NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT
BIOLOGICAL OPINION

Agency:	National Marine Fisheries Service, Restoration Center (lead) U.S. Army Corps of Engineers, New England District
Activity Considered:	**Removal of Coopers Mill Dam on the Sheepscot River in Whitefield, Maine** NER-2018-14772 GARFO-2018-02170
Conducted by:	National Marine Fisheries Service Greater Atlantic Region
Date Issued:	6/29/18
Approved by:	

TABLE OF CONTENTS

1. INTRODUCTION AND BACKGROUND

This constitutes the biological opinion (Opinion) of NOAA's National Marine Fisheries Service (NMFS) under the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531-1543). The Opinion analyzes the effects to species and critical habitat listed by NMFS of the removal of the Coopers Mill Dam and continued operation of a dry hydrant on the Sheepscot River in Whitefield, Maine. NOAA's Restoration Center (RC) is providing funding to the Atlantic Salmon Federation (ASF) for the proposed project. ASF is also obtaining a permit from the U.S. Army Corps of Engineers (USACE), New England District to be issued pursuant to section 10 of the Rivers and Harbors Act. RC is acting as the lead federal agency for the purposes of the section 7 consultation. This Opinion is based on information provided in the Biological Assessment received on February 5, 2018 and other sources of information cited herein. A complete administrative record of this consultation will be maintained at our Maine Field Office in Orono, Maine. Formal consultation was initiated on February 5, 2018.

1.1. Consultation History

- May 18, 2017 – NMFS and the U.S. Fish and Wildlife Service (U.S. FWS) held a meeting to discuss funding and roles for both agencies involved with consultation under section 7 of the ESA, as amended.
- June 1, 2017 – USACE received an application for the Coopers Mill dam removal from ASF.
- January 26, 2018 – NMFS met with ASF to discuss revisions to the BA and NLAA determination.
- February 5, 2018 – NMFS initiated consultation under section 7 of the ESA, as amended.
- March 2, 2018 – NMFS Protected Resources sent letter to RC to acknowledge the receipt of complete BA and supporting documents to initiate consultation on February 5, 2018.

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 a Biological Assessment provided to NMFS on February 5, 2018; 2) Determination of Endangered Status for the Gulf of Maine Distinct Population Segment of Atlantic salmon; Final Rule (74 FR 29345; June 19, 2009); 3) Status Review for Anadromous Atlantic Salmon (*Salmo salar*) in the United States (Fay *et al.* 2006); 4) Designation of Critical Habitat for Atlantic salmon Gulf of Maine Distinct Population Segment (74 FR 29300; June 19, 2009); 5) Final Recovery Plan for Shortnose Sturgeon (December, 1998); and, 6) final listing determinations for the five distinct population segments of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) (77 FR 5880 and 77 FR 5914; February 6, 2012).

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

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

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

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

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

2. PROJECT DESCRIPTION AND PROPOSED ACTION

This project will remove the Coopers Mills Dam in Whitefield, Maine and replace one existing dry hydrant and intake with two new dry hydrant intakes. The dam currently prevents safe, timely and effective upstream and downstream passage for federally endangered Atlantic salmon and other diadromous sea-run fish. The current condition of the dam (leaks from holes in structure) and location of the fishway (requires full head pond/impoundment) does not allow for adequate water flows during summer low flow conditions and typically will become dewatered and will not be functional for passing any fish species. On a recent site visit to the dam in June 2018, we observed the head pond was very low and the fishway was completely dewatered. Restoring connectivity in this reach of the Sheepscot River will provide Atlantic salmon access to spawning and rearing habitat that is upstream of this project and opportunities for movement of resident fish species both upstream and downstream. The purpose of maintaining a dry hydrant in the Sheepscot river at Coopers Mill Dam is strictly for public safety during emergency firefighting operations. The dry hydrant is used for filling fire suppressant equipment with raw river water extracted directly from the river through instream intakes that are specially designed to prevent fish from becoming entrained or impinged during pumping operations. The two intakes provide a redundancy and as a backup. The high water intake will only be operable in higher water conditions and to the low water hydrant will be submerged all twelve months of the year.

The in-water work is currently scheduled to begin on July 15, 2018, with completion anticipated by September 30, 2018. Terrestrial activities associated with the project could continue twelve months beyond the start of the in-water work.

The following paragraphs provide an overview of the anticipated approach to project construction as described in the BA provided on February 5, 2018.

General Site Management
Site preparation will initiate with the establishment of ingress/egress, construction access and staging areas to facilitate the work. Access to the site will be via the established Basin Lane access off of Main Street in Coopers Mills. These areas will be utilized for equipment, vehicular, crew and materials movements and staging, and onsite maintenance as necessary. These areas will be delineated and marked with construction fencing and/or silt fencing as site conditions dictate at each location. These areas will be returned to pre-project or better condition following project completion. Appropriate best management practices (BMPs) will be in place to prevent environmental damages associated with equipment fueling, operation and maintenance, and other construction activities. The BMPs to reduce environmental impacts such as turbidity, sedimentation, and contaminants are described in the BA and will be a requirement of the State and Federal permits needed for the project. The following sections describe some of the operations during construction that are most relevant to aquatic resources within the action area.

Drawdown of Impoundment
Following establishment of site management provisions, the impoundment will be drawn down by modifying the operation of the Denil fish ladder at river left. This will be done by fully opening the head gate, followed by removal of the baffles to maximize discharge through the fish ladder. After the impoundment is below the hydraulic inlet to the fish ladder, draw down will

proceed by manipulating the gates located in the right abutment so that there is continuous flow past the site for the duration of the project. The applicant believes that one of the gates is damaged to the extent that it may only be fully removed in a single event, and not operated. The applicant believes that the other gate may be operated more precisely. While the final precise operation of the gates will depend on the actual condition of the gates at the time of construction, the applicant anticipates using the operable gate to progressively lower the impoundment until drawdown is maximized with that gate. The other gate will then be removed for the final drawdown. Irrespective of whether the flow is through the fishway, the gates in the right abutment, or through the location of the former spillway (after removal), the river will flow into the action area and exit into the pool at the base of the dam ensuring that existing flow regimes and flow patterns downstream of the pool will not change. During drawdown, any previously wetted areas upstream and downstream of the dam site will be monitored for the presence of fish and invertebrates. Efforts will be made to remove any remaining fish from these areas should they become isolated from the main flow of the river channel during drawdown. Similarly, any remaining fish and invertebrates in the immediate project area will be removed prior to construction activities. In the unlikely event that Atlantic salmon juveniles are present within the action area and become isolated from the main channel or within a cofferdam, they will be captured by using electro-fishing gear. All Atlantic salmon will be appropriately handled and enumerated as described in the BA and placed into suitable habitat located below the project and outside of the action area. The Maine DMR biologists will be conducting all fish removal activities and will be following established protocols identified in the Standard Operating Procedures for Electro-Fishing (MDMR 2005).

The drawdown will proceed slowly to limit the amount of accumulated sediment that is mobilized in the impoundment. The maximum rate of drawdown of the impoundment will not exceed 0.5 feet per hour, and 2 feet per day draining the project area gradually over several days. Rates will be reduced as required to reduce turbidity and maximize drainage and drying of exposed sediments. It is likely that some downstream sediment transport will occur during the initial drawdown process with operation of the gates. It may be necessary to manually open a channel leading to the gates initially to minimize the transport of fine sediments. This may be accomplished using hand labor, or if access conditions allow, equipment-based excavation. The overall volume of accumulated fine sediment within the impoundment is minimal, estimated at less than 1,000 cubic yards, which is an extremely small amount for a waterway the size of the Sheepscot River. The accumulated fine sediment is predominantly located in a 50-foot reach of the impoundment directly upstream of the dam.

Temporary Access Development near Dam

Following drawdown of the impoundment, while the river flow is routed through the low-level gates in the right abutment, a temporary access/coffer dam will be established between the river left bank and the right end of the spillway on the upstream side of the dam. This temporary access may include fill similar to a traditional cofferdam, or may involve construction with alternate materials including bridging with trench boxes and crane mats, or other suitable approach. This temporary access will be in place for approximately 30 days, barring an unforeseen delay in project construction.

The final design for the temporary access will be proposed by the construction contractor, which will be submitted for review by the engineer of record. The approved temporary access will comply with all applicable permit requirements. During the period when the temporary access is placed, the river flow will be to the river right of the work area, through the gates. After establishment of the temporary access alignment, a sediment barrier (using turbidity curtain or bulk bags) will be established upstream of the low level gates to moderate the delivery of sediment and turbid water to the downstream river while the excavation for the upstream dry hydrant intakes occurs. Since there will be continuous flow through the site at all times in all areas except those that have been purposely isolated to construct the required work, migration past the project is expected to occur without delay. However, since the extent of migration for adults is significantly lower during the summer work window, we do not expect any adult fish to be migrating into the project area, but if they do, they can freely swim past the project. The BMPs that will be in place during the duration of the project are designed to minimize any water quality effects from construction and significantly reduce the potential for trapping or stranding of fish. As explained above, any fish stranded will be relocated from areas that are isolated from the active flow as needed during the duration of the project..

Demolition of Coopers Mills Dam
Upon completion of the portions of the hydrant system in the impoundment discussed below, the sediment barrier upstream of the low-level gates will be reconfigured to direct flow through the low level gates. This will enable spillway demolition and excavation of accumulated sediment directly upstream of the spillway in a manner that limits release of turbidity to the downstream river. Any excavation in the small pool of water that may be present upstream of the spillway will be isolated from the active flow with a floating turbidity curtain. The volume of anticipated active excavation of accumulated sediment is estimated at less than 650 cubic yards.

The spillway, river left abutment, and Denil fishway will then be demolished and removed. This work will be accomplished with an hydraulic excavator for masonry construction (dam spillway), and an hydraulic excavator and hydraulic hammer for concrete overlays and reinforced concrete (abutments and fishway). Following demolition, control of water will be modified to route the river flow through the area of the former spillway, enabling demolition and removal of the targeted areas of the right abutment, including the gate structures. Once this work is complete, the temporary access, remaining accumulated sediment slated for removal, control of water and erosion control facilities will be decommissioned and full river flow will be routed through the area of the former impoundment and spillway.

Construction of Upstream Dry Hydrant and Habitat Improvements
The work upstream of the dam includes excavation for, and installation of two water intakes to serve as replacements for the existing dry hydrant intake. These will each be fitted with a fish friendly, custom designed strainer head. Only one of the intakes is designed to be submerged during the summer months. The installation of supplemental boulders to augment ledge outcrops and native coarse substrate to provide required water levels for the dry hydrant that needs to be submerged throughout the summer is planned. The need to install the boulders will be determined after drawdown of the impoundment, following initial excavation for the hydrant intakes.

Access will be established to the intake locations along the alignment of the future access ramp that will be used for hydrant system operation following construction. Crane mats, small bulk bag and sand bag coffer dams, and turbidity curtains will be used to isolate the access alignment from any active river flow as needed, and also to isolate the areas of dry hydrant intake location. If active flow areas are required to be isolated from the main river flow, fish relocation will be performed in concert with exclusion barrier construction. Preliminary excavation of the areas proposed for the hydrant intakes will then occur, which will lead to determination of the final locations for the hydrant intakes. Based on observations of the drained impoundment in summer 2016, due to the presence of variable ledge in areas of the former impoundment, it is expected that the preliminary excavation will lead to determination of the final, most opportune location for the hydrant intakes. This preliminary excavation will also facilitate determination of whether the supplemental boulders mentioned above will be installed.

Once the location is finalized, the remaining hydrant intake excavations and associated pipe trenches will be completed. Instream excavation areas will be isolated from the surrounding area by coffer dams. Once the coffer dams are installed, the area within the dams will be surveyed to determine that no fish are present within them. Any fish located within the dams will be relocated to parts of the reach outside of the construction area. The coffer dams will then be pumped dry. Water removed from the coffers will be pumped to upland sediment basins constructed of hay bales lined with geotextile fabric and allowed to passively filter over land. The piping system will then be assembled, and backfilled. If deemed necessary, the supplemental boulders would be constructed by a combination of work zone exclusion and wet construction using clean alluvial materials (boulders, plus clean cobbles and gravel for bedding as needed). Bank stabilization associated with the hydrants as shown on the hydrant plans will also be completed at this time as deemed necessary, using the same work area isolation techniques as described above to prevent sediment from entering the river.

Ultimately, the active work zone will be tailored to specific site conditions. In some instances, there may not be interaction between flow and exposed sediment due to low impoundment levels, requiring only sand bags and/or bulk bags to distinguish between the active work zone and active stream flow or similarly sensitive areas. Construction of the dry hydrant system and intakes will require removal of a combination of accumulated sediment, river alluvium, and selected ledge. Accumulated sediment and river alluvium will be excavated with a hydraulic excavator, while the ledge will by shaped by hydraulic hammer.

Remaining Site Improvements
Following completion of the work described above that is within or directly adjacent to the former impoundment or active flowing stream, the remaining site improvements will be completed. If any of this work requires ground disturbance adjacent to the active flowing stream, BMPs will be utilized to maintain separation and prevent discharge of soil or sediment-laden water to the river. The site improvements are outside of the high water mark and consist of stabilizing two old mill foundation walls, construction of a small viewing platform, and installation of a kiosk describing the mill history and fisheries of the river.

Mitigation/Minimization Efforts
Prior to the demolition of the Coopers Mills Dam, site preparation will initiate with the establishment of an ingress, egress and staging area for construction equipment. The

impoundment will be drawn down by modifying the operation of the Denil fish ladder at river left and the low-level gates within the right abutment, all as described above. The maximum rate of drawdown of the impoundment will not exceed 0.5 feet per hour, and 2 feet per day. It is anticipated that it will take 48 hours to draw down the impoundment. Rates will be reduced as required to reduce turbidity and maximize drainage and drying of exposed sediments. River flows will be maintained throughout the project; water diversions will redirect the flow of water to allow construction to occur in the dry to reduce sedimentation and turbidity.

Fish relocation will be performed as necessary in isolated areas. MDMR will be either on site (during drawdown and coffer dam placement) or on call and available during all construction activities in the event any Atlantic salmon are observed. If this occurs at any point during construction, activities will cease, and contractors will contact the oversight engineer and the Atlantic Salmon Federation. ASF will coordinate with NMFS and MDMR on the removal of ESA listed Atlantic salmon.

2.1. 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 encompasses all areas where both the direct and indirect effects of the proposed action would affect listed species and critical habitat.

The Coopers Mills Dam is located approximately 0.5 mile below Long Pond surrounded by various ledges, outcrops and drops and is the second dam on the mainstem Sheepscot River from the ocean. The current condition of the dam limits fish passage and creates a small impoundment that directly effects water quality and riverine habitat. The riverine impoundment is approximately 750 foot long and is located on a relatively flat section of the river. The impoundment has altered the instream habitat such that is not fully functioning as Atlantic salmon juvenile rearing and spawning habitat. During this project, the impounded area above the dam will be mostly dewatered with the exception of maintaining a continuous run of the river flow that will be redirected during construction to work in the dry. The estimated water flows during the year, typically range from 20-30 cubic feet per second (CFS) however, during the in-water work window, flows typically drop. For example, in September 2016, the flows dropped to 4.5 CFS. The action area for this project includes the impounded reach above the dam where the dry hydrant intakes will be installed, in addition to an area approximately 30 meters immediately below the dam.

3. STATUS OF AFFECTED SPECIES AND CRITICAL HABITAT IN THE ACTION AREA

While threatened and endangered Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) and endangered shortnose sturgeon (*Acipenser brevirostrum*) occur in the lower Sheepscot River, these species are not known to pass the Head Tide Dam (located downstream of the Coopers Mills Dam) and therefore, do not occur in the action area. Thus, sturgeon will not be considered in this consultation.

We have determined that the following endangered or threatened species may be affected by the proposed action:

Fish

Gulf of Maine DPS of Atlantic salmon Endangered

Critical Habitat

Designated for the Gulf of Maine DPS of Atlantic salmon

This section will focus on the status of Atlantic salmon and critical habitat 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

The combination of dams and poor fish passage has led to a decrease in salmon productivity in the Sheepscot river. The current production of Atlantic salmon juveniles is occurring below the Coopers Mill Dam in accessible habitat because there is currently no stocking of hatchery reared fish and no natural production occurring above the Coopers Mill Dam. However, prior to 2012, fry and parr were stocked above the dam as well as some returning adults may have spawned in suitable spawning habitat above the site. Overall, the presence of juveniles in the lower mainstem of the Sheepscot River relies mostly on hatchery stocked fish with only a few adults returning annually to spawn.

Documented adult returns to the Sheepscot river have been extremely low and from 1967 through 2006 less than 400 adult wild fish have returned to spawn over this time period. Of these, 30 fish were 1 SW and 10 were 3SW the remainder were 2 SW (USASAC 2017). There were 4 total redds observed in the Sheepscot River in 2016, all of which were in the mainstem below the action area. There were 16 redds in 2017. The number of redds observed was a decrease from previous years. The total population estimate for all smolts exiting the Sheepscot River (hatchery 0+ parr origin and wild/naturally reared origin) was 2,924 ± 262. The hatchery smolt population estimate was calculated 2,007 ± 257. The wild smolt population estimate was 983 ± 113 (USASAC 2017).

3.1.1. Gulf of Maine DPS of Atlantic Salmon

The Atlantic salmon is an anadromous fish species that spends most of its adult life in the ocean but returns to freshwater to reproduce. The Atlantic salmon is native to the North Atlantic Ocean, from the Arctic Circle to Portugal in the eastern Atlantic, from Iceland and southern Greenland, and from the Ungava region of northern Quebec south to the 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 current GOM DPS includes all anadromous Atlantic salmon whose freshwater range occurs in the watersheds from the Androscoggin River northward along the Maine coast to the Dennys River, and wherever these fish occur in the estuarine and marine environment. The following impassable falls delimit the upstream extent of the freshwater range: Rumford Falls in the town of Rumford on the Androscoggin River; Snow Falls in the town of West Paris on the Little Androscoggin River; Grand Falls in Township 3 Range 4 BKP WKR on the Dead River in the Kennebec Basin; the un-named falls (impounded by Indian Pond Dam) immediately above the Kennebec River Gorge in the town of Indian Stream Township on the Kennebec River; Big Niagara Falls on Nesowadnehunk Stream in Township 3 Range 10 WELS in the Penobscot Basin; Grand Pitch on Webster Brook in Trout Brook Township in the Penobscot Basin; and Grand Falls on the Passadumkeag River in Grand Falls Township in the Penobscot Basin. The marine range of the GOM DPS extends from the Gulf of Maine, throughout the Northwest Atlantic Ocean, to the coast of Greenland.

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

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

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

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

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

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

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

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

The spring migration of post-smolts out of the coastal environment is generally rapid, within several tidal cycles, and follows a direct route (Hyvarinen *et al.* 2006, Lacroix and McCurdy 1996, Lacroix *et al.* 2004). Post-smolts generally travel out of coastal systems on the ebb tide and may be delayed by flood tides (Hyvarinen *et al.* 2006, Lacroix and McCurdy 1996, Lacroix *et al.* 2004, Lacroix and Knox 2005). Lacroix and McCurdy (1996), however, found that post-smolts exhibit active, directed swimming in areas with strong tidal currents. Studies in the Bay of Fundy and Passamaquoddy Bay suggest that post-smolts aggregate together and move near the coast in "common corridors" and that post-smolt movement is closely related to surface currents in the bay (Hyvarinen *et al.* 2006, Lacroix and McCurdy 1996, Lacroix *et al.* 2004). European post-smolts tend to use the open ocean for a nursery zone, while North American post-smolts appear to have a more near-shore distribution (Friedland *et al.* 2003). Post-smolt distribution may reflect water temperatures (Reddin and Shearer 1987) or the major surface-current vectors (Lacroix and Knox 2005). Post-smolts live mainly on the surface of the water column and form shoals, possibly of fish from the same river (Shelton *et al.* 1997).

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

3.1.2. Status and Trends of the Gulf of Maine DPS of Atlantic Salmon

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 2). 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).

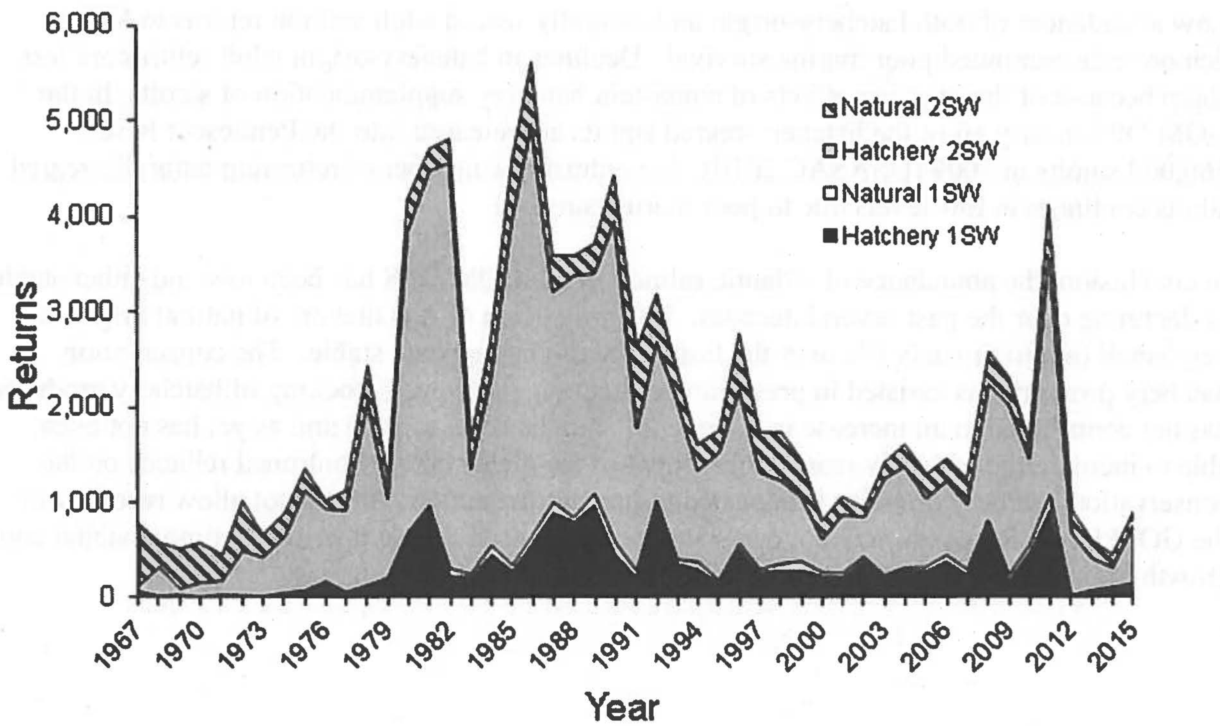

Figure 2. Adult returns to the GOM DPS Rivers between 1967 and 2017 (Fay *et al.* 2006, USASAC 2001-2017).

Contemporary abundance estimates are informative in considering the conservation status of the

GOM DPS today. After a period of population growth in the 1980s, adult returns of salmon in the GOM DPS declined steadily between the early 1990s and the early 2000s but have been increasing again over the last few years. The population growth observed in the 1980s 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.

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 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 preventing extinction. 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 is expected to prevent extinction but will not allow recovery of the GOM DPS. Recovery will not occur without increased access to critical salmon habitat and growth of naturally reared salmon populations.

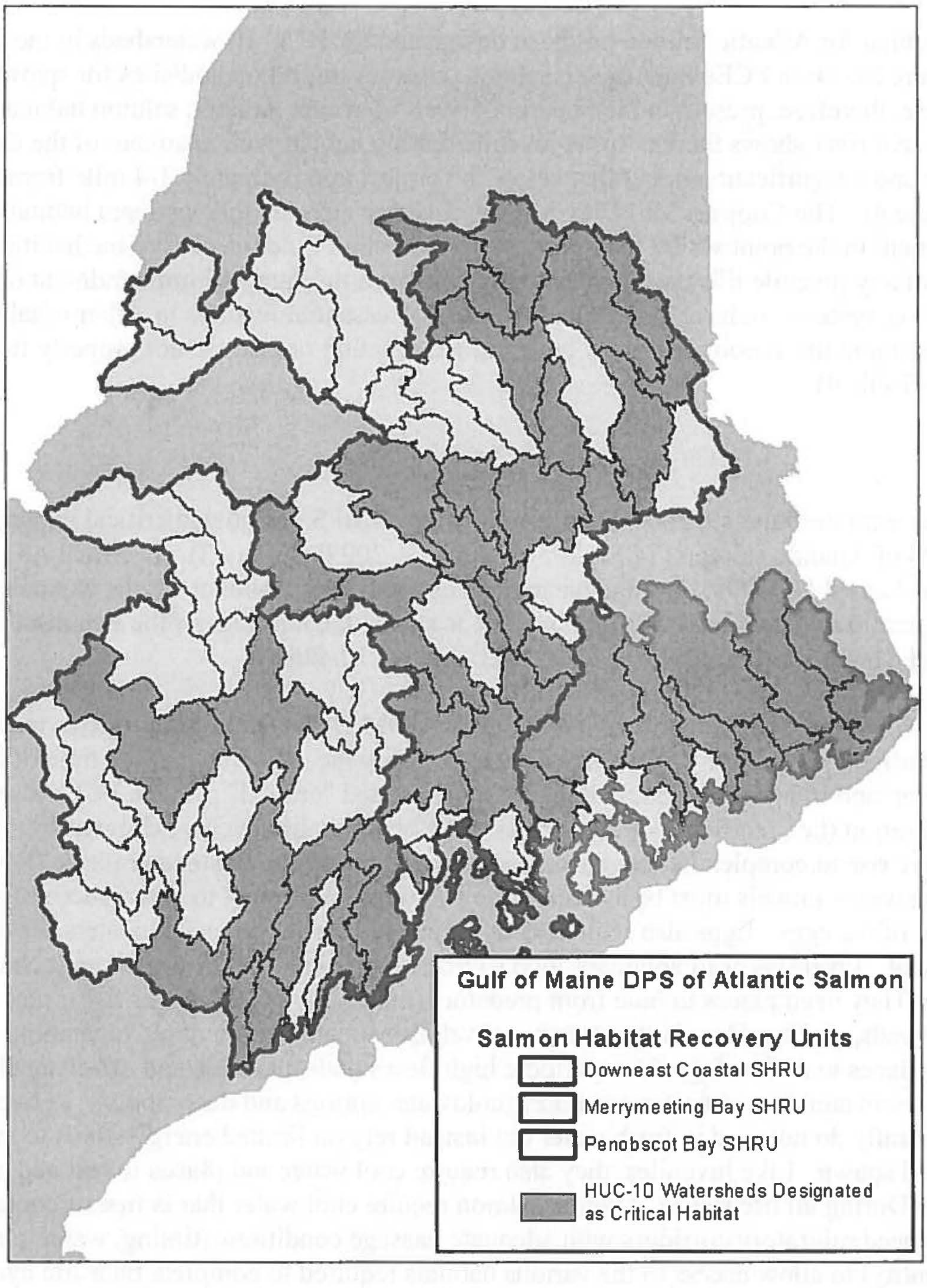

Figure 3. The Gulf of Maine DPS of Atlantic salmon and the three salmon habitat recovery units with HUC 10 Watersheds Designated as Critical Habitat.

3.2. Critical Habitat for Atlantic Salmon

Critical Habitat in the action area

Critical habitat for Atlantic salmon has been designated for HUC 10 watersheds in the GOM DPS (Figure 2). Both PCEs for Atlantic salmon (sites for migration and sites for spawning and rearing) are, therefore, present in the Sheepscot river. A recent Atlantic salmon habitat survey of the Sheepscot river shows there is some juvenile rearing habitat well upstream of the Coopers Mill Dam and a significant amount just below the project approximately 1/4 mile from the action area (Figure 4). The Coopers Mill Dam has significantly affected the upstream habitat within the impoundment to the point where the impoundment does not function as riverine habitat and does not support any juvenile life stages. Due to impacts from the dam and impoundment on a free flowing river system, we have determined that several essential features to Atlantic salmon critical habitat in the action area likely have limited function or else are not properly functioning currently (Table 4).

Critical Habitat 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 3). The final rule was revised on August 10, 2009. In this revision, designated critical habitat for the expanded GOM DPS of Atlantic salmon was reduced to exclude trust and fee holdings of the Penobscot Indian Nation and a table was corrected (74 FR 39003; August 10, 2009).

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

Primary Constituent Elements of Atlantic Salmon Critical Habitat

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

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

<u>Physical and Biological Features of the Spawning and Rearing PCE</u>

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.

<u>Physical and Biological Features of the Migration PCE</u>

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.

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

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

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

Salmon Habitat Recovery Units within Critical Habitat for the GOM DPS

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

<u>Downeast Coastal SHRU</u>

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

Penobscot Bay SHRU

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

Merrymeeting Bay SHRU

The Merrymeeting Bay SHRU drains approximately 2,691,814 hectares of land (6,651,620 acres) and contains approximately 339,182 units of spawning and rearing habitat for Atlantic salmon located among approximately 5,950 kilometers 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 kilometers of perennial river, stream, and estuary habitat and 799 square kilometers 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 kilometers of river, stream, and estuary habitat and 100 square kilometers of lake habitat have been excluded from critical habitat pursuant to section 4(b)(2) of the ESA.

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 3). 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.

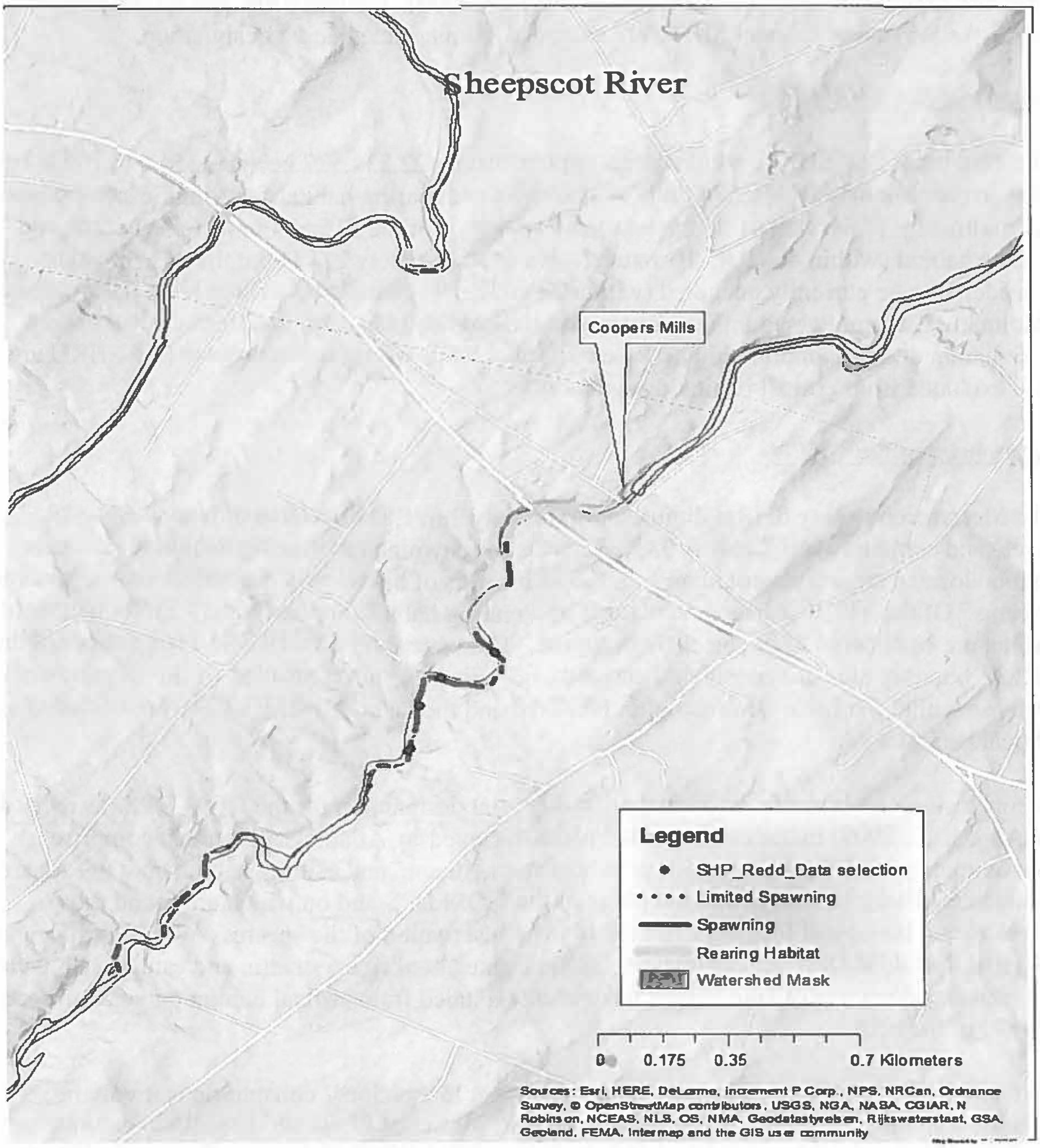

Figure 4. Sheepscot River Atlantic salmon mapped spawning and rearing habitat. Red areas of the river show Atlantic salmon spawning (16 redds) in 2017.

Table 3. Matrix of Primary Constituent Elements (PCEs) and essential features for assessing the environmental baseline of the action area.

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

Table 3 continued…

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

Table 3 continued…

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

Table 4. The assumed condition 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	Upstream passage delays and inefficiencies limit access to spawning habitat.	Adult abundance and productivity,
Habitat Elements, Channel Dynamics, Watershed Condition	Adult, incubating eggs, juvenile, smolt	Freshwater migration, spawning, and rearing	Impoundments degrade spawning and rearing habitat, increase predation, limit productivity, and delay migrations.	Adult abundance and productivity Juvenile growth rate
Water Quality	Adult, juvenile, incubating eggs	Freshwater spawning and rearing	Impoundments degrade spawning and rearing habitat.	Adult abundance and productivity Juvenile growth rate

3.2.1. Factors Affecting Atlantic salmon in the Action Area

3.2.1.1. Dams

According to Fay *et al.* (2006), the greatest impediment to self-sustaining Atlantic salmon populations in Maine is obstructed fish passage and degraded habitat caused by dams. In addition to direct loss of production in habitat from impoundment and inundation, dams also alter natural river hydrology and geomorphology, interrupt natural sediment and debris transport processes, and alter natural temperature regimes (Wheaton *et al.* 2004). These impacts can have profound effects on aquatic community composition and adversely affect entire aquatic ecosystem structure and function. Furthermore, impoundments can significantly change the prey resources available to salmon due to the existing riverine aquatic communities upstream of a dam site which have been replaced by lacustrine communities following construction of a dam. Anadromous Atlantic salmon inhabiting the GOM DPS are not well adapted to these artificially created and maintained impoundments (NRC 2004). Conversely, other aquatic species that can thrive in impounded riverine habitat will proliferate, and can significantly change the abundance and species composition of competitors and predators.

The Coopers Mill Dam on the Sheepscot River is the second dam on the mainstem from the ocean. The current condition of the dam limits fish passage and creates a small impoundment that directly effects water quality and riverine habitat.

Fish Passage

The Coopers Mill Dam can prevent or impair fish passage of Atlantic salmon and other diadromous fish species both upstream and downstream of the dam. Only under certain high flow conditions would salmon and other species be able to pass through the action area due to inefficient fish passage facilities. In addition, the first barrier to migration, the Head Tide dam is located further downstream of the action area and impairs fish passage during certain flow conditions. The combination of dams and poor fish passage has led to a decrease in salmon productivity in the Sheepscot river. Overall, the presence of juveniles in the Sheepscot River relies mostly on hatchery stocked fish with only a few adults returning annually to spawn.

Migratory Delay and Timing

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

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

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

3.2.1.2. Predation

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

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

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

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

3.2.1.3. Contaminants and Water Quality

Pollutants discharged from point sources affect water quality within the action area of this consultation. Common point sources of pollutants include publicly operated waste treatment facilities, overboard discharges (OBD), and industrial sites and discharges. The Maine Department of Environmental Protection (DEP) issues permits under the National Pollutant Discharge Elimination System (NPDES) for licensed point source discharges. Conditions and license limits are set to maintain the existing water quality classification. Generally, the impacts of point source pollution are greater in the larger rivers of the GOM DPS. The DEP has a schedule for preparing a number of Total Maximum Daily Load (TMDL) analyses for rivers and streams within the GOM DPS. TMDLs allocate a waste load for a particular pollutant for impaired waterbodies.

3.2.2. Summary of Factors Affecting Recovery of Atlantic Salmon

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

Threats to the Species

The recovery plan for the previously designated GOM DPS (NMFS and USFWS 2005), the latest status review (Fay *et al.* 2006), and the 2009 listing rule all provide a comprehensive assessment of the many factors, including both threats and conservation actions, that are currently affecting the status and recovery of listed Atlantic salmon. The USFWS and NMFS 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
- Conservation 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 difficult to assess in the wild and therefore is primarily documented at conservation hatcheries, fish culture facilities and commercial 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. he 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 direct genetic effects from farmed salmon escapees interbreeding with wild salmon still exist.

Threats to Critical Habitat within the GOM DPS

The final rule designating critical habitat for the GOM DPS identifies a number of activities that have and will likely continue to impact the biological and physical features of spawning, rearing, and migration habitat for Atlantic salmon. These include agriculture, forestry, changing land-use and development, hatcheries and stocking, roads and road-crossings and other instream activities (such as alternative energy development), mining, dams, dredging, and aquaculture. Most of these activities have or still do occur, at least to some extent, in each of the three SHRUs.

Today, dams are the greatest impediment, outside of marine survival, to the recovery of salmon in the Penobscot, Kennebec and Androscoggin river basins (Fay *et al.* 2006). Hydropower dams in the Merrymeeting Bay SHRU significantly impede the migration of Atlantic salmon and other diadromous fish and either reduce or eliminate access to roughly 330,000 units of historically accessible spawning and rearing habitat. In addition to hydropower dams, agriculture and urban development largely affect the lower third of the Merrymeeting Bay SHRU by reducing substrate and cover, reducing water quality, and elevating water temperatures. Additionally, smallmouth bass and other non-indigenous species such as brown trout introductions, significantly degrade habitat productivity throughout the Merrymeeting Bay SHRU by altering natural predator/prey relationships.

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

Efforts to Protect the GOM DPS and its Critical Habitat

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

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

A wide variety of activities have focused on protecting Atlantic salmon and restoring the GOM

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

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

Atlantic salmon parr and adults may occur in the action area. It is extremely unlikely that fry will be present in the action area during construction for several reasons. This is because we do not expect any spawning occurred upstream of the dam (due to a lack of passage) in 2017 and therefore there was not any reproduction that could result in fry in 2018. Further, there was no fry stocking in the project area or upstream in 2018.

However, given the presence of freshwater rearing habitat in close proximity to the dam we expect that parr may occur in the action area below the dam and, due to the maintenance of a zone of passage during construction. Consequently, parr may migrate through the action area during the work window. Parr may be present from adults that spawned in the river or from hatchery fry and/or eggs that are stocked by Maine DMR. Because there is no spawning or stocking occurring above the dam, there are no smolts to move downstream past the project; further, the project will take place outside the time of year when smolts migrate downstream in Maine rivers.

Given recent adult returns to the Sheepscot River, where very few adults passed upstream of the Coopers Mill dam to spawn successfully, we would expect very few adults returning to the river in general and even fewer fish to be motivated to swim into the project area in 2018. Any adult that enters the Sheepscot river and successfully passes upstream of the Head Tide Dam would have the opportunity to move into or migrate through the project area. Most of the adult Atlantic salmon entering the Sheepscot river prefer to hold in cooler water temperatures and typically have been observed resting in the lower mainstem river where the west branch converges. However, in the past (only one year) adults were observed holding in the area just below the Coopers Mills Dam just downstream of the Denil fishway, perhaps waiting to ascend the fishway and pass upstream of the dam. When water temperatures start to decline in the fall, adults will migrate during periods of increased flow from seasonal rains. Typically, during the summer months July-late September, adults will hold in areas of the river where there are cold springs located at the confluence of the west branch, above Head Tide dam and well below the action area. The summer work window does not coincide with the migratory window for adults. As such, we would not anticipate adults would be migrating during the summer when warmer water temperatures reduces their urge to migrate. We do not expect any other holding or resting behavior to occur in the action area and expect adults to be using the rest of the action area just for migratory movements on their way upstream. There is no suitable spawning habitat in the action area. Based on this information, while considering that the number of adults potentially present in the action area is very small, we will also consider effects of the action on adults.

4. ENVIRONMENTAL BASELINE

The Environmental Baseline provides a snapshot of a species health or status at a given time within the action area and is used as a biological basis upon which to analyze the effects of the proposed action. Assessment of the environmental baseline includes an analysis of the past and present impacts of all state, federal, or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR 402.02). An environmental baseline that does not meet the biological requirements of a listed species may increase the likelihood that adverse effects of the proposed action will result in jeopardy to a listed species or in destruction or adverse modification of designated critical habitat.

For all GOM DPS rivers in Maine, current Atlantic salmon populations (including hatchery contributions) are well below CSE levels required to sustain themselves (Fay *et al.* 2006), which is further indication of their poor population status. The abundance of Atlantic salmon in the GOM DPS has been low and either stable or declining over the past several decades. 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.

The Coopers Mill dam can prevent or impair fish passage of Atlantic salmon and other diadromous fish species both upstream and downstream of the dam. During typical summer flow conditions, leaks in the existing dam allow the head pond to drop to a level below the opening to the fishway, thus effectively dewatering the entire fishway. Currently, only under certain flow conditions can salmon and other species pass through the action area due to inefficient fish passage facilities. In addition, the first barrier to migration, the Head Tide Dam is located further downstream of the action area and impairs fish passage during certain low flow conditions.

A number of activities within the Sheepscot River drainage will likely continue to impact the biological and physical features of spawning, rearing, and migration habitat for Atlantic salmon. These include agriculture, forestry, changing land-use and development, hatcheries and stocking, roads and road-crossings and other instream activities (such as alternative energy development), mining, dams, dredging, and aquaculture. Existing dams have contributed to degraded substrate and cover, water quality, water temperature, and changed biological communities, which have reduced the quality and quantity of habitat available to Atlantic salmon populations within the Sheepscot River resulting in a decrease in productivity and abundance of juvenile life stages. In the recent past, the number of adults returning to the Sheepscot River has been very small and limited stocking has occurred. However, the Atlantic salmon in the Sheepscot River are one of only seven remaining locally adapted stocks, making this population, despite its small size, very important to the survival and recovery of the Merrymeeting Bay SHRU and the GOM DPS as a whole.

The action area for this consultation includes the aquatic habitat immediately above and below the present dam site. However, due to the impoundment and existing dam, the current condition of Atlantic salmon critical habitat within the action area is impacted to the level that is not fully functional (Table 4). Therefore, in order to complete the jeopardy and destruction or adverse modification of critical habitat analyses in this Opinion, we made several determinations regarding the environmental baseline in the action area chosen for this dam removal project. These include the following: 1) overall abundance of Atlantic salmon is very low and is orders of magnitude lower than historic abundance levels; 2) the percentage of naturally reared fish versus those from hatchery supplementation efforts is low throughout the drainage; 3) low marine survival is negatively affecting the entire GOM DPS and contributing to low numbers of adult returns to all rivers; 4) Atlantic salmon abundance in the project's action area will vary annually depending on the location relative to ongoing conservation hatchery stocking locations and known spawning activity; 5) throughout the GOM DPS access to and quality of salmon habitat is often affected by dams limiting the current function of migration, spawning and rearing habitats; and 6) the current project's action area is experiencing some degradation of aquatic habitat function as a result of the existing dam (Table 4).

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

In the Environmental Baseline section of an Opinion, we discuss the anticipated impacts of all proposed Federal actions in the action area that have already undergone formal or early section 7 consultation. We have not completed any formal or early section 7 consultations for other activities in the action area.

4.2. Scientific Studies

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

USFWS is also authorized under an ESA section 10 endangered species blanket permit to conduct the conservation hatchery program at the Craig Brook and Green Lake National Fish Hatcheries. The mission of the hatcheries is to raise Atlantic salmon parr and smolts for stocking into selected Atlantic salmon rivers in Maine. Over 90% of adult returns to the GOM DPS are currently supported through production at the hatcheries. Approximately 20,000 eggs are planted annually in the Sheepscot River annually. The hatcheries help to ensure that the species does not go extinct.

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 Sheepscot River permitted by the USACE. 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.

State of Maine stocking program

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

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. While there are hydroelectric projects in the Merrymeeting Bay SHRU there are none on the Sheepscot River or in the action area.

5. CLIMATE CHANGE

The discussion below presents background information on global climate change and information on past and predicted future effects of global climate change throughout the range of the listed species considered here. 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.

5.1. Background Information on Global climate change

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

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

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

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

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

While debated, researchers anticipate: 1) the frequency and intensity of droughts and floods will change across the nation; 2) a warming of about 0.2°C (0.4°F) per decade; and 3) a rise in sea level (NAST 2000). A warmer and drier climate will reduce stream flows and increase water temperature resulting in a decrease of DO and an increase in the concentration of nutrients and toxic chemicals due to reduced flushing. Sea level is expected to continue rising: during the 20th century global sea level has increased 15 to 20 centimeters (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 river catchments where salmon are found are heavily populated and have already been affected by a range of stresses associated with agriculture, industrialization, and urbanization (Elliot *et al.* 1998). Climate effects related to temperature regimes and flow conditions determine juvenile salmon growth and habitat (Friedland 1998). One study conducted in the Connecticut and Penobscot rivers, where temperatures and average discharge rates have been increasing over the last 25 years, found that dates of first capture and median capture dates for Atlantic salmon have shifted earlier by about 0.5 days/ year, and these consistent shifts are correlated with long-term changes in temperature and flow (Juanes *et al.* 2004). Temperature increases are also expected to reduce the abundance of salmon returning to home waters, particularly at the southern limits of Atlantic salmon spatial distribution (Beaugrand and Reid 2003).

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, and may increase 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 may cause increased deformities and premature emergence of fry which could result in decreased survival.

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° C), 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 resulting in poor survival. However, during the construction period (i.e., summer of 2018), we do not expect climate change to result in any impacts to Atlantic salmon or the habitat in the action area that have not been considered in the Status of the Species or the Environmental Baseline. The removal of the Coopers Mills Dam will improve connectivity in the Sheepscot River watershed; improved access to upstream habitats is expected to improve the resiliency of the Gulf of Maine DPS in light of a changing climate.

6. EFFECTS OF THE ACTION

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

Removing dams in the GOM DPS will benefit endangered Atlantic salmon. Following the removal of a dam, Atlantic salmon adults and smolts would no longer experience fish passage delays, injury or death related to interactions with the Coopers Mill Dam. Adult Atlantic salmon returning to spawn would no longer have their migration obstructed, nor would they be subjected to migratory delay and potential injury associated with navigating a fishway. Atlantic salmon smolts would no longer experience delays, injury, and death due to an ineffective downstream fishway. Salmon often concentrate at the base of dams, making them more vulnerable to predation or fishing, and this impact would also be removed or reduced. Dam removals would improve spawning, incubation, and juvenile rearing habitat by increasing dissolved oxygen, reducing water temperatures, and releasing stored nutrients from the impoundment and by changing formerly impounded upstream reaches into more productive riffle and run habitat with improved cover and substrate. The reduction of warm, impounded water would also make the site less suitable to warm water and non-native fish species (i.e., chain pickerel, largemouth bass, black crappie) that may compete and/or prey on Atlantic salmon.

Dam removals are expected to result in riparian and instream plant community changes at each site. These effects would occur both upstream and downstream of the former dam and would depend on a number of factors, including size of the stream, barrier, and impoundment; stream discharge; dewatered sediment grain size and composition; and geomorphic characteristics of the stream channel and valley (Collins *et al.* 2007). Potential effects are numerous and include increases in forested and shrub-dominated riparian vegetation, loss of emergent plants and submerged aquatic vegetation after dewatering impounded water, and increased downstream seed dispersal via stream flow (Collins *et al.* 2007). Dam removal would increase recruitment of large woody debris from upstream sources, which would increase instream habitat diversity and complexity for plants, macroinvertebrates, and fish. Effects on riparian and instream habitat from dam removal would generally be beneficial, by restoring ecological process and conditions that existed prior to dam construction.

While the outcome of this action will be beneficial, improve the baseline, increase the quality and quantity of available habitat, improve connectivity, and reduce risk to salmon in the Sheepscot River, there will be short-term effects experienced during dam removal activities which may negatively affect Atlantic salmon and their habitat. Those effects are considered here. These activities will affect the GOM DPS of Atlantic salmon as well as designated critical habitat. The sections that follow present our analysis of the following: (1) construction activities associated with the removal of the dam structure and installation of the two dry hydrant intakes, and (2) the long term operation of a dry hydrant.

6.1. Construction Effects

6.1.1. Cofferdams, Dewatering, and Fish Relocation

Isolation of a stream work area within a cofferdam is a conservation measure intended to minimize the overall adverse effects of construction activities on aquatic species including Atlantic salmon and their habitat. Dewatering of stream habitat inside a cofferdam could have a lethal effect on any fish within the enclosed area. To avoid the death of fish caught inside a cofferdam as a result of dewatering, qualified biologists with MDMR will capture and remove all Atlantic salmon and other fish species. During drawdown and during coffer dam installation, the MDMR will be present to collect and enumerate fish, including Atlantic salmon, if present. MDMR biologists will use electro-fishing gear to capture and remove any fish isolated from the main flow (i.e., within coffer dams or ledge outcrops) that may be present. The MDMR will follow all protocols to safely capture and handle all Atlantic salmon as described in the Electro-Fishing Wadeable Stream guidelines (MDMR 2005). Capturing and handling salmon can cause physiological stress and lead to physical injury or death, including cardiac or respiratory failure from electrofishing (Snyder 2003). Studies have shown that all aspects of fish handling are stressful and can lead to immediate or delayed mortality (Murphy and Willis 1996) when fish are handled roughly, not properly restrained, sedated during handling, or kept out of the water for extended periods. Fish injured during handling, in association with a disease epizootic, typically die within one to fourteen days. Examples of injuries that can lead to disease problems are loss of mucus, loss of scales, damage to the integument, and internal damage.

Despite precautions, some mortality is possible during the removal of fish from within cofferdams. The MDMR annually reports juvenile salmon mortality rates associated with electrofishing activities in GOM DPS waters. While the MDMR usually handles a few thousand juvenile salmon each year during electrofishing, mortalities are usually less than two percent of total fish captured. From 2001-2009, MDMR's electrofishing mortality during young of the year (YOY) and parr population estimation and broodstock collection has ranged from 3.33% (2001) to 0.82% (2006) with an average mortality rate of 1.70% for both life stages combined over that period (Trial 2010). The vast majority of the mortality is to YOY.

Baum (1997) reported that Maine Atlantic salmon rivers support, on average, between five and ten parr per 100 m^2 of habitat (or one salmon habitat unit), based on data collected by the MDMR. MDMR calculated juvenile salmon densities within multiple rivers within all three SHRUs in the GOM DPS (Table 5). The five-year (2006-2011) GOM DPS average for juvenile Atlantic salmon median densities is 10.3 salmon/100 m^2. These data were obtained from electrofishing efforts in many streams and rivers located in watersheds throughout the GOM DPS and represent the best available scientific information to assist in determining the number of juvenile Atlantic salmon that are likely to be displaced or collected and relocated when a portion of a stream is dewatered within a cofferdam.

Table 5. Median juvenile (salmon/100 m^2) Atlantic salmon densities sampled from within streams and rivers in the GOM DPS by MDMR between 2006 and 2011 (USASAC 2012).

	GOM DPS	Downeast Coastal	Merrymeeting Bay	Penobscot Bay
2006	2.5	5.7	1.6	0.2
2007	4.8	10.2	4.3	0.0
2008	13.7	10.6	3.8	26.6
2009	19.4	11.4	9.1	37.7
2010	12.0	13.2	5.2	17.8
2011	9.3	6.2	10.5	11.1
Average	**10.3**	**9.6**	**5.8**	**15.6**

Projects such as this one that use cofferdams to isolate instream work areas potentially could capture some juvenile Atlantic salmon within the cofferdam areas. While we expect the presence of Atlantic salmon juveniles (i.e., parr) in the action area to be largely limited to areas below the dam, the presence of suitable rearing habitat further upstream and in close proximity downstream of the dam, and the maintenance of a zone of passage throughout the project period, means that there could be movement of some juvenile salmon through the project area during construction Although, we would not anticipate any parr movements to occur during the work window due to warmer water temperatures.

Capture and relocation of juveniles during cofferdam construction and dewatering could result in injury and/or mortality of those individuals. The number of juveniles likely to be captured, and potentially injured, or killed can be quantified based on the estimated area affected and the SHRU-specific median densities (Table 5) that may occur during capture and relocation. It is difficult to precisely predict how much instream habitat that will be isolated in this project based on different characteristics (i.e. width of channel, ledge and flow conditions, channel morphology, size of dam) that will define the area required for construction. For dam removals, it is conservatively assumed that no more than three habitat units of instream habitat would be affected, based on a maximum distance of 30 meters downstream of the dam, and an assumed 10 meter stream width. However, as we anticipate that between one and three habitat units will be affected for this project in some way, only approximately two habitat units would be temporarily coffer dammed and dewatered.

It is assumed that for this project all juvenile salmon within the cofferdam would be subject to some level of stress during the capture and relocation process. The number of injuries or mortalities can be quantified based on SHRU-specific estimates of juvenile densities, as well as the estimated mortality that may occur during capture and relocation. Based on the best available information, we assume that no more than 1.70% of the salmon that are captured will suffer injury or death (Trial 2010).

The median juvenile (YOY and parr) density in the Merrymeeting Bay SHRU between 2006 and 2011 ranged between 1.6 and 10.5 juveniles/unit (average of 5.8 juveniles/unit) based on sampling conducted by MDMR in several rivers (USASAC 2012). Assuming this average density, we anticipate that up to 12 juvenile Atlantic salmon (5.8 juveniles/unit x 2 habitat units affected) may be trapped within the cofferdam, exposed to electrofishing and subsequent handling, and removed from the cofferdam.

Given a 1.70% mortality rate, it is expected that very few juvenile salmon will be killed. Given the low expected mortality rate, we anticipate that no more than one (1.7% x 12 fish = 0.204 fish) juvenile salmon will be injured or killed.

Given recent adult returns to the Sheepscot River, where very few passed upstream of the Coopers Mill dam to spawn successfully, we would expect very few adults returning to the river in general and even fewer fish to be motivated to swim into the project area in 2018. Any adult that successfully passes upstream of the Head Tide Dam would have the opportunity to move into or migrate through the project area. However, we know that adults prefer to hold in cooler water temperatures and have been observed resting in the lower mainstem river where the west branch converges. Because of this, we would expect that any adult Atlantic salmon in the area where the dam is being removed and cofferdams are being constructed will not be holding or resting but will be quickly moving through the area; daily observations will be made to ensure no adults are in the action area. As such, we expect the risk of entrapment to be extremely low. Furthermore, adults may also move away from the work area due to the in-water activity. The combination of these factors make it extremely unlikely that any adult Atlantic salmon will be captured in the cofferdam. Therefore, we do not expect the capture, injury or mortality of any adults.

6.1.2. Water Quality Effects

Sediments and Turbidity

Construction activities associated with the proposed project, including cofferdam construction and removal, access road construction, and the potential removal of accumulated sediments, will temporarily introduce sediment and increase turbidity downstream of the dam. In addition, accumulated sediments in the impoundment could be released downstream following dam removal. While permittees will be required to employ erosion and sedimentation BMPs to prevent and minimize erosion and sedimentation during construction, some release of fine materials and turbidity is likely to occur as a result of these in-water activities.

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

Studies of the effects of turbid waters on fish suggest that concentrations of suspended solids can reach thousands of milligrams per liter before an acute toxic reaction is expected (Burton 1993). The studies reviewed by Burton demonstrated lethal effects to fish at concentrations of 580 mg/L to 700,000 mg/L depending on species. However, sublethal effects have been observed at substantially lower turbidity levels. Behavioral avoidance of turbid waters may be one of the most important effects of suspended sediments (DeVore *et al.* 1980, Birtwell *et al.* 1984, Scannell 1988). Salmonids have been observed to move laterally and downstream to avoid turbid plumes (McLeay *et al.* 1984, 1987, Sigler *et al.* 1984, Lloyd 1987, Scannell 1988, Servizi and Martens 1991). Juvenile salmonids tend to avoid streams that are chronically turbid, such as glacial streams or those disturbed by human activities, except when the fish need to traverse these streams along migration routes (Lloyd *et al.* 1987).

Exposure duration is a critical determinant of the occurrence and magnitude of physical or behavioral effects (Newcombe and MacDonald 1991). Salmonids have evolved in systems that periodically experience short-term pulses (days to weeks) of high suspended sediment loads, often associated with flood events, and are adapted to such high pulse exposures. Adult and larger juvenile salmonids appear to be little affected by the high concentrations of suspended sediments that occur during storm and snowmelt runoff episodes (Bjornn and Reiser 1991). However, research indicates that chronic exposure can cause physiological stress responses that can increase maintenance energy and reduce feeding and growth (Redding *et al.*

1987, Lloyd 1987, Servizi and Martens 1991). In a review of the effects of sediment loads and turbidity on fish, Newcombe and Jensen (1996) concluded that more than six days exposure to total suspended solids (TSS) greater than ten milligrams per liter is a moderate stress for juvenile and adult salmonids and that a single day exposure to TSS in excess of 50 mg/l is a moderate stress.

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

In-water work will primarily be conducted within the confines of dewatered cofferdams; therefore, sediment releases are only anticipated during the drawdown of the impoundment and installation and removal of the dam and cofferdam structures. The drawdown of the impoundment is anticipated to occur over a 48 hour timeframe and during this time increased sediment loads may cause turbidity. Atlantic salmon in the action area may experience turbid waters during dam deconstruction and removal of cofferdams. However, single day TSS levels in excess of 50 mg/l are not anticipated during these activities because: 1) BMPs for erosion and sedimentation control will be employed throughout construction; 2) instream flow will be isolated at the project to direct currents away from the work area: and 3) time of year restrictions (e.g., in stream work window) will minimize impacts to all life stages. Therefore, we do not expect any Atlantic salmon to be injured or killed due to exposure to elevated TSS levels during construction activities. We anticipate construction activities will be completed before the peak migration period resumes in the fall and turbidity levels are expected to have dissipated completely and returned to ambient pre construction conditions. Additionally, as the dam structures are being removed, passage will be maintained for salmon until the project has been completed, therefore, the increase in turbidity associated with construction is not anticipated to affect migration and would be discountable.

Contaminants

Use of heavy equipment near a water body introduces the risk that toxic contaminants (e.g., fuel, oil, etc.) could be released into the waterway. Chemical contaminants can be introduced into waterbodies through direct contact with contaminated surfaces or by the introduction of storm or washwater runoff and can remain in solution in the water column or deposit on the existing bed material. Research has shown that exposure to contaminants can reduce reproductive capacity, growth rates, and resistance to disease, and may lead to lower survival rates for salmon (Arkoosh 1998a, 1998b). The risk for contaminants entering the waterway would increase during construction, possibly degrading habitat condition.

To reduce the potential for introducing contaminants into the waterway during construction activities, the applicant will follow several BMPSs including: a) no equipment, materials, or machinery shall be stored, cleaned, fueled or repaired within any wetland or watercourse; b) dumping of oil or other deleterious materials on the ground will be forbidden; c) the contractor shall provide a means of catching, retaining, and properly disposing of drained oil, removed oil filters, or other deleterious material; and d) all oil spills shall be reported immediately to the appropriate regulatory body. These BMPs will reduce the likelihood of any contaminant releases into the action area during construction activities. As such, the release of contaminants into the action area is extremely unlikely and effects to Atlantic salmon are therefore, discountable.

6.1.3 Acoustic Effects

Noise will be generated by equipment (hoe rams, excavators, etc.) required for the breach of the dam, demolition of stone masonry, concrete structures, and by vehicles operating on the temporary access roads. As the majority of the demolition work will be conducted in the dry, Atlantic salmon exposure to elevated levels of underwater sound/pressure will be minimal because impulse transmission from one medium (air or water) is not easily transmitted across the air/water interface to a different medium (Akamatsu *et. al.* 2002, as referenced *in* Popper 2003).

The Fisheries Hydroacoustic Working Group (FHWG) was formed in 2004 and consists of biologists from NMFS, USFWS, Federal Highway Administration (FHWA), and the California, Washington and Oregon DOTs, supported by national experts on sound propagation activities that affect fish and wildlife species of concern. In June 2008, the agencies signed an MOA documenting criteria for assessing physiological effects of pile driving on fish (FHWG 2008). The criteria were developed for the acoustic levels at which physiological effects to fish could be expected. It should be noted, that these are onset of physiological effects (Stadler and Woodbury 2009), and not levels at which fish are necessarily mortally damaged. These criteria were developed to apply to all species, including several species of Pacific salmon, which are biologically similar to Atlantic salmon, and for these purposes can be considered surrogates. The interim criteria are:

- Peak SPL: 206 decibels relative to 1 micro-Pascal (dB re 1 μPa).
- cSEL: 187 decibels relative to 1 dB re 1μPa2-s for fishes above 2 grams (0.07 ounces).
- cSEL: 183 dB re 1μPa2-s for fishes below 2 grams (0.07 ounces).

At this time, these criteria represent the best available information on the thresholds at which physiological effects to salmon are likely to occur. It is important to note that physiological effects may range from minor injuries, from which individuals are anticipated to completely recover with no impact to fitness, to significant injuries that will lead to death. The severity of injury is related to the distance from the pile being installed and the duration of exposure. The likelihood of significant injury increases the closer the individual fish is to the source and the greater the duration of the exposure.

The existing dam will be demolished using a hydraulic hoe ram. The hoe ram is expected to be the loudest noise source associated with the project. The available information on the noise associated with hoe ramming suggests that the amount of peak noise produced can vary between 150 dB re 1 μPa at 15 meters from the source (FHWA 2008) and 190 dB re 1 μPa at 30 meters away from the source (Dolat 1997). NMFS (2004), in a biological opinion for a bridge replacement project that involved pier demolition with a hoe ram in California, noted that there is a ten-fold decrease in the driving energy delivered by a hoe ram as compared to a pile-driving hammer. During demolition of concrete piers in the Connecticut River, Dolat (1997) measured sound in the water from use of a hoe ram. Peak sound measurements 30 meters from the demolition of a pier without a cofferdam was 190 dB re 1 μPa and for a pier with a cofferdam was 181 dB re 1 μPa. Another set of sound measurements on either side of the cofferdam showed 187 dB re 1 μPa inside and 180 dB re 1 μPa outside of the cofferdam. As demolition of the Coopers Mills Dam will occur in the dry, it is anticipated that noise levels will be on the lower end of this scale (i.e., approximately 150 dB re 1 uPa Peak) given the impulse transmission from air is not easily transmitted across the air/water interface to water (Akamatsu *et. al.* 2002, as referenced *in* Popper 2003) As the peak noise levels expected from the use of a hoe ram in the dry are well below the FHWG thresholds, we do not anticipate any injury or mortality of any Atlantic salmon exposed to noise associated with the dam removal project.

Sound Induced Behavior Modification

The FHWG has not yet provided criteria for sound levels that would affect the behavior of fish and, therefore, might be considered to cause fish to experience behavioral modifications, such as avoidance. For the purposes of this consultation we will use 150 dB re 1 μPa RMS as a conservative indicator of the noise level at which there is the potential for behavioral effects. Noise levels exceeding 150 dB re 1 μPa RMS will not always result in behavioral modifications or that could rise to the level of "take" (i.e., harm or harassment), but there is the potential, upon exposure to noise at this level, to experience some behavioral response. Behavioral responses could range from a temporary startle to avoidance of an ensonified area. Although more research is needed, there are several studies that support this as a conservative threshold for behavioral effects. Observations by Feist *et al.* (1992) suggest sound levels greater than 150 dB may disrupt normal migratory behavior of salmon and steelhead. They observed that salmonids respond by avoiding the area of greatest sound levels and attempt to swim along the opposite side of the channel or along the shoreline furthest away from the active pile driving operation. Turnpenny *et al.* (1994) and Wysocki *et al.* (2007) documented that salmonids exposed to noise levels up to 150 dB re 1 μPa RMS did not exhibit signs of stress. Given these studies, 150 dB re 1 μPa RMS is a conservative estimate of what sound levels might result in behavioral modifications, such as avoidance, by listed Atlantic salmon.

As noted above, the peak noise level associated with even the loudest activity (hoe ram) is expected to be 150 dB re 1 uPa. This is equivalent to an RMS level of approximately 140 dB re 1 uPa (using the conversions in Greene 1997). Because even the noisiest activity is below the noise level that may result in a behavioral response, it is extremely unlikely that any Atlantic salmon exposed to the hoe ramming noise (i.e., swimming through the action area outside of the cofferdam) would exhibit a behavioral response. Therefore, all effects from sound are discountable.

6.2. Effects of Dry Hydrant Installation and Operations

Two low profile river intakes will be installed as part of the dam removal project. The two intakes are replacing an existing instream intake used for water withdrawal to fill fire suppression equipment. The installation of the dry hydrant intake pipes will be done in the dry. The riverbed will be prepared for the placement of the pipe in the streambed anchored by concrete blocks designed to keep the intake from resting directly on the stream bottom. The substrate in the vicinity is mostly ledge with some fine sediment. Since all the work will be done behind a sand bag cofferdam, we anticipate very little turbidity and impacts to water quality from the placement of the structure. Therefore, any potential effects from the installation of the dry hydrants will be insignificant.

The dry hydrant structure will have two intake pipes and will have a perforated screen over each of the instream intake structures. The new intake screens will have ¼" holes providing 99 square inches of open area to reduce pumping velocities to below 2 feet per second (fps) minimizing the risk of juvenile fish getting impinged on the intake head. As noted below, the design conforms with federal guidelines to reduce impingement of fish. The standard operating procedures for pumping also decreases the likelihood that juvenile salmon will not be impinged on the head or entrained in the intake. Accordingly, the typical draw rate of 250gpm (0.557 cfs) (as verified by the Town of Whitefield and the Town of Windsor Fire Chiefs) reduces intake velocities to 0.8 feet per second, well below guidelines recommended by NOAA and USFWS. As such, a 2016 technical report prepared by NOAA, USFWS, and USGS titled, Federal Interagency Nature-like Fishway Passage Design Guidelines for Atlantic Coast Diadromous Fishes, recommended that any velocity below 2.25 fps would not exceed the active swim speeds and therefore would be protective of juvenile salmonids (<=20cm). Additionally, a 2016 USFWS Region 5 Fish Passage Engineering Design Criteria report recommended that hydropower dam trash racks be designed to have a velocity of 1 foot per second or less to be protective of juvenile salmonids. These two studies demonstrate that the two intakes being installed for the dry hydrant with custom designed screened heads to reduce the intake velocity to approximately 0.8 fps will be protective of any juvenile salmon that might be in the vicinity.

Low summer flows in this section of the Sheepscot River are approximately 20 cfs; thus, summer hydrant use of 250 gpm would represent less than 3% of river flow. However, the majority of hydrant use occurs in the winter when flows for this area of the Sheepscot average 200 cfs, with water usage then representing <0.3 % of river flow an estimated 5-10 times per year. The very low flow into the dry hydrants would be unlikely to draw fish into the vicinity of the hydrant intake. This coupled with the low intake velocity (0.8 fps) make it extremely unlikely that any Atlantic salmon will be impinged on the dry hydrant intake. Therefore, effects of installation and operation of the dry hydrant are discountable.

7. ATLANTIC SALMON CRITICAL HABITAT

As discussed in section 3.1.3, critical habitat for Atlantic salmon has been designated in the GOM DPS of Atlantic salmon and the action area falls within the designated critical habitat. The habitat in the action area does not currently function properly for rearing or migration due to the presence of the dam. Within the action area of this consultation, the PCEs for Atlantic salmon include: 1) juvenile rearing habitat and 2) sites for migration. The analysis presented in the status of the species and the environmental baseline shows several habitat indicators are not properly functioning in the action area, and biological requirements of Atlantic salmon are not being met in the action area (Table 4). The removal of the Coopers Mill Dam will improve the habitat and connectivity in the action area.

7.1 Juvenile Rearing Habitat PCE

The essential features identified for juvenile rearing in the action area are:

1) Freshwater rearing sites with space to accommodate growth and survival of Atlantic salmon parr.
2) 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.
3) Freshwater rearing sites with cool, oxygenated water to support growth and survival of Atlantic salmon parr.

Removal of the existing dam may temporarily degrade Atlantic salmon critical habitat as a result of clearing, excavating, grading, filling or other construction activities. These activities could temporarily degrade water quality by increasing turbidity, siltation, and/or altering flows, potentially impacting rearing habitat. However, due to BMPs and State and Federal regulations, these impacts are expected to be minor and temporary and will be limited to the area where the dam is located and the area immediately upstream and downstream of the dam. The project will be beneficial to previously impacted juvenile rearing habitat in the action area and an overall improvement in the function of juvenile rearing habitat that will benefit Atlantic salmon.

Juvenile Rearing-- The fry life stage extends from spring emergence through mid to late summer, and then the parr occupy rearing habitat for two years prior to emigrating to marine waters as smolts. Newly emerged fry prefer shallow, low velocity, riffle habitat with a clean gravel substrate, and parr prefer riffle habitat associated with diverse rough gravel substrate. Habitat occupancy is a function of territoriality, and biotic and abiotic habitat features, including stream morphology, substrate, gradient, and cover; food availability; and the presence of predators and competitors. Cover is needed to buffer extreme temperatures and high flows, and provides protection from predators. Dam removal will improve habitat for juvenile rearing by changing formerly impounded upstream reaches into more productive riffle and run habitat with improved water quality, cover, substrate and drift characteristics.

7.2 Migration PCE

The essential features identified for migration in the action area are:

1) Freshwater and estuary migratory sites free from physical and biological barriers that delay or prevent access of adult salmon seeking spawning grounds needed to support recovered populations;

2) Freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation; and
3) Freshwater and estuary migration sites free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment.

The proposed dam removal is expected to result in an improvement in the action area's ability to function for the migration of Atlantic salmon and improve the value of the habitat for the conservation of the species. The project will: 1) remove the current physical barrier that delays and prevents access of adult salmon seeking to pass to upstream spawning grounds; 2) is expected to result in an increase in the abundance and diversity of the native fish community in the Sheepscot River due to improvements in passage for anadromous species; and 3) remove the current physical barrier that delays or prevents emigration of any downstream migrating smolts to the marine environment. Effects of habitat alterations during dam removal (i.e., presence of the bypass, turbidity and noise) that will affect the migration of Atlantic salmon through the action area will be so small that they cannot be meaningfully measured, evaluated or detected. This is because there will be a zone of passage maintained throughout construction which will allow Atlantic salmon to pass through the project area without a meaningful delay. Therefore, any effects to the value of the action area for migration to the conservation of the species will be so small that they cannot be meaningfully measured, detected or evaluated, and effects are insignificant.

Providing safe passage during construction phase

When constructed, the temporary access will include provisions for bypass of river flow through a culvert or bridge in the temporary access alignment. These provisions will be necessary for later stages of dam demolition, but will initially be blocked so that the temporary access will serve as a coffer dam to enable separation of the work area as the spillway and left abutment are demolished and removed. While this work is proceeding, the river flow will be bypassed around the temporary access/coffer dam through the gates in the right abutment.

In later stages of construction, after the dam spillway and left abutment have been removed, the management of flow through the dam to the downstream reach will change. In order to work on removal of portions of the right abutment, the routing of flow will change from the gates in the right abutment to the temporary bypass provisions in the temporary access/coffer dam described above. In this way, flow will be routed through the temporary access and through the footprint of the former spillway which at this point time will have been removed, while still enabling equipment access to the right abutment, and demolition of the same outside of the active channel flow. The temporary work access constructed to access the right abutment will allow river discharge to flow in an unimpeded manner. The final design of the temporary work access will be completed by the selected contractor, subject to project engineer and ASF approval. The range of options may include: 1) wooden crane mats placed on temporary supports such as concrete waste blocks, 2) timber decking over steel girders on temporary supports, or 3) temporary culvert placed through coffer dam.

Migration-- While migrating upstream, adult Atlantic salmon must traverse a range of stream gradients, water qualities, and channel conditions between the estuary and headwaters where spawning occurs. Upstream migration commences in late April, peaks by July and may continue sporadically through mid-fall. Barriers to migration can prevent access to spawning habitat, delay migration, or impair fish health. Atlantic salmon smolts emigrate downstream in late April-June. The emigration period is short, prompted by environmental conditions (water temperature, daylight length, increased flow, etc.), and metabolic changes in the smolt (production of enzymes necessary to adapt to saltwater). Smolts require a barrier-free corridor from rearing habitat to the marine environment so that they can emigrate before either environmental or metabolic conditions change. A delay in smolt migration can decrease their ability to osmoregulate in the marine environment, which is a necessary adaptation for survival. Delays at barriers can also result in increased predation on emigrating smolt by avian and aquatic predators. Therefore, dam removal will eliminate a source of delay, stress or mortality, resulting in improved habitat for adults migrating upstream and smolts emigrating downstream in the Merrymeeting Bay SHRU.

Removal of Coopers Mill Dam is expected to significantly improve critical habitat for Atlantic salmon within the Merrymeeting Bay SHRU by improving habitat for spawning, incubation, rearing, and migration. The effects of the proposed action on the primary constituent elements of designated critical habitat are expected to be insignificant, discountable or beneficial because:

1. The proposed project will have a long-term beneficial effect by ensuring upstream and downstream fish passage for Atlantic salmon and other fish to 30 miles of the Sheepscot River watershed. It will also improve stream function by eliminating the impoundment behind the dam and restoring 1,000 feet of river habitat to a series of riffles and pools. The removal of the impoundment will allow the natural downstream movement of sediment and wood, lowering water temperatures, and remove habitat for non-native predators such as smallmouth bass and pickerel;

2. The proposed project will be constructed during the during the low flow period, which will simplify erosion and sediment management at the site and will allow vegetation to quickly stabilize any exposed upland sediment. Any migratory habitat impairment from sedimentation will be minimized during construction and it will be temporary and insignificant;

3. The migration/movement of various life stages of Atlantic salmon are currently impaired as the existing fishway is inoperable and may be dewatered up to six months each year due to leaks in the dam. These leaks also lessen the occurrence of spill over the dam which was likely the preferred pathway for smolts migrating downstream in the past. The short-term effects of the construction may restrict movement of fish, however, these effects are expected to be insignificant.

4. Any minor long term impacts associated with operating the hydrant are expected to be discountable due to their infrequent use and low maintenance design. The town fire chief estimates the hydrants would get used on average once each summer and 5-10 times the rest of the year for water withdrawal. Their infrequent usage would typically use < 1% of the river flow during the winter months when the fire load in town is greatest and < 3% of the flow during the

very rare use during July and August. The Atlantic Salmon Federation has also constructed a dry hydrant one mile away in the West Branch of the Sheepscot that will likely result in even usage of these two hydrants in the future.

5. The existing hydrant intake will be removed and replaced with a low water and a high water intake that are each equipped with a custom designed fish friendly, low profile, trout stream strainer head. The high water intake will only be operable in higher water conditions and is meant to provide redundancy and as a backup to the low water hydrant that will be submerged all twelve months of the year.

6. The Whitefield Fire Chief has stated that standard operating procedures (SOP's) when they arrive at a hydrant is to backflush first, then gradually increase flows, and to pump at a rate of 250gpm. This is all done to ensure their equipment is not harmed but will also motivate any fish to quickly vacate the immediate area around the intake head.

7. At 250gpm the velocity of water through the intake screen is 0.8 feet per second which is below thresholds recommended by NOAA, USFWS, and USGS for juvenile salmonids and impingement and is therefore discountable.

The result of the Coopers Mills Dam removal will be to reduce the effect small dams have on Atlantic salmon and its critical habitat (Table 6). The dam removal would significantly improve the migration PCE by improving access to spawning and rearing habitat upstream of the dam. The removal of the dam would lead to the additional benefits of improved water quality, and potentially restoration of historic spawning and rearing habitat upstream of the former impoundment.

Table 6. Atlantic salmon critical habitat essential features following Coopers Mill Dam removal .

Pathway/Indicator	Life Stages Affected	PCEs Affected	Dam Removal Effect
Access to Historical Habitat	Adult, smolt, juvenile	Migration	Unimpeded upstream passage will eliminate barriers and delays to spawning habitat. Unimpeded downstream passage will eliminate direct and indirect mortality of smolts and kelts
Habitat Elements, Channel Dynamics, Watershed Condition	Adult, smolt, juvenile, eggs	Migration, Spawning, and rearing	Removing impoundments will restore spawning and rearing habitat, decrease predation, increase productivity, and facilitate migrations

Water Quality	Adult, juvenile, eggs	Spawning and rearing	Removing impoundments will improve water quality (temperature and dissolved oxygen) for spawning and rearing habitat below project

8. 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.

In December 1999, the State of Maine adopted regulations prohibiting all angling for sea-run salmon statewide. A limited catch-and-release fall fishery (September 15 to October 15) for Atlantic salmon in the Penobscot River was authorized by the MASC for 2007. The fishery was closed prior to the 2009 season. Despite strict state and federal regulations, both juvenile and adult Atlantic salmon remain vulnerable to injury and mortality due to incidental capture by recreational anglers and incidental catch in commercial fisheries. The best available information indicates that Atlantic salmon are still incidentally caught by recreational anglers. Evidence suggests that Atlantic salmon are also targeted by poachers (NMFS 2005). Commercial fisheries for elvers (juvenile eels) and alewives may also capture Atlantic salmon as bycatch. No estimate of the numbers of Atlantic salmon caught incidentally in recreational or commercial fisheries exists.

Pollution from point and non-point sources has been a major problem in this river system, which continues to receive discharges from sewer treatment facilities and paper production facilities (metals, dioxin, dissolved solids, phenols, and hydrocarbons). Contaminants introduced into the water column or through the food chain, eventually become associated with the benthos where bottom dwelling and feeding species like shortnose and Atlantic sturgeon are particularly vulnerable. Atlantic salmon are also vulnerable to impacts from pollution and are also likely to continue to be impacted by water quality impairments in the GOM DPS.

Impacts to Atlantic salmon 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.

9. INTEGRATION AND SYNTHESIS OF EFFECTS

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

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

Recovery is defined as, "Improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in section 4(a)(1) of the Act." Below, for the GOM DPS of Atlantic salmon, we summarize the status of the species and consider whether the proposed action will result in reductions in reproduction, numbers or distribution of that species and then considers whether any reductions in reproduction, numbers or distribution resulting from the proposed action would reduce appreciably the likelihood of both the survival and recovery of that species, as those terms are defined for purposes of the federal ESA.

We have determined that while the net result of the project will be beneficial for Atlantic salmon, the proposed action will result in the capture of up to 12 juvenile Atlantic salmon during construction and the injury or mortality of no more than 1 of those individuals. All other effects of the proposed action will be insignificant or discountable.

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

The proposed dam removal project will result in the capture and potential injury of 12 juvenile Atlantic salmon and the mortality of no more than one individual. Here, we consider the effect of the loss of this individual on the reproduction, numbers and distribution of the Gulf of Maine DPS. We also consider the benefits of the project that will result from removal of the dam and improved connectivity in the Sheepscot River watershed.

The reproductive potential of the Gulf of Maine DPS will not be affected in any way other than through a reduction in the numbers of individuals. The loss of one juvenile Atlantic salmon would have the effect of reducing the amount of potential reproduction, as any dead Atlantic salmon would have no potential for future reproduction. However, this reduction in potential future spawners is so small it is likely undetectable; this is due to the high natural mortality of juvenile Atlantic salmon, the low adult return rate (i.e., the number of juveniles that return to spawn as adults) and that it is limited to only one juvenile. Given this, we expect that the future reduction in the number of eggs laid or juveniles produced in future years would have an undetectable effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individuals that would be killed as a result of the action, any effect to future year classes is anticipated to be undetectable. Further, because the removal of the Coopers Mills Dam will remove a barrier to the upstream migration of spawning adults and the downstream migration of any offspring, we expect that the action will result in improvements in habitat that can result in an increase in the reproduction, numbers and distribution of Atlantic salmon in the Sheepscot River, the Merrymeeting Bay SHRU and the Gulf of Maine DPS.

Based on the information provided above, including the consideration of the death of one juvenile Atlantic salmon, the proposed project will not appreciably reduce the likelihood of survival of the Gulf of Maine DPS (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect GOM DPS Atlantic salmon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic salmon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of one juvenile is an extremely small percentage of the population and will not change the status or trends of the species as a whole; (2) the loss of one juvenile will not result in the loss of any age class; (3) the loss of one juvenile will not have an effect on the levels of genetic heterogeneity in the population; (4) the loss of one juvenile in 2018 will have such a small effect on reproductive output that the loss of this individual will not change the status or trends of the species; (5) the actions will have no effect on the ability of GOM DPS Atlantic salmon to shelter or forage; (6) the action will improve connectivity in the Sheepscot River and improve the likelihood of the successful migration of adults and their offspring, thus potentially resulting in future increases in numbers and reproduction; and (7) the project will improve distribution of Atlantic salmon in the Sheepscot River.

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

As explained above, the proposed action will result in a net benefit to Atlantic salmon by removing a barrier to upstream and downstream migration and improving the connectivity of habitat within the Sheepscot River. This project directly addresses one of the primary threats (dams) identified in the original 2005 Atlantic salmon recovery plan and the 2016 draft recovery plan. The removal of this barrier to Atlantic salmon migration will improve the species ability to recover in the wild by increasing access to spawning and rearing habitat that was previously inaccessible. Therefore, we have determined that the proposed action will not appreciably reduce the likelihood that Atlantic salmon will recover in the wild. Therefore, the action will not appreciably reduce the likelihood that the GOM DPS of Atlantic salmon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the action is not likely to appreciably reduce the survival and recovery of this species.

9.1. Atlantic Salmon Critical Habitat

Critical habitat for Atlantic salmon has been designated in the GOM DPS. Within the action area of this consultation, the PCEs for Atlantic salmon include: 1) juvenile rearing and spawning habitat 2) sites for migration (excluding marine migration).

Summary of Construction Effects

The removal of the Coopers Mills Dam authorized under the BO will temporarily reduce the functioning of critical habitat in the vicinity of the dam. It is estimated that approximately two habitat units will be temporarily impacted by the placement and dewatering of cofferdams. This equates to two habitat units during the construction phase. The construction activities will temporarily degrade the functioning of the adjacent rearing PCE due to dewatering and elevated turbidity levels.

The migration PCE is not currently fully functional at this dam due to the lack of effective upstream fish passage. The temporary disturbance that will occur as a result of construction activities is not expected to further degrade the PCE. The demolition of the Coopers Mills Dam may require the placement of a significant amount of temporary fill below the ordinary high water (OHW) line. Under the provisions of the BO and USACE permit, the entirety of the temporary fill will be placed and removed during the summer work window July 15 – Sept. 30, 2018. The removal of the dam and impoundment will allow the natural stream processes such as downstream movement of sediment and wood, lowering water temperatures, increase dissolved oxygen and would remove habitat for non-native predators such as smallmouth bass and pickerel thus increasing the function of the juvenile rearing habitat. Therefore, construction activities are unlikely to further degrade the PCE and will have a minor short-term impact which will not affect the overall functioning of the critical habitat for juvenile Atlantic salmon.

Effects to critical habitat during construction will be insignificant and discountable. The dam removal is expected to result in an improvement in the ability of the habitat in the action area to function as juvenile rearing and migratory habitat. Therefore, it is expected to result in an increase in the value of the critical habitat in the action area for the conservation of the species. Therefore, the proposed project is not likely to adversely affect Atlantic salmon critical habitat.

10. 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 adversely affect critical habitat designated for the GOM DPS.

11. INCIDENTAL TAKE STATEMENT

Section 9 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. 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). On December 21, 2016, we issued *Interim Guidance on the Endangered Species Term "Harass"*[2]. For use on an interim basis, we interpret "harass" to mean to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering". Harm is further defined by us to include any act, which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR §222.102; NMFS 1999b). 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.

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

11.1. Amount or Extent of Take

This ITS exempts the following take of GOM DPS Atlantic salmon during the construction

[2] http://www.nmfs.noaa.gov/op/pds/documents/02/110/02-110-19.pdf

activities associated with the removal of the Coopers Mills Dam: capture and injury of up to 12 juvenile Atlantic salmon and mortality of 1 juvenile Atlantic salmon.

11.2. Reasonable and Prudent Measures

In order to effectively monitor the effects of this action, it is necessary to monitor the impacts of the action to document the amount of incidental take (i.e., the number of Atlantic salmon captured, injured or killed) and to examine any salmon that are captured during this monitoring. Monitoring provides information on the characteristics of the salmon encountered and may provide data which will help develop more effective measures to avoid or minimize future interactions with listed species. We do not anticipate any additional injury or mortality to be caused by removing the fish from the water and examining them as required in the RPMs.

We believe the following reasonable and prudent measures are necessary and appropriate for NMFS and USACE to minimize and monitor impacts of incidental take.

1. The applicant must adhere to all Best Management Practices identified in the Biological Assessment.
2. A sufficient zone of passage must be maintained at all times during the project to allow for unimpeded migration of Atlantic salmon through the action area.
3. All live salmon captured during the project must be released back into the Sheepscot River at an appropriate location away from any construction activity that avoids the additional risk of death or injury.
4. All salmon captures, injuries or mortalities associated with the project must be reported to NMFS within 24 hours.
5. The applicant must report to NMFS upon the start and end of in-water work.

11.3. Terms and Conditions

In order to be exempt from prohibitions of section 9 of the ESA, NMFS and USACE must comply with the following terms and conditions of the Incidental Take Statement, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary. Any incidental taking that is in compliance with the terms and conditions specified in this Incidental Take Statement shall not be considered a prohibited taking of the species concerned (ESA Section 7(o)(2)). In carrying out all of these terms and conditions, NMFS as lead Federal agency in this consultation, is responsible for coordinating with the other Federal agencies that are party to the consultation, as well as with project sponsors and contractors.

1. To implement RPM #1, all Best Management Practices must be incorporated as permit conditions into any permit issued by the USACE and conditions of any funding provided by NMFS RC.
2. To implement RPM #1, the applicant must report on any incidences when BMPs were not implemented as described in the BA.
3. To implement RPM #2, the applicant must maintain sufficient flow past the project at all times from beginning to end of dam removal to allow for the passage of Atlantic salmon

past the project.

4. To implement RPM #3, the applicant must coordinate with Maine DMR to implement a plan for relocation of any Atlantic salmon removed from the work area to minimize subsequent exposure to effects of the project.
5. To implement RPM #4, the applicant must report to NMFS (via email: incidental.take@noaa.gov) within 24 hours of any interactions with Atlantic salmon, including the capture and release of live fish. This report must include the date of the interaction as well as the life stage and fate (i.e., live, dead, injured) of the fish and, if dead, information on the disposition of the fish.
6. To implement RPM #5, the applicant must report to NMFS (via email: David.Bean@noaa.gov) within 24 hours of the start of in-water work and again within 24-hours of the completion of all in-water work.

12. 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. As such, we recommend NMFS RC and USACE consider implementing the following Conservation Recommendations:

1. Prioritize funding for future dam removal projects in Atlantic salmon critical habitat to help address the threat of barriers and improve the likelihood of recovery of the species. This action also helps to address one of the priorities (improving connectivity) identified in the Atlantic salmon Species in the Spotlight Action Plan.
2. Develop and implement a program to monitor the effects of dam removals, including the proposed project, on fish and their ecosystems, including the effects to Atlantic salmon and the essential features of their critical habitat.

13. REINITIATION NOTICE

This concludes formal consultation concerning the proposed removal of the Coopers Mills Dam to be funded by NMFS RC and permitted by the USACE. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may not have been previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species; or (4) a new species is listed or critical habitat designated that may be affected by the identified action. In instances where the amount or extent of incidental take is exceeded, section 7 consultation must be reinitiated immediately.

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