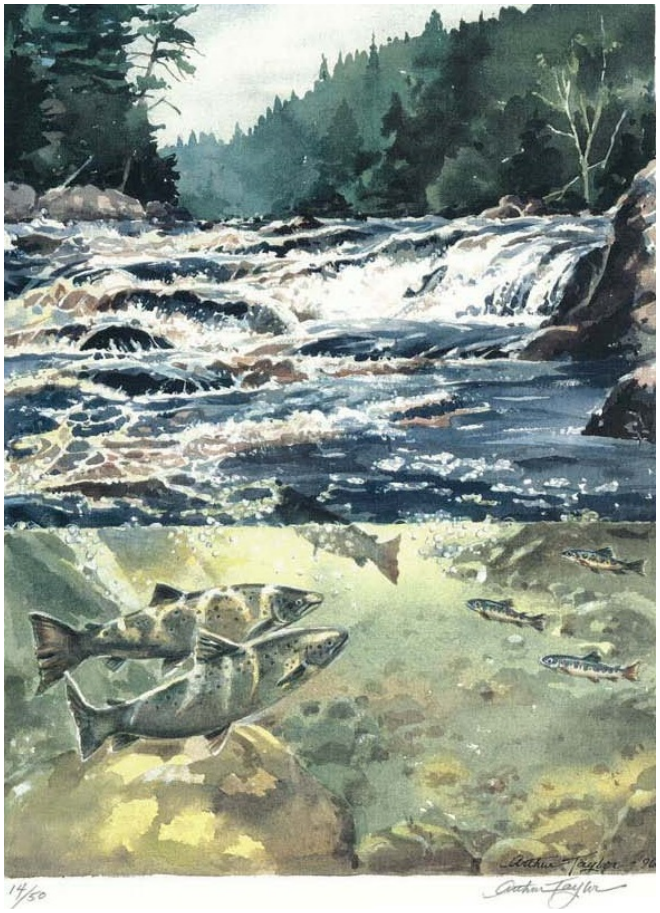
Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon (*Salmo salar*)

PUBLIC REVIEW DRAFT



U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

U.S. Department of Interior
Fish and Wildlife Service
Ecological Services and Fisheries

Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon (*Salmo salar*)

Approved:* _____

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* Approval will be obtained following the public and peer review comment period.

PREFACE

This draft recovery plan has been developed pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) (ESA). The plan document is accompanied by a Web site that contains supplemental scientific assessments and supporting information. Draft recovery plans are subject to public review, and comments received during the review period are considered during preparation of the final plan. The supplemental information is accessible for informational purposes but is not subject to formal public review.

The ESA establishes policies and procedures for identifying, listing, and protecting species of fish, wildlife, and plants that are endangered or threatened with extinction. The purposes of the ESA are "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, [and] to provide a program for the conservation of such endangered species and threatened species." The ESA definition of "species" includes any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature. An endangered species is defined as any species which is in danger of extinction throughout all or a significant portion of its range. A threatened species is defined as any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

The Gulf of Maine (GOM) distinct population segment (DPS) of Atlantic salmon was originally listed as endangered in December 2000 (65 FR 69459) and encompassed salmon populations in small river systems along the Maine coast. Subsequently, new data led to expansion of the GOM DPS to include, in addition to the coastal rivers, populations in larger river systems covering a more extensive geographic area. The final rule for the expanded DPS was published in June 2009 (74 FR 29344).

The Secretaries of the Department of the Interior and the Department of Commerce are responsible for administering ESA provisions as they apply to GOM DPS of Atlantic salmon. Management authority for endangered and threatened species under the Departments' jurisdictions has been delegated to the U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA-Fisheries). These agencies, collectively referred to as the Services, share Federal jurisdiction for GOM Atlantic salmon, with USFWS having lead responsibility primarily for freshwater habitat and NOAA-Fisheries having lead responsibility primarily for the estuary and marine environments and for dams.

To help identify and guide recovery needs for listed species, section 4(f) of the ESA directs the Secretaries to develop and implement recovery plans for listed species. A recovery plan must include: (1) A description of site-specific management actions necessary to conserve the species; (2) objective, measurable criteria that, when met, will allow the species to be removed from the endangered and threatened species list; and (3) estimates of the time and funding required to achieve the plan's goals.

This recovery plan specifically addresses the planning requirements of the ESA for the GOM DPS of Atlantic salmon listed in 2009. It presents a recovery strategy based on the biological

and ecological needs of the species as well as current threats and conservation accomplishments that affect its long-term viability. This recovery document wholly supersedes the recovery plan approved in 2005 for the DPS listed in 2000. Insofar as it addresses the 2009 expanded DPS, it is considered to be the initial recovery plan for the currently listed entity.

DISCLAIMER

Recovery plans describe actions that are thought to be necessary to recover and/or protect endangered or threatened species. This recovery plan for the GOM DPS of Atlantic salmon (*Salmo salar*) was prepared by the USFWS in cooperation with, and with major contributions from, NOAA-Fisheries.

Recovery plans are neither regulatory nor decision documents; rather, they are technical advisory documents that provide recommendations to achieve stated recovery objectives. Objectives will be attained and funds expended contingent on appropriations, priorities, and other budgetary constraints. Nothing in this plan should be construed as a requirement that any Federal agency obligate or pay funds in contravention of the Anti-Deficiency Act, 31 U.S.C. 1341, or any other law or regulation.

Recovery plans do not necessarily represent the views or the official position or approval of any individuals or agencies other than the USFWS and NOAA-Fisheries. This plan will represent the official position of the USFWS and NOAA-Fisheries only after it has been approved by the Northeast Regional Director for the USFWS and the Assistant Administrator for NOAA-Fisheries. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and completion of recovery actions.

Literature citations should read as follows:

U.S. Fish and Wildlife Service and NOAA-Fisheries. 2016. Draft recovery plan for the Gulf of Maine Distinct Population Segment of Atlantic salmon (*Salmo salar*). 61 pp.

Review copies of this draft recovery plan can be downloaded via the Internet at:

http://www.fws.gov/northeast/EcologicalServices/recovery.html

or

http://www.nero.noaa.gov/prot_res/altsalmon

Copies will also be provided upon request to the U.S. Fish and Wildlife Service, Maine Field Office, 17 Godfrey Drive, Suite 2, Orono, Maine 04473; telephone 207-866-3344.

GUIDE TO THE PLAN

This draft document represents a departure from the 2005 recovery plan for the GOM DPS of Atlantic salmon in that it does not include detailed supplementary information. Rather, the plan focuses on the statutory requirements of the ESA, which are to identify, to the maximum extent practicable, recovery criteria, recovery actions, and time and cost estimates. More in-depth scientific information and analyses, as well as activities that address the site-specific recovery actions, are contained in other documents made available on the Atlantic Salmon Restoration Web site (see box 1 below). Although the material on the Web site is not part of the recovery plan itself, hyperlinks to specific Web pages are provided throughout this document. Note also that technical and management terms are defined in a glossary provided on Web site.

The major sections of the plan include:

Part I. **Introduction**, which describes the listed entity and governance structure for recovery and summarizes the threats and conservation measures that affect the current status of the DPS

Part II. **Recovery Strategy**, which lays out the long-term guiding principles for the criteria and actions that comprise the GOM DPS recovery program

Part III. **Recovery Goals, Objectives, and Criteria**

Part IV. **Recovery Actions**, describing the long-term actions needed to meet recovery criteria and general implementation responsibilities

Part V. **Time and Cost Estimates** for achieving the ESA delisting goal

Box 1. SIGNIFICANT CHANGES BETWEEN THIS RECOVERY PLAN AND THE 2005 PLAN

- This recovery plan addresses the expanded range of the GOM DPS of Atlantic salmon described in the 2009 listing rule (June 19, 2009: 74 FR 29344).
- This plan reflects a new recovery planning approach (termed the Recovery Enhancement Vision, or REV) being adopted by the USFWS. REV plans focus on the statutory elements of recovery criteria, recovery actions, and time and cost estimates.
- Details about biology and threats, and other supporting documentation can be accessed at the Atlantic Salmon Restoration Web site.
- A long-term implementation strategy and site-specific recovery actions at a Salmon Habitat Recovery Unit (SHRU) scale are identified in this plan, while management activities that implement recovery actions in the short term can be found in SHRU-level workplans posted on the Atlantic Salmon Restoration Web site.

ACKNOWLEDGMENTS

The foremost intent of this recovery plan is to provide recovery goals and objectives toward which all stakeholders can cooperatively work. This plan builds on the significant body of published work and expert knowledge regarding Atlantic salmon and other diadromous species.

Many individuals have contributed to the development of this draft plan. Current writing team members Dan Kircheis, Peter Lamothe, Mary Parkin, and Laury Zicari have worked from a draft authored by Antonio Bentivoglio. In addition, the following individuals have made substantial contributions to the plan: Alex Abbott, Bill Archambault, William Ardren, Ernie Atkinson, Mike Bailey, Meredith Bartron, Dave Bean, Colby Bruchs, Steve Coghlan, Mary Colligan, Scott Craig, Paul Christman, Oliver Cox, Kim Damon-Randall, Serena Doose, Rob Dudley, Kayla Easler, Stewart Fefer, Jaime Geiger, Clayton Hawkes, Chris Holbrook, Bob Houston, Ted Koch, John Kocik, Steve Koenig, Ben Letcher, Trent Liebech, Greg Mackey, Wende Mahaney, Mark McCollough, Steve McCormick, Mike Millard, Martin Miller, Slade Moore, Katrina Mueller, Lori Nordstrom, Paul Phifer, Peter Ruksznis, Paul Santavy, Rory Saunders, Fred Seavey, Tim Sheehan, Steve Shepard, Randy Spencer, John Sweka, Joan Trial, Tara Trinko Lake, Jed Wright, and Joe Zydlewski.

Special thanks go to Ruth Taylor and Ed Baum for providing the copyrights for the use of Arthur Taylor's "Coming Home" painting as the cover art for this recovery plan.

This plan is dedicated to the treasured memory of Melissa Laser, Clem Fay, Joris Naiman, and Barbara Arter and their outstanding contributions to Atlantic salmon recovery in Maine. The accomplishments of Melissa and Clem have been noted in previous documents and are an inspiration for current and future conservation efforts needed to recover this endangered species. Here, we would like to elaborate on those most recently lost, Joris and Barbara.

Joris Naiman was the Department of Interior Solicitor who spent countless hours reviewing both the original Atlantic salmon recovery plan and, for as long as he could sustain his energy, this draft plan. He cared greatly that we, as Federal servants, adhere to both the letter and the spirit of the ESA. Although his intellect was his defining feature, he had a sense of adventure that included flying helicopters. Joris never hesitated to point out flaws in logic or to delve deeply into the meaning of how we proposed to recover salmon in the GOM DPS. He was a major force in ensuring the integrity of recovery plans, a legacy that we hope we have carried forward in this draft plan.

Barbara Arter was a conservationist and avid fly fisher who worked tirelessly as a volunteer, teacher, and consultant to advocate and promote the conservation of natural resources in Maine. She was never afraid to ask the tough questions, and always with a smile. As a conservation planner, she was diligent and thorough in her investigations. She made significant contributions to the Atlantic salmon program in writing watershed management plans, facilitating project oriented workshops and meetings, and, more recently, serving as the Science Information Coordinator for the Diadromous Species Research and Restoration Network. Barbara's determination, insights, abilities, personality, and laughter will be greatly missed by all those fortunate enough to have worked with her.

EXECUTIVE SUMMARY

After originally listing the Gulf of Maine (GOM) distinct population segment (DPS) of Atlantic salmon as endangered in December 2000 and publishing a recovery plan in November 2005, the USFWS and NOAA-Fisheries conducted a second status review and listed an expanded GOM DPS on June 19, 2009. The expanded DPS encompasses all anadromous Atlantic salmon in a freshwater range covering the watersheds from the Androscoggin River northward along the Maine coast to the Dennys River and includes all associated conservation hatchery populations used to supplement these natural populations. Concurrently with the new listing, critical habitat was designated within the range of the expanded GOM DPS. This recovery plan pertains to the expanded DPS and accounts for new information.

RECOVERY PLANNING APPROACH: The plan is based upon a planning approach recently endorsed by the USFWS and, for this plan, by NOAA-Fisheries. The new approach, termed the Recovery Enhancement Vision (REV), focuses on the three statutory requirements in the ESA, including site-specific recovery actions; objective, measurable criteria for delisting; and time and cost estimates to achieve recovery and intermediate steps. It also provides relevant background information for understanding the proposed recovery program, including a summary of the governance structure, threats, conservation measures, and recovery strategy for the DPS. Other relevant data and analyses are posted on the Atlantic Salmon Restoration Web site. Links to specific Web pages are provided throughout this plan.

RECOVERY UNITS: Recovery units for the expanded DPS were delineated in the 2009 critical habitat rule. These units, designated as Salmon Habitat Recovery Units (SHRUs)[1], respond to life history needs and the environmental variation associated with freshwater habitats. The SHRUs encompass the full range of the DPS, including:

- Merrymeeting Bay, which covers the Androscoggin and Kennebec, and extends east to include the Sheepscot, Pemaquid, Medomak, and St. George watersheds,

- Penobscot Bay, which covers the entire Penobscot basin and extends west to and includes the Ducktrap watershed, and

- Downeast, including all coastal watersheds from the Union River east to the Dennys River.

THREATS TO THE DPS: This plan includes an updated threats analysis for the expanded GOM DPS. The 2009 listing rule called particular attention to three major threats to Atlantic salmon: dams, inadequacy of regulatory mechanisms related to dams, and low marine survival. In addition, a number of secondary threats were identified, including threats to habitat quality and accessibility, commercial and recreational fisheries, disease and predation, inadequacy of regulatory mechanisms related to water withdrawal and water quality, aquaculture, artificial propagation, climate change, competition, and depleted diadromous fish communities.

[1] Recovery units also assist with the implementation of Section 7 consultations under the ESA. However, each Section 7 consultation must assess the effects of an action to the recovery unit and the entire listed entity.

Collectively, these stressors were deemed a fourth major threat. Since the 2009 listing, our understanding of threats to the DPS has continued to grow. New and emerging threats, all of which are considered to constitute significant impediments to recovery, include road stream crossings that impede fish passage, international intercept fisheries, and the new information about the effects of climate change. It is important to note that, as recovery proceeds, information and the level of concern about various threats will continue to evolve.

RECOVERY STRATEGY: This recovery plan is based on two premises: first, that recovery must focus on rivers and estuaries located in the GOM DPS until we better understand threats in the marine environment, and second, that survival of Atlantic salmon in the GOM DPS will be dependent on conservation hatcheries through much of the recovery process. In addition, the scientific foundation for this plan includes conservation biology principles regarding population viability, our understanding of freshwater habitat viability, and threats abatement needs.

The recovery strategy also incorporates adaptive management, phasing of recovery actions, a geographic framework based upon the three SHRUs, and a collaborative approach that focuses on full inclusion of partners in implementing recovery actions. This recovery plan includes a table that generally identifies the priority, timing, and involved parties for the various actions, but it is important to recognize that annual decisions made about recovery priorities will be formulated in SHRU-level workplans.

RECOVERY GOAL: The overall goal of this recovery plan is to remove the GOM DPS of Atlantic salmon from the Federal List of Endangered and Threatened Wildlife. The interim goal is to reclassify the DPS from endangered to threatened status.

RECOVERY OBJECTIVES AND CRITERIA: The objectives and criteria in this plan address biological recovery needs and abatement of threats, as summarized below.[2]

> **Reclassification Objectives –** Maintain sustainable, naturally reared populations with access to sufficient suitable habitat in at least two of the three SHRUs, and ensure that management options for marine survival are better understood. In addition, reduce or eliminate those threats that, either individually or in combination, pose a risk of imminent extinction to the DPS.
>
> **Delisting Objectives –** Maintain self-sustaining, wild populations with access to sufficient suitable habitat in each SHRU, and ensure that necessary management options for marine survival are in place. In addition, reduce or eliminate all threats that, either individually or in combination, pose a risk of endangerment to the DPS.
>
> **Biological Reclassification Criteria –** Reclassification of the GOM DPS from endangered to threatened will be considered when all of following criteria are met:

[2] The biological recovery criteria for the GOM DPS of Atlantic salmon were established in the 2009 critical habitat final rule (NOAA 2009).

1. The DPS has a total annual escapement of at least 1,500 naturally reared adults spawning in the wild, with at least 2 of the 3 SHRUs having at least 500 naturally reared adults.
2. The population in each of at least two of the three SHRUs has a population growth rate of greater than 1.0 in the 10-year period preceding reclassification.
3. Adults originating from hatchery-stocked eggs, fry, and parr are included when estimating population growth rates.
4. Sufficient suitable spawning and rearing habitat for the offspring of the 1,500 naturally reared adults is accessible and distributed throughout designated Atlantic salmon critical habitat, with at least 7,500 accessible and suitable habitat units (HUs) in each of at least two of the three SHRUs, located according to the known and potential migratory patterns of returning salmon.

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

1. The DPS has a self-sustaining annual escapement of at least 2,000 wild adults in each SHRU, for a DPS-wide total of at least 6,000 wild adults.
2. Each SHRU has a population growth rate of greater than 1.0 in the 10-year period preceding delisting, and, at the time of delisting, the DPS demonstrates self-sustaining persistence.
3. Sufficient suitable spawning and rearing habitat for the offspring of the 6,000 wild adults is accessible and distributed throughout the designated Atlantic salmon critical habitat, with at least 30,000 accessible and suitable HUs in each SHRU, located according to the known migratory patterns of returning wild adult salmon.

Threats Abatement Criteria: Threats to GOM DPS identified both in the 2009 listing rule and since then must be diminished prior to reclassification and, to a greater extent, delisting. Therefore, this plan includes criteria specific to reducing threats to the survival and recovery of the species. In order to delist Atlantic salmon, each individual primary threat must be sufficiently abated according to stated criteria in section III. The Services also recognize that primary threats may change over time. In addition, an implementation strategy for making tradeoffs among responses to secondary threats that will allow a sufficient reduction in extinction risk will be developed as the recovery process advances. To facilitate such a strategy, the adaptive management and collaborative aspects of the Recovery Strategy will come into play. Overall, threats monitoring and relevant research will be critical in determining to what extent secondary threats must be resolved in association with abatement of primary threats. Numerous criteria for abating both primary and secondary threats are detailed in the body of the recovery plan.

RECOVERY ACTIONS: This recovery plan focuses on the site-specific actions necessary to recover the GOM DPS of Atlantic salmon. These actions address both survival and recovery needs and are site-specific to the extent practicable as required by section 4(f)(1)(B)(I) of the Act. In this plan, the site is scaled to the SHRU, taking into account both the comprehensive nature and long timeframe needed to reach reclassification and delisting objectives; thus, SHRUs constitute the geographic scale in which recovery progress will be measured and adaptive management will be applied. SHRU-level workplans will provide the basis for determining activities that should be implemented in the short term for each of the plan's recovery actions.

Although these workplans will link back to this recovery plan, they are not considered part of the plan itself. It should also be noted that some of the plan's recovery actions are at the scale of the DPS or are not geographically based (e.g., genetics studies and other research). The seven categories of recovery actions include:

- **Habitat Connectivity**, intended to enhance connectivity between the ocean and freshwater habitats important for salmon recovery;
- **Genetic Diversity**, intended to maintain the genetic diversity of Atlantic salmon populations over time;
- **Conservation Hatchery**, intended to increase adult spawners through the conservation hatchery program;
- **Freshwater Conservation**, intended to increase adult spawners through the freshwater production of smolts;
- **Marine and Estuary**, intended to increase survival in these habitats by increasing understanding of these salmon ecosystems and identifying the location and timing of constraints to the marine productivity of salmon in support of management actions to improve survival;
- **Federal/Tribal Coordination**, intended to facilitate consultation with all involved Tribes on a government-to-government basis; and
- **Outreach, Education, and Engagement**, intended to collaborate with partners and engage interested parties in recovery efforts for the GOM DPS.

ESTIMATED TIME TO RECOVERY: A 75-year timeframe is projected to achieve delisting of the GOM DPS of Atlantic salmon. This accounts for approximately 15 generations of salmon and assumes an estimated upper limit for resource investment into implementation of recovery actions. It is difficult to estimate a time and cost for reclassification because of uncertainties associated with the current significant threats to the species, especially marine survival, and impacts of climate change. The earliest possible time scenario would be 10 years based on the current reclassification criteria.

ESTIMATED COST OF RECOVERY: The total cost of recovery over 75 years is roughly estimated to be $351,070,000. The estimated cost for the 10-year reclassification scenario is $140,428,000.

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PART I. INTRODUCTION

A. Listed Entity and Recovery Units

1. Gulf of Maine Distinct Population Segment of Atlantic Salmon

Atlantic salmon populations in the United States have been grouped into the Long Island Sound, Central New England, and Gulf of Maine (GOM) population segments (figure 1, Fay et. al 2006). Under the Endangered Species Act (ESA), a distinct population segment of a vertebrate species is treated as a species for listing and recovery purposes if it meets the qualifying criteria defined by the joint Distinct Population Segment (DPS) policy of 1996 (61 FR 4722; February 7, 1996). This policy lays out three criteria, all of which must be met before a population segment can be listed as a DPS, including the discreteness of the population segment in relation to the remainder of the species to which it belongs, the significance of the population segment to the species to which it belongs, and the population segment's conservation status in relation to the ESA's standards for listing as endangered or threatened.

Figure 1. Freshwater range of Atlantic salmon in the United States. Rivers are grouped into three population segments. Only rivers in the GOM currently support wild populations of Atlantic salmon.

In the Long Island Sound and Central New England population segments, all native Atlantic salmon populations have been extirpated. As of 2014, nonnative Atlantic salmon were still present in the Central New England population segment as an artifact of a 40-year reintroduction program in the Connecticut and Merrimack Rivers. However, in 2013 those programs were discontinued, and the remaining legacy program is not believed to be sufficient to maintain salmon runs in Central New England. Only the GOM population segment supports native wild salmon populations, all of which are at extremely low population size, leading to the designation of this population segment as a DPS.

The GOM DPS of Atlantic salmon was first listed by the U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA-Fisheries) (collectively referred to as the Services) as endangered in 2000 (65 FR 69459). The 2000 GOM DPS included all naturally reproducing remnant populations of Atlantic salmon from the Kennebec River downstream of the former Edwards Dam site, northward to the mouth of the St. Croix River. At the time of the 2000 listing, however, there were uncertainties associated with biological and genetic relationships of Atlantic salmon inhabiting the Androscoggin River, Kennebec River, and Penobscot River to wild Atlantic salmon populations (figure 2).

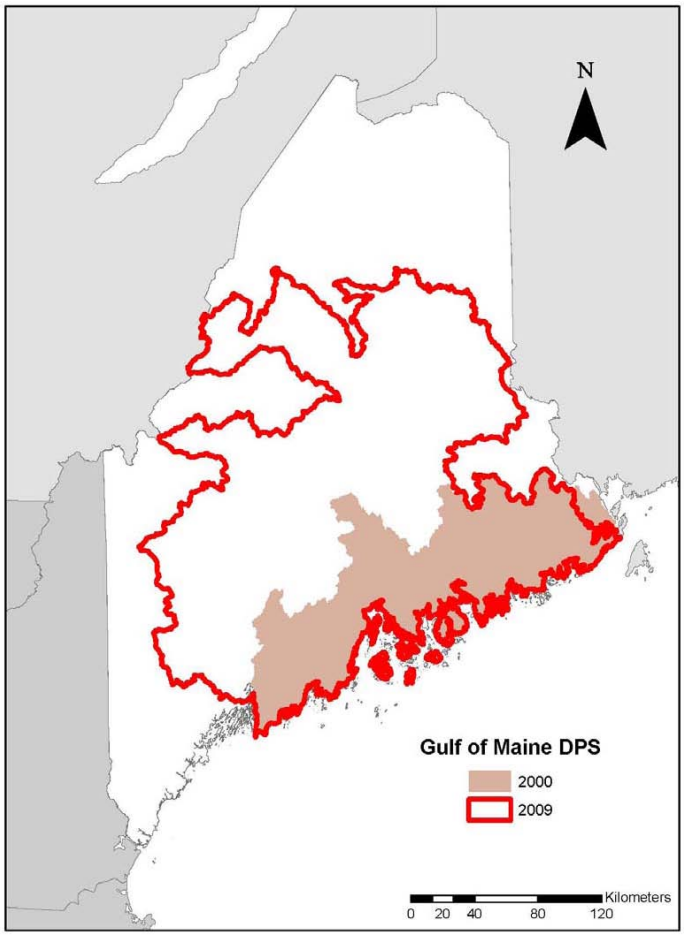

Figure 2. Geographic range of the GOM DPS as defined in the 2000 and 2009 listing rules.

A subsequent status review by Fay et al. (2006) recommended that the GOM DPS be expanded to incorporate all naturally reproducing anadromous Atlantic salmon having a freshwater range in the watersheds from the Androscoggin River northward along the Maine coast to the Dennys River, including all associated conservation hatchery populations used to supplement these natural populations. The marine range, which remained unchanged, extends from the GOM throughout the Northwest Atlantic Ocean to the coast of Greenland. The USFWS and NOAA-Fisheries jointly listed this expanded GOM DPS as endangered on June 19, 2009 (74 FR 29344).

2. Atlantic Salmon Recovery Units

In considering recovery needs for the GOM DPS at the time of the 2009 listing, we identified the geographic and population-level factors that would buffer the DPS from adverse demographic and environmental events. This included the fundamental need to ensure that Atlantic salmon are well distributed across their GOM range to accommodate metapopulation dynamics. To address life history characteristics as well as demographic and environmental variation, a geographic framework represented by three SHRUs within the DPS was established (figure 3; also see NOAA 2009, appendix A).

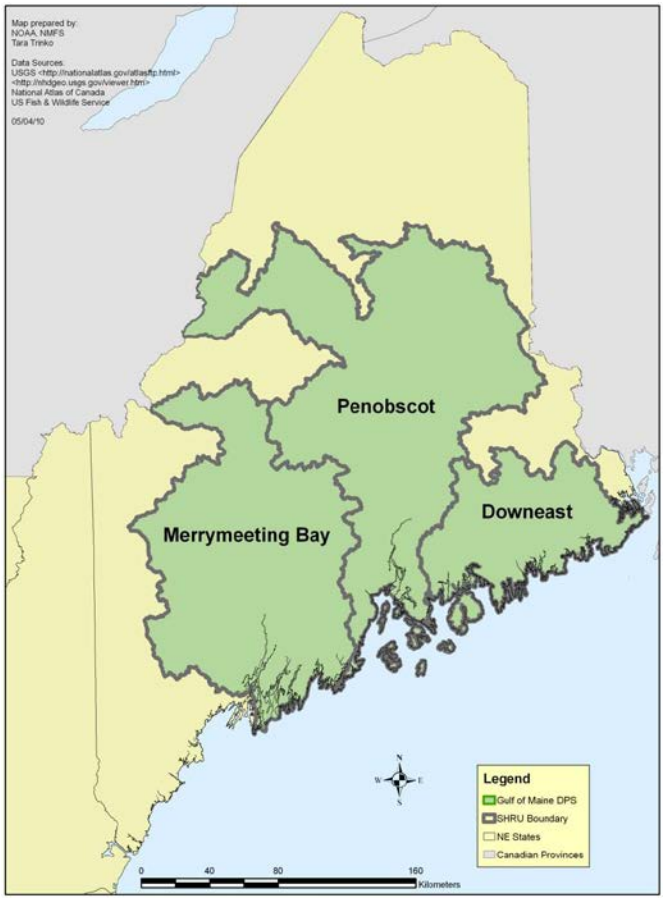

Figure 3. Salmon Habitat Recovery Units within the GOM DPS, as defined in the 2009 critical habitat rule.

The three SHRUs delineated for the GOM Atlantic salmon DPS are the:

- Merrymeeting Bay SHRU – Incorporates two large basins, the Androscoggin and Kennebec, and extends east to include the Sheepscot, Pemaquid, Medomak, and St. George watersheds;
- Penobscot Bay SHRU – Includes the entire Penobscot basin and extends west to include the Ducktrap watershed; and

- Downeast Coastal SHRU – Includes all coastal watersheds from the Union River east to the Dennys River.

The Services will use the recovery units to assist with the appropriate implementation of Section 7 consultations under the ESA. In doing so, the Services will assess the effects of an action on the recovery unit and the entire range of the listed entity.

B. Overview of Recovery Governance and Coordination

1. Recovery Governance Structure

Recovery of the GOM DPS requires coordination of numerous conservation planning and management efforts across the entire DPS. An effective governance structure is key to charting a comprehensive long-term recovery program that facilitates interagency and intergovernmental cooperation along with the strategic involvement of a full range of partners and interested parties.

The USFWS, NOAA-Fisheries, Maine Department of Marine Resources (MDMR), and the Penobscot Indian Nation (PIN) share a stewardship interest and governmental responsibility for recovering Atlantic salmon. A governance structure has been established to facilitate coordination and decision making among these entities.

The governance structure, which is subject to change, includes an Action Team for each major recovery program element, an Atlantic salmon Policy Board, and an Atlantic salmon Management Board. The Action Teams develop implementation plans, review and recommend changes in or approval of project proposals, identify and resolve areas of policy or scientific disagreement, and coordinate to implement and monitor recovery actions. The Policy Board guides broad policy direction, annually reaffirms program priorities, and commits resources for recovery implementation. The Management Board provides updates on potential and real changes to resource commitments and resolves differences of priorities among Action Teams.

The GOM DPS of Atlantic salmon cannot be recovered without broader participation. The governance structure is intended not only to guide recovery efforts among the government entities but to engage other partners in the salmon recovery program, including governmental agencies, nongovernmental organizations (NGOs), commercial and recreational interests, and the general public. Types of recovery actions that NGOs and other partners have implemented to date include dam removals, passage inventories and improvements at road stream crossings, hatchery production of fry, fry stocking, parr stocking, and land conservation and protection.

Collaboration, local initiatives, public involvement and support, monitoring, and adaptive management will continue to be essential to this recovery effort.

The recovery governance structure has several stated purposes, including:

- Ensuring that recovery of the GOM DPS is achieved in a manner that is transparent and easily understood in terms of roles and responsibilities of the government entities,
- Ensuring that the best available science is being integrated into recovery,
- Ensuring that resources are made available to implement recommended actions in any given funding cycle,
- Resolving disputes and ensure continuity of operations throughout the operational year,
- Ensuring effective communication among the agencies and the various organizational levels within the agencies,
- Ensuring effective communication among the agencies and their partners in recovery, including NGOs, commercial and recreational interests and the general public,
- Ensuring that the trust responsibilities of the Federal agencies to federally recognized Tribes are appropriately exercised, and
- Ensuring that those proposals requesting agency resources are vetted and determined to be consistent with agency policies and available resources (see proposal review process).

Atlantic salmon recovery is also guided by multi-agency, issue-specific documents, interagency agreements, and international cooperative efforts. The value of these guidance documents is in no way diminished by completion of a recovery plan, and they will continue to provide important technical guidance for recovery actions.

Given our Federal trust responsibilities with regard to Tribal consultation, we provide more detail below on coordination with Maine Tribes relative to Atlantic salmon recovery.

2. Tribal Coordination and Collaboration

In Maine, the Wabanaki people represent four Tribes: the Passamaquoddy Tribe in Washington County, the PIN based at Indian Island on the Penobscot River, the Houlton Band of Maliseets in Northern Maine, and the Aroostook Band of Micmacs, also in Northern Maine. Atlantic salmon and the suite of diadromous fish indigenous to Maine's rivers, streams, lakes, and ponds are of great cultural importance to these Tribes for religious/cultural ceremonies, subsistence, and commerce, all of which have been negatively affected by the decline of Atlantic salmon. Up through 1988[3], the PIN harvested Atlantic salmon for sustenance; since then, however, the Tribe has voluntarily abstained from harvesting Atlantic salmon out of concern for the health of the species. The Passamaquoddy Tribe and PIN also hold lands containing habitat that is critical to the survival and recovery of Atlantic salmon. As a result, the working relationship between the Services, the State of Maine, and the Tribes is crucial to the recovery of Atlantic salmon.

[3] Two salmon were harvested for ceremonial purposes in 1988 by Tribal members; see 50 CFR 29344.

The PIN, along with the Services and MDMR, are co-participants in the management of Atlantic salmon. The PIN has member participation on Atlantic salmon Action Teams, the Atlantic salmon Policy Board, and the Atlantic salmon Management Board. Beyond the Management Board, the Services are committed to working with all Tribes in Maine in managing Atlantic salmon while finding ways to best achieve the fisheries needs of the Tribes.

C. Threats to Species Viability

1. Threats Identified at Time of Listing

This section summarizes the primary and secondary threats—described according to the ESA's five listing factors in the box below—upon which the 2009 rule for the Atlantic salmon GOM DPS was based (74 FR 29344), and which continue to affect its survival and recovery.

Box 2. FIVE LISTING FACTORS UNDER THE ESA (§4(a)(1))

A species is listed when it is determined to be endangered or threatened because of any of the following factors:

(A) The present or threatened destruction, modification, or curtailment of its habitat or range;
(B) Overutilization for commercial, recreational, scientific, or educational purposes;
(C) Disease or predation;
(D) The inadequacy of existing regulatory mechanisms; and
(E) Other natural or manmade factors affecting its survival.

These factors must also be evaluated when reclassifying or delisting any listed species.

The 2009 listing rule highlighted the following three threats as the most significant factors in the decline of Atlantic salmon in Maine:

Significant Listing Factors

Dams (Factor A)
Dams significantly impede migration pathways and increase direct and indirect mortality of Atlantic salmon. Within the range of the GOM DPS, dams hinder access to much of the suitable habitat that was historically available, and hydroelectric turbines cause significant mortality to kelts and smolts as they migrate past dams on their journeys to the ocean. Dams also create impoundments that inundate formerly free-flowing rivers, reduce water quality, and change fish and other aquatic species' community composition; delay migration of smolts and adults; change

thermal regimes; alter natural flow regimes; and negatively affect diadromous fish upon which salmon depend.

Inadequate regulatory mechanisms related to dams (Factor D)

Inadequacy of regulatory mechanisms is a concern for both hydroelectric and nonhydroelectric dams within the GOM DPS in terms of providing fish passage necessary for Atlantic salmon survival. Many of the Federal Energy Regulatory Commission's (FERC) rulings and regulations and State policies and regulations have proved to be ineffective at producing the necessary fish passage, or have not been adopted. Most dams within the range of the DPS do not contribute to generation of electricity, are typically small, and do not have fish passage, and many are no longer fully functioning or in use.

Marine survival (Factor E)

Survival of GOM DPS salmon in their marine environment has declined over the last 25 years. Continued low marine survival rates for U.S. stocks of Atlantic salmon can be attributed to four general sources (direct and indirect): predation, starvation, diseases and parasites, and abiotic factors such as changing ocean conditions. Overall, marine survival is poor throughout the Atlantic Ocean and is heavily influenced by both nearshore and open ocean survival rates. Current investigations of mortality integrate the four mortality factors and, if applicable, fishing mortality. More research is needed to achieve a clearer picture of marine survival and what actions can be taken to increase survival rates.

Secondary Listing Factors

The 2009 rule also mentioned a number of secondary stressors that collectively threaten the continued existence of the GOM DPS of Atlantic salmon. These factors are summarized below.

Habitat Complexity (Factor A)

Some forest, agricultural, and other land use practices have reduced habitat complexity within the GOM DPS. Historic timber harvest practices reduced the abundance and diversity of large wood and large boulders from many rivers. Large wood is important for Atlantic salmon during several life history stages. Survival of salmon fry has been correlated with the availability of low-velocity microhabitats, while older juveniles use large wood for stream cover, particularly during winter. In general, large wood may increase overwinter survival by increasing habitat complexity.

Water Quantity (Factor A)

Direct water withdrawals and groundwater withdrawals for crop irrigation and commercial and public use can directly impact Atlantic salmon habitat by depleting stream flow. Reduced stream flow can reduce the quantity of habitat, increase water temperature, and reduce dissolved oxygen. The cumulative effects of individual water withdrawal impacts on Maine rivers is poorly understood; however, it is known that adequate water supply and quality is essential to all life stages and life history behaviors of Atlantic salmon, including adult migration, spawning, fry emergence, and smolt emigration.

Water Quality (Factor A)
Maine's water quality classification system provides for different water quality standards for different classes of water. These standards were not developed specifically for Atlantic salmon, and the lower quality standard classes may not provide high enough water quality to protect all life stages of Atlantic salmon—many Atlantic salmon are found in these areas. Atlantic salmon may also be impacted by degraded water quality caused by point and non-point source discharges.

Fish Harvest (Factor B)
Intercept fisheries, by-catch in recreational fisheries, and poaching result in direct mortality or cause stress, thus reducing reproductive success and survival of Atlantic salmon. Although international commercial harvest has been highly restricted since 2002, this issue has reemerged as a growing concern (see New and Emerging Threats below). Recreational angling of many freshwater species occurs throughout the range of the GOM DPS, and the potential exists for the incidental capture and misidentification of both juvenile and adult Atlantic salmon. Direct or indirect mortality may result even in fish that are released as a result of injury or stress.

Disease Outbreaks (Factor C)
Disease outbreaks, whether occurring in the natural or hatchery environment, have the potential to cause negative population-wide effects. Atlantic salmon are susceptible to numerous bacterial, viral, and fungal diseases. Parasites can also affect salmon. Federally managed conservation hatcheries adhere to rigorous disease prevention protocols and management regulations designed to prevent the introduction of pathogens into the natural and hatchery environments; prevent and control, as necessary, disease outbreaks in hatchery populations; and prevent the inadvertent spread of pathogens between facilities and river systems.

Predation (Factor C)
The impact of predation on the GOM DPS is important because of the imbalance between the low numbers of adults returning to spawn and the increase in population sizes of both native and nonnative predators. Increased numbers of predators combined with decreased abundance of alternative prey have likely increased predation mortality on juvenile Atlantic salmon, especially at the smolt life stage.

Depleted Diadromous Communities (Factor E)
Damming rivers, thus preventing migration to former spawning grounds, was a major factor in the decline of Atlantic salmon, and much of the co-evolved suite of diadromous fish. Many coevolved diadromous species have experienced dramatic declines throughout their ranges, and current abundance indices are fractions of historical levels. The dramatic decline in diadromous species has negative impacts on Atlantic salmon populations, including depletion of an alternative food source for predators of salmon, serving as food for juvenile and adult salmon, nutrient cycling, and habitat conditioning. These impacts may be contributing to decreased survival in lower river and estuarine areas; further, although the impacts do not occur in the open ocean, the demographic impact to the species occurs after smolt emigration, and is thus a component of the marine survival regime.

Artificial Propagation (Factor E)
The conservation hatchery programs at Craig Brook and Green Lake National Fish Hatcheries (CBNFH and GLNFH) are vital to preserving individual and composite genetic stocks until freshwater and marine conditions improve, allowing for greater abundance of wild salmon. Without hatchery production, the likelihood of imminent extinction would be substantially higher, and it is also important to know that hatchery salmon are protected as part of the GOM DPS. Nonetheless, inherent risks associated with the broodstock and stocking program for the DPS include domestication and loss of genetic variability, along with the potential for catastrophic loss due to the limited number of hatcheries maintaining GOM DPS Atlantic salmon. To mitigate these risks, a broodstock management plan has been implemented with the goal of maintaining genetic diversity throughout the hatchery management process, including estimating genetic diversity for each captive broodstock.

Aquaculture (Factor E)
Concerns about aquaculture continue, including the risk of exposing native salmon to serious salmon pathogens and genetic and ecological risks. Although recent advances in containment and marking of aquaculture fish offer more control over the potential for negative impacts, they do not eliminate the risk aquaculture fish pose to wild Atlantic salmon.

Competition (Factor E)
Prior to 1800, the resident riverine fish communities in Maine were made up of native species. Today, Atlantic salmon coexist with a diverse array of nonnative resident fishes, including brown trout, largemouth bass, smallmouth bass, and northern pike. The range expansion of these nonnative species is of particular concern, because they often require similar resources and can exclude salmon from preferred habitats, reduce food availability, and increase predation.

2. New and Emerging Threats

In addition to the threats identified at the time of listing, additional information on two stressors is causing growing concern due to their effects on Atlantic salmon in the GOM: (1) The barriers to fish passage caused by culverts and other road stream crossings, and (2) climate change. Both of these threats are considered to be significant factors affecting the DPS.

Road Stream Crossings (Factor A)
Together with dams, lack of access to suitable freshwater habitat due to road stream crossings has become a major concern with regard to recovery of the GOM DPS of Atlantic salmon. The amount of accessible freshwater habitat is a fraction of historical levels; this was initially caused by building dams and later by road stream crossings that created barriers to upstream migration. Fish passage barriers continue to prevent fish from reaching essential spawning and rearing habitat. These barriers also impair ecological complexity and increase the salmon's vulnerability to higher rates of extinction from demographic, environmental, and genetic stochasticity.

Intercept Fisheries (Factor B)
Intercept fisheries in the North Atlantic have posed a significant challenge to recovery of the GOM DPS. For instance, the reported catch estimate for the West Greenland fishery in 2014

was 57.8 tons; given the potential for under-reporting for the 2014 fishery at West Greenland, total catch in Greenland that year may have been higher.

In response, a new regulatory measure for the interceptory, mixed stock salmon fishery at West Greenland was adopted at the 2015 annual meeting of the North Atlantic Salmon Conservation Organization(NASCO), effective through 2017. Although this measure does not include a stated catch limit for the fishery, Greenland unilaterally set a 45-ton quota for the 2015 to 2017 time period. The new regulations maintain the prohibition on exports of Atlantic salmon from Greenland and will require Greenland to implement stronger monitoring, control, and reporting requirements. The new measures include enhanced licensing requirements for fishermen, such as annual catch reporting to maintain a license and in-season catch reporting, that will allow Greenland to swiftly close the fishery if and when the catch limit is reached. They also ensure that if any overharvest of the unilateral catch cap occurs in a particular year, it will result in an equal reduction in the catch limit for the following year and will preclude any under-harvest from carrying forward to a future year. It should be noted that these regulations are subject to periodic review and revision.

Populations of United States origin salmon are also harvested by St. Pierre and Miquelon (an offshore territory of France located off the coast of Newfoundland). Although smaller in scale than the West Greenland fishery, this fishery operates outside any international management regime, as France (with respect to St. Pierre and Miquelon) has refused to join NASCO as a party. Moreover, the domestic management regime in place does not effectively limit what can be caught.

Climate Change (Factor E)

At the time of listing in 2009, although there was reasonable certainty that climate change was affecting Atlantic salmon in the GOM DPS (e.g., NRC 2003, Fay et al. 2006), there was uncertainty about how and to what extent. Since listing, new and emerging science has led to a better understanding of climate change effects and their ramifications for salmon. Recent information indicates that climate change is having significant impacts on the ecosystems that Atlantic salmon depend on and, in turn, is affecting the overall survival and recovery of Atlantic salmon (Mills et al. 2013).

Briefly, climate change can affect all aspects of the salmon's life history as entire ecosystems shift from one state to another, altering habitat features through increases in sea surface temperatures. Global averaged combined land and ocean surface temperatures show a warming of 0.85 °C (0.65 to 1.06 °C) over the period of 1880 to 2012 (Intergovernmental Panel on Climate Change 2013).

It can also affect changes in frequency of seasonal cycles of phytoplankton, zooplankton, and fish populations in the marine environment (Greene and Pershing 2007); changes in freshwater hydrologic regimes; and alterations in the timing and frequency of river ice flows. All of these factors influence environmental cues that stimulate Atlantic salmon migration, spawning, and feeding activities. As this is now considered to be an emerging threat to the viability of the DPS, new information and analyses will be posted on the Web site (see the Climate Change hyperlink above) as they become available.

D. Historical and Contemporary Conservation Measures

Atlantic salmon conservation and restoration efforts have been underway for more than 150 years. The earliest efforts to restore and improve anadromous fish runs in New England rivers were driven by depletion of stocks through nonsustainable commercial fisheries, coupled with some habitat loss due to impassable dams. Pollution was also considered a factor in fish population declines.

Subsequently, artificial propagation and fish culture programs were established first at CBNFH and later at GLNFH. These programs have allowed Atlantic salmon to survive during times that many of Maine's rivers were not suitable for salmon survival; they also allowed for maintenance of an economically important recreational fishery through the early 1990s. The hatchery programs are now essential in preserving the genetic integrity of the last remaining Atlantic salmon populations in the United States.

Efforts to restore river habitats in order to support Atlantic salmon started with the recognition that dams without fish passage were a major threat to the species. A number of Federal laws were then enacted that contributed to Atlantic salmon conservation, including the Water Pollution Control Act of 1948, which subsequently became the Clean Water Act of 1972 (CWA), and the Anadromous Fish Conservation Act of 1965. The CWA significantly curtailed pollution that had once caused rivers and streams in Maine to be toxic to both humans and fish, while the Anadromous Fish Conservation Act provided resources to install fishways on most of the mainstem dams in the Penobscot River and remove or breach defunct dams in the Narraguagus, Machias, and Sheepscot Rivers. By all indications, these efforts were working to restore salmon, and in the early 1970s Atlantic salmon returns began increasing. Through the mid-1980s, between 2,000 and 3,000 adult returns were being documented on the Penobscot fairly consistently.

In 1983, the State of Maine adopted its first prioritized, biologically based, Statewide restoration and management plan for Atlantic salmon (Baum 1997). This plan was directed at building and maintaining a viable run of Atlantic salmon and fishery in the seven remaining rivers that contained wild Atlantic salmon. Unfortunately, shortly thereafter Atlantic salmon marine survival rates crashed, leading to precipitous declines in GOM salmon populations.

In the 1990s, the salmon program shifted to stock preservation, including genetics studies, in an attempt to understand why populations were declining. During this time, Federal hatcheries transitioned to a program aimed at preserving remaining river-specific natural genetic diversity. Other management and science efforts also shifted towards more active conservation, including closing a commercial export fishery in Greenland that was believed to be central to the decline, and assessing freshwater habitats.

Although commercial fisheries for Atlantic salmon within the United States have been closed since 1947, fisheries continue within the species' migratory corridor off the coast of Canada and Greenland. To effectively engage in issues requiring international collaboration such as these distant water fisheries, the United States maintains a presence at the NASCO and International Conference for the Exploration of the Seas (ICES). The United States is a signatory to the

"Convention for the Conservation of Salmon in the North Atlantic Ocean" which entered into force in October 1983, creating NASCO to ensure that the burden of Atlantic salmon conservation was shared by both States of Origin and Distant Water Countries. NASCO promotes the conservation, restoration, enhancement, and rational management of salmon stocks in the North Atlantic Ocean through international cooperation.

With the 2000 Federal listing of Atlantic salmon as endangered and the initial recovery plan (NOAA and USFWS 2005), emphasis was placed on making major improvements to the conservation hatchery and stocking programs, and expanding habitat conservation efforts. Conservation efforts were also directed toward concerns with aquaculture, protecting accessible freshwater habitats by reducing threats from water and land use practices, and identifying impacts associated with water quality.

Although significant habitat improvements have been undertaken for many decades (e.g., Edwards dam removal), there was an emphasis shift since the mid-2000s. This included improving connectivity by locating and removing culvert barriers, removing dams when possible, and installing fishways when dam removal was not feasible. These efforts were exemplified by the removal of two mainstem hydroelectric projects and construction of a bypass at a third project on the Penobscot River. In addition, the Services and hydro developers in the GOM DPS have worked together to craft plans for fish passage at hydro facilities. Downstream and upstream fish passage improvement projects and fish passage studies are now underway at many hydro projects within the designated critical habitat area for Atlantic salmon.

The conservation efforts of the past century, largely driven by regulatory measures, have afforded important conservation benefit to the GOM DPS and the entire suite of diadromous fish that coexist alongside Atlantic salmon. Without these efforts, salmon, along with many other diadromous species, would likely have been extirpated from Maine's rivers and streams decades ago.

PART II. RECOVERY STRATEGY

The following recovery strategy recognizes that the survival and recovery of the GOM DPS of Atlantic salmon currently relies on the conservation hatchery programs. Reliance on the hatchery programs is expected to continue until: (1) More is understood about the factors involved in marine survival, and (2) both adequate stream passage and marine survival rates can be achieved to the point where wild salmon are returning to spawn at sustainable levels. Therefore, the primary drivers of ongoing and future recovery efforts are the need to reduce uncertainty and the ability to address those factors most likely to allow increased numbers of wild salmon to return to their spawning habitat each year. Each element of this strategy is discussed below.

A. Foundation

1. Conservation Frameworks

The central aim of recovery of the GOM DPS is a population that has a low risk of extinction in the foreseeable future due to threats from environmental variation, demographic variation, or changes in genetic diversity. The foundational principles for achieving this aim are based on Shaffer and Stein's (2000) "3 Rs" principles and McElhaney et al.'s (2000) principles regarding viable salmon populations (VSPs). The 3 Rs framework identifies resilience (population health), redundancy (distribution), and representation (genetic and niche diversity) as the basic indicators of species viability. In general, the more resilient, redundant, and representative a species is, the more likely it is to persist over time, even under changing environmental conditions. The VSP framework, originally used to determine the conservation status of Pacific salmonids, is now recognized as a tool that can be applied to evaluating the viability of additional salmonid species.

2. Conservation Assessments

In addition to these conservation frameworks, recovery of the GOM DPS is predicated on the assessment results for three fundamental aspects of Atlantic salmon conservation: population viability, habitat availability, and abatement of threats to the species. Although each of these aspects pertains to the rangewide status of the species, the near- to mid-term recovery focus is on assessing and managing for viability in the freshwater environment, as we know what is needed to restore freshwater habitats. Although marine survival is the biggest driver of Atlantic salmon population trends in the GOM DPS, the maximum potential abundance of the salmon is directly proportional to the quantity and quality of habitats that are available for spawning and juvenile rearing. Further, barriers that block or impede salmon passage and threats that reduce the quality and quantity of habitat decrease the potential abundance of salmon–an abundance that is needed to support a sufficiently large, geographically distributed population that is resilient to environmental perturbations such as poor marine conditions, drought, and extreme temperatures.

Population Viability

Increasing the abundance, productivity, and distribution of naturally reared Atlantic salmon in GOM DPS rivers addresses both the 3 Rs and VSP frameworks. Increased abundance and productivity rates will improve the resilience of each population in the DPS, while maintaining a wide distribution of Atlantic salmon across the range of the DPS. Increased abundance and productivity rate will ensure that the metapopulation characteristics of Atlantic salmon are retained and provide redundancy and representation of populations across the range. Atlantic salmon have strong homing characteristics that allow local breeding populations to become well-adapted to a particular environment. At the same time, limited straying does occur among salmon populations; this helps maintain population diversity through exchange of some genes between populations and allows for population expansion and recolonization of extirpated populations. Accommodating these life history characteristics and distributional needs should provide protection from demographic and environmental variation.

Assessment of both population-level and rangewide extinction risks provides the foundation for setting recovery thresholds with respect to abundance, productivity, and distribution. This assessment requires analysis of the various factors that influence viability. Overall analysis results indicate that a minimum of 2,000 adult wild salmon must return to spawn in each SHRU to achieve rangewide population viability.

It is important to note that the USFWS Maine Fisheries Complex's hatchery program is critical to maintaining genetic diversity and effective population size while populations are low (see Phased Approach below). It is also important, however, to recognize that hatchery management is subject to funding availability. Hatchery funding contingencies could lead to changes in the recovery strategy for the DPS in the future.

Freshwater Habitat Availability

The life history of the Atlantic salmon requires a high degree of access between freshwater, estuarine, and marine environments, and sufficiently suitable natural habitats must be available to support wild populations. Habitat access is categorized as: (1) Habitat with No Access, (2) Habitat with Impeded Access, (3) Habitat that is Accessible, and (4) Habitat that is Fully Accessible. These categories are fully defined in section F, below.

To ensure the long-term sustainability of wild populations, there must be sufficient access to suitable habitat to support spawning and juvenile rearing. Ultimately, returning adults will dictate the actual amount of habitat needed, but the minimum amount of suitable habitat that must be accessible to returning adults is considered to be 30,000 HUs per SHRU to delist the DPS, as explained in the 2009 critical habitat rule (NOAA 2009, appendix C).

This estimate is tied to the number of 2,000 adult wild spawners in each SHRU needed to ensure the long-term viability of the GOM DPS. Suitable freshwater habitat is assessed at the hydrological unit code (HUC) at level 10 (small watersheds) and is based on observations of physical and biological features that salmon most often select (*https://water.usgs.gov/GIS/huc.html*). Although the habitat quality assessment provides

reasonable predictability of where the best habitats are for the spawning and rearing of Atlantic salmon, they do not represent verifiable evidence of the productivity of a HUC 10 watershed. Not until areas that are currently impeded or inaccessible allow for uninterrupted migration will we be able to fully assess the productive potential of a particular habitat area for Atlantic salmon. Likewise, the optimal composition and spatial distribution of this habitat throughout each SHRU is uncertain, as tools to identify and characterize habitat productivity at fine resolution across entire watersheds are currently limited. These limitations will be addressed through adaptive management approaches.

Threats Abatement

Recovery criteria should correspond to the five factors upon which determinations to list, reclassify, and delist a species are based. Although not every identified threat needs to be completely eliminated to remove a species from the Federal endangered species list, current and foreseeable threats must be abated to the point where a recovered species is unlikely to become in danger of extinction again within the foreseeable future.

Because the level of uncertainty regarding threats and management options in the marine environment is high, this recovery strategy places a primary focus on abating threats in the freshwater environment and increasing our understanding of threats to marine survival. As we learn more about opportunities to improve marine survival rates, the recovery strategy, and recovery criteria based on the strategy, will expand accordingly to address those threats.

B. Adaptive Strategy

Recovery strategies are predicated on maximizing the likelihood of recovery success. To accomplish this, the strategy must address many sources of uncertainty. Assumptions must be made about future conditions, including environmental conditions, threats, funding availability, partner interest, and the species' response to management actions. To maintain the maximum likelihood of recovery success over time, the recovery strategy may need to be revised should any of these assumptions prove to be incorrect. Adaptive management, that is, adjusting management as management results and other events become better understood, provides a systematic means of addressing uncertainties and is an important approach for any recovery strategy. In addition to being a guiding principle for the overall recovery strategy, recovery actions that can benefit from a formal adaptive management process are specified as such in Part IV of this plan.

C. Phased Approach

Given the unavoidable complexity and uncertainties associated with recovery of the GOM DPS, as well as inevitable funding constraints, this recovery strategy adopts a stepwise approach that outlines a pathway towards recovery through four phases. The recovery actions outlined in this plan will be linked to each phase (see Part IV) to demonstrate their role in the overall recovery effort.

The four recovery phases are described below. Since the 2000 listing of Atlantic salmon populations, a number of recovery actions have already been addressed; consequently, the actions in phase 1 are largely complete, and the overall recovery effort has generally entered phase 2.

Phase 1: The first recovery phase focuses on identifying the threats to the species and characterizing the habitat needs of the species necessary for their recovery.

Phase 2: The second recovery phase focuses on ensuring the persistence of the GOM DPS through the use of the conservation hatcheries while abating imminent threats to the continued existence of the DPS. By the end of this phase, reclassification from endangered to threatened should be possible (see Part III).

Recovery actions associated with phase 2 are geared toward creating the necessary foundation for establishment and protection of sufficiently resilient wild populations to withstand foreseeable long-term stresses, and toward providing Atlantic salmon with access to suitable habitat throughout their life cycle. Given our current level of understanding, phase 2 focuses on freshwater habitat used by Atlantic salmon for spawning, rearing, and upstream and downstream migration; it also emphasizes research on threats within the marine environment.

Phase 3: The third phase of recovery will focus on increasing the abundance, distribution, and productivity of naturally reared Atlantic salmon. It will involve transitioning from dependence on the conservation hatcheries to wild smolt production and ensuring that mechanisms are in place to address continuing threats to the species in both the freshwater and ocean environments. We recognize that this is a long-term endeavor that will also need to address the information gaps associated with marine survival and, with this information in hand, identify appropriate management actions. At the end of phase 3, delisting should be possible (see Part III).

Phase 4: The final phase of recovery is characterized by a self-sustaining wild population geographically distributed across connected habitats throughout the GOM DPS area, with minimal dependence on human intervention to complete its natural life cycle; mechanisms are in place that prevent or abate the foreseeable threats to the long-term survival of the species. This phase will involve postdelisting monitoring to show that full recovery is being sustained.

D. Geographic Framework

Recovery of the GOM DPS is contingent on a wide range of research and management actions over an extended period of time. To organize recovery actions and ensure that they are implemented as effectively as possible, the geographic framework represented by SHRUs developed in the 2009 critical habitat rule has been carried over to the recovery strategy for the DPS. These SHRUs (Downeast, Penobscot, and Merrymeeting Bay) provide a framework for articulating spatial distribution objectives and ensuring that viable populations are established across the major geographic regions within the DPS, and that threats are addressed effectively across the DPS.

E. Coordination and Collaboration

Federal agencies, state agencies, Tribes, industries, conservation organizations, private citizens, and other groups have been working toward restoring Atlantic salmon populations in Maine for over 100 years; many of these groups continue to provide support to salmon recovery throughout the DPS. To promote continued, strategic coordination among the wide array of partners to salmon recovery in Maine, the following approach to recovery implementation has been devised.

1. DPS-wide Recovery Implementation Strategy

This plan lays out site-specific recovery actions that should lead to the achievement of rangewide recovery objectives as measured by the recovery criteria. The geographic scale at which these site-specific actions are described is the SHRU. This scale takes into account both the comprehensive scope and long timeframe needed to reach recovery objectives; it is also an appropriate scale at which to monitor recovery progress and apply adaptive management strategies. SHRU-level workplans will provide the basis for determining activities that should be implemented in the short term for each of the plan's recovery actions. Although these workplans will link back to this recovery plan, they are not considered part of the plan itself. It should also be noted that some of the plan's recovery actions are at the scale of the DPS or are not geographically based (e.g., genetics studies and other research).

2. SHRU-level Workplans

The workplan for each SHRU will identify activities that will be implemented, contingent on availability of resources, over successive 5-year periods. The initial SHRU-level workplans identify activities that, within each SHRU and ultimately on a DPS-wide basis, will contribute to a coordinated recovery effort aimed toward meeting the recovery criteria laid out in Part III. Some activities may be unique to a particular SHRU, while others may apply to all three SHRUs but at differing priorities or levels of effort.

We anticipate that the SHRU-level workplans will change over time as a function of adaptive management and identification of newly identified opportunities or threats. Regular discussions about the workplans, involving partners and the interested public, will be held to ensure that recommended activities are responsive to ongoing and emerging needs and opportunities.

F. Definitions Pertaining to Recovery Criteria and Actions

For ease of reference, we are providing the following definitions for concepts and terms contained in Part III, Recovery Criteria, and Part IV, Recovery Actions. Further discussion of these concepts is presented in the 2009 critical habitat rule.

1. Habitat Accessibility Categories

Habitat with No Access: Habitat above a barrier (dam or road stream crossing) that has no fish passage.

Habitat with Impeded Access: Habitat above a barrier that temporarily blocks or impairs a salmon's natural ability to pass (e.g., a culvert or dam with a fishway with limited function).

Habitat that is Accessible: At a minimum, the habitat must allow for movement of parr that seek out suitable habitats for feeding and sheltering, downstream movements of smolts during the spring migration, and upstream and downstream movement of adults that seek out habitats for spawning and resting. To meet this standard, habitat must be either: (1) Accessible above a dam with upstream and downstream passage that does not preclude recovery, or (2) accessible above road stream crossings set at the correct elevation using the Stream Simulation methodology.

Habitat that is Fully Accessible: Habitat where there is no artificial barrier between it and the ocean.[4]

2. Critical Habitat Features

Certain recovery criteria reference critical habitat features. Under section 3 of the ESA, critical habitat is defined as specific areas supporting those physical and biological features that are essential for the conservation of the species and that may require special management considerations or protection. The necessary physical and biological features constituting critical habitat are described in detail at: *http://atlanticsalmonrestoration.org/resources/documents/atlantic-salmon-recovery-plan-2015/recovery-plan-pages/critical-habitat*. These include: (1) Seven habitat features essential to spawning and rearing, and (2) six habitat features essential to migration, as defined below:

Spawning and rearing

1. Deep, oxygenated pools and cover (e.g., boulders, woody debris, vegetation) 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.

[4] The Services may categorize some bridges with natural stream channels and bottomless culverts as fully accessible if the area beneath the bridge has a gradient, stream width, floodplain, and configuration similar to the existing natural channel upstream or downstream of the crossing.

5. Freshwater rearing sites with a combination of river, stream, and lake habitats that accommodate Atlantic salmon parrs' 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.

Migration

1. Freshwater and estuary migratory sites free of physical and biological barriers that delay or prevent access for 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, 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 of 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.

PART III. RECOVERY GOALS, OBJECTIVES, AND CRITERIA

The following goals, objectives, and criteria set standards for ascertaining when recovery progress has been made under the ESA. These standards refer to the definitions of endangered and threatened under section 3 of the ESA: endangered means that a species is *in danger of extinction throughout all or a significant portion of its range*, whereas a threatened species is *likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range*.

Recovery goals, objectives, and criteria thus guide the recovery action program toward accomplishments that bring the species closer to the definition of threatened and, ultimately, to the point where neither definition applies and listing is no longer warranted. It is important to note that the criteria in recovery plans are subject to change based on new information and insights, and that the statutory process for making reclassification and delisting determinations is the five-factor analysis under ESA section 4(a)(1). Significant changes to this document may require a plan revision which is subject to the public review and comment period provisions under ESA section 4(f)(4).

A. Recovery Goals

The ultimate goal of this recovery program is to improve the long-term population viability of the GOM DPS of Atlantic salmon to the point where it no longer requires the protections of the ESA and can be removed from the Federal List of Endangered Wildlife and Threatened Wildlife. The intermediate goal is to reclassify the DPS from endangered to threatened by improving conditions to the point where it is no longer in danger of extinction but, in the absence of continued ESA protections, would likely revert to an endangered species in the foreseeable future.

B. Recovery Objectives

1. Reclassification Objectives

- Maintain a sustainable, naturally reared population in each of at least two of the three SHRUs and ensure access to sufficient suitable habitat in each of these two SHRUs for these populations.
- Ensure that management options, if any, for marine survival are better understood.
- Reduce or eliminate those threats that either individually or in combination endanger the DPS.

2. Delisting Objectives

- Maintain self-sustaining, wild populations in each SHRU, and ensure access to sufficient suitable habitat in each SHRU for these populations.
- Ensure that necessary and available management options for marine survival are in place.
- Reduce or eliminate those threats that either individually or in combination threaten the DPS.

C. Recovery Criteria

In accordance with section 4(f) of the ESA, this section presents criteria for identifying when the reclassification and delisting objectives for the GOM DPS have been achieved. The starting point for these criteria is the preliminary delisting criteria that were described in detail in the 2009 critical habitat rule (74 FR 29300). Both biological and threats-abatement criteria are required to address recovery objectives. Atlantic salmon abundance and productivity criteria cannot be met without addressing low marine survival and mortality from dams.

These criteria reflect the achievement of recovery through the strategy described in the Part II Recovery Strategy section of this plan. If the recovery strategy changes as a result of altered conditions or new information, these criteria may be revised. Please note that, for ease of reference, terms regarding habitat access or critical habitat features in the following criteria are defined in Part II, section F, above.

1. Biological Criteria[5]

Reclassification Criteria:

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

1a. Abundance: The DPS has total annual returns of at least 1,500 naturally reared adults spawning in the wild, with at least 2 of the 3 SHRUs having an annual escapement of at least 500 naturally reared adults.

[5] It is important to note that the criteria for both reclassification and delisting address *only* the conditions needed to achieve a probability of long-term viability such that ESA protections are no longer warranted. The abundance criteria for DPS salmon do not take into account additional numbers of fish to support either recreational or sustenance fishing. Establishment of harvestable levels of salmon would necessarily be above and beyond these recovery criteria.

1b. ***Productivity:*** The population in each of at least two of the three SHRUs has a geometric mean population growth rate of greater than 1.0 in the 10-year (two-generation) period preceding reclassification.

1c. ***Origin:*** Adults originating from hatchery-stocked eggs, fry, and parr–but not from hatchery-stocked smolts or adults–are included when estimating population growth rates.

1d. ***Habitat:*** Sufficient suitable spawning and rearing habitat for the offspring of the 1,500 naturally reared adults is accessible and distributed throughout designated Atlantic salmon critical habitat, with at least 7,500 accessible and suitable HUs in each of at least two of the three SHRUs, located according to the known and potential migratory patterns of returning salmon.

Delisting Criteria:

Delisting of the GOM DPS will be considered when all of the following criteria are met:

1e. ***Abundance*:** The DPS has a self-sustaining annual escapement of at least 2,000 wild adults in each SHRU, for a DPS-wide total of at least 6,000 wild adults.

1f. ***Productivity:*** Each SHRU has a geometric mean population growth rate of greater than 1.0 in the 10-year (two-generation) period preceding delisting, *and* at the time of delisting, the DPS demonstrates self-sustaining persistence, whereby the total wild population in each SHRU has less than a 50-percent probability of falling below 500 adult wild spawners in the next 15 years based on population viability analysis (PVA) projections.

1g. ***Habitat:*** Sufficient suitable spawning and rearing habitat for the offspring of the 6,000 wild adults is accessible and distributed throughout the designated Atlantic salmon critical habitat, with at least 30,000 accessible and suitable HUs in each SHRU, located according to the known migratory patterns of returning wild adult salmon. This will require both habitat protection and restoration at significant levels.

2. Threats-abatement Criteria

The criteria in this section describe how the five listing factors (see box 2) will be addressed to determine whether a species warrants the protections of the ESA. The criteria focus first on primary threats to the DPS (including ongoing threats identified in the 2009 listing rule, as well as emerging threats). These criteria are followed by criteria for threats considered to be secondary on an individual basis but which, in combination, constitute a major threat.

There is uncertainty about the extent to which each threat factor must be reduced to reach and sustain the biological recovery criteria. This uncertainty will be resolved as recovery actions addressing threats are implemented, which will then allow us to frame more specific and quantitative threats abatement criteria.

Reclassification Criteria:

The following threats-abatement criteria must be met to the extent necessary to support a GOM DPS of Atlantic salmon that is no longer in danger of extinction. Completion of the recovery actions needed to meet these criteria will signal the end of phase 2 of the recovery process for the DPS as described in the Recovery Strategy section of this plan.

2a. ***Dams and road stream crossings (Factor A):*** A combination of dam removals, passage improvements at dams, passable road crossing structures, and removal or redesign of any other instream barriers to fish passage provides salmon access to a minimum of 7,500 suitable HUs in each SHRU (see Biological Criterion 1d, above).

2b. ***Regulatory mechanisms for dams (Factor D):*** A Species Protection Plan or an equivalent plan is in place for FERC-licensed dams in Atlantic salmon designated critical habitat.

2c. ***Climate change (Factor E):*** A water quality monitoring program is established to track climate change trends and effects on: (a) freshwater, estuarine, and marine habitats, and (b) salmon health. This program includes adaptive management strategies to mitigate or protect salmon from any harmful effects associated with climate change. In addition, freshwater areas that have greater resilience to climate change are identified, quantified, and incorporated into recovery goals and actions.

2d. ***Low marine survival (Factor E):*** In combination with the climate change monitoring program, a program for identifying and quantifying additional anthropogenic threats in the marine environment is designed and implemented, and adaptive management strategies for mitigating the harmful effects of these threats, when possible, are developed. These factors include, but are not necessarily limited to, intercept fisheries and aquaculture management.

2e. ***Loss of genetic diversity (Factor E):*** Extant DPS family groups and genetic diversity are maintained at levels needed to support Biological Criteria 1a, 1b, and 1c, above, through adaptive hatchery practices and stock management strategies. To prevent possible entry of deleterious traits associated with aquaculture, each DPS population is maintained at greater than 50 effective population size.

Delisting Criteria

The following threats-based criteria must be met to the extent necessary to support a recovered GOM DPS of Atlantic salmon. Completion of the recovery actions needed to meet these criteria will signal the end of phase 3 of the recovery process for the DPS as described in the Recovery Strategy section of this plan.

Delisting criteria addressing primary threats:

2f. ***Dams (Factor A):*** Upstream and downstream passage at dams is improved by dam removal or through operational changes that provide access to spawning and nursery

habitats (freshwater habitat that is categorized as accessible or fully accessible habitat will be counted toward meeting this recovery criterion), reduce direct and indirect mortality of upstream and downstream migrating salmon, and provide for properly functioning critical habitat features.

2g. ***Road stream crossings (Factor A):*** Upstream and downstream passage at culverts is improved through culvert removal or through culvert installation or replacement that provides access to spawning and nursery habitats (freshwater habitat that is categorized as accessible or fully accessible habitat will be counted toward meeting this recovery criterion), reduces degradation of surrounding habitat features, and provides for properly functioning critical habitat features.

2h. ***Regulatory mechanisms for dams (Factor D):*** Regulatory mechanisms for hydroelectric and nonhydroelectric dams are in place and effectively enforced that maintain accessible and fully accessible upstream and downstream passage, water quality conditions that support a recovered population, and properly functioning critical habitat features.

2i. ***Marine survival (Factor E):*** Marine survival is at a level that supports a recovered population, factors that influence marine survival (including intercept fisheries) are identified and quantified, management measures that maintain marine survival are implemented, and an adaptive management strategy that incorporates marine survival models into Atlantic salmon management plans and regulatory mechanisms is implemented.

2j. ***Climate change (Factor E):*** Recognizing a high degree of uncertainty, climate-induced threats to Atlantic salmon in both their freshwater and marine environments are addressed to meet the following conditions:

- Sufficient data, data collection tools, and predictive models are in place to allow for accurate forecasting of climate conditions as they relate to Atlantic salmon survival in freshwater and marine environments; and
- Robust predictive models and appropriate actions are incorporated into Atlantic salmon management and regulatory mechanisms.

Delisting criteria addressing secondary threats:

This category of threats includes multiple stressors that, *in combination*, rise to the level of a significant extinction risk to DPS salmon. Within this category, tradeoffs can be made in terms of how different stressors are addressed; in other words, not every criterion for secondary threats has to be met to consider delisting. As progress is achieved in addressing these threats, and as a better understanding is gained of how addressing these threats contributes to achievement of the biological criteria, the extent to which these threats must be addressed to support a recovered GOM DPS of Atlantic salmon can be better described.

2k. ***Instream flow conditions (Factor A):*** Instream flow conditions, including water temperature, support Atlantic salmon spawning, incubation, rearing, and migration.

2l. ***Water quality (Factor A):*** Water quality supports Atlantic salmon spawning, incubation, rearing, and migration.

2m. ***Habitat complexity (Factor A):*** Riparian conditions, including large wood debris and natural alluvial processes, provide for suitable Atlantic salmon habitat through appropriate forest and land management practices.

2n. ***Overutilization (Factor B):*** Utilization of GOM DPS Atlantic salmon for commercial, recreational, scientific, and educational purposes, and utilization related to bycatch and poaching, are managed by meeting the following conditions:

- Utilization monitoring programs and management plans are in place and implemented; and
- NASCO participation continues to ensure adequate management of intercept fisheries that impact United States-origin GOM DPS of Atlantic salmon.

2o. ***Disease (Factor C):*** Bacterial, viral, and fungal disease risks are managed by all hatcheries and other facilities by implementing rigorous disease prevention and management measures and protocols that incorporate the most up-to-date science and information by all hatcheries and other facilities.

2p. ***Predation (Factor C):*** Plans for the stocking, introduction, and management of nonindigenous species that prey on Atlantic salmon support a recovered GOM DPS of Atlantic salmon and are implemented.

2q. ***Regulatory mechanisms related to water withdrawals (Factor D):*** Regulatory mechanisms that ensure maintenance of natural variations in flows and water levels are enforced.

2r. ***Regulatory mechanisms related to water quality (Factor D):*** Regulatory mechanisms that protect water quality necessary to support Atlantic salmon spawning, rearing, and migration needs are enforced.

2s. ***Regulatory mechanisms related to illegal utilization (Factor D):*** Regulatory mechanisms that control illegal utilization of GOM DPS Atlantic salmon are enforced.

2t. ***Regulatory mechanisms related to predation and competition (Factor D):*** Regulatory mechanisms that prohibit the illegal stocking and introduction of any species that prey on, or compete with, Atlantic salmon are enforced.

2u. ***Artificial propagation (Factor E):*** Atlantic salmon hatchery, broodstock, and stocking management plans are implemented to reduce the risks of domestication and loss of genetic diversity of the GOM DPS of Atlantic salmon.

2v. Aquaculture (Factor E): Programs and management plans are implemented to ensure that aquaculture practices adequately reduce interactions of aquaculture fish with wild populations of Atlantic salmon.

2w. Depleted diadromous fish communities (Factor E): Co-evolved diadromous species are restored to the extent necessary to support a recovered GOM DPS of Atlantic salmon.

2x. Competition by nonnative species (Factor E): Plans for the stocking, introduction, and management of nonindigenous species that compete with Atlantic salmon support a recovered GOM DPS of Atlantic salmon and are implemented.

D. Evaluating Recovery Progress

The Services and our partners monitor progress towards recovery through the Environmental Conservation Online System (ECOS), a gateway Web site that provides access to data systems in the USFWS and other government data sources (see: *http://ecos.fws.gov/ecp/*). This central point of access assists USFWS and NOAA-Fisheries personnel in managing data and information, and it provides public access to information from numerous USFWS databases.

PART IV. RECOVERY ACTIONS

As explained in Part II, this recovery plan focuses on the statutory requirements of the ESA, including site-specific recovery actions. The geographic scale at which these actions are described is the SHRU. This scale takes into account both the comprehensive scope and long timeframe needed to achieve recovery objectives; it is thus the appropriate scale at which to monitor recovery progress and apply adaptive management strategies. Geographically based activities that can be implemented in the short term will be determined through SHRU-level workplans that will be updated as new implementation ideas, new opportunities, and additional information become available. Although these workplans will link back to the following recovery actions, they are not considered part of the recovery plan itself. It should also be noted that some of the following recovery actions will be implemented at the scale of the DPS or are not geographically based.

A. Recovery Actions

1. Habitat Connectivity: Enhance connectivity between the ocean and freshwater habitats important for salmon recovery.

1.1 Identify and prioritize highest priority fish passage barriers for remediation. This action should ensure that the most productive areas are well connected to each other and to the GOM, and that restoration projects are prioritized based on their biological merits. The prioritization must provide a clear and transparent way of assessing the relative biological value of individual restoration opportunities.

1.2 Perform fish passage barrier assessments throughout the GOM DPS. Assessing the effects of barriers requires accurate data on the amount of habitat in a watershed, both above and below a given barrier, as well as the accessibility of a given barrier as it exists without any restorative action. On-the-ground barrier surveys are required to measure barrier height and seasonal flow characteristics (depth, velocity, etc.) to ensure that priorities are set using accurate information.

1.3 Determine the feasibility of connectivity projects important to Atlantic salmon. After potential restoration projects have been identified, comprehensive feasibility analyses (including alternatives analyses) are needed to ensure that a given project has a reasonable likelihood of being completed.

1.4 Conduct engineering studies for potential fish passage improvement projects. Once the feasibility of a given restoration project has been analyzed and deemed

appropriate to move forward, the project must be designed by a professional engineer (PE).

1.5 Permit potential fish passage improvement projects. A variety of local, State, and Federal regulations must be complied with during restoration project implementation. Among other things, this requires application to a variety of regulatory agencies for permits to conduct the project.

1.6 Remove dams according to the prioritization guidelines, as feasible. One of the significant variables affecting the Atlantic salmon population is the availability of spawning and rearing habitats available to them. Barriers to fish passage lower the ceiling on the overall carrying capacity of the GOM DPS. For the population to grow and be self-sustaining, the carrying capacity ceiling must be raised to a level that overall production of smolts generated from freshwater habitats is substantial enough to withstand periods of low marine survival. Dam removal offers the highest likelihood of raising the ceiling by reconnecting large amounts of freshwater habitat required for salmon to successfully complete their life history. Dam removals will be accomplished through a variety of agency staff work and the funding from external groups.

1.7 Remove or replace culverts according to the prioritization guidelines, as feasible. Culverts and other road crossings can block the migration of salmon and other migratory fish, particularly in headwater areas where culverts are ubiquitous across the landscape. Headwater habitats can serve as spawning and nursery habitats and are often important areas for temporary or longterm feeding and thermal refuge by Atlantic salmon parr. The effects of known passage barriers can be ameliorated by culvert removal (often through road de-commissioning), culvert replacement (i.e., resizing to 1.2 bank-full width or greater), or bridge construction.

1.8 Install fishways according to the prioritization guidelines, as feasible. In some instances, removal of fish passage barriers (particularly dams) is deemed to be unacceptable at a given site. However, traditional engineered fishways and nature-like fishways (rock ramps, nature-like bypasses, etc.) may be installed to partially ameliorate the effects of a given barrier. If properly designed, these fishways can provide sufficient protection to Atlantic salmon and their ecosystems.

1.9 Establish fish passage efficiency targets that do not "jeopardize the continued existence" of the GOM DPS of Atlantic salmon. One of the primary factors leading to the listing as endangered of the GOM DPS is the presence and continued operation of mainstem hydroelectric dams. Fish passage efficiency targets need to be developed that ensure that dam operations can continue in a manner that does not result in jeopardy to the species.

1.10 Enforce fish passage efficiency targets developed under action 1.9. Once fish passage efficiency targets have been established, NOAA-Fisheries will work with

dam owners and other affected stakeholders to effectively implement and monitor these targets.

1.11 Establish accessible passage criteria for road stream crossings. Fish passage criteria need to be established at road/stream crossings that describe the set of conditions necessary to allow for movement of all life stages of Atlantic salmon.

1.12 Implement passage criteria at road stream crossings through ESA consultation and permitting actions. Passage criteria developed through 1.11 will be implemented through section 7 consultation work with Federal action agencies and permit applicants.

1.13 Conduct pre- and post-barrier removal and fish passage improvement monitoring using up-to-date methods. Post-barrier removal habitat and ecology monitoring is essential to determine whether these projects provided the expected benefits to Atlantic salmon. Determining the effectiveness of habitat barrier removals may include, but is not limited to, the following studies:

- Monument cross-sectional surveys,
- Grain size distribution surveys,
- Photo station surveys,
- Wetland and riparian plant community surveys,
- Fish community structure surveys,
- Juvenile salmon migration studies,
- Adult salmon migration studies,
- Water quality surveys,
- Benthic macroinvertebrate surveys,
- Enumeration of salmon spawning habitat made available as a result of the restoration,
- Enumeration of salmon rearing habitat made available as a result of the restoration, and
- Enumeration of salmon spawning and rearing habitat made accessible as a result of restoration.

2. Genetic Diversity: Maintain the genetic diversity of Atlantic salmon populations over time.

2.1 Genetically monitor Atlantic salmon. Exact methods and analyses will likely change over time; however, any genetic method used must ensure that hatchery Atlantic salmon are genetically fit and that the genetic integrity of the DPS is maintained. Monitoring activities will include, but not be limited to, the following:

- Annually characterize parr and sea-run adults,
- Monitor broodstocks for evidence of genetic diseases or deleterious genetic traits,

- Monitor estimates of genetic diversity of the wild or naturally reproducing Atlantic salmon,
- Continually monitor critical trait variation (quantitative, morphometric, other physical trait) to assess risks of inadvertent selection,
- Track spawning history for all Atlantic salmon held for broodstock purposes, and
- Monitor effectiveness of aquaculture biological opinions.

2.2 Prioritize ongoing genetic data analysis needs with respect to management goals. Given limited funding, annual assessment of priorities for genetic analysis is important to determine that annual monitoring needs are completed and prioritize additional needs based on needed application of genetic methods for monitoring, assessment, or evaluation of ongoing studies or programs.

2.3 Conduct a gap analysis to determine if additional areas of genetic study are needed. Existing data should be examined in terms of the overall genetic assessment needs of the program. This analysis may include review of literature to identify new tools, techniques, or analyses that, if applied to the Maine Atlantic salmon program, could provide additional insight into the restoration program.

2.4 Manage data resulting from production, stocking, and genetic evaluation to facilitate program assessment and monitoring. This includes database development and management and maintenance of information from annual updating and evaluations.

2.5 Genetically analyze and evaluate management practices relating to DPS recovery. Monitoring results from Action 2.1 and ongoing research results will be used to genetically evaluate management practices relating to DPS recovery. This includes, but is not limited to, the following practices:

- Genetically assess consequences of alternate stocking strategies for multiple life history stages,
- Annually evaluate broodstock collection practices by genetically determining parentage to identify percentage of families recovered from stocking events,
- Use genetic monitoring data to evaluate if hatchery practices (including spawning, stocking, or rearing) are resulting in artificial selection,
- Evaluate the genetic implications of collecting adult fish for captive propagation versus potential offspring of wild reproduction in the parr collections, allowing for increased natural escapement,
- Evaluate and optimize grading practices to reduce genetic selection (initial emphasis on grading for smolt production), and
- Develop and complete additional, experimental genetic analyses and provide genetic analysis to support projects to evaluate hatchery production of Atlantic salmon.

2.6 Use genetic analyses to inform and improve best hatchery management practices. This will include, but is not limited to, the following genetics applications:

- Use genetic data to inform selection of spawning pairs to minimize inbreeding and to guide spawning practices,
- Use genetic analyses to optimize practices to reduce risks of inadvertent selection that might reduce fitness in the wild,
- Optimize practices to reduce risks of inadvertent selection that might reduce fitness in the wild,
- Implement pedigree lines if demographic, family recovery, aquaculture escape event, or another parameter limits the potential collection of a broodstock year class,
- Maintain and enhance, as applicable, the genetic viability of river-specific broodstocks for supplementation according to the broodstock management plan, and
- Link hatchery production parameters (i.e., changes in fecundity, broodstock reproducing, etc.) to genetic characteristics of the broodstocks to assist in monitoring fitness.

2.7 Implement stocking practices that broadly distribute genetic groups (families) throughout the stocking sites. This action is intended to minimize the loss of genetic diversity and maximize selective pressures in both the freshwater and marine environments to the seven river-specific brood stocks maintained in the conservation hatcheries.

2.8 Implement the practices identified in the broodstock management plan to maintain genetic diversity for each broodstock. This will include incorporation of parr that are not assigned to hatchery broodstocks as long as those individuals have passed screening requirements.

2.9 Implement collection practices that obtain representative genetic variation. Implement recommendations identified in the broodstock management plan and work with broodstock collectors to ensure that broodstock collection practices obtain representative genetic variation from each population. This would include collecting the majority of artificial and wild-spawned families and widespread field collection for the parr collection programs.

2.10 As needed, evaluate, improve, and enhance the hatchery product and broodstock management practices in experimental environments outside of hatchery production requirements. Provide genetic analysis to support studies that require genetic analysis to identify individuals stocked as part of experimental studies.

2.11 Screen incoming parr and adults for aquaculture escapees. Use the genetic screening practices identified in the broodstock management plan to screen incoming parr and adults for aquaculture escapees. This work is completed annually by the USFWS Conservation Genetics Lab for both parr and adult collections, and results are provided to CBNFH prior to spawning.

2.12 Prevent aquaculture adults from entering rivers. Use existing trapping facilities and weirs and emergency methods when large escapes occur and trapping is possible.

3. Conservation Hatchery: Increase adult spawners through the conservation hatchery program.

3.1 Conduct annual fish health, disease, and biosecurity activities related to conservation hatcheries' annual activities. These activities, which currently occur at the Lamar Fish Health Center and Lamar Fish Tech Center, will be adapted as necessary.

3.2 As long as needed, maintain captive brood populations for DPS rivers. This action includes spawning, stocking, and brood collection activities. Captive brood populations will be maintained for the following rivers:

- Dennys River,
- East Machias River,
- Machias River,
- Narraguagus River,
- Pleasant River, and
- Sheepscot River.

3.3 Maintain sea-run-based broodstock for the Penobscot River through annual capture, transport, holding, and spawning of adult salmon returning to the river. Penobscot sea-run brood will continue to be utilized as the preferred source of all hatchery products for the Penobscot River. The conservation hatcheries may target the production of multiple life stages including providing eggs, fry, parr, and smolts for stocking efforts.

3.4 Maintain and spawn Penobscot River domestic broodstock, including stocking activities, as needed. Green Penobscot eggs will be used to prevent production shortfalls for stocking the Penobscot.

3.5 As appropriate, annually collect salmon parr from the Penobscot River to maintain brood. This action is contingent on upon enough adult salmon returning to allow spawning to occur in the river. It is based on concerns about the relatively low numbers of returning adult salmon to the Penobscot River since 2012, and the intent is to collect salmon parr from the watershed to increase the size of the brood for the river and prevent the loss of genetic diversity in the population.

3.6 Investigate the feasibility of developing river-specific broods for the Kennebec and Androscoggin rivers. Developing individual broods for these rivers that historically supported large numbers of Atlantic salmon could prove to be an important long-term recovery action for the DPS.

3.7 Stock adult spent brood into river of origin. All spent hatchery brood, with a few exceptions due to research projects, will continue to get released back into their river of origin.

3.8 As appropriate, continue to provide eggs to Pleasant River and East Machias River hatcheries for the purpose of increased biosecurity for these broods. This action supports partners' efforts with alternative rearing and stocking strategies.

3.9 When possible, produce Atlantic salmon (numbers and life stages) necessary to implement upstream and downstream fish passage studies at hydroelectric and other fish passage structures/barriers within the GOM DPS. Production of salmon for this activity should not impact brood management. However, due to the importance of these passage studies consideration should be taken to provide salmon when possible.

3.10 Mark significant number of smolt/parr releases. Continue to mark representative samples of hatchery-produced smolt and parr for positive identification as returning adults (both for production/stocking assessments and research projects).

3.11 Enumerate smolt emigration from freshwater rearing habitats. This information is used to assess freshwater habitat productivity and hatchery product survival from fry through smolt, and provides the basic information needed to calculate smolt-to-adult survival.

3.12 Monitor and assess instream fry and parr. This action is the primary mechanism for providing freshwater life-stage information to assess hatchery product success relative to specific benchmarks in the wild. This action also covers substantial wild (progeny of natural spawning) production monitoring, since these fish are captured while sampling for hatchery products, although it is often impossible to distinguish the wild from hatchery products at these life stages.

4. Freshwater Conservation: Increase adult spawners through the freshwater production of smolts.

4.1 Implement a DPS-wide juvenile salmon sampling plan. This will include assessment of abundance, overwinter survival, parr migration distances, and habitat utilization. Implement a standardized juvenile assessment sampling scheme across the DPS to provide large parr trend information at the HUC 10 and SHRU scales.

The goal is to maximize the use of information collected from individual action assessments and minimize additional sampling needed to have enough power to detect changes in long-term trend dataset. The assessment will rely primarily on catch-per-unit-effort (CPUE) electrofishing protocol for stream resident juveniles. An approach integrating CPUE with the few long-term salmon population assessment sites allows sampling more sites in sub-drainages and provides an index of relative population abundance and distribution that can be related to juvenile Atlantic salmon density.

4.2 **Implement a smolt production evaluation program in selected rivers.** Estimates of emigrating smolts provide a measure of smolt production that links parr production to adult returns and redd counts. The goal is to conduct smolt trapping at one long-term site within each SHRU to establish an index of smolt production.

4.3 **Monitor reaches for natural re-colonization and redds.** This effort should be adjusted as stocking/reintroduction strategies change. While the standardized assessment will focus on occupied habitat, this action will monitor unoccupied areas for natural re-colonization (areas with no active stock enhancement, but accessible by Atlantic salmon) through annual juvenile assessments and redd surveys with a goal of documenting changes in distribution of Atlantic salmon.

4.4 **Monitor environmental limiting factors.** These factors may include water temperature, pH, impacts of sedimentation, impacts of non-point source pollution, gravel, mining, other stream channel degradation, minimum flows, impacts of irrigation water withdrawals (both surface and groundwater withdrawals), impacts of reduced habitat complexity, and availability of cold water refugia. A systematic monitoring network to provide data to identify environmental limiting factors, both short- and long-term, in each SHRU from headwater streams to coastal rivers should be developed and implemented as resources allow. This monitoring network will complement existing U.S. Geological Survey gage sites.

4.5 **Identify areas for riparian habitat improvement and management.** Areas for riparian habitat improvements will be identified in conjunction with habitat surveys and modeling efforts. Riparian zones benefit fish habitat by providing overhead cover and shade, woody debris, organic matter (leaf litter provides food sources for invertebrates and fish), and invertebrates, and can improve water quality.

4.6 **Develop, implement, and update a reintroduction plan using data from sampling and habitat utilization monitoring.** The reintroduction plan will identify strategies for stocking hatchery brood that incorporate overall habitat quality and habitats that have become accessible through the implementation of fish passage projects. The plan will be adapted as habitat suitability and accessibility changes and wild populations begin to be reestablished.

4.7 Monitor for aquaculture escapees and respond as needed. The genetic screening practices identified in the broodstock management plan will be used to annually screen incoming parr and adults for aquaculture escapees.

4.8 Stock/reintroduce hatchery products according to broodstock management plan/strategic stocking plan/reintroduction plan. Release hatchery products in accordance with guidance documents. Depending on the phase of recovery, hatchery products will be used to achieve different conservation goals.

4.9 Assess impacts of avian, piscine, and mammalian predation. Identify the sources of predation and its effects on juvenile, smolt, and adult Atlantic salmon in freshwater

4.10 Develop a strategic plan for minimizing the impacts of predation. The strategic plan will be shared with the Tribes, State and Federal agencies, and nongovernmental partners.

4.11 Develop strategic plans for freshwater habitat management and restoration. Habitat restorations should be prioritized based on the expected benefits to Atlantic salmon populations, benefits to co-evolved diadromous species, accessibility (current and future) to adult Atlantic salmon, and the degree and type of degradation by contrasting current and predicted juvenile Atlantic salmon production.

4.12 Implement freshwater habitat management and restoration projects. Once habitat restoration projects have been identified and prioritized, the projects need to be completed in a timely manner to maximize the benefit to Atlantic salmon in the DPS. Project implementation and completion will likely take many forms involving State, Federal, nongovernmental, and private partnerships.

4.13 Conduct studies of the ecological role of co-evolved diadromous species.

4.14 Monitor the effectiveness of CWA State water quality standards for salmon waters. This will involve consulting with the State and EPA as appropriate. Continual monitoring of the effectiveness of water quality standards within the DPS is necessary to ensure habitat suitability and survival of Atlantic salmon while they inhabit freshwater habitats.

4.15 Monitor, evaluate, and engage in review of introduced species stocked as sport fish in or near salmon waters. Also monitor and evaluate impacts of incidental catch of Atlantic salmon while sport fishing. Minimize the potential impact of recreational fishing within the DPS, in areas inhabited by Atlantic salmon. Work with State agencies and local sportsmen groups to determine potential impacts.

4.16 Establish and implement an in-lieu-fee-based mitigation program targeted at unavoidable impacts to streams and rivers. Work with partners to identify projects where in-lieu-fee-based mitigation for identified impacts to Atlantic salmon is the best solution.

5. Marine and Estuary: Increase Atlantic salmon survival through increased ecosystem understanding and identification of spatial and temporal constraints to salmon marine productivity to inform and support management actions that improve survival.

5.1 Reduce effects of human activities on migratory smolts in estuary, coastal, and Northeast Shelf Domestic waters. This will include: (a) minimizing potential effects of construction activities on Atlantic salmon migration success through estuaries, bays, and the GOM by effective permit conditions; (b) enhancing and protecting estuarine and marine habitat areas through coastal zoning and marine spatial planning; (c) protecting Atlantic salmon from fisheries in domestic waters through support of updates to the New England Fisheries Management Council (NEFMC) Atlantic salmon Fisheries Management Plan (FMP) that prohibit possession and any directed catch and through support of other FMP's that reduce/eliminate incidental catch in Federal waters; and (d) examining various marine-phase data to gain insights into survival bottlenecks.

5.2 Perpetuate an active U.S. management role at NASCO to improve at-sea distant water survival of Atlantic salmon through reduction of fishing mortality and evaluation of drivers of natural mortality at sea. This will be accomplished by: (a) participating in annual stock assessments supporting International Council for the Exploration of the Sea Working Group on North Atlantic Salmon (ICES WGNAS) advice to NASCO to protect salmon in distant water fisheries; (b) participating in NASCO's International Atlantic Salmon Research Board (IASRB) to better understand factors influencing natural mortality of salmon at sea through cooperative science; (c) continuing participation in, and oversight of, NASCO's West Greenland sampling to monitor catch for U.S. salmon and enhance estimates of catch and effort; and (d) continuing participation in and oversight of Salmon at Sea—International Atlantic Salmon Research Board (SALSEA) Greenland transition to next IASRB initiative.

5.3 Integrate current estuary-coastal salmon science findings into operational fish and habitat management activities while continuing to study the location and mechanisms of estuarine-coastal mortality. This action will include: (a) continued building of domestic and international acoustic and satellite tracking infrastructure in estuaries, bays, the GOM, and Northwest Atlantic, and facilitate partnerships with the Integrated Ocean Observing System community and Ocean Tracking Network through initiation and support of ecosystem-based tracking studies; (b) supporting bioenergetics modeling/analysis of marine salmon to evaluate the importance of predator and prey fields and ocean circulation on Atlantic salmon growth and survival in the GOM and Northwest Atlantic Ocean; (c) continuing to archive and analyze historical high seas tag recaptures databases and

scale collections; and (d) continuing to support adaptive management studies based on Nearshore Survival Workshop recommendations and recent science advances to proactively change management approaches to improve survival and understanding of driving factors.

5.4 Minimize impacts of climate change and marine prey base shifts by managing salmon populations for resilience. This will include: (a) examining interactions of salmon with predators and parasites–continue to monitor the occurrence of marine mammal scars on returning adults to the adult trap in the Penobscot River; (b) conducting smolt telemetry, hydro-acoustic and survey projects to further investigate migration timing and ecology in estuary and coastal waters; and (c) continuing a comprehensive evaluation of existing marine related data for correlations at U.S., North America, and North Atlantic scales to better characterize impact of oceanographic changes on Atlantic salmon survival in the Northwest Atlantic.

6. Federal/Tribal Coordination: Consult with all involved Tribes on a government-to-government basis.

6.1 Engage with Tribes on a regular basis to assure that Federal agencies meet their full and appropriate Tribal trust responsibilities. This may be accomplished by, for example, holding regularly scheduled meetings as well as through the development and implementation of the SHRU-level workplans.

6.2 Ensure that the Penobscot Indian Nation continues to share co-management responsibility of Atlantic salmon. PIN, the State of Maine, and the Services will continue to oversee governance of Atlantic salmon recovery efforts.

7. Outreach, Education, and Engagement: Collaborate with partners and engage interested parties in recovery efforts for the GOM DPS.

7.1 Improve stakeholder and public knowledge of ecosystem restoration and sea-run fish resources in Maine. NGOs and agencies will work to develop coordinated outreach media content to inform and educate.

7.2 Develop a Web site where basic information about all sea run fish, including their biology, ecology, conservation can be accessed. The Web site should include a photo/video library with activities/resources of partner NGOs and agencies.

7.3 Involve interested parties in the development and updating of SHRU-level workplans. In-depth information about SHRU-level workplans and their implementation and SHRU-level meetings should be posted on the Web site developed for 7.2.

7.4 As appropriate, continue existing outreach programs in coordination with partners. This may include Salmon in Schools and Fish Friends programs, hatchery outreach programs, and Friend of the Craig Brook and Green Lakes Hatcheries programs. It will include new contacts, materials, and Web-based resources as needed.

7.5 Collaborate on preparation of outreach materials. Video shorts will be developed for posting on the Web site and Facebook regarding sea-run resources and restoration activities. In addition, portable exhibits about ecosystem restoration, sea-run fish ecology will be created. This will also include an interactive mapping tool that shows growth of connected habitat and includes data about adult returns and other highlights of recovery efforts. Implementation plans, meeting announcements and agendas, presentation materials, calendars of meetings, meeting minutes, and other recovery-related materials will also be posted.

7.6 Participate in key outreach events with representatives from the full range of sea run fish restoration partners. Atlantic salmon conservation partners will join the agencies in highlighting the fish's biology and efforts at its restoration.

7.7 Connect Atlantic salmon recovery action teams with stakeholders and other members of the public. Invite stakeholders to participate in regularly scheduled recovery meetings.

7.8 Encourage participation in the activities coordinated by the Connectivity Action Team. This could include citizen science surveys, barrier removal, installation of large woody debris, and volunteering to assist in NGO-sponsored restoration work.

7.9 Provide training, for stakeholders and others, about Atlantic salmon recovery activities. This could include training such as how to build fish-friendly road/stream crossings, thus promoting consideration by landowners, municipal officials, and other stakeholders about incorporating fish-friendly designs into their road/stream crossing maintenance actions.

7.10 Continue to support Stream Smart training. If warranted, "next steps" training sessions should be developed.

7.11 Coordinate recovery activities and explain Endangered Species requirements to involved and interested parties. Working within a set governance structure, activities will be coordinated annually within and among SHRUs and rangewide for activities such as research and activities within the estuarine and marine portions of the range. Upon request, training courses, seminars, and presentations to clarify ESA protections for Atlantic salmon will be developed and provided.

B. Action Implementation

The following DPS-wide implementation table provides the action priorities (see Box 3), listing factors (see Box 2 in section D, Threats to Species Viability), recovery phases (see Part II), timeframes, 5-year costs, and responsible parties for the recovery actions described above.

Action priority numbers and recovery phases are closely aligned. Recovery phases are, however, based additionally on operational considerations such as feasibility and the need to complete one action in order to begin implementing another. For instance, research on marine survival needs to be well underway or completed before effective management actions can commence, despite

Box 3. RECOVERY ACTION PRIORITY NUMBERS

Priority 1: An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.

Priority 2: An action that must be taken to prevent a significant decline in species population/habitat quality, or some other negative impact short of extinction,

Priority 3: All other actions necessary to provide for the full recovery of the species.

the need to maintain adequate marine survival rates to prevent extinction; in this case, some Priority 1 actions may not be included in Recovery phase 1.

Note that the timeframes and costs take the entire recovery period into account and thus provide the information needed for Part IV of this plan. It should also be noted that each recovery action either addresses one or more of the five listing factors *or* is directly related to arresting and reversing declining population trends in order to meet the biological recovery criteria in Part III of the plan.

For those recovery actions that are geographically based, the actions in this table will tier down to SHRU-level workplans that describe activities with a 5-year horizon. Regularly scheduled SHRU-level meetings will be held to identify potential projects and report on past accomplishments.

In addition to NOAA-Fisheries and USFWS, Maine DMR, and the PIN, key recovery collaborators, as of 2016, include: American Rivers; Appalachian Mountain Club; Atlantic Salmon Federation; Downeast Land Trust; Downeast Salmon Federation; Ducks Unlimited; Environmental Protection Agency; Fisheries Improvement Network; Forest Products Council; Forest Society of Maine; Huber, Inc.; Keeping Maine's Forests; Maine Audubon; Maine Department of Environmental Resources; Maine Department of Inland Fisheries and Wildlife; Maine Department of Transportation; Maine Forest Service; Maine Rivers; Maine Tree Foundation; Natural Resources Conservation Service; Natural Resources Council of Maine; Penobscot River Restoration Trust; Project SHARE; Sewell, Inc.; The Nature Conservancy;

Trout Unlimited; University of Maine Cooperative Extension Service; USGS; University of Maine; and the ACOE, among many others.

Table 1. GOM DPS of ATLANTIC SALMON DPS-WIDE RECOVERY IMPLEMENTATION TABLE							
Action Number	**Listing Factor**	**Recovery Phase**	**Action Priority**	**Action Description**	**Action Duration**	**Costs**	**Responsible/ Contributing Parties**
1.1	A	2	2	Identify and prioritize highest-priority fish passage barriers for remediation.	Complete	$10,000	NOAA, USFWS
1.2	A	2	2	Perform fish passage barrier assessments throughout the GOM DPS.	Ongoing	$150,000	NOAA, USFWS
1.3	A	2	2	Determine the feasibility of connectivity projects important to Atlantic salmon.	Ongoing	$250,000	NOAA, USFWS USDA-NRCS NGOs Private citizens
1.4	A	2	2	Conduct engineering studies for potential fish passage improvement projects.	Ongoing	$250,000	NOAA, USFWS USDA-NRCS NGOs Private citizens
1.5	A, D	2, 3	2	Permit potential fish passage improvement projects.	Ongoing	$50,000	NOAA, USFWS State agencies Municipalities
1.6	A	2, 3	2	Remove dams according to the prioritization guidelines, as feasible.	Ongoing	$17,500,000	NOAA, USFWS FERC, USDA-NRCS MDMR, other State agencies PIN Dam owners NGOs Private citizens

1.7	A	2, 3	2	Remove or replace culverts according to the prioritization guidelines, as feasible.	Ongoing	$18,750,000	NOAA, USFWS Federal Highways, USDA-NRCS, FEMA PIN MDOT Culvert owners NGOs Private citizens
1.8	A	2, 3	2	Install fishways according to the prioritization guidelines, as feasible.	Ongoing	$3,750,000	NOAA, USFWS FERC, USDA-NRCS State agencies Dam owners NGOs Private citizens
1.9	A, D	2	1	Establish fish passage efficiency targets that do not "jeopardize the continued existence" of the GOM DPS.	1-5 years	$500,000	NOAA FERC Dam owners
1.10	A, D	2, 3	1	Enforce fish passage efficiency targets developed under action 1.9.	Ongoing	$5,000,000	NOAA, USFWS FERC Dam owners
1.11	A, D	2	1	Establish accessible upstream passage criteria for road stream crossings.	1-5 years	$50,000	USFWS
1.12	A	2, 3	1	Implement upstream passage criteria at road stream crossings through ESA consultation and permitting actions.	Ongoing	$625,000	NOAA, USFWS Federal Highways, USDA-NRCS State agencies
1.13	A	2	2	Conduct pre- and post- barrier removal and fish passage improvement monitoring using up-to-date methods.	Ongoing	$750,000	NOAA, USFWS Dam owners Road crossing owners Interested citizens
2.1	A	2	1	Genetically monitor Atlantic salmon.	Ongoing	$1,502,000	USFWS, NOAA MDMR DSF

2.2	A	2	1	Prioritize ongoing genetic data analysis needs with respect to management goals.	Ongoing	$20,000	USFWS
2.3	A	2	2	Conduct a gap analysis to determine if additional areas of genetic study are needed.	Ongoing	$32,500	USFWS, NOAA MDMR
2.4	A	2	1	Manage data resulting from production, stocking, and genetic evaluation to facilitate program assessment and monitoring.	Ongoing	$32,500	USFWS
2.5	A	2	1	Genetically analyze and evaluate management practices relating to DPS recovery.	Ongoing	$1,001,000	USFWS MDMR
2.6	A	2	2	Use genetic analyses to inform and improve best hatchery management practices.	Ongoing	$240,000	USFWS MDMR DFS
2.7	A	2	1	Implement stocking practices that broadly distribute genetic groups (families) throughout the stocking sites.	Ongoing	$15,000	USFWS MDMR
2.8	A	2	1	Implement the practices identified in the broodstock management plan to maintain genetic diversity for each broodstock.	Ongoing	$54,000	USFWS MDMR
2.9	A	2	1	Implement collection practices that obtain representative genetic variation.	Ongoing	$90,000	USFWS MDMR
2.10	A	2	1	Evaluate, improve, and enhance the hatchery product and broodstock management practices in experimental environments outside of hatchery production requirements.	As needed	$350,000	USFWS
2.11	A	2	1	Screen incoming parr and adults for aquaculture escapees.	Ongoing	$70,000	USFWS
2.12	A	2	1	Prevent aquaculture adults from entering rivers.	Ongoing	$435,000	USFWS, NOAA MDMR
3.1	C	N/A	2	Conduct Annual Fish Health, Disease, and Biosecurity Activities related to conservation hatcheries annual activities.	Ongoing	$760,000	USFWS

3.2	--[6]	2	1	As long as needed, maintain captive brood populations for DPS rivers.	Ongoing	$2,100,000	USFWS MDMR
3.3	--	2	1	Maintain sea-run based broodstock for the Penobscot River through annual transport, holding, and spawning of adults returning to the river.	Ongoing	$125,000	USFWS
3.4	--	2	1	Maintain and spawn Penobscot River domestic broodstock, including stocking activities, as needed.	Ongoing	$225,000	USFWS
3.5	--	2	2	As appropriate, annually collect salmon parr from the Penobscot River to maintain brood.	Ongoing	$180,000	USFWS MDMR
3.6	--	2	3	Investigate feasibility of developing river specific broods for Kennebec and Androscoggin rivers.	Through 2016	$25,000	USFWS, NOAA MDMR
3.7	--	2	3	Stock adult spent brood into river of origin.	Ongoing	$130,000	USFWS
3.8	--	2	2	As appropriate, provide eggs to the Pleasant River and East Machias River hatcheries for the purpose of increased biosecurity for these broods.	Ongoing	$60,000	USFWS MDMR ASF, DFS
3.9	A, B	2	2	As necessary, produce Atlantic salmon necessary to implement upstream and downstream fish passage studies at hydroelectric and other fish passage structures/barriers within the GOM DPS.	Duration of studies	$1,000,000 (dependent on numbers and life stage)	USFWS, NOAA Private industry
3.10	A-E	2	3	Mark significant number of smolt/parr releases.	Ongoing	$300,000	USFWS, NOAA MDMR NGOs

[6] Actions 3.2-3.8 do not address the five listing factors; rather, they constitute a transitional population management program to bolster salmon numbers and distribution.

3.11	A-E	2	3	Enumerate smolt migration from freshwater rearing habitats.	Ongoing	$600,000	NOAA MDMR NGOs
3.12	A-E	2	3	Monitor and assess instream fry and parr.	Ongoing	$1,000,000	MDMR
4.1	A	1	3	Implement a DPS-wide juvenile salmon sampling plan.	Ongoing	$850,000	USFWS MDMR
4.2	A	1	3	Implement a smolt production evaluation program in selected rivers.	Ongoing	$1,000,000	MDMR
4.3	A	3	3	Monitor reaches for natural re-colonization and redds.	Ongoing	$25,000	MDMR
4.4	A	1, 2	3	Monitor environmental limiting factors.	Ongoing	$150,000	MDMR
4.5	A	1, 2	3	Identify areas for riparian habitat improvement and management.	Ongoing	$25,000	MDMR USFWS
4.6	A	1	3	Develop, implement, and update a reintroduction plan using data from sampling and habitat utilization monitoring.	Phase 1-2	$20,000	USFWS MDMR
4.7	E	1, 2	1	Monitor for aquaculture escapees and respond as needed. .	Ongoing	$80,000	NOAA USFWS
4.8	A	1, 2, 3	2	Stock/reintroduce hatchery products according to strategic stocking plan/reintroduction plan.	Phases 1-3	$500,000	USFWS MDMR
4.9	C	1	3	Assess impacts of avian, piscine, and mammalian predation on DPS salmon.	Ongoing	$75,000	USFWS MDMR
4.10	C	1	3	Develop a strategic plan for minimizing predation.	Ongoing	$20,000	USFWS MDMR
4.11	A	2	3	Develop strategic plans for freshwater habitat management and restoration.	Phases 1-2	$30,000	USFWS MDMR
4.12	A	2	3	Implement freshwater habitat management and restoration projects.	Phases 2-3	$5,000,000	USFWS
4.13	E	1	3	Develop and implement studies of the ecological role of co-evolved diadromous species.	Phases 1-3	$75,000	NOAA USFWS
4.14	A	1	3	Monitor the effectiveness of CWA State water quality standards for salmon waters.	Ongoing	$50,000	USFWS NOAA

4.15	B	1	3	Monitor, evaluate, and engage in review of introduced species stocked as sport fish in or near salmon waters.	Ongoing	$75,000	USFWS MDMR
4.16	A	2	2	Establish and implement an in-lieu-fee-based mitigation program targeted at unavoidable impacts to streams and rivers.	Ongoing	$100,000	USFWS
5.1	A, E	2	2	Reduce effects of human activities on migratory smolts in estuary, coastal, and Northeast Shelf Domestic waters.	Ongoing	$480,000	NOAA Private and public landowners, including municipalities
5.2	E	2	1	Continue active U.S. management role at NASCO to improve at-sea distant water survival of Atlantic salmon through reduction of fishing mortality and evaluation of drivers of natural mortality at sea.	Ongoing	$981,000	NOAA ASF, ISFA, Dept. of State
5.3	E	2	2	Integrate estuary-coastal salmon science findings into operational fish and habitat management activities while continuing studies to better understand the location and mechanisms of estuarine-coastal mortality.	Ongoing	$996,000	NOAA MDMR ASF and other partners
5.4	E	2	2	Minimize impacts of climate change and marine prey base shifts by managing salmon populations for resilience.	Ongoing	$216,000	NOAA MDMR
6.1	E	1, 2, 3	1	Engage with Tribes on a regular basis to ensure that Federal agencies meet their full and appropriate Tribal trust responsibilities.	Ongoing	--	NOAA, USFWS
6.2	E	1, 2, 3	1	Ensure that the Penobscot Indian Nation continues to share co-management responsibility of Atlantic salmon.	Ongoing	--	NOAA, USFWS, MDMR
7.1	E	2, 3, 4	3	Improve stakeholder and public knowledge of ecosystem restoration and sea run fish resources in Maine.	Ongoing	$40,000	NOAA, USFWS MDMR PIN NGOs

7.2	E	2, 3	3	Develop a Web site where basic information about all sea run fish, including their biology, ecology, and conservation, can be accessed.	Completed; updating ongoing	$40,000	USFWS
7.3	E	2, 3	3	Involve interested parties in the development and updating of SHRU-level workplans.	Ongoing	$10,000	NOAA, USFWS
7.4	E	2, 3	3	As appropriate, continue existing outreach programs in coordination with partners. .	Ongoing	$140,000	USFWS TNC, DSF
7.5	E	2, 3	3	Collaborate on preparation of outreach materials.	Ongoing	$60,000	NOAA, USFWS NGOs
7.6	E	3	3	Participate in key outreach events with representatives from the full range of sea run fish restoration partners.	Ongoing	$60,000	NOAA, USFWS NGOs
7.7	E	2, 3, 4	3	Connect recovery action teams with stakeholders and other members of the public.	Ongoing	$110,000	NOAA, USFWS NGOs
7.8	E	3	3	Encourage participation in the activities coordinated by the Connectivity Action Team.	Ongoing	$10,000	USFWS, NOAA MDMR
7.9	E	4	3	Provide training, for stakeholders and others, about Atlantic salmon recovery activities.	1-5 years	$50,000	USFWS, NOAA MDMR NGOs
7.10	E	3	3	Continue to support StreamSmart training.	1-5 years	$40,000	USFWS, NOAA Maine Audubon, other NGOs
7.11	E	3	3	Coordinate recovery actions and explain Endangered Species requirements to involved and interested parties.	1-5 years	$410,000	USFWS, NOAA

PART V. TIME AND COST ESTIMATES

A. Time to Delisting

Recovery of the GOM DPS of Atlantic salmon is projected to take 75 years. This accounts for approximately 15 generations of salmon and is based on an assumed upper limit of available resources for implementation of recovery actions. It should be noted that both this time estimate and the cost estimate below are unavoidably speculative, given the uncertainties surrounding recovery of this DPS.

Estimating the time and cost for reclassification is equally difficult. The earliest possible time to reclassification is estimated to be 10 years.

B. Cost of Recovery

Incremental costs of recovery are calculated at 5-year intervals. Estimated costs in the preceding Implementation Table include project, staff, and operating costs for the next 5 years, with a total 5-year cost of $70,214,000. Assuming that costs of the various actions will accrue unevenly, and further, that costs will diminish over time as projects are completed and best management practices are implemented, the cost over 75 years is roughly estimated to be one-third of the fully accrued cost, amounting to a total cost of recovery of $351,070,000.

To meet the intermediate recovery goal of reclassifying the DPS from endangered to threatened status, we have used the best-case time scenario outlined above, leading to a cost estimate of $140,428,000.

We strongly emphasize that this figure involves a high degree of uncertainty about the actual trajectory recovery will take over the long term. It is, therefore, highly subject to change and should not be used with any intent other than meeting our legal requirement to provide the public with our best understanding of the general level of effort and expense that might be needed to meet the ultimate recovery goal of delisting.

It is also important to note the costs involved in implementing recovery actions for the GOM DPS of Atlantic salmon will also provide other vital ancillary benefits. These include, but are not limited to, conservation of other diadromous species in the GOM, improved water quality and flow in salmon rivers, an enhanced understanding of sustainable management for numerous aquatic resources, and a reduction of stressors that affect not only Atlantic salmon but general environmental quality. Thus, although the recovery program for the GOM DPS does not include any actions that do not directly benefit DPS salmon, neither does it preclude other important benefits of these actions.

PART VI. LITERATURE CITED

The information and recommendations in this plan are based on a plethora of published technical papers and agency documents relating to Atlantic salmon biology, threats, and conservation. The literature cited in this section is limited to sources that refer to status and policy documents to which this plan directly responds.

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APPENDIX: LIST OF POSTED SUPPORTING MATERIALS

- Statement of Cooperation
- 2016 Atlantic Salmon Recovery Plan – Public Review Draft
- Governance Structure
- Atlantic Salmon Recovery Framework
- Recovery Proposals Review and Approval Process
- Multi-agency issue documents, interagency agreements, and international cooperative efforts
- Threats as of 2009 and associated literature references
- New and emerging threats
- Craig Brook and Green Lake National Fish Hatcheries Web sites
- East Machias Aquatic Resource Center Web site
- Detailed discussion of stakeholder recovery efforts
- Initial recovery plan (NOAA and USFWS 2005)
- 2009 critical habitat rule, Appendix A
- Population viability analysis
- SHRU-level workplans
- Full list of references, including technical references cited on the Web site
- Glossary