

Figure 7. April and May flow exceedance for the Worumbo Project (Auburn USGS Gage 01059000)

Migratory Delay

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

6.2. Effects of Aquatic Monitoring and Evaluation

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

The downstream smolt survival studies will involve obtaining Atlantic salmon smolts from GLNFH, surgically implanting radio transmitter tags, and then conducting paired releases in groups up and downriver of the Worumbo Project. The handling and implantation of radio tags will injure all of the fish used in the studies, and a small proportion will likely be killed. Miller Hydro will monitor and evaluate the effectiveness of the downstream fish passage facilities for up to three years at the Worumbo Project. It is expected that at least 172 smolts will be used per year (102 smolts released upriver of the dam over three releases + up to 60 smolts released as controls downriver of the dam over three releases + ten smolts used in a tag retention study). This equates to 516 smolts being used as part of the three year study.

Upstream passage efficiency studies will be conducted using adult Atlantic salmon trapped at the Brunswick Project. The adult fish will be PIT tagged prior to being released into the Brunswick headpond. Topsham Hydro, the operator of the Pejepscot Project, will be tagging up to 40 upstream migrants a year between 2013 and 2015 to monitor passage at the Pejepscot Project. It is anticipated that Miller Hydro will utilize the same fish for the monitoring of the upstream fishway at Worumbo. Therefore, the monitoring of upstream passage at Worumbo will not involve any additional handling and tagging effects to adult Atlantic salmon.

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

Tagging

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

The method proposed for the downstream passage studies is to surgically implant radio tags within the body cavities of the smolts. These tags do not interfere with feeding or movement. However, the tagging procedure is difficult, requiring considerable experience and care (Nielsen 1992). Because the tag is placed within the body cavity, it is possible to injure a fish's internal organs. Infections of the sutured incision and the body cavity itself are also possible (Chisholm and Hubert 1985, Mellas and Haynes 1985).

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

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

All 516 Atlantic salmon smolts used in the downstream survival study will be harassed and injured. In addition, a proportion of the smolts are anticipated to be killed due to handling and tagging. There is some variability in the reported level of mortality associated with tagging juvenile salmonids. NMFS did not document any immediate mortality while tagging 666 hatchery reared juvenile Atlantic salmon between 1997 and 2005 prior to their release into the Dennys River. After two weeks of being held in pools, only two (0.3%) of these fish were subject to delayed mortality. Over the same timeframe, NMFS surgically implanted tags into wild juvenile Atlantic salmon prior to their release into the Narraguagus River. Of the 679 fish tagged, 13, or 1.9%, died during surgery (NMFS, unpublished data). It is likely there were

delayed mortalities as a result of the surgeries, but this could not be quantified because fish were not held for an extended period. In a study assessing tagging mortality in hatchery reared yearling Chinook salmon, Hockersmith *et al.* (2000) determined that 1.8% (20 out of 1,133) died after having radio tags surgically implanted. Given this range of mortality rates, it is anticipated that no more than 2% of Atlantic salmon smolts (four per year or twelve total) will be killed due to handling and tagging during the proposed downstream monitoring over three years of study.

All Atlantic salmon kelts used in the downstream passage studies will be harassed and injured due to handling and tagging. However, long term effects of handling and tagging on adult salmon appear to be negligible. Bridger and Booth (2003) indicate that implanting tags gastrically does not affect the swimming ability, migratory orientation, and buoyancy of test fish. Due to handling and tag insertion, it is possible that a small proportion of study fish can be killed due to delayed effects. In a study assessing tagging mortality in hatchery reared yearling Chinook salmon, Hockersmith *et al.* (2000) determined that 2% (28 out of 1,156) died after having radio tags gastrically implanted. Given the size differential between a yearling Chinook and an adult Atlantic salmon, it is expected that this would represent a conservative estimate of tagging mortality in the adult salmon being used in the passage studies at the Worumbo Project. Given the small number of Atlantic salmon kelts being tagged (no more than 60 kelts over three years) and that adult salmon are less likely than yearling Chinook salmon to be significantly injured by tag implantation, it is not expected that any adult Atlantic salmon will be killed as part of the upstream passage studies. Injuries are expected to be minimized by having trained professionals conduct the procedures using established protocols.

6.3. Effects of the Emergency Spillway Rehabilitation

Species Presence

In 2011, 44 Atlantic salmon were passed at the Brunswick Project between June 3 and September 13. The 2011 telemetry study conducted using 21 of these salmon indicated that 43% (nine fish) passed the Pejepscot Project and approached the Worumbo Project (MDMR 2012b). Assuming that tagged and untagged fish passed the Pejepscot Project in equal proportions, approximately 19 adult salmon (43% of 44) are estimated to have been between the Pejepscot and Worumbo Projects during between July 2011 and January 2012, and, therefore, could have been exposed to the construction effects associated with the emergency spillway rehabilitation project. Given that the in-water work was not conducted during the smolt outmigration and as there is no spawning habitat in the mainstem between the two dams, it is unlikely that any salmon parr or smolts would have been affected by the repair.

Turbidity

Elevated total suspended solids (TSS) concentrations have the potential to adversely affect adult and juvenile Atlantic salmon, Atlantic and shortnose sturgeon in the Penobscot River. 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 580mg/L to 700,000mg/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, Newcomb and Jensen (1996) concluded that more than six days exposure to total suspended solids (TSS) greater than 10 mg/l 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). 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 re-deposited 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 little 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.

The placement and removal of fill in the Androscoggin River between July 2012 and January 2013 led to elevated turbidity levels at a time of year when salmon were known to be migrating in the river. Regular TSS measurements were made daily during the installation and removal of the cofferdam, and every four to five days while work was being conducted within cofferdams.

Turbidity levels downstream of the project were less than 50 mg/l above background for the majority of in-water work (Figure 8). On July 29, 2011 a turbidity curtain broke loose and the downstream TSS levels increased to nearly 300 mg/l. In water work ceased until the curtain could be repaired and turbidity levels came back down. Turbidity levels exceeded 50 mg/l a second time when the cofferdammed area was being dewatered. Between August 1 and August 3 levels went as high as 175 mg/l. According to Newcomb and Jensen (1996), exposures to TSS levels similar to those detected on July 29, and between August 1st and 3rd, could lead to moderate physiological effects and impaired homing behavior. Therefore, individual salmon immediately below the dam would have been affected by the project. Most of the tagged salmon, however, were documented using habitat roughly 800 meters downriver of the dam near the confluence with the Little River, where TSS levels were likely lower, or else had passed upriver of the dam, where TSS levels were at background levels. Given the consistently elevated TSS levels, however, it can be assumed that some of the Atlantic salmon in the action area were adversely affected.

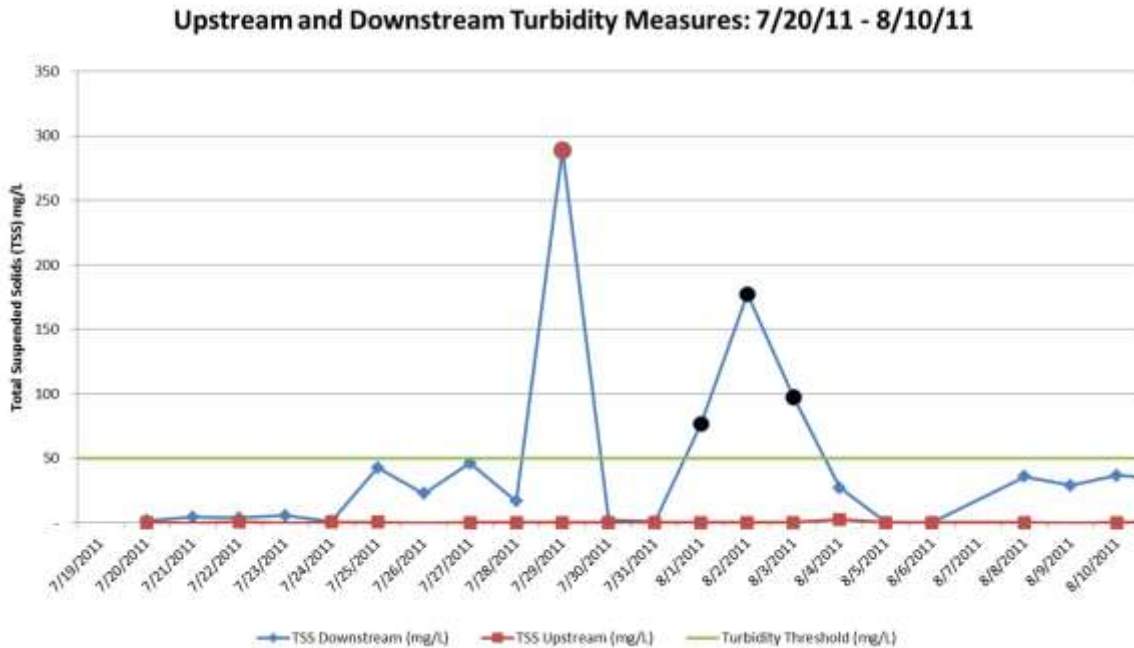


Figure 8. Total suspended solid (TSS) measurements during the rehabilitation of the spillway at the Worumbo Project in 2011.

Entrapment

The project to rehabilitate the timber crib spillway at the Worumbo Project involved the placement of a solid fill cofferdam immediately upstream of the spillway. There was a risk that a salmon could have been entrapped within the cofferdam, which was over an acre in size. Consultant (HDR) biologists were onsite to monitor the area daily for fish presence, and NMFS biologists were onsite for the dewatering of much of the enclosed area. No Atlantic salmon were detected in the enclosed area. In addition to the cofferdam, the small channel on the Durham side of the bypass reach needed to be isolated by a sediment barrier prior to the removal of the

timber crib dam. Two radio tags were detected in the channel. NMFS and HDR biologists surveyed the area extensively in an attempt to locate and remove any fish prior to the isolation of the reach. When no salmon were located, a diver was used to better survey the area where the tags appeared to be transmitting. Although no salmon were discovered, a radio tag that had been regurgitated was located. As the other tag never moved, it is assumed that it was regurgitated as well, and that no salmon were located in the reach.

On September 19, 2011, the pond level at Worumbo was reduced by ten inches to allow Miller Hydro to lower some mechanical flashboard panels. After completing the work on the panels, Miller Hydro removed a section of the dam safety boat barrier system that was damaged during the last high water period. During removal, the crew spotted an adult salmon swimming through a small channel in the bypass reach towards the spillway. As the pond began to refill, bypass flow over the spillway was increased into the area where the salmon was spotted and the crew lost sight of it. Given that there was sufficient water in the channel, and that it was not isolated, it is not expected that this fish was entrapped.

Project Long Term Effects

The new concrete spillway has a vertical upstream face, with a downward face constructed at a 1-to-1 rounded-face (ogee slope). As a result of input from NMFS, the Obermeyer on the concrete spillway has the ability to provide both concentrated and ribbon bypass flows. The panel heights have been modified to three separate groups, which are independently operable. These modifications allow Miller Hydro to provide all the required bypass flows, while maintaining the pond elevation between 98.66 feet and 98.85 feet under either the concentrated flow regime or the ribbon flow regime with the downstream fishway either on line or off line and the adjustable eel gate in any position from fully open to fully closed.

It is expected that the new spillway will lead to an improvement in downstream passage survival over the previous spillway for the following reasons:

1. Minimum bypass flows will be concentrated during the fish passage season providing more depth of water over the section where the fish pass, which should reduce injuries,
2. The smooth faced ogee shaped spillway will slow fish decent and prevent the fish from free falling onto the rocks in the bypass,
3. The plunge pool at the base of the dam should further prevent the fish from striking the rocks below the dam.

6.4. Critical Habitat

6.4.1. Interim Species Protection Plan

Critical habitat for Atlantic salmon has been designated in the Androscoggin River including the sections of river in the vicinity of the Worumbo Project. Within the action area of this consultation, the PCEs for Atlantic salmon include: 1) sites for spawning and rearing; and, 2)

sites for migration (excluding marine migration). The analysis presented in the environmental baseline shows several habitat indicators are not properly functioning, and biological requirements of Atlantic salmon are not being met in the action area. We expect that the proposed project would continue to harm these already impaired habitat characteristics. We expect the continued operations of these projects to cause adverse effects to some essential features of critical habitat, including water quality, substrate, migration conditions, and forage in a similar manner as present in the environmental baseline. However, designated critical habitat in the Androscoggin River watershed is anticipated to improve for Atlantic salmon due to the modifications made to improve downstream survival for smolts during the spillway rehabilitation project in 2011. In addition, the ISPP is intended to be an adaptive process that will lead to an improvement in upstream and downstream passage based on the results of the proposed studies. Table 7 below summarizes the condition of essential features of Atlantic salmon critical habitat following implementation of the ISPP at the Worumbo Project.

Table 7. Atlantic salmon critical habitat essential features following implementation of the ISPP at the Worumbo Project.

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

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

One of the essential features that is described for the migration PCE refers to the need for diverse native fish communities that serve as a protective buffer against predation. River herring (alewife and blueback herring) reproduce in lake, pond, and riverine habitats throughout the Androscoggin and Little Androscoggin River watersheds below Lewiston Falls. The average number of river herring trapped at the Brunswick Project between 1983 and 2010 is 43,678. In

2011, 54,896 river herring were trapped at the Brunswick fish trap (MDMR 2012). Thirty-eight percent of these were stocked in Sabattus, Little Sabattus, Lower Range, No Name, Marshall and Taylor Ponds. Forty-seven percent were released into the Brunswick headpond and the remaining 15% were used to stock habitats outside of the Androscoggin River watershed (MDMR 2012). All the ponds where river herring are stocked in the Androscoggin are upriver of the Worumbo Project. In addition, several thousand of the fish that are released in the Brunswick headpond (11,106 in 2010) also move upriver of Worumbo of their own volition, as they seek out spawning habitat (Letter from Topsham Hydro to FERC, 2010 Summary of Annual Agency Consultation, dated April 7, 2011). Therefore, thousands of alewives a year are exposed to the effects of downstream passage at the Worumbo Project during adult outmigration in spring and early summer, and juvenile outmigration in the late summer and fall. In a November 20, 2000 letter to Miller Hydro, MDMR described how juvenile alewives had been observed being killed at a rate of twenty per minute in the Worumbo tailrace. Empirical studies to measure downstream survival of river herring at the Worumbo Project have been inconclusive, but it can be assumed that a proportion of these fish are being injured or killed due to passage at the Worumbo Project. Therefore, it can be concluded that the operation of the Worumbo Project degrades the migratory PCE by reducing the abundance of other diadromous species that serve as a buffer against the predation of Atlantic salmon.

6.4.2. Emergency Spillway Rehabilitation

The completed construction activities temporarily reduced the status of several habitat indicators relative to Atlantic salmon critical habitat. We expect that these activities caused temporary adverse effects to the migratory PCE of critical habitat by reducing water quality due to increased noise and turbidity and the filling of habitat. Construction was timed so that in-water effects to the habitat (turbidity, noise and the presence of temporary fill) did not coincide with the smolt outmigration period. However, construction effects did occur at a time when adult pre-spawn salmon were migrating through the project area.

The construction of the new spillway placed temporary and permanent fill below the ordinary high water (OHW) line in the Androscoggin River. The total temporary fill was 1.4 acres (60,000 square feet), while the permanent fill was 0.23 acres (10,221 square feet). The permanent fill associated with the new structure is slightly less (448 square feet) than what was in place prior to the project (Table 8). As previously indicated, all of the temporary fill was placed and removed in the Androscoggin River outside of the spring outmigration period. However, it was in place during a time of year when pre-spawn Atlantic salmon were migrating through the area. As fish would only be migrating through the Project in the vicinity of the upstream fishway, it is anticipated that the temporary fill, which was placed on the opposite side of the river, would have had a discountable effect on the migration PCE. Although the placement of permanent fill (the new spillway) removed a small amount of habitat in the Worumbo headpond, it is not expected that it will create a barrier to migration. Therefore, the placement of temporary and permanent fill did not substantially alter the functioning of the habitat for Atlantic salmon.

Table 8. The amount of permanent fill in the Androscoggin River associated with the old timber crib spillway and the new concrete spillway.

	DESCRIPTION	AREA (Sq. Ft.)
Old Structures		
	Timber Crib Dam	9568
	Concrete Spillway	1131
	Total	10699
New Structures		
	New Concrete Spillway	7283
	Spillway Modifications	1807
	Concrete Spillway	1131
	Total	10221

7. CUMULATIVE EFFECTS

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

Impacts to Atlantic salmon from non-federal activities are largely unknown in the Androscoggin River. It is possible that occasional recreational fishing for anadromous fish species may result in incidental takes of Atlantic salmon. Despite strict state and federal regulations, both juvenile and adult Atlantic salmon remain vulnerable to injury and mortality due to incidental capture by recreational anglers and incidental catch in commercial fisheries. The best available information indicates that Atlantic salmon are still incidentally caught by recreational anglers. Evidence suggests that Atlantic salmon are also targeted by poachers (NMFS 2005). MDMR reported that one of the Atlantic salmon that was radio tagged during the 2011 telemetry study was poached near the confluence with the Little River, 800 meters downstream of the Worumbo Project (MDMR 2012b). Commercial fisheries for elvers (juvenile eels) and alewives may also capture Atlantic salmon as bycatch. No estimate of the numbers of Atlantic salmon caught incidentally in recreational or commercial fisheries exists.

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

Contaminants associated with the action area are directly linked to industrial development along the waterfront. PCBs, heavy metals, and waste associated with point source discharges and

refineries are likely to be present in the future due to continued operation of industrial facilities. In addition many contaminants such as PCBs remain present in the environment for prolonged periods of time and thus would not disappear even if contaminant input were to decrease. It is likely that Atlantic salmon will continue to be affected by contaminants in the action area in the future.

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

8. INTEGRATION AND SYNTHESIS OF EFFECTS

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

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

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

Atlantic salmon in the GOM DPS currently exhibit critically low spawner abundance, poor marine survival, and are confronted with a variety of additional threats. The abundance of Atlantic salmon in the GOM DPS has been low and either stable or declining over the past

several decades. The proportion of fish that are of natural origin is extremely low (approximately 6% over the last ten years) and is continuing to decline. The conservation hatchery program has assisted in slowing the decline and helping to stabilize populations at low levels, but has not contributed to an increase in the overall abundance of salmon and has not been able to halt the decline of the naturally reared component of the GOM DPS.

NMFS recognizes that the new spillway at the Worumbo Project will improve survival rates for Atlantic salmon smolts, and that the proposed ISPP is intended to gather information necessary to develop a final SPP that will lead to an improvement in upstream and downstream passage for Atlantic salmon over current conditions. However, the project will continue to affect the abundance, reproduction and distribution of salmon in the Androscoggin River by delaying and injuring migrating pre-spawn adults, as well as outmigrating smolts and kelts. In addition, the proposed passage studies will require the use of GOM DPS Atlantic salmon; all of which will be injured or killed as a result. Operation of the Worumbo Project will also affect the migration PCE of Atlantic salmon critical habitat by maintaining the project impoundment, reducing safe passage, and reducing the numbers of diadromous fish (particularly river herring) that serve as a prey buffer to salmon.

Summary of Upstream Passage Effects

The Worumbo Project is not 100% effective at passing all Atlantic salmon that are motivated to access habitat upriver. Adult salmon that are not passed at the Project will either spawn in downstream areas, return to the ocean without spawning, or die in the river. These salmon are significantly affected by the stress, injury and mortality associated with locating and successfully passing the Project. Although no studies have looked directly at the fate of fish that fail to pass through upstream fish passage facilities on the Androscoggin River, we convened an expert panel in 2010 to provide the best available information on the fate of these fish in the Penobscot River. The panel was comprised of state, federal, and private sector Atlantic salmon biologists and engineers with expertise in Atlantic salmon biology and behavior at fishways. The group estimated a baseline mortality rate of 1% for Atlantic salmon that fail to pass a fishway at a given dam on the Penobscot River (NMFS 2011). Assuming that the existing fishway is at least 20% effective, this would mean that 0.8% (1% mortality x 80% that fail to pass) of Atlantic salmon that attempt to pass the Worumbo Project will die. The number of Atlantic salmon migrating past the Worumbo Project between 2003 and 2012 has ranged between zero and seven (Table 5). Assuming similar passage rates, no more than 35 pre-spawn adults (seven fish x five years) are expected to pass the project over the five year interim period covered by this consultation. Therefore, no more than one adult (0.8% x 35) is expected to die due to the effects of upstream passage.

The existing hydroelectric projects result in a certain amount of delay in upstream migration. Numerous studies collectively report a wide range in time needed for individual adult salmon to pass upstream of various dams in the Penobscot River once detected in the vicinity of a spillway or tailrace. The yearly pooled median passage time for adults at Milford Dam ranged from 1.0 days to 5.3 days over five years of study, while the total range of individual passage times over this study period was 0.1 days to 25.0 days. The yearly pooled median passage time for adults at the West Enfield or Howland Dam ranged from 1.1 days to 3.1 days over four years of study,

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