Alewife

Alosa pseudoharengus

Photo by NHFG

Federal Listing	
State Listing	SC
Global Rank	G5
State Rank	S5
Regional Status	High

Justification (Reason for Concern in NH)

Alewife numbers have declined significantly throughout their range. Commercial landings of river herring, a collective term for alewives and blueback herring, have declined by 93% since 1985 (ASMFC 2009). Dams severely limit accessible anadromous fish spawning habitat, and alewives must use fish ladders for access to most spawning habitat in New Hampshire during spring spawning runs. River herring are a key component of freshwater, estuarine, and marine food webs (Bigelow and Schroeder 1953). They are an important source of prey for many predators, and they contribute nutrients to freshwater ecosystems (Macavoy et al. 2000).

Distribution

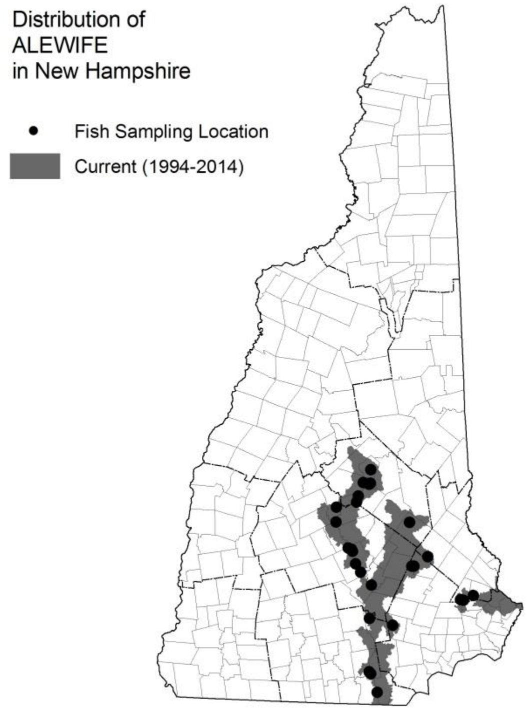
The alewife is found in Atlantic coastal rivers from Newfoundland to North Carolina. It has been introduced into a number of inland waterbodies (Scott and Crossman 1973). In New Hampshire, alewives migrate into the Merrimack River and the seacoast drainages (Scarola 1987).

Habitat

Adult alewives migrate from the ocean into freshwater spawning habitats with slow moving water, including riverine oxbows, lakes, ponds, and mid-river sites (Scott and Crossman 1973). Juveniles remain in freshwater until late summer and early fall when they migrate downstream into estuaries and eventually to the ocean. There is little information available on alewife movement and habitat use in the ocean.

NH Wildlife Action Plan Habitats

- Large Warmwater Rivers
- Warmwater Lakes and Ponds
- Warmwater Rivers and Streams



Distribution Map

Current Species and Habitat Condition in New Hampshire

Coastal Watersheds:
Alewife populations in the coastal watersheds are generally stable or increasing in recent years at fish ladders where river herring and other diadromous species have been monitored since 1979. However, alewife numbers in all rivers are still well below their potential. Populations have not yet responded to recent increases in available habitat due to dam removals or fish passage improvements.

Salmon Falls River: The Salmon Falls River supports a mixed run of both alewives and blueback herring. The run is monitored at a fish ladder maintained by staff with the hydroelectric company that owns the South Berwick Dam, at the head of tide. The fish ladder is in Maine, but it is monitored once every 3 to 5 years by staff from the Marine Division of the NHFG. Counts typically range between 10,000 and 15,000 river herring per year. Length, weight, and age data are not available.

Cocheco River: In the last three years, river herring returns have been slightly below the long term average of about 30,000 fish per year. Both alewives and blueback herring occur in the Cocheco River. The relative abundance of each species is highly variable, but alewives generally outnumber blueback herring, which return later in the spring.

Bellamy River: River herring have been observed in the river since the removal of a timber crib dam at the head of tide in 2004. There are currently no population estimates available.

Oyster River: The Oyster River herring run is primarily composed of blueback herring, but an increasing number of alewives have been observed at the fish ladder in recent years.

Lamprey River: The Lamprey River contains the most abundant alewife population in coastal New Hampshire. Alewife counts at the fish ladder over the last three years (2012 – 2014) have ranged between 79,000 and 86,000 fish per year. This is more than double the long term average. Recent improvements in fish passage, including a fish ladder constructed at the next upstream dam and a dam removal in Epping, should greatly expand the quality and quantity of spawning habitat available to alewives in the Lamprey River. However, there are some concerns that the fish ladder has reached its capacity, and may limit the total number of alewives that can enter the river.

Exeter River: The river herring count at the Exeter River has only exceeded 1,000 fish once since 2001. The fish ladder does not appear to be effectively passing the large number of river herring that are frequently observed downstream, near the head of tide. Plans to remove the Great Works Dam have the potential to greatly improve access to spawning habitat up river. Monitoring the number of river herring that return to the Exeter River will require new sampling methods without a fish ladder.

Winnicut River: River herring numbers ranged between 5,000 and 10,000 fish per year before the Winnicut Dam and fishway were removed in 2009. Unfortunately, a fish ladder installed beneath the Route 33 bridge to help ensure passage was poorly designed and has created a velocity barrier for migrating fish. Efforts are currently under way to modify the structure to restore fish passage into the Winnicut River.

Taylor River: The river herring run in the Taylor River was primarily composed of blueback herring. The run has been essentially extirpated, with less than 100 fish counted at the ladder in recent years. Contributing factors include poor water quality in the impoundment upstream and issues with the fish ladder. Due to leaks in the dam, which has fallen into disrepair, it is difficult to maintain water in the fish ladder without draining the impoundment. Fish passage will not likely improve until the dam is either removed or repaired.

Other coastal rivers and tributaries: There are anecdotal reports of herring runs in some of the smaller rivers and streams that flow into Great Bay or coastal NH. There are no data to confirm these reports or provide population estimates.

Merrimack River Watershed

Efforts to restore river herring (alewives and blueback herring) to the Merrimack River watershed began as early as 1830, with the construction of a fish ladder at the Amoskeag Dam in Manchester. Fish ladders were then built at the dams constructed in Lowell and Lawrence, MA sometime after 1847. Early records from the New Hampshire Fish and Game Commission in 1879 and 1882 show a strong alewife run at the fish ladder on the Essex Dam in Lawrence, MA . Precolonial alewife runs in the Merrimack River likely numbered in the millions. Fish passage was not consistently provided at the dams above Amoskeag, including the Hooksett Dam and the Garvins Falls Dam, which essentially extirpated the river herring population in the upper Merrimack River (Noon 2003).

Modern attempts to restore river herring, along with other diadromous species, began with new fishway construction at the first three dams on the lower Merrimack River mainstem. Trap and transport efforts to restore river herring to the Merrimack River began in the 1990's as a partnership between the United States Fish and Wildlife Service (USFWS), the New Hampshire Fish and Game Department (NHFG), and Massachusetts Division of Fisheries and Wildlife (MDFW). These agencies, in addition to the United States Forest Service (USFS) and National

Marine Fisheries Service (NMFS), are represented on the Merrimack River Policy Committee, an interstate cooperative which makes decisions related to diadromous fish resources in the Merrimack River.

Prior to 1990, alewives were stocked in Lake Winnisquam to provide forage for salmonids and export excess nutrients from effluent flowing into the lake in the early 1980's. An unintentional consequence of the stocking was a large increase in the Merrimack River alewife run after juvenile herring emigrated to the sea and attempted to return as adults. Five years after the first alewives were stocked in Lake Winnisquam, nearly 400,000 river herring returned to the Merrimack River.

Unfortunately, Fisheries managers were not prepared to deal with this number of fish and river herring were unable to access the majority of their historic spawning habitat. The temporary increase in river herring numbers masked the underlying problem of poor connectivity between marine and freshwater habitats. The last stocking of Lake Winnisquam occurred in 1990, and not long afterward the run declined. The average number of river herring counted at the Essex Dam in Lawrence after 1995 was less than 7,000 fish, compared to an average of over 100,000 returning alewives in the years prior to 1995.

After 1990, alewife trap and transport efforts shifted to smaller waterbodies in the Merrimack River watershed, including a number of stocking sites in the Contoocook, Suncook, and Nashua River drainages. These stocking efforts were limited in scale by a lack of fish available for transfer. Additional factors that may have limited alewife restoration include overharvest or bycatch issues in ocean fisheries, or predation from striped bass, which peaked in abundance in the 1990's during a period of significant decline in river herring returns (Grout 2006; Schultz et al. 2009).

Population Management Status

The New Hampshire Fish and Game Department is working to restore river herring to coastal rivers and the Merrimack River watershed. Fish ladders are monitored at the first dams on the major tributaries of Great Bay, including the Cocheco, Oyster, Lamprey, and Exeter Rivers. However, much of the former spawning habitat of river herring remains inaccessible in New Hampshire. Dam removals are the best long term strategies for restoring river herring runs. Fish passage construction at dams is the next best option where removal is not possible. Fishways can be effective, but they must be constantly monitored and passage rates can vary significantly by species and flow rate. In some rivers, primarily the Lamprey and Cocheco Rivers, NHFG biologists have transferred alewives from fishways near the mouth of the river to inaccessible spawning habitat upstream to help increase the population size.

The New Hampshire Fish and Game Department is working with partners like the U. S. Fish and Wildlife Service and the Massachusetts Fish and Wildlife Division to restore river herring numbers in the Merrimack River. In 2012, NHFG and USFWS resumed alewife transfers to a number of stocking sites, including Lake Winnisquam, throughout the Merrimack River watershed as part of a three phase river herring restoration plan for the Merrimack River (MRTC 2014). The plan was modelled after the successful river herring restoration efforts by the Maine Department of Marine Resources in the Kennebec River watershed, which now supports a river herring run of over 2,000,000 fish annually (MDMR 2009).

Regulatory Protection (for explanations, see Appendix I)

- Anadromous Fish Conservation Act
- Harvest permit - season/take regulations

Quality of Habitat

Coastal Watersheds

The amount of spawning habitat available to alewives in the coastal watersheds has increased since 2005. The greatest restoration benefit came from fish passage improvements in the Lamprey River. Despite this increase in habitat available to river herring in the coastal drainages, the majority of spawning habitat is still blocked by dams. Estimates of accessible spawning habitat, here measured in river km, are intended to provide a rough idea of current versus potential habitat availability. Actual spawning runs may be limited by unforeseen barriers such as small waterfalls or the ruins of old dams. Mapping the actual extent of restored spawning runs and documenting important spawning areas within rivers will be important to refining restoration goals. The following is a summary of accessible habitat status by river:

Lamprey River: Fish ladder construction at the Wiswall Dam improved access and the removal of the Bunker Pond Dam opened up a potential 75 km of the Lamprey River watershed to migrating alewives. A recent telemetry study by biologists with the Marine Division of NHFG has shown that alewife upstream movement is currently blocked by the ruins of a dam, known as Wadleigh Falls. It is hoped that some minor modifications of the stream channel will improve fish passage at the site.

Winnicut River: The Winnicut River Dam removal and fish ladder construction has the potential to improve access for spawning river herring, but it needs some modifications. Fish passage engineers with the USFWS have identified a velocity barrier caused by the design of the fish ladder that was installed to ensure fish passage underneath the bridge, which is located just upstream from the dam removal site. Minor adjustments to this fish ladder should restore access to approximately 6 km of potential spawning habitat.

Exeter River: The Great Works Dam at the head of tide in Exeter has been proposed for removal. This would greatly improve alewife passage into the river. Fish passage is currently limited to less than 1,000 fish per year by a poorly functioning fish ladder. The Exeter River has approximately 19 km of potential alewife spawning habitat. There is a fish ladder at the Pickpocket Dam, which is approximately 10 river km from the head of tide. Not much is known about the efficiency of this ladder due to the small number of fish that have historically reached the Pickpocket Dam.

Cocheco River: The first two dams on the Cocheco River contain active hydropower facilities. A relatively long fish ladder at the Central Ave Dam provides fish passage over the dam and the ledges on which the dam was constructed. This fishway provides access to approximately 5 km of potential river herring spawning habitat. The next upstream dam, the Watson Dam, is the upstream limit for fish passage in the Cocheco River. There is some question about the ability of river herring to ascend the steep ledges, known as Factory Falls, downstream of the Watson Dam. If it can be proven that river herring reach the Watson Dam, then upstream fish passage would be negotiated through the FERC hydropower licensing process. Downstream fish passage for juvenile river herring is required at the Central Ave Dam, but there is little information on juvenile herring survival during the downstream migration period.

Oyster River: The Oyster River has historically been considered a primarily blueback herring run, but an increasing number of alewives have been noted in the fish ladder at the head of tide. The impoundment upstream of the dam is suitable spawning habitat for alewives, but low dissolved oxygen levels in the summer may inhibit juvenile survival. The total length of accessible river habitat is relatively short, at less than 4 km.

Bellamy River: The removal of a small timber crib dam at the head of tide provided access to a small amount of freshwater river habitat (less than 1 km). Anecdotal reports suggest that there is a river herring run in the river, but the abundance of the run and the relative composition of alewives vs. blueback herring is unknown. Proposed dam removals on the next two upstream dams (upper and lower Sawyers Mill Dams) would provide access to over 6 km of potential alewife spawning habitat.

Salmon Falls River: There are approximately 1.5 river km of potential spawning habitat upstream of the fish ladder at the South Berwick Dam. Fish passage is not provided at the next upstream dam, which is owned by the town of Rollinsford.

Coastal tributaries:
The extent of suitable spawning habitat in the small rivers and streams that drain into the Great Bay and the seacoast is unknown. Without fishways, these streams are difficult to monitor. Some streams, such as Fresh Creek in Rollinsford, may have great restoration potential. Replacing an elevated stream crossing at the head of tide, on Fresh Creek, would both restore salt marsh habitat and provide access for diadromous species, possibly including searun brook trout, to over 5 km of freshwater habitat.

Merrimack River Watershed
The ultimate success of river herring restoration in the New Hampshire portion of the Merrimack River watershed will depend on improvements in fish passage that will allow river herring to reach as much suitable spawning habitat as possible. Fish passage is currently available at the first three dams on the mainstem of the Merrimack River and at the first two dams on the Nashua River. The long term goal of a self-sustaining river herring population in the Merrimack River will depend largely on the efficiency of these existing fishways and on the construction of new fishways at dams throughout the upper Merrimack River watershed, including tributaries like the Suncook River, the Soucook River, and the Contoocook River. At least 6,877 acres of potential alewife spawning habitat in lakes and ponds has been identified where fish passage construction may be feasible in the Merrimack River watershed (NHFG unpublished data).

Habitat Protection Status

N/A

Habitat Management Status

Fishways must be monitored to ensure efficient passage. Seemingly minor adjustments in flow through a fish passage facility can make a big difference in its performance. Attraction flow and water velocity through the fishway can fluctuate significantly with changes in water level at a dam.

Dams must also be monitored for downstream passage in the fall when juvenile river herring are migrating to the ocean. Dam removals are the preferred solution in most cases, because river herring are able to move freely upstream and downstream, while fishways have a relatively narrow range of flows where passage is optimal. There are currently 10 fishways in NH that require some level of maintenance and monitoring for river herring. The coastal fishways are monitored by NHFG staff. The Merrimack River dams are monitored by a combination of hydroelectric company staff and biologists from the USFWS and NHFG.

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Disturbance from dams that block species from spawning areas or other important habitat (Threat Rank: High)

Dams block access to freshwater spawning habitat.

Dams have greatly reduced the amount of freshwater habitat available to alewives and other diadromous species (Limburg and Waldman 2009).

Mortality resulting from over-harvest related to commercial fishing bycatch (Threat Rank: Medium)

River herring are unintentionally harvested in the commercial midwater trawl fishery for Atlantic herring and mackerel. River herring bycatch makes up a small proportion of total harvest, but it has the potential to severely deplete river herring spawning runs, especially in smaller river systems or populations under restoration.

Massachusetts Department of Marine Fisheries and the National Marine Fisheries Service monitor bycatch using fisheries observers and port sampling (Cieri 2008).

Mortality from hydropower turbines (Threat Rank: Medium)

River herring are killed as they pass through hydropower turbines.

River herring mortalities are observed each year downstream of the dams on the Winnipesauke River and the Merrimack River.

List of Lower Ranking Threats:

Mortality and disturbance (predator avoidance) from predation at fishways (striped bass)

Disturbance from dams causing delayed migration

Species impacts from changes in timing of migration and flooding that decrease spawning success

Actions to benefit this Species or Habitat in NH

Population assessment

Objective:
Assess the current and potential productivity of diadromous fish species in New Hampshire waters.

General Strategy:
Setting restoration goals for diadromous fish species is difficult without realistic targets for population recovery. Developing population models based on fecundity, extent and quality of habitat, and sources of mortality would help estimate the potential abundance of diadromous fish species under different

management scenarios. This information would be useful to fisheries managers as they set stocking targets or prioritize restoration work. Understanding the potential abundance of diadromous fish populations would more clearly define successful restoration and put current population levels in perspective.

Political Location: **Watershed Location:**

Reduce bycatch

Primary Threat Addressed: Mortality resulting from over-harvest related to commercial fishing bycatch

Specific Threat (IUCN Threat Levels): Biological resource use / Fishing & harvesting aquatic resources / Unintentional effects (species being assessed is not the target)

Objective:
Reduce the number of river herring caught unintentionally in the commercial Atlantic herring and mackeral fishery.

General Strategy:
The Massachusetts Department of Marine Resources (DMR) and the National Marine Fisheries Service (NMFS) coordinate Fisheries Observer and Port Sampling bycatch monitoring programs. There is also a volunteer bycatch avoidance program operated in real time by Mass DMR based on bycatch reports from vessels at sea. Seasonal area closures and catch quotas have also been used to reduce impacts related to the commercial fishery. State and federal agencies should support efforts to improve bycatch data collection and avoidance. NHFG should investigate the necessity and feasibility of increased port sampling for river herring bycatch at New Hampshire landing areas.

Political Location: **Watershed Location:**

Improve fish passage at dams.

Primary Threat Addressed: Disturbance from dams that block species from spawning areas or other important habitat

Specific Threat (IUCN Threat Levels): Natural system modifications / Dams & water management/use / Dams (size unknown)

Objective:
Construct, maintain, and monitor fishways at dams that currently limit access to suitable freshwater habitat for diadromous fish.

General Strategy:
At sites where dam removal is not an option, fish passage construction can improve connectivity between freshwater and marine habitats. Fish passage construction may be negotiated during the Federal Energy Regulatory Commission (FERC) dam relicensing process. Fish passage engineers with the USFWS are available to assist with designing the appropriate fishway for a particular site, depending on the needs of the species and the size of the dam (among other factors). At some sites outside of FERC jurisdiction, funding may have to come from other sources. Once installed, there should be a plan for fish passage operation, maintenance, and monitoring. Identifying the party

responsible for each aspect of fishway operation is critical for maintaining effective passage over the long term. Periodic performance evaluations should also be completed at each fishway to ensure that fish are moving efficiently through the project without excessive delays.

Political Location: **Watershed Location:**

Map spawning habitat

Objective:
Map the spawning habitat used by anadromous fish in the Merrimack River and Coastal watersheds.

General Strategy:
While spawning adults are counted each spring in many New Hampshire Rivers, the exact location of actual spawning areas has yet to be mapped. The extent of suitable spawning habitat for alewives, blueback herring, and American shad is not well known. This research would likely involve the use of radio telemetry and visual surveys during the spawning season.

Political Location: **Watershed Location:**

Marine research

Objective:
Investigate the factors that influence river herring abundance and survival at sea.

General Strategy:
A number of factors, including bycatch in commercial fisheries, changes in the marine food webs, and striped bass predation, have been blamed for the dramatic declines in river herring populations, but more information is needed on the relative importance of the factors limiting river herring survival at sea. A better understanding of potential marine productivity would be useful in setting restoration goals for spawning rivers.

Political Location: **Watershed Location:**

Monitor fish passage

Objective:
Monitor upstream and downstream passage at dams.

General Strategy:
Monitor river herring passage at dams with trained staff, video equipment or periodic sampling. Assess the efficiency of upstream and downstream passage facilities. Make recommendations for improving existing or proposed fish passage structures.

Political Location: **Watershed Location:**

Dam removal

Primary Threat Addressed: Disturbance from dams that block species from spawning areas or other important habitat

Specific Threat (IUCN Threat Levels): Natural system modifications / Dams & water management/use / Dams (size unknown)

Objective:
Remove barriers to migration.

General Strategy:
When the opportunity presents itself, dam removals provide the best long term solution to reconnecting diadromous fish with their historical freshwater spawning habitat. Dam removal projects are challenging and they often stall without a dedicated project manager. Hiring and training staff to identify and facilitate dam removal projects will increase the number of projects that can be completed each year. Creating priority lists of dam removal projects for each species would also help focus resources on the projects with the most benefit as well as help generate funding.

Political Location: **Watershed Location:**

Fish transfers

Primary Threat Addressed: Disturbance from dams that block species from spawning areas or other important habitat

Specific Threat (IUCN Threat Levels): Natural system modifications / Dams & water management/use / Dams (size unknown)

Objective:
Transfer diadromous fish species into suitable freshwater habitat that is currently inaccessible due to dams or other manmade barriers.

General Strategy:
In some cases it may be appropriate to move diadromous fish into habitat that is currently inaccessible. Improving access to quality spawning habitat may increase the spawning population within a river system. In many cases, a certain number of returning fish will trigger fish passage at a dam where a fish passage prescription has been negotiated through the FERC dam relicensing process. In other cases, congregations of diadromous species downstream from a dam may demonstrate a clear need for fish passage at the site. Sources of fish transfers should come from within basin whenever possible, but in river reaches where diadromous fish species have been extirpated, fish may need to be transferred from neighboring watersheds. The risk of introducing diseases or invasive organisms should be considered when transfering fish from out of basin. Some level of testing may be required.

Political Location: **Watershed Location:**

References, Data Sources and Authors

Data Sources

Literature reviews and historical records of fish passage at dams in New Hampshire and Massachusetts were used to identify distribution and habitat requirements. River herring management plans, fishway counts, and stocking records.

Data Quality

River herring numbers are monitored annually at fishways on the Connecticut, Merrimack, and coastal rivers. The current distribution of river herring in New Hampshire is well documented. Accounts of historical distribution vary, but early records suggest that many lakes and ponds in the Merrimack River and coastal watersheds supported abundant alewife runs (Noon 2003)
Adult river herring annual return counts are estimates, but reliable for monitoring population trends. The quality of the data varies by site. Limited length, age, sex, and weight data are available for coastal rivers. Increased subsampling of the river herring population will be conducted by the Massachusetts Department of Marine Fisheries for the Merrimack River. Passage efficiency and upstream movement studies (pit tag and telemetry) have been conducted on the Lamprey River. Other than the Lamprey River, passage efficiency has not been recently studied on most fishways.

Downstream passage mortality has been monitored and route selection studies have been conducted for some dams in the Merrimack River watershed, but sample sizes were low. There is little known about juvenile production potential in different waterbodies, factors that influence survival at sea, and population structure and upstream/downstream passage efficiency in the Merrimack River.

2015 Authors:

Matthew Carpenter, NHFG, Benjamin Nugent, NHFG

2005 Authors:

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