NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT
BIOLOGICAL OPINION

Agency: Federal Energy Regulatory Commission (FERC)

Activity Considered: **Proposed Amendment of License for the Pejepscot Project (FERC No. 4784)**

F/NER/2012/01859

Conducted by: National Marine Fisheries Service
Northeast Region

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Approved by: for John Bullard

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1. INTRODUCTION AND BACKGROUND

This constitutes the biological opinion (Opinion) of NOAA's National Marine Fisheries Service (NMFS) under the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531-1543) concerning the effects of the Federal Energy Regulatory Commission's (FERC) approval of an application to amend the license for the incorporation of protection measures for Atlantic salmon at the Pejepscot Project, as described in a proposed interim species protection plan (ISPP). The Pejepscot Project is an existing hydroelectric project located on the Androscoggin River in Maine.

By letter filed with FERC on April 12, 2012, Topsham Hydro Partners (Topsham Hydro) requested that its license for the Pejepscot Project be amended to incorporate the provisions of a five-year ISPP. In a letter dated July 14, 2010, the FERC designated Topsham Hydro as their non-federal representative to conduct informal ESA section 7 consultation with NMFS. These consultations would consider effects of actions proposed in the ISPP to minimize effects to listed Atlantic salmon.

This Opinion is based on information provided in the FERC's May 7, 2012 Biological Assessment and ISPP. A complete administrative record of this consultation will be maintained by the NMFS's Maine Field Office in Orono, Maine. Formal consultation was initiated on May 7, 2012. This Opinion is only valid for the five year term of the ISPP (2012-2016).

No other federal agencies have actions associated with the proposed project. Pursuant to the section 7 regulations (50 CFR §402.07), when a particular action involves more than one Federal agency, the consultation responsibilities may be fulfilled through a lead agency. FERC is the lead Federal agency for the proposed actions under consideration in this consultation.

1.1. Consultation History

- **July 14, 2010** – FERC designated Topsham Hydro to act as its non-federal representative in conducting informal consultation under Section 7 of the ESA regarding federally listed Atlantic salmon at the Pejepscot Project.

- **November 23, 2011** – Topsham Hydro updated FERC on its progress on working with the Services to prepare a draft Biological Assessment and ISPP.

- **December 30, 2011** – Topsham Hydro provided a draft BA and ISPP to NMFS for review and comment.

- **February 3, 2012** – NMFS provided comments on the draft BA and ISPP to Topsham Hydro.

- **February 27, 2012** – NMFS and USFWS met with Topsham Hydro to discuss draft BA and ISPP.

- **March 21, 2012** – Topsham Hydro submitted a revised draft BA and ISPP to NMFS.

- **April 12, 2012**-Topsham Hydro filed a draft BA and ISPP with the FERC.

- **May 7, 2012** – FERC adopted the BA and ISPP and submitted a letter to NMFS requesting the initiation of formal consultation.

- **June 4, 2012** – NMFS submitted a letter to FERC indicating that all of the information required to initiate a formal consultation for the project had been received. In this letter NMFS noted that the date that the initiation request was received (May 7, 2012) will serve as the commencement of the formal consultation process.

1.2. Relevant Documents

The analysis in this Opinion is based on a review of the best available scientific and commercial information. Specific sources are listed in section 13 and are cited directly throughout the body of the document. Primary sources of information include: 1) information provided in FERC's May 7, 2012 initiation letter and attached BA and ISPP in support of formal consultation under the ESA; 2) Determination of Endangered Status for the Gulf of Maine Distinct Population Segment of Atlantic salmon; Final Rule (74 FR 29345; June 19, 2009); 3) Status Review for Anadromous Atlantic Salmon (*Salmo salar*) in the United States (Fay *et al.* 2006); 5) Designation of Critical Habitat for Atlantic salmon Gulf of Maine Distinct Population Segment (74 FR 29300; June 19, 2009); 4) Final Recovery Plan for Shortnose Sturgeon (December, 1998); and 5) Final listing determinations for the five distinct population segments of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*). On February 6, 2012, we published notice in the *Federal Register* listing the Atlantic sturgeon as "endangered" in the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs, and as "threatened" in the Gulf of Maine DPS (77 FR 5880 and 77 FR 5914).

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

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

- Identifies the action area based on the action agency's description of the proposed action (Section 2);
- Evaluates the current status of the species with respect to biological requirements indicative of survival and recovery and the essential features of any designated critical habitat (Section 3);
- Evaluates the relevance of the environmental baseline in the action area to biological

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

In completing the last step, NMFS determines whether the action under consultation is likely to jeopardize the ESA-listed species or result in the destruction or adverse modification of designated critical habitat. If so, NMFS must identify a reasonable and prudent alternative(s) (RPA) to the action as proposed that avoids jeopardy or adverse modification of critical habitat and meets the other regulatory requirements for an RPA (see 50 CFR §402.02). In making these determinations, NMFS must rely on the best available scientific and commercial data.
The critical habitat analysis determines whether the proposed action will destroy or adversely modify designated or proposed critical habitat for ESA-listed species by examining any change in the conservation value of the primary constituent elements of that critical habitat. This analysis focuses on statutory provisions of the ESA, including those in section 3 that define “critical habitat” and “conservation”, in section 4 that describe the designation process, and in section 7 that set forth the substantive protections and procedural aspects of consultation. Although some “properly functioning” habitat parameters are generally well known in the fisheries literature (e.g., thermal tolerances), for others, the effects of any adverse impacts are considered in more qualitative terms. The analysis presented in this Opinion does not rely on the regulatory definition of “adverse modification or destruction” of critical habitat at issue in the 9th Circuit Court of Appeals (Gifford Pinchot Task Force *et al.* v. U.S. Fish and Wildlife Service, No. 03-35279, August 6, 2004).

2. PROJECT DESCRIPTION AND PROPOSED ACTION

FERC is proposing to amend the license held by Topsham Hydro for the Pejepscot Project to incorporate provisions of an ISPP for Atlantic salmon. Provisions of the ISPP will require Topsham Hydro to: (1) expand the operating periods for existing upstream and downstream fish passage facilities beginning in 2012; (2) investigate improvements in debris management at the passage facilities in 2012; (3) conduct studies of upstream and downstream Atlantic salmon passage between 2013 and 2015; and (4) implement debris management improvements between 2013 and 2015. The ISPP is valid for a 5 year period (2016). In 2016, this Opinion will no longer be valid and section 7 consultation will need to be reinitiated by FERC to consider the effects of operating the project through the current FERC license period (2022).

2.1. Existing Hydroelectric Facility

The Pejepscot Project, which spans the width of the Androscoggin River on the border between Cumberland and Sagadahoc Counties, consists of the dam, spillway, fish passage facilities, two powerhouses, a sheet-pile floodwall, and ancillary equipment. The Project has a drainage area of 3,420 square miles, and at normal pool elevation of 67.5 feet, has a reservoir surface area of 225 acres and gross storage of 3,278 acre-feet. Average annual inflow to the reservoir is 6,800 cubic feet per second (cfs) (Table 1).

The Pejepscot Dam is a 560-foot-long, 48-foot-high, rock- and gravel-filled, timber-crib, overflow structure with a sheet-pile cutoff to bedrock along the upstream side. The cribs are topped with a 5 foot-thick reinforced concrete slab to protect the dam from erosion during periods of high river flow. At the right (west) end of the dam where the abutment rock level is high, there is no cribwork, and the dam consists of a low, mass-concrete section. The dam is abutted on the right by a high bedrock outcrop and on the left (east) by a mass-concrete and stone-masonry pier.

Table 1. Characteristics of the Pejepscot Project on the Androscoggin River.

Facility Characteristics	**Topsham Hydro**
Drainage Area	3,420 square mile
Reservoir Surface Area	225 acres
Volume	3,278 acre-feet at elevation 67.5 feet
Average Annual Inflow to Reservoir	6,800 cfs
Length of Dam	560 feet
Height of Dam	48 feet
Spillway Discharge Capacity	95,000 cfs
Units	3 Francis and 1 Kaplan
Trash Racks	Francis: • 1.5 inch clear bar spacing Kaplan: • From elevation 61.35 feet down to 55.1 feet: 1.5 inch clear bar spacing • From 55.1 feet down to 36 feet: 5.5 inch clear bar spacing

Spillway capacity is provided by overtopping the crest of the dam. The crest is equipped with five, 96-foot-long by 3-foot-high, hydraulically operated, bascule gates separated by concrete piers. The gates can be operated automatically or manually. The hydraulic pump units that operate the gates are contained in the mass-concrete pier forming the left abutment of the dam. The crest gate seals are heated to permit operation of the gates during cold weather, including movement when subjected to heavy ice pressure.

The Project has a spillway discharge capacity of 95,000 cfs. Overtopping of the dam does not occur until the headwater reaches an elevation of 81 feet, at which point the spillway discharge is approximately 110,000 cfs.

The powerhouses at the Project include an old (original) powerhouse that was constructed in 1898, and a new powerhouse that was constructed from 1985 to 1987. The combined installed capacity of the four generating units is 14.575 MW. The Project has two separate intake structures, the old powerhouse intake and the new powerhouse intake, both of which are integral with the powerhouses. The original (northerly) powerhouse contains three rehabilitated horizontal Francis units (identified as Unit Nos. 21, 22, and 23) with a combined flow capacity of 1,050 cfs and an output capacity of about 1.6 MW. Each of the units has an intake gate for dewatering, which is operated with a rack-and-pinion gear-type hoist. The tailrace water passage for the three units can be isolated from the downstream tailwater by means of a bulkhead-type gate, which is operated from the new powerhouse intake deck using a mobile crane. The new powerhouse contains a vertical-shaft, low speed, adjustable-blade, propeller type (Kaplan) turbine (identified as Unit No. 1) rated at 12.975 MW, with four blades 18 feet in diameter; it rotates at 82 rpm; and the rated capacity of the turbine is 7,100 cfs. The trash rack for the Kaplan unit intake extends from elevation 61.35 feet to 36 feet. The trash rack has a clear bar spacing of 1.5 inch from elevation 61.35 feet down 75 inches (6.25 feet). The remaining portion of the trash rack (19.1 feet) has a clear bar spacing of 5.5 inches. The three Francis units have 1.5 inch bar spacing on the trash rack (Table 2).

Operations

The Pejepscot Project is operated as a run of the river facility. The main turbine generator unit (Unit 1) is operated on pond level control. Unit 1 controls the turbine wicket gates to maintain a preset pond level which is normally elevation 67.3 feet or 0.2 feet below the top of the spill gates. When Unit 1 nears its rated flow capacity of 7,100 cfs, one or more of the three small units in the old powerhouse (Units 21, 22 and 23) is manually started and set at its best efficiency point near the maximum turbine flow. Unit 1 maintains pond level at the set point until it is at its maximum capacity and then the pond level begins to increase. The small units are mainly operated during high spring runoff and after large storm events that increase river flow (they are last on and first off). They are also operated during maintenance of Unit 1.

When the pond level reaches elevation 69.0 feet (1.5 feet above the spill gates), the gates begin to lower starting with Gate 1, closest to the powerhouse. The gates operate on pond level control and as flow increases they maintaining the pond level of 69.0 feet until all five gates are open. When the flow starts decreasing and the pond level drops to elevation 68.0 feet the gates start to close to maintain a level above 68.0. When all five gates are closed then the pond is again on turbine pond level control until the pond level exceeds elevation 69.0.

Fish Passage

Migratory fish restoration efforts on the Androscoggin River have historically focused on alewife (*Alosa pseudoharengus*) and American shad (*A. sapidissima*) because of the limited number of Atlantic salmon in the river (letter from Maine Department of Marine Resources (MDMR) to

FERC dated March 25, 2010). The Pejepscot Project contains both upstream and downstream fish passage facilities. The fish passage designs were reviewed and approved by state and federal agencies before being approved by FERC. After construction, the fish passage facilities were tested for efficiency and approved by FERC.

The upstream fish passage facility is a vertical lift (elevator) that lifts migratory fish in a hopper about 30 feet vertically from near the powerhouse tailrace to reservoir level behind the diversion dam. The lift hopper is about 20 feet long and seven feet wide with a sloping bottom that assists in removal of the fish from the hopper. The inlet to the hopper is a V-trap about eight inches wide by eight feet high opening. In front of the entry gate there are four attraction pumps under a grating that create an additional flow up to 160 cfs through the entry channel to attract the fish to the lift, each pump capable of pumping 40 cfs of flow. The pumps are Flygt 20 HP submersible attraction pumps with 60 Hz motor and can be sequenced to change the volume of water passing through the entry channel, depending on the flow out of the powerhouse tailrace. The lift basket discharges the fish into a metal channel about six feet wide and eight feet high. The channel is approximately 110 feet long from the lift hopper to the gate at the dam. Along the channel is a viewing window to observe the fish along with a crowding panel that moves the fish closer to the window for viewing. There is a continuous flow of about 30 cfs from the reservoir to the lift basket to attract the fish to the reservoir.

The upstream fish passage is currently operated when the Maine Department of Marine Resources (MDMR) notifies the plant operator to begin the seasonal operation. For example, the upstream fish passage was operated from May 16 to July 11; and from May 18 to August 6, in 2008 and 2009, respectively. In a letter from NMFS to FERC dated May 18, 2010, NMFS stated that operation of the upstream fishway from May through November would benefit Atlantic salmon. NMFS indicated that its recommendations regarding fish passage operation should be considered interim protection measures until consultation under section 7 is completed. In 2010, the upstream fish passage was operated from May 26 to October 22 due to moderate river flows (Letter from Topsham Hydro to FERC dated April 7, 2011).

The lift is operated automatically to lift the fish hopper every two hours beginning at 8 a.m. for a total of five lifts per day. The four attraction pumps are on automatic operation to adjust the number of pumps operating with the flow coming through the turbine and out the tailrace. There is a preset weir in the channel that provides an attraction flow through the channel and hopper. The channel from the hopper to the reservoir is opened when the seasonal operation is started for passage of anadromous fish. The gates in the channel that allow fish to be counted through the observation window are left open unless they are being used for counting. There is no active counting of fish at the plant and historically, the counting facilities have only been used for efficiency tests. The upstream lift facility is currently operated until MDMR notifies the plant operator that the facility can be stopped.

The downstream fish passage facilities consist of two entry weirs, one on either side of the turbine intake, with attraction lights near the water surface. From each weir an outlet pipe transports the fish in water down to the water below the dam. The weir gates are four feet wide and are part of an inlet box with the outlet pipe located on the side opposite the weir. The right side weir has a 30-inch diameter transport pipe and the left side weir has a 24-inch diameter transport pipe. Both pipes have a free discharge to the water below the dam. The flow through each entrance at normal pond is 30 to 35 cfs, resulting in a combined flow of 60 to 70 cfs.

The downstream fish passage facilities operate under the direction of MDMR. To provide downstream passage for anadromous species including Atlantic salmon smolts and post-spawned adults (i.e., kelts) migrating in the Androscoggin River system, the downstream fishway is currently operated from April 1 to June 30, and October 15 to December 31, as river conditions allow (Letter from Topsham Hydro to FERC dated January 26, 2011).

Maintenance

The majority of upstream fish passage facility maintenance is completed outside of the passage season, typically during the winter months. Preseason maintenance includes inspection of the hoist(s), maintenance on the weir gate operator, inlet channel inspection, dewatering and cleaning of the pump pit every three years, and cleaning of the viewing window. The attraction pumps are removed, tested, and inspected. Repairs are made as needed and all four pumps used to provide attraction flows to the upstream passage facility have been replaced between 2006 and 2009. The pumps are stored in the powerhouse until they are reinstalled, usually in March. The lift, hopper, and other metal parts are inspected and replaced as needed. The lift motor is inspected and tested, as are all the cables. During the operating season, daily adjustments are made to the weir gate and lift operation. Occasionally pumps are pulled if debris becomes lodged into an impeller. At the end of the season, the pumps are pulled, pressure washed and stored in the old powerhouse, the entrance gate is closed and the upper channel is pressure washed and cleaned. The oil and megger attraction pumps are changed. The facility and its components are inspected daily to ensure proper operation, and minor maintenance is performed as necessary.

Downstream fish passage facility maintenance is also largely completed during the winter months. The downstream weirs have large-spaced racks to prevent large debris from entering the fishway. Any debris is cleared as soon as river conditions allow safe access. In most cases, debris management is only necessary at high flow when there is also considerable spill over the spillway, which allows for downstream passage for any migrating Atlantic salmon. During the operating season, daily inspections are conducted and trash is removed from the bar racks as necessary. Occasionally, the gates will have to be closed to remove trash inside the entrance box using Topsham Hydro’s boat.

Topsham Hydro will continue to incorporate debris management into the operations and maintenance at the Topsham Project fish passage facilities. As access to the trash racks in front of the downstream fish passage intakes at the right and left ends of the new powerhouse intake is currently a challenge, and fouling of the racks has been identified as a concern with respect to the effectiveness of downstream fish passage, Topsham Hydro is currently investigating options to enhance and improve debris management. Potential options include installation of new access platforms that would provide access for operators to be able to remove debris from the fish passage intake racks and guide the debris to the mechanical rake.

2.2. Proposed Action

The ISPP is valid for a five-year period (2012- 2016) to allow Topsham Hydro to study existing measures to protect downstream migrating Atlantic salmon. Provisions of the ISPP will require Topsham Hydro to undertake the following activities:

- Conduct upstream passage studies on pre-spawn adult Atlantic salmon;
- Conduct downstream survival studies for outmigrating smolts and kelts;
- Expand the operational period for the upstream and downstream fish passage facilities; and
- Implement measures to improve debris management.

During this interim period, the survival levels to recover listed Atlantic salmon will be better defined and the resulting information will be used to develop a final SPP for Atlantic salmon. At the end of the five year period (2016), Topsham Hydro will file a final SPP for Atlantic salmon in consultation with FERC. The final SPP will reinitiate formal section 7 consultation under the ESA. Table 2 provides an overview of this process. Specific measures of the ISPP are described below.

Table 2. Overview of Interim Species Protection Plan implementation.

2012	2013 – 2015	Late 2015 – 2016(after 2015 field season is completed)
• Topsham Hydro develops SPP (covering 2012-2016) and Draft BA • FERC issues BA • NMFS issues Biological Opinion and Incidental Take Statement covering 2012 – 2016 • Topsham Hydro expands period that upstream and downstream bypass facilities are operated • Topsham Hydro completes investigations into options to enhance and improve debris management	• Topsham Hydro conducts Atlantic salmon upstream passage and downstream passage monitoring studies • Topsham Hydro implements debris management measures	• Topsham Hydro and FERC reinitiate consultation • Topsham Hydro develops subsequent SPP (covering period of 2017 to issuance of new license), including additional Atlantic salmon enhancement/protection measures, if determined to be necessary based on 2013 – 2015 monitoring results • NMFS issues Incidental Take Statement to cover period of subsequent SPP

Following the end of the 2015 field season, Topsham Hydro, in consultation with the Services, will evaluate upstream and downstream monitoring study results. Based on the monitoring results and in consultation with the Services, Topsham Hydro will determine if additional enhancements are appropriate to further protect Atlantic salmon and will revise the SPP accordingly to cover the period from 2017 to when a new license is issued (current license expires in 2022). The subsequent SPP will also be submitted to FERC for incorporation into the Project license. At that time, FERC will re-initiate formal section 7 consultation with NMFS.

On April 12, 2012, Topsham Hydro filed a draft BA and ISPP with FERC. The BA and ISPP were developed in consultation with NMFS. By filing the BA and ISPP with FERC absent any proposed federal action at the Pejepscot Project, Topsham Hydro is being proactive in conducting section 7 consultation for the protection of listed Atlantic salmon. The proposed action under consideration in this formal consultation is FERC's proposed amendment of the existing license for the Pejepscot Project to incorporate provisions of the ISPP. Upon receipt of this Opinion, FERC will complete a proceeding amending the license of the Pejepscot Project to incorporate the measures contained in the ISPP.

The proposed interim process is intended to be adaptive and, as such, Topsham Hydro will be coordinating and consulting with NMFS throughout the five year period. If early study results indicate that the study design is not adequately measuring passage efficiency, Topsham Hydro will work with NMFS to correct it. Likewise, if the early study results indicate that the upstream and downstream fishways at the Pejepscot Project are not highly efficient at passing Atlantic salmon, Topsham Hydro will coordinate with NMFS and modify operations at the Pejepscot Project to avoid and minimize effects to Atlantic salmon to the extent practicable. To that end, Miller Hydro will meet with NMFS annually to discuss study results, potential modifications to the study design and/or potential changes to the operation of the facility that may be necessary to reduce adverse effects to the species.

2.2.1. Fish Passage and Survival Studies

2.2.1.1. Upstream Passage Study

Upstream effectiveness studies will be conducted between 2013 and 2015. Topsham Hydro will conduct upstream passage salmon monitoring studies for up to three years (2013-2015) using PIT tagging. The upstream monitoring study is expected to be conducted in cooperation with other dam owners to the extent practicable. Topsham Hydro shall install PIT tag detection equipment at the Pejepscot Project fish lift entrance and exit to evaluate salmon success in using the fishway. This study would require that Atlantic salmon collected in the Brunswick fishway collection facility over the three-year period be PIT tagged. Topsham Hydro will consult with NMFS when formulating a study plan.

2.2.1.2. Downstream Fish Passage Study

Topsham Hydro will conduct a three year study at the Pejepscot Project to determine whether additional protective measures are necessary for Atlantic salmon smolts and kelts at the project. To provide an estimate of smolt survival, Topsham Hydro will conduct paired-release radio telemetry studies using up to172 smolts per year (102 smolts released upriver of the dam over three releases + up to 60 smolts released as controls downriver of the dam over three releases + ten smolts used in a tag retention study) between 2013 and 2015. Topsham Hydro will consult with NMFS when formulating a study plan.

Downstream passage studies involving kelts will also be conducted between 2013 and 2015. The intent of this study is to determine the existing downstream survival for Atlantic salmon kelts at the Pejepscot Project. The study will be up to three years in length and will coincide with smolt monitoring. It is anticipated that the study will involve the handling and radio tagging of no more than 20 male kelts per project per year. Topsham Hydro will consult with NMFS when formulating a study plan.

2.2.2. Fish Passage Operation

Topsham Hydro has proposed to expand the period that upstream passage facilities operate. The upstream lift, which has been operating between May and October, will operate between April 15 and November 15, as river conditions allow, under the proposed license amendment.

The downstream fish bypass facilities are currently operated under the direction of MDMR with the goal to facilitate passage throughout anadromous fish migration seasons (April 1 to June 30, and October 15 to December 31, as river conditions allow). Topsham Hydro is proposing to expand the period that downstream bypass facilities are operated so that they operate throughout the agency-defined migration season of April 1 to December 31, as river conditions allow.

2.2.3. Debris Management

Branches from streamside trees and other debris naturally fall into rivers or onto river banks and floodplains. High flows can carry woody debris downstream and debris can become lodged at hydroelectric facilities. The presence of debris represents aesthetic and safety concerns, but with regard to Atlantic salmon, the primary issue is that debris may accumulate at downstream or upstream passage facilities, causing adverse flow conditions.

Debris management at the Pejepscot Project fish passage facilities is incorporated into Topsham Hydro's operations and maintenance activities. In the event that debris is observed to be blocking or adversely affecting fishways, Topsham Hydro operators perform the necessary debris removal activities. Access to the trash racks in front of the downstream fish passage intakes at the right and left ends of the new powerhouse intake is currently a challenge, and fouling of the racks has been identified as a concern that could affect the effectiveness of downstream fish bypass facilities. Topsham Hydro is currently investigating options to enhance and improve debris management. One possible option includes the installation of new access platforms that would provide access for operators to be able to remove debris from the fish passage intake racks and guide the debris to the mechanical rake. These new platforms and access ladders would be attached to the concrete walls above each downstream weir. No in-water work would be necessary. Topsham Hydro shall continue to incorporate debris management into operations and maintenance procedures at the Project to ensure that fish passage facilities provide free and open access to migrating Atlantic salmon. Topsham Hydro shall complete current investigations into options to enhance and improve debris management during 2012. Implementation of the debris management improvements will occur between 2013 and 2015 (Table 2).

2.3. Action Area

The action area is defined as “all areas to be affected directly or indirectly by the Federal action and not merely the immediate area (project area) involved in the proposed action” (50 CFR 402.02). The action area must encompass all areas where both the direct and indirect effects of the proposed action would affect listed species and critical habitat.

Operation of the Pejepscot Project under the terms of the ISPP is expected to affect much of the Androscoggin River occupied by listed Atlantic salmon. Given its location low in the river, operation of the Pejepscot Project is likely to affect most adults returning to spawn and most smolts returning to the ocean to grow. Therefore, the entire Androscoggin River represents the action area for this consultation.

3. STATUS OF AFFECTED SPECIES AND CRITICAL HABITAT

Endangered Atlantic salmon (*Salmo salar*) have been documented in the action area for this consultation. Additionally, the action area is within the area that has been designated as critical habitat for GOM DPS Atlantic salmon. While shortnose and Atlantic sturgeon are known to occur in the Androscoggin River downstream of the Brunswick Dam, they do not occur in the vicinity of the Pejepscot Project and will not be affected by the project. Therefore, this Opinion only considers the potential effects to listed Atlantic salmon and its critical habitat.

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

3.1. Gulf of Maine DPS of Atlantic Salmon

3.1.1. Species Description

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

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

The current GOM DPS includes all anadromous Atlantic salmon whose freshwater range occurs in the watersheds from the Androscoggin River northward along the Maine coast to the Dennys

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

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

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

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

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

Beland 1981). The female then continues digging upstream of the last deposition site, burying the fertilized eggs with clean gravel.

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

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

When fry reach approximately four centimeters in length, the young salmon are termed parr (Danie *et al.* 1984). Parr have eight to eleven pigmented vertical bands on their sides that are believed to serve as camouflage (Baum 1997). A territorial behavior, first apparent during the fry stage, grows more pronounced during the parr stage, as the parr actively defend territories (Allen 1940, Kalleberg 1958, Danie *et al.* 1984). Most parr remain in the river for two to three years before undergoing smoltification, the process in which parr go through physiological changes in order to transition from a freshwater environment to a saltwater marine environment. Some male parr may not go through smoltification and will become sexually mature and participate in spawning with sea-run adult females. These males are referred to as "precocious parr." First year parr are often characterized as being small parr or 0+ parr (four to seven centimeters long), whereas second and third year parr are characterized as large parr (greater than seven cm long) (Haines 1992). Parr growth is a function of water temperature (Elliott 1991); parr density (Randall 1982); photoperiod (Lundqvist 1980); interaction with other fish, birds, and mammals (Bjornn and Reiser 1991); and food supply (Swansburg *et al.* 2002). Parr movement may be quite limited in the winter (Cunjak 1988, Heggenes 1990); however, movement in the winter does occur (Hiscock *et al.* 2002) and is often necessary, as ice formation reduces total habitat availability (Whalen *et al.*1999). Parr have been documented using riverine, lake, and estuarine habitats; incorporating opportunistic and active feeding strategies; defending territories from competitors including other parr; and working together in small schools to actively pursue prey (Gibson 1993, Marschall *et al.*1998, Pepper 1976, Pepper *et al.* 1984, Hutchings 1986, Erkinaro *et al.* 1998, Halvorsen and Svenning 2000, O'Connell and Ash 1993, Erkinaro *et al.* 1995, Dempson *et al.* 1996, Klemetsen *et al.* 2003).

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

The spring migration of post-smolts out of the coastal environment is generally rapid, within several tidal cycles, and follows a direct route (Hyvarinen *et al.* 2006, Lacroix and McCurdy 1996, Lacroix *et al.* 2004). Post-smolts generally travel out of coastal systems on the ebb tide and may be delayed by flood tides (Hyvarinen *et al.* 2006, Lacroix and McCurdy 1996, Lacroix *et al.* 2004, Lacroix and Knox 2005). Lacroix and McCurdy (1996), however, found that post-smolts exhibit active, directed swimming in areas with strong tidal currents. Studies in the Bay of Fundy and Passamaquoddy Bay suggest that post-smolts aggregate together and move near the coast in "common corridors" and that post-smolt movement is closely related to surface currents in the bay (Hyvarinen *et al.* 2006, Lacroix and McCurdy 1996, Lacroix *et al.* 2004). European post-smolts tend to use the open ocean for a nursery zone, while North American post-smolts appear to have a more near-shore distribution (Friedland *et al.* 2003). Post-smolt distribution may reflect water temperatures (Reddin and Shearer 1987) or the major surface-current vectors (Lacroix and Knox 2005). Post-smolts live mainly on the surface of the water column and form shoals, possibly of fish from the same river (Shelton *et al.* 1997).
During the late summer and autumn of the first year, North American post-smolts are concentrated in the Labrador Sea and off of the west coast of Greenland, with the highest concentrations between 56°N. and 58°N. (Reddin 1985, Reddin and Short 1991, Reddin and Friedland 1993). The salmon located off Greenland are composed of both 1SW fish and fish that have spent multiple years at sea (multi-sea winter fish or MSW) and also includes immature salmon from both North American and European stocks (Reddin 1988, Reddin *et al.* 1988). The first winter at sea regulates annual recruitment, and the distribution of winter habitat in the Labrador Sea and Denmark Strait may be critical for North American populations (Friedland *et al.* 1993). In the spring, North American post-smolts are generally located in the Gulf of St.

Lawrence, off the coast of Newfoundland, and on the east coast of the Grand Banks (Reddin 1985, Dutil and Coutu 1988, Ritter 1989, Reddin and Friedland 1993, Friedland *et al.* 1999). Some salmon may remain at sea for another year or more before maturing. After their second winter at sea, the salmon over-winter in the area of the Grand Banks before returning to their natal rivers to spawn (Reddin and Shearer 1987). Reddin and Friedland (1993) found immature adults located along the coasts of Newfoundland, Labrador, and Greenland, and in the Labrador and Irminger Sea in the later summer and autumn.

3.1.2. Status and Trends of Atlantic Salmon in the GOM DPS

The abundance of Atlantic salmon within the range of the GOM DPS has been generally declining since the 1800s (Fay *et al.* 2006). Data sets tracking adult abundance are not available throughout this entire time period; however, a comprehensive time series of adult returns to the GOM DPS dating back to 1967 exists (Fay *et al.* 2006, USASAC 2001-2012) (Figure 4). It is important to note that contemporary abundance levels of Atlantic salmon within the GOM DPS are several orders of magnitude lower than historical abundance estimates. For example, Foster and Atkins (1869) estimated that roughly 100,000 adult salmon returned to the Penobscot River alone before the river was dammed, whereas contemporary estimates of abundance for the entire GOM DPS have rarely exceeded 5,000 individuals in any given year since 1967 (Fay *et al.* 2006, USASAC 2010).

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

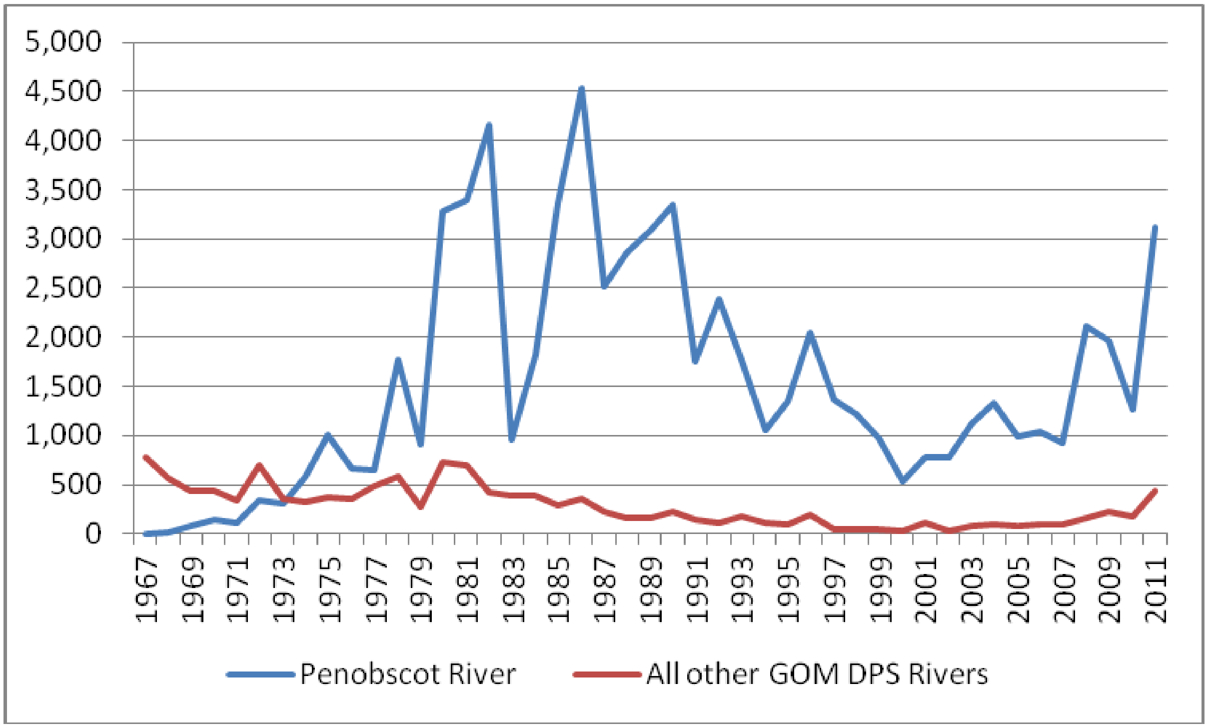

Figure 4. Adult returns to the GOM DPS Rivers between 1967 and 2011(Fay *et al.* 2006, USASAC 2001-2012).

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

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

In conclusion, the abundance of Atlantic salmon in the GOM DPS has been low and either stable or declining over the past several decades. The proportion of fish that are of natural origin is very small (approximately 6% over the last ten years) but appears stable. The conservation hatchery program has assisted in slowing the decline and helping to stabilize populations at low levels. However, stocking of hatchery products has not contributed to an increase in the overall abundance of salmon and as yet has not been able to increase the naturally reared component of the GOM DPS. Continued reliance on the conservation hatchery program could prevent extinction but will not allow recovery of the GOM DPS, which must be accomplished through increases in naturally reared salmon.

3.1.3. Critical Habitat for Atlantic Salmon in the GOM DPS

Coincident with the June 19, 2009 endangered listing, NMFS designated critical habitat for the GOM DPS of Atlantic salmon (74 FR 29300; June 19, 2009) (Figure 5). The final rule was revised on August 10, 2009. In this revision, designated critical habitat for the expanded GOM DPS of Atlantic salmon was reduced to exclude trust and fee holdings of the Penobscot Indian Nation and a table was corrected (74 FR 39003; August 10, 2009).

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

Primary Constituent Elements of Atlantic Salmon Critical Habitat

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

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

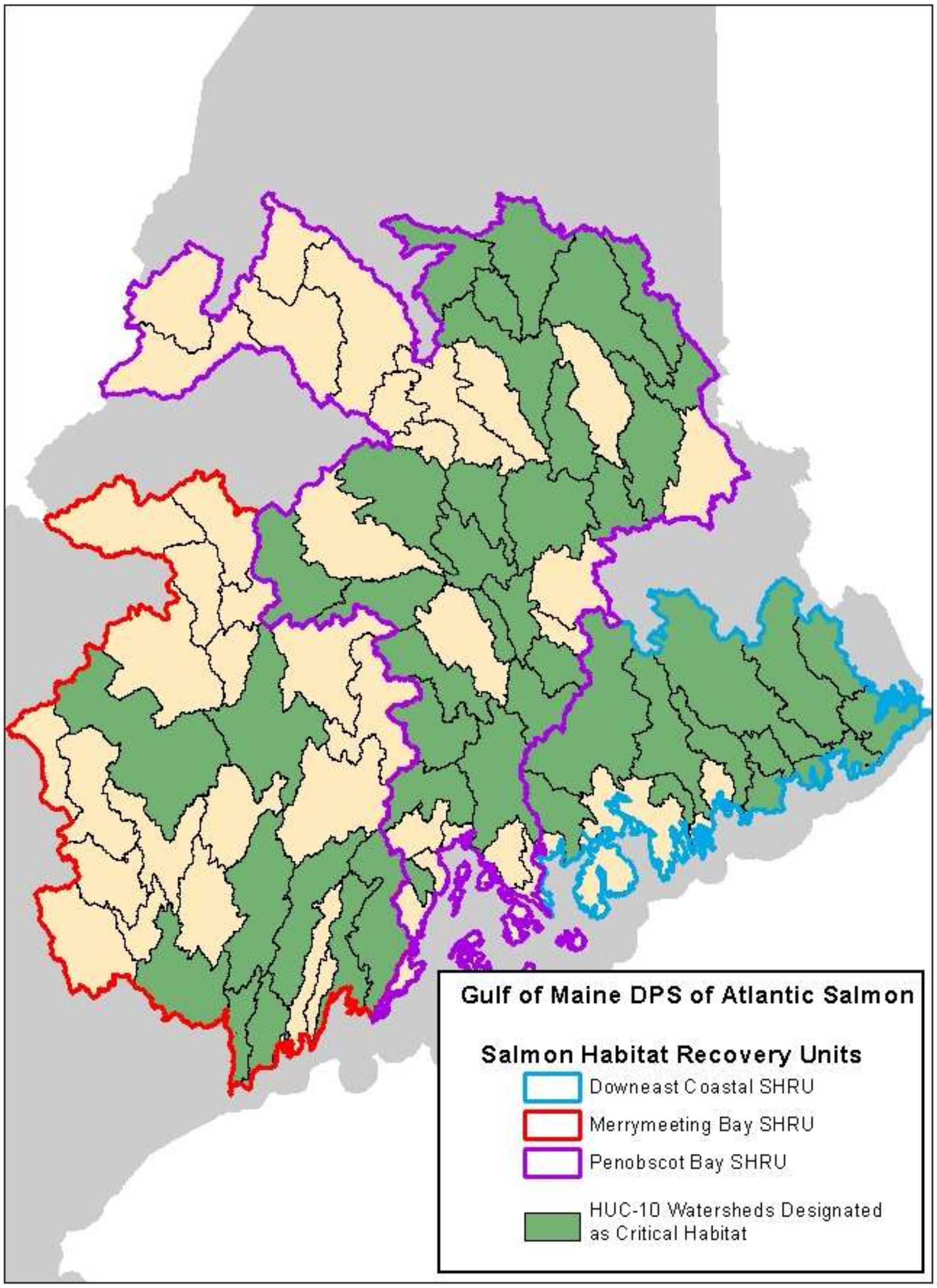

Figure 5. HUC-10 Watersheds Designated as Atlantic Salmon Critical Habitat within the GOM DPS.

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

Physical and Biological Features of the Spawning and Rearing PCE

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

Physical and Biological Features of the Migration PCE

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

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

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

Salmon Habitat Recovery Units within Critical Habitat for the GOM DPS

In describing critical habitat for the GOM DPS, NMFS divided the DPS into three Salmon Habitat Recovery Units or SHRUs. The three SHRUs include the Downeast Coastal, Penobscot Bay, and Merrymeeting Bay. The SHRU delineations were designed by NMFS 1) to ensure that a recovered Atlantic salmon population has widespread geographic distribution to help maintain genetic variability and 2) to provide protection from demographic and environmental variation. A widespread distribution of salmon across the three SHRUs will provide a greater probability of population sustainability in the future, as will be needed to achieve recovery of the GOM DPS. Areas designated as critical habitat within each SHRU are described in terms of habitat units. One habitat unit represents 100 m^2 of salmon spawning or rearing habitat. The quantity of habitat units within the GOM DPS was estimated through the use of a GIS-based salmon habitat model (Wright *et al.* 2008). For each SHRU, NMFS determined that there were sufficient habitat units available within the currently occupied habitat to achieve recovery objectives in the future; therefore, no unoccupied habitat (at the HUC-10 watershed scale) was designated as critical habitat. A brief historical description for each SHRU, as well as contemporary critical habitat designations and special management considerations, are provided below.

Downeast Coastal SHRU

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

Penobscot Bay SHRU

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

Merrymeeting Bay SHRU

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

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

3.1.4. Status of Atlantic Salmon and Critical Habitat in the Action Area

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

The Androscoggin River originates at Umbagog Lake near Errol, New Hampshire and flows roughly 260 km past several towns including, Rumford, Dixfield, Jay, Livermore Falls, and Brunswick as well as the city of Lewiston-Auburn (MDEP 1999). The upper portions of the Androscoggin, like the Kennebec, are high gradient. The Androscoggin River drops over 305 meters from its headwaters to where it meets the sea, with an average gradient of 3.9 meters per km. In the Androscoggin watershed, Rumford Falls was the upper extent of Atlantic salmon migration, while Lewiston Falls was believed to be the upper extent of alewife and shad migrations (Foster and Atkins 1867). The Little Androscoggin River is the largest major sub-basin of the Androscoggin with historically important salmon habitat that was accessible as far up as Snow’s Falls located 3.2 km outside of West Paris (Foster and Atkins 1867). Prior to its damming, the Androscoggin River provided access to a large and diverse aquatic habitat for great numbers of diadromous and resident fish species (Foster and Atkins 1867).

Historically, Atlantic salmon were reportedly abundant in the Androscoggin River, but adult returns have dwindled and native stocks of Atlantic salmon are considered extirpated south of the Androscoggin River watershed. Dams, pollution, and over-fishing have contributed to the decline of Atlantic salmon in the Androscoggin River. The returns of adult Atlantic salmon to the Androscoggin River in recent years have been small, and mostly comprised of stray, hatchery origin fish from active restoration programs on other rivers (Letter from MDMR to FERC dated March 25, 2010, Table 3).

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

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

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

Adult Atlantic salmon are released above the Brunswick Dam to continue upstream migration after biological data (e.g., length) are collected. The mean fork length of returning adults was 603 mm in 2008 and 735 in 2009 (MDMR 2010). Several adult salmon have been captured at the Brunswick fishway with fin-clips or tags, indicating that these fish are strays or stocked landlocked salmon from other rivers (MDMR 2010). The Maine Atlantic Salmon Technical Advisory Committee (MASTAC) collects fin-clips for genetic samples in an attempt to identify the origin of returning salmon (MDMR 2010). The MASTAC plans to conduct future analyses to determine the origin of these and all other adult Atlantic salmon captured at the Brunswick fishway (MDMR 2010).

The next two dams encountered on the Androscoggin River upstream of the Brunswick Dam are the Topsham and Worumbo Dams. Both projects have anadromous upstream passage facilities. With passage at the first three dams on the river, Atlantic salmon have access up to Lewiston Falls (Fay *et al.* 2006, MDMR 2010). This available habitat represents approximately 27 miles of accessible water in the lower Androscoggin River from the Brunswick Project to Lewiston Falls. Atlantic salmon habitat is quantified in the GOM DPS by mapping Hydrologic Unit Codes 10 scale (HUC10) to define suitable Atlantic salmon habitat units (NMFS 2009). Each habitat unit equals 100 square meters. The Androscoggin River consists of 70,249 historic HUC10 habitat units. An estimated 24% (16,978 units) of these historic habitat units within the Androscoggin River system are considered to be occupied and occur in the lower Androscoggin River drainage (NMFS 2009). Atlantic salmon habitat quality is measured in HUC10s based on the suitability of several parameters using a scale from zero to three, which include temperature, biological communities, water quality, and substrate and cover. Low quality habitat scores have been assigned to the lower Androscoggin River where the Pejepscot Project is located, while high scores were determined in the upper inaccessible reaches of the river (NMFS 2009).

Fay *et al.* (2006) report that "...practically all suitable rearing habitat in the Androscoggin River watershed is not currently accessible to Atlantic salmon. " The availability of suitable spawning habitat is unknown; no documentation of successful spawning in the Androscoggin River exists although naturally reared fish have been documented to occur in the river (MDMR 2012). HDR (2011) evaluated the spawning habitat in the Little River and found numerous barriers and poor substrates. Despite these conditions, MDMR documented a radio tagged Atlantic salmon in 2011 moving throughout the Little River, and it may have spawned in one of its tributaries (MDMR, unpublished data). The mainstem Androscoggin River is not expected to provide spawning habitat due to the existing impoundments and/or unsuitable substrates. However, tributaries in the central reaches of the Androscoggin River contain abundant (-40,000 units) suitable Atlantic salmon spawning and rearing habitat that is presently inaccessible due to dams (NMFS 2009b). An assessment of habitat performed by the NASCO (NASCO 2009) identified the mainstem Androscoggin River in the vicinity of the Topsham Project as having low quality habitat. Consequently, no spawning or rearing habitat is expected to occur either in the Pejepscot Project impoundment or tailwater. Above Worumbo Dam the only sizeable stream that might provide suitable spawning and rearing habitat would be the Sabattus River; however, Lower Dam (a.k.a. Farwell Mill Dam), which is located about 1.8 miles upstream in the mouth of the Sabattus River, blocks access to the majority of the habitat upstream of the Pejepscot Dam (and Worumbo Dam).

Atlantic salmon stocking practices are common in the region for the Gulf of Maine DPS stock enhancement program, although the Androscoggin River has been stocked with less fish than any other river with a stocking program for anadromous Atlantic salmon. A total of 13,000 fry have been stocked in the Androscoggin River since stocking commenced in 2001 (USASAC 2012). Most recently, the total number of juvenile salmon stocked in the Androscoggin River (fry only) was 2,000 individuals in 2009 and 1,000 in 2010 and 1,000 in 2011 (USASAC 2010, 2011, 2012). These numbers are most likely estimates of the amount of fry stocked into the Little River by school groups participating in salmon outreach programs (MDMR 2010). In comparison, other major GOM rivers were stocked at the following levels in 2011 (number of juveniles indicated in parenthesis): the Penobscot (1.8 million), Machias (347,500), Dennys (539,000), and Kennebec (85,000) rivers (USASAC 2012).

Other than fish counts conducted at the Brunswick and Worumbo hydroelectric facilities, there have been few studies of Atlantic salmon in the Androscoggin River. In 2011, MDMR radio tagged 21adult salmon (12 wild and 9 hatchery raised) when they were trapped at the Brunswick Dam (MDMR 2012). 29% (6 out of 21) of these fish dropped out of the Androscoggin soon after they were released, and at least four of these continued their migration in the Kennebec River. 43% (9 out of 21) of the tagged fish successfully migrated past the Pejepscot Project, whereas fewer than 10% (2 out of 21) successfully passed all three dams in the lower Androscoggin (MDMR, unpublished data). The remaining 29% (6 out of 21) passed the Brunswick Project but did not migrate any further in the River. The study showed minimal use of tributaries in the system, although many fish were detected holding in the vicinity of cool water tributaries during the summer months (Little River and Meadow Brook downstream of the Worumbo project; Gerrish Brook upstream of the Worumbo Project; and Simpson Brook downstream of the Pejepscot Project). One female Atlantic salmon was detected several times in the Little River, and may have spawned in one of its tributaries.

The fact that only 10% (2 out of 21) of the tagged adult Atlantic salmon successfully migrated past all three of the lower dams in 2011 may indicate poor passage efficiencies at the Pejepscot and Worumbo Projects, but likely also suggests that the salmon are poorly motivated to seek out upstream habitat. This conclusion is further supported by the fact that nearly one third of the salmon dropped out of the river soon after release in the Brunswick headpond and did not return. Overall, this study appears to support the conclusion that the majority of salmon that enter the Androscoggin are strays that were stocked in other GOM DPS rivers.

The Androscoggin River is considered within the same Ecological Drainage Unit (EDU) as the Penobscot and Kennebec Rivers (Fay *et al*. 2006), which was considered in the decision to expand the GOM DPS in 2009 (USFWS and NMFS 2009). While salmon migration and habitat use studies are limited in the Androscoggin River, a number of studies have been conducted in the Penobscot River that may be relevant to the Androscoggin River. Specifically, adult Atlantic salmon returns are most common in June on the Penobscot River (MDMR 2007, 2008b), and have been tracked with telemetry and observed to stop migration and seek thermal refuge when temperatures exceed 22°C (Holbrook 2007). Adult salmon have also been observed falling back and out of the river during periods of very high water temperatures (Shepard 1995, Holbrook 2007). After spawning, kelts have been observed in the lower Penobscot River in November (USASAC 2007). Based on NMFS Penobscot River smolt trapping studies in 2000 - 2005, smolts migrate from the Penobscot between late April and early June with a peak in early May (Fay *et al.* 2006). These NMFS data also demonstrate that the majority of the smolt migration appears to take place over a two-week period after water temperatures rise to 10°C.

Critical Habitat

Critical habitat for Atlantic salmon has been designated in the Androscoggin River (Figure 6). One PCE for Atlantic salmon (sites for migration) is present in the action area. To facilitate and standardize determinations of effect for section 7 consultations involving Atlantic salmon critical habitat, we developed the “Matrix of PCEs and Essential Features for Designated Atlantic Salmon Critical Habitat in the GOM DPS” (Table 4). The matrix lists the PCEs, physical and biological features (essential features) of each PCE, and the potential conservation status of critical habitat within an action area. The PCEs in the matrix (spawning and rearing, and migration) are described in regards to five distinct Atlantic salmon life stages: (1) adult spawning; (2) embryo and fry development; (3) parr development; (4) adult migration; and, (5) smolt migration. The conservation status of the essential features may exist in varying degrees of functional capacity within the action area. The three degrees of functional capacity used in the matrix are described in ascending order: (1) fully functioning; (2) limited function; and (3) not properly functioning. Using this matrix along with information presented in FERC’s BA and site-specific knowledge of the project, we determined that several essential features to Atlantic salmon in the action area have limited function or are not properly functioning currently (Table 5).

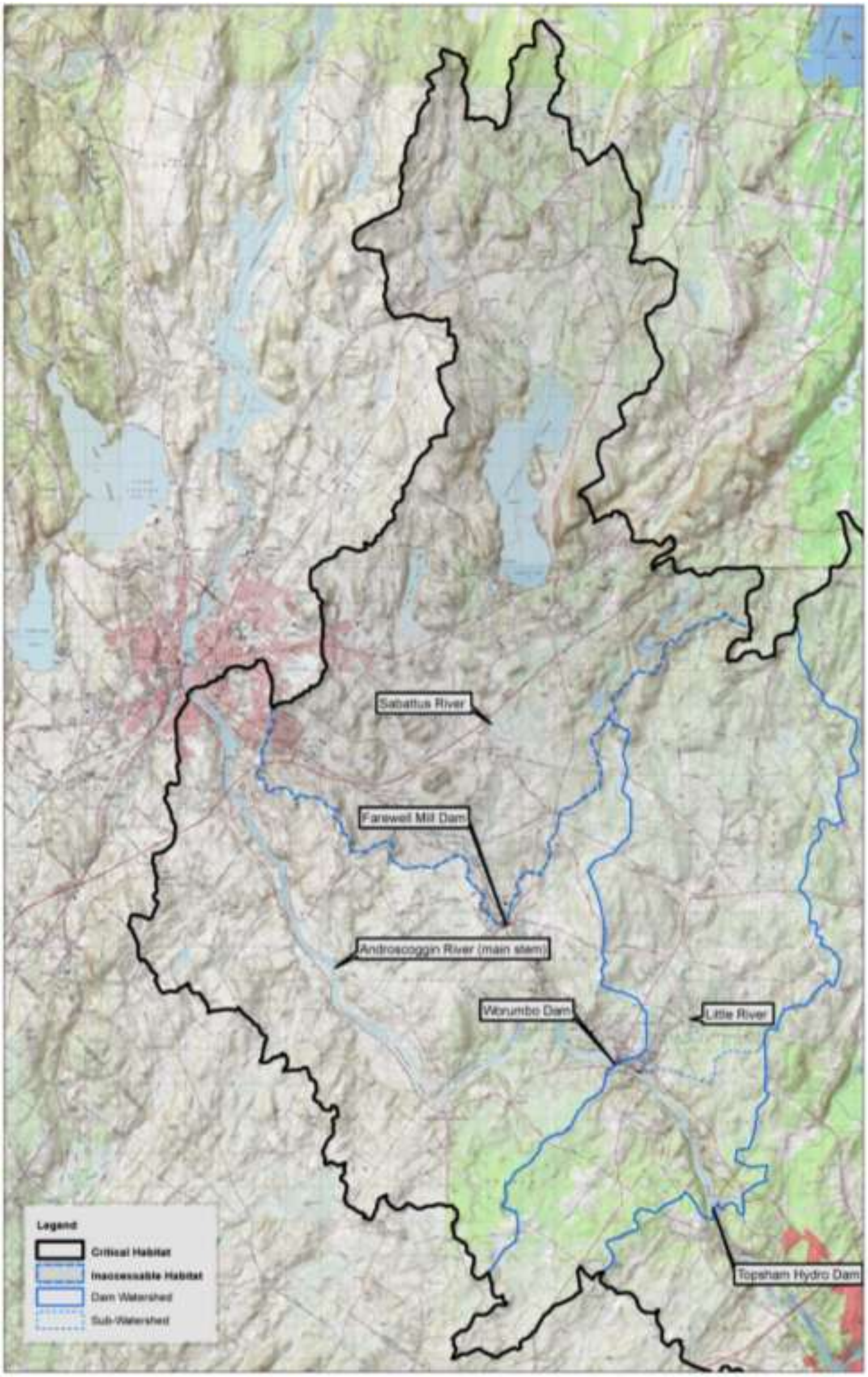

Figure 6. Designated critical habitat in the Androscoggin River watershed.

Table 4. Matrix of Primary Constituent Elements (PCEs) and essential features for assessing the environmental baseline of the action area.

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

TABLE 4 continued…

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

TABLE 4 continued…

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

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

Pathway/Indicator	Life Stages Affected	PCEs Affected	Effect	Population Viability Attributes Affected
Passage/Access to Historical Habitat	Adult, juvenile, smolt	Freshwater migration	Impeded upstream passage delays access to spawning habitat. Impeded downstream passage will result in direct and delayed mortality of smolts and kelts.	Adult abundance and productivity.

3.1.5. Factors Affecting Atlantic salmon in the Action Area

3.1.5.1. Hydroelectric Facilities

Within the Merrymeeting Bay SHRU there are roughly 104 dams of which 15 are FERC licensed mainstem dams used for power generation or storage, resulting in over 59 km of impounded river (Maine DEP 1999). Therefore, both the Kennebec and Androscoggin watersheds are major power producers. On the Androscoggin below Rumford (the upper extent of the range of Atlantic salmon), major Hydro-power facilities include the upper and lower stations at the Rumford Falls project in Rumford; Riley/Jay/Livermore Projects in Jay, Riley and Livermore; Gulf Island/Deer Rips project in Lewiston-Auburn; Lewiston Falls project in Lewiston/Auburn; the Worumbo Project in Lisbon/Durham; Pejepscot in Topsham/Brunswick; and the Brunswick project in Brunswick/Topsham. Today, the upper extent of fish passage in the Androscoggin River is Lewiston Falls 32 km upstream from Merrymeeting.

Habitat Alteration

Dams have eliminated or degraded vast, but to date unquantified, reaches of suitable rearing habitat in the Androscoggin River watershed. The Androscoggin River consists of 70,249 historic habitat units, with 16,978 units considered to be occupied. Because Atlantic salmon cannot volitionally access habitat upstream of the Lewiston Falls Project on the mainstem and the Barker Mill Dam on the Little Androscoggin, habitat in the upper areas of the Androscoggin River watershed are not accessible. Impoundments created by dams limit access to habitat, alter habitat, and degrade water quality through increased temperatures and lowered dissolved oxygen levels. Furthermore, because hydropower dams are typically constructed in reaches with moderate to high underlying gradients, significant areas of free-flowing habitat have been converted to impounded habitats in the Androscoggin River watershed. Coincidently, these moderate to high gradient reaches, if free-flowing, would likely constitute the highest value as Atlantic salmon spawning, nursery, and adult resting habitat within the context of all potential salmon habitat within these reaches.

Compared to a natural hydrograph, the operation of dams in a store-and-release mode in the upper reaches of the Androscoggin River watershed results in reduced spring runoff flows, less severe flood events, and augmented summer and early fall flows. Such operations in turn reduce sediment flushing and transport and physical scouring of substrates, and increase surface area and volume of summer and early fall habitat in the main stem. The extent to which these streamflow modifications in the upper Androscoggin River watershed impact salmon populations, habitat (including migratory corridors during applicable seasons), and restoration efforts is unknown. However, increased embeddedness of spawning and invertebrate colonization substrates, diminished flows during smolt and kelt outmigration, and enhanced habitat quantity and, potentially, “quality” for non-native predators such as smallmouth bass, are likely among the adverse impacts to salmon. Conversely, higher summer and early fall stream flows may provide some benefits to Atlantic salmon or their habitat within affected reaches, and may also help mitigate certain potential water quality impacts (e.g., dilution of harmful industrial and municipal discharges).

Habitat Connectivity

Pre-spawn adults

In 1982, Central Maine Power Company (CMP) reconstructed the hydroelectric facility in Brunswick-Topsham, the first upstream dam on the Androscoggin River (Brown *et al*. 2006). CMP installed a slot fishway with a trapping and sorting facility. At that time, the MDMR began the Anadromous Fish Restoration Program in the lower Androscoggin River main stem and tributaries below Lewiston Falls. In 1987, the Pejepscot Project, the second dam on the Androscoggin River, had upstream fish passage installed. In 1988, upstream passage facilities were installed at the Worumbo Project, the third upstream dam on the river. This provided an opportunity for anadromous species to migrate upstream as far as Lewiston Falls (Brown *et al.* 2006).

No upstream passage studies for Atlantic salmon have been conducted at the dams on the Androscoggin River, although annual counts of prespawn migrating Atlantic salmon trapped at the Brunswick and Worumbo Dams have been made since 1983. Few Atlantic salmon are known to migrate upriver of all three passable dams in the lower Androscoggin River. As described previously, between 3 and 44 Atlantic salmon per year (average of 16 fish) passed the Brunswick Dam between 2003 and 2011 (Table 6). Of these, only 15% (average of 2 fish) successfully passed the Worumbo Project. Similarly, in a radio telemetry study in 2011, MDMR documented that fewer than 10% (2 out of 21) of tagged salmon passed at the Brunswick Project successfully migrated past the Worumbo Project. In the same study, MDMR documented that 43% (9 out of 21) of tagged salmon successfully passed the Pejepscot project (MDMR, unpublished data). Individual Atlantic salmon may use existing habitat and tributaries between dams and may not attempt to pass the next upstream dam. Tributaries exist between the Brunswick Project and upstream of the Pejepscot Project that may contain Atlantic salmon habitat (MDMR 2010). Individual Atlantic salmon may migrate to these tributaries to spawn or seek thermal refuge, instead of migrating further upstream past the Pejepscot Project.

Table 6. The number of Atlantic salmon passing the Brunswick and Worumbo Projects between 2003 and 2012, and the proportion that are known to pass all three of the lower-most dams in the Androscoggin River.

Year	Brunswick Project	Worumbo Project	Proportion that Pass the Worumbo Project
2003	3	1	33%
2004	12	1	8%
2005	10	0	0%
2006	6	2	33%
2007	21	7	33%
2008	18	2	11%
2009	24	1	4%
2010	9	5	56%
2011	44	3	7%
Average	**16**	**2**	**15%**

Outmigrating smolts and kelts

Smolts from the Androscoggin River have to navigate through multiple dams on their migrations to the estuary every spring. The route that a salmon smolt takes when passing a project is a major factor in its likelihood of survival. Fish that pass through a properly designed downstream bypass have a better chance of survival than a fish that goes over a spillway, which, in turn, has a better chance of survival than a fish swimming through the turbines. It can be assumed that close to 100% of smolts will survive when passing through a properly designed downstream bypass. Survival over a spillway has been estimated at 97.1% (Normandeau 2011). Survival through turbines varies significantly based on numerous factors, but as described above can be significantly lower than the other two routes.

Survival of smolts migrating past dams in the Androscoggin River is presently unknown. However, smolt studies conducted by Holbrook (2007) on the Penobscot River documented significant losses of smolts in the vicinity of mainstem dams. Of the tagged salmon smolts used in the study in 2005 and 2006, 43% and 60%, respectively, were lost in the vicinity of the West Enfield, Howland, and Milford Dams. Although these data do not definitively reveal sources of mortality, these losses are likely attributable to the direct and indirect effects of the dams (e.g., physical injury, predation). Alden Research Laboratory (Alden 2012) modeled the smolt survival rates of 15 hydroelectric dams in the Penobscot River. The average of the mean survival rates at the 15 projects (accounting for both direct and indirect mortality) was 89.5%, but survival at individual dams fell as low as 61.5%.

Atlantic salmon kelts move downstream after spawning in November or, alternatively, overwinter in freshwater and outmigrate early in the spring (mostly mid-April through late May). Lévesque *et al.* (1985) and Baum (1997) suggest that 80% of kelts overwinter in freshwater habitat prior to returning to the ocean. No kelt survival studies have been conducted on the Androscoggin River, however, downstream passage success at dams on the Penobscot has been studied. Kelt passage occurred during periods of spill at most dams, and a large portion of study fish used the spillage. Kelt attraction to, and use of, downstream passage facilities was highly variable depending on facility, year of study, and hydrological conditions (e.g., spill or not). Shepard (1989) documented that kelts relied on spillage flows to migrate past the Milford and Veazie Dams on the Penobscot River during a study conducted in 1988. In fact, some kelts spent hours to days searching for spillway flows to complete their downstream migration during the 1988 study.

Alden Lab (2012) has modeled the current survival rates of kelts at the dams on the Penobscot River, based on turbine entrainment, spill mortality estimates and bypass efficiency. Alden Lab's analysis accounted for both immediate and delayed mortality associated with dam passage. Through the three months of outmigration, Alden Lab indicates that mean survival rates at 14 of the dams (Medway is excluded) on the Penobscot range between 61% and 93%.

3.1.5.2. Predation

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

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

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

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

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

3.1.5.3. Delayed Effects of Downstream Passage

In addition to direct mortality sustained by Atlantic salmon at hydroelectric projects, Atlantic salmon in the Androscoggin River will also sustain delayed mortality as a result of repeated passage events at multiple hydroelectric projects. Studies have investigated what is referred to as latent or delayed mortality, which occurs in the estuary or ocean environment and is associated with passage through one or more hydro projects (Budy *et al.* 2002, ISAB 2007, Schaller and Petrosky 2007, Haeseker *et al.* 2012). The concept describing this type of delayed mortality is known as the hydrosystem-related, delayed-mortality hypothesis (Budy *et al.* 2002, Schaller and Petrosky 2007, Haeseker *et al.* 2012).

Budy *et al.* (2002) examined the influence of hydropower experience on estuarine and early ocean survival rates of juvenile salmonids migrating from the Snake River to test the hypothesis that some of the mortality that occurs after downstream migrants leave a river system may be due to cumulative effects of stress and injury associated with multiple dam passages. The primary factors leading to hydrosystem stress (and subsequent delayed mortality) cited by Budy *et al.* (2002) were dam passage (turbines, spillways, bypass systems), migration conditions (e.g., flow, temperature), and collection and transport around dams, all of which could lead to increased predation, greater vulnerability to disease, and reduced fitness associated with compromised energetic and physiological condition. In addition to linking hydrosystem experience to delayed mortality, Budy *et al.* (2002) cited evidence from mark-recapture studies that demonstrated differences in delayed mortality among passage routes (i.e., turbines, spillways, bypass and transport systems).

More recent studies have corroborated the indirect evidence for hydrosystem delayed mortality presented by Budy *et al.* (2002) and provided data on the effects of in-river and marine environmental conditions (Schaller and Petrosky 2007, Haeseker *et al.* 2012). Based on an evaluation of historical tagging data describing spatial and temporal mortality patterns of downstream migrants, Schaller and Petrosky (2007) concluded that delayed mortality of Snake

River Chinook salmon was evident and that it did not diminish with more favorable oceanic and climatic conditions. Estimates of delayed mortality reported in this study ranged from 0.75 to 0.95 (mean = 0.81) for the study years of 1991-1998 and 0.06 to 0.98 (mean = 0.64) for the period of 1975-1990. Haeseker *et al.* (2012) assessed the effects of environmental conditions experienced in freshwater and the marine environment on delayed mortality of Snake River chinook salmon and steelhead trout. This study examined seasonal and life-stage-specific survival rates of both species and analyzed the influence of environmental factors (freshwater: river flow spilled and water transit time; marine: spring upwelling, Pacific Decadal Oscillation, sea surface temperatures). Haeseker *et al.* (2012) found that both the percentage of river flow spilled and water transit time influenced in-river and estuarine/marine survival rates, whereas the Pacific Decadal Oscillation index was the most important factor influencing variation in marine and cumulative smolt-to-adult survival of both species. Also, freshwater and marine survival rates were shown to be correlated, demonstrating a relation between hydrosystem experience on estuarine and marine survival. The studies described above clearly support the delayed-mortality hypothesis proposed by Budy *et al.* (2002). However, only one of the studies was able to (or tried to) quantify delayed mortality and the estimates varied considerably.

Although delayed mortality following passage through a hydrosystem has been demonstrated by the studies discussed above, effectively quantifying such losses remains difficult, mainly because of practical limitations in directly measuring mortality after fish have left a river system (i.e., during time spent in estuaries and the marine environment). Evaluations of delayed mortality have generally produced indirect evidence to support the link between hydrosystem experience and estuary and marine survival rates (and smolt-to-adult returns). In fact, in a review of delayed mortality experienced by Columbia River salmon, ISAB (2007) recommended that attempts should not be made to provide direct estimates of absolute delayed mortality, concluding that measuring such mortality relative to a damless reference was not possible. Alternatively, it was suggested that the focus should be on estimating total mortality of in-river fish, which was considered more critical to the recovery of listed salmonids. Consequently, it is difficult to draw absolute or quantifiable inferences from the Columbia River studies to other river systems beyond the simple conclusion that delayed mortality likely occurs for most anadromous salmonid populations. Additionally, although there is evidence of differential mortality between upper and lower river smolts in the Columbia River basin (Schaller and Petrosky 2007), data are not available for estimating a cumulative mortality rate based on the number of dams passed by downstream migrants.

Given the difficulty in estimating this type of mortality at the present time, we do not have sufficient data to specifically assess the effect of hydrosystem-related mortality in the Androscoggin River. Thus, we have not attempted to quantify the latent (or delayed) loss of smolts or kelts attributed to the Pejepscot Project in this Opinion. Nevertheless, considering that there are presently 15 FERC licensed hydroelectric projects in the Androscoggin River watershed, it can be assumed that practically all smolts and kelts in the river must pass at least two hydroelectric dams during the downstream migrations and the resulting loss of endangered Atlantic salmon could be significant. According to a model developed by NMFS for the Penobscot River (2012; Figure 7), even a small cumulative mortality rate (1-10%) could have a significant effect on the number of returning 2 SW female Atlantic salmon in the Penobscot River watershed.

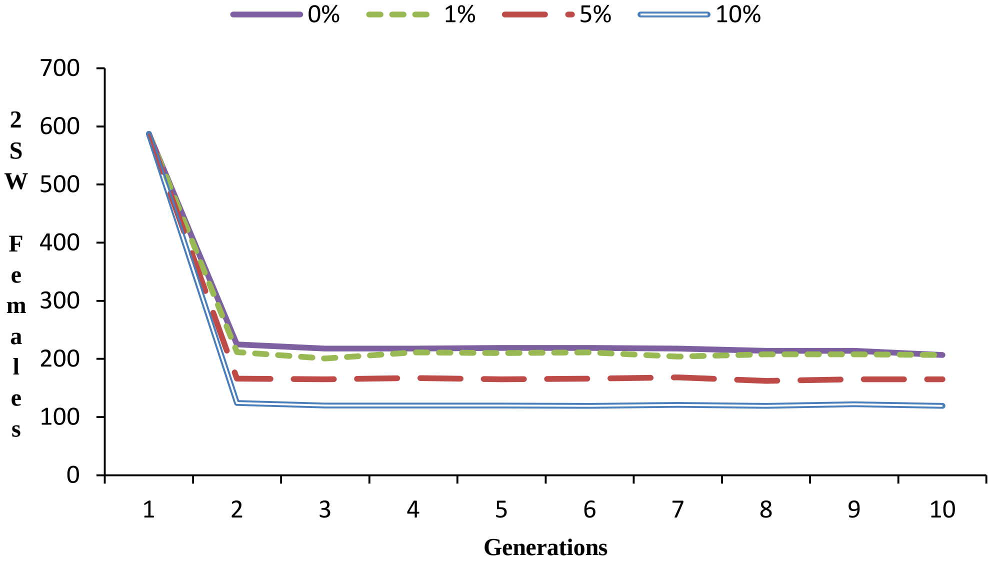

Figure 7. The potential effects of cumulative delayed mortality on the abundance of returning Atlantic salmon (NMFS 2012).

3.1.5.4. Contaminants and Water Quality

Pollutants discharged from point sources affect water quality within the action area of this consultation. Common point sources of pollutants include publicly operated waste treatment facilities, overboard discharges (OBD), a type of waste water treatment system), and industrial sites and discharges. The Maine Department of Environmental Protection (MDEP) issues permits under the National Pollutant Discharge Elimination System (NPDES) for licensed point source discharges. Conditions and license limits are set to maintain the existing water quality classification. Generally, the impacts of point source pollution are greater in the larger rivers of the GOM DPS.

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

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

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

3.1.6. Summary of Factors Affecting Recovery of Atlantic Salmon

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

Threats to the Species

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

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

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

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

- Water extraction

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

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

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

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

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

5. **Other natural or manmade factors –** Poor marine survival rates of Atlantic salmon are a significant threat, although the causes of these decreases are unknown. The role of ecosystem function among the freshwater, estuarine, and marine components of the Atlantic salmon’s life history, including the relationship of other diadromous fish species

in Maine (e.g., American shad, alewife, sea lamprey), is receiving increased scrutiny in its contribution to the current status of the GOM DPS and its role in recovery of the Atlantic salmon. While current state and federal regulations pertaining to finfish aquaculture have reduced the risks to the GOM DPS (including eliminating the use of non-North American Atlantic salmon and improving containment protocols), risks from the spread of diseases or parasites and from farmed salmon escapees interbreeding with wild salmon still exist.

Threats to Critical Habitat within the GOM DPS

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

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

Efforts to Protect the GOM DPS and its Critical Habitat

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

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

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

3.2. Summary of Information on Atlantic Salmon in the Action Area

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

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

4. ENVIRONMENTAL BASELINE OF THE ACTION AREA

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

4.1. Formal or Early Section 7 Consultations

Several Federal actions have occurred in the action area of this consultation. NMFS has not completed any formal ESA Section 7 consultations for projects within the Androscoggin River watershed; therefore, no take of Atlantic salmon has been exempted by us.

4.2. Scientific Studies

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

USFWS is also authorized under an ESA section 10 endangered species blanket permit to conduct the conservation hatchery program at the Craig Brook and Green Lake National Fish Hatcheries. The mission of the hatcheries is to raise Atlantic salmon parr and smolts for stocking into selected Atlantic salmon rivers in Maine. Over 90% of adult returns to the GOM DPS are currently provided through production at the hatcheries. Approximately 1,000 fry are stocked annually in the Androscoggin River. The hatcheries provide a significant buffer from extinction for the species.

4.3. Other Federally Authorized Activities in the Action Area

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

4.4. State or Private Activities in the Action Area

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

4.5. Impacts of Other Human Activities in the Action Area

Other human activities that may affect listed species and critical habitat include direct and indirect modification of habitat due to hydroelectric facilities and the introduction of pollutants from paper mills, sewers, and other industrial sources. Pollution has been a major problem for this river system, which continues to receive discharges from sewer treatment facilities and paper production facilities (metals, dioxin, dissolved solids, phenols, and hydrocarbons).

Hydroelectric facilities can alter the river’s natural flow pattern and temperatures and release silt and other fine river sediments during dam maintenance can be deposited in sensitive spawning habitat nearby. These facilities also act as barriers to normal upstream and downstream movements, and block access to important habitats. Passage through these facilities may result in the mortality of downstream migrants

5. CLIMATE CHANGE

The discussion below presents background information on global climate change and information on past and predicted future effects of global climate change throughout the range of the listed species considered here. Additionally, we present the available information on predicted effects of climate change on listed species and critical habitat in the action area. Climate change is relevant to the Status of the Species, Environmental Baseline and Cumulative Effects sections of this Opinion; rather than include partial discussion in several sections of this Opinion, we are synthesizing this information into one discussion. Consideration of effects of the proposed action in light of predicted changes in environmental conditions due to anticipated climate change are included in the Effects of the Action section below (section 6.0 below).

5.1. Background Information on Global climate change

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

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

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

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

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

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

5.2. Effects to Atlantic Salmon and Critical Habitat

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

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

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

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

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

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

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

6. EFFECTS OF THE ACTION

This section of an Opinion assesses the direct and indirect effects of the proposed action on threatened and endangered species or critical habitat, together with the effects of other activities that are interrelated or interdependent (50 CFR §402.02). Indirect effects are those that are caused later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration (50 CFR § 402.02). We have not identified any interrelated or interdependent actions.

6.1. Hydroelectric Operations

6.1.1. Upstream Fish Passage

To complete their upstream migration, all pre-spawn Atlantic salmon in the Androscoggin River must navigate past numerous hydroelectric projects via fishways. Fishways collect motivated fish into human-made structures that allow them to proceed in their migration. These fish are necessarily crowded together into a narrow channel or trap, which exposes them to increased levels of injury and delay, as well as to stress from elevated water temperatures, energetic exhaustion and disease. Forcing fish to alter their migratory behavior and potentially exposing them to the corresponding stress and injury negatively affects 100% of the Atlantic salmon motivated to migrate past a hydroelectric project.

The fish lift at the Pejepscot Project was designed to pass anadromous fish including Atlantic salmon, and consequently it provides access for adult Atlantic salmon to habitat upstream of the Project. With passage facilities also at the Worumbo and Brunswick Projects, Atlantic salmon can migrate up to impassable barriers 1) in the main stem to the next upstream dam at Lewiston Falls in Lewiston, 2) to Lower Barker Mills Dam in the Little Androscoggin River in Auburn, and 3) through the Farnsworth Mill Dam to Lower Dam (a.k.a. Farwell) in the Sabattus River in Lisbon (MDMR 2010). Atlantic salmon are known to successfully utilize the upstream fishway at the Pejepscot Project. However, no fishway is 100% effective at passing Atlantic salmon. No upstream passage studies have been conducted with Atlantic salmon at the Pejepscot Project.

As described above, a tracking study conducted by MDMR in 2011 found that 43% of the adult Atlantic salmon that were passed at the Brunswick Project, successfully migrated past the Pejepscot Project (MDMR, unpublished data). This data does not adequately assess passage efficiency, however, as many of the fish were not motivated to move upriver. If only the fish that approached the Pejepscot Project are assessed, it can be conservatively estimated that 75% (9 out of 12) of the Atlantic salmon that were motivated to move upstream of the Pejepscot Project were able to pass. This assumes that the fish that dropped out of the river or held in the Brunswick headpond were not motivated to migrate upstream. Based on this calculation, we believe that the upstream fish lift at the Pejepscot Project is at least 75% effective at passing prespawn Atlantic salmon.

Adult salmon that are not passed at the Pejepscot Project will spawn in downstream areas, return to the ocean without spawning, or die in the river. These salmon are significantly affected by the presence of a fishway at the Pejepscot Project. Although no studies have looked directly at the fate of fish that fail to pass through upstream fish passage facilities on the Androscoggin River, we convened an expert panel in 2010 to provide the best available information on the fate of these fish at fishways on the Penobscot River. The panel was comprised of state, federal, and private sector Atlantic salmon biologists and engineers with expertise in Atlantic salmon biology and behavior at fishways. The group estimated a baseline mortality rate of 1% for Atlantic salmon that fail to pass a fishway at a given dam on the Penobscot River (NMFS 2010). Therefore, assuming a similar effect occurs at fishways on the Androscoggin River, 1% of the Atlantic salmon that fail to pass the Pejepscot Project, may be subject to mortality. The remaining 99% of the fish that fail to pass the Project are expected to either spawn in potentially unsuitable habitat downstream or return to the ocean without spawning.

6.1.2. Downstream Fish Passage

Under the proposed action, the Pejepscot Project would continue to affect outmigrating juvenile salmon and kelts by: 1) injury and mortality associated with entrainment through project facilities, 2) delayed outmigration influencing outmigrating timing, 3) potential to increase predation on outmigrating juveniles in project reservoirs, and 4) increasing stress levels, which leads to a subsequent decrease in saltwater tolerance. The project's reservoir would continue to alter water quality, stream channel migratory routes, and the timing and behavior of outmigrating fish.

To evaluate survival of Atlantic salmon smolts passing downstream of the Pejepscot Project, Topsham Hydro will conduct a survival study at the project between 2013 and 2015. Lacking empirical data, Topsham Hydro conducted a desktop analysis of whole station survival, which combines smolt distributions and survival estimates for all passage routes (e.g., spillway, turbines, and fishways) through the Project. This was performed using May median (50% exceedance), low (90% exceedance), and high (10% exceedance) flows.

Immediate smolt survival through the Topsham Project turbines was estimated using empirical estimates compiled in the scientific literature (EPRI Turbine Passage Survival Database). Survival over the spillway is estimated at 97.1%. This rate was used by Normandeau Associates, Inc. (2011) for a similar analysis at the Weston Project on the Kennebec River, and represents the mean survival from field trials conducted at five hydroelectric projects. Survival through the downstream bypass/fishway was assumed to be 100% based on intended design for successful passage through agency consultation.

Based on this analysis, the estimate of immediate whole station survival (i.e. survival of smolts passing the Project) during May median flows (50% exceedance) is 96.5% at the Pejepscot Project. Table 7 combines the smolt distributions and survival estimates for all passage routes (e.g., spillway, turbines, and fishways).

Table 7. Pejepscot whole station smolt immediate survival summary at May median flow

Flow and Fish Passage Routes	MEDIAN FLOW (9,830 cfs)				
	50% EXCEEDANCE				
	Flow		Smolts		
	Cfs	%	N_a	N_s	SR (%)
Spill	1,600	16.3	163	158	97.1
Powerhouse	8,230	83.7	837	-	-
Francis Turbines	1,050	10.7	65	60	91.1
Kaplan Turbines	7,100	72.2	442	418	94.6
DS Fishway	80	0.8	330	330	100
Whole Station	9,830	100	1,000	966	96.6

N_a = number approaching; N_s = number surviving; SR = survival rate; DS = downstream; US = upstream.

For comparison purposes, an Advanced Hydro Turbine model analysis (Franke *et al.* 1997) was also conducted for the Kaplan turbine at the Topsham Project. The Franke analysis was not performed for the three small Francis units because design drawings are not available for some required unit dimensions. Despite not being able to evaluate the three Francis units, the analysis of only the Kaplan unit is still informative. The Advanced Hydro Turbine model analysis yielded an immediate survival of 98.1% (range: 96.3% - 99.2%) for smolts for the Kaplan turbine.

A desktop analysis provides an estimate of immediate survival and does not assess potential impacts resulting from migratory delays, non-lethal injuries, or delayed mortality. Alden Research Laboratory (2012) estimated an indirect mortality of 5% for hydroelectric projects on the Penobscot River, due primarily to predation and sublethal injuries during passage. When added to what was estimated by Topsham Hydro's desktop analysis, this level of indirect mortality would equate to a survival rate of approximately 91.6%. Smolt studies that will be conducted by Topsham Hydro between 2013 and 2015 will determine actual survival rates at the project.

The desktop analysis also did not evaluate kelt survival at the Pejepscot Project. During the downstream migration, Atlantic salmon kelts will pass the project via spillage, through the downstream passage facility, or through turbine entrainment. In April and May when most kelts are expected to pass the project, flows in the Kennebec River are typically greater than the projects hydraulic capacity (Figure 9). As such, we expect a proportion of kelts to safely pass the project via spillage. The remaining kelts are likely to pass via the existing downstream passage facility or through the project's turbines. Larger fish are more likely to experience injury or mortality from turbine entrainment (EPRI 1997a, 1997b). The Pejepscot trashracks have a bar spacing of 1.5 inches (Francis units and elevation 61.35 feet to 55.1 feet on the Kaplan unit) and 5.5 inches (elevation 55.1 feet to 36 feet on the Kaplan unit) (clear spacing), which would not completely prevent entrainment of kelts. Normandeau (2011) calculated a mean survival rate of 72% for kelts passing a Kaplan turbine on the Kennebec River. This estimate represents the best available information to estimate survival of kelts at the Pejepscot

Project. Kelt studies that will be conducted by Topsham Hydro between 2013 and 2015 will determine actual survival rates at the project.

Migratory Delay

The potential for delays in the timely passage of smolts encountering hydropower dams is evident in some tracking studies on the Penobscot. At the Mattaceunk Dam, the average time needed for hatchery smolts to pass the dam, after being detected in the forebay area, was 15.6 hours (range 0 to 72 hours), 39.2 hours (range 0 to 161 hours), 14.6 hours (range 0 to 59.4 hours) and 30 hours (range 0.2 to 226 hours) in four different study years (GNP 1995, GNP 1997, GNP 1998, GNP 1999).   At the West Enfield Dam, the median delay was 0.86 hours (range 0.3 to 49.7 hours) for hatchery smolts in 1993 (BPHA 1993), and approximately 13 hours (range 0.2 to 102.9 hours) for wild smolts in 1994 (BPHA 1994). At the Orono Dam, the median delay between release and passage of smolts was 3.4 hours (range 0.6 to 33.3 hours) in 2010 (Aquatic Science Associates, Inc 2011). While these delays can lead to direct mortality of Atlantic salmon from increased predation (Blackwell and Juanes 1998), migratory delays can also reduce overall physiological health or physiological preparedness for seawater entry and oceanic migration (Budy *et al.* 2002). Various researchers have identified a “smolt window” or period of time in which smolts must reach estuarine waters or suffer irreversible effects (McCormick *et al.* 1999). Late migrants lose physiological smolt characteristics due to high water temperatures during spring migration (McCormick *et al.* 1999). Similarly, artificially induced delays in migration from dams can result in a progressive misalignment of physiological adaptation of smolts to seawater entry, smolt migration rates, and suitable environmental conditions and cues for migration. If so, then these delays may reduce smolt survival (McCormick *et al.* 1999).

6.2. Effects of Aquatic Monitoring and Evaluation

In order to determine the effectiveness of the upstream and downstream fish passage facilities, Topsham Hydro proposes to conduct downstream survival studies for Atlantic salmon kelts and smolts and an upstream passage efficiency study for pre-spawn adults at the Pejepscot Project.

The downstream smolt survival studies will involve obtaining Atlantic salmon smolts from GLNFH, surgically implanting radio transmitter tags, and then conducting paired releases in groups up and downriver of the Pejepscot Project. The handling and implantation of radio tags will injure all of the fish used in the studies, and a small proportion will likely be killed. Topsham Hydro will monitor and evaluate the effectiveness of the downstream fish passage facilities for up to three years at the Pejepscot Project. It is expected that 172 smolts will be used per year, for a total of 516 smolts.

Upstream passage efficiency studies will be conducted using adult Atlantic salmon trapped at the Brunswick Project. The adult fish will be PIT tagged prior to being placed upstream of the project. Between 2003 and 2011, the number of adult salmon that have been trapped at the Brunswick Dam has ranged between 2 and 44, with an average of 16. Therefore, handling and tagging associated with the upstream passage studies will injure up to 40 adult Atlantic salmon per year, as practicable. As three years of study may be necessary to obtain sufficient data, it is expected that no more than 120 adult salmon could be injured due to passage monitoring over the five year term of the ISPP.

Topsham Hydro has also proposed to conduct a downstream kelt study. Although a study plan has not been submitted yet, it is assumed that it will involve the radio tagging of no more than 20 male kelts per year for a maximum of three years. These fish will all be subject to injury due to handling and tagging. As three years of study may be necessary to obtain sufficient data, it is expected that no more than 60 kelts could be injured due to passage monitoring over the five year term of the ISPP.

Tagging

Techniques such as PIT tagging, coded wire tagging, fin-clipping, and the use of radio transmitters are common to many scientific research efforts using listed species. All sampling, handling, and tagging procedures have an inherent potential to stress, injure, or even kill the marked fish. Radio telemetry will be used as the primary technique for the proposed studies.

There are two techniques used to implant fish with radio tags and they differ in both their characteristics and consequences. First, a tag can be inserted into a fish's stomach by pushing it past the esophagus with a plunger. Stomach insertion does not cause a wound and does not interfere with swimming. This technique is benign when salmon are in the portion of their spawning migrations during which they do not feed (Nielsen 1992). In addition, for short-term studies, stomach tags allow faster post-tagging recovery and interfere less with normal behavior than do tags attached in other ways. This is the technique that Topsham Hydro proposes to use on adult Atlantic salmon for the upstream passage studies.

The second method for implanting radio tags is to surgically place them within the body cavities of (usually juvenile) salmonids. These tags do not interfere with feeding or movement. However, the tagging procedure is difficult, requiring considerable experience and care (Nielsen 1992). Because the tag is placed within the body cavity, it is possible to injure a fish's internal organs. Infections of the sutured incision and the body cavity itself are also possible (Chisholm and Hubert 1985, Mellas and Haynes 1985). This is the technique that Topsham Hydro proposes to use on Atlantic salmon smolts for the downstream passage studies.

Fish with internal radio tags often die at higher rates than fish tagged by other means because radio tagging is a complicated and stressful process. Mortality is both acute (occurring during or soon after tagging) and delayed (occurring long after the fish have been released into the environment). Acute mortality is caused by trauma induced during capture, tagging, and release. It can be reduced by handling fish as gently as possible. Delayed mortality occurs if the tag or the tagging procedure harms the animal in direct or subtle ways. Tags may cause wounds that do not heal properly, may make swimming more difficult, or may make tagged animals more vulnerable to predation (Howe and Hoyt 1982, Matthews and Reavis 1990, Moring 1990). Tagging may also reduce fish growth by increasing the energetic costs of swimming and maintaining balance.

All fish used in the proposed study will be subject to handling by one or more people. There is an immediate risk of injury or mortality and a potential for delayed mortality due to mishandling. Those same fish that survive initial handling will also be subject to tag insertion for identification purposes during monitoring activities. It is assumed that a 100% of the fish that are handled and tagged will suffer injury.

All 516 Atlantic salmon smolts used in the downstream survival study will be harassed and injured. In addition, a proportion of the smolts are anticipated to be killed due to handling and tagging. There is some variability in the reported level of mortality associated with tagging juvenile salmonids. NMFS did not document any immediate mortality while tagging 666 hatchery reared juvenile Atlantic salmon between 1997 and 2005 prior to their release into the Dennys River. After two weeks of being held in pools, only two (0.3%) of these fish were subject to delayed mortality. Over the same timeframe, NMFS surgically implanted tags into wild juvenile Atlantic salmon prior to their release into the Narraguagus River. Of the 679 fish tagged, 13, or 1.9%, died during surgery (NMFS, unpublished data). It is likely there were delayed mortalities as a result of the surgeries, but this could not be quantified because fish were not held for an extended period. In a study assessing tagging mortality in hatchery reared yearling Chinook salmon, Hockersmith *et al.* (2000) determined that 1.8% (20 out of 1,133) died after having radio tags surgically implanted. Given this range of mortality rates, it is anticipated that no more than 2% of Atlantic salmon smolts (or 11 individuals) will be killed due to handling and tagging during the proposed downstream monitoring over three years of study.

All adult salmon used in the upstream and downstream passage studies will be harassed and injured due to handling and tagging. However, long term effects of handling and tagging on adult salmon appear to be negligible. Bridger and Booth (2003) indicate that implanting tags gastrically does not affect the swimming ability, migratory orientation, and buoyancy of test fish. Due to handling and tag insertion, it is possible that a small proportion of study fish can be killed due to delayed effects. In the study conducted by Hockersmith *et al.* (2000), it was determined that 0.3% (3 out of 1,078) of yearling Chinook salmon died after being implanted with a PIT tag. Given the size differential between a yearling Chinook and an adult Atlantic salmon, it is expected that this would represent a conservative estimate of tagging mortality in the adult salmon (pre spawn and kelts) being used in the passage studies at the Pejepscot Project. Given the small number of Atlantic salmon being tagged (no more than 120 fish over three years) and that adult salmon are less likely than yearling Chinook salmon to be significantly injured by PIT tag implantation, it is not expected that any adult Atlantic salmon will be killed as part of the upstream passage studies. Similarly, it is not expected that any kelts that are released as part of a downstream kelt study will be killed by the insertion of radio tags. Injuries are expected to be minimized by having trained professionals conduct the procedures using established protocols.

6.3. Critical Habitat

Critical habitat for Atlantic salmon has been designated in the Androscoggin River including the sections of river in the vicinity of the Pejepscot Project. Within the action area of this consultation, the PCEs for Atlantic salmon include: 1) sites for spawning and rearing; and, 2) sites for migration (excluding marine migration). The analysis presented in the environmental baseline shows several habitat indicators are not properly functioning, and biological requirements of Atlantic salmon are not being met in the action area. We expect that the proposed project would continue to harm these already impaired habitat characteristics. We expect the continued operations of these projects to cause adverse effects to some essential features of critical habitat, including water quality, substrate, migration conditions, and forage in a similar manner as present in the environmental baseline. However, designated critical habitat in the Androscoggin River watershed is anticipated to improve for Atlantic salmon due to the expansion of the period that the upstream and downstream fishways operate. In addition, the ISPP is intended to be an adaptive process that will lead to an improvement in upstream and downstream passage based on the results of the proposed studies.

The Pejepscot Project operates as a run-of-river facility to protect fish and wildlife resources, where a continuous discharge from the Project that approximates the instantaneous sum of all the inflow to the reservoir is maintained. Project operations do not result in rapidly fluctuating water levels that could cause potential effects, such as stranding or reduction of spawning habitat for fish, including Atlantic salmon. Additionally, run-of-river flow requirements below the Pejepscot Project are maintained per the FERC license, and fish passage operation flow protocols have been established in consultation with USFWS, NMFS, and MDMR

Expanding the period that upstream passage facilities will operate at the Pejepscot Project will improve migration habitat for Atlantic salmon. Likewise, expanding the period that the existing downstream passage facility operates also improves migration habitat for the species. Table 8 below summarizes the condition of essential features of Atlantic salmon critical habitat following implementation of the ISPP at the Pejepscot Project.

Table 8. Atlantic salmon critical habitat essential features following implementation of the ISPP at the Pejepscot Project.

Pathway/Indicator	**Life Stages Affected**	**PCEs Affected**	**Effect**	**Population Viability Attributes Affected**
Passage/Access to Historical Habitat	Adult, juvenile, smolt	Freshwater migration	Improved upstream passage will reduce delays to spawning habitat. Improved downstream passage will reduce direct and delayed mortality of smolts and kelts.	Adult abundance and productivity.

7. CUMULATIVE EFFECTS

Cumulative effects are defined in 50 CFR §402.02 as those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation. The effects of future state and private activities in the action area that are reasonably certain to occur are continuation of recreational fisheries, discharge of pollutants, and development and/or construction activities resulting in excessive water turbidity and habitat degradation.

Impacts to Atlantic salmon from non-federal activities are largely unknown in the Androscoggin River. It is possible that occasional recreational fishing for anadromous fish species may result in incidental takes of Atlantic salmon. Despite strict state and federal regulations, both juvenile and adult Atlantic salmon remain vulnerable to injury and mortality due to incidental capture by recreational anglers and incidental catch in commercial fisheries. The best available information indicates that Atlantic salmon are still incidentally caught by recreational anglers. Evidence suggests that Atlantic salmon are also targeted by poachers (NMFS 2005). Commercial fisheries for elvers (juvenile eels) and alewives may also capture Atlantic salmon as bycatch. No estimate of the numbers of Atlantic salmon caught incidentally in recreational or commercial fisheries exists.

Pollution from point and non-point sources has been a major problem in this river system, which continues to receive discharges from sewer treatment facilities and paper production facilities (metals, dioxin, dissolved solids, phenols, and hydrocarbons). Atlantic salmon are vulnerable to impacts from pollution and are likely to continue to be impacted by water quality impairments in the Androscoggin River and its tributaries.

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

Sources of contamination in the action area include atmospheric loading of pollutants, stormwater runoff from development, groundwater discharges, and industrial development. Chemical contamination may have an effect on listed species reproduction and survival.
As noted above, impacts to listed species from all of these activities are largely unknown. However, we have no information to suggest that the effects of future activities in the action area will be any different from effects of activities that have occurred in the past.

8. INTEGRATION AND SYNTHESIS OF EFFECTS

In the discussion below, NMFS considers whether the effects of the proposed action reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the GOM DPS of Atlantic salmon in the wild by reducing the reproduction, numbers, or distribution. The purpose of this analysis is to determine whether the proposed action, in the context established by the status of the species, environmental baseline, and cumulative effects, would jeopardize the continued existence of the GOM DPS of Atlantic salmon. In addition, the analysis will determine whether the proposed action will adversely modify designated critical habitat for Atlantic salmon.

In the NMFS/USFWS Section 7 Handbook, for the purposes of determining jeopardy, survival is defined as, “the species’ persistence as listed or as a recovery unit, beyond the conditions leading to its endangerment, with sufficient resilience to allow for the potential recovery from endangerment. Said in another way, survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a species with a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species’ entire life cycle, including reproduction, sustenance, and shelter.”

Recovery is defined as, “Improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in Section 4(a)(1) of the Act.” Below, for the GOM DPS of Atlantic salmon, the listed species that may be affected by the proposed action, NMFS summarizes the status of the species and considers whether the proposed action will result in reductions in reproduction, numbers or distribution of that species and then considers whether any reductions in reproduction, numbers or distribution resulting from the proposed action would reduce appreciably the likelihood of both the survival and recovery of that species, as those terms are defined for purposes of the Federal Endangered Species Act.

NMFS has determined that the proposed action will result in harm or harassment to Atlantic salmon in the action area. While lethal injuries and/or mortalities will being reduced by expanding the period of operation of existing downstream and upstream passage facilities, it is anticipated that some level of take will continue during the term of the ISPP.

Atlantic salmon in the GOM DPS currently exhibit critically low spawner abundance, poor marine survival, and are confronted with a variety of additional threats. The abundance of Atlantic salmon in the GOM DPS has been low and either stable or declining over the past several decades. The proportion of fish that are of natural origin is extremely low (approximately 6% over the last ten years) and is continuing to decline. The conservation hatchery program has assisted in slowing the decline and helping to stabilize populations at low levels, but has not contributed to an increase in the overall abundance of salmon and has not been able to halt the decline of the naturally reared component of the GOM DPS.

NMFS recognizes that the proposed ISPP will lead to an improvement in upstream and downstream passage for Atlantic salmon from current conditions. However, the project will continue to affect the abundance, reproduction and distribution of salmon in the Androscoggin River by delaying and injuring migrating pre-spawn adults, as well as outmigrating smolts and kelts. In addition, the proposed passage studies will require the use of GOM DPS Atlantic salmon. All of these fish will be injured as a result of the studies, and some will be killed. Operation of the Pejepscot Project will also affect the migration PCE of Atlantic salmon critical habitat, primarily as a result of maintaining the project impoundment which affects water quality, substrate, cover and shelter and safe passage.

Summary of Upstream Passage Effects

Even when operated pursuant to the amended license, the Pejepscot Project will not be 100% effective at passing all Atlantic salmon that are motivated to access habitat upriver. Adult salmon that are not passed at the Project will either spawn in downstream areas, return to the ocean without spawning, or die in the river. These salmon are significantly affected by the stress, injury and mortality associated with locating and successfully passing the Project. Although no studies have looked directly at the fate of fish that fail to pass through upstream fish passage facilities on the Androscoggin River, we convened an expert panel in 2010 to provide the best available information on the fate of these fish in the Penobscot River. The panel was comprised of state, federal, and private sector Atlantic salmon biologists and engineers with expertise in Atlantic salmon biology and behavior at fishways. The group estimated a baseline mortality rate of 1% for Atlantic salmon that fail to pass a fishway at a given dam on the Penobscot River (NMFS 2011). Assuming that the existing fishway is at least 75% effective, based on the 2011 telemetry study, this would mean that 0.25% (1% mortality x 25% that fail to pass) of Atlantic salmon that attempt to pass the Pejepscot Project will die, while 24.75% would be harassed due to significant delay and forced straying downstream.

The existing hydroelectric projects result in a certain amount of delay in upstream migration. Numerous studies collectively report a wide range in time needed for individual adult salmon to pass upstream of various dams in the Penobscot River once detected in the vicinity of a spillway or tailrace. The yearly pooled median passage time for adults at Milford Dam ranged from 1.0 days to 5.3 days over five years of study, while the total range of individual passage times over this study period was 0.1 days to 25.0 days. The yearly pooled median passage time for adults at the West Enfield or Howland Dam ranged from 1.1 days to 3.1 days over four years of study, while the total range of individual passage times over this study period was 0.9 days to 61.1 days (Shepard 1995). It is unknown what level of delay occurs at the Pejepscot Project, although it is anticipated to be similar to what has been observed at other dams. The proposed upstream passage studies will quantify the amount of significant delay (greater than 48 hours) between 2013 and 2015. If levels of delay are deemed excessive, measures will be incorporated in the final SPP that will minimize this effect.

Summary of Downstream Passage Effects

A portion of Atlantic salmon smolts and kelts will be injured or killed while passing downstream at the Pejepscot Project. Based upon information in FERC's BA, it is estimated that direct survival of smolts would be approximately 96.6% (desktop analysis). Approximately 5% of smolts and kelts are also expected to die due to indirect effects associated with dam passage. Therefore, it is expected that 91.6% of smolts that pass the Pejepscot Project will survive. Survival of kelts is estimated to be approximately 72% assuming all individuals pass via the projects' turbines. Under the terms of the ISPP, this level of take is expected to occur only until 2016.

8.1. Survival and Recovery Analysis

Jeopardy is defined by USFWS and NMFS (1998) as "an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species." Therefore, to determine if the proposed action will jeopardize the GOM DPS of Atlantic salmon, an analysis of the effects on survival and recovery must be conducted.

Survival Analysis

The first step in conducting this analysis is to assess the effects of the proposed project on the survival of the species. Survival can be defined as the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a species with a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter (USFWS and NMFS 1998).
While implementing the proposed ISPP will result in injury and mortality of some Atlantic salmon, the relatively short time frame of the action (5 years) will greatly reduce the potential of the project to affect the long-term survival potential of the species. The proposed ISPP will not affect the distribution of the species in the Androscoggin River. Lengthening the period of passage is expected to slightly improve reproduction of the species by maximizing the opportunity for pre-spawn adults to pass upstream of the Project and access suitable spawning habitat. Therefore, NMFS has determined that the proposed action will not appreciably reduce the likelihood that Atlantic salmon will survive in the wild.

Recovery Analysis

The second step in conducting this analysis is to assess the effects of the proposed project on the recovery of the species. Recovery is defined as the improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in section 4(a)(1) of the ESA (USFWS and NMFS 1998). As with the survival analysis, there are three criteria that are evaluated under the recovery analysis; reproduction, numbers and distribution. In the recovery analysis, the same measures are used to evaluate these criteria as are used in the survival analysis. However, unlike with survival, the recovery analysis requires an adjustment to the existing freshwater and marine survival rates to allow for a population that has a positive growth rate. The recovery condition includes existing dam passage rates, but does not include hatchery supplementation as it is assumed that in a recovered population, stocking will not be necessary to sustain a viable population.

In certain instances an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, NMFS has determined that the proposed action will not appreciably reduce the likelihood that Atlantic salmon will survive in the wild. Here, NMFS considers the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate.

Section 4(a)(1) of the ESA requires listing of a species if it is in danger of extinction throughout all or a significant portion of its range (i.e., “endangered”), or likely to become in danger of extinction throughout all or a significant portion of its range in the foreseeable future (i.e., “threatened”) because of any of the following five listing factors: (1) The present or threatened destruction, modification, or curtailment of its habitat or range, (2) overutilization for commercial, recreational, scientific, or educational purposes, (3) disease or predation, (4) the inadequacy of existing regulatory mechanisms, (5) other natural or manmade factors affecting its continued existence.

At existing freshwater and marine survival rates (the medians have been estimated by NMFS as 1.1% and 0.4%, respectively), it is unlikely that Atlantic salmon will be able to achieve recovery. A significant increase in either one of these parameters (or a lesser increase in both) will be necessary to overcome the significant obstacles to recovery. NMFS has created a conceptual model to indicate how marine and freshwater survival rates would need to change in order to recover Atlantic salmon (NMFS 2010). In Figure 8, the dot represents current marine and freshwater survival rates; the curved line represents all possible combinations of marine and freshwater survival rates that would result in a stable population with a growth rate of zero. If survival conditions are above the curved line, the population is growing, and, thus, trending towards recovery (lambda greater than one). The straight lines indicate the rates of freshwater survival that have been historically observed (Legault 2004). This model indicates that there are many potential routes to recovery; for example, recovery could be achieved by significantly increasing the existing marine survival rate while holding freshwater survival at existing levels, or, conversely, by significantly increasing freshwater survival while holding marine survival at today’s levels. Conceptually, however, the figure makes clear that an increase in both freshwater and marine survival will lead to the shortest and, therefore, most likely, path to achieving a self-sustaining population that is trending towards recovery.

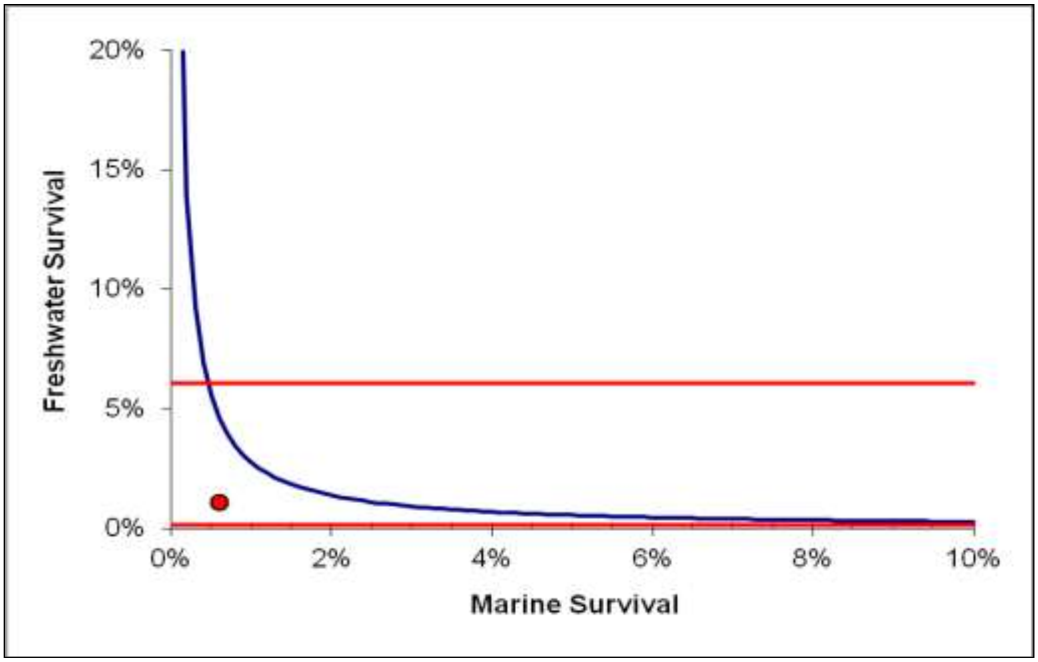

Figure 8. NMFS (2010) conceptual model depicting marine and freshwater survival relative to

recovery of the GOM DPS of Atlantic salmon (Note: The dot represents current conditions, the curved line represents recovery, and the straight lines are the historic maximum and minimum freshwater survival).

In order to assess the effect that the proposed project would have on recovery, marine and freshwater survival rates need to be increased to a point that will allow for the recovery of the species. To do this, assumptions need to be made about what constitutes a realistic increase in these parameters. In the mid-1980's to early 1990's there was a 50% to 70% decline in Atlantic salmon marine survival rates. This event is referred to as the regime shift (Chaput *et al*. 2005); the causes for this shift are unknown at this time (Windsor *et al*. 2012). Based on the smolt to adult return rate for wild fish in the Narraguagus River, USFWS (2012) estimated that the pre-regime shift marine survival rate ranged between 0.9% and 5.2%, with an average of 3.0%. A four-fold increase in the current median marine survival rate (from 0.4% to 1.7%) will allow for a rate that is within the range estimated to have existed prior to the regime shift.

Freshwater survival rates have historically ranged between 0.1% and 6.0%, with an average of 1.5% (Legault 2004). A two fold increase in the existing median freshwater survival rate (from 1.1% to 2.2%) creates a condition that is above the historical mean, but is within the range that has been observed and, when coupled with improved marine survival, will allow for a modest positive growth rate in the Atlantic salmon population.

While implementing the proposed ISPP will result in some loss of Atlantic salmon smolts and kelts, the relatively short time frame of the action (5 years) will greatly reduce the potential of the project to affect the long-term recovery potential of the species. In addition, the proposed ISPP will improve upstream and downstream passage at the project by increasing the period that the passage facilities are operational. Therefore, NMFS has determined that the proposed action will not appreciably reduce the likelihood that Atlantic salmon will recover in the wild.

8.2. Summary of Effects to Atlantic Salmon

In this section, NMFS summarizes the effects of the proposed action on the GOM DPS of Atlantic salmon in conjunction with the environmental baseline. Based on the information provided above, the proposed action will not appreciably reduce the likelihood of survival for Atlantic salmon in the wild (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). While juvenile and adult Atlantic salmon mortality associated with dam passage at the Pejepscot Project will continue to have an adverse effect on Atlantic salmon in the Androscoggin River for a relatively short period (5 years), we believe that the loss will not be sufficient to appreciably diminish the species ability to achieve recovery. As such, there is not likely to be an appreciable reduction in the likelihood of survival and recovery in the wild of the Androscoggin River population or the species as a whole.

The proposed action will not affect Atlantic salmon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent Atlantic salmon from completing their entire life cycle, including reproduction, sustenance, and shelter. The above analysis predicts that the proposed project will lead to an improvement in the abundance and reproduction of Atlantic salmon; and will not affect the distribution of the species. This is the case because: 1) the upstream fishway will allow more Atlantic salmon to pass the project by expanding the operational period to between April 15 and November 15; and 2) the downstream fish bypass will allow more Atlantic salmon smolts and kelts to safely pass the project during outmigration by expanding the operational period to April 1 to December 31; and 3) improved access will likely lead to an increase in reproduction by increasing the opportunity for pre-spawn adults to access spawning habitat in the accessible portions of the Androscoggin River and thus increase the number of returning Atlantic salmon to the Androscoggin River.

Despite the threats faced by individual Atlantic salmon inside and outside of the action area, the proposed action will not increase the vulnerability of individual Atlantic salmon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed action. While we are not able to predict with precision how climate change will impact Atlantic salmon in the action area or how the species will adapt to climate change-related environmental impacts, no additional effects related to climate change to Atlantic salmon in the action area are anticipated over the life of the proposed action (5 years). We have considered the effects of the proposed action in light of cumulative effects explained above, including climate change, and has concluded that even in light of the ongoing impacts of these activities and conditions, the conclusions reached above do not change.

9. CONCLUSION

After reviewing the best available information on the status of endangered and threatened species under NMFS jurisdiction, the environmental baseline for the action area, the effects of the action, and the cumulative effects, it is our biological opinion that the proposed action may adversely affect but is not likely to jeopardize the continued existence of the GOM DPS of Atlantic salmon. Furthermore, the proposed action is not expected to result in the destruction or adverse modification of critical habitat designated for the GOM DPS.

10. INCIDENTAL TAKE STATEMENT

Section 9(a)(1) of the ESA prohibits any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct) of endangered species without a specific permit or exemption. We interpret the term ‘‘harm’’ as an act which actually kills or injures fish or wildlife. It is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as spawning, rearing, feeding, and migrating (50 CFR §222.102, NMFS 1999b). The term “harass” has not been defined by us; however, it is commonly understood to mean to annoy or bother. In addition, legislative history helps elucidate Congress' intent that harassment would occur where annoyance adversely affects the ability of individuals of the species to carry out biological functions or behaviors: “[take] includes harassment, whether intentional or not. This would allow, for example, the Secretary to regulate or prohibit the activities of birdwatchers where the effect of those activities might disturb the birds and make it difficult for them to hatch or raise their young” (HR Rep. 93-412, 1973). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity by a Federal agency or applicant (50 CFR §402.02). Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the ESA, provided that such taking is in compliance with the terms and conditions of the incidental take statement.

An incidental take statement specifies the amount or extent of any incidental taking of endangered or threatened species. It also provides reasonable and prudent measures that are necessary and appropriate to minimize and/or monitor incidental take and sets forth terms and conditions with which the action agency must comply in order to implement the reasonable and prudent measures. The measures described in this section are nondiscretionary. If the FERC fails to include these conditions in the license articles or Topsham Hydro fails to assume and carry out the terms and conditions of this incidental take statement, the protective coverage of section 7(a)(2) may lapse. To monitor the effect of incidental take, the FERC must require Topsham Hydro to report the progress of the action and its effect on each listed species to NMFS, as specified in this incidental take statement (50 CFR §402.14(i)(3)).

10.1. Amount or Extent of Take

The following sections describe the amount or extent of take that we expect would result based on the anticipated effects of the proposed action. If the proposed action results in take of a greater amount or extent than that described above, the FERC would need to reinitiate consultation. The exempted take includes only take incidental to the proposed action.

Hydroelectric Operations

As described above, section 9(a)(1) of the ESA prohibits any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct) of endangered species without a specific permit or exemption. The Merriam-Webster Dictionary defines “collect” as “to bring together into one body or place”. The dictionary further defines “capture” as “to take captive” and “trap” as “to place in a restricted position”. The function of a fishway is to temporarily collect, capture and trap all migrating fish that are motivated to pass a dam, and to provide a mechanism for them to do so. Therefore, it is anticipated that 100% of the Atlantic salmon that use the upstream passage facility at the Pejepscot Project are collected, captured and trapped and, therefore, could potentially be exposed to the stress, injury and delay associated with being forced into fishways.

According to the expert panel convened by NMFS (2011), 1% of the salmon that fail to pass upstream of a fishway on the Penobscot River will die. Assuming that this rate is similar to what would occur on the Androscoggin River, it is anticipated that, over the term of the ISPP (five years), 75% of salmon that are motivated to pass the Pejepscot Project will do so successfully but will be collected, captured, and trapped; 24.75% will be harassed as they will not be able to access potentially suitable spawning habitat upstream of the Project; and 0.25% will die. Since there is no way of estimating the exact number of adult Atlantic salmon that will be motivated to pass the Pejepscot Project, take has been estimated in terms of proportions of fish.

Continued operation of the Pejepscot Project for the term of the ISPP (5 years) will result in the injury or death of up to 8.4% (100% - 91.6%) of the total number of smolts in the project area and 28% of all kelts in the project area (100% - 72%). Under the terms of the ISPP, this level of take is expected to occur only until 2016.

Fish Passage Monitoring

To assess the present level of upstream passage for pre spawn Atlantic salmon at the Pejepscot Project, Topsham Hydro will conduct an upstream passage study that will involve the PIT tagging of up to 40 adults a year for three years. This will result in the injury and harassment of up to 120 adult salmon over the course of the study (2013-2015). No pre spawn adult salmon are anticipated to be killed by the handling and tagging associated with the proposed study.

To assess the present levels of smolt survival at the Pejepscot Project, Topsham Hydro proposes to obtain 172 hatchery smolts per year for three years. These fish would be tagged or held for observation, which would likely lead to injury or delays in migration. The result of the studies will be used by Topsham Hydro and us to determine whether additional protection measures are needed at the project. As such, the level of take associated with conduct of the survival studies will be 516 Atlantic salmon smolts during the term of the ISPP. In addition to injury and migration delay, some mortality of smolts due to handling and surgery is expected. Based on previous studies, up to 2% (or 11 fish) of the smolts that are handled and tagged with radio tags are expected to die.

To assess the present levels of kelt survival at the Pejepscot Project, Topsham Hydro will conduct a downstream smolt study that will involve the tagging of up to 20 kelts a year for three years. This will result in the injury and harassment of up to 60 kelts over the course of the study (2013-2015). No kelts are anticipated to be killed by handling and tagging associated with the proposed study.

We believe this level of incidental take is a reasonable estimate of incidental take that will occur given the seasonal distribution and abundance of Atlantic salmon in the action area. In the accompanying biological opinion, we determined that this level of anticipated take is not likely to result in jeopardy to the species.

10.2. Reasonable and Prudent Measures

We believe the following reasonable and prudent measures are necessary and appropriate to minimize and monitor incidental take of Atlantic salmon. Please note that these reasonable and prudent measures and terms and conditions are in addition to the measures contained in the April 12, 2012 ISPP that Topsham Hydro has committed to implement and FERC is proposing to incorporate into the project license. As these measures will become mandatory requirements of any new license issued, we do not repeat them here as they are considered to be part of the proposed action. Therefore, FERC should require that Topsham Hydro complete the following measures:

1. FERC must ensure, through enforceable conditions of the project license, that Topsham Hydro complete an annual monitoring and reporting program to confirm that Topsham Hydro is minimizing incidental take and reporting all project-related observations of dead or injured salmon to NMFS.

10.3. Terms and Conditions

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

1. To implement reasonable and prudent measure #1, FERC must require Topsham Hydro to do the following:
    a. Notify NMFS of any changes in operation including maintenance activities and debris management at the project during the term of the ISPP. Also, allow NMFS to inspect fishways at the projects at least annually.
    b. Contact NMFS within 24 hours of any interactions with Atlantic salmon, including non-lethal and lethal takes (Dan Tierney: by email (Dan.Tierney@noaa.gov) or phone (207) 866- 3755 and the Section 7 Coordinator (incidental.take@noaa.gov)
    c. In the event of any lethal takes, any dead specimens or body parts must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with NMFS.
    d. Prepare in consultation with NMFS a plan to study the survival of migrating adults, smolts, and kelts at the Pejepscot Project.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize and monitor the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, the level of incidental take is exceeded, reinitiation of consultation and review of the reasonable and prudent measures are required. FERC must immediately provide an explanation of the causes of the taking and review with NMFS the need for possible modification of the reasonable and prudent measures.
The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize and monitor the impact of incidental take that might otherwise result from the proposed action. The FERC has reviewed the RPMs and Terms and Conditions outlined above and have agreed to implement all of these measures as described herein. The discussion below explains why each of these RPMs and Terms and Conditions are necessary and appropriate to minimize or monitor the level of incidental take associated with the proposed action and how they represent only a minor change to the action as proposed by the FERC.

RPM #1 as well as Term and Condition #1 are necessary and appropriate to ensure the proper documentation of any interactions with listed species as well as requiring that these interactions are reported to NMFS in a timely manner with all of the necessary information. This is essential for monitoring the level of incidental take associated with the proposed action. This RPM and the Terms and Conditions represent only a minor change as compliance will not result in any increased cost, delay of the project or decrease in the efficiency of the project.

11. CONSERVATION RECOMMENDATIONS

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

1. If any lethal take occurs, FERC and/or Topsham Hydro should arrange for contaminant analysis of the specimen. If this recommendation is to be implemented, the fish should be frozen and NMFS should be contacted immediately to provide instructions on shipping and preparation.

2. FERC should require all licensees in the GOM DPS to provide safe and effective upstream and downstream fish passage to protect listed Atlantic salmon and other diadromous fish species. This can be accomplished through station shutdowns during the smolt passage season (April to June) and kelt passage season (October to December and April to June) or the installation of highly effective fishways.

3. FERC should require all licensees in the GOM DPS to document the effectiveness of station shutdowns or fishways in protecting listed Atlantic salmon.

4. FERC should require all licensees in the GOM DPS to operate their hydroelectric facilities to protect listed Atlantic salmon. This can be accomplished by requiring these facilities to operate in a run-of-river mode to simulate a natural stream hydrograph.

12. REINITIATION NOTICE

This concludes formal consultation concerning FERC’s proposal to amend the license for the Pejepscot Project to incorporate the provisions of the proposed ISPP. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may not have been previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species; or (4) a new species is listed or critical habitat designated that may be affected by the identified action. In instances where the amount or extent of incidental take is exceeded, section 7 consultation must be reinitiated immediately. In 2016, this Opinion will no longer be valid and consultation under section 7 will need to be reinitiated by FERC.

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