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NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT
BIOLOGICAL OPINION

Agency: **Environmental Protection Agency (EPA), Region I**

Activity Considered: **Kennebec River Fish Assemblage Study**
F/NER/2012/02509

Conducted by: National Marine Fisheries Service
Northeast Region

Date Issued: _____

Approved by: _____ for John Bullard
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1.0 INTRODUCTION AND BACKGROUND

1.1 Introduction

This constitutes the Biological Opinion (Opinion) of NOAA's National Marine Fisheries Service (NMFS) on the effects of the US Environmental Protection Agency's (EPA) proposed funding of a multi-year bioassessment study on the Kennebec and Sebasticook Rivers in accordance with Section 7 of the Endangered Species Act (ESA), as amended (16 U.S.C. 1531 et seq.). This study will be carried out annually from 2012-2016. This Opinion is based on the information provided in the EPA's original Biological Assessment (BA) dated July 25, 2009, Biological Opinions issued by us in 2009, 2010, and 2011, and an updated BA and project description which we received on July 6, 2012. Additional sources of information used in this Opinion include correspondence with EPA staff, Midwest Biodiversity Institute (MBI) , recently published scientific papers, and data collected from previous years' biological assessments. Consultation was initiated on July 9, 2012. A complete administrative record of this consultation will be kept at our Main Field Office in Orono, Maine.

The proposed action entails funding the Midwest Biodiversity Institute (MBI) to conduct an electrofishing survey the in lower Kennebec River and Sebasticook River in Maine during 2012 - 2016. The purpose of the survey is to document changes to fish assemblages in the rivers following the removal of the Edwards Dam in 2001 and the Ft. Halifax dam in 2009. All proposed sample sites occur within the geographic range of the listed Gulf of Maine (GOM) Distinct Population Segment (DPS) of Atlantic salmon, shortnose sturgeon, and Atlantic sturgeon. The Kennebec River sampling sites also occur within designated critical habitat for the GOM DPS of Atlantic salmon.

1.2 Past Consultations on Kennebec River Bioassessment Studies

The Kennebec River bioassessment study has been the subject of previous consultation between NMFS and EPA. We produced a Biological Opinion dated September 21, 2009 on the effects of the study to be carried out in 2009. In the Opinion we concluded that the proposed action was not likely to adversely affect shortnose sturgeon and was likely to adversely affect but not likely to jeopardize the continued existence of the GOM DPS of Atlantic salmon. The Incidental Take Statement (ITS) included with the Opinion exempted the non-lethal taking of two Atlantic salmon. No listed species were encountered during the bio-assessment studies in 2009.

On August, 26, 2010, we issued an Opinion on the effects of the study to be carried out in 2010. In the Opinion we concluded that the proposed action was not likely to adversely affect shortnose sturgeon and was likely to adversely affect but not likely to jeopardize the continued existence of the GOM DPS of Atlantic salmon. The Incidental Take Statement (ITS) included with the Opinion exempted the non-lethal taking of two Atlantic salmon. No listed species were encountered during the bio-assessment studies in 2009.

On August 29, 2011, we issued an Opinion on the effects of the study to be carried out in 2011. In the Opinion we concluded that the proposed action was not likely to adversely affect shortnose sturgeon and was likely to adversely affect but not likely to jeopardize the continued existence of the GOM DPS of Atlantic salmon. The Incidental Take Statement (ITS) included with the Opinion exempted the non-lethal taking of two Atlantic salmon. Four Atlantic salmon were encountered during the 2011 survey.

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1.3 Consultation History

As noted above, we have previously considered effects of this study on an annual basis. On June 11, 2012, we received a request from EPA to initiate formal consultation on the study proposed for 2012. On July 2, 2012, EPA, MBI, and NMFS discussed the likelihood of the survey to continue into the future. At this time, EPA indicated that it was reasonably likely that the study would be completed annually from 2012-2016. On July 6, 2012, we received an updated Biological Assessment (BA) to reflect a multi-year bioassessment survey.

1.4 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 10 and are cited directly throughout the body of the document. Primary sources of information include: 1) Information provided in EPA's June 11, 2012 initiation letter and attached Project Description and BA for New England Rivers and Streams Fish Assemblage Assessments, dated July 25, 2011; 2) Subsequent edits and revisions to the BA (July 6, 2012); 3) Determination of Endangered Status for the Gulf of Maine Distinct Population Segment of Atlantic salmon; Final Rule (74 FR 29345; June 19, 2009); 4) Status Review for Anadromous Atlantic Salmon (*Salmo salar*) in the United States (Fay *et al.* 2006); 5) Designation of Critical Habitat for Atlantic salmon Gulf of Maine Distinct Population Segment (74 FR 29300; June 19, 2009); 6) Final Recovery Plan for Shortnose Sturgeon (December, 1998); and 7) Determination of Threatened Status for the Gulf of Maine Distinct Population Segment of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) (77 FR 5880; February 6, 2012).

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

This section describes 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 us 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);
- Establishes the status of any listed species in the action area, as well as the status of any designated critical habitat (Section 4);
- Establishes the environmental baseline in the action area by reviewing previous section 7 consultations specific to the action area, on-going authorized federal actions, state and local activities, and other unregulated human activities (Section 5);
- Evaluates the relevance of climate change on environmental baseline and status of the species (Section 6);
- 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 7);

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- Determines and evaluates any cumulative effects within the action area (Section 8); 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 9).

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. Conservation recommendations that are discretionary agency activities can also be suggested in order 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.

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

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2.0 DESCRIPTION OF THE PROPOSED ACTION

U.S. EPA, Region I is proposing to fund a multi-year biological assessment project in the Kennebec and Sebasticook Rivers in Maine that will begin in the fall of 2012 and will be conducted annually, each fall through 2016. The project includes a fish assemblage survey based on a single gear electrofishing methodology. The project is designed to document changes in fish assemblages following the removal of the Edwards Dam in 1999 and has been ongoing since 2002. The study, as it has in the past, will follow the Index of Biotic Integrity (IBI) study design (see below) which involves conducting electrofishing surveys in eight- randomly selected 1-km reaches of the Kennebec River adjacent to the shoreline (Table 1). Additionally, three reaches in the Sebasticook River will be similarly electrofished to document changes in fish assemblages following the removal of the Ft. Halifax Dam in 2008. The EPA is proposing to provide funding to the Midwest Biodiversity Institute (MBI) to complete a contract to carry out this work. In keeping with the methodology established by Yoder *et al.* (2006a; i.e., "the IBI approach"), electrofishing will be conducted from a boat at each electrofishing site during the fall (September/October).

2.1 Field Sampling Methods

Methods for the collection of fish in the survey are based on the IBI Methodology. IBI type sampling occurs over a 1-km long transect with the sampling equipment described below. A

total of eight sites will be sampled biannually (September and October) in the lower Kennebec River between the Lockwood Dam in Waterville downstream to the site of the former Edwards Dam in Augusta which is at the head of tide (Table 1). Three additional sites will be sampled annually (September) in the Sebasticook River between the Benton Falls Dam in Benton Falls and the former Ft. Halifax Dam site in Winslow (Table 1).

Table 1. Electrofishing locations for the lower Kennebec and lower Sebasticook Rivers, 2012.

BASIN	RIVER	RIVER NAME	Site_I.D.	RM	Latitude	Longitude	Drainage Area	Location description
50	001	Kennebec River	KEN-1A	17.6	44.56295	-69.62125	3135	Dst. Lockwood - Winslow side
50	001	Kennebec River	KEN-1-09	17.3	44.54518	-69.62703	3135	Dst. Lockwood - Waterville side
50	001	Kennebec River	KEN-2-09	16.5	44.53445	-69.63996	5181	Dst. Sebasticook R.
50	001	Kennebec River	KEN-3-09	15.1	44.52236	-69.65501	5181	Petty's Rips
50	001	Kennebec River	KEN-4-09	11.0	44.46805	-69.68568	5412	Sixmile Falls
50	001	Kennebec River	KEN-5-09	9.0	44.44346	-69.69695	5419	Ust. Sidney Boat Launch
50	001	Kennebec River	KEN-6-09	4.2	44.38586	-69.72981	5450	Sevenmile Island
50	001	Kennebec River	KEN-7-09	0.1	44.33058	-69.76851	5469	Edwards Dam site (removed)
50	100	Sebasticook River	Seb-FH-3	5.3	44.57407	-69.55857	859.3	Dst. Benton Falls Dam
50	100	Sebasticook River	Seb-FH-2	3.5	44.55568	-69.57560	891.8	Midpoint between Ft. Halifax & Benton Falls
50	100	Sebasticook River	Seb-FH-1	1.5	44.53882	-69.60600	2000	Ust. Ft. Halifax dam (removed)

Figure 1. Proposed electrofishing sites in lower Kennebec River..

2.2 Electrofishing Methodology

Electrofishing entails passing an electric current through the water to capture or control fish. The electric current causes fish within the effective area of the electric field to become temporarily stunned or immobilized (referred to as electrotaxis) to facilitate capture by nets.

An electrofishing boat will make a single pass along each transect, traveling approximately 1 km

along the shoreline. Electric currents will be applied to maintain power densities sufficient to generate electrotaxis in targeted fish (i.e., shad, salmon, and eels). Minimum settings will be estimated by measuring water conductivity and evaluating behavioral responses of fish prior to changing settings. Efforts to adjust settings will favor low frequency and pulse width to minimize any injuries to fish. Target electrical currents are 2 to 4 amps, 400 volts, and 60 pulses per second. Based upon these settings, the expected range of electrotaxis for fish in the electric field will be approximately 4.5 meters in diameter down to a depth of approximately 2.5 meters. During sampling the anode and cathode will be held as far apart as practical to generate a more diffuse field in order to minimize the risk of injury to fish. Stunned fish will be captured using hand held nets and removed from the water as rapidly as possible.

Captured fish will be immediately placed in aerated live wells containing ambient river water. Each transect typically takes 45 minutes to complete with an additional 45 minutes to process all of the fish captured. The total time held for each fish will vary; however, as fish are processed after each transect the maximum holding time for any one fish will be 90 minutes. Captured fish will be identified to species, measured, enumerated and released alive.

Individual electrofishing sites are located along the shoreline with the most diverse habitat features in accordance with established methods (Yoder *et al.* 2006 a,b). This is generally along the gradual outside bends of larger rivers, but it is not invariable. Sampling distance is determined with a GPS unit and/or laser range finder.

2.3 Sampling Procedure

A boat-rigged, pulsed D.C. electrofishing apparatus will be used to sample fish. The electrofishing apparatus will be housed in a 16 foot long john boat specifically constructed and modified for electrofishing. In shallow areas, a 14 foot raft will be used. Electric current will be converted, controlled, and regulated by Smith-Root 2.5 or 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 µS/cm2 and the low range is used at higher conductivities up to 1200 µS/cm2. Lower conductivities usually produce lower amperage readings.

The electrode array on the 16- foot long boat consists of four 8- foot long cathodes (negative polarity; 1inch diameter flexible steel conduit) which are suspended from the bow and two-three gangs of anodes (positive polarity) suspended from a retractable aluminum boom, the number used being dependent on the conductivity of the water. The raft configuration is similar except there are six cathodes in two gangs of three suspended from the sides of the raft. In both platforms the gangs of anodes consist of four 3/8 inch woven steel cable strands (each 4- foot in length) formed into a “gang” by binding them together near the attachment point on the boom. These gangs are added or detached as conditions change; anodes are increased at low conductivity (three gangs) and reduced (two gangs and/or fewer wires) at high conductivity. The anodes are suspended from a retractable aluminum boom that extends 9 feet in front of the bow on the 16- foot boat and 8 feet on the 14- foot raft. The width of both arrays is 3 feet. Anodes and cathodes are replaced when they are lost, damaged, or become worn. For night sampling,

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100-Watt floodlights are fixed on the guardrail and side rails on the netting platform located on the bow of the 16- foot boat; the 14- foot raft is not used at night. These are powered by the 12-volt DC output of the 5.0 GPP generator. Auxiliary lighting includes headlamps worn by the sampling crew and hand held lamps of 500,000 to 1,000,000 candle power. A 16- foot boat electrofishing crew consists of a boat driver and two netters; the 14- foot raft crew consists of a raft driver and one netter.

For boat and raft electrofishing at individual sampling locations, the accepted procedure is to slowly and methodically maneuver the electrofishing boat in a down current direction along the shoreline maneuvering in and around submerged cover to advantageously position the netters to pick up stunned and immobilized fish. This may require frequent turning, backing, shifting between forward and reverse, changing speed, etc. depending on current velocity and cover density and variability. 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. In all cases, there is a minimum time that should be spent sampling each zone regardless of the catch. In practice this is generally in the range of 2000-2500 seconds for 0.5 km, but could range upwards to 3500-4000 seconds where there is extensive instream cover and slack flows. For the 1.0 km standard distance, this was determined to be from 3000-4000 seconds for impounded and tidal sites and 3500-4500 seconds or more at riverine sites.

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 are attracted to the anode array and/or stunned. A concerted effort is made to capture every fish sighted by both the netters and driver. Since the ability of the netters to see stunned and immobilized fish is partly dependent on water clarity, sampling is conducted only during periods of "normal" water clarity and flows. Periods of high turbidity and high flows are avoided due to their negative influence on sampling efficiency. If high flow conditions prevail, sampling will be delayed until flows and water clarity return to seasonal, low flow norms.

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2.4 Field Sample Processing Procedures

Captured fish are immediately placed in an on-board live well for processing. Water is replaced regularly in warm weather to maintain adequate dissolved oxygen levels in the water and to minimize mortality. Aeration will be provided to further minimize stress and mortality. Special handling procedures are employed for certain species. For example, adult Atlantic salmon or sturgeon would not be netted when sighted and the electric current would be turned off upon observation of these species. Any size estimates would be made visually. Fish that are not retained for voucher or other purposes are released back into the water after they are identified to species, examined for external anomalies, weighed and, if necessary, measured for total length. Every effort is made to minimize holding and handling times. Non-indigenous species may be kept and appropriately disposed of out of the water per the request of the state management agencies. The majority of captured fish are identified to species in the field; however, any uncertainty about the field identification of individual fish requires their preservation for later laboratory identification. Fish are preserved for future identification in borax buffered 10% formalin and labeled by date, river or stream, and geographic identifier (e.g., river mile). Fish weighing less than 1000 grams are weighed to the nearest gram on a spring dial scale (1000 g x 2g) or a 1000 g hand held spring scale. Fish weighing more than 1000 grams weighed to the

nearest 25 grams on a 12 kg spring dial scale (12 kg x 50 g) or a 50 kg hand held spring scale. Samples that are comprised of two or more distinct size classes of fish (e.g., y-o-y, juveniles, and adults) are processed separately.

2.5 Electrofishing Effective Range

The electrofishing method as described generally produces an electric field of approximately 4.5-5.5 meters in diameter and depths of up to 2.5-3.5 meters. It is most effective along the shoreline and adjacent to hard structures such as bedrock ledges, woody debris, and hard substrates. The effective extent of the electric field is species dependent and based on the susceptibility of each to the electric field. The size of individual fish also affects their susceptibility to being influenced by the electric field. Generally larger fish are the most susceptible as the voltage gradient increases with length, but the method is generally effective for all sizes of fish >25 cm.

2.6 Sampling Site Configuration

The sampling sites are generally located immediately adjacent to the shoreline or submerged features such as bedrock ledges and gravel shoals. Generally, the "deepest side" of the river with the "best combination and heterogeneity of habitat, flow, and structural cover" is thoroughly sampled. 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.

2.7 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 within the Kennebec River and Sebasticook Rivers where electrofishing sampling will occur. As explained above, the action will involve running multiple transects along the shoreline at specific locations in the two rivers. Each transect will result in an electric field 4.5-5.5 meters wide, 2.5-3.5 meters deep and 1 km long. Thus, the action area is defined as the reaches of the Kennebec River and Sebasticook River being sampled by the proposed study (Table 1, above). The proposed action is not expected to have any direct or indirect effects to listed species outside of the eleven discrete areas where electric current will be experienced.

3.0 SPECIES THAT ARE NOT LIKELY TO BE ADVERSELY AFFECTED BY THE PROPOSED ACTION

3.1 Shortnose Sturgeon

A population of endangered shortnose sturgeon occurs in the Kennebec River. A Schnabel estimate using tagging and recapture data from 1998, 1999 and 2000 indicates an adult population estimate of 9,488 for the estuarine complex (Squires 2003). This is the most recent population estimate for the Kennebec River shortnose sturgeon population; however, this estimate includes fish from the Androscoggin and Sheepscot rivers as well and does not include an estimate of the size of the juvenile population.

In the Kennebec River, shortnose sturgeon move to the spawning grounds occurs in early spring (April - May). Movement to the spawning areas is triggered in part by water temperature and fish

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typically arrive at the spawning locations when water temperatures are between 8-9°C. Shortnose sturgeon typically spawn at the most upstream accessible site with suitable conditions. The Lockwood Dam at Waterville is the upstream limit of shortnose sturgeon in the Kennebec River. Spawning sites have been identified near Gardiner in the Kennebec River, at the base of the Brunswick Dam in the Androscoggin River. Since the removal of the Edwards Dam in 1999, shortnose sturgeon have been able to travel as far upstream as the Lockwood Dam. Therefore, an additional spawning site may be present between Augusta and Waterville. Shortnose sturgeon quickly leave the spawning grounds for summer foraging areas when temperatures exceed 15°C (Squiers *et al.* 1982).

Summer foraging areas have been identified in the Sasanoa River entrance and in the mainstem of the Kennebec River below Bath. Between June and September, shortnose sturgeon forage in shallow waters on mud flats that are covered with rooted aquatic plants. In the summer months, concentrations of shortnose sturgeon have also been known to move up into the freshwater reaches of the Kennebec River and foraging shortnose sturgeon have also been seen in Montsweag and Hockomock Bays in the Sheepscot River, which is located near the eastern end of the Sasanoa River (NMFS 1996).

Until a study aimed at specifically determining overwintering locations was conducted by the Maine Department of Marine Resources (DMR) in 1996 for the Maine Department of Transportation (DOT), the sites thought to be the most likely overwintering sites were deep pools below Bluff Head, and possibly in adjacent estuaries such as the Sheepscot (Squiers and Robillard 1997). The 1996 study of overwintering activity suggests that at least one overwintering site is located above Bath in Merrymeeting Bay.

Based on the best available information on the seasonal distribution of shortnose sturgeon in the Kennebec River, adult shortnose sturgeon are only likely to be present in the Augusta to Waterville section of the river in the spring while migrating to and from any spawning sites that may exist in this river reach. If spawning occurs in this reach, early life stages could also be present in the spring, with larvae drifting further down into the river in the early summer. As noted above, each of the eleven sites selected for electrofishing will be sampled in the fall (September/October).

No shortnose sturgeon of any life stage is likely to be present in the action area during the survey period. Therefore, no shortnose sturgeon will be exposed to any effects of the proposed action. This conclusion is supported by the lack of interactions with or observations of any shortnose sturgeon during the past 10 years of electrofishing sampling within this reach of the river, including sampling by EPA in 2011. Therefore, we have determined that all effects to shortnose sturgeon will be discountable. As such, shortnose sturgeon will not be considered further in this Opinion.

4.0 STATUS OF AFFECTED SPECIES AND CRITICAL HABITAT

Several species listed under NMFS' jurisdiction occur in the action area for this consultation. NMFS has determined that the action being considered in this biological opinion may affect the following endangered or threatened species under NMFS' jurisdiction:

Fish

Gulf of Maine DPS of Atlantic salmon	Endangered

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Gulf of Maine DPS of Atlantic sturgeon	Threatened
New York Bight of Atlantic sturgeon	Endangered

Critical Habitat
Designated for the Gulf of Maine DPS of Atlantic salmon

4.1 Gulf of Maine Distinct Population Segment of Atlantic Salmon

The Atlantic salmon is an anadromous fish species that spends most of its adult life in the ocean but returns to freshwater to reproduce. The Atlantic salmon is native to the North Atlantic Ocean, from the Arctic Circle to Portugal in the eastern Atlantic, from Iceland and southern Greenland, and from the Ungava region of northern Quebec south to the Housatonic River (Bigelow and Schroeder 1953). In the United States, Atlantic salmon historically ranged from Maine south to Long Island Sound. However, the Central New England DPS and Long Island Sound DPS have both been extirpated (65 FR 69459; November 17, 2000).

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

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

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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 Hatchery (CBNFH), both operated by the USFWS. Excluded from the GOM DPS are landlocked Atlantic salmon and those salmon raised in commercial hatcheries for the aquaculture industry (74 FR 29344; June 19, 2009).

Atlantic salmon have a complex life history that includes territorial rearing in rivers to extensive feeding migrations on the high seas (Figure 3). During their life cycle, Atlantic salmon go through several distinct phases that are identified by specific changes in behavior, physiology, morphology, and habitat requirements.

Adult Atlantic salmon return to rivers from the sea and migrate to their natal stream to spawn; a small percentage (1-2%) of returning adults in Maine will stray to a new river. Adults ascend the rivers within the GOM DPS beginning in the spring. The ascent of adult salmon continues into the fall. Although spawning does not occur until late fall, the majority of Atlantic salmon in Maine enter freshwater between May and mid-July (Meister 1958; Baum 1997). Early migration is an adaptive trait that ensures adults have sufficient time to effectively reach spawning areas despite the occurrence of temporarily unfavorable conditions that naturally occur within rivers (Bjornn and Reiser 1991). Salmon that return in early spring spend nearly 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.

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

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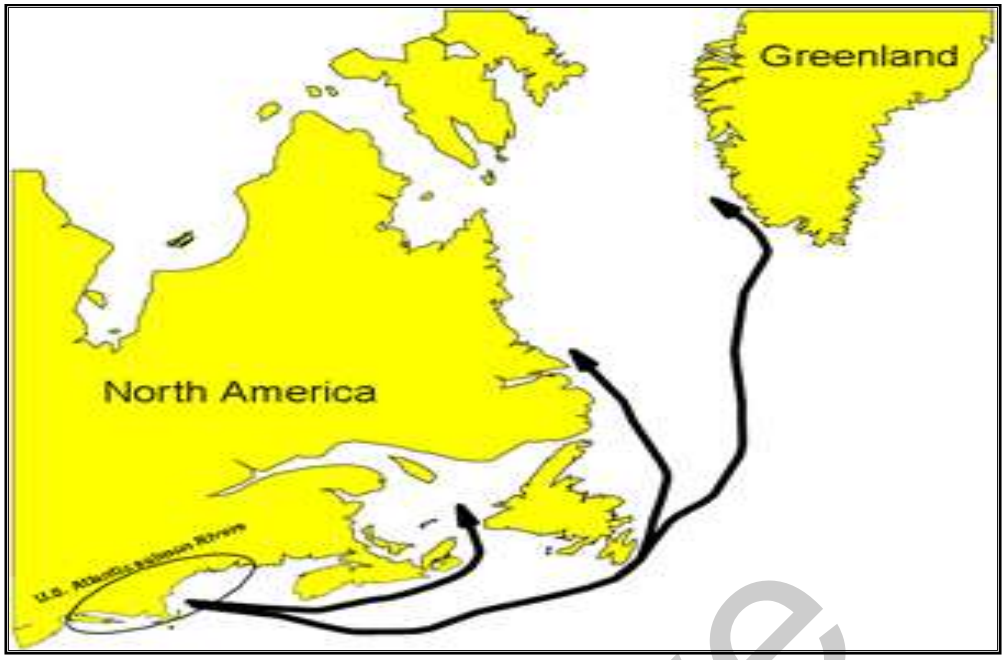

Figure 3. GOM DPS of Atlantic Salmon Migration Route.

A single female may create several redds before depositing all of her eggs. Female anadromous Atlantic salmon produce a total of 1,500 to 1,800 eggs per kilogram of body weight, yielding an average of 7,500 eggs per two sea-winter (2SW) female (an adult female that has spent two winters at sea before returning to spawn) (Baum and Meister 1971). After spawning, Atlantic salmon may either return to sea immediately or remain in fresh water until the following spring before returning to the sea (Fay *et al.* 2006). From 1996 to 2011, approximately 1.3 percent of the "naturally-reared" adults (fish originating from natural spawning or hatchery fry) in the Penobscot River were repeat spawners (USASAC 2012).

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

When fry reach approximately four centimeters in length, the young salmon are termed parr (Danie *et al.* 1984). Parr have eight to eleven pigmented vertical bands on their sides that are believed to serve as camouflage (Baum 1997). A territorial behavior, first apparent during the fry stage, grows more pronounced during the parr stage, as the parr actively defend territories (Allen 1940; Kalleberg 1958; Danie *et al.* 1984). Most parr remain in the river for 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

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

In a parr's second or third spring (age 1 or age 2, respectively), when it has grown to 12.5 to 15 cm in length, a series of physiological, morphological, and behavioral changes occur (Schaffer and Elson 1975). This process, called "smoltification," prepares the parr for migration to the ocean and life in salt water. In Maine, the vast majority of naturally reared parr remain in fresh water for two years (90 percent or more) with the balance remaining for either one or three years (USASAC 2005). In order for parr to undergo smoltification, they must reach a critical size of ten centimeters total length at the end of the previous growing season (Hoar 1988). During the smoltification process, parr markings fade and the body becomes streamlined and silvery with a pronounced fork in the tail. Naturally reared smolts in Maine range in size from 13 to 17 cm, and most smolts enter the sea during May to begin their first ocean migration (USASAC 2004). During this migration, smolts must contend with changes in salinity, water temperature, pH, dissolved oxygen, pollution levels, and various predator assemblages. The physiological changes that occur during smoltification prepare the fish for the dramatic change in osmoregulatory needs that come with the transition from a fresh to a salt water habitat (Ruggles 1980, Bley 1987, McCormick and Saunders 1987, McCormick *et al.* 1998). The transition of smolts into seawater is usually gradual as they pass through a zone of fresh and saltwater mixing that typically occurs in a river's estuary. Given that smolts undergo smoltification while they are still in the river, they are pre-adapted to make a direct entry into seawater with minimal acclimation (McCormick *et al.* 1998). This pre-adaptation to seawater is necessary under some circumstances where there is very little transition zone between freshwater and the marine environment.

The spring migration of post-smolts out of the coastal environment is generally rapid, within several tidal cycles, and follows a direct route (Hyvarinen *et al.* 2006, Lacroix and McCurdy 1996, Lacroix *et al.* 2004). 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, Lacroix and Knox 2005). Lacroix and McCurdy (1996), however, found that post-smolts exhibit active, directed swimming in areas with strong tidal currents. Studies in the Bay of Fundy and Passamaquoddy Bay suggest that post-smolts aggregate together and move near the coast in "common corridors" and that post-smolt movement is closely related to surface currents in the bay (Hyvarinen *et al.* 2006; Lacroix and McCurdy 1996; Lacroix *et al.* 2004). European post-smolts tend to use the open ocean for a nursery zone, while North American post-smolts appear to have a more near-shore distribution (Friedland *et al.* 2003). Post-smolt

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distribution may reflect water temperatures (Reddin and Shearer 1987) or the major surface-current vectors (Lacroix and Knox 2005). Post-smolts live mainly on the surface of the water column and form shoals, possibly of fish from the same river (Shelton *et al.* 1997).
During the late summer and autumn of the first year, North American post-smolts are concentrated in the Labrador Sea and off of the west coast of Greenland, with the highest concentrations between 56°N. and 58°N. (Reddin 1985; Reddin and Short 1991; Reddin and Friedland 1993). The salmon located off Greenland are composed of both 1SW fish and fish that have spent multiple years at sea (multi-sea winter fish or MSW) and also includes immature salmon from both North American and European stocks (Reddin 1988; Reddin *et al.* 1988). The first winter at sea regulates annual recruitment, and the distribution of winter habitat in the Labrador Sea and Denmark Strait may be critical for North American populations (Friedland *et al.* 1993). In the spring, North American post-smolts are generally located in the Gulf of St. Lawrence, off the coast of Newfoundland, and on the east coast of the Grand Banks (Reddin 1985; Dutil and Coutu 1988; Ritter 1989; Reddin and Friedland 1993; and Friedland *et al.* 1999). Some salmon may remain at sea for another year or more before maturing. After their second winter at sea, the salmon over-winter in the area of the Grand Banks before returning to their natal rivers to spawn (Reddin and Shearer 1987). Reddin and Friedland (1993) found immature adults located along the coasts of Newfoundland, Labrador, and Greenland, and in the Labrador and Irminger Sea in the later summer and autumn.

4.1.1 Status and Trends of Atlantic Salmon in the GOM DPS

The abundance of Atlantic salmon within the range of the GOM DPS has been generally declining since the 1800s (Fay *et al.* 2006). Data sets tracking adult abundance are not available throughout this entire time period; however, Fay *et al.* (2006) present a comprehensive time series of adult returns to the GOM DPS dating back to 1967 (Figure 4). It is important to note that contemporary abundance levels of Atlantic salmon within the GOM DPS are several orders of magnitude lower than historical abundance estimates. For example, Foster and Atkins (1869) estimated that roughly 100,000 adult salmon returned to the Penobscot River alone before the river was dammed, whereas contemporary estimates of abundance for the entire GOM DPS have rarely exceeded 5,000 individuals in any given year since 1967 (Fay *et al.* 2006).

Contemporary abundance estimates are informative in considering the conservation status of the GOM DPS today. After a period of population growth in the 1970s, adult returns of salmon in the GOM DPS have been steadily declining since the early 1980s and appear to have stabilized at very low levels since 2000 (Figure 3). The population growth observed in the 1970s is likely attributable to favorable marine survival and increases in hatchery capacity, particularly from GLNFH that was constructed in 1974. Marine survival remained relatively high throughout the 1980s, and salmon populations in the GOM DPS remained relatively stable until the early 1990s. In the early 1990s marine survival rates decreased, leading to the declining trend in adult abundance observed throughout 1990s. The increase in the abundance of returning adult salmon observed between 2008 and 2011 may be an indication of improving marine survival.

Adult returns to the GOM DPS have been very low for many years and remain extremely low in terms of adult abundance in the wild. Further, the majority of all adults in the GOM DPS return to a single river, the Penobscot, which accounted for 91 percent of all adult returns to the GOM DPS in 2007. Of the 1044 adult returns to the Penobscot in 2006, 996 of these were the result of smolt stocking and only the remaining 48 were naturally-reared. A total of 916 and 2,117 adult salmon returned to the Penobscot River in 2007 and 2008, respectively. Most of these returns

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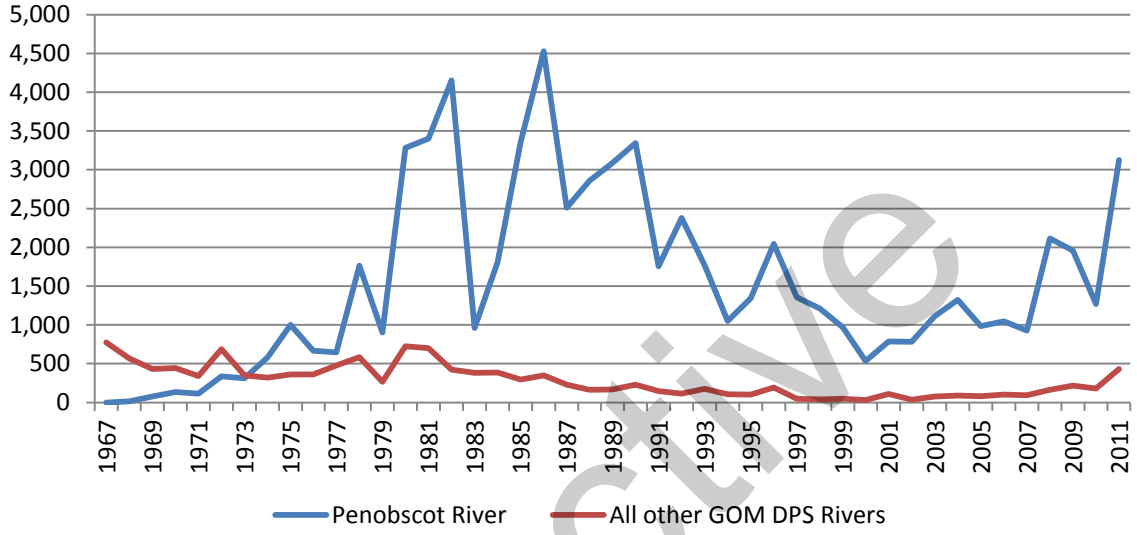
were also of hatchery origin (USASAC 2008). The term naturally-reared includes fish originating from natural spawning and from hatchery fry (USASAC 2008). Hatchery fry are included as naturally-reared because hatchery fry are not marked; therefore, they cannot be distinguished from fish produced through natural spawning. Because of the extensive amount of fry stocking that takes place in an effort to recover the GOM DPS, it is possible that a substantial number of fish counted as naturally-reared were actually stocked as fry.

Figure 4. Adult returns to the GOM DPS Rivers between 1967 and 2011(Fay *et al.* 2006, USASAC 2001-2012).



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Low abundances of both hatchery-origin and naturally-reared adult salmon returns to Maine demonstrate continued poor marine survival. Declines in hatchery-origin adult returns are less sharp because of the ongoing effects of consistent hatchery supplementation of smolts. In the GOM DPS, nearly all of the hatchery-reared smolts are released into the Penobscot River -- 560,000 smolts in 2009 (USASAC 2010). In contrast, the number of returning naturally-reared adults continues at low levels due to poor marine survival.

In conclusion, the abundance of Atlantic salmon in the GOM DPS has been low and either stable or declining over the past several decades. The proportion of fish that are of natural origin is very small (approximately 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 products 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 could prevent extinction in the short term, but recovery of the GOM DPS must be accomplished through increases in naturally reared salmon.

4.2 Designated Critical Habitat for the GOM DPS of Atlantic Salmon

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) (Figure 5). The final rule was revised on August 10, 2009. In this revision, designated critical habitat for the expanded GOM DPS of Atlantic salmon was reduced to exclude trust and fee holdings of the Penobscot Indian Nation and a table was corrected (74 FR 39003; August 10, 2009).

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

4.2.1 Primary Constituent Elements of Atlantic Salmon Critical Habitat

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

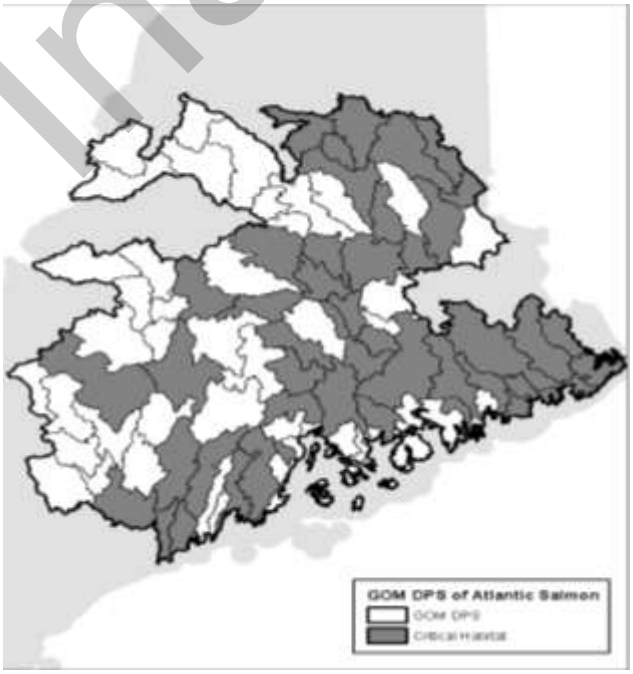

Figure 5. HUC-10 Watersheds Designated as Atlantic salmon critical habitat within the GOM

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DPS.

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

Physical and Biological Features of the Spawning and Rearing PCE

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

Physical and Biological Features of the Migration PCE

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

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

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In estuaries, critical habitat is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of extreme high water, whichever is greater.

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

4.2.2 Salmon Habitat Recovery Units within Critical Habitat for the GOM DPS

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

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

<u>Downeast Coastal SHRU</u>

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

<u>Penobscot SHRU</u>

The Penobscot SHRU, which drains approximately 22,234,522 hectares (54,942,705 acres), contains approximately 315,574 units of spawning and rearing habitat for Atlantic salmon among approximately 17,440 km of rivers, lakes and streams. Of the 315,574 units of spawning and rearing habitat (within 46 HUC-10 watersheds), approximately 211,000 units of habitat are considered to be currently occupied (within 28 HUC-10 watersheds). Three HUC-10 watersheds

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(Molunkus Stream, Passadumkeag River, and Belfast Bay) are excluded from critical habitat designation due to economic impact. Certain tribal lands within the Penobscot SHRU are also excluded from critical habitat designation.

Merrymeeting Bay SHRU

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

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

4.3 Status of Atlantic Salmon and Critical Habitat in the Action Area

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

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

In addition, some Atlantic salmon production may be occurring in the Sebasticook River. In 2010, four adult Atlantic salmon were passed over the Benton Falls Dam in the Sebasticook River.

4.3.1 Atlantic Salmon Adults

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

Between 2007 and 2009, manual tracking radio telemetry studies were conducted in the Kennebec River watershed to test if this technology can be used to observe the behavior of adult Atlantic salmon during known spawning periods (MDMR 2010). Study fish were translocated to the Sandy River in 2007 and 2008, and were monitored into the fall of 2009. Sixteen of the 18 adult salmon tracked in the study were detected in the Sandy River throughout the spawning season, and displayed known migratory patterns throughout their residency in the Sandy River, including longer-range migration after release in the spring, minimal movement in the summer, and short-range migration in the fall during spawning (MDMR 2010). Only one of the tagged adult salmon migrated downstream before spawning would have occurred. Five of the radio tags were detected in identical locations in 2009 as observed in 2008, and it was determined that these fish regurgitated their tags, or were mortalities. In addition, redd counts and juvenile surveys confirmed that adult salmon translocated to the Sandy River successfully spawned (MDMR 2010). The total trap catch for 2011 was 64 adult sea-run Atlantic salmon; 21 were of hatchery origin two-sea winter (2SW), and 43 were naturally reared (41-2SW, 2-1SW). All 64 adult Atlantic salmon were trucked and released to the Sandy River.

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Table 2. Adult Atlantic salmon returns by origin to the Kennebec River recorded from 1975 to 2011.

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

Source: USASAC 2011.

Table 3. Adult Atlantic salmon captured at the Lockwood Project fishlift and translocated to the Sandy River.

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

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

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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). Spring flows resulting in spillage at the dams facilitate out-migration of adult salmon (Shepard 1988). The number of kelts in the Kennebec River is proportional to the number of adults entering the river each year to spawn.

4.3.2 Juvenile Atlantic Salmon

The Kennebec River serves as migration corridor for adults returning to freshwater to spawn and for smolts and kelts returning to the ocean. Little suitable spawning or rearing habitat occurs in the mainstem Kennebec River in the vicinity of EPA's proposed electrofishing sites. Thus, neither fry nor parr would be expected to occur in the action area.

Generally, salmon smolts begin moving out of Maine rivers in mid-April to June. Atlantic salmon smolts originating in the Sandy River will occur in the action area as they migrate to the ocean. Most data concerning the emigration of smolts in Maine have been collected in the Penobscot River. Based on unpublished data from smolt-trapping studies in 2000 – 2005 by NMFS' Northeast Science Center, smolts migrate from the Penobscot between late April and early June. The majority of the smolt migration appears to take place over a three to five week period after water temperatures rise to 10°C.

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

While the annual abundance of smolts in the Kennebec River is presently unknown, MDMR estimates the current egg stocking and natural reproduction in the Sandy River may be producing over 10,000 smolts annually. Smolt abundance is the river is likely to remain stable or grow as restoration efforts in the river continue.

4.3.4 Designated Critical Habitat for Atlantic Salmon in the Action Area

As discussed in section 3.1.3, critical habitat for Atlantic salmon has been designated in the Kennebec River. One PCE for Atlantic salmon (sites for migration) is present in the action area as it was described in Section 3 of this Opinion. To facilitate and standardize determinations of effect for section 7 consultations involving Atlantic salmon critical habitat, we developed the "Matrix of PCEs and Essential Features for Designated Atlantic Salmon Critical Habitat in the GOM DPS" (Table 4). The matrix lists the PCEs, physical and biological features (essential features) of each PCE, and the potential conservation status of critical habitat within an action area. The PCEs in the matrix (spawning and rearing, and migration) are described in regards to five distinct Atlantic salmon life stages: (1) adult spawning; (2) embryo and fry development; (3) parr development; (4) adult migration; and, (5) smolt migration. The conservation status of the essential features may exist in varying degrees of functional capacity within the action area. The three degrees of functional capacity used in the matrix are described in ascending order: (1) fully functioning; (2) limited function; and (3) not properly functioning. The PCEs present in the action area of this consultation include adult and smolt migration.

Using this matrix along with information presented in FERC's BA and site-specific knowledge of the action area, we determined that one essential feature of smolt and adult migration may have limited function in the action area (Table 5). Approximately 208 miles of the Kennebec River and its tributaries, including all 10 reaches where sampling is proposed, are listed as

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impaired by the DEP. Combined sewer overflows (CSO) from Skowhegan to the Gardiner-Randolph region on the river produce elevated bacteria levels, thus inhibiting recreation uses of the river (primary contact). There are six active CSOs in the action area, as well as two that are inactive. Between Waterville and Augusta there are currently four wastewater treatment facilities rated as "major" point sources of effluent discharge. A facility discharging effluent to surface water with an EPA rating score of > 80 points based on such factors as flow volume, toxic pollutant potential, and public health impact is classified as a "major" source. Further, the Kennebec River has restricted fish consumption due to the presence of dioxin from industrial point sources. The Sebasticook River is also contaminated with PCBs and other persistent hazardous materials.

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

		Conservation Status Baseline		
PCE	Essential Features	Fully Functioning	Limited Function	Not Properly Functioning
A) Adult Spawning: (October 1st - December 14th)				
	Substrate	highly permeable course gravel and cobble between 1.2 to 10 cm in diameter	40- 60% cobble (22.5-256 mm dia.) 40-50% gravel (2.2 – 22.2 mm dia.); 10-15% course sand (0.5 -2.2 mm dia.), and <3% fine sand (0.06-0.05mm dia.)	more than 20% sand (particle size 0.06 to 2.2 mm), no gravel or cobble
	Depth	17-30 cm	30 - 76 cm	< 17 cm or > 76 cm
	Velocity	31 to 46 cm/sec.	8 to 31cm/sec. or 46 to 83 cm/sec.	< 5-8 cm/sec. or > 83cm/sec.
	Temperature	7° to 10^oC	often between 7° to 10^oC	always < 7° or > 10^oC
	pH	> 5.5	between 5.0 and 5.5	< 5.0
	Cover	Abundance of pools 1.8-3.6 meters deep (McLaughlin and Knight 1987). Large boulders or rocks, over hanging trees, logs, woody debris, submerged vegetation or undercut banks	Limited availability of pools 1.8-3.6 meters deep (McLaughlin and Knight 1987). Large boulders or rocks, over hanging trees, logs, woody debris, submerged vegetation or undercut banks	Absence of pools 1.8-3.6 meters deep (McLaughlin and Knight 1987). Large boulders or rocks, over hanging trees, logs, woody debris, submerged vegetation or undercut banks
	Fisheries Interactions	Abundant diverse populations of indigenous fish species	Abundant diverse populations of indigenous fish species, low quantities of non-native species present	Limited abundance and diversity of indigenous fish species, abundant populations of non-native species
B) Embryo and Fry Development: (October 1st - April 14th)				
	Temperature	0.5^oC and 7.2^oC, averages nearly 6oC from fertilization to eye pigmentation	averages < 4oC, or 8 to 10^oC from fertilization to eye pigmentation	>10^oC from fertilization to eye pigmentation
	D.O.	at saturation	7-8 mg/L	< 7 mg/L
	pH	> 6.0	6 - 4.5	< 4.5
	Depth	5.3-15cm	NA	<5.3 or >15cm
	Velocity	4 – 15cm/sec.	NA	<4 or > 15cm/sec.
	Fisheries Interactions	Abundant diverse populations of indigenous fish species	Abundant diverse populations of indigenous fish species, low quantities of non-native species present	Limited abundance and diversity of indigenous fish species, abundant populations of non-native species

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TABLE 4 continued…

PCE	Essential Features	Conservation Status Baseline: Fully Functioning	Limited Function	Not Properly Functioning
C) Parr Development: (All year)				
	Substrate	gravel between 1.6 and 6.4 cm in diameter and boulders between 30 and 51.2 cm in diameter. May contain rooted aquatic macrophytes	gravel < 1.2cm and/or boulders > 51.2. May contain rooted aquatic macrophytes	no gravel, boulders, or rooted aquatic macrophytes present
	Depth	10cm to 30cm	NA	<10cm or >30cm
	Velocity	7 to 20 cm/sec.	< 7cm/sec. or > 20 cm/sec.	velocity exceeds 120 cm/sec..
	Temperature	15° to 19°C	generally between 7-22.5oC, but does not exceed 29oC at any time	stream temperatures are continuously <7oC or known to exceed 29oC
	D.O.	> 6 mg/l	2.9 - 6 mg/l	< 2.9 mg/l
	Food	Abundance of larvae of mayflies, stoneflies, chironomids, caddisflies, blackflies, aquatic annelids, and mollusks as well as numerous terrestrial invertebrates and small fish such as alewives, dace or minnows	Presence of larvae of mayflies, stoneflies, chironomids, caddisflies, blackflies, aquatic annelids, and mollusks as well as numerous terrestrial invertebrates and small fish such as alewives, dace or minnows	Absence of larvae of mayflies, stoneflies, chironomids, caddisflies, blackflies, aquatic annelids, and mollusks as well as numerous terrestrial invertebrates and small fish such as alewives, dace or minnows
	Passage	No anthropogenic causes that inhibit or delay movement	Presence of anthropogenic causes that result in limited inhibition of movement	barriers to migration known to cause direct inhibition of movement
	Fisheries Interactions	Abundant diverse populations of indigenous fish species	Abundant diverse populations of indigenous fish species, low quantities of non-native species present	Limited abundance and diversity of indigenous fish species, abundant populations of non-native species

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TABLE 4 continued…

PCE	Essential Features	Conservation Status Baseline: Fully Functioning	Limited Function	Not Properly Functioning
D) Adult migration: (April 15th- December 14th)				
	Velocity	30 cm/sec to 125 cm/sec	In areas where water velocity exceeds 125 cm/sec adult salmon require resting areas with a velocity of < 61 cm/s	sustained speeds > 61 cm/sec and maximum speed > 667 cm/sec
	D.O.	> 5mg/L	4.5-5.0 mg/l	< 4.5mg/L
	Temperature	14 – 20°C	temperatures sometimes exceed 20oC but remain below 23°C.	> 23°C
	Passage	No anthropogenic causes that delay migration	Presence of anthropogenic causes that result in limited delays in migration	barriers to migration known to cause direct or indirect mortality of smolts
	Fisheries Interactions	Abundant diverse populations of indigenous fish species	Abundant diverse populations of indigenous fish species, low quantities of non-native species present	Limited abundance and diversity of indigenous fish species, abundant populations of non-native species
E) Juvenile Migration: (April 15th - June 14th)				
	Temperature	8 - 11oC	5 - 11°C.	< 5oC or > 11oC
	pH	> 6	5.5 - 6.0	< 5.5
	Passage	No anthropogenic causes that delay migration	Presence of anthropogenic causes that result in limited delays in migration	barriers to migration known to cause direct or indirect mortality of smolts

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Table 5. Current conditions of essential features of Atlantic salmon critical habitat in the action area having limited function or not properly functioning.

Pathway/Indicator	Life Stages Affected	PCEs Affected	Effect	Population Viability Attributes Affected
Passage/Access to Historical Habitat	Adult, juvenile, smolt	Freshwater migration	Impaired water quality.	Adult abundance and productivity.

4.3.5 Factors Affecting Atlantic Salmon in the Action Area

The upstream extent of the survey area in both the Kennebec and the Sebasticook Rivers are delineated by hydroelectric dams. While there are no dams in the action area, hydroelectric dams and subsequent impoundments can still negatively impact Atlantic salmon within the action area.

Operation of hydroelectric storage dams on these rivers results in lesser spring runoff flows,

lesser severity of flood events, and augmented summer flows (FERC 1997). Although few Atlantic salmon naturally occur in the lower Kennebec River due to the lack of upstream fish passage at the main stem dams, available rearing habitat for Atlantic salmon is impacted by alteration of the natural hydrograph (Fay *et al.* 2006). Additionally, the lower Kennebec River serves as *the* migratory pathway for all Atlantic salmon stocked in the upper watershed and changes in the hydrology brought about by dams likely affects the species migration. In addition to direct mortality while passing through a dam's turbines during seaward migrations, kelts and smolts are exposed to indirect mortality caused by sub-lethal injuries, increased stress, and/or disorientation. A large proportion of indirect mortality is a result of disorientation caused by downstream passage which can then lead to elevated levels of predation immediately downstream of the project (Mesa 1994; Ward *et al.* 1995; Ferguson *et al.* 2006).

Native and introduced fish species, such as smallmouth bass, chain pickerel, and northern pike are important predators of Atlantic salmon within the range of the GOM DPS (Fay *et al.* 2006). Smallmouth bass are important predators of smolts in main stem habitats, although bioenergetics modeling indicates that bass predation is insignificant at 5°C and increases with increasing water temperature during the smolt migration (Van den Ende 1993). Chain pickerel are known to feed upon smolts within the range of the GOM DPS and certainly feed upon fry and parr, as well as smolts, given their piscivorous feeding habits (Van den Ende 1993). Northern pike were illegally stocked in Maine, and their range has expanded. Northern pike are ambush predators that rely on vision and thus, predation upon smolts occurs primarily in daylight with the highest predation rates in low light conditions at dawn and dusk (Bakshtansky *et al.* 1976). Hatchery smolts experience higher rates of predation by fish than wild smolts, particularly from northern pike (Ruggles 1980, Bakshtansky *et al.* 1976).

Many species of birds also 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 and belted kingfishers are likely the most important predators of Atlantic salmon in freshwater environments.

Pollutants discharged to the Kennebec and Sebasticook Rivers from point sources and non-point sources affect water quality within the action area. Common point sources of contaminants include publicly operated waste treatment facilities, and industrial discharges. Agriculture and animal husbandry are frequent non-point sources of contaminated effluents.

The State of Maine classifies the Kennebec River reach that encompasses the action area as Class C. Under Maine Revised Statutes, Title 38, §465 they define Class C water bodies as those that must be of such quality that they are suitable for the designated uses of drinking water supply after treatment; fishing; agriculture; recreation in and on the water; industrial process and cooling water supply; hydroelectric power generation, except as prohibited under Title 12, section 403; navigation; and as a habitat for fish and other aquatic life. In their 2010 Integrated Water Quality Monitoring and Assessment Report, Maine DEP described the Kennebec and Sebasticook River action areas as impaired due to elevated levels of two environmentally persistent carcinogenic compounds i.e., dioxin and polychlorinated biphenyls.

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. With a combined population of nearly 35,000, the Waterville-Augusta action area is one of the more

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densely populated reaches of the river. For reaches of rivers and streams within the Kennebec River watershed that do not meet designated uses, the DEP calculates a total maximum daily loads (TMDL) and allocates a waste load for each particular pollutant.

Water quality and quantity in the lower Kennebec River has drastically improved since log drives in the river were halted in the mid-1970s. The elimination of the log drives along with the implementation of water quality regulations and the removal of Edwards Dam has added to those improvements. However as mentioned above, the water quality in the action area is still considered degraded and does not meet state standards for all designated uses.

4.3.5.1 Summary of Factors Affecting Recovery of Atlantic Salmon

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

4.3.5.2 Threats to the Species

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

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

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

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

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

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1. **Present or threatened destruction, modification, or curtailment of its habitat or range –** Historically and, to a lesser extent currently, dams have adversely impacted Atlantic salmon by obstructing fish passage and degrading riverine habitat. Dams are considered to be one of the primary causes of both historic declines and the contemporary low abundance of the GOM DPS. Land use practices, including forestry and agriculture, have reduced habitat complexity (e.g., removal of large woody debris from rivers) and habitat connectivity (e.g., poorly designed road crossings) for Atlantic salmon. Water withdrawals, elevated sediment levels, and acid rain also degrade Atlantic salmon habitat.

2. **Overutilization for commercial, recreational, scientific, or educational purposes** – While most directed commercial fisheries for Atlantic salmon have ceased, the impacts from past fisheries are still important in explaining the present low abundance of the GOM DPS. Both poaching and by-catch in recreational and commercial fisheries for other species remain of concern, given critically low numbers of salmon.

3. **Predation and disease –** Natural predator-prey relationships in aquatic ecosystems in the GOM DPS have been substantially altered by introduction of non-native fishes (e.g., chain pickerel, smallmouth bass, and northern pike), declines of other native diadromous fishes, and alteration of habitat by impounding free-flowing rivers and removing instream structure (such as removal of boulders and woody debris during the log-driving era). The threat of predation on the GOM DPS is noteworthy because of the imbalance between the very low numbers of returning adults and the recent increase in populations of some native predators (e.g., double-crested cormorant), as well as non-native predators. Atlantic salmon are susceptible to a number of diseases and parasites, but mortality is primarily documented at conservation hatcheries and aquaculture facilities.

4. **Inadequacy of existing regulatory mechanisms –** The ineffectiveness of current federal and state regulations at requiring fish passage and minimizing or mitigating the aquatic habitat impacts of dams is a significant threat to the GOM DPS today. Furthermore, most dams in the GOM DPS do not require state or federal permits. Although the State of Maine has made substantial progress in regulating water withdrawals for agricultural use, threats still remain within the GOM DPS including those from the effects of irrigation wells on salmon streams.

5. **Other natural or manmade factors –** Poor marine survival rates of Atlantic salmon are a significant threat, although the causes of these decreases are unknown. The role of ecosystem function among the freshwater, estuarine, and marine components of the Atlantic salmon's life history, including the relationship of other diadromous fish species in Maine (e.g., American shad, alewife, sea lamprey), is receiving increased scrutiny in its contribution to the current status of the GOM DPS and its role in recovery of the Atlantic salmon. While current state and federal regulations pertaining to finfish aquaculture have reduced the risks to the GOM DPS (including eliminating the use of non-North American Atlantic salmon and improving containment protocols), risks from the spread of diseases or parasites and from farmed salmon escapees interbreeding with wild salmon still exist.

4.3.5.3 Threats to Critical Habitat within the GOM DPS

The final rule designating critical habitat for the GOM DPS identifies a number of activities that have and will likely continue to impact the biological and physical features of spawning, rearing, and migration habitat for Atlantic salmon. These include agriculture, forestry, changing land-use

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and development, hatcheries and stocking, roads and road-crossings and other instream activities (such as alternative energy development), mining, dams, dredging, and aquaculture. Most of these activities have or still do occur, at least to some extent, in each of the three SHRUs.

The Penobscot SHRU once contained high quality Atlantic salmon habitat in quantities sufficient to support robust Atlantic salmon populations. 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 twenty 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 below the Great Works Dam.

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.

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

4.3.5.4 Efforts to Protect the GOM DPS and its Critical Habitat

Efforts aimed at protecting Atlantic salmon and their habitats in Maine have been underway for well over one hundred years. These efforts are supported by a number of federal, state, and local government agencies, as well as many private conservation organizations. The 2005 recovery

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plan for the originally-listed GOM DPS (NMFS and USFWS 2005) presented a strategy for recovering Atlantic salmon that focused on reducing the most severe threats to the species and immediately halting the decline of the species to prevent extinction. The 2005 recovery program included the following elements:

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

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

4.4 Summary of Information on Atlantic Salmon in the Action Area

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

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

Activities occurring in the action area have the potential to impact the GOM DPS of Atlantic salmon. Despite improvements in water quality and the elimination of directed fishing for these species, Atlantic salmon still face numerous threats in this river system. As noted above, the total effect of hydroelectric facilities in the Kennebec River Basin is largely unknown; however, it is certain that they affect habitat and connectivity in the Kennebec River for Atlantic salmon.

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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 10%) and is continuing to decline. The conservation hatchery program has assisted in slowing the decline and helping to stabilize populations at low levels, but has not contributed to an increase in the overall abundance of salmon and has not been able to halt the decline of the naturally reared component of the GOM DPS.

A number of activities within the Kennebec SHRU will likely continue to impact the biological and physical features of spawning, rearing, and migration habitat for Atlantic salmon. These include agriculture, forestry, changing land-use and development, hatcheries and stocking, roads and road-crossings and other instream activities (such as alternative energy development), mining, dams, dredging, and aquaculture. Dams, along with degraded substrate and cover, water quality, water temperature, and biological communities, have reduced the quality and quantity of habitat available to Atlantic salmon populations within the Kennebec SHRU. The removal of the lowermost dams on the Kennebec and Sebasticook Rivers has allowed improved upstream passage and downstream survival, and will likely lead to an increase in the abundance of returning Atlantic salmon to the SHRU.

4.5 Atlantic Sturgeon

The Atlantic sturgeon is a subspecies of sturgeon distributed along the eastern coast of North America from Hamilton Inlet, Labrador, Canada to Cape Canaveral, Florida, USA (Scott and Scott 1988; ASSRT 2007). We have delineated U.S. populations of Atlantic sturgeon into five DPSs (77 FR 5880 and 77 FR 5914. On February 6, 2012, we published notice in the *Federal Register* listing the New York Bight (NYB), Chesapeake Bay, Carolina, and South Atlantic DPSs of Atlantic sturgeon *(Acipenser oxyrinchus oxyrinchus)* as "endangered," and the GOM DPS as "threatened" (77 FR 5880 and 77 FR 5914). The effective date of the listings was April 6, 2012. The DPSs do not include Atlantic sturgeon that are spawned in Canadian rivers. Therefore, Canadian spawned fish are not included in the listings. However, genetic data as well as tracking and tagging data demonstrate sturgeon from each DPS and Canada occurs throughout the full range from Labrador, Canada to Cape Canaveral, Florida.

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

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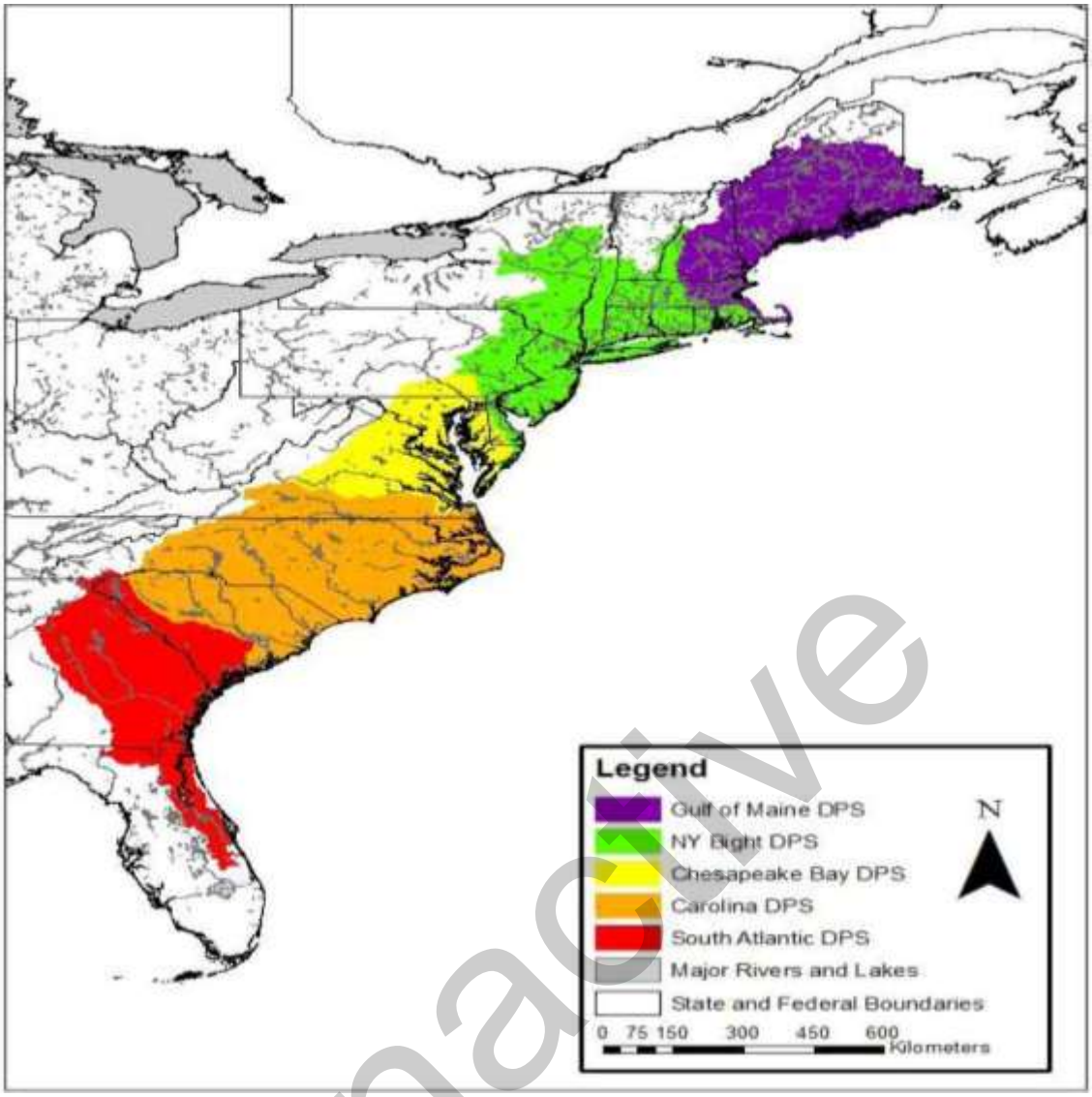

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Figure 2. Five Distinct Population Segments of Atlantic Sturgeon Map

4.5.1 Atlantic sturgeon life history

Atlantic sturgeon are long lived (approximately 60 years), late maturing, estuarine dependent, anadromous[1] fish (Bigelow and Schroeder 1953; Vladykov and Greeley 1963; Mangin 1964; Pikitch *et al.* 2005; Dadswell, 2006; ASSRT, 2007). They are a relatively large fish, even amongst sturgeon species (Pikitch *et al.* 2005). Atlantic sturgeons are bottom feeders that suck food into a ventrally-located protruding mouth (Bigelow and Schroeder 1953). Four barbels in front of the mouth assist the sturgeon in locating prey (Bigelow and Schroeder, 1953). Diets of adult and migrant subadult Atlantic sturgeon include mollusks, gastropods, amphipods, annelids, decapods, isopods, and fish such as sand lance (Bigelow and Schroeder, 1953; ASSRT, 2007; Guilbard *et al.* 2007; Savoy, 2007). Juvenile Atlantic sturgeon feed on aquatic insects, insect larvae, and other invertebrates (Bigelow and Schroeder, 1953; ASSRT, 2007; Guilbard *et al.* 2007).

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

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

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

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

Larval Atlantic sturgeon (*i.e.* less than 4 weeks old, with total lengths (TL) less than 30 mm; Van Eenennaam *et al*. 1996) are assumed to undertake a demersal existence and inhabit the same

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riverine or estuarine areas where they were spawned (Smith *et al.* 1980; Bain *et al.* 2000; Kynard and Horgan 2002; ASMFC 2009). Studies suggest that age-0 (*i.e.*, young-of-year), age-1, and age-2 juvenile Atlantic sturgeon occur in low salinity waters of the natal estuary (Haley 1999; Hatin *et al.* 2007; McCord *et al.* 2007; Munro *et al.* 2007) while older fish are more salt tolerant and occur in higher salinity waters as well as low salinity waters (Collins *et al.* 2000). Atlantic sturgeon remain in the natal estuary for months to years before emigrating to open ocean as subadults (Holland and Yelverton 1973; Dovel and Berggen 1983; Waldman *et al.* 1996; Dadswell 2006; ASSRT, 2007).

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

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4.5.2 Distribution and Abundance

Atlantic sturgeon underwent significant range-wide declines from historical abundance levels due to overfishing in the mid to late 19th century when a caviar market was established (Scott and Crossman 1973; Taub 1990; Kennebec River Resource Management Plan 1993; Smith and Clugston 1997; Dadswell 2006; ASSRT 2007). Abundance of spawning-aged females prior to this period of exploitation was predicted to be greater than 100,000 for the Delaware, and at least 10,000 females for other spawning stocks (Secor and Waldman 1999; Secor 2002). Historical records suggest that Atlantic sturgeon spawned in at least 35 rivers prior to this period. Currently, only 16 U.S. rivers are known to support spawning based on available evidence (*i.e.*, presence of young-of-year or gravid Atlantic sturgeon documented within the past 15 years) (ASSRT 2007). While there may be other rivers supporting spawning for which definitive

evidence has not been obtained (e.g., in the Penobscot and York Rivers), the number of rivers supporting spawning of Atlantic sturgeon are approximately half of what they were historically. In addition, only four rivers (Kennebec, Hudson, Delaware, James) are known to currently support spawning from Maine through Virginia where historical records support there used to be fifteen spawning rivers (ASSRT 2007). Thus, there are substantial gaps in the range between Atlantic sturgeon spawning rivers amongst northern and mid-Atlantic states which could make recolonization of extirpated populations more difficult.

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

4.5.3 Threats faced by Atlantic sturgeon throughout their range

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

Based on the best available information, we have 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

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commercial fishing activity.

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

Fisheries bycatch in U.S. waters is a threat faced by all 5 DPSs. At this time, we have an estimate of the number of Atlantic sturgeon captured and killed in sink gillnet and otter trawl fisheries authorized by Federal FMPs (NMFS NEFSC 2011) in the Northeast Region but do not have a similar estimate for Southeast fisheries. We also do not have an estimate of the number of Atlantic sturgeon captured or killed in state fisheries. At this time, we are not able to quantify the effects of other significant threats (e.g., vessel strikes, poor water quality, water availability, dams, and dredging) in terms of habitat impacts or loss of individuals. While we have some information on the number of mortalities that have occurred in the past in association with certain activities (e.g., mortalities in the Delaware and James rivers that are thought to be due to vessel strikes), we are not able to use those numbers to extrapolate effects throughout one or more DPS. This is because of (1) the small number of data points and, (2) lack of information on the percent of incidences that the observed mortalities represent.

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

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4.6 Determination of DPS Composition Within The Action Area

As explained above, the range of all 5 DPSs overlaps and extends from Canada through Cape Canaveral, Florida. We have considered the best available information to determine from which DPSs individuals in the action area are likely to have originated. We have determined that Atlantic sturgeon in the action area are likely to originate from two of the five ESA listed DPSs as well as from the St. John River in Canada. Fish originating from the St. John River are not listed under the ESA. Currently, if the fish does not have an identifying tag, the only way to tell the river (or DPS) of origin for a particular individual is by genetic sampling. The distribution of Atlantic sturgeon is influenced by geography, with Atlantic sturgeon from a particular DPS becoming less common the further you are from the river of origin. Areas that are geographically close are expected to have a similar composition of individuals. The nearest area to the action area for which mixed stock analysis is available is the Bay of Fundy, Canada. In this area, 63% of individuals are Canadian (St. John River) origin, 36% are GOM DPS origin and 1% are NYB origin. We do not currently have a mixed stock analysis for the action area. In

the Kennebec River, we expect the composition to be similar to that in the Bay of Fundy; however, we expect that GOM DPS individuals will be more frequent than Canadian origin individuals. Therefore, in the action area, we expect Atlantic sturgeon to occur at the following frequencies: St. John River (Canada) 36%, Gulf of Maine DPS 63% and New York Bight DPS 1%. This assumption is supported by some preliminary genetic analyses of fish caught in rivers within the Gulf of Maine; these results demonstrate that the fish are predominantly of Gulf of Maine origin with some St. John River and Hudson River fish present. The genetic assignments have a plus/minus 5% confidence interval; however, for purposes of section 7 consultation, we have selected the reported values above, which approximate the mid-point of the range, as a reasonable indication of the likely genetic makeup of Atlantic sturgeon in the action area. These assignments and the data from which they are derived are described in detail in Damon-Randall et al. (2012).

4.7 Gulf of Maine DPS of Atlantic sturgeon

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

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

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

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

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

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accessible habitat in this river. Atlantic sturgeon occur in the Merrimack River but spawning has not been documented. Like the Penobscot, it is unknown how the Essex Dam affects the likelihood of spawning occurring in this river.

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

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

Summary of the Gulf of Maine DPS

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

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

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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.

4.8 New York Bight DPS of Atlantic sturgeon

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

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

There is no abundance estimate for the Delaware River population of Atlantic sturgeon. Harvest records from the 1800's indicate that this was historically a large population with an estimated 180,000 adult females prior to 1890 (Secor and Waldman, 1999; Secor, 2002). Sampling in 2009 to target young-of- the year (YOY) Atlantic sturgeon in the Delaware River (i.e., natal sturgeon) resulted in the capture of 34 YOY, ranging in size from 178 to 349 mm TL (Fisher, 2009) and the collection of 32 YOY Atlantic sturgeon in a separate study (Brundage and O'Herron in Calvo

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et al., 2010). Genetics information collected from 33 of the 2009 year class YOY indicates that at least 3 females successfully contributed to the 2009 year class (Fisher, 2011). Therefore, while the capture of YOY in 2009 provides evidence that successful spawning is still occurring in the Delaware River, the relatively low numbers suggest the existing riverine population is limited in size.

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

Summary of the New York Bight DPS

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

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

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

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

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

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

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

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5.0 ENVIRONMENTAL BASELINE

Environmental baselines for biological opinions include the past and present impacts of all state, federal or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR 402.02). The environmental baseline for this Opinion includes the effects of several activities that may affect the survival and recovery of the listed species and may affect critical habitat in the action area.

5.1 Actions that have undergone Formal or Early Section 7 Consultations

Federal actions that have occurred in the action area of this consultation include ESA Section 7 consultation for the Lockwood Hydroelectric Project. No take of Atlantic salmon was exempted in this consultations and no take occurred.

As explained in section 1.0, we completed three formal consultations concerning the US Environmental Protection Agency's (EPA) proposed support of a bioassessment study in the Kennebec River in 2009, 2010 and 2011. We exempted the non-lethal take of up to two adult Atlantic salmon for each year of the study. No salmon were encountered in either 2009 or 2010, however, four Atlantic salmon were encountered in 2011; no mortalities have occurred.

MDMR is authorized under the USFWS' endangered species blanket permit (No. 697823) issued pursuant to Section 10 of the ESA to conduct monitoring, assessment, and habitat restoration activities for listed Atlantic salmon populations in Maine. The extent of take from MDMR activities during any given year is not expected to exceed 2% of any life stage being impacted, except that for adults, it would be less than 1%. MDMR will continue to conduct Atlantic salmon research and management activities in the Kennebec River watershed while the proposed action is carried out. The information gained from these activities will be used to further salmon conservation actions in the GOM DPS.

We are also a sub-permittee under USFWS' ESA section 10 endangered species blanket permit. Research authorized under this permit is currently ongoing regarding Atlantic salmon populations in the Merrymeeting Bay SHRU. Although these activities will result in some take of Atlantic salmon, adverse impacts are expected to be minor and such take is authorized by an existing ESA permit. The information gained from these activities will be used to further salmon conservation actions in the GOM DPS.

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 provided through production at the hatcheries. The hatcheries provide a significant buffer from extinction for the species.

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5.2 Other Federally Authorized Activities in the Action Area

We have completed several informal consultations on effects of in-water construction activities in the Kennebec River permitted by the ACOE. This includes several dock, pier, and bank stabilization projects. No interactions with Atlantic salmon have been reported in association with any of these projects.

5.3 State or Private Activities in the Action Area

We are not aware of any state or private activities currently affecting listed Atlantic salmon in the action area of this consultation.

5.4 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 hydroelectric facilities and the introduction of pollutants from paper mills, sewers, and other industrial sources. Pollution has been a major problem for this river system, which continues to receive discharges from sewer treatment facilities and paper production facilities (metals, dioxin, dissolved solids, phenols, and hydrocarbons). Hydroelectric facilities in the Kennebec and Sebasticook Rivers establish the upstream boundaries of the action area. Those facilities can alter the river's natural flow pattern and temperatures and release silt and other fine river sediments into downstream areas. These facilities also act as barriers to normal upstream and downstream movements, and block access to important habitats. Passage

through these facilities may result in the mortality of downstream migrants. Thus, the effects of hydroelectric operations could affect the number and distribution of Atlantic salmon in the action area of this consultation.

6.0 CLIMATE CHANGE

The discussion below presents background information on global climate change and information on past and predicted future effects of global climate change throughout the range of the listed species considered here. Climate change is relevant to the Status of the Species, Environmental Baseline and Cumulative Effects sections of this Opinion; rather than include partial discussion in several sections of this Opinion, we are synthesizing this information into one discussion. Consideration of effects of the proposed action in light of predicted changes in environmental conditions due to anticipated climate change are included in below.

6.1 Background Information on Global climate change

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

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

The past three decades have witnessed major changes in ocean circulation patterns in the Arctic, and these were accompanied by climate associated changes as well (Greene *et al.* 2008). Shifts in atmospheric conditions have altered Arctic Ocean circulation patterns and the export of freshwater to the North Atlantic (Greene *et al.* 2008; IPCC 2006). With respect specifically to the North Atlantic Oscillation (NAO), changes in salinity and temperature are thought to be the result of changes in the earth's atmosphere caused by anthropogenic forces (IPCC 2006). The NAO impacts climate variability throughout the northern hemisphere (IPCC 2006). Data from the 1960s through the present show that the NAO index has increased from minimum values in

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the 1960s to strongly positive index values in the 1990s and somewhat declined since (IPCC 2006). This warming extends over 1000m (0.62 miles) deep and is deeper than anywhere in the world oceans and is particularly evident under the Gulf Stream/ North Atlantic Current system (IPCC 2006). On a global scale, large discharges of freshwater into the North Atlantic subarctic seas can lead to intense stratification of the upper water column and a disruption of North Atlantic Deepwater (NADW) formation (Greene *et al.* 2008; IPCC 2006). There is evidence that the NADW has already freshened significantly (IPCC 2006). This in turn can lead to a slowing down of the global ocean thermohaline (large-scale circulation in the ocean that transforms low-density upper ocean waters to higher density intermediate and deep waters and returns those waters back to the upper ocean), which can have climatic ramifications for the whole earth system (Greene *et al.* 2008).

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

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

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

6.2 Potential Effects to Atlantic Salmon and Critical Habitat

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

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

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

The productivity and feeding conditions in Atlantic salmon's overwintering regions in the ocean are critical in determining the final weight of individual salmon and whether they have sufficient energy to migrate upriver to spawn (Lehodey *et al.* 2006). Survival is inversely related to body size in pelagic fishes, and temperature has a direct effect on growth that will affect growth-related sources of mortality in post-smolts (Friedland 1998). Post-smolt growth increases in a linear trend with temperature, but eventually reaches a maximum rate and decreases at high temperatures (Brett 1979 *in* Friedland 1998). When at sea, Atlantic salmon eat crustaceans and small fishes, such as herring, sprat, sand-eels, capelin, and small gadids, and when in freshwater,

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adults do not feed but juveniles eat aquatic insect larvae (FAO 2012). Species with calcium carbonate skeletons, such as the crustaceans that salmon sometimes eat, are particularly susceptible to ocean acidification, since ocean acidification will reduce the carbonate availability necessary for shell formation (Wood *et al.* 2008). Climate change is likely to affect the abundance, diversity, and composition of plankton, and these changes may have important consequences for higher trophic levels like Atlantic salmon (Beaugrand and Reid 2003).

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

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

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

6.3 Potential Effects to Atlantic Sturgeon

Global climate change may affect all DPSs of Atlantic sturgeon in the future; however, effects of increased water temperature and decreased water availability are most likely to affect the South Atlantic and Carolina DPSs. Rising sea level may result in the salt wedge moving upstream in affected rivers. Atlantic sturgeon spawning occurs in fresh water reaches of rivers because early life stages have little to no tolerance for salinity. Similarly, juvenile Atlantic sturgeon have

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limited tolerance to salinity and remain in waters with little to no salinity. If the salt wedge moves further upstream, Atlantic sturgeon spawning and rearing habitat could be restricted. In river systems with dams or natural falls that are impassable by sturgeon, the extent that spawning or rearing may be shifted upstream to compensate for the shift in the movement of the saltwedge would be limited. While there is an indication that an increase in sea level rise would result in a shift in the location of the salt wedge, at this time there are no predictions on the timing or extent of any shifts that may occur; thus, it is not possible to predict any future loss in spawning or rearing habitat. However, in all river systems, spawning occurs miles upstream of the saltwedge. It is unlikely that shifts in the location of the saltwedge would eliminate freshwater spawning or rearing habitat. If habitat was severely restricted, productivity or survivability may decrease.

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

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

Adult salmon appear to be returning to the Penobscot River about two weeks ahead of when they migrated historically (USFWS 2012). During research at the Craig Brook National Fish Hatchery, USFWS biologists found that when spawning occurs in the hatchery on this accelerated schedule, the young fish mature too early in the spring. In the incubators, they absorb their internal yolk sacs and need to be released into the river to feed before the water is warm enough to support the invertebrate animals they need as food. As hatchery-raised fish comprise 95-percent of the salmon population in the Penobscot, USFW biologists are manipulating water temperatures and length of daylight in an attempt to bring the captive fish more in sync with seasonal river conditions.

An additional concern in recovering the Atlantic salmon in light of climate change is how the rivers in the Downeast region of Maine are experiencing extreme fluctuations in water flows – heavier rainfalls happening less frequently, combined with earlier snow and melting river ice – that have been predicted in certain climate change models (USFWS 2012). During these weather events, the high-flowing water doesn't have a chance to absorb into the river beds, which contain minerals that serve as a buffer to changing water chemistry. This lack of buffering can increase the acidity of the water. Biological studies show that it can take weeks for a salmon in this life stage to recover after being exposed to acidic conditions (McCormick *et al.* 2011). Acidic pH

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levels in the water lower than 6 (7 is neutral) can cause naturally occurring aluminum levels in the water to become reactive to the fish (Liebich *et al*. 2011). This can prevent calcium from binding to the fishes' gills – a necessary process for their transition to the marine environment. As the smoltification process is time sensitive, this delayed transition could help explain the reason smolts are being lost in the estuaries.

7.0 EFFECTS OF THE ACTION

This section of an Opinion assesses the direct and indirect effects of the proposed action on endangered Atlantic salmon and its 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 interdependent or interrelated actions. As explained in the "Description of the Action" section above, the proposed action will involve electrofishing at eleven sites in the Kennebec River and three sites in the Sebasticook River. All sampling will take place in the fall (September/October). This section of the Opinion analyzes the effects of the proposed sampling events on Atlantic salmon present within the action area of this consultation.

7.1 Effects to Atlantic salmon

Based upon the best available data, Atlantic salmon could be present in any of the proposed sample sites in the Kennebec or Sebasticook Rivers. Due to the time of year when sampling will occur and the types of habitats that will be sampled, no spawning or overwintering fish will be affected; similarly no Atlantic salmon eggs or other early life stages would be present in the action area during this time of year. Additionally, as all sampling will take place in deeper, non-wadeable habitats, no parr would occur in the areas to be sampled. Also, no smolts will be present in the action area at the time of sampling. Therefore, the only Atlantic salmon likely to be exposed to effects of the action are adults.

As evidenced by the timing of the counts of Atlantic salmon at the Lockwood fish lift from 2009 to 2011 (Table 3), the number of returning adults in the Kennebec River is greatest during the spring and early summer. Salmon returning to the Androscoggin River also show similar temporal trends however they are not part of the action area of this consultation. During late summer and fall (August to October), only two fish have used the Lockwood fishway from 2009 to 2011. Based on this information, we expect few Atlantic salmon to be present in the action area during September and October. Nevertheless, as Atlantic salmon adults have been documented in the action area in September and October, it is reasonable to expect that Atlantic salmon will be encountered during the proposed electrofishing surveys. From 2001 – 2011, MBI encountered a total of six adult Atlantic salmon during sampling by MBI in the lower Kennebec and Sebasticook Rivers. On August 12, 2002, two adult Atlantic salmon were encountered during electrofishing in Waterville. Both fish swam away unharmed. In October 2011, four adult Atlantic salmon were encountered during sampling; three salmon in the Kennebec River near Waterville and one salmon in the Sebasticook River downstream of the Benton Falls Dam. Each of these fish also swam away unharmed by the encounter with electrofishing gear. It should be noted that the adult salmon returns in Maine were relatively high in 2011compared to previous years which may explain the relatively high number of salmon encountered during sampling; 64 adult Atlantic salmon were documented number of returning to the Kennebec River in 2011. From 2006 to 2010, an average of 18 Atlantic salmon returned to the Kennebec River

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annually.

Electrofishing can cause mortality or injury to fish. Fish encountering the electric current typically undertake an involuntary movement toward the positive electrode. Harmful effects to fish during electrofishing can include spinal injuries, bleeding at gills or vent, hemorrhaging, and excessive physiological stress (Snyder 2003). Snyder (2003), however, states that injuries heal and seldom result in delayed mortality if electrofishing is conducted carefully. Handling and anesthesia associated with electrofishing surveys can also cause harm to fish. Snyder (2003), in a review of the effects of electrofishing on fish, notes that electrofishing mortalities related to asphyxiation are often the result of poor handling.

To estimate the number of salmon that may be encountered during the surveys, we considered a number of factors including: the seasonal distribution of Atlantic salmon in the Kennebec River watershed, the number of adult Atlantic salmon returning to the Kennebec River from 2006-2011, the number of Atlantic salmon captured at the Lockwood fish lift in September 2006-2011, the number of Atlantic salmon encountered during past years of electrofishing supported surveys between Waterville and Augusta, the short duration of the study, the small number of areas being sampled (11 total), and the relatively small effective range of the electrofishing boat. Based on current trends and historic data collected over several years, we expect that no more than four adult Atlantic salmon will encounter the electric current associated with the electrofishing gear annually during the five-year study, which is the maximum number of Atlantic salmon encountered in one year in the past. This is a reasonable estimate because we do not expect there to be a greater number of Atlantic salmon in the action area during 2012-2016 than there was in 2011 and there are no changes proposed for the study that make the likelihood of encounter greater than in past years.

The electrofishing survey to be undertaken in the Kennebec River watershed will be performed pursuant to protocols developed specifically by the MASC to minimize the potential for injury or mortality to Atlantic salmon. Mortality rates during electrofishing surveys carried out by MDMR in the GOM DPS of Atlantic salmon have annually remained below 1% (MDMR unpublished data). Documented mortality of large parr during MASC electrofishing surveys in the Narraguagus has been less than 0.1%. None of the six Atlantic salmon encountered during past sampling by MBI have been injured or killed. No injury or mortality of adult Atlantic salmon is expected as the guidelines designed specifically to minimize the potential for injury or mortality will be followed.

Based upon this information, of the four adult Atlantic salmon that may encountered annually during the survey, none are expected to experience mortality. Exposed salmon may be temporarily stunned and may roll or twitch. The available information indicates that these fish will recover immediately, likely within five minutes. It is likely that any adult Atlantic salmon encountered during electrofishing will recover and swim away. No Atlantic salmon will be netted.

In summary, based on the limited size of the effective area of the electrofishing boat and the likely distribution of Atlantic salmon in the action area, no more than four Atlantic salmon are expected to be affected annually during the five year survey. Exposed salmon may be temporarily stunned and exhibit rolling or twitching behavior, but no injuries or mortalities are expected and any effects will be temporary. As no sampling will occur during salmon spawning activities and any adults encountered during sampling will have time to recover prior to any subsequent spawning activities, no significant effects to spawning salmon are expected. It is

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important to note that the low number of expected encounters is supported by the available information for other electrofishing surveys in the Kennebec River. As explained above, this survey has taken place for the last eight years and only six Atlantic salmon have been observed.

7.2 Effects to Designated Critical Habitat

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

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

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

The project will not result in a migration barrier as the electrofishing operation will only affect a small portion of the river at any given time, and because the electrofishing boat has a small effective range, electric current, which could deter fish from passing through the affected area, 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. 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 electrification; there will be no other water quality impacts of the proposed action and therefore the project is not expected to affect water quality at the time of any salmon migrations in the action area. 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 insignificant.

7.3 Effects to Atlantic Sturgeon

The EPA IBI study has taken place in the action area for nine years. During this time period, only one Atlantic sturgeon was encountered (fall 2007). The Atlantic sturgeon was observed near Sevenmile Island which is located approximately five miles upstream of the City of Augusta. According to the Maine Department of Marine Resources, encountering an adult Atlantic sturgeon in the action in early fall is unlikely (pers. comm., Gail Wipplehauser, August 23, 2012). At this time of year, adults are expected to have left the river after spawning.

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However, juveniles and subadults may be present in the action area and may be exposed to the electrofishing current.

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 DC current (68% vs. 10%) with no mortality (Holliman and Reynolds 2002). The available mortality data for sturgeon indicates that mortality resulting from exposure to electrofishing current is likely to be zero.

In order to be exposed to the electric current, a fish must be close to the electrofishing boat. Dense aggregations of Atlantic sturgeon are not likely in the action area during the time of year when sampling will occur. The small amount of sampling and small area of the river where electric current will be experienced makes the potential for exposure of Atlantic sturgeon to the electric current low. However, as evidenced by the past observation of an Atlantic sturgeon during this survey, it is likely that an Atlantic sturgeon will be encountered. Given the past rate of encounters (1 in nine years), we anticipate that no more than one Atlantic sturgeon will be encountered during the five years of the IBI study.

Atlantic sturgeon exposed to electrical current may be temporarily stunned and exhibit rolling or twitching behavior, but no injuries or mortalities are expected and any effects will be temporary. As no sampling will occur during Atlantic sturgeon spawning activities and any adults encountered during sampling will have months to recover prior to any subsequent spawning activities, no significant effects to spawning Atlantic sturgeon are expected.

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, As such, we have determined that adverse effects to Atlantic sturgeon will be temporary and no mortality is anticipated.

8.0 CUMULATIVE EFFECTS

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

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Actions carried out or regulated by the State of Maine within the action area that may affect Atlantic salmon and Atlantic sturgeon include the authorization of state fisheries and the regulation of point and non-point source pollution through the National Pollutant Discharge Elimination System (NPDES) program. We are not aware of any local or private actions that are reasonably certain to occur in the action area that may affect listed species. It is important to note that the definition of "cumulative effects" in the section 7 regulations is not the same as the NEPA definition of cumulative effects.[2]

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

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

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

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

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resulting from the proposed action would reduce appreciably the likelihood of both the survival and recovery of these species, as those terms are defined for purposes of the federal Endangered Species Act.

9.1 GOM DPS of Atlantic Salmon

The GOM DPS of Atlantic salmon is listed as endangered throughout its range. Atlantic salmon in the GOM DPS currently exhibit critically low spawner abundance, poor marine survival, and are still confronted with a variety of threats. Numbers of endangered adult Atlantic salmon returning to the GOM DPS are extremely low, with only 1014 adults in 2007, and only 16 of these returning to the Kennebec (NMFS and USFWS 2009). Based upon the best available scientific information, we have determined that the proposed study will result in the exposure of a total of 20 Atlantic salmon to the electric current associated with the electrofishing equipment; we expect that there will be an average of four Atlantic salmon encountered in each of the five years of the study. Based upon assumptions outlined in this Opinion, no injury or mortality of Atlantic salmon is likely to occur during the project.

This action will not reduce reproduction of Atlantic salmon in the Kennebec River watershed because it will (1) not result in the mortality of any Atlantic salmon and therefore will not affect any potential reproduction of any individuals; (2) not affect any spawning adults; (3) not affect spawning habitat; and (4) as recovery from exposure is expected to be rapid and complete, will not affect the reproductive fitness of any individual by reducing fecundity or increasing the interval between spawning.

This action will not reduce the numbers of Atlantic salmon in the Kennebec River watershed because it will not result in the mortality of any Atlantic salmon. The proposed action will not reduce distribution because the action will not impede Atlantic salmon from accessing any habitat, including spawning, foraging or overwintering grounds in the Kennebec River watershed. Further, the action is not expected to reduce the river by river distribution of Atlantic salmon.

For these reasons, we believe that there is not likely to be any reduction in reproduction, numbers or distribution of GOM DPS Atlantic salmon and therefore no reduction in the likelihood of survival of this species. As there will not be a reduction in reproduction or numbers of Atlantic salmon and no reduction in the rangewide distribution of this species, this action is not likely to impede the ability of the species to recover or affect the rate of recovery. As such, there is not likely to be an appreciable reduction in the likelihood of survival and recovery in the wild of the Kennebec River SHRU or the species as a whole.

9.2 Critical Habitat for Atlantic Salmon

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

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9.3 Atlantic Sturgeon

As explained above, one Atlantic sturgeon is expected to be encountered during the five year study. This fish could originate from either the GOM DPS or the New York Bight DPS. Here, we consider the effects to these DPSs.

9.3.1 Gulf of Maine DPS of Atlantic sturgeon

Individuals originating from the GOM DPS are likely to occur in the action area. The GOM DPS has been listed as threatened. While Atlantic sturgeon occur in several rivers in the GOM DPS, recent spawning has only been documented in the Kennebec river. The capture of a larvae in the Androscoggin River suggests that spawning may also be occurring in this river. No total population estimates are available. GOM origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. While there are some indications that the status of the GOM DPS may be improving, there is currently not enough information to establish a trend for any life stage or for the DPS as a whole.

We have estimated that the proposed survey will result in the exposure of one Atlantic sturgeon over a five year period to electric current. This fish could originate from the GOM DPS. No injury or mortality is anticipated and recovery from exposure is expected to be rapid and complete. The survival of any GOM DPS Atlantic sturgeon will not be affected by these surveys. 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 the encounter there will be no delay or disruption of any essential behavior including spawning, there will be no reduction in individual fitness or any future reduction in numbers of individuals. Additionally, the proposed action will not affect their spawning habitat in any way and will not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds.

The proposed action is not likely to reduce distribution because the action will not impede 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 exposure to the electric current.

Based on the information provided above, the exposure of one GOM DPS Atlantic sturgeon surveys will not appreciably reduce the likelihood of survival of this species (*i.e.*, it will not increase the risk of extinction faced by this species) given that: (1) there will be no mortality and therefore, no reduction in the numbers of GOM DPS Atlantic sturgeon; (2) there will be no effect to the fitness of any individuals and no effect on reproductive output of the GOM DPS of Atlantic sturgeon; (3) and, the action will have only a minor and temporary effect on the distribution of GOM DPS Atlantic sturgeon in the action area (related to the temporary exposure of the affected individual) and no effect on the distribution of the species throughout its range.

As there will not be a reduction in reproduction or numbers of Atlantic salmon and no reduction in the rangewide distribution of this species, this action is not likely to impede the ability of the species to recover or affect the rate of recovery. Therefore, the proposed action is not likely to appreciably reduce the likelihood of the survival and recovery of the GOM DPS of Atlantic sturgeon.

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9.3.2 New York Bight DPS of Atlantic sturgeon

Individuals originating from the NYB DPS are likely to occur in the action area. The NYB DPS has been listed as endangered. While Atlantic sturgeon occur in several rivers in the NYB DPS, recent spawning has only been documented in the Delaware and Hudson rivers. NYB DPS origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently not enough information to establish a trend for any life stage, for the Hudson or Delaware River spawning populations or for the DPS as a whole. Some Delaware River fish have a unique genetic haplotype (the A5 haplotype); however, whether there is any evolutionary significance or fitness benefit provided by this genetic makeup is unknown. Genetic evidence indicates that while spawning continued to occur in the Delaware River and in some cases Delaware River origin fish can be distinguished genetically from Hudson River origin fish, there is free interchange between the two rivers. This relationship is recognized by the listing of the New York Bight DPS as a whole and not separate listings of a theoretical Hudson River DPS and Delaware River DPS. Thus, while we can consider the loss of Delaware River fish on the Delaware River population and the loss of Hudson River fish on the Hudson River population, it is more appropriate, because of the interchange of individuals between these two populations, to consider the effects of these mortalities on the New York Bight DPS as a whole.

We have estimated that the proposed survey will result in the exposure of one Atlantic sturgeon over a five year period to electric current. This fish could originate from the NYB DPS. No injury or mortality is anticipated and recovery from exposure is expected to be rapid and complete. The survival of any NYB DPS Atlantic sturgeon will not be affected by these surveys. 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 the encounter there will be no delay or disruption of any essential behavior including spawning, there will be no reduction in individual fitness or any future reduction in numbers of individuals. Additionally, the proposed action will not affect their spawning habitat in any way and will not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds.

The proposed action is not likely to reduce distribution because the action will not impede 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 exposure to the electric current.

Based on the information provided above, the exposure of one NYB DPS Atlantic sturgeon surveys will not appreciably reduce the likelihood of survival of this species (*i.e.*, it will not increase the risk of extinction faced by this species) given that: (1) there will be no mortality and therefore, no reduction in the numbers of NYB DPS Atlantic sturgeon; (2) there will be no effect to the fitness of any individuals and no effect on reproductive output of the NYB DPS of Atlantic sturgeon; (3) and, the action will have only a minor and temporary effect on the distribution of GOM DPS Atlantic sturgeon in the action area (related to the temporary exposure of the affected individual) and no effect on the distribution of the species throughout its range.

As there will not be a reduction in reproduction or numbers of Atlantic salmon and no reduction in the rangewide distribution of this species, this action is not likely to impede the ability of the

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species to recover or affect the rate of recovery. Therefore, the proposed action is not likely to appreciably reduce the likelihood of the survival and recovery of the NYB DPS of Atlantic sturgeon.

10.0 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 or the GOM or New York Bight DPS of Atlantic sturgeon. Additionally, as any effects to designated critical habitat will be insignificant, we have concluded that the action is not likely to adversely affect critical habitat designated for the GOM DPS of Atlantic salmon. Additionally, we have determined that the proposed action is not likely to adversely affect shortnose sturgeon.

11.0 INCIDENTAL TAKE STATEMENT

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

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

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11.1 Amount or Extent of Incidental Take

11.1.1 Atlantic Salmon

The proposed action has the potential to directly affect Atlantic salmon by causing them to be stunned by the electric current, and then be captured and handled. As explained in the "Effects of the Action" section of this consultation, no mortalities are likely and all Atlantic salmon exposed to the current are expected to recover quickly. While Atlantic salmon may exhibit behaviors such as rolling or twitching, no injuries are likely to be sustained.

Based on available population estimates, the known distribution of the species within the action area, the location of the sampling sites, and the effective range of the electrofishing boat, we have determined that no more than 20 adult Atlantic salmon are likely to be effected during the five-year electrofishing survey period. We expect there to be an average of four exposures for each of the five years.

While no injuries or mortalities to any Atlantic salmon are expected, the anticipated interaction of twenty Atlantic salmon with sampling gear is considered harassment under Section 9 of the ESA. In the accompanying biological opinion, we have determined that this level of anticipated take is not likely to result in jeopardy to the species. This ITS serves to exempt the take, by harassment, of twenty Atlantic salmonover the five year life of the action.

11.1.2 Atlantic Sturgeon

As noted previously, when exposed to electrical current sub-adult and juvenile Atlantic sturgeon may exhibit behaviors such as rolling or twitching, but no injuries are likely to be sustained. Based on the best available information and past encounters with Atlantic sturgeon during this study, we have determined that no more than one juvenile or sub-adult Atlantic sturgeon from the GOM or NYB DPS is likely to be affected by the electrofishing survey over the five year study period. While no injuries or mortalities to any Atlantic sturgeon are expected, the anticipated interaction of one Atlantic sturgeon with sampling gear would be considered harassment under Section 9 of the ESA. In the accompanying biological opinion, NMFS determined that this level of anticipated take is not likely to result in jeopardy to the species.

12. Reasonable and Prudent Measures

Reasonable and prudent measures are those measures necessary and appropriate to minimize incidental take of a listed species. We believe the following reasonable and prudent measures are necessary and appropriate to minimize and monitor impacts of incidental take of Atlantic salmon and Atlantic sturgeon:

1. EPA must ensure that the contractor contact the NMFS NERO Protected Resources Division before sampling commences and again upon completion of the sampling activity.
2. EPA must ensure that personnel electrofishing have appropriate training in electrofishing and be trained in the handling and identification of Atlantic salmon.
3. EPA must ensure that all electrofishing procedures are designed to minimize the potential for injury or mortality of Atlantic salmon.
4. EPA must ensure that the contractor promptly report all interactions with listed species salmon to NMFS Protected Resources Division

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12.1 Terms and Conditions

In order to be exempt from prohibitions of section 9 of the ESA, EPA must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and which outline required reporting/monitoring requirements. These terms and conditions are non-discretionary. These terms and conditions must be included as part of the contractual and assistance agreements between EPA and MBI and their subcontractors.

1. To implement RPM #1, EPA must contact us within 48 hours of beginning and ending sampling (Max Tritt: by email (Max.Tritt@noaa.gov) or phone (207-866-3756) or the Section 7 Coordinator by phone (978-281-9328) or fax (978-281-9394)).

2. To implement RPM #2, EPA must contact us within 24 hours of any interactions with any listed fish species, including non-lethal and lethal takes (both incidental.take@noaa.gov and Max Tritt: by email (Max.Tritt@noaa.gov) or phone (207-866-3756).

3. To implement RPM #2, personnel shall be trained in Atlantic salmon and sturgeon biology and MDMR electrofishing and handling protocols.

4. To implement RPM #3, EPA must instruct the contractor that in the event adult salmon or juvenile Atlantic sturgeon come in contact with sampling gear, all electrofishing must cease for 5 minutes or until the fish is observed to recover and leave the sampling area.

5. To implement RPM #3, EPA must instruct the contractor to not net any live Atlantic salmon or Atlantic sturgeon, but to retain dead specimens.

6. To implement RPM #4, in the event of any lethal take of Atlantic salmon or Atlantic sturgeon, any dead specimens or body parts must be photographed, and immediately preserved (refrigerate or freeze) until disposal procedures are discussed with us.

7. To implement RPM#4, in the event of any observation or interaction with a listed species, an incident report form (Appendix A) must be completed and submitted to us within 24 hours by fax (978-281-9394) or e-mail (incidental.take@noaa.gov and Max.Tritt@noaa.gov)) of any interaction with a listed species.

8. To implement RPM #4, the EPA must submit a final report at the end of each calendar year summarizing the results of sampling activities and any takes of listed species to NMFS by email to: incidental.take@noaa.gov.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize and monitor the impact of incidental take that might otherwise result from the proposed action. Specifically, these RPMs and Terms and Conditions will keep NMFS informed of when sampling activities are taking place and will require EPA to report any take in a reasonable amount of time, as well as avoid additional sources of injury and mortality to adult fish that may result from handling associated with netting. Term and Condition #1, #2, #6, and #7 are specifically designed to monitor take. Term and Condition #3 will insure that any Atlantic salmon are appropriately identified which is necessary and appropriate to monitor take. As Atlantic salmon adults may be vulnerable to additional injury and/or mortality if captured in a hand held net, Term and Condition #5 is necessary and appropriate to prevent the occurrence of this additional source of injury and mortality. Term and Condition #4 will further reduce any impacts to the species by allowing any adult Atlantic salmon interacting with sampling gear to

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recover and move outside of the sampling area. As we does not anticipate any lethal take, the implementation of Term and Condition #6 is necessary and appropriate to preserve any dead Atlantic salmon so that they may be salvaged and examined to determine the cause of death. Genetic information is also important to document, if possible, whether the fish was naturally reared or hatchery origin.

13.0 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. We have determined that the proposed action is not likely to jeopardize the continued existence of endangered Atlantic salmon. To further reduce the adverse effects of fisheries sampling on listed species, we recommend that EPA implement the following conservation recommendations:

- If any lethal take occurs, the EPA should arrange for contaminant analysis of the specimen. If this recommendation is to be implemented, the fish should be immediately frozen and we should be contacted within 24 hours to provide instructions on shipping and preparation

14.0 REINITIATION OF CONSULTATION

This concludes formal consultation on the proposal by the EPA to fund an electrofishing survey in the lower Kennebec and Sebasticook Rivers. 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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Inactive

APPENDIX A. INCIDENT REPORT: TAKE – EPA BIOASSESSMENT

Photographs should be taken and the following information should be collected from all salmon or sturgeon (alive and dead) found in association with the survey. Please submit all necropsy results (including sex and stomach contents) to NMFS upon receipt.

Observer's full name:_____
Reporter's full name:_____

Species Identification:_____

Describe construction activities ongoing within 24 hours of observation:_____
_____

Date animal observed:_____ Time animal observed: _____
Date animal collected:_____ Time animal collected:_____

Environmental conditions at time of observation (i.e., tidal stage, weather):
_____
_____

Water temperature (°C) at site and time of observation:_____
Describe location of fish and how it was documented (i.e., observer on boat):
_____

Species Information:
Species _____

Fork length (or total length) _____ Weight _____

Condition of specimen/description of animal
_____
_____
_____
_____

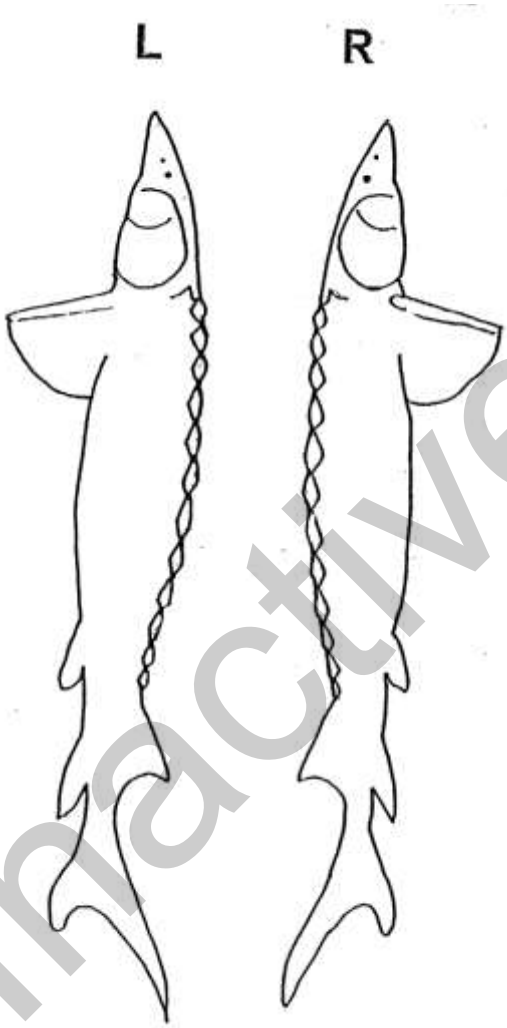
Fish Decomposed: NO SLIGHTLY MODERATELY SEVERELY
Fish tagged: YES / NO *Please record all tag numbers.* Tag # _____

Photograph attached: YES / NO
(please label *species, date, geographic site* and *vessel name* on back of photograph)

Inactive

Appendix A. Continued

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



Inactive

Description of fish condition: