DOWNEAST FISHERIES PARTNERSHIP 2019

Up and up: River Herring in Eastern Maine

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Downeast Fisheries Partnership

Downeast Fisheries Partnership

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Introduction

River herring runs in eastern Maine are coming back! A string of successful projects, from the opening of the St. Croix fishway to the renewal of commercial fishing on Card Mill Stream in Franklin, have fueled growing momentum for restoration of rivers and streams, big and small. This report is an update on the status of river herring runs in eastern Maine. It describes the value of river herring and some of the many projects underway to allow river herring to swim upstream to their spawning habitat.

Because river herring are a keystone species in freshwater and marine systems—and are so responsive to restoration efforts—they have become a focus of the Downeast Fisheries Partnership effort to restore fisheries in eastern Maine. Here, fisheries are important ecologically, economically, historically, and culturally.

The Passamaquoddy at Sipayik. describe river herring as "the fish that feeds all"; they relied on river herring for thousands of years and French colonists settled in East Machias because river herring presented a ready source of food. Today, much-diminished river herring populations provide bait for the lobster fishery and the re-emerging halibut fishery.

They are also a source of smoked alewives, known locally as "bloaters," a delicacy enjoyed by generations in eastern Maine. Less visible, but also important, river herring have played a big role in nearshore food webs. Each fall juveniles pour out from the mouths of rivers and streams, providing forage for marine fish, such as cod and haddock.

"The vision of restored fisheries is big enough to embrace all of us. Opening up the rivers and streams for fish passage is an exciting experiment; we want our kids involved so they can be a part of building a new future for eastern Maine."

SCOTT PLANTING, FORMER PRESIDENT, MAINE SEA COAST MISSION

The National Marine Fisheries Service now recognizes that Maine's eastern coastal shelf is ecologically distinct from the rest of the Gulf of Maine. This development lays the groundwork for managing fish stocks in eastern Maine's coastal waters apart from —and more holistically than—those in the rest of the Gulf of Maine. The role of river herring as forage for marine species supports the argument that the Downeast ecosystem reaches from the headwaters of coastal watersheds to the edge of the coastal shelf, connected together by rivers and sea run fish.

Found along much of the eastern seaboard, river herring are coastal species for much of their life cycle, but every spring swarms of these little fish fight their way up rivers and streams—or they try to.

Challenges for River Herring

Even in eastern Maine, rivers and streams are far from wild. Our larger rivers were dammed as early as the 1760s. By the 1840s, river herring were blocked from 95% of their spawning habitat. Many dams, built for power generation or water storage, have outlived their usefulness, but continue to prevent river herring from reaching their spawning grounds. Others have potential for adding fish passage. Culverts and bridges have aged or were poorly designed or constructed; few can accommodate increased flows resulting from climate impacts.

Obstacles to migration aren't the only problems faced by river herring. Thousands of tons of river herring were harvested annually by foreign fishing trawlers in the 1950s and 1960s, contributing to their decline. Today, trawlers fishing for Atlantic herring, a marine species, sometimes catch river herring as well, raising concerns that they may be impeding their recovery. The National Marine Fisheries Service is reviewing a petition to list alewives and blueback herring as threatened or endangered. A decision is expected in 2019.

Rivers and streams in eastern Maine are low in calcium, resulting in acid conditions that are not ideal for fish. The Downeast Salmon Federation has found that placing clam shells in streams improves water quality and they are working to distribute clam shells more widely. Finally, even where river herring have access to lakes and ponds, fishways must be maintained and streams monitored on a weekly basis to ensure they are free of obstacles such as beaver dams. These dams, though a natural part of the ecology of eastern Maine rivers, can restrict the movement of river herring, both as adults and juveniles. They become particularly problematic in years of extreme low river flows. Keeping brooks open and free of dams has been a part of river herring management since the earliest years of statehood; for example, in 1883 the Town of Sullivan allocated funds to keep Flanders Stream clear of beaver dams.

"This fish is important. It's not just important to people. It's called 'the fish that feeds all.' From tiny bacteria in the streams to eagles, osprey, bear, mink, whatever. There's a lot of different animals that rely on this fish."

EDWARD BASSETT, SIPAYIK ENVIRONMENT DEPARTMENT

What Can Be Done?

Fisheries restoration is ultimately about people. About all of us! Right now, we have the opportunity to rebuild fisheries in our region, potentially restoring them to numbers not seen, in some places, for more than 200 years.

The Downeast Fisheries Partnership was created to bring the power of collaboration to meet our goals--working together we are more effective in promoting improved fish passage and restored fisheries. Our vision is that the communities of eastern Maine can sustain themselves forever by fishing. Our mission is to connect those of you working on fisheries restoration to one another and to connect your work to the "fishing forever" vision, in which communities thrive through effective stewardship and use of their local aquatic resources.

As human interaction with eastern Maine's rivers and streams continues and even increases, another goal is to provide information regarding the value of river herring to fishermen, communities, and state and federal agencies, as they make decisions that impact these waterways.

What are River Herring?

River herring is a collective term for two species, alewives (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*). Alewives are much more abundant in Maine than blueback herring. Alewives and blueback herring are very similar in size and appearance (about 10 inches long and weighing about half a pound). These are small fish that play an outsized role in the health of rivers, estuaries and coastal waters.

They have a remarkable life history. These fish live most of their lives in saltwater. After about three to four years, adult alewives migrate upriver in spring to spawn in freshwater lakes and ponds. Adult bluebacks prefer to spawn in moving water, i.e. rivers and streams. Species that accomplish this feat of shifting back and forth between fresh and saltwater are known as diadromous fish.

Benefits of River Herring

River herring provide innumerable ecological benefits and ecosystem services. They are prey for wildlife such as osprey, eagle, mink, and otter. Lobstermen rely on the harvest of river herring in the spring as a source of fresh bait. Smoked alewives ("bloaters") are part of eastern Maine's seafood heritage, a tradition kept alive by a handful of people with backyard smokers. The Downeast Salmon Federation recently built a rolling smokehouse that they take to schools, fairs, and other celebrations, demonstrating the smoking process and sharing samples.

One of the most important benefits of river herring is the role they play in river and marine ecosystems. Through their annual migration upriver and downriver, herring drive the exchange of nutrients between fresh and marine waters. In the spring, mature river herring migrate upriver. Each female produces tens of thousands of eggs, an energy-packed food source for fish, insects, birds, and other wildlife. Only a fraction of the eggs survives. But even so, the juveniles produced in a given lake or pond can number in the hundreds of millions.

What Does This Have to Do With Codfish?

Ted Ames, a lifelong Downeast fisherman and scholar of fisheries ecology, has researched the role of river herring in the life cycle of cod and related fish, such as haddock, white hake, and pollock. From historical data, he discovered that cod spawning grounds occurred at the mouths of coastal rivers where juvenile herring appear after migrating downstream. River herring are rich with lipids, a type of fat that cod need to reproduce. Ames notes that fisheries managers in the 1800s expressed concern that the decline of coastal cod populations might be related to the damming of rivers and streams leading in turn to the decline of river herring.

Ted Ames' research on the connection between cod and juvenile river herring came after his first discovery: that cod in the Gulf of Maine are not part of one big population, rather, they form a series of subpopulations each with its own spawning areas and migration patterns. This work upended the logic of today's fisheries management paradigm, which assumes one Gulf of Maine cod population. Much work is underway to adapt management to the reality of a more complex stock structure.

TED AMES,
DOWNEAST FISHERMAN

"The general conclusions which have been reached as a result of repeated conversations with Captain Treat and other fishermen on the coast incline me to believe that the reduction in the cod and other fisheries, so as to become practically a failure, is due to the decrease off our coast in the quantity, primarily, of alewives; and secondarily, of shad and salmon, more than any other cause."

SPENCER BAIRD, US COMMISSIONER OF FISH AND FISHERIES, 1874

An individual river herring can spawn year after year, but as many as half die after they spawn. The breakdown of their bodies provides nutrients that support the base of the food chain in lakes, rivers, and streams, helping to ensure that their young will have enough to eat. Juveniles grow quickly and migrate downriver a few weeks after hatching.

By late fall, the new generation will have found its way out to estuaries and coastal waters. It appears that younger alewives linger in estuaries and ocean bays; older fish range widely, including offshore.

River herring are an important resource in lake, river, estuarine, and nearshore food webs where they are preyed upon by a wide range of freshwater and marine animals. They are particularly important for juvenile groundfish, such as cod, which require fat-rich prey in order to mature into reproductive adults. We now believe recovery of river herring is critical to bringing back populations of cod, haddock, and other groundfish that have all but collapsed in eastern Maine.

Restoring river herring will benefit other species, too. Every native species of sea-run fish is still present in eastern Maine, although greatly reduced in number. In addition to alewives and blueback herring, these species include American shad, Atlantic salmon, American eel, striped bass, sea-run brook trout, rainbow smelt, sea lamprey, short-nosed sturgeon, Atlantic sturgeon, and tom-cod.

River herring directly benefit endangered Atlantic salmon. On their journey upriver in the spring, they act as a "prey buffer," attracting predators away from juvenile salmon which are leaving rivers for the sea.

For all these reasons, Eastern Maine is an excellent laboratory for testing the impact of river herring restoration on the entire ecosystem, from inland headwaters to coastal shorelines to the deeper waters of the Gulf of Maine.

Eagles and ospreys prey upon river herring during the spring migration.
Photo by Morning Sentinel/Michael G. Seamans.

Management

Because alewives and bluebacks are so similar in size and appearance, the two species are collectively referred to as river herring and no distinction is made between them by the State of Maine for the purposes of management .

River herring are managed at three levels of government: the Atlantic States Marine Fisheries Commission, the Maine Department of Marine Resources, and local municipalities.

The Atlantic States Marine Fisheries Commission, a state/federal partnership, oversees management of coastal species that migrate up and down the eastern seaboard. It regulates river herring fisheries in the fifteen Atlantic coast states. The Commission prohibits commercial and recreational harvest unless a state has a "River Herring Sustainable Management Plan" that has been reviewed and approved by the Commission.

Maine is one of five states that have an approved plan (the others are New Hampshire, New York, North Carolina, and South Carolina). Offshore commercial fisheries, such as for Atlantic herring, that catch river herring as bycatch are managed by the National Marine Fisheries Service and regional fisheries management councils.

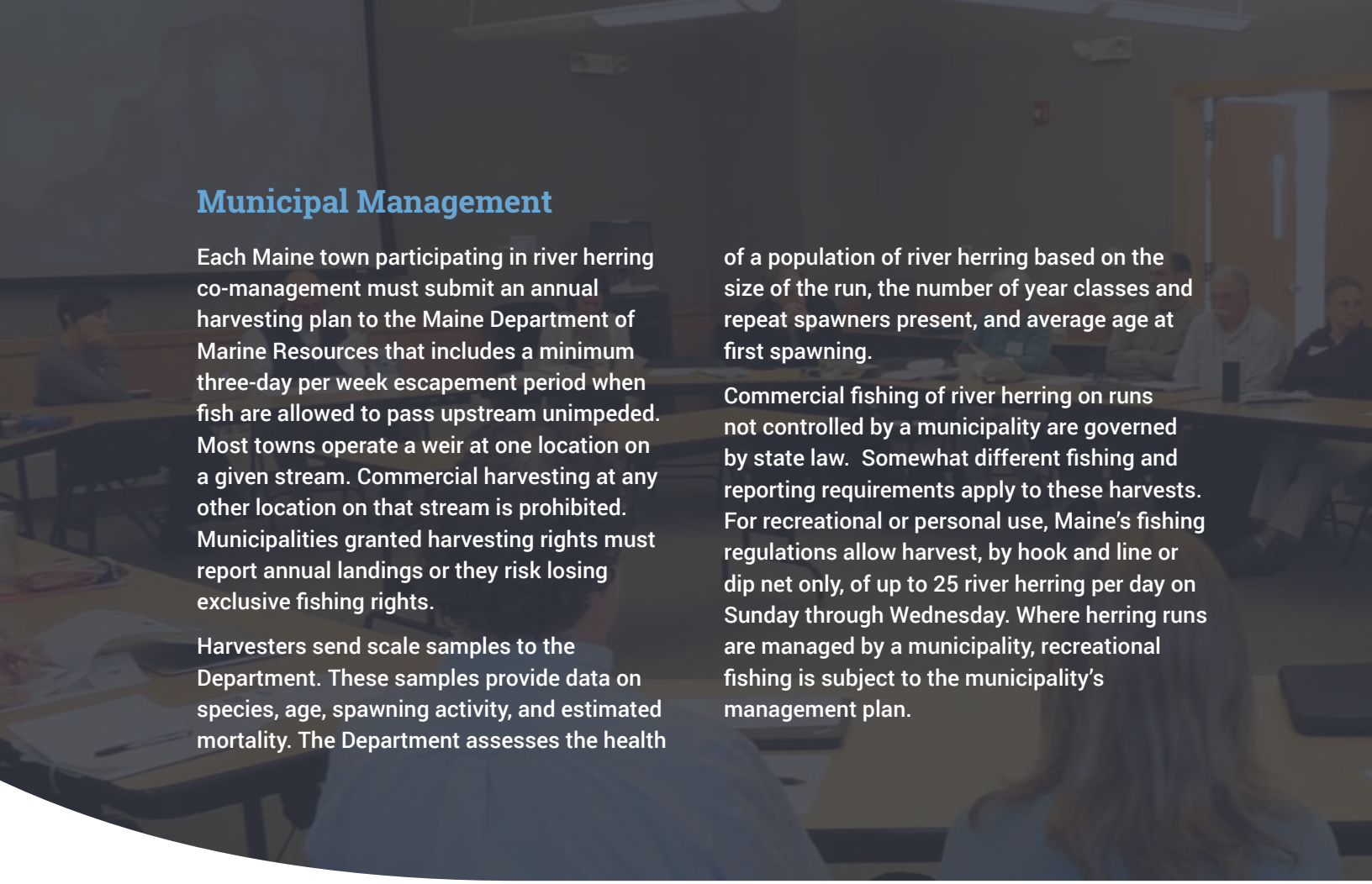
The Maine Department of Marine Resources is responsible for implementing Maine's River Herring Sustainable Management Plan, which is reviewed and approved by the Atlantic States Marine Fisheries Commission every five years.

State law in Maine provides for local management of commercial river herring fisheries. Municipalities benefit from such arrangements by leasing exclusive fishing rights to a harvester and collecting a share of the value of the harvest. Municipalities that wish to manage their local river herring fisheries must meet standards established by Maine's River Herring Sustainable Management Plan.

The Maine Department of Marine Resources tracks river herring harvest data, such as landings and population age structure. It works with municipalities that manage local river herring commercial fisheries to ensure that such fisheries are managed sustainably. It supports restoration activities and the establishment of new (or restored) commercial fisheries.

This arrangement, where the Maine Department of Marine Resources and a municipality work together to manage river herring, is effective because it combines the local knowledge of fishermen with the state's scientific expertise and statewide overview. This type of partnership is known as co-management. It is recognized as a key component of sustainably managed fisheries. Maine's lobster and clam fisheries are also co-managed.

For those wishing to restore a river herring run for the purpose of commercial harvest, data must be collected for several years, particularly fish counts and scales (to determine age). The purpose is to allow the Maine Department of Marine Resources to assess whether sustainable numbers of fish and a population with a healthy age structure have been established before a commercial harvest is initiated.



Municipal Management

Each Maine town participating in river herring co-management must submit an annual harvesting plan to the Maine Department of Marine Resources that includes a minimum three-day per week escapement period when fish are allowed to pass upstream unimpeded. Most towns operate a weir at one location on a given stream. Commercial harvesting at any other location on that stream is prohibited. Municipalities granted harvesting rights must report annual landings or they risk losing exclusive fishing rights.

Harvesters send scale samples to the Department. These samples provide data on species, age, spawning activity, and estimated mortality. The Department assesses the health of a population of river herring based on the size of the run, the number of year classes and repeat spawners present, and average age at first spawning.

Commercial fishing of river herring on runs not controlled by a municipality are governed by state law. Somewhat different fishing and reporting requirements apply to these harvests. For recreational or personal use, Maine's fishing regulations allow harvest, by hook and line or dip net only, of up to 25 river herring per day on Sunday through Wednesday. Where herring runs are managed by a municipality, recreational fishing is subject to the municipality's management plan.

Specific policies regarding data collection requirements for river herring restoration are currently under review. The Alewife Harvesters of Maine, Maine Center for Coastal Fisheries, and the Downeast Salmon Federation are working closely with the Maine Department of Marine Resources to promote policies that allow fishermen to both harvest river herring and contribute to river herring restoration.

> "The types of observations fishermen make provide us with invaluable information. They don't see at the microscopic or global scales, they see at the local scale."
>
> ROBIN ALDEN, FORMER EXECUTIVE DIRECTOR, MAINE CENTER FOR COASTAL FISHERIES

Status in 2018

The total river herring harvest in Maine in 2018 was 1,962,660 pounds, about 3.9 million fish. Slightly more than one third of this harvest occurred in eastern Maine.

River herring are currently commercially harvested at sites on ten rivers and streams between the Penobscot and the St. Croix.

Figure 1. River Herring Harvest Sites in Eastern Maine

RIVER HERRING HARVEST SITES IN EASTERN MAINE

- Orland River, Orland
- Union River, Ellsworth
- Grist Mill Stream and Card Mill Stream, Franklin
- Flanders Stream, Sullivan
- West Bay Pond, Gouldsboro
- Tunk Stream, Steuben
- Narraguagus River, Cherryfield
- East Machias River, East Machias
- Little River, Perry

At these sites, as per Maine Department of Marine Resources, the harvest in 2018 amounted to 714,627 pounds, about 1,434,500 fish. State regulations prevent the release of data that would reveal an individual fisherman's catch. Because river herring are generally harvested by one fisherman at each harvest site, catch data are aggregated by county before being made available by Maine Department of Marine Resources.

Darrell Young—Alewife Enthusiast

Among staff at the Downeast Salmon Federation, Darrell Young is known as "one of the rock stars." As Sarah Madronal, Downeast Salmon Federation Fisheries Biologist, puts it: "Darrell goes above and beyond. He's been very consistent gathering data for Card Mill Stream at Donnell Pond and at Grist Mill Stream. His river maintenance effort is very high, and he even gets involved doing advocacy work." Young is currently on the board of Alewife Harvesters of Maine and is also Co-Director of the Maine Elver Fishermen Association.

He is the alewife harvester for the Town of Franklin, for which he has exclusive rights. Young worked hard over several years to open up fish passage and re-establish commercial fishing on two streams in Franklin, Grist Mill Stream and Card Mill Stream. He has been harvesting alewives for 18 years. The harvest plan for Franklin requires that 100 bushels of river herring (approximately 12,000 fish) be allowed to pass upstream before the commercial harvest can begin. Young must count the fish passing upstream, record his harvest, collect scale samples, clear obstacles such as beaver dams, and monitor fishways to ensure they are working properly.

Young sees harvesters as key to the success of river herring conservation in Maine. If they can harvest, fishermen will put in the effort to sustain the runs. Like other harvesters, Young has noted the importance of keeping beaver dams under control, saying that he has seen alewives wedge themselves into these dams to the point of death.

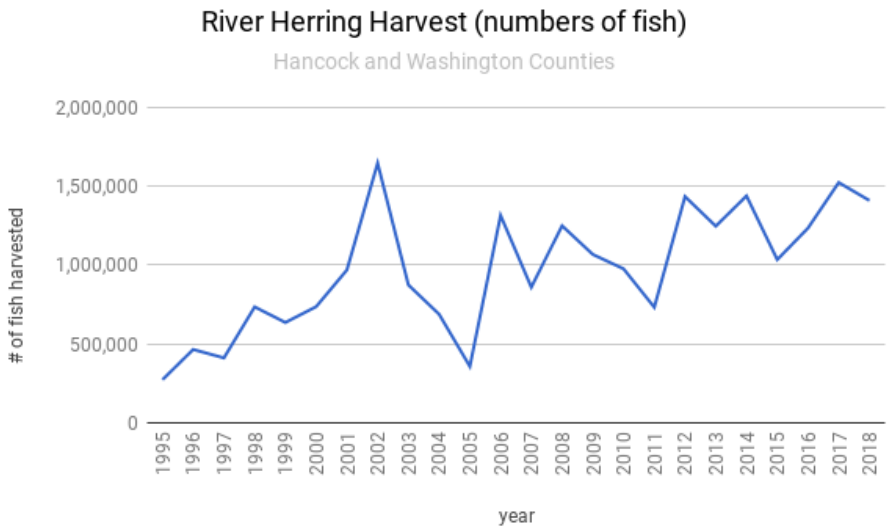
> "If they can't make it to the pond to spawn, they're not going to survive. With every brook that people are taking care of, the harvesters are building it up. We're doing it the right way now."

Table 1. 2018 Landings Data: *Source: Maine Department of Marine Resources, 2018*

LOCATION (STATE OR COUNTY)	POUNDS	FISH COUNT (APPROXIMATE)
Maine	1,962,660	3,925,300
Hancock & Washington	714,627	1,435,000
Hancock	357,673	718,000
Washington	356,954	717,000

Landings are trending upwards, but are quite variable. The source of the variability is unclear, but is likely due to both environmental factors and decision-making by harvesters that result in lower-than-potential harvests.

Maine Department of Marine Resources reports that river herring runs in eastern Maine exhibit higher age at first spawning, a good sign for the health of these runs.



"Eastern Maine is a place where we can demonstrate fisheries management success."

DWAYNE SHAW, EXECUTIVE DIRECTOR, DOWNEAST SALMON FEDERATION

Restoration Activities in Eastern Maine

The presence of river herring in eastern Maine is by no means limited to the streams and rivers identified in Figure 1. Several others are known to have runs and there are undoubtedly many other streams where river herring would migrate to upstream spawning habitat if not blocked by a dam, perched culvert, or broken down fishway.

Types of Fish Passage

Where dam removal is not feasible, installation of fishways allow fish to reach ponds and lakes. Fishways can be either manufactured or engineered to replicate natural conditions.

An example of an engineered, nature-like fishway is a **pool and weir system**. It uses a series of small dams and pools to gradually step down from the level of the pond to stream level. Simulating a natural stream, pool and weir systems are less expensive to install and maintain than manufactured fishways, but are best suited for replacing low height dams.

A baffle fishway on the Pennamaquan River.

THERE ARE SEVERAL TYPES OF MANUFACTURED FISHWAYS:

- **Bypass channels are built to mimic natural river channels. They include rocks and structures to hold shape over time and control drops and flows. An example outside this region is the Howland Dam Fish Bypass on the Penobscot River.**
- **Baffle fishways use symmetrical baffles to slow and redirect the flow of water within wooden, concrete, or metal channels. Baffles may be placed on the floor or walls of the channel, which may or may not have resting pools.**
- **Fish elevators or fish lifts are used to move fish over bigger dams. Fish are collected in a hopper that lifts them to the top of the dam. They pass through a flume as they enter the lake, where they can be counted.**
- **Trap-and-truck is a method of fish passage in which fish are captured and transferred to a tanker truck, which transports the fish upstream for release above the dam. The river herring run on the Union River is maintained through a trap and truck program.**
- **Stocking by hand is used to transport fish over an impassable barrier or from a nearby river when river herring are no longer present in a river system. Adding fish from nearby rivers can jumpstart renewal of river herring populations. Plans for stocking must be approved by Maine Department of Marine Resources before any stocking takes place.**

The river herring that swarm the rivers of eastern Maine today are a small fraction of the fish that once thronged these rivers every spring in the years before dams and roads proliferated. But these fish provide the foundation for rebuilding both ecosystem health and fisheries.

Comprehensive assessment of river herring across the region is required to get a handle on how many streams currently, or could potentially, support river herring migrations. The Downeast Salmon Federation, the Nature Conservancy, Alewife Harvesters of Maine, the Passamaquoddy Tribe at Sipayik, Maine Sea Grant, and other groups are collecting data on river herring abundance. More funding is required for comprehensive and long-term monitoring to ensure effective management and continued restoration.

Assessment of the restoration potential of rivers and streams in eastern Maine includes several factors. Are river herring present? Is passage blocked so that no fish move upstream? What are the interests and concerns of the local community and its residents? These may include fish passage, commercial fishing, flood control, head pond retention, fire suppression, and impact on upstream lakes and ponds. How is the community weighing competing uses? What resources can be brought to bear?

The factors that drive efforts to restore fish passage are also varied. In several cases, fishermen are leading the effort to bring back river herring runs. Their interest is in harvesting river herring and selling their catch. Some communities that currently benefit from commercial river herring harvests would like to expand those harvests by improving or replacing existing fishways.

Others are committed to restoring river herring runs for their ecological benefits and the opportunity to observe the spectacle of the annual migration. In still other cases, municipalities replacing failing culverts or bridges find that nature-like fishways are an economical alternative. Finally, the Federal Energy Regulatory Commission requires that hydroelectric dams address fish passage during relicensing.

While potential river herring production in eastern Maine can be difficult to estimate accurately, many opportunities for restoring river herring runs have been identified and much work has already been accomplished or is underway.

FISH MONITORING

- **Visual Counting:** Volunteers stand at a bottleneck in the stream and count the fish they see, keeping track with a handheld clicker device. Fish are counted for set periods of time and the total run is estimated by extrapolating the counts over the the duration of the run.
- **Electronic Fish Counting:** An apparatus made of electrified PVC tubes detects and counts fish as they pass through. The system requires maintenance to prevent pipes from clogging and to ensure proper operation. Electronic fish counting has been used on the Pennamaquan River.
- **Video Counting:** Video cameras record fish passing upstream. Volunteers count fish in timed segments of the video footage. Video cameras are in use on Patten Stream and at Pokey Dam on the East Machias.
- **Acoustic Tags:** Small acoustic tags are attached to river herring. The signals of the fish are picked up by special receivers that allow the fish to be tracked as they migrate upstream. Acoustic tags have been used to track river herring on the St. Croix River.

LEFT: Notch through which river herring must pass allows for visual counts.

RIGHT: An electronic fish counter on the Pennamaquan River.

Estimating potential productivity

Maine Department of Marine Resources estimates that a minimum of 235 adult alewives per acre of lake surface are required to ensure that the alewife population is sustainable. This figure is based upon a limited number of studies and doesn't take into account alewives that choose to spawn in the slow-moving parts of a river system. Research is needed that will help managers understand the impact of the local factors on alewife populations. Research is also needed to assess blueback herring populations, which only spawn in streams.

Downeast Fisheries Partnership calculated the potential carrying capacity of the alewife spawning habitat in the Narraguagus watershed. The amount of lake, pond, and slower moving river habitat was calculated using mapping software called ArcGIS and data from the US Geological Survey's National Hydrography Dataset and Maine Department of Marine Resources' Atlantic Salmon Habitat dataset. The analysis revealed that there is an estimated 4,114 acres of alewife spawning habitat (362 acres of surveyed flatwater and 3,752 lake acres) in the Narraguagus watershed. Using the figure of 235 alewives per acre of lake surface, alewife population potential is therefore approximately 970,000 fish. It appears that the Narraguagus river herring run, currently estimated to be about 300,000 fish, has room to grow!

Sunrise County Economic Council, Downeast Salmon Federation, and Washington County Council of Governments, based on lake acreage, that the commercial river herring harvests in Washington County are generated by only 6% of the potential habitat in the County.

Case Studies in river herring restoration

The following examples of fish restoration projects reflect all of these factors, and demonstrate a variety of challenges and opportunities. While not a comprehensive list, these efforts are representative of the types of river herring restoration projects in eastern Maine.

Bagaduce River

Bailey Bowden, a lifelong fisherman and resident of Penobscot, spearheaded the restoration of fish passage to Wight's and Pierce's Ponds in the Bagaduce River watershed. Bailey worked with Ciona Ulbrich of the Maine Coast Heritage Trust and Mike Thalhauser of the Maine Center for Coastal Fisheries on the design and construction of naturalized fish passage systems at the outlets of both ponds. The partnership included the National Oceanic and Atmospheric Administration and the Nature Conservancy, which contributed much of the funding. A step-pool system consisting of a series of stone weirs was used that replicates natural stream conditions and requires less maintenance than manufactured fishways. Each pond has a series of four weirs. Another benefit of using this design is that recreational fishing is allowed. Maine State law otherwise bars fishing within 150 feet of a manufactured fishway. Water levels in the ponds have not changed, allowing for continued boat access.

Boat access to both ponds will continue, with full use of the boat ramps. Pierce's Pond received additional amenities, including parking lot reconstruction to allow school buses for educational visits, wheel chair access, and a walking trail. The boat ramp has been replaced, a stone table and seating were added, and interpretive signage was installed that describes anadromous fish migrations, the Bagaduce watershed, and historic water powered mills.

Pierce's Pond

Bailey Bowden, Bagaduce River, Penobscot

Bowden's ancestors were among the first settlers of the Town of Penobscot.

Bowden is a lifelong resident of Penobscot, where he chairs both the Shellfish Conservation Committee and the Alewife Committee. He has fished recreationally and commercially in the Bagaduce River watershed since his childhood, and has been particularly active in the conservation of river herring and smelt, combating invasive species such as green crab, and restoring and enhancing clam flats. In 2016, his work was recognized with the Gulf of Maine Council on the Marine Environment "Longard Award," which honors volunteers for their commitment to environmental protection and sustainability within the Gulf of Maine.

According to Bowden, the main goal of the alewife committee is "to document that we have a sustainable fishery." He is working with the Maine Department of Marine Resources to re-establish municipal management of river herring in Penobscot. "Local control is better. We live here, so we know what's going on."

"When I first started doing this work, I was totally on my own," says Bowden. He attended a Downeast Fisheries Partnership river herring workshop in 2015. "I was completely blown away when I found out there were so many fish lovers out there who were as excited as me about this alewife work. It opened up a whole new world. I've come to realize that this work is all about partnerships. That's how we're going to get things done and it is really exciting."

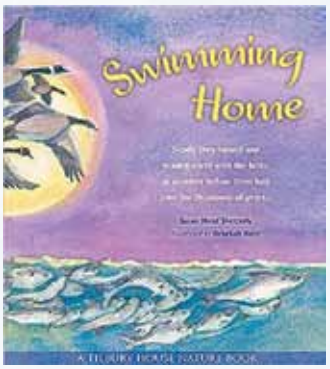
Alewives: Small Fish, Big Impact—a spring 2016 project of Island Readers & Writers in Washington County

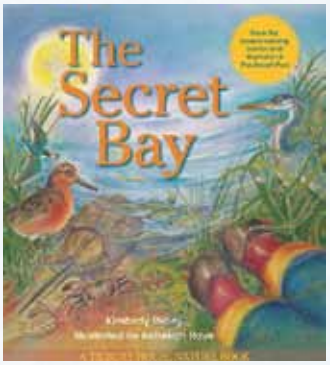
"The Island Readers and Writers made river herring the theme of our programming in the spring of 2016. We used Susan Shetterly's *Swimming Home*, about the trials and tribulations of an alewife swimming upstream with grades K-2 and Kim Ridley's *The Secret Bay* for grades 3-8; both books were illustrated by, Rebekah Raye. Students from schools in Beals, Jonesport, Whiting, Lubec, Edmunds, and Pembroke learned about how alewives are part of a food web that includes the smallest copepod and the grand osprey.

The Downeast Salmon Federation offered hands-on activities that made the books and the facts come alive and some students participated in research projects at the Downeast Institute.

These experiences exposed students to new ideas and will help them become more informed and engaged citizens. Many are from fishing families and can now make connections between what they have learned and what they see around them."

RUTH FELDMAN, FORMER PROGRAM DIRECTOR, ISLAND READERS & WRITERS





As part of Island Readers and Writers' community-wide program, "Alewives: Small Fish, Big Impact," Maine artist Rebekah Raye engaged students at Beatrice Rafferty Elementary School.

Patten Stream

After several years of effort, instigated by a commercial fisherman, the community of Surry rallied to create fish passage on Patten Stream. Footings poured during construction of a bridge back in the mid-20th century created a four-foot drop in the stream, completely blocking access for river herring to 1,200 acres of upstream spawning habitat. In 2009, a local group formed with the goal of finding a way to remove the impediment to fish passage. They understood the role of river herring as prey for groundfish and, with the decline in groundfishing, wanted to help put things to rights.

After attempts at building wooden fishways were unsuccessful, a community-led effort resulted in the construction of a rock weir fishway. Between 2009 to 2015, community members used a bucket brigade to hand-carry hundreds of thousands of fish over the falls to their spawning habitat. Their efforts helped jumpstart the move toward a more natural run installed in 2016. The Downeast Salmon Federation has worked with the town to monitor the fish run using a camera purchased by the town.

A local artist and writer, Susan Hand Shetterly, was inspired to write and illustrate a children's book, Swimming Home, to tell the story of the Patten Stream river herring renewal.

Union River

A coalition made up of non-governmental organizations and federal and state agencies is tackling a much larger fish passage effort in Ellsworth on the Union River. The Union River watershed is roughly 500 square miles and ranks second in size, in eastern Maine, after the St. Croix River watershed.

Archaeological evidence suggests that river herring were harvested on the Union early in the history of European settlement. Native Americans undoubtedly made use of river herring on this river for many preceding centuries. Efforts to protect river herring began in the early 1800s, but failed to prevent overharvesting and dam construction.

When the Ellsworth Dam and hydroelectric facility was built in 1907 (Graham Lake Dam followed around 1923), fish passage was not included. The Union River is the largest river in Maine that does not provide volitional fish passage—passage that is continuously available without trapping or transporting of fish.

A trap and truck program, where fish are captured below the dams, transported by truck, and released above the dams, began in 1974. This system, while far from optimal, has helped river herring maintain a foothold above the Ellsworth dams for the past forty years.

Currently, the hydroelectric facility's license, which includes both the Leonard Lake dam and the upstream dam at Graham Lake, is up for renewal at the Federal Energy Regulatory Commission. Proponents of improved fish passage, led by the Downeast Salmon Federation, are working with state and federal agencies to explore options for

increased passage of river herring, as well as safe passage both upstream and downstream for all other native migratory fish, including shad, eels, and endangered Atlantic salmon.

Downstream passage also poses problems for river herring and other sea run fish. The mortality of significant numbers of juvenile and adult river herring, adult eels, and endangered Atlantic salmon have been documented during downstream migration, mostly likely as a result of passing through the dam's turbines.

As staff at the Federal Energy Regulatory Commission and federal and state natural resource agencies review the application for renewal of the facility's license, they are assessing changes that will be needed to accommodate safe passage of migratory fish. Their initial findings, released in 2018, appear to fall short as major improvements in fish passage would not be required for nearly fifteen years.

Narraguagus River

The Narraguagus River supports an active river herring harvest on the river's mainstem. The harvest site is located at the ice control dam in the heart of Cherryfield, where the Narraguagus has supported a commercial river herring harvest in all but six of the last 45 years.

Efforts to expand fish passage on the Narraguagus River face a different set of issues. Flooding caused by ice jams inundated Cherryfield in several incidents in the late 1940s and 1950s. In an attempt to prevent a recurrence, an ice control dam was built by the Army Corps of Engineers in 1961 and a fishway was installed. The fishway may have been state of the art at the time it was built, but it provides limited fish passage compared to newer fishways. In addition, the dam itself has structural damage.

The Downeast Salmon Federation and Maine Coast Heritage Trust have raised funding for the Army Corps of Engineers to review options for replacing the ice control dam and managing ice buildup. Fish passage and harvest will be included in any changes to the structure.

East Machias River

The East Machias River enjoys an active harvest and a rich heritage related to river herring. The current harvest is limited to one tributary at Gardner Lake, but this river has the potential for a larger mainstem harvest like the Narraguagus River.

Two recently completed projects, at Pokey Dam and on Beaverdam Stream, have addressed longstanding hindrances to the upstream migration of river herring in the upper reaches of this river system. The failing fishway in Pokey Dam at the outlet of Crawford Lake has been replaced, opening access for river herring to over 4,500 acres of lake habitat. The project was led by the Downeast Salmon Federation and the Crawford-Pocomoonshine Watershed Association with support from the Atlantic Salmon Federation, the Maine Department of Marine Resources, Kennebec Valley Chapter and Greater Boston Chapters of Trout Unlimited, The Nature Conservancy, National Marine

Keeping East Machias Alive with "Bloaters"

Late at night, while the East Machias River is high with spring rains, a swirl of smoke can be seen coming from the roof of a little structure along the river bank. Nearly all of the citizens of East Machias are fast asleep--except for Bucket Davis. He's out adding sawdust to a smoldering fire that will turn silvery river herring into golden "bloaters," whole-fish river herring that have been cured by salting and smoking.

Bloaters on yellow paper, Van Gogh, 1889

For decades, Davis has been carrying on the spring rite of turning the bounty of river herring runs into smoked fish that fill the freezers of his neighbors in East Machias. As a selectman he works to maintain the town's commercial harvest at Gardner Lake. His passion for smoking fish is contagious and he shares his art willingly with students from the local middle and high school. The town river herring program has a new provision allowing Davis and his student helpers to harvest a small number of alewives in downtown East Machias--bringing fish straight from the river to the doors of his smokehouse.

Davis is not only teaching these students how to harvest and preserve alewives but and is engaging them in the monitoring and management of their local fishery.

Bucket Davis of East Machias teaching students how to harvest and preserve river herring.

"The Emperor Charles V is said to have erected a statue to the inventor of bloaters."

GEORGE ORWELL, *THE ROAD TO WIGAN PIER*, 1937

Fisheries Service, and United States Fish and Wildlife Service. This portion of the East Machias River, which had been almost entirely blocked, has the potential to support a river herring run of over a million fish and now provides access to brook trout and Atlantic salmon in addition to river herring. Since the fishway's reconstruction in 2015, Downeast Salmon Federation has monitored the river herring migration through the fishway with a solar powered underwater video camera. The data will help the town of East Machias and the state of Maine determine harvest potential from the river. The monitoring has documented over 300,000 fish reaching the lake annually, including a large percentage of blueback herring.

Pokey Dam in 2012 and in 2014

Fish passage on Beaverdam Stream in Wesley had been blocked by two impassable culverts and a road crossing. So-called hanging—or perched—culverts, set well above the water level of a stream, are a serious barrier for migrating fish.

After years of work with landowners, community members, and funders, Downeast Salmon Federation completed removal of the culverts and road crossing in September of 2018.

Shortly after restoration of the stream bed was completed, juvenile Atlantic salmon were stocked into the new habitat, illustrating the benefits of river herring restoration for other sea-run species.

Orange River

River herring have no access to their spawning grounds in the upper reaches of the Orange River watershed. The Rocky Lake Dam, the Lubec Water and Electric Light Dam and the Whiting Corner Dam all block fish passage. Despite this long-term lack of access, using underwater photography, river herring have been observed schooling at the base of the Whiting Corner Dam. It is unclear whether these fish are strays from other river systems or the result of spawning that occurs below the dam. Recent feasibility studies considered several options for addressing issues at each dam. They range from dam removal to dam repair and construction of fish passage, which could be either "nature-like" fish passage in which a stream bed is constructed that mimics riverine habitat or a manufactured solution such as a fish ladder.

The Whiting Corner Dam is the most challenging obstacle to fish passage. It is the highest of the three dams and is closest to the outlet of the Orange River into Cobscook Bay. A fishway in the dam at Whiting that once provided fish passage deteriorated several decades ago. Although the mill powered by the dam is long gone, the dam holds back a head pond in the center of Whiting. The pond, created when the river was dammed in 1830, is a defining feature of Whiting Corner and highly valued by the community. It is also a source of water for fighting fires in the region, an issue of concern for many residents who remember the serious fire that occurred in Whiting in the 1980s. Restoration of the Orange River and its native sea run fish, will require balancing the interest in maintaining the Whiting pond and the goal of restoring river herring to the watershed.

Pennamaquan River

The Pennamaquan River in Pembroke, Maine, lies in the heart of the ancestral Passamaquoddy homeland. The Pennamaquan River has four fishways intended to help the river herring reach their spawning grounds. In 1975, the Town of Pembroke recorded a commercial harvest of 168,000 lbs of river herring. However, the fishways have deteriorated (the newest was built in 1958), greatly restricting the annual fish migration. Repairs have been made, but an engineering study is needed in order to fully evaluate the efficiency of the fishways and identify necessary repairs. The Downeast Salmon Federation has received funding to replace the lower—and least functional—fish ladder.

In the meantime, much effort, led by Maine Sea Grant, is going into monitoring the run. During the six-week migration period, dedicated community volunteers conduct three counts per day, rain or shine, for thirty minutes at a time. Electronic monitoring has also been conducted by Maine Department of Marine Fisheries and Downeast Salmon Federation. Other organizations participating in the monitoring effort include the Passamaquoddy Tribe at Sipayik and the Town of Pembroke.

Since 2012, and on behalf of the Town of Pembroke, Maine Sea Grant staff have been collecting weekly biological data and fish scales, which are submitted to Maine Department of Marine Resources. Monitoring of the run began in 2014, and while it's difficult to make firm conclusions yet, the number of river herring passing upstream,

while variable, appears to be increasing. This apparent increase could be the result of recent fishway repairs or changes in river flow and other natural causes that affect the size of the run from year to year.

Upstream view of a baffle fishway on the Pennamaquan River.

St. Croix River

The number of river herring migrating upstream on the St. Croix River, the border between the U.S. and Canada in eastern Maine, reached an all-time low of 900 fish in 2002. The run dramatically declined due to fishway closures at the dams on the main stem of the river. These closures began in 1987 and were the result of a misconception that juvenile river herring were causing a decline in juvenile smallmouth bass survival by competing for prey. This bass decline has since been attributed to lake drawdown practices that were occurring in the mid-1980s that affected bass nesting habitat. In 2013, the lower river was opened back up to fish migration, but much of the historic river herring habitat in the St. Croix remains inaccessible to migrating fish. With its extensive watershed, the St. Croix contains more than half of the lake and pond habitat off limits to river herring in eastern Maine. There is immense motivation on many sides to see abundant runs of river herring return once again to this great river.

In the Penobscot River, dam removals and fish passage improvements are contributing to the re-establishment of a large river herring population; river herring runs, negligible in 2012, reached nearly 2 million fish in 2017. The hope is that the same scale of results can be achieved in the St. Croix River, where in the early 1980s the river herring run reached 2.5 million fish.

In June 2017, it was reported that the St. Croix River saw the passage of more than 150,000 river herring, the highest number in almost 20 years. These fish likely hatched in the river four years earlier, progeny of the fish that entered the fishway when it was first re-opened in 2013. There are indications that the numbers of shad may also be increasing.

Edward Bassett – The Fish That Feeds All

Eddie Bassett is an environmental specialist with the Passamaquoddy Tribe, also known as Sipayik. He is an alewife harvester and a member of the Schoodic River Keepers. Bassett was active in efforts to re-open fish passage on the St. Croix River in 2013 and has collaborated with the Atlantic States Marine Fisheries Commission Technical Expert Working Group.

The St. Croix River, known as the Schoodic River by the Passamaquoddy, "has traditionally been able to produce millions because the headwaters are very productive alewife spawning areas," says Bassett. "We're hoping that we can bring the population up so that the fish can recover. I think we'll be able to. I think it's going to work."

Bassett has documented the cultural importance of river herring to East Coast Native American tribes and First Nations in Canada, noting that the staggering abundance of river herring, pollock, and other fish was the reason for the Passamaquoddy settling in their homeland.

Bassett says that his work is focused on helping the fish survive. "My work that I'm doing with alewives and river restoration is to make sure that the environment is capable of holding those resources for future generations to be able to access and survive off of. That is really central to our continued survival, culturally, spiritually and physically. I think it's noble and worthy work to try to help ecosystems recover wherever they are."

"Whatever we see in front of us, if it's not as productive as it used to be, try to help in your own little way to make it productive."

Research is now underway to test the effectiveness of the re-opened fishways, many more than 50 years old. To address these questions, several studies are being conducted by a wide range of agencies and participating organizations, including the Atlantic Salmon Federation, the Passamaquoddy Tribe at Sipayik, University of Maine, Maine Department of Marine Resources, the US Fish and Wildlife Service, the National Oceanic and Atmospheric Administration, the International Joint Commission, and Fisheries and Ocean Canada. They include tagging studies to assess the ability of fish to find and use the fishways and nutrient exchange studies exploring how nutrients are added to freshwaters by in-migrating adult alewives and removed by out-migrating juveniles.

According to the St. Croix International Waterway Commission, which counts migrating river herring in a trap at the Milltown Dam, at head of tide on the St. Croix between Calais, ME, and St. Stephen, NB, abundance is increasing, from 26,798 fish in 2014 to 270,659 fish in 2018.

River herring research on the St. Croix River.

Looking Ahead

Imagine a healthy ecosystem, from the upper reaches of the watersheds that feed eastern Maine's coastal rivers and streams to the spawning grounds of cod and haddock just offshore, from the Penobscot River to the ancestral homeland of the Passamaquoddy.

Restoration will not bring back the river herring populations that supported Native Americans for millenia or that European explorers found. But there is enormous

opportunity to dramatically increase the abundance of fish in eastern Maine's rivers, streams, and coastal waters. In turn, having more fish in these systems will restore nutrient cycles, support wildlife, drive coastal food webs, and sustain recreational, sustenance, and commercial fishing. This is where we're headed and much of the work has already begun. Research, monitoring or restoration is underway on over twenty rivers and streams in eastern Maine.

Commercial harvests will follow and provide a source of locally caught seafood for residents. Just as important, getting fish passage right will increase revenues for municipalities, reduce maintenance costs, and make our communities more resilient to the effects of climate change already evident in the region. The Sunrise County Economic Council, Downeast Salmon Federation, and Washington County Council of Governments recently estimated that river restoration in Washington County has the potential to increase the value of the river herring bait fishery by fifteen times! Development of a gourmet food market for river herring would contribute significantly more value.

Restoring fish passage happens one river or stream at a time—each is unique in terms of its physical characteristics, ecological properties, history of human uses and impacts, and value to the communities through which it runs. Local communities have an important role to play in restoration. They are often defined by their waterways. Residents know them well and have much at stake in developing consensus on potential restoration activities.

Taken together, restoration projects conducted stream by stream will generate a collective benefit to the region as ecosystem productivity increases, and as the region's reputation grows for commercial river herring harvests, recreational fishing, nature-based tourism, and fresh, high quality seafood.

Here's what you can do to help:

- Is fish passage being discussed in your community? Attend meetings, read up on it, and get involved. Follow fish restoration activities in other communities.
- Volunteer to count fish during the spring run. Monitoring fish runs is critical for effective management.
- To help rebuild a run, help move fish over a perched culvert or failing ladder until fish passage is achieved.
- Join organizations committed to fish restoration to stay informed and support their work .
- Attend meetings where river herring management is the topic at municipal alewife management committees, Maine Department of Marine Resources, the Legislature, or Atlantic States Marine Fisheries Commission.

Together, we can make a difference, not only for river herring in our own communities, but for ecosystem health and fisheries across the region.

Downeast Fisheries Partnership

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