# Sea Lamprey

*Petromyzon marinus*

Federal Listing
State Listing SC Global Rank
State Rank S3
Regional Status


*Photo by John Lyons*

## Justification (Reason for Concern in NH)

Sea lampreys are blocked from much of their spawning habitat by dams. In New Hampshire they depend on functional fishways to reach suitable spawning habitat. Although Atlantic coastal populations are not currently considered threatened, there have been significant declines in lamprey populations throughout the northern hemisphere (Renaud 1997). A complex life cycle, which is dependent on multiple habitats in freshwater and marine ecosystems, makes the sea lamprey vulnerable to the effects of urbanization in coastal watersheds (Creel 2003). Sea lamprey may also be impacted by a decline in host species due to overfishing of marine fish stocks (Nislow and Kenard 2009).

## Distribution

The sea lamprey inhabits Atlantic coastal rivers throughout eastern North America and western Europe, as far south as the western Mediterranean Sea and the gulf coast of Florida (Scott and Crossman 1973). In New Hampshire, sea lampreys migrate into the Connecticut River, Merrimack River, and coastal rivers up to the first impassable barriers.

## Habitat

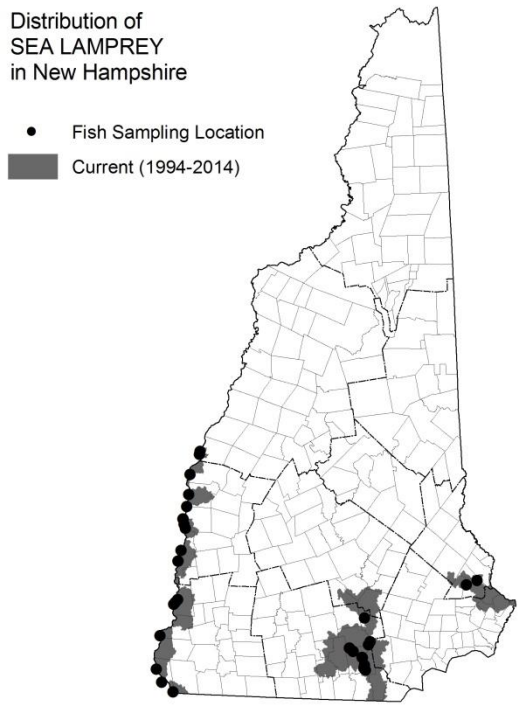
Sea lampreys spend their adult lives in the ocean as a parasite on other fish. After 20 to 30 months at sea they migrate into freshwater, following pheromones from larvae (ammocoetes) upstream (Vrieze and Sorenson 2001). Sea lampreys construct nests in gravel/cobble riffle sections of freshwater streams (Scarola 1987). Once hatched, the larvae float downstream to slow moving pools where they burrow into the substrate and filter feed on organic detritus drifting in the water column (Scarola 1987).

In freshwater, sea lampreys use river reaches with gravel substrate for spawning. Spawning habitat is similar to that used by salmon, occurring at the upstream end of riffles and the tail end of pools. Ammocoetes require fine silt and sand that is loose enough to burrow into, yet protected from washing away in higher flows. These areas often occur on the inside of river bends, along stream banks, and behind structures such as boulders or fallen trees.

Sea lamprey play an important ecological role in freshwater. Their nests improve spawning substrate for other fish species and create interstitial spaces between stones for macroinvertebrates (Kircheis 2004). Sea lamprey ammocoetes are filter feeders, which, in large numbers, may trap nutrients and improve water quality. Adult sea lampreys die after spawning and their carcasses release marine derived nutrients into freshwater rivers (Nislow and Kynard 2009).

## NH Wildlife Action Plan Habitats

- Large Warmwater Rivers
- Warmwater Rivers and Streams
- Coldwater Rivers and Streams
- Estuarine
- Marine




**Distribution Map**

## Current Species and Habitat Condition in New Hampshire

Sea lamprey numbers are well below their potential in New Hampshire rivers. Populations are generally declining or stable at low levels despite improvements in access to spawning habitat.

Coastal Watersheds
Sea lampreys typically number less than a 1,000 in coastal rivers where fish counts are recorded. The majority of sea lamprey returns are recorded each spring in the Cocheco, Exeter, and Lamprey Rivers. Sea lamprey numbers have remained low since the early 1980's, when over 25,000 sea lampreys were removed from coastal fish ladders for medical research.

Merrimack River
Sea lamprey counts at the Essex dam in Lawrence average 6,603 annual returns since 1983. Counts have declined each decade, with an average of 12,220 sea lamprey counted per year between 1985 and 1994, 6,160 between 1995 and 2004, and 2,270 in the last 10 years. No sea lamprey were recorded in 2006 due to flooding.

Connecticut River
The average number of sea lampreys counted at the Holyoke Fishway each spring since 1975 is 34,231, with a peak of 100,000 counted in 1998. Annual sea lamprey counts at the Holyoke dam are highly variable, but returns have been below average since 2010. A recent sea lamprey pit tagging study showed that most sea lamprey move rapidly upstream between dams, but only 50% of the sea lamprey that enter fish ladders successfully pass through the ladder (Ted Castros Santos, USGS, unpublished data).

**Population Management Status**

There are no current stocking efforts focused on sea lamprey. Migrating sea lampreys are able to detect pheremones from ammocoetes, which they use to navigate to their spawning grounds. This trait makes stocking sea lamprey upstream a potential restoration strategy for seeding new populations in rivers or stream where sea lampreys have been denied access. This approach would be most effective where a migration barrier is expected to be removed or mitigated, either by dam removal or fishway construction. However, population recovery may be limited by the availability of marine host species (Nislow and Kenard 2009).

**Regulatory Protection (for explanations, see Appendix I)**

- Harvest permit - season/take regulations

**Quality of Habitat**

The extent and quality of sea lamprey spawning and juvenile rearing habitat in New Hampshire is not well known. A large proportion of historic sea lamprey spawning habitat is currently inaccessible due to impassable dams.

Coastal watersheds:
Access to spawning habitat for sea lamprey has improved in coastal rivers over the last 10 years. A newly constructed fish ladder at the Wiswall Dam and the removal of the Bunker Pond Dam, on the Lamprey River, has greatly increased the amount of river habitat that is accessible to Sea Lamprey (12 km). The ruins of the Wadleigh Falls Dam, in Lee, has been shown to act as a barrier to river herring migration, but its effect on sea lamprey upstream movement is unknown. Potential dam removals or fishway improvements on the Exeter, Bellamy, and Winnicut Rivers may offer opportunities for sea lampreys to increase their range in New Hampshire. In the Cocheco River, sea lampreys have access to approximately 5 km of river from the fish ladder at the Cocheco Falls Dam in Dover upstream to the Watson Dam. A possible migration barrier, known as Factory Falls, which is downstream from the Watson Dam, may limit diadromous fish passage in the Cocheco River.

Merrimack River:
In the Merrimack River, sea lampreys are able to reach the Hooksett Dam, although they are rarely observed at the Amoskeag Dam Fishway, in Manchester. The Souhegan River is accessible up to the McLane Dam in Milford. Baboosic Brook, a tributary to the Souhegan River, is known to contain sea lamprey spawning habitat and ammocoetes. Sea lamprey ammocoete numbers have increased at the mouth of the Souhegan River, where excellent burrowing habitat was created by sediment deposited after the Merrimack Village Dam was removed in 2008. Juveniles have also been captured in a number of other small tributaries to the Merrimack River, but the extent of spawning habitat or the total number of individuals that spawn in the mainstem is not well known.

Connecticut River:
Sea Lamprey ammocoetes have been documented in the Connecticut River as far north as the town of Hanover, near the mouth of the White River. The location and relative importance of sea lamprey spawning areas in the mainstem and tributaries of the upper Connecticut River is not well understood. Studies related to the relicensing of the Connecticut River dams owned by TransCanada Corporation will provide more information on sea lamprey population status and spawning habitat in the upper Connecticut River.

**Habitat Protection Status**

**Habitat Management Status**

Efforts to improve the efficiency and monitoring of fishways will benefit sea lampreys, but dam removals will have the greatest long term benefit. The end of Atlantic salmon restoration efforts in the Merrimack and Connecticut Rivers was a setback for sea lamprey, which often share spawning areas with Atlantic salmon. Maintaining and improving fish passage solely for sea lamprey can be a challenge due to its image as a nuisance species not commonly targeted by anglers. Fisheries managers should emphasize the important ecological role of sea lamprey in freshwater and seek to improve access to spawning habitat whenever possible.

## 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 sea lamprey and other diadromous species (Limburg and Waldman 2009). Before the construction of dams on the Merrimack River, sea lamprey were documented as far north as the Baker River in the town of Wentworth (Noon 2003). Currently, the Hooksett Dam is the upstream limit of sea lamprey migration in the Merrimack River. Access to the majority of sea lamprey habitat in New Hampshire coastal rivers is currently limited by dams.

**Disturbance from dams that delay upstream or downstream migration (Threat Rank: Medium)**

Delays in migration occur at dams as fish try to successfully navigate fish passage facilities. These delays may become energetically costly to the point where they impact spawning behavior.

A recent pit tagging study of migrating sea lampreys documented delays and poor passage efficiency at a number of dams on the Connecticut River (Ted Castro-Santos, USGS, personal communication). Sea lampreys have limited energy budgets during migration and delays at dams may force them to use poor quality spawning habitat, which could decrease recruitment.

**List of Lower Ranking Threats:**

Mortality from hydropower turbines

Species impacts from the overfishing of marine host species

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

## Actions to benefit this Species or Habitat in NH

### 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 licensing process. In other cases, congregations of diadromous species downstream from a dam 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 transferring fish from out of basin. Some level of testing may be required.

**Political Location:** **Watershed Location:**

### Marine research

**Objective:**
Investigate the factors that influence sea lamprey abundance and survival at sea.

**General Strategy:**
Marine food webs have been altered by centuries of commercial fishing pressure. There is little information on the abundance and availability of preferred or suitable marine hosts for sea lampreys and how changes in host populations may influence sea lamprey population dynamics. It is unclear whether the availability and size of host species is currently influencing marine growth and survival of sea lampreys in the ocean. More research is needed on the factors necessary for the successful completion of the marine phase of the sea lamprey's life cycle.

**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:**

**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 FERC licensing 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:**

**Monitor fish passage**

**Objective:**
Monitor upstream and downstream passage at dams.

**General Strategy:**
Monitor diadromous fish 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:**

**Map spawning habitat**

**Objective:**
Map the spawning habitat used by anadromous fish in the Connecticut, Merrimack, 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, sea lamprey, 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:**

## References, Data Sources and Authors

**Data Sources**
Sea lamprey records are entered into the NHFG fish survey database.
Fish passage counts are maintained by state and federal Fish and Wildlife agencies, and in some cases, hydropower company staff. Juvenile sea lamprey distribution was obtained from survey data collected by NHFG.

**Data Quality**
There are counts of annual sea lamprey returns at most fishways extending back to the early 1980's. The number of sea lamprey that fail to pass through fishways is not well known.
The actual locations of sea lamprey spawning habitat and ammocoete habitat within New Hampshire watersheds are not well documented. Juveniles are occasionally captured during electrofishing surveys for other species. The presence of juvenile sea lampreys is an indication that spawning habitat exists upstream.
The quality of the data depends on the method of counting at each fishway. The best count data comes from the staffed counting rooms at the Essex Dam, on the Merrimack River, and the Holyoke Dam, on the Connecticut River, or the video counting software deployed by Vermont Fish and Wildlife on the upper Connecticut River dams. The automated counting systems used on most coastal river fish ladders do not distinguish between sea lamprey and other species, but all sea lamprey are counted and passed by hand on the Cocheco River.

**2015 Authors:**
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**2005 Authors:**

## Literature

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