatures to support emergence, territorial development and feeding activities of Atlantic salmon fry.
4. Freshwater rearing sites with space to accommodate growth and survival of Atlantic salmon parr.
5. Freshwater rearing sites with a combination of river, stream, and lake habitats that accommodate parr's ability to occupy many niches and maximize parr production.
6. Freshwater rearing sites with cool, oxygenated water to support growth and survival of Atlantic salmon parr.
7. Freshwater rearing sites with diverse food resources to support growth and survival of Atlantic salmon parr.

Physical and Biological Features of the Migration PCE

1. Freshwater and estuary migratory sites free from physical and biological barriers that delay or prevent access of adult salmon seeking spawning grounds needed to support recovered populations.
2. Freshwater and estuary migration sites with pool, lake, and instream habitat that provide cool, oxygenated water and cover items (*e.g.*, boulders, woody debris, and vegetation) to serve as temporary holding and resting areas during upstream migration of adult salmon.
3. Freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation.
4. Freshwater and estuary migration sites free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment.
5. Freshwater and estuary migration sites with sufficiently cool water temperatures and water flows that coincide with diurnal cues to stimulate smolt migration.
6. Freshwater migration sites with water chemistry needed to support sea water adaptation of smolts.

Habitat areas designated as critical habitat must contain one or more PCEs within the acceptable range of values required to support the biological processes for which the species uses that habitat. Critical habitat includes all perennial rivers, streams, and estuaries and lakes connected to the marine environment within the range of the GOM DPS, except for those areas that have been specifically excluded as critical habitat. Critical habitat has only been designated in areas (HUC-10 watersheds) considered currently occupied by the species. Critical habitat includes the stream channels within the designated stream reach and includes a lateral extent as defined by the ordinary high-water line or the bankfull elevation in the absence of a defined high-water line. In estuaries, critical habitat is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of extreme high water, whichever is greater.

For an area containing PCEs to meet the definition of critical habitat, the ESA also requires that the physical and biological features essential to the conservation of Atlantic salmon in that area "may require special management considerations or protections." Activities within the GOM DPS that were identified as potentially affecting the physical and biological features of salmon habitat and, therefore, requiring special management considerations or protections include agriculture, forestry, changing land-use and development, hatcheries and stocking, roads and road-stream crossings, mining, dams, dredging, and aquaculture.

Salmon Habitat Recovery Units within Critical Habitat for the GOM DPS

In describing critical habitat for the GOM DPS, NMFS divided the DPS into three Salmon Habitat Recovery Units or SHRUs. The three SHRUs include the Downeast Coastal, Merrymeeting, and Penobscot Bay. The SHRU delineations were designed by NMFS 1) to ensure that a recovered Atlantic salmon population has widespread geographic distribution to help maintain genetic variability and 2) to provide protection from demographic and environmental variation. A widespread distribution of salmon across the three SHRUs will provide a greater probability of population sustainability in the future, as will be needed to achieve recovery of the GOM DPS.

Areas designated as critical habitat within each SHRU are described in terms of habitat units. One habitat unit represents 100 m^2 of salmon spawning or rearing habitat . The quantity of habitat units within the GOM DPS was estimated through the use of a GIS-based salmon habitat model (Wright *et al.* 2008). For each SHRU, NMFS determined that there were sufficient habitat units available within the currently occupied habitat to achieve recovery objectives in the future; therefore, no unoccupied habitat (at the HUC-10 watershed scale) was designated as critical habitat. A brief historical description for each SHRU, as well as contemporary critical habitat designations and special management considerations, are provided below.

Downeast Coastal SHRU

The Downeast Coastal SHRU encompasses fourteen HUC-10 watersheds covering approximately 747,737 hectares (1,847,698 acres) within Washington and Hancock counties. In this SHRU there are approximately 59,066 units of spawning and rearing habitat for Atlantic salmon among approximately 6,039 km of rivers, lakes and streams. Of the 59,066 units of spawning and rearing habitat, approximately 53,400 units of habitat in eleven HUC-10 watersheds are considered to be currently occupied. The Downeast SHRU has enough habitat units available within the occupied range that, in a restored state (*e.g.* improved fish passage or improved habitat quality), the Downeast SHRU could satisfy recovery objectives as described in the final rule for critical habitat (74 FR 29300; June 19, 2009). Certain tribal and military lands within the Downeast Coastal SHRU are excluded from critical habitat designation.

Penobscot SHRU

The Penobscot SHRU, which drains approximately 22,234,522 hectares (54,942,705 acres), contains approximately 315,574 units of spawning and rearing habitat for Atlantic salmon among approximately 17,440 km of rivers, lakes and streams. Of the 315,574 units of spawning and rearing habitat (within 46 HUC-10 watersheds), approximately 211,000 units of habitat are considered to be currently occupied (within 28 HUC-10 watersheds). Three HUC-10 watersheds (Molunkus Stream, Passadumkeag River, and Belfast Bay) are excluded from critical habitat designation due to economic impact. Certain tribal lands within the Penobscot SHRU are also excluded from critical habitat designation.

Merrymeeting Bay SHRU

The Merrymeeting Bay SHRU drains approximately 2,691,814 hectares of land (6,651,620 acres) and contains approximately 339,182 units of spawning and rearing habitat for Atlantic salmon located among approximately 5,950 km of historically accessible rivers, lakes and streams. Of the 339,182 units of spawning and rearing habitat, approximately 136,000 units of habitat are considered to be currently occupied. There are forty-five HUC-10 watersheds in this SHRU, but only nine are considered currently occupied. Lands controlled by the Department of Defense within the Little Androscoggin HUC-10 and the Sandy River HUC-10 are excluded as critical habitat.

In conclusion, the June 19, 2009 final critical habitat designation for the GOM DPS (as revised on August 10, 2009) includes 45 specific areas occupied by Atlantic salmon that comprise approximately 19,571 km of perennial river, stream, and estuary habitat and 799 km^2 of lake habitat within the range of the GOM DPS and on which are found those physical and biological features essential to the conservation of the species. Within the occupied range of the GOM DPS, approximately 1,256 km of river, stream, and estuary habitat and 100 $km^2$of lake habitat have been excluded from critical habitat pursuant to section 4(b)(2) of the ESA.

Status of Atlantic Salmon and Critical Habitat in the Action Area

A summary of the status of the species rangewide and designated critical habitat in its entirety was provided above. This section will focus on the status of Atlantic salmon and designated critical habitat in the action area.

Atlantic salmon occurring in the action area of this consultation could originate from freshwater reaches of either the Kennebec or Androscoggin Rivers. The Kennebec River in the vicinity of the BIW serves as migration habitat for adults returning to freshwater to spawn and for smolts and kelts returning to the ocean. No spawning or rearing habitat has been identified directly upstream or downstream of BIW (USFWS 2011, Atlas of Maine 2009). Thus, neither fry or parr would not be expected to occur in the action area.

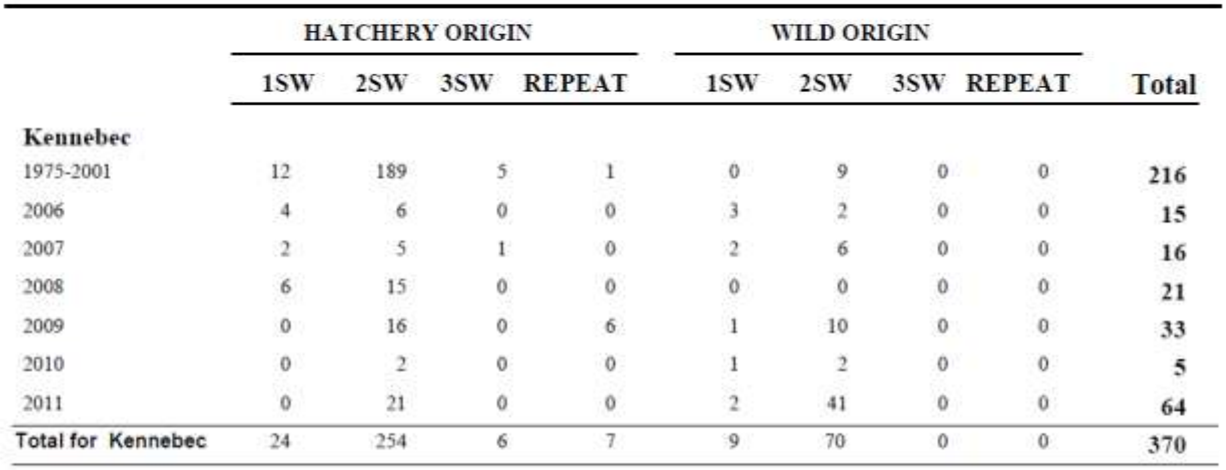
The Kennebec River watershed supports a small run of Atlantic salmon. Restoration efforts in the watershed have utilized egg, fry, and parr stocking to promote returning adult salmon. From 2003 to 2007, an average of 30,000 fry was release annually to the Sandy River (Paul Christman, MDMR, personal communication). While this effort produced smolts and adult returns, it was not large enough to boost the population to any great extent. More recently a large-scale restoration project was initiated utilizing eggs. This effort is more substantial in comparison to previous juvenile introductions. In 2010, 2011 and 2012, 600,000, 860,000 and 920,000 eggs respectively were release into the Sandy River. Based upon life-stage survival estimates from literature, the smolt production estimates for each of these cohorts is 9,060, 12,986 and 13,892. Given that the Sandy River is relatively pristine, it is possible that production could exceed these estimates. In fact, some juvenile production data from the Sandy River suggests these smolt estimates are likely low. The first of these cohorts likely migrated in the spring of 2012. Given an annual supply of eggs for this project, smolt production should continue into the unforeseeable future.

The returns of adult Atlantic salmon to the Androscoggin River in recent years have been small, and mostly comprised of stray, hatchery origin fish from active restoration programs on other rivers (Letter from MDMR to FERC dated March 25, 2010, Table 3). Prior to 2007, MDMR stated that there were no indications that the Androscoggin River had a reproducing population of Atlantic salmon (letter from MDMR to FERC dated March 25, 2010). Documented annual runs of returning adult salmon consisted primarily (98%) of fish originating as hatchery smolts released into Maine rivers. In 2007 and 2008 several returning adults captured at the Brunswick fishway were determined to be fry-stocked or naturally reared fish. As stocking efforts in other DPS rivers increase, so does the amount of strays captured at the Brunswick Dam.

Atlantic Salmon Adults

Counts for Atlantic salmon in the Kennebec River are available since 2006 when a fishlift was installed at the first dam on the river (Lockwood Dam)(NMFS and USFWS 2009). Adult Atlantic salmon are trapped, and biological data (e.g., fork lengths) are collected before the salmon are trucked and released in the Sandy River, which is an upstream tributary of the Kennebec River containing plentiful spawning and rearing habitat (MDMR 2011a). Returning adult salmon at this first dam on the Kennebec River averaged eight fish per year from 1975 to 2000 and 18 per year fish from 2006 to 2010 (Table 1). In 2011, 64 adult Atlantic salmon returned to the Kennebec River (MDMR 2012). Monthly return data for 2009, 2010, and 2011 indicate peak adult returns occur in the months of June and July (Table 2). In the Kennebec River, adult Atlantic salmon returns peak in June and July (Table 3).

Table 1. Adult Atlantic salmon returns by origin to the Kennebec River recorded from 1975 to 2010.



	HATCHERY ORIGIN				WILD ORIGIN				
	1SW	2SW	3SW	REPEAT	1SW	2SW	3SW	REPEAT	Total
Kennebec									
1975-2001	12	189	5	1	0	9	0	0	**216**
2006	4	6	0	0	3	2	0	0	**15**
2007	2	5	1	0	2	6	0	0	**16**
2008	6	15	0	0	0	0	0	0	**21**
2009	0	16	0	6	1	10	0	0	**33**
2010	0	2	0	0	1	2	0	0	**5**
2011	0	21	0	0	2	41	0	0	**64**
Total for Kennebec	24	254	6	7	9	70	0	0	**370**

Source: USASAC 2011.
Note: Sixty-four adult Atlantic salmon had returned to the Kennebec River in 2011 (MDMR 2012).

Table 2. Adult Atlantic Salmon captured at the Lockwood Project fishlift and translocated to the Sandy River.

Year	Maturity	Month of Capture						Total
		May	June	July	Aug	Sept	Oct	
2009	MSW Wild ♂	0	2	0	0	0	1	3
	MSW Wild ♀	0	2	3	0	0	2	7
	MSW Hatchery ♂	0	0	5	0	1	0	6
	MSW Hatchery ♀	1	0	6	1	0	0	8
	Domestic ♂	1	0	0	0	0	0	1
	Domestic ♀	3	0	0	0	0	0	3
	Domestic Unk[1]	0	1	0	0	0	0	1
	Total	**5**	**5**	**14**	**1**	**1**	**3**	**29**
2010	MSW Wild ♂	0	0	0	0	0	0	0
	MSW Wild ♀	0	2	0	0	0	0	2
	MSW Hatchery ♂	0	0	0	0	0	0	0
	MSW Hatchery ♀	0	2	0	0	0	0	2
	1SW Wild ♂	0	0	0	0	0	1	1
	1SW Wild ♀	0	0	0	0	0	0	0
	1SW Hatchery ♂	0	0	0	0	0	0	0
	1SW Hatchery♀	0	0	0	0	0	0	0
	Total	**0**	**4**	**0**	**0**	**0**	**1**	**5**
2011	MSW Wild ♂	0	9	5	0	1	0	15
	MSW Wild ♀	0	12	12	0	0	1	25
	MSW Hatchery ♂	0	4	8	0	0	0	12
	MSW Hatchery ♀	0	5	3	0	0	0	8
	1SW Wild ♂	0	2	0	0	0	0	2
	1SW Wild ♀	0	0	0	0	0	0	0
	1SW Hatchery ♂	0	0	0	0	0	0	0
	1SW Hatchery♀	0	0	0	0	0	0	0
	MSW Hatchery Unknown	0	1	1	0	0	0	2
	Total	**0**	**33**	**29**	**0**	**1**	**1**	**64**

Source: MDMR 2010, 2011a, 2012.
Note: Unk[1] = Sex Unknown of Domestic Atlantic salmon

Counts for Atlantic salmon in the Androscoggin River are available since 1983 when a fishway was constructed by Central Maine Power at the Brunswick Dam; the first dam on the mainstem of the river. Between 1983 and 2011, the number of returning adult salmon passing the Brunswick dam annually has ranged between 1 and 185, with an average of approximately 26 fish per year (MDMR 2011). However, over the last 11 years (2001 to 2011) the annual salmon counts have shown a marked decrease, ranging between 2 and 44, with an average of approximately 14 fish per year.

Table 3. Adult Atlantic salmon returns by origin to the Androscoggin River recorded from 1983 to 2011 at the Brunswick Project (USASAC 2012).

	Hatchery Origin				Wild Origin				
Androscoggin	**1SW**	**2SW**	**3SW**	**Repeat**	**1SW**	**2SW**	**3SW**	**Repeat**	**Total**
1983-2000	26	507	6	2	6	83	0	1	**631**
2001	1	4	0	0	0	0	0	0	**5**
2002	0	2	0	0	0	0	0	0	**2**
2003	0	3	0	0	0	0	0	0	**3**
2004	3	7	0	0	0	1	0	0	**11**
2005	2	8	0	0	0	0	0	0	**10**
2006	5	1	0	0	0	0	0	0	**6**
2007	6	11	0	0	1	2	0	0	**20**
2008	8	5	0	0	2	1	0	0	**16**
2009	2	19	0	0	0	3	0	0	**24**
2010	2	5	0	0	0	2	0	0	**9**
2011	2	25	0	0	1	16	0	0	**44**
Total	**57**	**597**	**6**	**2**	**10**	**108**	**0**	**1**	**737**

Juvenile Atlantic Salmon

Smolts produced from either the Kennebec or Androscoggin River watersheds can occur in the action area of this consultation. Smolts in Maine typically emigrate during April through June. Smolt abundance estimates are not available for the Androscoggin River. While the annual abundance of smolts in the Kennebec River is presently unknown, MDMR estimates the current egg stocking and natural reproduction in the Sandy River may be producing over 10,000 smolts annually. Smolt abundance is the river is likely to remain stable or grow as restoration efforts in the river continue.

In the spring of 2012, a smolt-trapping study was conducted on the Sandy River, a tributary to the Kennebec River, by NextEra Energy. NextEra Energy installed a rotary screw trap in the lower reaches to sample outmigrating Atlantic salmon smolts. The Sandy River RST was operational from April 18, 2012 to May 30, 2012. A total of 52 smolts were captured during 29 days of sampling. The first smolt was captured on April 18 and the last smolt was captured on May 21. Peak capture of smolts occurred in the first week of May. Ambien water temperatures in the Sandy River during sampling ranged from 8° C to 19° C.

Critical Habitat

As discussed above, critical habitat for Atlantic salmon has been designated in the Kennebec River. One PCE for Atlantic salmon (sites for migration) is present in the action area as it was described in Section 3 of this Opinion. To facilitate and standardize determinations of effect for section 7 consultations involving Atlantic salmon critical habitat, NMFS developed the "Matrix of PCEs and Essential Features for Designated Atlantic Salmon Critical Habitat in the GOM DPS" (Table 4). The matrix lists the PCEs, physical and biological features (essential features) of each PCE, and the potential conservation status of critical habitat within an action area. The PCEs in the matrix (spawning and rearing, and migration) are described in regards to five distinct Atlantic salmon life stages: (1) adult spawning; (2) embryo and fry development; (3) parr development; (4) adult migration; and, (5) smolt migration. The conservation status of the essential features may exist in varying degrees of functional capacity within the action area. The three degrees of functional capacity used in the matrix are described in ascending order: (1) fully functioning; (2) limited function; and (3) not properly functioning. Using this matrix along with site-specific knowledge of the action area, NMFS determined that the migration essential feature in the action area is functioning currently.

Table 4. Matrix of Primary Constituent Elements (PCEs) and essential features for assessing the status of Atlantic salmon critical habitat in the action area.

		Conservation Status Baseline		
PCE	Essential Features	Fully Functioning	Limited Function	Not Properly Functioning
A) Adult Spawning: (October 1st - December 14th)				
	Substrate	highly permeable course gravel and cobble between 1.2 to 10 cm in diameter	40- 60% cobble (22.5-256 mm dia.) 40-50% gravel (2.2 – 22.2 mm dia.); 10-15% course sand (0.5 -2.2 mm dia.), and <3% fine sand (0.06-0.05mm dia.)	more than 20% sand (particle size 0.06 to 2.2 mm), no gravel or cobble
	Depth	17-30 cm	30 - 76 cm	< 17 cm or > 76 cm
	Velocity	31 to 46 cm/sec.	8 to 31cm/sec. or 46 to 83 cm/sec.	< 5-8 cm/sec. or > 83cm/sec.
	Temperature	7^{o} to 10^{o}C	often between 7^{o} to 10^{o}C	always < 7^{o} or > 10^{o}C
	pH	> 5.5	between 5.0 and 5.5	< 5.0

Cover	Abundance of pools 1.8-3.6 meters deep (McLaughlin and Knight 1987). Large boulders or rocks, over hanging trees, logs, woody debris, submerged vegetation or undercut banks	Limited availability of pools 1.8-3.6 meters deep (McLaughlin and Knight 1987). Large boulders or rocks, over hanging trees, logs, woody debris, submerged vegetation or undercut banks	Absence of pools 1.8-3.6 meters deep (McLaughlin and Knight 1987). Large boulders or rocks, over hanging trees, logs, woody debris, submerged vegetation or undercut banks
Fisheries Interactions	Abundant diverse populations of indigenous fish species	Abundant diverse populations of indigenous fish species, low quantities of non-native species present	Limited abundance and diversity of indigenous fish species, abundant populations of non-native species
B) Embryo and Fry Development: (October 1st - April 14th)			
Temperature	0.5^{o}C and 7.2^{o}C, averages nearly 6oC from fertilization to eye pigmentation	averages < 4oC, or 8 to 10^{o}C from fertilization to eye pigmentation	>10^{o}C from fertilization to eye pigmentation
D.O.	at saturation	7-8 mg/L	< 7 mg/L
pH	> 6.0	6 - 4.5	< 4.5
Depth	5.3-15cm	NA	<5.3 or >15cm
Velocity	4 – 15cm/sec.	NA	<4 or > 15cm/sec.

Fisheries Interactions	Abundant diverse populations of indigenous fish species	Abundant diverse populations of indigenous fish species, low quantities of non-native species present	Limited abundance and diversity of indigenous fish species, abundant populations of non-native species
C) Parr Development: (All year)			
Substrate	gravel between 1.6 and 6.4 cm in diameter and boulders between 30 and 51.2 cm in diameter. May contain rooted aquatic macrophytes	gravel < 1.2cm and/or boulders > 51.2. May contain rooted aquatic macrophytes	no gravel, boulders, or rooted aquatic macrophytes present
Depth	10cm to 30cm	NA	<10cm or >30cm
Velocity	7 to 20 cm/sec.	< 7cm/sec. or > 20 cm/sec.	velocity exceeds 120 cm/sec..
Temperature	15^{o} to 19^{o}C	generally between 7-22.5oC, but does not exceed 29oC at any time	stream temperatures are continuously <7oC or known to exceed 29oC
D.O.	> 6 mg/l	2.9 - 6 mg/l	< 2.9 mg/l

Food	Abundance of larvae of mayflies, stoneflies, chironomids, caddisflies, blackflies, aquatic annelids, and mollusks as well as numerous terrestrial invertebrates and small fish such as alewives, dace or minnows	Presence of larvae of mayflies, stoneflies, chironomids, caddisflies, blackflies, aquatic annelids, and mollusks as well as numerous terrestrial invertebrates and small fish such as alewives, dace or minnows	Absence of larvae of mayflies, stoneflies, chironomids, caddisflies, blackflies, aquatic annelids, and mollusks as well as numerous terrestrial invertebrates and small fish such as alewives, dace or minnows
Passage	No anthropogenic causes that inhibit or delay movement	Presence of anthropogenic causes that result in limited inhibition of movement	barriers to migration known to cause direct inhibition of movement
Fisheries Interactions	Abundant diverse populations of indigenous fish species	Abundant diverse populations of indigenous fish species, low quantities of non-native species present	Limited abundance and diversity of indigenous fish species, abundant populations of non-native species
D) Adult migration: (April 15th- December 14th)			
Velocity	30 cm/sec to 125 cm/sec	In areas where water velocity exceeds 125 cm/sec adult salmon require resting areas with a velocity of < 61 cm/s	sustained speeds > 61 cm/sec and maximum speed > 667 cm/sec

D.O.	> 5mg/L	4.5-5.0 mg/l	< 4.5mg/L
Temperature	14 – 20^{o}C	temperatures sometimes exceed 20oC but remain below 23^{o}C.	> 23^{o}C
Passage	No anthropogenic causes that delay migration	Presence of anthropogenic causes that result in limited delays in migration	barriers to migration known to cause direct or indirect mortality of smolts
Fisheries Interactions	Abundant diverse populations of indigenous fish species	Abundant diverse populations of indigenous fish species, low quantities of non-native species present	Limited abundance and diversity of indigenous fish species, abundant populations of non-native species
E) Juvenile Migration: (April 15th - June 14th)			
Temperature	8 - 11oC	5 - 11^{o}C.	< 5oC or > 11oC
pH	> 6	5.5 - 6.0	< 5.5
Passage	No anthropogenic causes that delay migration	Presence of anthropogenic causes that result in limited delays in migration	barriers to migration known to cause direct or indirect mortality of smolts

Factors Affecting Atlantic salmon in the Action Area

Predation

In addition to direct mortality during downstream passage, kelts and smolts are exposed to indirect mortality caused by sub-lethal injuries, increased stress, and/or disorientation. A large proportion of indirect mortality is a result of disorientation caused by downstream passage, which can lead to elevated levels of predation immediately downstream of the project (Mesa 1994; Ward *et al.* 1995; Ferguson *et al.* 2006).

Smallmouth bass and chain pickerel are each important predators of Atlantic salmon within the range of the GOM DPS (Fay *et al.* 2006). Smallmouth bass are a warm-water species whose range now extends through north-central Maine and well into New Brunswick (Jackson 2002). Smallmouth bass are very abundant in the Merrymeeting Bay SHRU —smallmouth bass inhabit much of the main stem migratory corridor. Smallmouth bass likely feed on fry and parr though little quantitative information exists regarding the extent of bass predation upon salmon fry and parr. Smallmouth bass are important predators of smolts in main stem habitats, although bioenergetics modeling indicates that bass predation is insignificant at 5°C and increases with increasing water temperature during the smolt migration (Van den Ende 1993).

Chain pickerel are known to feed upon smolts within the range of the GOM DPS and certainly feed upon fry and parr, as well as smolts, given their piscivorous feeding habits (Van den Ende 1993). Chain pickerel feed actively in temperatures below 10°C (Van den Ende 1993, MDIFW 2002). Smolts were, by far, the most common item in the diet of chain pickerel observed by Barr (1962) and Van den Ende (1993). However, Van den Ende (1993) concluded that, "daily consumption was consistently lower for chain pickerel than that of smallmouth bass", apparently due to the much lower abundance of chain pickerel.

Northern pike were illegally stocked in Maine, and their range now includes portions of the lower Merrymeeting Bay SHRU. Northern pike are ambush predators that rely on vision and thus, predation upon smolts occurs primarily in daylight with the highest predation rates in low light conditions at dawn and dusk (Bakshtansky *et al.* 1982). Hatchery smolts experience higher rates of predation by fish than wild smolts, particularly from northern pike (Ruggles 1980, Bakshtansky *et al.* 1982).

Many species of birds prey upon Atlantic salmon throughout their life cycle (Fay *et al.* 2006). Blackwell *et al.* (1997) reported that salmon smolts were the most frequently occurring food items in cormorant sampled at main stem dam foraging sites. Common mergansers, belted kingfishers cormorants, and loons prey would likely prey upon Atlantic salmon in the Kennebec River. The abundance of alternative prey resources such as upstream migrating alewife, likely minimizes the impacts of cormorant predation on the GOM DPS (Fay *et al.* 2006).

Contaminants and Water Quality

Pollutants discharged from point sources affect water quality within the action area of this consultation. Common point sources of pollutants include publicly operated waste treatment facilities, overboard discharges (OBD), a type of waste water treatment system), and industrial sites and discharges. The Maine Department of Environmental Protection (DEP) issues permits under the National Pollutant Discharge Elimination System (NPDES) for licensed point source discharges. Conditions and license limits are set to maintain the existing water quality classification. Generally, the impacts of point source pollution are greater in the larger rivers of the GOM DPS. The DEP has a schedule for preparing a number of TMDLs for rivers and streams within the Kennebec River watershed. TMDLs allocate a waste load for a particular pollutant for impaired waterbodies. The main stem of the Kennebec River downstream of Augusta has restricted fish consumption due to the presence of dioxin from industrial point sources. Combined sewer overflows in Augusta and other communities along the river produce elevated bacteria levels, thus inhibiting recreation uses of the river (primary contact). The lower 22.7 miles of the Kennebec River downstream of its confluence with the Carrabassett River is impaired due to contamination of polychlorinated biphenyls. Other tributaries to the Kennebec River including the Sebasticook River area impaired due to contamination of mercury, PCBs, dioxin, and bacteria from industrial and municipal point sources.

Poor water quality within segments of the Androscoggin River is of particular concern for fisheries restoration. The U.S. Environmental Protection Agency (USEPA) noted that two segments of the Androscoggin, including the lower four miles of the Gulf Island dam impoundment and the Livermore Falls impoundment do not attain water quality standards for class C waters (USEPA 2005). The non-attainment status is caused by point source discharges upriver from the three paper mills located in Berlin, New Hampshire (Fraser Paper), Rumford, Maine (Mead WestVaco), and Jay, Maine (International Paper); five municipal point sources from locations in Berlin and Gorham, New Hampshire and Bethel, Rumford-Mexico, and Livermore Falls, Maine; and non-point source pollutant loads from land use activities, particularly that related to residential development, silviculture, and agriculture (USEPA 2005).

The MDEP has four standards for classification of freshwater which are not classified as “great ponds”. These are class AA, A, B, and C waters, in which class AA is the highest classification in which waters are considered to be “outstanding natural resources and which should be preserved because of their ecological, social, scenic or recreational importance”; and class C waters is the lowest classification in which class C waters “shall be of such quality that they are suitable for the designated uses of drinking water supply after treatment; fishing; recreation in and on the water; industrial process and cooling water supply; hydroelectric power generation, except as prohibited…, navigation, and as a habitat for fish and other aquatic life.” (State of Maine, Title 38 *§ 465*).

The Gulf Island Dam impoundment does not meet the Class C standards for dissolved oxygen concentration in the summer at depths of 30 to 80 feet. In addition to the pollution sources upstream from the dam, the dam itself contributes to non-attainment of DO criteria and algae growth by creating an environment of low water movement and low vertical mixing with the deeper water column (USEPA 2005). The Livermore Falls impoundment does not attain the class C aquatic life criteria in which dissolved oxygen shall not fall below an instantaneous minimum of 5 ppm and 60 percent saturation, and a 30 day average long term minimum of 6.5 ppm (USEPA 2005).

Summary of Factors Affecting Recovery of Atlantic Salmon

There are a wide variety of factors that have and continue to affect the current status of the GOM DPS and its critical habitat. The potential interactions among these factors are not well understood, nor are the reasons for the seemingly poor response of salmon populations to the many ongoing conservation efforts for this species.

The recovery plan for the previously designated GOM DPS (NMFS and USFWS 2005), the latest status review (Fay *et al.* 2006), and the 2009 listing rule all provide a comprehensive assessment of the many factors, including both threats and conservation actions, that are currently affecting the status and recovery of listed Atlantic salmon. The Services are writing a new recovery plan that will include the current, expanded GOM DPS and its designated critical habitat. The new recovery plan provides the most up to date list of significant threats affecting the GOM DPS. These are the following:

- Dams
- Inadequacy of existing regulatory mechanisms for dams
- Continued low marine survival rates for U.S. stocks of Atlantic salmon
- Lack of access to spawning and rearing habitat due to dams and road-stream crossings

In addition to these significant threats there are a number of lesser stressors. These are the following:

- Degraded water quality
- Aquaculture practices, which pose ecological and genetic risks
- Climate change
- Depleted diadromous fish communities
- Incidental capture of adults and parr by recreational anglers
- Introduced fish species that compete or prey on Atlantic salmon
- Poaching of adults in DPS rivers
- Recovery hatchery program (potential for artificial selection/domestication)
- Sedimentation of spawning and rearing habitat
- Water extraction

Fay *et al.* (2006) examined each of the five statutory ESA listing factors and determined that each of the five listing factors is at least partly responsible for the present low abundance of the GOM DPS. The information presented in Fay *et al.* (2006) is reflected in and supplemented by the final listing rule for the new GOM DPS (74 FR 29344; June 19, 2009). The following gives a brief overview of the five listing factors as related to the GOM DPS.

1. **Present or threatened destruction, modification, or curtailment of its habitat or range –** Historically and, to a lesser extent currently, dams have adversely impacted Atlantic salmon by obstructing fish passage and degrading riverine habitat. Dams are considered to be one of the primary causes of both historic declines and the contemporary low abundance of the GOM DPS. Land use practices, including forestry and agriculture, have reduced habitat complexity (e.g., removal of large woody debris from rivers) and habitat connectivity (e.g., poorly designed road crossings) for Atlantic salmon. Water withdrawals, elevated sediment levels, and acid rain also degrade Atlantic salmon habitat.
2. **Overutilization for commercial, recreational, scientific, or educational purposes** – While most directed commercial fisheries for Atlantic salmon have ceased, the impacts from past fisheries are still important in explaining the present low abundance of the GOM DPS. Both poaching and by-catch in recreational and commercial fisheries for other species remain of concern, given critically low numbers of salmon.
3. **Predation and disease –** Natural predator-prey relationships in aquatic ecosystems in the GOM DPS have been substantially altered by introduction of non-native fishes (e.g., chain pickerel, smallmouth bass, and northern pike), declines of other native diadromous fishes, and alteration of habitat by impounding free-flowing rivers and removing instream structure (such as removal of boulders and woody debris during the log-driving era). The

threat of predation on the GOM DPS is noteworthy because of the imbalance between the very low numbers of returning adults and the recent increase in populations of some native predators (e.g., double-crested cormorant), as well as non-native predators. Atlantic salmon are susceptible to a number of diseases and parasites, but mortality is primarily documented at conservation hatcheries and aquaculture facilities.

4. **Inadequacy of existing regulatory mechanisms –** The ineffectiveness of current federal and state regulations at requiring fish passage and minimizing or mitigating the aquatic habitat impacts of dams is a significant threat to the GOM DPS today. Furthermore, most dams in the GOM DPS do not require state or federal permits. Although the State of Maine has made substantial progress in regulating water withdrawals for agricultural use, threats still remain within the GOM DPS, including those from the effects of irrigation wells on salmon streams.
5. **Other natural or manmade factors –** Poor marine survival rates of Atlantic salmon are a significant threat, although the causes of these decreases are unknown. The role of ecosystem function among the freshwater, estuarine, and marine components of the Atlantic salmon's life history, including the relationship of other diadromous fish species in Maine (e.g., American shad, alewife, sea lamprey), is receiving increased scrutiny in its contribution to the current status of the GOM DPS and its role in recovery of the Atlantic salmon. While current state and federal regulations pertaining to finfish aquaculture have reduced the risks to the GOM DPS (including eliminating the use of non-North American Atlantic salmon and improving containment protocols), risks from the spread of diseases or parasites and from farmed salmon escapees interbreeding with wild salmon still exist.

Threats to Critical Habitat within the GOM DPS

The final rule designating critical habitat for the GOM DPS identifies a number of activities that have and will likely continue to impact the biological and physical features of spawning, rearing, and migration habitat for Atlantic salmon. These include agriculture, forestry, changing land-use and development, hatcheries and stocking, roads and road-crossings and other instream activities (such as alternative energy development), mining, dams, dredging, and aquaculture. Most of these activities have or still do occur, at least to some extent, in each of the three SHRUs. Today, dams are the greatest impediment, outside of marine survival, to the recovery of salmon in the Penobscot, Kennebec and Androscoggin river basins (Fay *et al.* 2006). Hydropower dams in the Merrymeeting Bay SHRU significantly impede the migration of Atlantic salmon and other diadromous fish and either reduce or eliminate access to roughly 330,000 units of historically accessible spawning and rearing habitat. In addition to hydropower dams, agriculture and urban development largely affect the lower third of the Merrymeeting Bay SHRU by reducing substrate and cover, reducing water quality, and elevating water temperatures. Additionally, smallmouth bass and brown trout introductions, along with other non-indigenous species, significantly degrade habitat quality throughout the Merrymeeting Bay SHRU by altering natural predator/prey relationships.

Impacts to substrate and cover, water quality, water temperature, biological communities, and migratory corridors, among a host of other factors, have impacted the quality and quantity of habitat available to Atlantic salmon populations within the Downeast Coastal SHRU. Two hydropower dams on the Union river, and to a lesser extent the small ice dam on the lower Narraguagus River, limit access to roughly 18,500 units of spawning and rearing habitat within these two watersheds. In the Union River, which contains over 12,000 units of spawning and rearing habitat, physical and biological features have been most notably limited by high water temperatures and abundant smallmouth bass populations associated with impoundments. In the Pleasant River and Tunk Stream, which collectively contain over 4,300 units of spawning and rearing habitat, pH has been identified as possibly being the predominate limiting factor. The Machias, Narraguagus, and East Machias rivers contain the highest quality habitat relative to other HUC 10's in the Downeast Coastal SHRU and collectively account for approximately 40 percent of the spawning and rearing habitat in the Downeast Coastal SHRU.

Efforts to Protect the GOM DPS and its Critical Habitat

Efforts aimed at protecting Atlantic salmon and their habitats in Maine have been underway for well over one hundred years. These efforts are supported by a number of federal, state, and local government agencies, as well as many private conservation organizations. The 2005 recovery plan for the originally-listed GOM DPS (NMFS and USFWS 2005) presented a strategy for recovering Atlantic salmon that focused on reducing the most severe threats to the species and immediately halting the decline of the species to prevent extinction. The 2005 recovery program included the following elements:

1. Protect and restore freshwater and estuarine habitats;
2. Minimize potential for take in freshwater, estuarine, and marine fisheries;
3. Reduce predation and competition for all life-stages of Atlantic salmon;
4. Reduce risks from commercial aquaculture operations;
5. Supplement wild populations with hatchery-reared DPS salmon;
6. Conserve the genetic integrity of the DPS;
7. Assess stock status of key life stages;
8. Promote salmon recovery through increased public and government awareness; and
9. Assess effectiveness of recovery actions and revise as appropriate.

A wide variety of activities have focused on protecting Atlantic salmon and restoring the GOM DPS, including (but not limited to) hatchery supplementation; removing dams or providing fish passage; improving road crossings that block passage or degrade stream habitat; protecting riparian corridors along rivers; reducing the impact of irrigation water withdrawals; limiting effects of recreational and commercial fishing; reducing the effects of finfish aquaculture; outreach and education activities; and research focused on better understanding the threats to Atlantic salmon and developing effective restoration strategies. In light of the 2009 GOM DPS listing and designation of critical habitat, the Services will produce a new recovery plan for the expanded GOM DPS of Atlantic salmon.

Summary of Information on Atlantic Salmon in the Action Area

Adult returns for the GOM DPS remain well below conservation spawning escapement (CSE). For all GOM DPS rivers in Maine, current Atlantic salmon populations (including hatchery contributions) are well below CSE levels required to sustain themselves (Fay *et al.* 2006), which is further indication of their poor population status. The abundance of Atlantic salmon in the GOM DPS has been low and either stable or declining over the past several decades. The proportion of fish that are of natural origin is very small (approximately 6% over the last ten years) and is continuing to decline. The conservation hatchery program has assisted in slowing the decline and helping to stabilize populations at low levels, but has not contributed to an increase in the overall abundance of salmon and has not been able to halt the decline of the naturally reared component of the GOM DPS.

A number of activities within the Merrymeeting Bay SHRU will likely continue to impact the biological and physical features of spawning, rearing, and migration habitat for Atlantic salmon. These include agriculture, forestry, changing land-use and development, hatcheries and stocking, roads and road-crossings and other instream activities (such as alternative energy development), mining, dams, dredging, and aquaculture. Dams, along with degraded substrate and cover, water quality, water temperature, and biological communities, have reduced the quality and quantity of habitat available to Atlantic salmon populations within the Merrymeeting Bay SHRU.

4.2 Shortnose sturgeon

Shortnose sturgeon life history

Shortnose sturgeon are benthic fish that mainly occupy the deep channel sections of large rivers. They feed on a variety of benthic and epibenthic invertebrates including mollusks, 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)[2] when the freshwater temperatures increase to 8-9ºC. 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

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[2] For purposes of this consultation, Northern rivers are considered to include tributaries of the Chesapeake Bay northward to the St. John River in Canada. Southern rivers are those south of the Chesapeake Bay.

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 and a mean of 11,568 eggs/kg body weight (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 develops 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. Dispersal rates differ at least regionally, laboratory studies on Connecticut River larvae indicated dispersal peaked 7-12 days after hatching in comparison to Savannah River larvae that had longer dispersal rates with multiple, prolonged peaks, and a low level of downstream movement that continued throughout the entire larval and early juvenile period (Parker 2007). Synder (1988) and Parker (2007) considered individuals to be juvenile when they reached 57mm TL. Laboratory studies demonstrated that larvae from the Connecticut River made this transformation on day 40 while Savannah River fish made this transition on day 41 and 42 (Parker 2007).

The juvenile phase can be subdivided in to young of the year (YOY) and immature/ sub-adults. YOY and sub-adult habitat use differs and is believed to be a function of differences in salinity tolerances. Little is known about YOY behavior and habitat use, though it is believed that they are typically found in channel areas within freshwater habitats upstream of the saltwedge for about one year (Dadswell et al. 1984, Kynard 1997). One study on the stomach contents of YOY revealed that the prey items found corresponded to organisms that would be found in the channel environment (amphipods) (Carlson and Simpson 1987). Sub-adults are typically described as age one or older and occupy similar spatio-temporal patterns and habitat-use as adults (Kynard 1997). Though there is evidence from the Delaware River that sub-adults may overwinter in different areas than adults and do not form dense aggregations like adults (ERC Inc. 2007). Sub-adults feed indiscriminately, typical prey items found in stomach contents include aquatic insects, isopods, and amphipods along with large amounts of mud, stones, and plant material (Dadswell 1979, Carlson and Simpson 1987, Bain 1997).

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 reach between 7-9.7ºC, 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 their natal river (Kieffer and Kynard 1996). In the Merrimack River, males returned to only one reach during a four year telemetry study (Kieffer and Kynard 1996). Squires (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 (1996) 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 - 15º, and bottom water velocities of 0.4 to 0.8 m/sec (Dadswell et al. 1984; Hall et al. 1991, Kieffer and Kynard 1996, NMFS 1998). For northern shortnose sturgeon, the temperature range for spawning is 6.5-18.0ºC (Kieffer and Kynard in press). 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 or sub-adults tend to move downstream in fall and winter as water temperatures decline and the salt wedge recedes and 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). Non-spawning movements include 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. 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 et al. 1994; Rogers and Weber 1995; Weber 1996).

While shortnose sturgeon do not undertake the significant marine migrations seen in Atlantic sturgeon, telemetry data indicates that shortnose sturgeon do make localized coastal migrations. This is particularly true within certain areas such as the Gulf of Maine (GOM) and among rivers in the Southeast. Interbasin movements have been documented among rivers within the GOM and between the GOM and the Merrimack, between the Connecticut and Hudson rivers, the Delaware River and Chesapeake Bay, and among the rivers in the Southeast.

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 3ºC (Dadswell et al. 1984) and as high as 34ºC (Heidt and Gilbert 1978). However, temperatures above 28ºC are thought to adversely affect shortnose sturgeon. In the Altamaha River, temperatures of 28-30ºC during summer months create unsuitable conditions and shortnose sturgeon are found in deep cool water refuges. Dissolved oxygen (DO) also seems to play a role in temperature tolerance, with increased stress levels at higher temperatures with low DO versus the ability to withstand higher temperatures with elevated DO (Niklitchek 2001).

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 values 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 century and early twentieth century, shortnose sturgeon commonly were taken in a commercial fishery for the closely related and commercially valuable Atlantic sturgeon (*Acipenser oxyrinchus*). 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, in the final recovery plan NMFS recognized 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)[3] of shortnose sturgeon under the ESA. Although genetic information

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[3] 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.

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 1997) 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.

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 nineteen separate populations of shortnose sturgeon as subpopulations (one of which occurs in the action area) 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. Population sizes vary across the species' range. From available estimates, the smallest populations occur in the Cape Fear (~8 adults; Moser and Ross 1995) in the south and Merrimack and Penobscot rivers in the north (~ several hundred to several thousand adults depending on population estimates used; M. Kieffer, United States Geological Survey, personal communication; Dionne 2010), while the largest populations are found in the Saint John (~18, 000; Dadswell 1979) and Hudson Rivers (~61,000; Bain et al. 1998). As indicated in Kynard 1996, 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 1996 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 or jeopardize 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 (Varanasi 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).

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).

Contaminant analysis was conducted on two shortnose sturgeon from the Delaware River in the fall of 2002. Muscle, liver, and gonad tissue were analyzed for contaminants (ERC 2002). Sixteen metals, two semivolatile compounds, three organochlorine pesticides, one PCB Aroclor, as well as polychlorinated dibenzo-p-dioxins (PCDDs), and polychlorinated dibenzofurans (PCDFs) were detected in one or more of the tissue samples. Levels of aluminum, cadmium, PCDDs, PCDFs, PCBs, DDE (an organochlorine pesticide) were detected in the "adverse affect" range. It is of particular concern that of the above chemicals, PCDDs, DDE, PCBs and cadmium, were detected as these have been identified as endocrine disrupting chemicals. Contaminant analysis conducted in 2003 on tissues from a shortnose sturgeon from the Kennebec 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). While no directed studies of chemical contamination in shortnose sturgeon have been undertaken, it is evident that the heavy industrialization of the rivers where shortnose sturgeonare found is likely adversely affecting this species.

During summer months, especially in southern areas, shortnose sturgeon must cope with the physiological stress of water temperatures that may exceed 28ºC. 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. Shortnose sturgeon are known to be adversely affected by dissolved oxygen levels below 5 mg/L. 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 28ºC (Flourney et al. 1992). At these temperatures, concomitant low levels of dissolved oxygen may be lethal.

Global climate change may affect shortnose sturgeon in the future. Rising sea level may result in the salt wedge moving upstream in affected rivers, possibly affecting the survival of drifting larvae and YOY shortnose sturgeon that are sensitive to elevated salinity. Similarly, for river systems with dams, YOY may experience a habitat squeeze between a shifting (upriver) salt wedge and a dam causing loss of available habitat for this life stage.

The increased rainfall predicted by some models in some areas may increase runoff and scour spawning areas and flooding events could cause temporary water quality issues. Rising temperatures predicted for all of the U.S. will likely exacerbate existing water quality problems with DO and temperature. While this occurs primarily in rivers in the southeast U.S. and the Chesapeake Bay, it may start to occur more commonly in the northern rivers. One might expect range extensions to shift northward (i.e. into the St. Lawrence River, Canada) while truncating the southern distribution. Increased droughts (and water withdrawal for human use) predicted by some models in some areas may cause loss of habitat including loss of access to spawning habitat. Drought conditions in the spring may also expose eggs and larvae in rearing habitats. If a river becomes too dry all shortnose sturgeon life stages, including adults, may become susceptible to strandings. Low flow and drought conditions are also expected to cause additional water quality issues. Any of the conditions associated with climate change are likely to disrupt river ecology causing shifts in community structure and the type and abundance of prey. Additionally, cues for spawning migration and spawning could occur earlier in the season causing a mismatch in prey that are currently available to developing shortnose sturgeon in rearing habitat.

Implications of climate change to shortnose sturgeon have been speculated, yet no scientific data are available on past trends related to climate effects on this species and current scientific methods are not able to reliably predict the future magnitude of climate change and associated impacts or the adaptive capacity of this species. Due to a lack of scientific data, the specific effects to this species resulting from climate change are not predictable or quantifiable to any degree that would allow for more detailed analysis in this consultation. Given this uncertainty and the likely rate of change associated with climate impacts (i.e., the century scale), it is unlikely that climate related impacts will have a significant effect on shortnose sturgeon over the temporal scale of the proposed action (i.e., August 2011).

Status of Shortnose Sturgeon in the Kennebec River

On September 19, 1994, NMFS received a petition from the Edwards Manufacturing Company, Inc., to delist shortnose sturgeon occurring in the Androscoggin and Kennebec rivers. In the ensuing status review, NMFS found that the petition to delist this population segment was not warranted because: 1) the population estimate used by the petitioners was less reliable than the best estimate accepted by NMFS; 2) the best population estimate available did not exceed the interim threshold at which the population segment would be a candidate for delisting; 3) no recent information was available to assess the population dynamics; and 4) threats to shortnose sturgeon habitat still exist throughout the Androscoggin and Kennebec rivers (NMFS 1996).

The Kennebec system includes the Kennebec, Androscoggin and Sheepscot Rivers. Shortnose sturgeon occur in the estuarine complex formed by the Sheepscot, Kennebec, and Androscoggin rivers. Atkins (1887) documented the presence of sturgeon in Maine rivers, though they were identified as common sturgeon (*Acipenser sturio*). Fried and McCleave (1973) discovered shortnose sturgeon within Montsweag Bay in the Sheepscot River in 1971. This was the first reported occurrence of shortnose sturgeon in Maine. Shortnose were subsequently found in the Kennebec River by ME DMR in 1977 (Squiers and Smith, 1979). Historically, the upstream extent of shortnose sturgeon in the Kennebec is thought to have been Ticonic Falls (rkm 98).

Sturgeon were tagged with Carlin tags from 1977 to 1981, with recoveries in each of the following years. A Schnabel estimate of 7,200 (95% CI, 5,000 to 10,800) adults for the combined estuarine complex was computed from the tagging and recapture data from 1977 through 1981 (Squiers et al. 1982). A Schnabel estimate using tagging and recapture data from 1998 - 2000 indicates a population estimate of 9,488 (95% CI, 6,942 to 13,358) for the estuarine complex (Squiers 2003). The average density of adult shortnose sturgeon/hectare of habitat in the estuarine complex of the Kennebec River was the second highest of any population studied through 1983 (Dadswell et al, 1984). The Schnabel estimate from 1998-2000 is the most recent population estimate for the Kennebec River shortnose sturgeon population; however, this estimate includes fish from the Androscoggin and Sheepscot rivers as well and does not include an estimate of the size of the juvenile population. A comparison of the population estimate for the estuarine complex from 1982 (Squiers et al. 1982) to 2000 (Maine DMR 2003) suggests that the adult population has grown by approximately 30% in the last twenty years. Based on this information, NMFS believes that the shortnose sturgeon population in the Kennebec River is increasing; however, without more information on the status of more recent year classes (i.e., juveniles) it is difficult to speculate about the long term survival and recovery of this population.

Spawning

In 1999, the Edward's Dam, which represented the first significant impediment to the northward migration of shortnose sturgeon in the Kennebec River, was removed. The Lockwood Dam continues to operate, though it is not thought to impede shortnose access to historic habitat given that the Lockwood Project is situated at Ticonic Falls (rkm 98), the historic upstream extent of shortnose in the Kennebec River. Thus, with the removal of the Edwards dam almost 100% of historic habitat is now accessible. Since the removal of the Edwards Dam, shortnose sturgeon have been documented at the Lockwood Dam (rkm 98) indicating this habitat is being utilized to some extent. It is unknown if additional spawning sites above the site of the former Edwards Dam are now being used. In populations of shortnose sturgeon that have free access to the total length of a river (e.g., no dam within the species' historical range in the river), spawning areas are located at the most upstream reach of the river used by sturgeon (NMFS 1998). Based on this pattern, it is likely that shortnose sturgeon may now be spawning in additional upriver sites. In order to monitor the recolonization of the habitat above Edwards Dam, ME DMR conducted ichthyoplankton surveys from 1997 through 2001. Sampling sites were located both above and below the dam and were surveyed using surface tows with plankton nets and stationary sets with D-shaped plankton nets. While no shortnose sturgeon eggs or larvae were collected above the former dam site in 2000 or 2001 (Wippelhauser 2003), small numbers of eggs and larvae were collected at sites in the first nine kilometers below the site (rkm 61-70). In May of 1999, 135 shortnose sturgeon were captured approximately 10 km below Edwards dam (rkm 60) and were assumed to be on the spawning run. The presence of ELS and the captures in 1999, indicate that the major spawning area for shortnose sturgeon in the Kennebec River is likely located in the first 11 km below the former Edwards Dam site (rkms 59-70) (Squiers et al. 1982, Wippelhauser 2003). While there have not been any directed studies to determine if shortnose sturgeon are utilizing the habitat above the former Edwards Dam for spawning, several shortnose sturgeon have been captured incidental to other studies in Waterville (and some at the base of the Lockwood Dam), 27 km above the former Edwards Dam.

In the Kennebec River, movement to the spawning grounds is suspected to occur in early spring (April - May) when water temperatures are between 8-9ºC. In general shortnose sturgeon quickly leave the spawning grounds for summer foraging areas when temperatures exceed 15ºC (Squiers et al. 1982).

In the Androscoggin River, shortnose sturgeon migration, and thus spawning, was likely limited historically by the natural falls located at the Brunswick Dam (rkm 44). From 1971-1981, MEDMR conducted gillnet studies to identify spawning areas. During this period large numbers of shortnose sturgeon were captured between Brunswick and Topsham, approximately 400m downstream of the Rt 201 Bridge. Water temperatures ranged between 8.5. and 14.5°C (late April until the end of May), many of the males captured were freely expressing milt and several females were ripe (Squiers et al. 1982). Tracking studies to delineate spawning habitat were performed on the Androscoggin River during 1993. Gill nets were used to capture study animals and catch rates were recorded. Gill net catch-per-unit-effort during this study was the highest recorded in this area, suggesting that the population in the Androscoggin has increased since last surveyed. This study indicated that spawning was concentrated in the reach of river approximately 500m downstream of the Brunswick Dam. Additionally, based upon egg collections at this site, spawning occurred from May 7-19 and temperatures ranged from 7°-17°C. The spawning migration is estimated to extend from the last week in April through May.

Foraging

Foraging areas have been identified in the Sasanoa River entrance[4] and in the mainstem of the Kennebec River below Bath, from mid-April through November or early December (Squiers 1982, Normandeau 1999). Between June and September, shortnose sturgeon forage in shallow waters on mud flats that are covered with rooted aquatic plants. In the summer months, concentrations of shortnose sturgeon have also been known to move up into the freshwater reaches of the Kennebec River and foraging shortnose sturgeon have also been seen in Montsweag and Hockomock Bays in the Sheepscot River, which is located near the eastern end of the Sasanoa River (NMFS 1996). McCleave et al. (1977) examined several stomachs from shortnose sturgeon captured in Montsweag Bay and found crangon shrimp (*Crangon septemspinosous*); clams (*Mya arenaria*); and small winter flounder (*Pseudopleuronectes americanus*) were common prey items.

Overwintering

Studies indicate that at least a portion of the shortnose sturgeon population in the Kennebec River overwinters in Merrymeeting Bay (ME DMR 1996). The seasonal migrations of shortnose sturgeon are believed to be correlated with changes in water temperature. In 1999, when a tracking study was performed by Normandeau Associates, the water temperature near Bath Iron Works (BIW) reached the 8-9ºC threshold (believed to be the trigger prompting spawning fish to migrate to the spawning area) in mid-April. Also during the tracking study, several fish presumed to be non-spawning sturgeon, were documented in the Chops Point and Swan Island areas (north of Doubling Point) in late March and then were found to have migrated south to the BIW region (e.g., north and south of the BIW Pier and Museum Point) early in April.

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[4] The Sasanoa River entrance is located directly across the Kennebec River from the Bath Iron Works facility. The river is less than ½ mile wide at this point.

Until a study aimed at specifically determining overwintering locations was conducted by the MEDMR in 1996 for the Maine Department of Transportation (DOT), the sites thought to be the most likely overwintering sites were deep pools below Bluff Head, and possibly in adjacent estuaries such as the Sheepscot (Squiers and Robillard 1997). The 1996 study of overwintering activity suggests that at least one overwintering site is located above Bath. This is based on tracking 15 shortnose sturgeon collected and released in the vicinity of the Sasanoa River (Pleasant Cove), Winnegance Cove (near the Doubling Point reach), and Merrymeeting Bay (north of Bath and the Sasanoa River entrance). Tracking was done from October through January. Eleven of these fish were relocated in Merrymeeting Bay. Two of the fish from Pleasant Cove were never found in Merrymeeting Bay; one Pleasant Cove fish moved to Winnegance Cove and back to Pleasant Cove and another moved to Days Ferry (half way between Bath and Merrymeeting Bay). All of the fish that continued to transmit after November were only found in upper Merrymeeting Bay on the east-side of Swan Island. This is consistent with the trends for movement of shortnose sturgeon in the Delaware River (O'Herron 1992). Overwintering sturgeon in the Delaware River are found in the area of Newbold Island, in the Trenton to Kinkora river reach, in an area geographically similar to the area around Swan Island.

Fisheries sampling was conducted from April 1997 through June 1998 by Normandeau Associates, using a semi-balloon otter trawl with 1 ½ inch mesh in the cod end and a ¼ inch liner. Sampling occurred monthly in April, May and December. At the request of NMFS and Maine DMR, sampling frequency increased to twice monthly from June through November 1997 and April through June 1998. Trawl locations were located near the BIW outfitting pier (T1), south of the pier near the dry dock facility (T2), and south of Trufant Ledge (T3). In August, 1997 additional stations were added near Sasanoa Point (T4), Hanson Bay (T5), north of Hospital Point on the west (T6) and east (T7) shores, and in Winnegance Creek (T8). During high slack tide, two tows were made at each sampling location. Three of these sampling locations are in the vicinity of Doubling Point (T6, T7 and T8) (located approximately one nautical mile south of BIW). Results of the trawl study confirmed that shortnose sturgeon were present in the Bath area from April through November. No sampling was conducted between December and March.

Beginning in 1998, 17 shortnose sturgeon were collected via gillnet in the BIW area and were tagged and released near the capture site. Tracking began in 1998 and continued into 1999. Some of the fixed receivers were moved from their original locations and redeployed in areas of higher shortnose sturgeon abundance. In 1999, tracking was performed in three primary locations from late March through early May and mid-September through Mid-December. Through December 15, all scans detected shortnose sturgeon in the vicinity of BIW. No tracking was conducted between mid-December and mid-March. In addition, trawling activities from 1999-2001 consistently captured shortnose sturgeon in the Bath area from April through November when trawls were deployed. Studies were not conducted outside of that time of year.

Interbasin Movement

The University of Maine and ME DMR have recently collected data indicating quite extensive coastal migrations between the Kennebec and Penobscot Rivers. The distance between the mouth of the Kennebec and Penobscot rivers is approximately 70 km. These studies were undertaken in 2006 and are ongoing. During 2006 sonic transmitters were implanted in a total of 39 shortnose sturgeon from June 14, 2006-September 27, 2007 in the Penobscot River

(Fernandes 2008). Eleven individuals have been subsequently detected by the passive receiver array in the Kennebec River. Fish originating in the Kennebec River have also been subsequently detected in the Penobscot River (Fernandes 2008). The motivation to undertake these coastal migrations is not entirely clear; however, fish migrating from the Penobscot River to the Kennebec River have been documented at known overwintering sites and suspected spawning areas. 7 shortnose sturgeon tagged in the Penobscot River and detected leaving the river between September and November 2007 were subsequently detected in the Kennebec river. 4 of the 7 individuals were located in February of 2008 at the suspected overwintering site in Merrymeeting Bay (Fernandes 2008). Furthermore, some of the females moving from the Penobscot to the Kennebec were also documented with late stage eggs (Fernandes 2008). Telemetry data also indicates that shortnose sturgeon utilize smaller coastal river systems during these migrations. Fish moving between the Penobscot and Kennebec rivers have been documented utilizing a number of small coastal rivers in between these two larger systems including the Damariscotta, St. George, Medomak, and Passagassawakeag.

Shortnose Sturgeon in the Action Area

Several studies were conducted in the late 1990s to document the presence and seasonal distribution of shortnose sturgeon near the BIW facility. The results of these studies as well as other available information on the presence of shortnose sturgeon in the action area is summarized below.

Fisheries sampling was conducted from April 1997 through June 1998 by Normandeau Associates, using a semi-balloon otter trawl with 1 ½ inch mesh in the cod end and a ¼ inch liner. Sampling occurred monthly in April, May and December. At the request of NMFS and Maine DMR, sampling frequency increased to twice monthly from June through November 1997 and April through June 1998. Trawl locations were located near the BIW outfitting pier (T1), south of the pier near the dry dock facility (T2), and south of Trufant Ledge (T3). In August, 1997 additional stations were added near Sasanoa Point (T4), Hanson Bay (T5), north of Hospital Point on the west (T6) and east (T7) shores, and in Winnegance Creek (T8). During high slack tide, two tows were made at each sampling location. Three of these sampling locations are in the vicinity of Doubling Point (T6, T7 and T8) (located approximately one nautical mile south of BIW). Results of the trawl study confirmed that shortnose sturgeon were present in the Bath area from April through November. No sampling was conducted between December and March. In addition, trawling activities from 1999-2001 consistently captured shortnose sturgeon in the Bath area from April through November when trawls were deployed. Studies were not conducted outside of that time of year.

Beginning in 1998, 17 shortnose sturgeon were collected via gillnet in the BIW area and were tagged and released near the capture site. Tracking began in 1998 and continued into 1999. Some of the fixed receivers were moved from their original locations and redeployed in areas of higher shortnose sturgeon abundance. In 1999, tracking was performed in three primary locations from late March through early May and mid-October through Mid-December. Through December 15, all scans detected shortnose sturgeon in the vicinity of BIW. From October 21 through November 4, 1999, seven shortnose sturgeon were detected ranging from North to South of the BIW Pier, Chops Point, Fishers Eddy, and Doubling Point. Five of these sturgeon were in the immediate vicinity of BIW. From November 4 through November 12, 1999, four tagged shortnose sturgeon were detected, three of which were in the immediate vicinity of BIW. Tagged shortnose sturgeon were also tracked in the vicinity of BIW from November 18 – 23, one of which was in the immediate vicinity of BIW. The tracks from November 23 – December 15 detected two shortnose sturgeon in the immediate vicinity of BIW. No tracking was attempted after December 15 due to icing conditions in the Kennebec River.

Based on tracking and trawl data detailed above, shortnose sturgeon are expected to be present in the BIW area year round. Concentrations of shortnose sturgeon are expected to be present in the action area from early April – mid November, with numbers being the highest in the summer months and at least a few individuals present throughout the winter. The highest concentration of shortnose sturgeon is expected in the Bath area between June and September when shortnose sturgeon are on the summer foraging grounds which include the entrance to the Sassanoa River, located less than half a mile across the river from the sinking basin and included in the action area for this consultation, and the mainstem Kennebec River immediately below Bath. During the June through September time period, large concentrations of adult fish are known to be actively foraging in this region and hundreds of shortnose sturgeon have been documented in the action area at this time. Shortnose sturgeon adults and juveniles are likely to be present in the action area during the dredging window of October 1 – May 31. Due to the distance from the spawning grounds (greater than 25 km), no spawning adults, eggs or larvae are likely to be present in the action area at any time of year. An analysis of tracking studies conducted from 1996-1999 suggests that the numbers of shortnose sturgeon in the action area begins to decrease in early to mid-November as water temperatures drop below 10°C and most shortnose sturgeon migrate upstream to the overwintering area in Merrymeeting Bay. Tracking conducted in 1996 and 1997 indicated that most shortnose sturgeon had moved upstream from the Bath area to the overwintering area by mid-late November. These studies also indicate that shortnose sturgeon are very mobile while in the action area and that at least some individuals remain in the Bath area through mid-December (when tracking ceased).

4.3 Status of Atlantic sturgeon

The section below describes the Atlantic sturgeon listing, provides life history information that is relevant to all DPSs of Atlantic sturgeon and then provides information specific to the status of each DPS of Atlantic sturgeon. Below, we also provide a description of which Atlantic sturgeon DPSs likely occur in the action area and provide information on the use of the action area by Atlantic sturgeon.

The Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) is a subspecies of sturgeon distributed along the eastern coast of North America from Hamilton Inlet, Labrador, Canada to Cape Canaveral, Florida, USA (Scott and Scott, 1988; ASSRT, 2007; T. Savoy, CT DEP, pers. comm.). NMFS has delineated U.S. populations of Atlantic sturgeon into five DPSs[5] (77 FR 5880 and 77 FR 5914). These are: the Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs (see Figure 7). The results of genetic studies suggest that natal origin influences the distribution of Atlantic sturgeon in the marine environment (Wirgin and King, 2011). However, genetic data as well as tracking and tagging data demonstrate sturgeon from each DPS and Canada occur throughout the full range of the subspecies.

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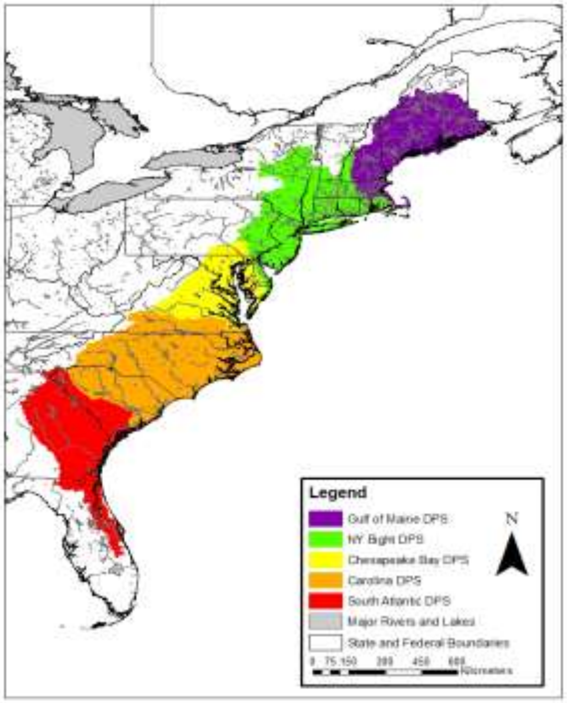
[5] To be considered for listing under the ESA, a group of organisms must constitute a “species.” A “species” is defined in section 3 of the ESA to include “any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature.”

Therefore, sturgeon originating from any of the 5 DPSs can be affected by threats in the marine, estuarine and riverine environment that occur far from natal spawning rivers.

On February 6, 2012, we published notice in the *Federal Register* that we were listing the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs as "endangered," and the Gulf of Maine DPS as "threatened" (77 FR 5880 and 77 FR 5914). The effective date of the listings was April 6, 2012. The DPSs do not include Atlantic sturgeon that are spawned in Canadian rivers. Therefore, Canadian spawned fish are not included in the listings.

As described below, individuals originating from the five listed DPSs may occur in the action area. Information general to all Atlantic sturgeon as well as information specific to each of the relevant DPSs, is provided below.

Figure 7. Map Depicting the Boundaries of the five Atlantic sturgeon DPSs



4.3.1 *Atlantic sturgeon life history*

Atlantic sturgeon are long lived (approximately 60 years), late maturing, estuarine dependent, anadromous[6] fish (Bigelow and Schroeder, 1953; Vladykov and Greeley 1963; Mangin, 1964; Pikitch *et al.*, 2005; Dadswell, 2006; ASSRT, 2007).

The life history of Atlantic sturgeon can be divided up into five general categories as described in the table below (adapted from ASSRT 2012).

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[6] Anadromous refers to a fish that is born in freshwater, spends most of its life in the sea, and returns to freshwater to spawn (NEFSC FAQ's, available at http://www.nefsc.noaa.gov/faq/fishfaq1a.html, modified June 16, 2011)

Age Class	**Size**	**Description**
Egg		Fertilized or unfertilized
Larvae		Negative photo-taxic, nourished by yolk sac
Young of Year (YOY)	**0.3 grams <41 cm TL**	Fish that are > 3 months and < one year; capable of capturing and consuming live food
Sub-adults	**>41 cm and <150 cm TL**	Fish that are at least age 1 and are not sexually mature
Adults	**>150 cm TL**	Sexually mature fish

Table 5. Descriptions of Atlantic sturgeon life history stages.

They are a relatively large fish, even amongst sturgeon species (Pikitch *et al.*, 2005). Atlantic sturgeons are bottom feeders that suck food into a ventrally-located protruding mouth (Bigelow and Schroeder, 1953). Four barbels in front of the mouth assist the sturgeon in locating prey (Bigelow and Schroeder, 1953). Diets of adult and migrant subadult Atlantic sturgeon include mollusks, gastropods, amphipods, annelids, decapods, isopods, and fish such as sand lance (Bigelow and Schroeder, 1953; ASSRT, 2007; Guilbard *et al.*, 2007; Savoy, 2007). While in the river, Atlantic sturgeon feed on aquatic insects, insect larvae, and other invertebrates (Bigelow and Schroeder, 1953; ASSRT, 2007; Guilbard *et al.*, 2007).

Rate of maturation is affected by water temperature and gender. In general: (1) Atlantic sturgeon that originate from southern systems grow faster and mature sooner than Atlantic sturgeon that originate from more northern systems; (2) males grow faster than females; (3) fully mature females attain a larger size (i.e. length) than fully mature males; and (4) the length of Atlantic sturgeon caught since the mid-late 20th century have typically been less than 3 meters (m) (Smith *et al.*, 1982; Smith *et al.*, 1984; Smith, 1985; Scott and Scott, 1988; Young *et al.*, 1998; Collins *et al.*, 2000; Caron *et al.*, 2002; Dadswell, 2006; ASSRT, 2007; Kahnle *et al.*, 2007; DFO, 2011). The largest recorded Atlantic sturgeon was a female captured in 1924 that measured approximately 4.26 m (Vladykov and Greeley, 1963). Dadswell (2006) reported seeing seven fish of comparable size in the St. John River estuary from 1973 to 1995. Observations of large-sized sturgeon are particularly important given that egg production is correlated with age and body size (Smith *et al.*, 1982; Van Eenennaam *et al.*, 1996; Van Eenennaam and Doroshov, 1998; Dadswell, 2006). However, while females are prolific with egg production ranging from 400,000 to 4 million eggs per spawning year, females spawn at intervals of 2-5 years (Vladykov and Greeley, 1963; Smith *et al.*, 1982; Van Eenennaam *et al.*, 1996; Van Eenennaam and Doroshov, 1998; Stevenson and Secor, 1999; Dadswell, 2006). Given spawning periodicity and a female's relatively late age to maturity, the age at which 50 percent of the maximum lifetime egg production is achieved is estimated to be 29 years (Boreman, 1997). Males exhibit spawning periodicity of 1-5 years (Smith, 1985; Collins *et al.*, 2000; Caron *et al.*, 2002). While long-lived, Atlantic sturgeon are exposed to a multitude of threats prior to achieving maturation and have a limited number of spawning opportunities once mature.

Water temperature plays a primary role in triggering the timing of spawning migrations (ASMFC, 2009). Spawning migrations generally occur during February-March in southern systems, April-May in Mid-Atlantic systems, and May-July in Canadian systems (Murawski and Pacheco, 1977; Smith, 1985; Bain, 1997; Smith and Clugston, 1997; Caron *et al.*, 2002). Male sturgeon begin upstream spawning migrations when waters reach approximately 6° C (43° F) (Smith *et al.*, 1982; Dovel and Berggren, 1983; Smith, 1985; ASMFC, 2009), and remain on the spawning grounds throughout the spawning season (Bain, 1997). Females begin spawning migrations when temperatures are closer to 12° C to 13° C (54° to 55° F) (Dovel and Berggren, 1983; Smith, 1985; Collins *et al.*, 2000), make rapid spawning migrations upstream, and quickly depart following spawning (Bain, 1997).

The spawning areas in most U.S. rivers have not been well defined. However, the habitat characteristics of spawning areas have been identified based on historical accounts of where fisheries occurred, tracking and tagging studies of spawning sturgeon, and physiological needs of early life stages. Spawning is believed to occur in flowing water between the salt front of estuaries and the fall line of large rivers, when and where optimal flows are 46-76 cm/s and depths are 3-27 m (Borodin, 1925; Dees, 1961; Leland, 1968; Scott and Crossman, 1973; Crance, 1987; Shirey *et al.* 1999; Bain *et al.*, 2000; Collins *et al.*, 2000; Caron *et al.* 2002; Hatin *et al.* 2002; ASMFC, 2009). Sturgeon eggs are deposited on hard bottom substrate such as cobble, coarse sand, and bedrock (Dees, 1961; Scott and Crossman, 1973; Gilbert, 1989; Smith and Clugston, 1997; Bain *et al.* 2000; Collins *et al.*, 2000; Caron *et al.*, 2002; Hatin *et al.*, 2002; Mohler, 2003; ASMFC, 2009), and become adhesive shortly after fertilization (Murawski and Pacheco, 1977; Van den Avyle, 1983; Mohler, 2003). Incubation time for the eggs increases as water temperature decreases (Mohler, 2003). At temperatures of 20° and 18° C, hatching occurs approximately 94 and 140 hours, respectively, after egg deposition (ASSRT, 2007).

Larval Atlantic sturgeon (i.e. less than 4 weeks old, with total lengths (TL) less than 30 mm; Van Eenennaam *et al.* 1996) are assumed to undertake a demersal existence and inhabit the same riverine or estuarine areas where they were spawned (Smith *et al.*, 1980; Bain *et al.*, 2000; Kynard and Horgan, 2002; ASMFC, 2009). Studies suggest that age-0 (i.e., young-of-year), age-1, and age-2 Atlantic sturgeon occur in low salinity waters of the natal estuary (Haley, 1999; Hatin *et al.*, 2007; McCord *et al.*, 2007; Munro *et al.*, 2007) while older fish are more salt tolerant and occur in higher salinity waters as well as low salinity waters (Collins *et al.*, 2000). Atlantic sturgeon remain in the natal estuary for months to years before emigrating to open ocean as subadults (Holland and Yelverton, 1973; Dovel and Berggen, 1983; Waldman *et al.*, 1996; Dadswell, 2006; ASSRT, 2007).

After emigration from the natal estuary, subadults and adults travel within the marine environment, typically in waters less than 50 m in depth, using coastal bays, sounds, and ocean waters (Vladykov and Greeley, 1963; Murawski and Pacheco, 1977; Dovel and Berggren, 1983; Smith, 1985; Collins and Smith, 1997; Welsh *et al.*, 2002; Savoy and Pacileo, 2003; Stein *et al.*, 2004; USFWS, 2004; Laney *et al.*, 2007; Dunton *et al.*, 2010; Erickson *et al.*, 2011; Wirgin and King, 2011). Tracking and tagging studies reveal seasonal movements of Atlantic sturgeon along the coast. Satellite-tagged adult sturgeon from the Hudson River concentrated in the southern part of the Mid-Atlantic Bight at depths greater than 20 m during winter and spring, and in the northern portion of the Mid-Atlantic Bight at depths less than 20 m in summer and fall (Erickson *et al.*, 2011). Shirey (Delaware Department of Fish and Wildlife, unpublished data reviewed in ASMFC, 2009) found a similar movement pattern for juvenile Atlantic sturgeon based on recaptures of fish originally tagged in the Delaware River. After leaving the Delaware River estuary during the fall, juvenile Atlantic sturgeon were recaptured by commercial fishermen in nearshore waters along the Atlantic coast as far south as Cape Hatteras, North Carolina from November through early March. In the spring, a portion of the tagged fish re-entered the Delaware River estuary. However, many fish continued a northerly coastal migration through the Mid-Atlantic as well as into southern New England waters where they were recovered throughout the summer months. Movements as far north as Maine were documented. A southerly coastal migration was apparent from tag returns reported in the fall. The majority of these tag returns were reported from relatively shallow near shore fisheries with few fish reported from waters in excess of 25 m (C. Shirey, Delaware Department of Fish and Wildlife, unpublished data reviewed in ASMFC, 2009). Areas where migratory Atlantic sturgeon commonly aggregate include the Bay of Fundy (e.g., Minas and Cumberland Basins), Massachusetts Bay, Connecticut River estuary, Long Island Sound, New York Bight, Delaware Bay, Chesapeake Bay, and waters off of North Carolina from the Virginia/North Carolina border to Cape Hatteras at depths up to 24 m (Dovel and Berggren, 1983; Dadswell *et al.*, 1984; Johnson *et al.*, 1997; Rochard *et al.*, 1997; Kynard *et al.*, 2000; Eyler *et al.*, 2004; Stein *et al.*, 2004; Wehrell, 2005; Dadswell, 2006; ASSRT, 2007; Laney *et al.*, 2007). These sites may be used as foraging sites and/or thermal refuge.

4.3.2 Determination of DPS Composition in the Action Area

As explained above, the range of all five DPSs overlaps and extends from Canada through Cape Canaveral, Florida. The distribution of Atlantic sturgeon is influenced by geography, with Atlantic sturgeon from a particular DPS becoming less common the further from the river of origin one moves. Areas that are geographically close are expected to have a similar composition of individuals. We have considered the best available information to determine from which DPSs individuals in the action area are likely to have originated.

There is currently no mixed stock analysis for the Kennebec River. Mixed stock analysis is available for the Bay of Fundy. Given the geographic proximity of the Bay of Fundy to the action area, it is reasonable to anticipate similar distribution in these two areas (93% Gulf of Maine DPS (60% St. John, 40% Kennebec) and 7% New York Bight DPS). However, in the action area we would expect a higher frequency of Kennebec River origin individuals than St. John River individuals. As such, in the action area we expect Atlantic sturgeon to occur at the following frequencies: Gulf of Maine 93% (60-100% Kennebec and up to 40% St. John (Canada)) and 7% New York Bight. These occurrences are supported by preliminary genetic analyses of fish caught in the Gulf of Maine (see Damon-Randall *et al*. 2012). The genetic assignments have a plus/minus 5% confidence interval; however, for purposes of section 7 consultation we have selected the reported values above, which approximate the mid-point of the range, as a reasonable indication of the likely genetic makeup of Atlantic sturgeon in the action area. These assignments and the data from which they are derived are described in detail by Damon-Randall *et al.* (2012).

4.3.3 Distribution and Abundance

Atlantic sturgeon underwent significant range-wide declines from historical abundance levels due to overfishing in the mid to late 19th century when a caviar market was established (Scott and Crossman, 1973; Taub, 1990; Kennebec River Resource Management Plan, 1993; Smith and Clugston, 1997; Dadswell, 2006; ASSRT, 2007). Abundance of spawning-aged females prior to this period of exploitation was predicted to be greater than 100,000 for the Delaware, and at least 10,000 females for other spawning stocks (Secor and Waldman, 1999; Secor, 2002). Historical records suggest that Atlantic sturgeon spawned in at least 35 rivers prior to this period. Currently, only 16 U.S. rivers are known to support spawning based on available evidence (i.e., presence of young-of-year or gravid Atlantic sturgeon documented within the past 15 years) (ASSRT, 2007). While there may be other rivers supporting spawning for which definitive evidence has not been obtained (e.g., in the Penobscot and York Rivers), the number of rivers supporting spawning of Atlantic sturgeon are approximately half of what they were historically. In addition, only four rivers (Kennebec, Hudson, Delaware, James) are known to currently support spawning from Maine through Virginia where historical records support there used to be fifteen spawning rivers (ASSRT, 2007). Thus, there are substantial gaps in the range between Atlantic sturgeon spawning rivers amongst northern and mid-Atlantic states which could make recolonization of extirpated populations more difficult.

There are no current, published population abundance estimates for any of the currently known spawning stocks. Therefore, there are no published abundance estimates for any of the five DPSs of Atlantic sturgeon. An annual mean estimate of 863 mature adults (596 males and 267 females) was calculated for the Hudson River based on fishery-dependent data collected from 1985-1995 (Kahnle *et al.*, 2007). An estimate of 343 spawning adults per year is available for the Altamaha River, GA, based on fishery-independent data collected in 2004 and 2005 (Schueller and Peterson, 2006). Using the data collected from the Hudson River and Altamaha River to estimate the total number of Atlantic sturgeon in either subpopulation is not possible, since mature Atlantic sturgeon may not spawn every year (Vladykov and Greeley, 1963; Smith, 1985; Van Eenennaam *et al.*, 1996; Stevenson and Secor, 1999; Collins *et al.* 2000; Caron *et al.*, 2002), the age structure of these populations is not well understood, and stage to stage survival is unknown. In other words, the information that would allow us to take an estimate of annual spawning adults and expand that estimate to an estimate of the total number of individuals (e.g., yearlings, subadults, and adults) in a population is lacking. The ASSRT presumed that the Hudson and Altamaha rivers had the most robust of the remaining U.S. Atlantic sturgeon spawning populations and concluded that the other U.S. spawning populations were likely less than 300 spawning adults per year (ASSRT, 2007).

Kahnle *et al.* (2007) estimated the number of total mature adults per year in the Hudson River using data from surveys in the 1980s to mid-1990s and based on mean harvest by sex divided by sex specific exploitation rate. While this data is over 20 years old, it is currently the best available data on the abundance of Hudson River origin Atlantic sturgeon. The sex ratio of spawners is estimated to be approximately 70% males and 30% females. As noted above, Kahnle *et al.* (2007) estimated a mean annual number of mature adults at 596 males and 267 females. It is important to note that the authors of this paper have stated that this is an estimate of the annual mean number of Hudson River mature adults during the 1985-1995 period, not an estimate of the number of spawners per year.

4.3.4 Threats faced by Atlantic sturgeon throughout their range

Atlantic sturgeon are susceptible to over exploitation given their life history characteristics (e.g., late maturity, dependence on a wide-variety of habitats). Similar to other sturgeon species (Vladykov and Greeley, 1963; Pikitch *et al.*, 2005), Atlantic sturgeon experienced range-wide declines from historical abundance levels due to overfishing (for caviar and meat) and impacts to habitat in the 19th and 20th centuries (Taub, 1990; Smith and Clugston, 1997; Secor and Waldman, 1999).

Based on the best available information, NMFS has concluded that unintended catch of Atlantic sturgeon in fisheries, vessel strikes, poor water quality, water availability, dams, lack of regulatory mechanisms for protecting the fish, and dredging are the most significant threats to Atlantic sturgeon (77 FR 5880 and 77 FR 5914; February 6, 2012). While all of the threats are not necessarily present in the same area at the same time, given that Atlantic sturgeon subadults and adults use ocean waters from the Labrador, Canada to Cape Canaveral, FL, as well as estuaries of large rivers along the U.S. East Coast, activities affecting these water bodies are likely to impact more than one Atlantic sturgeon DPS. In addition, given that Atlantic sturgeon depend on a variety of habitats, every life stage is likely affected by one or more of the identified threats.

An ASMFC interstate fishery management plan for sturgeon (Sturgeon FMP) was developed and implemented in 1990 (Taub, 1990). In 1998, the remaining Atlantic sturgeon fisheries in U.S. state waters were closed per Amendment 1 to the Sturgeon FMP. Complementary regulations were implemented by NMFS in 1999 that prohibit fishing for, harvesting, possessing or retaining Atlantic sturgeon or its parts in or from the Exclusive Economic Zone in the course of a commercial fishing activity.

Commercial fisheries for Atlantic sturgeon still exist in Canadian waters (DFO, 2011). Sturgeon belonging to one or more of the DPSs may be harvested in the Canadian fisheries. In particular, the Bay of Fundy fishery in the Saint John estuary may capture sturgeon of U.S. origin given that sturgeon from the Gulf of Maine and the New York Bight DPSs have been incidentally captured in other Bay of Fundy fisheries (DFO, 2010; Wirgin and King, 2011). Because Atlantic sturgeon are listed under Appendix II of the Convention on International Trade in Endangered Species (CITES), the U.S. and Canada are currently working on a conservation strategy to address the potential for captures of U.S. fish in Canadian directed Atlantic sturgeon fisheries and of Canadian fish incidentally in U.S. commercial fisheries. At this time, there are no estimates of the number of individuals from any of the DPSs that are captured or killed in Canadian fisheries each year. Based on geographic distribution, most U.S. Atlantic sturgeon that are intercepted in Canadian fisheries are likely to originate from the Gulf of Maine DPS, with a smaller percentage from the New York Bight DPS.

Fisheries bycatch in U.S. waters is a threat faced by all five DPSs. At this time, we have an estimate of the number of Atlantic sturgeon captured and killed in sink gillnet and otter trawl fisheries authorized by Federal FMPs (NMFS NEFSC 2011) in the Northeast Region but do not have a similar estimate for Southeast fisheries. We also do not have an estimate of the number of Atlantic sturgeon captured or killed in state fisheries. At this time, we are not able to quantify the effects of other significant threats (e.g., vessel strikes, poor water quality, water availability, dams, and dredging) in terms of habitat impacts or loss of individuals. While we have some information on the number of mortalities that have occurred in the past in association with certain activities (e.g., mortalities in the Delaware and James rivers that are thought to be due to vessel strikes), we are not able to use those numbers to extrapolate effects throughout one or more DPS. This is because of (1) the small number of data points and, (2) lack of information on the percent of incidences that the observed mortalities represent.

As noted above, the NEFSC prepared an estimate of the number of encounters of Atlantic sturgeon in fisheries authorized by Northeast FMPs (NEFSC 2011). The analysis prepared by the NEFSC estimates that from 2006 through 2010 there were 2,250 to 3,862 encounters per year in observed gillnet and trawl fisheries, with an average of 3,118 encounters. Mortality rates in gillnet gear are approximately 20%. Mortality rates in otter trawl gear are believed to be lower at approximately 5%.

4.3.5 Gulf of Maine DPS of Atlantic sturgeon

The Gulf of Maine DPS includes the following: all anadromous Atlantic sturgeons that are spawned in the watersheds from the Maine/Canadian border and, extending southward, all watersheds draining into the Gulf of Maine as far south as Chatham, MA. Within this range, Atlantic sturgeon historically spawned in the Androscoggin, Kennebec, Merrimack, Penobscot, and Sheepscot Rivers (ASSRT, 2007). Spawning still occurs in the Kennebec and Androscoggin Rivers, and it is possible that it still occurs in the Penobscot River as well. Spawning in the Androscoggin River was just recently confirmed by the Maine Department of Marine Resources when they captured a larval Atlantic sturgeon during the 2011 spawning season below the Brunswick Dam. There is no evidence of recent spawning in the remaining rivers. In the 1800s, construction of the Essex Dam on the Merrimack River at river kilometer (rkm) 49 blocked access to 58 percent of Atlantic sturgeon habitat in the river (Oakley, 2003; ASSRT, 2007). However, the accessible portions of the Merrimack seem to be suitable habitat for Atlantic sturgeon spawning and rearing (i.e., nursery habitat) (Keiffer and Kynard, 1993). Therefore, the availability of spawning habitat does not appear to be the reason for the lack of observed spawning in the Merrimack River. Studies are on-going to determine whether Atlantic sturgeon are spawning in these rivers. Atlantic sturgeons that are spawned elsewhere continue to use habitats within all of these rivers as part of their overall marine range (ASSRT, 2007). The movement of subadult and adult sturgeon between rivers, including to and from the Kennebec River and the Penobscot River, demonstrates that coastal and marine migrations are key elements of Atlantic sturgeon life history for the Gulf of Maine DPS as well as likely throughout the entire range (ASSRT, 2007; Fernandes, *et al.*, 2010).

Bigelow and Schroeder (1953) surmised that Atlantic sturgeon likely spawned in Gulf of Maine Rivers in May-July. More recent captures of Atlantic sturgeon in spawning condition within the Kennebec River suggest that spawning more likely occurs in June-July (Squiers *et al.*, 1981; ASMFC, 1998; NMFS and USFWS, 1998). Evidence for the timing and location of Atlantic sturgeon spawning in the Kennebec River includes: (1) the capture of five adult male Atlantic sturgeon in spawning condition (i.e., expressing milt) in July 1994 below the (former) Edwards Dam; (2) capture of 31 adult Atlantic sturgeon from June 15,1980, through July 26,1980, in a small commercial fishery directed at Atlantic sturgeon from the South Gardiner area (above Merrymeeting Bay) that included at least 4 ripe males and 1 ripe female captured on July 26,1980; and, (3) capture of nine adults during a gillnet survey conducted from 1977-1981, the majority of which were captured in July in the area from Merrymeeting Bay and upriver as far as Gardiner, ME (NMFS and USFWS, 1998; ASMFC 2007). The low salinity values for waters above Merrymeeting Bay are consistent with values found in other rivers where successful Atlantic sturgeon spawning is known to occur.

Several threats play a role in shaping the current status of Gulf of Maine DPS Atlantic sturgeon. Historical records provide evidence of commercial fisheries for Atlantic sturgeon in the Kennebec and Androscoggin Rivers dating back to the 17th century (Squiers *et al.*, 1979). In 1849, 160 tons of sturgeon was caught in the Kennebec River by local fishermen (Squiers *et al.*, 1979). Following the 1880's, the sturgeon fishery was almost non-existent due to a collapse of the sturgeon stocks. All directed Atlantic sturgeon fishing as well as retention of Atlantic sturgeon by catch has been prohibited since 1998. Nevertheless, mortalities associated with bycatch in fisheries occurring in state and federal waters still occurs. In the marine range, Gulf of Maine DPS Atlantic sturgeon are incidentally captured in federal and state managed fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (Stein *et al.*, 2004; ASMFC 2007). As explained above, we have estimates of the number of subadults and adults that are killed as a result of bycatch in fisheries authorized under Northeast FMPs. At this time, we are not able to quantify the impacts from other threats or estimate the number of individuals killed as a result of other anthropogenic threats. Habitat disturbance and direct mortality from anthropogenic sources are the primary concerns.

Riverine habitat may be impacted by dredging and other in-water activities, disturbing spawning habitat and also altering the benthic forage base. Many rivers in the Gulf of Maine DPS have navigation channels that are maintained by dredging. Dredging outside of Federal channels and in-water construction occurs throughout the Gulf of Maine DPS. While some dredging projects operate with observers present to document fish mortalities, many do not. To date we have not received any reports of Atlantic sturgeon killed during dredging projects in the Gulf of Maine region; however, as noted above, not all projects are monitored for interactions with fish. At this time, we do not have any information to quantify the number of Atlantic sturgeon killed or disturbed during dredging or in-water construction projects are also not able to quantify any effects to habitat.

Connectivity is disrupted by the presence of dams on several rivers in the Gulf of Maine region, including the Penobscot and Merrimack Rivers. While there are also dams on the Kennebec, Androscoggin and Saco Rivers, these dams are near the site of natural falls and likely represent the maximum upstream extent of sturgeon occurrence even if the dams were not present. Because no Atlantic sturgeon are known to occur upstream of any hydroelectric projects in the Gulf of Maine region, passage over hydroelectric dams or through hydroelectric turbines is not a source of injury or mortality in this area. While not expected to be killed or injured during passage at a dam, the extent that Atlantic sturgeon are affected by the existence of dams and their operations in the Gulf of Maine region is currently unknown. The extent that Atlantic sturgeon are affected by operations of dams in the Gulf of Maine region is currently unknown; however, the documentation of an Atlantic sturgeon larvae downstream of the Brunswick Dam in the Androscoggin River suggests that Atlantic sturgeon spawning may be occurring in the vicinity of at least that project and therefore, may be affected by project operations. The range of Atlantic sturgeon in the Penobscot River is limited by the presence of the Veazie and Great Works Dams. Together these dams prevent Atlantic sturgeon from accessing approximately 29 km of habitat, including the presumed historical spawning habitat located downstream of Milford Falls, the site of the Milford Dam. While removal of the Veazie and Great Works Dams is anticipated to occur in the near future, the presence of these dams is currently preventing access to significant habitats within the Penobscot River. While Atlantic sturgeon are known to occur in the Penobscot River, it is unknown if spawning is currently occurring or whether the presence of the Veazie and Great Works Dams affects the likelihood of spawning occurring in this river. The Essex Dam on the Merrimack River blocks access to approximately 58% of historically accessible habitat in this river. Atlantic sturgeon occur in the Merrimack River but spawning has not been documented. Like the Penobscot, it is unknown how the Essex Dam affects the likelihood of spawning occurring in this river.

Gulf of Maine DPS Atlantic sturgeon may also be affected by degraded water quality. In general, water quality has improved in the Gulf of Maine over the past decades (Lichter *et al.* 2006; EPA, 2008). Many rivers in Maine, including the Androscoggin River, were heavily polluted in the past from industrial discharges from pulp and paper mills. While water quality has improved and most discharges are limited through regulations, many pollutants persist in the benthic environment. This can be particularly problematic if pollutants are present on spawning and nursery grounds as developing eggs and larvae are particularly susceptible to exposure to contaminants.

There are no empirical abundance estimates for the Gulf of Maine DPS. The Atlantic sturgeon SRT (2007) presumed that the Gulf of Maine DPS was comprised of less than 300 spawning adults per year, based on abundance estimates for the Hudson and Altamaha River riverine populations of Atlantic sturgeon. Surveys of the Kennebec River over two time periods, 1977-1981 and 1998-2000, resulted in the capture of nine adult Atlantic sturgeon (Squiers, 2004). However, since the surveys were primarily directed at capture of shortnose sturgeon, the capture gear used may not have been selective for the larger-sized, adult Atlantic sturgeon; several hundred subadult Atlantic sturgeon were caught in the Kennebec River during these studies.

Summary of the Gulf of Maine DPS

Spawning for the Gulf of Maine DPS is known to occur in two rivers (Kennebec and Androscoggin) and possibly in a third. Spawning may be occurring in other rivers, such as the Sheepscot or Penobscot, but has not been confirmed. There are indications of increasing abundance of Atlantic sturgeon belonging to the Gulf of Maine DPS. Atlantic sturgeon continue to be present in the Kennebec River; in addition, they are captured in directed research projects in the Penobscot River, and are observed in rivers where they were unknown to occur or had not been observed to occur for many years (e.g., the Saco, Presumpscot, and Charles rivers). These observations suggest that abundance of the Gulf of Maine DPS of Atlantic sturgeon is sufficient such that recolonization to rivers historically suitable for spawning may be occurring. However, despite some positive signs, there is not enough information to establish a trend for this DPS.

Some of the impacts from the threats that contributed to the decline of the Gulf of Maine DPS have been removed (e.g., directed fishing), or reduced as a result of improvements in water quality and removal of dams (e.g., the Edwards Dam on the Kennebec River in 1999). There are strict regulations on the use of fishing gear in Maine state waters that incidentally catch sturgeon. In addition, there have been reductions in fishing effort in state and federal waters, which most likely would result in a reduction in bycatch mortality of Atlantic sturgeon. A significant amount of fishing in the Gulf of Maine is conducted using trawl gear, which is known to have a much lower mortality rate for Atlantic sturgeon caught in the gear compared to sink gillnet gear (ASMFC, 2007). Atlantic sturgeon from the GOM DPS are not commonly taken as bycatch in areas south of Chatham, MA, with only 8 percent (e.g., 7 of the 84 fish) of interactions observed in the Mid Atlantic/Carolina region being assigned to the Gulf of Maine DPS (Wirgin and King, 2011). Tagging results also indicate that Gulf of Maine DPS fish tend to remain within the waters of the Gulf of Maine and only occasionally venture to points south. However, data on Atlantic sturgeon incidentally caught in trawls and intertidal fish weirs fished in the Minas Basin area of the Bay of Fundy.(Canada) indicate that approximately 35 percent originated from the Gulf of Maine DPS (Wirgin *et al.*, in draft).

As noted previously, studies have shown that in order to rebuild, Atlantic sturgeon can only sustain low levels of bycatch and other anthropogenic mortality (Boreman, 1997; ASMFC, 2007; Kahnle *et al.*, 2007; Brown and Murphy, 2010). NMFS has determined that the Gulf of Maine DPS is at risk of becoming endangered in the foreseeable future throughout all of its range (i.e., is a threatened species) based on the following: (1) significant declines in population sizes and the protracted period during which sturgeon populations have been depressed; (2) the limited amount of current spawning; and, (3) the impacts and threats that have and will continue to affect recovery.

4.3.6 New York Bight DPS of Atlantic sturgeon

The New York Bight DPS includes the following: all anadromous Atlantic sturgeon spawned in the watersheds that drain into coastal waters from Chatham, MA to the Delaware-Maryland border on Fenwick Island. Within this range, Atlantic sturgeon historically spawned in the Connecticut, Delaware, Hudson, and Taunton Rivers (Murawski and Pacheco, 1977; Secor, 2002; ASSRT, 2007). Spawning still occurs in the Delaware and Hudson Rivers, but there is no recent evidence (within the last 15 years) of spawning in the Connecticut and Taunton Rivers (ASSRT, 2007). Atlantic sturgeon that are spawned elsewhere continue to use habitats within the Connecticut and Taunton Rivers as part of their overall marine range (ASSRT, 2007; Savoy, 2007; Wirgin and King, 2011).

The abundance of the Hudson River Atlantic sturgeon riverine population prior to the onset of expanded exploitation in the 1800's is unknown but, has been conservatively estimated at 10,000 adult females (Secor, 2002). Current abundance is likely at least one order of magnitude smaller than historical levels (Secor, 2002; ASSRT, 2007; Kahnle *et al.*, 2007). As described above, an estimate of the mean annual number of mature adults (863 total; 596 males and 267 females) was calculated for the Hudson River riverine population based on fishery-dependent data collected from 1985-1995 (Kahnle *et al.*, 2007). Kahnle *et al.* (1998; 2007) also showed that the level of fishing mortality from the Hudson River Atlantic sturgeon fishery during the period of 1985-1995 exceeded the estimated sustainable level of fishing mortality for the riverine population and may have led to reduced recruitment. All available data on abundance of juvenile Atlantic sturgeon in the Hudson River Estuary indicate a substantial drop in production of young since the mid 1970's (Kahnle *et al.*, 1998). A decline appeared to occur in the mid to late 1970's followed by a secondary drop in the late 1980's (Kahnle *et al.*, 1998; Sweka *et al.*, 2007; ASMFC, 2010). Catch-per-unit-effort data suggests that recruitment has remained depressed relative to catches of juvenile Atlantic sturgeon in the estuary during the mid-late 1980's (Sweka *et al.*, 2007; ASMFC, 2010). In examining the CPUE data from 1985-2007, there are significant fluctuations during this time. There appears to be a decline in the number of juveniles between the late 1980s and early 1990s and while the CPUE is generally higher in the 2000s as compared to the 1990s, given the significant annual fluctuation it is difficult to discern any trend. Despite the CPUEs from 2000-2007 being generally higher than those from 1990-1999, they are low compared to the late 1980s. There is currently not enough information regarding any life stage to establish a trend for the Hudson River population.

There is no abundance estimate for the Delaware River population of Atlantic sturgeon. Harvest records from the 1800's indicate that this was historically a large population with an estimated 180,000 adult females prior to 1890 (Secor and Waldman, 1999; Secor, 2002). Sampling in 2009 to target young-of- the year (YOY) Atlantic sturgeon in the Delaware River (i.e., natal sturgeon) resulted in the capture of 34 YOY, ranging in size from 178 to 349 mm TL (Fisher, 2009) and the collection of 32 YOY Atlantic sturgeon in a separate study (Brundage and O'Herron in Calvo *et al.*, 2010). Genetics information collected from 33 of the 2009 year class YOY indicates that at least 3 females successfully contributed to the 2009 year class (Fisher, 2011). Therefore, while the capture of YOY in 2009 provides evidence that successful spawning is still occurring in the Delaware River, the relatively low numbers suggest the existing riverine population is limited in size.

Several threats play a role in shaping the current status and trends observed in the Delaware River and Estuary. In-river threats include habitat disturbance from dredging, and impacts from historical pollution and impaired water quality. A dredged navigation channel extends from Trenton seaward through the tidal river (Brundage and O'Herron, 2009), and the river receives significant shipping traffic. Vessel strikes have been identified as a threat in the Delaware River; however, at this time we do not have information to quantify this threat or its impact to the population or the New York Bight DPS. Similar to the Hudson River, there is currently not enough information to determine a trend for the Delaware River population.

Summary of the New York Bight DPS

Atlantic sturgeon originating from the New York Bight DPS spawn in the Hudson and Delaware rivers. While genetic testing can differentiate between individuals originating from the Hudson or Delaware river the available information suggests that the straying rate is high between these rivers. There are no indications of increasing abundance for the New York Bight DPS (ASSRT, 2009; 2010). Some of the impact from the threats that contributed to the decline of the New York Bight DPS have been removed (e.g., directed fishing) or reduced as a result of improvements in water quality since passage of the Clean Water Act (CWA). In addition, there have been reductions in fishing effort in state and federal waters, which may result in a reduction in bycatch mortality of Atlantic sturgeon. Nevertheless, areas with persistent, degraded water quality, habitat impacts from dredging, continued bycatch in state and federally-managed fisheries, and vessel strikes remain significant threats to the New York Bight DPS.

In the marine range, New York Bight DPS Atlantic sturgeon are incidentally captured in federal and state managed fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (Stein *et al.*, 2004; ASMFC 2007). As explained above, currently available estimates indicate that at least 4% of adults may be killed as a result of bycatch in fisheries authorized under Northeast FMPs. Based on mixed stock analysis results presented by Wirgin and King (2011), over 40 percent of the Atlantic sturgeon bycatch interactions in the Mid Atlantic Bight region were sturgeon from the New York Bight DPS. Individual-based assignment and mixed stock analysis of samples collected from sturgeon captured in Canadian fisheries in the Bay of Fundy indicated that approximately 1-2% were from the New York Bight DPS. At this time, we are not able to quantify the impacts from other threats or estimate the number of individuals killed as a result of other anthropogenic threats.

Riverine habitat may be impacted by dredging and other in-water activities, disturbing spawning habitat and also altering the benthic forage base. Both the Hudson and Delaware rivers have navigation channels that are maintained by dredging. Dredging is also used to maintain channels in the nearshore marine environment. Dredging outside of Federal channels and in-water construction occurs throughout the New York Bight region. While some dredging projects operate with observers present to document fish mortalities many do not. We have reports of one Atlantic sturgeon entrained during hopper dredging operations in Ambrose Channel, New Jersey. At this time, we do not have any information to quantify the number of Atlantic sturgeon killed or disturbed during dredging or in-water construction projects are also not able to quantify any effects to habitat.

In the Hudson and Delaware Rivers, dams do not block access to historical habitat. The Holyoke Dam on the Connecticut River blocks further upstream passage; however, the extent that Atlantic sturgeon would historically have used habitat upstream of Holyoke is unknown. Connectivity may be disrupted by the presence of dams on several smaller rivers in the New York Bight region. Because no Atlantic sturgeon occur upstream of any hydroelectric projects in the New York Bight region, passage over hydroelectric dams or through hydroelectric turbines is not a source of injury or mortality in this area. The extent that Atlantic sturgeon are affected by operations of dams in the New York Bight region is currently unknown.

New York Bight DPS Atlantic sturgeon may also be affected by degraded water quality. In general, water quality has improved in the Hudson and Delaware over the past decades (Lichter *et al.* 2006; EPA, 2008). Both the Hudson and Delaware rivers, as well as other rivers in the New York Bight region, were heavily polluted in the past from industrial and sanitary sewer discharges. While water quality has improved and most discharges are limited through regulations, many pollutants persist in the benthic environment. This can be particularly problematic if pollutants are present on spawning and nursery grounds as developing eggs and larvae are particularly susceptible to exposure to contaminants.

Vessel strikes occur in the Delaware River. Twenty-nine mortalities believed to be the result of vessel strikes were documented in the Delaware River from 2004 to 2008, and at least 13 of these fish were large adults. Given the time of year in which the fish were observed (predominantly May through July, with two in August), it is likely that many of the adults were migrating through the river to the spawning grounds. Because we do not know the percent of total vessel strikes that the observed mortalities represent, we are not able to quantify the number of individuals likely killed as a result of vessel strikes in the New York Bight DPS.

Studies have shown that to rebuild, Atlantic sturgeon can only sustain low levels of anthropogenic mortality (Boreman, 1997; ASMFC, 2007; Kahnle *et al.*, 2007; Brown and Murphy, 2010). There are no empirical abundance estimates of the number of Atlantic sturgeon in the New York Bight DPS. As described in the final listing rule, NMFS has determined that the New York Bight DPS is currently at risk of extinction due to: (1) precipitous declines in population sizes and the protracted period in which sturgeon populations have been depressed; (2) the limited amount of current spawning; and (3) the impacts and threats that have and will continue to affect population recovery.

5.0 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 Opinion includes the effects of several activities that may affect the survival and recovery of the listed species in the action area. The activities that shape the environmental baseline in the action area of this consultation generally include: dredging operations, discharges that affect water quality, scientific research, shipping and other vessel traffic, fisheries, and recovery activities associated with reducing those impacts.

5.1 Federal Actions that have Undergone Formal or Early Section 7 Consultation

We have undertaken several ESA section 7 consultations to address the effects of actions authorized, funded or carried out by Federal agencies. Each of those consultations sought to develop ways of reducing the probability of adverse impacts of the action on listed species. Consultations are detailed below.

5.1.1 Maintenance Dredging of Kennebec River Federal Navigation Channel

The authorized Federal navigation project in the Kennebec River consists of a channel 27 feet deep at mean low water (MLW) and 500 feet wide extending about 13 miles upstream from the river mouth at Popham Beach to the city of Bath. About eight miles upstream of Bath, the Federal navigation project provides for a navigation channel 17 feet deep MLW and 150 feet wide along the east side of Swan Island for 14 miles to the city of Gardiner. An 18-foot deep MLW and 150 feet wide channel extends through the ledge at Lovejoy Narrows opposite the upper end of Swan Island. A training wall was built along the Beef Rock Shoal opposite the lower end of Swan Island and another training wall was built opposite South Gardiner. A secondary channel 12 feet deep and 100 feet wide was provided along the west-side of Swan Island to Richmond, with the navigation channel deepening to 15 feet MLW near the upper end of Swan Island. A 16-foot deep MLW channel was provided at Gardiner. A channel 11 feet deep MLW and 150 feet wide extends seven miles to the upper limit of the Federal navigation project in Augusta.

The USACE 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. These sites have been dredged a total of approximately 16 times since 1950. Dredging has been performed using a hopper dredge and the amount of material removed has ranged from 4,707 cy to 108,830 cy. Disposal sites have historically been located in the river north of Bluff Head in 95-100 feet of water and approximately 0.4 nautical miles south of Jackknife Ledge in depths of 40-50 feet. In recent years, dredging occurred in 1991, 1997, 2000, 2002, October 2003 and August 2011 (see Table 6).

Table 6. Maintenance dredging of the Kennebec River Federal navigation Channel at Doubling Point since 1991.

Location	Dates	Volume Removed (cy)	Observer Present?	Interactions with Shortnose Sturgeon
Doubling Point	1991	10,000	No	2 lethal
Doubling Point	1997	10,000	Yes	0
Doubling Point	December 2000	10,000	Yes	0
Doubling Point	April 2002	10,000	Yes	0
Doubling Point	10/6-10/10/2003	10,000	Yes	3 lethal 2 injured but alive upon release
Doubling Point and Popham Beach	August 2011	70,000	Yes	0

Several consultations have taken place between us and USACE on the effects of dredging the navigation channel on shortnose sturgeon. In 1989 and 1991, the USACE implemented restrictions permitting dredging operations at the Doubling Point reach from September 15 to October 15 and from March 1 through April 30 and at Popham Beach from November 1 through April 30. Consultation on dredging in 1989 and 1991 was concluded informally, with NMFS concurring with the determination that dredging was not likely to adversely affect shortnose sturgeon.

During dredging operations in October 1991, two shortnose sturgeon with severe lacerations were observed floating just downstream of the dredge site. It was subsequently determined that these fish were killed during the ongoing maintenance dredging of the Doubling Point reach. On August 28, 1997, NMFS issued an Opinion to USACE regarding the effects of maintenance dredging of the navigation channel. The dredging window that was established in 1997 allowed dredging in both the Doubling Point and Popham Beach areas from November 1 through April 30. No interactions with shortnose sturgeon were observed during dredging operations completed in November 1997.

In a letter dated November 29, 2000, NMFS indicated that new information on the distribution of shortnose sturgeon in the Kennebec River was available and that the Opinion issued in 1997 would be amended to include a Term and Condition restricting dredging to the December 1 – March 1 time frame. Dredging of the Doubling Point reach was completed in December 2000 with no interactions with shortnose sturgeon observed.

Consultation was reinitiated in 2002. The USACE proposed that dredging at Doubling Point be allowed from November 1 – April 30. NMFS issued an Opinion on April 16, 2002 on the effects of annual maintenance dredging of the navigation channel in the November 1 – April 30 time frame. Accompanying this Opinion was an Incidental Take Statement which authorized the annual incidental taking of 2 shortnose sturgeon at Doubling Point during December 1 – March 1 and a total of 4 shortnose sturgeon in the November 1 – November 30 or March 2 – April 30 time frame. Dredging occurred in late April 2002 with no interactions with shortnose sturgeon observed.

Due to emergency conditions, the Doubling Point and Popham Beach reaches were dredged in October 2003. Dredging occurred over the course of four days with approximately 10,000 cubic yards of material removed from the channel. During this dredge operation, five shortnose sturgeon were entrained by a hopper dredge in the Doubling Point reach. Two of the sturgeon died on board the dredge. The remaining three fish were alive; however, two of the fish suffered significant injuries and although released, likely died due to the severity of their injuries. The fifth fish was released with minor injuries. An Opinion regarding the effects of the emergency dredging operations was issued to the USACE on January 13, 2004.

We completed a consultation with USACE on dredging of the navigation channel in July 2011. In this Opinion, we concluded that the proposed dredging and disposal was likely to adversely affect but not likely to jeopardize shortnose sturgeon and was not likely to adversely affect the GOM DPS of Atlantic salmon or its critical habitat. We also determined that as the action was not likely to jeopardize any DPS of Atlantic sturgeon, no conference was necessary. USACE performed maintenance dredging in the vicinity of Doubling Point (below Bath) and at the mouth of the river near Popham Beach in August 2011. The dredge removed approximately 70,000 cubic yards (i.e. 50,000 cubic yards from Doubling Point and 20,000 cubic yards from Popham Beach) of clean sandy material. The work was performed with a hopper dredge. Dredged material removed from Doubling Point was disposed of at the previously used in-river disposal site located north of Bluff Head. Water depths at the in-river disposal site range from about 30’ to 100’ of water. Material dredged from the Popham Beach area was disposed at a previously used 500-yard circular near-shore disposal site located about 0.4 nautical miles south of Jackknife Ledge in depths of about 40 to 50 feet. An endangered species observer was present for all dredging operations and no interactions with shortnose or Atlantic sturgeon were observed.

5.1.2 Maintenance Dredging of BIW Facilities

As explained in the Consultation History section, maintenance dredging has occurred at the BIW sinking basin four times since construction was completed in January 2000 (see Table 7). Dredging most recently occurred in the sinking basin and landing grids in 2009 and at Pier 3 in March 2011. Since 1997, two interactions (one lethal) with shortnose sturgeon (2003 and 2009) and one with Atlantic sturgeon (2001) have been observed.

Table 7. Dredging Activities at Bath Iron Works since 1997 (all with mechanical dredge)

Location	Dates	Volume Removed (cy)	Observer Present?	Interactions with Sturgeon
Pier 3	3/31-5/2/1997	6,480	Yes	0

Pier 3	9/10-10/6/1997	4,384	Yes	0
Sinking Basin (original construction)	11/7/98-1/5/2000	500,000	4/2-10/31 only	0
Pier 2	6/6-6/8 and 6/19-6/22/2001	3,320	Yes	1 Atlantic captured in dredge bucket and released unharmed
Sinking Basin	4/7-4/30/2003	7,870	Yes	1 shortnose killed
Sinking Basin	12/14-12/24/2003	44,000	Yes	0
Landing Grid	November 2004	4,000 cy	Yes	0
Pier 3	9/23-9/30/2005	1,900	Yes	0
Pier 3	11/7-11/22/2005	3,760	Yes	0
Sinking Basin	November – December 2007	53,500	Yes	0
Landing Grid	January 2008	2,500cy	Yes	0
Pier 3	March 2009	1,000 cy	Yes	0
Pier 3	June 2009	1,000 cy	Yes	1 shortnose sturgeon captured in dredge bucket and released unharmed
Pier 3	November 2009	6,704 cy	Yes	0
Landing Grid	December 2009	3,808 cy	Yes	0
Sinking Basin	November-December 2009	18,170 cy	Yes	0
Pier 3	March 2011	1,800 cy	Yes	0

5.1.3 Scientific Studies

On July 27, 2007, NMFS Office of Protected Resources issued a Biological Opinion on the effects of issuing a grant to Maine DMR to fund a conservation program for rainbow smelt, Atlantic sturgeon and Atlantic salmon. The activities will occur in several rivers in Maine including the Kennebec River. The Opinion exempts the incidental take of up to 10 live shortnose sturgeon (due to entanglement in gill net gear) and up to 50 shortnose sturgeon eggs in D-nets. No research has been conducted under this program to date.

Ms. Gail Wipplehauser of Maine DMR currently possesses a Section 10(a)(1)(A) Permit to conduct scientific research on shortnose sturgeon in the Kennebec River (Permit 16306). The permit is valid from May 2012 – May 2017. The permit authorizes (annually) capturing, handling, tagging, weighing and releasing 400 juvenile or adult shortnose sturgeon each year. The permit also authorizes the lethal capture of up to 50 shortnose sturgeon eggs and larvae.

Maine DMR also holds a Section 10(a)(1)(A) Permit to conduct scientific research on Atlantic sturgeon in the Kennebec River (Permit 16526). The permit is valid from April 2012 – April 2017. The permit authorizes (annually) capturing, handling, tagging, weighing and releasing 225 juvenile or adult Atlantic sturgeon each year. The permit also authorizes the lethal capture of up to 100 Atlantic sturgeon eggs and larvae.

MDMR has conducted periodic monitoring of Atlantic salmon populations in the Kennebec River. MDMR was authorized in 2009 to sample listed Atlantic salmon in the GOM DPS under the USFWS' endangered species blanket permit (No. 697823) issued pursuant to Section 10(a)(1)(A) of the ESA. Under USFWS permit No. 697823, MDMR is authorized to take (typically meaning capture) up to 2% of any given lifestage of Atlantic salmon during scientific research and recovery efforts (except for adults of which less than 1% can be taken). Lethal take of salmon in the Kennebec River during MDMR sampling is expected to be less than 2% consistent with take estimates for other Maine streams where such records are maintained by MDMR.

It is possible that research in the action area may have influenced and/or altered the migration patterns, reproductive success, foraging behavior, and survival of shortnose sturgeon. Shortnose sturgeon have also been incidentally captured in research activities targeting other species. For example, five shortnose sturgeon were captured in a beach seine targeting striped bass in the Kennebec River in the spring of 2007. These fish were returned to the water alive with no apparent injuries.

5.2 State or Private Actions in the Action Area

5.2.1 State Authorized Fisheries

Shortnose and Atlantic sturgeon are taken incidentally in anadromous fisheries along the East Coast and may be targeted by poachers (NMFS 1998, ASSRT 2007). The Kennebec 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*). Historically, the river and its tributaries supported the largest commercial fishery for shad in the State of Maine. However, pollution and the construction of dams decimated the shad runs in the late 1920s and early 1930s. Shortnose sturgeon in the Kennebec River may have been taken as bycatch in the shad fishery or other fisheries active in the action area. It has been estimated that approximately 20 shortnose sturgeon are killed each year in the commercial shad fishery 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 river has not been well documented due to confusion over distinguishing between Atlantic sturgeon and shortnose sturgeon. Due to a lack of reporting, no information on the number of shortnose or Atlantic sturgeon caught and released or killed in commercial or recreational fisheries on the Kennebec River is available.

Unauthorized take of Atlantic salmon is prohibited by the ESA. However, if present, Atlantic salmon juveniles may be taken incidentally in fisheries by recreational anglers. Due to a lack of reporting, no information on the number of Atlantic salmon caught and released or killed in recreational fisheries in the Kennebec River is available.

5.3 Other Impacts of Human Activities in the Action Area

5.3.1 Contaminants and Water Quality

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 sturgeon are particularly vulnerable.

Several characteristics of 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 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 is 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 concentration in pallid sturgeon livers indicates that DDE increase proportionally with fish size (NMFS 1998).

Contaminant analysis conducted in 2003 of tissues from a shortnose sturgeon from the Kennebec 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).

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 pH or receiving waters, which may lead to mortality, changes in fish behavior, deformations, and reduced egg production and survival.

6.0 CLIMATE CHANGE

The discussion below presents background information on global climate change and information on past and predicted future effects of global climate change throughout the range of the listed species considered here. Additionally, we present the available information on predicted effects of climate change in the action area and how listed salmon and sturgeon may be affected by those predicted environmental changes over the life of the proposed action (i.e., between now and 2019). Climate change is relevant to the Status of the Species, Environmental Baseline and Cumulative Effects sections of this Opinion; rather than include partial discussion in several sections of this Opinion, we are synthesizing this information into one discussion. Consideration of effects of the proposed action in light of predicted changes in environmental conditions due to anticipated climate change are included in the Effects of the Action section below (section 7.0 below).

6.1 Background Information on Global climate change

The global mean temperature has risen 0.76ºC (1.36°F) over the last 150 years, and the linear trend over the last 50 years is nearly twice that for the last 100 years (Intergovernmental Panel on Climate Change (IPCC) 2007a) and precipitation has increased nationally by 5%-10%, mostly due to an increase in heavy downpours (NAST 2000). There is a high confidence, based on substantial new evidence, that observed changes in marine systems are associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation. Ocean acidification resulting from massive amounts of carbon dioxide and other pollutants released into the air can have major adverse impacts on the calcium balance in the oceans. Changes to the marine ecosystem due to climate change include shifts in ranges and changes in algal, plankton, and fish abundance (IPCC 2007b); these trends are most apparent over the past few decades. Information on future impacts of climate change in the action area is discussed below.

Climate model projections exhibit a wide range of plausible scenarios for both temperature and precipitation over the next century. Both of the principal climate models used by the National Assessment Synthesis Team (NAST) project warming in the southeast by the 2090s, but at different rates (NAST 2000): the Canadian model scenario shows the southeast U.S. experiencing a high degree of warming, which translates into lower soil moisture as higher temperatures increase evaporation; the Hadley model scenario projects less warming and a significant increase in precipitation (about 20%). The scenarios examined, which assume no major interventions to reduce continued growth of world greenhouse gases (GHG), indicate that temperatures in the U.S. will rise by about 3^{o}-5^{o}C (5^{o}-9^{o}F) on average in the next 100 years which is more than the projected global increase (NAST 2000). A warming of about 0.2^{o}C (0.4°F) per decade is projected for the next two decades over a range of emission scenarios (IPCC 2007). This temperature increase will very likely be associated with more extreme precipitation and faster evaporation of water, leading to greater frequency of both very wet and very dry conditions. Climate warming has resulted in increased precipitation, river discharge, and glacial and sea-ice melting (Greene *et al.* 2008).

The past three decades have witnessed major changes in ocean circulation patterns in the Arctic, and these were accompanied by climate associated changes as well (Greene *et al.* 2008). Shifts in atmospheric conditions have altered Arctic Ocean circulation patterns and the export of freshwater to the North Atlantic (Greene *et al.* 2008, IPCC 2006). With respect specifically to the North Atlantic Oscillation (NAO), changes in salinity and temperature are thought to be the result of changes in the earth's atmosphere caused by anthropogenic forces (IPCC 2006). The NAO impacts climate variability throughout the northern hemisphere (IPCC 2006). Data from the 1960s through the present show that the NAO index has increased from minimum values in the 1960s to strongly positive index values in the 1990s and somewhat declined since (IPCC 2006). This warming extends over 1000m (0.62 miles) deep and is deeper than anywhere in the world oceans and is particularly evident under the Gulf Stream/ North Atlantic Current system (IPCC 2006). On a global scale, large discharges of freshwater into the North Atlantic subarctic seas can lead to intense stratification of the upper water column and a disruption of North Atlantic Deepwater (NADW) formation (Greene *et al.* 2008, IPCC 2006). There is evidence that the NADW has already freshened significantly (IPCC 2006). This in turn can lead to a slowing down of the global ocean thermohaline (large-scale circulation in the ocean that transforms low-density upper ocean waters to higher density intermediate and deep waters and returns those waters back to the upper ocean), which can have climatic ramifications for the whole earth system (Greene *et al.* 2008).

While predictions are available regarding potential effects of climate change globally, it is more difficult to assess the potential effects of climate change over the next few decades on coastal and marine resources on smaller geographic scales, such as the Delaware River, especially as climate variability is a dominant factor in shaping coastal and marine systems. The effects of future change will vary greatly in diverse coastal regions for the U.S. Warming is very likely to continue in the U.S. over the next 25 to 50 years regardless of reduction in GHGs, due to emissions that have already occurred (NAST 2000). It is very likely that the magnitude and frequency of ecosystem changes will continue to increase in the next 25 to 50 years, and it is possible that the rate of change will accelerate. Climate change can cause or exacerbate direct stress on ecosystems through high temperatures, a reduction in water availability, and altered frequency of extreme events and severe storms. Water temperatures in streams and rivers are likely to increase as the climate warms and are very likely to have both direct and indirect effects on aquatic ecosystems. Changes in temperature will be most evident during low flow periods when they are of greatest concern (NAST 2000). In some marine and freshwater systems, shifts in geographic ranges and changes in algal, plankton, and fish abundance are associated with high confidence with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels and circulation (IPCC 2007).

A warmer and drier climate is expected to result in reductions in stream flows and increases in water temperatures. Expected consequences could be a decrease in the amount of dissolved oxygen in surface waters and an increase in the concentration of nutrients and toxic chemicals due to reduced flushing rate (Murdoch *et al.* 2000). Because many rivers are already under a great deal of stress due to excessive water withdrawal or land development, and this stress may be exacerbated by changes in climate, anticipating and planning adaptive strategies may be critical (Hulme 2005). A warmer-wetter climate could ameliorate poor water quality conditions in places where human-caused concentrations of nutrients and pollutants other than heat currently degrade water quality (Murdoch *et al.* 2000). Increases in water temperature and changes in seasonal patterns of runoff will very likely disturb fish habitat and affect recreational uses of lakes, streams, and wetlands. Surface water resources in the southeast are intensively managed with dams and channels and almost all are affected by human activities; in some systems water quality is either below recommended levels or nearly so. A global analysis of the potential effects of climate change on river basins indicates that due to changes in discharge and water stress, the area of large river basins in need of reactive or proactive management interventions in response to climate change will be much higher for basins impacted by dams than for basins with free-flowing rivers (Palmer *et al.* 2008). Human-induced disturbances also influence coastal and marine systems, often reducing the ability of the systems to adapt so that systems that might ordinarily be capable of responding to variability and change are less able to do so. Because stresses on water quality are associated with many activities, the impacts of the existing stresses are likely to be exacerbated by climate change. Within 50 years, river basins that are impacted by dams or by extensive development may experience greater changes in discharge and water stress than unimpacted, free-flowing rivers (Palmer *et al.* 2008).

While debated, researchers anticipate: 1) the frequency and intensity of droughts and floods will change across the nation; 2) a warming of about 0.2^{o}C (0.4°F) per decade; and 3) a rise in sea level (NAST 2000). A warmer and drier climate will reduce stream flows and increase water temperature resulting in a decrease of DO and an increase in the concentration of nutrients and toxic chemicals due to reduced flushing. Sea level is expected to continue rising: during the 20th century global sea level has increased 15 to 20 cm (6-8 inches).

6.2 Species Specific Information on Climate Change Effects

6.2.1 Atlantic salmon

Atlantic salmon may be especially vulnerable to the effects of climate change in New England, since the areas surrounding many watersheds s where salmon are found are heavily populated and have already been affected by a range of stresses associated with agriculture, industrialization, and urbanization (Elliot *et al*. 1998). Climate effects related to temperature regimes and flow conditions determine juvenile salmon growth and habitat (Friedland1998). One study conducted in the Connecticut and Penobscot rivers, where temperatures and average discharge rates have been increasing over the last 25 years, found that dates of first capture and median capture dates for Atlantic salmon have shifted earlier by about 0.5 days/ year, and these consistent shifts are correlated with long-term changes in temperature and flow (Juanes *et al*. 2004). Temperature increases are also expected to reduce the abundance of salmon returning to home waters, particularly at the southern limits of Atlantic salmon spatial distribution (Beaugrand and Reid 2003).

One recent study conducted in the United Kingdom that used data collected over a 20-year period in the Wye River found Atlantic salmon populations have declined substantially and this decline was best explained by climatic factors like increasing summer temperatures and reduced discharge more than any other factor (Clews *et al*. 2010). Changes in temperature and flow serve as cues for salmon to migrate, and smolts entering the ocean either too late or too early would then begin their post-smolt year in such a way that could be less optimal for opportunities to feed, predator risks, and/or thermal stress (Friedland 1998). Since the highest mortality affecting Atlantic salmon occurs in the marine phase, both the temperature and the productivity of the coastal environment may be critical to survival (Drinkwater *et al*. 2003). Temperature influences the length of egg incubation periods for salmonids (Elliot *et al*. 1998) and higher water temperatures could accelerate embryo development of salmon and cause premature emergence of fry.

Since fish maintain a body temperature almost identical to their surroundings, thermal changes of a few degrees Celsius can critically affect biological functions in salmonids (NMFS and USFWS 2005). While some fish populations may benefit from an increase in river temperature for greater growth opportunity, there is an optimal temperature range and a limit for growth after which salmonids will stop feeding due to thermal stress (NMFS and USFWS 2005). Thermally stressed salmon also may become more susceptible to mortality from disease (Clews *et al*. 2010). A study performed in New Brunswick found there is much individual variability between Atlantic salmon and their behaviors and noted that the body condition of fish may influence the temperature at which optimal growth and performance occur (Breau *et al*. 2007).

The productivity and feeding conditions in Atlantic salmon's overwintering regions in the ocean are critical in determining the final weight of individual salmon and whether they have sufficient energy to migrate upriver to spawn (Lehodey *et al*. 2006). Survival is inversely related to body size in pelagic fishes, and temperature has a direct effect on growth that will affect growth-related sources of mortality in post-smolts (Friedland 1998). Post-smolt growth increases in a linear trend with temperature, but eventually reaches a maximum rate and decreases at high temperatures (Brett 1979 in Friedland 1998). When at sea, Atlantic salmon eat crustaceans and small fishes, such as herring, sprat, sand-eels, capelin, and small gadids, and when in freshwater, adults do not feed but juveniles eat aquatic insect larvae (FAO 2012). Species with calcium carbonate skeletons, such as the crustaceans that salmon sometimes eat, are particularly susceptible to ocean acidification, since ocean acidification will reduce the carbonate availability necessary for shell formation (Wood *et al*. 2008). Climate change is likely to affect the abundance, diversity, and composition of plankton, and these changes may have important consequences for higher trophic levels like Atlantic salmon (Beaugrand and Reid 2003).
In addition to temperature, stream flow is also likely to be impacted by climate change and is vital to Atlantic salmon survival.

In-stream flow defines spatial relationships and habitat suitability for Atlantic salmon and since climate is likely to affect in-stream flow, the physiological, behavioral, and feeding-related mechanisms of Atlantic salmon are also likely to be impacted (Friedland 1998). With changes in in-stream flow, salmon found in smaller river systems may experience upstream migrations that are confined to a narrower time frame, as small river systems tend to have lower discharges and more variable flow (Elliot *et al*. 1998). The changes in rainfall patterns expected from climate change and the impact of those rainfall patterns on flows in streams and rivers may severely impact productivity of salmon populations (Friedland 1998). More winter precipitation falling as rain instead of snow can lead to elevated winter peak flows which can scour the streambed and destroy salmon eggs (Battin *et al*. 2007, Elliot *et al*. 1998). Increased sea levels in combination with higher winter river flows could cause degradation of estuarine habitats through increased wave damage during storms (NSTC 2008). Since juvenile Atlantic salmon are known to select stream habitats with particular characteristics, changes in river flow may affect the availability and distribution of preferred habitats (Riley *et al*. 2009). Unfortunately, the critical point at which reductions in flow begin to have a damaging impact on juvenile salmonids is difficult to define, but generally flow levels that promote upstream migration of adults are likely adequate to encourage downstream movement of smolts (Hendry *et al*. 2003).

Humans may also seek to adapt to climate change by manipulating water sources, for example in response to increased irrigation needs, which may further reduce stream flow and biodiversity (Bates *et al*. 2008).Water extraction is a high level threat to Atlantic salmon, as adequate water quantity and quality are critical for all life stages of Atlantic salmon (NMFS and USFWS 2005). Climate change will also affect precipitation, with northern areas predicted to become wetter and southern areas predicted to become drier in the future (Karl *et al*. 2009). Droughts may further exacerbate poor water quality and impede or prevent migration of Atlantic salmon (Riley *et al*. 2009).

It is anticipated that these climate change effects could significantly affect the functioning of the Atlantic salmon critical habitat. Increased temperatures will affect the timing of upstream and downstream migration and make some areas unsuitable as temporary holding and resting areas. Higher temperatures could also reduce the amount of time that conditions are appropriate for migration ($<23^{o}$ Celsius), which could affect an individual's ability to access suitable spawning habitat. In addition, elevated temperatures will make some areas unsuitable for spawning and rearing due to effects to egg and embryo development.

6.2.2 Atlantic sturgeon

Global climate change may affect all DPSs of Atlantic sturgeon in the future; however, effects of increased water temperature and decreased water availability are most likely to effect the South Atlantic and Carolina DPSs. Rising sea level may result in the salt wedge moving upstream in affected rivers. Atlantic sturgeon spawning occurs in fresh water reaches of rivers because early life stages have little to no tolerance for salinity. Similarly, juvenile Atlantic sturgeon have limited tolerance to salinity and remain in waters with little to no salinity. If the salt wedge moves further upstream, Atlantic sturgeon spawning and rearing habitat could be restricted. In river systems with dams or natural falls that are impassable by sturgeon, the extent that spawning or rearing may be shifted upstream to compensate for the shift in the movement of the saltwedge would be limited. While there is an indication that an increase in sea level rise would result in a shift in the location of the salt wedge, at this time there are no predictions on the timing or extent of any shifts that may occur; thus, it is not possible to predict any future loss in spawning or rearing habitat. However, in all river systems, spawning occurs miles upstream of the saltwedge. It is unlikely that shifts in the location of the saltwedge would eliminate freshwater spawning or rearing habitat. If habitat was severely restricted, productivity or survivability may decrease.

The increased rainfall predicted by some models in some areas may increase runoff and scour spawning areas and flooding events could cause temporary water quality issues. Rising temperatures predicted for all of the U.S. could exacerbate existing water quality problems with DO and temperature. While this occurs primarily in rivers in the southeast U.S. and the Chesapeake Bay, it may start to occur more commonly in the northern rivers. Atlantic sturgeon prefer water temperatures up to approximately 28°C (82.4°F); these temperatures are experienced naturally in some areas of rivers during the summer months. If river temperatures rise and temperatures above 28°C are experienced in larger areas, sturgeon may be excluded from some habitats.

Increased droughts (and water withdrawal for human use) predicted by some models in some areas may cause loss of habitat including loss of access to spawning habitat. Drought conditions in the spring may also expose eggs and larvae in rearing habitats. If a river becomes too shallow or flows become intermittent, all Atlantic sturgeon life stages, including adults, may become susceptible to strandings or habitat restriction. Low flow and drought conditions are also expected to cause additional water quality issues. Any of the conditions associated with climate change are likely to disrupt river ecology causing shifts in community structure and the type and abundance of prey. Additionally, cues for spawning migration and spawning could occur earlier in the season causing a mismatch in prey that are currently available to developing sturgeon in rearing habitat.

6.2.3 Shortnose sturgeon

Global climate change may affect shortnose sturgeon in the future. Rising sea level may result in the salt wedge moving upstream in affected rivers. Shortnose sturgeon spawning occurs in fresh water reaches of rivers because early life stages have little to no tolerance for salinity. Similarly, juvenile shortnose sturgeon have limited tolerance to salinity and remain in waters with little to no salinity. If the salt wedge moves further upstream, shortnose sturgeon spawning and rearing habitat could be restricted. In river systems with dams or natural falls that are impassable by sturgeon, the extent that spawning or rearing may be shifted upstream to compensate for the shift in the movement of the saltwedge would be limited. While there is an indication that an increase in sea level rise would result in a shift in the location of the salt wedge, for most spawning rivers there are no predictions on the timing or extent of any shifts that may occur; thus, it is not possible to predict any future loss in spawning or rearing habitat. However, in all river systems, spawning occurs miles upstream of the saltwedge. It is unlikely that shifts in the location of the saltwedge would eliminate freshwater spawning or rearing habitat. If habitat was severely restricted, productivity or survivability may decrease.

The increased rainfall predicted by some models in some areas may increase runoff and scour spawning areas and flooding events could cause temporary water quality issues. Rising temperatures predicted for all of the U.S. could exacerbate existing water quality problems with DO and temperature. While this occurs primarily in rivers in the southeast U.S. and the Chesapeake Bay, it may start to occur more commonly in the northern rivers. Shortnose sturgeon are tolerant to water temperatures up to approximately 28°C (82.4°F); these temperatures are experienced naturally in some areas of rivers during the summer months. If river temperatures rise and temperatures above 28°C are experienced in larger areas, sturgeon may be excluded from some habitats.

Increased droughts (and water withdrawal for human use) predicted by some models in some areas may cause loss of habitat including loss of access to spawning habitat. Drought conditions in the spring may also expose eggs and larvae in rearing habitats. If a river becomes too shallow or flows become intermittent, all shortnose sturgeon life stages, including adults, may become susceptible to strandings. Low flow and drought conditions are also expected to cause additional water quality issues. Any of the conditions associated with climate change are likely to disrupt river ecology causing shifts in community structure and the type and abundance of prey. Additionally, cues for spawning migration and spawning could occur earlier in the season causing a mismatch in prey that are currently available to developing shortnose sturgeon in rearing habitat; however, this would be mitigated if prey species also had a shift in distribution or if developing sturgeon were able to shift their diets to other species.

6.3 Effects of Climate Change in Relation to the Proposed Action

Information on how climate change will impact the action area is extremely limited. Available information on climate change related effects for the Kennebec River watershed largely focus on effects that rising water levels may have on the human environment or landscape level changes (see UMass Assessment of Landscape Changes). Available information is summarized in Jacobson et al. 2009. This report indicates that for Maine, regional sea surface temperatures have increased almost 2° Fahrenheit since 1970 (as measured in Boothbay), and the rate of sea-level rise has intensified. Tide-gauge records in Portland, Maine, show a local relative sea-level rise of approximately eight inches since 1912. Earlier snowmelt, peak river flows, and ice-out have been observed in Maine lakes. Models suggest that in the future temperatures will be warmer and there will be more precipitation in all seasons.

Sea level rise could result in the northward movement of the salt wedge in the Kennebec River. Potential negative effects of a shift in the salt wedge include restricting the habitat available for early life stages and juvenile sturgeon which are intolerant to salinity and are present exclusively upstream of the salt wedge. While there is an indication that an increase in sea level rise would result in a shift in the location of the salt wedge, at this time there are no predictions on the timing or extent of any shift that may occur.

As noted above, warming trends are evident. However, while it is possible to examine past water temperature data and observe a warming trend, there are not currently any predictions on potential future increases in water temperature in the action area specifically or the Kennebec River generally.

Sea surface temperatures have fluctuated around a mean for much of the past century, as measured by continuous 100+ year records at Woods Hole (Mass.), and Boothbay Harbor (Maine) and shorter records from Boston Harbor and other bays. Periods of higher than average temperatures (in the 1950s) and cooler periods (1960s) have been associated with changes in the North Atlantic Oscillation (NAO), which affects current patterns. Over the past 30 years however, records indicate that ocean temperatures in the Northeast have been increasing; for example, Boothbay Harbor's temperature has increased by about 1°C since 1970. For marine waters, the model projections are for an increase of somewhere between 3-4°C by 2100 and a pH drop of 0.3-0.4 units by 2100 (Frumhoff *et al.* 2007). Assuming that these predictions also apply to the action area, one could anticipate similar conditions in the action area over that same time period; considering that the proposed action will occur until 2019, we could predict an increase in ambient water temperatures of 0.034-0.045 per year for an overall increase of 0.24-0.32°C .

6.4 Effects of Climate Change in the Action Area to listed species

As there is significant uncertainty in the rate and timing of change as well as the effect of any changes that may be experienced in the action area due to climate change, it is difficult to predict the impact of these changes on shortnose and Atlantic sturgeon and Atlantic salmon. However, the short time period over which the proposed actions will occur (i.e., through November 2019) suggests that there are not likely to be major climate related changes experienced.

Over time, the most likely effect to shortnose and Atlantic sturgeon would be if sea level rise was great enough to consistently shift the salt wedge far enough north which would restrict the range of juvenile sturgeon and may affect the development of these life stages. Upstream shifts in spawning or rearing habitat in the Kennebec River are limited by the existence of the Lockwood Dam which is impassable by sturgeon. Similarly, the upstream movement of sturgeon is limited by the Brunswick Dam in the Androscoggin River. The available habitat for juvenile sturgeon could decrease over time; however, even if the saltwedge shifted several miles upstream, it seems unlikely that the decrease in available habitat would have a significant effect on juvenile sturgeon because there would still be many miles of available low salinity habitat between the salt wedge and the Lockwood or Brunswick dams.

In the action area, it is possible that changing seasonal temperature regimes could result in changes in the timing of seasonal migrations through the area as sturgeon and salmon make seasonal movements. For sturgeon, there could be shifts in the timing of spawning; presumably, if water temperatures warm earlier in the spring, and water temperature is a primary spawning cue, spawning migrations and spawning events could occur earlier in the year. However, because spawning is not triggered solely by water temperature, but also by day length (which would not be affected by climate change) and river flow (which could be affected by climate change), it is not possible to predict how any change in water temperature or river flow alone will affect the seasonal movements of sturgeon through the action area. For salmon, there could be shifts in the timing of downstream movements by smolts or shifts in the timing of returns to the river by adults. However, during the seven year time period considered here, major shifts in seasonal migrations due to climate change are unlikely given the relatively slow rate of predicted climate change.

Any forage species that are temperature dependent may also shift in distribution as water temperatures warm. However, because we do not know the adaptive capacity of these individuals or how much of a change in temperature would be necessary to cause a shift in distribution, it is not possible to predict how these changes may affect foraging sturgeon or salmon. If sturgeon or salmon distribution shifted along with prey distribution, it is likely that there would be minimal, if any, impact on the availability of food. Similarly, if sturgeon shifted to areas where different forage was available and sturgeon were able to obtain sufficient nutrition from that new source of forage, any effect would be minimal. The greatest potential for effect to forage resources would be if sturgeon or salmon shifted to an area or time where insufficient forage was available; however, the likelihood of this happening seems low because sturgeon and salmon feed on a wide variety of species and in a wide variety of habitats.

Limited information on the thermal tolerances of Atlantic and shortnose sturgeon is available. Atlantic sturgeon have been observed in water temperatures above 30°C in the south (see Damon-Randall *et al.* 2010); in the wild, shortnose sturgeon are typically found in waters less than 28°C. In the laboratory, juvenile Atlantic sturgeon showed negative behavioral and bioenergetics responses (related to food consumption and metabolism) after prolonged exposure to temperatures greater than 28°C (82.4°F) (Niklitschek 2001). Tolerance to temperatures is thought to increase with age and body size (Ziegweid *et al.* 2008 and Jenkins *et al.* 1993), however, no information on the lethal thermal maximum or stressful temperatures for subadult or adult Atlantic sturgeon is available. Shortnose sturgeon, have been documented in the lab to experience mortality at temperatures of 33.7°C (92.66°F) or greater and are thought to experience stress at temperatures above 28°C. For purposes of considering thermal tolerances, we consider Atlantic sturgeon to be a reasonable surrogate for shortnose sturgeon given similar geographic distribution and known biological similarities.

Normal surface water temperatures in the Kennebec River can be as high as 25°C at some times and in some areas during the summer months; temperatures in deeper waters and near the bottom are cooler. A predicted increase in water temperature of 3-4°C within 100 years is expected to result in temperatures approaching the preferred temperature of shortnose and Atlantic sturgeon (28°C) on more days and/or in larger areas. This could result in shifts in the distribution of sturgeon out of certain areas during the warmer months. Information from southern river systems suggests that during peak summer heat, sturgeon are most likely to be found in deep water areas where temperatures are coolest. Thus, we could expect that over time, sturgeon would shift out of shallow habitats on the warmest days. This could result in reduced foraging opportunities if sturgeon were foraging in shallow waters.

As described above, over the long term, global climate change may affect shortnose and Atlantic sturgeon by affecting the location of the salt wedge, distribution of prey, water temperature and water quality. Atlantic salmon are likely to be affected not only by conditions in rivers but also oceanic conditions. However, there is significant uncertainty, due to a lack of scientific data, on the degree to which these effects may be experienced and the degree to which shortnose or Atlantic sturgeon or Atlantic salmon will be able to successfully adapt to any such changes. Any activities occurring within and outside the action area that contribute to global climate change are also expected to affect listed species and their habitat within the action area. While we can make some predictions on the likely effects of climate change on these species, without modeling and additional scientific data these predictions remain speculative. Additionally, these predictions do not take into account the adaptive capacity of these species which may allow them to deal with change better than predicted.

7.0 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 actions on Atlantic and shortnose sturgeon and Atlantic salmon and designated critical habitat for the GOM DPS of Atlantic salmon in the action area within the context of the species current status, the environmental baseline and cumulative effects. As explained in the Description of the Action, the proposed action under consideration in this Opinion is the continuation of maintenance dredging and dredged material disposal operations at the BIW facility pursuant to permits issued by the USACE in 2009, and the installation of scour protection at Pier 4 for the Brake Wheel project. We have also considered the effects of use of the brake wheel system. Other operations of U.S. Navy vessels that may be built, outfitted or tested at BIW are considered in section 7 consultations carried out between NMFS' Office of Protected Resources and the U.S. Navy (see

The critical habitat analysis determines whether the proposed action will destroy or adversely modify designated or proposed critical habitat for ESA-listed species by examining any change in the conservation value of the primary constituent elements of that critical habitat. This analysis focuses on statutory provisions of the ESA, including those in Section 3 of the Act that define "critical habitat" and "conservation," in Section 4 that describe the designation process, and in Section 7 that set forth the substantive protections and procedural aspects of consultation. Although some "properly functioning" habitat parameters are generally well known in the fisheries literature (e.g., thermal tolerances), for others, the effects of any adverse impacts are considered in more qualitative terms. This analysis does not rely on the regulatory definition of "adverse modification or destruction" of critical habitat recently at issue in the 9th Circuit Court of Appeals (Gifford Pinchot Task Force et al. v. U.S. Fish and Wildlife Service, No. 03-35279, August 6, 2004).

As explained in the Description of the Action section above, dredging with a crane mounted clamshell dredge will be used for maintenance dredging at all locations. Refer to Figure 2 for locations of each area to be dredged. Below, the discussion will consider the effects of mechanical dredging, including the risk of capture of fish as well as the effects of suspended sediment associated with the dredging operations. Following, there is a discussion of the effects of disposal activities and a discussion of other effects of the proposed dredging including effects on prey and foraging and a discussion on the effects of the proposed dredging and disposal operations on critical habitat designated for Atlantic salmon. Last, we consider effects of the installation of scour protection at Pier 4. Because use of the brake wheels by BIW is an interrelated activity, we also consider effects to listed species and critical habitat that may result from propulsion testing at Pier 4 with the brake wheels. As the effects of the action are related to the seasonal presence and abundance of shortnose sturgeon and Atlantic salmon in the action area, the discussion of effects presented below is preceded by a summary of the best available information on the seasonal distribution of these species in the action area.

Based on the best available data (discussed in the Status of the Species section above), shortnose and Atlantic sturgeon are expected to be in the immediate vicinity of the BIW facilities, including the areas to be dredged, during the time period in which dredging is proposed to occur (October 1 – May 31), with few individuals present between mid-November and late April. As shortnose and Atlantic sturgeon have been documented in the action area during the time of year proposed for dredging, interactions between turgeon and the dredge operations may occur. Sturgeon in the action area could be juveniles, subadults or adults. No eggs or larvae occur in the action area.

As explained in the Status of the Species section above, Atlantic salmon occur in the action area between April 10 and November 7 each year. Upstream migrating adults could be present in the action area throughout this time period. Outmigrating smolts would be moving downstream through the action area from April through June. Due to the time of year when dredging will occur and the types of habitats in the action area, no spawning or overwintering fish will be affected; similarly no Atlantic salmon eggs or other early life stages would be present in the action area during this time of year. Additionally, as the action area consists of deep waters, no parr would occur in the action area.

Dredging activities occurring between April 10 - May 31 and October 1 – November 7 will overlap with the time of year when Atlantic salmon could be present in the action area. No Atlantic salmon are likely to be present in the action area between November 8 and April 9; as such, any dredging occurring in this time period would not expose any Atlantic salmon to effects of the action. As noted above, in the spring dredge window (April 10-May 31) outmigrating smolts and returning adults could be present in the action area. In the fall dredge window, the only life stage likely to be present would be returning adults.

Returning adults are not known to forage while making their upstream migrations. Movements through the action area by migrating adults are likely to be rapid, with residence times of less than 1 day. Similarly, outmigrating smolts would be moving rapidly through the action area, and would also have residence times of less than 1 day. While smolts may forage opportunistically while migrating out of rivers, extensive foraging by smolts is not likely to occur in the action area.

7.1 Capture in Dredge Bucket

As noted above, a mechanical bucket dredge will be used for the proposed dredging. Aquatic species can be captured in dredge buckets and may 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. Fish captured and emptied out of the bucket could suffer severe stress or injury, which could also lead to mortality.

Atlantic salmon

As explained above, Atlantic salmon are likely to be present in the action area during any dredging activity occurring between April 10 – May 31 and October 1 and November 7. There are no known incidences of Atlantic salmon being captured in a dredge bucket. As Atlantic salmon are highly mobile and not likely to be concentrated in the action area there is little risk of individuals being captured in the relatively slow moving dredge bucket. As such, the likelihood that an Atlantic salmon would be captured during any of the dredge events occurring at BIW are discountable and no Atlantic salmon are likely to be injured or killed as a result of interactions with the dredge equipment.

Shortnose and Atlantic Sturgeon

Shortnose sturgeon may 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 captured and emptied out of the bucket could suffer severe stress or injury, which could also lead to mortality. Few captures of sturgeon with dredge buckets have been reported. 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). On April 30, 2003, a shortnose sturgeon was captured in a clam-shell bucket dredge operating in the BIW sinking basin in the Kennebec River; the fish was nearly cut in half. This fish was killed during the last hour of a 24-hour a day dredging operation that had been ongoing for approximately six weeks. One shortnose sturgeon was captured in a clamshell bucket and detected in the dredge scow on June 1, 2009 during dredging operations at BIW. Outside of the action area, the only report of a capture of a sturgeon in a mechanical dredge is an Atlantic sturgeon killed in the Cape Fear River in a bucket and barge operation (NMFS 1998). Very few other mechanical dredge operations have employed observers to document interactions between sturgeon and the dredge; therefore, it is possible that interactions during other projects have occurred but just not been observed.

Based on the occurrence of sturgeon in the area where mechanical dredging will take place and the documented vulnerability of this species to capture with mechanical dredges, it is likely that a small number of sturgeon will be captured by the mechanical dredge operating to remove sediment at the BIW facilities. Since 1997 when endangered species observers began staffing dredging projects at BIW, two shortnose sturgeon and one Atlantic sturgeon have been documented to be captured with a mechanical dredge. Only one of these events (April 30, 2003) occurred during the proposed October 1 – May 31 dredge window, with the others occurring in June (2001 – Atlantic sturgeon; 2009 – shortnose sturgeon). Based on the best available information, the risk that a shortnose or Atlantic sturgeon would be captured in the slow moving dredge bucket is relatively low. This is evidenced by the small number of sturgeon captured during dredging operations at BIW since 1997, despite the occurrence of 17 dredge events since this time.

The greatest risk for interactions between mechanical dredges and individual sturgeon at the BIW facility is likely in the summer months when large concentrations of sturgeon are present in the action area while moving between foraging areas. It has also been speculated that during the summer months sturgeon may seek out the deep holes at the sinking basin as a thermal refugia and also that they may use the Pier 3 area as a resting area as there is a unique low velocity area located at this site. As no dredging will occur between June 1 and September 30 the time of year with the greatest likelihood of sturgeon captured will be avoided.

As noted above, shortnose sturgeon begin moving to the overwintering area in October and begin to return to the action area in April, with only a few individuals present in the Bath area between mid-November and late April. It is likely that of the months when dredging will be allowed to occur, the highest risk for capture would be in May and October as more sturgeon would be present in the action area than during the other months when dredging could occur. Seasonal distribution of Atlantic sturgeon is similar. In 2012 dredging will occur in November and December. However, while BIW has stated that every effort will be made to complete all future dredging between November 8 and April 9, it is possible that dredging will occur in May or October in the future.

Due to the nature of interactions between listed species 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 of a dredge event running from April 7 to April 30, 2003. Regardless, based on all available evidence, the risk of capture in a mechanical dredge is low. 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.

As noted above, only two shortnose sturgeon and one Atlantic sturgeon have been captured during 17 dredge events over the last 16 years. No more than one sturgeon has been captured during one dredge event. As such, we anticipate in the worst case that one sturgeon will be captured during each future dredge event. Given the past ratio of interactions with Atlantic and shortnose sturgeon we expect that 2/3 of future interactions will be with shortnose sturgeon and

1/3 with Atlantic sturgeon. Between now and the expiration of the dredging permit in November 2009, we anticipate seven dredge events[7]. Thus, a total of no more than seven sturgeon are likely to be captured by a mechanical dredge operating to conduct maintenance dredging over the 10 year life of the permit. Of these, we expect the capture of five shortnose and two Atlantic sturgeon. The majority of Atlantic sturgeon in the action area are likely to originate from the Kennebec River (GOM DPS); however, we also expect sturgeon from the St. John River (Canada) and the New York Bight (NYB) DPS to be present in the action area. As such, the two captured Atlantic sturgeon are likely to originate from either the GOM or NYB DPS. Given the size of all previously captured sturgeon (less than 100 cm), we expect the Atlantic sturgeon to be captured to be juveniles or subadults.

Sturgeon captured in a dredge bucket could be injured or killed. Sources of mortality include injuries suffered during contact with the dredge bucket or burial in the dredge scow. Of the three captures of sturgeon with mechanical dredges in the Kennebec River (two shortnose, 1 Atlantic), one of the shortnose sturgeon was killed. This fish suffered from a large laceration, likely experienced due to contact with the dredge bucket. The Atlantic sturgeon reportedly captured in the Cape Fear River was also killed. As the risk of mortality once captured is high, it is reasonable to expect that any of the shortnose sturgeon likely to be captured in the dredge bucket could suffer injury or mortality due to contact with the dredge bucket or through suffocation due to burial in the scow. Of the four recorded captures of sturgeon in mechanical dredge operations, two were killed. Thus, we anticipate a fifty-percent mortality rate. Using this mortality rate, we anticipate the mortality of three of the five shortnose sturgeon and one of the two captured Atlantic sturgeon. This dead Atlantic sturgeon could originate from the GOM or NYB DPS.

7.2 Interactions with the Sediment Plume

Dredging operations cause sediment to be suspended in the water column. This results in a sediment plume in the river, typically present from the dredge site and decreasing in concentration as sediment falls out of the water column as distance increases from the dredge site. Depending on the extent of dredging planned in any given year, up to six weeks of dredging could be scheduled, with dredging occurring 8-24 hours a day depending on location and time of year of the proposed dredging.

Water quality studies conducted in the action area by Normandeau Associates in 1997 and 2001 indicate that this is a naturally turbid area with naturally occurring fluctuations in turbidity. In 2001, Normandeau Associates monitored water quality during dredging operations at Bath Iron Works. Pre-dredge total suspended solids (TSS) levels ranged from 20-49mg/L. The maximum observed TSS levels during and after dredging was 55mg/L. This level was recorded during an ebb tide, 50 feet from the dredge. Additional monitoring was conducted during dredging at the Pier 2 berthing area in 2002. Pre-dredge turbidity ranged from 5.0-7.9 NTU with TSS values ranging from 12 -18 mg/L. During dredging, TSS ranged from 24 to 43 mg/L. While increased turbidity was experienced at a distance of 150 feet from the dredge, the highest concentrations were limited to the area within 50 feet of the dredge. As explained above, the USACE is

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[7] The following maintenance dredging events are currently predicted: 2012 (landing grid); 2013 (sinking basin (February) and berthing piers (Fall)); 2016 (sinking basin and landing grid); 2017 (berthing piers); and, 2019 (sinking basin).

requiring that BIW monitor TSS levels during dredging operations and will require that dredging operations cease if TSS levels are greater than 50mg/L above background concentrations. This will ensure that no sturgeon or salmon will be exposed to TSS levels greater than 50mg/L above background concentration levels.

Monitoring of twelve mechanical dredge operations in the Delaware River (Burton 1993) in 1992 indicated that sediment plumes have fully dissipated by 3,300-feet from the dredge area. 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.

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 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). Studies with striped bass adults showed that pre-spawners did not avoid concentrations of 954 to 1,920 mg/L to reach spawning sites (Summerfelt and Moiser 1976 and Combs 1979 in Burton 1993). The Normandeau 2001 report identified five species in the Kennebec River for which TSS toxicity information was available. The most sensitive species reported was the four spine stickleback which demonstrated less than 1% mortality after exposure to TSS levels of 100mg/L for 24 hours. Striped bass showed some adverse blood chemistry effects after 8 hours of exposure to TSS levels of 336mg/L. While there have been no directed studies on the effects of 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 and Atlantic sturgeon are assumed to be as least as tolerant to suspended sediment as other estuarine fish such as striped bass.

The life stages of shortnose and Atlantic 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. Juvenile and adult shortnose and Atlantic sturgeon are frequently found in turbid water and would be capable of avoiding any sediment plume by swimming higher in the water column. Laboratory studies (Niklitschek 2001 and 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. This behavior has also been observed in Atlantic sturgeon. While the increase in suspended sediments may cause 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 or around the plume. 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 or Atlantic sturgeon in the action area.

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. Atlantic salmon smolts are particularly susceptible to stress-induced mortality during the transition to the marine environment. Atlantic salmon adults rely on olfactory sense to identify and navigate their natal river. In a review of the effects of sediment loads and turbidity on fish, Newcomb and Jensen (1996) concluded that more than six days exposure to total suspended solids (TSS) greater than 10 mg/l is a moderate stress for juvenile and adult salmonids and that a single day exposure to TSS in excess of 50 mg/l is a moderate stress. Atlantic salmon smolt movement through estuaries is rapid (LeBar *et at.* 1978, Tytler *et at.* 1978). Based upon this information, the duration of any exposure to sediment plumes during this proposed project, if at all, would likely be less than 1 day for migrating Atlantic salmon smolts. Although adult Atlantic salmon movement through estuaries is less understood, but it can also be expected that adults would not be exposed to a sediment plume for more than one day. As indicated above, a single day exposure to TSS in excess of 50 mg/l is a moderate stress to salmonids; however, as dredging must cease if TSS levels are greater than 50mg/L, no Atlantic salmon of any life stage are expected to be exposed to TSS levels of 50mg/L. As such, any effects of the sediment plume on Atlantic salmon will be insignificant. Additionally, as the sediment plume is expected to have largely dissipated within 150 feet of the dredge and the river is approximately 0.5 miles wide at the site of dredging, there will be a sufficient zone of passage where Atlantic salmon can migrate up or down stream without being exposed to any effects of the sediment plume.

7.3 Dredged Material Disposal Operations

BIW will transport material removed from the berthing areas and the landing grid to a nearby dock where it will be offloaded by crane into dump trucks and disposed of at a State-approved non-wetland location. The only material that could be disposed of at an in river disposal site is material removed from the sinking basin which would be disposed of at the existing disposal site near Bluff Head.

Burial during disposal operations is another potential effect of dredging operations. Burial is probably most likely during the overwintering period when fish would be more lethargic and situated in deeper areas (such as disposal sites). Overwintering areas characteristically are areas of lower energy conditions, like deep pools, where the fish can expend less energy during a time period when they are not actively foraging. However, the above discussion on the location of shortnose sturgeon during the overwintering period suggests that concentrations of sturgeon would not be found at the dredge disposal site north of Bluff Head during the November through February time period. Furthermore, fish tracked during the fall and winter of 1997 and spring and fall of 1999 in the Doubling Point area, which is north of the disposal site, were making significant movements. While it is possible that some number of shortnose sturgeon may be present at or near the disposal site during the winter months, it is extremely unlikely that a juvenile or adult shortnose sturgeon would be buried due to the volume of material released from the scow at any one time, the type of sediment (i.e., coarse sand as opposed to heavy rocks) the dispersion of sediment throughout the water column as it falls, and the time it takes for material to reach the bottom. Burial during the spring and fall is also extremely unlikely to occur as shortnose sturgeon are very active at these times of year and are likely to be able to swim away from any sediment plume.

Shortnose sturgeon and Atlantic salmon near the disposal area may be exposed to increased suspended sediment levels. Impacts associated with this action include a short term localized increase in turbidity during disposal operations. During the discharge of sediment at a disposal site, suspended sediment levels have been reported as high as 500mg/L within 250 feet of the disposal vessel and decreasing to background levels within 1,000-6500 feet (USACE 1983). The USACE has reported that disposal at Bluff Head can result in a plume of suspended sediment extending for up to 3,000 feet from the disposal barge which is consistent with other available reports.

As explained above, exposure to elevated suspended sediment levels can cause stress to Atlantic salmon. The best available information indicates that an exposure of 50mg/L above background for more than 24 hours can be moderately stressful for Atlantic salmon. While disposal operations could result in TSS levels greater than 50mg/L above background, all efforts will be made to avoid in river disposal during the time of year when Atlantic salmon are likely to be present (i.e., April 10 – November 7). For the fall 2012 dredging, in river disposal will occur. However, as disposal will occur outside of the April 10 – November 7 window, no Atlantic salmon will be exposed to effects of disposal activities. As noted above, the USACE is implementing a permit condition requiring that any future in river disposal occurring between April 10 – November 7 occur with a sediment management plan in place. This plan will require that should disposal operations occur during the time of year when salmon could be present, continuous monitoring of TSS will be required and mitigation measures will be put in place to ensure that TSS levels of 50 mg/L above background are not reached. The plan will also require that disposal operations cease should TSS levels of 50mg/L above background be reached. These requirements will ensure that no Atlantic salmon are exposed to TSS levels of 50mg/L or greater above background. As such, any effects of in river disposal on Atlantic salmon will be insignificant.

The best available information on the effects of TSS on shortnose sturgeon is summarized above. 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 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). Studies with striped bass adults showed that pre-spawners did not avoid concentrations of 954 to 1,920 mg/L to reach spawning sites (Summerfelt and Moiser 1976 and Combs 1979 in Burton 1993). The Normandeau 2001 report identified five species in the Kennebec River for which TSS toxicity information was available. The most sensitive species reported was the four spine stickleback which demonstrated less than 1% mortality after exposure to TSS levels of 100mg/L for 24 hours. Striped bass showed some adverse blood chemistry effects after 8 hours of exposure to TSS levels of 336mg/L. While there have been no directed studies on the effects of 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.

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. Juvenile and adult shortnose sturgeon are frequently found in turbid water and would be capable of avoiding any sediment plume by swimming higher in the water column. Laboratory studies (Niklitschek 2001 and 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. 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.

7.4 Release of Contaminated Sediment

In addition to the release of sedimentation, dredging operations also have the potential to release contaminants that are present in the material to be dredged. However, the coarse nature of the material to be dredged makes it unlikely that any contaminants would adhere to the sand particles. Additionally, the material in the sinking basin has been tested in the past and there is no evidence that the material to be dredged is contaminated. Therefore, no release of contaminated material is expected.

7.5 Effects to Sturgeon Habitat

Since dredging involves removing the bottom material down to a specified depth, the benthic environment will be impacted by dredging operations. Shortnose sturgeon foraging grounds in the Kennebec estuary are typically shallow waters and mud flats covered with rooted aquatic plants. The areas to be dredged are not consistent with the type of habitat that supports shortnose sturgeon forage items (Normandeau 1998). For example, benthic surveys noted a lack of the usual shortnose sturgeon forage items in the area even before it was dredged to its design depth in 1999. As the areas to be dredged are subject to constant scouring and resettling of sediment, it is unlikely that even the minor amount of benthic forage that was historically present has been re-established. As such, shortnose sturgeon are not likely to be feeding in the area to be dredged and any effects of the removal of any potential forage items during dredging operations will be insignificant.

Disposal operations can also affect foraging habitat by burying prey. However, the Bluff Head area is not known to be used by foraging shortnose sturgeon and any effects to shortnose sturgeon foraging will be insignificant.

Sturgeon are known to seek out deeper waters during the summer months that serve as thermal refugia. The sinking basin is consistent with the depths sought by shortnose sturgeon and water quality monitoring indicates that dissolved oxygen levels would be suitable for shortnose sturgeon (Normandeau 1997). It has also been speculated that the area surrounding the BIW facility is used by shortnose sturgeon as a resting area because of the low velocity zone that exists immediately downstream of the outfitting pier which provides a place for traveling fish to rest away from the main river current (Normandeau 1997). The proposed dredging will not alter the area in a manner that precludes shortnose sturgeon from using the action area for thermal refugia or as a resting area.

7.6 Brake Wheel Project – Installation of Scour Protection

BIW is proposing to install stone rip rap along Pier 4 between November 8 and December 31, 2012. No Atlantic salmon will be present in the action area at this time of year; however, juvenile and adult shortnose sturgeon and yearling and subadult Atlantic sturgeon may be present near Bath at this time of year.

Stone will be dumped slowly bucket by bucket from an excavator. Due to the slow speed that the material will be dumped and the size of the stones being placed, it is extremely unlikely that any sturgeon would be crushed or injured by falling rocks.

The placement of stone will result in a localized and temporary increase in turbidity. However, any increase in turbidity is expected to be less than what is generated during dredging. As such, it is likely to be less than 50 mg/l above ambient conditions and any effects to shortnose and Atlantic sturgeon would be insignificant and discountable.

All immobile benthic resources present in the area where stone is placed will be buried. As such, there will be a loss of potential foraging area for sturgeon. However, given the extremely small size of the impacted area (0.19 acres), any effects to sturgeon are likely to be insignificant.

7.7 Operation of the Brake Wheel – Propulsion Testing

BIW will use the brake wheel for dockside testing of U.S. Navy vessels. We have considered the effects of suspended sediment, underwater noise and the potential for interactions between listed fish and the spinning propellers.

7.7.1 Suspended Sediment

The scour protection system is designed to stabilize the sediment in the area near Pier 4 where vessels will be tested at the brake wheel. Any sediment suspended due to the propeller would be limited to sediment that had settled on top of the scour since the last time the brake wheel was utilized. BIW has determined that the amount of sediment that could be suspended during vessel operations is small and that any increase in turbidity or suspended sediment would be less than that generated during dredging and would be limited to only the first few minutes that the vessel was being tested. As such, there is likely to be a temporary increase in suspended sediment of no more than 50mg/l. All effects to shortnose and Atlantic sturgeon and Atlantic salmon exposed to this temporary increase in suspended sediment will be insignificant and discountable.

8.7.2 Underwater Noise

Basic Background on Acoustics and Fish Bioacoustics

Sound in water follows the same physical principles as sound in air. The major difference is that due to the density of water, sound in water travels about 4.5 times faster than in air (approx. 4900 ft./s vs. 1100 ft./s), and attenuates much less rapidly than in air. As a result of the greater speed, the wavelength of a particular sound frequency is about 4.5 times longer in water than in air (Rogers and Cox 1988; Bass and Clarke 2003).

Frequency (i.e., number of cycles per unit of time, with hertz (Hz) as the unit of measurement) and amplitude (loudness, measured in decibels, or dB) are the measures typically used to describe sound. The hearing range for most fish ranges from a low of 20 Hz to 800 to 1,000 Hz. Most fish fit into this hearing range, although catfish may hear to about 3,000 or 4,000 Hz and some of the herring-like fishes can hear sounds to about 4,000 Hz, while a few, and specifically the American shad, can hear to over 100,000 Hz (Popper *et al.* 2003; Bass and Ladich 2008; Popper and Schilt 2008).

An acoustic field from any source consists of a propagating pressure wave, generated from particle motions in the medium that causes compression and rarefaction. This sound wave consists of both pressure and particle motion components that propagate from the source. All fishes have sensory systems to detect the particle motion component of a sound field, while fishes with a swim bladder (a chamber of air in the abdominal cavity) may also be able to detect the pressure component. Pressure detection is primarily found in fishes where the swim bladder (or other air chamber) lies very close to the ear, whereas fishes in which there is no air chamber near the ear primarily detect particle motion (Popper *et al.* 2003; Popper and Schilt 2009; Popper and Fay 2010). Sturgeon have swim bladders, but they are not located very close to the ear; thus, they are assumed to detect primarily particle motion rather than pressure.

The level of a sound in water can be expressed in several different ways, but always in terms of dB relative to 1 micro-Pascal (µPa). Decibels are a log scale; each 10 dB increase is a ten-fold increase in sound pressure. Accordingly, a 10 dB increase is a 10x increase in sound pressure, and a 20 dB increase is a 100x increase in sound pressure.

The following are commonly used measures of sound:

- Peak sound pressure level (SPL): the maximum sound pressure level (highest level of sound) in a signal measured in dB re 1 µPa.

- Sound exposure level (SEL): the integral of the squared sound pressure over the duration of the pulse (e.g., a full pile driving strike.) SEL is the integration over time of the square of the acoustic pressure in the signal and is thus an indication of the total acoustic energy received by an organism from a particular source (such as pile strikes).
  Measured in dB re $1 \mu Pa^2$-s.

- Single Strike SEL: the amount of energy in one strike of a pile.

- Cumulative SEL (cSEL or SEL_{cum}): the energy accumulated over multiple strikes. cSEL indicates the full energy to which an animal is exposed during any kind of signal. The rapidity with which the cSEL accumulates depends on the level of the single strike SEL. The actual level of accumulated energy (cSEL) is the logarithmic sum of the total number of single strike SELs. Thus, cSEL (dB) = Single-strike SEL + $10\log_{10}(N)$; where N is the number of strikes.

- Root Mean Square (RMS): the average level of a sound signal over a specific period of time.

Summary of Available Information on Underwater Noise and Fish

Sturgeon rely primarily on particle motion to detect sounds (Lovell *et al.* 2005). While there are no data both in terms of hearing sensitivity and structure of the auditory system for shortnose or Atlantic sturgeon, there are data for the closely related lake sturgeon (Lovell *et al.* 2005; Meyer *et al.* 2010), which for the purpose of considering acoustic impacts can be considered as a surrogate for shortnose and Atlantic sturgeon.

The available data suggest that lake sturgeon can hear sounds from below 100 Hz to 800 Hz (Lovell *et al.* 2005; Meyer *et al.* 2010). As noted by FHWA, since these two studies examined responses of the ear and did not examine whether fish would behaviorally respond to sounds detected by the ear, it is hard to determine thresholds for hearing (that is, the lowest sound levels that an animal can hear at a particular frequency) using information from these studies.

The swim bladder of sturgeon is relatively small compared to other species (Beregi *et al.* 2001). While there are no data that correlate effects of noise on fishes and swim bladder size, the potential for damage to body tissues from rapid expansion of the swim bladder likely is reduced in a fish where the structure occupies less of the body cavity, and, thus, is in contact with less body tissue. Although there are no experimental data that enable one to predict the potential effects of sound on sturgeon, the physiological effects of pile driving on sturgeon may actually be less than on other species due to the small size of their swim bladder.

Sound is an important source of environmental information for most vertebrates (e.g., Fay and Popper, 2000). Fish are thought to use sound to learn about their general environment, the presence of predators and prey, and, for some species, for acoustic communication. As a consequence, sound is important for fish survival, and anything that impedes the ability of fish to detect a biologically relevant sound could affect individual fish.

Richardson *et al.* (1995) defined different zones around a sound source that could result in different types of effects on fish. There are a variety of different potential effects from any sound, with a decreasing range of effects at greater distances from the source. Thus, very close to the source, effects may range from mortality to behavioral changes. Somewhat further from the source mortality is no longer an issue, and effects range from physiological to behavioral. As one gets even further, the potential for effects declines. The actual nature of effects, and the distance from the source at which they could be experienced will vary and depend on a large number of factors, such as fish hearing sensitivity, source level, how the sounds propagate away from the source and the resultant sound level at the fish, whether the fish stays in the vicinity of the source, the motivation level of the fish, etc.

Underwater sound pressure waves can injure or kill fish (Reyff 2003, Abbott and Bing-Sawyer 2002, Caltrans 2001, Longmuir and Lively 2001, Stotz and Colby 2001). Fish with swim bladders, including shortnose and Atlantic sturgeon are particularly sensitive to underwater impulsive sounds with a sharp sound pressure peak occurring in a short interval of time (Caltrans 2001). As the pressure wave passes through a fish, the swim bladder is rapidly squeezed due to the high pressure, and then rapidly expanded as the under pressure component of the wave passes through the fish. The pneumatic pounding on tissues contacting the swim bladder may rupture capillaries in the internal organs as indicated by observed blood in the abdominal cavity, and maceration of the kidney tissues (Caltrans 2001).

There are limited data from other projects to demonstrate the circumstances under which immediate mortality occurs: mortality appears to occur when fish are close (within a few feet to 30 feet) to driving of relatively large diameter piles. Studies conducted by California Department of Transportation (Caltrans, 2001) showed some mortality for several different species of wild fish exposed to driving of steel pipe piles 8 feet in diameter, whereas Ruggerone *et al.* (2008) found no mortality to caged yearling coho salmon (*Oncorhynchus kisutch*) placed as close as 2 feet from a 1.5 foot diameter pile and exposed to over 1,600 strikes. As noted above, species are thought to have different tolerances to noise and may exhibit different responses to the same noise source.

Physiological effects that could potentially result in mortality may also occur upon sound exposure as could minor physiological effects that would have no effect on fish survival. Potential physiological effects are highly diverse, and range from very small ruptures of capillaries in fins (which are not likely to have any effect on survival) to severe hemorrhaging of major organ systems such as the liver, kidney, or brain (Stephenson *et al.*, 2010). Other potential effects include rupture of the swim bladder (the bubble of air in the abdominal cavity of most fish species that is involved in maintenance of buoyancy). See Halvorsen *et al.* 2011 for a review of potential injuries from pile driving.

Effects on body tissues may result from barotrauma or result from rapid oscillations of air bubbles. Barotrauma occurs when there is a rapid change in pressure that directly affects the body gasses. Gas in the swim bladder, blood, and tissue of fish can experience a change in state, expand and contract during rapid pressure changes, which can lead to tissue damage and organ failure (Stephenson *et al.* 2010).

Related to this are changes that result from very rapid and substantial excursions (oscillations) of the walls of air-filled chambers, such as the swim bladder, striking near-by structures. Under normal circumstances the walls of the swim bladder do not move very far during changes in depth or when impinged upon by normal sounds. However, very intense sounds, and particularly those with very sharp onsets (also called “rise time”) will cause the swim bladder walls to move much greater distances and thereby strike near-by tissues such as the kidney or liver. Rapid and frequent striking (as during one or more sound exposures) can result in bruising, and ultimately in damage, to the nearby tissues.

There is some evidence to suggest that very intense signals may not necessarily have substantial physiological effects and that the extent of effect will vary depending on a number of factors including sound level, rise time of the signal, duration of the signal, signal intensity, etc. For example, investigations on the effects of very high intensity sonar showed no damage to ears and other tissues of several different fish species (Kane *et al.* 2010). Some studies involving exposure of fish to sounds from seismic air guns, signal sources that have very sharp onset times, as found in pile driving, also did not result in any tissue damage (Popper *et al.* 2007; Song *et al.* 2008). However, the extent that results from one study are comparable to another is difficult to determine due to difference in species, individuals, and experimental design. Recent studies of the effects of pile driving sounds on fish showed that there is a clear relationship between onset of physiological effects and single strike and cumulative sound exposure level, and that the initial effects are very small and would not harm an animal (and from which there is rapid and complete recovery), whereas the most intense signals (e.g., >210 dB cumulative SEL) may result in tissue damage that could have long-term mortal effects (Halvorsen *et al.* 2011; Casper *et al.* 2011, in prep.)

Criteria for Assessing the Potential for Physiological Effects – Salmon and Sturgeon
The Fisheries Hydroacoustic Working Group (FHWG) was formed in 2004 and consists of biologists from NMFS, USFWS, FHWA, and the California, Washington and Oregon DOTs, supported by national experts on sound propagation activities that affect fish and wildlife species of concern. In June 2008, the agencies signed an MOA documenting criteria for assessing physiological effects of pile driving on fish. The criteria were developed for the acoustic levels at which physiological effects to fish could be expected. It should be noted, that these are onset of physiological effects (Stadler and Woodbury, 2009), and not levels at which fish are necessarily mortally damaged. These criteria were developed to apply to all species, including listed green sturgeon and Pacific salmon, which are biologically similar to shortnose and Atlantic sturgeon and Atlantic salmon respectively, and for these purposes can be considered a surrogate. The interim criteria are:

- Peak SPL: 206 decibels relative to 1 micro-Pascal (dB re 1 µPa).
- cSEL: 187 decibels relative to 1 micro-Pascal-squared second (dB re 1µPa^2-s) for fishes above 2 grams (0.07 ounces).
- cSEL: 183 dB re 1µPa^2-s for fishes below 2 grams (0.07 ounces).

We have relied on these criteria in determining the potential for physiological effects in ESA Section 7 consultations. At this time, they represent the best available information on the thresholds at which physiological effects to sturgeon are likely to occur. It is important to note that physiological effects may range from minor injuries from which individuals are anticipated to completely recover with no impact to fitness to significant injuries that will lead to death. The severity of injury is related to the distance from the pile being installed and the duration of exposure. The closer to the source and the greater the duration of the exposure, the higher likelihood of significant injury.

A recent peer-reviewed study from the Transportation Research Board (TRB) of the National Research Council of the National Academies of Science describes a carefully controlled experimental study of the effects of pile driving sounds on fish (Halvorsen *et al.* 2011). This investigation documented effects of pile driving sounds (recorded by actual pile driving operations) under simulated free-field acoustic conditions where fish could be exposed to signals that were precisely controlled in terms of number of strikes, strike intensity, and other parameters. The study used Chinook salmon and determined that onset of physiological effects that have the potential of reduced fitness, and thus a potential effect on survival, started at above 210 dB re 1 µPa^2·s cSEL. Smaller injuries, such as ruptured capillaries near the fins, which the authors noted were not expected to impact fitness, occurred at lower noise levels. The peak noise level that resulted in physiological effects was about the same as the FHWG criteria.

Based on the available information, for the purposes of this Opinion, we consider the potential for physiological effects upon exposure to 206dB re 1 µPa peak and 187 dB re 1 µPa^2-s cSEL. Use of the 183 dB re 1 µPa^2-s cSEL threshold, is not appropriate for this consultation because all listed fish in the action area will be larger than 2 grams. As explained here, physiological effects could range from minor injuries that a fish is expected to completely recover from with no impairment to survival to major injuries that increase the potential for mortality, or result in death.

Available Information for Assessing Behavioral Effects

Results of empirical studies of hearing of fishes, amphibians, birds, and mammals (including humans), in general, show that behavioral responses vary substantially, even within a single species, depending on a wide range of factors, such as the motivation of an animal at a particular time, the nature of other activities that the animal is engaged in when it detects a new stimulus, the hearing capabilities of an animal or species, and numerous other factors (Brumm and Slabbekoorn 2005). Thus, it may be difficult to assign a single criterion above which behavioral responses to noise would occur.

In order to be detected, a sound must be above the “background” level. Additionally, results from some studies suggest that sound may need to be biologically relevant to an individual to elicit a behavioral response. For example, in an experiment on responses of American shad to sounds produced by their predators (dolphins), it was found that if the predator sound is detectable, but not very loud, the shad will not respond (Plachta and Popper 2003). But, if the sound level is raised an additional 8 or 10 dB, the fish will turn and move away from the sound source. Finally, if the sound is made even louder, as if a predator were nearby, the American shad go into a frenzied series of motions that probably helps them avoid being caught. It was speculated by the researchers that the lowest sound levels were those recognized by the American shad as being from very distant predators, and thus, not worth a response. At somewhat higher levels, the shad recognized that the predator was closer and then started to swim away. Finally, the loudest sound was thought to indicate a very near-by predator, eliciting maximum response to avoid predation. Similarly, results from Doksaeter *et al.* (2009) suggest that fish will only respond to sounds that are of biological relevance to them. This study showed no responses by free-swimming herring (*Clupea* spp.) when exposed to sonars produced by naval vessels; but, sounds at the same received level produced by major predators of the herring (killer whales) elicited strong flight responses. Sound levels at the fishes from the sonar in this experiment were from 197 dB to 209 dB (rms) re 1 µPa at 1,000 to 2,000Hz.

For purposes of assessing behavioral effects of pile driving at several West Coast projects, NMFS has employed a 150dB re 1 µPa RMS SPL criterion at several sites including the San Francisco-Oakland Bay Bridge and the Columbia River Crossings. For the purposes of this consultation we will use 150 dB re 1 µPa RMS as a conservative indicator of the noise level at which there is the potential for behavioral effects. That is not to say that exposure to noise levels of 150 dB re 1 µPa RMS will always result in behavioral modifications or that any behavioral modifications will rise to the level of “take” (i.e., harm or harassment) but that there is the potential, upon exposure to noise at this level, to experience some behavioral response. Behavioral responses could range from a temporary startle to avoidance of an ensonified area.

As hearing generalists, sturgeon rely primarily on particle motion to detect sounds (Lovell *et al.* 2005), which does not propagate as far from the sound source as does pressure. However, a clear threshold for particle motion was not provided in the Lovell study. In addition, flanking of the sounds through the substrate may result in higher levels of particle motion at greater distances than would be expected from the non-flanking sounds. Unfortunately, data on particle motion from most noise sources is not available at this time, and we are forced to rely on sound pressure level criteria. Although we agree that more research is needed, the studies noted above support the 150 dB re 1 µPa RMS criterion as an indication for when behavioral effects could be expected. We are not aware of any studies that have considered the behavior of shortnose or Atlantic sturgeon in response to underwater noise. However, given the available information from studies on other fish species, we consider 150 dB re 1 µPa RMS to be a reasonable estimate of the noise level at which exposure may result in behavioral modifications.

There is not an extensive body of literature on effects of anthropogenic sounds on fish behavior, and many of these studies were conducted under conditions that make the interpretation of the results uncertain. The results of the studies, summarized below, suggest that there is a potential for underwater sound of certain levels and frequencies to affect behavior of fish, but that it varies with fish species and the existing hydroacoustic environment. In addition, behavioral response may change over time as fish individuals habituate to the presence of the sound. Behavioral responses to other noise sources, such as noise associated with vessel traffic, and the results of noise deterrent studies, are also summarized below.

Mueller-Blenke *et al.* (2010), attempted to evaluate response of Atlantic cod (*Gadus morhua*) and Dover sole (*Solea solea*) held in large pens to playbacks of pile driving sounds recorded during construction of Danish wind farms. The investigators reported that a few representatives of both species exhibited some movement response, reported as increased swimming speed or freezing to the pile-driving stimulus at peak sound pressure levels ranging from 144 to 156 dB re 1 µPa for sole and 140 to 161 dB re 1 µPa for cod. These results must be interpreted cautiously as fish position was not able to be determined more frequently than once every 80 seconds.

Feist (1991) examined the responses of juvenile pink (*Oncorhyncus gorbuscha*) and chum (*O. keta*) salmon behavior during pile driving operations. Feist had observers watching fish schools in less than 1.5 m water depth and within 2 m of the shore over the course of a pile driving operation. The report gave limited information on the types of piles being installed and did not give pile size. Feist did report that there were changes in distribution of schools at up to 300 m from the pile driving operation, but that of the 973 schools observed, only one showed any overt startle or escape reaction to the onset of a pile strike. There was no statistical difference in the number of schools in the area on days with and without pile driving, although other behaviors changed somewhat.

Any analysis of the Feist data is complicated by a lack of data on pile type, size and source sound level. Without this data, it is very difficult to use the Feist data to help understand how fish would respond to pile driving and whether such sounds could result in avoidance or other behaviors. It is interesting to note that the size of the stocks of salmon never changed, but appeared to be transient, suggesting that normal fish behavior of moving through the study area was taking place no differently during pile driving operations than in quiet periods. This may suggest that the fish observed during the study were not avoiding pile driving operations.

Andersson *et al.* (2007) presents information on the response of sticklebacks (*Gasterosteus aculeatus*), a hearing generalist, to pure tones and broadband sounds from wind farm operations. Sticklebacks responded by freezing in place and exhibiting startle responses at SPLs of 120 dB (re: 1µPa) and less. Purser and Radford (2011) examined the response of three-spined sticklebacks to short and long duration white noise. This exposure resulted in increased startle responses and reduced foraging efficiency, although they did not reduce the total number of prey ingested. Foraging was less efficient due to attacks on non-food items and missed attacks on food items. The SPL of the white noise was reported to be similar (at frequencies between 100 and 1000 Hz) to the noise environment in a shoreline area with recreational speedboat activity. While this does not allow a comparison to the 150 dB re 1 µPa RMS guideline, it does demonstrate that significant noise-induced effects on behavior are possible, and that behaviors other than avoidance can occur.

Several of the studies (Andersson *et al.* 2007, Purser and Radford 2011, Wysocki *et al.* 2007) support our use of the 150 dB re 1 µPa RMS as a threshold for examining the potential for behavioral responses. We will use 150 dB re 1 µPa RMS as a guideline for assessing when behavioral responses to underwater noise may be expected. The effect of any anticipated response on individuals will be considered in the effects analysis below.

Effects of brake wheel operation on sturgeon and salmon

Vessels moored at Pier 4 and tested at the brake wheel will generate underwater noise. BIW and the Navy conducted an en engineering review of the brake wheel operations concluded that noise levels are expected to be greater than ship propulsion. The reason for this is that a brake wheel is intended to disperse all propulsion power through release of this energy into the water while providing no forward thrust. This is accomplished though chaotic cavitation of the water surrounding the brake wheel. The energy created by the ships propulsion system is converted into other energy forms, such as heat and noise. The very nature of the brake wheel will make it noisier than an efficient propeller which by design attempts to put all of the propulsion energy into moving the ship.

The Navy and BIW acoustic engineers have reviewed available information to determine the likely underwater noise associated with operation of brake wheel and ship operations at the dock during brake wheel operations. This analysis is based on testing in similar shallow water environments in Florida, operation of similar Navy vessels with noise dampening technologies integrated into the design and brake wheel engineering. The best available information indicates that the source level will be low frequency (less than 1,000 Hz) at 169-200 dB re 1uPa. Noise is expected to attenuate rapidly. At these lower frequencies in a shallow-water environment pier side at the BIW facility, we would expect bottom absorption to play a major role in attenuating sound at increased range from the source. This rapid attenuation results from the low frequency of the noise, the shallow water environment and the low salinity level at the test site. The Navy considers a 30logR attenuation rate to be appropriate in these conditions. The river is approximately 600 meters wide at the test site. This higher estimated attenuation factor is consistent with a shallow water propagation model the Navy is developing based on empirical data for propagation of low frequency sounds collected from a piers ide test site in Florida that has similar depths to Bath. This estimated attenuation may even be conservative given the reduced salinity and temperature of water at the Bath brake wheel test site compared to the Florida site.

The most conservative estimates suggest that the source level could be as high as 200 dB re 1uPa (peak). At this source level, at 300 meters (half-way across the river), noise (measured as RMS) would attenuate to 126 dB re 1uPa. At 600 meters (the opposite riverbank), noise would attenuate to 117 dB. If the source is 169 dB re 1uPa (peak), it would attenuate to 95 dB re 1uPa at 300 meters and 86 dB re 1uPa at 600 meters.

As outlined in the permit application, the brake wheel testing will be approximately seventeen weeks in duration, with a significant portion of the tests, approximately twelve weeks, being performed at, or less than, half power. While the test plan accommodates a schedule of up to ten hours per day, five days per week, given that it is a new design there will be frequent stops and starts and testing will not be continuous throughout the day. BIW cannot state with specificity the exact number of hours each day. A review of data conducted during land-based testing indicates that each shaft would run an average of two to four hours per day, some days will have no operations, some will be an hour or two, and still others may have several hours. BIW has committed to not running the break wheel for more than 12 hours per day.

The peak underwater noise of brake wheel operation could be as loud as 206 dB re 1uPa. Noise will attenuate rapidly. Noise louder than 150 dB re 1 µPa RMS will only be experienced within 50 meters of Pier 4. At 300 meters (half-way across the river), noise (measured as RMS) would attenuate to 126 dB re 1uPa; at 600 meters (the opposite riverbank), noise would attenuate to 117 dB. If the source is quieter than 200 dB, in-river noise would be even less.

Operation of the brake wheels will not result in peak noise levels greater than 206 dB re 1 µPa or cSEL greater than 187 dB re 1 μPa^2-s. Thus, there is no potential for physiological effects due to exposure to this noise. Given the extremely small footprint of the area where noise greater than 150 dB re 1 µPa RMS will be experienced (i.e., within 50 meters of the pier), it is extremely unlikely that the behavior of any individual sturgeon or salmon would be affected by noise associated with the brake wheels. Even if a sturgeon or salmon was within 50 meters of the pier while the break wheel was operating, we expect that the behavioral response would, at most, be limited to movement outside the area where noise greater than would be experienced (i.e., moving to an area at least 50 meters from the pier). Because this area is very small and it would take very little energy to make these movements, the effect to any individual sturgeon or salmon would be insignificant. Based on this analysis, all effects to shortnose and Atlantic sturgeon and Atlantic salmon exposed to noise associated with the operation of the brake wheel will be insignificant and discountable. Acoustic monitoring during brake wheel operations is expected to confirm these determinations.

7.7.3 Heat

BIW completed an assessment of potential water temperature rise due to the operation of the brake wheel testing of the DDG-1000 (see BIW's application documents for report). Four scenarios were considered: operation of a single brake wheel acting at half power, single brake wheel at full power, both brake wheels operating at half power and both brake wheels operating at full power. The assumptions built into the evaluation included: (1) all kinetic mechanical energy produced by the turbines will be transferred to the brake wheels without energy losses; (2) all energy will be converted to heat energy rather than a combination of heat and kinetic energy; (3) the volume of water influenced by the temperature rise is a function of an assumed area of water and the flow rate of the river; (4) the average velocity of the Kennebec River is 1.0 foot/second; and (5) no account was taken for mixing or dispersion of the assumed water volume. The change in water temperature in the river was predicted to increase from 0.1-0.4°F

(0.05-0.22°C) depending on the operational scenario. The report notes that because some of the mechanical energy will be transformed to kinetic energy rather than heat, the actual increases are expected to be a small fraction of the model results.

In the laboratory, juvenile Atlantic sturgeon showed negative behavioral and bioenergetics responses (related to food consumption and metabolism) after prolonged exposure to temperatures greater than 28°C (82.4°F) (Niklitschek 2001). Tolerance to temperatures is thought to increase with age and body size (Ziegweid *et al.* 2008 and Jenkins *et al.* 1993), however, no information on the lethal thermal maximum or stressful temperatures for subadult or adult Atlantic sturgeon is available. Shortnose sturgeon, have been documented in the lab to experience mortality at temperatures of 33.7°C (92.66°F) or greater and are thought to experience stress at temperatures above 28°C. For purposes of considering thermal tolerances, we consider Atlantic sturgeon to be a reasonable surrogate for shortnose sturgeon given similar geographic distribution and known biological similarities. Maximum normal water temperatures in the action area are approximately 25°C. The increase in temperature that may be experienced while the brake wheels are operational is very small. It will not result in temperatures reaching levels that are stressful for sturgeon. The effects of this temperature increase on shortnose and Atlantic sturgeon will be insignificant.

Atlantic salmon can tolerate temperature maxima of 19-27.7°C, depending on life stage. The predicted temperature increase of no more than 0.22°C will not result in temperatures reaching levels that are stressful for Atlantic salmon. The effects of this temperature increase on Atlantic salmon will be insignificant.

7.7.4 Potential for Interactions between the Brake Wheel and Salmon or Sturgeon

While at the dock, the DDG-1000 will have the propellers replaced by the brake wheels. We have considered whether salmon and sturgeon are likely to be struck by the moving components of the brake wheel.

Shortnose sturgeon have been occasionally documented with injuries consistent with vessel strikes. As noted in the 2007 Status Review and the final listing rule, in certain geographic areas vessel strikes have been identified as a threat to Atlantic sturgeon. While the exact number of Atlantic sturgeon killed as a result of being struck by boat hulls or propellers is unknown, it is an area of concern in the Delaware and James rivers. Atlantic salmon are not known to be vulnerable to vessel strikes, possibly due to their smaller size or location within the water column.

The DDG-1000 undergoing testing at Pier 4 will be stationary. While the brake wheel will have spinning parts, in order for a sturgeon to be struck, the fish would need to swim into the moving parts. This seems to be unlikely because: (1) the noise associated with brake wheel operations is likely to act as a behavioral deterrent that would exclude sturgeon from getting within 50 meters of the brake wheel; and, (2) the benthic area near the brake wheels will be covered with stone rip-rap eliminating forage opportunities in the immediate vicinity of the vessel which would minimize sturgeon presence in the area.

Based on this reasoning, we do not anticipate that any sturgeon or salmon will interact with the spinning brake wheels.

7.8 Critical Habitat designated for Atlantic salmon

The action area is a known migratory corridor for both juvenile and adult Atlantic salmon. A migratory corridor free from physical and biological barriers that delay or prevent access of adult salmon seeking spawning grounds or prevent emigration of smolts to the marine environment is identified in the critical habitat designation as essential for the conservation of Atlantic salmon. The Primary Constituent Elements (PCE) for designated critical habitat of listed Atlantic salmon in the action area are:

1) Freshwater and estuary migratory sites free from physical and biological barriers that delay or prevent access of adult salmon seeking spawning grounds needed to support recovered populations;
2) Freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation; and,
3) Freshwater and estuary migration sites free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment.

We have analyzed the potential impacts of the project on designated critical and PCEs in the action area and determined that the effects to these PCEs will be insignificant for the reasons outlined below.

The project will not result in a migration barrier as the turbidity, suspended solids and noise present in the water column during dredging will only affect a small portion of the river at any given time. Based on historic monitoring data, TSS levels as high as 55 mg/L could be experienced; however these levels would only be present within 50 feet (15 meters) of the dredge. The USACE will require monitoring to ensure that at a distance of 50 meters (164 feet) from the dredge, TSS levels remain below 50mg/L. The width of the river in the action area is approximately ½ mile. As such, the area where increased TSS would be experienced would be an extremely small area of the river at any given time. Similarly, should in river disposal occur at the time of year when Atlantic salmon are present, TSS levels during in river disposal operations will be monitored and restricted to 50mg/L above background. This will ensure that there is always a sufficient zone of passage past the dredging and disposal operations for any adult Atlantic salmon moving upstream or smolt migrating downstream through the action area. Underwater noise that may affect salmon movements will only be experienced within 50 meters of Pier 4 during the time when the brake wheels are operational. The area where increased underwater noise would be experienced would be an extremely small area of the river at any given time. Similarly, the increase in water temperature will be very small (less than 0.5°C), and will not affect the ability of salmon to move through the area. Given the limited effects of turbidity, suspended solids, noise and heat, we do not anticipate any impairment of the environment that would affect the ability of salmon to pass through the action area.

The proposed action will not alter the habitat in any way that would increase the risk of predation. Any effects to the water column will be limited to temporary increases in suspended sediment, noise and temperature; there will be no other water quality impacts of the proposed action and therefore the project is not expected to adversely affect water quality at the time of any salmon migrations in the action area. Atlantic salmon present in the action area are not likely to be foraging. While the deposition of rip-rap, dredging and disposal operations can affect benthic resources, salmon are not benthic feeders and the forage base for this species is not expected to be affected by the proposed actions.

Finally, as the action will not affect the natural structure of the nearshore habitat, there will be no reduction in the capacity of substrate, food resources, and natural cover to meet the conservation needs of listed Atlantic salmon. Based upon this reasoning, we have determined that any effects to designated critical habitat in the action area will be insignificant.

8.0 CUMULATIVE EFFECTS

Cumulative effects, as defined in 50 CFR § 402.02, are those effects of future State or private activities, not involving Federal activities, which are reasonably certain to occur within the action area. Future Federal actions are not considered in the definition of "cumulative effects."

Actions carried out or regulated by the State of Maine within the action area that may affect listed species and critical habitat include the authorization of state fisheries and the regulation of dredged material discharges through CWA 401-Certification and point and non-point source pollution through the National Pollutant Discharge point and non-point source pollution through the National Pollutant Discharge Elimination System (NPDES). We are not aware of any local or private actions that are reasonably certain to occur in the action area that may affect listed species. It is important to note that the definition of "cumulative effects" in the section 7 regulations is not the same as the NEPA definition of cumulative effects.[8]

State Water Fisheries - Future recreational and commercial fishing activities in state waters may take shortnose and Atlantic sturgeon. Information on interactions with shortnose and Atlantic sturgeon and the GOM DPS of Atlantic salmon for state fisheries operating in the action area is summarized in the Environmental Baseline section above, and it is not clear to what extent these future activities would affect listed species differently than the current state fishery activities described in the Status of the Species/Environmental Baseline section. However, this Opinion assumes effects in the future would be similar to those in the past and are, therefore, reflected in the anticipated trends described in the status of the species and environmental baseline sections of this Opinion.

State PDES Permits – The State of Maine has been delegated authority to issue NPDES permits by the EPA. These permits authorize the discharge of pollutants in the action area. Permitees include municipalities for sewage treatment plants and other industrial users. The states will continue to authorize the discharge of pollutants through the SPDES permits. However, this Opinion assumes effects in the future would be similar to those in the past and are therefore reflected in the status of the species and Environmental Baseline sections of this Opinion.

9.0 INTEGRATION AND SYNTHESIS OF EFFECTS

Dredging to be carried out by BIW pursuant to the permit issued by USACE is expected to result

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[8] Cumulative effects are defined for NEPA as "the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

in the capture of five shortnose sturgeon and two Atlantic sturgeon, with the serious injury or mortality of three of these shortnose sturgeon and one of these Atlantic sturgeon. The affected Atlantic sturgeon will originate from the GOM or NYB DPS. All other effects of the proposed action to shortnose and Atlantic sturgeon will be insignificant and discountable. All effects to the GOM DPS of Atlantic salmon and its designated critical habitat will be insignificant.

In the discussion below, we consider whether the effects of the proposed actions reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the listed species in the wild by reducing the reproduction, numbers, or distribution of the species. The purpose of this analysis is to determine whether the proposed action, in the context established by the status of the species, environmental baseline, and cumulative effects, would jeopardize the continued existence of shortnose sturgeon. In the NMFS/USFWS Section 7 Handbook, for the purposes of determining jeopardy, survival is defined as, "the species' persistence as listed or as a recovery unit, beyond the conditions leading to its endangerment, with sufficient resilience to allow for the potential recovery from endangerment. Said in another way, survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a species with a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter." Recovery is defined as, "Improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in Section 4(a)(1) of the Act."

9.1 GOM DPS of Atlantic salmon

The GOM DPS of Atlantic salmon is listed as endangered throughout its range. 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 1,014 adults in 2007, and only 16 of these returning to the Kennebec (NMFS and USFWS 2009). Since 2008, the number of Atlantic salmon returning to the Kennebec and Androscoggin rivers has ranged from a low of 17 (2010) to a high of 64 (2011). To date in 2012, five returns have been recorded (all at Lockwood Dam).

To the extent possible, dredging will be scheduled outside the time of year when Atlantic salmon are present in the action area. Dredging in 2012-2013 will not occur when Atlantic salmon are present. Similarly, the rip rap for the scour protection project will be placed outside of the time of year when salmon could be present. However, in future years dredging could occur when salmon are present. Additionally, the brake wheel could be operated during the time of year when salmon are present. For Atlantic salmon, we have determined that all effects of dredging, placement of rip-rap and brake wheel operations will be insignificant and discountable. This is because we do not expect Atlantic salmon to be captured in the dredge bucket and due to the small area of the river impacted by turbidity and noise and the small increase in heat anticipated.

All effects to Atlantic salmon will be insignificant and discountable. Because we do not anticipate any injury, mortality or impacts to fitness, the proposed actions will have no effect on the reproduction, numbers and distribution of the GOM DPS of Atlantic salmon.

9.2 Critical Habitat designated for Atlantic salmon

As explained above, the proposed action will have only an insignificant effect on critical habitat designed for the GOM DPS of Atlantic salmon. This conclusion is based on the determination that there will be no permanent impacts to the habitat and because: (1) the project will not result in a migration barrier to or through any estuarine habitat; (2) the project will not increase the risk of predation; (3) the project is not expected to affect water quality at the time of any salmon migrations in the action area; (4) the project will not significantly affect the forage of juvenile or adult Atlantic salmon because of the timing and location; and, (5) there will be no effects to the natural structure of the nearshore habitat and therefore there will be no reduction in the capacity of substrate, food resources, and natural cover to meet the conservation needs of listed Atlantic salmon.

9.3 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 Kennebec River form one of these nineteen populations. We have estimated that the proposed action will result in the capture of up to five shortnose sturgeon due to capture in the dredge bucket. We anticipate a 50% mortality rate and therefore expect that no more than three of the captured shortnose sturgeon will suffer significant injury or mortality.

Historically, shortnose sturgeon are believed to have inhabited nearly all major rivers and estuaries along nearly the entire east coast of North America. Today, only 19 populations remain. The present range of shortnose sturgeon is disjunct, with northern populations separated from southern populations by a distance of about 400 km. Population sizes range from under 100 adults in the Cape Fear and Merrimack Rivers to tens of thousands in the St. John and Hudson Rivers. As indicated in Kynard 1996, adult abundance is less than the minimum estimated viable population abundance of 1,000 adults for five of 11 surveyed northern populations and all natural southern populations. The only river systems likely supporting populations close to expected abundance are the St John, Hudson and possibly the Delaware and the Kennebec (Kynard 1996), making the continued success of shortnose sturgeon in these rivers critical to the species as a whole.

The Kennebec River population of shortnose sturgeon is the second largest in the United States. Historical estimates of the size of the population are not available as historic records of sturgeon in the river did not discriminate between Atlantic and shortnose sturgeon. A Schnabel estimate of 7,200 (95% CI, 5,000 to 10,800) adults for the combined estuarine complex was computed from the tagging and recapture data from 1977 through 1981 (Squiers et al. 1982). A Schnabel estimate using tagging and recapture data from 1998 - 2000 indicates a population estimate of 9,488 (95% CI, 6,942 to 13,358) for the estuarine complex (Squiers 2003). The average density of adult shortnose sturgeon/hectare of habitat in the estuarine complex of the Kennebec River was the second highest of any population studied through 1983 (Dadswell et al. 1984). The Schnabel estimate from 1998-2000 is the most recent population estimate for the Kennebec River shortnose sturgeon population; however, this estimate includes fish from the Androscoggin and Sheepscot rivers as well and does not include an estimate of the size of the juvenile population. A comparison of the population estimate for the estuarine complex from 1982 (Squiers et al. 1982) to 2000 (Maine DMR 2003) suggests that the adult population has grown by approximately 30% in the last twenty years. Based on this information, we believe the shortnose sturgeon population in the Kennebec River is increasing.

While no reliable estimate of the size of the shortnose sturgeon population in the Northeastern US or of the species throughout its range exists, it appears to be 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. The lack of information on the status of some populations, such as that in the Chesapeake Bay, add uncertainty to any determination on the status of this species as a whole. Based on the best available information (2010 Draft Biological Assessment for Shortnose Sturgeon) trends in abundance for shortnose sturgeon in Northeast Rivers demonstrate the majority of populations are stable (i.e., Delaware, Hudson, Connecticut, Merrimack). The Kennebec River Complex is the only population in the Northeast that shows an increasing trend in abundance. In the Southeast abundance trends for many riverine populations are unknown due to lack of data (i.e., Chowan, Tar Pamlico, Neuse, New, North, Santee, S-C Reservoir system, Satilla, St. Mary's, and St. John's). The Winyah Bay Complex, Cooper, Savannah, Ogeechee, and Altamaha Rivers show stable trends in abundance. The only riverine population in the Southeast demonstrating increasing trends in abundance is the ACE Basin.

As described in the Status of the Species/Environmental Baseline, and Cumulative Effects sections above, shortnose sturgeon in the action area are affected by impingement at water intakes, habitat alteration, bycatch in commercial and recreational fisheries, water quality and in-water construction activities. It is difficult to quantify the number of shortnose sturgeon that may be killed in the Kennebec River each year due to anthropogenic sources. Through reporting requirements implemented under Section 7 and Section 10 of the ESA, for specific actions NMFS obtains some information on the number of incidental and directed takes of shortnose sturgeon each year. Typically, scientific research results in the capture and collection of less than 100 shortnose sturgeon in the Kennebec River each year, with little if any mortality. We have occasional reports of interactions or mortalities of shortnose sturgeon in the Kennebec River resulting from dredging or other in-water construction activities. In most years there are or no reported mortalities but in some years there have been as many as five interactions with dredging that likely resulted in mortality. We have no quantifiable information on the effects of habitat alteration or water quality; in general, water quality has improved in the Kennebec River since the 1970s when the CWA was implemented. The removal of the Edwards Dam in 1998 has allowed shortnose sturgeon access to a greater portion of their historical range in the Kennebec River. Sturgeon have been documented throughout the river which suggests that the movement and distribution of shortnose sturgeon in the river is not limited by habitat or water quality impairments. We are not aware of any water intakes that impinge or entrain sturgeon in the Kennebec River. Bycatch in commercial and recreational fisheries likely continues to affect shortnose sturgeon in this river but we have no estimates of the number of individuals affected.

Despite ongoing threats, there is evidence that the Kennebec River population of shortnose sturgeon experienced tremendous growth between the late 1970s and the late 1990s and that the population is now stable or increasing. Shortnose sturgeon in the Kennebec River continue to experience anthropogenic and natural sources of mortality. However, we are not aware of any future actions that are reasonably certain to occur that are likely to change this trend or reduce the stability of the Kennebec River population. Also, as discussed above, we do not expect shortnose sturgeon to experience any new effects associated with climate change during the seven-year duration of the proposed action. As such, we expect that numbers of shortnose sturgeon in the action area will continue to be stable or increasing over the seven-year duration of the proposed action.

We have estimated that the proposed dredging will result in the capture of five shortnose sturgeon and the mortality of three of those sturgeon between now and the time the USACE permit expires in November 2019. This number represents a very small percentage of the shortnose sturgeon population in the Kennebec River, which is believed to be stable or increasing at high numbers, and an even smaller percentage of the total population of shortnose sturgeon rangewide. The best available population estimates indicate that there are approximately 9,488 (95% CI, 6,942 to 13,358) adult shortnose sturgeon in the Kennebec River and an unknown number of juveniles (Squiers 2003). While the death of three shortnose sturgeon over the next seven years will reduce the number of shortnose sturgeon in the population compared to the number that would have been present absent the proposed action, it is not likely that this reduction in numbers will change the status of this population or its stable trend. This is because this loss represents a very small percentage of the population (less than 0.03%, just considering the number of adults). The impact of this loss is even less when considered on an annual basis. Additionally, it is important to note that this is not a new source of mortality; dredging has been ongoing at BIW since at least 1997. We do not expect the rate of dredge interactions to change in the future, therefore, it is reasonable to expect that the continued dredging would not preclude maintenance of the population’s stable to increasing trend.

Reproductive potential of the Kennebec population is not expected to be affected in any other way other than through a reduction in numbers of individuals. A reduction in the number of shortnose sturgeon in the Kennebec River would have the effect of reducing the amount of potential reproduction in this system as the fish killed would have no potential for future reproduction. However, it is estimated that on average, approximately 1/3 of adult females spawn in a particular year and approximately ½ of males spawn in a particular year. Given that the best available estimates indicate that there are more than 9,000 adult shortnose sturgeon in the Kennebec River, it is reasonable to expect that there are at least 3,000 adults spawning in a particular year. It is unlikely that the loss of 3 shortnose sturgeon per year over a 7-year period would affect the success of spawning in any year. Additionally, this small reduction in potential spawners is expected to result in a small reduction in the number of eggs laid or larvae produced in future years and similarly, a very small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individuals that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be very small and would not change the stable trend of this population. Additionally, the proposed action will not affect spawning habitat in any way and will not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds.

The proposed action is not likely to reduce distribution because the action will not impede shortnose sturgeon from accessing any seasonal concentration areas, including foraging, spawning or overwintering grounds in the Kennebec River. Further, the action is not expected to reduce the river by river distribution of shortnose sturgeon. Additionally, as the number of shortnose sturgeon likely to be killed as a result of the proposed action is less than 0.04% of the

Kennebec River population, there is not likely to be a loss of any unique genetic haplotypes and therefore, it is unlikely to result in the loss of genetic diversity.

While generally speaking, the loss of a small number of individuals from a subpopulation or species can have an appreciable effect on the numbers, reproduction and distribution of the species, 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: the species is widely geographically distributed, it is not known to have low levels of genetic diversity (see status of the species/environmental baseline section above), and there are thousands of shortnose sturgeon spawning each year.

Based on the information provided above, the death of up to three shortnose sturgeon over a seven-year period resulting from the proposed continued maintenance dredging at BIW will not appreciably reduce the likelihood of survival of this species (i.e., it will not increase the risk of extinction faced by this species) because it will not cause so many mortalities that the population will decrease. This is because (1) the population trend of shortnose sturgeon in the Kennebec River is stable to increasing at high levels; (2) the death of a total of three shortnose sturgeon per year represents an extremely small percentage of the number of shortnose sturgeon in the Kennebec River and an even smaller percentage of the species as a whole; (3) the loss of these shortnose sturgeon is likely to have such a small effect on reproductive output of the Kennebec River population of shortnose sturgeon or the species as a whole that the loss of these shortnose sturgeon will not change the status or trends of the Kennebec River population or the species as a whole; (4) and, the action will have only a minor and temporary effect on the distribution of shortnose sturgeon in the action area (related to movements to avoid the area within 50 meters of the pier during brake wheel testing or to avoid the sediment plume during dredging or disposal) and no effect on the distribution of the species throughout its range.

In rare instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, NMFS has determined that the proposed action will not appreciably reduce the likelihood that shortnose sturgeon will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the likelihood that shortnose sturgeon can rebuild to a point where listing is no longer appropriate. A Recovery Plan for shortnose sturgeon was published in 1998. The Recovery Plan will outline the steps necessary for recovery and indicates that each population may be a candidate for downlisting (i.e., to threatened) when it reaches a minimum population size that is large enough to prevent extinction and will make the loss of genetic diversity unlikely. However, the plan states that the minimum population size for each population has not yet been determined. The Recovery Outline contains three major tasks, (1) establish listing criteria; (2) protect shortnose sturgeon populations and habitats; and, (3) rehabilitate habitats and population segments. We know that in general, to recover, a species must have a sustained positive trend over time and an increase in population. To allow those things to happen, a species must have enough habitat in suitable condition that allows all normal life functions to occur (i.e., spawning, foraging, resting) and have access to enough food. Here, we consider whether this proposed action will affect the population size and/or trend in a way that would affect the likelihood of recovery.

The proposed action is not expected to modify, curtail or destroy the range of the species since it will result in a small reduction in the number of shortnose sturgeon and since it will not affect the overall distribution of shortnose sturgeon. Any effects to habitat will be insignificant and discountable and will not affect the ability of shortnose sturgeon to carry out any necessary behaviors or functions. Any impacts to available forage will also be insignificant. The proposed action will result in the mortality of three shortnose sturgeon. However, the impact of this loss on the population is expected to be extremely small. Similarly, the impact on future reproductive output which would impact future year classes is also expected to be small. For these reasons, we do not expect this level of mortality, over a seven year period, to affect the persistence of the species. This action will not change the status or trend of the Kennebec River population of shortnose sturgeon or the species as a whole. Because the reduction in numbers will be small and the impact on reproduction and future year classes will also be small enough not to affect the stable trend of the population, the proposed action will not reduce the likelihood of improvement in the status of shortnose sturgeon. The effects of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The effects of the proposed action will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed action will not appreciably reduce the likelihood that shortnose sturgeon can be brought to the point at which they are no longer listed as endangered. Based on the analysis presented herein, the proposed action, is not likely to appreciably reduce the survival and recovery of this species.

9.4 Gulf of Maine DPS of Atlantic sturgeon

We expect that most of the Atlantic sturgeon in the action area will originate from the GOM DPS. The GOM DPS has been listed as threatened. While Atlantic sturgeon occur in several rivers in the GOM DPS, recent spawning has only been documented in the Kennebec; spawning is suspected to also occur in the Androscoggin river. No estimate of the number of Atlantic sturgeon in any river or for any life stage or the total population is available although the ASSRT stated that there were likely less than 300 spawners per year. Information available from commercial fisheries bycatch suggests that in the ocean the ratio of subadults to adults may be 2:1. GOM origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. While there are some indications that the status of the GOM DPS may be improving, there is currently not enough information to establish a trend for any life stage or for the DPS as a whole. As a result of the continuation of maintenance dredging at BIW, we expect the capture of two Atlantic sturgeon with the mortality of one of those. It is likely that both of these sturgeon will originate from the GOM DPS. We expect the individual to be a juvenile or subadult. Here, we consider the effect of the loss of this individual on the reproduction, numbers and distribution of the GOM DPS.

The reproductive potential of the GOM DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of one juvenile or subadult would have the effect of reducing the amount of potential reproduction as any dead GOM DPS Atlantic sturgeon would have no potential for future reproduction. However, this small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. Additionally, we have determined that any impacts to behavior will be minor and temporary and that there will not be any delay or disruption of any normal behavior including spawning; there will also be no reduction in individual fitness or any future reduction in numbers of individuals. The proposed actions will also not affect the spawning grounds within the Kennebec River. The actions will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by GOM DPS fish.

Because we do not have a population estimate for the GOM DPS, it is difficult to evaluate the effect of the mortality caused by these actions on the species. However, because the proposed actions will result in the loss of only one individual it is unlikely that this death will have a detectable effect on the numbers and population trend of the GOM DPS.

The proposed actions are not likely to reduce distribution because the actions will not impede Atlantic sturgeon from accessing any seasonal concentration areas, including foraging areas within the action area that may be used by GOM DPS subadults or adults. Further, the actions are not expected to reduce the river by river distribution of Atlantic sturgeon. Any effects to distribution will be minor and temporary and limited to the temporary avoidance of the area where suspended sediment levels are high or within 50 meters of the dock where noise will be elevated during break wheel operations.

Based on the information provided above, the death of one GOM DPS Atlantic sturgeon over the next seven years, will not appreciably reduce the likelihood of survival of the GOM DPS (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect GOM DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of one subadult GOM DPS Atlantic sturgeon will not change the status or trends of the species as a whole; (3) the loss of one subadult GOM DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of one subadult GOM DPS Atlantic sturgeon over a seven year period is likely to have such a small effect on reproductive output that the loss of this individual will not change the status or trends of the species; (5) the actions will have only a minor and temporary effect on the distribution of GOM DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range; and, (6) the actions will have no effect on the ability of GOM DPS Atlantic sturgeon to shelter and only an insignificant effect on any foraging GOM DPS Atlantic sturgeon.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed actions will not appreciably reduce the likelihood that the GOM DPS will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed actions will affect the likelihood that the GOM DPS can rebuild to a point where listing is no longer appropriate. No Recovery Plan for the GOM DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria which once attained would allow the species to be delisted. We know that in general, to recover, a species must have a sustained positive trend over time and an increase in population. To allow those things to happen, a species must have enough habitat in suitable condition that allows all normal life functions to occur (i.e., spawning, foraging, resting) and have access to enough food. Here, we consider whether this proposed actions will affect the population size and/or trend in a way that would affect the likelihood of recovery.

The proposed actions are not expected to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of GOM DPS Atlantic sturgeon and since it will not affect the overall distribution of GOM DPS Atlantic sturgeon. Any effects to habitat will be insignificant and discountable and will not affect the ability of Atlantic sturgeon to carry out any necessary behaviors or functions. Any impacts to available forage will also be insignificant. The proposed actions will result in an extremely small amount of mortality (one individual) and a subsequent small reduction in future reproductive output. For these reasons, the proposed actions will not affect the persistence of the GOM DPS of Atlantic sturgeon. These actions will not change the status or trend of the GOM DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed actions will not reduce the likelihood of improvement in the status of the GOM DPS of Atlantic sturgeon. The effects of the proposed actions will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The effects of the proposed actions will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed actions will not appreciably reduce the likelihood that the GOM DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed actions are not likely to appreciably reduce the survival and recovery of this species.

Despite the threats faced by individual GOM DPS Atlantic sturgeon inside and outside of the action area, the proposed actions will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed action in light of cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change. Based on the analysis presented herein, the proposed actions, resulting in the mortality of one subadult GOM DPS Atlantic sturgeon are not likely to appreciably reduce the survival and recovery of this species.

9.5 New York Bight DPS of Atlantic sturgeon

The NYB DPS has been listed as endangered. While Atlantic sturgeon occur in several rivers in the NYB DPS, recent spawning has only been documented in the Delaware and Hudson rivers. As noted above, we expect approximately 7% of the Atlantic sturgeon in the action area to originate from the New York Bight DPS. It is possible that the Atlantic sturgeon captured and killed during maintenance dredging could originate from the NYB DPS.

There is limited information on the demographics of the Hudson River population of Atlantic sturgeon. An annual mean estimate of 863 mature adults (596 males and 267 females) was calculated for the Hudson River based on fishery-dependent data collected from 1985-1995 (Kahnle *et al.* 2007). No data on abundance of juveniles are available prior to the 1970s; however, catch depletion analysis estimated conservatively that 6,000-6,800 females contributed to the spawning stock during the late 1800s (Secor 2002, Kahnle *et al.* 2005). Two estimates of immature Atlantic sturgeon have been calculated for the Hudson River population, one for the 1976 year class and one for the 1994 year class. Dovel and Berggren (1983) marked immature fish from 1976-1978. Estimates for the 1976 year class at age were approximately 25,000 individuals. Dovel and Berggren estimated that in 1976 there were approximately 100,000 juvenile (non-migrant) Atlantic sturgeon from approximately 6 year classes, excluding young of year.

In October of 1994, the NYDEC stocked 4,929 marked age-0 Atlantic sturgeon, provided by a USFWS hatchery, into the Hudson Estuary at Newburgh Bay. These fish were reared from Hudson River brood stock. In 1995, Cornell University sampling crews collected 15 stocked and 14 wild age-1 Atlantic sturgeon (Peterson *et al.* 2000). A Petersen mark-recapture population estimate from these data suggests that there were 9,529 (95% CI = 1,916 – 10,473) age-0 Atlantic sturgeon in the estuary in 1994. Since 4,929 were stocked, 4,600 fish were of wild origin, assuming equal survival for both hatchery and wild fish and that stocking mortality for hatchery fish was zero.

Information on trends for Atlantic sturgeon in the Hudson River are available from a number of long term surveys. From July to November during 1982-1990 and 1993, the NYSDEC sampled the abundance of juvenile fish in Haverstraw Bay and the Tappan Zee Bay. The CPUE of immature Atlantic sturgeon was 0.269 in 1982 and declined to zero by 1990. This study has not been carried out since this time.

The Long River Survey (LRS) samples ichthyoplankton river-wide from the George Washington Bridge (rkm 19) to Troy (rkm 246) using a stratified random design (CONED 1997). These data, which are collected from May-July, provide an annual index of juvenile Atlantic sturgeon in the Hudson River estuary since 1974. The Fall Juvenile Survey (FJS), conducted from July – October by the utilities, calculates an annual index of the number of fish captured per haul. Between 1974 and 1984, the shoals in the entire river (rkm 19-246) were sampled by epibenthic sled; in 1985 the gear was changed to a three-meter beam trawl. While neither of these studies were designed to catch sturgeon, given their consistent implementation over time they provide indications of trends in abundance, particularly over long time series. When examining CPUE, these studies suggest a sharp decline in the number of young Atlantic sturgeon in the early 1990s. While the amount of interannual variability makes it difficult to detect short term trends, a five year running average of CPUE from the FJS indicates a slowly increasing trend since about 1996. Interestingly, that is when the in-river fishery for Atlantic sturgeon closed. While that fishery was not targeting juveniles, a reduction in the number of adult mortalities would be expected to result in increased recruitment and increases in the number of young Atlantic sturgeon in the river. There also could have been bycatch of juveniles that would have suffered some mortality.

In 2000, the NYSDEC created a sturgeon juvenile survey program to supplement the utilities' survey; however, funds were cut in 2000, and the USFWS was contracted in 2003 to continue the program. In 2003 – 2005, 579 juveniles were collected (N = 122, 208, and 289, respectively) (Sweka et al. 2006). Pectoral spine analysis showed they ranged from 1 – 8 years of age, with the majority being ages 2 – 6. There has not been enough data collected to use this information to detect a trend, but at least during the 2003-2005 period, the number of juveniles collected increased each year which could be indicative of an increasing trend for juveniles.

NYB DPS origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. The largest single source of mortality appears to be capture as bycatch in commercial fisheries operating in the marine environment. A bycatch estimate provided by NEFSC indicates that approximately 376 Atlantic sturgeon die as a result of bycatch each year. Mixed stock analysis from the NMFS NEFOP indicates that 49% of these individuals are likely to originate from the NYB and 91% of those likely originate from the Hudson River, for a total of approximately 167 adult and subadult mortalities annually. Because juveniles do not leave the river, they are not impacted by fisheries occurring in Federal waters. Bycatch and mortality also occur in state fisheries; however, the primary fishery that impacted juvenile sturgeon (shad), has now been closed and there is no indication that it will reopen soon. NYB DPS Atlantic sturgeon are killed as a result of anthropogenic activities in the Hudson River and other rivers; sources of potential mortality include vessel strikes and entrainment in dredges. As noted above, we expect the mortality of two Atlantic sturgeon as a result of the Tappan Zee Bridge replacement project; it is possible that these individuals could originate from the Hudson River. There could also be the loss of a small number of juveniles at other water intakes in the River including the Danskammer and Roseton plants.

The Atlantic sturgeon that will be killed at BIW may originate from the NYB DPS. Because juveniles do not leave their river of origin, we expect that this fish would be a subadult, most likely from the Hudson River. The mortality of one subadult Atlantic sturgeon from the NYB DPS represents a very small percentage of the population. While the death of this individual will reduce the number of NYB DPS Atlantic sturgeon compared to the number that would have been present absent the proposed action, it is not likely that this reduction in numbers will change the status of this species as this loss represents a very small percentage of the Hudson River population or the DPS as a whole.

Because there will be no loss of adults, the reproductive potential of the NYB DPS will not be affected in any way other than through a reduction in numbers of individual future spawners. The loss of one subadult over a seven year period would have the effect of reducing the amount of potential reproduction as any dead NYB DPS Atlantic sturgeon would have no potential for future reproduction. This small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individuals that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. The proposed action will also not affect the spawning grounds within the Hudson River or Delaware River where NYB DPS fish spawn. There will be no effects to spawning adults and therefore no reduction in individual fitness or any future reduction in spawning by these individuals.

The proposed action is not likely to reduce distribution because the action will not impede NYB DPS Atlantic sturgeon from accessing any seasonal concentration areas, including foraging, spawning or overwintering grounds in the Delaware or Hudson River or elsewhere. Any effects to distribution will be minor and temporary and limited to the temporary avoidance of the area of increased turbidity or increased noise.

Based on the information provided above, the death of one subadult NYB DPS Atlantic sturgeon over the next seven years, will not appreciably reduce the likelihood of survival of the New York Bight DPS (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect NYB DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of one NYB DPS Atlantic sturgeon represents an extremely small percentage of the species; (2) the death of one NYB DPS Atlantic sturgeon will not change the status or trends of the species as a whole; (3) the loss of one NYB DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of one NYB DPS Atlantic sturgeon is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the species; (5) the action will have only a minor and temporary effect on the distribution of NYB DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range; and, (6) the action will have no effect on the ability of NYB DPS Atlantic sturgeon to shelter and only an insignificant effect on individual foraging NYB DPS Atlantic sturgeon.

In rare instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the NYB DPS will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the likelihood that the NYB DPS can rebuild to a point where listing is no longer appropriate. No Recovery Plan for the NYB DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria which once attained would allow the species to be delisted. We know that in general, to recover, a species must have a sustained positive trend over time and an increase in population. To allow those things to happen, a species must have enough habitat in suitable condition that allows all normal life functions to occur (i.e., spawning, foraging, resting) and have access to enough food. Here, we consider whether this proposed action will affect the population size and/or trend in a way that would affect the likelihood of recovery.

The proposed action is not expected to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of NYB DPS Atlantic sturgeon and since it will not affect the overall distribution of NYB DPS Atlantic sturgeon. Any effects to habitat will be insignificant and discountable and will not affect the ability of Atlantic sturgeon to carry out any necessary behaviors or functions. Any impacts to available forage will also be insignificant. The proposed action will result in a small amount of mortality and a subsequent small reduction in future reproductive output. For these reasons, it is not expected to affect the persistence of the NYB DPS of Atlantic sturgeon. This action will not change the status or trend of the NYB DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed action will not reduce the likelihood of improvement in the status of the NYB DPS of Atlantic sturgeon. The effects of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The effects of the proposed action will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed action will not appreciably reduce the likelihood that the NYB DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed action, is not likely to appreciably reduce the survival and recovery of this species.

Despite the threats faced by individual NYB DPS Atlantic sturgeon inside and outside of the action area, the proposed action will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed action.

10.0 CONCLUSION

After reviewing the best available information on the status of endangered and threatened species and critical habitat under NMFS jurisdiction, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the proposed action may adversely affect but is not likely to jeopardize the continued existence of shortnose sturgeon, or the GOM or NYB DPS of Atlantic sturgeon. We have also determined that the proposed actions are not likely to adversely affect the GOM DPS of Atlantic salmon. Similarly, the action is not likely to adversely affect critical habitat designated for the GOM DPS of Atlantic salmon and therefore will not result in the destruction or adverse modification of this habitat.

11.0 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA prohibits the take of endangered species of fish and wildlife. “Fish and wildlife” is defined in the ESA “as any member of the animal kingdom, including without limitation any mammal, fish, bird (including any migratory, non-migratory, or endangered bird for which protection is also afforded by treaty or other international agreement), amphibian, reptile, mollusk, crustacean, arthropod or other invertebrate, and includes any part, product, egg, or offspring thereof, or the dead body or parts thereof.” 16 U.S.C. 1532(8). “Take” is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by NMFS to include any act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. “Otherwise lawful activities” are those actions that meet all State and Federal legal requirements except for the prohibition against taking in ESA Section 9 (51 FR 19936, June 3, 1986), which would include any state endangered species laws or regulations. Section 9(g) makes it unlawful for any person "to attempt to commit, solicit another to commit, or cause to be committed, any offense defined [in the ESA.]" 16 U.S.C. 1538(g). See also 16 U.S.C. 1532(13)(definition of "person"). Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement. The prohibitions against take for shortnose sturgeon and the New York Bight DPS of Atlantic sturgeon are in effect now. We published a proposed 4(d) rule for the GOM DPS of Atlantic sturgeon on June 10, 2011 (*76 FR 34023*). The prohibitions on take of GOM DPS Atlantic sturgeon will take effect on the date the final 4(d) rule is effective and so will the exemptions provided by this ITS pertaining to the GOM DPS.

The measures described below are non-discretionary, and must be undertaken by USACE so that they become binding conditions for the exemption in section 7(o)(2) to apply. USACE has a continuing duty to regulate the activity covered by this Incidental Take Statement. If USACE (1) fails to assume and implement the terms and conditions or (2) fails to require BIW or their contractors to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to grants, permits and/or contracts as appropriate, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, USACE or BIW must report the progress of the action and its impact on the species to the NMFS as specified in the Incidental Take Statement [50 CFR §402.14(i)(3)] (See U.S. Fish and Wildlife Service and National Marine Fisheries Service's Joint Endangered Species Act Section 7 Consultation Handbook (1998) at 4-49).

11.1 Amount or Extent of Incidental Take

The proposed dredging project has the potential to directly affect shortnose and Atlantic sturgeon by causing sturgeon to become entrapped in the bucket of the dredge. These interactions are likely to cause injury and/or mortality to some shortnose and Atlantic sturgeon. Based on the known seasonal distribution of sturgeon in the Kennebec River and information available on historic interactions between sturgeon and dredging operations, we anticipate that no more than 1 sturgeon is likely to be directly affected by this action each time that dredging takes place. The following maintenance dredging events are currently predicted: November – December 2012 (landing grid); 2013 (sinking basin (February) and berthing piers (Fall)); 2016 (sinking basin and landing grid); 2017 (berthing piers); and, 2019 (sinking basin). Seven dredging events are expected before the permit expires in November 2019. We have estimated that no more than one sturgeon is likely to be captured each year that dredging occurs and that 2/3 of captured sturgeon will be shortnose sturgeon and the remainder will be Atlantic. We anticipate a 50% mortality rate. Therefore, we anticipate the take of five shortnose sturgeon and two Atlantic sturgeon (from the New York Bight or Gulf of Maine DPS) and the mortality of no more than three of the captured shortnose sturgeon and no more than one of the captured Atlantic sturgeon. We believe this level of incidental take is reasonable given the seasonal distribution and abundance of shortnose and Atlantic sturgeon in the action area, the level of take historically in the action area, and the level of take of sturgeon at other dredging projects. In the accompanying biological opinion, we determined that this level of anticipated take is not likely to result in jeopardy to the species.

11.2 Reasonable and Prudent Measures

Below, we identify seven Reasonable and Prudent Measures to minimize take. These measures are in addition to the special conditions already contained in the permit issued by USACE for maintenance dredging at BIW (see Section 3.1 above). The following reasonable and prudent measures are necessary and appropriate to minimize and monitor incidental take resulting from the proposed actions:

1. USACE or BIW must contact us prior to the commencement of each dredging event and again upon completion of the dredging activity.
2. An endangered species observer must be present to observe all mechanical dredging activities to monitor for any capture of sturgeon.
3. The USACE shall ensure that dredges are equipped and operated in a manner that provides endangered/threatened species observers with a reasonable opportunity for detecting interactions with listed species and that provides for handling, collection, and identification of sturgeon captured during project activity. Full cooperation with the endangered species observer program is essential for compliance with the ITS.
4. All interactions with listed species during dredging operations must be properly documented and promptly reported to us.
5. The USACE must ensure that all measures are taken to protect any sturgeon that survive capture in the mechanical dredge.
6. A hydroacoustic monitoring program must be implemented during operation of the brake wheel.
7. A turbidity and/or suspended sediment monitoring program must be implemented during installation of the stone rip rap for the brake wheel scour protection project.
8. A turbidity and/or suspended sediment monitoring program must be implemented during operation of the brake wheel.

11.3 Terms and Conditions

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

1. To implement RPM #1, the USACE must contact NMFS (Julie Crocker: by email (julie.crocker@noaa.gov) or phone (978) 282-8480 or (978)-281-9328)) within three days of the commencement of each dredging event and again within three days of the completion of dredging activity. This correspondence will serve both to alert us of the commencement and cessation of dredging activities and to give us an opportunity to provide USACE with any updated contact information or reporting forms.
2. To implement RPM#2, USACE must require that observer coverage is sufficient for 100% monitoring of dredging operations. This monitoring coverage must involve the

placement of a NMFS-approved observer on board the dredge or scow where dredged material is being deposited for every day that dredging is occurring. The NMFS approved observer must observe all discharges of dredged material from the dredge bucket to the scow or hopper. All biological material disposed of at the disposal site must be documented by a NMFS-approved observer as outlined in Appendix A.

3. To implement RPM#2, at least two weeks prior to each dredge event, USACE or BIW must submit to us the names and qualifications of any observers to be used on board the dredge(s). USACE and BIW must ensure that they only employ observers that have written confirmation from NMFS that they have met the qualifications to be a "NMFS-approved observer" as outlined in Appendix A. If substitute observers are required during dredging operations, USACE and BIW must ensure that NMFS approval is obtain before those observers are deployed on dredges.

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

5. To implement RPM #4, the USACE or BIW must contact us within 24 hours of any interactions with shortnose or Atlantic sturgeon or Atlantic salmon, including non-lethal and lethal takes. These observations must be recorded on the form included as Appendix B (take report) and be submitted to us via e-mail **within 24 hours** (incidental.take@noaa.gov). We will provide contact information annually when alerted of the start of dredging activity. Until alerted otherwise, the USACE should contact us by phone (Julie Crocker (978) 282-8480) and e-mail (incidental.take@noaa.gov).

6. To implement RPM #4, the USACE and BIW must ensure that any sturgeon observed during project operations (including live or dead whole sturgeon or body parts observed at the disposal location or on board the dredge or scow) are photographed. The photographs should be submitted as soon as possible by e-mail (incidental.take@noaa.gov).

7. To implement RPM #4, in the event of any lethal takes of shortnose or Atlantic sturgeon any dead specimens or body parts must be photographed, measured, and held in cold storage until disposal procedures are discussed with NMFS. The form included as Appendix C (Sturgeon Salvage Form) must be completed and submitted to NMFS via e-mail (incidental.take@noaa.gov).

8. To implement RPM #4, if any take of shortnose sturgeon occurs, the NMFS-approved observer must take fin clips (according to the procedure outlined in Appendix D) for ongoing analysis of the genetic composition of the Kennebec River shortnose sturgeon population.

9. To implement RPM #4, if any non-lethal or lethal take of Atlantic sturgeon occurs, the NMFS-approved observer must take fin clips (according to the procedure outlined in Appendix D) for genetic analysis.

10. To implement RPM #4, any time a take occurs USACE must immediately contact us (Julie Crocker at (978)282-8480 or the Section 7 Coordinator at (978) 281-9328) to review the situation. At that time, USACE must provide us with information on the amount of material dredged thus far and the amount remaining to be dredged during that cycle. Also at that time, USACE should discuss with us whether any new management measures could be implemented to prevent the total incidental take level from being exceeded.

11. To implement RPM #4, the USACE must submit a final report summarizing the results of dredging and any takes of listed species to NMFS within 30 working days of the completion of each dredging event (by mail to the attention of the Section 7 Coordinator, NMFS Protected Resources Division, 55 Great Republic Drive, Gloucester, MA 01930).

12. To implement RPM#4, if the take estimate for any dredging event is exceeded, USACE must work with us to determine whether the additional take represents new information revealing effects of the action that may not have been previously considered.

13. To implement RPM #5, any sturgeon observed in the dredge scow during mechanical dredging operations must be removed with a net. After photographing and identification, if alive, the fish must be returned to the river away from the dredge site.

14. To implement RPM #6, the U.S. Navy and BIW must develop a hydroacoustic monitoring program to be implemented during brake wheel use. A proposed monitoring plan must be submitted to us for approval at least 30 days prior to the first time the brake wheel is used. The monitoring plan must be sufficient to document sound source levels, verify the calculated attenuation rate and determine at what distance from the source noise levels reach 150 dB re 1uPa RMS. The monitoring program must be implemented when the ship is operating at half and full power. Noise levels half-way across the river and on the opposite side of the river should also be monitored. This monitoring plan must be in place for a sufficient duration to document underwater noise during the full suite of testing scenarios. This program can be discontinued when the necessary data have been collected. If changes in brake wheel operation are proposed in the future that would result in different levels of underwater noise, the monitoring program would need to be implanted again.

15. To implement RPM #8, the USACE, US Navy and/or BIW must develop a monitoring plan for turbidity and/or suspended sediment to be implemented during deposition of stone rip rap for the scour protection project. A proposed monitoring plan must be submitted to us for approval at least 10 days prior to the installation of rip rap.

16. To implement RPM #8, the USACE, US Navy and/or BIW must develop a monitoring plan for turbidity and/or suspended sediment to be implemented during operation of the brake wheel. This program must be sufficient to assess the effects of operation of the brake wheel on turbidity and/or suspended sediment in the Kennebec River during operations of the brake wheel. A proposed monitoring plan must be submitted to us for approval at least 30 days prior to the first time the brake wheel is used.

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. Specifically, these RPMs and Terms and Conditions will keep us informed of when and where dredging and disposal activities are taking place and will require USACE to report any take in a reasonable amount of time, as well as implement measures to monitor for capture during dredging. The USACE and the applicant (BIW) have reviewed the RPMs and Terms and Conditions outlined above and has agreed to implement all of these measures as described herein and in the referenced Appendices. The discussion below explains why each of these RPMs and Terms and Conditions are necessary and appropriate to minimize or monitor the level of incidental take associated with the proposed action and how they represent only a minor change to the action as proposed by the USACE and US Navy.

RPM #1 and Term and Condition #1 are necessary and appropriate because they will serve to ensure that we are aware of the dates and locations of all dredging activities. This will allow us to monitor the duration and seasonality of dredging activities as well as give us an opportunity to provide USACE with any updated contact information for NMFS staff. This is only a minor change because it is not expected to result in any delay to the project and will merely involve an occasional telephone call or e-mail between USACE and NMFS staff.

RPM #2 and #3 and implementing Term and Conditions (#2-4) are necessary and appropriate because they require that the USACE have sufficient observer coverage to ensure the detection of any interactions with listed species. This is necessary for the monitoring of the level of take associated with the proposed action. The inclusion of these RPMs and Terms and Conditions is only a minor change as the USACE included some level of observer coverage in the original project description and the clarification of coverage and responsibilities will not represent an increase in the cost of the project and will not result in any delays. These also represent only a minor change as in many instances they serve to clarify the duties of the observers.

RPM #4 and the implementing Terms and Conditions (#5-12) are necessary and appropriate to ensure the proper handling and documentation of any interactions with listed species as well as requiring that these interactions are reported to us in a timely manner with all of the necessary information. This is essential for monitoring the level of incidental take associated with the proposed action. Term and Condition #12 requires that USACE work with us to determine if any takes above those estimated for each contract represent new information on the effects of the project that was not previously considered. In a situation where the estimated level of take for a particular contract is exceeded but the overall level of take exempted by the ITS is not exceeded, compliance with this condition will allow USACE and NMFS to determine if reinitiation of consultation is necessary at the time that the take occurs. These RPMs and Terms and Conditions represent only a minor change as compliance will not result in any increased cost, delay of the project or decrease in the efficiency of the dredging operations.

RPM #5 and Term and Condition #13 are necessary and appropriate to ensure that any sturgeon that survive capture in a mechanical dredge are given the maximum probability of remaining alive and not suffering additional injury or subsequent mortality through inappropriate handling. This represents only a minor change as following these procedures will not result in an increase in cost or any delays to the proposed project.

RPM#6-8 and their implementing Terms and Conditions (#14-16) are necessary and appropriate to verify assumptions made by us and confirming that no take due to exposure to increased turbidity or suspended sediment or noise is likely. This represents only a minor change as following these procedures will not result in only a small increase in cost and no delays to the proposed project.

12.0 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. We recommend that USACE use their authorities to carry out the following conservation recommendations.

(1) Population information on certain life stages of shortnose sturgeon is still sparse for this river system. USACE should support further studies to evaluate habitat and the use of the river, in general, by juveniles as well as use of the area upstream of the former Edwards Dam by all life stages.

(2) If any lethal take occurs, USACE should 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

13.0 REINITIATION OF CONSULTATION

This concludes formal consultation on the actions proposed by USACE, the U.S. Navy and Bath Iron Works. 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.

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APPENDIX A

MONITORING SPECIFICATIONS FOR MECHANICAL DREDGES

I. EQUIPMENT SPECIFICATIONS

A. Floodlights

Should dredging occur at night or in poor lighting conditions, 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 (i.e., each time the bucket is emptied into the scow) 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 sturgeon to species 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 sturgeon (alive or dead) or sturgeon parts are taken incidental to the project(s), NMFS must be notified within 24 hours. Contact information will be provided to USACE on an annual basis. An incident report (form to be provided by NMFS) must be filled out for all observations of listed species. All take reports should be submitted via e-mail to incidental.take@noaa.gov. Incident reports shall be completed for every take regardless of the state of decomposition. Every incidental take (alive or dead, decomposed or fresh) must be photographed. A final report including all completed load sheets, photographs, and relevant incident reports are to be submitted via e-mail (incidental.take@Noaa.gov) or mail (to the attention of the Section 7 Coordinator, NMFS Protected Resources Division, 55 Great Republic Drive, Gloucester, MA 01930).

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 sturgeon (alive or dead) or sturgeon parts are observed during disposal operation, the procedure for notification and documentation outlined above should be completed.

E. Disposition of Parts

As required above, NMFS must be contacted as soon as possible following a take. Any dead sturgeon should be held in cold storage until disposition can be discussed with NMFS. Under no circumstances should dead sturgeon be disposed of without confirmation of disposition details with 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 USACE 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) 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

ENDANGERED SPECIES OBSERVER FORM
Bath Iron Works Maintenance Dredging

Daily Report

Date: ________________________________

Geographic Site:____

Location: Lat/Long ____________________ Vessel Name ___________________________

Weather conditions:____

____

Water temperature: Surface ____________ Below midwater (if known) ____________

Incidents involving endangered or threatened species? (Circle) Yes No

(*If yes, fill out Incident Report of Shortnose Sturgeon Mortality and Sturgeon Salvage Form*)

Comments (type of material, biological specimens, unusual circumstances, etc:)

____

____

____

____

____

____

Observer’s Name: ____

Observer’s Signature: ____

Incident Report of Sturgeon Take
Bath Iron Works Maintenance Dredging

Species ________________________________
Date __________________ Time (specimen found) ______________

Geographic Site ____
Location: Lat/Long____
Vessel Name _____________________________ Load #____________________
Begin load time ____________________ End load time___________________
Begin dump time ____________________ End dump time __________________

Location where specimen recovered: ____
____
____

Weather conditions____

Water temp: Surface ____________ Below midwater (if known) ____________

Species Information: *(please designate cm/m or inches.)*

Fork length ______________ Total Length ____________ Weight ______________________

Condition of specimen/description of animal
____
____
____
____

Fish Decomposed: NO SLIGHTLY MODERATELY SEVERELY
Fish tagged: YES / NO *Please record all tag numbers.* Tag # ________________

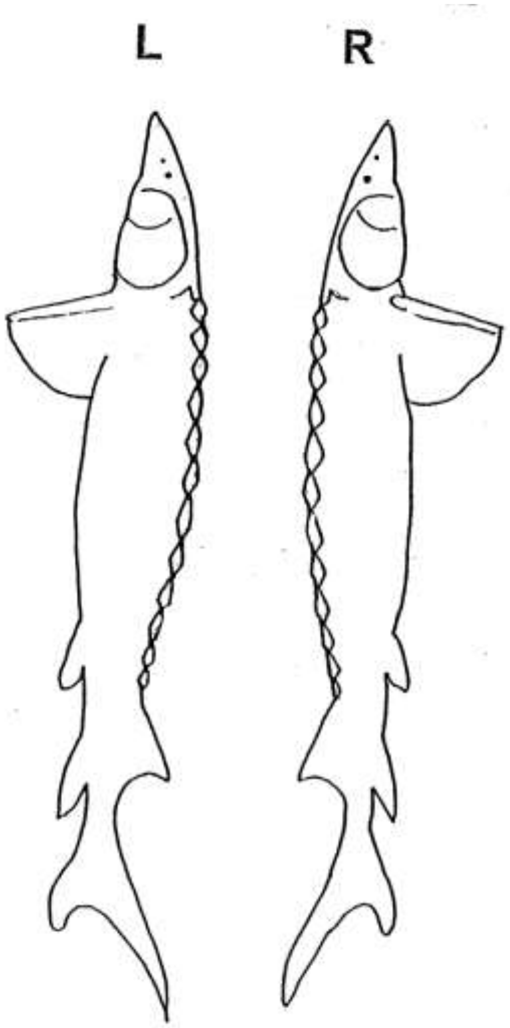
Photograph attached: YES / NO
(please label *species*, *date*, *geographic site* and *vessel name* on back of photograph or in e-mail transmitting digital photo)

If Alive, time and location of return to water: ____
If Dead, where is fish being held____

Comments/other (include justification on how species was identified)

Appendix B

Draw wounds, abnormalities, tag locations on diagram and briefly describe below



Description of fish condition:

Observer's Name ____

Observer's Signature ____

Appendix B

STURGEON SALVAGE FORM

For use in documenting dead sturgeon in the wild under ESA permit no. 1614 (version 05-16-2012)

INVESTIGATORS'S CONTACT INFORMATION
Name: First ______________ Last ____________________
Agency Affiliation ______________ Email____________________
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/Video:__________
____
____

SAMPLES COLLECTED? ☐ Yes ☐ No

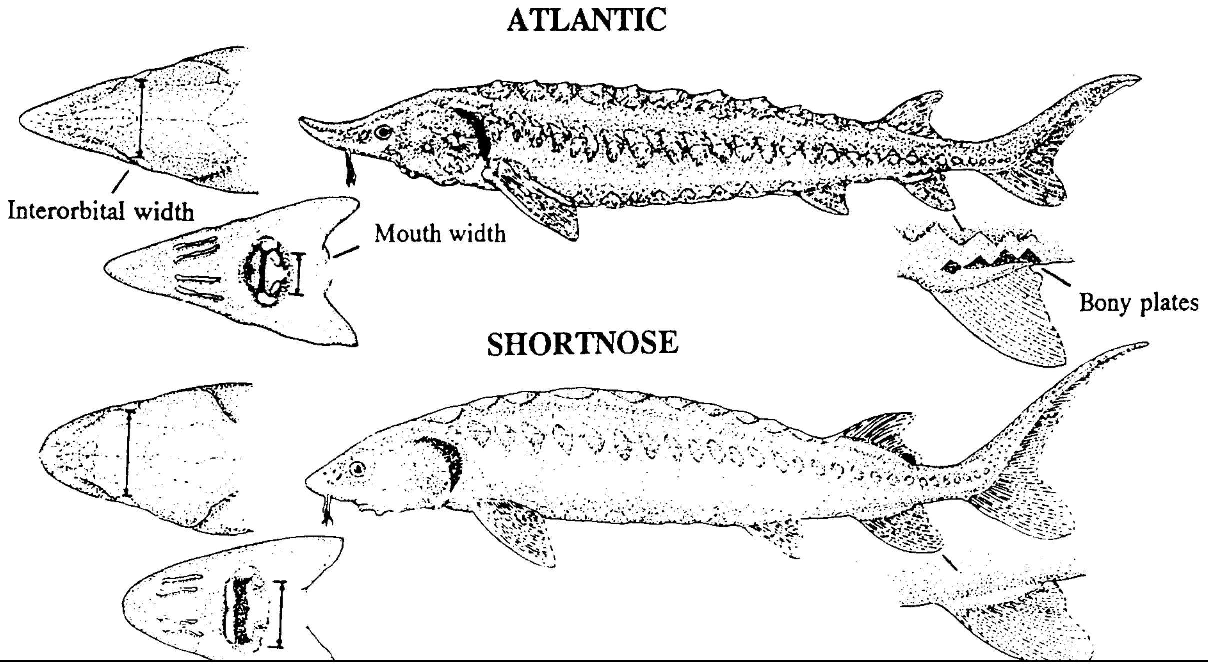
Sample	How preserved	Disposition (person, affiliation, use)

Comments:
____
____
____

Distinguishing Characteristics of Atlantic and Shortnose Sturgeon (version 07-20-2009)

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	Paired plates posterior to the rectum & anterior to the anal fin.	1-3 pre-anal plates almost always occurring as median structures (occurring singly)
Plates along the anal fin	Rhombic, bony plates found along the lateral base of the anal fin (see diagram below)	No plates along the base of anal fin
Habitat/Range	Anadromous; spawn in freshwater but primarily lead a marine existence	Freshwater amphidromous; found primarily in fresh water but does make some coastal migrations

* 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.

Submit completed forms (within 30 days of date of investigation) to: **Northeast Region Contacts** – Shortnose Sturgeon Recovery Coordinator (Jessica Pruden, Jessica.Pruden@noaa.gov, 978-282-8482) or Atlantic Sturgeon Recovery Coordinator (Lynn Lankshear, Lynn.Lankshear@noaa.gov, 978-282-8473); **Southeast Region Contacts**- Shortnose Sturgeon Recovery Coordinator (Stephania Bolden, Stephania.Bolden@noaa.gov, 727-824-5312) or Atlantic Sturgeon Recovery Coordinator (Kelly Shotts, Kelly.Shotts@noaa.gov, 727-551-5603).

APPENDIX D

Procedure for obtaining fin clips from sturgeon for genetic analysis

Obtaining Sample

1. Wash hands and use disposable gloves. Ensure that any knife, scalpel or scissors used for sampling has been thoroughly cleaned and wiped with alcohol to minimize the risk of contamination.

2. For any sturgeon, after the specimen has been measured and photographed, take a one-cm square clip from the pelvic fin.

3. Each fin clip should be placed into a vial of 95% non-denatured 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. All vials should be sealed with a lid and further secured with tape Please use permanent marker and cover any markings with tape to minimize the chance of smearing or erasure.

Storage of Sample

1. If possible, place the vial on ice for the first 24 hours. If ice is not available, please refrigerate the vial. Send as soon as possible as instructed below.

Sending of Sample

1. 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:

Julie Carter
NOAA/NOS – Marine Forensics
219 Fort Johnson Road
Charleston, SC 29412-9110
Phone: 843-762-8547

a. Prior to sending the sample, contact Russ Bohl at NMFS Northeast Regional Office (978-282-8493) to report that a sample is being sent and to discuss proper shipping procedures.