NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT
BIOLOGICAL OPINION

Agency: Environmental Protection Agency, Region 1

Activity Considered: Environmental Protection Agency-2019 National Rivers and Streams Assessment: Maine, Massachusetts Rhode Island, Connecticut, New York and New Jersey Rivers and Streams

GAR-2019-00129

Conducted by: National Marine Fisheries Service
Greater Atlantic Region Fisheries Office

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1.0 INTRODUCTION AND BACKGROUND

This constitutes the biological opinion (Opinion) of NOAA's National Marine Fisheries Service (NMFS) under the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531-1543). This Opinion analyzes the effects to listed Atlantic salmon, and Atlantic and shortnose sturgeon from conducting the proposed Environmental Protection Agency (EPA) National Rivers and Streams Assessment in portions of NMFS Greater Atlantic region. We have provided an incidental take statement (ITS), pursuant to section 7(a)(2), to exempt take of Atlantic salmon, Atlantic sturgeon, and shortnose sturgeon, that is reasonably certain to occur as a result of electrofishing activities conducted by EPA. The proposed project will provide information to better understand the ecological issues and interactions that may affect large river management and species restoration. The term of the proposed survey is August 1, 2019 through September 30, 2019.

This Opinion is based on information provided in the Biological Assessment (March 15, 2019), previous consultations on similar activities, and relevant sources of scientific information as cited herein. A complete administrative record of this consultation will be maintained at our Maine Field Office in Orono, Maine.

1.1 Consultation History

- May 8, 2018 – NMFS received email from EPA to discuss 2019 National Rivers and Stream Assessment.

- October 23, 2018 – NMFS received draft BA from EPA for review and comment.

- February 26, 2019 – EPA and NMFS (GARFO and SERO) had a conference call to discuss scope of project and recommend approach to ESA consultation.

- March 15, 2019 – NMFS received request for initiation and supporting BA from EPA in regards to the 2019 NRSA.

1.2 Relevant Documents

The analysis in this Opinion is based on a review of the best available scientific and commercial information. Specific sources are listed in section 13 and are cited directly throughout the body of the document. Primary sources of information include: 1) information provided in the Biological Assessment from EPA in their request for consultation letter dated March 15, 2019; 2) Determination of Endangered Status for the Gulf of Maine Distinct Population Segment of Atlantic salmon; Final Rule (74 FR 29345; June 19, 2009); 3) Status Review for Anadromous Atlantic Salmon (*Salmo salar*) in the United States (Fay *et al.* 2006); 4) Designation of Critical Habitat for Atlantic salmon Gulf of Maine Distinct Population Segment (74 FR 29300; June 19, 2009); 5) Final Recovery Plan for Atlantic salmon (January, 2019); 6) Final Recovery Plan for Shortnose Sturgeon (December, 1998); and, 7) Final listing determinations for the five distinct population segments of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) (77 FR 5880 and 77 FR 5914).

1.3 Application of ESA Section 7(a)(2) Standards – Analytical Approach

This section reviews the approach used in this Opinion in order to apply the standards for determining jeopardy and destruction or adverse modification of critical habitat as set forth in section 7(a)(2) of the ESA and as defined by 50 CFR §402.02 (the consultation regulations). Additional guidance for this analysis is provided by the Endangered Species Consultation Handbook, March 1998, issued jointly by NMFS and the USFWS. In conducting analyses of actions under section 7 of the ESA, we take the following steps, as directed by the consultation regulations:

- Identifies the action area based on the action agency's description of the proposed action (Section 2);
- Evaluates the current status of the species with respect to biological requirements indicative of survival and recovery and the essential features of any designated critical habitat (Section 3);
- Evaluates the relevance of the environmental baseline in the action area to biological requirements and the species' current status, as well as the status of any designated critical habitat (Section 4);
- Evaluates the relevance of climate change on environmental baseline and status of the species (Section 5);
- Determines whether the proposed action affects the abundance, reproduction, or distribution of the species, or alters any physical or biological features of designated critical habitat (Section 6);
- Determines and evaluates any cumulative effects within the action area (Section 7); and,
- Evaluates whether the effects of the proposed action, taken together with any cumulative effects and the environmental baseline, can be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the affected species, or is likely to destroy or adversely modify their designated critical habitat (Section 8).

In completing the last step, we determine whether the action under consultation is likely to jeopardize the ESA-listed species or result in the destruction or adverse modification of designated critical habitat. If so, we must identify a reasonable and prudent alternative(s) (RPA) to the action as proposed that avoids jeopardy or adverse modification of critical habitat and meets the other regulatory requirements for an RPA (see 50 CFR §402.02). In making these determinations, we must rely on the best available scientific and commercial data.

2.0 DESCRIPTION OF THE PROPOSED ACTION

The Environmental Protection Agency (EPA) proposes to conduct fish assemblage assessments in rivers and streams with the Index of Biotic Integrity (IBI) approach. EPA will carry out these activities by entering into contracts with qualified individuals or organizations who will implement the assessments in identified waterbodies. The National Rivers and Stream Assessment (NRSA) is intended to gauge aquatic biotic responses to water quality and habitat changes. The EPA has used a Quality Assurance Project Plan approach to develop a standardized quantitative sampling methodology to generate contemporary baseline data in study areas. Data collected during the proposed study will be used to evaluate abundance and distribution of aquatic species found in the watershed to compare with previous baseline information on the current status of these fisheries. ESA listed species are not targeted by any of the proposed sampling. All proposed work will be conducted between August 1, 2019 and September 30, 2019.

National Rivers and Streams Assessment (NRSA)
The intention of the National Rivers and Streams Assessment project is to provide a comprehensive "State of the Flowing Waters" assessment for rivers and streams across the United States. In addition to rivers and streams, the national assessments will also include coastal waters, lakes, and wetlands in a revolving annual sequence (rivers and streams are scheduled for 2018-9). The purpose of these national assessments is to generate statistically-valid reports on the condition of the Nation's water resources and identify key stressors to these systems. The goal of the 2018-9 NRSA is to address two key questions about the quality of the Nation's rivers and streams:

- What percent of the Nation's rivers and streams are in good, fair, and poor condition for key indicators of water quality, ecological health, and recreation?
- What is the relative importance of key stressors such as nutrients and pathogens?

The NRSA is designed to be completed during an index period of late May through September 1[1]. Field crews will collect a variety of measurements and samples from predetermined sampling reaches (located with an assigned set of coordinates), and from randomized stations along the sampling reach. The field crews will also document the physical habitat conditions along the sampling reach. Candidate sampling locations are selected by U.S. EPA using a probability based survey design. Using this survey design allows data from the subset of sampled sites to be applied to the larger target population, and assessments with known confidence bounds to be made. Candidate sites are field verified and then sampled if they meet the target population criteria. For non-wadeable rivers sampling sites are configured to include 40 times the mean wetted width at the "X" point not to exceed a total length of 4 km.

Proposed NRSA Sites
For the NRSA EPA contractor assigned sampling, a total of 168 base sites and an approximately equal number of overdraw sites are currently allocated between Connecticut (N=20), Massachusetts (N=20), Maine (N=27), Rhode Island (N=20), New York (N=67), and New Jersey (N=14) (EPA NRSA BA Appendix Tables C-1 through C-7). The base sites are the first candidates for sampling with the overdraw sites serving as replacements should a base site fail the test of qualifying as an NRSA target site or not being sampled due to access or safety considerations. All base sites and overdraw sites are screened for the potential occurrence of ESA listed species (EPA NRSA BA Appendix Tables C-1 through C-7). In this Opinion, we consider effects of sampling at all base sites and overdraw sites where occurrence of the ESA species overlaps with sampling areas. There are a number of NRSA sites in Maine that potentially hold Atlantic Salmon (Table 1), and would likely be fished using either the wadeable or non-wadeable (boatable) electrofishing methods. NRSA sites in Maine, the rest of New England , New York, New Jersey, where Atlantic sturgeon and shortnose sturgeon would likely be encountered are major rivers, and would be surveyed with electrofishing gear using only the non-wadeable or boatable fishing methods. Since the NRSA sites are proposed to be surveyed

1 This applies to all chemical, physical, and biological indicators; fish assemblage sampling in non-wadeable rivers will conform to the July 1 - September 30 (October 15 in southern New England) seasonal index period.

between June and September, the early spring (January to May) spawning seasons for both Atlantic and shortnose sturgeon are avoided.

NRSA Rivers and Streams with ESA Listed Species

We have reviewed the list of base and overdraw sites and have considered the best available information on the distribution of listed species in the rivers where sampling will occur and have determined that shortnose and Atlantic sturgeon may be present in the river reaches corresponding to the following sample sites:

- Penobscot River: ME_10014 (near Veazie, Maine)
- Kennebec River: ME_10030 (near Vassalboro, Maine) and ME_10031 (near Waterville, Maine)
- Merrimack River: MA_10633 (near West Newbury, MA)
- Connecticut River: CT_10011, 10020, 10005, 10007, 10029, 10430, 10431, 10432; MA_10010 (shortnose sturgeon only); MA_10004, 10631, and 10632.
- Hudson River: NJ_10004, NY_10098, NY_10077, NY_10041, NY_10016

With the exception of MA_10010, all of these sites also overlap with waters designated as critical habitat for either the Gulf of Maine (Penobscot, Kennebec, Merrimack) or New York Bight (Connecticut and Hudson) DPSs of Atlantic sturgeon.

The surveys are proposed in stream and river habitat throughout the Downeast Coastal, Merrymeeting Bay, and Penobscot Bay Salmon Habitat Recovery Units (SHRU) (Figure 3). It is anticipated that most projects being sampled for the NRSA program will occur within small (< 10 meters wide) freshwater tributaries; however, it is also possible that some sites could occur within tidal habitat in the lower main stem river. There are ten base sites and another six alternative or over-sample sites that could contain juvenile Atlantic salmon and are located in Atlantic salmon critical habitat (Table 1). These sites include three sites in the Downeast SHRU, three in the Merrymeeting Bay SHRU, and eight in the Penobscot Bay SHRU. The overdraw sites are one in the Downeast, three in Penobscot Bay, and the remaining five in Merrymeeting Bay. The sites to be sampled are in small wadeable tributaries in some of the larger drainages (Penobscot, Kennebec, Sheepscot, Machias).

Survey sites in Maine where there is the potential to encounter juvenile Atlantic salmon are identified in Table 1 below. All of these sites are upstream of barriers that are impassable by sturgeon. It is also likely that some electrofishing sites in Maine which are located within designated critical habitat, do not contain juvenile salmon. This is primarily due to stream connectivity and or hatchery stocking practices throughout the geographic range of the GOM DPS of Atlantic salmon.

Electrofishing Methodology

The fish sampling method is designed to provide a representative sample of the fish community, collecting all but the rarest fish taxa inhabiting the site. It is intended to accurately represent species richness, species guilds, relative abundance, size, and presence of anomalies. The intended uses of the fish assemblage data are to calculate predictive models of multimetric indicators (MMIs; similar to an Index of Biotic Integrity (IBI); Pont et al. 2008, USEPA 2013a) and possibly Observed/Expected (O/E) taxa richness. In addition, the fish assemblage data provides a starting point for developing potential indicators of ecosystem services related to fish. Fish sampling for the NRSA employs a transect design as described in the BA, including randomization to broadly sample and characterize various large rivers and streams throughout the Greater Atlantic Region. Pulsed D.C. electrofishing equipment ranges from battery-powered backpack units in the smallest wadeable streams to generator-powered units that are either bank-set or floated in small prams for larger wadeable streams. Raft and boat mounted configurations are used in non-wadeable rivers.

Wadeable stream sites and gear

Wadeable stream site sampling crews consist of one electrofisher operator, one dip-netter (1/4" mesh dip net), and an optional bucket carrier (who may also have a net to aid in transferring fish to the livewell). For safety, all crew members are required to wear non-breathable waders and insulated gloves. To aid vision, wear polarized sunglasses and a hat or visor. The final determination of the electrofisher settings is decided by the lead fish taxonomist.

In wadeable stream sites, sampling begins at the downstream stream end of the sampling reach defined for the site and proceed upstream. The total length of the reach is calculated to be between 150 m and/or 40 channel widths, totaling 10 subreaches within a section of river to be surveyed. Total time the electric current will be on will vary between 500 and 700 seconds per subreach. Sampling is conducted by subreach (area between transects), but it is not necessary to allocate effort equally among all 10 subreaches. The fish are processed at the end of each subreach to minimize mortality and stress to fish.

Wadeable streams are sampled with pulsed D.C. electrofishing rigs ranging from battery powered backpack units to generator powered pram mounted or bank set units. A Wisconsin ABP-2 or Halltech HT-2000 battery powered backpack electrofishing units are used in the smallest wadeable streams where the use of the generator powered units is not necessary. These units operate on approximately 200 W of power at a peak of 250 VDC at 1-10 A. The effective range of the field is <1 meter diameter and depths of a few cm for the backpack units. The Smith-Root 2.5 GPP unit produces up to 1000 volts DC at 2-8 amperes depending on the relative conductivity and the anode ring size. This unit is also used in low conductivity (<50-100 µS/cm) streams. The T&J 1736 DCV unit produces 125-250 VDC at 2-4 A and is used in higher conductivity streams (>100 µS/cm). The effective range is 3-4 meters and depths of 1 meter for the 2.5 GPP unit to 2-3 meters and depths <1 meter for the T7J unit. The pulse configuration for all units consists of a fast rise, slow decay wave that can be adjusted to 30, 60, or 120 Hz (pulses per second). Generally, electrofishing is conducted at 60 or 120 Hz, depending on which selection is producing the optimum combination of voltage and amperage output and most effectively and safely stunning fish. Sampling is conducted by wading in an upstream direction. One or two assist netters collect stunned fish and place them in an aerated holding tank or a floating live net.

Non-wadeable sites and gear

Non-wadeable or boatable fish sampling sites are generally located on larger portions of the river immediately adjacent to the shoreline or submerged features such as bedrock ledges and gravel shoals. For the NRSA protocol, the first bank is selected randomly and then alternated every 2-3 transects within a 40 X mean width long site. Sampling time is specified at a maximum of 700 seconds per transect and a minimum of 3500 seconds per site as the cumulative time the electric current is applied to the water. A 1.0 km site typically requires between 3600 and 5400 seconds of "current time", i.e., the cumulative time that the electric field is activated within a site (the netters operate a foot pedal switch, current is applied intermittently). The variance in time fished is affected by site navigability, current velocity, current types, boat maneuverability, and the number of fish collected. Consequently, the typical maximum amount of time that electricity will be applied to the water at any location would be approximately 128 minutes. In larger rivers, such as those designated as critical habitat for Atlantic and shortnose sturgeon, a sampling crew may spend 6-8 hours on the river due to river crossing time from transect to transect and time spent sorting the fish between transects.

A boat-rigged, pulsed D.C. electrofishing apparatus is employed in larger non-wadeable rivers where navigation with a john boat is feasible. This consists of 16-18' john boats specifically constructed and modified for electrofishing. Electric current is converted, controlled, and regulated by Smith-Root 5.0 GPP alternator-pulsator that produces up to 1000 volts DC at 2-20 amperes depending on the relative conductivity. The pulse configuration consists of a fast rise, slow decay wave that can be adjusted to 30, 60, or 120 Hz (pulses per second). Generally, electrofishing is conducted at 60 or 120 Hz, depending on which selection is producing the optimum combination of voltage and amperage output and most effectively and safely stunning fish. The voltage range is selected based on what percentage of the power range produces the highest amperage readings. Generally, the high range is used at conductivity readings less than 50-100 $\mu S/cm^2$ and the low range is used at higher conductivities up to 1200 $\mu S/cm^2$. Lower conductivities usually produce lower amperage readings. A 16' raft rigged for electrofishing is used to sample intermediate sized rivers where using a john boat is impractical due to navigational issues such as shallow depths, high gradients, large boulders, and fast flows. This method employs the same basic design as the john boats, but uses either a Smith-Root 2.5 or 5.0 GPP unit. The Smith-Root 2.5 GPP alternator-pulsator produces up to 1000 volts DC at 2- 8 amperes depending on the relative conductivity. The principles of operation are the same as with the 5.0 GPP unit.

The electrode array on the john boats consists of a cathode curtain (negative polarity; 1/4" stainless steel cables) which is suspended from the bow and 2 gangs of umbrella anodes (positive polarity) suspended from two retractable aluminum booms, the number of droppers being dependent on the conductivity of the water. The raft configuration consists of 6 cathodes in two gangs of 3 suspended from each side of the raft. Three gangs of anodes are located at the end of a retractable boom and consist of four 3/8" woven steel cable strands (each 4' in length) formed into a "gang" by binding them together near the attachment point on the boom. These gangs are enlarged or reduced as conditions change; anode gangs are increased at low conductivity (3 gangs) and reduced (2 gangs and/or fewer wires) at higher conductivity. The anodes are suspended from a retractable aluminum boom that extends 2.5 m in front the 16' raft. The width of both arrays is approximately 0.9 meters. Anodes and cathodes are replaced when they are lost, damaged, or become worn. A john boat electrofishing crew consists of a boat driver and one netter; the 16' raft crew consists of a raft driver and one netter. Limited access to free-flowing segments may necessitate launching at an upstream location and recovering at a downstream location. Put-in and take-out sampling is conducted where navigational barriers preclude contiguous navigation.

For boat and raft electrofishing at individual sampling locations, the procedure is to maneuver the electrofishing boat in a down current direction along the shoreline maneuvering along and around submerged cover with the netter picking up stunned and immobilized fish. The driver's task is to maneuver the electrofishing boat in a manner that positions the netter to pick up stunned and immobilized fish. The driver also monitors and adjusts the 2.5 or 5.0 GPP pulsator to provide the maximum yet safe operational mode in terms of voltage range, pulse setting, and amperage. In moderately swift to fast current the procedure is to electrofish with or slightly ahead of the current through the fast water sections. Electrofishing efficiency is enhanced by keeping the boat and electric field moving with or at a slightly faster rate than the prevailing current velocity. Fish are usually oriented into the current and must turn sideways or swim into the approaching electric field to escape. As such they present an increased voltage gradient making the fish more susceptible to the electric current. Sampling in an upstream direction is prohibited as this significantly diminishes sampling effectiveness. Although sampling effort is measured by distance, the time fished is an important indicator of adequate effort. Time fished can legitimately vary over the same distance as dictated by cover and current conditions and the number of fish encountered. Safety features include easily accessible toggle switches on the pulsator unit and next to the driver and a foot pedal switch operated by the netter. Netters wear jacket style life preservers, rubber gloves, and all crew members wear chest waders. Netters are required to wear polarized sunglasses to facilitate seeing stunned fish in the water during each daytime boat electrofishing run. A boat net with a 2.5m long handle and 7.62mm Atlas mesh knotless netting is used to capture stunned fish as they appear in the view of the netter. A concerted effort is made to capture every fish sighted by both the netters and driver.

Special Precautions
EPA will employ the following special precautions while undertaking the proposed study. These precautions will be made conditions of any contract EPA enters into to carry out the proposed action.

Fish Handling and Disposition – Any sturgeon or adult Atlantic salmon that are encountered and visibly identified as such while electrofishing will not be netted or otherwise handled. The electric current will be interrupted until it can be determined that a resumption of the electric current will not re-affect that individual fish. In the unlikely event that a sub adult sturgeon is inadvertently captured (i.e., netted) it will be returned to the water and away from the subsequent sampling site.

2.1 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." For purposes of this Section 7 consultation, the action area is defined as all areas where electrofishing sampling has the potential to affect listed species under the jurisdiction of NMFS. As explained above, the action will involve running multiple transects along the shoreline in a number of New England and Mid-Atlantic rivers. Each transect is 4.5-5.5 meters wide, 2.5-3.5 meters deep and 4 km long. Thus, the action area is defined as these stretches of the Hudson, Connecticut, Merrimack, Penobscot and Kennebec rivers being sampled by the proposed study where shortnose and/or

Atlantic sturgeon and their designated critical habitat occur as well as the additional waterbodies listed in Table 1 where Atlantic salmon and/or their designated critical habitat occur. For backpack electrofishing, the area immediately downstream of the transect site would experience a temporary increase in sediment from wading during electrofishing activities. The proposed action is not expected to have any direct or indirect effects to listed species outside of the areas where electric current and this temporary increase in suspended sediment will be experienced.

Table 1. EPA designated electrofishing sites where Atlantic salmon may occur

Site Name	County	Site ID	ESA Species	Latitude	Longitude
BASE SITES					
E. Br. Penobscot River	Penobscot	NRS18-10007	**Atlantic Salmon**	45.87866621520	-68.62034334480
Machias River	Washington	NRS18-10003	**Atlantic Salmon**	44.73737623480	-67.54984267770
Piscataquis River	Piscataquis	NRS18-10005	**Atlantic Salmon**	45.25733170570	-68.94965872110
E. Br. Penobscot River	Penobscot	NRS18-10007	**Atlantic Salmon**	45.89866814380	-68.61411192240
Ducktrap Tributary	Penobscot	NRS18-10034	**Atlantic Salmon**	44.266098	-69.053988
Gordon Brook	Penobscot	NRS18-10034	**Atlantic Salmon**	45.47867027710	-68.21031490380
Kennebec River	Somerset	NRS18-10015	**Atlantic Salmon**	44.640170	-69.592740
Penobscot River	Penobscot	NRS18-10027	**Atlantic Salmon**	44.610221	-68.839784
Seboeis River	Penobscot	NRS18-10011	**Atlantic Salmon**	46.024310	-68.603420
Machias River	Washington	NRS18-10025	**Atlantic Salmon**	46.582451	-68.694842
Ragged Brook	Penobscot	NRS18-10009	**Atlantic Salmon**	46.032820	-68.605420
Crocker Brook	Washington	NRS18-10021	**Atlantic Salmon**	44.774672	-67.498394
Kennebec River	Somerset	NRS18-10030	**Atlantic Salmon**	44.421550	-69.705600
Naraguagus River	Washington	NRS18-10194	**Atlantic Salmon**	44.852156	-68.072800
Wesserunsett Stream	Lincoln	NRS18-10036	**Atlantic Salmon**	44.889160	-69.663980
Kennebec River	Somerset	NRS18-10031	**Atlantic Salmon**	44.501090	-69.676140

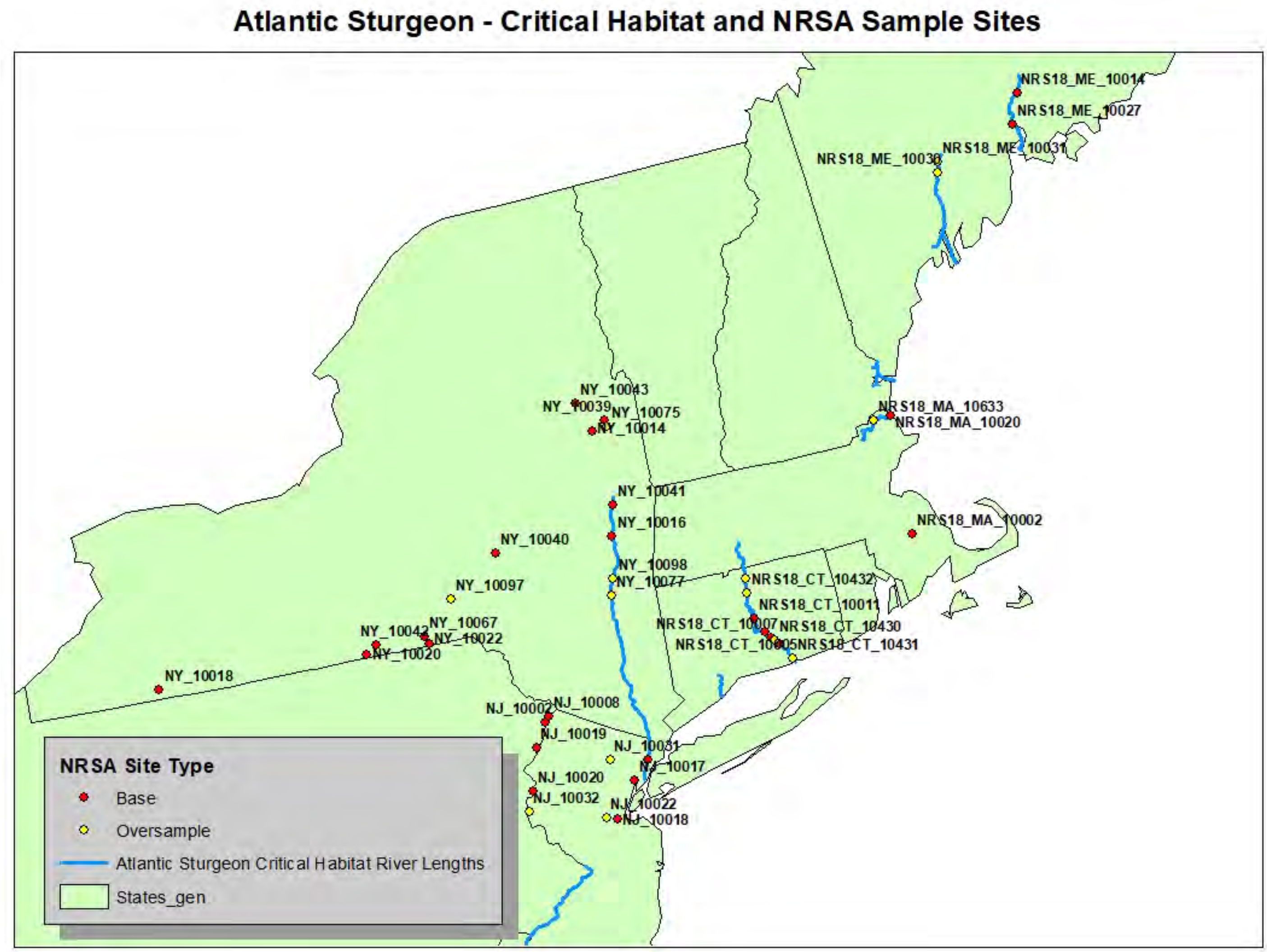


Figure 1. NRSA 2019 contractor sampling sites in Connecticut, Massachusetts, Maine, New Jersey, and New York, including sites where Atlantic and/or shortnose sturgeon may occur (see list above).

3.0 CRITICAL HABITAT NOT LIKELY TO BE ADVERSELY AFFECTED BY THE PROPOSED ACTION

We conclude that an action "may affect, but is not likely to adversely affect" a listed species or designated critical habitat when its effects are wholly beneficial, insignificant or discountable. Beneficial effects are contemporaneous positive effects without any adverse effects to the species or critical habitat. Insignificant effects relate to the size or severity of the impact. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur (see page xvi of the ESA Section 7 Handbook).

We use two criteria to identify the ESA-listed species or critical habitat that are not likely to be adversely affected by the proposed action, as well as the effects of activities that are interrelated to or interdependent with the Federal agency's proposed action. The first criterion is exposure, or a reasonable expectation of a co-occurrence, between one or more potential stressors associated with the proposed activities and ESA-listed species or designated critical habitat. If we conclude that an ESA-listed species or designated critical habitat will not be exposed to any stressors associated with the proposed activities, then the proposed action has no effect on listed species. The second criterion is the probability and extent of a response given exposure. ESA-listed species or designated critical habitats that are exposed to a potential stressor but effects of that exposure will be insignificant or discountable (see above) are not likely to be adversely affected by the proposed action. We applied these criteria and determined that the proposed action is not likely to adversely affect critical habitat designated for the Gulf of Maine DPS of Atlantic salmon or critical habitat designated for the New York Bight or Gulf of Maine DPS of Atlantic sturgeon.

3.1 Effects of the Action on Atlantic Sturgeon Critical Habitat

As explained above, the action area overlaps with the Penobscot River, Kennebec River and Merrimack River critical habitat units designated for the Gulf of Maine DPS of Atlantic sturgeon and the Connecticut River and Hudson River critical habitat units designated for the New York Bight DPS of Atlantic sturgeon. NRSA sites in Maine, the rest of New England , New York, New Jersey, where Atlantic sturgeon and shortnose sturgeon would likely be encountered are major rivers, and would be surveyed with electrofishing gear using only the non-wadeable or boatable fishing methods. Since the NRSA sites are proposed to be surveyed between June and September, the early spring (January to May) spawning seasons for both Atlantic and shortnose sturgeon are avoided.

There are four physical and biological features (PBF) that are part of the critical habitat (see 82 FR 39160, August 17, 2017) as described below.

As identified in the final designation, the physical features essential to the conservation of the species and that may require special management considerations or protection are:

(1) Hard bottom substrate (e.g., rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (i.e., 0.0 to 0.5 parts per thousand (ppt) range) for settlement of fertilized eggs, refuge, growth, and development of early life stages;

(2) Aquatic habitat with a gradual downstream salinity gradient of 0.5 up to as high as 30 ppt and soft substrate (e.g., sand, mud) between the river mouth and spawning sites for juvenile foraging and physiological development;

(3) Water of appropriate depth and absent physical barriers to passage (e.g., locks, dams, thermal plumes, turbidity, sound, reservoirs, gear, etc.) between the river mouth and spawning sites necessary to support: (i) Unimpeded movement of adults to and from spawning sites; (ii) Seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary; and, (iii) Staging, resting, or holding of subadults or spawning condition adults. Water depths in main river channels must also be deep enough (e.g., at least 1.2 m) to ensure continuous flow in the main channel at all times when any sturgeon life

stage would be in the river.

(4) Water, between the river mouth and spawning sites, especially in the bottom meter of the water column, with the temperature, salinity, and oxygen values that, combined, support: (i) Spawning; (ii) Annual and interannual adult, subadult, larval, and juvenile survival; and, (iii) Larval, juvenile, and subadult growth, development, and recruitment (e.g., 13 °C to 26 °C for spawning habitat and no more than 30 °C for juvenile rearing habitat, and 6 milligrams per liter (mg/L) dissolved oxygen (DO) or greater for juvenile rearing habitat).

PBFs 1, 3 and 4 are present in the action area. PBF 2 is associated with salinity greater than 0.5 ppt; waters with such salinity levels will not be sampled.

Feature One: Hard bottom habitat with salinity less than 0.5 ppt
The use of boats and electrofishing gear in the action area will have no effect on PBF 1. This is because the vessel will not interact with the river bottom and therefore, would not impact any hard bottom habitat. The vessel will be loaded or unloaded at existing boat launch facilities in the identified rivers and streams and is not expected to set an anchor. The vessel will operate in areas where there is adequate water depth to prevent bottoming out or otherwise scouring the riverbed. The sampling will occur in deeper portions of the lower river where wading will not be an appropriate method for sampling. The proposed action will also not effect salinity in any way.

Feature Three: Water absent physical barriers to passage between the river mouth and spawning sites
Electrofishing results in a temporary electric current in the area being sampled that stuns fish thereby impacting their movements. However, the electric current impacts a particular portion of a waterway for only seconds at a time and never extends from bank to bank. Therefore, there is never a complete barrier to passage and the ability of the stream segment to function for migration is restored as soon as the electricity is shut off. Because there will always be a zone of passage through the action area, and areas will be inaccessible due to noise for only short, intermittent periods, the electrofishing activity will not prevent any sturgeon from passing through the action area, and any impediments to the movements of juvenile, subadult or adult sturgeon will be temporary (seconds in duration). The proposed electrofishing will not reduce water depth or impact river flow.

Based on the assessment here, any effect of the proposed action on the ability of the habitat in the action area to support the movement of Atlantic sturgeon will be so small that it cannot be meaningfully measured or detected. Therefore, effects are insignificant.

Feature Four: Water with the temperature, salinity, and oxygen values that, combined, provide for dissolved oxygen values that support successful reproduction and recruitment and are within the temperature range that supports the habitat function
These water quality conditions are interactive and both temperature and salinity influence the dissolved oxygen saturation for a particular area. The electrofishing and associated vessel activity will have no effects on water temperature, salinity or dissolved oxygen. Therefore, there will be no effect to PBF four.

Conclusions
Because all effects to Atlantic and shortnose sturgeon and critical habitat designated for the two DPSs of Atlantic sturgeon in the action area are insignificant, the EPA NRSA survey proposed to be carried out is not likely to adversely affect critical habitat designated for the Gulf of Maine or New York Bight DPS of Atlantic sturgeon.

3.2 Effects of the action on Atlantic salmon critical habitat

Critical habitat has been designated for the GOM DPS of Atlantic salmon (74 FR 29300; June 19, 2009) (Figure 2). EPA NRSA sample sites are proposed within the designated critical habitat (Table 1). Within the action area of this consultation, the PCEs for Atlantic salmon include: 1) sites for spawning and rearing; and, 2) sites for migration. The analysis presented in the status of the species and the environmental baseline shows several habitat indicators are not properly functioning, and biological requirements of Atlantic salmon are not being met in the action area. We have analyzed the potential impacts of the project on designated critical and PCEs in the action area. We have determined that the effects to these PCEs will be insignificant for the reasons outlined below.

Sites for spawning and rearing
The proposed action will not occur during the time of year when spawning and rearing occur. All effects to habitat will be minor and temporary and limited to temporary increases in turbidity associated with wading through the streams. Conditions will return to baseline prior to the resumption of any spawning or rearing activity. As such, the project will have no effect on the ability of the action area to support spawning and rearing.

Sites for migration
The project will not result in a migration barrier for a number of reasons; 1) the electrofishing operation will only affect a small portion of the river at any given time; 2) the electrofishing boat has a small effective range and electric current, which could deter fish from passing through the affected area; and lastly, the electrical field will be experienced in an extremely small area of the river at any given time. This will ensure that there is always a sufficient zone of passage past the electrofishing operation for any adult Atlantic salmon moving upstream past the area being sampled. In smaller tributaries and wadeable streams, the site being surveyed will be temporarily disturbed during operations, and after the survey is completed will be restored to existing conditions. The project 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 turbidity and electrification; there will be no other water quality impacts of the proposed action. The types of species that will be stunned by the electrofishing gear and be subject to capture by the researchers are not likely to be the same species that juvenile or adult Atlantic salmon forage on; therefore, the project will not significantly affect the forage of juvenile or adult Atlantic salmon. 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 so small that they can not be meaningfully, measured, evaluated or detected and therefore will be insignificant.

4.0 STATUS OF SPECIES THAT MAY BE AFFECTED BY THE PROPOSED ACTION

We have determined that the following species may be adversely affected by the proposed action:

Fish	
Gulf of Maine DPS of Atlantic salmon (*Salmo salar*)	Endangered
Shortnose sturgeon (*Acipenser brevirostrum*)	Endangered
GOM DPS of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*)	Threatened
NYB DPS of Atlantic sturgeon	Endangered

4.1 Shortnose Sturgeon

Shortnose sturgeon are fish that occur in rivers and estuaries along the East Coast of the U.S. and Canada (SSSRT 2010). They have a head covered in bony plates, as well as protective armor called scutes extending from the base of the skull to the caudal peduncle. Other distinctive features include a subterminal, protractile tube-like mouth, and chemosensory barbels for benthic foraging (SSSRT 2010). Sturgeon have been present in North America since the Upper Cretaceous period, more than 66 million years ago. The information below is a summary of available information on the species. More thorough discussions can be found in the cited references as well as the SSSRT's Biological Assessment (2010). Detailed information on the populations that occur in the action area is provided in section 4.7 while details on activities that impact individual shortnose sturgeon in the action area can be found in sections 4.8 and 5.0.

Life History and General Habitat Use

There are differences in life history, behavior, and habitat use across the range of the species. Current research indicates that these differences are adaptations to unique features of the rivers where these populations occur. For example, there are differences in larval dispersal patterns in the Connecticut River (MA) and Savannah River (GA) (Parker 2007). There are also morphological and behavioral differences. Growth and maturation occurs more quickly in southern rivers but fish in northern rivers grow larger and live longer.

Shortnose sturgeon live on average for 30-40 years (Dadswell et al. 1984). Males mature at approximately 5-10 years and females mature between age 7 and 13, with later maturation occurring in more northern populations (Dadswell et al. 1984). Females typically spawn for the first time 5 years post-maturation (age 12-18; Dadswell 1979; Dadswell et al. 1984) and then spawn every 3-5 years (Dadswell 1979; Dadswell et al. 1984;). Males spawn for the first time approximately 1-2 years after maturity with spawning typically occurring every 1-2 years (Kieffer and Kynard 1996; NMFS 1998; Dadswell et al. 1984). Shortnose sturgeon are iteroparous (spawning more than once during their life) and females release eggs in multiple "batches" during a 24 to 36-hour period (total of 30,000-200,000 eggs). Multiple males are likely to fertilize the eggs of a single female.

Cues for spawning are thought to include water temperature, day length and river flow (Kynard 2012). Shortnose sturgeon spawn in freshwater reaches of their natal rivers when water temperatures reach 9–15°C in the spring (Dadswell 1979; Taubert 1980a and b; Kynard 1997). Spawning occurs over gravel, rubble, and/or cobble substrate (Dadswell 1979, Taubert 1980a and b; Buckley and Kynard 1985b; Kynard 1997) in areas with average bottom velocities between 0.4 and 0.8 m/s. Depths at spawning sites are variable, ranging from 1.2 - 27 m (multiple references in SSSRT 2010). Eggs are small and demersal and stick to the rocky substrate where spawning occurs.

Shortnose sturgeon occur in waters between 0 – 34°C (Dadswell et al. 1984; Heidt and Gilbert 1978); with temperatures above 28°C considered to be stressful. Depths used are highly variable, ranging from shallow mudflats while foraging to deep channels up to 30 m (Dadswell et al. 1984; Dadswell 1979). Salinity tolerance increases with age; while young of the year must remain in freshwater, adults have been documented in the ocean with salinities of up 30 parts-per-thousand (ppt) (Holland and Yeverton 1973; Saunders and Smith 1978). Dissolved oxygen affects distribution, with preference for DO levels at or above 5mg/l and adverse effects anticipated for prolonged exposure to DO less than 3.2mg/L.

General life history for the species throughout its range is summarized in the table below:

Stage	**Size (mm)**	**Duration**	**Behaviors/Habitat Used**
Egg	3-4	13 days post spawn	stationary on bottom; Cobble and rock, fresh, fast flowing water
Yolk Sac Larvae	7-15	8-12 days post hatch	Photonegative; swim up and drift behavior; form aggregations with other YSL; Cobble and rock, stay at bottom near spawning site
Post Yolk Sac Larvae	15 – 57	12-40 days post hatch	Free swimming; feeding; Silt bottom, deep channel; fresh water
Young of Year	57 – 140 (north); 57-300 (south)	From 40 days post-hatch to one year	Deep, muddy areas upstream of the saltwedge
Juvenile	140 to 450-550 (north); 300 to 450-550 (south)	1 year to maturation	Increasing salinity tolerance with age; same habitat patterns as adults
Adult	450-1100 average; (max recorded 1400)	Post-maturation	Freshwater to estuary with some individuals making nearshore coastal migrations

Shortnose sturgeon feed on benthic insects, crustaceans, mollusks, and polychaetes (Dadswell et al. 1984). Both juvenile and adult shortnose sturgeon primarily forage over sandy-mud bottoms, which support benthic invertebrates (Carlson and Simpson 1987, Kynard 1997). Shortnose sturgeon have also been observed feeding off plant surfaces (Dadswell et al. 1984).

Following spawning, adult shortnose sturgeon disperse quickly down river to summer foraging grounds areas and remain in areas downstream of their spawning grounds throughout the remainder of the year (Buckley and Kynard 1985, Dadswell et al. 1984; Buckley and Kynard 1985; O’Herron et al. 1993).

In northern rivers, shortnose aggregate during the winter months in discrete, deep (3-10m) freshwater areas with minimal movement and foraging (Kynard et al. 2012; Buckley and Kynard 1985a; Dadswell 1979, Li et al. 2007; Dovel et al. 1992; Bain et al. 1998a and b). In the winter, adults in southern rivers spend much of their time in the slower moving waters downstream near the salt-wedge and forage widely throughout the estuary (Collins and Smith 1993, Weber et al. 1998). Pre-spawning sturgeon in some northern and southern systems migrate into an area in the upper tidal portion of the river in the fall and complete their migration in the spring (Rogers and Weber 1995). Older juveniles typically occur in the same overwintering areas as adults while young of the year remain in freshwater (Jenkins et al. 1993, Jarvis et al. 2001).

Listing History

Shortnose sturgeon were listed as endangered in 1967 (32 FR 4001), and the species remained on the endangered species list with the enactment of the ESA in 1973. Shortnose sturgeon are thought to have been abundant in nearly every large East Coast river prior to the1880s (see Catesby 1734; McDonald 1887; Smith and Clugston 1997). Pollution and overfishing, including bycatch in the shad fishery, were listed as principal reasons for the species' decline. The species remains listed as endangered throughout its range. While the 1998 Recovery Plan refers to Distinct Population Segments (DPS), the process to designate DPSs for this species has not been undertaken. The SSSRT published a Biological Assessment for shortnose sturgeon in 2010. The report summarized the status of shortnose sturgeon within each river and identified stressors that continue to affect the abundance and stability of these populations.

Current Status

There is no current total population estimate for shortnose sturgeon rangewide. Information on populations and metapopulations is presented below. In general, populations in the Northeast are larger and more stable than those in the Southeast (SSSRT 2010). Population size throughout the species' range is considered to be stable; however, most riverine populations are below the historic population sizes and most likely are below the carrying capacity of the river (Kynard 1996).

Population Structure

There are 19 documented populations of shortnose sturgeon ranging from the St. Johns River, Florida (possibly extirpated from this system) to the Saint John River in New Brunswick, Canada. There is a large gap in the middle of the species range with individuals present in the Chesapeake Bay separated from populations in the Carolinas by a distance of more than 400 km. Currently, there are significantly more shortnose sturgeon in the northern portion of the range.

Recent developments in genetic research as well as differences in life history support the grouping of shortnose sturgeon into five genetically distinct groups, all of which have unique geographic adaptations (see Grunwald et al. 2008; Grunwald et al. 2002; King et al. 2001; Waldman et al. 2002b; Walsh et al. 2001; Wirgin et al. 2009; Wirgin et al. 2002; SSSRT 2010). These groups are: 1) Gulf of Maine; 2) Connecticut and Housatonic Rivers; 3) Hudson River; 4) Delaware River and Chesapeake Bay; and 5) Southeast. The Gulf of Maine, Delaware/Chesapeake Bay and Southeast groups function as metapopulations. The other two groups (Connecticut/Housatonic and the Hudson River) function as independent populations.

While there is migration within each metapopulation (i.e., between rivers in the Gulf of Maine and between rivers in the Southeast) and occasional migration between populations (e.g., Connecticut and Hudson), interbreeding between river populations is limited to very few individuals per generation; this results in morphological and genetic variation between most river populations (see Walsh et al. 2001; Grunwald et al. 2002; Waldman et al. 2002; Wirgin et al. 2005). Indirect gene flow estimates from mtDNA indicate an effective migration rate of less than two individuals per generation. This means that while individual shortnose sturgeon may move between rivers, very few sturgeon are spawning outside their natal river; it is important to remember that the result of physical movement of individuals is rarely genetic exchange.

Summary of Status of Northeast and Mid-Atlantic Rivers
In NMFS's Greater Atlantic Region, shortnose sturgeon are known to spawn in the Kennebec, Androscoggin, Merrimack, Connecticut, Hudson and Delaware Rivers. Shortnose sturgeon are also known to occur in the Penobscot and Potomac Rivers; although it is unclear if spawning is currently occurring in those systems.

Gulf of Maine Metapopulation
Tagging and telemetry studies indicate that shortnose sturgeon are present in the Penobscot, Kennebec, Androscoggin, Sheepscot and Saco Rivers. Individuals have also been documented in smaller coastal rivers; however, the duration of presence has been limited to hours or days and the smaller coastal rivers are thought to be only used occasionally (Zydlewski et al. 2011).

Since the removal of the Veazie and Great Works Dams (2013 and 2012, respectively), in the Penobscot River, shortnose sturgeon range from the Bay to the Milford Dam. Shortnose sturgeon now have access to their full historical range. Adult and large juvenile sturgeon have been documented to use the river. While potential spawning sites have been identified, no spawning has been documented. Foraging and overwintering are known to occur in the river. Nearly all pre-spawn females and males have been documented to return to the Kennebec or Androscoggin Rivers. Robust design analysis with closed periods in the summer and late fall estimated seasonal adult abundance ranging from 636-1285 (weighted mean), with a low estimate of 602 (95% CI: 409.6-910.8) and a high of 1306 (95% CI: 795.6-2176.4) (Fernandes 2008; Fernandes et al. 2010; Dionne 2010 in Maine DMR 2010).

Kennebec/Androscoggin/Sheepscot
The estimated size of the adult population (>50cm TL) in this system, based on a tagging and recapture study conducted between 1977-1981, was 7,200 (95% CI = 5,000 - 10,800; Squiers et al. 1982). A population study conducted 1998-2000 estimated population size at 9,488 (95% CI = 6,942 -13,358; Squiers 2003) suggesting that the population exhibited significant growth between the late 1970s and late 1990s. Spawning is known to occur in the Androscoggin and Kennebec Rivers. In both rivers, there are hydroelectric facilities located at the base of natural falls thought to be the natural upstream limit of the species. The Sheepscot River is used for foraging during the summer months.

Merrimack River
The historic range in the Merrimack extended to Amoskeag Falls (Manchester, NH, rkm 116; Piotrowski 2002); currently shortnose sturgeon cannot move past the Essex Dam in Lawrence,

MA (rkm 46). A current population estimate for the Merrimack River is not available. Based on a study conducted 1987-1991, the adult population was estimated at 32 adults (20–79; 95% confidence interval; B. Kynard and M. Kieffer unpublished information). However, recent gill-net sampling efforts conducted by Kieffer indicate a dramatic increase in the number of adults in the Merrimack River. Sampling conducted in the winter of 2009 resulted in the capture of 170 adults. Preliminary estimates suggest that there may be approximately 2,000 adults using the Merrimack River annually. Spawning, foraging and overwintering all occur in the Merrimack River.

Tagging and tracking studies demonstrate movement of shortnose sturgeon between rivers within the Gulf of Maine, with the longest distance traveled between the Penobscot and Merrimack rivers. Genetic studies indicate that a small, but statistically insignificant amount of genetic exchange likely occurs between the Merrimack River and these rivers in Maine (King et al. 2013). The Merrimack River population is genetically distinct from the Kennebec-Androscoggin-Penobscot population (SSSRT 2010). In the Fall of 2014, a shortnose sturgeon tagged in the Connecticut River in 2001 was captured in the Merrimack River. To date, genetic analysis has not been completed and we do not yet know the river of origin of this fish.

<u>Connecticut River Population</u>
The Holyoke Dam divides the Connecticut River shortnose population; there is currently limited successful passage downstream of the Dam. No shortnose sturgeon have passed upstream of the dam since 1999 and passage between 1975-1999 was an average of four fish per year. The number of sturgeon passing downstream of the Dam is unknown. Despite this separation, the populations are not genetically distinct (Kynard 1997, Wirgin et al. 2005, Kynard et al.2012). The most recent estimate of the number of shortnose sturgeon upstream of the dam, based on captures and tagging from 1990-2005 is approximately 328 adults (CI = 188–1,264 adults; B. Kynard, USGS, unpubl. Data in SSSRT 2010); this compares to a previous Peterson mark-recapture estimate of 370–714 adults (Taubert 1980a). Using four mark-recapture methodologies, the longterm population estimate (1989-2002) for the lower Connecticut River ranges from 1,042-1,580 (Savoy 2004). Comparing 1989-1994 to 1996-2002, the population exhibits growth on the order of 65-138%. The population in the Connecticut River is thought to be stable, but at a small size.

As described in SSSRT (2010), shortnose sturgeon in the Connecticut River inhabit a reach downstream of the Turners Falls Dam (Turners Falls, MA; rkm 198) to Long Island Sound. Construction of the Turners Falls Dam was completed in 1798 and built on a natural falls-rapids. Turners Falls is believed to be the historic upstream boundary of shortnose sturgeon in the Connecticut River; however, there have been anecdotal sightings of sturgeon upstream of the dam and in the summer of 2017 an angler reported a catch of a shortnose sturgeon upstream of the Turners Falls Dam. This information suggests that occasional shortnose sturgeon are present upstream to the dam; however, we have no information on how shortnose sturgeon accessed this reach or how many sturgeon may be present in this area.

While limited spawning may occur below the Holyoke Dam, successful spawning has only been documented upstream of the Holyoke Dam. Abundance of pre-spawning adults was estimated each spring between 1994–2001 at a mean of 142.5 spawning adults (CI =14–360 spawning adults) (Kynard et al. 2012). Overwintering and foraging occur in both the upper and lower portions of the river. Occasionally, sturgeon have been captured in tributaries to the Connecticut River including the Deerfield River and Westfield River. Additionally, a sturgeon tagged in the CT river was recaptured in the Housatonic River (T. Savoy, CT DEP, pers. comm.). Three individuals tagged in the Hudson were captured in the CT, with one remaining in the river for at least one year (Savoy 2004).

Hudson River Population

The Hudson River population of shortnose sturgeon is the largest in the United States. Studies indicated an extensive increase in abundance from the late 1970s (13,844 adults (Dovel et al. 1992), to the late 1990s (56,708 adults (95% CI 50,862 to 64,072; Bain et al. 1998). This increase is thought to be the result of high recruitment (31,000 – 52,000 yearlings) from 1986-1992 (Woodland and Secor 2007). Woodland and Secor examined environmental conditions throughout this 20-year period and determined that years in which water temperatures drop quickly in the fall and flow increases rapidly in the fall (particularly October), are followed by high levels of recruitment in the spring. This suggests that these environmental factors may index a suite of environmental cues that initiate the final stages of gonadal development in spawning adults. The population in the Hudson River exhibits substantial recruitment and is considered to be stable at high levels.

Delaware River-Chesapeake Bay Metapopulation

Shortnose sturgeon range from Delaware Bay up to at least Scudders Falls (rkm 223); there are no dams within the species' range on this river. The population is considered stable (comparing 1981-1984 to 1999-2003) at around 12,000 adults (Hastings et al. 1987 and ERC 2006b). Spawning occurs primarily between Scudders Falls and the Trenton rapids. Overwintering and foraging also occur in the river. Shortnose sturgeon have been documented to use the Chesapeake-Delaware Canal to move from the Chesapeake Bay to the Delaware River.

The current abundance of shortnose sturgeon in the Chesapeake Bay is unknown. Incidental capture of shortnose sturgeon was reported to the USFWS and MDDNR between 1996-2008 as part of an Atlantic Sturgeon Reward Program. During this time, 80 shortnose sturgeon were documented in the Maryland waters of the Bay and in several tidal tributaries. To date, no shortnose sturgeon have been recorded in Virginia waters of the Bay.

Spawning has not been documented in any tributary to the Bay although suitable spawning habitat and two pre-spawning females with late stage eggs have been documented in the Potomac River. Current information indicates that shortnose sturgeon are present year round in the Potomac River with foraging and overwintering taking place there. Shortnose sturgeon captured in the Chesapeake Bay are not genetically distinct from the Delaware River population.

Southeast Metapopulation

There are no shortnose sturgeon between Maryland waters of the Chesapeake Bay and the Carolinas. Shortnose sturgeon are only thought to occur in the Cape Fear River and Yadkin-Pee Dee River in North Carolina and are thought to be present in very small numbers.

The Altamaha River supports the largest known population in the Southeast with successful self-sustaining recruitment. The most recent population estimate for this river was 6,320 individuals (95% CI = 4,387-9,249; DeVries 2006). The population contains more juveniles than expected. Comparisons to previous population estimates suggest that the population is increasing; however, there is high mortality between the juvenile and adult stages in this river. This mortality is thought to result from incidental capture in the shad fishery, which occurs at the same time as the spawning period (DeVries 2006).

The only available estimate for the Cooper River is of 300 spawning adults at the Pinoplis Dam spawning site (based on 1996-1998 sampling; Cooke et al. 2004). This is likely an underestimate of the total number of adults as it would not include non-spawning adults. Estimates for the Ogeechee River were 266 (95%CI=236-300) in 1993 (Weber 1996, Weber et al. 1998); a more recent estimate (sampling from 1999-2004; Fleming et al. 2003) indicates a population size of 147 (95% CI = 104-249). While the more recent estimate is lower, it is not significantly different than the previous estimate. Available information indicates the Ogeechee River population may be experiencing juvenile mortality rates greater than other southeastern rivers.

Spawning is also occurring in the Savannah River, the Congaree River, and the Yadkin-Pee Dee River. There are no population estimates available for these rivers. Occurrence in other southern rivers is limited, with capture in most other rivers limited to fewer than five individuals. They are thought to be extremely rare or possibly extirpated from the St. Johns River in Florida as only a single specimen was found by the Florida Fish and Wildlife Conservation Commission during extensive sampling of the river in 2002/2003. In these river systems, shortnose sturgeon occur in nearshore marine, estuarine, and riverine habitat.

Threats Throughout the Species Range

Because sturgeon are long-lived and slow growing, stock productivity is relatively low; this can make the species vulnerable to rapid decline and slow recovery (Musick 1999). In well studied rivers (e.g., Hudson, upper Connecticut), researchers have documented significant year to year recruitment variability (up to 10 fold over 20 years in the Hudson and years with no recruitment in the CT). However, this pattern is not unexpected given the life history characteristics of the species and natural variability in hydrogeologic cues relied on for spawning.

The small amount of effective movement between populations means recolonization of currently extirpated river populations is expected to be very slow and any future recolonization of any rivers that experience significant losses of individuals would also be expected to be very slow. Despite the significant decline in population sizes over the last century, gene diversity in shortnose sturgeon is moderately high in both mtDNA (Quattro et al. 2002; Wirgin et al. 2005; Wirgin et al. 2000) and nDNA (King et al. 2001) genomes.

A population of sturgeon can go extinct as a consequence of demographic stochasticity (fluctuations in population size due to random demographic events); the smaller the metapopulation (or population); the more prone it is to extinction. Anthropogenic impacts acting on top of demographic stochasticity further increase the risk of extinction.

All shortnose sturgeon populations are highly sensitive to increases in juvenile mortality that would result in chronic reductions in the number of sub-adults as this leads to reductions in the number of adult spawners (Anders et al. 2002; Gross et al. 2002; Secor 2002). Populations of shortnose sturgeon that do not have reliable natural recruitment are at increased risk of experiencing population decline leading to extinction (Secor et al. 2002). Elasticity studies of shortnose sturgeon indicate that the highest potential for increased population size and stability comes from YOY and juveniles as compared to adults (Gross et al. 2002); that is, increasing the number of YOY and juveniles has a more significant long term impact to the population than does increasing the number of adults or the fecundity of adults.

The Shortnose Sturgeon Recovery Plan (NMFS 1998) and the Shortnose Sturgeon Status Review Team's Biological Assessment of shortnose sturgeon (2010) identify habitat degradation or loss and direct mortality as principal threats to the species' survival. Natural and anthropogenic factors continue to threaten the recovery of shortnose sturgeon and include: poaching, bycatch in riverine fisheries, habitat alteration resulting from the presence of dams, in-water and shoreline construction, including dredging; degraded water quality which can impact habitat suitability and result in physiological effects to individuals including impacts on reproductive success; direct mortality resulting from dredging as well as impingement and entrainment at water intakes; and, loss of historical range due to the presence of dams. Shortnose sturgeon are also occasionally killed as a result of research activities. The total number of sturgeon affected by these various threats is not known.

Climate change, particularly shifts in seasonal temperature regimes and changes in the location of the salt wedge, may impact shortnose sturgeon in the future. Hare et al. (2016) assessed the vulnerability to climate change of a number of species that occur along the U.S. Atlantic coast. The authors define vulnerability as "the extent to which abundance or productivity of a species in the region could be impacted by climate change and decadal variability." As described by Hare et al., the effect of climate on shortnose sturgeon populations is not well understood. Like Atlantic sturgeon, shortnose sturgeon were given a Vulnerability Rank of Very High (99% certainty from bootstrap analysis) as well as a Climate Exposure rank of Very High. While many aspects of Shortnose Sturgeon life history and ecology are linked to temperature, river flow, dissolved oxygen, salinity, but the effect of change in these environmental variables on Shortnose Sturgeon is unclear (Cech and Doroshov, 2005; Ziegeweid et al., 2008a, 2008b). At the southern end of their range, productivity could be reduced by salt-water intrusion and decreases in summer dissolved oxygen (Jager et al., 2013). Changes in water availability may also impact the productivity of southern populations of shortnose sturgeon. Studies in the Hudson River indicate that flow volume and water temperature in the fall months preceding spawning were significantly correlated with subsequent year-class strength (Woodland and Secor 2007), which suggests increased vulnerability in some future scenarios. Spawning and rearing habitat may be restricted by increased salt water intrusion in rivers with dams or other barriers that limit access to upstream freshwater reaches; however, no estimates of the impacts of such change are currently available. Hare et al. conclude that the effect of climate change on Shortnose Sturgeon is estimated to be neutral, but this estimate has a high degree of uncertainty (<66% certainty in expert scores) and that climate factors have the potential to decrease (sea level rise; reduced dissolved oxygen) or increase (temperature) productivity of Shortnose Sturgeon. The authors also conclude that the effect of ocean acidification over the next 30 years is likely to be minimal.

Survival and Recovery
The 1998 Recovery Plan outlines 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; the minimum population size for each population has not yet been determined. The Recovery Outline contains three major tasks: (1) establish delisting criteria; (2) protect shortnose sturgeon populations and habitats; and, (3) rehabilitate habitats and population segments. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting and spawning. In many rivers, particularly in the Southeast, habitat is compromised and continues to impact the ability of sturgeon populations to recover. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting and migrations of all individuals. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. The loss of any population or metapopulation would result in the loss of biodiversity and would create (or widen) a gap in the species' range.

Summary of Status
Shortnose sturgeon remain listed as endangered throughout their range, with populations in the Northeast being larger and generally more stable than populations in the Southeast. All populations are affected by mortality incidental to other activities, including dredging, power plant intakes and shad fisheries where those still occur, and impacts to habitat and water quality that affect the ability of sturgeon to use habitats and impacts individuals that are present in those habitats. While the species is overall considered to be stable (i.e., its trend has not changed recently, and we are not aware of any new or emerging threats that would change the trend in the future), we lack information on abundance and population dynamics in many rivers. We also do not fully understand the extent of coastal movements and the importance of habitat in non-natal rivers to migrant fish. While the species has high levels of genetic diversity, the lack of effective movement between populations increases the vulnerability of the species should there be a significant reduction in the number of individuals in any one population or metapopulation as recolonization is expected to be very slow. All populations, regardless of size, are faced with threats that result in the mortality of individuals and/or affect the suitability of habitat and may restrict the further growth of the population. Additionally, there are several factors that combine to make the species particularly sensitive to existing and future threats; these factors include: the small size of many populations, existing gaps in the range, late maturation, the sensitivity of adults to very specific spawning cues which can result in years with no recruitment, and the impact of losses of young of the year and juveniles to population persistence and stability.

4.2 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. Because electrofishing will take place in freshwater, we only expect fish natal to the sampled river to be present. As such, only Atlantic sturgeon from the Gulf of Maine and New York Bight DPSs are expected to occur in the action area.

Species description
Atlantic sturgeon occupy ocean waters and associated bays, estuaries, and coastal river systems from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida (ASMFC 2006; Stein et al. 2004) (Figure 2). Atlantic sturgeon are listed as five distinct population segments under the ESA 77 FR 5880 and 77 FR 5914, February 6, 2012). 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. Therefore, sturgeon originating from any of the five DPSs can be affected by threats in the marine, estuarine and riverine environment that occur far from natal spawning rivers.

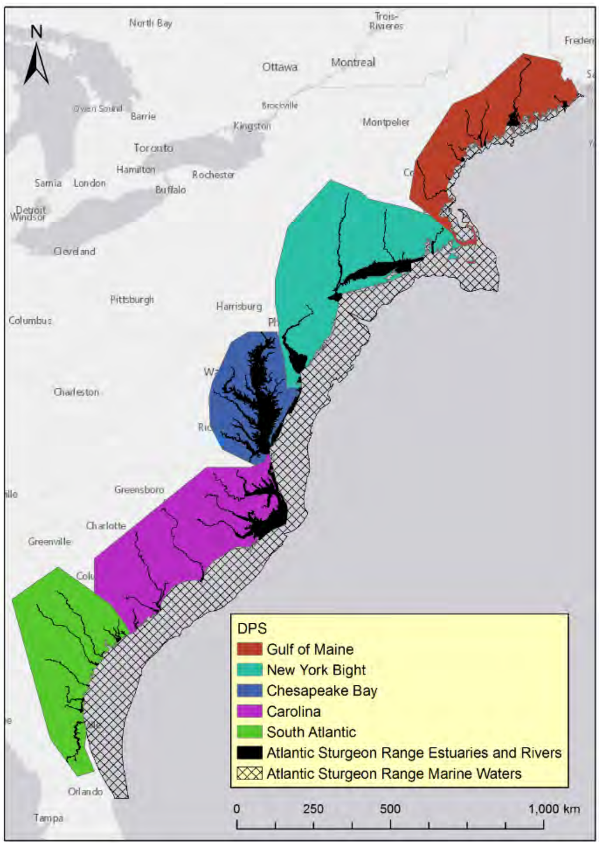
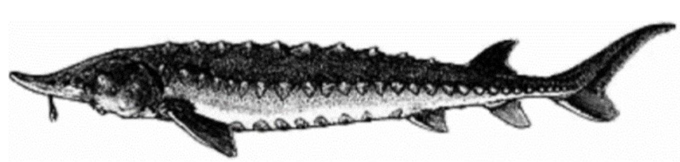


Figure 2. Geographic Range of Atlantic sturgeon

The Atlantic sturgeon is a long-lived, late maturing, anadromous species. Atlantic sturgeon attain lengths of up to approximately 14 feet, and weights of more than 800 pounds. They are bluish black or olive brown dorsally with paler sides and a white ventral surface and have



Adult Atlantic Sturgeon.

five major rows of dermal scutes (Colette and Klein-MacPhee 2002). Five DPSs were listed under the Endangered Species Act on February 6, 2012. The Gulf of Maine DPS was listed as threatened, and the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs were listed as endangered (Table 3).

Table 3 Atlantic sturgeon information bar provides species' Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment, recent status review, and recovery plan.

Distinct Population Segment	**ESA Status**	**Recent Review Year**	**Listing**	**Recovery Plan**	**Critical Habitat**
Gulf of Maine	Threatened	2007	77 FR 5880	No	82 FR 39160
New York Bight	Endangered	2007	77 FR 5880	No	82 FR 39160
Chesapeake	Endangered	2007	77 FR 5880	No	82 FR 39160
Carolina	Endangered	2007	77 FR 5914	No	82 FR 39160
South Atlantic	Endangered	2007	77 FR 5914	No	82 FR 39160

Atlantic sturgeon were once present in 38 river systems and, of these, spawned in 35 of them. Individuals are currently present in 36 rivers, and spawning occurs in at least 20 of these (ASSRT 2007). The decline in abundance of Atlantic sturgeon has been attributed primarily to the large U.S. commercial fishery which existed for the Atlantic sturgeon from the 1870s through the mid 1990s. The fishery collapsed in 1901 and landings remained at between one to five percent of the pre-collapse peak until ASMFC placed a two generation moratorium on the fishery in 1998 (ASMFC 1998). The majority of the populations show no signs of recovery, and new information suggests that stressors such as bycatch, ship strikes, and low DO can and do have substantial impacts on populations (ASSRT 2007). Additional threats to Atlantic sturgeon include habitat degradation from dredging, damming, and poor water quality (ASSRT 2007). Climate change related impacts on water quality (e.g., temperature, salinity, dissolved oxygen, contaminants) have the potential to impact Atlantic sturgeon populations using impacted river systems. These effects are expected to be more severe for southern portions of the U.S. range of Atlantic sturgeon (Carolina and South Atlantic DPSs).

Life history

Atlantic sturgeon size at sexual maturity varies with latitude with individuals reaching maturity in the Saint Lawrence River at 22 to 34 years (Scott and Crossman 1973). Atlantic sturgeon spawn in freshwater, but spend most of their adult life in the marine environment. Spawning adults generally migrate upriver in May through July in Canadian systems (Bain 1997; Caron et al. 2002; Murawski and Pacheco 1977; Smith 1985; Smith and Clugston 1997). Atlantic sturgeon spawning is believed to occur in flowing water between the salt front and fall line of large rivers at depths of three to 27 meters (Bain et al. 2000; Borodin 1925; Crance 1987; Leland 1968; Scott and Crossman 1973). Atlantic sturgeon likely do not spawn every year; spawning intervals range from one to five years for males (Caron et al. 2002; Collins et al. 2000; Smith 1985) and two to five years for females (Stevenson and Secor 2000; Van Eenennaam et al. 1996; Vladykov and Greeley 1963).

Sturgeon eggs are highly adhesive and are deposited on the bottom substrate, usually on hard surfaces (Gilbert 1989; Smith and Clugston 1997) between the salt front and fall line of large rivers (Bain et al. 2000; Borodin 1925; Crance 1987; Scott and Crossman 1973). Following spawning in northern rivers, males may remain in the river or lower estuary until the fall; females typically exit the rivers within four to six weeks (Savoy and Pacileo 2003). Hatching occurs approximately 94 to 140 hours after egg deposition at temperatures of 20 and 18 degrees Celsius, respectively (Theodore et al. 1980). The yolk sac larval stage is completed in about eight to 12 days, during which time larvae move downstream to rearing grounds over a six to 12 day period (Kynard and Horgan 2002). Juvenile sturgeon continue to move further downstream into waters ranging from zero to up to ten parts per thousand salinity. Older juveniles are more tolerant of higher salinities as juveniles typically spend two to five years in freshwater before eventually becoming coastal residents as sub-adults (Boreman 1997; Schueller and Peterson 2010; Smith 1985).

Upon reaching the subadult phase, individuals move to coastal and estuarine habitats (Dovel and Berggren 1983; Murawski and Pacheco 1977; Smith 1985; Stevenson 1997). Tagging and genetic data indicate that subadult and adult Atlantic sturgeon travel widely once they emigrate from rivers. Despite extensive mixing in coastal waters, Atlantic sturgeon exhibit high fidelity to their natal rivers (Grunwald et al. 2008; King et al. 2001; Waldman et al. 2002). Because of high natal river fidelity, it appears that most rivers support independent populations (Grunwald et al. 2008; King et al. 2001; Waldman and Wirgin 1998; Wirgin et al. 2002; Wirgin et al. 2000). Atlantic sturgeon feed primarily on polychaetes, isopods, American sand lances and amphipods in the marine environment, while in fresh water they feed on oligochaetes, gammarids, mollusks, insects, and chironomids (Guilbard et al. 2007; Johnson et al. 1997; Moser and Ross 1995; Novak et al. 2017; Savoy 2007).

2017 ASMFC Stock Assessment

The ASMFC released a new benchmark stock assessment for Atlantic sturgeon in October 2017 (ASMFC 2017a). The assessment used both fishery-dependent and fishery-independent data, as well as biological and life history information. Fishery-dependent data came from commercial fisheries that formerly targeted Atlantic sturgeon (before the moratorium), as well as fisheries that catch sturgeon incidentally. Fishery-independent data were collected from scientific research and survey programs.

At the coastwide and DPS levels, the stock assessment concluded that Atlantic sturgeon are depleted relative to historical levels. The low abundance of Atlantic sturgeon is not due solely to effects of historic commercial fishing, so the ‘depleted’ status was used instead of ‘overfished.’

This status reflects the array of variables preventing Atlantic sturgeon recovery (e.g., bycatch, habitat loss, and ship strikes).

As described in the Assessment Overview, Table 4 shows "the stock status determination for the coastwide stock and DPSs based on mortality estimates and biomass/abundance status relative to historic levels, and the terminal year (i.e., the last year of available data) of indices relative to the start of the moratorium as determined by the ARIMA2 analysis."

Table 4. Stock status determination for the coastwide stock and DPSs (from the ASMFC's Atlantic Sturgeon Stock Assessment Overview, October 2017)

	Mortality Status	Biomass/Abundance Status	
Population	Probability that $Z > Z_{50\%EPR}$ 80%	Relative to Historical Levels	Average probability of terminal year of indices > 1998* value
Coastwide	7%	Depleted	95%
Gulf of Maine	74%	Depleted	51%
New York Bight	31%	Depleted	75%
Chesapeake Bay	30%	Depleted	36%
Carolina	75%	Depleted	67%
South Atlantic	40%	Depleted	Unknown (no suitable indices)

* For indices that started after 1998, the first year of the index was used as the reference value. EPR= Eggs Per Recruit.

Despite the depleted status, the assessment did include signs that the coastwide index is above the 1998 value (95% chance). The Gulf of Maine, New York Bight, and Carolina DPS indices also all had a greater than 50% chance of being above their 1998 value; however, the index from the Chesapeake Bay DPS (highlighted red) only had a 36% chance of being above the 1998 value. There were no representative indices for the South Atlantic DPS. Total mortality from the tagging model was very low at the coastwide level. Small sample sizes made mortality estimates at the DPS level more difficult. The New York Bight, Chesapeake Bay, and South Atlantic DPSs all had a less than 50% chance of having a mortality rate higher than the threshold. The Gulf of Maine and Carolina DPSs (highlighted red) had 74%-75% probability of being above the mortality threshold (ASMFC 2017a).

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). 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

2 "The ARIMA (Auto-Regressive Integrated Moving Average) model uses fishery-independent indices of abundance to estimate how likely an index value is above or below a reference value" (ASMFC 2017a).

Waldman 1999).

Because a DPS is a group of populations, the stability, viability, and persistence of individual populations that make up the DPS can affect the persistence and viability of the larger DPS. The loss of any population within a DPS could result in: (1) a long-term gap in the range of the DPS that is unlikely to be recolonized; (2) loss of reproducing individuals; (3) loss of genetic biodiversity; (4) loss of unique haplotypes; (5) loss of adaptive traits; and (6) reduction in total number. The persistence of individual populations, and in turn the DPS, depends on successful spawning and rearing within the freshwater habitat, emigration to marine habitats to grow, and return of adults to natal rivers to spawn.

Based on the best available information, we 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 likely originate from the Gulf of Maine DPS, with a smaller percentage from the New York Bight DPS.

Individuals from all 5 DPSs are caught as bycatch in fisheries operating in U.S. waters. 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%.

Hare et al. (2016) assessed the vulnerability to climate change of a number of species that occur along the U.S. Atlantic coast. The authors define vulnerability as "the extent to which abundance or productivity of a species in the region could be impacted by climate change and decadal variability." Atlantic sturgeon were given a Vulnerability Rank of Very High (99% certainty from bootstrap analysis) as well as a Climate Exposure rank of Very High. Three exposure factors contributed to this score: Ocean Surface Temperature (4.0), Ocean Acidification (4.0) and Air Temperature (4.0). The authors concluded that Atlantic Sturgeon are relatively invulnerable to distribution shifts and that while the effect of climate change on Atlantic Sturgeon is estimated to be negative, there is a high degree of uncertainty with this prediction. Secor and Gunderson (1998) found that juvenile metabolism and survival were impacted by increasing hypoxia in combination with increasing temperature. Niklitschek and Secor (2005) used a multivariable bioenergetics and survival model to generate spatially explicit maps of potential production in the Chesapeake Bay; a 1°C temperature increase reduced productivity by 65% (Niklitschek and Secor 2005). These studies highlight the importance of the availability of water with suitable temperature, salinity and dissolved oxygen; climate conditions that reduce the amount of available habitat with these conditions would reduce the productivity of Atlantic sturgeon. Changes in water availability may also impact the productivity of southern populations of Atlantic sturgeon. Spawning and rearing habitat may be restricted by increased salt water intrusion in rivers with dams or other barriers that limit access to upstream freshwater reaches; however, no estimates of the impacts of such change are currently available. Hare et al. conclude that most climate factors have the potential to decrease productivity (sea level rise; reduced dissolved oxygen, increased temperatures) but that understanding the magnitude and interaction of different effects is difficult. The effect of ocean acidification over the next 30 years is predicted to be minimal.

4.2.1 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 occurs in the Kennebec River, and it is possible that it occurs in the Penobscot River as well. The capture of a larval Atlantic sturgeon in the Androscoggin River below the Brunswick Dam in the spring of 2011 indicates spawning may also occur in that river. There is no evidence of recent spawning in the remaining 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 (ASSRT 2007; Fernandes *et al.* 2010).

The current status of the Gulf of Maine DPS is affected by historical and modern fisheries dating as far back as the 1800s (Squiers *et al.* 1979; Stein *et al.* 2004; ASMFC 2007). Incidental capture of Atlantic sturgeon in state and Federal fisheries continues today. 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. Dredging can also result in the mortality of individuals. 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. We 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.

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.

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 the Kennebec River. Recent collection of an Atlantic sturgeon larva in the Androscoggin indicates spawning may occur there as well. 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, the Veazie Dam on the Penobscot River). 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.

4.2.2 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. There is no recent evidence (within the last 15 years) of spawning in the Taunton River (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).

In 2014, several presumed age-0 Atlantic sturgeon were captured in the Connecticut River; the available information indicates that successful spawning took place in 2013 by a small number of adults. Genetic analysis of the juveniles indicates that the adults were likely migrants from the South Atlantic DPS (Savoy et al. 2017). As noted by the authors, this conclusion is counter to prevailing information regarding straying of adult Atlantic sturgeon. As these captures represent the only contemporary records of possible natal Atlantic sturgeon in the Connecticut River and the genetic analysis is unexpected, more information is needed to establish the frequency of spawning in the Connecticut River and whether there is a unique Connecticut River population of Atlantic sturgeon.

The abundance of the Hudson River Atlantic sturgeon riverine population prior to the onset of expanded exploitation in the 1800s 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. A decline in the abundance of young Atlantic sturgeon appeared to occur in the mid to late 1970s followed by a secondary drop in the late 1980s (Kahnle *et al.* 1998; Sweka *et al.*,2007; ASMFC 2010). At the time of listing, catch-per-unit-effort (CPUE) data suggested that recruitment remained depressed relative to catches of juvenile Atlantic sturgeon in the estuary during the mid-late 1980s (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 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. Standardized mean catch per net set from the NYSDEC juvenile Atlantic sturgeon survey have had a general increasing trend from 2006 – 2015, with the exception of a dip in 2013.

In addition to capture in fisheries operating in Federal waters, bycatch and mortality also occur in state fisheries; however, the primary fishery that impacted juvenile sturgeon (shad) in the Hudson River, has now been closed and there is no indication that it will reopen soon. In the Hudson River, sources of potential mortality include vessel strikes and entrainment in dredges. Individuals are also exposed to effects of bridge construction (including the replacement of the Tappan Zee Bridge). Impingement at water intakes, including the Danskammer, Roseton and Indian Point power plants also occurs. Recent information from surveys of juveniles (see above) indicates that the number of young Atlantic sturgeon in the Hudson River is increasing compared to recent years, but is still low compared to the 1970s. There is currently not enough information regarding any life stage to establish a trend for the entire Hudson River population.

There is no abundance estimate for the Delaware River population of Atlantic sturgeon. Harvest records from the 1800s 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 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, and four fish were entrained in the Delaware River during maintenance and deepening activities in 2017 and 2018. At this time, we do not have any additional information to quantify the number of Atlantic sturgeon killed or disturbed during dredging or in-water construction projects. We 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.

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. Additionally, 138 sturgeon carcasses were observed on the Hudson River and reported to the NYSDEC between 2007 and 2015. Of these, 69 are suspected of having been killed by vessel strike. Genetic analysis has not been completed on any of these individuals to date, given that the majority of Atlantic sturgeon in the Hudson River belong to the New York Bight DPS, we assume that the majority of the dead sturgeon reported to NYSDEC belonged to the New York Bight DPS. Given the time of year in which the fish were observed (predominantly May through July), it is likely that many of the adults were migrating through the river to the spawning grounds.

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. We 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.

4.3 Status of the Gulf of Maine DPS of Atlantic salmon

The GOM DPS of anadromous Atlantic salmon was initially listed by USFWS and NMFS (collectively, the Services) as an endangered species on November 17, 2000 (65 FR 69459). A subsequent rule issued by the Services (74 FR 29344, June 19, 2009) expanded the geographic range for the GOM DPS of Atlantic salmon. The GOM DPS of Atlantic salmon is defined as 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 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, as well as private watershed-based facilities (Downeast Salmon Federation's East Machias and Pleasant River facilities). 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).

Coincident with the June 19, 2009 endangered listing, we designated critical habitat for the GOM DPS of Atlantic salmon (74 FR 29300; June 19, 2009). 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).

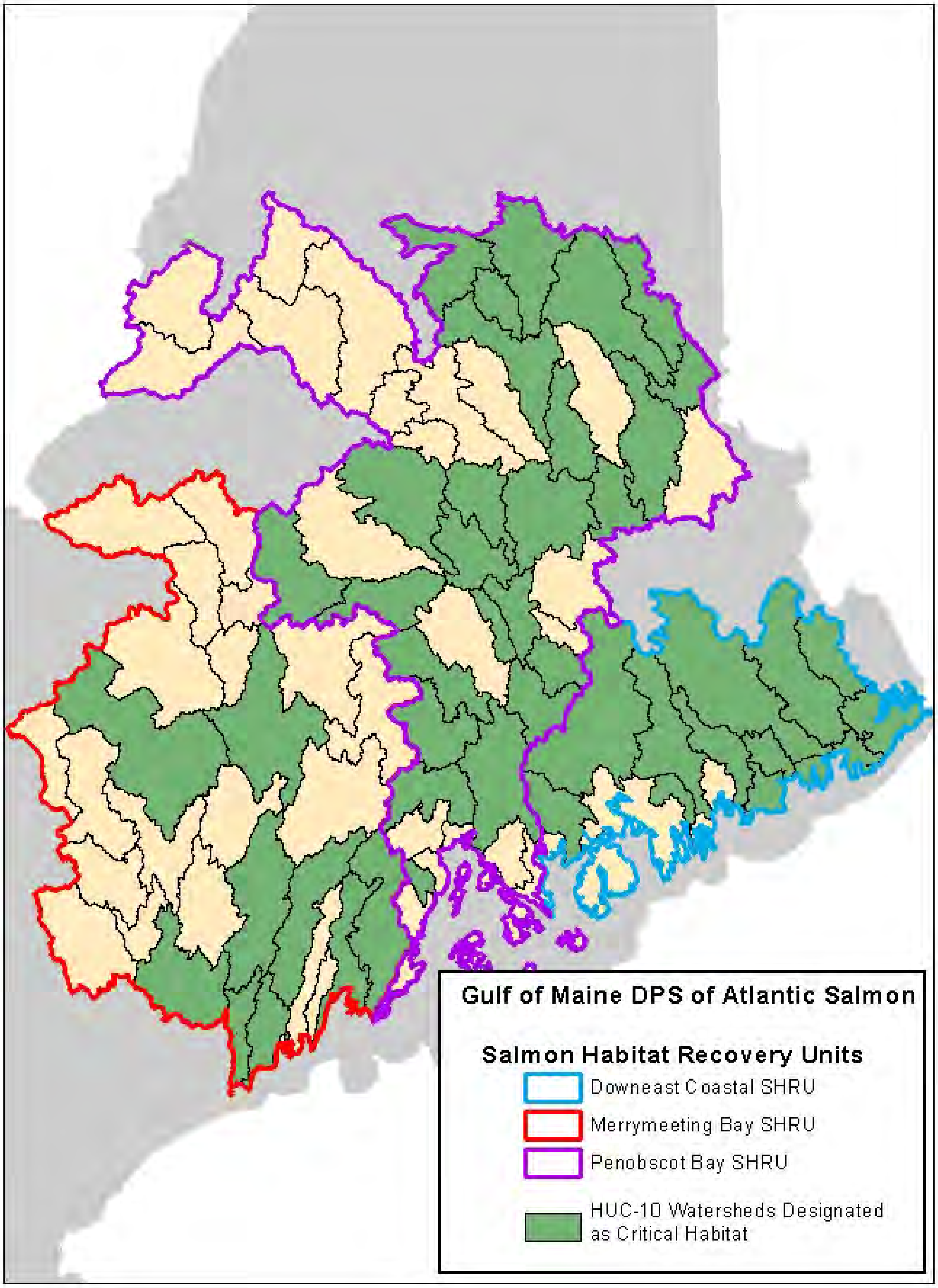


Figure 3. Gulf of Maine DPS of Atlantic salmon habitat recovery units and designated critical habitat.

Life History

Atlantic salmon spend most of its adult life in the ocean and returns to freshwater to reproduce. Atlantic salmon have a complex life history that includes territorial rearing in rivers to extensive feeding migrations on the high seas (Figure 4). During their life cycle, Atlantic salmon go through several distinct phases that are identified by specific changes in behavior, physiology, morphology, and habitat requirements.

Spawning

Adult Atlantic salmon return to rivers in Maine from the Atlantic Ocean and migrate to their natal streams to spawn. 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), but may enter at any time between early spring and late summer. Early migration is an adaptive trait that ensures adults have sufficient time to reach spawning areas (Bjornn and Reiser 1991). Salmon that return in early spring spend nearly five 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.

From mid-October to mid-November, adult females select sites in rivers and streams 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 and water velocity is increasing (McLaughlin and Knight 1987; White 1942). The female salmon creates an egg pit (redd) by digging into the substrate with her tail and then deposits eggs while male salmon release sperm to fertilize the eggs. After spawning, the female continues digging upstream of the last deposition site, burying the fertilized eggs with clean gravel. Females produce a total of 1,500 to 1,800 eggs per kilogram of body weight, yielding an average of 7,500 eggs per two sea-winter (SW) female (an adult female that has spent two winters at sea before returning to spawn) (Baum and Meister 1971). After spawning, male and female Atlantic salmon either return to sea immediately or remain in fresh water until the following spring before returning to the sea (Fay *et al.* 2006).

After spawning, the adults (“kelts”) move downstream toward the sea. Movement may be triggered by increased water temperatures or flows. Some migrate toward the sea immediately, either moving partway downstream or returning to the ocean (Ruggles 1980; Don Pugh, U.S. Geological Survey (USGS) personal communication). Most kelts, however, overwinter in the river and return to the sea in the spring. Kelts that remain in the river appear to survive well through the winter (Ruggles 1980; Jonsson et al. 1990). The relative survival of kelts, however, has not been calculated for Maine rivers. After reaching the ocean, few kelt survive as indicated by the lack of repeat spawners in the GOM DPS (NMFS and USFWS 2005).

Eggs

The fertilized eggs develop in the redd for a period of 175 to 195 days, hatching in late March or April (Danie *et al.*1984).

Alevins and Fry

Newly hatched salmon, also referred to as sac fry, remain in the redd for approximately six weeks after hatching and are nourished by their yolk sacs (Gustafson-Greenwood and Moring 1991). In three to six weeks, they consume most of their yolk sac, travel to the surface to gulp air to fill their swim bladders, and begin to swim freely; at this point they are called "fry." Survival from the egg to fry stage in Maine is estimated to range from 15 to 35% (Jordan and Beland 1981).

Parr

When fry reach approximately 4 cm in length, the young salmon are termed "parr" (Danie *et al.* 1984). Most parr remain in the river for two to three 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."

Smolts

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). The spring migration of smolts to the marine environment takes 25 to 45 days. Most smolts migrate rapidly, exiting the estuary within several tidal cycles (Hyvarinen *et al.* 2006; Lacroix and McCurdy 1996; Lacroix *et al.* 2004, 2005).

Based on NMFS Penobscot River smolt trapping studies in 2000 - 2005, smolts migrate between late April and early June with a peak in early May (Fay *et al.* 2006). These data also demonstrate that the majority of the smolt migration appears to take place over a two-week period after water temperatures rise to 10°C. Timing of smolt migrations may differ amongst rivers within the GOM DPS.

Post-smolts

Smolts are termed post-smolts after ocean entry to the end of the first winter at sea (Allan and Ritter 1977). 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 some aggregation and common migration corridors related to surface currents (Hyvarinen *et al.* 2006; Lacroix and McCurdy 1996; Lacroix *et al.* 2004). Post-smolt distribution may reflect water temperatures (Reddin and Shearer 1987) and/or the major surface-current vectors (Lacroix and Knox 2005). Post-smolts travel mainly at the surface of the water column (Renkawitz *et al.* 2012) and may form shoals, possibly of fish from the same river (Shelton *et al.* 1997). Post-smolts grow quickly, achieving lengths of 30-35 cm by October (Baum 1997). Smolts can experience high mortality during the transition to saline environments for reasons that are not well understood (Kocik *et al.* 2009; Thorstad *et al.* 2012).

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° N. and 58°N. (Reddin 1985; Reddin and Short 1991; Reddin and Friedland 1993, Sheehan *et al.* 2012). Atlantic salmon located off Greenland are primarily composed of non-maturing first sea winter (1SW) fish, which are likely to spawn after their second sea winter (2SW), from both North America and Europe, plus a smaller component of previous spawners who have returned to the sea prior to their next spawning event (Reddin 1988; Reddin *et al.* 1988). The following spring, 1SW and older fish 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).

Adults

Some salmon may remain at sea for another year or more before maturing. After their second winter at sea, the salmon likely 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.

The average size of Atlantic salmon is 71-76 cm (28-30 inches) long and 3.6-5.4 kg (8-15 pounds) after two to three years at sea. Although uncommon, adults can grow to be as large as 30 pounds (13.6 kg). The natural life span of Atlantic salmon ranges from two to eight years (ASBRT 2006). Following spawning in the fall, Atlantic salmon kelts may immediately return to the sea, or over-winter in freshwater habitat and migrate in the spring, typically April or May (Baum 1997).

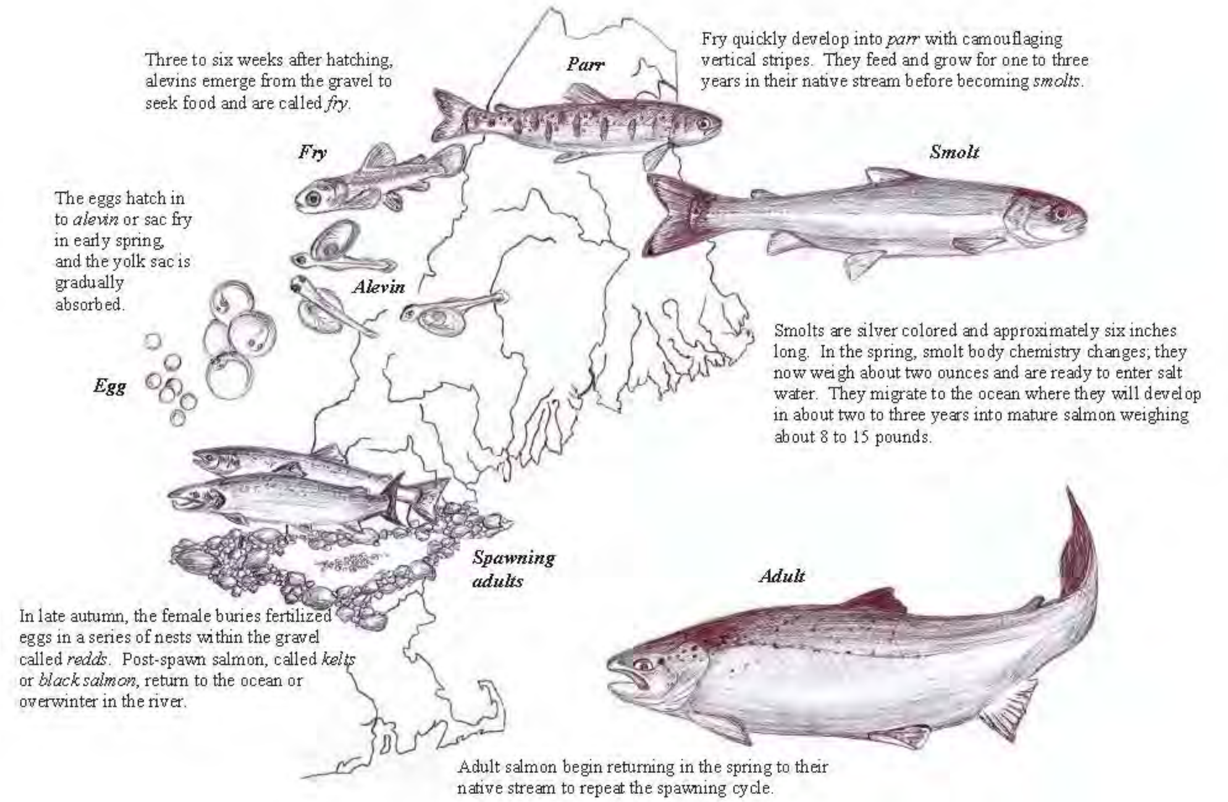


Figure 4. Life Cycle of the Atlantic salmon (diagrams courtesy of Katrina Mueller).

Reproduction, Distribution, and Abundance of Atlantic salmon

The reproduction, distribution, and abundance of Atlantic salmon within the range of the GOM DPS have been generally declining since the 1800s (Fay *et al.* 2006). A comprehensive time series of adult returns to the GOM DPS dating back to 1967 exists (Fay *et al.* 2006, USASAC 2013). 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 estimates of abundance for the entire GOM DPS have rarely exceeded 5,000 individuals in any given year since 1967 (Fay *et al.* 2006, USASAC 2013).

After a period of population growth between the 1970s and the early 1980s, adult returns of salmon in the GOM DPS peaked between approximately 1984 and 1991 before declining during the 2000s. Adult returns fluctuated over the last few years, with increases observed from 2008 to 2011, and a decrease again in 2012, 2013, and 2014 (Figure 5). Presently, the majority of all adults in the GOM DPS return to a single river, the Penobscot, which accounted for over 90% of all adult returns to the GOM DPS over the last decade. The population growth observed in the 1970s is likely attributable to favorable marine survival and increases in hatchery capacity, particularly from GLNFH (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 the 1990s and early 2000s. The increase in abundance of returning adult salmon observed between 2008 and 2011 may be an indication of improving marine survival; however the declines in 2012 - 2014 may suggest otherwise. Returns to U.S. waters in 2013 were only 611 fish (the sum of documented returns to traps and returns estimated by redd counts on selected Maine rivers), which ranks 43rd in the 47-year time-series (USASAC 2014). Estimated returns to USA rivers in 2016 totaled 626 and ranks 24 out of 26 years for the 1991-2016 time series. The returns in 2017 were much higher at 925 (USASAC 2018). Despite consistent smolt production, there has been extreme variability in annual returns over the last five years (See Figure 5 below).

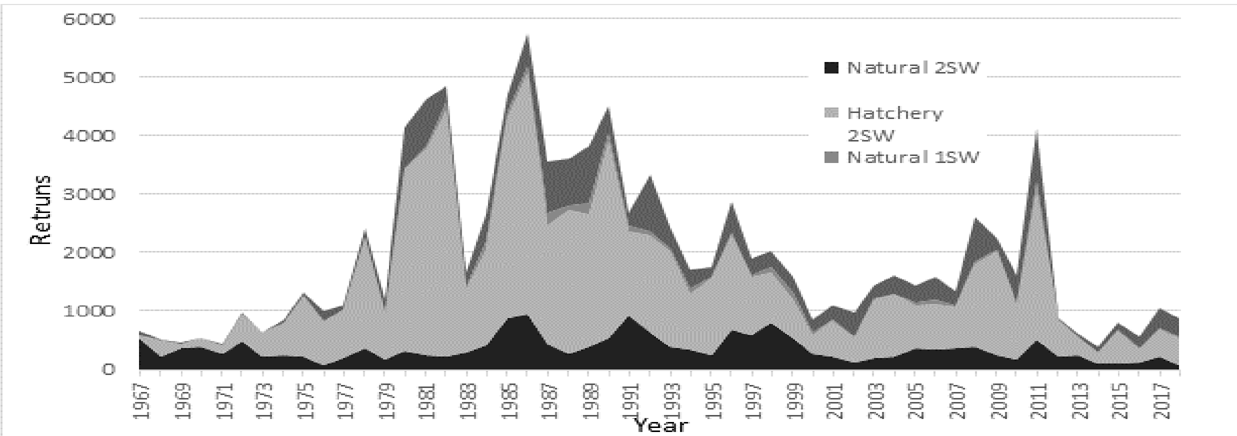


Figure 5. Summary of natural vs. hatchery adult salmon returns to the GOM DPS Rivers between 1967 and 2018 (USASAC 2019).

Since 1967 when numbers of adult returns were first recorded, the vast majority of adult returns have been the result of smolt stocking; only a small portion of returning adults were naturally reared (Figure 5). Natural reproduction of the species is contributing to only a fraction of Atlantic salmon returns to the GOM DPS. 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. Low abundances of both hatchery-origin and naturally reared adult salmon returns to Maine demonstrate continued poor marine survival.

The abundance of Atlantic salmon in the GOM DPS has been low, and the trend has been 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), but appears stable. The conservation hatchery program has assisted in slowing the decline and helping to stabilize populations at low levels. However, stocking of hatchery fry and smolts has not contributed to an increase in the overall abundance of salmon and, as yet, has not been able to increase the naturally reared component of the GOM DPS. Continued reliance on the conservation hatchery program is expected to prevent extinction in the short term, but recovery of the GOM DPS will not be accomplished without significant increases in naturally reared salmon.

The historic distribution of Atlantic salmon in Maine has been described extensively by Baum

(1997) and Beland (1984), among others. In short, substantial populations of Atlantic salmon existed in nearly every river in Maine that was large enough to maintain a spawning population. The upstream extent of the species' distribution extended far into the headwaters of even the largest rivers. Today, the spatial structure of Atlantic salmon is limited by obstructions to passage and also by low abundance levels and the majority of all adults return to the Penobscot River. Within the range of the GOM DPS, the Kennebec, Androscoggin, Union, and Penobscot Rivers contain dams that severely limit passage of salmon to significant amounts of spawning and rearing habitat. Atlantic salmon presently have unobstructed access to only about 5% of their historic habitat in the Penobscot River (NOAA 2009).

Salmon Habitat Recovery Units
As part of the 2009 GOM DPS listing and designation of critical habitat, we defined three Salmon Habitat Recovery Units (SHRU): the Merrymeeting Bay SHRU, the Penobscot Bay SHRU, and the Downeast SHRU (Figure 3). As defined in the Endangered Species Consultation Handbook[3], a Recovery Unit is a "management subset of the listed species that is created to establish recovery goals or carry out management actions." The NMFS Interim Recovery Plan Guidance[4] goes on to state that recovery units are frequently managed as management units, though makes the distinction that recovery units are deemed necessary to both the survival and recovery of the species, whereas management units are defined as not always being "necessary" to both the survival and recovery.

Merrymeeting Bay SHRU

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 352,000 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.

Downeast Coastal SHRU

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

3 http://www.nmfs.noaa.gov/pr/pdfs/laws/esa_section7_handbook.pdf
4 http://www.nmfs.noaa.gov/pr/pdfs/recovery/guidance.pdf

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 10s in the Downeast Coastal SHRU and collectively account for approximately 40 percent of the spawning and rearing habitat in the Downeast Coastal SHRU.

Penobscot Bay SHRU

The mainstem Penobscot has the highest biological value to the Penobscot SHRU because it provides a central migratory corridor crucial for the entire Penobscot SHRU. 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 Penobscot SHRU. A combined total of 20 FERC-licensed hydropower dams in the Penobscot SHRU significantly impede the migration of Atlantic salmon and other diadromous fish to nearly 300,000 units of historically accessible spawning and rearing habitat. Agriculture and urban development largely affect the lower third of the Penobscot SHRU below the Piscataquis River sub-basin by reducing substrate and cover, reducing water quality, and elevating water temperatures. Introductions of smallmouth bass and other non-indigenous species significantly degrade habitat quality throughout the mainstem Penobscot and portions of the Mattawamkeag, Piscataquis, and lower Penobscot sub-basins by altering predator/prey relationships. Similar to smallmouth bass, recent Northern pike introductions threaten habitat in the lower Penobscot River. Of the 323,700 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). Of the 211,000 occupied units within the Penobscot SHRU, NMFS calculated these units to be the equivalent of nearly 66,300 functional units or approximately 20 percent of the historical functional potential.

Survival and Recovery of the GOM DPS

In January, 2019, the USFWS and NMFS issued the final recovery plan for the 2009 expanded listing of the GOM DPS of Atlantic salmon (USFWS and NMFS 2018). The 2018 Final Recovery Plan presents a new recovery planning approach (termed the Recovery Planning and Implementation, or RPI) which has been adopted by the USFWS. RPI plans focus on the statutory elements of recovery criteria, recovery actions, and time and cost estimates. The 2018 plan presents a recovery strategy based on the biological and ecological needs of the species as well as current threats and conservation accomplishments that affect its long-term viability. The recovery plan issued in 2019 wholly supersedes the recovery plan approved in 2005 for the DPS listed in 2000 (NMFS and USFWS, 2005).

The overall goal of the 2018 recovery plan is to remove the GOM DPS of Atlantic salmon from the Federal List of Endangered and Threatened Wildlife. The interim goal is to reclassify the DPS from endangered to threatened status. Provided below are the biological criteria for reclassification and delisting.

Biological Criteria for Reclassification – Reclassification of the GOM DPS from endangered to threatened will be considered when all of the following biological criteria are met:

- *Abundance*: The DPS has total annual returns of at least 1,500 adults originating from wild origin, or hatchery stocked eggs, fry or parr spawning in the wild, with at least 2 of the 3 SHRUs having a minimum annual escapement of 500 naturally reared adults.
- *Productivity*: Among the SHRUs that have met or exceeded the abundance criterion, the population has a positive mean growth rate greater than 1.0 in the 10-year (two-generation) period preceding reclassification.
- *Habitat*: In each of the SHRUs where the abundance and productivity criterion have been met, there is a minimum of 7,500 units of accessible and suitable spawning and rearing habitats capable of supporting the offspring of 1,500 naturally reared adults.

Biological Criteria for Delisting - Delisting of the GOM DPS will be considered when all of the following criteria are met:

- *Abundance*: The DPS has a self-sustaining annual escapement of at least 2,000 wild origin adults in each SHRU, for a DPS-wide total of at least 6,000 wild adults.
- *Productivity*: Each SHRU has a positive mean population growth rate of greater than 1.0 in the 10-year (two-generation) period preceding delisting. In addition, at the time of delisting, the DPS demonstrates self-sustaining persistence, whereby the total wild population in each SHRU has less than a 50-percent probability of falling below 500 adult wild spawners in the next 15 years based on population viability analysis (PVA) projections.
- *Habitat*: Sufficient suitable spawning and rearing habitat for the offspring of the 6,000 wild adults is accessible and distributed throughout the designated Atlantic salmon critical habitat, with at least 30,000 accessible and suitable Habitat Units in each SHRU, located according to the known migratory patterns of returning wild adult salmon. This will require both habitat protection and restoration at significant levels.

Summary of Rangewide Status of Atlantic salmon

The GOM DPS of Atlantic salmon currently exhibits critically low spawner abundance, poor marine survival, and is confronted with a variety of additional threats. The abundance of GOM DPS Atlantic salmon has been low and either stable or declining over the past several decades. The proportion of fish that are of natural origin is extremely low (approximately 6% over the last ten years) and is continuing to decline. The spatial distribution of the GOM DPS has been severely reduced relative to historical distribution patterns. The conservation hatchery program assists in slowing the decline and helps 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. Continued reliance on the conservation hatchery program could prevent extinction in the short term, but recovery of the GOM DPS must be accomplished through increases in naturally reared salmon.

Threats Faced by Atlantic Salmon Throughout Their Range

Atlantic salmon face a number of threats to their survival, most of which are outlined in the

Recovery Plan (NMFS and USFWS 2018) and the latest status review (Fay *et al.* 2006). We consider the following to be the most significant threats to the GOM DPS of Atlantic salmon:

- 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
- 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
- Recovery hatchery program (potential for artificial selection/domestication)
- Sedimentation of spawning and rearing habitat
- Water extraction
- Diseases
- Predation
- Greenland Mixed Stock Fishery.

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.

Starting in the 1960s, Greenland implemented a mixed stock Atlantic salmon fishery off its western coast (Sheehan *et al.* 2015). The fishery primarily takes 1 sea winter (1 SW) North American and European origin Atlantic salmon that would potentially return to natal waters as mature, 2 SW spawning adults or older. Because of international concerns that the fishery would have deleterious on the contributing stock complexes, a quota system was agreed upon and implemented in 1976, and since 1984, catch regulations have been established by the North Atlantic Salmon Conservation Organization (NASCO) (Sheehan *et al*. 2015). In recent years, Greenland had limited the mixed stock salmon fishery for internal consumption only, which in the past has been estimated at 20 metric tons.

In 2015, Greenland unilaterally set a 45-ton commercial quota for 2015, 2016, and 2017 (Sheehan et al. 2015). Based on historic harvest estimates, it is estimated that on average, approximately 100 adult salmon of U.S. origin would be harvested annually under a 45-ton quota. With recent U.S. returns of Atlantic salmon averaging less than 1,500 individuals per year, the majority of which originated from hatcheries, this harvest constitutes a substantial threat to the survival and recovery of the GOM DPS. As such, the United States continued to negotiate with the government of Greenland and participants of the fishery both within and outside of NASCO to ultimately establish a new regulatory measure in 2018.

The new regulatory measure agreed to in 2018 includes a 30-ton quota and a number of elements that, if well implemented, will significantly improve the management and control of the fishery. For example, all fishers for Atlantic salmon in Greenland, including both private and commercial fishers, will now be required to obtain a license. All fishers will also be required to provide an accurate and detailed report of their fishing activities and landings, including no fishing effort and zero landings, prior to receiving a license to fish the following year. These requirements provide increased confidence in the accuracy of the reported landings and fishing activities moving forward.

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, throughout the Gulf of Maine.

Hare et al. (2016) gave Atlantic salmon a Vulnerability Rank of Very High (100% certainty from bootstrap analysis) as well as a Climate Exposure rank of Very High and Distributional Vulnerability Rank of Moderate (87% certainty from bootstrap analysis). The authors conclude that the effect of climate change on Atlantic salmon in the Northeast U.S. Shelf Ecosystem is very likely to be negative (>95% certainty in expert scores) due to the effects of warming on freshwater and marine habitats and the potential to effect the phenology of Atlantic salmon migration. Ocean acidification could also affect olfaction, which Atlantic salmon use for natal homing.

As described in Hare et al., several studies have examined the effects of climate on the abundance and distribution of Atlantic salmon. In a review, Jonsson and Josson (2009) concluded that the thermal niche of Atlantic salmon will likely shift northward causing decreased production and possibly extinction at the southern end of the range. The Gulf of Maine DPS is the southernmost populations of Atlantic salmon in the Northwest Atlantic Ocean. Friedland et al. (2014) found that declines in post-smolt survival were associated with ocean Warming and hypothesized that in the Northwest Atlantic, the decline in survival was a result of early ocean migration by post-smolts. Mills et al. (2013) suggested that poor trophic conditions, likely due to climate-driven environmental factors, and warmer ocean temperatures are constraining the productivity and recovery of Atlantic Salmon in the Northwest Atlantic. Available evidence suggests that climate change and long-term climate variability will reduce the productivity of the Gulf of Maine DPS of Atlantic Salmon.

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.

5.0 ENVIRONMENTAL BASELINE

The Environmental Baseline provides a snapshot of a species health or status at a given time within the action area and is used as a biological basis upon which to analyze the effects of the proposed action. Assessment of the environmental baseline includes an analysis of 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).

Shortnose and Atlantic sturgeon and their habitat in the Penobscot, Kennebec, Merrimack, Connecticut and Hudson rivers have been affected by several different factors including: impaired water quality from both point and non-point sources; incidental take in scientific studies and commercial and recreational fisheries; construction and demolition of bridges; dredging activities; impingement and entrainment at water intakes, and, the operation of hydroelectric and other dams and electric generating facilities. Atlantic sturgeon are also exposed to fisheries in the marine environment where they can be incidentally caught and killed. A number of formal ESA section 7 consultations consider the effects of a variety of activities in these rivers. In all cases, we have concluded that the effects of the proposed actions analyzed in consultations are likely to adversely affect but not likely to jeopardize the continued existence of these sturgeon species. The effects of state or private actions that are contemporaneous with the proposed IBI survey are largely limited to state fisheries and anthropogenic activities that impact water quality. We do not have any quantitative analysis of the effects of these activities on shortnose or Atlantic sturgeon but anticipate at least occasional bycatch and poaching in the action area. In many areas water quality impacts the suitability and availability of habitat for important life functions. In some rivers, including the Hudson River, vessel strikes are a serious concern with a number of shortnose and Atlantic sturgeon killed each year.

Over the life of the action, shortnose and Atlantic sturgeon in the action area will 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 current trends. Given the short duration of the proposed action we expect that numbers of shortnose and Atlantic sturgeon in the action area will be stable over the life of the action.

Atlantic salmon

The action area for this consultation includes sample sites in rivers and streams within the geographic range of Atlantic salmon in each of the three SHRUs (Table 6). 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 in the action area and since the action will occur in rivers and streams throughout the species range, the status of the species rangewide is appropriate to incorporate into this analysis for these activities. However, for establishing the Environmental Baseline for this proposed project action area; since we do not have reach specific information for each sample site, the list of rivers and streams have been broken into SHRU specific regions with the status of the species and habitat in each of the SHRUs summarized below.

Therefore, in order to complete the jeopardy and destruction or adverse modification of critical habitat analyses in this Opinion, we made several assumptions regarding the environmental baseline in each of the SHRUs. These assumptions include the following: 1) overall abundance of Atlantic salmon is very low and is orders of magnitude lower than historic abundance levels; 2) the percentage of naturally reared fish versus those from hatchery supplementation efforts is low throughout the GOM DPS; 3) low marine survival is negatively affecting the entire GOM DPS and contributing to low numbers of adult returns to all rivers; 4) Atlantic salmon abundance in each site will vary depending on the location relative ongoing conservation hatchery stocking locations, accessible salmon habitat and known spawning activity; 5) throughout the GOM DPS access to and quality of salmon habitat is often affected by dams and poorly designed road-stream crossings, limiting the current function of migration, spawning and rearing habitats.

Table 6. List of occupied salmon rivers and streams proposed for sampling within each SHRU

E. Br. Penobscot River	Penobscot SHRU
Wesserunsett Stream	Penobscot SHRU
Piscataquis River	Penobscot SHRU
E. Br. Penobscot River	Penobscot SHRU
Ducktrap Tributary	Penobscot SHRU
Gordon Brook	Penobscot SHRU
Seboeis River	Penobscot SHRU
Penobscot River (2)	Penobscot SHRU
Ragged Brook	Penobscot SHRU
Kennebec River	Merrymeeting Bay SHRU
Kennebec River (2)	Merrymeeting Bay SHRU
Kennebec River (3)	Merrymeeting Bay SHRU
Crocker Brook	Downeast SHRU
Naraguagus River	Downeast SHRU
Machias River	Downeast SHRU
Machias river (2)	Downeast SHRU

Summary of Atlantic salmon and its critical habitat in the action area

Adult returns for the entire GOM DPS remain well below conservation spawning escapement (CSE) and for each SHRU have not reached the full production potential of accessible vacant habitat. 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. More recently, adult returns to the Penobscot Bay SHRU has increased, with over 1100 fish returning to the river in 2019. Most of the returning adults in the Penobscot river originate from a hatchery stocking program which has led to the proportion of returning fish that are of hatchery origin very large, with the natural origin being very small (approximately 6% over the last ten years) and is continuing to decline due to low natural reproduction. 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 each of the SHRUs 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. Existing dams have contributed to degraded substrate and cover, water quality, water temperature, and changed biological communities which have reduced the quality and quantity of habitat available to Atlantic salmon populations within the entire GOM DPS; resulting in a decrease in productivity and abundance of juvenile life stages in each of the SHRUs.

Downeast Coastal SHRU

The Downeast Coastal SHRU encompasses fourteen HUC 10 watersheds covering approximately 1,852,549 acres within Washington and Hancock Counties in Eastern Maine. Within this SHRU there are several watersheds actively managed for Atlantic salmon including the Dennys, Machias, East Machias, Pleasant, Narraguagus, and Union rivers. As a complex, these rivers are typically small to moderate sized coastal drainages in the Laurentian Mixed Forest Province ecoregion (Bailey 1995). This commonality of zoogeographic classification makes coarse level descriptions of watersheds very similar between the rivers. The watersheds of the Downeast Coastal SHRU are best known for containing five watersheds with extant Atlantic salmon populations. The Downeast Coastal SHRU once contained high quality Atlantic salmon habitat in quantities sufficient to support robust Atlantic salmon populations. Degradation of habitat and the construction of dams have diminished both habitat quality and availability. In the Downeast Coastal SHRU, there are approximately 61,400 units of historical spawning and rearing habitat for Atlantic salmon among approximately 6,039 km of rivers, lakes and streams. 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.

Penobscot Bay SHRU

The Penobscot Bay SHRU includes the entire Penobscot basin and extends west as far as, and includes the Ducktrap River watershed, and east as far as, and includes the Bagaduce River watershed. The Penobscot basin is the largest river basin in Maine and the second largest in New

England. The river drains a 22,225,200 ha (22,252 km2)) watershed, roughly one-quarter of the state's land area, that occupies sections of Aroostook, Hancock, Penobscot, Piscataquis, Somerset, Waldo, and Washington counties (Baum 1983). The Penobscot SHRU once contained high quality Atlantic salmon habitat in quantities sufficient to support robust Atlantic salmon populations. The construction of dams in the Penobscot SHRU has greatly diminished both habitat quality and availability. Degradation of habitat quality and availability from forestry, development, and land management practices has also occurred. In the Penobscot SHRU, there are approximately 323,700 units of historically accessible spawning and rearing habitat for Atlantic salmon among approximately 17,440 km of rivers, lakes and streams. Of the 323,700 units of spawning and rearing habitat, approximately 211,000 units of habitat are considered to be currently occupied. The mainstem Penobscot has the highest biological value to the Penobscot SHRU because it provides a central migratory corridor for the entire Penobscot SHRU. 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 Penobscot SHRU.

Merrymeeting Bay SHRU

The Merrymeeting Bay SHRU includes two major basins- the Kennebec and Androscoggin, each of which have numerous sub-basins; and three major coastal watershed outside of the Kennebec and Androscoggin basins, which include the Sheepscot, Medomak and St. George watersheds. The Merrymeeting Bay SHRU extends west as far as, and includes the Androscoggin River watershed, and east as far as, and includes the St. George River watershed. The Kennebec River, the largest watershed in the SHRU, flows 233 km from Moosehead Lake to Merrymeeting bay where it joins with the Androscoggin River (Maine DEP, 1999) and flows another 32 km out to the Atlantic Ocean (Reed & Sage, 1975). The Kennebec watershed drains a land area of 3,771,520 acres, constituting approximately one-fifth of the total land area of Maine occupying much of Somerset and Kennebec County and portions of Franklin, Penobscot, Waldo, Sagadahoc, and Androscoggin Counties (MSPO, 1993). The Androscoggin River flows 277 km from Umbagog Lake to Merrymeeting bay, and drains approximately 2,208,000 acres (Maine DEP, 1999), occupying much of Oxford and Androscoggin Counties and portions of Kennebec, Franklin, and Cumberland Counties in Maine. The Androscoggin also occupies a portion of Coos County, New Hampshire. The small coast drainages east of Small Point include the Sheepscot, Medomak and St. George Rivers. These drainages drain approximately 672,127 acres, or roughly 10 percent of the entire Merrymeeting Bay SHRU and occupy much of Knox and Lincoln Counties as well as portions of Waldo and Kennebec County. In the Merrymeeting Bay SHRU, there are approximately 372,600 units of historically accessible spawning and rearing habitat for Atlantic salmon located among approximately 5,950 km of historically accessible rivers, lakes and streams. This habitat was once of high enough quality to support a robust Atlantic salmon population. However, the construction of dams, and to a lesser extent pollution, has degraded habitat quality and accessibility and is likely responsible for the decline of Atlantic salmon populations within the Merrymeeting Bay SHRU. Today, dams are the greatest impediment, outside of marine survival, to the recovery of salmon in the 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 352,000 units of historically accessible spawning and rearing habitat.

5.1.1. Impacts of Federal Actions that have Undergone Formal or Early Section 7 Consultation

We have completed formal and informal section 7 consultations for other activities that may directly impact these proposed activities occurring in the action area. Some of these activities have included fish passage at Hydro-electric dams, bridge and road construction activities permitted by the ACOE, pier and ramp installations and several dam removal projects.

5.1.2. Scientific Studies

MDMR is authorized under the USFWS' endangered species blanket permit (No. 697823) to conduct monitoring, assessment, and habitat restoration activities for listed Atlantic salmon populations in Maine. The extent of take from MDMR activities during any given year is not expected to exceed 2% of any life stage being impacted; for adults, it would be less than 1%. MDMR will continue to conduct Atlantic salmon research and management activities in the GOM DPS while the proposed action is carried out. The information gained from these activities will be used to further salmon conservation actions. Some of this research and enhancement activity may occur in the action area.

USFWS is also authorized under an ESA section 10 endangered species blanket permit to conduct the conservation hatchery program at the Craig Brook and Green Lake National Fish Hatcheries. The mission of the hatcheries is to raise Atlantic salmon parr and smolts for stocking into selected Atlantic salmon rivers in Maine. Over 90% of adult returns to the GOM DPS are currently supported through production at the hatcheries. Approximately 1,000, 000 juvenile salmon and over 100,000 eggs are planted annually in the GOM DPS . The hatcheries help to ensure that the species does not go extinct.

5.1.3. State or Private Activities in the Action Area

In 2009, the MDMR closed all Atlantic salmon fishing in Maine. There is no indication that the fishery will be reinstated in the future.

State of Maine stocking program

Competitive interactions between wild Atlantic salmon and other salmonid fishes, especially introduced species, are not well understood and in Maine. State managed programs supporting recreational fisheries often include stocking non-indigenous salmonid fish into rivers containing anadromous Atlantic salmon. Interactions between wild Atlantic salmon and other salmonids include; indigenous brook trout (S*alvelinus fontinalis*) and landlocked Atlantic salmon (*Salmo salar sebago*) and hatchery reared non-indigenous brown trout (*Salmo trutta*) and rainbow trout (*Oncorhynchus mykiss*). Competition plays an important role in habitat use by defining niches that are desirable for optimal feeding, sheltering and spawning. Limited resources may also increase competitive interactions which may act to limit the time and energy fish can spend obtaining nutrients essential to survival. This is most noticeable shortly after fry emerge from redds, when fry densities are at their highest (Hearn 1987) and food availability is limited. Prior residence of wild salmonids may infer a competitive advantage during this time over domesticated hatchery juveniles (Letcher 2002; Metcalfe 2003); even though the hatchery reared individuals may be larger (Metcalfe 2003). This may limit the success of hatchery cohorts stocked annually to support the recovery of Atlantic salmon. Annual population assessments and smolt trapping estimates conducted on GOM DPS rivers indicates stocking of hatchery reared Atlantic salmon fry and parr in areas where wild salmon exist could limit natural production and may not increase the overall population level in freshwater habitats. The amount of quality habitat available to wild Atlantic salmon may also increase inter and intra-specific interactions between species due to significant overlap of habitat use during periods of poor environmental conditions such as during drought or high water temperatures. These interactions may impact survival and cause Atlantic salmon, brook and brown trout populations to fluctuate from year to year. However, since brook trout and Atlantic salmon co-evolved, wild populations should be able to co-exist with minimal long-term effects (Hearn 1987; Fausch 1988). Domesticated Atlantic salmon produced by the commercial aquaculture industry that escape from hatcheries or net pens also compete with wild Atlantic salmon for food, space and mates.

5.1.4. Impacts of Other Human Activities in the Action Area

Other human activities that may affect listed species and critical habitat include direct and indirect modification of habitat due to pollutants from agriculture, sewers, and other industrial sources. Pollution has been a major problem for this river system, which continues to receive non-point discharges from agriculture and urban development in addition to point source discharges from sewer treatment facilities.

Dams and Fish Passage
Hydroelectric facilities can alter the river's natural flow pattern and temperatures and release silt and other fine river sediments during dam maintenance can be deposited in sensitive spawning habitat nearby. These facilities also act as barriers to normal upstream and downstream movements, and block access to important habitats. According to Fay et al. (2006), the greatest impediment to self-sustaining Atlantic salmon populations in Maine is obstructed fish passage and degraded habitat caused by dams. In addition to direct loss of production in habitat from impoundment and inundation, dams also alter natural river hydrology and geomorphology, interrupt natural sediment and debris transport processes, and alter natural temperature regimes (Wheaton et al. 2004). These impacts can have profound effects on aquatic community composition and adversely affect entire aquatic ecosystem structure and function. Furthermore, impoundments can significantly change the prey resources available to salmon due to the existing riverine aquatic communities upstream of a dam site which have been replaced by lacustrine communities following construction of a dam. Anadromous Atlantic salmon inhabiting the GOM DPS are not well adapted to these artificially created and maintained impoundments (NRC 2004). Conversely, other aquatic species that can thrive in impounded riverine habitat will proliferate, and can significantly change the abundance and species composition of competitors and predators.

Migratory Delay and Timing
Early migration is an adaptive trait that ensures adult Atlantic salmon have sufficient time to

effectively reach spawning areas despite the occurrence of temporarily unfavorable conditions that naturally occur within rivers (Bjornn and Reiser 1991). Gorsky (2005) found that migration of Atlantic salmon was significantly affected by flow and temperature conditions in the Penobscot River. He found that high flow led to a decrease in the rate of migration and that rates increased with temperature up to a point (around 23° C) where they declined rapidly. To avoid high flows and warmer temperatures in the river, Atlantic salmon have adapted to migrating in the late spring and early summer, even though spawning does not occur until October and November. Between 2007 and 2010, 78% of migrating Atlantic salmon migrated past the first dam on the Penobscot River in May and June.

To access high quality summer holding areas close to spawning areas in the GOM DPS, Atlantic salmon must migrate past multiple dams. Delay at these dams can, individually and cumulatively, affect an individual's ability to access suitable spawning habitat within the narrow window when temperature and flow conditions in the river are suitable for migration. In addition, delays in migration can cause over ripening of eggs, which can lead to increased chance of egg retention, and reduced egg viability in pre-spawn female salmonids (deGaudemar and Beall 1998). It is not known what level of delay at each dam would significantly affect a migrant's ability to access suitable spawning habitat, as it would be different for each individual and tributary, and would vary from year to year depending on environmental conditions.

Dams can also delay smolt migration to the ocean, which can lead to direct mortality through increased predation (Blackwell and Juanes 1998) and delayed mortality by affecting physiological health or preparedness for marine entry and migration (Budy et al. 2002). Delays in migration may cause salmon to lose physiological smolt characteristics due to high water temperatures during spring migration, and can result in progressive misalignment of physiological adaptations to seawater entry; thereby, reducing smolt survival (McCormick et al. 1999). In addition to direct mortality sustained by Atlantic salmon at dams, Atlantic salmon in the GOM DPS sustain delayed mortality as a result of repeated passage events at multiple dams. Lastly, because Atlantic salmon often encounter multiple dams during their migratory life cycle, losses are cumulative and often biologically significant (Fay et al. 2006).

Predation

Since dams can create impoundments that favor various predators of Atlantic salmon, it is important to describe the effects these species may have on the population.

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 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 fry and parr, as well as smolts within the range of the GOM DPS, 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", this is apparently due to the much lower abundance of chain pickerel in riverine habitats frequently occupied by smallmouth bass.

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 Androscoggin 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), 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 Total Maximum Daily Load (TMDL) analyses for rivers and streams within the GOM DPS. TMDLs allocate a waste load for a particular pollutant for impaired waterbodies.

6.0 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). We have not identified any interrelated or interdependent actions.

6.1 Effects of the Action on shortnose and Atlantic sturgeon
In this section we summarize information on the likely occurrence of Atlantic and shortnose sturgeon in the reaches that will be sampled during the 2019 NRSA survey during the August and September sampling period and then describe the effects to Atlantic and shortnose sturgeon and their habitat from any exposure to the proposed sampling.

Hudson River
All of the sampling sites in the Hudson River that overlap with the range of shortnose and Atlantic sturgeon are located between river mile (rm) 10 and rm 150.

Shortnose sturgeon occur in the Hudson River from upper Staten Island (rm -3) to the Troy Dam (rm 155) (Bain et al. 2000, ASA 2008). Spawning occurs in upstream areas with suitable habitat in April and May with early life stages present through June. The broad summer range occupied by adult and juvenile shortnose sturgeon extends from approximately rm 23.5-110; however, individual shortnose sturgeon may be present from Staten Island to the Troy Dam during this period. During a mark recapture study conducted from 1976-1978, Dovel et al. (1979) captured larvae near Hudson, NY (rm 117) and young of the year were captured further south near Germantown (rm 106). Electrofishing will occur near rm 112 and rm 105 sites between August and September. During this time of year, juvenile and adult shortnose sturgeon are likely to be present in those river reaches.

The range of Atlantic sturgeon in the Hudson River extends from New York Harbor to the Troy Dam (Bain et al. 2000; Hattala and Fox, personal communication 2014). During the August-September sampling period, young of the year, juvenile, subadult and adult Atlantic sturgeon may be present in the Hudson River. Young-of-year (YOY) have been recorded in the Hudson River between rm 37 and rm 91 (Dovel and Berggren, 1983; Kahnle *et al.*, 1998; Bain *et al.*, 2000), which is downstream of all sampling sites. Catches of immature sturgeon (age 1 and older) suggest that juveniles utilize the estuary from the Tappan Zee Bridge through Kingston (rm 26- rm 91) (Dovel and Berggren, 1983; Bain *et al.*, 2000). Seasonal movements are apparent with juveniles occupying waters from rm 37 to rm 67 during summer months and then moving downstream as water temperatures decline in the fall, primarily occupying waters from rm 12 to rm 46 (Dovel and Berggren, 1983; Bain *et al.*, 2000). Tracking data from tagged juvenile Atlantic sturgeon indicates that during the spring and summer individuals are most likely to occur within rm 37-105. During the winter months, juvenile Atlantic sturgeon are most likely to occur between rm 12 and 46. Subadults and adults are present in the lower reaches of the river during migrations in and out of the river in the spring, summer, and fall. Based on this information, only the sampling location in the lower Hudson River near rm 10 is likely to overlap with the presence of Atlantic sturgeon in the August-September sampling period. Atlantic sturgeon in the area where sampling will occur are expected to originate from the New York Bight DPS, and Gulf of Maine DPS, with the majority of individuals originating from the New York Bight DPS, and the majority of those individuals originating from the Hudson River.

Connecticut River

Sample sites in the Connecticut River that overlap with the range of Atlantic sturgeon range from the site near Old Lyme, CT (rm 3) to the Holyoke Dam. Sites that overlap with the range of shortnose sturgeon extend upstream to the Turners Falls Dam.

Shortnose sturgeon occur from the river confluence with Long Island Sound to the Turners Falls Dam. Anecdotal evidence, including a photograph of a single shortnose sturgeon caught by an angler, suggests potential occurrence of some number of individuals upstream of the Turners Falls Dam; however, at this time the available information is extremely limited.

Shortnose sturgeon are well distributed throughout the river over the course of the year. Upstream of the Holyoke Dam, many sturgeon are present in the Deerfield Confluence Area. There is a concentration area in a 9-km reach near Agawam, MA (rkm 120–112) throughout the year, in an area impounded by the breached log-crib Enfield Dam (Buckley and Kynard 1985; Kynard *et al*. 2012). Downstream of the Enfield Dam, adults occupy tidally influenced reaches between rkm 100–0 throughout the year (Buckley and Kynard 1985; Savoy 1991a and b; Savoy 2004). Tagging and telemetry data in the Connecticut River demonstrate that many adult shortnose sturgeon make downstream movements into the estuary during times of high freshwater outflow. Shortnose sturgeon also move into the reach near rkm 6-20 between late April and mid-May. Most shortnose sturgeon depart this area for upstream foraging sites by mid-June, although some individuals stay in the estuary until late July (Savoy 2004).

There is only one modern record of an Atlantic sturgeon caught in the Massachusetts portion of the Connecticut River. On August 31, 2006, a 152.4 cm TL Atlantic sturgeon was observed in the Holyoke Dam spillway lift. The Atlantic sturgeon was not sexed and was described at the time as a subadult. Prior to this capture, Atlantic sturgeon were thought to occur only as far upstream as the fall line, located near Hartford, CT. However, it is important to note that little effort to sample the Massachusetts reach of the Connecticut River for Atlantic sturgeon has taken place. Nearly all other documented occurrences of Atlantic sturgeon in the Connecticut River have been downstream of the breached Enfield Dam (rkm 110). Most Atlantic sturgeon captured within tidal waters or freshwater in Connecticut are thought to be migrant subadults from the Hudson River (ASSRT 2007). Waldman et al. (2013) determined through mtDNA and microsatellite DNA analysis of Atlantic sturgeon collected between 1989-2011,that subadults were primarily of Hudson River origin (65-70%), but that subadults were present from all five DPSs.

Merrimack River
During the summer months, shortnose sturgeon in the Merrimack River are largely present in an 11-km reach between rkm 13-23, where shortnose sturgeon spent most of their time in the Merrimack River (e.g. summer, fall, and winter). More recent tracking data have confirmed this stretch of the Merrimack River as the primary riverine habitat utilized by foraging shortnose sturgeon during the summer months. The proposed sampling site is within this reach of the Merrimack River; therefore, we expect shortnose sturgeon may occur at this site.

No spawning of Atlantic sturgeon is known to currently occur in the Merrimack River; therefore, only subadult and adult Atlantic sturgeon are present in the river. Tagged sub-adult Atlantic sturgeon have been detected as far upstream as rkm 25. Tagged adult Atlantic sturgeon have been detected up to RKM 10 (Kieffer and Kynard 1993, Kieffer personal communication, 2018). The proposed sampling site is near RKM 20; thus, we only expect subadults to be present. Individuals are likely to have originated from the Gulf of Maine or New York Bight DPS.

Kennebec River
Shortnose and Atlantic sturgeon are present in the Kennebec River from the mouth up to the Lockwood Dam (rm 61). Sampling in the Kennebec River at two sites below Lockwood dam are proposed. As reported in SSSRT 2010, tracking data and gillnet studies indicate that the majority of shortnose sturgeon feed in the Bath region of the Kennebec River (rm 10-18) from mid April through late November and early December. Sturgeon then migrate upriver to overwinter in Merrymeeting Bay. Based on limited gillnetting data and telemetry data it appears that shortnose sturgeon occasionally make forays upriver to the Augusta/Gardiner (rm 37-43) area during the summer months. Distribution of Atlantic sturgeon is similar to shortnose sturgeon, with young of the year, juveniles and subadults expected to occur largely downstream

of Augusta in the summer. However, Atlantic and shortnose sturgeon have been observed during electrofishing surveys of the Waterville to Augusta reach of the Kennebec River in August and September. Based on this, we expect shortnose and Atlantic sturgeon to occur in the area where sampling occur in the August-September sampling period. Atlantic sturgeon in the Kennebec River are likely to originate from the New York Bight and Gulf of Maine DPS, with the majority of individuals from the Gulf of Maine DPS.

Penobscot River

Currently, shortnose and Atlantic sturgeon in the Penobscot River occur in the area below Veazie Dam. The recent removal of the Veazie dam has provided access to habitat below the next dam upstream (e.g., Milford dam). However, since the removal of the Veazie dam, only one sturgeon has been captured at the Milford fishlift, this individual was released downstream and not allowed to pass upstream. Only one sampling site is proposed downstream of the dam and it is located near the dam. Telemetry studies indicate that while shortnose and Atlantic sturgeon are present in the river and estuary throughout the year, their movements vary by season in response to water temperature and flow. During the summer, shortnose sturgeon are present from Veazie to the river mouth with concentration areas from rkm 40 to 20 (Fernendes 2008, Zydlewski 2009a, Zydlewski 2009b). As such, shortnose sturgeon may occur in the river reach where sampling will occur.

Nearly all Atlantic sturgeon captured in recent studies (e.g., Fernandes et al. 2010, Altenritter et al. 2017) have been subadults. As described in Altenritter et al. (2017), consistently across study years, tagged Atlantic sturgeon spent the majority of their time (67– 84% annually) in the mesohaline reaches of the estuary, typically between rkm 20 and 30, occasionally moving into the upper reaches of the estuary (upstream of the salt wedge) or back into the lower estuary and bay, but often only for short periods. In the Penobscot River, 90–98% of the detections each year occurred between rkm 15 and 30. Movements into (spring) and out of the river (fall) to/from this reach was rapid. While tagged Atlantic sturgeon were detected as far upstream as rkm 40, more recent tracking efforts have shown very few tagged Atlantic or shortnose sturgeon moved into the freshwater reach below the Veazie dam. Researchers suspect that subadult Atlantic sturgeon are using the Penobscot estuary for foraging based on their very specific summer use and some preliminary diet analyses. Based on this information, we do not expect Atlantic sturgeon to occur in the reach where sampling will occur during the sampling period.

Effects of 2019 NRSA Sampling on Sturgeon

The NRSA sampling, or similar IBI surveys have taken place in New England for nearly 17 years. As described in EPA's BA, only five Atlantic sturgeon have been encountered in nearly 17 years of sampling throughout New England and all except one occurred in the Lower Kennebec River (between Waterville and Augusta), the other encounters occurred at the mouth of the Presumpscot River (Appendix A-1 of EPA's BA). All of these events took place in August or September during an IBI survey of eight sites in the lower Kennebec River that took place annually from 2002-2017. Of these incidences, two occurred in 2014, one in 2012, one in 2006, and one in 2005. Eleven shortnose sturgeon have been encountered over this 17-year period with 9 individuals in the Lower Kennebec River (between Waterville and Augusta) and 1 individual at the mouth of the Presumpscot River (Appendix A-1) during the same Lower Kennebec River IBI study. These encounters were in September and October. The only other encounter was of a shortnose sturgeon in the Connecticut River during NRSA sampling in July 2008. In all cases, encountered sturgeon were observed to experience an electric shock, quickly recover, and swim away.

Electrofishing can cause mortality or injury to fish. Limited information is available regarding effects to sturgeon. Moser (2000) conducted limited laboratory experiments on the effects of electrofishing on shortnose sturgeon. Shortnose sturgeon were exposed to electrical current for up to 60 seconds at a time, four to five minutes a day. Despite this extensive level of exposure, no mortality occurred. Shortnose sturgeon recovered very quickly from exposures and no difference in growth was seen in control and exposed subjects suggesting that feeding behaviors were not affected. Sturgeon were initially more responsive to the electroshocking treatment than catfish; however, they recovered quickly and moved to avoid the stimulus. More sturgeon than catfish rolled onto their side or completely rolled upside-down within the first 15 seconds. They also exhibited more twitching, rigor and avoidance behaviors than did catfish. But, sturgeon generally recovered immediately after the experiment. Over 75% of the sturgeon recovered immediately, with maximum recovery times of 5 minutes. Sturgeon were exposed repeatedly over a 32-day period and no long term mortality was seen. Electrofishing injury rates for shovelnose sturgeon (*Scaphirhynchus platorynchus*) were documented to be 0% according to Snyder (2003). Lab studies conducted on juvenile white sturgeon (*Acipenser transmontanus*) showed higher injury rates for pulsed DC current compared to normal DC current (68% versus 10%) with no mortality (Holliman and Reynolds 2002). Available data for sturgeon indicate that mortality resulting from exposure to electrofishing current is likely to be zero. Exposed sturgeon are likely to be stunned and may roll or twitch. The available information indicates that most sturgeon will recover immediately, with all exposed sturgeon recovering within five minutes. It is likely that most sturgeon will recover and swim away before they are observed at or near the surface. As none of the proposed sample sites overlap with spawning windows for sturgeon and any adults encountered during sampling will have time to recover prior to any subsequent spawning activities, no significant effects to spawning sturgeon are expected. Further, as recovery from exposure is expected to occur within five minutes, any delay in carrying out normal behaviors will be temporary and not likely to result in the abandonment of any behavior or have any fitness consequences for that individual.

There are several factors that make the risk of interactions with shortnose and Atlantic sturgeon low. In order to be directly affected by the sampling, an individual sturgeon would need to be close enough to the electrofishing boat to be exposed to the electric current. At any given time in the survey, the electric current extends across an area only 4.5 meters wide and 2.5 meters deep. Electrofishing will largely be contained along the shallow margins of the shoreline. In some areas, particularly those with vegetated mudflats or shellfish beds, sturgeon occur in the nearshore shallows while foraging. However, habitats in the areas where electrofishing will occur are not consistent with the areas where sturgeon are known to forage. The nearshore, shallow location of the transects combined with the small effective range of the electric current, make the risk low. However, past surveys have exposed sturgeon to electric current and stunned sturgeon have been observed during similar IBI surveys. Up to two sturgeon have been observed during prior year IBI surveys operating in the action area. However, that survey involved more intense effort than the current survey (sampling 8 sites in the Kennebec River twice per year and sampling of the Presumpscot sites four times per year). The only sturgeon ever encountered during past NRSA surveys in these waterbodies was a single sturgeon in the Connecticut River in 2008. Because a similar level of effort will occur for the 2019 NRSA survey in waterbodies that have been sampled in the past, it is reasonable to rely on past encounters to predict encounters for the 2019 surveys. As such, we anticipate that no more than one sturgeon will be exposed to the electrofishing surveys. Since these fish will not be netted, handled or identified, we assume this individual could be either a shortnose or Atlantic sturgeon. Given that the majority of Atlantic sturgeon in the areas to be sampled will originate from the Gulf of Maine or New York Bight DPS, we expect any Atlantic sturgeon encountered to be from the Gulf of Maine or New York Bight DPSs. Effects will be limited to minor short term exposure to the electrical field causing the individual to experience slight electrotaxis. We anticipate any individual to fully recover from this minor, temporary injury and swim away within minutes and regain normal behavior shortly after exposure with no lasting effects.

Vessel Strikes
Atlantic sturgeon and shortnose sturgeon are vulnerable to vessel strikes. However, given that the increase in vessel traffic in the action area will be limited to a single, shallow draft electrofishing boat that will be moving very slowly, and that operations will be limited to less than an hour in any one location, any increase in risk of vessel strike compared to the baseline is so small that it cannot be meaningfully measured, detected, or evaluated. No vessel strikes have been observed in the previous survey efforts. Based on this, effects of the proposed action on the risk of vessel strike for shortnose or Atlantic sturgeon are insignificant.

Turbidity and Other Effects to Habitat
The proposed action may result in small, short term, localized increases in turbidity and suspended sediments where backpack electrofishing is carried out and stream bottoms are disturbed by foot traffic. Additonally, because these sites are outside of the historic range of these species, Atlantic and shortnose sturgeon are not expected to occur in any of the streams that will be sampled with this methodology. Therefore, no Atlantic or shortnose sturgeon will be exposed to any increases in turbidity or suspended sediment due to the proposed action. Boat electrofishing will not result in any disturbance to the bottom; therefore there will be no effect on any forage items for sturgeon.

6.2 Effects of the Action on Atlantic salmon

Electrofishing Effects
Atlantic salmon may be killed or more likely temporarily disturbed, displaced, or injured by electrofishing activities. Capturing and handling salmon can cause physiological stress and lead to physical injury or death, including cardiac or respiratory failure from electrofishing (Snyder 2003). Studies have shown that all aspects of fish handling are stressful and can lead to immediate or delayed mortality (Murphy and Willis 1996). Direct mortality may occur when fish are handled roughly, not properly restrained, sedated during handling, or kept out of the water for extended periods. Fish injured during handling, in association with a disease epizootic, typically die within one to fourteen days. Examples of injuries that can lead to disease problems are loss of mucus, loss of scales, damage to the integument, and internal damage.

Despite precautions, some mortality is possible during the sampling of fish. The EPA has agreed to work with the MDMR when sampling rivers and streams with Atlantic salmon in Maine to minimize handling and avoid duplicative sampling of juvenile Atlantic salmon parr during the year. The MDMR annually reports juvenile salmon mortality rates associated with electrofishing activities in GOM DPS waters. While the MDMR usually handles a few thousand juvenile salmon each year during electrofishing, mortalities are usually less than two percent of total fish captured. MDMR staff instituted changes in operating protocols that reduced electrofishing mortality of YOY salmon from 2.72 percent in 2001 to 0.44 percent in 2011 (Trial 2012). Total electrofishing mortality in 2011 for juvenile salmon was 0.69 percent. From 2007-2011, MDMR reported a mean mortality of 1.38 percent for both YOY and 1+ or older parr combined, with the number of salmon handled ranging between 3,480 and 9,419.

Baum (1997) reported that Maine Atlantic salmon rivers support, on average, between five and ten parr per 100 m^2 of habitat (or one salmon habitat unit), based on data collected by the MDMR. MDMR calculated juvenile salmon densities within areas deemed suitable for rearing in multiple rivers within all three SHRUs in the GOM DPS (USASAC 2016; Table 6). These data were obtained from electrofishing efforts in many streams and rivers located in watersheds throughout the GOM DPS and represent the best available scientific information to assist in determining the number of juvenile Atlantic salmon that are likely to be captured during electrofishing activities as a result of the EPA National Rivers and Streams Assessment.

Table 7. Minimum (min), median, and maximum (max) relative abundance of juvenile Atlantic salmon population (fish/minute) based on timed single pass catch per unit effort (CPUE) sampling in selected Maine Rivers, 2016. Drainages are grouped by Salmon Habitat Recovery Unit (line).

		Parr				YOY			
Drainage	**Year**	**n**	**Min**	**Median**	**Max**	**n**	**Min**	**Median**	**Max**
Dennys	2016	2	1.46	1.88	2.29	2	2.43	2.79	3.15
East Machias	2016	24	0	3	11.6	24	0	0	3.8
Machias	2016	3	0.39	2.76	3	3	3.2	8.49	9.94
Narraguagus	2016	12	0	0.1	3.16	12	0	0.4	3.36
Pleasant	2016	6	0.19	0.6	2.4	6	0	1	3.18
Sandy River	2016	39	0	0.2	1.97	39	0	0.2	9.4
Sheepscot	2016	24	0	0.2	3.58	24	0	0.5	10.13
Mattawamkeag	2016	15	0	0.33	1.68	15	0	0.98	6.45
Penobscot	2016	32	0	1.12	3.2	32	0	1.71	18.33
Piscataquis	2016	31	0	0.9	4.63	31	0	1.84	10.59

Survey sites that have the potential to capture some juvenile Atlantic salmon are identified in Table 1. It is also likely that some electrofishing sites in Maine which are located within designated critical habitat, do not contain juvenile salmon. This is primarily due to stream connectivity and or hatchery stocking practices throughout the geographic range of the GOM DPS of Atlantic salmon.

Due to the short-term nature of the instream work and the timing of the work window in relation to the adult run-timing, it is anticipated that a small proportion of the total annual run could be migrating upstream in rivers within the geographic range of the GOM DPS at the time that electrofishing activities are underway. However, given the recent adult returns to small GOM DPS rivers, restricted upstream access for adults in the Penobscot river captured at Milford fishlift along with features of smaller riverine habitat considered in the site selection (e.g., depth, velocity and substrate); the likelihood of an adult being present at any given site is extremely low. Given the level of instream activity associated with setting up the site and other electrofishing-related activities along the stream banks, no adults are anticipated to be present in the project area. Therefore, we do not believe that take of an adult salmon is reasonably likely to occur.

Capture of juveniles during electrofishing activities could result in minor injury, and potentially mortality of Atlantic salmon juveniles. The number of juveniles likely to be captured, injured, or killed can be quantified based on the estimated area affected and the SHRU-specific median densities (Table 7) that may occur at the designated site. The anticipated amount of Atlantic salmon habitat is based on the EPA NRSA site selection process to define suitable sites for assessing fish populations within Maine. Accordingly, each site is expected to have different characteristics (i.e. depth and width of river and Atlantic salmon habitat present) that will define the upstream and downstream boundaries within the site. However, it can be conservatively estimated that no more than three habitat units of rearing habitat would be affected per site, based on the mean wetted stream width and a maximum length of 40 times the wetted width, which would contain approximately 3 units of Atlantic salmon habitat (100 m^2).

It is assumed that during the survey all juvenile salmon within the site would be subject to some level of stress during electrofishing and the capture and handling process. The number of injuries or mortalities can be quantified based on SHRU-specific estimates of juvenile densities, as well as the estimated mortality that may occur during capture and relocation. It is assumed that no more than 1.38% of the fish that are captured will suffer injury or death (Trial 2012).

Downeast Coastal SHRU

The median juvenile (YOY and parr) density in the Downeast Coastal SHRU in 2016 ranged between 12 and 0 juveniles/unit (average of approximately 4 juveniles/unit) based on sampling conducted by MDMR in several rivers (USASAC 2016). Assuming this average density, it is anticipated that no more than 36 juvenile Atlantic salmon (4 juveniles/unit x 9 units) could be affected at each site. Therefore, it is expected that up to 9 habitat units (3 site x 3 habitat units), as well as 36 juvenile salmon (9 habitat units x 4 juveniles/unit), could be affected by electrofishing activities over the term of the survey (August- September 2019).

Given a 1.38% mortality rate, it is expected that few juvenile salmon will be killed at any individual site. However, assuming that one site is sampled within the SHRU, it is possible that up to one juvenile salmon (1.38% x 36 fish) will be injured or killed over the term of the survey as a result of electrofishing related to sampling efforts for the fish assemblage survey.

Merrymeeting Bay SHRU

The median juvenile (YOY and parr) density in the Merrymeeting Bay SHRU in 2016 ranged between .2 and .5 juveniles/unit (average of approximately 1 juveniles/unit) based on sampling conducted by MDMR in several rivers (USASAC 2016). Assuming this average density, it is anticipated that 3 juvenile Atlantic salmon (1 juveniles/unit x 3 habitat units affected per site) could be affected at each site. Therefore, it is expected that up to 21 habitat units (7 sites x 3 habitat units), as well as 21 juvenile salmon (21 habitat units x 1 juveniles/unit), could be affected by electrofishing activities over the term of the survey (August – September 2019).

Given a 1.38% mortality rate, it is expected that few juvenile salmon will be killed at any given project. However, assuming that seven sites are authorized within the SHRU, it is possible that one juvenile salmon (1.38% x 21 fish) will be injured or killed over the term of the survey as a result of electrofishing related to sampling efforts for the fish assemblage survey.

Penobscot Bay SHRU

The median juvenile (YOY and parr) density in the Penobscot Bay SHRU in 2016 ranged between 0.9 and 1.84 juveniles/unit (average of 2.25 juveniles/unit) based on sampling conducted by MDMR in several rivers (USASAC 2016). Assuming this average density, it is anticipated that 7 juvenile Atlantic salmon (2.25 juveniles/unit x 3 units) could be affected at each site considered in this Opinion. Therefore, it is expected that up to 30 habitat units (10 sites x 3 habitat units), as well as 67 juvenile salmon (30 habitat units x 2.25 juveniles/unit), could be affected by electrofishing activities over the term of the survey (August – September 2019).

Given a 1.38% mortality rate, it is expected that few juvenile salmon will be killed at any given project and 10 sites are sampled within the SHRU, it is possible that one juvenile salmon (1.38% x 67 fish) will be injured or killed over the term of the survey as a result of electrofishing related to sampling efforts for the fish assemblage survey.

Given recent adult returns to GOM DPS rivers, the likelihood of an adult being present at any given project site is extremely small. In addition, adult salmon will only be able to access a small subset of the sites identified given existing barriers to passage throughout the GOM DPS. Further, given the level of instream activity associated with sampling-related activities along the stream banks, we do not expect any adults to be present during the survey. Additionally, given the small number of adults returning the GOM DPS rivers where sampling will occur and the small area impacted by the electric current at any one time, we do not anticipate that any adults will be exposed to the electric current.

Sediments and Turbidity

Electrofishing activities occurring in small stream reaches using the backpack electrofishing unit will temporarily introduce sediment and increase turbidity downstream of the site, and some release of fine materials and turbidity is likely to occur as a result of the in-water activities such as wading.

Elevated TSS concentrations may affect Atlantic salmon in the action area. According to Herbert and Merkens (1961), the most commonly observed effects of exposure to elevated TSS concentrations on salmonids include: 1) avoidance of turbid waters in homing adult anadromous salmonids, 2) avoidance or alarm reactions by juvenile salmonids, 3) displacement of juvenile salmonids, 4) reduced feeding and growth, 5) physiological stress and respiratory impairment, 6) damage to gills, 7) reduced tolerance to disease and toxicants, 8) reduced survival, and 9) direct mortality. Fine sediment deposited in salmonid spawning gravel can also reduce interstitial water flow, leading to depressed DO concentrations, and can physically trap emerging fry on the gravel.

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 580 mg/L to 700,000 mg/L depending on species. However, sublethal effects have been observed at substantially lower turbidity levels. Behavioral avoidance of turbid waters may be one of the most important effects of suspended sediments (DeVore *et al.* 1980, Birtwell *et al.* 1984, Scannell 1988). Salmonids have been observed to move laterally and downstream to avoid turbid plumes (McLeay *et al.* 1984, 1987, Sigler *et al.* 1984, Lloyd 1987, Scannell 1988, Servizi and Martens 1991). Juvenile salmonids tend to avoid streams that are chronically turbid, such as glacial streams or those disturbed by human activities, except when the fish need to traverse these streams along migration routes (Lloyd *et al.* 1987).

Exposure duration is a critical determinant of the occurrence and magnitude of physical or behavioral effects (Newcombe and MacDonald 1991). Salmonids have evolved in systems that periodically experience short-term pulses (days to weeks) of high suspended sediment loads, often associated with flood events, and are adapted to such high pulse exposures. Adult and larger juvenile salmonids appear to be little affected by the high concentrations of suspended sediments that occur during storm and snowmelt runoff episodes (Bjornn and Reiser 1991). However, research indicates that chronic exposure can cause physiological stress responses that can increase maintenance energy and reduce feeding and growth (Redding *et al.* 1987, Lloyd 1987, Servizi and Martens 1991). In a review of the effects of sediment loads and turbidity on fish, Newcombe and Jensen (1996) concluded that more than six days exposure to total suspended solids (TSS) greater than ten milligrams per liter 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.

At moderate levels, turbidity has the potential to adversely affect primary and secondary productivity, and at high levels has the potential to injure and kill adult and juvenile fish. Turbidity might also interfere with feeding (Spence *et al.* 1996). Eggs and newly emerged salmonid fry may be vulnerable to even moderate amounts of turbidity (Bjornn and Reiser 1991). Other behavioral effects on fish, such as gill flaring and feeding changes, have been observed in response to pulses of suspended sediment (Berg and Northcote 1985). Fine redeposited sediments also have the potential to adversely affect primary and secondary productivity (Spence *et al.* 1996), and to reduce incubation success (Bell 1991) and cover for juvenile salmonids (Bjornn and Reiser 1991). Larger juvenile and adult salmon appear to be little affected by ephemeral high concentrations of suspended sediments that occur during most storms and episodes of snowmelt. However, other research demonstrates that feeding and territorial behavior can be disrupted by short-term exposure to turbid water.

In-water work during backpack electrofishing activities will primarily be conducted by several individuals wading in the stream over a limited reach for a short time; therefore, sediment releases are only anticipated during the electrofishing activities from disturbance of the substrate. Single day TSS levels in excess of 50 mg/l are not anticipated during these activities. Therefore, we expect that all effects to Atlantic salmon exposed to increased turbidity will be so small that they cannot be meaningfully measured, evaluated, or detected and therefore are insignificant.

7.0 CUMULATIVE EFFECTS

Cumulative effects are defined in 50 CFR §402.02 as those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation.

The effects of future state and private activities in the action area that are reasonably certain to occur are continuation of recreational fisheries, discharge of pollutants, and development and/or construction activities resulting in excessive water turbidity and habitat degradation. We do not anticipate any effects to occur over the time period of the proposed action that were not already captured in the Status of the Species or Environmental Baseline of this Opinion.

8.0 INTEGRATION AND SYNTHESIS OF EFFECTS

In the discussion below, we consider whether the effects of the proposed action 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 GOM DPS of Atlantic salmon. 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 the GOM DPS of Atlantic salmon.

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." Below, for the GOM DPS of Atlantic salmon, we summarize the status of the species and consider whether the proposed action will result in reductions in reproduction, numbers or distribution of that species and then considers whether any reductions in reproduction, numbers or distribution resulting from the proposed action would reduce appreciably the likelihood of both the survival and recovery of that species, as those terms are defined for purposes of the federal ESA.

We have determined that the proposed action will result in handling up to 124 juvenile Atlantic salmon with a very small percentage that may experience injury, and/or mortality. While lethal injuries and/or mortalities are being reduced by following the MDMR electrofishing protocols it is anticipated that some Atlantic salmon will be injured or killed as a result of electrofishing activities (up to three individuals ,<1.38%). Additionally, we anticipate that one Atlantic or shortnose sturgeon will be exposed to the electric current and experience minor, temporary electrotaxis from which complete recovery is anticipated.

8.1 Gulf of Maine DPS of Atlantic Salmon

GOM DPS Atlantic salmon currently exhibit critically low spawner abundance, poor marine survival, and are confronted with a variety of additional threats. The abundance of GOM DPS Atlantic salmon has been low and either stable or declining over the past several decades. The proportion of fish that are of natural origin is extremely low (approximately 6% over the last ten years) and is continuing to decline. The conservation hatchery program assists in slowing the decline and helps 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.

Capturing and handling salmon causes physiological stress and can cause physical injury or mortality although these effects can be kept to a minimum through proper handling procedures as specified in the State of Maine Department of Marine Resources Electrofishing in Wadeable Streams in Maine protocols (Attachment 1).

Based on MDMR juvenile density data (2016) and the number of sites expected to be surveyed in each SHRU, it is anticipated that up to 124 juvenile salmon (36, 21, 67) in the Downeast Coastal, Merrymeeting Bay, and Penobscot Bay SHRUs, respectively could be captured and experience minor injury over the term of the survey. We expect that nearly all of these fish will be returned safely to the stream after the activities are completed without any lasting consequence. Of the 124 juvenile salmon collected, it is expected that three (one each in the Downeast Coastal, Merrymeeting Bay, and Penobscot Bay SHRUs, respectively) could be killed either due to exposure to the electrofishing current or due to handling. All other effects of the proposed action on Atlantic salmon will be insignificant or discountable.

As explained above, we determined that the proposed NRSA will result in the capture and collection of up to 124 juveniles (e.g.,parr), no more than three of thesejuveniles are likely to be injured or killed. All other effects of in-water work will be insignificant or discountable. Parr released after survey alive are not expected to experience any reductions in fitness and will quickly recover.

In the discussion below, we consider whether the effects of the proposed action 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 GOM DPS of Atlantic salmon. 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 the

GOM DPS of Atlantic salmon. In addition, the analysis will determine whether the proposed action will adversely modify designated critical habitat for Atlantic salmon.

GOM DPS Atlantic salmon currently exhibit critically low spawner abundance, poor marine survival, and are confronted with a variety of additional threats. The abundance of GOM DPS Atlantic salmon has been low and either stable or declining over the past several decades. The proportion of fish that are of natural origin is extremely low (approximately 6% over the last ten years) and is continuing to decline. The conservation hatchery program assists in slowing the decline and helps 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.

The proposed electrofishing survey will result in the capture, collection and potential minor injury of 124 juvenile Atlantic salmon and the mortality of no more than three individuals. Here, we consider the effect of the loss of these individuals on the reproduction, numbers and distribution of the Gulf of Maine DPS.

The reproductive potential of the Gulf of Maine DPS will not be affected in any way other than through a reduction in the numbers of individuals. The loss of three juvenile Atlantic salmon would have the effect of reducing the amount of potential reproduction, as any dead Atlantic salmon would have no potential for future reproduction. However, this reduction in potential future spawners is so small it is likely undetectable; this is due to the high natural mortality of juvenile Atlantic salmon, the low adult return rate (i.e., the number of juveniles that return to spawn as adults) and that it is limited to only one juvenile. Given this, we expect that the future reduction in the number of eggs laid or juveniles produced in future years would have an undetectable 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 action, any effect to future year classes is anticipated to be undetectable.

Based on the information provided above, including the consideration of the death of three juvenile Atlantic salmon, the proposed project will not appreciably reduce the likelihood of survival of the Gulf of Maine 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 salmon 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 salmon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of three juveniles is an extremely small percentage of the population and will not change the status or trends of the species as a whole; (2) the loss of three juveniles will not result in the loss of any age class; (3) the loss of three juveniles will not have an effect on the levels of genetic heterogeneity in the population; (4) the loss of three juveniles in 2019 will 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 actions will have no effect on the ability of GOM DPS Atlantic salmon to shelter or forage.

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 action will not appreciably reduce the likelihood that the GOM DPS will survive in the wild, which includes consideration of recovery potential. Here, we consider whether the action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range…" (threatened) is no longer appropriate. Thus, we have considered whether the action will appreciably reduce the likelihood that the species can rebuild to a point where the GOM DPS of Atlantic salmon is no longer in danger of extinction throughout all or a significant part of its range.

All effects to habitat are minor and temporary; the action will result in the mortality of a very small number of juvenile salmon. As described in the 2019 final recovery plan for Atlantic salmon, recovery of the species is based on achieving goals related to abundance, productivity and habitat accessibility and suitability. The proposed action will have no effect on habitat accessibility and suitability. Any effects on abundance and productivity are limited to the effects of the loss of no more than three juvenile salmon. This loss will be so small that its effect on the abundance and productivity of any SHRU or the DPS as a whole will be insignificant. Therefore, we have determined that the proposed action will not appreciably reduce the likelihood that Atlantic salmon will recover in the wild. As such, the action will not appreciably reduce the likelihood that the GOM DPS of Atlantic salmon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the action is not likely to appreciably reduce the survival and recovery of this species.

8.2 Atlantic Sturgeon

We have estimated that the proposed action will result in the minor injury of one sturgeon during the 2019 EPA NRSA survey and since the sturgeon will not be handled or fully identified to the species, it could either be an Atlantic or shortnose sturgeon. Here we discuss the potential that an Atlantic sturgeon exposed to the electrical current may originate from the New York Bight or Gulf of Maine DPS. This injury will be temporary in nature.

8.2.1 New York Bight DPS of Atlantic sturgeon

We expect the action to result in temporary injury to one New York Bight DPS Atlantic sturgeon. We do not expect any mortalities. As such, there will be no reduction in the numbers of NYB DPS Atlantic sturgeon and no change in the status of this species or its trend. Reproductive potential of the NYB DPS is not expected to be affected in any way. As all sturgeon are anticipated to fully recover from exposure to the electric current and there will not be any delay or disruption of any essential behavior including spawning, there will be no reduction in individual fitness or any future reduction in numbers of an individual sturgeon. There will be no effect to migration because any disturbance to movement will last no longer than a few minutes.

The proposed action is not likely to reduce distribution because the it will not impede NYB DPS Atlantic sturgeon from accessing any seasonal concentration areas, including foraging, spawning or overwintering grounds in the action area or elsewhere. Any effects to distribution will be minor and temporary and limited to the temporary stunning of a single individual.

Based on the information provided above, the minor injury of one NYB DPS Atlantic sturgeon in 2019, 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 proposed 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 or completing essential behaviors including reproducing, foraging and sheltering. This is the case because: (1) there will be no mortalities; (2) because there will be no mortalities there will be no change the status or trends of the species as a whole; (3) there will be no effect on the levels of genetic heterogeneity in the population; (4) there will not be any loss of any age class; (5) there will be no effect on reproductive output; (6) the project will have no 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, (7) the project will have no effect on the ability of NYB DPS Atlantic sturgeon to shelter and no 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 appreciably reduce its likelihood of recovery. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the NYB DPS of Atlantic sturgeon will survive in the wild, which includes consideration of recovery potential. Here, we consider whether the proposed action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range…" (threatened) is no longer appropriate. Thus, we have considered whether the proposed action will appreciably reduce the likelihood the population can rebuild to a point where the NYB DPS of Atlantic sturgeon is no longer in danger of extinction through all or a significant part of its range.

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 listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting and migrations of all individuals. For Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. Here, we consider whether this proposed action will affect the Hudson River population of Atlantic sturgeon in a way that would affect the NYB DPS likelihood of recovery.

The proposed action will not change the status or trend of any population of Atlantic sturgeon or the status and trend of the NYB DPS as a whole. Further, it will not result in any mortality and no reduction in future reproductive output. Because there will be no effect on numbers or reproductive output, it will not affect the trend of the population. The proposed action will have only insignificant effects on habitat and will not impact the action area in a way that makes additional growth of the population less likely, that is, it will not reduce any river's carrying capacity. The proposed action will not affect estuarine or oceanic habitats that are important for sturgeon. Because it will not reduce the likelihood that any river population can recover, it will not reduce the likelihood that the NYB DPS as a whole can recover. 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 endangered. Based on the analysis presented herein, the proposed action is not likely to appreciably reduce the survival and recovery of this species.

8.2.2 Gulf of Maine DPS of Atlantic sturgeon

We have estimated that the proposed action will result in the exposure to the electric field causing minor and fully recoverable temporary electrotaxis of one Atlantic sturgeon that may originate from the New York Bight or Gulf of Maine DPS.

No injury and no mortality is anticipated. The survival of any GOM DPS Atlantic sturgeon will not be affected by the project. As such, there will be no reduction in the numbers of GOM DPS Atlantic sturgeon and no change in the status of this species or its trend. Reproductive potential of the GOM DPS is not expected to be affected in any way. As all sturgeon are anticipated to fully recover from exposure to the electric current and there will not be any delay or disruption of any essential behavior including spawning, there will be no reduction in individual fitness or any future reduction in numbers of an individual sturgeon. There will be no effect to migration because any disturbance to movement will last no longer than a few minutes.

The proposed action is not likely to reduce distribution because it will not impede GOM DPS Atlantic sturgeon from accessing any seasonal concentration areas, including foraging, spawning or overwintering grounds in the action area or elsewhere. Any effects to distribution will be minor and temporary and limited to the temporary electrotaxis of a single individual.

Based on the information provided above, the minor injury of one GOM DPS Atlantic sturgeon in 2019, 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 proposed 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 or completing essential behaviors including reproducing, foraging and sheltering. This is the case because: (1) there will be no mortalities; (2) because there will be no mortalities there will be no change the status or trends of the species as a whole; (3) there will be no effect on the levels of genetic heterogeneity in the population; (4) there will not be any loss of any age class; (5) there will be no effect on reproductive output; (6) the project will have no 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, (7) the project will have no effect on the ability of GOM DPS Atlantic sturgeon to shelter and no effect on individual foraging GOM DPS Atlantic sturgeon.

In rare instances, an action that does not appreciably reduce the likelihood of a species' survival might appreciably reduce its likelihood of recovery. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the GOM DPS of Atlantic sturgeon will survive in the wild, which includes consideration of recovery potential. Here, we consider whether the proposed action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range…" (threatened) is no longer appropriate. Thus, we have considered whether the proposed action will appreciably reduce the likelihood the population can rebuild to a point where the GOM DPS of Atlantic sturgeon is no longer in danger of extinction through all or a significant part of its range.

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 listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting and migrations of all individuals. For Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. Here, we consider whether this proposed action will affect any population of Atlantic sturgeon in a way that would affect the GOM DPS likelihood of recovery.

The proposed action will not change the status or trend of any population of Atlantic sturgeon or the status and trend of the GOM DPS as a whole. Further, it will not result in any mortality and no reduction in future reproductive output. Because there will be no effect on numbers or reproductive output, it will not affect the trend of the population. The proposed action will have only insignificant effects on habitat and will not impact the action area in a way that makes additional growth of the population less likely, that is, it will not reduce any river's carrying capacity. The proposed action will not affect estuarine or oceanic habitats that are important for sturgeon. Because it will not reduce the likelihood that any river population can recover, it will not reduce the likelihood that the GOM DPS as a whole can recover. Therefore, the proposed action 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 endangered. Based on the analysis presented herein, the proposed action is not likely to appreciably reduce the survival and recovery of this species.

8.3 Shortnose Sturgeon

We have estimated that the proposed action will result in the minor injury of one sturgeon during the 2019 EPA NRSA survey and since the sturgeon will not be handled or fully identified to the species, it could either be an Atlantic or shortnose sturgeon. Here we discuss the potential that a shortnose sturgeon is exposed to the electrical current. This injury will be temporary in nature.

We anticipate only a minor injury and no mortality is expected. The survival of any shortnose sturgeon will not be affected by the project. As such, there will be no reduction in the numbers of shortnose sturgeon and no change in the status of this species or its trend. Reproductive potential of the species is not expected to be affected in any way. As all sturgeon are anticipated to fully recover from exposure to the electric current and there will not be any delay or disruption of any essential behavior including spawning, there will be no reduction in individual fitness or any future reduction in numbers of an individual sturgeon. There will be no effect to migration because any disturbance to movement will last no longer than a few minutes.

The proposed action is not likely to reduce distribution because it will not impede shortnose sturgeon from accessing any seasonal concentration areas, including foraging, spawning or overwintering grounds in the action area or elsewhere. Any effects to distribution will be minor and temporary and limited to the temporary stunning of a single individual.

Based on the information provided above, the minor injury of one shortnose sturgeon in 2019, will not appreciably reduce the likelihood of survival of the species (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 proposed project will not affect shortnose 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 shortnose sturgeon from completing their entire life cycle or completing essential behaviors including reproducing, foraging and sheltering. This is the case because: (1) there will be no mortalities; (2) because there will be no mortalities there will be no change the status or trends of the species as a whole; (3) there will be no effect on the levels of genetic heterogeneity in the population; (4) there will not be any loss of any age class; (5) there will be no effect on reproductive output; (6) the project will have no effect on the distribution of shortnose sturgeon in the action area and no effect on the distribution of the species throughout its range; and, (7) the project will have no effect on the ability of shortnose sturgeon to shelter and no effect on individual foraging shortnose sturgeon.

In rare instances, an action that does not appreciably reduce the likelihood of a species' survival might appreciably reduce its likelihood of recovery. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the species will survive in the wild, which includes consideration of recovery potential. Here, we consider whether the proposed action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range…" (threatened) is no longer appropriate. Thus, we have considered whether the proposed action will appreciably reduce the likelihood the population can rebuild to a point where shortnose sturgeon is no longer in danger of extinction through all or a significant part of its range.

A Recovery Plan for shortnose sturgeon was published in 1998 pursuant to Section 4(f) of the ESA. The Recovery Plan outlines 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 delisting criteria; (2) protect shortnose sturgeon populations and habitats; and, (3) rehabilitate habitats and population segments. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting, and migrations of all individuals. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. The proposed action will have no effect on the number of shortnose sturgeon or impact the population trend. It will not impact access to habitat or reduce the amount of available habitat or affect conditions for successful development of early life stages. Further, the action will not impact habitat connectivity. For these reasons, the proposed action will not appreciably reduce the likelihood that the species 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.

9.0 CONCLUSION

After reviewing the best available information on the status of endangered and threatened species under our jurisdiction, the environmental baseline for the action area, the effects of the 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 the GOM DPS of Atlantic salmon, shortnose sturgeon, and the NYB, GOM DPSs of Atlantic sturgeon. We also conclude that the proposed action may affect but is not likely to adversely affect critical habitat designated for the GOM DPS of Atlantic salmon or the NYB or GOM DPS of Atlantic sturgeon.

10.0 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). A "person" is defined in part as any entity subject to the jurisdiction of the United States, including an individual, corporation, officer, employee, department or instrument of the Federal government (see 16 U.S.C. 1532(13)). Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not the purpose of carrying out an otherwise lawful activity 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. In issuing ITSs, NMFS takes no position on whether an action is an "otherwise lawful activity."

10.1 Amount or Extent of take

This ITS serves two important functions: (1) it provides an exemption from the Section 9 prohibitions for any taking incidental to the proposed action that is in compliance with the terms and conditions; and (2) it provides the means to insure the action as it is carried out is not jeopardizing the continued existence of affected species by monitoring and reporting the progress of the action and its impact on the species such that consultation can be reinitiated if any of the criteria in 50 CFR 402.16 are met.

Atlantic salmon

We anticipate the capture and minor injury of up to 124 juveniles during electrofishing activities; the majority of individuals will be collected and released with no more than minor, fully recoverable injuries. We anticipate the mortality of no more than three juveniles.

The number of juvenile salmon anticipated to be harassed, injured, or killed was quantified based on SHRU-specific estimates of parr and YOY densities, as well as the estimated mortality that may occur during capture and handling. All juvenile salmon within the selected sites will be subject to harassment or harm during the capture and handling process, while an extremely small subset are expected to be killed as a result of electrofishing, capture, and handling (Table 7). It is assumed that no more than 1.38% of the fish that are captured will suffer injury or death (Trial 2012). It is anticipated no adult Atlantic salmon will be encountered, captured and handled and therefore, no take of adult Atlantic salmon is anticipated.

Table 7. Estimate of take of juvenile Atlantic salmon anticipated due to the electrofishing activities conducted by EPA during their Fish Assemblage surveys.

SHRU	Harassment	Mortality
Downeast Coastal	36	1
Merrymeeting Bay	21	1
Penobscot Bay	67	1
GOM DPS	124	3

Sturgeon

As explained in the "Effects of the Action" section, both shortnose and Atlantic sturgeon may occur in the action area. Given the past interaction rate during the previous ten year assessment period, we expect that no more than one sturgeon (either Atlantic or shortnose) will be encountered during the EPA NRSA surveys. Atlantic sturgeon from two DPSs (NYB and GOM) could be present in the action area; therefore, the affected Atlantic sturgeon could be from either of the two DPSs.

We anticipate the minor and recoverable injury of no more than one sturgeon, either one shortnose sturgeon or one Atlantic sturgeon (Gulf of Maine or New York Bight DPS) due to exposure to the electric current. We do not anticipate any mortality; therefore, no lethal take is exempted.

10.2 Reasonable and Prudent Measures

In order to effectively monitor the effects of this action, it is necessary to document the amount of incidental take (i.e., the number of each life stage encountered, captured, collected, injured or killed) and to report these individuals within 48 hours. We have determined that the following reasonable and prudent measures are necessary or appropriate for EPA and their contractors to minimize and monitor impacts of incidental take of listed species.

1. EPA must implement protocols to minimize the potential for mortality of Atlantic salmon and sturgeon. Special precautions include no netting or handling of any Adult Atlantic salmon or any life stage of Atlantic or shortnose sturgeon. All electrofishing must immediately cease until all animals have moved safely away from the electrofishing area.
2. EPA must report all interactions with listed species to NMFS in a timely manner.

10.3 Terms and Conditions

1) To implement RPM #1, to minimize handling and duplicative sampling of wild Atlantic salmon, EPA must coordinate electrofishing activities with Maine DMR in Rivers and Streams containing Atlantic salmon (Table 1) whenever possible. Contact person at Maine DMR is Sean Ledwin and he can be reached via email (Sean.M.Ledwin@maine.gov) or phone - 207-624-6348.
2) To implement RPM #1, electric shock must be shut off immediately if any salmon or sturgeon are observed in the survey area. No shocking may be started if sturgeon or salmon are observed in the transect.

3) To implement RPM #2, to minimize handling stress and mortality to captured Atlantic salmon parr, EPA must adhere to the Maine DMR Electrofishing Protocols (see Appendix A), including following water temperature thresholds for field sampling.
4) To implement RPM #2, EPA must notify NMFS within 48 hours of any interactions with listed species by phone (David Bean, 207-866-4172). A written report must be submitted via e-mail (incidental.take@noaa.gov) on the next business day. The report must include information on the location of the incident, the condition of the fish and photographs (whenever possible).
5) To implement RPM#2, EPA must submit an annual report to the NMFS GARFO office describing electrofishing activities conducted and listing any interactions with listed species.

11.0 CONSERVATION RECOMENDATIONS

In addition to Section 7(a)(2), which requires agencies to ensure that all projects will not jeopardize the continued existence of listed species, Section 7(a)(1) of the ESA places a responsibility on all federal agencies to "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered 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. As such, NMFS recommends that the EPA consider the following Conservation Recommendation:

1. EPA should use its authorities to support studies on the effects of electrofishing on NMFS listed species and their habitats.

12.0 REINITIATION NOTICE

This concludes formal consultation concerning your proposal to survey designated rivers and streams in Maine that could contain endangered Atlantic salmon. 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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