UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
55 Great Republic Drive
Gloucester, MA 01930

February 13, 2026

Debbie-Anne Reese, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, D.C. 20426

**RE: Endangered Species Act Section 7 Formal Consultation for the amendment to the existing license for the Milford (P-2534) Hydroelectric Project.**

Dear Secretary Reese:

Enclosed is our Biological Opinion (Opinion), issued under section 7(a)(2) of the Endangered Species Act (ESA), for the Federal Energy Regulatory Commission's (FERC) proposal to revise the Species Protection Plan (SPP) for the GOM DPS of Atlantic salmon for the Milford (P-2534) Hydroelectric Project. The SPP includes measures to improve passage conditions at the project to protect ESA-listed Atlantic salmon in the Penobscot River in Maine. We concluded consultation on the original SPP on August 31, 2012, and the project license was amended to incorporate the provisions on October 9, 2012. The SPP was revised (and our consultation reinitiated) as a result of take being exceeded, and to incorporate new information relevant to the effects of project operation. This Opinion also considers effects of an emergency dam repair conducted in 2017.

In the Opinion, we use the best available scientific and commercial data to analyze effects of the proposed action on ESA-listed species that occur in the action area. We conclude that the proposed actions may adversely affect but are not likely to jeopardize the continued existence of the Gulf of Maine distinct population segment (GOM DPS) of Atlantic salmon, shortnose sturgeon, or the GOM DPS of Atlantic sturgeon or result in the destruction or adverse modification of critical habitat designated for the GOM DPS of Atlantic salmon. We also conclude that the continued operation of the Milford Project is not likely to adversely affect critical habitat designated for the GOM DPS of Atlantic sturgeon.

As required by section 7(b)(4) of the ESA, an incidental take statement (ITS) is provided with the Opinion. The ITS exempts an identified amount of incidental take of Atlantic salmon, shortnose sturgeon, and Atlantic sturgeon from the ESA section 9 prohibitions on take. This incidental take will result from activities associated with the ongoing operation of the hydroelectric facilities consistent with the description of the proposed actions in the Opinion. The ITS also specifies Reasonable and Prudent Measures (RPMs) and implementing Terms and Conditions necessary and appropriate to minimize the impact of these activities on ESA-listed species. In order to be exempt from the prohibitions on take, FERC must comply (or must ensure that the licensee, Black Bear Hydro Partners, LLC, complies) with the RPMs and their implementing terms and conditions. These additional requirements are designed to minimize the amount or extent of ESA-listed species, including Atlantic salmon. A key component of the proposed actions is implementation of an adaptive management framework to ensure that necessary changes to project operations and/or facilities are implemented, and to ensure that FERC and Black Bear will pursue any necessary additional changes to avoid exceeding the amount of take exempted by the ITS. Annual reporting that is required by the ITS will continue to supply information on the level of take resulting from the proposed action.

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. We encourage FERC to evaluate additional measures within your authority that could be implemented to further reduce effects of these projects on Atlantic salmon and other sea run fish. 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. In the Opinion, we provide a number of Conservation Recommendations for your consideration.

This Opinion concludes consultation for the FERC's proposed action to approve the modified SPP for the Milford Project. As described in 50 CFR 402.15, the action agency has several responsibilities following issuance of a biological opinion. As such, FERC is obligated to: (a) Determine whether and in what manner to proceed with the actions in light of your section 7 obligations and our biological opinion; and (b) notify us of your final decision on the action. We look forward to hearing from you on these matters.

As outlined in 50 CFR 402.16, reinitiation of consultation is required and shall be requested by FERC or by NOAA's National Marine Fisheries Service (NMFS), where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (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 not considered in the Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the identified action.

If you have any questions or concerns about the consultation, please contact Dan Tierney in our Protected Resources Division at (207) 866-3755 or Dan.Tierney@noaa.gov.

Sincerely,

Julia Crocker

Julia Crocker
Acting Assistant Regional Administrator
for Protected Resources

**NATIONAL MARINE FISHERIES SERVICE**
**ENDANGERED SPECIES ACT**
**BIOLOGICAL OPINION**

**Agency:** Federal Energy Regulatory Commission (lead)
U.S. Army Corps of Engineers, New England District

**Activity Considered:** Continued Operation of the Milford Project (P-2534), with a modified Species Protection Plan

GARFO-2025-01713

**Conducted by:** National Marine Fisheries Service
Greater Atlantic Regional Fisheries Office

**Date Issued:** February 13, 2026

**Approved by:** Julia Crocker

Julie Crocker
Acting Assistant Regional Administrator
for Protected Resources

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# 1. INTRODUCTION AND BACKGROUND

This constitutes the biological opinion (Opinion) of NOAA's National Marine Fisheries Service (NMFS) issued under the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531-1543) regarding the effects of the Federal Energy Regulatory Commission's (FERC) proposed approval of Black Bear Hydro Partners, LLC (Black Bear or Licensee) revised Species Protection Plan (SPP) to include new fish passage measures at the Milford Project (P-2534) on the Penobscot River, Maine. This Opinion concludes the reinitiation of formal consultation on the continued operations of the Milford Project, consistent with the terms of an amended license. The previous Biological Opinion was issued to FERC on August 31, 2012. The Milford Project is an 8.2 megawatt (MW) hydroelectric project owned and operated by Black Bear. The Project is located on the mainstem of the Penobscot River in the towns of Milford and Old Town, Maine.

In addition to FERC's authorization, the proposed action will also require a permit from the U.S. Army Corps of Engineers (USACOE) for the discharge of fill below the ordinary high-water mark (OHWM), to be issued pursuant to the Rivers and Harbors Act and/or Clean Water Act. This Opinion will also consider the effects of the emergency dam repair that occurred at the Milford Project in 2017. Black Bear incorporated the after-the-fact application for a dredge and fill permit to the USACOE, as well as the associated Biological Assessment, as attachment E of the Biological Assessment. Emergency consultation, consistent with 50 CFR 402.05, was requested at the time of the emergency repair; however, the consultation was not closed out at that time.

This Opinion is based on the best scientific and commercial data available, including but not limited to, information provided in Black Bear's April 25, 2025 Biological Assessment. A complete administrative record will be maintained by NMFS. On June 2, 2025, we deemed the information submitted by FERC sufficient to assess the effects of the proposed action on ESA-listed species and designated critical habitat and that the information constituted the best scientific and commercial data available (50 CFR §402.14(c)(-(d)); ESA formal Section 7 consultation was initiated on that date.

*ESA Section 7 Regulations*

On April 5, 2024, NMFS and the U.S. Fish and Wildlife Service (FWS) (the Services) published joint final revisions to the 2019 Section 7 regulations in the Federal Register (89 FR 24268). These updates to the regulations governing interagency consultation (50 CFR part 402) were effective on May 6, 2024. As such, we are applying the updated regulations to this consultation. The 2024 regulatory changes, like those from 2019, were intended to improve and clarify the consultation process, and, with one exception from 2024 (offsetting reasonable and prudent measures, none of which are included in this Opinion), were not intended to result in changes to the Services' existing practice in implementing section 7(a)(2) of the Act (89 FR 24268; 84 FR 45015). We have considered the prior rules and affirm that the substantive analysis and conclusions articulated in this Biological Opinion and its Incidental Take Statement would not have been any different under the 2019 regulations or pre-2019 regulations. While revisions to the regulations were proposed in November 2025 (90 FR 52600), no final rule to revise the regulations has been issued.

## 1.1. Consultation History

Emergency Repair

- **June 29, 2017 –** Black Bear initiated Emergency Action Plan for the dam safety condition at the Milford Project due to the discovery of voids in the dam.
- **June 30, 2017** -- Black Bear filed a letter with FERC requesting designation as FERC's non-federal representative under 50 CFR § 402.08 using the emergency consultation procedures specified in NOAA's joint regulations at 50 CFR § 402.05. Emergency consultation was needed due to dam safety concerns resulting from the discovery of a void and areas of undermining at Milford Dam.
- **July 3, 2017** – FERC designated Black Bear to act as its non-federal representative in conducting consultation under section 7 of the ESA regarding federally listed species at the Milford Project.
- **July 17, 2017** – Black Bear, FERC, NMFS, MDEP, and ACOE had a meeting to discuss plan for repair and to discuss avoidance and minimization measures. NMFS provided recommendations consistent with the emergency consultation procedures.
- **June 6, 2018** – Black Bear submitted draft BA for the emergency repair to NMFS for review. NMFS provided comments on June 15, 2018.

**Species Protection Plan**

- **August 31, 2012 –** NMFS issued a biological opinion on FERC's proposal to amend the licenses of five hydro projects (including the Milford Project) on the Penobscot River in order to incorporate provisions of a Species Protection Plan for Atlantic salmon, as well as a handling plan for Atlantic and shortnose sturgeon. NMFS determined that the proposed action would not jeopardize the survival or recovery of any listed species, nor destroy or adversely modify any designated critical habitats.
- **March 26, 2019** – Black Bear requests that FERC designate it as its non-federal representative in conducting consultation under section 7 of the ESA

for the reinitiation of consultation due to new information regarding migratory delay, stranding in the bypass reach, and the collection of salmon at the fish trap at the exit of the Denil fishway.

- **April 25, 2019 –** FERC designated Black Bear to act as its non-federal representative in conducting consultation under section 7 of the ESA regarding federally listed species at the Milford Project.
- **October 1, 2019 to May 20, 2024** –Black Bear and NMFS held several meetings to discuss the reinitiation of consultation due to new information and the exceedance of take documented during Black Bear's upstream passage evaluations authorized under our August 31, 2012 Opinion. Black Bear and NMFS discussed study results and other new information that informed the development of new measures, as well as potential alternatives for reducing migratory delay and the stranding of adult salmon in the project bypass reach.
- **April 25, 2025** – Black Bear submitted a draft Biological Assessment and Species Protection Plan to FERC.
- **June 2, 2025 –** FERC requested formal section 7 consultation for the implementation of fish passage measures at the Milford Project, as well as for the emergency repair that occurred at the project in 2017.
- **September 17, 2025 –** NMFS requested a 60-day extension of time to complete the Opinion to allow for adequate coordination with other agencies on the implications of operating the Denil fishway on broodstock collection of Atlantic salmon.
- **September 24, 2025 –** FERC approved our request for a 60-day extension for the completion of our Biological Opinion.
- **October 2, 2025 –** On September 19, 2025, Black Bear responded to an information request from NMFS (e-mail dated September 8) by submitting a draft description of the construction approach for the installation of the spillway flow diversion wall. NMFS provided comments and Black Bear submitted a final version on October 2, 2025.
- **November 26, 2025** – NMFS requested a second 60-day extension of time to complete the Opinion due to the 43- day lapse of federal appropriations, and to provide adequate time to consider new information provided by the USACOE regarding their draft special conditions for the proposed construction of the spillway diversion wall.
- **December 15, 2025 –** FERC approved our request for an additional 60-day extension for completion of our Biological Opinion.
- **December 18, 2025** – USACOE provided draft special conditions for the construction of the spillway diversion wall.

## 2. PROJECT DESCRIPTION AND PROPOSED ACTION

The Milford Project consists of two dams: the Milford Development Dam is located at river mile 38.5 on the main stem of the Penobscot River, and the Gilman Falls Dam which is located on the Stillwater Branch of the Penobscot River (Figure 1). The Project impoundment extends upstream from the Milford and Gilman Falls Dams a distance of approximately 3 miles (5 kilometers) and comprises approximately 235 acres.

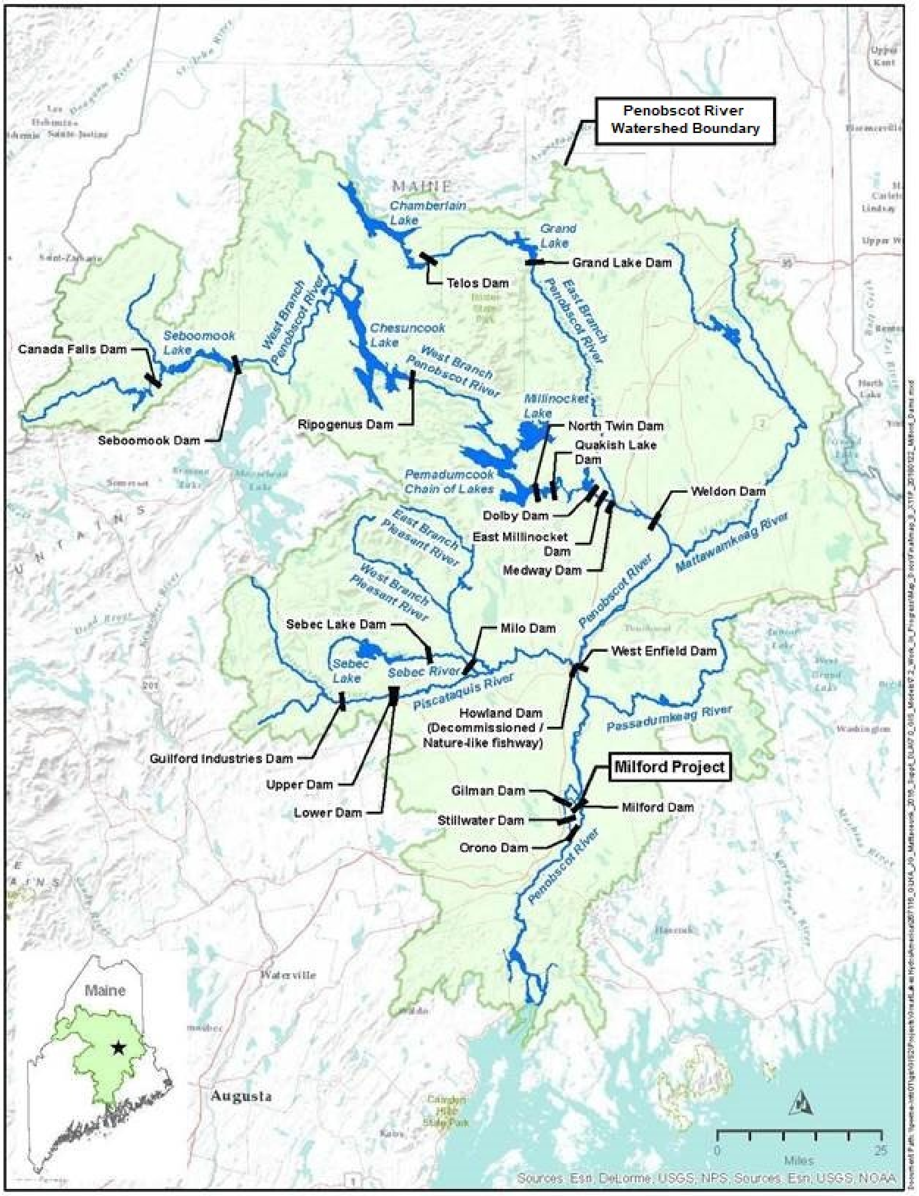


Figure 1. Project location in the Penobscot River Basin

*Milford Development Dam*

The Milford Development consists of a 1,159-foot-long, 20-foot-high, concrete gravity dam topped with 4.5-foot-high, steel-hinged flashboards on the western spillway and a 4.0-foot-high Obermeyer inflatable flashboard system on the eastern spillway. The permanent concrete crest elevation of the dam is 97.2 feet[1], and the normal headpond elevation is 101.7 feet. The Gilman Falls Development, part of the Milford Project, is located on the western side of Marsh Island, which separates the main stem and Stillwater Branch of the Penobscot River. The Gilman Falls Development includes Gilman Falls Dam, which is a 450-foot-long concrete gravity structure located in Old Town, Maine, on the Stillwater Branch of the Penobscot River. Gilman Falls Dam regulates flow into the Stillwater Branch, and it has no power generation facilities. The Milford Project is operated in a run-of-river mode.

From the powerhouse towards Marsh Island, Milford Dam consists of the following sections:

1. A Denil fishway with an entrance adjacent to the tailrace and an exit adjacent to the forebay trashracks.
2. A concrete sluiceway (log sluice) and gate 25 feet wide with two, 4-foot-wide abutments.
3. A 380-foot-long concrete gravity spillway equipped with an Obermeyer inflatable flashboard system at a permanent concrete crest elevation of 97.2 feet and a steel-hinged beam with a top elevation of 98.23 feet, which controls the flow release.
4. A 4-foot-wide weir used for seasonal upstream eel passage.
5. A concrete gravity spillway 588 feet long with 572 feet of steel-hinged flashboards and a permanent concrete crest elevation of 97.2 feet and a steel-hinged beam with a top elevation of 98.2 feet, which controls the flow release.
6. A concrete abutment 145 feet long and approximately 15 feet high with a maximum elevation of 106 feet.

A powerhouse, built in 1906, is located on the eastern end of Milford Dam in the Town of Milford. It is a steel-framed, brick structure with a masonry foundation, and it measures approximately 226 feet long, 85 feet wide, and 78 feet high. The powerhouse was originally designed and constructed to house twelve 25-cycle units. During the period between 1941 and 1956, the 25-cycle units were replaced by four larger, 60-cycle units with a combined nameplate rating of 6.4 megawatts (MW), leaving four-wheel pits vacant. In 2011, two new Canadian Hydro Components units were installed in the empty bays. The current total installed capacity of the powerhouse is 8.23 MW.

The powerhouse has inner trashracks with 1-inch clear bar spacing over the full depth of the racks, with two surface and one bottom downstream fish passage entrances. The Milford Development also has full depth angled trashracks with 4-inch spacing that are located upstream and exterior to the powerhouse. Although utilized primarily for debris control, these exterior trashracks lead to the log sluice and Obermeyer inflatable flashboard system.

*Gilman Falls Dam*

From Marsh Island west toward an island in the Stillwater Branch, the Gilman Falls Dam is composed of the following sections (Figure 2):

[1] All elevations are referenced to the National Geodetic Vertical Datum which is equivalent to 1929 Mean Sea Level Datum unless otherwise noted.

1. A non-overflow section, 49 feet in width, with a maximum deck elevation of 107.5 feet.
2. The east abutment wall, which is 3.5 feet wide, with a maximum elevation of 102.5 feet.
3. The main spillway, which has 4.4-foot-high flashboards and is 311 feet long, has a permanent crest elevation of 97.3 feet. It includes a center abutment 25 feet wide that has a maximum elevation of 102.3 feet.
4. The west abutment wall, which is 2 feet wide, has a maximum elevation of 102.1 feet.
5. A gate structure which is 86 feet wide with a maximum elevation of 110.3 feet. This structure houses (1) one timber stoplog opening, which is 6 feet wide with the top elevation at 100.8 feet, (2) one Tainter gate which is 30 feet wide, (3) a second Tainter gate which is 20 feet wide, and (4) a spare bay with a stoplog opening, which is 15 feet wide with a permanent crest elevation of 100.6 feet. Each gate has a maximum elevation of 102.3 feet and is separated by piers which are 3 feet wide.
6. Approximately 75 feet of the channel has a steel-paneled, inflatable rubber flashboard crest control system attached to a pre-existing concrete sill.

An island, approximately 85 feet in width, separates the above structures from the west shore of the Stillwater Branch of the Penobscot River.


Figure 2. An overview of the Gilman Falls Dam, which is part of the Milford Hydroelectric Project. The dam is located on the Stillwater Branch.

*Maintenance Activities*

Black Bear implements debris and fish passage maintenance plans for the Milford Project as described in the Milford Project's Fish Passage Operations and Maintenance Plan (Attachment B of the BA). Black Bear has hired dedicated seasonal staff and a full-time fisheries biologist to supervise, inspect, monitor and operate the upstream fish lift and downstream fish passage facilities at the Milford Project.

Additional maintenance activities include periodic visual inspections of the trashracks for debris, an annual 1-2 week maintenance shutdown of the fish lift in August and implementing both a pre-season operational and maintenance start-up procedure and an end of season shut-down procedure for the fish lift.

### 2.1. **Fish Passage Facilities**

Upstream Passage

As described in the their 2012 SPP and our 2012 Biological Opinion, the FERC license requires Black Bear to operate upstream passage at the Milford Project to achieve a passage performance standard for adult prespawn Atlantic salmon. The performance standard for upstream fish passage requires that 95% of upstream migrating Atlantic salmon pass the dam within 48 hours of approaching within 200 meters of the Project when the river temperature is at or below 23°C (as it is deemed unsafe to handle fish under warm water conditions).

A fish lift with a single entrance, having an attraction flow of 180-210 cubic feet per second (cfs), is located on the east shore immediately downstream from the powerhouse. The fish lift includes an upper flume that exits to the head pond, and it incorporates a fish trapping, sorting, and trucking facility. Black Bear operates the fish lift from April 15 to November 15, as river conditions allow (i.e., when flow and ice conditions are sufficient to support operation of the lift). The following provides an overview of the fish lift operations:

- In the beginning of the season (April 15 to early May), the fish lift cycle is operated during daytime hours from 5:00 a.m. to 8:00 p.m. at a maximum lift interval of every 60 minutes.
- Daytime operations:
    - As the anadromous fish run increases in numbers, the Milford fish lift cycle time is reduced, eventually down to 15-minute intervals during daylight hours when river herring are most active.
    - The daytime lift frequency may be reduced further to 10-minute cycles during the most active periods of the peak river herring passage days to prevent overcrowding of the hopper.
    - As the anadromous fish run drops off, the Milford fish lift's timing frequency is adjusted accordingly during the upstream passage season, eventually up to a maximum duration of once every 60 minutes.
- Nighttime operations:
    - Nighttime operation of the fish lift (8:00 p.m. – 5:00 a.m.) generally begins in early May following a couple of days of consistent catches of river

herring, and continues through August 31.
- The frequency of nighttime lifts ranges from 30 to 60 minutes, depending on the time of year (i.e., shorter intervals in May and June when there is more fish passage activity at night).

The existing Denil fishway, which is not currently in use, has an entrance adjacent to the tailrace in the vicinity of the Bay 2 downstream passage outflow and an exit adjacent to the forebay trashracks. A small Atlantic salmon broodstock trapping facility was installed within the exit flume of the fishway in 2014 as a contingency in case the primary fish lift and its associated fish sorting and collection facility were inoperable or down for maintenance. However, it was determined that the collection trap was harmful to salmon, likely due to its small size (approximately 4 ft x 4 ft x 3.6 ft = 58 $ft^3$) and high velocity through the facility. As a result, a new contingency collection trap to capture Atlantic salmon broodstock was completed in 2021. The new trap was modified so that it would be safer for any Atlantic salmon that enter it. The new collection trap is larger (7 ft x 6 ft x 5 ft [210 ft3]), has walls made of 1.25-inch clear space bars on three sides, and is located outside the exit of the Denil fishway, in the headpond (Figure 3). The larger trap and location provide for favorable velocity conditions for fish that are captured and holding in the trap, while the bar spacing allows river herring to volitionally continue their upstream migration. When in use, the rectangular trap is lowered into the headpond such that fish exiting the Denil fishway pass directly into it. The trap has an inward facing funnel at the entrance intended to retain adult salmon in the trap once they have entered.

Figure 3. The new trap constructed in 2021 that can be placed at the exit of the Denil fishway.

In the bypass reach on the western side of the dam, Black Bear leaves two short sections of steel-hinged flash boards uncaulked to provide flow in the bypass area for the purpose of affording adult Atlantic salmon egress from the area and to reduce the risk of fish stranding in the spillway ledge pools. In an evaluation conducted by Normandeau Associates in 2023, it was found that the leakage flow into the large pool located immediately downstream of the flashboard section leads to a measurable increase in water depth and wetted width within the outlet channel leading to the tailrace (Normandeau Associates, 2023). Although none of the locations evaluated during the 2023 assessment met the minimum Atlantic salmon passage depth guidance (Turek et al., 2016) of three body depths plus 0.25 feet (i.e., 2.25 feet), most transects were very close with a thalweg depth between two and three body depths (i.e., 1.3-2 feet). In addition to the leakage through the boards, Black Bear implements a monitoring and rescue procedure whereby fish passage staff monitor the bypass area for stranded fish when the boards are raised and following spill events throughout the fish passage season.

The Gilman Falls Dam does not have a fishway, as salmon are not passed into the Stillwater Branch at the downstream Orono and Stillwater Projects. However, it is expected that adult salmon that fall back over the dam into the Stillwater, after passing upstream at the Milford Dam, could likely navigate the channel on the west side of the Gilman Falls dam or re-approach the Milford Dam if they choose to reascend.

<u>Downstream Passage</u>

As described in the their 2012 SPP and our 2012 Biological Opinion, the FERC license requires Black Bear to operate downstream passage at the Milford Project to achieve a survival standard for Atlantic salmon smolts and kelts. The performance standard, as defined in the 2012 SPP, is a minimum of 96% survival, based on a 75% confidence interval. That is, no fewer than 96% of downstream migrating smolts and kelts approaching the dam structure survive passing the dam structure, which is measured from 200 meters upstream of the trashracks downstream to a point where delayed effects of passage can be quantified. Fish that stop moving prior to reaching the most downstream telemetry array or take longer than 24 hours to pass the project have been considered to have failed in their passage attempt.

The downstream fish passage facilities at the Milford Project consist of two surface bypass flumes passing through the powerhouse wall at its western end and near the center of the station, which pass up to a combined 280 cfs during the passage season. The entrances are located at the face of the interior full-depth trashracks, which have 1-inch clear spacing. Each surface bypass is capable of passing up to 280 cfs. The licensee has also installed a low-level bypass for American eels at the bottom of the trashracks, directly below the surface bypass entrance at the west end of the powerhouse. The low-level bypass is designed to pass up to 70 cfs and has a 4-foot by 4-foot entrance that reduces to a 24-inch-diameter pipe, which in turn discharges into an unused turbine bay. The two surface bypasses are opened for the duration of the adult alosine outmigration period, while the low-level bypass is open from August 15 to November 15 annually to provide downstream eel passage. In addition to the downstream passage facility described above, a bypass sluice is also located at the downstream end of the exit flume of the upstream fish passage facility for incidental downstream passage of fish that end up in the flume. Non-generational flow can also be passed via a 25-foot-wide, bottom-opening sluice gate located adjacent to the mid-channel side of the powerhouse.

When fully opened under normal headpond conditions, the sluice gate is capable of passing approximately 2,000 cfs. Prior to downstream passage via one of the existing surface bypass flumes located on the interior full-depth trashracks; fish must first pass through an outer full depth angled trash rack which has 4-inch clear spacing. Based on visual observations and results of the 2017 telemetry evaluation, adult American shad appeared to be reluctant to pass through the existing outer trash rack structure at Milford. To facilitate through-passage and increase the likelihood of downstream migrant usage of the existing downstream surface bypass flumes located at the western end and center of the powerhouse, Black Bear installed a pair of open windows in the outer rack in 2018. These two "shad" windows measure approximately 5.8 feet in width and 8.5 feet tall and are centered on bays #2 and #7 of the Milford powerhouse (i.e., the two bays containing entrances to the downstream passage surface bypass flumes). The shad windows are surface-oriented with the upper opening elevation at 103.7 feet, approximately 2 feet higher than normal full pond (i.e., elevation 101.7 feet). These two windows were installed in the outer rack prior to the onset of the 2018 adult alosine passage effectiveness study.
The priority for passing spill at the Project is the following sequence: log sluice, rubber dam (Obermeyer inflatable flashboard system), then spillway. Since 2016, Black Bear has implemented an enhancement measure contained in the SPP's tiered, decision-making process to target an increase in spill at the Milford Project (i.e., 20-50% of river flow) to support the downstream passage and survival of Atlantic salmon smolts. The licensee provides these spills 24 hours per day for a two-week period.

The Gilman Falls Dam has no dedicated downstream passage facilities. As it does not generate electricity, all fish pass downstream over the spillway or through the gate.

## 2.2. Proposed Action

Although not specified by FERC in its request for consultation, we anticipate that Black Bear will apply for, and FERC will issue, an amendment to the exiting Milford license to incorporate the provisions of the proposed action and this Opinion as mandatory conditions at the project. We anticipate that these requirements would become part of the current license, and consequently that that they would be in place until the expiration of that license (i.e., until the license expiration date of March 31, 2038). As such, the term of the action considered by this consultation is approximately 13 years (2025-2038), which encompasses at least 12 fish passage seasons (2026-2037). In the event that FERC does not issue a new license by March of 2038, we would expect them to issue annual licenses that require that the proposed SPP measures continue to be implemented and the analysis in this opinion would remain valid.

In addition to FERC's action, the USACOE is proposing to issue a permit for the discharge of permanent and temporary fill below the ordinary high-water mark (OHWM) of the Penobscot River during the construction of the spillway diversion wall. The USACOE's proposed special conditions are described below.

### 2.2.1. Atlantic Salmon Species Protection Plan

Black Bear will continue to implement measures consistent with the 2012 SPP that have been incorporated into the project license. This section presents additional enhancement measures, consistent with the description in the 2025 BA, that will be implemented to reduce upstream passage delay and strandings, and to enhance downstream passage of Atlantic salmon.

Upstream Passage Enhancements

Black Bear proposes to operate the existing Denil fishway, in addition to the fish lift, throughout the Atlantic salmon migration period of April 15 to November 15 (24-hours a day). This fishway was the primary fishway at the project until the lift was constructed in 2013, but has rarely been operated since. Its operation will provide an additional passage route for Atlantic salmon that approach the project powerhouse. Black Bear is proposing to install the trap that was constructed in 2021 for the purpose of collecting broodstock, if and when that is deemed necessary by the resource agencies.

Black Bear is proposing to build a spill diversion wall to contain the flow from the western side of the Obermeyer inflatable flashboard system. The intention of this measure is to reduce the risk of adult salmon being attracted to the bypass area and potentially becoming stranded in the ledges below the center portion of the spillway[2]. After opening the sluice gate, the Obermeyer inflatable flashboard system is the second option for spilling water in excess of station generating capacity at the Milford Project. When the Obermeyer is lowered, some flow on the western side of the Obermeyer spills over the center ledges towards the west/Old Town side of the river (yellow arrow in Figure 4). This creates two issues that can result in Atlantic salmon becoming stranded or delayed: 1) the spill provides attraction flow to the spillway for upstream migrating Atlantic salmon, and 2) salmon that are in the spillway area can ascend upstream over the center ledges (from the west side), to the base of the dam at the top of the ledges where the eel ramp is currently located. Black Bear proposes to construct a concrete diversion wall (Figure 4, red dotted line) on the downstream ledge (Figure 5) to keep the flow concentrated on the east/Milford side of the ledges and in closer proximity to the fish lift and the Denil fishway entrances during periods when the Obermeyer is lowered.

[2] The proposed spill diversion wall will direct Obermeyer flow away from the western side of the bypass under inflow conditions less than 17,320 cfs and greater than 9,220 cfs. For the median inflow year (based on 2017-2022) at Milford, flows in excess of that range are expected to be present during 12 percent of the upstream passage season (April 15 to November 15). For the peak period of upstream salmon passage at Milford (May 1 to July 15) median inflow is less than 9,220 cfs 61 percent of the time, between 9,220 and 17,320 cfs 27% of the time and in excess of 17,320 cfs 12 percent of the time (see Section 5.1.2). Inflow conditions more than the total hydraulic capacity of 17,320 cfs (i.e., capacity sum for upstream and downstream fish passage facilities, powerhouse, sluice gate, and Obermeyer gate) are outside of the control of Black Bear and will pass downstream via the western overflow spillway section.

Figure 4. Schematic of proposed spill diversion wall (red dotted line – approximate location). Yellow arrow shows where, when the Obermeyer is lowered, some flow on the western side of the Obermeyer spills over the center ledges. Red line depicts approximate location of proposed flow diversion wall.

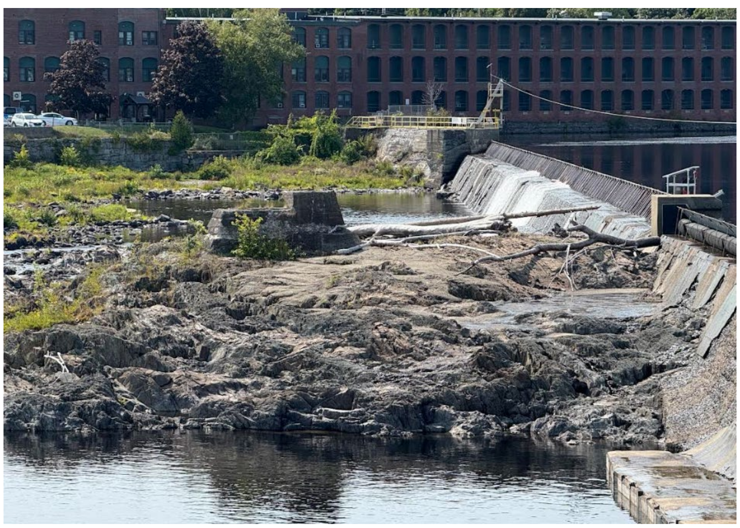

Figure 5. The approximate location of the proposed spillway diversion wall. The wall be constructed on top of the ledge just downstream of the dam.

*Construction of the Spill Diversion Wall*

Black Bear did not provide construction details for the installation of the diversion wall in the BA, but did respond to an information request from NMFS on October 2, 2025 (Attachment A). The below summary is based on information provided in that response.

The proposed construction of a 50-foot long by 4-foot wide by 10-foot high flow diversion wall at the Milford Hydro facility will require a temporary drawdown of the Milford impoundment to facilitate construction. The impoundment drawdown needed to facilitate the construction will be limited to approximately six inches (0.5 feet) below normal pond level for an estimated duration of eight weeks, and will be scheduled during low flow period (July/August) in 2026. This limited drawdown will maintain river flow conditions and allow fish passage to continue, while providing stable working conditions for the installation of the diversion wall. Operations will be adjusted as necessary to ensure water levels remain stable during the construction period.

The scope of work is expected to include the following activities:

- Mobilization of equipment and personnel,
- The installation of barge sections in the headpond to support crane operations (estimated 50-ton RT crane),
- Form and place a leveling pad (no more than 10 ft sq, 3 ft tall, 12 CY of material) on existing downstream ledge to support wall installation,
- Install rock anchors along footprint of wall into ledge with appropriate embedment (assumed 16" depth),
- Form and place reinforced concrete diversion wall, approximately 10' tall x 50' long, with a 4' base (~200 square feet) tapering to 2' at the top,
- Demobilize barge sections and crane,
- Clean up and restore the work site.

Construction equipment will include a 50-ton rough terrain crane on modular barge sections, supported by a small work boat for positioning. An excavator, loader, or skid steer will be used for site preparation, embankment work, and material handling, with concrete placed by pump truck or crane and bucket. Dewatering pumps will maintain dry conditions downstream, and generators, welders, and light towers will provide power and lighting as needed.

Contractors will employ best management practices (BMPs) to prevent erosion, sedimentation, or accidental discharges into the river. All fuel and oil storage will be placed in secondary containment, and spill response kits will be staged on site to ensure immediate response capability. Construction waste and debris will be collected and removed from the work area promptly, with disposal at approved off-site facilities to prevent any potential impact to water quality or aquatic habitat.

The work window for construction was selected by Black Bear to minimize potential impacts to fish passage. Construction will occur outside the peak spring downstream smolt migration period (April through June) and after the peak July upstream migration of adult Atlantic salmon. The limited six-inch drawdown and stable eight-week schedule will further reduce the likelihood of disruption to upstream or downstream passage during the project.

Barges will be used to stage equipment in the headpond; however, fueling and equipment maintenance will take place on land at designated staging sites located away from the river. All portable equipment, including generators and welders, will be placed in secondary containment to minimize the potential for spills or runoff. Temporary scaffolding or work trestles, if required, will be installed and maintained in accordance with BMPs to avoid adverse effects to water quality.

All downstream work associated with the diversion wall will be conducted in the dry. A stabilized earthen leveling pad and temporary cofferdam or containment system will isolate the work zone from active river flows, eliminating direct in-water construction. Pumps and dewatering systems will be fitted with appropriate filtration or energy dissipation devices to prevent sediment from entering the tailwater, and turbidity curtains or silt booms will be deployed as necessary to minimize the incidental release of sediment generated during construction.

Daily environmental inspections will be conducted throughout the work period to confirm proper implementation of BMPs. If any Atlantic salmon or other diadromous fish are observed within the action area during the drawdown, activities will be adjusted immediately and appropriate resource agencies will be notified. At the conclusion of the project, a final inspection will be completed to ensure that all construction materials, temporary structures, and debris have been removed and that the site has been restored to stable pre-construction conditions.

The USACOE has proposed the following special conditions (via e-mail dated December 18, 2025) for the discharge permit for this activity:

1. In-Water Work Window
The permittee shall conduct all construction activities at or below the OHWM only during periods of low flow and within the in-water work window of July 15 to September 30. Work above the OHWM may occur outside this window.
2. Soil Erosion and Water Pollution Control Plan (SEWPCP)
The permittee shall not discharge any pollutants. The permittee shall submit an SEWPCP designed to avoid and minimize erosion and pollution, including the following components:

A. Project Contact: Identify a contact responsible for implementing the SEWPCP (name, phone number, address).
B. Schedule: Provide a schedule and sequence for all activities involving soil disturbance.
C. Emergency Procedures: Establish emergency storm response procedures, including a list of on-site materials and corrective action plans. All work, except for efforts to prevent resource damage, shall cease during high flows.
D. Control Measures: Specify the type and location of all temporary erosion and sedimentation control measures.
E. Mulching: Detail the mulching type, thickness, and application frequency for disturbed areas.
F. Seeding: Note the location and frequency of temporary seeding.
G. Dust Control: Describe dust control procedures for all staging, stockpile, and haul road areas.
H. Sedimentation Control: Detail the location and method for temporary sedimentation control at all catch basin inlets/outlets and outlet areas.
I. In-Water Work Description: Describe all in-water work, including timing, temporary stream diversions, and the type, location, and size of cofferdams. Do not allow uncured concrete or form materials to enter the active stream channel.
J. Dewatering Plan: Describe the design and location of sedimentation basins for dewatering cofferdams, including contingency plans for overflow.

K. Inspection Schedule: Provide inspection and maintenance schedules for all erosion and sedimentation controls, including the method, frequency, and disposal location of removed sediment.

L. Removal Schedule: Detail the procedures and schedule for removing all temporary erosion and sedimentation control measures.

M. Waste Management: Establish procedures to confine, remove, and dispose of all construction waste, including debris, discharge water, concrete, grout, washout facilities, welding slag, petroleum products, and other hazardous materials.

N. Spill Prevention, Control, and Containment Plan (SPCCP): The permittee shall provide a written SPCCP that describes measures to prevent or reduce impacts from potential spills. The SPCCP shall contain a hazardous materials inventory and describe handling and monitoring procedures.

(1) All vehicles carrying fuel shall have equipment and materials to contain or clean up spills, including appropriately sized spill kits, absorbent pads, and booms.

(2) All pumps and generators in use shall have appropriate spill containment structures.

(3) Store fuel on an impervious surface at least 100 feet from streams.

(4) Store waste liquids under cover on an impervious surface until they can be transported to an approved treatment facility.

3. Site Preparation

A. Flagging Sensitive Areas: Before construction, flag critical riparian vegetation, wetlands, and other sensitive sites to minimize disturbance.

B. Staging Area: Locate all vehicle, equipment, and fuel staging areas outside the 100-year floodplain and more than 100 feet from streams (200 feet from groundwater wells or 400 feet from public wells).

C. Temporary Erosion Controls: Install sediment barriers before construction begins, per the MaineDOT Best Management Practices for Erosion and Sedimentation Control (February 2008). Remove temporary controls once the site is stabilized post-construction.

D. Clearing and Grubbing: Minimize vegetation clearing. Where necessary, cut trees and shrubs at ground level, leaving the root stock in place to stabilize soil and promote regrowth.

E. Stockpile Materials: During excavation, stockpile large wood, topsoil, and native channel material above the bankfull elevation for later use in site restoration. Materials needed for restoration may be staged within the 100-year floodplain.

4. Heavy Equipment Use

A. Equipment Choice: Use equipment appropriately sized for the project and operate it in a manner that minimizes environmental effects (e.g., using low-pressure tires, temporary mats, and avoiding hard turns).

B. Fueling, Cleaning, and Inspection:

(1) Before entering the project area, clean all equipment of petroleum, dirt, and plant material and repair any leaks. Fuel and service all equipment within the established staging area.

(2) Inspect equipment daily for fluid leaks before operation.

(3) Clean equipment thoroughly before operating it below the OHWM or within 50 feet of any water body.

(4) Dispose of contaminated soil in accordance with State and Federal regulations.

C. Temporary Access Roads: Use existing roadways where possible. Minimize new temporary roads, build them away from erosion-prone slopes, and revegetate them after construction.

D. Ledge Removal: To prevent acoustic trauma to Atlantic salmon, the operator shall use a "soft start" when operating a hoe ram to break ledge or bedrock.

E. Timely Completion: Complete all earthwork as quickly as possible to minimize the time heavy equipment is in stream channels, riparian areas, and wetlands.

5. Site Restoration

A. Stabilize and revegetate all disturbed soil adjacent to waterways with a native conservation seed mix appropriate for Maine. If seeding is not viable due to the season, use geotextile, hay bales, and riprap for temporary protection.

B. Loosen compacted soil in access roads, staging areas, and other paths as needed.

C. Reconstruct the stream channel cross-section and gradient to reflect natural conditions after culvert removal or replacement, using the Stream Simulation design.

D. Use restoration materials (large wood, boulders) that mimic those found in the project vicinity. These materials may be salvaged from the site or hauled in, but not taken from other streams or wetlands.

E. Use steep-slope terracing where necessary.

F. Complete all site restoration activities within five days of the final construction phase.

6. Work Area Isolation and Atlantic Salmon Evacuation

A. Isolate Work Area: The permittee shall install block nets upstream and downstream of the construction zone and secure them to the stream bed and banks. The permittee shall monitor the nets daily.

B. Evacuate Fish: The permittee shall capture all Atlantic salmon trapped within the isolated area and release them to a safe site upstream. Use electrofishing and other approved methods (herding, netting) to minimize injury, following the "Maine Department of Marine Resources... Standard Operating Procedure... 2010" and NMFS "Guidelines for Electrofishing... 2000."[3]

C. Dewater Construction Site: The permittee shall use cofferdams to isolate the construction area.

(1) Build cofferdams with non-erosive materials and use only a vibratory hammer for sheet pile installation.

(2) Use a screen on all pump intakes that meets NMFS sizing and velocity criteria to prevent the entrainment and impingement of juvenile Atlantic salmon.

D. Re-water Stream: After construction, slowly re-water the site to prevent a sudden increase in turbidity. Capture the first flush of turbid water and pump it through a sediment treatment system. Monitor downstream during re-watering to prevent stranding aquatic organisms.

*Upstream Passage Performance Standard and Monitoring*

[3] We have not considered effects of electrofishing in this Opinion. A term and condition has been included that specifies that minimally invasive methods should be employed, which does not include electrofishing.

As noted above, the 2012 Species Protection Plan incorporated a passage performance standard that required 95% of adult salmon that approach within 200 meters of the dam to pass the project within 48 hours. Black Bear proposes to update the upstream fish passage performance standard and consider it to be achieved if 95% of adult test fish that approach within 200 m of Milford Dam successfully pass the dam, with at least 75 percent passing within 48 hours and the remaining test fish (needed to achieve 95 percent passage efficiency) passing within 96 hours.

If, after implementation of the above measures (i.e., operating the Denil and constructing a spill diversion wall), it is determined that the standard is not being achieved, Black Bear proposes to work with NMFS to identify any "additional potential operational and/or structural measures to be considered for the performance standard to be met or that that may be necessary to reduce adverse effects to the species."

Black Bear is proposing to conduct an upstream Atlantic salmon passage study at the Milford Project to evaluate if the performance standard is being met with the new and existing protection measures. The 95 percent performance standard will be evaluated using radio telemetry or similarly accepted methods. Black Bear anticipates that the study will involve the following, with details to be refined in a study plan that will be developed in consultation with the resource agencies. Black Bear will coordinate with resource agencies to stock uniquely marked Atlantic salmon produced at Green Lake National Fish Hatchery, or other hatchery sources agreed to by the resource agencies, upstream of the Project. When the adult salmon return to the Penobscot River two years after being stocked as smolts, their origin can be confirmed during handling at the Milford fish lift. A sample of these fish[4] will then be radio-tagged and released back downstream of the Project. Using a telemetry receiver array, radio-tagged salmon that then swim to within 200 meters of Milford Dam will be tracked to determine their success in using the upstream fishway or lift. Black Bear will coordinate with NMFS to develop an agreed plan to monitor passage of Atlantic salmon at the Denil fishway.

Black Bear proposes to conduct a one-year monitoring study to determine if the performance standard is being met. However, they also indicate that it could take them up to three years to demonstrate achievement of the standard. As such, we anticipate that up to three years of telemetry studies may be needed to demonstrate compliance. If Black Bear cannot demonstrate achievement of the proposed cumulative performance/delay standard within three years, it will consult with NMFS regarding additional operational or infrastructure improvements. In consultation with NMFS, the licensee will develop and implement additional operational or infrastructure measures, as reasonable and practicable, that are likely to meet or exceed the upstream performance standard.

Although Black Bear has proposed to construct the spillway diversion wall in 2026, they cannot proceed with construction until they have received authorizations from FERC and the ACOE and until they have hired a contractor to do the work. Given the time needed for these steps, it is likely that construction won't occur until 2027; meaning that the first passage season when both

[4] The availability and number of adult salmon used in the study will depend on the number of returns to the Penobscot River. If returns are low, most salmon may need to be collected and taken to the hatchery in order to achieve the minimum broodstock target to facilitate the survival of the species; any remaining salmon could then be available for the study.

proposed upstream measures (i.e., operate the Denil and construction of the wall) are being implemented is expected to be 2028. As indicated, the evaluation of passage conditions is expected to take up to three years. Although the evaluation was proposed to begin in 2028, the earliest that smolts could be stocked upstream of the dam to provide a source of motivated study fish would be 2027, which would result in returning adults in 2029. Given this timeline, we would expect the evaluation period would begin in 2029 and could extend through 2031. As such, we expect that the proposed action should allow for the performance standard to be achieved by the fish passage season in year six (i.e., 2031) of the 13-year term of the proposed action.

Downstream fish passage enhancement

In their implementation of the adaptive management plan included in the 2012 SPP, Black Bear has been providing supplemental spill (20-50% of river flow) at the Milford Project for 14 days during the smolt migration. In the proposed action we are considering, Black Bear has proposed to increase the duration of spill releases from 14 days to 54 days to in order to protect a larger proportion of the smolt outmigration window. The timing of the spill period will be determined in consultation with NMFS annually and will be informed by the results of the agency smolt run timing model (Frechette et al., 2023).

*Downstream Passage Survival Standard and Monitoring*

The 2012 Species Protection Plan, and our 2012 Biological Opinion, incorporated a passage survival standard that requires that 96% (within a 75% confidence interval) of smolts that approach within 200 meters of the dam to pass the project within 24 hours. The 2016 to 2018 smolt survival studies demonstrated that survival at the Project was 96.5 percent (point average of 3 years), and that during the test periods when the 20-50 percent spill adaptive management measure was implemented, the Project achieved the 96 percent survival standard, as specified by the SPP. This standard is reflected in the RPMs and Terms and Conditions of the 2012 BiOp's ITS; as explained in that Opinion, exceedance of the standard is considered exceedance of the amount and extent of take exempted through that ITS.

Consistent with the requirements of the 2012 BiOp, once the downstream smolt performance standard has been met at the Milford Project, Black Bear will continue to conduct a one-year study every 10 years to verify that the standard continues to be met. In the 2025 BA, Black Bear indicates that the smolt survival standard was met in 2018 with the conclusion of the smolt survival studies. However, as described in the *Effects of the Action* section below, the standard was only achieved when supplemental spill was provided for the *entirety* of the 2016- 2018 smolt run evaluation period, which is not consistent with how downstream passage is operated at the project currently (spill is provided for only two weeks). Black Bear's proposed measure to increase the spill duration from 14 to 54 days should allow for the spill measure to be applied through the entirety of the smolt run, which would align with the spill conditions during the 2016-2018 period when the standard was achieved. Regardless, Black Bear has proposed that a smolt survival study be conducted in 2028, which will verify whether the standard has been achieved with the implementation of the proposed measures. The 2012 BiOp also indicated that a three-year kelt study would be required within 10 years of the performance standard for smolts being met. In the BA, Black Bear proposes to carry out that study in 2028. However, in conversations with the state and federal agencies, Black Bear has committed to conducting the kelt study a year earlier (2027) due to the availability of tagged fish in the river being used for an upstream passage study at the upstream Mattaceunk Project. Therefore, we expect that the first year of the study will occur in 2027 but consider it possible that it could be delayed to 2028. As indicated, the amended license requires that three years of kelt survival studies be conducted, which we expect to occur during the term of this SPP.

Although Black Bear did not incorporate downstream measures into their proposed implementation schedule (below), we expect that the proposed measure extending the spill window from 14 to 54 days would begin the first passage season after FERC amends the license to incorporate the SPP considered herein or otherwise approves operations consistent with the SPP. The effects of this extended spill measure would be evaluated in the 2028 smolt survival study. As such, the proposed action will allow for the performance standard to be achieved and verified by 2028; two years into the 13-year term of the proposed action.

<u>Implementation Schedule</u>

Black Bear has proposed a schedule for the implementation of the revised SPP, dependent on the issuance of this Opinion, FERC's approval, and the USACOE's issuance of a permit. Below, we have updated it to emphasize that the timeline is relative to the issuance of these authorizations.

- First passage season after authorizations issued (likely 2026 or 2027):
    - Develop agreement with USFWS for rearing, marking, and stocking of smolts (50-100K) upstream of Milford.
    - Develop upstream monitoring plan in consultation with NMFS.
    - Increase the duration of spill releases (20-50% of river flow) from 2 weeks to 54 days. The timing of the spill period will be determined in consultation with NMFS and will be informed by the results of the agency smolt run timing model.

- Second passage season after authorizations issued (likely 2027 or 2028)
    - Release uniquely marked smolts to provide motivated adults for upstream passage evaluation.
    - Design and install spill diversion wall.
    - Upstream Passage – Operate Denil fishway in conjunction with the fish lift throughout the Atlantic salmon migration period of April 15 to November 15 (shakedown year for the Denil fishway).
    - Initiate a downstream passage effectiveness study for kelts. This was proposed for 2028 in the BA/SPP, but Black Bear has since committed to conducting the evaluation a year earlier. The 2012 amended license for this project requires three years of kelt evaluation; Black Bear did not propose any modifications to these evaluations in the BA or revised SPP. Our expectation is that these evaluations would occur during the term of this SPP.

- Third passage season after authorizations issued (likely 2028 or 2029)

- Operate Denil fishway in conjunction with fish lift with diversion wall installed.
- Conduct upstream fish passage effectiveness study; this may continue for two additional years dependent on results.
- Conduct the 10-year downstream passage standard verification study for smolts (scheduled for 2028). Additional study years may be needed if the performance standard is not met.

As indicated above, Black Bear has proposed to conduct a "one year monitoring study" of upstream passage effectiveness but also indicates that it may take them three years to demonstrate compliance with the upstream performance standards. As such, we anticipate that up to three years of telemetry studies may be needed.

Description of 2017 Dam Repair Activities

In June of 2017, scour and undermining damage were identified along sections of Milford Dam, including scour areas on dam sections on each side of a ledge outcrop near the middle of the river. Scour on the west (Old Town) side of the dam (below the flashboard spillway section) was very deep, but there were no seepage leaks detected. The undermining on the east (Milford) side of the dam (below the Obermeyer inflatable flashboards) had a scour hole that was the full depth of the dam base and flow was passing through it from the head pond. The need for repairs of the scour and undermining damage during the expected summer low-flow season, initially discussed between Black Bear and FERC on June 21, 2017, was subsequently identified by FERC as an emergency dam safety repair. Discussions with FERC and NMFS began on June 29, 2017, regarding the need to use the emergency consultation procedures within the ESA in accordance with 50 CFR § 402.05. FERC designated Black Bear as their non-federal representative for consultation under the ESA on July 3, 2017. Black Bear and FERC held a meeting with NMFS, USACOE, and the Maine Department of Environmental Protection (MDEP) on July 17, 2017 to discuss the planned repair activities and environmental protection measures. NMFS provided recommendations to minimize risk to Atlantic salmon.

An inspection of the dam identified five scour holes along sections of the Milford Dam that required repair. Additionally, in consultation with NMFS and while repair crews were mobilized and on site, crews filled several natural voids in a ledge outcrop below Milford Dam to reduce the likelihood of fish being stranded when river flows drop. Access was provided to the repair areas through both a temporary access road (with culverts) constructed across the tailrace from the west (Old Town) side of the river, and by removing trees on the east (Milford) side of the river to allow the fabrication and placement of a barge in the head pond. A crane was placed on the barge, and it was positioned at the Obermeyer spillway above the dam in order to deliver materials (concrete forms, sand bags, etc.) to the repair area, hold dive equipment, and help with positioning of the concrete hoses.

NMFS has emergency consultation procedures (50 CFR §402.05) when there is "a situation involving an act of God, disasters, casualties, national defense or security emergencies, etc., and includes response activities that must be taken to prevent imminent loss of human life or property" (USFWS and NMFS 1998). FERC determined that the undermining of the dam posed a safety emergency and requested an emergency section 7 consultation with NMFS, thus enabling expedited procedures. Black Bear filed an after-the-fact dredge and fill permit for the emergency repairs with the U.S. Army Corps of Engineers on July 27, 2018, which included a BA prepared in consultation with NMFS.

Black Bear met with FERC, USACOE, Maine DEP, and NMFS on July 17, 2018 to discuss potential measures to reduce effects to the environment and listed species. Environmental mitigation measures developed and carried out during the emergency repair included:

- In-stream erosion and sedimentation control
- Stabilization of disturbed soils/spoils disposal areas
- Maintenance of water levels
- Minimizing the magnitude and duration of in-stream activity
- Avoiding environmentally sensitive areas or time periods
- Minimizing the drawdown period and extent to minimize effects to the operation of the fish lift.
- Implementing Atlantic salmon and sturgeon stranding protocols (attachment C of BA).

### 2.2.2. Sturgeon Handling Plan

Black Bear has developed this sturgeon handling plan to provide for safe handling of any Atlantic or shortnose sturgeon that (1) may be encountered by personnel during fish lift operations, and (2) in the event of their stranding below the project spillways during flashboard replacement or other situations requiring impoundment drawdown. The provisions of the plan were part of the proposed action in the 2012 Opinion, and were updated in 2017.

#### Fish Lift Operations

Because of concerns regarding the safety of downstream passage for shortnose and Atlantic sturgeon, and the fact that Milford represents the historical limit of upstream migration for sturgeon (MDMR and MDIFW 2009, NOAA 2012, Fernandes 2008), sturgeon will not be passed upstream of the Milford dam. If sturgeon are collected at the fish lift, Black Bear will implement procedures consistent with a sturgeon handling plan to ensure that sturgeon are properly documented and released safely below the dam. Additionally, this plan will include procedures for biological sampling inclusive of a fin clip for genetic analysis.

#### Sturgeon Stranding

When the flashboards are replaced at the Milford dam, or other operations cause spill or leakage conditions, there is a possibility that sturgeon may become stranded in pools below the dam spillways. When these situations occur, and if deemed safe to do so, Black Bear will check these pools as soon as possible for the presence of sturgeon. If any are found, Black Bear will follow the same procedures as outlined above for the fish lifts, with one exception – if alive and uninjured, the sturgeon will be moved to the river below the dam at a point that will provide for movement of the fish out of the area. We note that to date, no stranded sturgeon have been observed at the Milford dam.

## 2.3. **Action Area**

The action area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area (project area) involved in the proposed action" (50 CFR 402.02). The action area must encompass all areas where consequences of the proposed action may affect listed species and critical habitat. For this action, the action area includes the project facilities and the approximately 6-kilometer reach of mainstem habitat within the Penobscot River affected by project operations. The reach extends from the upper end of the impoundment (5 km upstream of the dam) downstream to the southern end of French Island, approximately 1.2 kilometers downstream of the dam (Figure 6). The downstream limit is defined to represent the extent of any effects associated with the diversion of flow from the bypass reach on the western side of the dam to the main channel on the eastern side of the dam. We anticipate that any construction related effects (including the drawdown of the impoundment to allow for construction of the diversion wall) will also be limited to this area. The action area only includes mainstem habitat as we do not anticipate that tributary habitat will be affected by dam operations or the implementation of fish passage measures at the Project.

Although Gilman Falls Dam is a component of the Milford Project and regulates flows in the Stillwater Branch, we do not anticipate that the habitat downstream of the dam will be affected by the proposed action. That is because the flow allocation between the mainstem and the Stillwater was established by a court decree in 1911 and has been incorporated into the Penobscot Multi-Party Agreement (MPA), which is consistent with the terms of the current FERC license; and there is no proposal to change that allocation. Additionally, there are no construction activities planned at that dam as part of this proposed action, and therefore there are no construction-related effects. Consequently, we do not expect that the proposed action will lead to any effects downstream of the Gilman Falls Dam. As juvenile and adult salmon could occur in the vicinity and be affected by passage conditions, we consider the footprint of the dam itself to be within the action area for the proposed action.

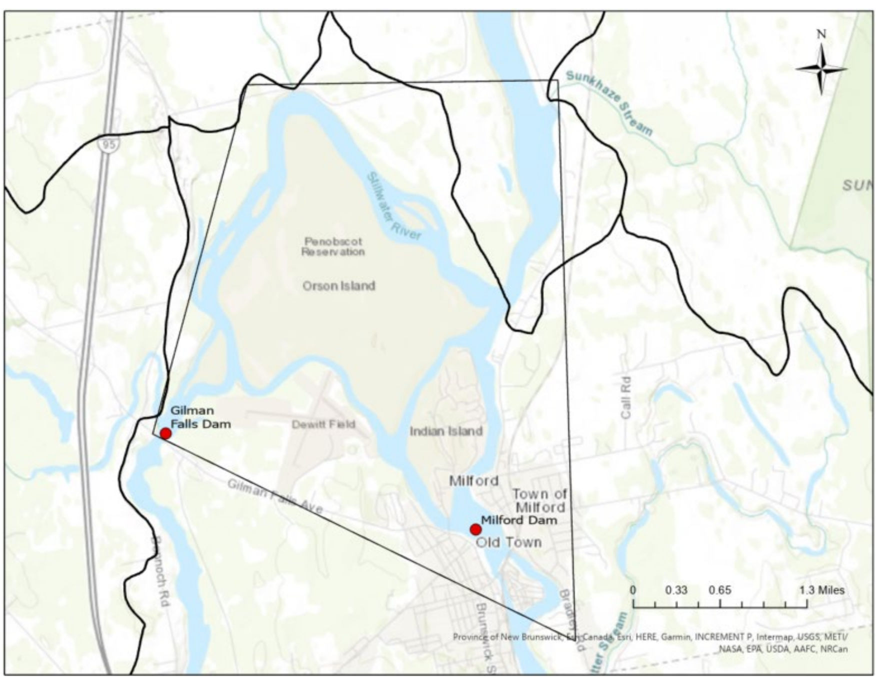

Figure 6. Action area for the revised SPP being proposed at the Milford Project within the Penobscot River. The action area includes the riverine habitat within the polygon; including the impoundment upstream of Milford and Gilman Falls, as well as the habitat in the mainstem downstream of Milford Dam. The habitat in the Stillwater Branch downstream of Gilman Falls Dam is not considered part of the action area.

## 3. STATUS OF THE SPECIES AND CRITICAL HABITAT RANGEWIDE

We have determined that the actions being considered in this Opinion may affect the endangered or threatened species and critical habitat under our jurisdiction listed in Table 1.

Table 1. ESA-listed species and critical habitat in the action area.

| **ESA-Listed Species** | **Scientific Name** | **Distinct Population Segment (DPS)** | **Federal Register (FR) Citation** | **Recovery Plan** |
|---|---|---|---|---|
| Atlantic salmon | *Salmo salar* | Gulf of Maine | 74 FR 29344 | Final Recovery plan: (USFWS & NMFS, 2019) |
| Atlantic Sturgeon | *Acipenser oxyrinchus oxyrinchus* | Gulf of Maine | 77 FR 5880 | N/A[5] |
| Shortnose Sturgeon | *Acipenser brevirostrum* | Range-wide | 32 FR 4001 | NMFS 1998 |
| | | | | |
| **Designated Critical Habitat (species)** | **Scientific Name** | **Distinct Population Segment (DPS)** | **Federal Register (FR) Citation** | **Recovery or River Unit** |
| Atlantic salmon | *Salmo salar* | Gulf of Maine | 74 FR 29300 | Penobscot Bay Salmon Habitat Recovery Unit |

[5] A Recovery Outline for the 5 distinct populations of Atlantic sturgeon was published by NMFS in 2018. It is available at: https://media.fisheries.noaa.gov/dam-migration/ats_recovery_outline.pdf (last accessed January 15, 2026).

| | | | | |
|---|---|---|---|---|
| Atlantic Sturgeon | *Acipenser oxyrinchus oxyrinchus* | Gulf of Maine | 82 FR 39160 | Penobscot River |

### 3.1. Gulf of Maine DPS of Atlantic Salmon

The Gulf of Maine (GOM) Distinct Population Segment (DPS) of anadromous Atlantic salmon was initially listed by USFWS and NMFS (collectively, the Services) as an endangered species on November 17, 2000 (65 FR 69459) (Figure 7). A subsequent rule issued by the Services expanded the geographic range for the GOM DPS of Atlantic salmon (June 19, 2009; 74 FR 29344). The GOM DPS of Atlantic salmon is defined as 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 marine range of the GOM DPS extends from the Gulf of Maine, throughout the Northwest Atlantic Ocean, to the Labrador Sea. 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 Hatcheries (CBNFH), both operated by the USFWS, as well as private watershed-based facilities (Downeast Salmon Federation’s East Machias and Pleasant River facilities). Excluded from the GOM DPS are landlocked Atlantic salmon and those salmon raised in commercial hatcheries for the aquaculture industry.

Coincident with the June 19, 2009 endangered listing, NMFS designated critical habitat for the GOM DPS of Atlantic salmon (74 FR 29300).

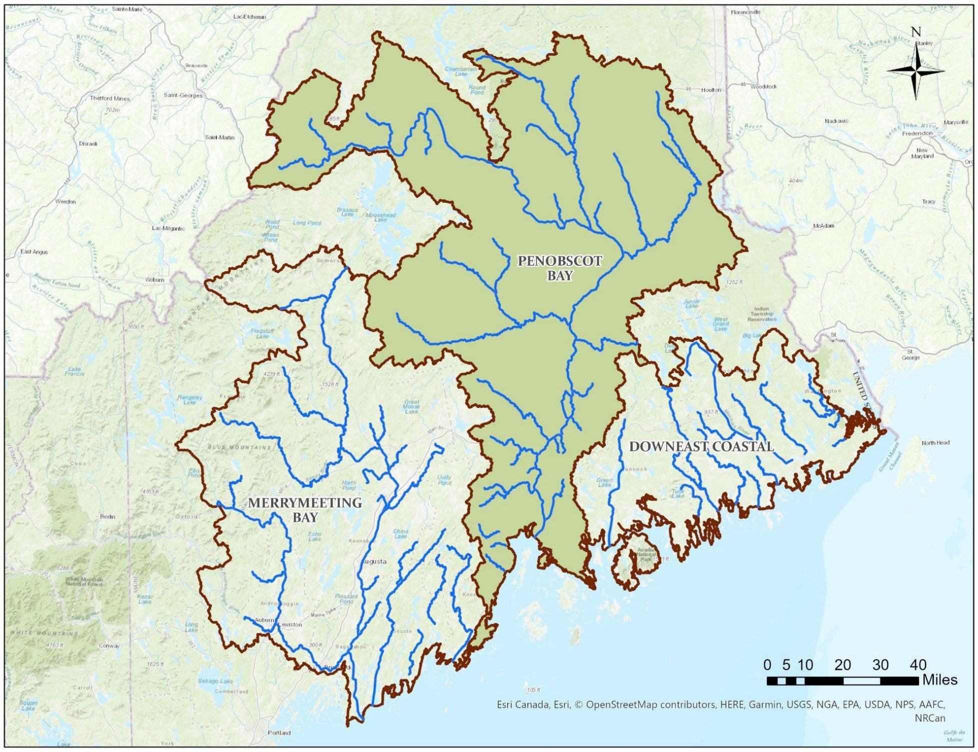


Figure 7. The GOM DPS for Atlantic salmon with the three recovery units identified. The Penobscot River watershed is shown in green.

### 3.1.1. Survival and Recovery of the GOM DPS

The USFWS and NMFS issued a recovery plan (Recovery Plan) for Atlantic salmon on February 12, 2019 (USFWS & NMFS, 2019). The Recovery Plan presents a recovery strategy based on the biological and ecological needs of the species as well as current threats and conservation accomplishments that affect its long-term viability. The Recovery Plan is based on two premises: first, that recovery must focus on rivers and estuaries located in the GOM DPS until the Services have a better understanding of the threats in the marine environment, and second, that survival of Atlantic salmon in the GOM DPS will be dependent on conservation hatcheries through much of the recovery process. In addition, the scientific foundation for the plan includes conservation biology principles regarding population viability, an understanding of freshwater habitat viability, and threats abatement needs.

The GOM DPS consists of three Salmon Habitat Recovery Units (SHRUs) (74 FR 29300, June 19, 2009). The three SHRUs are the Downeast Coastal SHRU, Penobscot Bay SHRU, and Merrymeeting Bay SHRU. The SHRU delineations were designed to: 1) ensure that a recovered Atlantic salmon population has widespread geographic distribution to help maintain genetic variability; and 2) 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, which will be needed to achieve recovery of the GOM DPS.

As described in the Recovery Plan, and consistent with the requirements of ESA section 4, reclassification of the GOM DPS from endangered to threatened will be considered when all of following criteria are met:

- Abundance: The DPS has total annual returns of at least 1,500 naturally reared adults (i.e., originating from spawning in the wild, or from hatchery stocked eggs, fry or parr), with at least two of the three SHRUs having a minimum annual escapement of 500 naturally reared adults;
- Productivity: Among the SHRUs that have met or exceeded the abundance criterion, the population has a positive mean growth rate greater than 1.0 in the 10-year (two-generation) period preceding reclassification; and,
- Habitat: In each of the SHRUs where the abundance and productivity criterion have been met, there is a minimum of 7,500 units[6] of accessible and suitable spawning and rearing habitats capable of supporting the offspring of 1,500 naturally reared adults.

As described in the Recovery Plan, the delisting criteria are:

- Abundance: The DPS has a self-sustaining annual escapement of at least 2,000 wild origin adults in each SHRU, for a DPS-wide total of at least 6,000 wild adults;
- Productivity: Each SHRU has a positive mean population growth rate of greater than 1.0 in the 10-year (two-generation) period preceding delisting. In addition, at the time of delisting, the DPS demonstrates self-sustaining persistence, whereby the total wild population in each SHRU has less than a 50-percent probability of falling below 500 adult wild spawners in the next 15 years based on population viability analysis (PVA) projections; and
- Habitat: Sufficient suitable spawning and rearing habitat for the offspring of the 6,000 wild adults is accessible and distributed throughout the designated Atlantic salmon critical habitat, with at least 30,000 accessible and suitable habitat units in each SHRU, located according to the known migratory patterns of returning wild adult salmon. This will require both habitat protection and restoration at significant levels. NMFS and USFWS expect that when these delisting criteria are met it would mean that the five listing factors (i.e., present or threatened destruction, modification, or curtailment of its habitat or range; over-utilization of the species for commercial, recreational, scientific, or educational purposes; disease or predation; inadequacy of existing regulatory mechanisms; and, other natural or manmade factors affecting its continued existence) had been addressed such that the species no longer met the definition of threatened or endangered.

### 3.1.2. Atlantic Salmon Life History

Atlantic salmon spend most of their adult life in the ocean and return to freshwater to reproduce. Atlantic salmon have a complex life history that includes territorial rearing in rivers to extensive feeding migrations on the high seas (Figure 8). During their life cycle, Atlantic salmon go through several distinct phases that are identified by specific changes in behavior, physiology,

[6] One habitat unit equals 100 square meters.

morphology, and habitat requirements.

Spawning

Adult Atlantic salmon return to rivers in Maine from the Atlantic Ocean and migrate to their natal streams to spawn. Although spawning does not occur until late fall, the majority of Atlantic salmon in Maine enter freshwater between May and mid-July; however, individuals may enter at any time between early spring and late summer (Baum, 1997). Early migration is an adaptive trait that ensures adults have sufficient time to reach spawning areas (Bjornn & 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.

From mid-October to mid-November, adult females select sites in rivers and streams for spawning. 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 and water velocity is increasing (McLaughlin & Knight, 1987). The female salmon creates an egg pit (i.e., redd) by digging into the substrate with her tail and then deposits eggs while male salmon release sperm to fertilize the eggs. After spawning, the female continues digging upstream of the last deposition site, burying the fertilized eggs with clean gravel. Females 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 (SW) female (an adult female that has spent two winters at sea before returning to spawn) (Baum & Meister, 1971).

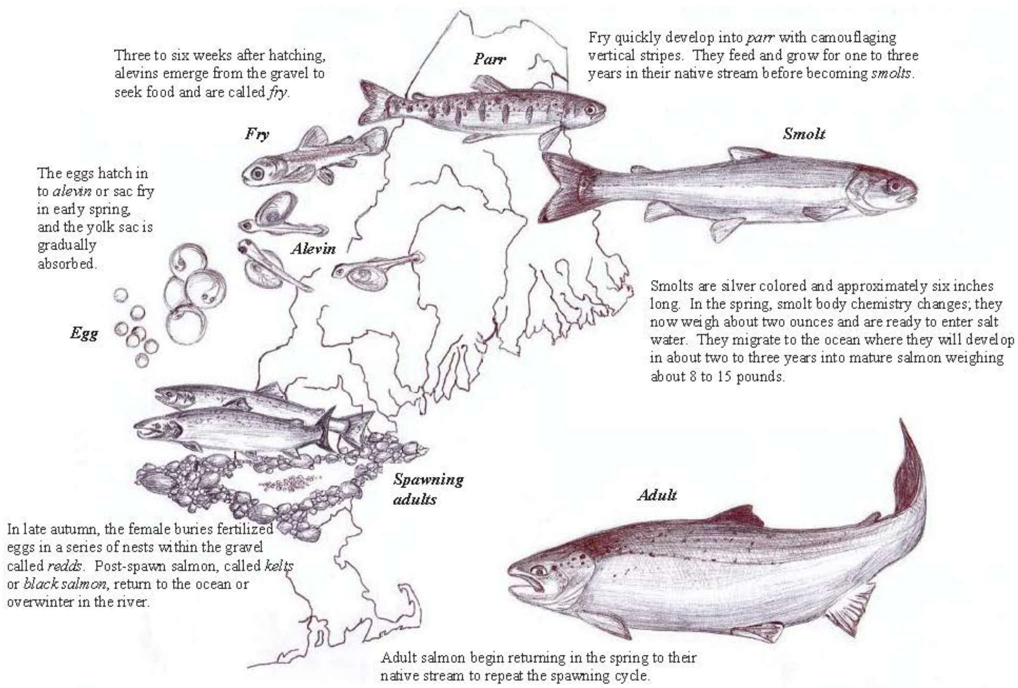


Figure 8. Life Cycle of the Atlantic salmon (diagrams courtesy of Katrina Mueller)

Postspawn Adult Salmon (Kelts)

Atlantic salmon are iteroparous, meaning they are able to spawn more than once. Repeat spawners may comprise a significant proportion of a self-sustaining Atlantic salmon population, with estimates reaching upwards of 60% for some populations (Lawrence et al., 2016). Repeat spawners provide considerable benefits to Atlantic salmon populations as repeat spawning females are considerably larger than first time spawners. Larger fish have greater fecundity and larger egg size, resulting in increased fitness of their progeny (Beacham & Murray, 1993; Fleming, 1996). Repeat spawners also increase genetic diversity because they add additional year classes to the spawning population (Niemelä et al., 2006; Saunders & Schom, 1985). Consequently, a salmon population with a higher proportion of repeat spawners is widely considered to be more resilient and better able to compensate for the many threats posed through their life-cycle (Babin et al., 2021; Baktoft et al., 2020; Lawrence et al., 2016; Maynard et al., 2018; Schindler et al., 2010). In years when marine survival is particularly low, a higher proportion of repeat-spawners can partially offset the overall reduction in returns given their higher fecundity. As such, it has been estimated that a high proportion of repeat spawners may reduce the probability of population decline by 27% or greater (Lawrence et al., 2016). Lawrence et al. (2016) has estimated that a salmon population in a river with four dams is 16% less likely to face decline if it has kelt stage as part of its life history[7].

It is thought that only a small proportion of adult salmon that survive spawning will migrate back to the ocean in the fall, whereas the majority (>80%) overwinter in the river and then out-migrate

[7] Assuming a 90% per dam passage survival probability.

in the subsequent spring (Maynard et al., 2018; Babin et al., 2021). Though initial survival after spawning may be upwards of 80 percent for first time spawners (Maynard et al., 2018), in-river mortality among overwintering postspawn adults can be quite high (~50% or greater), particularly in males (up to 100%) (Babin et al., 2021; Maynard et al., 2018). This mortality is a result of depleted energy reserves after a lengthy migration when salmon are not feeding. Although this is a natural part of salmon life-history, the presence of dams can significantly increase postspawn mortality due to the additional depletion of reserves associated with substantial migratory delay at multiple dams during their spawning run (Baktoft et al., 2020; Rubenstein et al., 2022).

Since 1970, repeat spawners have represented just over 1% (on average) of the US adult returns (Maynard et al., 2018). The low proportion is likely due to a number of factors such as poor marine survival, and the presence of dams on all major river systems. Dams lead to energy depletion in prespawn adults, which can lead to increased prespawn and postspawn mortality (S. Rubenstein, 2021).

Out-migrating postspawn salmon are subjected to similar challenges as out-migrating smolts when it comes to passing dams. Postspawn adults may experience both direct mortality (e.g., turbine strikes) and indirect mortality as a result of injury or delay (Baktoft et al., 2020). As with prespawn adults, postspawn adults are exposed to delay at dams as they migrate back out to the ocean. Delay of kelts at hydro-dams has been shown to reduce their remaining energy reserves by as much as 4 to 5 percent, which may lead to reduced postspawn survival (Baktoft et al., 2020). Babin et al. (2021) found that kelt movement slowed in dam reservoirs as kelts either entered searching mode or underwent multiple reversals, resulting in lower migration success. Jonnson et al. (1997) found that even minor additional energy expenditures by kelts resulted in considerable reduction in postspawn survival (Jonsson et al., 1997).

Eggs

The fertilized eggs develop in the redd for a period of 175 to 195 days, hatching in late March or April (Danie et al., 1984).

Alevins and Fry

Newly hatched salmon, referred to as alevin or sac fry, remain in the redd for approximately 6 weeks after hatching and are nourished by their yolk sacs (Gustafson-Greenwood & Moring, 1991). In 3 to 6 weeks, they consume most of their yolk sac, travel to the surface to gulp air to fill their swim bladders, and begin to swim freely; at this point they are called fry. Survival from the egg to fry stage in Maine is estimated to range from 15 to 35% (Jordan & Beland, 1981).

Parr

When fry reach approximately 4 cm in length, the young salmon are termed parr (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.

Smolts

During the smoltification process, the body becomes streamlined and silvery with a pronounced fork in the tail. Naturally reared smolts (i.e., smolts that were produced through spawning in the wild, or that were stocked as eggs or fry) 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). Researchers have identified a "smolt window" or period of time in which smolts must reach estuarine waters or suffer irreversible negative effects (McCormick et al., 1998). Late migrants lose physiological smolt characteristics due to high water temperatures during spring migration. Most smolts migrate rapidly if unimpeded (Hyvärinen et al., 2006; Lacroix & McCurdy, 1996; Lacroix & Knox, 2005; Lacroix et al., 2004).

Atlantic salmon from the USFWS conservation hatchery program are stocked throughout the GOM DPS. Therefore, salmon smolts migrating to the ocean may be a result of either spawning in the wild or the stocking of hatchery reared salmon; generally, eggs, fry, parr, or smolts. A proportion of salmon stocked as smolts may hold over in the vicinity of their stocking location, rather than migrating to sea, as they are not physiologically ready for the transition to saltwater. Available information indicates that approximately 5-10% of stocked smolts may hold over, and that it could vary based on whether the fish are graded (i.e., sorted based on size) prior to stocking (Kocik, J. and J. Hawkes, NOAA's Northeast Fisheries Science Center, personal communication, October 6, 2021). These juvenile salmon that hold over, technically parr, likely move to rearing habitat in the mainstem or in nearby tributaries prior to migrating to the ocean the following year.

*Predation*

Smallmouth bass and chain pickerel are each significant predators of juvenile Atlantic salmon within the range of the GOM DPS; including the Mattaceunk Project impoundment (Fay et al., 2006; Mensinger et al., 2025; Mensinger et al., 2023). In a study conducted by Mensinger et al. (2025) in the impoundment, 23% of tethered smolts were consumed by these species within one hour of deployment. Smallmouth bass are a warm-water species whose range now extends through north-central Maine and well into New Brunswick (Jackson, 2002). Smallmouth bass are important predators of smolts in mainstem habitats, although bioenergetics modeling indicates that bass predation is insignificant at 5°C and increases with increasing water temperature during the smolt migration (van den Ende, 1993).

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

Many avian species 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 item in cormorant sampled at mainstem dam foraging sites (Blackwell et al., 1997). Given their piscivorous diets, common mergansers, belted kingfishers, cormorants, and loons likely prey upon Atlantic salmon in the Penobscot River.

Post-smolts

Smolts are termed post-smolts after ocean entry to the end of the first winter at sea (Allan & Ritter, 1977). Post-smolts generally travel out of coastal systems on the ebb tide and may be delayed by flood tides (Hyvärinen et al., 2006; Lacroix & McCurdy, 1996; Lacroix & Knox, 2005; Lacroix et al., 2004). 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 some aggregation and common migration corridors related to surface currents (Hyvärinen et al., 2006; Lacroix & McCurdy, 1996; Lacroix et al., 2004). Post-smolt distribution may reflect water temperatures (Reddin & Shearer, 1987) and/or the major surface-current vectors (Lacroix & Knox, 2005). Post-smolts travel mainly at the surface of the water column (Renkawitz et al., 2012) and may form shoals, possibly of fish from the same river (Shelton et al., 1997). Post-smolts grow quickly, achieving lengths of 30-35 cm by October (Baum, 1997). Smolts can experience high mortality during the transition to saline environments for reasons that are not well understood (Kocik et al., 2009; Thorstad et al., 2012).

During the late summer and autumn of the first year, North American post-smolts are concentrated in the Labrador Sea and off the west coast of Greenland, with the highest concentrations between 56° N. and 58°N. (Reddin, 1985; Reddin & Friedland, 1993; Reddin & Short, 1991; Renkawitz et al., 2021). Atlantic salmon located off Greenland are primarily composed of non-maturing first sea winter (1SW) fish, which are likely to return to their natal river to spawn after their second sea winter (2SW) plus a smaller component of previous spawners who have returned to the sea prior to their next spawning event; these fish are from rivers in North America and Europe (Reddin et al., 1988). The following spring, 1SW and older fish are generally located in the Gulf of St. Lawrence, off the coast of Newfoundland, and on the eastern edge of the Grand Banks (Dutil & Coutu, 1988; Friedland et al., 1999; Reddin & Friedland, 1993; Ritter, 1997).

Adults

Some salmon may remain at sea for one or two years before they are ready to return to the rivers to spawn. After their second winter at sea, the salmon likely over-winter in the area of the Grand Banks before returning to their natal rivers to spawn (Reddin & Shearer, 1987).

The average size of Atlantic salmon is 71-76 cm (28-30 inches) long and 3.6-5.4 kg (8-15 pounds) after two to three years at sea. Although uncommon, adults can grow to be as large as 30 pounds (13.6 kg). The natural lifespan of Atlantic salmon ranges from two to eight years (Fay et al., 2006).

### 3.1.3. Status and Trends of the GOM DPS

The historic distribution and abundance of Atlantic salmon in Maine has been described extensively (Baum, 1997; Beland, 1984). In short, substantial populations of Atlantic salmon existed in nearly every river in Maine that was large enough to maintain a spawning population.

The upstream extent of the species' distribution extended far into the headwaters of even the largest rivers (Saunders et al., 2006).

Today, the spatial distribution of the GOM DPS of Atlantic salmon is limited directly by dams that obstruct passage and indirectly by low abundance levels. Within the range of the GOM DPS, the Kennebec, Androscoggin, Union, Narraguagus, and Penobscot rivers contain dams that severely limit passage of salmon to significant amounts of spawning and rearing habitat. Indirectly, the spatial distribution of the GOM DPS of Atlantic salmon is also limited by low abundance (i.e., lack of potential donor or source populations) as well as the species' strong and inherent homing tendencies (Pess et al., 2014).

The reproduction and abundance of Atlantic salmon within the range of the GOM DPS have been generally declining since the 1800s (Fay et al., 2006). A comprehensive time series of adult returns to the GOM DPS dating back to 1967 exists (Figure 9; Fay et al., 2006; USASAC, 2025). 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 (Foster & Atkins, 1867) estimated that as many as 216,000 adult salmon may have returned to the Kennebec River alone before the river was dammed, whereas 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, 2021).

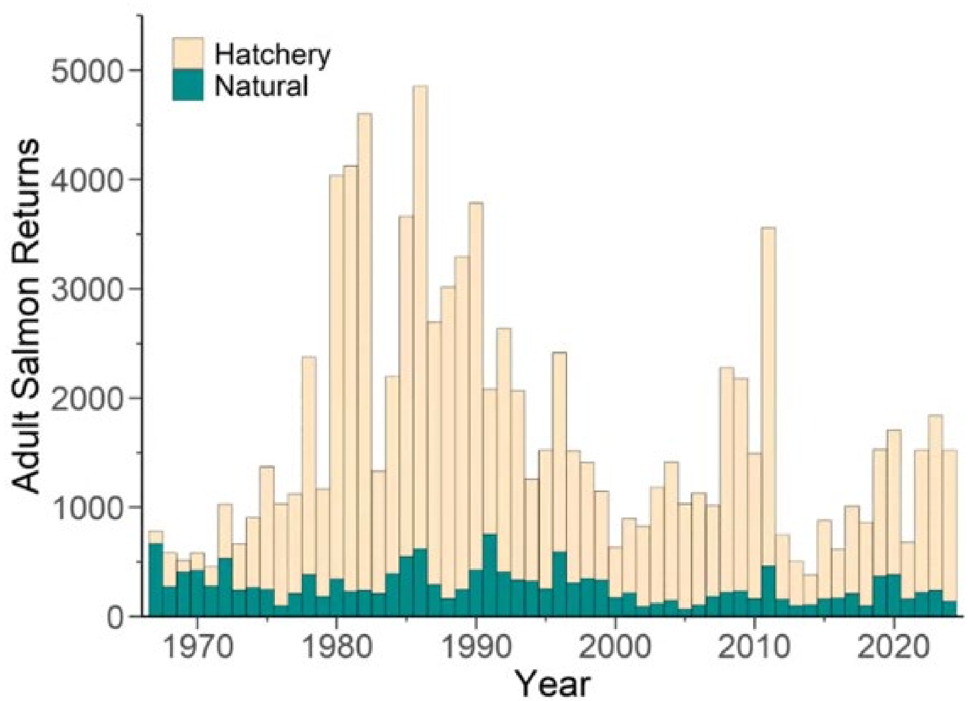


Figure 9. Summary of naturally reared (NR) vs. hatchery reared (HR) adult salmon returns to the

GOM DPS Rivers between 1967 and 2024 (USASAC, 2025).

After a period of population growth between the 1970s and the early 1980s, adult returns of salmon in the GOM DPS have been declining since the early 1990s, stabilizing at very low levels during the 2000s. The population growth observed in the 1970s is likely attributable to favorable marine survival and increases in hatchery capacity, particularly from the USFWS Green Lake National Fish Hatchery (GLNFH) (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 that persists today.

The pattern of low marine survival is not unique to the GOM DPS of Atlantic salmon. Chaput et al. (2005) first raised the potential for a "regime shift" in marine survival for Atlantic salmon throughout North America resulting in decreased productivity and abundance. The effects of this regime shift appear to be particularly acute at the southern edge of the range with many researchers implicating the effects of climate change as a key driver in the ongoing reductions in marine survival of Atlantic salmon (Mills et al., 2013). Marine survival, growth, and maturation are affected in complex ways by warming conditions in the ocean (Friedland, 1998; Friedland & Todd, 2012) and a warming ocean is generally problematic for Atlantic salmon (Friedland & Todd, 2012) except in the northernmost portions of the range (Jonsson & Jonsson, 2009). Reductions in energy content of prey resources in the marine environment may also be linked to recent changes in climate and reduced marine survival (Renkawitz et al., 2015), but considerable uncertainty remains. While the reasons for the decline in marine survival of Atlantic salmon are not well understood at this time, a growing consensus has emerged: abundant healthy wild smolts should be free to emigrate from rivers to the ocean if populations are to sustain the contemporary challenges imposed by the marine environment (Thorstad et al., 2021).

Since 1967 when numbers of adult returns were first recorded, the vast majority of adult returns have been the result of smolt stocking; only a small portion of returning adults were naturally reared (Figure 9). The term "naturally reared" includes fish originating from both natural spawning and from stocked hatchery eggs and fry (USASAC, 2012). Adults that result from the stocking of eggs and fry are included as naturally reared because hatchery eggs and fry are not marked, and therefore cannot be visually distinguished from fish produced through natural spawning. While the Penobscot hosts the largest run in the GOM DPS by far (10-year average of 83% of the total returns), only 11% of that run on average consisted of naturally reared fish (CMS, 2024). This compares to 84% and 37% of the run in the Downeast Coastal and Merrymeeting Bay SHRUs, respectively. The distinction between hatchery and naturally reared adult salmon is critical in understanding the potential for the achievement of the recovery criteria as laid out in the Final Recovery Plan (USFWS & NMFS 2019). Only naturally reared and wild salmon are considered when determining achievement of the downlisting and delisting criteria. Hatchery returns do not count towards the criteria themselves; however, if they return and successfully spawn in the wild their progeny would be counted toward the criteria. Therefore, in the context of reaching downlisting and delisting goals, a more meaningful metric than the total adult returns to the GOM DPS is the abundance of naturally reared or wild returns (Figure 10).

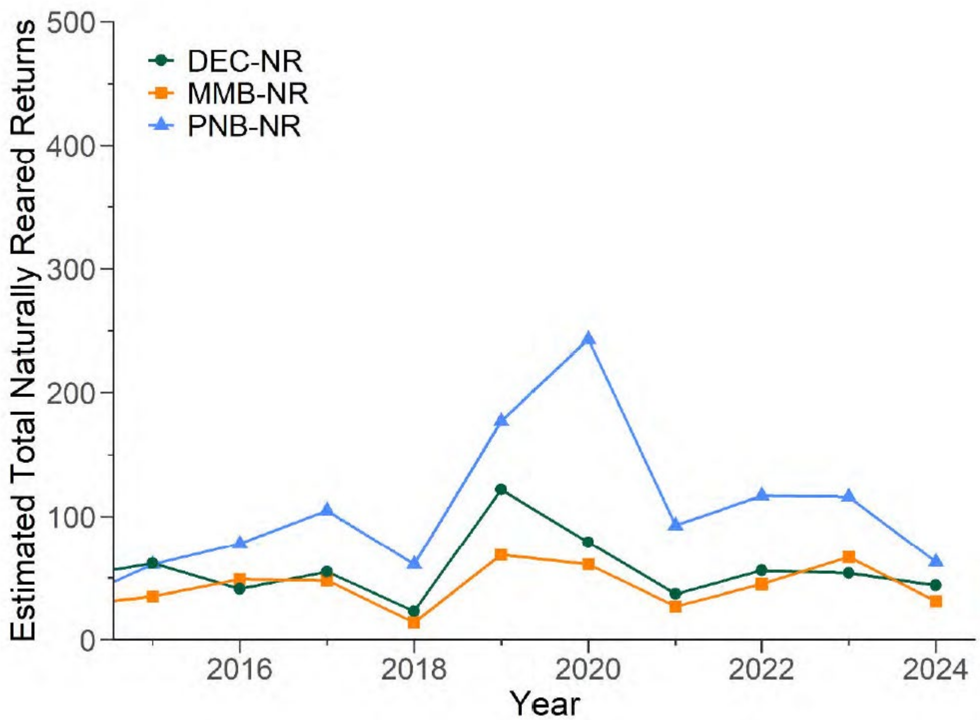


Figure 10. Time series of the last decade of naturally reared adult returns to the Merrymeeting Bay (Orange), Penobscot Bay (Blue), and Downeast Coastal (Green) SHRUs. Note: naturally reared interim target of 500 natural spawners is maximum axis value (USASAC, 2025).

Although the *proportion* of naturally reared salmon is significantly higher in the Downeast and Merrymeeting Bay SHRUs, the more extensive stocking effort in the Penobscot SHRU leads to a higher number of naturally reared adults compared to the other SHRUs. Of the naturally reared or wild adults returning to the GOM DPS in 2024, 48%, 34%, and 6% returned to the Penobscot Bay, Downeast, and Merrymeeting Bay SHRUs, respectively (CMS, 2025). It should be emphasized that this distribution is dependent on current stocking effort (lifestage and abundance), and by itself should not be construed to mean that any one SHRU is inherently more important or suitable in regards to its contribution to recovery.

### 3.1.4. Summary of Rangewide Status of Atlantic Salmon

The GOM DPS of Atlantic salmon currently exhibits critically low spawner abundance, poor marine survival, and is 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 small and displays little sign of growth. The most recent five-year review for the species concluded that:

> The demographic risks to Atlantic salmon remain high. The three SHRUs have 10-year average abundance of less than 100 natural spawners per SHRU. Of the eight locally adapted populations that remain in the GOM DPS, seven are supported by conservation hatcheries that act to buffer extinction risk. The eighth, the Ducktrap River, is at very high risk of extirpation. With naturally reared populations being very low, the geometric mean population growth rates have been, as can be expected, highly variable. Given the

high degree of variability in the population growth rates and the very low population abundances of naturally reared fish, we will need to continue to monitor population trajectories very carefully. (NMFS & USFWS, 2020)

The spatial distribution of the GOM DPS has been severely reduced relative to historical distribution patterns due to the construction of dams. 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. Although the hatchery program is critical, it alone cannot recover the species. Recovery of the GOM DPS must be accomplished through increases in naturally reared salmon, which will only occur if the ongoing threats to the species (as defined in the 2019 Recovery Plan) are abated. This can be accomplished by improving connectivity at dams and road stream crossings, and through projects that improve freshwater habitat productivity.

### 3.1.5. Atlantic Salmon Critical Habitat

Coincident with the June 19, 2009 endangered listing, we designated critical habitat for the GOM DPS of Atlantic salmon (74 FR 29300; June 19, 2009). 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). That designation defines critical habitat as "specific areas within the geographical area occupied by the species at the time of listing, on which are found those physical or biological features that are essential to the conservation of the listed species and that may require special management considerations or protection."

Physical and Biological Features of Atlantic Salmon Critical Habitat

Designation of critical habitat is based on the known physical and biological features within the occupied areas of a listed species that are deemed essential to the conservation of the species. For the GOM DPS, the physical and biological features (PBFs; also known as primary constituent elements) essential for the conservation of Atlantic salmon are: 1) sites for spawning and rearing, and, 2) sites for migration (excluding marine migration[8]) (Table 2). Although each habitat does have distinct features, spawning and rearing habitats were not separated into distinct PBFs in the critical habitat designation. The reason for this is that the GIS-based habitat prediction model approach that was used to designate critical habitat (74 FR 29300; June 19, 2009) cannot consistently distinguish between spawning and rearing habitat across the entire range of the GOM DPS.

Table 2. The physical and biological features for Atlantic salmon critical habitat.

| **PBFs for Spawning and Rearing (SR) Habitat** |
| --- |

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

| | |
|---|---|
| ***SR1*** | 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. |
| ***SR2*** | 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. |
| ***SR3*** | 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. |
| ***SR4*** | Freshwater rearing sites with space to accommodate growth and survival of Atlantic salmon parr. |
| ***SR5*** | 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. |
| ***SR6*** | Freshwater rearing sites with cool, oxygenated water to support growth and survival of Atlantic salmon parr. |
| ***SR7*** | Freshwater rearing sites with diverse food resources to support growth and survival of Atlantic salmon parr. |
| **PBFs for Migration (M) Habitat** | |
| ***M1*** | 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. |
| ***M2*** | 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. |
| ***M3*** | Freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation. |
| ***M4*** | Freshwater and estuary migration sites free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment. |
| ***M5*** | Freshwater and estuary migration sites with sufficiently cool water temperatures and water flows that coincide with diurnal cues to stimulate smolt migration. |
| ***M6*** | Freshwater migration sites with water chemistry needed to support seawater adaptation of smolts. |

Habitat areas designated as critical habitat must contain one or more physical and biological features within the acceptable range of values required to support the biological processes for which the species uses that habitat (Table 3). 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 includes the stream channels within the designated stream reach and includes a lateral extent as defined by the ordinary high-water line or the bankfull elevation in the absence of a defined high-water line. In estuaries, critical habitat is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of extreme high water, whichever is greater. Critical habitat was designated in areas (HUC-10 watersheds) occupied by the species at the time of listing. As described in the designation, for each SHRU, we determined that there were sufficient habitat units 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.

Table 3. The factors that determine the suitability of habitat for the different life stages of Atlantic salmon, as well as the acceptable range of values required to support these biological processes.

| | **Spawning Habitat** | | **Rearing Habitat** | **Migration Habitat** | |
|---|---|---|---|---|---|
| | *Spawning* | *Embryo/Fry Development* | *Parr Development* | *Adults* | *Juveniles* |
| | Oct 1-Dec 14 | Oct 1-Apr 14 | All Year | Apr 15-Dec 14 | Apr 15-Jun 14 |
| **Depth** | 17-76 cm | 5-15 cm | 10-30 cm | | |
| **Velocity** | 8-83 cm/sec | 4-15 cm/sec | < 120 cm/sec | 30-125 cm/sec | |
| **Temperature** | 7-10°C | < 10°C | 7-22.5°C | <23°C | 5-11°C |
| **pH** | >5.0 | > 4.5 | | | >5.5 |
| **DO** | | saturation, or 7-8 mg/L | >2.9 mg/L | >4.5 mg/L | |
| **Substrate** | Cobble/Gravel | Cobble/Gravel | Gravel/Boulders | | |
| **Cover** | Pools, large boulders, woody debris | | | | |
| **Fisheries** | Many native fish species; few non-native fish species | | | | |
| **Food** | | | Macroinvertebrates and small fish | | |

We have determined that the action area contains spawning and rearing PBFs 1-7 (SR 1-7) and the migratory PBFs 1-6 (M 1-6). We discuss the features and their current status in the action area in the Environmental Baseline (Section 4).

### 3.1.6. Factors Affecting Atlantic Salmon and Critical Habitat

Atlantic salmon face a number of threats to their survival, which are fully described in the Recovery Plan (USFWS & NMFS, 2019) with additional information provided in the 2020 5-Year Review. As described in the listing rule and the Recovery Plan, we consider the following to be the most significant threats to the GOM DPS of Atlantic salmon:

- Lack of access to spawning and rearing habitat due to dams and road-stream crossings
- Reduced habitat complexity
- Continued low marine survival rates for U.S. stocks of Atlantic salmon
- Degraded water quality
- Water withdrawal
- Incidental capture of adults and parr by recreational anglers
- Poaching of adults
- Intercept fishery
- Introduced fish species that compete or prey on Atlantic salmon
- Diseases
- Predation
- Inadequate regulatory mechanisms related to dams
- Aquaculture practices, which pose ecological and genetic risks
- Climate change
- Depleted diadromous fish communities

- Recovery hatchery program (potential for artificial selection/domestication)
- Sedimentation of spawning and rearing habitat.

These conclusions were reaffirmed in the 2020 5-Year Review (NMFS & USFWS 2020).

Many actions have been implemented to protect and restore the GOM DPS of Atlantic salmon. These activities include hatchery supplementation, dam removal, fishway construction, upgrading road crossings, 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. As noted in the 2020 5-Year Review, while progress has been made to reduce or better understand many of those threats, each of these threats continues to contribute to the endangerment of the species (NMFS & USFWS 2020).

The final rule designating critical habitat for the GOM DPS identifies a number of activities that have and will likely continue to affect 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, throughout the Gulf of Maine.

### 3.1.7. Status of Critical Habitat for Atlantic Salmon in the Penobscot Bay SHRU

In Section 3.1.5, we identify the physical and biological features of critical habitat in the GOM DPS of Atlantic salmon. In this section, we examine the status of critical habitat within the Penobscot Bay SHRU. Areas designated as critical habitat within each SHRU, including Penobscot Bay, 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 available for salmon rearing in each SHRU was estimated through the use of a GIS-based salmon habitat model (Wright et al., 2008). For each SHRU, we determined that there were sufficient habitat units available within the currently occupied habitat to achieve recovery objectives in the future; therefore, no unoccupied habitat was designated as critical habitat. Using the model, we estimate that approximately two-thirds of the habitat units within the Penobscot Bay SHRU are within the designated critical habitat for Atlantic salmon (i.e., 227,062 units in CH/359,333 total units in SHRU = 63%). In addition to habitat abundance, the model also identifies the proportion of each modeled reach that is expected to be suitable for juvenile rearing. The Maine Stream Habitat Viewer[9] categorized these proportions into three classes with the first, second, and third classes predicted to contain >50%, 27-50%, and <26% rearing habitat, respectively. As areas that contain a higher proportion of rearing habitat are more likely to produce juvenile salmon, class 1 habitats are expected to be the most suitable for rearing and class 3 habitats expected to be least

[9] Maine Stream Habitat Viewer. Atlantic salmon Modeled Rearing Habitat. Layer maintained by US Fish and Wildlife Service Gulf of Maine Coastal Program. https://webapps2.cgis-solutions.com/MaineStreamViewer/

suitable[10]. Using the model and the established classification, we can describe how the suitability and abundance of rearing habitat compares between the upper portion of the watershed (upstream of the Milford Dam, the first dam on the river) and the lower portion of the river (habitat between the head of tide and the Milford Dam). Of the approximately 129,000 class 1 habitat units in the critical habitat within the Penobscot Bay SHRU, 84% occur in the upper river (upstream of Milford).

As most of the suitable habitat is in the upper river, it is necessary for salmon to migrate upstream of multiple dams to access it. The migration PBFs identified in Table 2 above are not fully functional throughout much of the 211,000 units of critical habitat due to dams. Similarly, the spawning and rearing PBFs of much of the 211,000 units of critical habitat do not adequately function due to impoundments and flow modifications caused by dams. Presently, only a fraction of habitat (the 18,600 units below the first mainstem dam on the Penobscot River) is fully accessible to Atlantic salmon without interference from artificial barriers (e.g., dams).

Dams significantly affect Atlantic salmon in the Penobscot Bay SHRU through habitat alteration, fish passage delays, and entrainment and impingement of juveniles and kelts. There are approximately 110 dams in the Penobscot Bay SHRU watershed. The SHRU contains a large number of FERC licensed and exempt dams that block or hinder access for diadromous fish species. These dams are concentrated on the mainstem Penobscot, as well as the Piscataquis River and the West Branch of the Penobscot. Of the 30 FERC licensed or exempt dams in the Penobscot Bay SHRU, 11 are within critical habitat. Few of the dams in the Penobscot Bay SHRU have fishways for diadromous fish, although most of those in critical habitat have either a fish ladder or a fish lift/trap. The three mainstem dams on the Penobscot (i.e., Milford, West Enfield, and Mattaceunk) have fish passage facilities. In addition to hindering passage, dams have altered significant amounts of riverine habitat in the Penobscot River through the creation of impoundments. Removal of the Veazie and Great Works Dams in 2012 and 2013 restored a substantial amount to free-flowing habitat in the lower Penobscot River; however, the remaining three dams still impound abundant riverine habitat.

### 3.1.1. Status and Trends of Atlantic Salmon in the Penobscot Bay SHRU

A summary of the status of the species rangewide and designated critical habitat in its entirety was provided above. This section will focus on the status of Atlantic salmon and designated critical habitat in the Penobscot Bay SHRU. The SHRU includes the entire Penobscot basin and extends west as far as, and including, the Ducktrap watershed, and east as far as, and including, the Bagaduce watershed. The Penobscot Bay SHRU is dominated by a large, complex river system (Penobscot River) that serves as the primary migration corridor to numerous watersheds representing diverse habitats.

[10] In the context of the Wright et al. (2008) model, what we refer to as suitability is actually a measure of habitat abundance or density within a stream reach, rather than a measure of quality. A segment of river modeled as class 1 would be expected to have a higher proportion of productive habitat than one modeled as class 3. However, this does not suggest that a unit of habitat in a class 1 reach would necessarily produce more salmon parr than a unit of habitat in a class 3 reach (i.e., quality).

As indicated previously, the Penobscot River hosts the largest run of Atlantic salmon in the GOM DPS. In addition to the Penobscot and the major tributaries (e.g., Piscataquis, Pleasant, East Branch Penobscot, Mattawamkeag), several smaller tributaries also see returning salmon, including Cove Brook, Kenduskeag Stream, Great Works Stream, Soudabscook Stream, and the Ducktrap River. Cove Brook, the Ducktrap River, and the Penobscot itself were all determined to host distinct individual populations at the time of listing. Cove Brook's population was determined to be extirpated in 2009, and the Ducktrap population is at an elevated risk of extirpation, with only 17 returns over the last eight years (USASAC, 2025).

The Penobscot River population still persists, which is largely attributable to USFWS' conservation hatchery program and a significant smolt stocking program (Figure 11). Over the last 10 years, the total number of prespawn Atlantic salmon returning to the Penobscot River ranged between 261 and 1,570 annually; with an average return of 921 individuals (derived from data in USASAC (2024)). Of the prespawn adult salmon that return to the Penobscot Bay SHRU to spawn, approximately 11% (10-year average) are of naturally reared or wild origin (CMS, 2025).

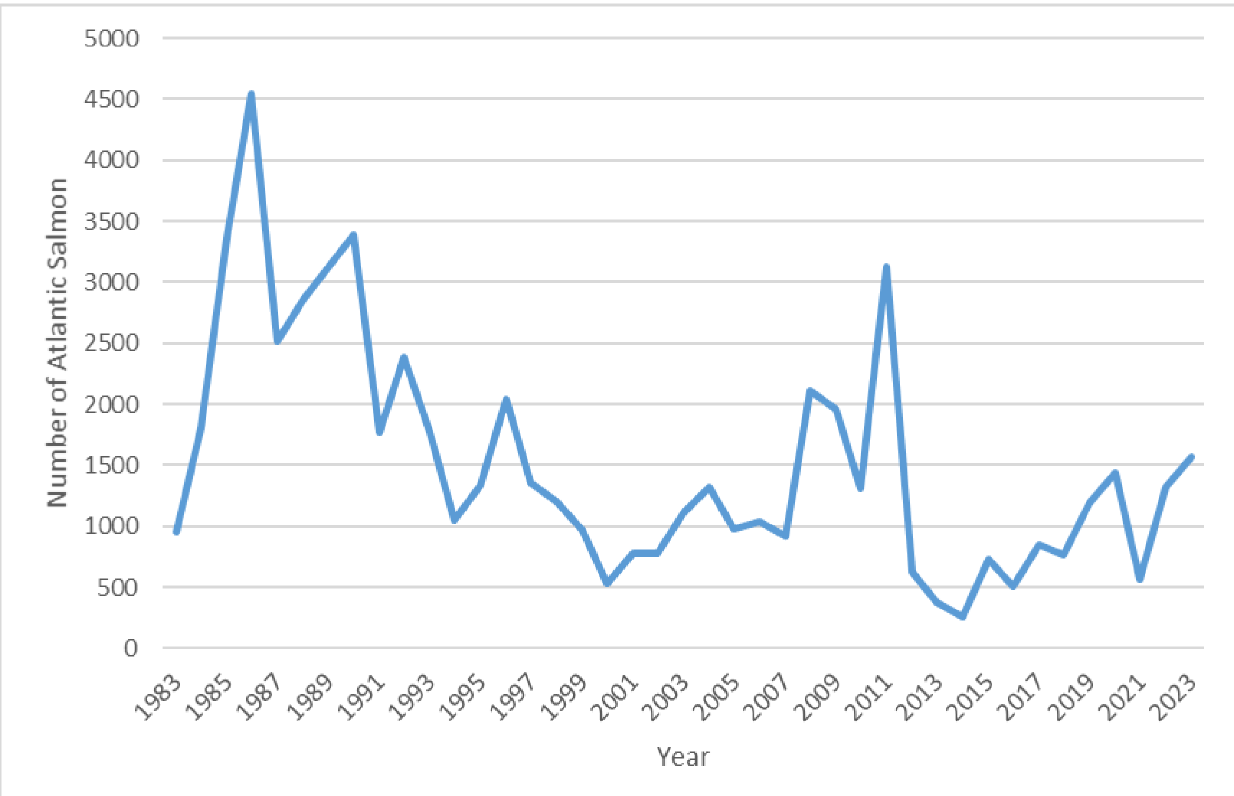


Figure 11. Adult returns to the Penobscot River between 1983 and 2023. Counts were made at the Veazie Dam prior to 2013, and at the Milford Dam since that time (Fay *et al.* 2006, USASAC 2024).

Most adult Atlantic salmon returning to the Penobscot River are intercepted at the first mainstem dam in the lower Penobscot River (Milford Dam). The remaining salmon return to the lower river tributaries downstream of the dam (e.g., Ducktrap, Cove, Great Works, Soudabscook). The trap at the Milford Dam began operation in 2014. Adult Atlantic salmon returns were previously recorded at the Veazie Dam fishway, until the dam was removed in 2013. Adults captured at the Milford Dam fishway are either taken to CBNFH for captive breeding or returned to the river upstream of the Milford Dam. The collection of salmon to be used as broodstock is discussed in more detail in section 4.4.1.

Adult returns for the Penobscot Bay recovery unit remain well below the biological criteria established for each SHRU in the 2019 Recovery Plan. The 2019 Recovery Plan identifies a self-sustaining annual escapement target of 2,000 wild origin adults for each SHRU as a delisting criteria. That is, NMFS and USFWS consider this to be an indication that the five listing factors have been addressed and the species may no longer be threatened or endangered. As such, we consider that this target will need to be met before delisting of the species under the ESA can proceed. Similarly, the Plan indicates that an escapement of 500 naturally reared adults returning to two of the three SHRUs would be required to downlist the species from endangered to threatened (i.e., that meeting this abundance criteria would indicate that the species may meet the definition of threatened but not endangered).

The abundance of Atlantic salmon in the SHRU remains low. The 10-year (2015-2024) average number of naturally-reared or wild adults returning to the Penobscot Bay SHRU is 110 (CMS, 2025). This constitutes 22% of the total needed for consideration of downlisting (reclassification to threatened), and approximately 5% of what is needed for consideration of delisting. 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 significantly increase the naturally reared component of the GOM DPS.

In 2020, NMFS and USFWS completed a 5-year review that evaluated whether the reclassification criteria had been achieved for the GOM DPS of Atlantic salmon (NMFS & USFWS, 2020). The review concluded that the demographic risks to Atlantic salmon are still high, that the number of naturally reared or wild adults is still less than 100 per SHRU, and that the primary threats have not been sufficiently abated. A number of activities within the Penobscot Bay SHRU will continue to impact the biological and physical features of spawning, rearing, and migration habitat for Atlantic salmon. In freshwater, the primary threat to the species and to the functioning of critical habitat is the lack of abundant accessible spawning and rearing habitat, which is attributable to ineffective fish passage at dams, and at road-stream crossings.

## 3.2. Shortnose Sturgeon

Shortnose sturgeon occur in the portion of the action area below the Milford dam. Shortnose sturgeon are fish that occur in rivers and estuaries along the East Coast of the U.S. and Canada (SSSRT, 2010). They have a head covered in bony plates, as well as protective armor called scutes extending from the base of the skull to the caudal peduncle. Other distinctive features include a subterminal, protractile tube-like mouth, and chemosensory barbels for benthic foraging (SSSRT, 2010). Sturgeon have been present in North America since the Upper Cretaceous period, more than 66 million years ago. The information below is a summary of available information on the species. More thorough discussions can be found in the cited references as well as the Shortnose Sturgeon Status Review Team's (SSSRT) Biological Assessment (2010).

### 3.2.1. Life History and General Habitat Use

There are differences in life history, behavior, and habitat use across the range of the species. Current research indicates that these differences are adaptations to unique features of the rivers where these populations occur. For example, there are differences in larval dispersal patterns in the Connecticut River (MA) and Savannah River (GA) (Parker, 2007). There are also morphological and behavioral differences. Growth and maturation occurs more quickly in southern rivers but fish in northern rivers grow larger and live longer. We provide general life history attributes in Table 4.

Table 4. Shortnose sturgeon general life history for the species throughout its range

| Stage | Size (mm) | Duration | Behaviors/Habitat Used |
|---|---|---|---|
| Egg | 3-4 | 13 days postspawn | stationary on bottom; Cobble and rock, fresh, fast flowing water (0.4-0.8 m/s) |
| Yolk Sac Larvae | 7-15 | 8-12 days post hatch | Photonegative; swim up and drift behavior to seek areas with bottom cover for shelter; form aggregations with other YSL; Cobble and rock habitats |
| Post Yolk Sac Larvae | 15 - 57 | 12-40 days post hatch | Free swimming; feeding; Silt bottom, deep channel; fresh water |
| Young of Year | 57 – 140 (north); 57-300 (south) | From 40 days post-hatch to one year | Deep, muddy areas upstream of the salt wedge |
| Juvenile | 140 to 450-550 (north); 300 to 450-550 (south) | 1 year to maturation | Increasing salinity tolerance with age; same habitat patterns as adults |
| Adult | 450-1100 average;<br>(max recorded 1400) | Post-maturation | Freshwater to estuary with some individuals making nearshore coastal migrations |

Shortnose sturgeon live on average for 30-40 years (Dadswell et al., 1984). Males mature at approximately 5-10 years and females mature between age 7 and 13, with later maturation occurring in more northern populations (Dadswell et al., 1984). Females typically spawn for the first time 5 years post-maturation (age 12-18; Dadswell, 1979; Dadswell et al., 1984) and then spawn every 3-5 years (Dadswell, 1979; Dadswell et al., 1984;). Males spawn for the first time approximately 1-2 years after maturity with spawning typically occurring every 1-2 years (Kieffer and Kynard, 1996; NMFS, 1998; Dadswell et al., 1984). Shortnose sturgeon are iteroparous (spawning more than once during their life) and females release eggs in multiple "batches" during a 24 to 36-hour period (total of 30,000-200,000 eggs). Multiple males are likely to fertilize the eggs of a single female.

Cues for spawning are thought to include water temperature, day length and river flow (Kynard et al,, 2012, Kynard et al. 2016). Shortnose sturgeon spawn in freshwater reaches of their natal rivers when water temperatures reach 9–15°C in the spring (Dadswell, 1979; Taubert, 1980a and b; Kynard, 1997). Spawning occurs over gravel, rubble, and/or cobble substrate (Dadswell, 1979, Taubert, 1980a and b; Buckley and Kynard, 1985b; Kynard, 1997) in areas with average bottom velocities between 0.4 and 0.8 m/s. Depths at spawning sites are variable, ranging from 1.2 - 27 m (multiple references in SSSRT (2010)). Eggs are small and demersal and stick to the rocky substrate where spawning occurs.

Shortnose sturgeon occur in waters between 0-34°C (Dadswell et al., 1984; Heidt & Gilbert, 1978); with temperatures above 28°C considered to be stressful. Depths used are highly variable, ranging from shallow mudflats while foraging to deep channels up to 30 m (Dadswell et al*.,* 1984; Dadswell, 1979). Salinity tolerance increases with age; while young of the year must remain in freshwater, adults have been documented in the ocean with salinities of up 30 parts-per-thousand (ppt) (Holland and Yeverton, 1973; Saunders and Smith, 1978). Dissolved oxygen affects distribution, with preference for DO levels at or above 5mg/l and adverse effects anticipated for prolonged exposure to DO less than 3.2mg/L (Secor and Niklitschek 2001).

Shortnose sturgeon feed on benthic insects, crustaceans, mollusks, and polychaetes (Dadswell et al., 1984). Both juvenile and adult shortnose sturgeon primarily forage over sandy-mud bottoms, which support benthic invertebrates (Carlson and Simpson, 1987; Kynard, 1997). Shortnose sturgeon have also been observed feeding off plant surfaces (Dadswell et al*.,* 1984).

Following spawning, adult shortnose sturgeon disperse quickly down river to summer foraging grounds areas and remain in areas downstream of their spawning grounds throughout the remainder of the year (Buckley and Kynard, 1985a, Dadswell et al., 1984; Buckley and Kynard, 1985b; O'Herron et al., 1993).

In northern rivers, shortnose aggregate during the winter months in discrete, deep (3-10m) freshwater areas with minimal movement and foraging (Kynard et al., 2012; Buckley and Kynard, 1985a; Dadswell, 1979, Li et al., 2007; Dovel et al., 1992; Bain et al., 1998a and b). In the winter, adults in southern rivers spend much of their time in the slower moving waters downstream near the salt-wedge and forage widely throughout the estuary (Collins and Smith, 1993, Weber et al., 1998). Prespawning sturgeon in some northern and southern systems migrate into an area in the upper tidal portion of the river in the fall and complete their migration in the spring (Rogers and Weber, 1995). Older juveniles typically occur in the same overwintering areas as adults while young of the year remain in freshwater (Jenkins et al*.,* 1993; Jarvis et al. 2001).

Listing History

Shortnose sturgeon were listed as endangered in 1967 (32 FR 4001), and the species remained on the endangered species list with the enactment of the ESA in 1973. Shortnose sturgeon are thought to have been abundant in nearly every large East Coast river prior to the 1880s (see McDonald, 1887; Smith and Clugston, 1997). Pollution and overfishing, including bycatch in the shad fishery, were listed as principal reasons for the species' decline. The species remains listed as endangered throughout its range. While the 1998 Recovery Plan refers to Distinct Population Segments (DPS), the process to designate DPSs for this species has not been undertaken. The SSSRT published a Biological Assessment for shortnose sturgeon in 2010. The report summarized the status of shortnose sturgeon within each river and identified stressors that continue to affect the abundance and stability of these populations.

Current Status

There is no current total population estimate for shortnose sturgeon rangewide. Information on populations and metapopulations is presented below. In general, populations in the Northeast are larger and more stable than those in the Southeast (SSSRT, 2010). Population size throughout the species' range is considered to be stable; however, most riverine populations are below the historic population sizes and most likely are below the carrying capacity of the river (Kynard, 1996).

*Population Structure*

There are 19 documented populations of shortnose sturgeon ranging from the St. Johns River, Florida (possibly extirpated from this system) to the Saint John River in New Brunswick, Canada. There is a large gap in the middle of the species range with individuals present in the Chesapeake Bay separated from populations in the Carolinas by a distance of more than 400 km. Currently, there are significantly more shortnose sturgeon in the northern portion of the range.

Developments in genetic research as well as differences in life history support the grouping of shortnose sturgeon into five genetically distinct groups, all of which have unique geographic adaptations (see Grunwald et al., 2008; Grunwald et al., 2002; King et al., 2001; Waldman et al., 2002b; Walsh et al., 2001; Wirgin et al., 2009; Wirgin et al., 2002; SSSRT, 2010). These groups are: 1) Gulf of Maine; 2) Connecticut and Housatonic Rivers; 3) Hudson River; 4) Delaware River and Chesapeake Bay; and 5) Southeast. The Gulf of Maine, Delaware/Chesapeake Bay and Southeast groups function as metapopulations[11]. The other two groups (Connecticut/Housatonic and the Hudson River) function as independent populations.

While there is migration within each metapopulation (i.e., between rivers in the Gulf of Maine and between rivers in the Southeast) and occasional migration between populations (e.g., Connecticut and Hudson), interbreeding between river populations is limited to very few individuals per generation; this results in morphological and genetic variation between most river populations (see Walsh et al., 2001; Grunwald et al., 2002; Waldman et al., 2002; Wirgin et al., 2005). Indirect gene flow estimates from mtDNA indicate an effective migration rate of less than two individuals per generation. This means that while individual shortnose sturgeon may move between rivers, very few sturgeon are spawning outside their natal river; it is important to remember that the result of physical movement of individuals is rarely genetic exchange.

[11] A metapopulation is a group of populations in which distinct populations occupy separate patches of habitat separated by unoccupied areas (Levins 1969). Low rates of connectivity through dispersal, with little to no effective movement, allow individual populations to remain distinct as the rate of migration between local populations is low enough not to have an impact on local dynamics or evolutionary lineages (Hastings and Harrison 1994). This interbreeding between populations, while limited, is consistent, and distinguishes metapopulations from other patchy populations.

Summary of Status of Northeast Rivers

In NMFS' Greater Atlantic Region, shortnose sturgeon are known to spawn in the Kennebec, Androscoggin, Merrimack, Connecticut, Hudson, and Delaware Rivers. Shortnose sturgeon are also known to occur in the Penobscot and Potomac Rivers; although it is unclear if spawning is currently occurring in those systems.

Gulf of Maine Metapopulation

Tagging and telemetry studies indicate that shortnose sturgeon are present in the Penobscot, Kennebec, Androscoggin, Sheepscot, and Saco Rivers. Individuals have also been documented in smaller coastal rivers; however, the duration of presence has been limited to hours or days and the smaller coastal rivers are thought to be only used occasionally (Zydlewski et al., 2011).

Penobscot River

Since the removal of the Veazie and Great Works Dams (2013 and 2012, respectively), in the Penobscot River, shortnose sturgeon range from the Bay to the Milford Dam. Shortnose sturgeon now are presumed to have access to their full historical range. Adult and large juvenile sturgeon have been documented to use the river. The first documented use of habitat upstream of the former Veazie Dam (rkm 46.8) occurred in October 2015, when three acoustically tagged fish moved into the first 5 km of restored river (Johnston, 2016; Johnston et al., 2019), but spring movements upstream of the former Veazie Dam have not been documented (Johnston, 2016; Johnston et al., 2019). While potential spawning sites have been identified, no spawning has been documented despite females with late stage eggs being captured in the Penobscot River in summer and fall (Fernandes et al., 2010; Dionne et al., 2013; Johnston, 2016; Johnston et al, 2019). Foraging and overwintering are known to occur in the river. Nearly all prespawn females and males detected in the Penobscot River have been documented to return to the Kennebec or Androscoggin Rivers. Robust design analysis with closed periods in the summer and late fall estimated seasonal adult abundance ranging from 636-1285 (weighted mean), with a low estimate of 602 (95% CI: 409.6-910.8) and a high of 1306 (95% CI: 795.6-2176.4) (Fernandes, 2008; Fernandes et al., 2010; Dionne, 2010 in Maine DMR (2010)).

*Kennebec/Androscoggin/Sheepscot Rivers*

The estimated size of the adult population (>50cm TL) in this system, based on a tagging and recapture study conducted between 1977 and 1981, was 7,200 (95% CI = 5,000 - 10,800; Squiers et al. 1982). A population study conducted 1998-2000 estimated population size at 9,488 (95% CI = 6,942 -13,358; Squiers 2003) suggesting that the population exhibited significant growth between the late 1970s and late 1990s. Spawning is known to occur in the Androscoggin and Kennebec Rivers (Wippelhauser and Squiers 2015, Wippelhauser et al. 2015). In both rivers, there are hydroelectric facilities located at the base of natural falls thought to be the natural upstream limit of the species. As such, these dams (Lockwood Dam on the Kennebec and Brunswick Dam on the Androscoggin) are not considered to limit the movements of sturgeon in these rivers. The Sheepscot River is used for foraging during the summer months.

Altenritter et al. (2017) found that a large proportion of female shortnose sturgeon tagged in the

Penobscot River migrated to the Kennebec River during probable spawning windows. They also found that shortnose sturgeon in the Penobscot River were larger and had a higher condition factor than shortnose sturgeon in the Kennebec River. Based on this, they speculated that "increased abundance and resource limitation in the Kennebec River may be constraining growth and promoting migration to the Penobscot River by individuals with sufficient initial size and condition." These individuals then return to spawn in the Kennebec River at larger size that could potentially result in increased reproductive potential compared to nonmigratory females. Thus, migrants could experience an adaptive reproductive advantage relative to nonmigratory individuals. Further, Altenritter et al. (2017) noted that although migrants to the Penobscot River may be a small proportion of the Kennebec River population, they could disproportionately contribute to regional recruitment and facilitate population resilience to disturbance.

Merrimack River

The historic range in the Merrimack extended to Amoskeag Falls (Manchester, NH, river kilometer 116; Piotrowski (2002)); currently shortnose sturgeon cannot move past the Essex Dam in Lawrence, MA (river kilometer 46). A current population estimate for the Merrimack River is not available. Based on a study conducted 1987-1991, the adult population was estimated at 32 adults (20–79; 95% confidence interval; B. Kynard and M. Kieffer unpublished information). However, recent gill-net sampling efforts conducted by Kieffer indicate a dramatic increase in the number of adults in the Merrimack River. Sampling conducted in the winter of 2009 resulted in the capture of 170 adults. Preliminary estimates suggest that there may be approximately 2,000 adults using the Merrimack River annually. Spawning, foraging and overwintering all occur in the Merrimack River.

Tagging and tracking studies demonstrate movement of shortnose sturgeon between rivers within the Gulf of Maine, with the longest distance traveled between the Penobscot and Merrimack rivers (Altenritter et al., 2017, Wippelhauser et al., 2017). Genetic studies indicate that a small, but statistically insignificant amount of genetic exchange likely occurs between the Merrimack River and these rivers in Maine (King et al., 2013). The Merrimack River population is genetically distinct from the Kennebec-Androscoggin-Penobscot population (SSSRT, 2010). In the fall of 2014, a shortnose sturgeon tagged in the Connecticut River in 2001 was captured in the Merrimack River. To date, genetic analysis has not been completed and we do not yet know the river of origin of this fish.

Connecticut River

The Holyoke Dam divided the range of Connecticut River shortnose sturgeon anduntil major modifications were implemented at the project's fish passage facilities in 2016, there was limited successful passage downstream of the Dam. Fishways have been operational at the project since the 1950s, however we have no information on sturgeon passage until 1975. Upstream passage between 1975-1999 was an average of four fish per year. From 1999 through 2016, all shortnose sturgeon collected in the lifts were released back downstream given concerns about the risk of mortality from downstream passage. Following fishway upgrades and studies, upstream passage resumed in 2017. Since 2017, the number of shortnose sturgeon passed upstream has ranged between a low of 18 and a high of 91.

The number of sturgeon passing downstream of the Dam is less well known due to difficulties in monitoring downstream passage. However, the 2016 fishway improvements have been shown to significantly reduce the potential for serious injury or mortality. Despite this separation, the populations are not genetically distinct (Kynard, 1997, Wirgin et al., 2005, Kynard et al., 2012). The most recent estimate of the number of shortnose sturgeon upstream of the dam, based on captures and tagging from 1990-2005 is approximately 328 adults (CI = 188–1,264 adults; B. Kynard, USGS, unpubl. Data in SSSRT 2010); this compares to a previous Peterson mark-recapture estimate of 370–714 adults (Taubert, 1980a). Using four mark-recapture methodologies, the long-term population estimate (1989-2002) for the lower Connecticut River ranges from 1,042-1,580 (Savoy, 2004). Comparing 1989-1994 to 1996-2002, the population exhibits growth on the order of 65-138%. The population in the Connecticut River is thought to be stable, but at a small size.

As described in SSSRT (2010), shortnose sturgeon in the Connecticut River inhabit a reach downstream of the Turners Falls Dam (Turners Falls, MA; river kilometer 198) to Long Island Sound. Construction of the Turners Falls Dam was completed in 1798 and built on a natural falls-rapids. Turners Falls is believed to be the historic upstream boundary of shortnose sturgeon in the Connecticut River; however, there have been anecdotal sightings of sturgeon upstream of the dam and in the summer of 2017 an angler reported a catch of a shortnose sturgeon upstream of the Turners Falls Dam. This information suggests that occasional shortnose sturgeon are present upstream to the dam; however, we have no information on how shortnose sturgeon accessed this reach or how many sturgeon may be present in this area, if any.

While limited spawning is thought to occur below the Holyoke Dam, until recently successful spawning (i.e., capture of viable eggs and larvae) has only been documented upstream of the Holyoke Dam. Abundance of prespawning adults was estimated each spring between 1994 and 2001 at a mean of 142.5 spawning adults (CI =14–360 spawning adults) (Kynard et al., 2012). Overwintering and foraging occur in both the upper and lower portions of the river. Occasionally, sturgeon have been captured in tributaries to the Connecticut River including the Deerfield River and Westfield River. Additionally, a sturgeon tagged in the Connecticut River was recaptured in the Housatonic River (T. Savoy, CT DEP, pers. comm.). Three individuals tagged in the Hudson were captured in the CT, with one remaining in the river for at least one year (Savoy, 2004). In spring 2021, the CT DEEP captured a number of shortnose sturgeon eggs on egg mats below the Holyoke Dam. Young of year shortnose sturgeon were also observed by divers monitoring for listed mussels at a construction site in Springfield, MA. These observations suggest that occasional spawning may occur below the dam; however, we do not have sufficient information to determine how frequently such an occurrence may happen.

Hudson River

The Hudson River population of shortnose sturgeon is the largest in the United States. Studies indicated an extensive increase in abundance from the late 1970s (13,844 adults (Dovel et al., 1992), to the late 1990s (56,708 adults (95% CI 50,862 to 64,072; Bain et al., 1998). This increase is thought to be the result of high recruitment (31,000 – 52,000 yearlings) from 1986-1992 (Woodland and Secor, 2007). Woodland and Secor examined environmental conditions throughout this 20-year period and determined that years in which water temperatures drop quickly in the fall and flow increases rapidly in the fall (particularly October), are followed by high levels of recruitment in the spring. This suggests that these environmental factors may index a suite of environmental cues that initiate the final stages of gonadal development in spawning adults. The population in the Hudson River exhibits substantial recruitment and is considered to be stable at high levels.

Delaware River-Chesapeake Bay Metapopulation

Shortnose sturgeon range from Delaware Bay up to at least Scudders Falls (river kilometer 223); there are no dams within the species' range on this river. The population is considered stable (comparing 1981-1984 to 1999-2003) at around 12,000 adults (Hastings et al., 1987 and ERC, 2006b). Spawning occurs primarily between Scudders Falls and the Trenton rapids. Overwintering and foraging also occur in the river. Shortnose sturgeon have been documented to use the Chesapeake-Delaware Canal to move from the Chesapeake Bay to the Delaware River.

In Chesapeake Bay, shortnose sturgeon have most often been found in Maryland waters of the mainstem bay and tidal tributaries such as the Susquehanna, Potomac, and Rappahannock Rivers (Kynard et al., 2016; SSSRT, 2010). Spells (1998), Skjeveland et al. (2000), and Welsh et al. (2002) all reported one capture each of adult shortnose sturgeon in the Rappahannock River. Recent documented use of Virginia waters of Chesapeake Bay is currently limited to two individual shortnose sturgeon: one captured in 2016 (Balazik, 2017) and a second sturgeon (a confirmed gravid female) caught in 2018 in the James River (Balazik, pers. comm. 2018). Spawning has not been documented in any tributary to the Bay although suitable spawning habitat and two prespawn females with late stage eggs have been documented in the Potomac River. Current information indicates that shortnose sturgeon are present year round in the Potomac River with foraging and overwintering taking place there. Shortnose sturgeon captured in the Chesapeake Bay are not genetically distinct from the Delaware River population.

Southeast Metapopulation

There are no shortnose sturgeon between Maryland waters of the Chesapeake Bay and the Carolinas. Shortnose sturgeon are only thought to occur in the Cape Fear River and Yadkin-Pee Dee River in North Carolina and are thought to be present in very small numbers.

The Altamaha River supports the largest known population in the Southeast with successful self-sustaining recruitment. The most recent population estimate for this river was 6,320 individuals (95% CI = 4,387-9,249; DeVries, 2006). The population contains more juveniles than expected. Comparisons to previous population estimates suggest that the population is increasing; however, there is high mortality between the juvenile and adult stages in this river. This mortality is thought to result from incidental capture in the shad fishery, which occurs at the same time as the spawning period (DeVries, 2006).

The only available estimate for the Cooper River is of 300 spawning adults at the Pinoplis Dam spawning site (based on 1996-1998 sampling; Cooke et al., 2004). This is likely an underestimate of the total number of adults as it would not include non-spawning adults. Estimates for the Ogeechee River were 266 (95%CI=236-300) in 1993 (Weber, 1996; Weber et al., 1998); a more recent estimate (sampling from 1999-2004; Fleming et al., 2003) indicates a population size of 147 (95% CI = 104-249). Available information indicates the Ogeechee River population may be experiencing juvenile mortality rates greater than other southeastern rivers.

Spawning is also occurring in the Savannah River, the Congaree River, and the Yadkin-Pee Dee River. There are no population estimates available for these rivers. Occurrence in other southern rivers is limited, with capture in most other rivers limited to fewer than five individuals. They are thought to be extremely rare or possibly extirpated from the St. Johns River in Florida as only a single specimen was found by the Florida Fish and Wildlife Conservation Commission during extensive sampling of the river in 2002/2003. In these river systems, shortnose sturgeon occur in nearshore marine, estuarine, and riverine habitat.

### 3.2.2. Threats

Because sturgeon are long-lived and slow growing, stock productivity is relatively low; this can make the species vulnerable to rapid decline and slow recovery (Musick, 1999). In well studied rivers (e.g., Hudson, upper Connecticut), researchers have documented significant year to year recruitment variability (up to 10 fold over 20 years in the Hudson and years with no recruitment in the CT). However, this pattern is not unexpected given the life history characteristics of the species and natural variability in hydrogeologic cues relied on for spawning.

The small amount of effective movement between populations means recolonization of currently extirpated river populations is expected to be very slow and any future recolonization of any rivers that experience significant losses of individuals would also be expected to be very slow. Despite the significant decline in population sizes over the last century, gene diversity in shortnose sturgeon is moderately high in both mtDNA (Quattro et al., 2002; Wirgin et al., 2005; Wirgin et al., 2000) and nDNA (King et al., 2001) genomes.

A population of sturgeon can go extinct as a consequence of demographic stochasticity (fluctuations in population size due to random demographic events); the smaller the metapopulation (or population), the more prone it is to extinction. Anthropogenic impacts acting on top of demographic stochasticity further increase the risk of extinction.

All shortnose sturgeon populations are highly sensitive to increases in juvenile mortality that would result in reductions in the number of adult spawners (Anders et al., 2002; Gross et al., 2002; Secor, 2002). Populations of shortnose sturgeon that do not have reliable natural recruitment are at increased risk of experiencing population decline leading to extinction (Secor et al*.,* 2002). Elasticity studies of shortnose sturgeon indicate that the highest potential for increased population size and stability comes from YOY and juveniles as compared to adults (Gross et al*.*, 2002); that is, increasing the number of YOY and juveniles has a more significant long-term impact to the population than does increasing the number of adults or the fecundity of adults.

The Shortnose Sturgeon Recovery Plan (NMFS, 1998) and the Shortnose Sturgeon Status Review Team's Biological Assessment of shortnose sturgeon (2010) identify habitat degradation or loss and direct mortality as principal threats to the species' survival. Natural and anthropogenic factors continue to threaten the recovery of shortnose sturgeon and include: poaching, bycatch in riverine fisheries, habitat alteration resulting from the presence of dams, in-water and shoreline construction, including dredging; degraded water quality which can impact habitat suitability and result in physiological effects to individuals including impacts on reproductive success; direct mortality resulting from dredging as well as impingement and entrainment at water intakes; and, loss of historical range due to the presence of dams. Shortnose sturgeon are also occasionally killed as a result of research activities. The total number of sturgeon affected by these various threats is not known. Climate change, particularly shifts in seasonal temperature regimes and changes in the location of the salt wedge, may impact shortnose sturgeon in the future (more information on Climate Change is presented in Section 5.0). More information on threats experienced in the action area is presented in the Environmental Baseline section of this Opinion.

### 3.2.3. Survival and Recovery

The 1998 Recovery Plan (NMFS, 1998) outlines the steps necessary for recovery and indicates that each population may be a candidate for downlisting (i.e., to threatened) when it reaches a minimum population size that is large enough to prevent extinction and will make the loss of genetic diversity unlikely; the minimum population size for each population has not yet been determined. The Recovery Outline contains three major tasks: (1) establish delisting criteria; (2) protect shortnose sturgeon populations and habitats; and, (3) rehabilitate habitats and population segments. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting and spawning. In many rivers, particularly in the Southeast, habitat is compromised and continues to impact the ability of sturgeon populations to recover. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting and migrations of all individuals. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. The loss of any population or metapopulation would result in the loss of biodiversity and would create (or widen) a gap in the species' range.

### 3.2.4. Summary of Status

Shortnose sturgeon remain listed as endangered throughout their range, with populations in the Northeast being larger and generally more stable than populations in the Southeast. All populations are affected by mortality incidental to other activities, including dredging, power plant intakes and shad fisheries where those still occur, and impacts to habitat and water quality that affect the ability of sturgeon to use habitats and impacts individuals that are present in those habitats. While the species is overall considered to be stable (i.e., its trend has not changed recently, and we are not aware of any new or emerging threats that would change the trend in the future), we lack information on abundance and population dynamics in many rivers. We also do not fully understand the extent of coastal movements and the importance of habitat in non-natal rivers to migrant fish. While the species has high levels of genetic diversity, the lack of effective movement between populations increases the vulnerability of the species, should there be a significant reduction in the number of individuals in any one population or metapopulation as recolonization is expected to be very slow. All populations, regardless of size, are faced with threats that result in the mortality of individuals and/or affect the suitability of habitat and may restrict the further growth of the population. Additionally, there are several factors that combine to make the species particularly sensitive to existing and future threats; these factors include: the small size of many populations, existing gaps in the range, late maturation, the sensitivity of adults to very specific spawning cues which can result in years with no recruitment, and the impact of losses of young of the year and juveniles to population persistence and stability.

## 3.3. Atlantic sturgeon

Atlantic sturgeon occur in the portion of the action area below the Milford Dam. An estuarine-dependent anadromous species, Atlantic sturgeon occupy ocean and estuarine waters, including sounds, bays, and tidal-affected rivers from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida (ASSRT, 2007) (Figure 12). The marine range of U.S. Atlantic sturgeon extends from Labrador, Canada, to Cape Canaveral, Florida. As Atlantic sturgeon travel long distances in these waters, all five DPSs of Atlantic sturgeon have the potential to be anywhere in this marine range.

On February 6, 2012, NMFS listed five DPSs of Atlantic sturgeon under the ESA: Gulf of Maine (GOM), New York Bight (NYB), Chesapeake Bay (CB), Carolina, and South Atlantic (77 FR 5880 and 77 FR 5914). The Gulf of Maine DPS is listed as threatened, and the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs are listed as endangered. As described below, only individuals from the Gulf of Maine DPS are expected to occur in the action area. Critical habitat for all five DPSs was designated in 2017 (82 FR 39160); the designation for the Gulf of Maine DPS includes the Penobscot River critical habitat unit as described further below.

### 3.3.1. Determination of DPS Composition in the Action Area

As explained above, the range of all five DPSs overlaps and extends from Canada through Cape Canaveral, Florida (Figure 12). The distribution of Atlantic sturgeon is influenced by geography, with Atlantic sturgeon from a particular DPS becoming less common the further from the river of origin one moves. Areas that are geographically close are expected to have a similar composition of individuals. We have considered the best available information to determine from which DPSs individuals in the action area are likely to have originated.

There is currently no mixed stock analysis[12] for the action area specifically; however, genetic analyses and telemetry studies indicate that within the Gulf of Maine nearly all Atlantic sturgeon originate from the Gulf of Maine DPS and that within the action area we would only expect Atlantic sturgeon originating from the Gulf of Maine DPS. Wippelhauser et al. (2017) tagged Atlantic sturgeon in four Gulf of Maine rivers, including the Penobscot, and tracked their movements between 2006 and 2014; they found that only 7% of the Atlantic sturgeon tagged in the four study rivers moved outside of the Gulf of Maine during the study period. Kazyak et al. (2021) examined genetic results of captured Atlantic sturgeon in three geographic regions (North of Cape Cod, Mid-Atlantic, and south of Cape Hatteras) to determine stock compositions in each of the three areas. They report that all individuals from the north region were from the Gulf of Maine DPS (87.8%) or Canadian River (12.2%). The authors state there was no indication that Atlantic sturgeon from other stocks were present in the samples from the north region, nor did they detect any differences in stock composition between individuals collected in

[12] A mixed stock analysis uses genetic studies to estimate the proportional contributions of individuals from different stocks in a particular geographic area or population.

riverine/estuarine habitats and offshore. Wirgin et al. (2012) determined that stocks in the Bay of Fundy were primarily from the St. John River (>60%) and the Kennebec River (34-36%). Together, these studies support the conclusion that Atlantic sturgeon in the Gulf of Maine are likely to originate from Canadian rivers or the Gulf of Maine DPS.

To date, no adults in spawning condition, juveniles, or early life stages have been collected in the Penobscot. As such, at this time spawning is not known to occur in the Penobscot despite accessible habitat that appears to be suitable for spawning and rearing. Therefore, the only Atlantic sturgeon we expect to occur in the action area are adults or subadults, most likely originating from the Kennebec River estuary, with a small number originating from Canadian rivers.

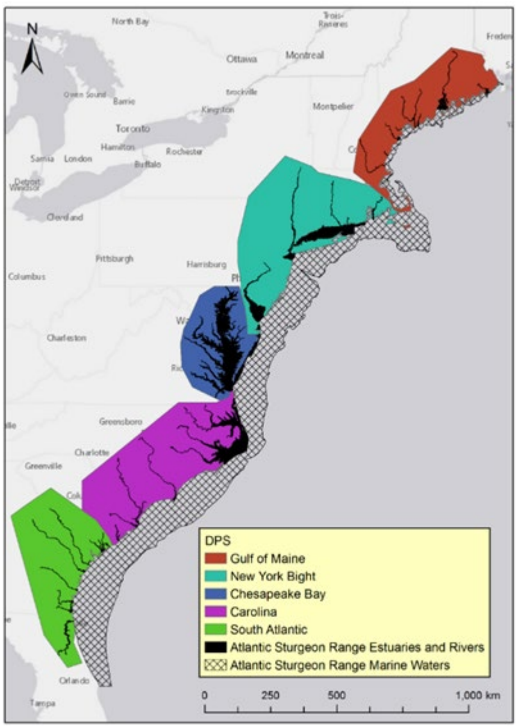

Figure 12**.** U.S. range of Atlantic sturgeon DPSs

Information available from the 2007 Atlantic sturgeon status review (ASSRT, 2007), 2017 ASMFC benchmark stock assessment (ASMFC, 2017), ASMFC 2024 Stock Assessment Update (ASMFC, 2024), final listing rules (77 FR 5880 and 77 FR 5914; February 6, 2012), and material supporting the designation of Atlantic sturgeon critical habitat (NMFS, 2017a), as well as the 5-Year Review for the Gulf of Maine DPSs (NMFS, 2022a) were used to summarize the life history, population dynamics, and status of the species.

### 3.3.2. Atlantic Sturgeon Life History

Atlantic sturgeon size at sexual maturity varies with latitude with individuals reaching maturity in the Saint Lawrence River at 22 to 34 years (Scott and Crossman, 1973). Atlantic sturgeon spawn in freshwater but spend most of their adult life in the marine environment. Spawning adults generally migrate upriver in May through July in Canadian systems (Bain, 1997; Caron et al., 2002; Murawski and Pacheco, 1977; Smith, 1985; Smith and Clugston, 1997). Atlantic sturgeon spawning is believed to occur in flowing water between the salt front and fall line of large rivers at depths of three to 27 meters (Bain et al., 2000; Borodin, 1925; Crance, 1987; Leland, 1968; Scott and Crossman, 1973). Atlantic sturgeon likely do not spawn every year; spawning intervals range from one to five years for males (Caron et al., 2002; Collins et al., 2000; Smith, 1985) and two to five years for females (Stevenson and Secor, 2000; Van Eenennaam et al., 1996; Vladykov and Greeley, 1963).

The life stages of Atlantic sturgeon can be divided up into six general categories as described in Table 5 below.

Table 5. Descriptions of Atlantic sturgeon life history stages.

| Age Class | Size | Description |
|---|---|---|
| Egg | ~2 to 3 mm diameter | Fertilized or unfertilized |
| Yolk Sac Larvae | ~6 to 14 mm TL | Negative phototaxis, nourished by yolk sac (endogenous feeding) |
| Post Yolk Sac Larvae | ~14 to 37 mm TL | Positive phototaxis, free swimming, actively feeding (exogenous feeding) |
| Young of Year (YOY) | 0.3 grams <41 cm TL | Fish that are > 3 months and < one year; capable of capturing and consuming live food |
| Juveniles | >41 cm and <76 cm TL | Fish that are at least age 1 and are not sexually mature and do not make coastal migrations. |
| Subadults | >76cm and <150cm TL | Fish that are not sexually mature but make coastal migrations |
| Adults | >150 cm TL | Sexually mature fish |

Sturgeon eggs are highly adhesive and are deposited on the bottom substrate, usually on hard surfaces (Gilbert, 1989; Smith and Clugston, 1997) between the salt front and fall line of large rivers (Bain et al., 2000; Borodin, 1925; Crance, 1987; Scott and Crossman 1973). Following spawning in northern rivers, males may remain in the river or lower estuary until the fall; females typically exit the rivers within four to six weeks (Savoy and Pacileo, 2003). Hatching occurs approximately 94 to 140 hours after egg deposition at temperatures of 20 and 18 degrees Celsius, respectively (Theodore et al., 1980).

Hatchlings (called free embryos) have a yolk sac that provides nourishment (endogenous feeding) during the first stage of larval development. Hatchlings are assumed to undertake a demersal existence, seek cover in the bottom substrate and yolk sac larvae (i.e., free embryos less than 4 weeks old, with total lengths (TL) less than 30 mm; Van Eenennaam et al., 1996) are assumed to inhabit the same riverine or estuarine areas where they were spawned (Kynard and Horgan 2002; Bain et al. 2000). The free embryo exhaust the yolk sac and become (post yolk sac) larvae after about eight days (Kynard and Horgan, 2002). Post yolk sac larvae drift downstream where they eventually settle, become demersal, and start foraging in freshwater reaches above the salt front (Kynard and Horgan, 2002).

Studies suggest that age-0 (i.e., young-of-year), age-1, and age-2 juvenile Atlantic sturgeon occur in low salinity waters of the natal estuary (Hilton et al., 2016) while older fish are more salt tolerant and occur in higher salinity waters as well as low salinity waters (Hilton et al., 2016; Collins et al., 2000). Atlantic sturgeon remain in the natal estuary for months to years before emigrating to open ocean as subadults (ASSRT, 2007; Dadswell, 2006; Dovel and Berggren, 1983; Hilton et al., 2016). Juvenile Atlantic sturgeon feed on aquatic insects, insect larvae, and other benthic invertebrates (ASSRT, 2007; Guilbard et al., 2007; Bigelow and Schroeder, 1953).

Tagging and genetic data indicate that subadult and adult Atlantic sturgeon travel widely once they emigrate from rivers. Despite extensive mixing in coastal waters, Atlantic sturgeon exhibit high fidelity to their natal rivers (Grunwald et al., 2008; King et al., 2001; Waldman et al., 2002). Because of high natal river fidelity, it appears that most rivers support independent populations (Grunwald et al., 2008; King et al., 2001; Waldman and Wirgin, 1998; Wirgin et al., 2002; Wirgin et al., 2000). Subadult and adult Atlantic sturgeon feed primarily on polychaetes, isopods, American sand lances and amphipods in the marine environment, while in fresh water they feed on oligochaetes, gammarids, mollusks, insects, and chironomids (Guilbard et al., 2007; Johnson et al., 1997; Moser and Ross, 1995; Novak et al., 2017; Savoy, 2007).

Based on fishery-independent, fishery dependent, tracking, and tagging data, Atlantic sturgeon appear to primarily occur inshore of the 50-meter depth contour (Stein et al., 2004a; Stein et al., 2004b; Laney et al., 2007; Dunton et al., 2010; Erickson et al., 2011; Dunton et al., 2015; Waldman et al., 2013; O'Leary et al., 2014; Wirgin et al., 2015a; Wirgin et al., 2015b). However, they are not restricted to these depths and excursions into deeper (e.g., 75 m) continental shelf waters have been documented (Timoshkin, 1968; Collins and Smith, 1997; Colette, 2002; Stein et al., 2004a; Dunton et al., 2010; Erickson et al., 2011). Data from fishery-independent surveys and tagging and tracking studies also indicate that some Atlantic sturgeon may undertake seasonal movements along the coast (Erickson et al., 2011; Dunton et al., 2010; Wippelhauser et al., 2012; Oliver et al., 2013; Post, 2014; Hilton et al., 2016). For instance, studies found that satellite-tagged adult sturgeon from the Hudson River concentrated in the southern part of the Mid-Atlantic Bight, at depths greater than 20 m, during winter and spring; while, in the summer and fall, Atlantic sturgeon concentrations shifted to the northern portion of the Mid-Atlantic Bight at depths less than 20 meters (Erickson et al., 2011).

In the marine range, several marine aggregation areas occur adjacent to estuaries and/or coastal features formed by bay mouths and inlets along the U.S. eastern seaboard (i.e., waters off North Carolina, Chesapeake Bay; Delaware Bay; New York Bight; Massachusetts Bay; Long Island Sound; and Connecticut and Kennebec River Estuaries). Depths in these areas are generally no greater than 25 meters (Bain et al., 2000; Stein et al., 2004a; Laney et al., 2007; Dunton et al., 2010; Erickson et al., 2011; Oliver et al., 2013; Waldman et al., 2013; O'Leary et al., 2014; Wippelhauser et al., 2012; Wippelhauser et al., 2015; Savoy and Pacileo, 2003). Although additional studies are still needed to clarify why Atlantic sturgeon aggregate at these sites, there is some indication that they may serve as thermal refuge, wintering sites, or marine foraging areas (Stein et al., 2004a; Dunton et al., 2010; Erickson et al., 2011).

Water temperature plays a primary role in triggering the timing of spawning migrations (Hilton et al., 2016). Spawning migrations generally occur during February-March in southern systems, April-May in Mid-Atlantic systems, and May-July in Canadian systems (Hilton et al., 2016). Male sturgeon begin upstream spawning migrations when waters reach approximately 6° C (43° F) (Hilton et al., 2016), and remain on the spawning grounds throughout the spawning season (Bain, 1997). Females begin spawning migrations when temperatures are closer to 12° C to 13° C (54° to 55° F) (Dovel and Berggren, 1983; Smith, 1985), make rapid spawning migrations upstream, and quickly depart following spawning (Bain, 1997). Females may leave the estuary and travel to other coastal estuaries until outmigration to marine waters in the fall (Smith et al., 1982; Dovel and Berggren, 1983; Smith, 1985; Bain, 1997; Bain et al., 2000; Greene et al., 2009; Balazik et al., 2012; Breece et al., 2013; NMFS, 2017; Hatin et al., 2002). Following spawning, males move downriver to the lower estuary and remain there until outmigration in the fall (Smith et al., 1982; Dovel and Berggren, 1983; Smith, 1985; Bain, 1997; Bain et al., 2000; Hatin et al., 2002; Greene et al., 2009; Balazik et al., 2012; Breece et al., 2013; Ingram et al., 2019).

Precise estimates of population growth rate (intrinsic rates) are unknown for the five listed DPSs of Atlantic sturgeon due to a lack of long-term abundance data. The Commission's 2017 stock assessment referenced a population viability assessment (PVA) that was done to determine population growth rates for the five DPSs based on a few long-term survey programs, but most results were statistically insignificant or utilized a model for which the available did not or poorly fit. In any event, the population growth rates reported from that PVA ranged from -1.8% to 4.9% (ASMFC, 2017).

The genetic diversity of Atlantic sturgeon throughout its range has been well-documented (ASSRT, 2007; Bowen & Avise, 1990; O'Leary et al., 2014; Ong et al., 1996; Waldman et al., 1996; Waldman & Wirgin, 1998). Overall, these studies have consistently found populations to be genetically diverse, and the majority can be readily differentiated. Relatively low rates of gene flow reported in population genetic studies (Fritts et al., 2016; Savoy et al., 2017; Wirgin et al., 2002) indicate that Atlantic sturgeon return to their natal river to spawn, despite extensive mixing in coastal waters.

### 3.3.3. Gulf of Maine DPS of Atlantic Sturgeon

The Gulf of Maine DPS includes the following: all anadromous Atlantic sturgeons that are spawned in the watersheds from the Maine/Canadian border and, extending southward, all watersheds draining into the Gulf of Maine as far south as Chatham, MA. Within this range, Atlantic sturgeon historically spawned in the Androscoggin, Kennebec, Merrimack, Penobscot, and Sheepscot Rivers (ASSRT, 2007). Spawning habitat is available and accessible in the Penobscot, Androscoggin, Kennebec, Merrimack, and Piscataqua (inclusive of the Cocheco and Salmon Falls rivers) rivers. As described more fully in section 3.3.4, spawning occurs in the Kennebec River. During the study period of 2009-2011, eight sturgeon, including one male in spawning condition, were also captured in the Androscoggin River estuary, which suggests that spawning may be occurring in the Androscoggin River as well (Wippelhauser et al., 2017). However, additional evidence, such as capture of a spawning female, sturgeon eggs or larvae, is not yet available to confirm that spawning is occurring in the Androscoggin River (NMFS, 2018).

Bigelow and Schroeder (1953) surmised that Atlantic sturgeon likely spawned in Gulf of Maine Rivers in May-July. More recent captures of Atlantic sturgeon in spawning condition within the Kennebec River suggest that spawning more likely occurs in June-July (ASMFC, 1998; NMFS and USFWS, 1998; Wippelhauser et al., 2017). Evidence for the timing and location of Atlantic sturgeon spawning in the Kennebec River includes: (1) the capture of five adult male Atlantic sturgeon in spawning condition (*i.e.*, expressing milt) in July 1994 below the (former) Edwards Dam; (2) capture of 31 adult Atlantic sturgeon from June 15, 1980, through July 26, 1980, in a small commercial fishery directed at Atlantic sturgeon from the South Gardiner area (above Merrymeeting Bay) that included at least four ripe males and one ripe female captured on July 26, 1980; (3) capture of nine adults during a gillnet survey conducted from 1977-1981, the majority of which were captured in July in the area from Merrymeeting Bay and upriver as far as Gardiner, ME (ASMFC, 2007; NMFS and U.S. FWS, 1998); and (4) the capture of three Atlantic sturgeon larvae between rkm 72 and rkm 75 in July 2011 (Wippelhauser et al., 2017). The low salinity values for waters above Merrymeeting Bay are consistent with values found in rivers where successful Atlantic sturgeon spawning is known to occur.

At this time, there is no evidence of recent spawning in the remaining rivers in the Gulf of Maine DPS. Atlantic sturgeons that are spawned elsewhere continue to use habitats within all of these rivers as part of their overall marine range (ASSRT, 2007). The movement of subadult and adult sturgeon between rivers, including to and from the Kennebec River and the Penobscot River, demonstrates that coastal and marine migrations are key elements of Atlantic sturgeon life history for the Gulf of Maine DPS (ASSRT, 2007; Fernandes et al., 2010; Wippelhauser et al. 2017).

Several threats play a role in shaping the current status of Gulf of Maine DPS Atlantic sturgeon. Historical records provide evidence of commercial fisheries for Atlantic sturgeon in the Kennebec and Androscoggin Rivers dating back to the 17th century (Squiers and Smith, 1979). In 1849, 160 tons of sturgeon was caught in the Kennebec River by local fishermen (Squiers and

Smith, 1979). Following the 1880s, the sturgeon fishery was almost non-existent due to a collapse of the sturgeon stocks. All directed Atlantic sturgeon fishing as well as retention of Atlantic sturgeon bycatch has been prohibited since 1998. Nevertheless, mortalities associated with bycatch in fisheries occurring in state and federal waters still occurs. In the marine range, Gulf of Maine DPS Atlantic sturgeon are incidentally captured in federal and state-managed fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (ASMFC, 2007; Stein et al., 2004a). Subadults and adults are killed as a result of bycatch in fisheries authorized under Northeast Fishery Management Plans (FMPs). At this time, we are not able to quantify the impacts from this and other threats or estimate the number of individuals killed as a result of anthropogenic threats. Habitat disturbance and direct mortality from anthropogenic sources are the primary concerns.

Riverine habitat may be impacted by dredging and other in-water activities, disturbing spawning habitat and also altering the benthic forage base. Many rivers in the Gulf of Maine DPS have navigation channels that are maintained by dredging. Dredging outside of Federal channels and in-water construction occurs throughout the Gulf of Maine DPS. While some dredging projects operate with observers present to document fish mortalities, many do not. To date, we have not received any reports of Atlantic sturgeon killed during dredging projects in the Gulf of Maine region; however, as noted above, not all projects are monitored for interactions with fish. At this time, we do not have any information to quantify the number of Atlantic sturgeon killed or disturbed during dredging or in-water construction projects. We are also not able to quantify any effects to habitat.

Access to the full range of historic habitat is currently disrupted by the presence of dams on some rivers in the Gulf of Maine region, including the Merrimack River. While there are also dams on the Penobscot, Kennebec, Androscoggin, and Saco Rivers, these dams are near the site of natural falls and likely represent the maximum upstream extent of sturgeon occurrence even if the dams were not present. Because no Atlantic sturgeon are known to occur upstream of any hydroelectric projects in the Gulf of Maine region, passage over hydroelectric dams or through hydroelectric turbines is not a source of injury or mortality in this area. While not expected to be killed or injured during passage at the dam, the extent that Atlantic sturgeon are affected by the existence of dams and their operations in the Gulf of Maine region is currently unknown. The tracking of spawning condition Atlantic sturgeon downstream of the Brunswick Dam in the Androscoggin River suggests that Atlantic sturgeon spawning may be occurring in the vicinity of at least that project and therefore, may be affected by project operations. Until it was breached in July 2013, the range of Atlantic sturgeon in the Penobscot River was limited by the presence of the Veazie Dam. Since the removal of the Veazie Dam and the Great Works Dam, sturgeon can now travel as far upstream as the Milford Dam. Atlantic sturgeon primarily occur within the mesohaline reach of the river, particularly in areas with high densities of sturgeon prey which means that the Penobscot River is likely an important foraging area for Atlantic sturgeon belonging to the Gulf of Maine DPS (Altenritter et al., 2017). There is no current evidence that spawning is occurring in the Penobscot River. Acoustic tag detections suggest that the adults that forage in the Penobscot River travel to the Kennebec River to spawn (Altenritter et al., 2017). The Essex Dam on the Merrimack River blocks access to approximately 58 percent of historically accessible habitat in this river. Atlantic sturgeon occur in the Merrimack River but spawning has not been documented. Like the Penobscot, it is unknown how the Essex Dam affects the likelihood of spawning occurring in this river.

Gulf of Maine DPS Atlantic sturgeon may also be affected by degraded water quality. In general, water quality has improved in the Gulf of Maine over the past decades (EPA, 2008; Lichter et al., 2006). Many rivers in Maine, including the Kennebec River, were heavily polluted in the past from industrial discharges from pulp and paper mills. While water quality has improved and most discharges are limited through regulations, many pollutants persist in the benthic environment. This can be particularly problematic if pollutants are present on spawning and nursery grounds, as developing eggs and larvae are particularly susceptible to exposure to contaminants.

The threat of vessel strike appears to be less for Atlantic sturgeon belonging to the Gulf of Maine DPS compared to the New York Bight or Chesapeake Bay DPSs based on the number of Atlantic sturgeon vessel struck carcasses that are found in Gulf of Maine rivers, and given the differences in vessel activity in the respective natal rivers. Nevertheless, some strikes do occur within the Gulf of Maine and sturgeon belonging to the Gulf of Maine can also be struck in other areas of their range including higher salinity waters of the Hudson River Estuary, Delaware River Estuary, and Chesapeake Bay.

We described in the listing rule that potential changes in water quality as a result of changing environmental conditions (temperature, salinity, dissolved oxygen, contaminants, etc.) in rivers and coastal waters inhabited by Atlantic sturgeon will likely affect riverine populations, and we expected these effects to be more severe for southern portions of the U.S. range. However, new information shows that the Gulf of Maine is one of the fastest warming areas of the world as a result of changing environmental conditions (Brickman et al., 2021; Pershing et al., 2015). Markin and Secor (2020) further demonstrate the effects of temperature on the growth rate of juvenile Atlantic sturgeon, and informs how changing environmental conditions may impact growth and survival of Atlantic sturgeon across their range. Their study showed that all juvenile Atlantic sturgeon had increased growth rate with increased water temperature regardless of their genetic origins. However, based on modeling and water temperature data from 2008 to 2013, they also determined that there is an optimal water temperature range, above and below which juveniles experience a slower growth rate, and they further considered how changes in growth rate related to warming water temperatures associated with changing environmental conditions might affect juvenile survival given the season (e.g., spring or fall) in which spawning currently occurs.

There are no abundance estimates for the Gulf of Maine DPS or for the Kennebec River spawning population. Wippelhauser and Squiers (2015) reviewed the results of studies conducted in the Kennebec River System from 1977-2001. In total, 371 Atlantic sturgeon were captured, but the abundance of adult Atlantic sturgeon in the Kennebec spawning population could not be estimated because too few tagged fish were recaptured (i.e., 9 of 249 sturgeon).

Another method for assessing the number of spawning adults is through determinations of effective population size, which measures how many adults contributed to producing the next generation based on genetic determinations of parentage from the offspring. Effective population size is always less than the total abundance of a population because it is only a measure of parentage, and it is expected to be less than the total number of adults in a population because not all adults successfully reproduce. Measures of effective population size are also used to inform whether a population is at risk for loss of genetic diversity and inbreeding. The effective population size of the Gulf of Maine DPS was assessed in two studies based on sampling of adult Atlantic sturgeon captured in the Kennebec River in multiple years. The studies yielded very similar results which were an effective population size of: 63.4 (95% CI=47.3-91.1) (ASMFC 2017) and 67 (95% CI=52.0–89.1) (Waldman et al. 2019).

#### 3.3.4. Summary of the Gulf of the Status Maine DPS of Atlantic Sturgeon

Spawning for the Gulf of Maine DPS is known to occur in the Kennebec River and may occur in the Androscoggin. While suitable and accessible spawning habitat occurs in other river, including the Penobscot, spawning has not been documented in the Gulf of Maine DPS outside of the Kennebec River.

In the Gulf of Maine, Atlantic sturgeon are well distributed and use several large coastal rivers and estuaries including the Penobscot, Saco, and Merrimack. The Saco River supports a large aggregation of Atlantic sturgeon that forage on sand lance in Saco Bay and within the first few kilometers (km) of the Saco River, primarily from May through October. Detections of acoustically-tagged sturgeon indicate that both adult and subadult Atlantic sturgeon use the area for foraging and come back to the area year after year (Little, 2013; Novak et al., 2017). Some sturgeon also overwinter in Saco Bay (Hylton et al., 2018; Little, 2013) which suggests that the river provides important wintering habitat as well, particularly for subadults. However, there is no information to indicate that the Saco River supports a spawning population of Atlantic sturgeon. It remains questionable whether sturgeon larvae could survive in the Saco River even if spawning were to occur because of the presence of the Cataract Dam at rkm 10 of the river (Little, 2013) which limits access to the freshwater reach. Some sturgeon that spawn in the Kennebec have subsequently been detected foraging in the Saco River and Bay (Novak et al., 2017; Wippelhauser et al., 2017).

Some of the impacts from the threats that contributed to the decline of the Gulf of Maine DPS have been removed (e.g., directed fishing), or reduced as a result of improvements in water quality and removal of dams (e.g., the Edwards Dam on the Kennebec River in 1999). There are strict regulations on the use of fishing gear in Maine state waters that incidentally catch sturgeon. In addition, there have been reductions in fishing effort in state and federal waters, which most likely would result in a reduction in bycatch mortality of Atlantic sturgeon. A significant amount of fishing in the Gulf of Maine is conducted using trawl gear, which is known to have a much lower mortality rate for Atlantic sturgeon caught in the gear compared to sink gillnet gear (ASMFC, 2007). Atlantic sturgeon from the Gulf of Maine DPS are not commonly taken as bycatch in areas south of Chatham, Massachusetts, with only 8 percent (e.g., 7 of 84 fish) of interactions observed in the New York region being assigned to the Gulf of Maine DPS (Wirgin and King, 2011). Tagging results also indicate that Gulf of Maine DPS fish tend to remain within the waters of the Gulf of Maine and only occasionally venture to points south. However, data on Atlantic sturgeon incidentally caught in trawls and intertidal fish weirs fished in the Minas Basin area of the Bay of Fundy (Canada) indicate that approximately 35 percent originated from the Gulf of Maine DPS (Wirgin et al., 2012). Thus, a significant number of the GOM DPS fish appear to migrate north into Canadian waters where they may be subjected to a variety of threats including bycatch. Dadswell et al. (2016) describes characteristics of the seasonal aggregation of sturgeon in the Bay of Fundy. Dadswell et al. does not identify the natal origin of each of the 1,453 Atlantic sturgeon captured and sampled for their study. However, based on Wirgin et al. (2012) and Stewart et al. (2017), NMFS considers the results of Dadswell et al. as representative of the movement of the Gulf of Maine DPS of Atlantic sturgeon. Dadswell et al. determined subadult and adult Atlantic sturgeon occur seasonally (approximately May to September) in the Bay of Fundy for foraging, and many return in consecutive years. Fork length (FL) of the 1,453 sampled sturgeon ranged from 45.8 to 267 cm, but the majority (72.5 percent) were less than 150 cm FL. The age of the sturgeon (i.e., 4 to 54 years old) is also indicative of the two different life stages. Detailed seasonal movements of sturgeon to and from the Bay of Fundy are described in Beardsall et al. (2016).

As noted previously, studies have shown that in order to rebuild, Atlantic sturgeon can only sustain low levels of bycatch and other anthropogenic mortality (Boreman, 1997; Brown and Murphy, 2010; ASMFC, 2007; Kahnle et al., 2007). We have determined that the Gulf of Maine DPS is at risk of becoming endangered in the foreseeable future throughout all of its range (i.e., is a threatened species) based on the following: (1) significant declines in population sizes and the protracted period during which sturgeon populations have been depressed; (2) the limited amount of current spawning; and, (3) the impacts and threats that have and will continue to affect recovery.

The ASMFC concluded for the 2017 Stock Assessment that it could not estimate abundance of the Gulf of Maine DPS or otherwise quantify the trend in abundance because of the limited available information. However, the Stock Assessment was a comprehensive review of the available information, and used multiple methods and analyses to assess the status of the Gulf of Maine DPS and the coast wide stock of Atlantic sturgeon. For example, the Stock Assessment Subcommittee defined a benchmark, the mortality threshold, against which mortality for the coast wide stock of Atlantic sturgeon as well as for each DPS were compared to assess whether the current mortality experienced by the coast wide stock and each DPS is greater than what it can sustain. In the 2017 Stock Assessment, ASMFC concluded that abundance of the Gulf of Maine DPS is "depleted" relative to historical levels and there is a 51 percent probability that abundance of the Gulf of Maine DPS has increased since implementation of the 1998 fishing moratorium. The ASMFC also concluded that there is a relatively high likelihood (74 percent probability) that mortality for the Gulf of Maine DPS exceeds the mortality threshold used for the Stock Assessment (ASMFC 2017a); this was updated to 55.5% in the 2024 Update.

In 2018, we announced the initiation of a 5-year review for the Gulf of Maine DPS. We reviewed and considered new information for the Gulf of Maine DPS that has become available since this DPS was listed as threatened in February 2012. We completed the 5-year review for the Gulf of Maine DPS in February 2022. Based on the best scientific and commercial data available at the time of the review, we concluded that no change to the listing status is warranted.

### 3.3.5. Atlantic Sturgeon Recovery Goals

A Recovery Plan has not been completed for any DPS of Atlantic sturgeon. In 2018, NMFS published a Recovery Outline to serve as an initial recovery-planning document. In this, the recovery vision is stated, “subpopulations of all five Atlantic sturgeon DPSs must be present across the historical range. These subpopulations must be of sufficient size and genetic diversity to support successful reproduction and recovery from mortality events. The recruitment of juveniles to the sub-adult and adult life stages must also increase and that increased recruitment must be maintained over many years. Recovery of these DPSs will require conservation of the riverine and marine habitats used for spawning, development, foraging, and growth by abating threats to ensure a high probability of survival into the future." The Outline also includes steps that are expected to serve as an initial recovery action plan. These include protecting extant subpopulations and the species' habitat through reduction of threats; gathering information through research and monitoring on current distribution and abundance; and addressing vessel strikes in rivers, the effects of changing environmental conditions and bycatch.

### 3.3.6. Critical Habitat Designated for the GOM DPS of Atlantic Sturgeon

On August 17, 2017, we issued a final rule to designate critical habitat for the threatened Gulf of Maine DPS of Atlantic sturgeon, the endangered New York Bight DPS of Atlantic sturgeon, the endangered Chesapeake Bay DPS of Atlantic sturgeon, the endangered Carolina DPS of Atlantic sturgeon, and the endangered South Atlantic DPS of Atlantic sturgeon (82 FR 39160). The rule was effective on September 18, 2017. The action area overlaps with the Penobscot River critical habitat unit designated for the Gulf of Maine DPS.

The conservation objective identified in the final rule is to increase the abundance of each DPS by facilitating increased successful reproduction and recruitment to the marine environment. We designated five critical habitat units to achieve this objective for the Gulf of Maine DPS: (1) Penobscot River mainstem from the Milford Dam downstream for 53 river kilometers to where the mainstem river discharges at its mouth into Penobscot Bay; (2) Kennebec River mainstem from the Ticonic Falls/Lockwood Dam downstream for 103 river kilometers to where the mainstem river discharges at its mouth into the Atlantic Ocean; (3) Androscoggin River mainstem from the Brunswick Dam downstream for 10 river kilometers to where the mainstem river discharges at its mouth into Merrymeeting Bay; (4) Piscataqua River from its confluence with the Salmon Falls and Cocheco rivers downstream for 19 river kilometers to where the mainstem river discharges at its mouth into the Atlantic Ocean as well as the waters of the Cocheco River from its confluence with the Piscataqua River and upstream 5 river kilometers to the Cocheco Falls Dam, and waters of the Salmon Falls River from its confluence with the Piscataqua River and upstream 6 river kilometers to the Route 4 Dam; and, (5) Merrimack River from the Essex Dam (also known as the Lawrence Dam) downstream for 48 river kilometers to where the mainstem river discharges at its mouth into the Atlantic Ocean. In total, these designations encompass approximately 244 kilometers (152 miles) of aquatic habitat.

As identified in the final rule, the physical and biological features that are essential to the conservation of the species and that may require special management considerations or protection are:

- Hard bottom substrate (*e.g.,* rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (*i.e.,* 0.0 to 0.5 parts per thousand (ppt) range) for settlement of fertilized eggs, refuge, growth, and development of early life stages;
- Aquatic habitat with a gradual downstream salinity gradient of 0.5 up to as high as 30 ppt and soft substrate (*e.g.,* sand, mud) between the river mouth and

spawning sites for juvenile foraging and physiological development;
- Water of appropriate depth and absent physical barriers to passage (*e.g.,* locks, dams, thermal plumes, turbidity, sound, reservoirs, gear, etc.) between the river mouth and spawning sites necessary to support:
  - Unimpeded movement of adults to and from spawning sites;
  - Seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary; and
  - Staging, resting, or holding of subadults or spawning condition adults.
- Water depths in main river channels must also be deep enough (*e.g.,* at least 1.2 m) to ensure continuous flow in the main channel at all times when any sturgeon life stage would be in the river.
- Water, between the river mouth and spawning sites, especially in the bottom meter of the water column, with the temperature, salinity, and oxygen values that, combined, support:
  - Spawning;
  - Annual and interannual adult, subadult, larval, and juvenile survival; and
  - Larval, juvenile, and subadult growth, development, and recruitment (*e.g.,*13 °C to 26 °C for spawning habitat and no more than 30 °C for juvenile rearing habitat, and 6 milligrams per liter (mg/L) dissolved oxygen (DO) or greater for juvenile rearing habitat).

Additional information for the Gulf of Maine DPS is available in the the ESA Section 4(b)(2) Report for Atlantic sturgeon critical habitat (NMFS, 2017). That document provides background information on the current status and function of the four critical habitat units designated for the Gulf of Maine DPS, and summarizes their ability to support reproduction, survival, and juvenile development, and recruitment. Additional information on the status of the Gulf of Maine DPS relevant to the current status and function of critical habitat can be found in Section 4.5.

The action area considered in this Opinion covers a portion of the Penobscot River critical habitat unit. The critical habitat designation is bank-to-bank within the Penobscot River. The portion of the action area that overlaps with the Penobscot River critical habitat unit contains PBFs 1, 3, and 4; it does not contain PBF 2 because the salinity in the action area is less than 0.5 ppt. More information on the PBFs within the action area is contained in the Environmental Baseline section below (section 4.4).

# 4. ENVIRONMENTAL BASELINE

The environmental baseline "refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, 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 which are contemporaneous with the consultation in process. The impacts to listed species or designated critical habitat from Federal agency activities or existing Federal agency facilities that are not within the agency's discretion to modify are part of the environmental baseline." (50

CFR §402.02). "Early" consultation in this definition refers to "a process requested by a Federal agency on behalf of a prospective applicant under section 7(a)(3) of the Act" (50 CFR§§402.02, 402.11) which is governed by formalized procedures set forth in 50 CFR§402.11.

The environmental baseline therefore, includes the past and ongoing impacts of the presence and operation of the Milford Project. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline; as such, because this proposed action to authorize an amendment of the license (or otherwise approve operations consistent with the SPP considered herein) is not a proposal to relicense the project, the existence and operation of the dam and the resultant effects (e.g., barrier to passage, creation of the impoundment) are part of the environmental baseline for this consultation.

## 4.1. Status of Atlantic salmon and Critical Habitat within the Action Area

A summary of the status of the species rangewide and designated critical habitat in its entirety was presented above. This section will focus on the status of Atlantic salmon and designated critical habitat in the action area. Habitat upstream of the Milford Project supports natural production of Atlantic salmon as well as a stocking program. As such, all life stages of Atlantic salmon could occur in the action area. As 84% of modeled rearing habitat in the Penobscot River lies upstream of the Milford Project (Wright et al., 2008), the action area serves as an essential migratory corridor for Atlantic salmon moving to that habitat to spawn, and for juvenile and postspawn salmon migrating to the ocean. Below, we summarize the status of each lifestage within the action area.

### 4.1.1. Prespawn Adults

Adult Atlantic salmon returning to the Penobscot River each year are recorded at the Milford Dam fish lift, which began operation in 2014 following its construction and the removal of the Great Works and Veazie Dams in 2012 and 2013, respectively. Adult Atlantic salmon were previously recorded at the Veazie Dam fishway until it was removed in 2013. As described in section 3, the number of returning adult Atlantic salmon to the Penobscot River are substantially higher than all other GOM DPS salmon rivers. As indicated in section 3.2, over the last 10 years, the total number of prespawn Atlantic salmon returning to the Penobscot River ranged between 261 and 1,570 annually (Table 7); with an average return of 921 individuals (derived from data in USASAC (2024)). Of the prespawn adult salmon that return to the Penobscot Bay SHRU to spawn, approximately 11% (10-year average) are of naturally reared or wild origin (CMS, 2025).

Table 7. Adult Atlantic salmon returns by origin to the Penobscot River recorded from 1968 to 2024 (USASAC 2025).

| | HATCHERY ORIGIN | | | | NATURALLY REARED ORIGIN | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1SW | 2SW | 3SW | Repeat | 1SW | 2SW | 3SW | Repeat | Total |
| Penobscot | | | | | | | | | |
| 1968-2014 | 13,443 | 51,338 | 304 | 743 | 838 | 4,384 | 37 | 102 | **71,189** |
| 2015 | 110 | 552 | 7 | 1 | 9 | 52 | 0 | 0 | **731** |
| 2016 | 208 | 218 | 2 | 1 | 10 | 68 | 0 | 0 | **507** |
| 2017 | 301 | 451 | 9 | 0 | 9 | 79 | 0 | 0 | **849** |
| 2018 | 276 | 434 | 0 | 1 | 15 | 45 | 0 | 1 | **772** |
| 2019 | 288 | 738 | 2 | 0 | 7 | 161 | 0 | 0 | **1,196** |
| 2020 | 177 | 998 | 16 | 5 | 18 | 221 | 3 | 1 | **1,439** |
| 2021 | 194 | 270 | 5 | 1 | 13 | 73 | 2 | 3 | **561** |
| 2022 | 308 | 898 | 6 | 5 | 0 | 105 | 2 | 0 | **1,324** |
| 2023 | 95 | 1,356 | 5 | 1 | 2 | 109 | 2 | 0 | **1,570** |
| 2024 | 316 | 978 | 19 | 5 | 18 | 40 | 2 | 0 | **1,378** |
| Total for Penobscot | 15,716 | 58,231 | 48 | 763 | 939 | 5,337 | 48 | 48 | **81,516** |

At the Milford trap and sort facility, adult Atlantic salmon are trapped, and biological data (e.g., fork length, gender, injuries) and samples (scales and tissue) are collected before they are taken to the USFWS Craig Brook National Fish Hatchery (CBNFH) as broodstock or released upstream of Milford Dam to continue their migration up the Penobscot River toward spawning and rearing habitat (USASAC, 2017). The origin of these adult migrant salmon is classified as hatchery or naturally reared based upon the presence of external tags applied to hatchery smolts, fin condition, and growth patterns that are evident from scale analyses. More recently, origin assignment has also included genetic analyses. Hatchery origin is assigned to salmon that were stocked as smolts, while naturally reared origin includes salmon that have reproduced naturally (wild) or been stocked as eggs, fry or parr.

According to current broodstock management plans, a minimum of 600 multi-sea winter and 50 one-sea winter adult salmon are targeted for collection each year from the Penobscot River for transport to the federal salmon hatcheries in Maine (USASAC, 2023). Because of low returns and the goal of providing an equal ratio of male and female spawners for genetic health, as well as a proportion of one-sea-winter returns (grilse), the goal of 650 spawners is not always achieved. The actual number taken for broodstock varies considerably. Based on USASAC reports for 2015-2024, just under half (annual average: 48%; range: 15-90%) of returning salmon have been taken to CBNFH for use as broodstock (USASAC 2015-2024). As such, on average, 52% (range: 10-85%) of returning salmon are passed upstream of the project to swim freely to spawning habitat in the upper river (Figure 13). On average, 443 salmon a year are taken as broodstock to CBNFH, and 478 are passed upstream of the Milford Dam.

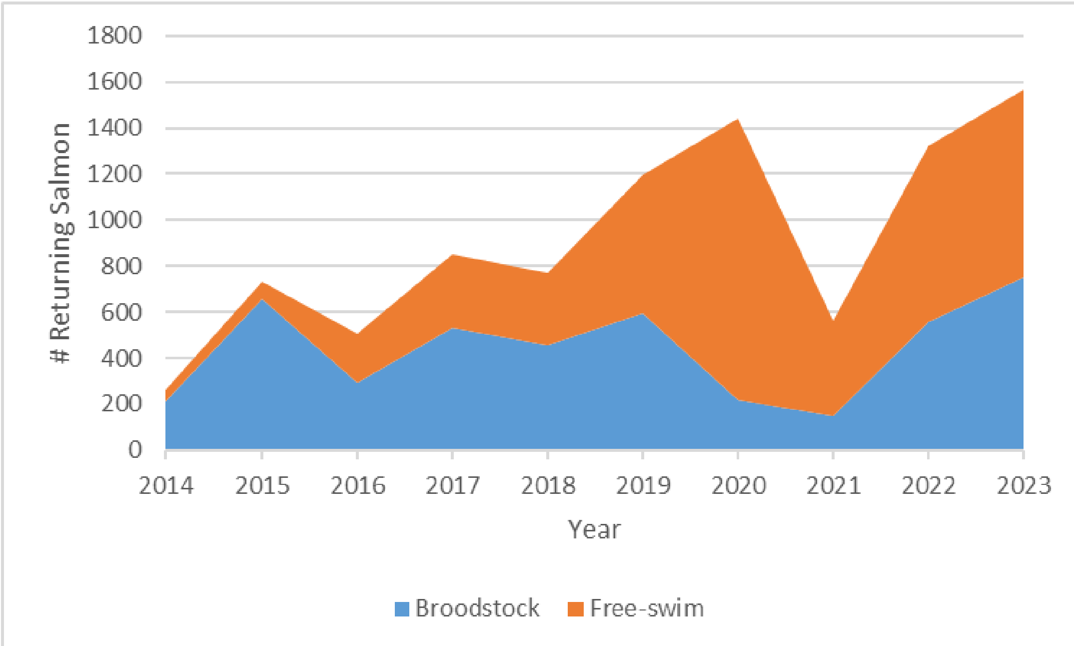

Figure 13. The total number of returning adult salmon to the Penobscot River captured at the Milford Project between 2014 and 2023, accounting for those that are taken for use as broodstock and those that are allowed to swim to the upper river (derived from USASAC 2015-2024).

#### 4.1.2. Smolts

The USFWS conservation hatchery program supports the Atlantic salmon recovery program by growing and releasing early life stages (egg, fry, parr, and smolts) of Atlantic salmon throughout the GOM DPS. The objective of this stocking is to maintain the existing salmon populations while increasing the proportion of wild or naturally reared adults returning to Maine rivers. As indicated in the Recovery Plan (2019) the program is "intended to provide demographic support and maintain genetic diversity appropriate for the purpose of recovering Atlantic salmon in the Gulf of Maine DPS." The Recovery Plan also notes that the hatcheries are "vital to preserving and stabilizing individual and composite genetic stocks until freshwater and marine conditions improve." Phase two of recovery (the current phase) "focuses on ensuring the persistence of the GOM DPS through the use of the conservation hatcheries while abating imminent threats to the continued existence of the DPS." Downlisting or delisting the DPS requires increasing abundance and addressing threats (i.e., the five listing factors outlined in the ESA). Therefore, the species cannot be recovered merely by increasing numbers through hatchery releases. The primary threats as outlined in the listing rule and the 2019 Recovery Plan are dams, road stream crossings, marine survival, and climate change (USFWS & NMFS, 2019). As none of the salmon runs are currently self-sustaining, the existing abundance and distribution of the species within the GOM DPS is driven by stocking.

In the Penobscot River, stocking over the last decade has consisted of egg (22%), fry (35%), parr (9%), and smolt (34%) stocking throughout the drainage (USASAC, 2025). On average, 1.7 million salmon (distributed across these lifestages) are stocked into the Penobscot watershed on an annual basis. The majority of the salmon run on the Penobscot is the result of stocked smolts and will likely remain as such for the foreseeable future. However, due to the stocking of early life stages (eggs, fry, parr) and the presence of prespawn salmon released upstream of Milford, we anticipate that some proportion of the smolts leaving the Penobscot would be considered naturally-reared. Based on NMFS' Penobscot River smolt trapping studies in 2000 - 2005, smolts migrate from the Penobscot between late April and early June with a peak in early May (Fay et al., 2006). Timing of smolt migrations may differ amongst rivers within the GOM DPS. Frechette et al. (2023) determined that the average duration of the smolt run over a 7-year period in the East Branch of the Penobscot and the Piscataquis River was 52 and 30 days, respectively; generally beginning around the middle of April and ending by the middle of June (Frechette et al., 2023).

In summary, Atlantic salmon return annually to the Penobscot River as a result of hatchery supplementation and natural spawning. Although some suitable habitat for all life functions exists in the accessible portions of the Penobscot River downriver of the Milford Dam (largely in the tributaries), we expect the action area to primarily serve as a migratory corridor for adult and juvenile salmon migrating to and from the abundant habitat upstream of the Milford Dam, primarily in the Piscataquis River and East Branch.

### 4.1.3. Critical Habitat in the Action Area

In 2009, NMFS designated critical habitat for the GOM DPS of Atlantic salmon (74 FR 29300; June 19, 2009). As defined in the ESA, critical habitat is "specific areas within the geographical area occupied by the species at the time of listing, on which are found those physical or biological features [PBFs] that are essential to the conservation of the listed species and that may require special management considerations or protection." As described in the critical habitat designation, the PBFs for Atlantic salmon include features of spawning and rearing and migration habitat (as described in Section 3.1.5). We have designated critical habitat for Atlantic salmon in the Penobscot River, including the entirety of the action area. The action area primarily functions as a migratory corridor for adult and juvenile salmon that are moving between the marine environment and spawning and rearing habitat in freshwater. There is spawning and rearing habitat in the action area, however. The status of this habitat is addressed below. Understanding the distribution, abundance, and suitability of those features in the Penobscot River as a whole is essential to understanding the importance of the PBFs in the action area; therefore, this information is presented below in order to establish the necessary context for considering the effects of the actions considered in this Opinion.

<u>PBFs for Spawning and Rearing Habitat</u>

Our approach to describing the status of the spawning and rearing PBFs in the action area has three parts. First, we identify whether the features are physically present within the action area. Then we determine whether the PBFs that are present have the potential to function within the action area. Lastly, we identify whether the necessary life stages of salmon actually have access to the PBFs. The last step is essential to understanding the conservation value of the habitat feature. For instance, although certain areas may have the physical features necessary to support spawning, if prespawn salmon cannot access it, it does not provide conservation value to the species. Table 3 describes the suitable range of various physical, chemical, and biological parameters that are necessary for the PBFs to be functioning. If outside of those ranges, the features are considered present but not functional. If the status of a feature is within the defined range, then it is considered functional. Functional habitat is differentiated into fully and limited functioning, based on the suitability of the habitat. For example, salmon parr can survive within a temperature range between 7°C and 22.5°C, but they feed and grow optimally when the temperature range is between 15°C and 19°C in the summer. In this example we would consider the 15°C to 19°C range to be fully functioning, whereas temperatures between 7°C to 15°C and 19°C to 22.5°C are in the limited function range. Below, we will make a determination for each PBF based on whether they are functioning and if they are, whether they are functioning at full or limited capacity. Once that has been established, we will determine whether the conservation value of the PBF is affected by accessibility. If the needed life stage has full access (no barriers), then accessibility will not affect the conservation value. Likewise, if there is a barrier that has a highly effective fishway then it would not affect the conservation value of the PBF. If, however, there is no, or limited, passage to the habitat then that would have a corresponding effect to the conservation value. For instance, if there is a dam without a fishway downstream of the habitat then the PBF could have the potential to function but would have low conservation value. Similarly, a dam with a marginally effective fishway would only allow the PBF to function with moderate conservation value. These accessibility functional categories are consistent with what is incorporated into the 2019 Final Recovery Plan for Atlantic salmon and, therefore, with the habitat recovery criteria.

Within the action area of this consultation, the PBFs of Atlantic salmon critical habitat include freshwater sites for spawning, rearing, and migration. However, the action area primarily serves as a migration corridor for upstream migrating adult salmon and downstream migrating post-spawned salmon and smolts. Significant areas of spawning and rearing habitat have been field-mapped upstream of the action area by the MDMR, predominantly in the Piscataquis River, East Branch of the Penobscot River, and the Mattawamkeag River. Based on a GIS-based Atlantic salmon habitat prediction model developed by the USFWS (Wright et al., 2008), there are approximately 51,791 units of rearing habitat upstream of the Mattaceunk Project. As such, salmon moving to and from that habitat must travel through the action area for this consultation.

PBFs for Spawning (SR1-SR3)

*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 (SR1).*

*Freshwater 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 (SR2), as well as to support emergence, territorial development, and feeding activities of Atlantic salmon fry (SR3).*

Maine DMR conducted spawning and rearing habitat surveys between 1985 and 2009 throughout much of the Penobscot River basin, including within the watersheds that have been designated as critical habitat[13]. In the action area, Maine DMR documented 54 habitat units of spawning

[13] Maine Department of Marine Resources. 2017. Atlantic salmon Habitat (ASHAB). Updated March 17, 2021. Accessed through Maine Office of GIS Data Catalog:

habitat, located around French Island (Figure 14). An additional six habitat units have been identified in Great Works Stream, a tributary to the mainstem roughly two miles downstream of the dam. In the Penobscot River, Maine DMR documented 475 habitat units of spawning habitat in the tributaries downstream of Milford (i.e., Kenduskeag Stream, Souadabscook Stream, and Marsh Stream), and approximately 2,500 habitat units in the major tributaries upstream of Milford (i.e., Piscataquis River, East Branch of the Penobscot River, and the Mattawamkeag River). No redds have been documented in the mapped spawning habitat in the action area during surveys conducted by MDMR, although some have been documented near the confluence with Great Works Stream, as well as in Great Works Stream itself. Although the habitat in the action area is likely not frequently used due to habitat limitations not considered in the survey (e.g., temperature), the documentation of redds in mapped spawning habitat further downstream suggests that the mainstem habitat could potentially be used for spawning.

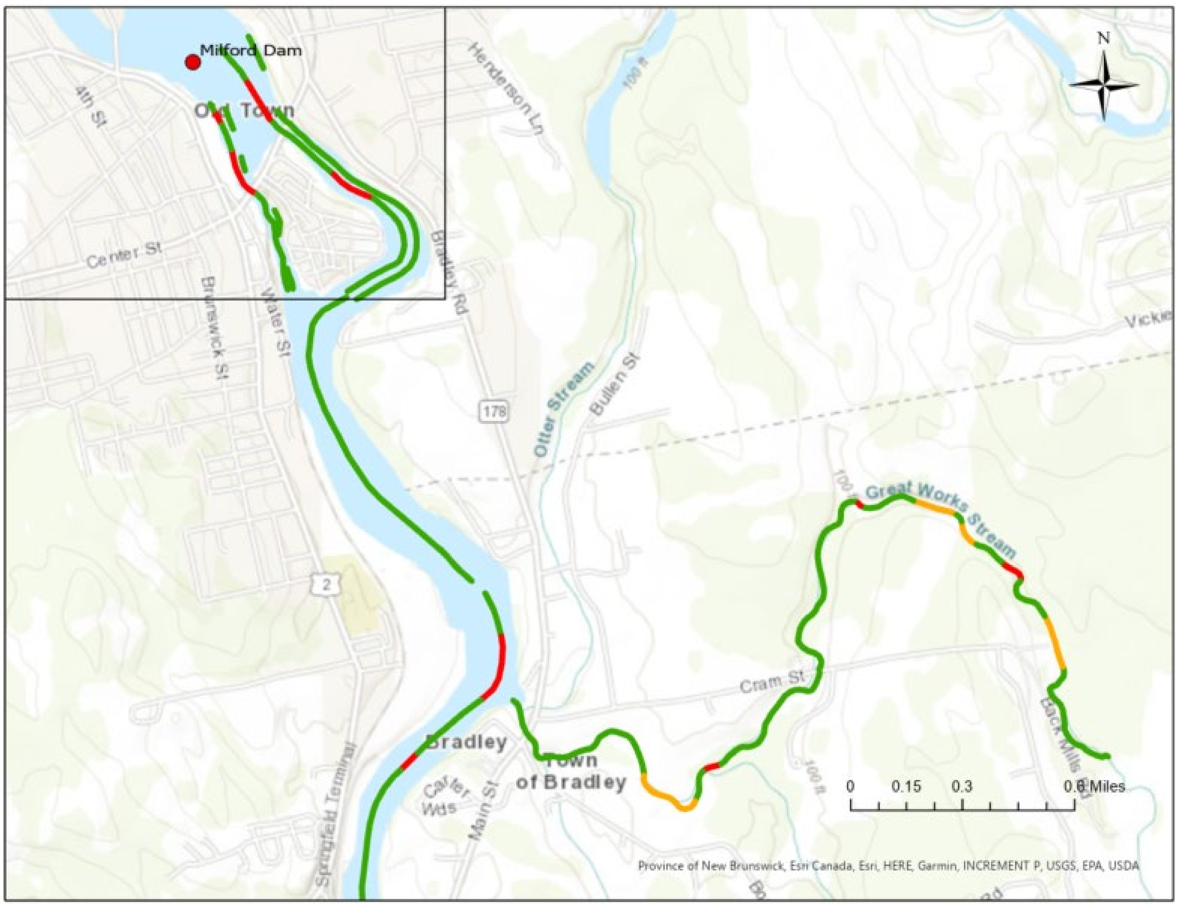


Figure 14. MDMR field surveyed spawning and rearing habitat in the vicinity of the Milford Project (ASHAB3). Red indicates spawning habitat; orange indicates limited spawning habitat; and green indicates rearing habitat. The box in the upper left corner signifies the approximate extent of the action area as defined.

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https://maine.hub.arcgis.com/datasets/1cd03b001cec43e1b33b87f7af3063e8/explore?location=45.232742%2C-69.119381%2C7.38

In the analysis below, we determine that although the PBFs SR 1 - 3 are present in the mainstem habitat in the action area, they only function at a limited capacity due to elevated temperatures, excessive depths, and the presence of abundant nonnative species that prey on juvenile salmon.

All adult salmon that enter the Penobscot River have access to the spawning habitat in the action area downstream of the Project. As the PBFs for spawning are present and have the potential to function at a limited capacity, and as the necessary life stage has access, we anticipate that the PBFs in the action area have moderate conservation value.

PBFs for Rearing (SR4-SR7)

*Freshwater rearing sites with the space (SR4), habitat diversity (SR5), cool water (SR6), and diverse food resources (SR7) necessary to support growth and survival of Atlantic salmon parr.*

Modeling conducted by Wright et al. (2008) indicates that salmon rearing habitat exists in the mainstem of the Penobscot, as well as in its tributaries. In section 3.5, we estimate that approximately two-thirds of the habitat units within the Penobscot Bay SHRU are within the designated critical habitat for Atlantic salmon (i.e., 227,062 units in CH/359,333 total units in SHRU = 63%). As described in section 3.1.7, of the approximately 129,000 class 1 habitat units in the critical habitat within the Penobscot Bay SHRU, 84% occur in the upper river (upstream of Milford). The mainstem habitat within the action area contains approximately 3,200 modeled habitat units[14]; three quarters of which are located in the project impoundment. The habitat within the action area is 100% class 3, which is expected for mainstem habitats that do not generally support the conditions necessary for rearing (Table 3). This is addressed in more detail below.

As the model inputs do not include the parameters listed in Table 3, nor does it consider the impounding and tailwater effects of the dam; its identification of the habitat in the action area as rearing habitat does not by itself indicate that it is functional. However, it is a useful screening tool for identifying areas that are likely to support the PBFs. Although we don't have specific information regarding the rearing PBFs in the action area, we can make reasonable assumptions based on what we know about mainstem habitats generally. Mainstem habitats tend to have warmer temperatures (SR 6), deeper water (SR 4), and lower habitat diversity (SR 5) than what would be observed in smaller streams, which would tend to be cool and shallow, with greater habitat complexity. Although some rearing occurs in mainstem habitat, Atlantic salmon tend to use large riverine habitats primarily as migratory corridors to access lower order tributaries that can provide suitable spawning and rearing habitat. This differential use of river and stream habitat for salmon migration and spawning/rearing is reflected in the model's classification of the action area (class 3). As such, we would not expect that the PBFs for rearing habitat would be fully functioning given the habitat that we have identified as occurring in the action area.

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[14] The modeled line segment from the model (Wright et al., 2008) is much longer than the actual action area as defined. Therefore, to estimate the modeled habitat for just the action area, we used the habitat width and habitat proportion from the model output, and measured the habitat length within the action area using the 'Measure' tool within ESRI's ArcGIS Pro 3.30. The estimate of rearing habitat was made by multiplying the width by the length by the modeled proportion of habitat anticipated to be suitable.

Below, we describe in greater detail how the parameters identified in Table 3 limit the functioning of the PBFs in the action area.

Temperature Effects to Spawning and Rearing PBFs

Cool water temperatures are important for Atlantic salmon, and are critical to several of the PBFs, including those for spawning and embryo/fry development (SR 1-3) and for parr development (SR 6). According to Stanley and Trial (Stanley & Trial, 1995), Atlantic salmon parr grow best between 13°C and 19°C (Dwyer & Piper, 1987), and can tolerate temperatures up to 27°C for short periods (DeCola, 1970). However, they cease feeding at 22.5°C and will die if exposed to temperatures exceeding 27.8°C for seven days (Elliott, 1991). Elliot (1991) further determined that temperature tolerance increased by approximately two degrees (~29.5°C), if parr were only exposed to warmer temperatures for 16 hours or less. Embryo development occurs around 6°C, but temperatures above 12°C will cause direct mortality, and above 8°C may cause secondary mortality due to fungal infections (Garside, 1973). Spawning can occur between 7°C and 10°C, with the optimal temperature for fertilization around 6°C. Consistent with PBF SR1, adult salmon need deep, oxygenated pools and cover (e.g., boulders, woody debris, vegetation, etc.) to rest and wait for conditions to be right for spawning. Atlantic salmon become stressed when water temperatures exceed 20°C, and may die if temperatures approach or exceed 25°C (Breau, 2013). Decola (1970) determined that Atlantic salmon can survive exposure to temperatures of 24 to 27°C if that exposure is for short periods (i.e., less than 7 days). In section 3 (Table 3), we identified the temperature thresholds that allow for functional rearing and spawning habitat. In Table 8, we have further broken down these thresholds to indicate what temperatures are necessary to allow for full versus limited functioning of the habitat.

Table 8. Temperature thresholds for functioning of the rearing and spawning PBFs.

| Stage | Time of Year | Full Function | Limited Function |
|---|---|---|---|
| Adult spawning (SR2) | October to December | Always < 10°C | Often < 10°C |
| Adult migration/holding (SR1, M 1, and M2) | May to December | <20°C | 20°C - 23°C |
| Embryo/Fry Development (SR3) | October to April | Averages ~6°C (0.5°C to 7.2°C) | Averages <4°C, or ranges between 8°C and 10°C |

| | | | |
|---|---|---|---|
| Parr Development (SR 6) | All Year | 15°C -19°C during the summer | 7°C - 22.5°C |

Seasonally, the mainstem of the Penobscot warms considerably, especially in the summer months. A temperature logger that is maintained by Maine DMR was located at the Milford fish trap during the fish passage season (April – November) between 2014 and 2023, excluding 2016 (EcoSheds)[15]. Below, we use the information from this logger to determine the functional status of the relevant PBFs in the action area in relation to temperature.

During the period relevant for adult spawning (SR 2), the average monthly temperature in the action area in October and November is approximately 12.8°C (standard deviation (sd): 2.9°C) and 6.9°C (sd:2.3°C), respectively. The temperature logger in the fish trap only logs from mid-April to mid-November, so the dataset does not include river temperature from the month of December where spawning may still be occurring. That said, we would anticipate that the temperature in December is lower than what is observed in the month of November. In a normally distributed dataset, we have the ability to estimate the proportion of time that a given value is exceeded based on how far away it is from the mean ((Zar, 1996), Chapter 6.2).[16] As such, assuming the 2014-2023 temperature dataset is normally distributed, we have calculated that the temperature was within the functional range (< 10°C) for spawning 17%, 91%, and 100% (assumed) of the time in the months of October, November, and December, respectively. As the temperature in the action area is generally within the appropriate range to support spawning, and as spawning was documented at least once in 1986, we consider PBF SR 2 to be functional in those months.

Fully functioning migratory habitat for adult salmon (PBF SR 1, M 1, and M 2) requires that the temperature be below 20°C. Above 20°C, salmon are physiologically stressed and may seek cooler water in which to hold until temperatures come back down. Adult salmon may die if temperatures approach or exceed 24°C for an extended amount of time (Breau, 2013). Decola (1970) determined that Atlantic salmon can survive exposure to temperatures of 24 to 27°C if that exposure is for short periods (i.e., less than 7 days). To ascertain the amount of time that the action area is above the stress (20°C) and lethal (24°C) thresholds for adult Atlantic salmon, we can consider the distribution of the nine-year temperature dataset (2014-2023, excluding 2016). We have conducted an analysis on the available temperature data to estimate the amount of time in the warm summer months (June – September) that we would expect the stress and mortality threshold values to be exceeded (Table 9).

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[15] SHEDS. Stream Temperature Database. Public Data Viewer. http://db.ecosheds.org/viewer (accessed on 9/10/2025). 2014-2023 temperature data from a station in the Penobscot River (1MAINST62.28) maintained by the Maine DMR. Dataset was edited to remove anomalous data (e.g., records indicating temperatures of zero degrees in the months of June and August).

[16] To estimate the probability of exceedance for a normally distributed dataset, we calculate the mean and standard deviation of the population, and then subtract the mean from the value of interest (in this case, the threshold temperature). We then divide by the standard deviation (SD). The result is the number of SDs away from the mean that particular value is (i.e., z-score). We can then compare the z-score to a table of normal curve probabilities to determine the proportion of values that exceed the temperature threshold (Table B.2; Zar, 1996).

Table 9. Summary of nine years (2014-2023; excluding 2016) of temperature information derived from data collected at a temperature logger (1MAINST62.28) maintained by the Maine DMR at the Milford fish trap. Assuming a normal distribution, we have estimated the proportion of time that the stress and mortality thresholds are exceeded for Atlantic salmon adults.

| | | | | Thresholds exceeded (% of month) | |
|---|---|---|---|---|---|
| Month | Average | Minimum | Maximum | Stress (>20°C) | Mortality (>24°C) |
| June | 19.8 | 14.0 | 27.7 | 46% | 4% |
| July | 24.3 | 18.6 | 28.6 | 100% | 56% |
| August | 23.0 | 8.9 | 31.5 | 86% | 36% |
| September | 19.7 | 13.8 | 25.6 | 46% | 5% |

Our analysis indicates that in the months of June, July, August, and September, the temperature exceeds the stress threshold (>20°C) for adult salmon, on average, between 46% (~14 days) and 100% (~30-31 days) of the time during these months. Similarly, the temperature is in excess of the mortality threshold (>24°C) for adult salmon, on average, between 4% (~ 1 out of 30 days) and 56% (~17 out of 30 days) of the time during these months. July and August are clearly the warmest months, with the average temperatures approaching or exceeding the mortality threshold. Given the significant proportion of time when the temperature is above the stress and mortality thresholds, we do not consider PBF SR1, M 1, and M2 to be functioning in the action area in the months of July and August. Even though the river is cooler in the months of June and September, temperatures still exceed the stress threshold a significant amount of time. As such, we consider these PBFs to function at a limited capacity in those months.

For the habitat in the action area to function for parr development (PBF SR 6), the temperature needs to stay between 7°C and 22.5°C throughout the year. As indicated above, smolts have been documented ceasing feeding behavior when temperature exceeds 22.5°C, and that they can be killed if they are exposed to temperatures in excess of 27.8°C for an extended amount of time (i.e., seven days), or to temperatures in excess of 29.5°C for as little as one day (16 hours) (Elliot, 1991). Using the information provided by the temperature logger at the fish trap at the Milford Project, we have estimated the proportion of time during each of the warm summer months that these temperatures would be expected to be exceeded (Table 10).

Table 10. Estimate of the proportion of time during each month where the temperature thresholds for salmon parr would be exceeded. Based on nine years of temperature data recorded at the Milford fish trap between 2014 and 2023 (2016 excluded).

| | Thresholds exceeded (% of month) | | |
|---|---|---|---|
| Month | Cessation of Feeding (>22.5°C) | Mortality (>27.8°C; 7 day threshold) | Mortality (>29.5°C; 1 day threshold) |
| June | 12% | 0% | 0% |
| July | 86% | 2% | 0% |
| August | 57% | 4% | 1% |
| September | 14% | 0% | 0% |

The average water temperature in the mainstem of the Penobscot within the action area exceeds 22.5°C in the months of July and August and, given the analysis in Table 10, we expect that the temperature could exceed the threshold in any of the four months. Maximum water temperatures recorded during the nine-year period exceed that feeding threshold in June, July, August, and September, and exceed the 27.8°C seven-day threshold for mortality in the months of July, and August. However, as indicated, that temperature would need to be exceeded for seven days to be lethal. Based on the data from the temperature logger, we would expect the temperature threshold to be exceeded only 2% and 4% of the time in July and August, respectively; which equates to approximately only one day. Similarly, the one-day threshold for mortality (29.5%) is only expected to occur 1% (approximately 0.3 days) of the time in the month of August. As neither of the mortality thresholds are expected to be exceeded for a sufficient period, we do not anticipate that the lethal temperature threshold for salmon parr is exceeded in the action area. Although we do not anticipate that temperatures are lethal, the threshold for feeding (22.5°C) is exceeded during the summer months, as described above. During these periods, the PBF is not functioning. As we expect that the temperature will not be sustained at that level, and as parr are mobile and are able to move to cold water areas during the summer (McCormick et al., 1998), it is possible that the habitat may still function at a limited capacity as long as long as the threshold is not exceeded regularly. Given the information provided above, we would anticipate that the SR 6 is not functioning in the months of July and August since parr feeding would be substantially limited; but that may function at a limited capacity in the months of June and September. During warm periods, parr would need to move to groundwater discharge areas in the mainstem, or potentially to cool water tributaries outside of the action area.

In addition to temperature, there are other parameters that define the functionality of the rearing habitat in the action area. To be functional, habitat must be of sufficient depth to support juvenile development. As the action area is comprised of mainstem riverine habitat, very little of it would be sufficiently shallow to support rearing even absent the dams. As indicated in Table 3, functional rearing habitat for salmon should be less than 30 cm (1 ft) deep. Given the depth of the mainstem, which is increased by the impoundment upstream of the dam, we expect habitat in this depth range to primarily occur in the areas along the river banks. Using the rearing habitat model (Wright et al., 2008) we estimate that that there are approximately 3,000 habitat units of class 3 rearing habitat in the mainstem habitat that comprises the action area[17]. Water depth was not a model input (nor is water temperature), however, so despite its categorization in the model it is likely that much of this habitat would fall outside of the functional range as well. As such, we anticipate that most of the action area is not functioning as rearing habitat due to depth, but that there may be isolated shallow areas (mostly along the banks) where it may function at a limited capacity.

In addition to abiotic features, functional spawning and rearing habitat must host abundant native fish species, and few nonnative species. Nonnative fish, some of which prey on juvenile Atlantic salmon, are abundant in the action area. Both smallmouth and chain pickerel occur throughout the action area (Mensinger et al., 2025), and Northern pike have been observed passing through the Milford fish lift in small numbers (i.e., 12 pike passed between 2014 and 2025; J. Valliere,

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[17] Estimated by multiplying the estimated bankfull width contained within the model results by the length of the reach in the action area and then multiplied the result by the proportion of the reach that is considered suitable for rearing by the model (i.e., 190 meter width x 1500 meter length x 0.26 = 2850 Hus).

Maine DMR, personal communication, 2025). These species are voracious predators of juvenile Atlantic salmon. Given the high abundance of nonnative species, and the lack of fully accessible passage for native sea-run species in the action area, this feature is functioning at a limited capacity.

In summary, although certain PBFs for rearing may function at a limited capacity at times in certain parts of the action area, the combined status of the features as described above would suggest that the area does not function as rearing habitat. The functioning of the habitat is negatively affected by depth, high temperatures, reduced abundance of native fish species, an abundance of nonnative predators, as well as the impounding of much of the action area by the Milford Project.

PBFs for Migration

The conservation value of the habitat in the action area is to function as a migratory corridor for adults attempting to access spawning habitat in the upper Penobscot River and for smolts emigrating from upstream habitat to the Atlantic Ocean. The presence of the dam in the lower River substantially alters the function of several PBFs for migration habitat in the action area.

*PBF M 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.*

For this PBF to function fully, any barriers to passage (dams and road-stream crossings) must allow for the safe, timely, and effective upstream passage of adult Atlantic salmon. The Milford dam delays and prevents full access of adult salmon moving to spawning grounds. The dam currently limits access of adult salmon to upstream spawning habitat. As such, PBF M 1 is functioning at a limited capacity.

*PBF M 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.*

As a large river with diverse habitat, river form, and flow patterns, the Penobscot River generally provides PBF M 2 function for Atlantic salmon. As summer temperatures in the action area frequently exceed the stress threshold (20°C), the action area likely does not provide cold water refuge for migrating prespawn adults. Although cool water habitat may be available in downstream tributaries (such as Great Works Stream), the conditions in the mainstem likely mean that this PBF functions at a limited capacity in the action area. As described above, we anticipate that PBF M 2 does not function in the action area in the month of July and August, and functions at a limited capacity in the months of June and September.

*PBF M 3: Freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation.*

Of particular relevance to PBF M 3 is the abundance and distribution of native alosine fish (i.e., alewife, blueback herring, and American shad). The presence or absence of these species likely play important roles in mitigating the magnitude of predation on Atlantic salmon smolts and adults from predators such as striped bass, double-crested cormorants, harbor seals, and gray seals. The migration time of prespawn adult alewives overlaps in time and space with the migration of Atlantic salmon smolts (Saunders et al., 2006). This overlap is mostly limited to the lower river and estuary, downstream of the action area, when outmigrating salmon smolts overlap in time and space with upstream migrating river herring and American shad, as well as abundant predators, such as harbor seals, gray seals, and striped bass. This critical area does not occur within the action area but the abundance of alosines is affected by productivity upstream of the dams on the Penobscot River and, therefore, is limited by passage survival and effectiveness at those projects. Table 5-13 of the BA indicates that both American shad and river herring have progressively increased over the last decade; with shad numbers increasing from approximately 1,800 in 2015 to a peak of approximately 11,500 in both 2021 and 2022; and river herring numbers increasing from 590,000 in 2015 to a peak of approximately 5.5 million in 2023; nearly a ten-fold increase. Brookfield fish counts at the lift in 2025 suggest that returns have increased even further to nearly 6 million herring. Although the Penobscot contains one of the largest alewife runs in the country, we anticipate that passage inefficiencies at the Milford Project continue to limit the run size. As such, the action area functions at a limited capacity as a migratory corridor for river herring and American shad in the months of May and June.

*PBF M 4: Freshwater and estuary migration sites free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment.*

For this PBF to function fully, any barriers to passage (dams and road-stream crossings) must allow for the safe, timely, and effective downstream passage of Atlantic salmon smolts. As described in section 4.4.1 below, the Milford Project directly (passage mortality primarily due to turbine entrainment) and indirectly (mortality due to elevated predation in the impoundment; hydrosystem delayed mortality) kills Atlantic salmon smolts in the action area as they migrate to the marine environment. The dam also delays the arrival of smolts to the estuary that successfully migrate past. Thus, PBF M 4 functions at a limited capacity in the action area.

*PBF M 5: Freshwater and estuary migration sites with sufficiently cool water temperatures and water flows that coincide with diurnal cues to stimulate smolt migration.*

PBF M 5 is fully functional in the action area; the action area has sufficiently cool water during the spring and water flows that coincide with diurnal cues to stimulate smolt migration. Operating the Milford Project in run-of-river mode provides nearly natural flows and prevents rapidly fluctuating water levels from occurring downstream of the project, which prevents stranding of migrating Atlantic salmon smolts or dewatering of habitat downstream the project. During spring months, high flows and low water temperatures in the action area are protective of the features of M 5. Operation of the Milford Project does not appear to have any effects on water temperatures during the spring migration season of smolts. Also, run-of-river operations mimic a natural hydrograph which allows for stimulation of smolt migration.

*PBF M 6: Freshwater migration sites with water chemistry needed to support seawater adaptation of smolts*

PBF M 6 in the action area is fully functional; the action area has the water chemistry needed to support sea water adaptation of smolts. During spring months when smolts are present in the action area, water quality in the action area is protective of the features of M 6.

To summarize, in this analysis we have indicated that the PBFs in the action area (SR 1 - 7; M 1 - 6) are present in the action area and most have the potential to function at a full or limited capacity. We have determined that the spawning PBFs (SR 1-3) have the potential to function at a limited capacity due to elevated temperatures, excessive depths, and the presence of abundant nonnative species that prey on juvenile salmon. We have determined that although the individual rearing PBFs (SR 4-7) may function at times in certain parts of the action area, the combined status of the features suggest that the action area does not function as rearing habitat. We have further determined that the migratory features (M 1 – M 4) function at a limited capacity due to the elevated temperatures and passage inefficiencies at the Milford Project. Finally, we have determined that water quality measures (M 5 and M 6) are fully functional in the action area. Adult and juvenile Atlantic salmon have full access to habitat downstream of the Milford Project, and limited access to habitat upstream of the Project due to passage inefficiencies. As such, the past and ongoing operations of the projects have degraded the conservation value of the PBFs M1-M4 to migrating salmon in the action area.

## 4.2. Status of Shortnose Sturgeon in the Action Area

In the 1998 Recovery Plan, NMFS recognized 19 populations of shortnose sturgeon occurring along the Atlantic coast, including the one in the Penobscot River (NMFS 1998). This determination was largely based on historic fishery and archaeological records. At the time of the publication of the Final Recovery Plan for Shortnose Sturgeon in 1998, the most recent capture of a shortnose sturgeon from the Penobscot River was in 1978. A University of Maine/USGS study carried out in 2006-2007, captured 151 shortnose sturgeon in the Penobscot River and demonstrated movement in and out of the river, primarily between the Penobscot and Kennebec (Fernandes et al. 2010). Since that time, extensive studies of the use of the Penobscot by shortnose sturgeon have been undertaken. However, despite access to suitable spawning habitat, to date, no adults in spawning condition, juveniles, or early life stages have been documented and at this time the Penobscot is not thought to support a spawning population of shortnose sturgeon.

Shortnose sturgeon are present in the lower Penobscot River, and with the removal of the two lower-most dams, Great Works (2012) and Veazie (2013), sturgeon are able to access 100 percent of their historic habitat in the Penobscot River, which extends upstream to Milford Dam. Based on recent research using recaptures of tagged fish, the shortnose sturgeon abundance in the lower Penobscot was estimated to be modest in size, ranging from several hundred to a few thousand individuals (Fernandes 2008). Telemetry studies indicate that while shortnose sturgeon are present in the river and estuary throughout the year, their movements vary seasonally in response to food availability, dynamic habitat parameters such as water temperature and flow, or life history requirements. From mid-October to mid-April, most tagged shortnose sturgeon concentrate in a relatively small section of river in the Bangor area. Following this overwintering period, they move downstream into the estuary, until returning upstream in summer during low flows. Tagged fish were detected 2 km (1.2 miles) below the Veazie Dam (now removed) by August. At the end of summer, shortnose sturgeon moved downstream to the location of the overwintering site in the Bangor area (Fernandes 2008, Zydlewski 2009a).

Outside of the spring spawning movements, shortnose sturgeon typically occur over soft substrates consisting of mud, silt, or sand and commonly in deeper channels or over tidal mud flats (NMFS 1998). Such habitat is extensive in the Penobscot River from the estuary upstream to the area around Bangor and Brewer (Fernandes 2008, Zydlewski 2009a, Zydlewski 2009b). Some of this soft sediment consists of bark, sawdust, or wood chips, which were deposited as a result of log-driving and operation of sawmills and pulp and paper operations on the river. These soft sediment areas were found to be used by shortnose sturgeon throughout the year in recent University of Maine studies (Fernandes 2008).

Moving upstream from the Bangor area into reaches that were formerly impounded by the Bangor Dam upstream to the Veazie Dam, the riverbed gradient increases, and the bottom substrates consist of ledge, boulders, cobble, and rubble (Penobscot River Restoration Trust 2008). Optimal shortnose sturgeon spawning habitats are in freshwater, but usually within areas of tidal influence, in deep water where the predominate substrate type is a combination of gravel, rubble, and cobble, and where water velocities are between 30 and 76 cm/s (Crance 1986). Bathymetric surveys showed deep water and negligible amounts of silt, sand, or other fine sediments in the 2.5-km reach downstream of the Veazie Dam. Spawning by shortnose sturgeon is likely in this reach, assuming that spring flows provide adequate water velocity. Tracked sturgeon were found within 2 km of the Veazie Dam. Additional modeling by researchers at the University of Maine showed that spawning habitat suitability (based on data on substrate and water velocity during predicted spawning periods) was also high downstream in the vicinity of the former Bangor Dam (Zydlewski 2009b). Given the cobble/boulder substrate conditions and relatively high-water velocities in the main stem between the Milford and Orono dams, it is possible that sturgeon will find suitable spawning habitat conditions in this area following the fairly recent removals of the Veazie and Great Works dams. However, sturgeon may not choose to migrate that far, since these areas are much further upstream than typical shortnose sturgeon spawning habitats and disjunct from the optimal juvenile and adult habitats in the tidal portions of the Penobscot River. Indeed, additional research on shortnose sturgeon movements demonstrate that the majority of tagged shortnose sturgeon emigrated from the Penobscot River and were found on spawning grounds in the Kennebec complex during spring (Johnson 2016). Results were similar between pre- and post-removal of the Veazie and Great Works dams. Based upon this information, it is expected that adult shortnose sturgeon could occur in the action area, likely originating from the Kennebec River. Since 2016, seven shortnose sturgeon have been captured at the Milford fish lift and relocated back downstream in accordance with the Milford Sturgeon Handling Plan, the last one being in May of 2021. A sturgeon was also observed in the fish lift in June of 2024 that was similar in size to previous shortnose sturgeon captures at Milford; however, since it was not handled, a final determination as to species could not be made. Based on the best available information, while suitable spawning habitat exists in the Penobscot River below Milford, no shortnose sturgeon spawning has been documented in the Penobscot River and no early life stages, or young of year sturgeon have been captured. As such, no spawning adults, early life stages, or juvenile shortnose sturgeon are expected to occur in the action area and presence is limited to adults.

## 4.3. Status of Atlantic Sturgeon in the Action Area

Comprehensive information on current or historic abundance of Atlantic sturgeon is lacking for most Maine river systems. Although some sampling has been directed at sturgeon species, data are largely available from studies directed at other species and provide evidence primarily of presence or absence.

The geomorphology of most small coastal rivers in Maine is not sufficient to support Atlantic sturgeon spawning populations, except for the Penobscot and the estuarial complex of the Kennebec, Androscoggin, and Sheepscot Rivers. During the summer months, the salt wedge intrudes almost to the site of impassable falls in these systems: St. Croix River (river kilometer [rkm] 16), Machias River (rkm 10), and the Saco River (rkm 10). Although surveys have not been conducted to document Atlantic sturgeon presence, subadults may use the estuaries of these smaller coastal drainages during the summer months.

The ASSRT (2007) reports on two relatively recent surveys conducted to document the presence of shortnose and Atlantic sturgeon in the Penobscot River.

The MDMR conducted a limited sampling effort in 1994 and 1995 to assess whether shortnose sturgeon were present in the Penobscot River. The MDMR made 55 sets of 90-m experimental gill nets for a total fishing effort of 409 net hrs (1 net hr = 100 yds fished for 1 hr). The majority of the fishing effort in the Penobscot River was in the upper estuary near head-of-tide. No shortnose or Atlantic sturgeon were captured. The sampling was determined to be inadequate to assess the presence of adult Atlantic sturgeon, because the mesh sizes would have been selective only for subadult Atlantic sturgeon that are commonly found in the lower estuary of larger river systems. In 2006, a similar gill net survey was implemented in the lower river using both 15 cm and 30 cm stretched mesh sinking gill nets. As of January 2007, sixty-two shortnose and seven Atlantic sturgeon were captured in 1,004 net hours. One of these Atlantic sturgeon, captured in July, may have been an adult based on its size (145 cm total length) and time of capture. Thus, it is probable that a small population of Atlantic sturgeon exists in the Penobscot River. This speculation is supported by archeological evidence that sturgeon were present, occasional observations by anglers, and at least one capture of an adult Atlantic sturgeon by a recreational fisherman (Bangor Daily News 2005).

Additional research on the presence and migratory behavior of Atlantic sturgeon has been conducted in association with the Penobscot River Restoration Program and removal of the two lowermost dams on the Penobscot River. A review of existing data from compiled gill net surveys and telemetry studies indicate that Atlantic sturgeon were rarely seen in the freshwater reach of the Penobscot River during the expected spawning period, but they were detected in the nearby Kennebec River system. This suggests that Atlantic sturgeon were likely not moving into the Penobscot River for spawning, but they use the lower river estuary for foraging (Altenritter et al. 2017). Altenritter et al. (2017) identified a 5-km reach of the mesohaline portion of the Penobscot River estuary where Atlantic sturgeon congregated year after year, with the majority of collected sturgeon assessed as subadults.

Based on the best available information, while suitable spawning habitat exists in the Penobscot River below Milford, no Atlantic sturgeon spawning has been documented in the Penobscot River and no early life stages, or young of year sturgeon have been captured. As such, only subadult and adult Atlantic sturgeon are expected in the action area and no spawning adults, early life stages, or juvenile Atlantic sturgeon are expected to occur in the action area.

## 4.4. Federal, State, and Private Activities in the Action Area

### 4.4.1. Federal Activities in the Action Area

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.

On August 31, 2012, we issued an Opinion[18] concerning FERC's issuance of a license amendments for the Milford, West Enfield, Stillwater, Orono, and Medway Hydroelectric Projects on the Penobscot River. Of these projects, only the Milford Project occurs within the action area. In this Opinion, we concluded that the continued operation of these projects, consistent with the terms of proposed license amendments, was likely to adversely affect, but not likely to jeopardize, the continued existence of any ESA listed species and was not likely to destroy or adversely modify any designated critical habitat.

Broodstock Collection and Transport to the Hatchery

USFWS has been authorized under an ESA section 10 endangered species blanket permit to conduct the conservation hatchery program at the Craig Brook National Fish Hatchery (CBNFH) and Green Lake National Fish Hatcheries (GLNFH). Transport of salmon from the trap at the Milford Project to the CBNFH is conducted by USFWS staff, whereas the sorting and handling of salmon is conducted by Maine DMR.

As indicated, the section 10 authorization covers the trapping and transport of salmon, as well as any handling and sampling that occurs after fish are trapped. The permit that previously covered these activities is outdated, however, future permitting actions are anticipated to address similar activities (Nicole Pauley, USFWS, personal communication, January 28, 2026). The following language describing the covered activities has been excerpted from the expired permit:

**Trapping:**

- Adults: Weirs and traps will be installed and operated to count spawners, collect broodstock, and collect biological data. Sea-run adults captured at traps may be transported from traps to hatchery, and from traps or hatchery to upriver locations. Traps will be operated each year from early May through mid-November, depending on in-river water levels and not to exceed 210 trap days on each river. Traps will be checked at least once daily during peak migration periods. Only persons trained in tending traps, as

[18] FERC Accession #: 20200806-5132

determined by BSRFH, are authorized to conduct these activities; if no one with adequate training is available, trapping operations will be suspended.

**Transporting:**

- Personnel transporting fish (adults and/or juveniles) will abide by the following guidelines: (1) When fish are being transported from the river to a hatchery, and river water temperature exceeds 18° C, transport temperatures will be maintained intermediate between the river and the receiving facility; and (2) when fish are being transported to riverine release sites, if the difference between the distribution tank and the receiving waters exceeds 3° C, staff will temper tank water to acclimate fish to river temperatures. Fish will not be transported at temperatures exceeding 22 ° C, except when salmon are transported to a hatchery environment.

**Handling, including collecting and sampling:**

- All adult salmon handled in fish traps are to be marked prior to returning them into the river. Salmon will be marked with an adipose fin punch. Salmon captured with an existing adipose fin punch should receive a second punch in the upper lobe of the caudal fin.
- Biological sampling, e.g., measurement of fork length or estimating the size of the fish, will occur at temperatures up to 22° C, based on biological sampling procedures established for each river (Nielsen, L.A. and D.L. Johnson. 1983. Fisheries techniques. American Fisheries Society. Bethesda, MD. and Schreck, C.B. and P.B. Moyle (eds). 1990. Methods for fish biology. American Fisheries Society. Bethesda, MD.).
- Scale samples for the purpose of determining age and origin will be collected pursuant to scale collection protocols specific to each river (Nielsen and Johnson 1983, Schreck and Moyle 1990).

<u>2017 Emergency Dam Repair</u>

As described in section 2.2.1, Black Bear conducted an emergency repair of the Milford Dam in 2017. According to their BA, that action had the following documented effects on listed species:

- At least seven GOM DPS Atlantic salmon were observed holding in a void under the dam and a deep pool near the dam while emergency repairs were in progress in August 2017. Observed fish were netted and relocated when possible consistent with the stranding procedure. All Atlantic salmon were released alive and unharmed to the main river or the project impoundment.
- The fishway was shutdown for the month of August in order to facilitate construction. During this period no Atlantic salmon were able to migrate past the Project.
- Atlantic and shortnose sturgeon would not be expected to be migrating further in the river as it is at the upstream extent of their historical range. No sturgeon were observed during project construction.

As described in the BA, FERC and Black Bear determined that the emergency repairs may have adversely affected listed Atlantic salmon, but that the emergency repairs did not likely adversely affect shortnose sturgeon or the Gulf of Maine DPS of Atlantic sturgeon. There were no shortnose or Atlantic sturgeon observed during the repair activities. We agree that this is a reasonable conclusion as even if individual sturgeon were present in the area when the repairs were taking place, any effects of exposure to increased noise and/or suspended sediment would be so small that they could not be meaningfully measured, detected, or evaluated and therefore would have been insignificant. FERC and Black Bear also determined there were no adverse effects to designated critical habitat for GOM DPS of Atlantic sturgeon. We agree that this is a reasonable conclusion as any effects would be limited to temporary disruptions of access to ledge areas; we have not identified any path for adverse effects to the physical and biological features of Atlantic sturgeon critical habitat in the action area. They also concluded that although there was a temporary effect to the migratory physical and biological feature of critical habitat designated for the Gulf of Maine DPS of Atlantic salmon, there were no effects that persisted after the fishway reopened. We agree with this conclusion as there are no paths to permanent effects to any of the features of Atlantic salmon critical habitat in the action area that could have resulted from the emergency repair activities.

Although seven Atlantic salmon were exposed to the effects of capture and handling, they were all safely released upstream of the project so that they could continue their migration to the upper river. Additional salmon may have been delayed by the dewatering of the fishway for the month of August in 2017. Given the time of year and warm water temperatures, we anticipate that relatively few salmon would have been migrating through the mainstem at the time the fish lift was inoperable. Based on the weekly fish trap data provided by Black Bear between 2022 and 2024, the average proportion of adult salmon that pass Milford in the month of August is only 2.3% (range 0.6% to 3.8%) of the total run. If we extrapolate that to the size of the run in 2017 (849 adult salmon; USASAC, 2018), then we can estimate that 20 salmon (i.e., 2.3% of 849 salmon) may have approached the Milford fishway when it was inoperable in the month of August. Seven salmon were located in the void in the dam and were passed safely upstream; suggesting that few additional salmon (potentially 13 salmon) may have been forced to delay their migration downstream of the dam. We expect that these salmon would locate holding pools downstream of the dam, either in the mainstem or in the lower river tributaries in the Penobscot. These salmon were likely adversely affected due to migratory delay in excess of 48 hours, and some proportion may have been exposed to energetic effects that reduced their potential to successfully spawn further upriver, or potentially to survive to spawn in future years.

Dams and Hydroelectric Facilities

There are two dams within the action area that impact Atlantic salmon (i.e., Milford and Gilman Falls); both associated with the Milford Hydroelectric Project. As indicated above, the dams are operating under a FERC license that was amended to incorporate measures that minimize effects to listed species. We consulted on the issuance of the amended license and issued an Opinion in 2012. The dams continue to operate consistent with license that was amended to incorporate the provisions of the 2012 SPP. The effects of the proposal to once again amend the Milford license is the subject of this Opinion. As such, we will analyze the future effects of the project over the remainder of the existing license under the terms of the proposed modified SPP in the *Effects of the Action* section (section 5.0). However, as the dams are operating under an amended license that has undergone consultation, and as they affect listed species within the action area, we consider their past effects as part of the environmental baseline. As such, we consider the past effects of the dams, including the effects to riverine processes (e.g., flow fluctuations, impoundments) and fish passage in the Penobscot River (i.e., passage efficiency, passage survival and injury, and migratory delay) in this section. Effects to salmon and sturgeon from the existence of the dams, including the resulting creation of a shared impoundment, are considered solely as an aspect of the environmental baseline for the proposed license amendment (or however FERC intends to approve operations consistent with this SPP), as the existence of the dams and resulting impoundment is not an effect of the proposed license amendment. Effects of the actions at the Milford Project are a result of the operation of the project pursuant to the FERC license to produce electricity or to pass fish, and are therefore, considered both in this Environmental Baseline section and in the Effects of the Action section.

### Fish Passage

#### *Upstream Passage*

Upstream passage in the action area currently occurs exclusively in the mainstem Penobscot River through the Milford Dam fish lift. Telemetry studies employing radio, acoustic, and PIT tag methods have been conducted at the Penobscot River projects by the Maine Atlantic Salmon Commission, the University of Maine, and various hydropower project licensees. These studies have shown wide variation in upstream passage success, depending on site-specific issues at each dam and environmental conditions during the study, particularly the temperature and flow regime (NMFS 2009b).

At Milford Dam, upstream passage efficiency (i.e., number of tagged adult salmon that pass upstream of the dam divided by the total number of tagged fish that approached the dam) ranged from 86 percent in 1987 to 100 percent in 1990 and averaged 90 percent (56 of 62) over five years of study (Dube 1988, Shepard 1991c, Shepard and Hall 1991, Shepard 1995). These studies occurred prior to the construction of the current fish lift, so the fishway being evaluated was the Denil fishway that is not currently operated, though its future operation is the subject of the proposed action considered in this biological opinion.

In 2014, an ad hoc fish passage committee comprised of fishery biologists and fish passage engineers from the USFWS and NMFS compared performance measures, standards, and historic dam passage rate data for west coast fishways and Pacific species of salmon to observed passage performance for Atlantic salmon utilizing Penobscot River fishways in a collaborative effort to develop a single set of fish passage guidelines to be used by both agencies (Brett Towler, USGS, personal communication, September 2024). As part of that joint agency review, passage results from a variety of studies were considered, including a robust data set of 827 PIT- tagged Atlantic salmon that had passed through the Denil fishway at the Milford Dam over the course of several years in the early 2000s as part of passage studies conducted by the University of Maine. That data set demonstrated that 100 percent of the tagged adult salmon using the Milford Denil fishway passed upstream of the dam within 96 hours of being detected at its entrance. It should be emphasized that this study was based on PIT tagging so it only documented internal efficiency of the Denil (i.e., passage effectiveness through the fishway itself). It does not provide an estimate of total passage efficiency (since it does not consider fish that couldn't locate the fishway entrance) nor does it account for delay associated with inadequate attraction to the fishway (as the delay estimate only considers the time it takes an individual to get from the entrance to the exit).

In 2005 and 2006, acoustic telemetry studies were used to assess upstream passage of adult salmon in the Penobscot River from the Veazie Dam upstream to the Howland and West Enfield Dams (Holbrook, 2007; Holbrook et al., 2009). Passage through the Denil fishway at Milford was 100 percent in 2005 and 67 percent in 2006; however, sample size at Milford was very small (n=3 both years) because of poor passage rates at the Veazie and Great Works Dams (Holbrook et al., 2009), both of which have since been removed. As such, it is not clear how representative these results are.

The Milford fish lift was constructed in 2013, and passage studies were conducted shortly thereafter by the University of Maine and Black Bear. Izzo et al. (2016) evaluated the upstream passage of adult Atlantic salmon on the Penobscot River during 2014 and 2015 with the objective of assessing potential delays at the remnant dam locations for Great Works and Veazie, the Stillwater Branch confluence/Orono Project tailwater, and the performance of the new fish lift at Milford. The majority of adult salmon that were radio-tagged by the University of Maine and known to have approached Milford Dam successfully ascended the fish lift (95.5% during 2014 and 100.0% during 2015) (Izzo et al. 2016). Individual tagged salmon made between 1 and 47 visits (median = 11) to the Milford fish lift entrance prior to passage, with the majority of visits lasting less than 90 minutes. Similar to observations made during the 2014 and 2015 University of Maine studies, adult salmon radio-tagged by Black Bear also demonstrated high upstream passage following arrival at Milford Dam. Passage rates observed during Black Bear's studies were: 2014 – 33 of the 38 were recaptured in the upper flume of the fish lift; 2015 – 47 of the 48 were recaptured in the upper flume of the fish lift (HDR 2015, Kleinschmidt 2016); providing a pooled efficiency estimate of 93%. Peterson (2022) summarized University of Maine passage studies at the project between 2014 and 2020, and concluded that an average of 92% (ranging between 82% (in 2020) and 100% (in 2014)) of salmon that approached the project passed (E Peterson, 2022).

<u>Migratory Delay</u>

While the fish passage facilities at Milford effectively pass a large percentage of the salmon that approach the dam, salmon passage is often delayed. Several studies have evaluated upstream passage behavior, including the time needed for individual adult salmon to pass upstream of various dams once detected in the vicinity of a spillway or tailrace. These studies documented certain consistent migratory behaviors, including frequent upstream and downstream movement, periods of holding in fast water, seeking thermal refugia in tributaries, migration delays, attraction to spillage at dams, episodes of long upstream movement past multiple dams, reduced migratory behavior in late summer, and inhibited movement at temperatures above 23°C (Erin Peterson, 2022; S. R. Rubenstein, 2021; Shepard, 1995).

Following the removal of the Great Works and Veazie Dams in 2012 and 2013, respectively, Milford became the first hydroelectric project on the mainstem of the Penobscot River. Since 2014, adult Atlantic salmon have been primarily passed upstream at Milford via the existing fish lift. Adult Atlantic salmon were radio-tagged during 2014 and 2015 as part of separate studies conducted by Black Bear and by researchers at the University of Maine. The primary objective of the 2014 and 2015 studies conducted by the licensee was to evaluate compliance with the upstream performance standard described in the 2012 BiOp and SPP. The median passage time observed for radio-tagged adult salmon at Milford was 1.1 days (range 0.1 to 16.1 days) during the 2014 studies and 7.8 days (range 0.1 to 35.1 days) during the 2015 studies conducted by the licensee (BBHP 2015; BBHP, 2016). During licensee evaluations, the majority of individuals did not achieve upstream passage within the 48-hour period following their initial detection in the Project tailrace (52% achieved ≤ 48 hours during 2014; 17% achieved ≤ 48 hours during 2015).

Concurrent to evaluation of adult salmon passage at Milford and as noted above, the University of Maine (Izzo et al., 2016) evaluated the upstream passage of adult Atlantic salmon on the Penobscot River during 2014 and 2015. In both years, upstream passage speeds through the remnant dam locations for Great Works and Veazie, as well as for the Stillwater confluence, were comparable to speeds through unobstructed reaches of river. Izzo et al. (2016) reported movement rates through the Milford Dam reach were up to 100 times slower than that observed in both unobstructed river reaches. Median upstream speeds at Milford were reported as 0.006 km/hr in 2014 and 0.005 km/hr in 2015; as opposed to 1.0 km/hr in 2014 and 0.5 km/ hr in 2015 in the unobstructed reaches downstream of Milford (Izzo et al., 2016). Passage times following arrival at Milford for adult salmon tagged by the University of Maine ranged from 0.03 to 78.4 days (median 3.0 days) during 2014 and 0.4 to 26.9 days (median 4.3 days) during 2015. When considered relative to the passage standard at Milford, 55 percent passed within the 48-hour window during 2014 and 34.7 percent did so during 2015 during the University of Maine studies. In 2018 and 2019, Rubenstein (2022) found that Atlantic salmon were delayed an average of 23 and 11 days, respectively, when attempting to pass Milford Dam (Rubenstein et al., 2022).

Delay at dams can, individually and cumulatively, affect a salmon's ability to access suitable spawning habitat within the narrow window when conditions in the river are suitable for migration. Additionally, migratory delay has negative energetic effects that may reduce the likelihood that salmon will successfully spawn and out migrate to the estuary following spawning. A small increase in energy expenditure could affect an individual's ability to spawn, or reduce the likelihood that they could survive to spawn in a subsequent year (S. Rubenstein, 2021). Although Pacific salmon are generally semelparous (i.e., spawn in a single year) and die after spawning, Atlantic salmon have evolved to be iteroparous (i.e., spawn in multiple years) and are capable of returning to the ocean after spawning and subsequently returning to their natal river to spawn again. Multi-year spawners tend to be larger and have increased reproductive potential, and therefore, are important demographic components of a population (Fleming, 1996; Maynard et al., 2017). However, repeat spawners have nearly been eliminated from the GOM DPS (Maynard et al., 2017).

The threshold for iteroparity has been hypothesized to be 80% energy expenditure during migration and spawning (Glebe & Leggett, 1981). That is, an individual that uses more than 80% of its energy reserves will likely die after spawning, while those that use less have the potential to survive to spawn in multiple years. At the completion of their spawning migration, the energy loss for Atlantic salmon during spawning has been estimated to be 60-70% (Jonsson et al., 1997). The amount of energy used likely varies based on the length of the migration and the environmental conditions they are exposed to during migration. Salmon that migrate under warmer conditions also use more energy than those that migrate under cool conditions. Water temperature directly affects the rate of all biochemical reactions in ectothermic animals, such as Atlantic salmon, including metabolic processes (Angilletta Jr et al., 2002). This effect predicts a theoretical doubling of biological processes every 10ºC, and this theoretical trend is validated by empirical data from salmonids (Brett & Groves, 1979). Although they spawn in late fall, Atlantic salmon have adapted to migrate to spawning grounds early in the summer, which minimizes the energetic cost of the migration. The optimum migration temperature for adult salmon is between 14°C and 20°C, which occurs primarily in the months of May and June in the GOM DPS. Frechette et al. (2018) found that Atlantic salmon used thermal refuges to maintain body temperatures between 16-20°C, indicating that temperatures above that range are likely to induce thermal stress. It is not unusual for the temperature in the mainstem of the Penobscot River (and other rivers in the GOM DPS) to exceed 20°C, particularly in the summer months at the tail end of the typical migration period (July through September).

In 2018 and 2019, Rubenstein (2021) conducted a study at the Milford Dam that evaluated the energetic effects of migratory delay of Atlantic salmon at dams, and how the effects are related to water temperature. In her examination of the thermal experience of adult salmon in the lower Penobscot River, Rubenstein (2021) found that 9 out of 21 tagged individuals exhibited behavioral thermoregulation, meaning that they were able to locate suitable thermal refuge. The remaining 12 salmon had a thermal experience that was similar to that of the downstream temperature logger, which potentially means that they could not locate cold water refuge, or else did not make significant use of it. Upstream delay of spawning adults associated with ineffective passage at dams may therefore force salmon to spend more time in warm water, which can increase the energy costs of migration, particularly if they cannot locate or make use of cold-water refuge. Rubenstein found that salmon lost an average of 18.2% (range between 3.1% and 65.8%) of their original endogenous fat reserves between capture and recapture at the Milford Dam. This is likely an overestimate of dam-related energy depletion, as Rubenstein released fish 18 km downstream of the Milford Project, and therefore some proportion of that fat loss occurred prior to fish encountering the dam (Rubenstein et al., 2022). Regardless, the energetic effects of cumulative delay imposed by multi-dam systems likely increase the chance that a returning adult Atlantic salmon will die before or after spawning (Rubenstein, 2021).

Stranding

The impoundment at the Milford Project is lowered at least annually to a point where the flashboards can safely be raised, resulting in a short period of receded flows downstream. Atlantic salmon have been observed stranded in ledge pools in the area immediately downstream of the dam following the installation and caulking of the flashboards. The caulking reduces leakage between the boards and halts flow to downstream pools. Since 2016, a total of 43 salmon (40 multi-sea-winter and 3 grilse) have been observed stranded in these pools. It should be noted that there is a large pool within this complex (located immediately downstream of the flashboard/spillway section) that cannot be inspected from above because it is too deep. In 2017, some of these pools on the east side of the center ledge (Milford side) were filled with concrete during dam repair work in order to prevent salmon from becoming stranded under lower flow conditions.

Starting in 2019, Black Bear has left two short sections of steel-hinged boards on the west side of the center ledges uncaulked in order to provide adequate flow into the bypass area for the purpose of affording Atlantic salmon and other diadromous fish egress to and from the area and to reduce the risk of fish being stranded in the pools below the spillway. Black Bear has also implemented a monitoring and rescue procedure whereby fish passage staff monitor the spillway area when the boards are raised and following spill events during the fish passage season. There have been no Atlantic salmon observed stranded in the pools below the spillway since 2019 (Table 11), which suggests leaving the two boards uncaulked may be successful at reducing stranding to those pools.

Table 11. Milford Atlantic salmon observed strandings from 2016-2024 (from Black Bear BA). Modifications made to address stranding are noted in the comments column.

| Year | Spillway | Top of Center Ledge | East Side of Center Ledge | Comments |
|---|---|---|---|---|
| 2016 | 4 | 0 | 0 | |
| 2017 | 1 | 1 | 10 | Pools on the east side of the center ledge were filled with concrete during 2017 dam repairs. |
| 2018 | 20 | 0 | 0 | |
| 2019 | 0 | 1 | 1 | Initial year of leaving two sections of steel-hinged flashboards uncaulked. |
| 2020 | 0 | 0 | 0 | |
| 2021 | 0 | 0 | 0 | |
| 2022 | 0 | 6 | 0 | Not considered stranded as egress flow was available |
| 2023 | 0 | 1 | 0 | |
| 2024 | 0 | 0 | 2 | Found in pools near the base of the center ledges during low tailwater. |

The modified caulking procedure was evaluated by Black Bear in August 2022 through an aquatic habitat assessment in the bypass section downstream of the spillway. The aquatic habitat assessment was requested by NMFS to assess the physical conditions within the outlet channel from the bypass reach pools when river flows are under control (i.e., less than 17,000 cfs and with no uncontrolled spill). Normandeau Associates, Inc. (Normandeau), on behalf of Black Bear, collected water depth information from the pool outlet channel under two conditions (1) with flashboards in place and 100 percent caulked (i.e., sealed), and (2) with flashboards in place, but with two short sections of boards left uncaulked[19] (as has been the protocol since 2019) to permit leakage flows to enter the pools and then drain out via the pool outlets to the tailrace (Normandeau 2023).

The provision of leakage flow into the large pool located immediately downstream of the flashboard/spillway section led to an increase in water depth and wetted width within the outlet

[19] Uncaulked sections are boards numbered 41 to 46 and 62 to 65, which equate to 30 and 20 board feet, respectively (comprising approximately 5.2% and 3.5% of the total spillway length of 572 feet).

channel leading to the tailrace. Water depths in the channel thalweg under leakage flow conditions were in excess of one foot at each of the ten cross sections, and the median depth among all wetted points was nearly twice that observed for the caulked flow condition. Although none of the ten cross sections met the minimum passage depth guidance of three body depths plus 0.25 foot (i.e., 2.25 feet), most transects had a thalweg depth between two and three body depths (Normandeau 2023).

Although stranding downstream of the spillway has been lower in recent years, adult salmon that ascend to the top of the center ledges during periods of spill can still become trapped in that location when the water recedes, as well as in some of the remaining ledge pools on the east side of the center ledges.

*Downstream Passage*

Smolts

Downstream passage of smolts has been studied extensively at the Milford Project. Recent smolt evaluations on the Penobscot River have focused on passage at the West Enfield, Milford, Stillwater, and Orono Projects (HDR 2015; Kleinschmidt 2016; Normandeau (2017, 2018, 2019). Although licensee studies during 2014-2018 were primarily focused on assessment of the passage survival for compliance with the performance standard, the study design implemented during those years also allowed for evaluation of additional metrics, including route of passage, forebay residence time, and the temporal distribution of arrival at the project dams. Specific to Milford, radio-tagged Atlantic salmon smolts have the potential to utilize the downstream fish bypass system, spill, or the turbine units to pass downstream. Turbine entrainment for downstream-passing smolts was highest at Milford during 2014 and 2015 when the Project was run under normal operations (44% during 2014 and 70% during 2015; Table 12). Following implementation of the enhanced protection measure targeting spills of 20 - 50 percent of river flow, 24 hours per day during the study period, the percentage of smolts entrained in the Milford turbines was reduced to 6-9 percent annually. The majority of smolt passage at Milford during 2016 - 2018 occurred via spill (Normandeau 2017, 2018, 2019). Radio-tagged Atlantic salmon smolts passed downstream of Milford quickly following their arrival at the Project. When assessed relative to the 24-hour passage criteria specified in the performance standard, between 98 and 100 percent of radio-tagged smolts passing at Milford did so within the specified time frame. Known passage times for 647 radio-tagged smolts at Milford, which were originally released in the vicinity of West Enfield during 2015 - 2018, support the general notion that smolt passage primarily occurs during night hours (Figure 15). Downstream passage events at Milford most frequently occurred between 2000 and 0700 hours (74% of total).

Table 12. Distribution of downstream passage route selection for radio-tagged Atlantic salmon smolts at Milford, 2014-2018 (from Black Bear BA).

| Year | Bypasses | No Pass | Spill | Turbines | Unknown |
|---|---|---|---|---|---|
| 2014 | 21.3 | 0.0 | 35.0 | 43.8 | 0.0 |
| 2015 | 7.4 | 0.0 | 8.4 | 69.5 | 14.7 |
| 2016 | 3.9 | 1.7 | 80.8 | 9.0 | 4.7 |
| 2017 | 2.3 | 1.9 | 84.6 | 9.0 | 2.3 |
| 2018 | 3.9 | 3.9 | 84.8 | 5.6 | 1.7 |

* 2014-15 – normal operations; 2016-2018 – enhanced protection measure targeting spills of 20-50 percent of river flow, 24 hours per day during the study period

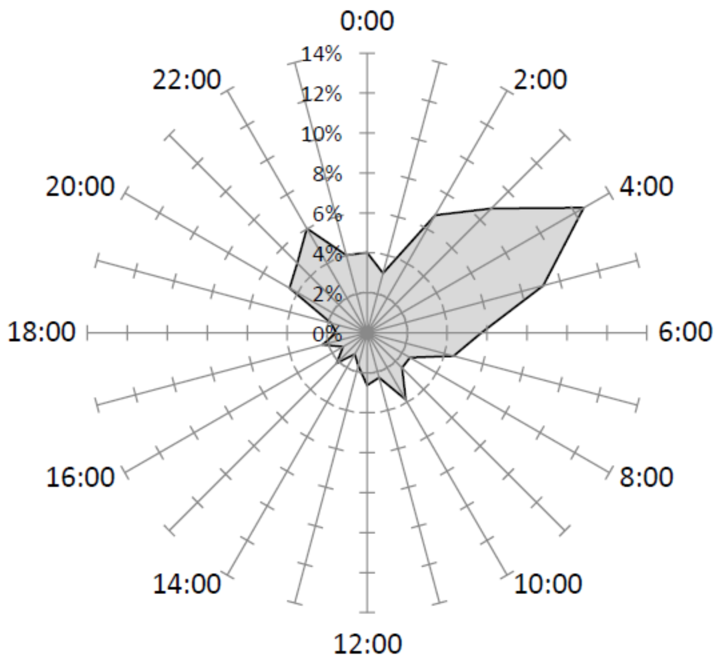


Figure 15. Frequency distribution of downstream passage timing for radio-tagged Atlantic salmon smolts at Milford, 2016-2018. The spokes represent individual hours of a 24-hour day. The gradations along each spoke represent the percentage of study smolts that passed within that hour (Black Bear BA, 2025).

As shown in Table 12, smolt passage through the Milford Project turbines ranged from 5.6 to 9.0 percent from 2016-2018 when Black Bear was spilling 20-50 percent of river flow, which was a decrease from the 43.8 to 69.5 percent observed in 2014-2015 when spill was not intentionally provided. Differences in spill conditions that occurred during the study periods and in subsequent years are summarized as follows:

- 2014-15 – normal operations (no targeted spill);
- 2016-2018 – enhanced protection measure targeting spills of 20-50 percent of river flow
  - 2016: spill flows provided 24 hours per day during the study period (May 1 to May 31);
  - 2017: spill flows provided 24 hours per day during the study period (May 1 to June 5):

    - 2018: spill flows provided 24 hours per day during the study period (May 1 to May 31)
- 2019-2024 - enhanced protection measure targeting spills of 20-50 percent of river flow, 24 hours per day during the two-week outmigration period.

Smolt Survival

Radio telemetry studies conducted by the licensees (HDR 2015; Kleinschmidt 2016; Normandeau 2017, 2018, 2019) and the University of Maine (as summarized in Stich et al. 2015a) represent the most comprehensive evaluation of Atlantic salmon smolt passage survival through the Penobscot River.

Licensee studies conducted over a five-year period (2014-2018) were focused on estimation of passage survival for compliance with the performance standard. As noted earlier, the projects were operated normally during the 2014 and 2015 study years; however, beginning in 2016, the licensees implemented enhanced protection measure targeting spills of 20-50 percent of river flow, 24 hours per day during the study period.

The specific analytical methodology for estimating passage survival was consistent among four of the five study years (2015-2018) and relied on the use of a mark-recapture Cormack Jolly-Seber estimation approach. All derived estimates of Project passage survival were adjusted to reflect losses attributable to background (i.e., natural) mortality within the Penobscot River. Table 13 provides a summary of the baseline project survival estimates for radio-tagged smolts passing downstream at Milford during 2014-2018. Baseline estimates considered the downstream detection information for all smolts, regardless of the duration of time required to pass downstream following arrival at the dam (i.e., without incorporation of the 24-hour performance criteria).

Table 13. Summary of baseline and adjusted smolt survival estimates for the Milford Project, 2014-2018 (from Black Bear BA). 2014-15 – normal operations (i.e., no supplemental spill); 2016-2018 – enhanced protection measure targeting spills of 20-50 percent of river flow, 24 hours per day during the study period. The adjusted survival estimate considers smolts with a residence of more than 24 hours as dead.

| Condition | Year | Release Locations Included | No. Smolts | Estimated Project Survival (%) | 75% Confidence Interval (%) | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Baseline | 2014 | Project group | 84/48 | 92.70 | 87.50 | 98.30 |
| | 2015 | Project group | 102 | 90.40 | 81.90 | 94.30 |
| | | All upstream | 200 | 84.90 | 77.30 | 88.10 |
| | 2016 | Project group | 95 | 92.50 | 88.10 | 96.30 |
| | | All upstream | 234 | 93.40 | 90.90 | 95.90 |
| | 2017 | Project group | 100 | 100.00 | 98.40 | 100.00 |
| | | All upstream | 267 | 99.30 | 98.00 | 100.00 |
| | 2018 | Project group | 68 | 98.90 | 95.40 | 100.00 |
| | | All upstream | 188 | 98.60 | 96.40 | 100.00 |
| Adjusted | 2015 | Project group | 102 | 84.80 | 72.70 | 92.40 |
| | | All upstream | 200 | 80.90 | 73.20 | 84.30 |
| | 2016 | Project group | 53 | 92.80 | 87.70 | 97.70 |
| | | All upstream | 122 | 91.60 | 88.20 | 94.70 |
| | 2017 | Project group | 98 | 98.10 | 95.70 | 100.00 |
| | | All upstream | 259 | 97.60 | 96.00 | 99.10 |
| | 2018 | Project group | 67 | 98.80 | 95.30 | 100.00 |
| | | All upstream | 187 | 98.60 | 94.70 | 100.00 |

The 2016 to 2018 smolt survival studies demonstrated that survival at the Project was 96.5 percent (point average of 3 years) when supplemental spill is provided. It is important to emphasize that under existing conditions at the Milford Project, supplemental spill is only being implemented for a two-week period, and not for the entirety of the smolt run, which can last as long as two months. As these studies were conducted with supplemental spill provided for the duration of the study period (rather than just a two-week period), the results indicate the *potential* smolt survival if the measure were implemented for the entire period, rather than the actual survival at the project currently.

As the 2016-2018 studies were conducted with the supplemental spill provided for the entire study, they are not representative of the actual smolt survival at the Milford Project under baseline conditions (i.e., supplemental spill is only provided for 14 days). Based on the standardized smolt run developed by Frechette et al. (2023), Black Bear has estimated the proportion of the smolt run that would be expected to pass the project prior to, during, and following the implementation of the 14-day supplemental spill window during the baseline scenario. According to Frechette et al. (2023), "the proportion of the run that passed the Milford Dam during the 14-d supplemental spill window at the dam was 0% in 2021 and 68% in 2020" (Frechette et al., 2023). As Black Bear currently uses the smolt run timing model to inform when best to initiate spill measures, they appear to have determined that it is appropriate to use the estimate provided for 2021 (68%) rather than what was estimated in 2020 (0%). This is reasonable for this analysis as a higher proportion would be expected given current reliance on the timing model, however, it likely overestimates the effectiveness of the spill measure that existed prior to the utilization of that model. They've estimated that approximately 31% of downstream smolt passage at Milford lands outside of the 14-day period of intentional spill; either prior to initiation (~24%) or after completion (~7%). Using this information, along with the route specific utilization and survival rates from the 2014-2018 study years, Black Bear's BA indicates that 93.3% of smolts survive the direct effects of passage at the Milford Project under baseline conditions, and that 6.7% die (Table 5-8 of Black Bear's BA, Table 20 in section 5.3.2 below).

Indirect Mortality

The spatial and temporal scope of indirect mortality to Atlantic salmon smolts is much larger than direct mortality. In the below analysis we identify two primary sources of indirect mortality; 1) mortality in the impoundment that is a consequence of a reduced rate of movement in smolts, which may result in an increase in predation from other fish or birds, and 2) mortality that occurs later in time in the estuary as a result of migratory delay and sub-lethal injury attributed to the passage at multiple dams (i.e., hydrosystem delayed mortality).

Impoundment Mortality

Impoundment mortality is the excess mortality associated with impoundments above the expected level of natural mortality. Although the Milford Project operates as run-of-river and does not have significant fluctuations in headpond level, it does have an impoundment that is 5 kilometers long and encompasses 235 acres. Impoundments created by dams limit access to habitat, alter habitat, and degrade water quality through increased temperatures and turbidity, as well as lowered dissolved oxygen levels. Furthermore, because hydropower dams are typically constructed in reaches with moderate to high underlying gradients, significant areas of free-flowing habitat have been converted to impounded habitats in the Penobscot River watershed. There is abundant information that demonstrates that large project impoundments have a negative effect on salmonids and their habitat (Havn et al., 2018; Jepsen et al., 1998; Keefer et al., 2012; Liew et al., 2016; Raymond, 1988; Stich et al., 2014; Todd et al., 2017; Venditti et al., 2000). Impounding water significantly modifies flowing, riverine habitats by converting them into still-water, lake habitats. This habitat modification creates ideal spawning conditions for non-native fish predators (e.g., bass, pike, pickerel), while eliminating suitable riverine habitat needed by certain anadromous fish species (e.g., Atlantic salmon, American shad, blueback herring) for spawning, rearing, and migration.

Supplementary data tables associated with Stich et al. (2015) provide reach-specific passage survival estimates for tagged Atlantic salmon smolts during the 2005-2014 passage studies conducted by the University of Maine. The average per kilometer survival rate in the 3.9 km of the Milford impoundment that was monitored (SA13) was 99.6% per km, with a range from 98.7% (2014) to 99.7 % (2006); whereas the average survival per kilometer in the 20.1 km free-flowing reach upstream of the Milford impoundment (SA11) was 99.8%, with a range of 99.5% (in 2006 and 2013) to 100.0% (in 2011) (Stich, Bailey, et al., 2015). We can estimate the amount of mortality attributable to the impounding of flow by the Milford dam by adjusting the impoundment survival rate by the free-flowing rate. As such, we can estimate that the impounding effect at Milford causes an increase in mortality of 0.3% per km (i.e., 1 – (99.5%/99.8%)); which equates to an average loss of 1.5% of smolts when extrapolated to the entire 5-km length of the impoundment (i.e., 1 – (99.7%^5-km). This is consistent with information provided in the reach survival estimates provided in Black Bear's smolt survival study reports conducted between 2015-2018 (BBHP, 2016, 2017b, 2018, 2019). Using a similar approach as above, we estimate that on average 1.9% of smolts (ranging between 0% and 4%) die in the 5 km Milford impoundment due to the impounding effects of the dam. Combining the information for 2005-2014 (based on Stich et al., 2015) and 2015-2018 (based on Black Bear's smolts survival studies), we anticipate an average of 1.6% of smolts that passed downstream through the action area between 2005 and 2018 died as a result of impoundment effects.

### Hydrosystem Delayed Mortality in the Estuary

In addition to direct mortality sustained by Atlantic salmon at the Milford dam and indirect mortality associated with the impoundment, at least some smolts experience delayed mortality in the estuary attributable to their interactions with the projects. Numerous studies have investigated what is referred to as latent or delayed mortality,[20] which occurs in the estuary or ocean environment and is associated with passage through one or more hydro projects (Budy et al., 2002; Haeseker et al., 2012; ISAB, 2007; Schaller & Petrosky, 2007; Stevens, 2019; Stich, Zydlewski, et al., 2015; Storch et al., 2022).

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

More recent studies have corroborated the indirect evidence for hydrosystem delayed mortality presented by Budy et al. (2002) and provided data on the effects of in-river and marine environmental conditions (Schaller and Petrosky, 2007; Haeseker et al., 2012). Based on an evaluation of historical tagging data describing spatial and temporal mortality patterns of downstream migrants, Schaller and Petrosky (2007) concluded that delayed mortality of Snake River Chinook salmon was evident and that it did not diminish with more favorable oceanic and climatic conditions.

A recent study by Storch et al. (2022) indicates that "while there are several factors that may dictate SARs [smolt to adult return rates] in any given year, the strong influence of hydrosystem effects is evident when comparing the success of populations in different subbasins throughout the system. Populations of yearling Chinook Salmon and steelhead in the Columbia River Basin that migrate past four or fewer mainstem dams survive at rates higher than those that must pass eight dams." They indicate that Chinook salmon that pass three or four dams in the Columbia River system have SAR rates that are nearly four times higher than those that have to pass eight dams; and nearly three times higher for steelhead (Storch et al., 2022). They attribute the cause

[20] Hydrosystem delayed mortality is also referred to as latent mortality (Budy et al., 2002; Haeseker et al., 2012; ISAB, 2007; Schaller & Petrosky, 2007). For clarity, we will utilize the term delayed mortality throughout.

of these much lower return rates to sub-lethal effects of dams that make it more difficult for juveniles to transition from freshwater to saltwater. Specifically, they indicate that "the condition of these fishes can be compromised by mechanical injury and stress during passage through bypass systems and turbines, with substantial delay in migration," and that "slowed outmigration may increase exposure to predation, competition, and elevated temperatures, thus increasing energetic costs and propensity for disease, and result in poorly timed estuary arrival" (Storch et al., 2022).

The extent that freshwater experience affects survival of smolts migrating through the estuarine and marine environment is contentious and the effect on Pacific salmonids continues to be debated (Storch et al., 2022). However, Storch et al. concludes that "an expansive body of evidence based on research and analyses across decades supports the role of freshwater factors as important determinants of life-cycle survival, and effects of these drivers can manifest during early ocean experience (i.e., delayed, or latent effects)" (Storch et al., 2022).

Although much of the research on hydrosystem delayed mortality has focused on Pacific salmon, studies have been conducted on the potential for it to affect Atlantic salmon in Maine. Stich et al. conducted an analysis on eight years (2005 to 2013) of Atlantic salmon smolt movement and survival data in the Penobscot River to determine what effect several factors (e.g., release location and date, river discharge, photoperiod, gill NKA enzyme activity, number of dams passed) have on survival through the estuary (Stich et al., 2015). They determined that estuary survival decreased as the number of dams passed during freshwater migration increased from two to nine (Figure 16). They estimated that each dam passed in the Penobscot led to a mortality rate of 6% in the estuary, which is distinct from direct mortality that occurs in the freshwater environment. Similar to Storch et al. (2022), Stich et al. (2015) attributed the cause of this mortality to migratory delay and sublethal injuries (such as scale loss) sustained during dam passage. These effects make smolts more susceptible to predation and disease.

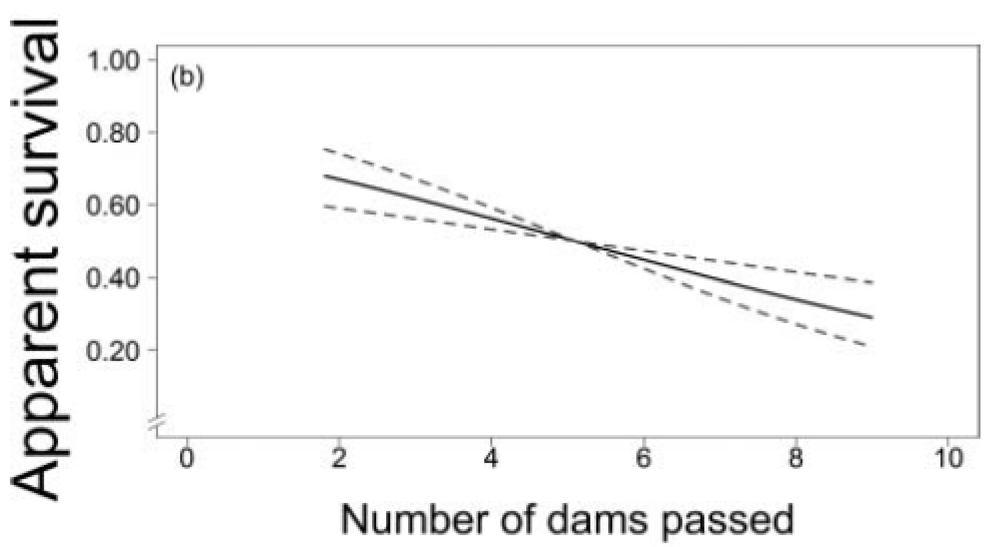

Figure 16. Apparent (or estimated) survival of Atlantic salmon smolts in the Penobscot River estuary based on the number of dams they passed during freshwater migration. The dark line is the mean survival and the dashed lines show the 95% confidence interval. The figure is excerpted from Stich et al. (2015).

A more recent evaluation conducted by researchers at the University of Maine endeavored to update the analysis conducted by Stich et al. (2015). Mensinger (2024) evaluated smolt survival through the Penobscot using the same data (2005 – 2013) as Stich et al. (2015), but also incorporated new survival information collected between 2014 and 2023 to determine if restoration actions taken during that period (e.g., the removal of two dams, the implementation of Species Protection Plan at the mainstem hydro projects) reduced cumulative delayed mortality in the Penobscot (Mensinger, 2024). The results were unexpected as they indicated that survival in the estuary was lower for fish that passed zero dams than for fish that passed up to four dams. Mensinger (2024) indicates that this is likely attributable in part to the inclusion of a large number of smolts in the model (53% of those added to the analysis) that were released into tide water downstream of the dams. The author indicated that "on average, these smolts incurred 4.6% greater mortality than smolts released further upstream" (Mensinger, 2024), and that this was assumed to be attributable to "high post-release mortality" (i.e., mortality attributable to handling, tagging, and stocking effects). In addition to initial mortality, these fish were also shown to move slower than fish that were stocked upstream of the dams (0.90 km/hr versus 1.22 km/hr) making these fish more susceptible to predation. As the results of this reevaluation were likely confounded by stocking location and handling/tagging effects, we will continue to consider the Stich et al. (2015) analysis as the best available information regarding hydrosystem delayed mortally effects in the Penobscot River.

No directed studies have been conducted to assess the amount of hydrosystem delayed mortality that occurs specifically at the Milford Project. However, given the occurrence of migratory delay and sublethal injury, we expect that delayed mortality occurs. It is not clear to what degree these two factors contribute to hydrosystem delayed mortality. As indicated above, Stich et al. (2015) estimated delayed mortality at projects on the Penobscot River as 6% per dam. We acknowledge that 6% is an average estimate of delayed mortality based on smolts that passed two to eight dams, and that an individual project's contribution may vary significantly from that average. We also recognize that delay and sublethal injury rates may vary based on conditions in the river and on the specifics of each individual project. However, applying the 6% average to these projects allows us to quantitatively estimate the total delayed mortality in the mainstem Penobscot River. However, the relative amount of hydrosystem delayed mortality that occurs at each individual project is based on the degree to which they delay and injure smolts. Therefore, to better inform the delayed mortality estimate at the Milford Project, we consider the scale of delay and injury that are currently caused by the project.

*Migratory Delay*

Dams can significantly delay smolt outmigration, especially in low water years, because the individual fish must search and find an available passage route. Delays can lead to mortality of Atlantic salmon by creating conditions that increase the risk of predation (Blackwell & Juanes, 1998), and can also reduce overall physiological health or physiological preparedness for seawater entry and oceanic migration (Budy et al., 2002). Researchers have identified a "smolt window" or period of time in which smolts must reach estuarine waters or suffer irreversible negative effects (McCormick et al., 1998). Late migrants lose physiological smolt characteristics due to high water temperatures during spring migration. 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 this occurs, these delays are expected to reduce smolt survival (McCormick et al., 1998).

The Milford Project causes migratory delay of Atlantic salmon smolts in the Penobscot River. In the smolt survival studies conducted between 2015 and 2018, Black Bear and its consultants documented the amount of time that smolts spent in the area within 200 meters upstream of the dam prior to passage; referring to this time as project residence time. Residence time is a useful metric for evaluating the effectiveness of measures implemented to reduce delay (by increasing guidance to non-turbine passage routes), but it underestimates total delay as it does not consider delay associated with reduced flow rates in the project impoundments. Here we will address residence time at the Milford Project. The survival information in Table 5.0-1. of Brookfield's 2018 *Lower Penobscot Smolt Report* indicates that of the smolts that survived passage at the Milford Project, 99% (in 2016), 98% (in 2017), and 100% (in 2018) did so in under 24 hours (BBHP, 2019). As such, under the studied condition, an average of 1% (range 0-2%) of smolts took more than 24 hours to pass the project. It is important to note that during these years supplemental spill was provided for the entire duration of the study (~5 weeks); whereas, the baseline condition at the project only has supplemental spill for a two-week period. To the extent that increasing spill reduces the amount of time a smolt would spend upstream of the project, the above proportions underestimate the amount of delay that occurs under baseline conditions. The conditions during the 2015 study did not include supplemental spill, so may be representative of what would be expected during the portion of the run that passes the project outside of the two week supplemental spill period. In that year the proportion of fish that took more than 24 hours to pass was 4% (based on the difference between the baseline survival and adjusted survival for all upstream releases; Table 13 above). To estimate baseline delay (using the metric of the proportion of fish delayed by more than 24 hours within 200 meters of the dam), we can assume that the 2016-2018 average delay (1%) applies to the average proportion of the run protected by the two-week supplemental spill period (69% of the run; as derived from Frechette et al., 2023); and that the 2015 rate (4%) applies to the remaining three weeks (31% of the run). Using this approach, we estimate that 3% of the run is delayed by more than 24 hours under baseline conditions (i.e., (69% * 1%) + (31% * 4%) = 2%).

As indicated, the above estimates do not consider delay associated with the reduced rate of movement through the project impoundment that comprises a major portion of the action area. Although Brookfield did not directly consider the amount of delay through the project impoundment, it can be extrapolated from the rate of movement information provided in the smolt survival studies conducted by Black Bear between 2016 and 2018 (BBHP, 2017b, 2018, 2019). Comparing the rate of movement through the impoundment during those studies to the rate observed through an unimpounded 26-km reach upstream of Milford allows us to estimate the project specific delay caused by the Milford impoundment (Table 14). This analysis suggests that on average the impoundment adds an additional 6.4 hours to the amount of time it takes salmon smolts to migrate through the action area.

Table 14. Analysis that estimates the amount of delay to Atlantic salmon smolt migration attributable to the presence of the Milford impoundment.

| | Median Movement rate (km/hr) | | Hours to pass impoundment (exrapolated to 5 km) | | Added Time Due to Impoundment |
|---|---|---|---|---|---|
| Year | Unimpounded (p9 to p10) | Impounded (p10 tp p11) | Unimpounded Rate | Impound Rate | |
| 2016 | 0.92 | 0.54 | 5.46 | 9.21 | 3.75 |
| 2017 | 0.63 | 0.26 | 7.89 | 19.44 | 11.56 |
| 2018 | 0.79 | 0.37 | 6.32 | 13.46 | 7.14 |
| **Average** | **0.78** | **0.39** | **6.41** | **12.80** | **6.40** |

*Injury*

As described above, sublethal injury is considered to be one of the causes of hydrosystem delayed mortality in the estuary. The available information indicates that a certain amount of sublethal injury will occur when smolts pass the Milford Project. These fish either succumb to their injuries in the river or estuary, are predated upon due to their reduced fitness, or continue their migration without obvious fitness consequences. At this time, we do not have sufficient information to determine the proportion of injured fish that fall into any of these three categories.

Although no empirical studies of injury have been conducted specifically at the Milford Project, injury rates for Atlantic salmon smolts that have passed through Kaplan/propeller style turbines are presented in Table 5-11 of FERC's BA. For reference, the Milford Project has three Kaplan turbines and one fixed blade turbine. This table summarizes the results of turbine tagging studies conducted by Normandeau at ten different hydroelectric projects. Smolts recaptured during these studies were assessed for scale loss and injuries following their initial recapture. Individuals were then held for a 48-hr period after which any incidence of latent mortality was recorded. Initial (1-hr) injury rates for Atlantic salmon smolt test fish varied widely from 0.6% to 13.7% (average = 7.5%), while those for control fish ranged from 0% to 2.0%. As the Milford Project has similar turbine types as to those summarized in the table, we anticipate that on average 7.5% of smolts that survive passage through the turbines will show some sign of injury.

In a 2017 study report at the Ellsworth Project on the Union River, Normandeau Associates conducted an analysis of the potential factors leading to injury rates through non-turbine routes (e.g., spillways, downstream bypasses, log sluices, etc) (BBHP, 2017a). In their analysis they compiled data from studies conducted at 22 facilities under 200 test conditions. They determined that the project head (i.e., the difference in elevation between the water level upstream and downstream of a dam) had a significant correlation with visible injury rate (Figures 17). The rated head at the Milford Project is 19 feet, which according to Normandeau's analysis would suggest that the injury rates through non-turbine routes at Milford would be extremely low. Therefore, Normandeau Associates' analysis would suggest that fish that migrate through a non-turbine route at such a low head dam would have an injury rate of close to 0%.

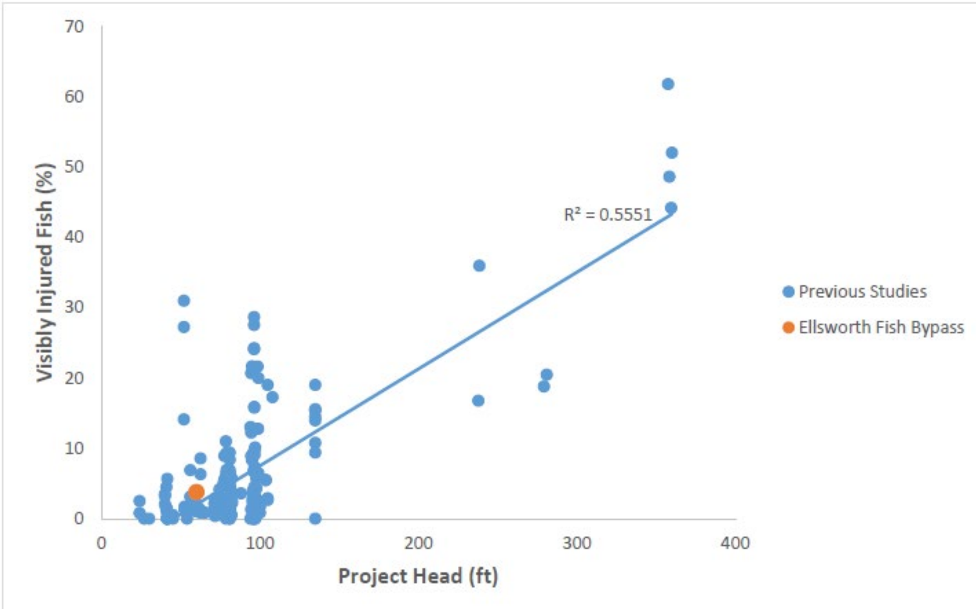


Figure 17. The relationship between project head and visible injury rate from previous studies of spillways and bypass structures (BBHP, 2017). For reference, the orange dot signifies the Ellsworth Hydro Project in Maine, which has a head of 70-feet, which is much higher than the Milford Project that is being considered in this analysis.

In the BA, Black Bear estimated the proportion of smolts that use the turbine, spillway, and bypass routes under baseline conditions (Table 5-8 of the BA), considering the implementation of 14-days of supplemental spill. Using information from that table we can estimate that under baseline conditions, approximately 26% of smolts on average migrate through the Kaplan units at the Milford Project. Using this information, as well as the analysis provided by Normandeau Associates (BBHP, 2017) regarding estimated injury rates through Kaplan turbines (7.5%) and non-turbine (0%) routes, we can estimate the amount of sub-lethal injury that smolts are subjected to when passing the Milford Project. As such, we estimate that the injury rate at the Milford Project under baseline conditions averages approximately 1.9% (i.e., 7.5% average injury rate x 26% of smolts on average passing via turbines = 1.9% of smolts being injured). It is probable that these injuries contribute to hydrosystem delayed mortality.

Based on the available information (Mensinger, 2024; Stevens et al., 2019; Stich, Zydlewski, et al., 2015; Storch et al., 2022), we have identified migratory delay and injury as probable causes for hydrosystem delayed mortality. Absent studies that identify to what degree these two factors contribute to delayed mortality; we assume that they contribute equally. In addition, our analysis of Normandeau's 2016-2018 study results (BBHP 2017, 2018, 2019) suggests that the impoundments could be slowing fish by an additional day on average. Our injury assessment above indicates that an average of 3% of smolts would be injured as a result of passing the Milford Project but ultimately survive passage at the dam and reach the estuary. Based on an analysis by Stich et al. (2015), we have estimated that, on average, passage at a single dam can lead to 6% delayed mortality in the estuary and that half of this effect would be attributable to migratory delay and the other half to sublethal injury. As the 6% per project estimate is an average over eight dams, we have weighed the project specific contribution by the relative degree that they affect the causative factors. As migratory delay and injury rates are relatively low at the Milford Project when compared to other projects in the Penobscot River, we anticipate that its contribution to hydrosystem delayed mortality is correspondingly low. As such, we anticipate that 3% (i.e., half of the average rate estimated by Stich et al., 2015) of the smolts that survive passage at Milford die in the estuary and marine environment due to effects associated with passage. As we assume that injury and delay contribute equally, we anticipate that they each contribute 1.5% delayed mortality at the project. Although this estimate is approximate, it is consistent with what has been observed elsewhere, and reflects the condition of the causative factors in the Penobscot River. Although imprecise, this approach recognizes that not all projects will lead to an equivalent amount of delayed mortality, and that project specific rates depend on the degree to which they delay and injure smolts.

To summarize, there are several sources of mortality associated with downstream passage through the Milford Project, including direct (6.5%) and indirect mortality (1.7% in the impoundment and 3% due to hydrosystem delayed mortality). Given the baseline mortality rates, we anticipate that on average if 100 smolts migrated through the action area, approximately 11 would die due to direct or indirect effects caused by the project. This does not include background levels of mortality in the action area that would occur regardless of the presence of the dams.

Postspawn Atlantic Salmon (Kelts)

Based on available information on returns to the Penobscot River, we anticipate that postspawn adults (i.e., kelts) pass downstream through the Milford Project annually in the spring and late fall (Baum, 1997). At the dam, there is potential for spillway and sluice passage. The Miramichi Salmon Association (MSA) measured the width of 93 Atlantic salmon kelts in 2012 and determined that the average width was 4.1 inches (Range 2.6-6.1 inches) (Reid, J., MSA, Personal Communication, May 18, 2012). As the spacing on the racks at the turbine intakes (inner racks have 1" spacing) are less than that width, we do not anticipate that kelts are entrained in the turbines.

Historic kelt studies in the lower Penobscot River documented that most kelts passed the dams in spilled water, typically over the spillways, but also through gates and sluices (Hall & Shepard, 1990). Downstream passage facilities were not in place at the lower river dams during these kelt studies; however, the Milford Project log sluice was opened in 1989 to test passage efficacy and kelt behavior and passed 6 of 22 tagged kelts despite the availability of large volumes of spillage (Hall and Shepard, 1990). The initial approach of kelts at the Veazie and Milford dams reflected the distribution of flow—that is, the proportion of kelts that approached spillways was highly correlated with spillway flow. In two years of kelt telemetry studies at the former Veazie and Milford dams, 35 of 49 kelts were delayed less than 2.0 hours before finding a safe route of passage in spilled water—there were no mortalities in the two years of study (Hall and Shepard 1990).

Previous MDMR research tracking tagged adult salmon (transported from Veazie Dam to spawning habitat in the Piscataquis River) has shown that adults can drop downstream quickly past many dams. Researchers noted that "the presence of dams did not appear to impede downstream movement of motivated salmon and some fish passed seven dams in as many days." In 2010, eight fish (total) that migrated downstream of Veazie Dam were recaptured 17 days after being released in the Piscataquis River, and "appeared in excellent condition and showed no adverse effects from passing downstream over multiple (up to seven) dams" (Spencer et al. 2011). Maynard et al. (2018) radio-tagged and monitored the outmigration patterns for post-spawned Atlantic salmon during 2015-2016. Individuals tagged during that study were predominantly multi-sea-winter female fish collected at the Milford fish lift prior to their transfer to and use as broodstock at the CBNFH. Maynard et al. (2018) released tagged fish upstream of the Marsh Island hydropower complex (i.e., Milford, Stillwater, and Orono) and at the head of tide in the lower Penobscot River. Kelts were monitored from November 2015 through July 2016. The majority of kelts released at both locations overwintered in the system, with only 12 percent of individuals departing the Penobscot immediately following tagging and release. Individual fish overwintering upstream of Milford Dam did so at mainstem locations between the dam and the confluence with the Piscataquis River. Apparent over-winter survival for kelts released into the Penobscot upstream of Milford was 43 percent. The majority of kelt outmigration documented at Milford occurred during March with a single individual out-migrating during May. Apparent survival down to the Penobscot estuary for kelts released upstream of Milford Dam did not differ from that of the tagged salmon released downstream at head of tide.

Between 2012 and 2024, six kelts (approximately one kelt every two years) have been found dead on the intake racks at the Milford Project. The cause of death of these fish is uncertain, but it was determined by NMFS that the presence of the Milford dam likely was a contributing factor. Although it is possible these fish were floating dead in the river prior to being impinged on the racks, it is also possible that they were alive, yet energetically depleted, and died as they sought a passage route past the dam.

Per the 2012 SPP and Biological Opinion, the performance standard for downstream-migrating kelts is 96% total project survival, which would include from 200 meters upstream of the trash racks and continuing downstream to a point where latent effects of passage can be quantified. The incidental take statement in our 2012 Opinion contains a corresponding expected mortality rate of 4%. In accordance with the SPP, Black Bear is scheduled to conduct an Atlantic salmon kelt downstream passage study at the Milford Project in 2028. However, they have since committed to conducting the study in 2027 to make use of adult salmon that will be tagged to evaluate the effectiveness of the upstream fishway at the Mattaceunk Project in the East Branch of the Penobscot.

<u>Atlantic and Shortnose Sturgeon</u>

As noted above, the Milford Dam is located at the presumed upstream historic limit of both species range in the Penobscot River. As such, the presence of the dams, while a barrier to upstream passage, do not limit access to the historic range of the species in the river the way that the Great Works and Veazie dams did prior to their removal. Sturgeon are occasionally captured in the fish lift, at a rate of less than 1 per year. In all cases except for one (2021), these fish have been returned to the mainstem below the dam without any apparent injury or other harm. The sturgeon inadvertently passed upstream in 2021 either remains upstream of the dam or passed back downstream; it is possible that this individual could be injured during its downstream migration but no additional information is available on the fate of this fish.

### 4.4.2. State of Private Activities in the Action Area

Other 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. Poaching of Atlantic salmon, shortnose sturgeon, and Atlantic sturgeon and incidental capture of these fish in legal fisheries have been reported in the GOM DPS; however, it is difficult to quantify due to a lack of information. Incidental capture and/or poaching of all three species likely occurred in the past in the action area and may continue in the future. We note that increased education and enforcement presence has been implemented in recent years to help address this concern. Additionally, Maine DMR implements a restriction (no closer than 150 feet of an operational fishway) on how close to the Milford dam fishermen can operate which helps to minimize risk of accidental capture.

State of Maine stocking program

The State of Maine stocks other salmonids into the Penobscot River watershed, including brook trout, splake, and landlocked salmon.[21] Competitive interactions between wild Atlantic salmon and other salmonid fishes, especially introduced species, are not well understood in Maine. State managed programs supporting recreational fisheries often include stocking non-indigenous salmonid fish into rivers containing anadromous Atlantic salmon. 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 that 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 confer 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 coexist with minimal long-term effects (Hearn, 1987; Fausch, 1988).

[21] Maine Department of Inland Fisheries and Wildlife. 2025 Stocking Report. www.maine.gov/ifw/fishing-boating/fishing/fish-stocking-report.html

Changing Environmental Conditions in the Action Area

In the Northeast U.S. (West Virginia to Maine), between 1895 and 2011, temperatures increased by nearly 2°C; precipitation increased by approximately 13 cm, and sea levels rose by approximately 30 cm (Melillo et al., 2014). Relative to other regions, the Northeast has experienced greater increases in extreme precipitation, and the rate of sea level rise exceeds the global average (Melillo et al., 2014). Looking forward, it is expected that temperatures in the Northeast could warm between 4.5°C to 10°C by the 2080s (Melillo et al., 2014).

In Maine, the average annual temperature has increased nearly 1.8°C in the last 124 years with northern and western Maine (1.7°C) warming at slower rates than coastal Maine (1.8°C) (Fernandez et al., 2020). Most of the warming that has occurred in Maine has happened since 1960 with an average annual increase of 0.026°C per year (Fernandez et al., 2020). The average annual precipitation in Maine has also increased. Maine's average annual precipitation has increased 15% (~15 cm) since 1895, with most of that increase in the form of rain and less snow. Much of the increased precipitation is associated with increases in storm intensity predominantly during the fall time (summarized in Fernandez et al., 2020). As for snowfall, the average annual snow depth has decreased by 20% (5.8 cm) since 1895 (Fernandez et al., 2020). Although Maine has seen a considerable increase in the average annual precipitation, Maine has also experienced increases in the severity and duration of drought events (Fernandez et al., 2020).

We anticipate that long term changes in environmental conditions could significantly affect the functioning of 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. During the 13-year term of the proposed action, we anticipate that water temperatures and precipitation in the action area will continue to increase, and that the amount of snow fall on an annual basis will decrease. These effects will likely reduce the amount of suitable habitat in the Penobscot River for salmon spawning, rearing, and migration.

We also anticipate that long term changes in environmental conditions could affect the functioning of habitat for Atlantic and shortnose sturgeon. Both species are tolerant to water temperatures up to approximately 28°C (82.4°F); these temperatures are experienced naturally in some areas of rivers during the summer months, although they are rare in the Penobscot. If river temperatures rise and are in excess of 28°C, sturgeon may be excluded from some habitats. Increased droughts (and water withdrawal for human use) predicted by some models in some areas may cause loss of habitat including loss of access to spawning habitat. Drought conditions in the spring may also expose eggs and larvae in rearing habitats. If a river becomes too shallow or flows become intermittent, all shortnose sturgeon life stages, including adults, may become susceptible to strandings. Low flow and drought conditions are also expected to cause additional water quality issues. Any of the conditions associated with changing environmental conditions are likely to disrupt river ecology causing shifts in community structure and the type and abundance of prey. Additionally, to the extent that spawning may occur in the future in the action area, warmer water temperatures during the spawning period could affect the duration of spawning (considering alignment between daylength, water temperature, and other environmental cues) and could affect the success of rearing if water temperatures near or exceed thermal stress levels.

As there is significant uncertainty in the rate and timing of environmental change as well as the effect of any changes that may be experienced in the action area due to changing environmental conditions, it is difficult to predict the impact of these. However, based on the best available information, we do not anticipate any changes to the distribution of Atlantic salmon, shortnose sturgeon, or Atlantic sturgeon in the action area related to changing environmental conditions over the life of the proposed action; we also do not anticipate any changes in the statuses of the species overall or in the action area or the effects of the Environmental Baseline due to changing environmental conditions during this period.

# 5. EFFECTS OF THE ACTION

This section of a biological opinion assesses the effects of the proposed action on the threatened or endangered species and/or critical habitat that occurs in the action area. Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action, but that are not part of the action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 CFR § 402.02). This Opinion examines the effects of the proposed action on the GOM DPS of Atlantic salmon, shortnose sturgeon, the GOM DPS of Atlantic sturgeon, and critical habitat designated for Atlantic salmon and Atlantic sturgeon. We consider these effects on the species and their habitats within the context of the species status now and projected over the course of the action.

FERC's proposed action is to approve changes to the operation of the Milford Project consistent with the licensee's amended SPP, we expect this to occur through issuance of an amendment to the existing license (or else incorporate it into the license through some other process), which would persist until the expiration of that license (i.e., March 31, 2038), or else to the expiration of any annual licenses issued during the relicensing process. Lacking information regarding how long annual licenses will be authorized by FERC, if at all, we consider the term of this consultation to be approximately 13 years, which encompasses 12 fish passage seasons (i.e., 2026 through 2037). As described previously, the past effects of the Milford Project that are not affected by the modification of the license to operate are considered as part of the environmental baseline (section 4), and therefore are not addressed in this section. The USACOE action to permit activities associated with project modification will occur within this timeline.

## 5.1. Summary of Species Presence in the Action Area

### 5.1.1. Atlantic Salmon

As described in section 4.1, Atlantic salmon are stocked and naturally produced in the habitat upstream of the Milford Project. In the last decade, the average annual return to the river has been 921 individuals, ranging between 261 and 1,570 (USASAC, 2024). Returning adult salmon intercepted at the Milford lift are either transported to the GLNFH, or are released upstream of the dam. As explained above, approximately half of the adult salmon are collected and transported to the hatchery and the remainder are released upstream of the project. We, therefore anticipate that, on average, approximately half of the adults returning to the Penobscot River will remain in the river and have the opportunity to successfully spawn upstream of the project and that some will survive to swim back through the action area as they migrate back out to the ocean as post-spawn adults (kelts). Smolts in the river are produced via natural production and through stocking of various lifestages in the Penobscot River. Over the last decade (2015-2024) over 17 million eggs and juvenile salmon (fry, parr, and smolts) have been stocked in the Penobscot River upstream of the action area (USASAC, 2025). As such, we anticipate that hundreds of thousands of wild, naturally reared, and hatchery smolts pass through the action area every year.

Due to flow alterations at the Gilman Falls dam (which is part of the Milford Project), the Stillwater Branch downstream of that dam is included in the action area. However, that branch is not currently maintained as a migratory corridor for anadromous species. The Orono Project, at the mouth of the Stillwater, has a fish trap but no upstream fishway. All salmon trapped at the Orono project are transported by truck to habitat in the mainstem upstream of Milford. Both adult and juvenile salmon may drop down into the Stillwater Branch over the Gilman Falls dam during their downstream migrations, so there is potential that a small number of individuals may occur in the Stillwater Branch at certain times of year. As the dams in the lower Stillwater lack passage (Orono and Stillwater Projects) salmon cannot move back upstream once they drop into the Stillwater Branch. However, adult salmon that pass downstream of just the Gilman Falls dam likely will be able to swim back upstream given a side channel on the west side of the river that is expected to support upstream passage.

#### 5.1.2. Shortnose and Atlantic Sturgeon

Sturgeon are not intentionally passed above the Milford Project as it is located at a natural falls, which is considered the historical upstream limit for both species in the Penobscot River. However, seven adult and subadult shortnose sturgeon have been documented using the fish lift. As noted above, an unidentified sturgeon was also observed in the fish lift in June 2024. Sturgeon do occur in the portion of the action area that occurs downstream of the Milford Dam. As described above, the action area extends approximately 8 km downstream from the dam. Adult and subadult shortnose sturgeon and adult and subadult Gulf of Maine DPS Atlantic sturgeon have been documented in the action area. While suitable habitat for sturgeon spawning was expected to be available in the Penobscot River (Fernandes et al., 2010; Wegener, 2012; Dionne et al., 2013; Johnston, 2016; Johnston et al., 2019), sturgeon spawning has yet to be documented in any portion of the action area downstream of the dam. As such, we do not anticipate eggs, larvae, or juvenile life stages to be present in the action area.

### 5.2. Effects of Hydroelectric Operations on Atlantic Salmon

In this Opinion we are considering the effects of the action that FERC has proposed at the Milford Project in the mainstem Penobscot River. The proposed action would result in additional license requirements designed to improve downstream and upstream fish passage at the project. The proposal includes operational and structural changes that are designed to improve passage efficiency and survival of Atlantic salmon smolts and kelts, as well as to reduce migratory delay.

FERC has proposed to incorporate a modified upstream passage performance standard for salmon into the amended license for the Milford Project. In the context of their proposed action, performance standards establish targets for the efficacy of upstream and downstream passage that are then incorporated into an adaptive management strategy for avoiding and minimizing effects to Atlantic salmon. In general, performance standards can serve as important benchmarks for monitoring the success or failure of passage modifications at a project. Black Bear has committed to achieving these standards and has proposed measures that they believe are sufficient to do so. If the standards are not achieved after the proposed measures have been implemented, Black Bear has committed to work with us to identify additional structural and operational passage measures based on the study results. They will then implement the new measures, which could include new construction and/or modification of facilities, and reevaluate with additional studies. This adaptive process will continue until the performance standards have been achieved. If future activities are proposed that would result in effects to listed species or critical habitat not considered in this Opinion, consultation would be required to be reinitiated to address those effects.

## 5.3. Fish Passage Effects

### 5.3.1. Upstream Passage

The Milford Project passes diadromous fish through a fish lift that was constructed in 2013. Salmon need swim-through passage at the project to access abundant, suitable spawning and rearing habitat that is located upstream of the Project in the Penobscot River and its tributaries. Black Bear has proposed two measures that affect upstream efficiency and migratory delay. As described in section 2.2.1., they have proposed to operate the existing Denil fishway 24 hours a day, 7 days a week through the fish passage season (April 15 to November 15), and to construct a spill diversion wall to contain the flow from the western side of the Obermeyer inflatable flashboard system. Black Bear has indicated that they will conduct studies for up to three years to verify that the performance standard has been achieved. If they cannot demonstrate achievement of the standard during that time Black Bear will consult with NMFS to develop and implement additional operational or infrastructure measures, as reasonable and practicable, that are likely to meet or exceed the upstream performance standard.

Black Bear has also proposed to modify the upstream passage delay standard. The current requirement is that 95% of adult salmon pass the Milford Project within 48 hours of approaching within 200 meters of the dam. Black Bear proposes to modify the standard such that “95 percent of adult test fish that approach within 200 m of Milford Dam successfully pass the dam, with at least 75 percent passing within 48 hours and the remaining test fish (needed to achieve 95% passage efficiency) passing within 96 hours” (Black Bear BA).

Black Bear has proposed to adaptively manage fish passage at the Milford Project to achieve these efficiency and delay performance standards. These standards may not be achieved immediately with the proposal to operate the Denil and the construction of a spill diversion wall, and it is possible that additional operational and structural modifications may be necessary in order to achieve the standards[22]. As described in section 2.2.1, we expect that it will take up to six years (i.e., 2031) for both the upstream efficiency and delay standards to be achieved.

These measures and standards have the potential to affect the migration of adult Atlantic salmon in the Penobscot River. These effects are considered below. It should be emphasized that the below analysis does not consider salmon that are captured and transported to the hatchery (average approximately 50% of the run), as the effects of collection are covered under the USFWS section 10 permit.

Passage Efficiency

In section 4.4.1, we described how studies conducted by Black Bear and the University of Maine have documented that passage efficiency at the Milford Project is generally high. The University of Maine studies conducted between 2014 and 2020 (no study was conducted in 2017) indicate that the Milford fish lift had an average efficiency of 93% (ranging between 82% (2020) and 100% (in 2014)) (E Peterson, 2022). In 2014 and 2015, Black Bear (BBHP, 2015, 2016) and the University of Maine (Izzo et al., 2016) conducted concurrent studies with similar results. Black Bear estimated a passage efficiency of 96% in 2014, whereas Izzo et al. (2016) estimated an efficiency of 95%. Likewise, in 2015 Black Bear estimated a passage efficiency of 98% and Izzo et al (2016) estimated a passage efficiency of 100%. To estimate an average passage efficiency for the lift during those two years, we have averaged the Izzo et al. (2016) and Black Bear (BBHP 2015, 2016) passage efficiency estimates (i.e., 2014: (96% + 95%)/2 = 95.5%; 2015: (98% + 100%)/2 = 99%). We can combine these estimates with others reported in Peterson (2022) for the 2016 to 2020 timeframe (not including 2017, when no studies were conducted), to determine the average passage efficiency of the lift over a six-year period (2014-2020; excluding 2017). As such, we estimate that the lift passes an average of 93%[23] of Atlantic salmon that approach within 200 m of the dam (without consideration of how long that passage takes). The available information indicates that the upstream efficiency standard of 95%, although met in three of the six years (2014-2016), is not met every year.

The proposal to operate a second fishway (the existing Denil fishway) is intended to create another passage option for salmon as the approach the Milford powerhouse. As the Denil was the sole fishway at Milford prior to the construction of the lift in 2013, studies conducted prior to that year can be used to estimate potential efficiency of the Denil fishway. As described in section 4.4.1, upstream passage efficiency (i.e., number of fish that pass upstream of the dam divided by the number of tagged fish that approached the downstream side of the dam) ranged from 86 percent in 1987 to 100 percent in 1990 and averaged 90 percent (56 of 62) over five years of study (Dube 1988, Shepard 1991c, Shepard and Hall 1991, Shepard 1995).

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[22] If the operational or structural modifications needed to achieve the performance standard could lead to effects not considered in this Opinion, reinitiation of section 7 consultation would be required.

[23] Average passage efficiency estimate using UMaine (Izzo et al., 2016, Peterson, 2022) and Black Bear (BBHP 2015, 2016) studies between 2014 and 2020 (sequential, excluding 2017): (95.5% + 99.0% + 98.0% + 90.0% + 94.0% + 82.0%) / 6 years = 93.1%.

Although no significant evaluations have been conducted to evaluate the effectiveness of operating the two fishways together, Black Bear temporarily operated the Denil fishway from September 16 to October 2, 2024, in order to assess the operation and safety of the collection trap at the exit of the Denil. During that 16-day period, a total of 11 salmon passed the Milford project; with five utilizing the Denil and the other six using the fish lift. Although a very small sample size, these results suggest that salmon will make use of the Denil when the lift is operating and that it potentially could pass a meaningful proportion of approaching fish.

Given the above information, we conclude that the Denil is, on average, 90% (86% to 100%) effective and the fish lift is 93% (82% to 100%) effective on average; that is, we expect that this percentage of adult salmon approaching the Project would successfully pass through the respective fishways. However, we recognize that there is considerable variability in the effectiveness of both fishways. Given the variability in the existing data, we cannot estimate precisely how the proposed action will affect overall efficiency. If we assume that 93% of salmon will pass the lift (the average calculated from six study years), and that 90% of the remaining fish will pass the Denil, the cumulative passage rate would exceed 99% on average (i.e., 93.0% + (90% * (100% - 93%)) = 99.3%; noting that the math is identical if the calculations are reversed (i.e., if 90% pass the Denil and 93% of the remaining fish pass the lift)). However, it is possible that fish that are unable to successfully pass the lift may also be unable to pass the Denil if entrance conditions aren't suitable. That said, as both fishways have a history of individually passing well over 90% of the salmon that approach the project, it is reasonable to anticipate that when operated together passage efficiency will consistently exceed the 95% passage efficiency standard. As such, we anticipate that when both fishways are operational, no more than 5% of adult salmon will fail to pass upstream. These fish will be adversely affected due to migratory delay and the energetic impacts of having to locate alternative spawning habitat somewhere downstream. These effects are explained more fully below. We expect this 95% performance standard to be achieved within three to six years. Prior to the achievement of the standard, we anticipate that no more than 7% of salmon that approach the project will be adversely affected by being blocked from migrating further upriver.

Migratory Delay

As described in section 4.1.1, delay at dams can, individually and cumulatively, affect a salmon's ability to access suitable spawning habitat within the narrow window when conditions in the river are suitable for migration. Migratory delay has adverse energetic effects that may reduce the likelihood that salmon will successfully spawn and out migrate to the estuary following spawning, which in turn reduces the potential for repeat spawning attempts in subsequent years. A small increase in energy expenditure could affect an individual's ability to spawn or reduce the likelihood that they could survive to spawn in a subsequent year.

We do not currently have information regarding the amount of migratory delay that would lead to a significant reduction in the energy stores of an individual salmon. This threshold likely varies considerably depending on the number of barriers in the system, the travel distance to suitable spawning habitat, and the environmental conditions (e.g., flow, water temperature) in the river during migration, as well as the baseline condition of any given individual (e.g., how robust their energy stores are upon entering the river). However, lacking specific information, we have determined that it is reasonable to assume that 48 hours allows sufficient time for an adult to locate and utilize a well-designed fishway without being delayed to the point that there is a significant disruption to normal behavioral patterns (i.e., spawning). We do not expect that salmon that are delayed for less than 48 hours will experience adverse energetic effects, nor that this delay would meaningfully contribute to a cumulative energetic effect associated with multiple dam passage events, that could cause mortality or a failure to spawn. Conversely, we consider fish that take longer than 48 hours to pass a dam to experience adverse effects, as this delay could lead to a reduction in the energy available for spawning, and may preclude repeat spawning (i.e., iteroparity).

In the BA, Black Bear focused their analysis regarding delay at the Milford Project on upstream passage studies conducted in 2014 and 2015. They indicate that these studies (HDR 2015 (in BBHP, 2015); Kleinschmidt 2016 (in BBHP, 2016); and Izzo et al., 2016) provide a baseline of delay by which the benefits of potential enhancements can be weighed. Although additional radio telemetry studies were conducted by University of Maine researchers between 2016 and 2020 (as reported in Peterson (2022), and described in section 4.4.1), they did not provide the same level of detail regarding the number of adults that took more than 48 hours to pass the project. Peterson (2022) reported the median amount of delay in each year, but did not provide an estimate of the proportion of fish that exceeded the 48-hour threshold. As such, we will rely on the 2014 and 2015 results from the studies described above to characterize the amount of migratory delay at the project. As we expect that the range of delay that occurred in those study years is consistent with what we would expect to be observed in most years, it is reasonable to use those study results to characterize the amount of migratory delay as defined in the delay standard from Black Bear's 2012 SPP. Table 15 summarizes passage relative to the existing 48-hour standard[24] (corrected to remove radio-tagged adult salmon which initially approached Milford when the fish lift was offline or if river temperature was in excess of 23°C). Excluding the 2014 Black Bear study (which was confounded by the timing of adult arrivals relative to outages of the Milford fish lift associated with its initial "shake-down" year of operation), a total of 107 radio-tagged adult Atlantic salmon approached Milford dam with the lift in operation and with the Penobscot River water temperature less than 23°C. When pooled across the three studies assessing fish lift performance, 28% of salmon passed upstream of the project did so within 48 hours of arrival; and 72% passed in more than 48 hours.

Table 15. Summary of overall passage effectiveness, passage delay, and performance relative to the current upstream passage standard for adult Atlantic salmon as observed at Milford during operation of the upstream fish lift (Black Bear BA).

[24] The proposed performance standard for upstream fish passage requires "95 percent of adult test fish that approach within 200 m of Milford Dam successfully pass the dam, with at least 75 percent passing within 48 hours and the remaining test fish (needed to achieve 95% passage efficiency) passing within 96 hours" (Black Bear BA).

| Study Year | Passage Effectiveness | Duration of Delay (days) | | | No. Approach Under Standard Conditions | < 48 Hours | | > 48 Hours | | Source |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Min | Median | Max | | No. | % | No. | % | |
| 2014 | 95% | 0.3 | 3.0 | 78.4 | 10 | 5 | 50.0% | 5 | 50.0% | Izzo 2016 |
| 2015 | 100% | 0.4 | 4.0 | 26.9 | 49 | 17 | 34.7% | 32 | 65.3% | Izzo 2016 |
| 2014 | 96% | 0.1 | 1.1 | 16.1 | - | - | - | - | - | HDR 2015 |
| 2015 | 98% | 0.1 | 7.8 | 35.1 | 48 | 8 | 17% | 40 | 83% | Kleinschmidt 2016 |

For comparison, Shepard (1995) evaluated passage effectiveness and migratory delay at the Milford Project between 1987 and 1992 when the Denil was the sole passage option. The overall median delay was 1.8 days, whereas the yearly pooled median passage time ranged from 1.0 days to 5.3 days over five years of study. The total range of individual passage times over this study period was 0.1 days to 25.0 days (Shepard, 1995). These results indicate that the Denil fishway exhibited an overall median delay between 1987 and 1992 that was approximately half that of what was observed at the lift in 2014 and 2015 (i.e., 1.8 days versus 4.0 days).

Black Bear's proposal to operate the Denil fishway, in addition to the fish lift, throughout the Atlantic salmon migration period of April 15 to November 15, 24 hours a day, is expected to reduce upstream migration delay by providing an additional route for migrating salmon to pass upstream of the Milford Dam. All of the salmon that approached the fish lift entrance (as determined by detection at the radio receiver at the fish lift entrance) in 2015, did so within 24 hours; with 78% of them approaching within five hours (Izzo et al., 2016). Despite this, the median delay recorded in that study year was four days, with nearly two-thirds of fish taking more than 48-hours to pass the project (Table 15). The rapidity with which salmon found the fishway entrance suggests that attraction may not be the primary reason for the significant delay regularly observed at the project. Therefore, it is reasonable to conclude that some other factor associated with conditions at the lift entrance is causing fish to hesitate to use it or otherwise affect their ability to enter and pass upstream. The addition of a second fishway operating 24 hours a day (unlike the lift which only operates for a portion of each day) in the vicinity of the powerhouse will provide another passage option for fish that approach the powerhouse but choose not to use the lift or are otherwise unable to use the lift (i.e., during a time of day when the lift is not operational).

In addition to operating the Denil fishway, Black Bear has proposed to improve passage conditions by building a spill diversion wall to move flow that would otherwise go into the bypass reach on the western side of the river into the tailrace on the eastern side of the river. Specifically, the intent of the wall is to divert flow from the western end of the Obermeyer inflatable flashboard system to reduce stranding previously observed in the bypass area and ledge pools downstream of the western side of the spillway, and to further reduce the risk of adult salmon being attracted to the bypass area and the ledges below the center portion of the spillway, thereby reducing potential migratory delay. Black Bear's analysis in the BA suggests that the benefit of the spillway diversion wall will occur after May 15, when median flow conditions are at levels such that water will be passed downstream via the Obermeyer section, sluice gate, and powerhouse. A majority of the radio-tagged adult Atlantic salmon released during the 2015 Black Bear study (67 percent; Kleinschmidt 2016) initially approached Milford between May 15 and June 1, when flows have typically receded to the point that flow passing over the flashboard spillway on the western half of the dam is otherwise minimal. At this point, the diversion of flow from the western end of the Obermeyer, which would normally flow into the bypass reach, into the tailrace will significantly reduce the amount of false attraction to the western side of the dam (away from the powerhouse and the two fishways). The reduction in attraction to the western side of the dam (and the corresponding increase in attraction to the eastern side of the dam) should reduce the potential for fish to move up to the spillway where they could be delayed as they search for opportunities to pass. Black Bear indicates that 67% of the fish approaching the project would benefit from this improvement, based on results from a study conducted by Kleinschmidt Associates in 2015 (Kleinschmidt, 2016).

In a study conducted by Peterson (2022), the researcher characterized delay of approaching salmon in 2019 and 2020 based on how they approached the Milford Project:

> Overall, most fish experiencing delay (52/96; 54%) demonstrated a pattern of Extensive Searching, whereby time was divided evenly between the east shore (with the fishway) and the west shore. Fish exhibiting this behavior experienced median delays of 14 days (range 1-139, [Figure 4.4]). Many of the remaining fish had either an Eastern Focus (20/96; 21%) or an Eastern Exclusive (15/96; 16%) approach pattern. These fish ascended the dam more rapidly with a median delay of 5 days (range 0-13 [Figure 4.5]). In contrast, those fish with a Western Focus (8/96; 8%) or a Western Exclusive (1/96; 1%) behavior were either delayed longer (median of 13; range 2-180) or did not pass. [Peterson, 2022]

This study indicates that fish that spend time searching for passage on the western side of the dam will experience nearly three times as much delay as individuals that approach the eastern side of the dam. Therefore, decreasing flow into the bypass reach on the western side of the river should reduce delay for fish that would otherwise approach on that side; and may reduce the amount of searching conducted by fish that conducting for extensive searches. We therefore conclude that it is reasonable to expect that this flow diversion would lead to a meaningful reduction in migratory delay at the project.

We recognize that there is uncertainty in the extent that the proposed measures will, by themselves, lead to an adequate reduction in migratory delay at the Milford Project to allow the Project to meet the identified performance standard. The information summarized above suggests that migratory delay in excess of 48 hours occurs at both of these fishways when they are operated alone. The assumption that the operation of the two fishways together will perform better than when either is operated alone is based on very limited information. The short study conducted by Black Bear in 2024 with both fishways operating suggests that salmon will readily make use of the Denil when the lift is operating. However, the implications of these results for migratory delay are not clear. That said, as salmon locate the entrance of the fish lift quickly (78% within 5 hours; 100% within 24 hours (Izzo et al., 2016)), and appear to be willing to make use of either fishway, it is reasonable to assume that the operation of a second fishway would reduce the amount of time it takes for individual salmon to pass the project. However, without additional study we are not able to quantify that reduction. Similarly, we have little quantitative information to indicate precisely how much the decrease in attraction flow into the bypass reach (due to the construction of a diversion wall) will reduce migratory delay. However, given the relative difference in delay observed by Peterson (2022) between fish approaching the western side of the river versus the eastern side, it is reasonable to anticipate this measure will lead to some further reduction in delay. Despite this, while we are able to conclude that the proposed measures are reasonably likely to reduce delay and improve passage efficiency, there is not yet empirical evidence to support a conclusion that these measures are sufficient to achieve the proposed modified delay standard. Black Bear has indicated that if, after a one to three year evaluation period (most likely beginning in 2028 or 2029), these measures do not result in the achievement of the modified delay standard (i.e., 75% of adults passing within 48 hours, 25% passing within 96 hours) they "will develop and implement additional operational or infrastructure measures, as reasonable and practicable, that are likely to meet or exceed the upstream performance standard." If more measures are needed, we anticipate that the implementation and evaluation of any "reasonable and practicable" measures would occur during the three-year evaluation period. As such, for the sake of this analysis, we anticipate that within six years (i.e., three years until evaluation in 2029 plus the three-year evaluation period) of the issuance of this Opinion the performance standard will have been achieved (no later than 2031). As such, we anticipate that the baseline amount of delay for fish that pass the project (i.e., 28% < 48 hours; 72% > 48 hours) will persist for three to six years. When scaling these estimates to the proportion of the run affected (rather than the proportion of fish that pass above Milford), we anticipate that 26% of salmon will pass the project within 48 hours, 67% will pass in over 48 hours, and 7% will fail to pass. We use these scaled estimates in the below analysis.

It should be noted that motivation to migrate is likely linked to origin and that this may be a significant confounding factor in any study results assessing upstream passage, including measures of delay; that is, the location in the river where each individual fish is stocked or naturally produced. For instance, fish that are naturally produced or stocked downstream of Milford may be less motivated to pass upstream of the dam than adult salmon that are produced upstream of the dam in the Piscataquis or East Branch of the Penobscot. This is because the fish originating from upstream of the dam are imprinted on that reach of the river and are expected to be more likely to seek to return to those upper river reaches. In effect, fish that were produced or stocked downstream of the dam, but that pass upstream regardless, are strays. This could potentially affect measures of efficiency and migratory delay below the dam. The expert panel on upstream passage convened by NMFS in 2010 (described below) supported this concept when they assumed that adults will home to specific production units (i.e., where they were produced), and they acknowledged the challenge in estimating straying rates associated with separating "hatchery origin fish…from wild origin fish within the model due to the effects of straying and poor homing for the two different origins" (NMFS, 2012). Straying is a natural process that helps maintain population diversity through exchange of genes between populations and allows for population expansion and recolonization of extirpated populations. However, Atlantic salmon have a high degree of river of origin homing with straying rates of only 1-3% (Baum, 1997). Given that low rate, it seems probable that many fish would at least hesitate prior to migrating to habitat upstream of their point of origin. As such, it is probable that the migratory delay observed at the Milford Project is at least partially influenced by whether or not the individual fish are motivated to migrate past the project to habitat where they were stocked or naturally produced; or whether they are straying upstream of their stocking or production location. To control for this effect, Black Bear has proposed to only use study fish that have been stocked upstream of the dam when they evaluate migratory delay starting in telemetry studies in 2028 or

2029. We expect that such an approach would produce results that are more representative of the effects of the dam on upstream passage, including delay.

*Effects to Atlantic salmon that are delayed or do not pass upstream*

An expert panel comprised of state, federal, and private sector Atlantic salmon biologists and engineers with expertise in Atlantic salmon biology and behavior convened in 2010 to assess the fate of prespawn Atlantic salmon that are not able to pass a dam (i.e., never move upstream past the dam). Based on best professional judgement and in consideration of the best available information, the panel concluded that adult salmon that are unable to safely pass hydroelectric projects in the Penobscot River will either spawn in downstream areas, return to the ocean without spawning, or die in the river (NMFS, 2012). The group estimated a baseline mortality rate of 1% for Atlantic salmon that fail to pass a fishway at a given dam in the Penobscot River watershed. With respect to the Milford Project, the expert panel concluded that most adult Atlantic salmon (99%) that do not pass the Milford Project will stray and successfully spawn in downstream tributaries. The panel did not anticipate that any salmon unable to pass upstream of Milford Dam would return to the ocean without successfully spawning in the Penobscot River watershed. Applying the expert panel's conclusions would indicate that during the term of the proposed action when 7% (interim phase) and 5% (implementation phase) of approaching salmon would be prevented from passing upstream of the project; 99.3% and 99.5% would move to downstream habitat to hold or spawn, and 0.07% and 0.05%, respectively, would die. Given recent adult returns, we would not equate this extremely low rate of mortality to any dead fish.

The expert panel did not address the fate of the majority of fish that fail to pass a project, other than that they would stray to neighboring rivers to potentially spawn. This is likely due to the complicated dynamics that occur at an individual level (e.g., freshwater and marine environmental conditions, hydrosystem experience, motivation to migrate due to stocking or rearing location, proximity to appropriate cold-water holding areas, etc.) that would contribute to the fish's ultimate fate. However, the panel's conclusions generally reflect the expectation that fish that cannot pass a dam will be able to spawn successfully in alternative habitat. However, new information regarding the effects of passage inefficiencies on migrating Atlantic salmon suggests that this conclusion may underestimate the effect of migratory delay.

Upstream passage studies using prespawn adult Atlantic salmon indicate that salmon rarely fall back in the river as soon as they encounter a barrier to passage. Rather, they make repeated efforts to pass the barrier and may spend days, weeks, or even months, in that effort. Information is available regarding how long fish stay downstream of a dam as they attempt to pass, and some information is available on the fate of salmon that eventually abandon their attempts and move downstream. Several studies in the Penobscot have monitored the movement of salmon downstream of dams prior to passage. Izzo et al. (2016) monitored passage of adult Atlantic salmon at the Milford Project in 2014 and 2015 and documented that, while passage efficiency was very high, it took a substantial amount of time for all of the study fish to pass. Of the 49 tagged salmon that passed the project in 2015, two-thirds took longer than 48 hours to pass, and one took as long as 26 days (Izzo et al., 2016). In the previous year, one fish took as long as 76 days to pass the project. Similarly, Rubenstein et al. (2022) determined that adult salmon took an average of 23 days (up to 155 days) in 2018; and 11 days (up to 30 days) in 2019 to pass the Milford Project (Rubenstein et al., 2022). This does not rule out the potential for prespawn adults to drop downstream after encountering a barrier in order to find alternative spawning habitat or refuge, as indicated by the expert panel. However, it does suggest that many salmon will continue their attempts to pass the dam for a significant amount of time prior to doing so. Given this, and new information regarding the effects of thermal conditions on adult salmon during migration, it is appropriate to expand the expert panel's estimate of baseline mortality to apply to fish that are significantly delayed.

The analysis in section 4.1.3 indicates that although the thermal stress threshold may be regularly exceeded in the action area downstream of the dam direct lethal effects due to elevated water temperature are less likely to occur. The mortality threshold of 24°C needs to be exceeded for seven consecutive days to be considered lethal; and while our analysis suggests that this could occur, a review of a subset of the data suggests that except for the months of July and August those >24°C days are unlikely to be consecutive. Regardless, it is clear that the temperature in the mainstem during the months of July and August, in particular, is hazardous for salmon, and mortality could occur if temperatures exceed thresholds for a period of consecutive days and fish are unable to locate cool water in which to hold.

In addition to the potential for thermally induced mortality of fish held in warm water below the dam, the blockage of passage is likely to increase energy depletion in prespawn salmon migrating to habitat above the Milford Dam. As described in section 4.4.1, Rubenstein (2021 and 2022) demonstrated that upstream passage delays could convey effects upon Atlantic salmon (S. Rubenstein, 2021; Rubenstein et al., 2022). Specifically, passage delay was directly linked to thermal experience and energy loss. As a consequence of these energetic effects, Rubenstein's work suggests that migratory delay due to dam passage may result in broader demographic effects by reducing the number of salmon that are able to spawn successfully, or to return to spawn again in subsequent years (iteroparity). Given Rubenstein's analysis, we anticipate that significant migratory delay (>48 hours) attributed to the blockage of passage at the Milford Project will lead to adverse effects in these individuals associated with energy loss. Similarly, salmon that fail to pass entirely are also expected to experience high levels of migratory delay. Although we expect most of these fish to eventually locate cold water and alternative spawning sites (as envisioned by the expert panel), we would expect them to use up some amount of their energy reserves during that search. As such, we anticipate that for the first three to six years of the proposed action that, in addition to the 7% that fail to pass, 67% of the run will be adversely affected due to passage delay (>48 hours) at the Milford Project. Similarly, we anticipate that during the implementation phase of the proposed action (year 7 to year 13) that, in addition to 5% that fail to pass, 24% of the run will be adversely affected. During this phase, only the 5% that fail to pass would be expected to be delayed by more than 96 hours.

We anticipate that adult Atlantic salmon that are held downstream of the Milford Project in the warm summer months will be exposed to adverse temperature conditions as they will be blocked from accessing cooler areas upstream where they would otherwise hold until it was time to move to spawning habitat in the months of November and December. Some salmon will likely fall back to cooler water tributaries lower in the river, or move to groundwater discharge areas in the mainstem. However, the disruption of normal migratory behavior during the warmest time of year could lead to some fish being exposed to warm water temperatures for extended periods of time; this is expected to cause them to use energy faster than they would have but for the presence of the dam. The depletion of energy stores would affect the condition of the fish and increases the potential that affected salmon will not survive to spawn. Given the variability in the timing of approach (i.e., some could arrive in the cooler months of May, June, September, and October whereas others could be in the area in the warm months of July and August), and the motivation to migrate (partially dependent on stocking location), we cannot estimate how long individual fish will be delayed overall or how long they would hold in warm water downstream of the dam prior to falling back to seek cool water refuge or alternative spawning habitat. However, we expect that of the fish that are delayed for longer than 48 hours, some will be exposed to adverse conditions that are expected to significantly affect their physiological condition and affect the probability that they survive. As such, we anticipate that a proportion of salmon that approach the Milford Project during the term of the action will be adversely affected.

Above, we have determined that migratory delay of greater than 48 hours would significantly disrupt the behavioral patterns of individual adults. Although delay can potentially impair essential behavioral patterns to the point that injury or mortality could occur as a result (e.g., an adult could die either before or after spawning because of the energy loss associated with migratory delay), we do not anticipate that to occur to every fish that is delayed by more than 48 hours. Although spawning habitat in the East Branch Penobscot and Piscataquis Rivers is a significant distance from the Milford Dam, there is abundant tributary habitat upstream and downstream of the dam that can provide cold water habitat for individuals to hold or to spawn. Additionally, most of the salmon delayed at Milford will approach the project prior to temperatures exceeding the mortality threshold of effect (above which the probability of energy depletion and mortality increases), and those that do not will be able to access cool water habitat in the tributaries downstream of the project (e.g., Soudabscook Stream, Kenduskeag Stream, Cove Brook, Ducktrap River, Great Works Stream). Salmon migrate significantly less when water temperatures exceed 23°C, and they generally find cold water areas to hold during these periods. As such, we anticipate that, although salmon exposed to warm water for an extended amount of time may deplete their energy reserves to the point of death, most of them will still be able to seek out and find cold water areas.

Under the ESA, "[t]he term `take' means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." We have determined that migratory delay of greater than 48 hours would significantly disrupt the migratory and spawning behaviors of adult salmon in the action area by depleting their energy reserves and exposing them to deleterious water temperatures that will cause physiological stress to those adults; above, we quantified the percentage of adult returns we expect to experience such effects. The consequence of that stress will depend on the condition and experience of the individual salmon, but is expected to span the spectrum between minor energetic effects (that could lead to minor changes in behavior) to injury, and potentially to mortality. For example, consequences of the delay to a healthy salmon in good condition that is delayed for only a few days is likely to be less severe than for a salmon in poor body condition that is delayed for multiple weeks and is present in the action area when water temperatures are warmest. To estimate the proportion of salmon that could be subject to injury or mortality due to migratory delay (rather than harassment), we consider the proportion that pass the Milford Project when the threshold temperatures for effect are exceeded. Table 9 in section 4.1.3 indicates that in July and August the temperature exceeds the stress threshold (>20°C) the majority of the time (100% in July, 86% in August); whereas it exceeds the lethal threshold (>24°C; threshold needs to be exceeded for 7 consecutive days to be lethal) approximately half of that time (56% in July, 36% in August)). In the months of June and September, temperatures rarely exceed the lethal threshold (<5% of the time), although the stress threshold is still reached regularly (46% of the time). Based on the weekly fish passage numbers reported by Black Bear over the last three years (2022-2024), we expect an average of 14% (10%-17%) of adult salmon pass in the months of July and August when we expect temperature to be the highest. If we apply the estimated proportion of delayed fish overall to the proportion of fish that pass in the two months when the temperature thresholds are regularly exceeded, we can estimate the proportion of the salmon run that could be at risk of injury due to delay at the project. As such, we anticipate that during the interim phase up to 10% of the salmon run would be injured (i.e., 74% exceed 48 hours x 14% passing in July and August = 10% of the total salmon run). During the implementation phase, the proportion of injured salmon is reduced to 4% (i.e., 29% exceed 48 hours x 14% passing in July and August = 4% of the total salmon run). As such, we anticipate that up to 10% of the run in the interim phase, and up to 4% of the run in the implementation phase, will be injured due to migratory delay. As indicated, it is reasonable to conclude that up to 10% of adult salmon could be injured due to energy depletion exacerbated by thermal stress during the interim phase of the action. If mortality results from that injury, it would likely occur later in time, either prior to spawning or afterwards. Although 4% of the run could be injured due to migratory delay during the implementation phase, we do not anticipate that these fish would die since we would not expect fish to be delayed for more than 96 hours. We would not expect that delay of that duration would lead to sufficient energy loss to kill a salmon; and, as that duration is considerably less than the 7-day lethal effect threshold described previously. As described in the Environmental Baseline, MDMR (2017) has mapped spawning habitat downstream of the Milford Project. We don't expect most of this habitat to function well as it occurs in the mainstem, but habitat has also been documented in multiple accessible tributaries (i.e., Cove Brook, Great Works Stream, Soudabscook Stream, Kenduskeag Stream) downstream of the action area.

As indicated above, some proportion of the injured fish could eventually die due to the cumulative effects of delay and exposure to warm temperatures during their riverine migration. However, for the reasons discussed above, we anticipate that most of these fish will successfully locate cold water habitat downstream and upstream of the project. To estimate the proportion of adult salmon that could die either as a result of failing to pass, or of being delayed by more than 48 hours, it is appropriate (for the reasons described above) to extend the expert panel's mortality estimate (i.e., 1% of affected individuals) to fish that are significantly delayed. As such, during the interim phase, we would expect that approximately 1% of the total run (i.e., 1% mortality estimate x 67% that pass in more than 48 hours = 0.74%, rounded up to 1%) would die. We anticipate that this mortality would come from the injured fish that are delayed in passing during the warmest time of year. As indicated above, given that migratory delay is capped a 96 hours during the implementation phase, we do not anticipate any fish to die as a result of migratory delay at that point.

NMFS Interim Guidance on the ESA Term "Harass" (PD 02-110-19; December 21, 2016) provides for a four-step process to determine if a response meets the definition of harassment. The Interim Guidance defines harassment as to "[c]reate 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."  The guidance states that NMFS will consider the following steps in an assessment of whether proposed activities are likely to harass: 1) Whether an animal is likely to be exposed to a stressor or disturbance (i.e., an annoyance); and, 2) The nature of that exposure in terms of magnitude, frequency, duration, etc. Included in this may be type and scale as well as considerations of the geographic area of exposure (e.g., is the annoyance within a biologically important location for the species, such as a foraging area, spawning/breeding area, or nursery area?); 3) The expected response of the exposed animal to a stressor or disturbance (e.g., startle, flight, alteration [including abandonment] of important behaviors); and 4) Whether the nature and duration or intensity of that response is a significant disruption of those behavior patterns which include, but are not limited to, breeding, feeding, or sheltering, resting or migrating.

Here, we carry out the four-step assessment to determine whether the failure to pass salmon leads to harassment.  We have established that prespawn migrating adult salmon in the action area will encounter the dam and that they will cause a disruption of their upstream migrations (step 1) and that 7% of adults in the interim phase and 5% of adults in the implementation phase will be blocked from passing the project, respectively (step 2).  We have established the expected response of the exposed adults (step 3): individual adults blocked from migrating upstream will stray downstream to search for suitable spawning habitat, which will delay their spawning and have energetic impacts.  Finally, we establish that the nature and duration of the response is a significant disruption of migration (step 4).  Based on this four-step analysis, we find that individual adults blocked from continuing their upstream migration are likely to be adversely affected and that effect amounts to harassment.  Therefore, we anticipate that up to 7% of migrating adults during the interim phase, and 5% of adults during the implementation phase will be blocked from accessing spawning habitat above Milford and will need to locate alternative habitat, which will lead to potential spawning delay, which we consider to meet the definition of harassment.

Here, we carry out the four-step assessment for determining if delaying passage of adult salmon at the Milford Project meets the definition of harassment.  This analysis does not consider the proportion of salmon that we consider above to be injured due to excessive delay during the warm summer months (i.e., July, August).  Rather it considers the delay of migrating adults that occurs outside of that time of year.  We have established that during the term of the action, prespawn adult salmon could be exposed to the thermal effects of migratory delay, which constitutes a disruption of their upstream migrations (step 1).  We expect that 57% (interim) and 20% (implementation) of the salmon run would be exposed to potentially detrimental habitat conditions downstream of the dam for more than 48 hours before they are able to pass the dam (step 2).  We have established the expected response of the exposed adults (step 3).  Individual adults delayed more than 48 hours during their upstream migration will need to expend additional energy, which will reduce the energy reserves available for successful spawning.  This effect is more pronounced when the stress temperature threshold (>20°C) is exceeded, which occurs between June and September.  Finally, we establish that the nature and duration of the response is a significant disruption of migration (step 4).  Based on this four-step analysis, we find that individual prespawn adults delayed for more than 48 hours are likely to be adversely affected and that effect meets the definition of harassment.

In summary, we expect adverse effects that rise to the level of take, as defined in the ESA, for all Atlantic salmon in the action area below the Project when they are delayed by more than 48 hours. Below, we have summarized the proportion of the run that is harassed, injured, and killed due to upstream passage inefficiencies (Table 16).

Table 16. The estimated amount of take associated with passage inefficiencies (i.e., blockage and delay) associated with the proposed revisions to the SPP at the Milford Project.

| | Type of Take | Interim (Y 1 - 6) | Implementation (Y 7-13) |
|---|---|---|---|
| **Proportion of Total Run** | | | |
| Fish that pass successfully within 48 hours | Not applicable* | 26% | 71% |
| Fish that fail to pass | Harassment | 7% | 5% |
| Fish that pass in > 48 hours | Harassment | 57% | 20% |
| Pass in > 48 hours in warm water | Injury | 9% | 4% |
| Mortality due to significant delay | Mortality | 1% | 0% |

* No adverse effects anticipated

Passage Injury

It is probable that some amount of injury is caused by passage through the Denil fishway and the fish trap at the Milford Project. To address this, the performance standard considered in the 2012 Opinion required that Black Bear monitor the condition of fish when they are trapped at Milford lift, indicating that:

> The upstream migrants must not exhibit any trauma, loss of equilibrium, or descaling greater than 20% of the body surface. Trauma is defined as injuries including, but not limited to, hemorrhaging, open wounds without fungus growth, gill damage, bruising greater than 0.5 cm in diameter, etc. Fish displaying these injuries or signs of trauma will be categorized as not having passed safely and will be considered failures.

Although a condition of the performance standard, this aspect was not implemented in the upstream passage studies as it was not possible to distinguish injury attributable to passage at the dam from injury sustained through any other part of an individual salmon's migration from the Labrador Sea. That said, it is highly probable that some of the injury observed in salmon attempting to pass the Milford Project is due to exposure to the project fishway, or potentially to the time they spend downstream searching for a route past the project. In a recent analysis of observed injuries at the project it was determined that over a 46-year period (1978-2024), 18% of salmon captured at the Milford Project or Veazie Project (prior to its removal) exhibited injury types (i.e., abrasion, contusion/bruise, laceration, scale loss, split/torn fin) that were deemed consistent with long searching behavior downstream of the dam (Hallett, 2026). It was also observed that injury rates were significantly higher starting after 2013, when the Veazie Dam was removed and salmon began being captured at the Milford Project. It is possible that the excessive delay downstream of the Milford Dam is the reason for this increase, or that there is some component (or components) of the fish lift and handling facility that leads to a higher injury rate. There could also have been changes in the monitoring approach or the scoring of fish condition over the 46-year evaluation period that affected that result. It is also possible that some other change occurred along the lengthy migration route taken by these fish. Despite the uncertainty, it appears likely that some amount of injury is associated with the passage of fish at the project. A review of the condition information recorded by Maine DMR since the construction of the Milford lift (Jason Valliere, Maine DMR, Personal Communication, 1/23/2026), indicates that 54 % of the injuries were categorized as 'abrasions'; 28% were categorized as 'scale loss'; 11% were categorized as 'split/torn fin'; and 6% were categorized as 'laceration'. Although it is impossible to ascertain the seriousness of these injuries from the available information, the fact that they were on fish that were actively migrating would suggest that the immediate effect to migration was minimal, and potentially insignificant. However, it is possible that the cumulative effects of multiple injuries associated with multiple fish passage events, or the delayed effect of injury sustained after a single passage event, could lead to the mortality of a fish. At this point, there is inadequate information to evaluate the specific source, scale, or consequence of any passage injuries associated with the action.

Stranding

As described in section 4.4.1, Black Bear implemented measures in 2017 (the filling of pools on the west side of the dam to prevent them from holding water) and 2019 (leaving two flashboards uncaulked to allow for leakage flow to allow egress out of certain pools) to reduce stranding. Black Bear's proposed enhancement measure to build a spill diversion wall to contain discharge flows from the western side of the Obermeyer inflatable flashboard system will further reduce the risk of adult salmon being attracted to, and becoming stranded in, the ledges below the center portion of the spillway. According to analysis in the BA, during the median flow year (Normandeau, 2023), unavoidable spill flow via the western overflow section and into the western reach downstream of Milford is present during the first half of May (May 1 through May 15). Median flow conditions after May 15 are at levels such that they will be passed downstream via the Obermeyer section, sluice gate, and powerhouse. A majority of the radio-tagged adult Atlantic salmon released during the 2015 Black Bear study (67 %; Kleinschmidt 2016) initially approached Milford between May 15 and June 1. The presence of the spill diversion wall to eliminate wayward discharge from the Obermeyer section into the ledges below the center portion of the spillway will reduce attraction and subsequent stranding to that area. In addition to constructing the wall, Black Bear proposes to continue monitoring downstream pools after significant spill events and during flashboard replacement, collect any stranded Atlantic salmon and release them back into the river, and provide flow into larger, inaccessible pools to maintain water quality suitable for salmon. Black Bear will record its monitoring actions following each significant spill event. Given the implementation of the proposed measures and the minimal stranding that has occurred since measures were implemented in 2017 and 2019 (Table 11 in section 4.4.1), we anticipate that no more than two salmon (the maximum number of salmon that have been stranded since 2019) a year will be temporarily captured due to stranding in the ledges below the dam on an annual basis.

For adult salmon, capture due to stranding delays migration, exposes individuals to greater predation risk, increases injury rates due to contact with the ledges, and increases stress due to handling and transport if they need to be rescued. Additionally, because stranding pools warm more rapidly than free flowing water, stranding pools induce stress and increase energy expenditure. Existing protocols to monitor stranding pools and rescue stranded salmon have prevented mortality, however, rescued salmon have been documented to have sustained injuries, and were subject to other stressors outlined above.

<u>Broodstock Collection</u>

As described in the *Environmental Baseline*, some prespawn adult Atlantic salmon that use the Milford lift are subsequently trapped and taken to the Craig Brook National Fish Hatchery, which is operated by the US Fish and Wildlife Service. These salmon are spawned out at the hatchery, and the resulting eggs and juveniles are used to sustain the salmon population in the Penobscot SHRU, as well as the Kennebec River in the Merrymeeting Bay SHRU. The vast majority of salmon returning to the Penobscot River are of hatchery origin. For example, in 2024, 1,321 of the 1,384 returning salmon (>95%) were of hatchery origin (CMS, 2025). As such, at this time the continued survival of the GOM DPS of Atlantic salmon is dependent on the continued production of juveniles in the hatcheries; which in turn is dependent on the ability to capture a sufficient number of adults at the Milford lift and trap. The operation of the Denil fishway would allow salmon to pass upstream of the dam without going through the lift where the trapping facility is located. This could reduce the likelihood of achieving established broodstock targets by reducing the number of adults available for trapping and transport to the hatchery. Black Bear has constructed a trap that can be installed on the end of the Denil to provide an alternative approach to capturing broodstock. However, the safety of the trap has not been adequately evaluated, and there are handling and transport challenges associated with operating it for the collection of broodstock (i.e., salmon would need to be captured out of the trap and transported to the handling facility). Ultimately, the decision regarding the safest and most efficient approach for the collection of broodstock will be made by Maine DMR and USFWS. We note here that the effects of broodstock collection at the Milford Project are not effects of FERC's action and are considered through a separate ESA process (i.e., issuance of an ESA section 10 permit by USFWS). Nevertheless, the proposed action considered in this Opinion is expected to result in adult salmon using the Denil fishway rather than the lift, and that could potentially result in a reduction in the number of fish available for broodstock collection. As the collection of broodstock is necessary to prevent extinction of the species, Black Bear may be required, under certain conditions, to either install the broodstock collection trap on the Denil fishway, or else shut down the Denil for a certain amount of time in order to facilitate the collection of broodstock at the existing collection facility.

A potential approach for minimizing the effect of operating the Denil fishway on the collection of broodstock at the existing fish lift and handling facility is to take it out of operation when necessary, which would result in all upstream migrants passing through the lift where they can be captured in that trap. In consideration of broodstock targets, Maine DMR and USFWS might decide that the Denil should not be operated until a certain date, in order to ensure that an adequate number of broodstock can be collected at the lift before another passage option is provided. During these periods we expect that migratory delay would be higher than when both fishways are in operation. However, salmon passing the project during these periods would be trapped and transported to the hatchery, rather than being allowed to swim pass the project to locate spawning habitat in the upper Penobscot. As captured fish would be released into cold-water holding pools at the hatchery within hours of being trapped, they are less susceptible to the energetic effects associated with migratory delay and the effects outlined above are less likely to impact individual fitness.

The alternative to not operating the Denil to meet broodstock collection targets at the lift is the installation of the trap at the exit of the Denil. Installing the trap should not affect the efficiency of the Denil fishway by salmon and other species since it does not affect attraction to the entrance or flow through the fishway itself. However, it could injure adult salmon that are trapped at the exit.

Regardless of the measures used for the collection of broodstock, we would not consider any resulting consequences to individuals as effects of this proposed action. Rather, they would be considered as effects of fisheries management activities that are addressed under the section 10 permit issued by USFWS.

#### 5.3.2. Downstream Passage

The continued operation of the Milford Project consistent with the terms of the proposed action will continue to affect migrating salmon by killing, injuring, and delaying smolts and kelts passing downstream through project facilities. Section 4.4.1 describes the effects that operating the project under the current license has on migrating salmon. We have estimated that under baseline conditions (e.g., operation of the project consistent with the terms of their current license) the project results in the mortality of approximately 11% of all smolts travelling through that reach of river due to both immediate and delayed effects. We also have estimated that under baseline conditions approximately 4% of migrating postspawn adults (kelts) are killed when migrating past the project (consistent with the performance standard and 2012 ITS). In this section we analyze how the operation of the project consistent with the proposed action is likely to affect smolt and kelt survival in the Penobscot River.

As indicated above, FERC has proposed to modify the Milford license to incorporate revisions to the existing SPP, presumably through an amendment to the license. The proposed revisions are designed to further reduce direct and indirect adverse effects to Atlantic salmon, including downstream migrating smolts. FERC has also proposed to continue the existing performance standard for smolts and kelts (96% survival). This standard, as defined, applies to direct mortality, but not indirect mortality (impoundment and hydrosystem delayed mortality). When evaluating the effects of the proposed passage measures in the context of the achievement of the established performance standard, we will consider all direct mortality attributable to the project. As such, we will proceed to evaluate the proposal with the understanding that the total mortality associated with dam passage can be represented by a conceptual equation: mortality in the impoundment[25] + direct mortality at the dam + hydrosystem delayed mortality in the estuary = total dam-related mortality; and that the established performance standard applies only to direct mortality. We consider these sources of mortality below.

Black Bear's proposal to enhance downstream passage conditions for smolts by increasing the duration of spill releases (20-50% of river flow) from 14 days to 54 days is consistent with

[25] Impoundment effects are not considered Effects of the Action (section 5) for the proposed license amendment, but are considered in the Environmental Baseline (section 4).

recent research and measures implemented at other hydro projects in the GOM DPS (Frechette et al. 2022; NMFS 2023; FERC 2024). In analyzing the effect of this measure, we need to determine how it affects direct and indirect (impoundment and hydrosystem delayed mortality) survival as described in section 4. The intent of the measure is to reduce turbine entrainment and increase passage over the spillway, downstream bypass, or sluice. Therefore, to analyze the effects we must first estimate how the measure will change the proportion of fish going to turbine and non-turbine passage routes, and then apply appropriate route specific survival rates as specified in Black Bear's BA. The information obtained from the smolt studies in 2014-2018 will be used to estimate both of these factors. As these studies provide specific information on the proportion of fish using each route and the direct survival through each route, it is relatively straightforward to estimate how a given measure could change survival at the project. However, it is less apparent how passage route selection relates to hydrosystem delayed mortality. As we understand it is affected by migratory delay and injury associated with turbine entrainment (BBHP, 2017; Storch et al., 2022; Stich et al., 2015; Stevens et al., 2019), we anticipate that any reduction in entrainment and migratory delay would lead to a reduction in hydrosystem delayed mortality.

To demonstrate the anticipated difference in smolt survival under the existing baseline condition (i.e., spill release of 20-50% of river flow for a 14-day duration) versus the proposed enhanced condition (i.e., spill release of 20-50% of river flow for a 54-day duration), passage route utilization and route-specific mortality rates observed during the 2014-2018 Black Bear smolt studies at the Milford Project were considered along with the Smolt Wave Projection Tool developed by NMFS and MDMR (Frechette et al., 2023). Frechette et al. (2023) utilized data from long-term smolt trapping locations in Maine to characterize run duration, identify a standardized smolt run, and develop a predictive model for the initiation of smolt emigration. As described in Frechette et al. (2023), the standardized smolt wave is unimodal with a duration of 54 days. The predictive run timing model incorporates the mean of the average daily air temperature for days 1 through 90 of the calendar year to predict the date of occurrence for 25% of the smolt run.

In the BA, Black Bear presented route utilization for radio-tagged Atlantic salmon smolts that moved downstream of Milford during the 2014-2018 studies by operating condition; those observed during implementation of "protective measures" (i.e., intentional spill release of 20-50% of river flow) or "normal operations" (i.e., no protective spill measures in place) (Table 17). To provide a single estimate of the distribution among downstream passage routes at Milford for each operating condition, individuals utilizing each route across the 2014 and 2015 study years were pooled as representative of "normal operations," while the 2016 through 2018 study years were pooled as representative of "protective measures." Route utilization was then calculated relative to the full number of smolts passing Milford during the corresponding multiple year period.

Table 17. Passage route utilization rates for Atlantic salmon smolts at Milford observed during the 2014-2018 Black Bear telemetry studies (Black Bear BA).

| Study Year | Spill Measures in Place? | #Detected w/ Known Passage | Route | | |
|---|---|---|---|---|---|
| | | | Spill | Bypass | Turbine |
| 2014 | No | 80 | 35% | 21% | 44% |
| 2015 | No | 81 | 10% | 9% | 81% |
| 2016 | Yes | 189 | 84% | 5% | 11% |
| 2017 | Yes | 256 | 88% | 2% | 9% |
| 2018 | Yes | 168 | 90% | 4% | 6% |
| 2014-2015 Pooled | No | 161 | 22% | 15% | 63% |
| 2016-2018 Pooled | Yes | 613 | 87% | 4% | 9% |

Black Bear has estimated route specific survival rates by averaging survival over the five study years (Table 18). To provide a single estimate of downstream passage survival at Milford, a weighted average was calculated that considers the annual variation in sample size within each downstream route as well as the contribution of each study year to the overall estimate based on the number of individuals passing in a given year. These weighted averages result in survival estimates for smolts passing Milford via spill, the downstream bypass facility, and the turbine units of 97.4%, 100.0%, and 80.7%, respectively.

Table 18. Annual and weighted-average route specific passage rates for Atlantic salmon smolts at Milford observed during the 2014-2018 Black Bear telemetry studies (Black Bear BA).

| Route | Study Year | n | Reported Survival Rate |
|---|---|---|---|
| Spill | 2014 | 28 | 96.4 |
| | 2015 | 8 | 100.0 |
| | 2016[a] | 189 | 94.9 |
| | 2017[a] | 226 | 99.1 |
| | 2018[a] | 151 | 98.0 |
| | **Weighted Avg.** | **602** | **97.4** |
| Bypass | 2014 | 17 | 100.0 |
| | 2015 | 7 | 100.0 |
| | 2016 | 9 | 100.0 |
| | 2017 | 6 | 100.0 |
| | 2018 | 7 | 100.0 |
| | **Weighted Avg.** | **46** | **100.0** |
| Turbine | 2014 | 35 | 88.6 |
| | 2015 | 66 | 69.5 |
| | 2016 | 21 | 81.0 |
| | 2017 | 24 | 95.8 |
| | 2018 | 10 | 90.0 |
| | **Weighted Avg.** | **156** | **80.7** |

a - weighted average of reported survival rates for Obermeyer and sluice gate

To evaluate the impact of Black Bear's proposal to enhance spill conditions by increasing the duration of spill releases (20-50% of river flow) from 14 to 54 days, information from Frechette et al. (2023) and the 2014-2018 Black Bear smolt passage route and survival studies were combined. Although not implemented during the study years, since 2023 Black Bear has implemented the spill measure at Milford based on the date predicted by the Smolt Wave Projection Tool as representing the first 25% of the cumulative smolt passage. Under the proposed enhancement to increase the duration of intentional spill (as opposed to spill that incidentally occurs when flow exceeds the powerhouse capacity) at Milford from two weeks to 54 days, Black Bear will begin protective measures each year on the initial predicted date of smolt passage at Milford.

Based on the standardized smolt run developed by Frechette et al. (2023), Black Bear has estimated the proportion of the smolt run that would be expected to pass the project prior to, during, and following the implementation of spill during the baseline and proposed enhanced scenarios (Table 19). For the baseline scenario, approximately 31% of downstream smolt passage at Milford lands outside of the 14-day period of intentional spill; either prior to initiation (~24%) or after completion (~7%); and that 69% pass within that two week period. In contrast, the proposed enhanced scenario represents 99.9% of the standardized smolt run when voluntary spill conditions are implemented for a 54-day period.

Table 19. Estimated cumulative percentage of the standardized Atlantic salmon smolt run occurring prior to, during, and after implementation of voluntary spill conditions under the baseline and proposed enhanced measures scenarios (Black Bear BA).

| Scenario | Percentage of Smolt Run Relative to Timing of Protective Measures | | | Run Days Encompassed |
|---|---|---|---|---|
| | Prior | During | Post | |
| Baseline | 24.29% | 68.88% | 6.84% | Days 21-34 |
| Proposed | 0.00% | 99.90% | 0.01% | Days 1-54 |

Total project survival for each scenario was calculated by taking the scenario-specific percentages of the standard smolt run for both the baseline and proposed scenarios; partitioning those values by the relative contributions of each passage route with and without intentional spill measures in place (Table 20). The route specific survival estimates are then applied to the proportion of fish anticipated to use each route and then the products are summed to estimate the total survival for the baseline and proposed scenarios. Total project survival for outmigrating smolts at Milford for the baseline scenario is estimated at 93%. The predicted estimate of total project survival for outmigrating smolts at Milford increases to 96% when the proposed enhanced voluntary spill conditions are extended to a 54-day period.

Table 20. Estimated total project survival of outmigrating smolts at Milford under the baseline and proposed enhanced measures scenarios. Revised Table 5-8 of BA to show more of the calculation.

| Scenario | % of Standardized Run | | Route | Use Rate | Prorated Use* | Route Survival | Prorate Survival^ | Total Survival |
|---|---|---|---|---|---|---|---|---|
| Baseline | Spill Measures | 0.689 | spill | 0.874 | 0.602 | 0.974 | 0.586 | 0.933 |
| | | | bypass | 0.036 | 0.025 | 1.000 | 0.025 | |
| | | | turbine | 0.090 | 0.062 | 0.807 | 0.050 | |
| | No Spill Measures | 0.311 | spill | 0.224 | 0.070 | 0.974 | 0.068 | |
| | | | bypass | 0.149 | 0.046 | 1.000 | 0.046 | |
| | | | turbine | 0.627 | 0.195 | 0.807 | 0.157 | |
| Proposed | Spill Measures | 0.999 | spill | 0.874 | 0.873 | 0.974 | 0.850 | 0.960 |
| | | | bypass | 0.036 | 0.036 | 1.000 | 0.036 | |
| | | | turbine | 0.090 | 0.090 | 0.807 | 0.073 | |
| | Spill Measures | 0.001 | spill | 0.224 | 0.000 | 0.974 | 0.000 | |
| | | | bypass | 0.149 | 0.000 | 1.000 | 0.000 | |
| | | | turbine | 0.627 | 0.001 | 0.807 | 0.001 | |

* Use Rate * % of Standardized Run

^ Prorated Use * Route Survival

Given this analysis, we anticipate that the proposal to increase the supplemental spill period from 14-days to 54-days will increase direct survival of smolts from 93% to 96% on average.

As indicated in section 4, we consider the causative factors for hydrosystem delayed mortality to be migratory delay and sublethal injury. In our analysis above, we indicate that turbine passage likely contributes to sublethal injury. As we have described, we anticipate that the proposed measure will reduce the proportion of fish that pass via the turbine units. Given the analysis above, we anticipate that turbine entrainment will be reduced from 26% to approximately 9%. The reduction in turbine entrainment also reduces the potential for injury. Based on these improvements, we anticipate that the proposed action would reduce sublethal injury rates from 1.9% to 0.7% (Table 21).

Table 21. The calculation of sublethal injury at the Milford Project. The baseline and proposed utilization rates are derived from Black Bear's analysis presented in table 5-8 of their BA. Injury rates are based on the 1-hour injury rates estimated in FPL Energy (2013; 1-hour injury rate for 7.5% for Kaplan units).

| **Baseline Conditions** | Kaplan | Non-Turbine | Injury (Sum) |
|---|---|---|---|
| Utilization | 25.7% | 74.3% | |
| Utilization X Injury Rate | 1.9% | 0.0% | 1.9% |
| **Proposed Condition** | | | |
| Utilization | 9.1% | 90.9% | |
| Utilization X Injury Rate | 0.7% | 0.0% | 0.7% |

Similar to injury, we expect migratory delay (residence time) will decrease at the project due to the proposed action. In section 4.4.1, we estimated that approximately 2% of smolts take longer than 24 hours to pass the Milford Project (from 200 meters upstream to the first downstream receiver). We estimated this by considering that the 2016-2018 delay (average of 1% > 24 hours; range between 0% and 2%) applied to the average proportion of the run protected by the supplemental spill period (69% of the run); and that the higher rate observed during the low flow year in 2015 (4% > 24 hours) applied to the proportion of the run when supplemental spill was not provided (i.e., 31% of the run). We have concluded above that 99.9% of the smolt run will pass Milford during the 54-day supplemental spill period. As such, we estimate that delay will be reduced such that no more than 1% of smolts will take more than 24 hours to pass the project ((99.9% x 1%) + (0.01% x 4%) = 1%).

We do not know, specifically, what amount of delay in a given river will lead to reduced fitness, increased predation rates, or an increase in hydrosystem delayed mortality. The threshold of effect likely varies significantly by river flow and temperature. Regardless, we expect that 24 hours per dam provides adequate opportunity for smolts to locate and utilize well-designed downstream fishways at hydroelectric dams. A 24-hour period would allow these migrants an opportunity to locate and pass the fishway during early morning and dusk, a natural diurnal migration behavior of Atlantic salmon. We can reasonably expect that passage times in excess of 24 hours per dam would result in unnatural delay for migrants, in addition to an increased energetic cost and stress, which could potentially lead to increased predation and may also lead to reduced fitness in the freshwater to saltwater transition.

Here, we carry out that four-step assessment for harassment. We have established that all outmigrating smolts will encounter the dam, which will result in a disruption of their downstream migrations (step 1) and that an average of 1% of smolts will be delayed for more than 24 hours during the implementation phase (step 2). We have established the expected response of the exposed smolts (step 3): individual smolts delayed more than 24 hours during their downstream migration will need to expend additional energy searching for a passage route; this is expected to result in physiological stress and will increase the time the individual is exposed to predators; this delay is also expected to affect an individual's ability to successfully make the transition to saltwater. Finally, we establish that the nature and duration of the response is a significant disruption of migration (step 4). Based on this four-step analysis, we find that individual smolts delayed for more than 24 hours on their downstream migration are likely to be adversely affected and that effect amounts to harassment. Therefore, we anticipate that up to 1% of salmon smolts that pass the project will be exposed to significant delay (i.e., take more than 24 hours to pass the dams), which we consider to meet the definition of harassment.

As indicated in section 4, we concluded that hydrosystem delayed mortality at the Milford Project was approximately 3% based on project specific estimates of migratory delay and sublethal injury; and that each of those factors contributes equally to the amount of delayed mortality (i.e., 1.5% due to delay; 1.5% due to injury). To estimate the potential reduction in this mortality caused by the proposed action, we determined the proportional difference between injury and delay under the baseline and proposed action scenarios and applied that change to the assumed delayed mortality described above. As such, we considered that since we estimate a 63% reduction in injury (i.e., (1.9% - 0.7%)/1.9% = 63%), we would anticipate a similar reduction in the component of delayed mortality attributed to injury (i.e., a 63% reduction of 1.5% is 0.6%). Similarly, we would anticipate a 66% (i.e., (2%-1%)/2% = 50%) reduction to the component attributable to migratory delay (i.e., a 50% reduction of 1.5% is 0.8%). Therefore, we conclude that Milford's total contribution to hydrosystem delayed mortality in the estuary is reduced from 3.0% to 1.4% (i.e., 0.6% + 0.8%).

In section 4.4.1, we identified several sources of mortality associated with downstream passage through the Milford Project under baseline conditions, including direct (6.7%) and indirect mortality (1.6% in the impoundment and 3% due to hydrosystem delayed mortality). As described above, we anticipate that direct mortality will be reduced to 4% and that indirect mortality will be reduced to 3.0% (1.6% in the impoundment and 1.4% due to hydrosystem delayed mortality). As such, we anticipate that on average if 100 smolts migrated through the action area, approximately 7 (as compared to 11 under baseline conditions) would die due to direct or indirect effects caused by the projects. This does not include background levels of mortality in the action area that would occur regardless of the presence of the dams.

Kelt Downstream Passage Survival

As indicated in section 4.4.1, the performance standard for downstream-migrating kelts contained in the 2012 SPP is 96% total project survival, which would include from 200 meters upstream of the trash racks and continuing downstream to a point where latent effects of passage can be quantified. The incidental take statement in our 2012 Opinion contains a corresponding expected mortality rate of 4%.

In Table 5-3 of their BA, Black Bear indicates that six kelts were killed and detected on the project trash racks between 2015 and early 2024. An additional three adult salmon were found dead at the project in 2024 and 2025 (1 in 2024; 2 in 2025) (as reported in Black Bear's annual take reports). These mortalities may have occurred due to effects of the project, or may have drifted downstream to the project after dying. Regardless, these fish were not killed due to passage through the turbines (as they were detected on racks upstream of the powerhouse), but may have died due to energetic effects associated with searching for a route to pass the project. No information is currently available regarding passage route selection and mortality associated with downstream passage at the Milford Project.

Based on available information on returns to the Penobscot River, we anticipate that postspawn adults (i.e., kelts) pass downstream through the Milford Project annually in the spring and late fall (Baum, 1997). Kelts primarily have been documented passing via spillways and sluices at projects in Maine; however, it is conceivable that they could pass through turbines if intake racks are not sufficiently narrow to exclude them. The Miramichi Salmon Association (MSA) measured the width of 93 Atlantic salmon kelts in 2012 and determined that the average width was 4.1 inches (Range 2.6-6.1 inches) (Reid, J., MSA, Personal Communication, May 18, 2012). As the spacing on the racks at the turbine intakes at Milford (2") is below the minimum width observed in this evaluation, we do not anticipate that kelts would be entrained at the project. Although the proposed supplemental spill at the project is not intended for kelt passage, it will coincide with a portion of their outmigration period in the spring. We anticipate that increased flow over the spillway, and the potential for a reduction in flow through the turbines, will increase attraction to non-turbine passage routes and therefore increase the rate of passage. However, as we do not anticipate that the proposal will change the route of passage for these salmon, we expect that the anticipated amount of mortality will not change from what was considered in 2012. As such, we anticipate that up to 4% of salmon kelts could be killed due to the effects of downstream passage at the Milford Project. In accordance with the SPP, Black Bear is scheduled to conduct an Atlantic salmon kelt downstream passage study at the Milford Project in 2027 in order to evaluate downstream survival. Although Black Bear has only proposed a single year of evaluation, the 2012 Opinion and the Milford Project's license amended in 2012[26], require three years of evaluation. As such, we anticipate that three years of study will be conducted during the term of this action; likely using salmon that are being radio tagged for upstream passage studies in the mainstem Penobscot.

## 5.4. Effects of Aquatic Monitoring and Evaluation

Black Bear has proposed studies involving Atlantic salmon at the Milford Project during the term of the license amendment. These studies are part of the proposed action. The studies that have been proposed are:

- Upstream:
    - Prespawn adults
        - One to three years of passage effectiveness studies using adult salmon produced from smolts stocked upstream of the Milford Project. Although Black Bear did not propose a specific number of study fish, we anticipate that up to 50 fish will be used per year of study, consistent with similar studies.
- Downstream:
    - Smolts
        - A single smolt survival study in 2028 to verify achievement of the performance standard. Although Black Bear did not propose a specific number of study fish, based on information from similar studies, we anticipate that approximately 200 smolts will be needed in order to obtain results with sufficiently low error rates. Although not proposed, we recognize that an additional study year or two may be needed (to evaluate new measures informed by the study results) if the standard is not achieved during the 2028 study. These additional years would be needed to evaluate the effectiveness of any new measures implemented based on the results of the first study year. As such, we anticipate that as many as 600 smolts (i.e., 200 smolts per study for up to three years) may be needed to verify the achievement of the performance standard.
    - Kelts
        - Although not included in the proposed SPP, Black Bear indicates in the BA thatthey will conduct an Atlantic salmon kelt downstream passage study in 2028. Since the BA was developed, Black Bear has accepted feedback from the agencies and has agreed to implement this study in 2027 instead. Additionally, although only one year has been proposed, Black Bear is required to conduct three years of evaluation according to the 2012 Opinion and the amended license for the project. These studies will likely be conducted using fish that are being captured, handled, and tagged for upstream passage effectiveness study at the Mattaceunk Project (p-2520) in the East Branch of the Penobscot, or as part of the one to three year evaluation being proposed as part of this action. As the effects to these study fish have already been considered, we will not consider them in this analysis.

[26] FERC Accession #: 20121009-3020

These studies proposed by the licensee, are necessary to monitor the effect of the proposed action, and would not occur but for the proposed action. We anticipate that the effects of handling and tagging will lead to minor injury of every study fish, but that they will recover after a short period and will be able to continue their migration. This conclusion is based on the results of numerous similar studies within the GOM DPS of Atlantic salmon (BWPH 2013, 2014, 2015, 2016; BBHP 2017, 2017b, 2018, 2019). Therefore, we do not expect that these effects will lead to a significant disruption of any behavior.

Techniques such as PIT tagging, coded wire tagging, fin-clipping, and the use of radio or acoustic transmitters are commonly used techniques with Atlantic salmon. All sampling, handling, and tagging procedures have an inherent potential to stress, injure, or even kill the marked fish. Telemetry using radio and/or acoustic tags will be the primary technique for the proposed downstream studies.

The method proposed for the downstream passage studies is to surgically implant tags within the body cavities of the smolts. These tags do not interfere with feeding or movement. However, the tagging procedure requires 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 & Hubert, 1985; Mellas & 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. Post-release 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 & Hoyt, 1982; Matthews & Reavis, 1990; Moring, 1990). These effects contribute to post-release handling mortality that is frequently observed in telemetry studies.

All fish used in the proposed study will be handled 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 100% of the fish that are handled and tagged will be injured.

A proportion of the smolts are anticipated to be killed due to handling and tagging. There is some variability in the reported level of mortality associated with tagging juvenile salmonids. We did not document any immediate mortality while tagging 666 hatchery reared juvenile Atlantic salmon between 1997 and 2005 prior to their release into the Dennys River. After 2 weeks of being held in pools, only two (0.3%) of these fish died. Over the same timeframe, we surgically implanted tags into wild juvenile Atlantic salmon prior to their release into the Narraguagus River. Of the 679 fish tagged, 13, or 1.9%, died during surgery (NMFS, unpublished data). It is likely there were delayed mortalities as a result of the surgeries, but this could not be quantified because fish were not held for an extended period. In a study assessing tagging mortality in hatchery reared yearling Chinook salmon, Hockersmith et al. (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 will be killed due to handling and tagging during the proposed downstream monitoring studies. As monitoring requires the tagging of up to 200 Atlantic salmon smolts per year, we anticipate that no more than twelve (i.e., 2% of 600) would be killed due to tagging effects. Although Black Bear has only proposed to conduct one year of study, we anticipate that additional study years may be needed if the standard is not achieved in that year.

All adult Atlantic salmon used in the passage studies will be injured due to handling and tagging. However, long term effects of handling and tagging on adult salmon appear to be negligible. Bridger and Booth (Bridger & 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 may die 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 worst-case estimate of tagging mortality in the adult salmon being used in the passage studies at the Milford Project. Given the number of Atlantic salmon being tagged (no more than 200 (i.e., (50 fish x 3 years for the upstream study) + 50 fish for the downstream study)), it is expected that up to four adult Atlantic salmon will be killed as part of the upstream and downstream passage studies. Injuries are expected to be minimized by having trained professionals conduct the procedures using established protocols.

Although the effects of broodstock collection are not considered here, it is possible that the trap will be needed to capture fish during the monitoring of the proposed action. Although there was evidence that the original undersized trap caused injury to salmon that were captured, Black Bear's study in 2024 of the new, larger trap indicated that none of the five fish showed sign of injury. Although a small sample size, this study provides the best available information regarding injury and mortality associated with trapping fish at the exit of the Denil fishway.

### 5.5. Effects to Atlantic Salmon Critical Habitat

On August 27, 2019, NMFS and USFWS published a revised regulatory definition of "destruction or adverse modification" (84 FR 44976). As that is the current regulatory definition, we use it for this analysis. As defined, destruction or adverse modification "means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species."

The critical habitat designation for the GOM DPS is for habitats that support successful Atlantic salmon spawning/rearing, and migration. The designated critical habitat does not include any unoccupied habitat. In order to determine if the proposed action may affect critical habitat, we consider whether it would impact the habitat in a way that would affect its ability to support spawning, rearing, and/or migration. Specifically, we consider the effects of the project on the physical features of the critical habitat and how these effects impact the conservation value of the habitat.  As defined in section 2 of this Opinion, the action area of the proposed action includes the mainstem of the Penobscot River from the upper extent of the Milford and Gilman Falls Dam impoundments to a point 1.2 kilometers downstream of the dam in the mainstem.  The action area in the Stillwater Branch is limited to the footprint of the Gilman Falls Dam.  The entirety of the action area falls within designated critical habitat.

In this analysis, we consider the consequences of the action on critical habitat in the action area.  For each PBF that may be affected by the action, we determine the effects to the feature.  In making this determination, we consider the action's potential to affect how each PBF functions to support the conservation needs of Atlantic salmon in the action area.  Part of this analysis is consideration of the conservation value of the habitat and whether the action will have effects on the ability of Atlantic salmon to use the feature(s), temporarily or permanently.  In the *Integration and Synthesis* section of this Opinion we consider the effects addressed here on the value of the critical habitat designated for the whole of the DPS.

In the *Environmental Baseline*, we described a two-step process for characterizing the function of each spawning and rearing PBF that is based: 1) on the presence and potential functional status of the feature, and 2) on the ability of the appropriate life stage of salmon to access and utilize the feature.  We determined that PBFs SR 1 – 7 and M 1 – 4 are present in the action area and have the potential to function at a limited capacity due to several of the functional parameters (described in Table 8) being outside of the fully functional range.  We have further determined that, although the rearing PBFs may individually function at a limited capacity, the combined status of the features suggest that rearing habitat does not function in the action area.  We have determined that PBF M 5 and M 6 are present and fully functional during the appropriate life stage period (April to June).  We further indicated that as the PBFs present upstream of the Milford Dam are not fully accessible and therefore have limited conservation value.  We determined the habitat in the mainstem downstream of the Milford Dam is fully accessible, and, given the status of the features, that the conservation value is limited.

All of the PBFs in the action area will be affected by the proposed action, except for M 5 and M 6.  M 5 refers to the need for cool water and sufficient flows to stimulate smolt migration in the spring.  Given the low suitability of the rearing habitat within the mainstem, we expect that few, if any, smolts are initiating migration in the action area.  The majority of smolts will be produced in upstream habitat, outside of the action area.  Additionally, as the project operates in run of river mode (inflow equals outflow), and as it doesn't significantly affect water temperatures in the spring months, the proposed actions will have no effect on PBF M 5, and it will not be considered further.  PBF M 6 refers to the need for water chemistry that will support seawater adaptation of smolts.  Specifically, this PBF addresses the need for low acidity water as smolts that are exposed to water that is too acidic (low pH) can lose their tolerance for salt water (USOFR, 2009), which would affect their ability to successfully transition to the ocean.  We do not anticipate that the proposed action will affect the pH of water in the action area; therefore, the project will have no effect on this feature and we will not consider PBF M6 further.

Below, we analyze the potential effects of the proposed action on the remaining PBFs.

### 5.5.1. PBFs for Spawning and Rearing (SR 1-SR 3)

*SR 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.*

PBF SR1 refers to the need for holding and resting areas that prespawn salmon can use during their upstream migration; referring specifically to pools "near freshwater spawning sites." Although no redds have been documented in the habitat in the action area by DMR, some were documented approximately two miles downstream near the confluence with Great Works Stream in 1986 (although none have been documented since then) and more were documented in the tributary itself. As such, assuming they can locate cold water, it is possible that adults could hold in the action area while they wait to spawn in nearby habitat. Pools have been documented in the bypass reach and in deeper water areas downstream of the dam in the vicinity of French Island. It is also possible that salmon would hold in any cold-water areas in the impoundment. However, as the water temperature in the action area regularly exceeds 20℃ in the warm summer months (June – September; as described in section 4.1.3), any holding areas present in the action area have the potential to function at a limited capacity.

The proposal to reduce flow into the bypass reach to reduce attraction to the western side of the dam, could reduce the functioning of PBF SR 1 in the action area. However, holding in the bypass reach pool can be detrimental for salmon given the elevated temperatures and the fact that the pools become isolated as flows in the river recede. As such, the conservation value of the pools downstream of the western portion of the dam is low. Black Bear maintains leakage flow into the pools (by intentionally leaving two sections of hinged flashboard uncaulked) to ensure a route of egress if salmon are holding in them when the flows come down. Still, the potential remains that salmon could become stranded, or may hold in the pools longer than is safe (given high water temperatures in exposed pools) given the relatively small amount of water flowing in and out. As such, although the reduction of flow into the bypass reach could reduce the function of the pools themselves, the overall effect of limiting access to the conservation value of the habitat is minimal. Regardless, the proposed action will adversely affect the functioning of PBF 1 in the action area for the 13-year term of the proposed action.

*SR 2: Freshwater 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.*

*SR 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.*

PBF SR 2 and SR 3 refer to the need for appropriate physical conditions to support spawning activity, as well as egg and fry development. As indicated above, 54 habitat units of spawning habitat has been documented by MDMR in the action area. In the *Environmental Baseline*, we have indicated that this feature has the potential to function at a limited capacity in the action area due to temperature and depth conditions, as well as an abundance of nonnative species.

The proposal to improve fish passage and reduce stranding at the Milford Project will not significantly change the potential of the downstream habitat to support egg and fry development. The proposal will lead to minor changes in flow through the area at certain times due to the spillway diversion wall; and effects from the construction of that wall could lead to a temporary increase in turbidity and noise. However, as all effects to the habitat are anticipated to be minor and temporary, we expect any effects to PBFs SR 2 and SR 3 to be so small that they cannot be meaningfully measured, detected or evaluated, and are therefore, insignificant.

*Freshwater rearing sites with the space (SR4), habitat diversity (SR5), cool water (SR6), and diverse food resources (SR7) necessary to support growth and survival of Atlantic salmon parr.*

PBFs SR 4 - 7 describe the physical and biological conditions necessary to support the rearing of salmon parr. Although the Wright et al. (2008) habitat model indicates that there is rearing habitat throughout the action area, it is all class 3 habitat, which means the model predicts that a relatively low proportion of the habitat contains the features necessary to support rearing. In addition, most of the modeled habitat is within the Milford impoundment and is therefore unlikely to function due to increased water depths, elevated temperatures, and the presence of nonnative fish predators. In the Environmental Baseline, we have indicated that these features have the potential to function at a limited capacity due to temperature, depth, and fish community conditions in the action area; and have acknowledged that collectively the status of these features means that rearing habitat is nonfunctional.

We do not expect a meaningful amount of juvenile rearing to occur in the action area downstream of the dam as it is unlikely that any salmon spawn in the area in most years. We do not expect any rearing to occur upstream of the dam in the impoundment due to the status of the features in that impacted habitat. Relative to habitat in the tributaries upstream and downstream of the Project, the rearing habitat in the action area is marginal and is unlikely to produce many smolts. Regardless of the functional status, the effects to this habitat will primarily involve minor changes in flow when the spillway diversion wall diverts water to the east side of the channel; as well as minor impacts from the turbidity and noise effects of construction. These effects are not expected to further reduce the functional capacity of PBF's SR 4- 7 and, as such, we expect that the effects to be so small that they cannot be meaningfully measured, detected or evaluated, and are therefore, insignificant.

### 5.5.2. PBFs for Migration (M1 – M4)

*M 1: Migratory sites free from physical and biological barriers that delay or prevent access of adult salmon seeking spawning grounds needed to support recovered populations*

The action area primarily functions as a migratory corridor for prespawn adult Atlantic salmon as they migrate to habitat in the Piscataquis River, Mattawamkeag River, the East Branch of the Penobscot River, as well as other smaller tributaries, to spawn. PBF M1 specifies that habitat be free of barriers that "delay or prevent access of adult salmon seeking spawning grounds." As indicated in Section 4.1.3, under baseline conditions this PBF functions at a limited capacity in the action area. The Milford Project is a physical barrier that limits prespawn salmon from accessing spawning habitat. As described previously, the average efficiency of the Milford fish lift is 93% (82% - 100%) according to Black Bear and University of Maine studies. The delay of upstream migrating adults in the Black Bear studies was, on average, 67% over 48 hours (2014-2015 average).

We anticipate that the proposal to operate the existing Denil fishway will increase average passage efficiency to over 95% (the current and proposed performance standard); and, in combination with the construction of a spillway diversion wall, could significantly reduce the amount of migratory delay experienced by adult salmon downstream of the dam. If the reduction in delay is not sufficient to achieve the proposed standard (i.e., 75% of fish in under 48 hours; 25% of fish in under 96 hours), Black Bear has committed to developing and implementing additional measures as necessary to achieve it.

This proposal will allow for the functioning of PBF M1 by providing swim-through passage through the system, which directly increases the conservation value of this PBF. As the Denil is already constructed, and the wall will likely be constructed in 2027 (pending necessary state and federal authorizations), the initial proposed measures will be implemented within three years of the issuance of this Opinion (i.e., first fish passage season with measures implemented would likely be 2028). The evaluation of passage conditions is expected to take up to three years (2029-2031), based on Black Bear's proposed action. As such, the proposed action will allow for the functioning of the PBF by year six (i.e., 2031) of the proposed action. Despite the significant improvement to the conservation value of the PBF, the proposed action will still adversely affect it as it may take up to six years for improvements to be realized, and because even after the standard has been achieved a small proportion of prespawn salmon will still be excluded from accessing upstream habitat.

*M 2: Freshwater and estuary migration sites with pool, lake, and in-stream 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.*

PBFs SR 1 and M 2 both describe the holding and resting areas that prespawn salmon can use during their upstream migration. SR 1 refers specifically to pools "near freshwater spawning sites," whereas M 2 speaks to the need for holding areas throughout the migratory corridor. As with SR 1, we determined in section 4.1.3 that PBF M 2 functions at a limited capacity due to warm water temperatures, excessive depths, and due to the presence of non-native species. The proposed action to divert some flow away from the habitat on the west side of the dam will affect PBF M 2 to the same degree as PBF SR 1. However, as with SR 1, holding in the bypass reach pools to rest or await spawning can be detrimental for salmon given the elevated temperatures and the fact that the pools become isolated as flows in the river recede, and are diverted to the east side of the dam. Consequently, although the reduction of flow into the bypass reach will adversely affect the function of the pools in regard to M 2, the overall effect of limiting access to the conservation value of the habitat is minimal. Regardless, the proposed action will adversely affect the functioning of PBF M 2 in the action area for the expected 13-year term of the consultation, as well as the term of any authorized annual licenses.

*M3: Freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation.*

The operation of the Denil fishway in the months of May and June could increase passage efficiency and reduce delay for other sea run fish species, such as river herring and American shad. Millions of herring are passed at the fish lift every year, and it is probable that some would make use of the Denil if it was available. Additionally, providing spill for 54 days during the smolt outmigration period would likely benefit some proportion of post spawn adult herring that would be able to make use of the spillway as a passage route, potentially leading to a reduction in turbine entrainment.

Despite potential improvements, under the proposed conditions, the number of alosines leaving the system will be limited due to passage inefficiencies at the Milford project. As such, we anticipate that the PBF will be adversely affected.

*M4: Migration sites free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment.*

As described in section 4, the Milford Project directly and indirectly kills Atlantic salmon smolts during their migration to the marine environment. We have estimated that under baseline operations this project currently kills approximately 9.3% of smolts (excluding impoundment mortality) migrating downstream through the mainstem Penobscot. Our analysis indicates that the proposed action will significantly reduce overall mortality, but that approximately 5.1% of smolts will still be killed. Therefore, as we still anticipate some passage mortality, the functioning of this PBF will continue to be limited. As such, although the implementation of the proposed downstream measures will improve the functioning of this PBF by providing downstream passage flows for the entirety of the smolt run starting in 2026, the continued operation of the dams under the proposed conditions will still adversely affect the PBF.

In summary, we anticipate that the PBFs SR 1 - 7, and PBF M 1 - 4 in the action area will be affected by the proposed action. Based on the effects of diverting flow from the bypass reach, we have determined adult holding habitat (SR 1 and M 2) in the action area will be adversely affected. Based on the low baseline functional status of juvenile rearing habitat (SR 4-7), as well as the temporary and minor nature of the effects, we have determined that effects to these PBFs will be insignificant. That is, we have determined that the proposed action is unlikely to meaningfully reduce the functional status of the rearing PBFs. Finally, although the proposed action will lead to improvements in the functioning of the migratory PBFs, we have concluded that the effects to the migratory corridor for prespawn adult salmon (M 1), juveniles (M 4), and other diadromous fish (M 3) will be adverse due to ongoing passage inefficiencies.

## 5.6. Effects to Shortnose and Atlantic Sturgeon

### 5.6.1. Stranding

The Milford Project impoundment is typically lowered at least annually to a point where the flashboards can safely be replaced, resulting in a short period (a few hours) of receded flows downstream. There is potential during these low flow periods for sturgeon to become stranded in ledge pools in the area immediately downstream of the dam following the installation and caulking of the flashboards. While no sturgeon strandings have been documented in the pools, sturgeon strandings have been documented below other dams where isolated pools can occur following changes in flow. These stranding events have been documented in the Connecticut and Kennebec rivers.

Data from the Holyoke Hydroelectric project on the Connecticut River can help in assessing the likely effects of stranding on sturgeon. In general, at this facility, several shortnose sturgeon are removed from pools at the base of the dam each year when spill over the dam ceases. Some shortnose sturgeon that have been rescued from these pools have been observed to have significant hemorrhaging along the ventral scutes and damage to their fins. These injuries are thought to occur from attempts at swimming in shallow, rocky areas where there is not enough water depth to avoid scraping along the rock and ledge. Mortality can occur if sturgeon remain in isolated pools, either as a result of injuries or increased temperature and decreased dissolved oxygen, or a combination of these factors. Since implementing rescue procedures in 1996, there has been no detected mortality of shortnose sturgeon stranded in pools below the Holyoke dam, indicating that a rescue procedure is an effective method for documenting and removing stranded sturgeon.

Black Bear has implemented a proactive monitoring and rescue procedure whereby fish passage staff monitor the spillway area for any fish below the dam when the boards are raised and following spill events. To date, no sturgeon have been observed stranded in pools below the Milford spillway. In estimating the number of sturgeon that may strand in isolated pools below the Cataract Project we have considered the number of sturgeon stranded at hydroelectric projects in the Connecticut (estimated annual average of 1 per year) and Kennebec rivers (1 every ten years below the Lockwood dam and 1 every ten years below the Brunswick dam). Because no sturgeon have been documented in the ledge pools downstream of the Milford Project to date we would expect any future stranding of sturgeon in this area to be a rare event. We consider the stranding rates from the Kennebec River to be a reasonable estimate of the amount of stranding anticipated to occur here because that project is similarly located at the site of a natural falls at the historic upstream limit of the river for sturgeon (in contrast to the Holyoke Project which is located many miles downstream of the spawning area for sturgeon and we expect sturgeon to be motivated to move upstream past the project). Therefore, we anticipate that one sturgeon (either shortnose or Atlantic) is likely to be stranded every ten years in the ledge pools downstream of the Milford Project. Over the duration of the project license, we would therefore anticipate the stranding of no more than two sturgeon below the dam (shortnose or Atlantic).

Black Bear has developed and will continue to implement a Sturgeon Handling Plan to provide for safe handling of any shortnose or Atlantic sturgeon that may be encountered by personnel in the event of stranding during flashboard replacement. Black Bear indicates in the BA that they will return any fish discovered below the dam to the mainstem of the Penobscot River downstream. The implementation of a handling plan will ensure that any sturgeon that are stranded in ledge pools are relocated in a way that will reduce the likelihood of injury and will eliminate this potential source of mortality in the Penobscot River. While the capture of sturgeon in nets and the subsequent transport and handling may stress the fish, this stress is not likely to be long lasting and will have no effect on the survival of the fish. Stranding would require sturgeon not only to be present in the area just downstream of the dam but also to be there during a period when there is a rapid decrease in flow, and end up in a pool that was isolated from the main flow such that an individual became stranded until there was additional flow to allow egress. We expect the stranded fish would experience stress and minor injury. The implementation of a handling plan and the use of proper handling techniques will minimize the potential for major injury. No mortality is expected to occur due to the short time period fish would be caught in the pools and the implementation of proper handling techniques. We do not expect the temporary holding and relocation of a stranded sturgeon to have any impact on its ability to carry out any life function.

### 5.6.2. Capture and Handling in Fish Lift

Following removal of the Veazie and Great Works dams in 2013 and 2014, sturgeon regained access to the section of river downstream of the Milford Project, creating the possibility that Atlantic and shortnose sturgeon could be captured at the Milford fish lift. During the operation of the fish lift, there is the potential for sturgeon to be exposed to mechanical injury and handled during the sorting process, which would include release of any sturgeon back to the river below the Project. Since the original Sturgeon Handling Plan was implemented in 2013, a total of seven shortnose sturgeon have been captured in the Milford fish lift, all of which were processed in accordance with the Sturgeon Handling Plan and released alive downstream of the Project. In addition, one sturgeon was observed on camera in the upper flume of the fish lift in 2024, but it was not handled and, thus, its species could not be determined. The fate of this fish is unknown. Combined, eight sturgeon (seven shortnose and one unknown) (approximately 0.6 per year) were captured at the project over the last 13 years. No Atlantic sturgeon have been known to be captured in the Milford fish lift. In our 2012 Opinion, we estimated that three shortnose sturgeon and one Atlantic sturgeon would be captured in the Milford fish lift annually. It appears that was an overestimate given the number that have been captured over the last 13 years. As such, we estimate that over the term of the proposed action, only 8 sturgeon (0.6 sturgeon per year x 13 years = 8 sturgeon; combination of shortnose and Atlantic) will be captured and released downstream of the Milford Project. These individuals will be netted from the handling tanks and released downstream. We anticipate that these fish would be exposed to stress and minor injury (scale loss and biological sampling) associated with handling consistent with the Sturgeon Handling Plan.

The proposed Sturgeon Handling and Protection Plan includes a condition that requires the licensee to require that all fishway operators are trained in handling sturgeon and that any sturgeon caught in the fishway or trap be removed with long handled nets and returned to the tailrace. This condition would ensure that no shortnose or Atlantic sturgeon are inadvertently passed above the dam, injured, or killed in the process of returning them below the dam.

All sturgeon collected during routine fishway operations at the Milford Project will be handled, weighed, measured, visually assessed for injury, and photographed. The handling, holding, weighing, measuring, and photographing procedures will follow NMFS protocols designed to minimize effects to individual sturgeon (Kahn and Mohead, 2010). We expect that individual fish will normally experience no more than short-term stresses as a result of these activities. Researchers have taken measurements and weights of thousands of sampled animals in the proposed manner with no apparent ill effect. No injury would be expected from these activities, and individuals would be worked up as quickly as possible to minimize stress. Procedures will be followed that are designed to minimize the risk of either introducing a new pathogen into a population or amplifying the rate of transmission from fish to fish of an endemic pathogen during handling.

*Tissue sampling*

Genetic samples will be taken from all captured fish. This will be done by taking a small (1 $cm^2$) tissue sample, clipped with surgical scissors from a section of soft fin rays. This procedure does does not appear to impair the sturgeon's ability to swim and is not thought to have any long-term adverse impact (Kahn and Mohead, 2010). Thousands of sturgeon have been sampled in this way with no apparent ill effect; therefore, we do not anticipate any long-term adverse effects to the sturgeon from this activity.

In summary, while handling and sampling may result in short term stress to individuals, we expect full recovery and no long-term consequences on the health or fitness of any individual. We do not expect handling and related activities to result in any serious injury or mortality of any individual.

5.6.3. Draft Tube Dewatering

During the operation and maintenance of the Milford Project, it may occasionally become necessary to dewater a turbine unit and the associated draft tube. If sturgeon were in the area when dewatering occurred, stranding could occur. The only known occurrences of sturgeon becoming stranded at hydroelectric projects during unit maintenance when facilities have been dewatered have been at the Brunswick Project on the Androscoggin River.

Data from the Brunswick Project on the Androscoggin River, Maine can help in assessing the likely effects of unit maintenance on sturgeon. In May 2010, several sturgeon were attracted into portions of the Brunswick Project Unit #1 when the unit was shut down for annual inspection. Specifically, Unit 1 was shut down on the morning of May 10 2010 to commence the annual inspection of the unit. This work requires dewatering of the internal components of the unit. To accomplish this work, the headgates upstream of the unit and the tailrace gates downstream of the units were installed and personnel then proceeded to drain the unit, a two day effort. In mid-morning of May 12 2010, when it was safe to enter, personnel observed five live and two dead sturgeon in the scroll case (between the turbine and head gate). During the recovery process, the five live sturgeon were rescued from the scroll case and the two dead sturgeon were collected from the wicket gate area. Additionally, 27 live sturgeon were found and all were rescued from the sump chamber. On May 13, 2010, the sump chamber was re-inspected and an additional four live sturgeon were recovered. After the last sturgeon was collected from the sump, the pipe leading to the sump was visually inspected then closed to prevent sturgeon from accessing the sump chamber. All 36 live sturgeon were released back into the Androscoggin River, just below the Project in the vicinity of the fishway entrance, and appeared to be in good condition at the time of release.

To date, there have been no recorded strandings of sturgeon during dewatering events at the Milford Project. Given the rarity of these stranding events generally and the lack of any occurrences at this project, any future stranding is extremely unlikely to occur and effects are discountable. However, to prevent any mortalities in the unlikely event that a sturgeon is stranded within the project, the modified license will require that all accessible areas are inspected for sturgeon prior to dewatering and that any sturgeon present are removed and returned to the river below the Project.

### 5.6.4. Downstream Passage

As explained above, the natural falls at the current location of the Milford Dam was the historical upstream migration limit for both sturgeon species in the Penobscot River. As such, no sturgeon are expected to occur upstream of the Project that would attempt to pass downstream of the Project. As upstream passage of sturgeon is not proposed, we do not expect any shortnose or Atlantic sturgeon to occur in the impoundment or to attempt to pass downstream of the project. We recognize that the fate of the sturgeon observed on video in the fishway flume in 2024 is unknown; however, we find that to be an unanticipated and unexpected event and do not expect any similar events over the term of the proposed action that could inadvertently result in the release of a sturgeon above the dam. As such, no downstream passage of any sturgeon is anticipated.

## 5.7. **Effects to Atlantic Sturgeon Critical Habitat**

As noted above, the action area extends from the upper end of the impoundment (5 km upstream of the dam) downstream to the southern end of French Island, approximately 1.2 km downstream of the Milford dam. The Penobscot River critical habitat unit extends from the point where the Penobscot River empties into Penobscot Bay to the Milford Dam, which is also likely the historical upstream migration limit for Atlantic sturgeon.

The action area is entirely freshwater (salinity <0.5 ppt); therefore, PBF 2 of Atlantic sturgeon critical habitat (that is, aquatic habitat with gradual downstream salinity gradient of 0.5 up to as high as 30 ppt and soft substrate (e.g., sand, mud) between the river mouth and spawning sites for juvenile foraging and physiological development) is not present in the action area. The other three PBFs are found in the action area, and we discuss effects of the proposed actions on those PBFs below.

*Feature One: Hard bottom substrate (e.g., rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (i.e., 0.0–0.5 ppt range) for settlement of fertilized eggs, refuge, growth, and development of early life stages*

In considering effects to PBF 1, we consider whether the proposed action will have any effect on areas of hard bottom substrate (e.g., rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (i.e., 0.0–0.5 ppt range) for settlement of fertilized eggs, refuge, growth, and development of early life stages. Therefore, we consider how the action may affect hard bottom substrate and salinity and how any effects may change the value of this feature in the action area. We also consider whether the action will have effects on access to this feature, temporarily or permanently.

As explained above, the entirety of the action area is tidal freshwater, where salinity levels are consistent with the requirements of PBF 1. During spring freshets, tidal freshwater extends to Winterport (river km 29), and during low flow months the salt front extends upstream as far as Hamden (river km 40) (ASMFC, 1998). The two lowermost dams on the Penobscot River, Great

Works Dam and Veazie Dam (at river km 56), were removed in 2012 and 2013, respectively, opening up all known historical Atlantic sturgeon habitat in the Penobscot River, and access to more of the tidal freshwater habitat. Side scan sonar surveys of the impoundments, conducted before the impoundments were removed to support deconstruction permitting and engineering studies, showed that greater than 95% of the beds of each impoundment were bedrock, boulder, and cobble (CR Environmental, 2008; classification from Madden et al., 2005). Finer fractions, mostly small gravel sizes and sand, were generally limited to littoral zones and/or found interstitially with larger materials (Collins et al., 2020). While we have designated critical habitat in the Merrimack, Piscataqua, and Penobscot Rivers, studies to date have only shown spawning activity to occur in the Androscoggin and Kennebec Rivers. As noted above, while suitable spawning habitat has been identified in the Penobscot River, there has been no documented spawning activity.

The continued operation of the Milford Project will have no effect on salinity in the action area. These actions will also not affect substrate type or result in a reduction in hard bottom habitat. It is possible that in certain operating conditions, flow modifications related to project operations could result in higher velocities that may result in the displacement or movement of gravel and small cobbles. Although the proposal to modify flows at the Milford Project throughout the Atlantic salmon migration period of April 15 to November 15 to reduce the risk of adult salmon being attracted to the bypass area will concentrate flow on the east side of the dam, the change in flow is anticipated to be small relatively speaking, and would not lead to a meaningful change in velocities downstream of the dam. As such, we would not expect there to be an increase in the movement of sediments. Based on the available information, any effects of the continued operation of the project consistent with the terms of the SPP will be so small that they cannot be meaningfully measured, detected, or evaluated and are therefore insignificant. As such, any effects on the function and value of PBF 1 are also insignificant.

*Feature Three: Water absent physical barriers to passage between the river mouth and spawning sites*

In considering effects to PBF 3, we consider whether the proposed action will have any effect on water of appropriate depth and absent physical barriers to passage (e.g., locks, dams, thermal plumes, turbidity, sound, reservoirs, gear, etc.) between the river mouth and spawning sites necessary to support: unimpeded movements of adults to and from spawning sites; seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary, and; staging, resting, or holding of subadults or spawning condition adults. We also consider whether the proposed action will affect water depth or water flow, as if water is too shallow it can be a barrier to sturgeon movements, and an alteration in water velocity could similarly impact the movements of sturgeon in the river. Therefore, we consider effects of the action on water depth and water flow and whether the action results in barriers to passage that impede the movements of Atlantic sturgeon. We also consider whether the action will have effects on access to this feature, temporarily or permanently. We recognize that the dam itself is a physical barrier to passage; however, as it is located at the historical upstream limit of the species in the river, and therefore upstream of spawning sites, we do not consider it to be a physical barrier to passage between the river mouth and spawning sites.

The Milford Dam, which is located at the upstream limit of critical habitat designated for Atlantic sturgeon in the Penobscot River, operates as a run-of-river facility. While the natural falls at the current location of the Milford Dam is thought to have historically been the upstream limit for sturgeon in the Penobscot, the licensee maintains a discharge from the Project so that, at any point in time, flows, as measured immediately downstream from the Project tailrace, approximate the sum of inflows to the Project reservoir. Allocation of flows between the mainstem of the Penobscot River and its Stillwater Branch were established in a 1911 court decree and integrated into the MPA for the Milford Project. The current FERC license and WQC for the Milford Project require a release of 3,800 cfs or inflow, whichever is less, with the following distribution: 3,268 cfs in the mainstem from the Milford powerhouse and 532 cfs in the Stillwater Branch, measured as 60 cfs from Gillman Falls. This distribution of flows between the mainstem and Stillwater Branch is consistent with the allocation outlined in the court decree. While Black Bear proposes to implement species protection measures that control flow release (i.e., build a spill diversion wall to contain flow from the western side of the Obermeyer inflatable flashboard system, and increase the duration of spill releases (20-50% of river flow) from 2 weeks to 54 days), the Milford Project will continue to operate as a run-of-river facility. As such, we do not expect continued operation of the project consistent with the terms of the SPP to result in conditions that would be a physical barriers to passage for any Atlantic sturgeon in the action area. Any effects of proposed enhancement measures for Atlantic salmon to reduce upstream passage delay and stranding and enhance downstream passage on PBF 3 will be so small that they cannot be meaningfully measured, detected, or evaluated and are therefore insignificant. As such, any effects on the function and value of PBF 3 are also insignificant.

*Feature Four: Water with the temperature, salinity, and oxygen values that, combined, provide for dissolved oxygen values that support successful reproduction and recruitment and are within the temperature range that supports the habitat function*

In considering effects to PBF 4, we consider whether the proposed action will have any effect on water, between the river mouth and spawning sites, especially in the bottom meter of the water column, with the temperature, salinity, and oxygen values that, combined, support: spawning; annual and interannual adult, subadult, larval, and juvenile survival; and larval, juvenile, and subadult growth, development, and recruitment. Therefore, we consider effects of the action on temperature, salinity and dissolved oxygen needs for Atlantic sturgeon spawning and recruitment. These water quality conditions are interactive and both temperature and salinity influence the dissolved oxygen saturation for a particular area. We also consider whether the action will have effects to access to this feature, temporarily or permanently and consider the effect of the action on the action area's ability to develop the feature over time.

As described above for PBF 3, as a run-of-river impoundment, the licensee maintains a discharge immediately downstream of the Project tailrace approximate to the sum of inflows to the Project reservoir. PBF 4 is present in the action area.

Continued operation of the Project consistent with the terms of the proposed action, will not affect temperature, salinity, or dissolved oxygen in the action area in a way that would affect the suitability of the habitat to support successful reproduction and recruitment. As such, there are no effects on PBF 4.

*Summary of Effects of Proposed Activities*

The continued operation of the Milford Project with the proposed terms of the SPP will affect Atlantic sturgeon critical habitat below the Milford Dam. We have determined that effects to PBF 1 and 3 will be so small that they are not able to be meaningfully measured, detected, or evaluated and are therefore insignificant. PBF 4 will not be affected by the proposed action.

## 5.8. Construction Effects

The proposed action includes construction activities associated with the construction of the spillway diversion wall. As described, this project is located within designated critical habitat for the GOM DPS of Atlantic salmon and adult salmon could be present in the action area when the work is being conducted. Similarly, the project occurs in the designated critical habitat for Atlantic sturgeon, and individuals of either species could occur in the area at the time of construction. Although Black Bear estimates that construction could occur over eight weeks in July and August; the USACOE has indicated that it will likely include a special condition requiring that the work occur during the standard low water summer work window (July 15 to September 30). During this period, the warm river temperatures lead to a reduction in the number of salmon migrating past the project. Despite this, salmon are documented swimming through the Milford Project in small numbers in the months of July – September and, therefore, could occur downstream of the dam while construction is underway. A small number of adult shortnose sturgeon and/or adult or subadult Atlantic sturgeon could also be present in the action area during the construction window.

The majority of construction activity associated with the construction of the spill diversion wall will be on the ledge outcrop just downstream of the spillway (Figure 5), which suggests that most of the work will occur in the dry.

### 5.8.1. Sedimentation and Turbidity

The construction activities associated with the proposed action that may produce turbidity include the construction of a spillway flow diversion wall; and increased outflow from the Project as necessary to draw down the impoundment. Although Black Bear intends to conduct construction on the ledge outcrop downstream of the dam in the dry, some turbidity is expected when water levels are restored. Although unlikely given the time of year, there is also the potential that a high flow event that limits the amount of control Black Bear can exert over the impoundment level (i.e., if flows exceed the capacity of the powerhouse and the log sluice) could occur. If this were to occur, it could potentially lead to the inundation of the work area, which would lead to an elevated amount of sediment being released downstream. Regardless of flow, we anticipate that the turbidity will return to background levels within 1.2 kilometers of the dam.

As described, adult salmon could be in the project vicinity during construction. TSS effects to Atlantic salmon worsen with increased levels of turbidity (Newcombe & Jensen, 1996). Juvenile and adult salmonids show minor physiological stress and sublethal effects at suspended sediment concentrations of 7 mg/L for a six-day exposure and at 55 mg/L for a seven-hour exposure (Newcombe & Jensen, 1996). There are three major categories of biological responses of

Atlantic salmon from turbidity effects. The three categories are behavioral responses, sub-lethal effects, and potential mortality, as defined below.

**Behavioral response** - The range of turbidity releases expected to result in behavioral reactions ranging from a startle response to avoidance.

- 1-20 mg/L for 1 hour
- 1 mg/L for 24 hours

**Sub-lethal effects** – The ranges of turbidity releases expected to result in sub-lethal effects including stress, reduction in feeding rates, and increased respiration rates.

- 20-22,026 mg/L for 1 hour
- 1 mg/L for 6 days

**Potential mortality** - A higher range of releases has the potential to result in fish mortality.

- >22,026 mg/L for 1 hour
- 7 mg/L for 30 months

Adult salmon could occur downstream of the dam during in-water work since as they seek an opportunity to pass one of the two fishways. As indicated above, the scale of substrate disturbance will substantially limit the potential for significant turbidity. Consistent with the categories above, we expect the anticipated TSS levels (5-10 mg/L above baseline conditions or a maximum temporary exposure of 20 mg/L) to potentially cause a behavioral response. This response would likely include avoidance of the portion of the Penobscot affected over a short period of time. As we expect all turbidity and TSS to quickly dissipate from the water column, we do not expect exposure to 20 mg/L for one hour or longer, and therefore, no sub-lethal effects will occur. Therefore, given the ephemeral nature of the stressor, the small amount of sediment disturbance, and the limited proportion of the migratory corridor affected we expect any effects to adult salmon migration (i.e., migratory delay due to avoidance of the portion of the river with elevated TSS) to be so small that they cannot be meaningfully measured, detected or evaluated, and therefore, insignificant.

### 5.8.2. Sound and Vibration Effects

Construction activities that are expected to generate sound in the aquatic environment during the Proposed Action include saw cutting, chipping, grinding, and jack hammering that occurs near the surface of the water, and the potential installation of scaffolding. All noise-producing activities will occur outside of the river, which limits the potential for underwater noise. In general, potential noise impacts to fish that may occur from construction and demolition activities include hearing damage, physical injury, and mortality (Popper and Hastings 2009; Popper et al. 2014, as cited in FHA 2017). Behavioral changes may also occur in fish due to hearing trauma, such as complications with the ability to detect predators and prey, the ability to communicate, and their perception of the surrounding environment (Popper et al., 2014).

NMFS uses the following acoustic thresholds when considering effects of underwater noise on protected fish species, including ESA listed Atlantic salmon[27]. These thresholds are based on the best available science (FHWG 2008). NMFS does not have physical injury thresholds for non-impulsive sources (e.g., vibratory pile driving) as physical injury is not an expected outcome of exposure to non-impulsive noises. The current criteria are:

Onset of Physical Injury for Impulsive Sources (e.g., impact pile driving):

- Fish ≥ 2g: peak SPL: 206 dB re 1 μPa; cumulative sound exposure level (12 hours: 187 dB re 1μ$Pa^2$-s
- Fish < 2g: peak SPL: 206 dB re 1 μPa; cumulative sound exposure level (12 hours: 183 dB re 1μ$Pa^2$-s

Onset of behavioral disturbance (all sources): $L_{RMS}$ 150 dB. Responses to temporary exposure of noise of this level is expected to be a range of responses indicating that a fish detects the sound, these can be brief startle responses or, in the worst case, we expect that listed fish would completely avoid the area ensonified above 150 dB re: 1 uPa rms.

The noise generating activities associated with the proposed action is the use of hand-held construction equipment (such as chipping hammers and rock drills) when preparing the ledge surface for the install. No pile driving or blasting has been proposed. Most construction activity is expected to occur in the dry on the ledge outcrop downstream of the dam, which will limit the potential for any Atlantic salmon to be exposed to increased noise as sound attenuates when it passes across the air-water boundary. Chicago Pneumatic, a company that makes hand-held construction equipment, has measured the amount of noise produced by their rock hammers and drills, and has reported them to produce sound between 88 and 113 r=1m dB(A) rel 20μPa in air[28]; given attenuation, we expect that any underwater noise would be even lower. Given that all noise will be produced in the air rather than underwater, and that the sound levels are expected to be below the onset of injury thresholds and the threshold where behavioral response would be expected, we anticipate that any effects of noise produced by construction equipment will be extremely unlikely to occur and thus, discountable.

<u>Effects of Construction on Sturgeon</u>

As noted above, construction of the diversion wall will occur within a cofferdam. The work window to construct the cofferdam is in the low flow period of July 15 to September 30. If spawning of shortnose or Atlantic sturgeon occurred in the Penobscot, we would expect early life stages to be present in the freshwater reach of the river during the summer months that overlap the construction period. However, as there is no Atlantic or shortnose sturgeon spawning expected to occur in the action area during the years that construction may occur, effects are extremely unlikely.

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[27] For more information, please refer to https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf; last accessed July 2, 2025.

[28] Chicago Pneumatics. Manual for the Rock Drill Rotary Hammer (CP0009): https://manuals.plus/chicago-pneumatic/cp-0009-rock-drill-rotary-hammer-manual as well as "Safety and operating instructions: Rock drills CP 0022, CP 0032, CP 0069.

Given the low flow conditions during the summer work window and the location of the planned wall, it is extremely unlikely that adult Atlantic or shortnose sturgeon would be present in the work area. It is probable that under low summer flows, the ledge outcrop where work will be conducted will be above the waterline. Therefore, while adult sturgeon may be present in the action area during the summer work window, any exposure to effects of construction are extremely unlikely. The area where the wall will be constructed is bedrock ledge. Any effects from the construction on habitat that may be used by sturgeon are extremely unlikely.

As explained above, any turbidity or noise is expected to be minor and temporary and below thresholds of concern; as such, effects to shortnose and Atlantic sturgeon, if any, will be insignificant.

Collection of Dead Salmon and Sturgeon

Occasionally dead sturgeon or salmon are detected at the Milford Project that have died as a result of a cause unrelated to the effects of project operation. These fish are often detected impinged on the project racks, or somewhere else within the project footprint. Black Bear needs to collect and examine these individuals in order to determine the cause of death so that they can ascertain whether they are incidental takes associated with the project. Although these fish are "collected" (considered a form of take under the ESA regulations), we anticipate no further adverse effect to them as they are already dead. Given annual reporting by Black Bear, we anticipate that no more than 4 dead listed fish (of any species) will be collected a year at the Milford Project.

## 6. CUMULATIVE EFFECTS

"Cumulative effects" are 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 (50 C.F.R. §402.02). Future Federal actions that are not part of the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. It is important to note that the ESA definition of cumulative effects is not equivalent to the definition of "cumulative impacts" under the National Environmental Policy Act (NEPA) and therefore, consideration of cumulative effects here may not consider the same activities considered in any NEPA document prepared in association with the proposed actions.

Impacts to ESA-listed fish from non-federal activities are not well documented in the Penobscot River. It is possible that occasional recreational fishing for anadromous fish species may result in the illegal capture of these species. Within the action area, 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. Commercial fisheries for elvers (juvenile eels) and alewives may also capture Atlantic salmon as bycatch. No estimate of the numbers of these ESA-listed species caught incidentally in recreational or commercial fisheries exists; however, we have no information to suggest that effects would be different than what is considered in the Status of the Species and Environmental Baseline sections of this Opinion.

Pollution from point and nonpoint 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, Atlantic sturgeon, and shortnose sturgeon are vulnerable to impacts from pollution and are likely to continue to be impacted by water quality impairments in the Penobscot River and its tributaries; however, we have no information to suggest that effects would be different than what is considered in the Status of the Species and Environmental Baseline sections of this Opinion.

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, Atlantic sturgeon, and shortnose sturgeon will continue to be affected by contaminants in the action area in the future; however, we have no information to suggest that effects would be different than what is considered in the Status of the Species and Environmental Baseline sections of this Opinion.

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.

## 7. INTEGRATION AND SYNTHESIS OF EFFECTS

The *Integration and Synthesis* section is the final step in our assessment of the effects to species and critical habitat as a result of implementing the proposed action. In this section, we add the *Effects of the Action* to the *Environmental Baseline* and the *Cumulative Effects*, while also considering the Status of the Species, to formulate the agency's biological opinion as to whether the proposed action is likely to reduce appreciably the likelihood of both the survival and recovery of any ESA-listed species in the wild by reducing its numbers, reproduction, or distribution. The purpose of this analysis is to determine whether the action, in the context established by the status of the species, environmental baseline, and cumulative effects, is likely to jeopardize the continued existence of the Gulf of Maine DPS of Atlantic salmon, the Gulf of Maine DPS of Atlantic sturgeon, or shortnose sturgeon. We also consider whether the proposed action is likely to result in the destruction or adverse modification of critical habitat designated for the Gulf of Maine DPs of Atlantic salmon. We concluded above that the proposed action is not likely to adversely affect critical habitat designated for the Gulf of Maine DPS of Atlantic sturgeon.

Below, for the listed species that may be affected by the action, we summarize the status of the species and consider whether the action will result in reductions in reproduction, numbers or distribution of these species and then consider whether any reductions in reproduction, numbers or distribution resulting from the action would reduce appreciably the likelihood of both the survival and recovery of these species, as those terms are defined for purposes of the federal Endangered Species Act. In making those assessments we consider the effects of the action in the context of the Status of the Species, Environmental Baseline, and Cumulative Effects.

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."

## 7.1. Shortnose Sturgeon

While no reliable estimate of the size of either the shortnose sturgeon population in the Northeastern US or of the species throughout its range exists, it is clearly below the size that could be supported if the threats to shortnose sturgeon were removed. As described in the Status of the Species, based on the number of adults in populations for which estimates are available, there are at least 104,662 adult shortnose sturgeon, including 18,000 in the Saint John River in Canada. The lack of information on the status of some populations, such as that in the Chesapeake Bay, adds uncertainty to any determination on the status of this species as a whole. Based on the best available information, NMFS believes that the status of shortnose sturgeon throughout their range is stable (SNSSRT 2010).

As explained in the effects of the action, with the exception of occasional capture in the fish lift or stranding in isolated pools below the dam, all effects of project operations on shortnose sturgeon will be insignificant or extremely unlikely. The project is located at the site of a natural falls and does not block access to any historically available habitats.

We have determined that up to eight sturgeon (shortnose and/or Atlantic sturgeon) will be captured in the Milford fish lift over the term of the proposed action. Additionally, we anticipate the capture of up to two sturgeon (either shortnose or Atlantic) due to stranding in the ledge pools downstream of the Milford Project over the duration of the project license. As such, the proposed action is expected to result in the capture or collection and minor injury of up to 10 shortnose sturgeon. The licensee will adhere to the Sturgeon Handling and Protection Plan to ensure that any sturgeon captured in the fishways, or in the ledge pools, are removed promptly and returned safely downstream. It is possible that some captured sturgeon could experience minor injuries, such as abrasions, due to contact with the concrete surface of the fish lift or the rocky bottom of the pools.No significant injury and no mortality is anticipated. The survival of any shortnose sturgeon will not be affected by the continued operation of the project. As such, there will be no reduction in the numbers of shortnose sturgeon and no change in the status of this species or its trend. Reproductive potential of the species is not expected to be affected in any way. As all sturgeon are anticipated to fully recover from collection and the short duration of any capture and handling will not cause a delay or disruption of any essential behavior including spawning, there will be no reduction in individual fitness or any future reduction in numbers of an individual sturgeon. There will be no effect to migration because the dam is upstream of the normal range of the species in the river.

The continued operation of the project is not likely to reduce distribution because it will not impede shortnose sturgeon from accessing any seasonal concentration areas, including foraging, spawning or overwintering grounds in the action area or elsewhere. Any effects to distribution will be minor and temporary and limited to the temporary capture and handling of the individual sturgeon.

Based on the information provided above, the non-lethal capture of up to ten shortnose sturgeon between now and 2038, will not reduce appreciably the likelihood of survival of the species (*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 proposed action will not affect shortnose sturgeon 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 shortnose sturgeon from completing their entire life cycle or completing essential behaviors including reproducing, foraging and sheltering. This is the case because: (1) there will be no mortalities; (2) because there will be no mortalities there will be no change the status or trends of the species as a whole; (3) there will be no effect on the levels of genetic heterogeneity in the population; (4) there will not be any loss of any age class; (5) there will be no effect on reproductive output; (6) the proposed action will have only a minor and temporary effect on the distribution of shortnose sturgeon in the action area (limited to only the temporary capture of no more than ten individuals) and no effect on the distribution of the species throughout its range; and, (7) the proposed action will have no effect on the ability of shortnose sturgeon to shelter and no effect on individual foraging shortnose sturgeon.

In rare instances, an action that does not appreciably reduce the likelihood of a species' survival might reduce appreciably its likelihood of recovery. As explained above, we have determined that the continued operation of the dam will not reduce appreciably the likelihood that the species will survive in the wild, which includes consideration of recovery potential. Here, we consider whether the continued operation of the dam will reduce appreciably 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 proposed action will appreciably reduce the likelihood the population can rebuild to a point where the species is no longer in danger of extinction through all or a significant part of its range.

A Recovery Plan for shortnose sturgeon was published in 1998 pursuant to Section 4(f) of the ESA. The Recovery Plan outlines the steps necessary for recovery and indicates that each population may be a candidate for downlisting (i.e., to threatened) when it reaches a minimum population size that is large enough to prevent extinction and will make the loss of genetic diversity unlikely. However, the plan states that the minimum population size for each population has not yet been determined. The Recovery Outline contains three major tasks, (1) establish delisting criteria; (2) protect shortnose sturgeon populations and habitats; and, (3) rehabilitate habitats and population segments. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting and migrations of all individuals. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. Here, we consider whether the operation of the project will affect the Gulf of Maine metapopulation of shortnose sturgeon in a way that would affect the species' likelihood of recovery.

The proposed action will not change the status or trend of the Gulf of Maine metapopulation of shortnose sturgeon or the status and trend of the species as a whole. It will not result in any mortality and no reduction in future reproductive output. Because there will be no effect on numbers or reproductive output, it will not affect the trend of the population. The proposed action will have only insignificant effects on habitat and will not impact the river in a way that makes additional growth of the population less likely. This is because any effects to habitat will be insignificant or extremely unlikely and the dam is located at the upstream limit of the presumed historic range of the species in the river. Because it will not reduce the likelihood that the Gulf of Maine metapopulation can recover, it will not reduce the likelihood that the species as a whole can recover. Therefore, the proposed action will not reduce appreciably the likelihood that the species can be brought to the point at which they are no longer listed as endangered. Based on the analysis presented herein, the continued operation of the dam consistent with the terms of the proposed SPP, is not likely to reduce appreciably the survival and recovery of this species.

## 7.2. GOM DPS of Atlantic Sturgeon

The Gulf of Maine DPS is listed as threatened. While Atlantic sturgeon occur in several rivers in the Gulf of Maine DPS, recent spawning has only been documented in the Kennebec River. There are no abundance estimates for the Gulf of Maine DPS as a whole. The estimated effective population size of the Kennebec River is less than 70 adults, which suggests a relatively small spawning population (NMFS 2022).

Gulf of Maine DPS Atlantic sturgeon are subject to numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently not enough information to establish a trend for any life stage or for the DPS as a whole. The 2017 ASMFC stock assessment concluded that the abundance of the Gulf of Maine DPS is "depleted" relative to historical levels; this was affirmed in the 2024 Update. The Commission also noted that the Gulf of Maine is particularly data poor among all five DPSs. The assessment concluded that there is a 51 percent probability that the abundance of the Gulf of Maine DPS has increased since implementation of the 1998 fishing moratorium. The Commission also concluded that there is a relatively high likelihood (74 percent probability) that mortality for the Gulf of Maine DPS exceeds the mortality threshold used for the assessment

(ASMFC 2017). However, the Commission noted that there was considerable uncertainty related to these numbers, particularly concerning trends data for the Gulf of Maine DPS. For example, the stock assessment notes that it was not clear if: (1) the percent probability for the trend in abundance for the Gulf of Maine DPS is a reflection of the actual trend in abundance or of the underlying data quality for the DPS; and, (2) the percent probability that the Gulf of Maine DPS exceeds the mortality threshold actually reflects lower survival or was due to increased tagging model uncertainty owing to low sample sizes and potential emigration.

As described in the 5-Year Review for the Gulf of Maine DPS (NMFS 2022), the demographic risk for the DPS is "moderate"[29] because of its low productivity (i.e., relatively few adults compared to historical levels), low abundance (i.e., only one confirmed spawning population and low DPS abundance, overall), and limited spatial distribution (i.e., limited spawning habitat within the one river known to support spawning). There is also new information indicating genetic bottlenecks as well as low levels of inbreeding. However, the recovery potential is considered high.

As explained in the effects of the action, with the exception of occasional capture in the fishlift or stranding in isolated pools below the dam, all effects of project operations on Atlantic sturgeon will be insignificant or extremely unlikely. The project is located at the site of a natural falls and does not block access to any historically available habitats. We have determined that up to eight sturgeon (either shortnose or Atlantic) will be captured in the Milford fishlift over the term of the proposed action. Additionally, we anticipate the capture of up to two sturgeon (either shortnose or Atlantic) due to stranding in the ledge pools downstream of the Milford Project over the duration of the project license. As such, we expect that up to 10 Gulf of Maine DPS Atlantic sturgeon will be captured or collected at the project and may experience minor injuries. The licensee will adhere to the Sturgeon Handling and Protection Plan to ensure that any Atlantic sturgeon captured in the fishways, or in the ledge pools, are removed promptly and returned safely downstream. It is possible that some captured Atlantic sturgeon could experience minor injuries, such as abrasions, due to contact with the concrete surface of the fish lift or the rocky bottom of the pools.

No significant injury and no mortality is anticipated. The survival of any Atlantic sturgeon will not be affected by the proposed action. As such, there will be no reduction in the numbers of Atlantic sturgeon and no change in the status of the Gulf of Maine DPS or its trend. Reproductive potential of the Gulf of Maine DPS is not expected to be affected in any way. As all sturgeon are anticipated to fully recover from collection and the short duration of any capture and handling will not cause a delay or disruption of any essential behavior including spawning, there will be no reduction in individual fitness or any future reduction in numbers of an individual sturgeon. There will be no effect to migration because the dam is upstream of the normal range of the species in the river.

The proposed action is not likely to reduce distribution because it will not impede Atlantic sturgeon from accessing any seasonal concentration areas, including foraging, spawning or overwintering grounds in the action area or elsewhere. Any effects to distribution will be minor and temporary and limited to the temporary capture and handling of the individual sturgeon.

[29] 84 FR 18243; April 30, 2019 - Listing and Recovery Priority Guidelines

Based on the information provided above, the non-lethal collection of up to ten GOM DPS Atlantic sturgeon for the life of the action, will not reduce appreciably the likelihood of survival of the Gulf of Maine DPS of Atlantic sturgeon (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 continued operation of the project will not affect the Gulf of Maine DPS of Atlantic sturgeon 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 the GOM DPS of Atlantic sturgeon from completing their entire life cycle or completing essential behaviors including reproducing, foraging and sheltering. This is the case because: (1) there will be no mortalities; (2) because there will be no mortalities there will be no change the status or trends of the DPS; (3) there will be no effect on the levels of genetic heterogeneity in the population; (4) there will not be any loss of any age class; (5) there will be no effect on reproductive output; (6) the continued operation of the dam will have only a minor and temporary effect on the distribution of the GOM DPS of Atlantic sturgeon in the action area (limited to only the temporary capture of no more than ten individuals) and no effect on the distribution of the DPS throughout its range; and, (7) the continued operation of the project will have no effect on the ability of Gulf of Maine DPS Atlantic sturgeon to shelter and no effect on individual foraging Gulf of Maine DPS Atlantic sturgeon.

No Recovery Plan for the Gulf of Maine DPS Atlantic sturgeon has been published. The Recovery Plan would outline the steps necessary for recovery and the demographic criteria, which once attained, would allow the species to be delisted. In January 2018, we published a Recovery Outline for the five DPSs of Atlantic sturgeon (NMFS 2018)[30]. This outline is meant to serve as an interim guidance document to direct recovery efforts, including recovery planning, until a full recovery plan is developed and approved. The outline provides a preliminary strategy for recovery of the species. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting, and migrations of all individuals. For Gulf of Maine DPS Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. As described in the vision statement in the Recovery Outline, subpopulations of all five Atlantic sturgeon DPSs must be present across the historical range. These subpopulations must be of sufficient size and genetic diversity to support successful reproduction and recovery from mortality events. The recruitment of juveniles to the sub-adult and adult life stages must also increase and that increased recruitment must be maintained over many years. Recovery of these DPSs will require conservation of the riverine and marine habitats used for spawning,

[30] Available online at: https://media.fisheries.noaa.gov/dam-migration/ats_recovery_outline.pdf; last accessed December 29. 2025

development, foraging, and growth by abating threats to ensure a high probability of survival into the future. Here, we consider whether this proposed action will reduce the Gulf of Maine DPS likelihood of recovery.

This action will not change the status or trend of the Gulf of Maine DPS. The proposed action will not affect the distribution of Atlantic sturgeon across the historical range. The proposed action will not result in any mortality or reproductive output. Therefore, it will not affect abundance in a way that would impair resiliency or genetic diversity. The proposed action will have only insignificant effects on habitat and will not impact habitat in a way that makes additional growth of the population less likely, that is, it will not reduce the habitat's carrying capacity. The proposed action will not result in any loss of habitat. For these reasons, the action will not reduce the likelihood that the Gulf of Maine DPS of Atlantic sturgeon can recover. Therefore, the proposed action will not reduce appreciably the likelihood that the Gulf of Maine DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the continued operation of the dam consistent with the terms of the proposed SPP, is not likely to appreciably reduce the survival and recovery of this species.

#### 7.2.1. Critical Habitat Designated for the Gulf of Maine DPS of Atlantic Sturgeon

As explained in section 5.7, we have determined that all effects of the continued operation of the Milford Project on PBFs 1 and 3 are insignificant; and that there will be no effect to PBF 4. PBF 2 does not occur in the action area. Based on this, all effects to the Penobscot River unit will be insignificant or extremely unlikely. Therefore, the continued operation of the Milford Project consistent with the terms of the proposed SPP is not likely to adversely affect critical habitat designated for the Gulf of Maine DPS of Atlantic sturgeon.

### 7.3. Gulf of Maine DPS of Atlantic Salmon

The GOM DPS of Atlantic salmon currently exhibits critically low spawner abundance, poor marine survival, and is 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. The conservation hatchery program assists in slowing the decline and helps stabilize populations at low levels, but to date 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 operation of the Milford Project pursuant to an amended license that incorporates the proposed measures will lead to an improvement in passage for Atlantic salmon as compared to current operations. While we expect an overall improvement compared to current conditions, the project will continue to result in adverse effects to Atlantic salmon and designated critical habitat. The project will continue to affect upstream and downstream passage of Atlantic salmon, result in the injury and death of individuals, and have a negative impact on salmon habitat. In the discussion below, we consider whether the effects of the proposed actions 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. We also determine whether the proposed action is likely to destroy or adversely modify designated critical habitat for the GOM DPS of Atlantic salmon.

### 7.3.1. Summary of Upstream Passage Effects

It is possible that the proposed enhancements (i.e., operation of the Denil fishway, construction of a spill diversion wall) will allow for the achievement of the passage performance targets immediately upon implementation (anticipated in year 3). However, if this does not occur, we have determined that it will take no longer than six years to meet the performance targets. As explained above, this timeline considers the time necessary to test proposed facilities, implement any additional operational or structural measures, pursuant to adaptive management, and then re-test those facilities to verify adherence to the standards. As such, we assume that the conditions described in the *Environmental Baseline* as the current or baseline conditions could persist for three to six years during the interim phase, and that 93% of prespawn adults will successfully locate and utilize the fishways at Milford. Consequently, we assume that up to 7% of salmon will fail to locate or use the existing lift or the Denil, and that these effects meet the definition of "harassment" as they will experience significant delay in their upstream migration and will need to locate alternative spawning habitat, which will contribute to energetic impacts. In addition to the salmon that don't pass, we anticipate that up to 67% will be significantly delayed (>48 hours), and therefore will be harassed (57%), injured (up to 9%), or killed (1%). After the measures have been fully implemented and evaluated (by the end of year six), we expect that the performance standards will have been achieved such that 95% of adult salmon will successfully utilize the upstream fishways, and that 75% will do so in 48 hours or less, and that the remaining 25% will do so in under 96 hours or less. The 5% that fail to pass will be harassed, but are expected to locate habitat downriver of the dam in the lower river tributaries (e.g., Soudabscook, Cove, Marsh, Kenduskeag Streams). In addition to the fish that fail to pass, 24% of the run will be significantly delayed (>48 hours), and therefore will be harassed (20%) or injured (4%) due to the energetic effects of delay. We do not anticipate mortality as a result of delay as it would be capped at 96 hours under the performance standard as proposed. Estimated take associated with passage inefficiencies at the Milford Project is shown in Table 16 in section 5.3.1.

A small number of adult salmon (up to 2 fish annually) may also experience adverse effects when they are captured due to stranding in pools downstream of the spillway.

### 7.3.2. Summary of Downstream Passage Effects

In section 4.4.1, we identified several sources of mortality associated with downstream passage through the Milford Project under baseline conditions, including direct (6.7%) and indirect mortality (1.6% in the impoundment and 3% due to hydrosystem delayed mortality). As described above, we anticipate that with the expansion of the supplemental spill duration to 54-days, direct mortality will be reduced to 4% and that indirect mortality will be reduced to 1.4%, attributable to hydrosystem delayed mortality. Consequently, we expect that the full implementation of the proposed downstream measures will lead to an improvement in smolt survival, such that only 5.4% of smolts will be killed due to the direct and indirect effects of dam passage. When the impoundment effects, part of the environmental baseline (i.e., not effects of the proposed action), are incorporated we estimate total project mortality rates of 7.1%. As such, we anticipate that on average if 100 smolts migrated through the action area, approximately 7 (as compared to 11 under baseline conditions) would die due to direct or indirect effects caused by the project. This does not include background levels of mortality in the action area that would occur regardless of the presence of the dam.

In addition to mortality, we anticipate that up to 2% (i.e, average of 1%; range 0% to 2%) of smolts will be harassed due to migratory delay in excess of 24 hours; and that 0.7% will be injured due to the effects of passage.

Atlantic salmon kelts migrate downstream in the fall after spawning, or in the spring after overwintering in freshwater. They are exposed to the same challenges associated with dam passage as smolts but, in general, are more likely to be struck by a turbine blade if they pass through the turbines due to their greater length (Alden Research Laboratory, 2012). As the spacing on the intake racks preclude the entrainment of kelts at the Milford Project, we do not anticipate that mortality would occur as a result of turbine passage. As the proposed measures will not affect kelt survival, and consistent with the performance standard incorporated in the project license, we anticipate that no more than 4% of salmon kelts could be killed due to the effects of downstream passage at the Milford Project, as described in our 2012 Opinion. In accordance with the SPP and the project license, Black Bear is scheduled to conduct a three-year Atlantic salmon kelt downstream passage study at the Milford Project starting in 2027 in order to evaluate downstream survival.

### 7.3.3. 2017 Emergency Repair of the Milford Dam

In addition to considering the implementation of the revised Species Protection Plan over the remaining term of the license at the Milford Project, it also considers the effects of the emergency repair that occurred at the dam in 2017. As indicated, we expect that seven salmon were adversely affected due to handling and transport when they were located within the void area that needed to be repaired. As described in section 4, we also expect that 2.3% of migrating adult salmon were delayed from passing upstream during the month-long fishway shut down in August of 2017. We estimated that this equated to 20 salmon given the run size in that year; meaning that there could have been approximately 13 additional salmon (20 salmon – 7 seven salmon observed in the work area) that were delayed from passing. We anticipate that these were exposed to the energetic effects of delay (described above), although they may have located cold-water pools downstream of the dam, either in the mainstem or in the lower river tributaries in the Penobscot, where they could hold for the duration of the fishway shutdown. These salmon were likely adversely affected due to migratory delay in excess of 48 hours, and some proportion may have been exposed to energetic effects that could have reduced their potential to successfully spawn further upriver, or potentially to survive to spawn in future years.

As the fishway was only inoperable for a short period, and as no mortalities were observed, we do not anticipate that the action reduced the abundance, reproduction, or distribution of the species; nor did it appreciably diminish the value of critical habitat as a whole for the conservation of the species.

### 7.3.4. Survival and Recovery Analysis

The 2019 Recovery Plan projects four phases of recovery over a 75-year timeframe to achieve delisting of the GOM DPS of Atlantic salmon. The four phases of recovery are:

> Phase 1: The first recovery phase focuses on identifying the threats to the species and characterizing the habitat needs of the species necessary for their recovery.
>
> Phase 2: The second recovery phase focuses on ensuring the persistence (survival) of the GOM DPS through the use of the conservation hatcheries while abating imminent threats to the continued existence of the DPS. Phase 2 focuses on freshwater habitat used by Atlantic salmon for spawning, rearing, and upstream and downstream migration; it also emphasizes research on threats within the marine environment.
>
> Phase 3: The third phase of recovery will focus on increasing the abundance, distribution, and productivity of naturally reared Atlantic salmon. It will involve transitioning from dependence on the conservation hatcheries to wild smolt production.
>
> Phase 4: In Phase 4, the GOM DPS of Atlantic salmon is recovered and delisting occurs. The GOM DPS will be considered recovered once: a) 2,000 wild adults return to each SHRU, for a DPS-wide total of at least 6,000 wild adults; b) each SHRU has a population growth rate of greater than 1.0 in the 10-year period preceding delisting, and, at the time of delisting, the DPS demonstrates self-sustaining persistence; and c) sufficient suitable spawning and rearing habitat for the offspring of the 6,000 wild adults is accessible and distributed throughout the designated Atlantic salmon critical habitat, with at least 30,000 accessible and suitable habitat units in each SHRU, located according to the known migratory patterns of returning wild adult salmon.

We are presently in Phase 2 of our recovery program (ensuring the survival of the GOM DPS through the use of the conservation hatcheries while abating imminent threats to the continued existence of the DPS). As indicated in the 2019 Recovery Plan for Atlantic salmon, the Services do not have plans to transition from dependence on conservation hatcheries to wild fish production in the foreseeable future.

The jeopardy analysis makes a conclusion regarding the survival and recovery of the GOM DPS of Atlantic salmon as a whole, and not just survival and recovery of the species in the action area. Therefore, in the survival and recovery portions of this analysis, we consider how the consequences to individual salmon that were identified in section 5 of this Opinion will affect the Penobscot River population of Atlantic salmon, how the consequences to the Penobscot River population will affect the Penobscot Bay SHRU, and then finally, how the consequences to the Penobscot SHRU are likely to affect the survival and recovery of the GOM DPS as a whole. It should be noted that, unlike in the other two SHRUs, the Penobscot River and its tributaries are the only rivers in the Penobscot Bay SHRU, and as such an analysis of the effects on the Penobscot River population is equivalent to an analysis of the SHRU itself. As highlighted in the 2019 Recovery Plan, the survival and recovery of the Penobscot SHRU is necessary for attainment of the delisting criteria and recovery of the GOM DPS.

The GOM DPS of Atlantic salmon currently exhibits critically low spawner abundance, poor marine survival, and is 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. 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.

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. We also determine whether the proposed action is likely to destroy or adversely modify designated critical habitat for the GOM DPS of Atlantic salmon.

Survival Analysis

The first step in conducting this analysis is to assess the consequences of the proposed action on the survival of the species. Survival is defined as the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a species with a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter (USFWS & NMFS, 1998). The three criteria that are evaluated under the survival analysis include: reproduction, numbers and distribution.

We are presently in Phase 2 of our recovery program, in which we work to ensure the survival of the GOM DPS through the use of the conservation hatcheries while abating imminent threats to the continued existence of the DPS. The focus of phase 2 is addressing the threats to salmon survival and recovery identified in the 2019 Recovery Plan (e.g., dams, climate change, marine survival, genetic diversity). As indicated in the 2019 Recovery Plan for Atlantic salmon, the Services do not have plans to transition from dependence on conservation hatcheries to wild fish production in the foreseeable future. Therefore, for purposes of our survival analysis, we assume hatchery supplementation will continue in the Penobscot Bay SHRU over the 13-year time horizon considered in this analysis. The hatchery program, sponsored by the U.S. Fish and Wildlife Service, has been in place for over 100 years and because we do not have any information to the contrary, we expect it will continue over the duration of the proposed action.

When considering how a proposed action is likely to affect the survival of a species, we consider effects to reproduction, numbers and distribution. The number of returning adult Atlantic salmon to the Penobscot Bay SHRU is a measure of both the reproduction and numbers of the species. We consider the ability of prespawn Atlantic salmon to access high quality spawning and rearing habitat throughout the major tributaries of the Penobscot River as a measure of distribution. Below, we analyze whether the proposed action will reduce the reproduction, numbers, or distribution of the Atlantic salmon in the action area and the Penobscot Bay SHRU to a point that reduces appreciably the species likelihood of survival in the wild.

To assess the overall effect of the proposed action on Atlantic salmon survival we will consider how it affects the abundance (and therefore reproduction) of adult prespawn salmon returning to the East Branch of the Penobscot River, where there is abundant spawning and rearing habitat. For simplicity, the analysis focuses on the relative number of hatchery returns, which is reasonable given that >90% of returns to the system are a product of hatchery stocking. A basic model can help predict the effect that the proposed modifications will have on the number of returning Atlantic salmon to the Penobscot River. The conditions we consider are: 1) *Environmental Baseline* - This is the existing condition analyzed in section 4 of this Opinion. This condition incorporates many of the improvements implemented as part of the initial SPP proposed by Black Bear and FERC in 2012, 2) *Interim Phase* (year 1 to 6) - This phase includes the achievement of the downstream standard in year one, as well as the six-year interim phase for upstream passage where we assume the passage rate will persist at existing levels, and 3) *Implementation Phase* (year 7 to 13) - effects anticipated after the measures necessary to achieve the identified downstream survival (and delay) and upstream passage (and delay) performance standards have been met. During this period, we anticipate that at a minimum the fishways will have achieved the upstream and downstream performance standards[31].

We can estimate the extent to which passage modifications at the Milford Project would reduce the effect that it has on the salmon run in the Penobscot River as a whole by comparing the *Environmental Baseline* condition to the *Interim* and *Implementation* phase conditions (Table 22). This model considers the proportion of smolts lost due to the direct and indirect effects of passing downstream through the Milford Dam (as described in sections 4 and 5). For upstream passage, the interim phase considers that salmon are passed at Milford at the existing average efficiency rate (93%) as we anticipate that the lift will continue to be the primary passage route as the Denil fishway is being evaluated. In the implementation phase, however, we assume upstream passage will occur through both fishways to achieve the passage standard (>95%). The model also includes freshwater (99.7% per km; Stevens et al. 2019)[32] and marine (0.16%; USASAC 2025)[33] survival rates. For the purpose of this model, we will consider the survival of smolts beginning at the confluence of the Piscataquis River, as that tributary contains abundant high value spawning and rearing habitat, in addition to a stocking program. As these survival factors are constant in all relevant conditions, they do not affect the proportional results.

Table 22. A conceptual model to demonstrate how the effects of the Milford Project could reduce the potential run to the Piscataquis River under different conditions. For the sake of this model, we have assumed a starting number of hatchery smolts. The model is intended to show the effects of this action at Milford specifically and is for illustrative purposes only. It should be

[31] Our analysis indicates that the downstream cumulative performance standard would likely be achieved during the first year of the interim phase, but that the upstream standard may take up to six years to be achieved. In the implementation phase we assume that both standards have been met.
[32] Extrapolating this rate over the 89-km reach from the Piscataquis River's confluence with the mainstem to Penobscot Bay, which equates to an in-river survival rate of 77% through that reach.
[33] 10-year average post smolt to adult return rate on the Penobscot River (USASAC, 2025) for hatchery stocked 2SW returns.

emphasized that proportional difference would be the similar regardless of the number of smolts used.

| | Conditions Evaluated | | |
|---|---|---|---|
| | Environmental Baseline | Interim Year 1-6 | Implementation Year 7-13 |
| **Outmigrating Smolts** | | | |
| Leave the Piscataquis River | 100,000 | 100,000 | 100,000 |
| Survive Milford | 89,000 | 93,200 | 93,200 |
| Survive Other Freshwater Threats | 68,118 | 71,332 | 71,332 |
| **Feed in Ocean for Two Years before Returning to the River** | | | |
| **Prespawn Adults** | | | |
| Return to the Penobscot | 109 | 114 | 114 |
| Pass Upstream of Milford | 101 | 106 | 108 |
| **% Increase Over Baseline** | | | |
| Return to the Penobscot | | 5% | 5% |
| Return to Above Milford | | 5% | 7% |

Using this simple model, we estimate that during the interim and implementation phases, Atlantic salmon will increase the number of returns to the Penobscot downstream of Milford by 5%, and increase the proportion that pass the project by 5% during the interim period, and 7% during the implementation period. As such, we expect that the proposed action will lead to an increase in the proportion of adults that are free to migrate to the Piscataquis, or to other suitable spawning habitat in the upper Penobscot River. The 5-7% increase constitutes a relatively small, yet meaningful, increase in the number and distribution of fish throughout the Penobscot River, and therefore the Penobscot Bay SHRU.

In section 5.3.1, we concluded that excessive migratory delay could lead to injury of 9% of adult salmon during the first three to six years of the proposed action (interim phase), and that 1% of these fish could die before or after spawning as a result. Overall, we anticipate that the proportion that will actually die will be small, as there are tributaries upstream and downstream of the project that could provide cold water refuge, or an alternative location to spawn. However, as we know that there is a detrimental effect of delay in warm water, it is reasonable to anticipate that 1% could die as a result of excessive migratory delay during the interim period. As delay will be held to under 96 hours during the implementation phase (years 7 to 13), we would not anticipate that affected individuals would die as a result of migratory delay during this phase.

The biological criteria for recovering Atlantic salmon described in the Recovery Plan indicate that, in addition to achieving the abundance criteria, each SHRU needs to have a positive mean population growth rate of greater than 1.0 in the 10-year (two-generation) period preceding delisting (USFWS & NMFS, 2019). A population with a growth rate of 1.0 is considered stable; whereas a population with a rate greater or less than 1.0 would be considered growing (i.e., positive growth rate) or declining (i.e., negative growth rate), respectively. The 10-year mean geometric replacement rate of naturally reared Atlantic salmon is reported annually for each of the three SHRUs (Figure 18). The growth rate of salmon in the Penobscot SHRU has varied around 1.0 over the last 10 years. The replacement rate of naturally reared salmon is the metric currently used for monitoring population growth of the GOM DPS of Atlantic salmon, and is reported annually by both the US Atlantic Salmon Assessment Committee (USASAC) and by the GOM DPS Atlantic Salmon Collaborative Management Strategy (CMS) management board. Therefore, we consider it the best available information regarding the productivity of Atlantic salmon within the GOM DPS. In 2021, the replacement rate of the GOM DPS as a whole dropped below 1.0 for the first time in a decade (0.96; 95% CL 0.57-1.16), and a similar trend was observed in the SHRU replacement rates (CMS, 2022). In 2024, the replacement rate of the GOM DPS has increased to 1.14 (CL 0.66 – 1.94); and the Penobscot has increased to 1.22 (CL 0.63 – 2.38). It is concerning that the replacement rate has generally declined, but since the confidence interval still overlaps 1.0, the USASAC still considers the population to be relatively stable (USASAC, 2022).

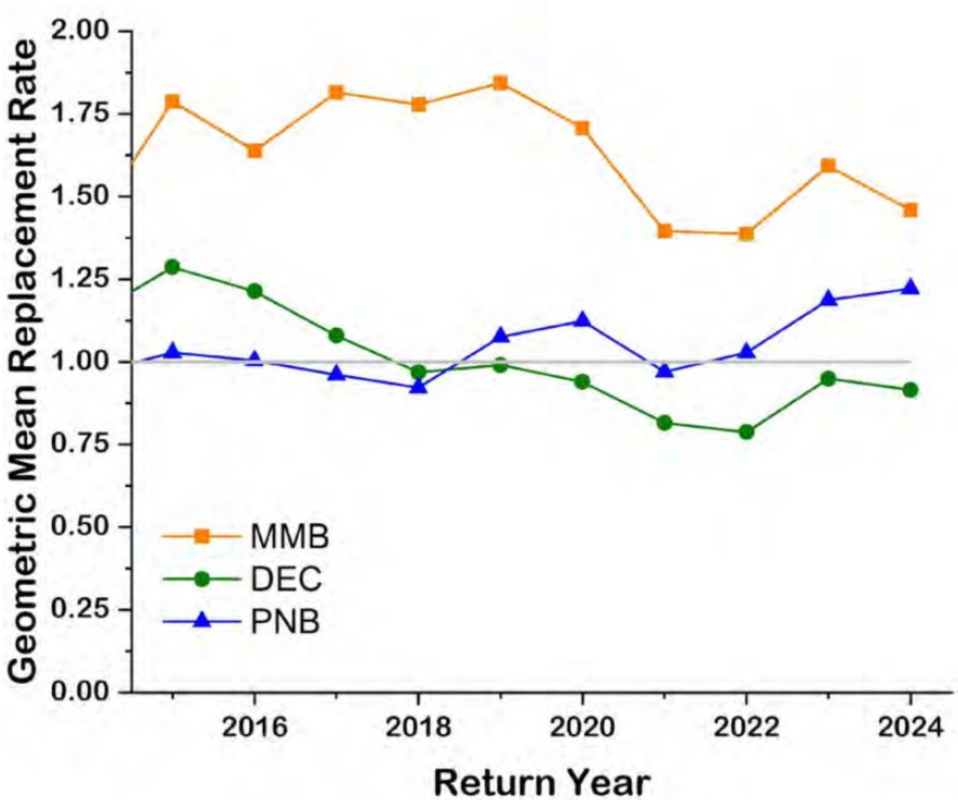


Figure 18. The 10-year geometric mean population growth rate (y-axis) of naturally-reared salmon in the GOM DPS and all three SHRUs from 2015 to 2024 (x-axis) (USASAC, 2025).

Throughout this period of stability, Atlantic salmon in the Penobscot River have been exposed to the combined effects of multiple dams, including the Milford Project. As the population has maintained a stable (although not positive) growth trajectory, we expect that the improvement of the conditions in the action area (i.e., reduced to 4% mortality of smolts, 4% mortality of kelts, and a prespawn adult passage rate of 95%) will lead to a population with a higher potential for positive growth. Increasing the productivity of the Penobscot River, where most of the habitat exists, should lead to a corresponding increase in the productivity of the Penobscot Bay SHRU as a whole.

The 2019 Recovery Plan describes accessible habitat as allowing “downstream movements of smolts during the spring migration, and upstream and downstream movement of adults that seek out habitats for spawning and resting” (USFWS and NMFS, 2019). We consider the amount of accessible habitat as the metric for determining how a proposed action affects the distribution of Atlantic salmon. Compared to current conditions, the proposed action will broaden the distribution of the species in the Penobscot River, as operating the Denil fishway, in addition to the existing lift, in compliance with high performance standards will provide safe and timely access of prespawn adult salmon to upstream habitats, and improve access to the migratory corridor in the lower river. Given the anticipated cumulative efficiency of the fishways when operated in compliance with the performance standards, we expect that approximately 95% of migrating adult salmon that approach the Milford Project will be able to volitionally access the abundant spawning and rearing habitat in the upper Penobscot River. As described in section 5, the remaining fish will remain below the dam, where we expect that they will stray to seek alternative spawning habitat.

In summary the effects of the proposed action (section 5) considered in the context of the status of the species (section 3), the environmental baseline (sections 4), and cumulative effects (section 6), is anticipated to adversely affect juvenile and adult Atlantic salmon. However, the improvements in survival and passage efficiency, as well as reductions in migratory delay, will substantially improve conditions relative the environmental baseline and will lead to an increase in the numbers, reproduction, and distribution of Atlantic salmon in the action area and, as a result, in the Penobscot River, the Penobscot Bay SHRU, and the DPS as a whole. As we anticipate that the USFWS conservation hatchery program will continue to operate, Atlantic salmon will continue to persist in the Penobscot River regardless of the effects of the dams. However, merely persisting is not sufficient to pass the survival test as defined above. When considering listed species, in addition to “exist[ing] into the future”, there is an expectation that the species “retain[s] the potential for recovery”, and that it have “sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring” (USFWS & NMFS, 1998). Similarly, the 2019 Recovery Plan indicates that “recovery actions associated with Phase 2 are geared toward creating the necessary foundation for establishment and protection of sufficiently resilient wild populations to withstand foreseeable long-term stresses, and toward providing Atlantic salmon with access to suitable habitat throughout their life cycle” (USFWS and NMFS, 2019). Although the proposed action will not eliminate the loss of salmon, the increase in survival and passage efficiency will allow for the “necessary foundation” that will allow for recovery. The proposed measures and performance standards will lead to an increase in the number of adults anticipated to return to the Penobscot River and its tributaries even when combined with the baseline effects, and will allow for increases in reproduction, abundance, and distribution. We make this conclusion in consideration of the status of the species as a whole, the status of Atlantic salmon in the action area, and in consideration of the threats experienced by Atlantic salmon in the action area as described in the Environmental Baseline and Cumulative Effects sections of this Opinion.

Recovery Analysis

The second step in conducting the jeopardy analysis is to assess the effects of the proposed action on the recovery of the species. Recovery is defined as the improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in section 4(a)(1) of the ESA (USFWS & NMFS, 1998). As with the survival analysis, there are three criteria that are evaluated under the recovery analysis: reproduction, abundance, and distribution.

In rare instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not reduce appreciably the likelihood that Atlantic salmon will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery.

We anticipate that over the term of the proposed action that Atlantic salmon produced in conservation hatcheries will continue to be stocked in all three habitat units, including the Penobscot Bay SHRU. As long as the hatchery continues to produce Atlantic salmon, the species will not go extinct in the wild. However, recovery of the species requires a self-sustaining population with a positive growth rate.

As described above, the condition of the GOM DPS of Atlantic salmon is dire. Adult return rates continue to be extremely low, and it is unlikely that the species can recover unless there is a significant improvement in both marine and freshwater survival. At existing freshwater and marine survival rates (the medians have been estimated by NMFS as 1.1% and 0.5%, respectively), it is unlikely that Atlantic salmon will be able to achieve recovery. A significant increase in either one of these parameters (or a lesser increase in both) will be necessary to overcome the significant obstacles to recovery. We have created a conceptual model to indicate how marine and freshwater survival rates would need to change in order to recover Atlantic salmon (NMFS, 2010). In Figure 19 the dot represents current marine and freshwater survival rates, whereas the curved line represents all possible combinations of marine and freshwater survival rates that would result in a stable population with a growth rate of zero. If survival conditions are above the curved line, the population is growing, and, thus, trending towards recovery (lambda greater than one). The straight lines indicate the rates of freshwater survival that have been historically observed (Legault, 2004). This model indicates that there are many potential routes to recovery; for example, recovery could be achieved by significantly increasing the existing marine survival rate while holding freshwater survival at existing levels, or, conversely, by significantly increasing freshwater survival while holding marine survival at today's levels. Conceptually, however, the figure makes clear that an increase in both freshwater and marine survival will lead to the shortest path to achieving a self-sustaining population that is trending towards recovery.

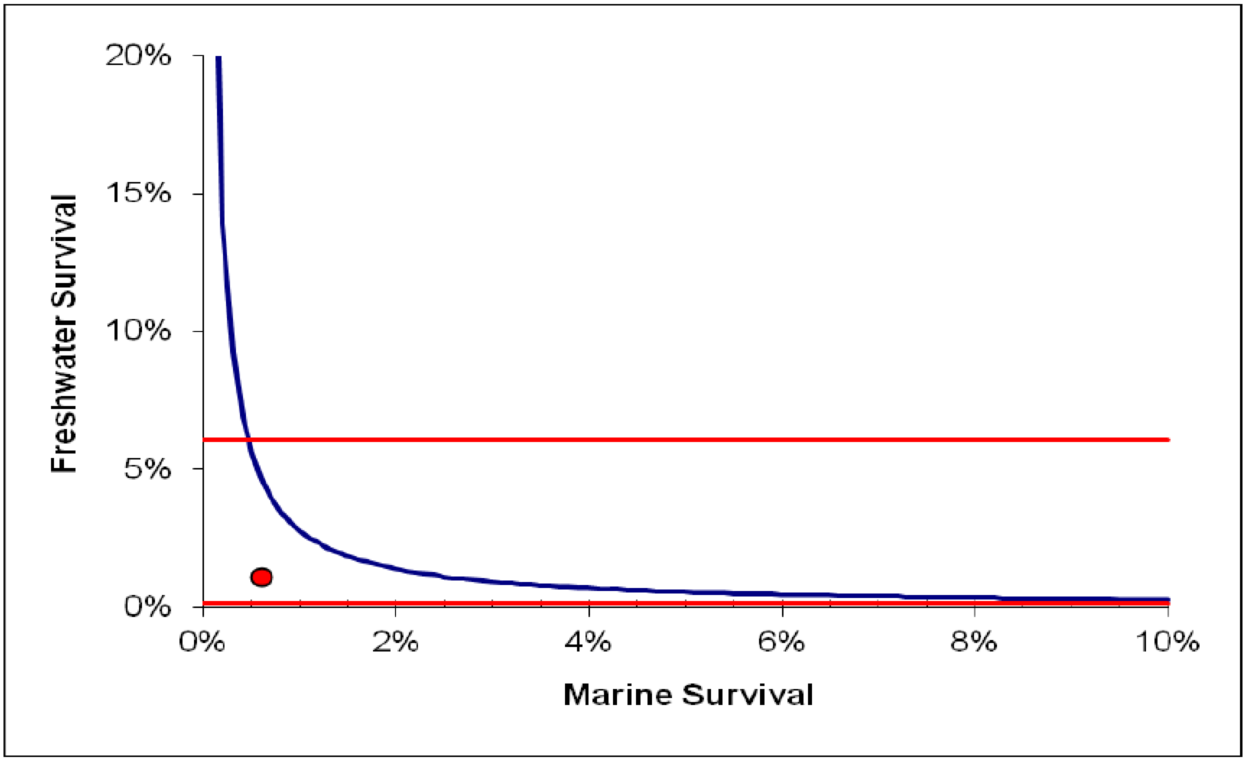

Figure 19. NMFS (2010) conceptual model depicting marine and freshwater survival relative to recovery of the GOM DPS of Atlantic salmon (Note: The dot represents current conditions, the curved line represents recovery, and the straight lines are the historic maximum and minimum freshwater survival).

Despite improvements, the proposed action will adversely affect freshwater survival (through the direct and indirect effects of dam passage) of smolts, kelts, and prespawn adults and marine survival (through hydrosystem delayed mortality) of smolts in the Penobscot River. As illustrated above, even with the improvements that will result from the proposed action, the number of smolts and adults surviving to reproduce in the Penobscot River and in the Penobscot Bay SHRU is lower than it would be absent the Milford dam. However, overall numbers, reproduction, and distribution will be improved when compared to the environmental baseline and the proposed action will not reduce appreciably the species likelihood of survival in the wild. This is important, as Atlantic salmon in the Penobscot Bay SHRU have maintained a relatively stable population (supported by stocking) despite past effects of the dam. As such, we expect that the improvement of the conditions in the Penobscot will lead to a population with a higher potential for positive growth. Increasing the productivity of the Penobscot River, where most of the habitat occurs, is expected to lead to a corresponding increase in the productivity of the Penobscot Bay SHRU as a whole, and an associated increase the potential for recovery.

As indicated in the survival analysis, we have estimated that given the anticipated survival rates resulting from implementation of the proposed action, as well as the achievement of the upstream and downstream performance standards, the Penobscot River will support a run size of adult returns to the upper Penobscot that is 7% larger than what is expected under baseline conditions. Therefore, conceptually, we can expect that the proposed action could lead to an increase in the abundance and reproduction in the Penobscot River, which in turn will increase the number of naturally reared and wild smolts that are outmigrating to the ocean. Increasing the number and condition of outmigrating smolts has been identified as the best strategy for overcoming poor marine survival (Thorstad et al., 2021). Therefore, given that the proposed action will increase abundance, reproduction, and productivity in the Penobscot River, and consequently, the Penobscot SHRU and the GOM DPS, the proposed action is not likely to appreciably reduce the species' potential for recovery. Furthermore, the increase in abundance and reproduction will improve the potential of the Penobscot Bay SHRU to achieve the abundance and productivity recovery criteria contained in the 2019 Recovery Plan. However, we expect that many marine and freshwater threats will still need to be addressed in order for those criteria to be achieved.

The proposed action will not affect Atlantic salmon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and will result in effects to the environment that would prevent Atlantic salmon from completing their entire life cycle, including reproduction, sustenance, and shelter. We expect that the proposed project will lead to an increase in the numbers, reproduction and distribution of Atlantic salmon.

## 7.4. Designated Critical Habitat

In this section, we consider the impacts of the proposed action on critical habitat in the action area and then consider how those impacts will affect the conservation value of critical habitat designated in the Penobscot Bay SHRU. We then consider those consequences in the context of critical habitat designated for the GOM DPS to determine whether the proposed action is likely to result in the destruction or adverse modification of critical habitat designated for the Gulf of Maine DPS of Atlantic salmon. On August 27, 2019, NMFS and USFWS published a revised regulatory definition of "destruction or adverse modification" (84 FR 44976). Destruction or adverse modification "means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.

According to the 2019 Atlantic salmon recovery plan (USFWS & NMFS, 2019), recovery of Atlantic salmon will require at least 30,000 accessible and suitable spawning and rearing habitat units in each SHRU including the Penobscot Bay SHRU. Presently, approximately 18,600 units are currently considered fully accessible in the Penobscot Bay SHRU downstream of the Milford Dam. Habitat upstream or downstream of a hydro dam will be considered "accessible" by the Services if Atlantic salmon passage performance standards necessary to avoid jeopardizing the species are achieved at any particular dam.

As explained in Section 5.5, the proposed action has the potential to affect the PBFs that are functioning in the action area. Although the proposed action will lead to improvements in the functioning of the migratory PBFs, we have concluded that the effects to the migratory corridor for prespawn adult salmon (M 2), juveniles (M 4), and other diadromous fish (M 3) will be adverse due to ongoing passage inefficiencies. Based on the effects of diverting flow from the bypass reach, we have also determined adult holding habitat (SR 1 and M 2) in the action area will be adversely affected. Here, we summarize the adverse effects and consider whether they result in a direct or indirect alteration of the critical habitat that appreciably diminishes the value of critical habitat as a whole for the conservation of the Gulf of Maine DPS of Atlantic salmon (i.e., we determine whether the proposed action is likely to result in the destruction or adverse modification of critical habitat). This analysis takes into account the geographic and temporal scope of the proposed action, recognizing that "functionality" of critical habitat necessarily means that it must now and must continue in the future to support the conservation of the species as a whole. The analysis takes into account any changes in amount, distribution, or characteristics of the critical habitat that will be required over time to support the successful recovery of the species. Destruction or adverse modification does not depend strictly on the size or proportion of the area adversely affected, but rather on the role the action area and the affected critical habitat serves with regard to the function of the overall critical habitat designation, and how that role is affected by the action. This analysis ties directly to the recovery objective of "access to sufficient suitable habitat" that is found in both the reclassification and delisting objectives.

*PBF M 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.*

In section 4, we determined that PBF M 1 functions at a limited capacity due to passage obstruction and delay of a proportion of the salmon run. In section 5, we determined that the operation of the Denil fishway (in addition to the fish lift), as well as the construction of a spillway diversion wall, will improve the function of PBF M 1 by year 7 of the proposed action, but that it will continue to be of limited function during the interim phase (year 1 to year 6). Further, we determined that while the action will lead to an improvement in the conservation value of the PBF, the proposed action will still adversely affect the PBF in the action area as passage may not be improved until year 6, and because a small proportion of prespawn salmon will still be excluded from passing the projects, even with the achievement of the performance standards.

The proposed action includes evaluations of the effectiveness of the Milford fishways and, informed by those studies, requirements to "develop and implement additional operational or infrastructure measures, as reasonable and practicable, that are likely to meet or exceed the upstream performance standard" (Black Bear's Draft BA and SPP, April 25, 2025). From experience at other projects, if a fishway is not sufficient to meet the standards, there may be relatively few alternatives for remedying poor upstream passage conditions at some projects. Typically, upstream passage ineffectiveness is related to inadequate attraction to the fishway itself. Fish that are attracted to a section of the dam that is distant from the fishway entrance (such as the spill into the bypass reach on the other side of the river), for instance, are unlikely to be attracted to the fishway entrance within a reasonable amount of time if competing flows cannot be adequately managed. In an instance such as this, we would anticipate that significant structural modifications, such as additional fishway entrances or additional new fishways, may be necessary to achieve the upstream performance standard. Although this type of measure is not precluded by the adaptive management protocol incorporated into the proposed action (assuming it is deemed "reasonable and practicable"), it is likely that structural changes would lead to new effects not considered in this Opinion, and therefore would necessitate reinitiation of consultation. However, we consider that operational and minor structural changes could be implemented as part of this adaptive management plan, and as described above, would be required and implemented within six years.

As indicated, we expect that the Milford Project will continue to adversely affect PBF M 1 in the action area by limiting access to the migratory corridor to a small proportion of Atlantic salmon that are migrating to spawning habitat in the upper Penobscot River. Black Bear's proposal to manage passage at the project to achieve a 95% standard means that a significant majority of salmon that are motivated to pass the project will be able to do so. This restoration of function to the PBF will allow upstream habitat to be considered accessible per the 2019 Recovery Plan, and will greatly increase the conservation value of PBF M 1 in the action area.

The conservation value of PBF M1 will continue to be diminished in the action area for the first six years of the action as Black Bear implements adaptive management to achieve the performance standards. It is possible that the standard could be achieved as soon as the Denil fishway becomes operational and the diversion wall is constructed, but it is possible that additional operational or structural changes, informed by testing of the Milford fishways, may be necessary to achieve the highly effective passage standard. Throughout the interim period as the Denil undergoes shakedown and evaluation, we anticipate that Atlantic salmon will continue to be passed primarily through the existing fish lift. When considering whether this delay will appreciably diminish the conservation value of critical habitat, we must consider the consequence of this adverse effect to the PBF in the action area on the function of the overall critical habitat designation. As indicated, Atlantic salmon that cannot swim above Milford are not necessarily blocked from accessing upstream habitat. Many of these salmon will move to cooler water in the tributaries downstream of the dam, where they can hold or spawn. As indicated above, MDMR has conducted field surveys of habitat downstream of Milford and have identified areas in the mainstem and its tributaries (i.e., Great Works, Souadabscook, Cove, Kenduskeag, Ducktrap) that have the physical characteristics to support spawning. Assuming consistent returns over the next six years, we anticipate that an average of 78 salmon a year (i.e., average passage of 1,039 fish (CMS, 2025; 10-year (2015-2024) average) divided by 93% equals 1,117 total fish; 1,117 fish – 1,039 fish captured at Milford = 78 fish) may be blocked from passing Milford during the interim phase, which would be reduced to an average of 55 fish under the implementation phase (i.e., (1039 fish/0.95 passage rate) – 1,039 fish = 55 fish). Given that the majority of salmon will be able to access suitable habit in the upper river we expect that the adverse effects to PBF M1 in the action area will be relatively minor and will not appreciably diminish the value of critical habitat for the conservation of the Gulf of Maine DPS of Atlantic salmon.

*SR 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.*

*M 2: Freshwater and estuary migration sites with pool, lake, and in-stream 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.*

Both PBF SR 1 and PBF M2 address the need for cool, well oxygenated areas with sufficient cover where adult Atlantic salmon can hold. The primary difference is that SR 1 specifies areas near spawning habitat, whereas M 2 more generally describes the need for the feature along the freshwater and estuarine migration pathway. In section 4, we determined that both PBFs are present in the action area and have the potential to function at limited capacity in the action area, but that the holding pools that occur within the bypass reach receive limited flow and, as such, have low conservation value. In section 5, we determined that the proposal to construct a spillway diversion wall would adversely affect the functioning of PBFs SR 1 and M 2 by diverting flow away from the bypass reach to the main channel. The proposal would reduce attraction to the western side of the dam, which would reduce attraction to the bypass and would further limit flow that is needed for fish to move back out of the reach into the main river. However, as described in section 5, holding in the bypass reach pools can be detrimental for salmon given the elevated temperatures and the fact that the pools become isolated as flows in the river recede, increasing the potential for salmon to become stranded. Black Bear maintains leakage flow into the pools (by intentionally leaving two sections of hinged flashboard uncaulked) to ensure a route of egress if salmon are holding in them when the flows come down. Still, the potential remains that salmon could become stranded, or may hold in the pools longer than is safe (given high water temperatures in exposed pools) given the relatively small amount of water flowing in and out. As such, although the reduction of flow into the bypass reach could reduce the function of the pools themselves, the overall effect of limiting access to the already low conservation value of the habitat is minimal. As the action will further limit attraction to holding pools that could be detrimental to salmon during warm, dry periods, we expect that the adverse effects to PBFs SR 1 and M2 will not appreciably diminish the value of critical habitat for the conservation of the Gulf of Maine DPS of Atlantic salmon.

***PBF for Coevolved Species (M 3)***

*PBF M 3: Freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation.*

In section 4, we determined that the PBF requiring abundant and diverse fish communities to buffer predation of salmon is functioning at a limited capacity in the action area above Milford as the other diadromous species (e.g., alewives, blueback herring, American shad) are all passed at the project. Efficiency of the existing passage facility prevents the PBF from being fully functional, however, river herring and shad have passed the project annually since the fish lift became operable. Table 5-13 of the BA indicates that both American shad and river herring have progressively increased; with shad numbers increasing from approximately 1,800 in 2015 to a peak of approximately 11,500 in both 2021 and 2022; and river herring numbers increasing from 590,000 in 2015 to a peak of approximately 5.5 million in 2023; nearly a ten-fold increase. Brookfield fish counts at the lift in 2025 suggest that returns have increased even further to nearly 6 million herring.

The proposal to operate an additional fishway will provide another passage opportunity for both river herring and American shad. We anticipate that this measure will lead to an increase in the abundance and distribution of these species upstream of the Milford Project. Given experience with Denil fishways on other systems in Maine (such as the St. Croix River), we would expect the Denil to pass hundreds of thousands of herring, if not more. Although some of these fish may have passed via the fish lift if not for the Denil, we expect that others would likely not have passed if not for the presence of the second fishway. In addition to leading to an increase in other sea run fish, the proposal to provide supplemental spill during the salmon smolt outmigration every spring, will potentially provide some benefit to adult alosines leaving the system post spawning. We anticipate that most adults would migrate through the action area after the supplemental spill period has ended.

In section 6, we determined that the proposed action will improve upstream access for alosines, which will improve the functioning of the PBF in the action area. As we expect the fishways will still block or slow access to some proportion of upstream migrants, and as the project will kill some proportion of outmigrating adults and juveniles; the proposed action will only allow for limited functioning of the PBF in the action area. We also determined that the action will continue to limit the conservation value of the PBF in the action area as it will directly limit the abundance and distribution of alosines in the upper Penobscot by limiting the number that pass upstream and downstream.

As addressed in section 4, much of the benefit of prey buffering for Atlantic salmon smolts occurs in the estuary and lower river. The Biological Valuation that supports the critical habitat designation (NMFS, 2009), describes the benefit this way:

> Adult and smolt migration through the estuary often coincides with the presence of alewives (*Alosa* spp.), American shad (*Alosa sapidissima*), blueback herring (*Alosa aestivalis*), and striped bass (Morone *saxatilis*). The abundance of diadromous species present during adult migration may serve as an alternative prey source for seals, porpoises and otters (Saunders et al., 2006)...
>
> As Atlantic salmon smolts pass through the estuary during migration from their freshwater rearing sites to the marine environment, they experience high levels of predation. Predation rates through the estuary often result in up to 50 percent mortality during this transition period between freshwater to the marine environment (Larsson, 1985). There is, however, large annual variation in estuarine mortality, which is believed to be dependent upon the abundance and availability of other prey items including alewives, blueback herring, and American shad, as well as the spatial and temporal distribution and abundance of predators (Anthony, 1994).

The effect is mostly limited to the estuary because smolts start outmigrating in mid-April, but adult alewives are not generally passed at Milford in significant numbers until the first or second week of May. However, we would expect the overlap to be more significant in the lower river and the estuary as the peak of the outmigrating smolt run coincides in space and time with the peak of the upstream alewife migration.

The benefit in freshwater could be more pronounced for adult Atlantic salmon as the upstream migration timing coincides with the migration of American shad and river herring. However, predators (such as seals, porpoises, and otters) that would be a threat to a large fish like an adult Atlantic salmon are more limited in the action area, which is well above the head of tide. As such, here we have primarily focused on how PBF M 3 functions for Atlantic salmon smolts.

Although large by today's standards, the herring runs observed at Milford over the last decade are substantially lower than what would have been expected historically. Regardless, this context suggests that PBF M 3 is likely functioning at some level in the lower Penobscot River and estuary regardless of the proposed action, and that the added production expected due to the operation of an additional fishway should only increase the functioning of the PBF in those areas even more. As such, we expect that the adverse effects to PBF M 3 will be relatively minor and will not appreciably diminish the value of critical habitat for the conservation of the Gulf of Maine DPS of Atlantic salmon.

*PBF M 4: Freshwater and estuary migration sites free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment.*

In section 4, we determined that PBF M 4 has limited functioning in the action area as the Milford Project leads to the delay, injury, and mortality of outmigrating Atlantic salmon smolts as a result of downstream passage at the dams. In section 5, we determined that the proposed operational measure (i.e., expanding the 14-day supplemental spill period to 54-days), as well as the achievement of the survival and delay standards, will improve the functionality of PBF M 4 in the action area by the first year of the proposed action. Although the proposal will increase the conservation value of the habitat with the PBF in the action area, smolt mortality and delay will still result from passage and therefore we expect that it will continue to function at a limited level. Similarly, we determined that the proposed action will still adversely affect the PBF as a proportion of smolts will still be delayed and killed due to effects of the project, even with the achievement of the performance standard.

As indicated, we expect that the Milford Project will continue to adversely affect PBF M 4 in the action area by delaying and preventing emigration of a proportion of Atlantic salmon smolts that are migrating from rearing habitat in the upper river to the ocean. Black Bear's proposal to implement operational changes at the project to achieve a 96% survival standard means that a higher proportion of salmon smolts should survive to the ocean. This restoration of function to the habitat with the PBF in the action area will allow this habitat to be considered accessible, and will increase the conservation value of PBF M 4 in the action area. Although the action will lead to a significant increase in the conservation value of the PBF, it will still lead to direct and indirect smolt mortality; and therefore, PBF M 4 will still function at a limited level during the implementation phase. Despite this, as the performance standard will have been achieved, we expect that the adverse effects to PBF M 4 will be relatively minor and will not appreciably diminish the value of critical habitat for the conservation of the Gulf of Maine DPS of Atlantic salmon.

We have concluded that the proposed actions will continue to limit the functioning of the PBFs in the designated habitat. However, we expect that the proposed operational and structural measures will increase the conservation value of the designated critical habitat as a result of improvements of access and function. The restoration of accessible passage (i.e., passage of a sufficiently high proportion of juveniles and adults to allow for survival and recovery) for the term of the proposed action will not appreciably diminish the conservation value of critical habitat for the conservation of the Penobscot Bay SHRU, and it is not likely to result in the destruction or adverse modification of critical habitat designated for the Gulf of Maine DPS of Atlantic salmon.

## 8. CONCLUSION

After reviewing and analyzing the current status of the listed species, the environmental baseline within the action area, the effects of the proposed action, and cumulative effects, it is our Opinion that the proposed actions may adversely affect but are not likely to jeopardize the continued existence of the GOM DPS of Atlantic salmon, shortnose sturgeon, or the GOM DPS of Atlantic sturgeon. Furthermore, the proposed actions are not likely to destroy or adversely modify critical habitat designated the GOM DPS of Atlantic salmon and are not likely to adversely affect critical habitat designated for the GOM DPS of Atlantic sturgeon.

## 9. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA prohibits the take of endangered species of fish and wildlife. "Fish and wildlife" is defined in the ESA "as any member of the animal kingdom, including without limitation any mammal, fish, bird (including any migratory, non-migratory, or endangered bird for which protection is also afforded by treaty or other international agreement), amphibian, reptile, mollusk, crustacean, arthropod or other invertebrate, and includes any part, product, egg, or offspring thereof, or the dead body or parts thereof" (16 U.S.C. §1532(8)). "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct.

Incidental take statements serve a number of functions, including providing reinitiation triggers for all anticipated take, providing exemptions from the Section 9 prohibitions against take, and identifying reasonable and prudent measures that will minimize the impact of anticipated incidental take and monitor incidental take that occurs. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. "Otherwise lawful activities" are those actions that meet all State and Federal legal requirements except for the prohibition against taking in ESA Section 9 (51 FR 19936, June 3, 1986), which would include any state endangered species laws or regulations. Section 9(g) makes it unlawful for any person "to attempt to commit, solicit another to commit, or cause to be committed, any offense defined [in the ESA]" (16 U.S.C. § 1538(g)). See also 16 U.S.C. § 1532(13) (definition of "person").

The measures described below must be undertaken by the relevant action agency and/or applicant so that they become binding conditions for the exemption in section 7(o)(2) to apply. FERC (and USACOE, as appropriate) has a continuing duty to regulate the activity covered by this ITS. If FERC (1) fails to assume and implement the terms and conditions or (2) fails to require the licensees or their contractors to adhere to the terms and conditions of the ITS through enforceable terms that are added to licenses and permits as appropriate, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, FERC or the licensee must report the progress of the action and its impact on the species to us as specified in the ITS [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).

## 9.1. **Amount or Extent of Take**

The following sections describe the amount or extent of take that we expect will result from the anticipated consequences of the proposed action. If the proposed action results in take of a greater amount or extent than that described, FERC and/or USACOE would need to reinitiate consultation immediately. The exempted take includes only take incidental to the proposed action.

We anticipate that up to four dead salmon or sturgeon (of either species) will be collected at the Milford Project annually for the purpose of determining whether they should be categorized as incidental take that occurred as a result of the proposed action.

### 9.1.1. Atlantic salmon

*Smolts*

We anticipate that direct and indirect mortality of smolts associated with passage at the Milford Project will not exceed the levels described in Table 23.

Table 23. A summary of the take of juvenile Atlantic salmon anticipated due to the proposed actions.

| Source | Type | Implementation Phase |
|---|---|---|
| Direct | Mortality | 4.0% |
| Indirect (HDM) | Mortality | 1.1% |
| Sublethal Injury | Injury | 0.7% |
| Delay (>24 hours) | Harassment | 1.0% |

Hydrosystem delayed mortality is difficult to monitor using traditional telemetry methods. In circumstances where we cannot effectively monitor take, we use a surrogate to estimate its extent. As described in 8- FR 26832 (June 10, 2015) a surrogate may be used to express the amount or extent of anticipated take when the incidental take statement: (1) Describes the causal link between the surrogate and take of the listed species; (2) describes why it is not practical to express the amount of anticipated take or to monitor take-related impacts in terms of individuals of the listed species; and (3) sets a clear standard for determining when the amount or extent of the taking has been exceeded. For this proposed action, the estimated migratory delay (>24 hour residence time per dam) and sublethal injury rates at the projects provide a surrogate for estimating the amount of incidental take associated with hydrosystem delayed mortality. We will consider take associated with indirect mortality (i.e., hydrosystem delayed mortality) to have been exceeded if smolts monitored during downstream passage studies exceed the average of the project specific migratory delay or sublethal injury rates. As such, take for HDM will be considered exceeded if the average delay (measured as the proportion of smolts that take more than 24 hours to pass each dam) exceeds 1%. Similarly, take for HDM will be considered exceeded if the average sublethal injury rate exceeds 0.7%. Lacking direct information regarding injury rate of smolts, we will assume that the threshold will be exceeded if turbine passage rates during the evaluation year(s) exceed 9.1%. This is reasonable as we estimated the injury rate based on the proportion of the run that we anticipated passing the project through the turbines (section 5.3.2). Take will be monitored at the projects through passage studies conducted after the implementation of the proposed measures.

*Kelts*

We anticipate that up to 4% of salmon kelts could be killed due to the effects of downstream passage at the Milford Project. In accordance with the SPP, Black Bear is scheduled to conduct an up to 3 years of Atlantic salmon kelt downstream passage study at the Milford Project, the first to occur in 2027 in order to evaluate downstream survival.

*Pre-Spawned Adults*

We anticipate that direct and indirect effects to prespawn adult Atlantic salmon associated with passage at the Milford Project will not exceed the levels described below.

Of the fish that approach the Milford Project during the interim phase (year 1 to 6), 7% will be harassed due to failure to pass the project, 57% will be harassed due to migratory delay in excess of 48 hours, 9% will be injured due to migratory delay when water temperatures are elevated in the months of July and August, and 1% will die due to significant migratory delay. During the implementation phase (year 7 to 13), we anticipate that 5% will be harassed due to failure to pass the project, 20% will be harassed due to migratory delay in excess of 48 hours, and 4% will be injured due to migratory delay when water temperatures are elevated in the months of July and August. Lacking direct information regarding the fate of adult salmon after they exit the action area, we will assume that the threshold for injury and mortality associated with migratory delay will be exceeded if more than 14% of the total run is delayed by more than 48 hours during the months of July and August during the upstream telemetry studies. This is reasonable as we estimated the injury and mortality rates based on the proportion of the run that was delayed during those months (section 5.3.1). Take will be monitored at the projects through passage studies conducted after the implementation of the proposed measures. The amount of take outlined in this paragraph is exempted by this ITS.

We anticipate that up to two salmon a year will be captured due to stranding in the pools downstream of the Milford dam during the expected 13-year term of the proposed action, for a maximum of 26 salmon (i.e., 2 salmon annually for 13 years). All of these salmon could experience minor injury due to handling and transport back to the river. This amount of take is exempted by this ITS.

*Fish Passage Monitoring*

All Atlantic salmon smolts used in the downstream passage studies will be handled and injured due to tag insertion. The proposed smolt studies are expected to involve handling and surgical implantation of radio tags in up to 200 smolts per project per year. Although Black Bear has only proposed a single year of study, we anticipate that as many as two additional years may be necessary if the standard is not achieved in the first year. As such, we anticipate that 200 smolts a year (no more than 600 smolts total) could be used for smolt survival studies. Of these, up to 2% (4 smolts per year; 12 smolts total) are expected to die due to handling and tagging. The remaining smolts are expected to be injured due to tag implantation and handling.

Study fish will be used to evaluate the effectiveness of upstream passage at the Milford Project, and will be used to determine the attainment of the passage and delay performance standards. Black Bear has indicated that it could take up to three years to verify passage success. As such, we anticipate that up to 50 salmon a year will be surgically implanted with radio tags over three years of studies. As such, adult passage studies will affect up to 150 adult salmon; and will kill up to three salmon. All other study fish will be harassed and experience minor, recoverable injury due to handling and tagging during the study. As indicated in our analysis above, the kelt study will be conducted using salmon that are tagged as part of an upstream passage study at a different project (Mattaceunk Project in the East Branch Penobscot) and, as such, we will not consider take of those study fish associated with tagging and handling in this Opinion.

#### 9.1.2. Shortnose and Atlantic sturgeon

We anticipate that up to two sturgeon (either species) will be captured due to stranding in the pools downstream of the Milford dam during the expected 13 year term of the proposed action. We anticipate that an additional eight sturgeon (either species) will be captured in the Milford fish lift during the term of the proposed action. All ten of these sturgeon could experience minor injury due to handling and transport back to the river.

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

### 9.2. **Reasonable and Prudent Measures**

The following reasonable and prudent measures are necessary or appropriate to minimize and monitor incidental take of Atlantic salmon, shortnose sturgeon, and Atlantic sturgeon.

1. Effects to ESA listed salmon and sturgeon must be minimized and monitored during project operations.
2. Project modifications and operations and effects to ESA listed species must be documented and reported throughout the life of the licenses.
3. Effects to ESA listed salmon and sturgeon must be minimized during construction activities.

#### 9.2.1. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, FERC and/or ACOE must comply (and ensure that the Licensees comply) with the following terms and conditions, which implement the reasonable and prudent measures above. These include take minimization, monitoring, and reporting measures required by the section 7 regulations (50 C.F.R. §402.14(i)). If FERC and/or USACOE fail to ensure compliance with these terms and conditions and the reasonable and prudent measures they implement, the protective coverage of section 7(o)(2) may lapse.

*To implement the requirements of reasonable and prudent measure #1, FERC must ensure that the following measures are implemented:*

1. Prepare, in consultation with NMFS, and implement a plan to measure the survival, migratory delay, and injury of downstream migrating Atlantic salmon smolts at the Milford Project using a scientifically acceptable methodology. The initial study plan must be approved by NMFS one year prior to the first study season. In any subsequent study years, any modifications to study methodology must be approved no later than March 31.
    a. The study must include the following components:
        i. Measure the total project survival of downstream migrating smolts from 200 meters upstream of the dam downstream to the point where delayed effects of passage can be quantified. The licensee must consult with NMFS to identify receiver locations that are sufficiently far downstream to document the effect of passage. The study must adequately document total project mortality, migratory delay, route of passage through the dam and associated mortalities with each route.
        ii. Use a Cormack-Jolly-Seber (CJS) model, or other agreed upon acceptable approach, to determine if the survival estimate and associated error bounds are within the scope of published telemetry work for salmon in the region. The study must use a sufficient number of study fish (not to exceed the number included in the ITS) to provide statistically valid results
        iii. The licensee must consult with NMFS concerning the application of appropriate statistical methodology and requirements for providing an electronic copy of model(s) and data to NMFS.
    b. All tags used in the study must have codes that are not duplicative of tags used by other researchers in the river, including university, state, federal and international tagging programs.
    c. If, after the first year of evaluation, it is determined that the standard is not being met, the licensee must work with NMFS to develop additional reasonable and prudent operational or structural measures to be implemented and evaluated the following passage season.

2. Prepare, in consultation with NMFS, and implement a plan to operate and evaluate adult Atlantic salmon upstream passage at the Milford Project, and to inform the development of a broodstock collection protocol.
    a. The licensee must develop a plan in coordination with NMFS, USFWS, Maine DMR, and the Penobscot Nation for the operation of the Denil fishway to ensure that fisheries management activities that are necessary for the survival and recovery of Atlantic salmon (i.e., broodstock collection) are prioritized. The plan must incorporate measures for safe access and efficient collection of Atlantic salmon broodstock at the trap, if that is determined to be necessary. The plan for Denil

operation and collection of broodstock should be developed and approved by NMFS no later than March 31 of the first year the Denil is operated. The plan should be reviewed and revised annually, as needed, based on the results of the upstream passage studies.

b. During the evaluation period, the licensee must provide an interim method to effectively count Atlantic salmon (and other diadromous species, if practicable) passing through the Denil fishway. If the Denil fishway is proven effective, the licensee must implement permanent fish counting measures for diadromous fish species at the exit of the fishway. Deployment of the measures must occur within one year of the performance standard being achieved.
c. The operation of the Denil fishway shall not commence until the passage season following the completion of all proposed upstream passage improvements, including the construction of the spillway diversion wall.
d. The licensee must conduct an evaluation of the operation of the Denil fishway, and must ensure that staff are adequately trained to conduct the required study components. The initial study plan must be approved by NMFS one year prior to the first study season. In any subsequent study years, any modifications to study methodology must be approved no later than March 31. The study plan must include the following components that may occur concurrently:
    i. Conduct a preliminary evaluation of the function and safety of the Denil fishway at the Milford Project the first year following construction of the spillway diversion wall. This study must document:
        1. The proportion and size distribution of adult Atlantic salmon (tagged and untagged) that use each of the two fishways,
        2. The effectiveness of an interim approach to counting salmon, and other species as appropriate, that use the Denil fishway,
        3. A qualitative or quantitative assessment of the use of the Denil fishway by river herring and American shad,
        4. Assess the condition (e.g., injury, scale loss) of salmon that use the Denil fishway relative to what is observed at the existing lift and handling facility.
            a. Assess the safety and operations of the trap for the capture and collection of adult salmon under various environmental, flow, and fish capacity (e.g., at the peak of the alewife run) conditions.
    ii. Conduct a one to three year evaluation of migratory delay and upstream passage efficiency at the Milford Project using radio telemetry. This study must document:
        1. Passage efficiency at the project as a whole, as well as at the two fishways individually.
        2. Migratory delay that occurs at the project as a whole, as well as at the two fishways individually.
        3. Condition (i.e., injury, scale loss) and size of adult salmon at capture. Document at both fishways if they are both operating to capture salmon for the study.

4. The effectiveness of passage at the two fishways under various operating conditions, including spill/no spill conditions.
5. Movements and habitat use downstream of the dam by tagged adult salmon that fail to pass the project, including the use of any tributaries or holding areas in the mainstem.
6. If, after the first year of evaluation, it is determined that the standard has not been met, the licensee must implement and evaluate additional operational or infrastructure measures that are likely to meet or exceed the upstream performance standard. New measures should be implemented and evaluated the following passage season.
7. The study plan shall be developed in coordination with USFWS, the State of Maine, NMFS, and PIN to ensure that, to the extent practicable, the use of hatchery products necessary for the evaluation of project effects does not interfere with efforts to increase escapement of naturally reared returns in the GOM DPS of Atlantic salmon. The licensee must notify NMFS when they come to an agreement with USFWS regarding an appropriate source of smolts to be stocked upstream of the Milford Project in 2027 to obtain returning adults that can be used for the study in 2029. The licensee must work with USFWS to develop an agreement for the raising, marking, and release of these fish within six months of the issuance of this Opinion.

e. To provide long-term monitoring of effects to Atlantic salmon and sturgeon, the licensee must develop a plan in coordination with NMFS to install PIT tag receivers at the Milford Project. The plan will address appropriate timing for the installation of the array, as well as maintenance, and the processing of the resulting data. The licensee shall install, operate, and maintain a PIT tag array near the entrance and exit of the fishways to monitor movements of any salmon and sturgeon in the project fishways. The PIT tag array must be installed no later than the passage season following the achievement of the performance standard (or some other deadline if mutually agreed upon by NMFS, the licensee, and FERC), and the design must be submitted to NMFS for review and approval at least 60 days before initial deployment. All PIT tag data collected must be submitted in the annual report by March 31 of the following year.
f. PIT tag all ESA-listed Atlantic salmon that are trapped and handled at the Milford fishway.

3. Prepare, in consultation with NMFS, and implement a plan to evaluate survival of postspawn adults (kelts) at the Milford Project dam for three years. The study must document the survival of downstream migrating kelts approaching within 200 meters of the dam downstream to the point where delayed effects of passage can be quantified. The study plan must be developed and approved by NMFS no later than March 31 of the year the study will be conducted.

    i. Unless dedicated kelts are available for this study, the licensee should monitor the survival of fish that are tagged for an upstream passage evaluation for three years.

ii. A Cormack-Jolly-Seber (CJS) model, or other acceptable approach, must be used to determine if the survival estimate and associated error bounds are within the scope of published telemetry work for salmon in the region.
iii. Procedures for the licensees to consult with NMFS concerning the application of appropriate statistical methodology and requirements for providing a copy of model(s) and data to NMFS.
iv. All tags released in the system must have codes that are not duplicative of tags used by other researchers in the river, including university, state, federal and international tagging programs.
v. If, after the first or second year of the three-year evaluation, it is determined that it is statistically impossible or improbable that the standard can be met, the study will cease and additional measures will be installed as soon as possible. If this occurs, the licensee must work with NMFS to develop additional appropriate operational or structural measures to be implemented and evaluated the following passage season.

4. Require that the licensee operate the upstream and downstream fishways at the Milford Project to ensure that passage of Atlantic salmon is safe, timely, and effective.
    a. Consult annually with NMFS regarding the appropriate timing for the initiation of the implementation of downstream spill measures. The timing of measures will be informed by the results of the smolt run timing model.
    b. Remove any debris that could affect the ability of fish to pass either the downstream or upstream fishways immediately upon inspection.
    c. Annual maintenance requiring the shutting down of upstream fishways should be conducted during the first two weeks of August. The fishway should not be inoperable for any longer than it takes to make the necessary repairs. If practicable, and if the Denil has proven to be a safe passage option, one of the two fishways should continue to operate at all times as maintenance occurs.
    d. Consult with NMFS regarding the timing of the replacement of flashboards.

5. Require that the licensee actively monitor for the stranding of listed fish downstream of the projects, as appropriate.
    a. Develop, in consultation with NMFS, an appropriate schedule for regularly surveying the ledges and pools downstream of the dam for stranded salmon and shortnose and Atlantic sturgeon. This plan should be completed no later than May 1, 2026.

6. Require that the Licensee update the sturgeon handling plan to incorporate the following conditions:
    a. The licensee must notify NMFS within 24 hours of any sturgeon observed or collected at the projects, inclusive of fish handled pursuant to the stranding and handling plan(s). These reports must be made via email using the forms available on NMFS webpage (nmfs.gar.incidental-take@noaa.gov; https://www.fisheries.noaa.gov/s3/2023-11/Take-Report-Form-11142023.pdf ). The licensee must record the weight, length, and condition of all sturgeon that are handled and submit this information to NMFS on the appropriate form. Sturgeon must also be scanned for PIT tags. Fin clips will be taken and submitted to the Atlantic Coast

Sturgeon Tissue Repository for genetic analysis, following NMFS recommended procedures as outlined here: https://media.fisheries.noaa.gov/dam-migration/sturgeon_genetics_sampling_revised_june_2019.pdf (or in any update to those procedures). Captured sturgeon, regardless of the presence or scale of injury, must be safely returned to the Penobscot River downstream of the Milford project.

b. In the unlikely event that a dead sturgeon is collected, it must be held until disposition instructions are provided by NMFS. If at all possible, the carcass must be placed on ice or be refrigerated. NMFS must be contacted immediately (nmfs.gar.incidental-take@noaa.gov) for further instructions on transport to a holder of an appropriate permit/authorization and/or for disposal.

c. On an annual basis, the licensee must coordinate with NMFS to determine if any updates to the sturgeon handling plan are necessary. By February 15 of each year, the licensee must either propose changes for NMFS to review and approve or request confirmation from NMFS that no changes are necessary. Any changes to the plan must be in place by March 31 of the relevant year. Requests for changes or confirmation should be submitted via e-mail to NMFS GARFO PRD (nmfs.gar.incidental-take@noaa.gov)

*To implement reasonable and prudent measure #2, FERC must require Black Bear to:*

8. Inspect the upstream and downstream fish passage facilities at the Milford Project daily when they are open. The licensee must submit summary reports to NMFS weekly during the fish passage season.
9. Notify NMFS of any changes in operation including maintenance activities and debris management at the project during the term of the amended license.
10. Ensure that new as-built drawings are provided to NMFS if there are any changes to the upstream and downstream fishways.
11. Allow NMFS staff to inspect the upstream and downstream fishways at reasonable times, including but not limited to annual engineering inspection.
12. Review and update Fishway Operations and Maintenance Plans a minimum of every three years in cooperation with NMFS. The plans must be updated as soon as possible to ensure they are consistent with the terms and conditions of this Opinion, as well as with the latest version of the State of Maine's *Atlantic salmon Trap Operating and Fish-Handling Protocols* (except where it may conflict with the terms and conditions included with this Incidental Take Statement).
13. In the event of a serious injury or mortality of any ESA listed species, allow NMFS access to investigate the source of the mortality and work in cooperation with NMFS to correct the source of serious injury/mortality.
14. Submit annual reports summarizing the results of proposed action and any takes of listed sturgeon or Atlantic salmon to NMFS by March 31.
15. Contact NMFS within 24 hours of any interactions with Atlantic salmon, shortnose sturgeon, or Atlantic sturgeon, including non-lethal and lethal takes (Dan Tierney: by email (Dan.Tierney@noaa.gov) or phone (207) 866-3755 and to: nmfs.gar.incidental-take@noaa.gov.

16. In the event of any lethal takes, any dead specimens or body parts must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with NMFS.

*To implement reasonable and prudent measure #3, USACOE must require the Licensee to:*

17. The licensee must ensure no listed fish are trapped in the work area prior to dewatering and construction activities. Listed fish should be removed using minimally invasive techniques (e.g., herding and netting). Electrofishing should not be conducted for the removal of adult salmon and sturgeon.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize and monitor the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, the level of incidental take is exceeded, reinitiation of consultation and review of the reasonable and prudent measures are required. FERC or the USACOE must immediately provide an explanation of the causes of the taking and review with us the need for possible modification of the reasonable and prudent measures.

The discussion below explains why the RPM and Terms and Conditions are necessary and appropriate to minimize or monitor the level of incidental take associated with the proposed action and how they represent only a minor change to the action as proposed by FERC.

RPM #1 and its associated Terms and Conditions for FERC are necessary or appropriate as they describe how FERC and Black Bear will be required to implement the measures and monitor their success. Terms and Conditions #1 - #3 require that Black Bear measure their adherence to proposed action in a way that is statistically sound and appropriate; as well as adequately monitor the effects of the action. Term and condition #2 requires that Black Bear coordinate closely with the fisheries management entities on the implementation and evaluation of upstream passage of Atlantic salmon to ensure that the operation of the Denil fishway does not limit the capture of salmon to be used as broodstock in the conservation hatchery program. Maintaining the hatchery program is a top priority for the salmon recovery program; and Black Bear should ensure that agency staff (or other staff, if authorized) can safely and effectively access and transport any salmon captured at the exit trap on the Denil. This RPM and the Terms and Conditions represent only a minor change as compliance will not result in any increased cost, delay of the project or decrease in the efficiency of the project.

RPM #1, Term and condition 2(e) requires that a preliminary evaluation of the operation of the Denil fishway be implemented during the initial year of operation to provide an early understanding of the effectiveness and safety of the fishway and its trap, which will inform the potential of the proposal to achieve the performance standard, but will also provide crucial information for the development of a broodstock collection protocol that will be developed and coordinated by the fisheries management agencies. Term and condition 2(d)i requires a preliminary assessment of the use of the Denil by Atlantic salmon, as well as other diadromous fish species. There is potential for the fishway to be less effective for salmon during the peak of the herring run when millions of alewives could be crowding the fishways at Milford. This RPM and the Terms and Conditions represent only a minor change as compliance will not result in any increased cost, delay of the project or decrease in the efficiency of the project.

RPM #1, Term and condition 2(f) requires that Black Bear PIT tag every adult salmon that is handled at the Milford fishway to be passed upstream, and that they install a PIT tag receiver at the fishway entrance and exit once the passage performance standard has been achieved (or other date that is mutually agreed upon by NMFS, the licensee, and FERC)). The receiver array will allow for the long-term monitoring of effects of the proposed action by monitoring the efficiency of the fishways, and will provide information regarding the use of the fishways by sturgeon and salmon that have been tagged at in other rivers; as well as provide an estimate of the number of salmon that fall back over the dam after being released into the headpond, as well as the timing associated with any subsequent passage attempts. These salmon will be exposed to the effects of passage multiple times, so understanding the proportion and the timing between attempts will allow us to better characterize these effects. This RPM and the Terms and Conditions represent only a minor change as compliance will not result in any increased cost, delay of the project or decrease in the efficiency of the project.

RPM #2 and its associated Term and Conditions for FERC and Brookfield are necessary and appropriate to ensure the proper documentation of any interactions with listed species as well as requiring that these interactions are reported to us in a timely manner with all of the necessary information. This is essential for monitoring the level of incidental take associated with the proposed action. This RPM and the Terms and Conditions represent only a minor change as compliance will not result in any increased cost, delay of the project or decrease in the efficiency of the project.

## 10. CONSERVATION RECOMMENDATIONS

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

- FERC should require Black Bear to install flow gauges on both the Penobscot River and the Stillwater Branch to ensure that existing flow requirements are being met. Historical average daily flow data from these gauges should be made publicly available.
- FERC should require that Black Bear implement measures to further protect the coevolved suite of sea-run species in the Penobscot River, particularly river herring and American shad. Healthy runs of these species are a component of designated critical habitat for Atlantic salmon. Measures that would further their restoration in the Penobscot River would include conducting upstream and downstream passage evaluations to ensure that the existing fishways are adequately protective.

- FERC should require that Brookfield develop a comprehensive strategy to compensate for all unavoidable effects of their actions in the GOM DPS of Atlantic salmon by requiring the licensee to carry out activities that improve the environmental baseline. This could involve the removal of other barriers to fish migration, or the construction of fishways. FERC and the licensee should work closely with the state and federal fisheries agencies to identify suitable projects that contribute to the recovery of Atlantic salmon and address the effects of degradation of designated critical habitat, over the duration of the new license and license amendments.

## 11. REINITIATION NOTICE

This concludes formal consultation concerning FERC's proposal to issue a temporary water level and flow variance for the Mattaceunk Project. 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 action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this Opinion; 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. Reinitiation of section 7 consultation is also required should FERC or GLHA not carry out the RPMs or associated Terms and Conditions contained within this Opinion.

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## Attachment A: Supplement to Proposed Action

*Provided by Black Bear Hydro on October 2, 2025*

**ACTION DESCRIPTION**

**1. Project Design**

The proposed action is the temporary drawdown of the Milford impoundment to facilitate construction of an assumed 50-foot long by 10-foot high flow diversion wall at the Milford Hydro Facility. The impoundment drawdown needed to facilitate the construction will be limited to approximately six inches (0.5 feet) below normal pond level of 101.70 ft for an estimated duration of eight weeks and will be scheduled during low river flow periods (late July through September).

This limited drawdown will maintain river flow conditions and allow fish passage to continue, while providing stable working conditions for the installation of the diversion wall. Operations will be adjusted as necessary to ensure water levels remain stable during the construction period.

Historically, typical flows at Milford during the construction period are as follows:

- **July:** 5,500 cfs
- **August:** 4,600 cfs
- **September:** 4,700 cfs
- **October:** 6,400 cfs

The hydraulic capabilities of the project features at full pond are as follows: flashboard section (9,700 cfs), Obermeyer crest gate (8,100 cfs), powerhouse (6,730 cfs), log sluice (2,000 cfs), and upstream and downstream fish passages combined (490 cfs) for a total hydraulic capacity of 27,020 cfs.

**2. Work to be Completed**

The scope of work is expected to include the following activities:

- Mobilization of equipment and personnel.
- The installation of barge sections in the headpond to support crane operations (estimated 50-ton RT crane).
- Form and place a leveling pad (no more than 10 ft sq, 3 ft tall, 12 CY of material) on the existing downstream ledge to support wall installation.
- Install rock anchors along the footprint of the wall into ledge with appropriate embedment (assumed 16" depth).
- Form and place the reinforced concrete diversion wall, approximately 10' tall x 50' long, with a 4' base tapering to 2' at the top.
- Demobilize barge sections and crane.
- Clean up and restore the work site.

Construction equipment will include a 50-ton rough terrain crane on modular barge sections, supported by a small work boat for positioning. An excavator, loader, or skid steer will be used for site preparation, embankment work, and material handling, with concrete placed by pump truck or crane and bucket. Dewatering pumps will maintain dry conditions downstream, and generators, welders, and light towers will provide power and lighting as needed.

The wall will function as a flow diversion structure to improve hydraulic control and long-term stability at the Milford Hydro Facility. Specifically, the diversion wall will be designed and installed to contain spill flows from the western side of the existing Obermeyer inflatable flashboard system at Milford Dam. The intention of this measure is to reduce the risk of adult salmon being attracted to the bypass area below Milford Dam and potentially becoming stranded in the ledges below the center portion of the dam's spillway. The work is expected to take approximately eight weeks to complete.

**Avoidance and Minimization Measures**

Contractors will employ best management practices (BMPs) to prevent erosion, sedimentation, or accidental discharges into the river. All fuel and oil storage will be placed in secondary containment, and spill response kits will be staged on site to ensure immediate response capability. Construction waste and debris will be collected and removed from the action area promptly, with disposal at approved off-site facilities to prevent any potential impact to water quality or aquatic habitat.

The maintenance work window has been selected to minimize potential impacts to fish passage. Construction will occur outside the peak spring downstream smolt and kelt migration period (April through June) and after the peak upstream migration of adult Atlantic salmon (May through mid-July). The limited six-inch drawdown and stable eight-week schedule will further reduce the likelihood of disruption to upstream or downstream fish passage during the project.

Barges will be used to stage equipment in the headpond; however, fueling and equipment maintenance will take place on land at designated staging sites located away from the river. All portable equipment, including generators and welders, will be placed in secondary containment to minimize the potential for spills or runoff. Temporary scaffolding or work trestles, if required, will be installed and maintained in accordance with BMPs to avoid adverse effects to water quality.

**3. In-Water Work Controls**

All downstream work associated with the diversion wall will be conducted in the dry. A stabilized earthen leveling pad and temporary “cofferdam” or containment system will isolate the work zone from active river flows, eliminating direct in-water construction. Pumps and dewatering systems will be fitted with appropriate filtration or energy dissipation devices to prevent sediment from entering the tailwater, and turbidity curtains or silt booms will be deployed as necessary to contain any incidental sediment generated during construction.

**4. Monitoring and Compliance**

Daily environmental inspections will be conducted throughout the work period to confirm proper implementation of BMPs. If any Atlantic salmon are observed within the action area during the construction period, activities will be adjusted immediately and appropriate resource agencies are notified. At the conclusion of the project, a final inspection will be completed to ensure that all construction materials, temporary structures, and debris have been removed and that the site has been restored