NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT
BIOLOGICAL OPINION

Agency: Federal Energy Regulatory Commission (FERC)

Activity Considered: **Proposed Amendment of License for the Hydro-Kennebec Project (FERC No. 2611)**
F/NER/2012/01860

Conducted by: National Marine Fisheries Service
Northeast Region

Date Issued: 9/17/12

Approved by: [signature] for John Bullard

Table of Contents

1.0 INTRODUCTION AND BACKGROUND

This constitutes the biological opinion (Opinion) of NOAA's National Marine Fisheries Service (NMFS) under the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531-1543) concerning the effects of the Federal Energy Regulatory Commission's (FERC) proposed amendment of license for the Hydro-Kennebec Project (FERC No. 2611) on the Kennebec River, Maine. By letter filed with FERC on April 12, 2011, Hydro-Kennebec, LLC (HK LLC) requested that its existing license for the Hydro-Kennebec Project be amended to incorporate provisions of an Interim Species Protection Plan (ISPP) for listed Atlantic salmon. FERC designated HK LLC as their non-federal representative to conduct informal ESA consultation with NMFS on July 14, 2011. These informal consultations culminated in the preparation of the ISPP filed with FERC on April 12, 2012. The specific measures contained in the ISPP that would be incorporated by FERC into the license of the Hydro-Kennebec Project would require HK LLC to: 1) monitor downstream passage of Atlantic salmon at the project in 2012-2014; 2) design upstream fish passage facilities in 2012-2014; 3) install upstream passage facilities in 2015; and 4) evaluate downstream monitoring results to determine if downstream passage enhancements are necessary at the project. The ISPP covers the period through 2016. At the end of 2016, our Opinion will no longer be valid. Therefore, consultation under section 7 of the ESA will be reinitiated with FERC and us in 2016. Prior to reinitiation, HK LLC will develop a final SPP to be effective from 2016 to the issuance of a new project license (the current license expires in 2036). The final SPP would include, as determined to be necessary based on the results of monitoring conducted from 2012 through 2014, additional Atlantic salmon enhancement measures.

This Opinion is based on information provided in the FERC's April 30, 2012 Biological Assessment (BA) and ISPP as well as additional information provided by HK LLC on August 3, 2012. 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 April 30, 2012. 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

- On January 5, 2011, HK LLC requested FERC to designate it as a non-federal representative for the purpose of informal consultation with NMFS pursuant to Section 7 of the ESA.
- On January 5, 2011, HK LLC submitted a letter to NMFS outlining a plan and process for addressing ESA issues for Atlantic salmon at the Hydro-Kennebec Project.
- On February 7, 2011, HK LLC met with NMFS to review the proposed Section 7 approach to ESA consultation and the draft BA outline.
- FERC granted the request on March 14, 2011, and requested that HK LLC provide a draft BA to FERC for review.
- On January 31, 2012, HK LLC provided NMFS with a preliminary draft BA and SPP.
- On March 2, 2012, HK LLC met with NFMS to discuss preparation of the BA and SP.
- On March 7, 2012, NMFS provided comments on the preliminary draft BA and SPP.

- On March 20, 2012, HK LLC submitted a revised draft BA and SPP for NMFS review.
- On March 21, 2012, NMFS provided comments on the revised draft BA and SPP.
- On March 26, 2012, HK LLC held a meeting with state and federal resources agencies to discuss the BA and SPP.
- On April 2, 2010, HK LLC called NMFS to review previous comments in order to finalize the draft BA and ISPP for filing with FERC.
- On April 2, 2012, HK LLC submitted a revised draft BA and SPP for NFMS review.
- On April 3, 2012, NMFS provided comments on the revised draft BA and SPP.
- On April 12, 2012, HK LLC filed the draft BA and SPP with FERC.
- On April 30, 2012, the FERC requested initiation of formal section 7 consultation with NMFS.
- On June 4, 2012, NMFS filed a letter with FERC initiating formal section 7 consultation for the Hydro-Kennebec Project.
- On August 3, 2012, HK LLC submits preliminary results of spring 2012 smolt survival study.

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 April 30, 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); and 4) Designation of Critical Habitat for Atlantic salmon Gulf of Maine Distinct Population Segment (74 FR 29300; June 19, 2009).

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).

2.0 PROJECT DESCRIPTION AND PROPOSED ACTION

FERC is proposing to amend the license held by HK LLC for their Hydro-Kennebec Project to incorporate provisions of an ISPP for Atlantic salmon. Provisions of the ISPP will require HK LLC to design and install upstream fish passage facilities at the Hydro-Kennebec Project and undertake studies to evaluate the effectiveness of current measures for protecting Atlantic salmon. The ISPP is valid through 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 (2036).

2.1 Existing Hydroelectric Facility

The Hydro-Kennebec Project is located on the Kennebec River in the cities of Waterville and Winslow, and the town of Benton, all in Kennebec County (Figure 1). The Hydro-Kennebec Project has a total installed capacity of 15.4 MW. The principle Project facilities include a concrete gravity dam with flashboards, forebay, reservoir, transmission line, appurtenant facilities, and a powerhouse containing two horizontal pit-type Kaplan turbines.
The Project consists of a 555-foot-long un-gated concrete gravity spillway, and a 200-foot-long gated spillway. The dam also includes an 18-foot-long east abutment adjacent to the powerhouse. The ungated spillway structure is 35 feet high at its maximum section with 6-foot-high wooden flashboards bringing the normal headpond elevation to 81 feet. The gated spillway

section has a permanent crest elevation of 68 feet and is equipped with three hydraulically controlled gates 15 feet high by 60 feet wide to maintain the maximum headwater elevation of 81 feet. Gross storage capacity of the impoundment is approximately 3,900 acre-feet.
The powerhouse is located between the middle retaining wall and the left bank and is 131.5 feet long and 62.2 feet wide at its base. The intake has steel trashracks supported by concrete piers and is equipped with steel maintenance gates and a mechanical trash rake. Each of the two pit-type Kaplan turbine units is capable of operating over a flow range of 1,550 cubic feet per second (cfs) to 3,961 cfs. The turbines are approximately 13 feet in diameter and have an operating speed of 115 rpm. The powerhouse draft tube has roller gates, which are hydraulically operated. Flow from the turbines is directly discharged to the tailrace and into the Kennebec River. The tailrace is separated from the Kennebec River by a narrow section of bedrock stabilized by rock anchors.

In addition to the Hydro-Kennebec Project, there are nine other dams on the Kennebec River including Moosehead Outlets (FERC No. 2671), Harris (FERC No. 2142), Wyman (FERC No. 2329), Williams (FERC No. 2335), Anson (FERC No. 2365), Abenaki (FERC No. 2364), Weston (FERC No. 2325), Shawmut (FERC No. 2322), and Lockwood (MDEP 2000) (Figure 1). The Lockwood Project is the first dam on the mainstem of the Kennebec River at river mile (RM) 63. The Hydro-Kennebec is the next dam on the mainstem of the river. The Lockwood Project has an operating fish lift with trapping, sorting, and trucking capabilities. Upstream-migrating Atlantic salmon are collected at the Lockwood Project and are trucked to the Sandy River, an upstream tributary of the Kennebec River. The Sandy River contains abundant spawning and rearing habitat (MDMR 2010).

2.1.1 Fish Passage Facilities

The Project does not presently have upstream fish passage facilities for anadromous fish species including Atlantic salmon. Upstream passage for American eel and interim downstream passage for all species is provided at the project. In accordance with the FERC license, upstream fish passage is required at the Hydro-Kennebec Project when 8,000 American shad are passed at the downstream Lockwood facility. This trigger has not yet been reached. Currently, the Lockwood Project traps fish in their fish lift and trucks them upstream of the Hydro-Kennebec Project. Downstream passage is provided from April to December annually. The requirements for the interim downstream fish passage at the Hydro-Kennebec Project are contained in the September 16, 1998 FERC order approving the Lower Kennebec River Comprehensive Hydropower Settlement Accord. Currently, the downstream passage is operated from April 1 through December 31, as conditions allow.

An interim downstream passage facility at the Hydro-Kennebec Project was installed in 2006 and designed to facilitate passage of Atlantic salmon, American shad, alewife, and other migratory species. Until recently, the downstream passage consisted of a floating 10-foot-deep, 160-foot-long angled Kevlar fish guidance boom located in the powerhouse forebay that guided fish to a 4-foot-wide by 8-foot-deep gated surface bypass slot, leading to a downstream plunge pool area that drains into the Project tailrace. Modifications were made to the fish boom in 2007 after flows overtopped the device near the bypass entrance, potentially allowing fish to pass over the boom. As a result, the manufacturer installed additional reinforcing cables, reshaped the fabric, and added additional flotation to the device. Although overtopping was still occasionally observed during high water events, these actions reduced the problem.

Installation of a new stronger and more reliable downstream fish guidance system (boom) was completed in January 2012. Although this new boom is similar in size to the fish boom that was previously in place at Hydro-Kennebec (10' deep by about 145' long), the design (perforated metal plate) and configuration (series of interlocking panels) is much different than the previous Kevlar boom. The new boom is also designed to be left in place year-round to increase deployment time, and will slide up and down with changing water levels and has much more flotation to prevent overtopping.

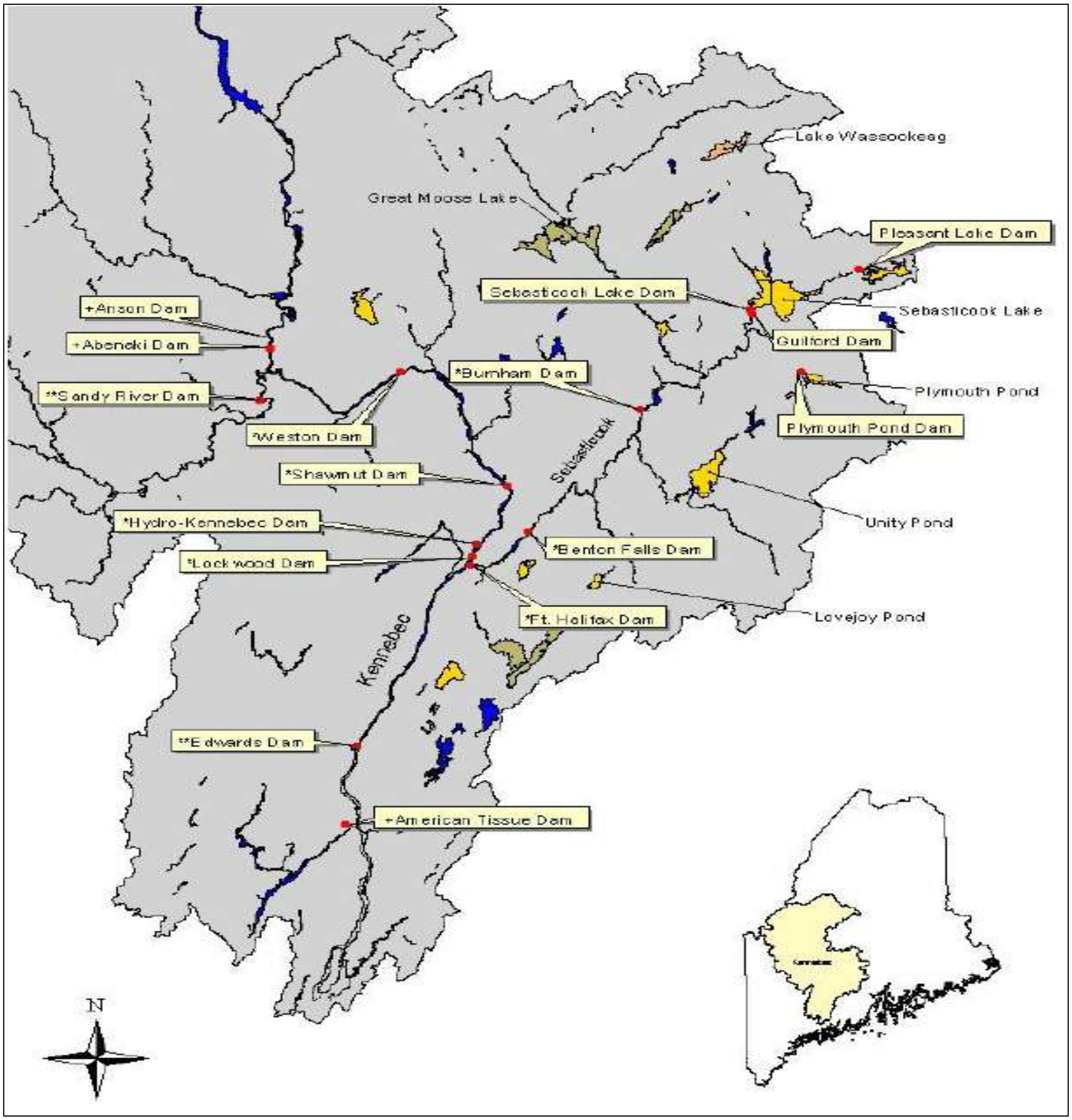
In 2007, the plunge pool was also deepened, as requested by the USFWS, by installing a weir in the fish bypass to minimize potential for fish injury (Madison Paper 2009). A confining sill was also installed on the roof of the draft tube extension in the tailrace to keep the discharge jet from the fish bypass channel from spreading over the exposed draft tube roof. The system washed out in 2007, was re-installed, and then washed out again during high flows in 2008. In 2008, the downstream fishway was dewatered to replace bolts that hold the gate structure in place per suggestion of an inspection (email from K. Bernier, HK LLC to resource agency staff, July 11, 2008). The downstream fish passage facility is capable of passing about 4% of the Project turbine flows, or a maximum of 320 cfs.

2.1.2 Project Operation

The Project is operated in a run-of-river mode in accordance with the FERC license. The headpond is typically operated with minimal impoundment fluctuation, and is generally maintained near the top of the flashboards. Based on the long-term hydrology annual flow duration curve, river flow is less than turbine hydraulic capacity approximately 88% of the time. The bascule gates are operated when river flows exceed turbine hydraulic capacity.
Because the Hydro-Kennebec Project operates in a run-of-river mode, flow fluctuations occurring in the Kennebec River downstream of the dam do not typically occur from Project operations. Similarly, Project operations do not result in rapidly fluctuating water levels that could cause potential effects, such as stranding or reduction of spawning and rearing habitat for fish, including Atlantic salmon.

The Hydro-Kennebec Project tailrace is connected to the mainstem of the river (no bypassed reach of river), though under low river flows when the bascule gates are closed, and as can be seen in Figure 2, elevated bedrock outcropping downstream of the dam becomes exposed.

Figure 1. Dams located on the Kennebec River.



*Kennebec Hydro Developers Group (KHDG) hydropower projects – Lower Kennebec River
**Hydropower projects that have been removed. Note Ft. Halifax Dam has also been removed.
+Other hydropower projects
Non-hydropower projects have no symbols
Source: MDMR 2010

Figure 2. Photograph of Hydro-Kennebec Project.

2.1.3 Project Maintenance Activities

Regular facility maintenance is performed to ensure safe operations throughout the year, including fish passage facility maintenance. Routine maintenance activities include inspections and raking of the trash racks upstream of the powerhouse in the event that frazil ice or debris has built-up (and reduced incoming flows or reduced the optimal performance of the passage facilities). Occasional maintenance outages occur due to frazil ice build-up, lightning, wicket gate problems, speed increaser failures, and miscellaneous equipment failures. Debris is removed when needed by the operators utilizing the trash rake, day or night. Raking effectively minimizes any impacts that debris has on operations and energy production. When the accumulation of grass is a problem, the operators have occasionally “burped” the units to dislodge the grass from the trashracks. Occasional maintenance outages occur due to frazil ice build-up, lightning, wicket gate problems, speed increaser failures, and miscellaneous equipment failures. The downstream fish bypass facility is inspected regularly, and maintenance activities, such as debris removal, are performed to sustain adequate downstream passage conditions.

Inspections and necessary maintenance activities of the upstream eelway are completed regularly to ensure successful operation throughout the duration of the upstream eel migration period.

2.2 Proposed Action

On April 6, 2012, the License of the Hydro-Kennebec Project filed a draft BA and ISPP with FERC. The BA and SPP were developed in consultation with NFMS. By filing the BA and SPP with FERC absent any proposed federal action at the Hydro-Kennebec Project, HK LLC 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 Hydro-Kennebec Project to incorporate provisions of the ISPP. Upon receipt of this Opinion, FERC will complete a proceeding amending the license of the Hydro-Kennebec Project to incorporate the measures contained in the ISPP.

The actions analyzed in this Biological Opinion include proposals by FERC to permit the continued operation of the Hydro-Kennebec Project and to continue implementation of various Atlantic salmon protections at the project (e.g., downstream fish passage, run-of-river operations, etc.). Provisions of the ISPP will require HK LLC to design and install upstream fish passage facilities at the Hydro-Kennebec Project and undertake studies to evaluate the effectiveness of current measures for protecting Atlantic salmon. During this interim period, the survival levels necessary to recover listed species will be better defined and the resulting information will be used to develop and analyze the long-term fish protection measures proposed in a final SPP that will be submitted to FERC in 2016. The interim SPP is valid until 2016 to allow HK LLC to design and construct the upstream fishway and to study existing measures to protect downstream migrating Atlantic salmon. In 2016, HK LLC 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 1 provides an overview of this process. Specific measures of the ISPP are described below.

The proposed interim process is intended to be adaptive and, as such, HK LLC will be coordinating and consulting with us throughout the period of the ISPP. If early study results indicate that the study design is not adequately measuring passage efficiency, HK LLC must work with us to correct it. Likewise, if the early study results indicate that the downstream passage at Hydro-Kennebec is not highly efficient at passing Atlantic salmon, HK LLC must coordinate with us and modify operations at the project to avoid and minimize effects to Atlantic salmon to the extent practicable. To that end, HK LLC will meet with us 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.

Table 1. Overview of Interim Species Protection Plan implementation.

2012	2012 – 2014	Late 2014 – 2015 (after 2014 field season is completed)
• HK LLC develops Interim SPP and Draft BA • FERC issues BA • NMFS issues BO and Incidental Take Statement covering 2012 – 2016	• HK LLC conducts Atlantic salmon downstream passage monitoring studies • HK LLC designs new upstream passage facilities, which would be targeted for construction in 2015.	• FERC and HK LLC re-initiate consultation • HK LLC develops Final SPP, including additional Atlantic salmon enhancement measures, if determined to be necessary from 2012 – 2014 monitoring results • NMFS issues new Biological Opinion with Incidental Take Statement to cover period of 2016 to issuance of new license (current license expires in 2036)

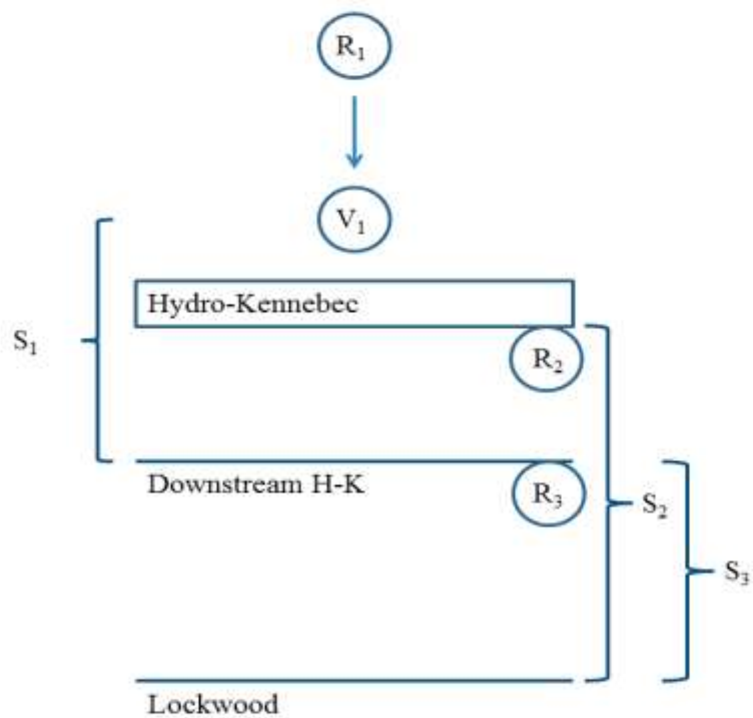
2.2.1 Upstream Fish Passage
HK LLC proposes to design and then construct a permanent upstream fish passage facility for Atlantic salmon and other migratory fish species at the Hydro-Kennebec Project. Upstream fishway design and consultation activities will occur from 2012 to 2014 with construction occurring no earlier than 2015. Fishway design will be based upon the biological needs of Atlantic salmon and other migratory fish species. Upstream effectiveness studies will be required following installation of the new facility. The final SPP that will be submitted to FERC in 2016 will consider the effects of these studies.

2.2.2 Downstream Fish Passage
As discussed in Section 2.1, HK LLC installed a new downstream fish guidance system at the Hydro-Kennebec Project in January 2012. The downstream fish passage facility operates from April to November annually to protect downstream migrating anadromous fish species including Atlantic salmon smolts and kelts.

Pursuant to the ISPP filed with FERC, HK LLC will continue to evaluate smolt downstream passage efficiency and survival at the project to determine whether additional protective measures are necessary for Atlantic salmon smolts and kelts at the project. To provide an estimate of whole station survival, HK LLC will conduct paired-release radio telemetry studies at the Hydro-Kennebec Project in 2012-2014 using the methodology described by Skalski et al.

(2010)[1](Figure 3). Using an upstream release and detections at the upstream side of the dam, a "virtual release" will be constructed of smolts known to have arrived alive at the Project. This "virtual release" group will be used to estimate survival through the dam (or specifically the downstream fishway) and downriver sufficiently far enough to avoid false positive detections due to dead, tagged fish. To account for additional mortality unrelated to dam passage and occurring within the downstream river stretch, a paired release of tagged fish will be conducted in the Project tailrace. Dam passage survival will then be estimated as the quotient of the reach survival estimate derived from the "virtual release" divided by the paired release survival estimate from the tailwater to the downstream detection station. If possible, paired tailwater releases will be coordinated to take advantage of smolts associated with ongoing studies at the Lockwood Project (owned and operated by NextEra Energy). In the event that the timing of releases does not coincide, a sub-set of the 100 radio-transmitters obtained for the evaluation of the Hydro-Kennebec downstream fishway will be used for the tailwater paired releases.

Figure 3. Schematic of the virtual-paired-release-recapture design.



Salmon smolt utilization of the downstream fishway will be assessed using Lotek SRX_400 (or Lotek SRX_600) radio telemetry receivers programmed with Code-Log software version W30 (receivers). The receiver will identify the pulse trains (codes) of VHF radio transmitters (radio tags) within a specified set of frequencies (channels) by sequentially scanning and recording valid signals in a 512k byte non-volatile data storage memory. At the downstream fishway and unit intakes, where it is expected that smolts will pass quickly, a DSP 500 Digital Spectrum

[1] The 2012 study has been completed and is discussed in Section 6.

Processor (DSP) will be utilized. The wideband digital receiver/coprocessor provides frequency discrimination using real or near real time spectrum analysis allowing for optimal temporal/spatial resolution. The DSP accomplishes this task by mapping input signals onto a 1 MHz baseband, which is then digitized by a 1-bit sampling analog-to-digital (A/D) converter. Digital radio tags (model NTC-3-1, Lotek Engineering), which measure 6.3 mm x 14.5 mm and weigh 0.8 g in air, will be used for this study. These tags transmit signals on one channel corresponding to a set frequency of 149-152 MHz. When set at a 2.0 second burst, these tags have an estimated life of 10 days.

Two types of antennas will be used for the study: Cushcraft P150-4 four-element Yagi antennas (4-element antenna) and custom-made underwater antennas (dropper antenna). Four-element antennas are aerial antennas that provide the greatest directional reception range of any antenna used in the study. The 4-element antenna will be used to confirm the upstream presence or downstream passage of fish. Dropper antennas will be vertically deployed. The dropper antennas ability to be placed at various depths in or below structures will be used to form reception ranges at points of passage (downstream fishway and turbine units). These antennas will be constructed by stripping the shielded end of a 50-OHM RG58A/U coaxial cable, the length of the stripped portion of cable is a multiple of half the wavelength (λ) of 150 MHz.

Hatchery-reared Atlantic salmon smolts will be used for the study and will be supplied by the Green Lake National Fish Hatchery in Maine. A group of approximately 200 fish will be transported from the hatchery to the Hydro-Kennebec Project in an aerated fish transport tank equipped with a water recirculation system and placed in tanks with flow through water systems. Smolts for each release will be tagged in five groups of 20 fish per release (for a total of 100 radio tagged smolts). For each tagging event, smolts will be anesthetized with MS-222 and a radio transmitter will be externally attached to the dorsal area of each smolt. After tagging, smolts will be measured to the nearest 1 mm fork length and transferred into a holding tank supplied with flowing river water. The smolts will be held for approximately four hours to observe smolt condition and account for any tag loss prior to release. Releases will take place after sunset and approximately 0.5 miles upstream of the Project. Each group of test smolts will be split into two batches and half will be released on each side of the river. HK LLC will release the first group of 20 test fish during May when spill conditions are under control and continue the releases over a two week period. If possible, releases will coincide with periods when the bascule gates are not spilling. The remaining smolts not tagged at the end of the study will be released into the Kennebec River downstream of the Project.

2.2.3 Monitoring and Reporting

HK LLC will prepare annual reports summarizing the previous year's study results with NMFS, assess the need to continue studies, and detail progress on design and construction of the upstream fishway. Following the completion of downstream passage studies, HK LLC will complete by 2015:

- Prepare a summary report of downstream fish monitoring results;
- Develop a final SPP that will include plans to monitor the effectiveness of the upstream fish passage facility and to evaluate additional enhancements, if necessary, to protect Atlantic salmon and that will cover a period of 2016 to when a new license is issued (current license expires in 2036); and

- Consult with NMFS to develop and finalize the final SPP.

The final SPP will be submitted to FERC for incorporation into the Project license articles. Submittal of the final SPP will reinitiate section 7 consultation between FERC and NMFS.

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

3.0 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 Kennebec River downstream of the Lockwood Dam, they do not occur in the vicinity of the Hydro-Kennebec Project and will not be affected by the project. Therefore, this Opinion only considers the potential effects to listed Atlantic salmon.

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.* 1998a; Halvorsen and Svenning 2000; O'Connell and Ash 1993; Erkinaro *et al.* 1995; Dempson *et al.* 1996; Halvorsen and Svenning 2000; Klemetsen *et al.* 2003).

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

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

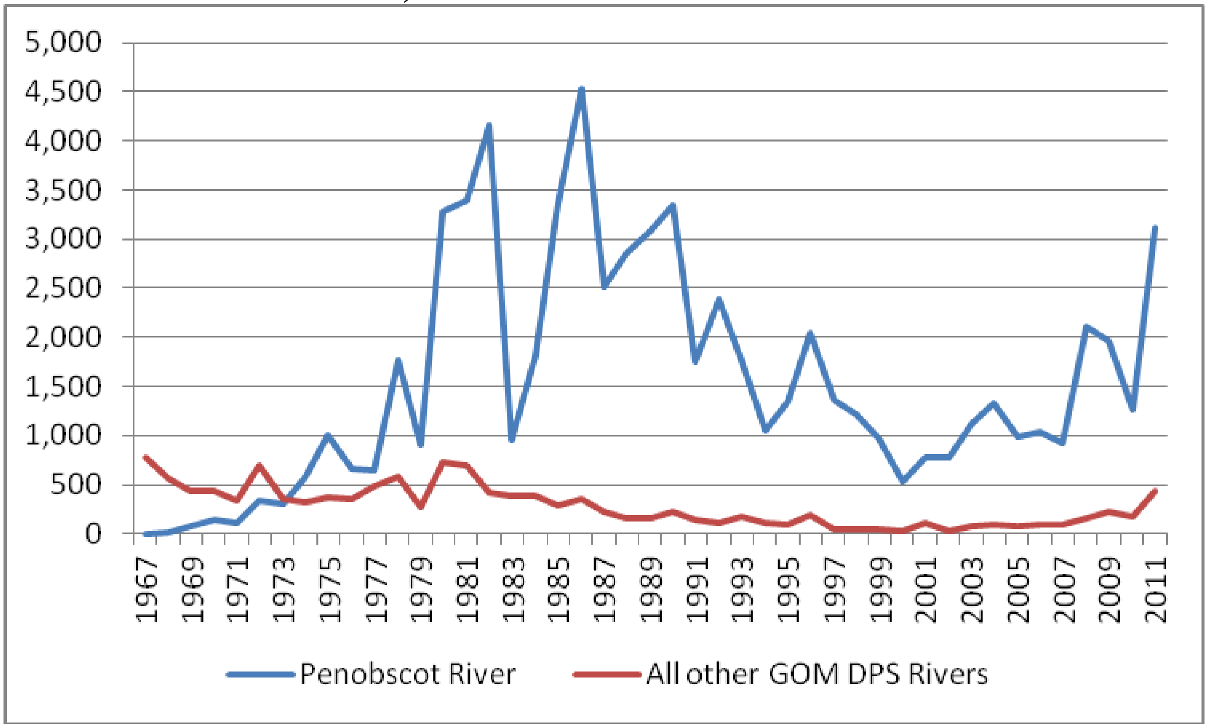
During the late summer and autumn of the first year, North American post-smolts are concentrated in the Labrador Sea and off of the west coast of Greenland, with the highest concentrations between 56^{o}N. and 58^{o}N. (Reddin 1985; Reddin and Short 1991; Reddin and Friedland 1993). The salmon located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

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; MASC 2011).

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.

3.2 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).

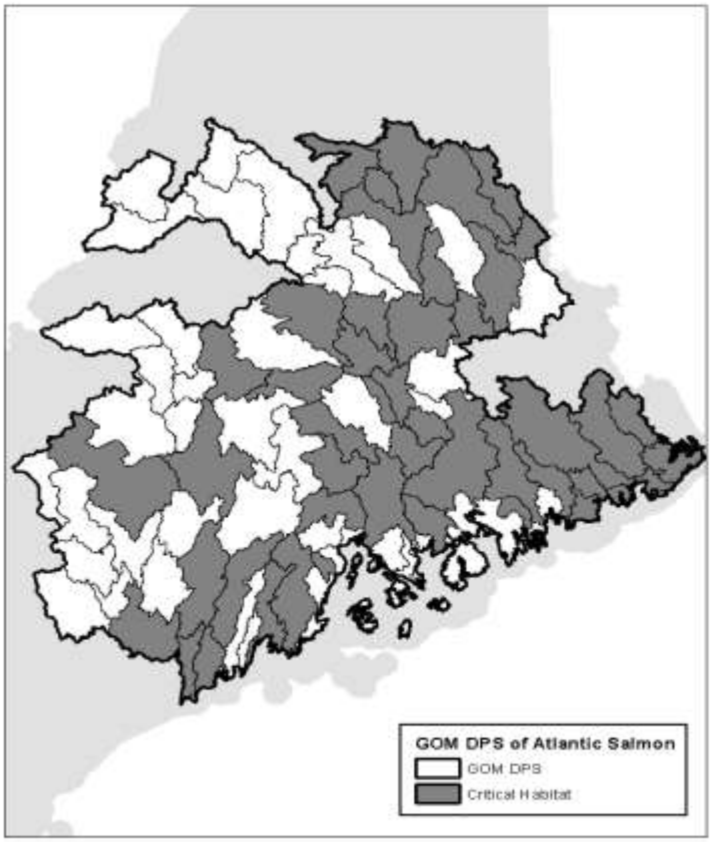
The status of Atlantic salmon critical habitat in the GOM DPS is important for two reasons: a) because it affects the viability of the listed species within the action area at the time of the consultation; and b) because those habitat areas designated "critical" provide PCEs essential for the conservation (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.

3.2.1 Primary Constituent Elements of Atlantic Salmon Critical Habitat

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

[2] Although successful marine migration is essential to Atlantic salmon, we were 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.

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

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

3.2.2.1 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.

3.2.2.2 Penobscot SHRU

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

3.2.2.3 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.

3.3 Summary of Status of Atlantic Salmon and Critical Habitat in the Action Area

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

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

In addition, some amount of natural reproduction is likely occurring in the Sandy River. Since the fishway at the Lockwood Project has been operational in 2006, adults have been captured and transported to the Sandy River. The eggs contributed to the Sandy River from these adults has ranged from 11,250 in 2006 to 247,500 in 2011. Estimated smolt production for this range would be between 169 and 3,735 annually.

3.3.1 Atlantic Salmon Adults

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

Atlantic salmon stocking practices are common in the region for the GOM DPS stock enhancement program. The total number of juvenile salmon stocked in the Kennebec River was 2,200 individuals (2,000 fry and 200 smolts) in 2009 and 147,000 fry in 2010 (USASAC 2010, 2011). In contrast, approximately 1.8 million juvenile salmon (fry, parr, and smolts) were stocked in the Penobscot River in 2010. Overall, 314,300 juvenile salmon, of which all were fry (except for 200 smolts) have been stocked in the Kennebec River since stocking commenced in 2001 (USASAC 2011). Given shortages of Atlantic salmon hatchery resources, MDMR has been supplementing Atlantic salmon populations by producing fry from streamside incubators and by planting Atlantic salmon eggs directly into gravel. Streamside incubation of eggs occurred from 2004 to 2007, and egg planting has continued since 2004. In 2010, MDMR planted approximately 530,000 Penobscot River origin eggs from the Green Lake National Fish Hatchery, and 51,000 eggs were planted from the USDA ARS National Cold Water Marine Aquaculture Center. All eggs were planted in the Sandy River drainage within the Kennebec River watershed (MDMR 2011a).

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

Table 2. Adult Atlantic salmon returns by origin to the Kennebec River recorded from 1975 to 2010.

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

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

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

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

Year	Maturity	Month of Capture						Total
		May	June	July	Aug	Sept	Oct	
2011	MSW Wild ♂	0	9	5	0	1	0	15
	MSW Wild ♀	0	12	12	0	0	1	25
	MSW Hatchery ♂	0	4	8	0	0	0	12
	MSW Hatchery ♀	0	5	3	0	0	0	8
	1SW Wild ♂	0	2	0	0	0	0	2
	1SW Wild ♀	0	0	0	0	0	0	0
	1SW Hatchery ♂	0	0	0	0	0	0	0
	1SW Hatchery♀	0	0	0	0	0	0	0
	MSW Hatchery Unknown	0	1	1	0	0	0	2
	Total	**0**	**33**	**29**	**0**	**1**	**1**	**64**

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

Following spawning in the fall, Atlantic salmon kelts may immediately return to the sea, or over-winter in freshwater habitat and migrate in the spring, typically April or May (Baum 1997). Spring flows resulting in spillage at the dams facilitate out-migration of adult salmon (Shepard 1988). The number of kelts in the Kennebec River is proportional to the number of adults entering the river each year to spawn. As such, the number of kelts in the Kennebec River is likely to be a few dozen annually.

3.3.2 Juvenile Atlantic Salmon

The Kennebec River in the vicinity of the Hydro-Kennebec Project serves as migration habitat for adults returning to freshwater to spawn and for smolts and kelts returning to the ocean. No spawning or rearing habitat has been identified directly upstream or downstream of the Hydro Kennebec Project (Figure 6)(USFWS 2011, Atlas of Maine 2009). The nearest mapped rearing habitat upstream of the Project is within the Sandy River located approximately 30 miles upstream of Hydro Kennebec and the nearest downstream mapped rearing habitat is downstream of the Lockwood Project (USFWS 2011, Atlas of Maine 2009). Two relatively small tributaries (Holland and Simpson Brooks) flow into the project reservoir. They are not known to support salmon spawning. Thus, neither fry or parr would not be expected to occur in the Project area. Generally, salmon smolts begin moving out of Maine rivers in mid-April to June. Atlantic salmon smolts originating in the Sandy River will occur in the Hydro-Kennebec Project as they migrate to the ocean. Most data concerning the emigration of smolts in Maine have been collected in the Penobscot River. Based on unpublished data from smolt-trapping studies in 2000 – 2005 by NMFS, smolts migrate from the Penobscot between late April and early June. The majority of the smolt migration appears to take place over a three to five week period after water temperatures rise to 10°C.

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

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

3.3.3 Critical Habitat

As discussed above, critical habitat for Atlantic salmon has been designated in the Kennebec River. One PCE for Atlantic salmon (sites for migration) is present in the action area as it was described in Section 3 of this Opinion. To facilitate and standardize determinations of effect for section 7 consultations involving Atlantic salmon critical habitat, 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. Mapped Atlantic salmon rearing habitat in the lower Kennebec River.

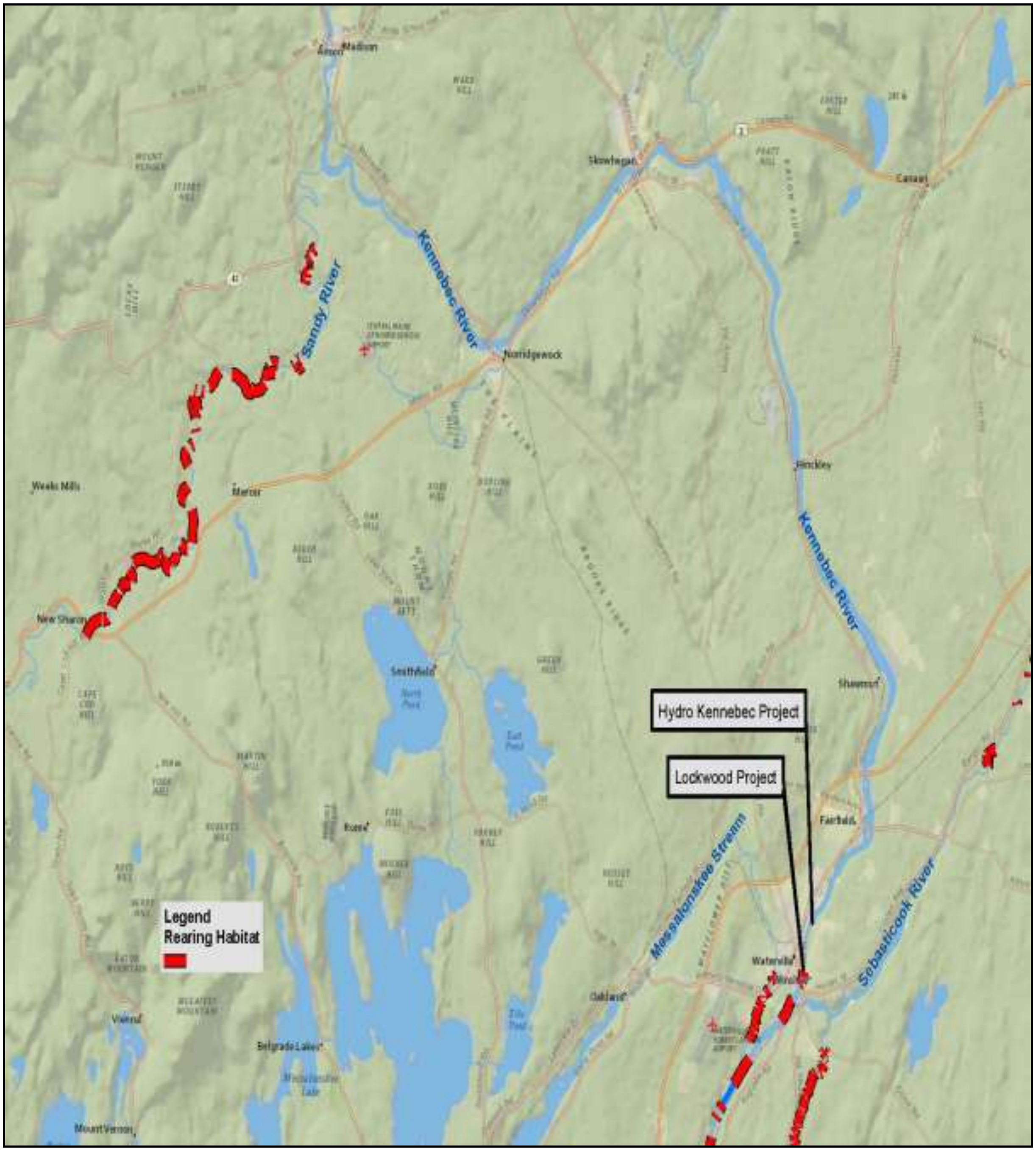


Table 4. Matrix of Primary Constituent Elements (PCEs) and essential features for assessing the status of Atlantic salmon critical habitat in the action area.

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

B) Embryo and Fry Development: (October 1st - April 14th)			
Temperature	0.5^{o}C and 7.2^{o}C, averages nearly 6oC from fertilization to eye pigmentation	averages < 4oC, or 8 to 10^{o}C from fertilization to eye pigmentation	>10^{o}C from fertilization to eye pigmentation
D.O.	at saturation	7-8 mg/L	< 7 mg/L
pH	> 6.0	6 - 4.5	< 4.5
Depth	5.3-15cm	NA	<5.3 or >15cm
Velocity	4 – 15cm/sec.	NA	<4 or > 15cm/sec.
Fisheries Interactions	Abundant diverse populations of indigenous fish species	Abundant diverse populations of indigenous fish species, low quantities of non-native species present	Limited abundance and diversity of indigenous fish species, abundant populations of non-native species
C) Parr Development: (All year)			
Substrate	gravel between 1.6 and 6.4 cm in diameter and boulders between 30 and 51.2 cm in diameter. May contain rooted aquatic macrophytes	gravel < 1.2cm and/or boulders > 51.2. May contain rooted aquatic macrophytes	no gravel, boulders, or rooted aquatic macrophytes present
Depth	10cm to 30cm	NA	<10cm or >30cm
Velocity	7 to 20 cm/sec.	< 7cm/sec. or > 20 cm/sec.	velocity exceeds 120 cm/sec..
Temperature	15^{o} to 19^{o}C	generally between 7- 22.5oC, but does not exceed 29oC at any time	stream temperatures are continuously <7oC or known to exceed 29oC
D.O.	> 6 mg/l	2.9 - 6 mg/l	< 2.9 mg/l

Food	Abundance of larvae of mayflies, stoneflies, chironomids, caddisflies, blackflies, aquatic annelids, and mollusks as well as numerous terrestrial invertebrates and small fish such as alewives, dace or minnows	Presence of larvae of mayflies, stoneflies, chironomids, caddisflies, blackflies, aquatic annelids, and mollusks as well as numerous terrestrial invertebrates and small fish such as alewives, dace or minnows	Absence of larvae of mayflies, stoneflies, chironomids, caddisflies, blackflies, aquatic annelids, and mollusks as well as numerous terrestrial invertebrates and small fish such as alewives, dace or minnows
Passage	No anthropogenic causes that inhibit or delay movement	Presence of anthropogenic causes that result in limited inhibition of movement	barriers to migration known to cause direct inhibition of movement
Fisheries Interactions	Abundant diverse populations of indigenous fish species	Abundant diverse populations of indigenous fish species, low quantities of non-native species present	Limited abundance and diversity of indigenous fish species, abundant populations of non-native species
D) Adult migration:	**(April 15th- December 14th)**		
Velocity	30 cm/sec to 125 cm/sec	In areas where water velocity exceeds 125 cm/sec adult salmon require resting areas with a velocity of < 61 cm/s	sustained speeds > 61 cm/sec and maximum speed > 667 cm/sec
D.O.	> 5mg/L	4.5-5.0 mg/l	< 4.5mg/L
Temperature	14 – 20^{o}C	temperatures sometimes exceed 20oC but remain below 23^{o}C.	> 23^{o}C
Passage	No anthropogenic causes that delay migration	Presence of anthropogenic causes that result in limited delays in migration	barriers to migration known to cause direct or indirect mortality of smolts

Fisheries Interactions	Abundant diverse populations of indigenous fish species	Abundant diverse populations of indigenous fish species, low quantities of non-native species present	Limited abundance and diversity of indigenous fish species, abundant populations of non-native species
E) Juvenile Migration:	**(April 15th - June 14th)**		
Temperature	8 - 11oC	5 - 11°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.

3.4 Factors Affecting Atlantic salmon in the Action Area

3.4.1 Hydroelectric Facilities

The Kennebec River Basin has been extensively developed for hydroelectric power production. There are currently 18 hydroelectric dams in the Kennebec watershed and 15 of these dams are impassable due to the lack of fishways. The Lockwood Project is the first impediment to upstream migration on the Kennebec River. There are 9 facilities upstream of the Lockwood Project on the mainstem Kennebec River and an additional 4 on upstream tributaries. The vast majority of salmon habitat (nearly 90%) in the Kennebec River watershed is located above Lockwood Project. Hydroelectric dams are known to impact Atlantic salmon through habitat alteration, fish passage delays, and entrainment and impingement.

3.4.1.1 Habitat Alteration

Dams have eliminated or degraded vast, but to date un-quantified, reaches of suitable rearing habitat in the Kennebec River watershed. The Kennebec River consists of 254,558 historic habitat units, with 44,402 units considered to be accessible by the Services. Because Atlantic salmon cannot volitionally access habitat upstream of the Lockwood Project, habitat in the upper areas of the Kennebec River including the Sandy River is not considered accessible by the Services. Impoundments created by these 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 Kennebec 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 Kennebec 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 Kennebec 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).

3.4.1.2 Habitat Connectivity

<u>3.4.1.2.1 Pre-spawn adults</u>

High quality spawning and rearing habitat is not presently accessible volitionally to Atlantic salmon. To access high quality spawning and rearing habitat in the Kennebec River watershed, Atlantic salmon must be trapped at the Lockwood Project and transported by trucks to upstream areas. This is due to the lack of upstream fish passage facilities at mainstem dams including the Hydro-Kennebec Project. While trap and truck fish passage can successfully move migrants to upstream areas, trap and truck operations to transport migratory fish species can result in adverse impacts including injury, disorientation, disease and mortality, delay in migration, and interruption of the homing instinct, which can lead to straying (OTA 1995). Other disadvantages to trap and truck passage include: holding and handling stress, reduced passage by other species that will not enter traps, and the need for long-term, guaranteed operational funding for dedicated biological staff, equipment, supplies, vehicles and tanks, etc.

<u>3.4.1.2.2 Outmigrating smolts</u>

Smolts from the upper Kennebec River have to navigate through multiple dams on their migrations to the estuary every spring. While several studies have been conducted at hydroelectric dams in the lower Kennebec River (including Hydro-Kennebec) to assess downstream passage effectiveness for smolts, survival of smolts migrating past dams in the Kennebec River is presently unknown. 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 through turbines varies significantly based on numerous factors, but as described above can be significantly lower than the other two routes.

3.4.1.2.3 Outmigrating kelts

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. Similar to smolts, the route that a kelt takes when passing a project is a major factor in its likelihood of survival. Kelts that pass through a properly designed downstream bypass have a better chance of survival than other routes such as turbine entrainment or spill over dams.

3.4.1.3 Predation

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

Smallmouth bass and chain pickerel are each important predators of Atlantic salmon within the range of the GOM DPS (Fay *et al.* 2006). Smallmouth bass are a warm-water species whose range now extends through north-central Maine and well into New Brunswick (Jackson 2002). Smallmouth bass are very abundant in the Kennebec 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 Kennebec 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 Kennebec

River. The abundance of alternative prey resources such as upstream migrating alewife, likely minimizes the impacts of cormorant predation on the GOM DPS (Fay *et al.* 2006).

3.4.1.4 Latent Effects of Downstream Passage

In addition to direct mortality sustained by Atlantic salmon at hydroelectric projects, Atlantic salmon in the Kennebec 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 latent mortality is known as the hydrosystem-related, delayed-mortality hypothesis (Budy *et al.* 2002, Schaller and Petrosky 2007, Haeseker *et al.* 2012).

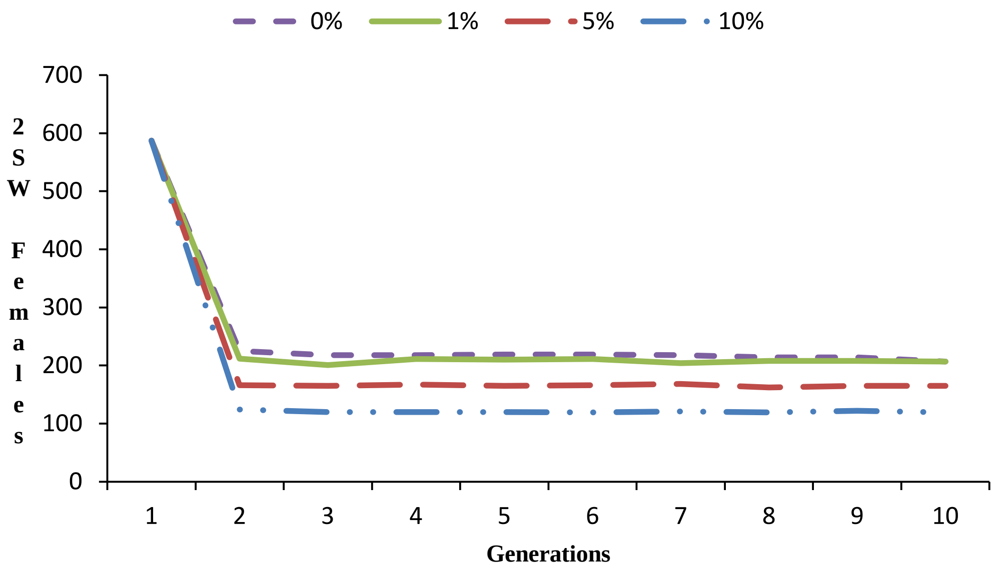
Budy *et al.* (2002) examined the influence of hydropower experience on estuarine and early ocean survival rates of juvenile salmonids migrating from the Snake River to test the hypothesis that some of the mortality that occurs after downstream migrants leave a river system may be due to cumulative effects of stress and injury associated with multiple dam passages. The primary factors leading to hydrosystem stress (and subsequent latent 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 latent mortality, Budy *et al.* (2002) cited evidence from mark-recapture studies that demonstrated differences in latent mortality among passage routes (i.e., turbines, spillways, bypass and transport systems).

More recent studies have corroborated the indirect evidence for hydrosystem latent 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 latent mortality of Snake River chinook salmon was evident and that it did not diminish with more favorable oceanic and climatic conditions. Estimates of latent 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 latent 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 latent mortality and the estimates varied considerably.

Although latent 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 latent 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 latent mortality experienced by Columbia River salmon, ISAB (2007) recommended that attempts should not be made to provide direct estimates of absolute latent 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 latent 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 Kennebec River. Thus, we have not attempted to quantify the latent (or delayed) loss of smolts or kelts attributed to HK LLC project in this Opinion. Nevertheless, considering that there are presently 18 FERC licensed hydroelectric projects in the Kennebec 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 us 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 latent mortality on the abundance of returning Atlantic salmon (NMFS 2012).



3.4.2 Contaminants and Water Quality

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

3.4.3 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.

3.4.3.1 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.

3.4.3.2 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.

3.4.3.3 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.

3.5 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.

4.0 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. We completed ESA Section 7 consultation for the Lockwood Hydroelectric Project and dredging at Bath Iron Works. No take of Atlantic salmon were exempted in any of these consultations.

We also completed two formal consultations for activities in Bond Brook, a tributary to the Kennebec River in Augusta, Maine. The first project involved coal tar remediation in the brook. The second project involved upgrades to a combined sewer overflow in Bond Brook. We exempted the non-lethal take of two adult Atlantic salmon for each project.

Lastly, we completed a formal consultation concerning the U.S. Environmental Protection Agency's (EPA) proposed support of a ioassessment study in the Kennebec River in 2010 and 2011. We exempted the non-lethal take of up to two adult Atlantic salmon for each year of the study.

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, except that for adults, it would be less than 1%. MDMR will continue to conduct Atlantic salmon research and management activities in the Kennebec River watershed while the proposed action is carried out. The information gained from these activities will be used to further salmon conservation actions in the GOM DPS.

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

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

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 Kennebec River permitted by the ACOE. This includes several dock, pier, and bank stabilization projects. No interactions with Atlantic salmon have been reported in association with any of these projects.

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

5.0 CLIMATE CHANGE

The discussion below presents background information on global climate change and information on past and predicted future effects of global climate change throughout the range of the listed species considered here. Additionally, we present the available information on predicted effects of climate change on listed species and critical habitat in the action area, and how they may be affected by those predicted environmental changes. 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 2007a) and precipitation has increased nationally by 5%-10%, mostly due to an increase in heavy downpours (NAST 2000). There is a high confidence, based on substantial new evidence, that observed changes in marine systems are associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation. Ocean acidification resulting from massive amounts of carbon dioxide and other pollutants released into the air can have major adverse impacts on the calcium balance in the oceans. Changes to the marine ecosystem due to climate change include shifts in ranges and changes in algal, plankton, and fish abundance (IPCC 2007b); these trends are most apparent over the past few decades. Information on future impacts of climate change in the action area is discussed below.

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

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

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

A warmer and drier climate is expected to result in reductions in stream flows and increases in water temperatures. Expected consequences could be a decrease in the amount of dissolved oxygen in surface waters and an increase in the concentration of nutrients and toxic chemicals due to reduced flushing rate (Murdoch et al. 2000). Because many rivers are already under a great deal of stress due to excessive water withdrawal or land development, and this stress may be exacerbated by changes in climate, anticipating and planning adaptive strategies may be critical (Hulme 2005). 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 0.2oC (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 degrees Celsius), which could affect an individual's ability to access suitable spawning habitat. In addition, elevated temperatures will make some areas unsuitable for spawning and rearing due to effects to egg and embryo development.

6.0 EFFECTS OF THE ACTION

This section of an Opinion assesses the direct and indirect effects of the proposed action on threatened and endangered species or critical habitat, together with the effects of other activities that are interrelated or interdependent (50 CFR 402.02). Indirect effects are those that are caused later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration (50 CFR 402.02). The ISPP expires in 2016. Therefore, this Opinion analyzes the effects of interim operation of the Hydro-Kennebec Project until 2016. In 2016, this Opinion will no longer be valid and consultation under Section 7 will need to be reinitiated by FERC.

6.1 Upstream Fish Passage

To complete their life cycle, pre-spawn Atlantic salmon in the Kennebec River require access to suitable spawning habitat. As most suitable spawning habitat occurs in the upper areas of the Kennebec River, Atlantic salmon must be able to migrate successfully above the Hydro-Kennebec Project. HK LLC proposes to install a new upstream fishway at the Hydro-Kennebec Project in 2015. Following installing of the new fishway, adult Atlantic salmon will be able to safely pass upstream of the Hydro-Kennebec Project. While no fishway is ever 100% effective at passing migrants, HK LLC proposes to work with state and federal fisheries agencies during the design of the new fishway. Therefore, we assume that new fishway will be highly effective at attracting and passing adult Atlantic salmon and other anadromous species in the Kennebec River. In addition, HK LLC will be obligated to demonstrate the effectiveness of the new facility through site-specific studies. If studies indicate the new fishway is not highly effective, HK LLC will be required to modify the fishway to improve effectiveness.

The ISPP for the Hydro-Kennebec Project is valid until 2016. This period will be used by HK LLC to design and construct the new upstream fish passage facility at the project. Construction of the new upstream fishway will occur in 2015 and should be operational in the spring of 2016. During this period, Atlantic salmon would continue to be trucked around the project by the MDMR. As such, upstream migrating Atlantic salmon would continue to be denied volitional access to upstream spawning habitat by the Hydro-Kennebec Project until 2016. While trap and truck fish passage can successfully move migrants to upstream areas, trap and truck operations to transport migratory fish species can result in adverse impacts including injury, disorientation, disease and mortality, delay in migration, and interruption of the homing instinct, which can lead to straying (OTA 1995). Other disadvantages to trap and truck passage include: holding and handling stress, reduced passage by other species that will not enter traps, and the need for long-term, guaranteed operational funding for dedicated biological staff, equipment, supplies, vehicles and tanks, etc. Therefore, we assume that all upstream migration adult Atlantic salmon will be affected by trap and truck operations on the Kennebec River. Since 2006, adult Atlantic salmon returns to the Kennebec River have ranged from 5 to 64 fish (average = 26). We expect these relatively low numbers of returning adults to continue throughout the duration of the ISPP.

6.2 Downstream Fish Passage

Under the proposed action, the Hydro-Kennebec 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.

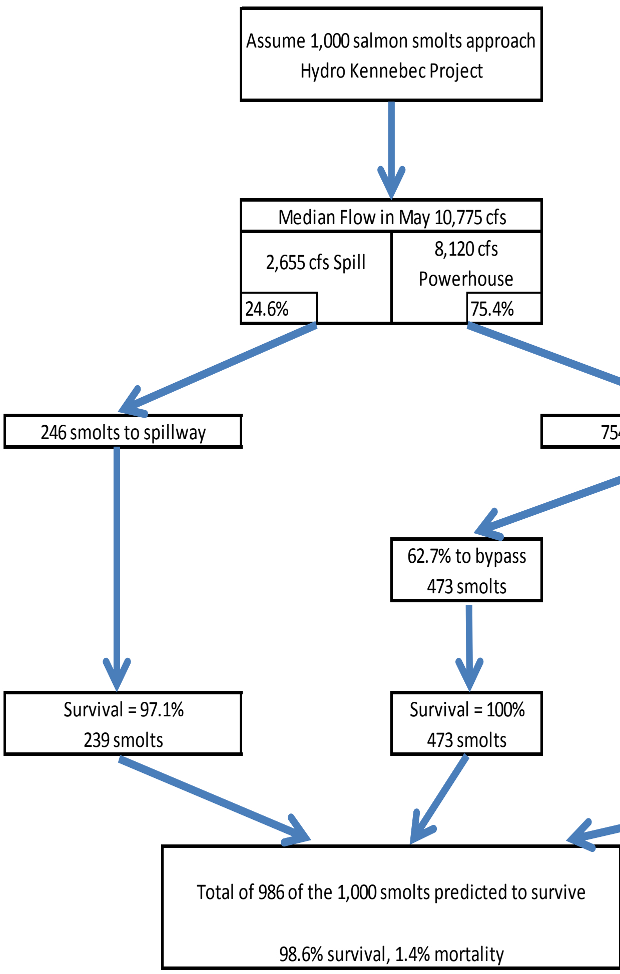
To evaluate survival of Atlantic salmon smolts passing downstream of the Hydro-Kennebec Project, HK LLC conducted a survival study at the project in the spring of 2012. The study also tested the effectiveness of the newly installed downstream fish guidance system at the project. Smolt releases were conducted upstream of the project during the evening hours on 22 May, 23 May, 24 May, and 25 May 2012. Across all four releases, a total of 98 radio-tagged Atlantic salmon smolts were released and downstream movements past the Project were monitored using stationary radio-telemetry.

Overall, a total of 89 out of the 98 Atlantic salmon smolts released upstream of Hydro-Kennebec passed the project. Of the individuals which moved downstream, 69% (61 of 89) passed through the downstream bypass, 21% (19 of 89) passed through Unit 1 and 10% (9 of 89) passed through Unit 2. Usage rates (among releases) for the downstream bypass ranged from 54% to 79%. A virtual-paired-release-recapture model was used to produce two estimates of dam passage survival for Atlantic salmon smolts at the Hydro-Kennebec Project. The estimated dam passage survival rates were 92.1% - 94.7%.

HK LLC also conducted an assessment of Atlantic salmon smolt and kelt survival in the BA submitted to FERC. The analysis estimated whole station survival using a standard desktop methodology for estimating turbine survival. Immediate smolt survival through the turbines was estimated by the following two separate methodologies: (1) empirical estimates compiled in the scientific literature (EPRI Turbine Passage Survival Database) and (2) the Advanced Hydro Turbine model (Franke et al. 1997). The estimates of whole station survival derived by HK LLC assumed a median May flow at the project with proportional smolt passage via turbine entrainment, spillage, and the downstream fish passage facility (Figure 8). The EPRI technique resulted in a mean turbine survival rate of 94.6%, while the Advanced Hydro Turbine model resulted in a mean turbine survival rate of 97.4%. Mean survival over the spillway was estimated to be 97.1% based on field trials conducted at five hydroelectric projects (Normandeau Associates, Inc. 2011). Survival through the downstream bypass/fishway was assumed to be 100% based on intended design for successful passage through agency consultation.

A desktop analysis provides an estimate of immediate survival and does not assess potential impacts resulting from migratory delays, non-lethal injuries, or latent death. Therefore, actual survival of smolts is likely less than reported in the FERC's BA. 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 *et al.* 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). Smolt studies that will be conducted by HK LLC in 2013 and 2014 will determine actual survival rates at the project.

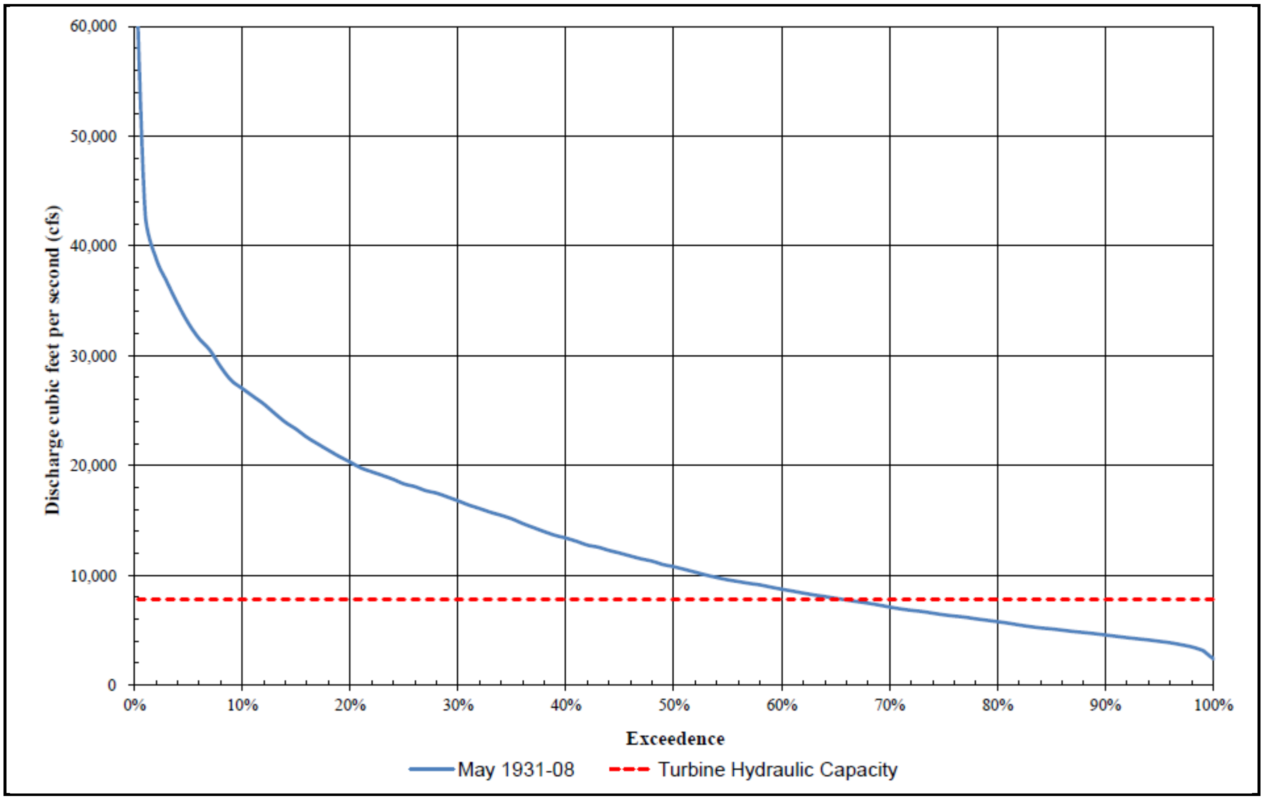
Figure 8. Example calculation of smolt survival for downstream passage at the Hydro-Kennebec Project during May median flow using the modeled turbine survival rate.



The desktop analysis also did not evaluate kelt survival at the Hydro-Kennebec 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 Hydro Kennebec trashracks have a bar spacing of 3 ½ inches wide by 8 inches high (clear spacing) which would not likely 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 Hydro-Kennebec Project.

Figure 9. May flow exceedance, Hydro-Kennebec Project USGS Gages 01046500, 01047000, 01048000, and 01049000.



6.3 Monitoring and Evaluation

In order to determine the effectiveness of the downstream fish passage facilities, HK LLC proposes to conduct downstream survival studies for Atlantic salmon kelts and smolts at the Hydro-Kennebec 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 Hydro-Kennebec 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. HK LLC will monitor and evaluate the effectiveness of the downstream fish passage facilities for up to three years at the Project. It is expected that 200 smolts will be used per year, for a total of 600 smolts.

HK LLC 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 not 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 not more than 60 kelts could be injured due to passage monitoring over the term of the ISPP (i.e., through 2016).

6.3.1 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 HK LLC 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 HK LLC 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 600 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. We 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, we 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 6 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 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 Hydro-Kennebec 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.

6.4 Effects to Critical Habitat

Critical habitat for Atlantic salmon has been designated in the Kennebec River including the section of river in the vicinity of the Hydro-Kennebec 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 operation of the Hydro-Kennebec Project 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 Kennebec River watershed is anticipated to improve for Atlantic salmon with the construction of a new upstream fishway.

The Hydro-Kennebec 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. The Hydro-Kennebec Project tailrace is connected to the mainstem of the river (no bypass), though under low river flows when the bascule gates are closed, elevated bedrock outcropping downstream of the dam become exposed.

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 (FERC 2005), including Atlantic salmon. Additionally, run-of-river flow requirements below the Hydro-Kennebec Project are maintained per the FERC license, and fish passage operation flow protocols have been established in consultation with USFWS, NMFS, and MDMR.

Providing upstream passage at the project will significantly improve migration habitat for Atlantic salmon. The existing downstream passage facility 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 Hydro-Kennebec Project.

Table 8. Atlantic salmon critical habitat essential features following implementation of the ISPP at the Hydro-Kennebec 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.

7.0 CUMULATIVE EFFECTS

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

Impacts to Atlantic salmon from non-federal activities are largely unknown in the Kennebec River. It is possible that occasional recreational fishing for anadromous fish species may result in incidental takes of this species. The operation of these hook and line fisheries and other fisheries could result in future sturgeon or Atlantic salmon mortality and/or injury.

In December 1999, the State of Maine adopted regulations prohibiting all angling for sea-run salmon statewide. 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.

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. 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 also vulnerable to impacts from pollution and are also likely to continue to be impacted by water quality impairments in the Kennebec 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.

Industrialized waterfront development will continue to impact the water quality in and around the action area. Sewage treatment facilities, manufacturing plants, and other facilities present in the action area are likely to continue to operate. Excessive water turbidity, water temperature variations and increased shipping traffic are likely with continued future operation of these facilities. As a result, Atlantic salmon foraging and/or distribution in the action area may be adversely affected.

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.

8.0 INTEGRATION AND SYNTHESIS OF EFFECTS

In the discussion below, we consider whether the effects of the proposed action reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the 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, we 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.

We have 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 operation of existing downstream passage facilities and installing a new upstream passage facility, 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.

We recognize 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 Kennebec 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 Hydro-Kennebec 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

During the term of the proposed ISPP, adult salmon will continue to be transported upstream of the Hydro-Kennebec Project. Atlantic salmon that are transported upstream of the project could suffer injury or stress that could comprise their ability to successfully spawn. In 2015, however, a new upstream passage facility will be installed at the project.

Summary of Downstream Passage Effects
A portion of Atlantic salmon smolts and kelts will be injured or killed while passing downstream at the Hydro-Kennebec Project. Based upon information in FERC's BA, it is estimated that survival of smolts would range from 92.1% - 94.7% (empirical data) and 94.6% to 97.4% (desktop analysis). To be conservation, we assume the lower survival rate (92.1%) occurs at the project. 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. The ISPP and this Opinion expire in 2016. Therefore, the following section analyzes whether interim operation of the project will jeopardize the GOM DPS of Atlantic salmon during this ISPP period. In 2016, this Opinion will no longer be valid and consultation under Section 7 will need to be reinitiated by FERC.

8.1.1 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 the 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 survival potential of the species. Almost all production of Atlantic salmon in the Kennebec River is the result of egg planting in the Sandy River. MDMR estimates that 13,892 smolts were produced in the Sandy River in 2012. Not all of these smolts will reach the Hydro-Kennebec Project due to natural instream mortality (e.g., predation) and losses at other upstream hydroelectric dams in the river (Weston and Shawmut). If we assume similar survival rates at Weston and Shawmut (92.1%) and a natural median in-river mortality of 0.002% per kilometer (NMFS 2012 based upon Penobscot River data), we estimate that 11,600 smolts would successfully approach the Hydro-Kennebec Project annually. Therefore, assuming a conservative survival rate of 92.1% at the Hydro-Kennebec Project, a total of 916 smolts will be killed by project operation each year of the 5 year ISPP. Based upon the current median marine survival rate of 0.4% (NMFS 2012), the operation of the Hydro-Kennebec Project under this production and survival scenario could conceptually cause an 8% reduction in adult returns to the Kennebec River (51 adults vs. 47 adults). We would expect this level of mortality to be reduced once the final SPP is implemented using data collected as part of the ISPP process. We did not attempt to quantify the effects of lost kelts on adult production in the Kennebec River due to the low proportion of repeat spawners in the GOM DPS.

HK LLC's proposed ISPP is expected to significantly benefit the distribution of the species by improving upstream and downstream passage at the project. Improved upstream passage will improve reproduction of the species since the effects of transporting adult Atlantic salmon around the project will be eliminated. Recent improvements to the downstream passage facility at the project are expected to increase the number of smolts surviving in the Kennebec River which will lead to increased number of adults returning to the river. We also expect current stocking practices to continue in the Sandy River during the ISPP period which will also help insure the survival of Atlantic salmon in the Kennebec River. Therefore, we have determined that this relatively small loss of adults through 2016 under the proposed action will not appreciably reduce the likelihood that Atlantic salmon will survive in the wild.

8.1.2 Recovery Analysis

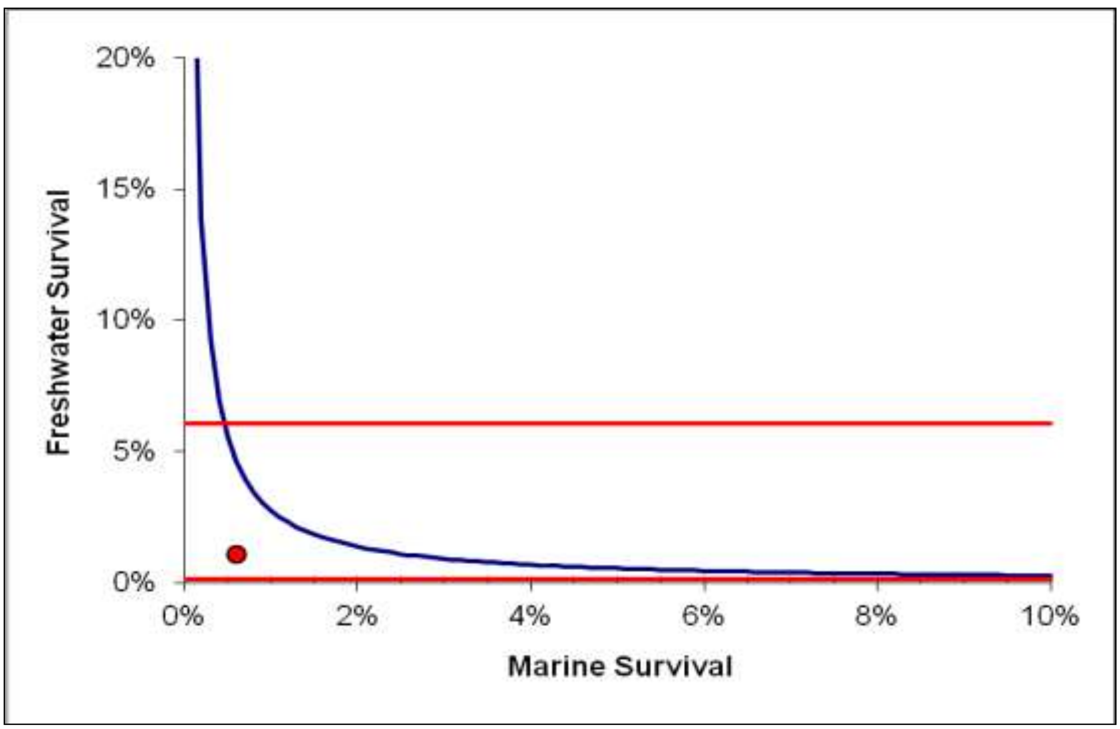
The second step in conducting this analysis is to assess the effects of the proposed project on the recovery of the species. Recovery is defined as the improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in section 4(a)(1) of the 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, we have determined that the proposed action will not appreciably reduce the likelihood that Atlantic salmon will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate.

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. We have 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 10, 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 realistic, path to achieving a self-sustaining population that is trending towards recovery.

Figure 10. 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 that 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 the 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 significantly benefit the distribution of the species by improving upstream passage at the project. Improved upstream passage is also expected to improve reproduction of the species since the effects of transporting adult Atlantic salmon around the project will be eliminated. Therefore, we have 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, we summarize 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 Hydro-Kennebec Project will continue to have an adverse effect on Atlantic salmon in the Kennebec 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 Kennebec 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 reproduction and distribution of Atlantic salmon. This is the case because: 1) the new upstream fishway will reduce injury to adult Atlantic salmon that were transported upstream pass the dam; and 2) the increase in the distribution of the species in the Kennebec River; and 3) improved access will upstream passage likely lead to an increase in reproduction in high quality spawning habitat in the upper Kennebec River and thus increase the number of returning Atlantic salmon to the Kennebec 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.

9.0 CONCLUSION

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

10.0 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. NMFS interprets 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 NMFS; 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 HK LLC 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 HK LLC to report the progress of the action and its effect on each listed species to us, 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. The incidental take provided by this Opinion is valid until 2016. In 2016, this Opinion will no longer be valid and consultation under Section 7 will need to be reinitiated by FERC.

Hydroelectric Operations

Continued operation of the Hydro-Kennebec Project for the term of the ISPP (5 years) will result in the injury or death of up to 7.9% (100% - 92.1%) 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 levels of smolt survival at the Hydro-Kennebec Project, HK LLC proposes to obtain 200 hatchery smolts from the GLNFH. These fish would be tagged or held for observation which would likely lead to injury or delays in migration. We expect that the study will need to be repeated three times to verify the results. The result of the studies will be used by HK LLC and us to determine whether additional protection measures are needed at the project during preparation of the final SPP. As such, the level of take associated with conduct of the survival studies will be 600 Atlantic salmon smolts during the term of the ISPP.

HK LLC also proposes 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 not 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 not more than 60 kelts could be injured due to passage monitoring over the term of the ISPP (i.e., through 2016). The result of the studies will be used by HK LLC and us to determine whether additional protection measures are needed at the project during preparation of the final SPP. As such, the level of take associated with conduct of the survival studies will be 60 Atlantic salmon smolts during the term of the ISPP.

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 at the Hydro-Kennebec Project. 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 HK LLC 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 HK LLC complete the following measures:

1. FERC must ensure, through enforceable conditions of the project licenses, that HK LLC complete an annual monitoring and reporting program to confirm that HK LLC is minimizing incidental take and reporting to NMFS any project-related observations of dead or injured salmon made by HK LLC.
2. To minimize incidental take from project operations, FERC must require that HK LLC measure and monitor the effects of their ISPP implementation for the protection of Atlantic salmon at the Hydro-Kennebec Project.

10.3 Terms and Conditions

In order to be exempt from prohibitions of section 9 of the ESA, FERC and HK LLC 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 HK LLC to do the following:
    a. Require HK LLC to consult with NMFS regarding the design of the new upstream fishway at the Hydro-Kennebec Project. Submit 30%, 60%, and 90% design drawings to NMFS for review and comment.
    b. Notify NMFS of any changes in operation including maintenance activities at the project during the term of the ISPP. Also, allow NMFS to inspect fishways at the projects at least annually.
2. To implement reasonable and prudent measure #2, FERC must require HK LLC to do the following:
    a. Contact NMFS within 24 hours of any interactions with Atlantic salmon, that HK LLC observes including non-lethal and lethal takes (Jeff Murphy: by email (Jeff.Murphy@noaa.gov) or phone (207) 866- 7379 and the Section 7 Coordinator (incidental.take@noaa.gov)
    b. 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.
    c. Prepare in consultation with NMFS a plan to study the survival of migrating kelts at the Hydro-Kennebec 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 us 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 as they describe how HK LLC will be required to measure and monitor the success of the proposed ISPP. These procedures represent only a minor change to the proposed action as following these procedures should not increase the cost of the project or result in any delays or reduction of efficiency of the project.

RPM #2 as well as Term and Condition #2 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 us in a timely manner with all of the necessary information. This is essential for monitoring the level of incidental take associated with the proposed action. 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.

11.0 CONSERVATION RECOMMENDATIONS

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

1. If any lethal take occurs, FERC and/or HK LLC should arrange for contaminant analysis of the specimen. If this recommendation is to be implemented, the fish should be frozen and we 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.

12.0 REINITIATION NOTICE

This concludes formal consultation concerning FERC's proposal to amend the license for the Hydro-Kennebec 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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