# Collaborative Management Strategy for the Gulf of Maine Distinct Population Segment of Atlantic Salmon

2024 REPORT OF 2023 ACTIVITIES

### Chapter 1 Introduction

The final recovery plan for the Gulf of Maine Distinct Population Segment (DPS) of Atlantic salmon was released in 2019. The final plan incorporates the strategies and many of the associated actions that were developed through the Atlantic salmon framework process that was established in 2011. It also details recovery goals, objectives and criteria needed for recovery, with three Salmon Habitat Recovery Units (SHRUs) representing the spatial scale of recovery (Merrymeeting Bay, Penobscot Bay and Downeast Coastal SHRUs.) Each SHRU is expected to meet certain criteria before a down listing or delisting decision can be made.

In the fall of 2018, we initiated an internal review of the framework process aimed at aligning our governance structure with the Recovery Plan and addressing the challenges associated with communications and decision making. Ultimately, this review resulted in what is now called the Collaborative Management Strategy (CMS). The fundamental purpose of the CMS is to:

- 1. Ensure that recovery of the Gulf of Maine DPS as defined in the final listing rule is achieved in accordance with the Final Recovery Plan (2019);
- 2. Increase transparency and accountability in decision making;
- 3. Ensure that decisions are guided by the best available science;
- 4. Help improve coordination of resources made available to implement recovery actions and recovery activities as described in the Final Recovery Plan and SHRU (Salmon Habitat Recovery Unit) specific work-plans;
- 5. Serve as a forum for dispute resolution;
- 6. Ensure horizontal and vertical communication among the agencies and the various organization levels within the agencies;
- 7. Assist federal agencies in delivering on trust responsibilities to federally recognized tribes; and
- 8. Provide opportunity for stakeholder engagement and venue for providing input and recommendations.

To find out more about the purpose and structure of the CMS, as well as to see a schedule for upcoming public meetings, please refer to <u>NOAA's Collaborative Management Strategy</u> website.<sup>1</sup>

The CMS recognizes that the path to recovery in each of the SHRUs may be different based on land use patterns, habitat conditions, and the relative degree to which the specific threats identified in the recovery plan occur across the landscape. Therefore, the intent of the structure is to empower the different SHRU committees to coordinate recovery efforts in their geographic region. The SHRU teams are responsible for planning, coordinating and tracking recovery efforts in each SHRU; as well as developing and maintaining work plans that incorporate goals, priorities and actions, including stocking recommendations. Additionally, they are tasked with developing annual reports that describe progress towards meeting recovery goals. This annual report contains the SHRU team's reports of 2023 activities.

<sup>&</sup>lt;sup>1</sup> https://www.fisheries.noaa.gov/new-england-mid-atlantic/endangered-species-conservation/collaborative-management-strategy-gulf-maine-atlantic-salmon-recovery-program

While the SHRU teams coordinate the recovery strategy in their respective regions, the Implementation Team (IT), which includes the Management Board, their support staff, and the SHRU Chairs, ensures vertical and horizontal communications across SHRUs, across agencies, with the Tribes, and among leadership. The IT provides a venue for collaboration and communication on substantive issues that affect the program as a whole or affect another agencies' ability to carry out its programs.

The CMS envisions that committees (Ad Hoc or Standing) will be established that will conduct specific tasks geared towards providing essential information necessary for the Implementation Team to make informed decisions in respect to the direction of the program. The Management Board authorizes and sets the charge for committees, and each committee is guided by a terms-of-reference.

This report includes four sections. The first is a high-level summary of the status of the GOM DPS of Atlantic salmon in relation to the reclassification and delisting criteria laid out in the 2019 recovery plan. The remaining three sections provide additional information at the SHRU level and are developed by the SHRU coordinating committees with significant input from stakeholders in their respective SHRUs.

## Chapter 2 GOM DPS Annual Summary

Under the ESA, a species must be listed if it is threatened or endangered because of any of the following five factors: 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. Determinations regarding delisting or downlisting must address the same five-factors. The 2019 final Recovery Plan contains downlisting and delisting criteria that, when met, would signal that the five-factors have been adequately addressed.

The biological criteria for reclassifying (downlisting) the GOM DPS of Atlantic salmon from endangered status to threatened status are:

- 1. *Abundance:* The DPS has total annual returns of at least 1,500 adults originating from wild origin, or hatchery stocked eggs, fry or parr spawning in the wild, with at least 2 of the 3 SHRUs having a minimum annual escapement of 500 naturally reared adults.
- 2. *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.
- 3. *Habitat:* In each of the SHRUs where the abundance and productivity criterion have been met, there is a minimum of 7,500 units of accessible and suitable spawning and rearing habitats capable of supporting the offspring of 1,500 naturally reared adults.

The biological criteria for removing Atlantic salmon from the endangered species list are:

- 1. *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.
- 2. **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.
- 3. *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.

In the below sections, we summarize the return data and habitat accessibility data from 2023 in reference to the reclassification and delisting criteria.

#### Abundance

In 2023, 1,836 adult salmon returned to the GOM DPS, of which 237 were wild or naturally reared (Table 2-1). Of the total, approximately 3% returned to the Downeast Coastal SHRU; 87% returned to the Penobscot Bay SHRU; and 10% returned to the Merrymeeting Bay SHRU. Of the 237 wild or naturally reared adults returning to the GOM, 49% returned to the Penobscot, 23% returned to the Downeast, and 28% returned to the Merrymeeting Bay. While this was a relatively strong year for both naturally reared and hatchery reared adult returns, the abundance of naturally reared returns remain well below what is needed for either reclassification or delisting (Table 2-2).

Table 2-1. Summary of adult returns for the GOM DPS in 2023 by SHRU. These numbers represent trap counts when available and redd based estimates of returns to the remaining rivers. Determination of origin is based on proration of adults at traps, smolts from corresponding cohort or primary lifestage stocked.

SHRU	Total Returns	Hatchery	Wild/naturally reared
Downeast Coastal	64	10	54
Merrymeeting Bay	180	113	67
Penobscot Bay	1592	1476	116
Total	1836	1599	237



Figure 2-1. Adult returns of Atlantic salmon from 2014 to 2023. Teal shaded area represents naturally reared origin salmon (wild, egg stocked or fry stocked). Tan shaded areas indicate hatchery origin salmon (fall parr, smolt, adult).

Table 2-2. The number of wild or naturally-reared returns to each SHRU in 2023 in relation to the reclassification and	delisting
goals described in the 2019 Recovery Plan.	

SHRU	Wild/natural reared returns	% of Downlisting goal	% of Delisting goal
Downeast Coastal	54	10.8%	2.7%
Merrymeeting Bay	67	13.4%	3.4%
Penobscot Bay	116	23.2%	5.8%



Figure 2-2. 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 target of 500 natural spawners is maximum axis value.

#### Productivity

In 2023, the 10-year geometric mean population growth rate for the GOM DPS was 1.16 (95% CL 0.69 - 1.93) (Figure 2-3). The reclassification and delisting productivity criteria require that *each SHRU* sustain a geometric mean replacement rate of more than 1.0, in addition to meeting the relevant abundance criteria. In 2023 the population growth rate was met in the Merrymeeting Bay SHRU and the Penobscot Bay SHRU, but not in the Downeast SHRU. For more information, refer to Chapters 3-5 of SHRU reports.



Figure 2-3. Replacement rate of naturally-reared salmon in the GOM DPS and all three SHRUs from 2014 to 2023.

#### Habitat

In 2023, a minimum of 20 connectivity projects were conducted that improved access to Atlantic salmon habitat units (Table 2-4). Not all of these improvements occurred in watersheds that are currently accessible to Atlantic salmon due to other passage obstructions downstream. For instance, a project located on a tributary that is upstream of an impassable dam will not make the habitat accessible to salmon in the context of our recovery criteria until the downstream barriers have been addressed. However, these types of projects will be critical for achieving the criteria once the downstream barriers have been made accessible.

SHRU	Projects Reported	Habitat Units Made Accessible
Merrymeeting Bay	*	*
Penobscot Bay	17	680.2
Downeast Coastal	3	3.7
GOM DPS	34	56

Table 2-3. The number of connectivity projects (culverts and dams) that have been reported in the SHRU annual reports for 2023, and the number of Atlantic salmon habitat units made accessible.\*No projects reported in 2023.

In years past, we have reported on the estimated total number of suitable and accessible habitat units. However, it has become apparent that our estimates of accessibility and suitability require considerable refinement. As we reported "accessibility" in previous reports, we did not fully factor in the effects of road-stream crossings, which are a considerable barrier to fish passage in many instances. Thus, the estimates we made were overly optimistic. Additional spatial analyses are needed before we can make a reliable estimate of the number of accessible habitat units in the three SHRUs. In addition, considerable uncertainty remains on what constitutes "suitable" habitat. The way we have done this in the past relies on simply estimating the number of habitat units from the existing habitat model produced by Wright et al. (2008). Greater attention toward defining what constitutes "suitable" habitat is needed before we can make a reliable estimate of the number of suitable habitat units. In 2024, NOAA-Fisheries hired a contractor to define, model, and map suitable Atlantic salmon habitats that can be used to annually report on progress towards attaining the habitat criterion in the Final Recovery Plan. She will also use the ICPP climate projections to model predictions of habitat suitability into the future to help inform ESA consultations.

As described in the Final Recovery Plan (2019), the life history of the Atlantic salmon requires a high degree of access between freshwater, estuarine, and marine environments, and sufficiently suitable natural habitats must be available to support wild populations. Habitat access is categorized as: (1) Habitat with No Access, (2) Habitat with Impeded Access, (3) Habitat that is Accessible, and (4) Habitat that is Fully Accessible. To ensure the long-term sustainability of wild populations, there must be sufficient access to suitable habitat to support spawning and juvenile rearing. Ultimately, returning adults will dictate the actual amount of habitat needed, however, the minimum amount of suitable habitat that must be accessible to returning adults to achieve delisting criteria is 30,000 Habitat Units per SHRU. Currently, none of the FERC licensed dams meet the minimum passage criteria necessary for upstream habitats to be considered "accessible" according to the definitions in the Final Recovery Plan.

## Chapter 3 Annual Report for the Downeast Recovery Unit – Calendar year 2023 activities

This report summarizes progress toward achievement of recovery goals for the Downeast Salmon Habitat Recovery Unit (Downeast SHRU) in 2023.

#### Abundance and population trends

Adult returns of Atlantic salmon to the Downeast SHRU remain at critically low levels (Figure 3-1) with only a total of 64 salmon returns to the entire Downeast SHRU in 2023. Population growth rates (or "replacement rates") for the GOM DPS are calculated over a span of two generations (10 years). In 2023, the naturally reared (NR) adult-to-adult replacement rate was 0.95 (95% CI: 0.60 - 1.51; Figure 3-2.). The adult return information and replacement rate presented below is from the work of the U.S. Atlantic Salmon Assessment Committee (USASAC 2024); therefore, the definition of "naturally reared" salmon does not include adults resulting from parr and/or smolt stocking.



Figure 3-1. Graph of adult returns for the last 10 years (from 2014 to 2023).



Figure 3-2. Replacement rate of naturally reared salmon in the Downeast SHRU from 2014 to 2023. Solid horizontal reference line indicates a spawner-to-spawner replacement rate of 1 based on a 5-year lifecycle (USASAC 2024). The term "DEC" refers to the Downeast Coastal SHRU.

Table 3-1. Summary of adult returns for the Downeast SHRU in 2023. These numbers represent trap count from the Narraguagus and Union Rivers and redd-based estimates of returns to the remaining rivers. Determination of origin is based on proration of adults at traps, smolts from corresponding cohort or primary lifestage stocked.

River	Adult returns	% Naturally reared	% Hatchery origin
Union	0	NA	NA
Narraguagus	21	100%	0%
Pleasant	14	100%	0%
East Machias	17	41%	59%
Machias	12	100%	0%
Dennys	0	NA	NA

#### **Spatial Distribution**

In previous years, the coordinating committee for the Downeast SHRU has reported the number of suitable and accessible habitat units. However, it has become apparent that estimates of accessibility and suitability require considerable refinement. The accessibility estimates made were overly optimistic because the effects of road stream crossings were not factored in. Additional spatial analyses are needed before a reliable estimate of the number of accessible habitat units in the Downeast SHRU can be made.

In addition, considerable uncertainty remains on what constitutes "suitable" habitat. Previous calculations of suitability relied on simple estimates of the number of habitat units from the existing habitat model produced by Wright et al. (2009). Greater attention toward defining what is truly "suitable" habitat is needed before a reliable estimate of the number of suitable habitat units exist in the Downeast SHRU can be made.

Contemporary spatial distribution of Atlantic Salmon in the Downeast SHRU is closely correlated with stocking activities since abundance levels are so low. A total of 559,903 salmon were stocked into the Downeast SHRU in 2023 (Table 3-2). Of these, 559,000 were stocked as fry. No fall parr were stocked (see below). At total of 406 gravid adults were also released comprised of 105 pre-spawn adults raised in freshwater at CBNFH and 300 raised in sea-water and placed into the Machias drainage as part of the Salmon for Maine Rivers project. This project is aimed at releasing gravid adults raised in a marine environment into their natal rivers and allowed to seek out preferred spawning areas and spawn naturally. Finally, 497 post-spawn adults were released as per normal operations at CBNFH following spawning.

Since 2012, the Peter Gray Hatchery (owned and operated by the Downeast Salmon Federation) had also stocked approximately 1.8 million age 0+ parr in the East Machias River and about 203,000 age 0+ parr in the Narraguagus River. Unfortunately, Infectious Pancreatic Necrosis Virus (IPNV) was detected during a routine health screening in the summer of 2023. Given the risks to potentially further spreading the disease, federal and state agencies, in coordination with DSF, decided that the best course of action was to depopulate the hatchery and sanitize the entire facility. So, the entire cohorts of the Narraguagus and East Machias strain 0+ parr (roughly 154,000 parr in total) were humanely euthanized and no stocking of parr occurred. Consequently, the numbers of juvenile salmon stocked in the Downeast SHRU in 2023 was substantially lower than in recent years. Following the decision to depopulate the hatchery, DSF oversaw a deep cleaning process and installed a new filtration system and ultraviolet irradiation technology during the winter of 2024.

Table 3-2. Summary of salmon stocked in the Downeast SHRU by river in 2023.

River	Life stage	Number
Union	Fry	1,000
Narraguagus	Fry	16,000
	Adult (post-spawn, captive)	318
Pleasant*	Fry	109,000
	Adult (pre-spawn, captive)	41
Machias*	Fry	212,000
	Adult (pre-spawn, captive)	25
	Adult (SFMR)	300
East Machias*	Fry	17,000
	Adult (pre-spawn, captive)	23
Dennys	Fry	204,000
	Adult (pre-spawn, captive)	17
	Adult (post-spawn, captive)	179

\*Because of bad weather conditions, USFWS staff were unable to release spent broodstock from the Pleasant, East Machias, and Machias rivers in 2023. These fish will be released in the spring of 2024.

The U.S. Atlantic Salmon Assessment Committee (USASAC) estimated December 2021 mean proportion occupancy attributed to stocking of juveniles and documented natural reproduction for each of the 3 SHRUs at a HUC-12 resolution (see USASAC 2022, Figure 2.4.1.2). While the three SHRUs vary in size and number of HUC-12 units, the amount of occupied juvenile rearing area is typically around 8,800 to 13,600 units of habitat in each SHRU.

Because of software changes and updates, the density of redd counts and stocking activities could not be tabulated this year. Standard estimates will be revisited in 2024 with updated tools. As such, we made a binary summary of observed redds or stocking activity in each discrete HUC. We found, redd survey coverage included 8 HUC-12s in 2022 (Figure 3.3 and 3.4) and with stocking there is an aggregate total of 15. No eggs or parr were stocked in 2023 in the Downeast SHRU (Table 3.2). This coverage was like previous years and surveys are focused on actively managed HUCs. A similar summary is presented for egg planting and juvenile stocking (Table 3.3).

Table 3-3. Summary of number of HUC-12 units in 2023 where occupancy was documented for Wild Production Areas (WPA) and hatchery production areas for each hatchery product that results in natural production in a river (Egg = EPA, Fry = FPA, and Parr = PPA).

SHRU	WPA	ΕΡΑ	FPA	РРА
Downeast Coastal	8	0	15	0



*Figure 3-3. Wild Production Areas 2023. Map highlighting known spawning activity in 2022 at a HUC-12 watershed summary level that visualizes occupancy in HUC-12 units where redd surveys were conducted.* 



Figure 3-4. Map of redds (red dots) surveyed in 2023 across the Gulf of Maine DPS. Coverage was expanded in the Penobscot watershed and occupancy density estimates will be provided next year as software upgrades are completed.

Barriers to fish passage continue to limit the spatial distribution of Atlantic salmon in the Downeast SHRU. For example, the Cherryfield Dam in the Narraguagus River and the remnants of the fishway at Saco Falls in the Pleasant River limit fish passage. Thus, reconnecting 30,000 units of suitable habitat remains a top priority in the Downeast SHRU. However, fish passage barriers are much less common in the Downeast SHRU in comparison to other SHRUs. In particular, many improvements at road-stream crossings have been completed throughout much of the Downeast SHRU largely through collaboration and partnerships involving Project SHARE, DSF, The Nature Conservancy in Maine, many municipalities, and the Maine Department of Transportation. In 2023, there were three projects that were completed that improved connectivity in the Downeast SHRU (Table 3-4). The primary partners involved in these projects were Project SHARE and the Maine Department of Marine Resources.

River	Project name	Passage improvement type (fully accessible vs accessible vs partially accessible*)	Stream miles made accessible (according to RP criteria)	Lake/pond acres made accessible
Narraguagus	Deer Lake Outlet Crossing- Bridge	Accessible	3.7 Units Mapped Rearing and 3.4 miles of upstream habitat with improved access	289
Narraguagus	West Branch Narraguagus Crossing- Concrete Open Bottom	Accessible	None but 4.8 miles of upstream habitat with improved access	N/A
Pleasant	Upper Colonel Brook Crossing- Concrete Open Bottom	Fully Accessible	None but 2.9 miles of upstream habitat with improved access	N/A

Table 3-4. Summary of fish passage projects completed in the Downeast SHRU in 2023.

\* To be considered fully accessible, the habitat above the project must be consistent with the criteria in part 2f of the final recovery plan.



Figure 3-5. Outlet of Deer Lake (Narraguagus watershed) following the completion of a connectivity improvement project by Project SHARE.

#### Diversity

For each broodstock within the Downeast SHRU, a target of 200 parr to collect and retain for broodstock use was implemented starting with the 2017 collection year. Results below represent the mean number of alleles per locus (based on 18 microsatellite loci) for each population, measured within the most recent collection of parr for broodstock, in this case, the 2021 collection (Figure 3.6). Allelic diversity (Figure 3.6) of the five broodstocks in the Downeast SHRU remain relatively stable over the time period measured. In the 2021 collection year, estimates of allelic diversity for the Downeast SHRU broodstocks were all slightly below average, but within the range of previous variation. Continued monitoring of estimates of genetic diversity is very important as the Downeast SHRU contains five of seven river-specific Atlantic salmon broodstocks remaining in the United States. More detailed summaries of genetic estimates of diversity are found in the USASAC report.



Figure 3-6. Graph of the mean number of alleles per locus for the five Downeast SHRU broodstocks, based on parr collected annually for broodstock collection surveys from 2008 to 2021. For all broodstocks, results represent the mean number of alleles per locus (based on 18 microsatellite loci) for the parr broodstock collected annually.

#### Emerging issues and priorities

The risks from commercial salmon aquaculture remain a critical threat to recovery potential in the Downeast SHRU with roughly 2,000,000 salmon stocked annually for commercial harvest (USASAC 2024). While documented escape events are relatively rare in recent years, in August 2023, there were two reported escapes of more than 50,000 post smolts from adjacent sea cages in Machias Bay. Continued vigilance for the potential for aquaculture-origin salmon entering the rivers of eastern Maine remains a key priority to minimize the risk of genetic introgression.

In the lower Narraguagus, there has been considerable progress regarding the feasibility of improving fish passage at the Cherryfield Dam (i.e., Stillwater Dam). This work is critical because the Cherryfield Dam is the only remaining mainstem dam on the Narraguagus River and the only mainstem dam on any river containing river-specific salmon in the Downeast SHRU. Once improvements are made at that site, Atlantic salmon and the full suite of diadromous fish will hopefully have full access to the entire Narraguagus River. Further upstream, Project SHARE has developed a habitat restoration program that has already restored connectivity in the upper Narraguagus and is now enhancing suitability of rearing habitat and restoring natural stream processes in the focus areas by adding instream complexity using wood and boulders.

Other ongoing priorities for our efforts to recover Atlantic salmon and the ecosystem upon which they depend include:

- The DSF will seek to recover its capacity to raise parr at the Peter Gray Hatchery.
- The future of the Ellsworth Dam in the Union River remains uncertain as the Department of Environmental Protection denied the water quality certification for the facility. Such certification is required for the Federal Energy Regulatory Commission to issue a new license.

• The Maine Department of Transportation continues to evaluate that future of the Machias Dyke Bridge that spans the Middle River and currently prevents recolonization of sea-run fish. The long-term outcome remains uncertain.

Other significant issues emerging from environmental monitoring include:

- A significant flood event occurred in the Narraguagus on December 12, 2023, where discharge at the USGS Cherryfield gage was 7,100 cubic feet per second. This value was the 4th largest event in 77 years of gage data.
- The winter of 2023-2024 was the second winter in a row where surface ice did not completely cover the active channel at Rt. 9 on the Narraguagus River. Significant anchor ice was observed on several cold days, but it is difficult to quantify this phenomenon. Time-lapse camera monitoring by USFWS-MEFWCO at Route 9 during winter of 2013-2014 recorded 71 days of full ice cover, winter of 2019-2020 recorded 54 days of ice cover, winter of 2020-2021 recorded 54 days of ice cover, winter of 2022-2023 recorded 38 days of ice cover, winter of 2022-2023 recorded 0 days of ice cover.
- USFWS (MeFWCO 2023) summarized our longest continuous water temperature monitoring dataset that is located at Rkm 48.2 in the Upper Narraguagus watershed. The overall mean annual trend over the period 2012-2021 suggests a warming rate of 0.3 °C per decade. These data are available upon request to Scott Craig (scott.craig@fws.gov).
- In 2023 USFWS worked with Project SHARE to collect field data on 57 stream-road crossings that had no survey data. Because the survey data contains information on Private Lands, the information is currently stored in a non-public accessible ArcGIS Online database under USFWS permissions. Based on the previous MeFWCO (2022b) report and new survey data collected in 2023, it appears there are 15 stream-road crossings that may block or potentially impede upstream fish passage to locations that have mapped rearing habitat at or above the structure.
- USFWS (2023) completed a report on eDNA (metabarcoding) sampling efforts from 2022 in five Downeast rivers. The project revealed the presence of several non-native species (e.g., largemouth bass). A complete report is available upon request to Scott Craig (scott.craig@fws.gov).

#### Stakeholder input

The following section is input solicited from some of the primary partners involved in Atlantic salmon recovery efforts in the Downeast SHRU. The input is provided directly from each organization.

#### Project SHARE

Project SHARE is a non-profit organization based in Downeast Maine that focuses on the restoration of riverine habitat in the Downeast Coastal SHRU. Nearly all of SHARE's field work involves the restoration of natural stream processes and can be broadly broken down into two types: restoration of habitat connectivity and enhancement of existing stream habitat. Habitat connectivity projects are projects that open previously inaccessible habitat (or have limited accessibility). Our habitat enhancement work involves adding complexity elements into stream channels, typically large wood, but boulders as well. SHARE specifically focuses on native salmonid (Atlantic salmon and Eastern brook trout) habitat, but our

projects can benefit most aquatic organisms. SHARE's primary focus is the Upper Narraguagus subwatershed where SHARE and the landowners have already reconnected 99.9% of the mapped salmon habitat.

In 2023, SHARE, and its partners restored fish passage at three road crossings within the SHRU. One project occurred in the Pleasant River watershed; and two in the Narraguagus watershed. The Deer Lake Outlet (mainstem Narraguagus River at Rkm 74.2) replaced an old boiler type culvert with a 25 ft bridge. The other projects replaced round metal culverts with a concrete open bottom structure. Each was designed and constructed following the AOP (aquatic organism passage) or StreamSmart principles. Upstream fish passage was restored to 11.1 miles and 289 lake acres.

Additionally in 2023, SHARE continued to focus on enhancing the habitat in the Upper Narraguagus, along with some smaller projects in Old Stream, West Branch Machias, and Northern Stream. Eight habitat enhancements were undertaken during the ten-week field season. All but one of those used a strategic approach where stream-side trees are felled into the river/stream. Most of the trees had their roots left partially intact so that the tree is anchored not only by its mass but also its root system. A total of 224 trees were added this way, which added much needed complexity elements to ~182 habitat units (18,200 m2). The final large wood treatment used a method we call self-placing wood, in which truckloads of wood are delivered to an access point and placed in the river. The wood is left unanchored so that it disperses downstream naturally during high flow events. This addition of 120 pieces happened in the upper Narraguagus mainstem at the top of a reach that has been treated by strategic means in the past. This to ensure that most of the self-placing wood stays within that reach, getting caught by the previous large wood additions. To date over 2,700 pieces of large wood have been added to various reaches throughout the SHRU, with over 2,100 pieces in the upper Narraguagus specifically.

#### Maine Coast Heritage Trust

MCHT staff has continued to work primarily in the Narraguagus and Orange rivers in the Downeast Region. It has been a breakthrough year on the Narraguagus River. After almost 10 years of focused effort in collaboration with DSF, TNC, and ASF, the Town of Cherryfield vote 49 to 0 in favor of deauthorizing the Cherryfield Ice Control Dam opening the door to replacing the Ice control dam which has impaired diadromous fish access to the river for more than 60 years, with a river width rock ramp. MCHT staff have continued to work closely with the Cherryfield Select Board and the partners to advance the feasibility study. MCHT has continued to support the large wood addition and engineered log structure work of project SHARE in the upper Narraguagus River. MCHT is working to raise awareness of the habitat suitability challenges of the Downeast rivers and the pioneering work of Project SHARE. To this end, MCHT staff have taken the lead on a video project using animation to tell the story of the history of the rivers in Maine, the impact of the log driving era on instream habitat, and the potential for restoration. The video will be released on World Fish Migration Day 2024. MCHT staff have also continued to work with DSF, TNC and FSM to protect land in the Narraguagus River watershed with over 5,000 acres of active projects land conserved land.

While the Orange River is not home to Atlantic salmon, it is designated critical habitat. After almost 10 years of hard work by MCHT and DSF, real progress was made in 2023 towards addressing the complete lack of fish passage in the Orange River Watershed. The town of Whiting has been the recipient of \$2.6M in Congressionally Directed Spending and is in the process of design and permitting for a vertical slot fishway at the Millpond Dam adjacent to MCHT's office in Whiting Village. Construction likely to be

completed in 2025. 2023 marked the opening or the Orange River Water Trail including a website in collaboration with Downeast Coastal conservancy, Cobscook Shores, IF&W, and DSF. MCHT currently has two active projects and one completed project in the Orange River watershed conserving over 800 acres.

#### Work plan for the next calendar year

- Finalize connectivity priority maps for the Downeast SHRU
  - On April 7, 2022, the Downeast coordinating committee hosted a virtual workshop on connectivity in the Downeast SHRU. The main goals of the workshop were to (1) review recent progress on connectivity and (2) exchange information related to the development of updating priorities for future work related to enhancing connectivity in the Downeast SHRU. The meeting was well attended by various stakeholder groups and other collaborators. Following the workshop, the coordinating committee will be updating the priority maps for connectivity improvements in hopes they are useful in generating support for progress toward enhanced connectivity in our salmon rivers of Downeast Maine.
- Cherryfield Dam
  - Work will continue improving fish passage at the Cherryfield Dam that partially obstructs the Narraguagus River. DSF is leading an effort to identify feasible alternatives to improve upstream and downstream passage for all diadromous species at the site.
- Improve fish passage at Saco Falls in the Pleasant River
  - The planning process is under way to restore full fish passage at Saco Falls. At certain flows, passage is possible through the falls but due to human caused changes, access is limited. The goals are to evaluate alternatives including rebuilding the existing fishway.
- Develop recovery toolbox in line with recovery action DES 9.1.

#### List of Reports and Publications resulting from Projects within SHRU

MeFWCO 2023. Summary of Water Temperature Collected at River Kilometer 48.2 in Narraguagus River (2011-2022). Feb. 16, 2023. 23p.

USFWS 2023. Census of Native and Non-native Fish in Downeast Maine using eDNA Metabarcoding: 2021-2022. Northeast Fishery Center, Lamar, PA. Aug. 17, 2023. 13p.

#### References

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## Chapter 4 Annual Report for the Penobscot Recovery Unit – Calendar year 2023 activities

This report summarizes progress toward achievement of recovery goals for the Penobscot Salmon Habitat Recovery Unit (Penobscot SHRU) in 2023.

## Summary of adult returns and redd counts for the previous year (abundance and population trends)

The number of returns to the Penobscot SHRU in 2023 was 1,592 (116 naturally reared and 1,476 hatchery origin); the highest number of adult returns in the ten-year time series (Table 4-1). Of the returns, 1,570 were documented at the Milford trap, and an additional 22 adults are estimated to have returned to the Penobscot Bay SHRU based on redd counts: 11 to Kenduskeag Stream, 8 to Great Works Stream, and 3 to the Ducktrap River. Neither the 2023 naturally reared returns nor the 10-year average of naturally reared returns met the minimum abundance criterion of 500 needed for downlisting from endangered to threatened (USFWS and NMFS 2019). However, over the last 10 years the trend in both hatchery and naturally reared returns continues to increase slightly. The proportional contribution of hatchery fish to the returning adults in the Penobscot SHRU remains high (92%).

The 10-year geometric mean replacement rate for naturally reared Atlantic salmon populations in the Penobscot SHRU was 1.19 (95% Cl 0.59 - 2.39), which is a slight increase from the previous year (Figure 4-2). A minimum 10-year geometric mean replacement rate of greater than 1 is needed for downlisting from endangered to threatened. As part of the reclassification criteria, additional parameters specific to habitat accessibility are also required.

In total, 754 sea-run adults were collected at the Milford Dam and transported to Craig Brook NFH. Collections began on May 14, comprising 32 trips, and concluded on June 27, 2023. The most adults collected in a single day was 54 so that the adults are collected throughout the run and to facilitate disease sample processing. Of the 754 adults collected, 234 were stocked in the Piscataquis River as 'pre-spawn releases'; 9 tested positive for Infectious Salmonid Anemia virus (non-pathogenic) and were released back to the Penobscot River; 10 were transportation mortalities; 4 were pre-spawn mortalities; and the remaining 497 were available as broodstock.



Figure 4-1. Graph of adult returns for the last 10 years (from 2014 to 2023).



Figure 4-2. The 10-year geometric mean replacement rate for the Penobscot SHRU from 2014 to 2023. The replacement rate for the Penobscot SHRU has averaged around 1 over the last 10 years. The replacement rate reflects only naturally reared Atlantic salmon, and the average replacement rate for naturally reared fish in the Penobscot SHRU.

Return Year	Number hatchery reared	Number of naturally reared
2014	239	29
2015	670	61
2016	429	78
2017	761	105
2018	711	61
2019	1028	177
2020	1196	243
2021	470	91
2022	1,228	106
2023	1,476	116

Table 4-1. The number of returns to the Penobscot SHRU and their origin (hatchery or naturally reared) between 2014 and 2023.

Table 4-2. Summary of adult returns for the Penobscot SHRU. Counts are from the Milford Dam fishway or redds based estimates from spawner surveys. (Table 3.0.1 from USASAC 2024).

River	Adult returns	# Naturally reared	# Smolt stocked
Penobscot (Milford Fish Lift)	1,570	113	1,457
Cove Brook	0	0	0
Ducktrap	3	3	0
Great Works	8	0	8
Kenduskeag	11	0	11
Souadabscook	0	0	0

#### Spatial Distribution

Spatial distribution of Atlantic salmon in the Penobscot SHRU is relative to habitat connectivity and natural spawning, as well as areas that are stocked. Occupancy of unstocked habitats are determined through redd count surveys and electro-fishing. Given the size of the Penobscot SHRU, not all areas are surveyed so the information below only provides an estimate of occupancy based on the best available information.

#### Connectivity

In years past, we have reported on the estimated total number of suitable and accessible habitat units. However, additional spatial analyses are needed before we can make a reliable estimate of the number of accessible habitat units in the Penobscot SHRU. In addition, considerable uncertainty remains on what constitutes "suitable" habitat. The way we have done this in the past relies on simply estimating the number of habitat units from the existing habitat model produced by Wright et al. (2008). In 2024, NOAA-Fisheries hired a contractor to define, model, and map suitable Atlantic salmon habitats that can be used to annually report on progress towards attaining the habitat criterion in the Final Recovery Plan. She will also use the ICPP climate projections to model predictions of habitat suitability into the future to help inform ESA consultations.

As described in the Final Recovery Plan (2018), the life history of the Atlantic salmon requires a high degree of access between freshwater, estuarine, and marine environments, and sufficiently suitable natural habitats must be available to support wild populations. Habitat access is categorized as: (1) Habitat with No Access, (2) Habitat with Impeded Access, (3) Habitat that is Accessible, and (4) Habitat that is Fully Accessible.

To ensure the long-term sustainability of wild populations, there must be sufficient access to suitable habitat to support spawning and juvenile rearing. Ultimately, returning adults will dictate the actual amount of habitat needed, though the minimum amount of suitable habitat that must be accessible to returning adults to achieve delisting criteria is 30,000 Habitat Units per SHRU. Figure 4-1 shows areas within designated critical habitat that are unimpeded by dams. Currently, none of the FERC license dams meets the minimum passage criteria necessary for upstream habitats to be considered "accessible" according to the definitions in the Final Recovery Plan.



Figure 4-3 Map of habitat within designated Critical Habitat that is unimpeded by Dams. This does not fully account for habitats blocked or impeded by culverts.

#### 2023 Connectivity Projects

In 2023, one fishway project and sixteen road crossings improved access to approximately 680 units of Atlantic salmon habitat. Existing downstream barriers or partial barriers prevent this habitat from counting towards the habitat criterion as defined in the Final Recovery Plan (Table 4-3).

Table 4-3. Summary of fish passage projects completed in 2023. Seventeen connectivity projects were completed that improved access to an estimated 680 units of salmon habitat. The total Atlantic salmon habitat units made accessible according to Recovery Plan criteria was 0 units.

Sub-Basin	Stream Name	Critical Habitat	Habitat Units	Project Type
Mattawamkeag	Baskahegan	No	557	Dam Fishway
Piscataquis	Mooresville Brook	Yes	5	Culvert
Pushaw	Rollins Brook	No	3.19	Culvert
Piscataquis	Henderson Brook	Yes	91.2	Bridge
Piscataquis	Pleasant River	Yes	23.8	13 Culverts
	Total:		680.19	

#### Estimates of Occupancy

The U.S. Atlantic Salmon Assessment Committee (USASAC) estimated December 2021 mean proportion occupancy attributed to stocking of juveniles and documented natural reproduction for each of the 3 SHRUs at a HUC-12 resolution (*see* USASAC 2022, Figure 2.4.1.2). While the three SHRUs vary in size and number of HUC-12 units, the amount of occupied juvenile rearing area is typically around 8,800 to 13,600 units of habitat in each SHRU.

Because of software changes and updates, the density of redd counts and stocking activities could not be tabulated this year. Standard estimates will be revisited in 2024 with updated tools. As such, we made a binary summary of observed redds or stocking activity in each discrete HUC. The Penobscot SHRU with 148 HUC-12 areas had cohort occupancy of between 10,300 and 18,400 units for the 3 cohorts in 22 areas (15%) where these 3 cohorts had a proportion occupancy above 0.01 (Figure 4-4).



Figure 4-4. Map for mean occupancy across the 2019 to 2023 cohorts as of December 2023. This does not include the 2023 cohort from last fall's wild spawning. The proportion is the total amount of habitat that has at least one salmon, divided by the total available rearing habitat based on the Wright et al. (2008) Salmon habitat model.

#### Stocking

In 2023, approximately 1,808,799 Atlantic salmon of various life stages (eggs, fry, parr and smolts) were stocked into the Penobscot SHRU (Table 4-4).

Eggs: The Penobscot drainage received 360,441 eggs from Green Lake NFH in 2023. These eggs were stocked from March 7th to March 31st within the Upper West Branch Pleasant River. The outreach program "Fish Friends" received 11,600 F2 eyed eggs which were transferred to more than two dozen classroom tanks.

Fry: 753,698 fry were stocked in the Penobscot SHRU in 2023. Approximately 373,142 of the fry were stocked into the Piscataquis watershed including the mainstem Piscataquis, West Branch Piscataquis, and Kingsbury Stream. The remaining fry, approximately 376,556, were stocked into the Pleasant River watershed. Additionally, 4000 fry were given to the "Fish Friends" outreach program.

Parr: In 2023, the Penobscot SHRU received 40,112 age 0 parr produced from Penobscot Sea Run Broodstock at Green Lake NFH. These are graded offs from the smolt allocation, to reduce density and promote growth of the remaining smolts. These parr were stocked into the West Branch Pleasant River. Green Lake NFH also transferred 100,000 Penobscot River origin age 0 parr to Nashua NFH as part of a smolt program for the Merrymeeting Bay SHRU.

Smolts: 642,948 age 1 smolts of Penobscot River origin were stocked in the Penobscot SHRU by Green Lake NFH in 2023. Approximately 546,968 of these smolts were stocked into the main stem of the Penobscot River downstream of the Milford Dam and French Island from Sandy Point Road. Another 95,580 smolts were stocked in the Piscataquis River in Abbot above the Guilford Dam in an effort to increase escapement of adults into the Piscataquis River. Smolt stocking began on April 10, 2023 and ended on April 26, 2023. Green Lake NFH provided 400 Penobscot River origin age 1 smolts to the Maine Cooperative Fish and Wildlife Research Unit at the University of Maine, Orono for research projects.

River	Eggs	Fry	Parr	Smolt
Mainstem Penobscot				546,968
Middle Branch Pleasant River				
West Branch Pleasant River	360,441	376,556	40,112	
West Branch Piscataquis River		46,807		
Mainstem Piscataquis River		237,436		95,580
Kingsbury Stream		88,899		
Kenduskeag Stream				
Cove Brook				
Marsh Stream				
East Branch Mattawamkeag				
Total	360,441	749,698	40,112	642,848

Table 4-4. Summary of salmon stocked by river in 2023 in the Penobscot SHRU.

#### Diversity

Of the seven river-specific broodstocks maintained for the DPS Atlantic salmon populations, the Penobscot River broodstock represents the largest number of individuals spawned and estimates of genetic diversity are higher than any of the other six broodstocks. In 2023, estimates of allelic diversity in the sea-run broodstock is consistent with the 16-year average (average mean number of alleles per locus = 13.34). Other metrics of genetic diversity such as estimates of effective population size were lower than in previous years ( $N_e$ =308.3) and was below the 16-year average observed between 2008 and 2023 (average  $N_e$ =402.4). Continued monitoring of estimates of genetic diversity is very important as the Penobscot SHRU contains the largest number of returning adults in any of the Maine populations, and it represents the largest river-specific Atlantic salmon broodstock remaining in the United States. More detailed summaries of genetic estimates of diversity are found in the USASAC report.

Table 4-5 shows the proportion of returns to the Penobscot relative to sea-age as well as naturally reared returns. Mixing across year classes is an important element of diversity for Atlantic salmon.



Figure 4-5 Graph of the mean number of alleles per locus for the sea-run Penobscot River broodstock based on the adults sampled at Milford Dam for transport to Craig Brook National Fish Hatchery from 2008 to 2023. Because the sea-run Penobscot broodstock is obtained from returning adults, there is a two- year difference in collection time due to the life stage being collected for broodstock (adults versus parr). Results represent the mean number of alleles per locus (based on 18 microsatellite loci) for the sea-run broodstock collected annually.

Table 4-5. Life history attributes from adult returns in the Penobscot SHRU in 2023 including age class distribution and percent naturally reared.

River	%1SW	%2SW	%3SW	%Repeat	%
				spawners	naturally
					reared
Penohscot	5 9%	93.4%	0.6%	0.1%	7 3%
SHRU	3.370	55.470	0.070	0.170	,

#### Emerging issues and priorities

In 2020, the Management Board requested each SHRU provide "must-do" projects that were of priority for the upcoming 5-year period. In developing the Penobscot SHRU work plan, six Keystone Issues were identified among the multiple actions within the work plan that were of highest priority for the Penobscot SHRU team. In 2022, the list of Keystone Issues was expanded to include actions to account for all ongoing and upcoming FERC relicensing proceedings and ESA section 7 consultations. The current keystone actions are as follows:

- Comprehensive Marking Program: The Penobscot SHRU Team is continuing to explore the feasibility of implementing a basin-wide marking program such that hatchery origin fish and project specific fish (e.g. Salmon for Maine's Rivers fish) can be easily distinguished from naturally reared returns. Marking of fish is a priority to account for the returns and escapement of naturally reared and wild origin spawners that contribute towards downlisting and delisting criteria.
- 2. Piscataquis River: The Penobscot SHRU Team continues to prioritize recovery efforts in the Piscataquis River sub-basin aimed at increasing escapement and natural reproduction in the Piscataquis River. Increasing access into the Piscataquis was a focus of the Penobscot River Restoration Project and remains a priority for the Penobscot SHRU team given the abundance of high-quality habitat in the basin. Our stocking plan focusses efforts in the Piscataquis basin, particularly the Pleasant River watershed, with the goal of reaching 150 naturally reared spawners within the next five years. In addition to focused stocking efforts, there will be an increased focus on addressing fish passage at the Browns Mills, Moosehead, and Guilford dams on the Piscataquis River.
- 3. Salmon for Maine's Rivers: This project is an effort to significantly increase the number of adult salmon spawning in the Penobscot River watershed by rearing juvenile salmon in marine netpens to maturity and releasing these fish as adults (potentially as many as 8,000 10,000) in suitable spawning habitats. Although the Salmon for Maine's Rivers project in the Penobscot River has encountered some setbacks, the project remains a priority for the SHRU Team to encourage the commitment of resources needed to support assessment and monitoring necessary to gauge project effects and its utility towards supporting recovery efforts.
- 4. **Stocking Plan:** The Penobscot SHRU Team stocking plan was completed and is currently being used to inform spring fry stocking, and broodstock collections. The plan aims to align stocking

efforts with the goals and priorities set forth by the Penobscot SHRU Team.

- 5. Lower River Tributaries: The Penobscot SHRU Team acknowledges the importance of the coastal streams and lower Penobscot River tributaries recognizing that these areas are not impacted by hydro-electric dams and they may provide our best opportunity to further recovery until passage issues at mainstem dams are resolved.
- 6. **FERC Actions:** All ongoing or upcoming hydro-relicensing proceedings and ESA Section 7 Consultations on dams in the Penobscot SHRU are a priority for the Penobscot SHRU. We prioritize this work to emphasize connectivity as a priority and to highlight the importance that all project operations aim to avoid any ecosystem impacts (which includes ensuring passage for all native species), and any impacts that may hamper or preclude Atlantic salmon recovery efforts. Below is a list of ongoing or upcoming FERC related actions:

#### FERC relicensing's (Federal Power Act):

- West Enfield (Mainstem)
- Pumpkin Hill/Lowell Tannery (Passadumkeag River)
- Ripogenus and Penobscot Mills (West Branch Penobscot)
- Medway (West Branch Penobscot)

#### ESA Section 7 consultations/reinitiations

- Milford (Mainstem) (re initiation of consultation triggered for failing to achieve performance standards related to delay)
- Browns Mills (Piscataquis)
- Mattagamon (Pending future developments)

#### Post-licensing

• Mattaceunk (Mainstem)

#### <u>Other</u>

Mayo Mill Surrender

#### Work plan for the next calendar year

- 1. Update the Penobscot SHRU workplan
- 2. Support efforts to address fish passage at the Mayo Mills Dam on the Piscataquis River
- Support efforts to evaluate fish passage effectiveness at the Howland Bypass and Browns Mills Dam
- 4. Continue to engage, when possible, on the Milford re-initiation to ensure proposed measures are consistent with the management objectives of the SHRU Team.
- 5. Continue to advance the priority actions of the SHRU team identified in the SHRU workplan and stocking plan, with particular attention towards increasing escapement of naturally reared spawners in the Piscataquis SHRU.

#### List of Reports and Publications resulting from Projects within SHRU

- Melnyk, L. J., Lazorchak, J. M., Kusnierz, D. H., Perlman, G. D., Lin, J., Venkatapathy, R., Sundaravadivelu, D., Thorn, J., Durant, J., Pugh, K., & Stover, M. A. (2023). One Health assessment of persistent organic chemicals and PFAS for consumption of restored anadromous fish. Journal of Exposure Science & Environmental Epidemiology. https://doi.org/10.1038/s41370-023-00620-3
- Peterson, E., Thors, R., Frechette, D., & Zydlewski, J. D. (2023). Adult Sea Lamprey approach and passage at the Milford Dam fishway, Penobscot River, Maine, United States. North American Journal of Fisheries Management, 43(4), 1052–1065. https://doi.org/10.1002/NAFM.10919
- Rubenstein, S. R., Peterson, E., Christman, P., & Zydlewski, J. D. (2023). Adult Atlantic salmon (Salmo salar) delayed below dams rapidly deplete energy stores. Canadian Journal of Fisheries and Aquatic Sciences, 80(1), 170–182. https://doi.org/10.1139/cjfas-2022-0008
- Whittum, K. A., Zydlewski, J. D., Coghlan, S. M., Hayes, D. B., Watson, J., & Kiraly, I. (2023). Fish
  Assemblages in the Penobscot River: A Decade after Dam Removal. Marine and Coastal Fisheries:
  Dynamics, Management, and Ecosystem Science, 15(c10227). https://doi.org/10.1002/mcf2.10227
- Zydlewski, J., Coghlan, S., Dillingham, C., Figueroa-Muñoz, G., Merriam, C., Smith, S., Smith, R., Stich, D., Vogel, S., Wilson, K., & Zydlewski, G. (2023). Seven dam challenges for migratory fish: Insights from the Penobscot River. Frontiers in Ecology and Evolution, 11. https://doi.org/10.3389/fevo.2023.1253657

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## Chapter 5 Annual Report for the Merrymeeting Bay Recovery Unit – Calendar year 2023 activities

Effective coordination of planning and implementation efforts throughout the Gulf of Maine Distinct Population Segment (DPS) is required for the successful restoration of Atlantic salmon. An effective governance structure is key to charting a comprehensive long-term recovery program that facilitates interagency and intergovernmental cooperation along with the strategic involvement of a full range of partners and interested parties. The Collaborative Management Strategy is the current Atlantic salmon governance structure. Implemented in the fall of 2019, it is the result of significant stakeholder and agency input and collaboration.

The Collaborative Management Strategy for the Gulf of Maine Atlantic Salmon Recovery Program, which is subject to change, includes Salmon Habitat Recovery Unit (SHRU) Teams for each major geographical area identified in the Recovery Plan for Atlantic Salmon in GOM. The SHRU Teams, in part, develop five-year work plans that include SHRU specific projects aimed at the goal of recovery of Atlantic salmon. This is a report of the 2023 activities of the Merrymeeting Bay (MMB) SHRU Team.

#### Abundance and Adult Population Trends

In the past ten years within the MMB SHRU, the adult population has increased, however it also has been highly variable. The increase in adult returns to the MMB SHRU is largely due to increases in the Kennebec River. This is likely a result of an increase in supplementation to the Sandy River that began in 2010 as well as improvements to marine survival, and improvements in downstream passage. The other shift that has occurred in the Kennebec River is the increased proportion of adult returns that are of hatchery origin. Hatchery origin adults captured in the Kennebec River are from a smolt stocking program that was initiated in the spring of 2020. The Androscoggin River has seen a modest positive population trend in the past four years. The Androscoggin River's proximity to the Kennebec River makes it a likely destination for straying Kennebec River salmon. As the population in the Kennebec River increases, an increase in adult returns to the Androscoggin River is expected. The Sheepscot River has not shown any significant changes in adult returns.

#### Adult returns of Atlantic Salmon from 2014-2023



Figure 5-1. Adult returns of Atlantic salmon in the Merrymeeting Bay SHRU for the last 10 years



Figure 5-2. The geometric mean replacement rate for the Merrymeeting Bay SHRU.

#### Adult Returns in 2023

#### Androscoggin River

The Brunswick fishway trap was operated from 12 May to 15 November 2023 by a combination of MDMR and Brookfield Renewable Partners (BRP) staff. Eight adult Atlantic salmon were passed at the Brunswick fishway trap. These consisted of five (62.5%) hatchery reared grilse, two (25.0%) hatchery

reared 2SW adults, and one naturally reared adult (12.5%) (Table 3.0.2.). One hatchery grilse was recaptured. Due to the proximity of the Androscoggin River to several other trapped rivers, adults that are handled at this facility are marked differently from other rivers with an upper caudal punch to identify strays from recaptured salmon. Biological data were collected from six trap-captured returning Atlantic salmon in accordance with the 2023 MDMR Adult Trap protocols, and the presence of marks and tags were recorded.

Occasionally an adult Atlantic salmon will pass undetected through the fishway at Brunswick during maintenance/cleaning, so a minimal redd count effort was conducted. Three small sections of the Little River where redds have been documented in past years were surveyed for redd presence, totaling 0.6 river kilometers covered. No redds or test pits were found in this section of river.

#### Kennebec River

The majority of the 162 Atlantic salmon returns to the Kennebec River drainage occurred at the Lockwood Dam (fish lift operated by Brookfield Renewable Power staff from 8 May to 31 October 2023). Of these, 158 were captured at Lockwood (Table 5.1.), and one Atlantic salmon was found between the Sebasticook River confluence and Lockwood fish lift and reported as a dead-on-arrival (DOA). Of the salmon captured at Lockwood, 2SW salmon accounted for 93.2% of the returns, 1SW salmon for 5.6% and repeat spawners for the remaining 1.2%. For 2SW returns, 57 were naturally reared and 94 were of hatchery origin. For 1SW returns, all were hatchery reared origin. Hatchery origin salmon made up 64.8% of returns to the Kennebec with naturally reared salmon making up the remaining 35.2%. Thirtyfour salmon were recaptured at Lockwood after being transported upstream to the Sandy River. All were likely of hatchery origin (100% of the 18 readable scales were of hatchery origin). The hatchery reared origin returns were likely from stocked smolts raised at the U.S. Fish and Wildlife Service (USFWS) Nashua National Fish Hatchery in New Hampshire and released in Waterville below Lockwood dam.

The dorsal fins of adults returning from smolt stocking in the Kennebec River (hatchery origin adults) tended to be eroded compared to their naturally reared counterparts. Therefore, dorsal score was used to prorate the origin of adults. Out of the four 2SW adults that were prorated as naturally reared, the freshwater ages were prorated based on the known freshwater proportions which were 83% 2-year-olds and 17% 3-year-olds.

Benton Falls fish lift facility, located on the Sebasticook River, was operated by Essex Hydro staff from 01 May to 01 November 2023. This facility does not allow for any biological sampling; only observations are made. Three Atlantic salmon were viewed using the fish lift; all were pro-rated as hatchery reared based on the lack of a stocking program and few adults returning over the last few years. One was prorated as a 3SW and two were prorated as 2SW based on size.

#### Sheepscot River

There were eight redds observed in the Sheepscot River; all were in the mainstem. Two redds were attributed to captive-reared outplants as they were near the stocking location. Captive-reared outplants are adult salmon that were raised in the hatchery and released to the river to spawning. A total of 55.6 river km were surveyed which contained 73.4% of the spawning habitat in the drainage. The Redds Based Returns model estimated that 10 adults returned (95% Cl 4 – 31). Breakdown of returns are as follows: one 1SW hatchery origin, one naturally reared 1SW, and eight naturally reared 2SW salmon.

Table 5-1. Adult returns to rivers where traps are used in the Merrymeeting Bay SHRU in 2023. Most adult salmon are caught at the Lockwood fish lift on the lower Kennebec River, Benton Falls fish lift on the Sebasticook River and Brunswick fish lift on the lower Androscoggin River.

	Hatchery			Naturally Reared / Wild					
									Total Sea-run
River	1SW	2SW	3SW	RPT	1SW	2SW	3SW	RPT	Returns
Lower Kennebec River	9	92	0	1	0	57	0	0	159
Sebasticook River	0	2	1	0	0	0	0	0	3
Lower Androscoggin R.	5	2	0	0	0	1	0	0	8

#### Distribution within the Merrymeeting Bay SHRU

The stocking effort in the MMB SHRU is focused in the Sandy River and the Sheepscot River with four age classes of juveniles (Figure 5-4 and Table 5-2). The primary supplementation strategy in the MMB SHRU is the planting of eyed eggs. In the Sandy River 654,000 eggs were planted between February and March. In addition to eggs, the Kennebec River received 99,000 smolts in the spring of 2023, which were stocked upstream of the four lower mainstem dams. The smolt supplementation is part of an effort to boost wild reproduction and releases are expected to continue annually for the next several years. In the Sheepscot River, 79,000 eggs were planted during the same timeframe. Eggs are generally divided between mainstem and tributaries according to the amount of juvenile rearing habitat in the vicinity of the planting site as well as estimated emergence rates. In the Sheepscot River a small number of fry are released annually in areas of the river where winter access may be preventative for egg planting. In 2023, 70,000 fry were released in the upper West Branch and the mainstem Sheepscot River above Sheepscot Pond. In addition, 0+parr were released at Kings Mills in Whitefield. In September 16,000 0+ parr were released.



Figure 5-3. Map of stocking locations in the Merrymeeting Bay SHRU.

Table 5-2. Atlantic salmon released in the Merrymeeting Bay SHRU.

	2023 MMB SHRU Stocking					
Drainage	Watershed	Eyed Eggs	Fry	Fall Parr	Smolts	
Kanadaaa	Sandy River	654,000	0	0	0	
Kennebec	Mainstem	0	0	0	99,000	
Sheepscot	All	79,000	70,000	16,000	0	



Figure 5-4. Map of the MMB SHRU showing river and stream reach accessibility for Atlantic salmon. Accessible watersheds have no mainstem dams, or else have dams that have fishways that have been evaluated and determined to be highly effective. The habitat in these watersheds meet our recovery criteria for accessibility. Partially accessible watersheds are above dams that have fishways that have yet to be evaluated. Not accessible watersheds are above dams that do not have swim through fishways. Watersheds above impassable dams where adult salmon are trucked are not considered accessible in terms of recovery. This map does not consider the effect of road stream crossings.

Table 5-3. Summary of number of Merrymeeting Bay SHRU HUC-12 units in 2023 where occupancy was documented for Wild Production Areas (WPA) and hatchery production areas for each hatchery product that results in natural production in a river (Egg = EPA, Fry = FPA, and Parr = PPA). WPA is a HUC that had documented wild reproduction, and a hatchery production area is a HUC that was stocked with any year class of salmon.

SHRU	WPA	EPA	FPA	РРА
Merrymeeting Bay	6	11	4	1



Figure 5-5. Wild Production Areas 2023. Map highlighting known spawning activity in 2022 at a HUC-12 watershed summary level that visualizes occupancy in HUC-12 units where redd surveys were conducted.



Figure 5-6. Map of redds (red dots) surveyed in 2023 across the Gulf of Maine DPS. Coverage was expanded in the Penobscot watershed and occupancy density estimates will be provided next year as software upgrades are completed.

#### Diversity

#### Genetic diversity for: Merrymeeting Bay SHRU 2024 Report Meredith Bartron, USFWS

For each broodstock within the Merrymeeting Bay SHRU, a target of 200 parr to collect and retain for broodstock use was implemented starting with the 2017 collection year. Results below represent the mean number of alleles per locus (based on 18 microsatellite loci) for the 2021 collection of Sheepscot River broodstock (Figure Y), which is the only broodstock maintained specifically within the Merrymeeting Bay SHRU. For the 2021 parr broodstock collection from the Sheepscot River, allelic diversity slightly increased over the previous collection year estimate (2020 collection year) and is slightly higher than the 14-year average (mean number of alleles = 11.57). Continued monitoring of estimates of genetic diversity is important as the Merrymeeting SHRU contains only one of the seven river-specific Atlantic salmon broodstocks remaining in the United States. More detailed summaries of genetic estimates of diversity are found in the USASAC report.



Figure 5-7. Graph of the mean number of alleles per locus for the Sheepscot broodstock, based on parr collected annually for broodstock collection surveys from 2008 to 2021. Also included are allelic diversity estimates for the other captively-spawned Atlantic salmon broodstocks for reference from the Downeast (Dennys, East Machias, Machias, Narraguagus, and Pleasant broodstocks) and Penobscot (Penobscot sea-run broodstock) SHRUs. Because the sea-run Penobscot broodstock is obtained from returning adults, there is a two- year difference in collection time due to the life stage being collected (adults versus parr). For all broodstocks, results represent the mean number of alleles per locus (based on 18 microsatellite loci) for the parr broodstock collected annually.

#### **Emerging Issues and Priorities**

Ensuring adequate fish passage at the Federal Energy Regulatory Commission (FERC) licensed hydropower dams within the SHRU is the primary concern associated with recovery in the SHRU. In March, FERC released a draft Environmental Impact Statement for the relicensing of the Shawmut Hydroelectric Project; and amending the licenses of the Weston Hydroelectric Project, Hydro-Kennebec Hydroelectric Project, and the Lockwood Hydroelectric Project. Following the conclusion of FERC's NEPA process it is expected that the licensing/license amendment decisions will be in the first quarter of 2025 (Fed Fiscal Year 2025). This represents a significant opportunity for stakeholders to influence the relicensing and amendment process.

Enhancing and protecting habitat within the SHRU's focus areas remains a high priority. To support this effort, focus will be given to completing the rapid stream assessment and spatial analysis of the entire Sheepscot Watershed, advancing habitat activities associated with the NRCS Regional Conservation Partnership Program grant to Maine Department of Marine Resources for focused in-stream habitat work, and working with land conservation partners to increase the number of riparian and upland acres of land protected by 15% throughout the SHRU as outlined in the Team's workplan.

A third priority for the SHRU will be to determine how to implement the recommendation presented to the Management Board for developing a broodstock management plan/smolt stocking program for the SHRU. A report was shared with the Management Board in April 2024.

Many of the highest priority fish passage barriers (aside from the hydroelectric dams) in priority habitat areas identified in the SHRU's workplan (e.g., upper Sandy River) have been addressed by members of the SHRU Team. As a result, funding and capacity appears to be moving towards work in other SHRUs. In the coming year the Team will need to prioritize additional projects in the workplan and look for additional funding streams.

Finally, damaging storms and flooding has long been an issue in the watersheds that make up the Merrymeeting Bay SHRU. However, over the past few years storms have become more intense and more frequent leaving significant impacts to property, infrastructure, and habitat within the SHRU. As a result, actions have been taken that have had negative impacts on important spawning habitats. With increased storms and flooding expected into the future, there is an opportunity to increase community engagement and work with towns to design solutions that build community and infrastructure resilience while also providing for ecosystem resilience and recovery.

#### Stakeholder Input

The stakeholders were invited to share any issues that were not part of this report's emerging issues and priorities. We did not receive specific stakeholder input for this report, however, stakeholders continue active engagement in the MMB SHRU Team.

#### Work Plan 2024

Table 5-4. Proposed actions for 2024.

#### Sheepscot Focus Area

Project	Action	Partners
Taylor Road Bridge	Remove bridge remnants	Property owner, MDMR,
		USFWS, NOAA, NGOs
Inadequate culvert	Replace culvert	Road Owner, NRCS, NGOs
(Trout Brook)		
Culverts	Identify and perform outreach.	Road owners, MEDMR,
		USFWS, NOAA, NGO's
Land Protection	Sheepscot River watershed is one of the most	Midcoast Conservancy
	subdivided salmon watersheds. This may	
	help to protect valuable habitat from future	
	anthropogenic effects.	
Inventory of	The Sheepscot River has many anthropogenic	MDMR, Midcoast
anthropogenic	effects via log drives, agriculture, remnant	Conservancy, USFWS, DEP,
structures in river	stream crossings that impact the flow of the	MCHT, ASF
	river that need to be inventoried and	
	surveyed.	

Project	Action	Partners
Hatchery Supplementation	Consider alternative to replace eliminated 0+ parr stocking program	USFWS, DMR
Qualitative Habitat	Qualitative habitat surveys to guide stocking and habitat restoration	
Habitat Structure Additions	Improve habitat by additions of large wood and other structures	MDMR, USFWS
Inadequate culvert	Finalize designs for Ben Brook culvert replacement	Midcoast Conservancy, NOAA
Water Quality Monitoring	Address gaps in early-season water quality data in tributaries to the Sheepscot	DEP
Watershed Restoration Plan (W. Branch)	Prepare watershed restoration plan for the West Branch Sheepscot	USFWS
Carrabassett River Habitat Survey	Perform a survey of habitat in the lower mainstem Carrabassett River	MDMR

#### Kennebec Focus Area

Project	Action	Partners
Lockwood Dam	Restore up- and downstream accessibility (accessible or fully accessible) via dam removal or by implementing safe, timely, and effective upstream and downstream passage.	Dam owner, FERC, NOAA, MEDMR, USFWS, NGOs, MEDEP, MEIFW
Hydro Kennebec Dam	Restore up- and downstream accessibility (accessible or fully accessible) via dam removal or by implementing safe, timely, and effective upstream and downstream passage.	Dam owner, FERC, NOAA, MEDMR, USFWS, NGOs, MEDEP, MEIFW
Shawmut Dam	Restore up- and downstream accessibility (accessible or fully accessible) via dam removal or by implementing safe, timely, and effective upstream and downstream passage.	Dam owner, FERC, NOAA, MEDMR, USFWS, NGOs, MEDEP, MEIFW

Project	Action	Partners
Weston Dam	Restore up- and downstream accessibility (accessible or fully accessible) via dam removal or by implementing safe, timely, and effective upstream and downstream passage.	Dam owner, FERC, NOAA, MEDMR, USFWS, NGOs, MEDEP, MEIFW
Henry Mitchell Brook (Temple Stream)	Collaborate with stakeholders to design replacement road crossings to accommodate 100- year flow and provide better passage to Atlantic salmon critical habitat.	Road owner, MEDMR, USFWS, NOAA, NGO's, Atlantic Salmon Federation, Maine Audubon
Sandy River Culverts	Work with towns of Temple, Phillips, Avon, and Madrid to complete existing conditions site surveys at priority culverts. Assess and design feasible options for road crossing replacements.	Road owners, MEDMR, USFWS, NOAA, NGO's
Chesterville Dam	Work with the dam owner (Maine IFW) and partners to explore opportunities for either dam removal or fish passage that meets accessibility criteria	Maine IFW, MEDMR, USFWS, NOAA, Atlantic Salmon Federation
Cobboseecontee Connectivity	Work with owners of the remaining mainstem dams to explore opportunities for dam removal or installation of fish passage for river herring,	MDMR, NOAA, USFWS, Maine Rivers
Smolt Stocking	Conduct smolt stocking (100,000 smolts) to maximize survival and increase adult returns	MDMR, USFWS, NOAA, Universities
Land Protection	Establish conservation easements, purchase or acquire property rights, etc.	USFWS, NGOs including TNC, HPA, etc.
Black Brook	Two town-owned crossings (15063 and 15061), two privately owned crossings (15186 and 15188), and a DOT owned crossing (15058) persist as barriers to passage upstream and downstream. Collaborate with stakeholders to replace road crossings to accommodate 100-year flow and provide better passage to Atlantic salmon critical habitat. Crossings #15063, 15186 and 15188 expected to be replaced in 2023	ASF, NOAA, USFWS, MDMR, DOT
DOT Crossings	Collaborate with DOT and stakeholders to replace road crossings to accommodate 100-year flow and provide better passage to Atlantic salmon critical habitat.	DOT and stakeholders

#### Androscoggin Focus Area

Project	Action	Partners
Sabattus River Connectivity	Work with dam owners to explore dam removal or fish passage improvements that maximize the production potential of river herring in Sabattus Pond, and allow for the survival and recovery of Atlantic salmon	Dam Owners, NGOs, MDMR, NOAA
Brunswick	Participate in FERC relicensing; request studies, provide comments, recommendations, terms and conditions, section 18 prescriptions, WQC conditions.	Dam owner, FERC, NOAA; Partners: MDMR, USFWS, MIFW, MEDEP, NGOs
Worumbo	Participate in FERC relicensing; request studies, provide comments, recommendations, terms and conditions, section 18 prescriptions, WQC conditions.	Dam owner, FERC, NOAA; Partners: MDMR, USFWS, MIFW, MDEP, NGOs
Little River	Habitat survey identifying spawning, rearing and other areas of importance.	MDMR and TU

#### **MMB SHRU Team Actions**

Project	Action
Annual Report	Submit Annual Report in accordance with CMS guidelines
Annual Meeting	Conduct Annual SHRU Team meeting in accordance with CMS guidelines.
FERC Sub- Committee	Convene FERC sub-committee to: 1) track and maintain information regarding the status of FERC processes; 2) encourage coordination, planning, and participation in FERC relicensing processes; and 3) to encourage coordination, planning, and participation in the post-license compliance monitoring and adaptive management of FERC projects in an effort to achieve the best possible passage outcomes.
Mapping/GIS	1) Compile or develop maps that depict mapped/predicted salmon habitat, barriers, and critical landscape elements and integrate this effort with similar initiatives (e. g. NOAA USGS); 2)

Project	Action
	Provide tools through the Maine Stream Habitat View or other interface to make the information available for use within the SHRU Team.
Broodstock Plan	Finalize broodstock management plan to support supplementation-related workplan elements
Smolt stocking plan for the evaluation of safe, timely, and effective upstream passage in the lower Kennebec River	Finalize plan to conduct smolt stocking upstream of the Weston Dam to ensure 200+ returning adults in the Kennebec River, necessary to complete the "Adult Studies" workplan task.

#### Table 5-5. New Activities added to the Merrymeeting Bay SHRU work plan.

#### **Kennebec River**

Activity	Description	Partner
Chesterville WMA	Work with the dam owner (Maine IFW) and	ASF, MDMR, MIFW,
Dam	partners to explore opportunities for either dam removal or fish passage that meets accessibility criteria.	USFWS, NOAA

#### Reports and Publications from the Merrymeeting Bay SHRU

- Ad Hoc Committee Report. 2024. Report to the Management Board of the Collaborative Management Strategy on the Risks and Benefits of a New Broodstock Program in the Merrymeeting Bay Salmon Habitat Recovery Unit.
- Ad Hoc Committee Report. 2024. Report to the Management Board of the Collaborative Management Strategy to Identify Potential Sources of Study Fish for Studies at Hydro Dams on the Kennebec River.

# Chapter 6 Update on Marine Survival – Calendar year 2023

(Excerpted from USASAC 2024)

The USASAC updated adult return rate metrics for Penobscot River hatchery-origin smolts based on 2023 returns. For naturally-reared smolts produced in the Narraguagus, Sheepscot, East Machias, and Sandy rivers, metrics for 2SW returns for 2021 cohort were updated after a gap in the 2020 time series as no smolt estimates were available due to the pandemic. Additionally, a naturally-reared smolt population estimate for the Sandy River in 2021 allowed the calculation of SAR for that system for the first time. For all these four populations, we used smolt emigration estimates and subsequent adult returns by sea age to generate a smolt-to-adult return rate (SAR). For the Penobscot River, we used the methods of Stevens et al. (2019) to decouple losses of smolts in-river and in the estuary to provide an estimate of post smolts entering the Gulf of Maine. This method accounts for both stocking location and flow-specific mortality to generate a post smolt survival estimate that was then applied to subsequent adult returns to calculate a post smolt to adult survival rate (PSAR) for the Penobscot.

Naturally-reared smolt abundance was the result of wild spawning, egg planting, fry stocking and stocking of ambient parr. The longest time series for naturally-reared populations is the Narraguagus River starting with the 1997 smolt cohort. Most of the adult return data for this population comes from trap counts of adults at the Cherryfield Dam. In years of high flow (salmon can bypass the trap), redd counts are used to estimate total returns. Sheepscot River smolts were monitored from 2009 to 2019. Biologists shifted smolt monitoring to the Sandy River in 2021-2023. East Machias smolt monitoring was conducted from 2013-2019 and 2021. Due to staff capacity and funding constraints, monitoring ended in the Sheepscot (2019), East Machias (2021), and the Sandy River (2023). When biologists estimate adult returns from redd counts, ages are pro-rated by standard methods used by USASAC (2019).

The 1 SW PSAR for the Penobscot 2023 returns was 0.02% and the SAR for the Narraguagus was 0.40%. Trends in the last ten years (smolt cohorts 2012-2021) indicate Penobscot hatchery-reared 1SW population PSAR averaged 0.05%. The Narraguagus River had a higher SAR in the last 10 years averaging 0.45%, with only seven years available because of incomplete estimates in (2016, 2017, and 2020). For the 11-year Sheepscot River time series, the average SAR was 0.16%. The eight-year East Machias grilse SAR was 0.51%. Grilse in Maine are typically a smaller component of returns and most commonly males.

Salmon predominantly return at 2SW, therefore return rates are higher than for grilse. In 2023, the 2021 smolt cohort PSAR for the Penobscot was 0.26%, marking the second year of a more than 1.5 fold increase (Figure 6-1). While these rates are higher than the average of 2SW salmon in the last ten years when the Penobscot PSAR averaged 0.15% (Figure 2.3.2.1), they remain much lower than the 1970 to 1990 average of 1.12%. The average SAR for 2SW returns to the Narraguagus for the past 10 years averaged (1.30%). For completed monitoring, the time-series averages of the Sheepscot (0.58%) and the East Machias (1.82%). While the inter-annual variability is large in these smaller populations, these data suggest consistently better marine performance for naturally-reared smolts. Despite the higher rates for the Narraguagus, Sheepscot, and East Machias, overall low smolt freshwater production results in lower number of adult returns in these three populations.

Within the Kennebec River, smolt stocking started in 2020 and 2SW returns of stocked smolts had SAR of only 0.01% in 2022 and 0.09% in 2023. With wild smolt production estimates in the Sandy River starting in 2021, the SAR for 2SW to Lockwood was 0.44% for the 2023 return year. More analysis of returns to this system will occur as the time-series lengthens but assessment of strays to the nearby Androscoggin River should be included in analysis in the future.

Marine survival remains a primary threat to the recovery of all GOM DPS stocks. Reviews of marine survival indicate the best management strategy to address current ocean conditions is to maximize the production of wild or naturally-reared smolts. Given the amount of vacant habitat across the DPS, there is significant unused habitat capacity. Additional hatchery capacity would be expected to boost returns by utilizing more habitat to produce fish as would prioritizing use of higher quality habitat and further evaluating habitat quality. For hatchery smolts, research and adaptive management changes could help close the marine performance gap and yield more spawners. Ongoing efforts to ensure safe downstream passage for both naturally-reared and hatchery smolts remains essential.



Figure 6-1. Time series of post-smolt to 2SW adult return rates for the Penobscot hatchery smolts (blue with dashed 0.14% decadal average 2010-2019) and naturally-reared smolt to adult return rates for the Narraguagus (olive with dashed 1.16% decadal average 2010-2019), Sheepscot (orange with dashed 0.58% time series average), East Machias (green with dashed 1.82% time series average), and Sandy (wine) for the 2012-2021 smolt cohorts. This is the first 2SW estimate for the Sandy River (0.44%).

#### References

USASAC (United States Atlantic Salmon Assessment Committee). 2024. Annual Report of the U.S. Atlantic Salmon Assessment Committee Report No. 36 -2023 Activities. United States Atlantic Salmon Assessment Committee.