Eastern Pearlshell

Margaritifera margaritifera

Federal Listing	N/A
State Listing	SGCN
Global Rank	G4
State Rank	S3
Regional Status	High

Photo by Ethan Nedeau

Justification (Reason for Concern in NH)

Freshwater mussels are the most imperiled fauna in North America, having suffered steep declines in diversity, abundance, and distribution within the last 200 years (Richter et al. 1997, Master et al. 2000, Lydeard et al. 2004). Eastern pearlshell populations are vulnerable to extirpation or extinction in New Hampshire. They are listed as a Regional Species of Greatest Conservation Need and are of high regional concern. Because their populations are closely linked to their host fish, coupled with dependability on clean, coldwater habitats, their vulnerability is increased. Where these conditions exist in New Hampshire, Vermont, and elsewhere in the northeast, eastern pearlshell populations are still rare and often absent (Nadeau 2008). This mussel species also has shown high intolerance of eutrophication and acidification (Nadeau 2008), where pH near or below 5.5 was found capable of decimating an eastern pearlshell population. The existence of dams, forest cutting and land clearing in northern upland habitats has probably restricted eastern pearlshell distribution (Nadeau 2008), and likely resulted in local extirpations historically.

Distribution

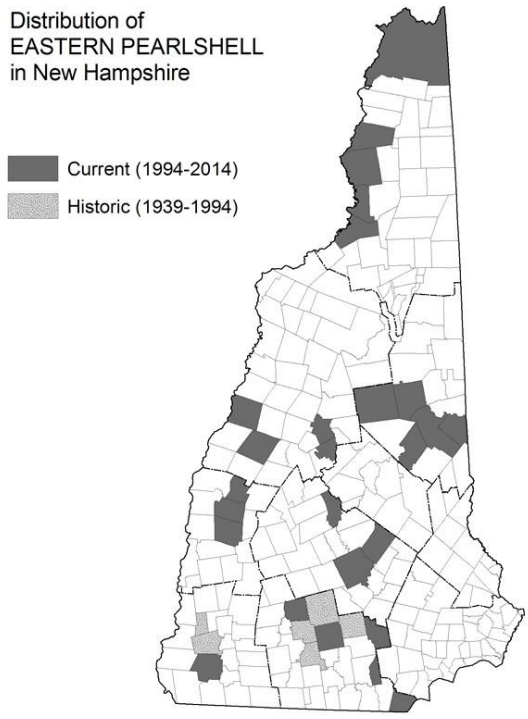
The Eastern pearlshell range stretches from Pennsylvania and New York up into Canada, and is the only North American mussel species that can be found on another continent, extending to Scandinavia and northern Europe (Nadeau 2008). In New Hampshire, Eastern pearlshell is found mainly in the Connecticut and Merrimack River watersheds. Populations appear to be very scattered throughout New Hampshire.

Habitat

Eastern pearshell is found in cold streams or rivers that support salmon or trout populations. It prefers sand, gravel, and cobble substrates. As part of its life cycle, all mussel species must attach to the fins or gills of a fish in order to grow and reach their next life stage, where they sink to the bottom of the waterbody and spend the rest of their lives. The eastern pearshell is only known to attach to Atlantic salmon (*Salmo salar*), and brook (*Salvelinus fontinalis*), rainbow (*Oncorhynchus mykiss*), and brown (*Salmo trutta*) trout.

NH Wildlife Action Plan Habitats

- Coldwater Rivers and Streams



Distribution Map

Current Species and Habitat Condition in New Hampshire

Because eastern pearlshell is a long-lived species (over 100 years), it is difficult to detect trends in populations without an established long-term monitoring program, which does not currently exist (Nedeau et al 2000). In other northeast states, there has been little evidence of reproductive success in recent years (Nedeau et al 2000). It's believed that eutrophication, acidity, sedimentation, and warmer water temperatures limit populations of pearlshell (Nedeau 2008). The most robust populations, with densities exceeding 200 animals per square meter, exist in just a few areas of Massachusetts and Connecticut (Nadeau 2008). Populations numbering over 50 individuals have been documented between Ossipee Lake and Lake Winnipesaukee. New Hampshire-specific data is lacking.

Population Management Status

There is little management particularly for eastern pearlshell in New Hampshire. NHFG works to restore fish passage in rivers and streams throughout the state, which greatly benefits the pearlshell by supporting its host fish. Historically, surveys have focused on mussel species that are more endangered, and thus have not adequately described the habitat, distribution and abundance of pearlshell in the state (Nedeau 2008).

Regulatory Protection (for explanations, see Appendix I)

- Fill and Dredge in Wetlands - NHDES

- Rivers Management and Protection Program - NHDES
- Comprehensive Shoreland Protection Act - NHDES
- Clean Water Act-Section 404

Quality of Habitat

Very little habitat information exists. Most pearlshell populations or site occurrences have not been assessed in many years. Ecological attributes have not been measured, and research is needed to determine population size, density, and recruitment and to assess habitat. NH DES conducted a new assessment of water quality in the Connecticut River mainstem in 2004. Of particular importance to mussel species, the assessment suggested that sedimentation and turbidity may be the greatest threat to water quality, particularly in the northern part of the state (Headwater CRJC 2009). In Cheshire county, sudden water releases from the Ball Mountain and Townsend Dams for whitewater recreation contribute to sedimentation and greatly affect the natural communities downstream (Wantastiquet CRJC 2009).

Habitat Protection Status

Habitat protection is variable among stream reaches and regions of the state. Some protection of riparian areas is provided by the NH Comprehensive Shoreland Protection Act (NHDES).

Habitat Management Status

Currently there are no management or restoration efforts targeting pearlshell habitat in the state. However, the Nature Conservancy, the Monadnock Conservancy, the Society for the Protection of New Hampshire Forests, and the Southwestern Regional Planning Commission have developed a conservation plan for the Ashuelot River Watershed (Zankel 2004). The Connecticut River Joint Commission published a Connecticut River Management Plan in 2008 (http://crjc.org/pdffiles/WATER.final.pdf).

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.

Habitat degradation and mortality from increased flooding that destroys mussel beds (Threat Rank: High)

Cycles of extreme episodic flooding and dewatering can cause direct adult mortality by scouring. Extreme fluctuations in flow disrupt mussel life cycles by exposing young mussels to flood-induced damage, mortality, or displacement to potentially unfavorable habitat downstream (Layzer et al. 1993, Richter et al. 1997). Dewatering exposes mussels to heat, desiccation, and opportunistic predators. Predator foraging efficiency increases with decreasing depth.

Undersized culverts placed at road stream crossings can be problematic in times of high flow or storm conditions, where flooding may result. Road stream crossings are extremely common and can alter habitat conditions, and thus have negative impacts on aquatic life. In addition, dam maintenance

often requires periodic de-watering and flooding that changes the habitat conditions, which has direct impacts on aquatic species (Nedeau 2008). Flooding typically leads to sedimentation, which can cause mass mortality of mussel beds.

Habitat impacts and disturbance from development of riparian habitats that increases stream temperature (Threat Rank: Medium)

Riparian corridors and adjacent lands are being rapidly developed in New Hampshire. Shorelines are highly valued for the recreation potential they offer, and associated structures (such as docks) and motorized boat traffic degrade habitat, lower water quality, and increase pollution.

As development increases and riparian vegetation buffers decrease, the effects of pollution on the biota in rivers and tributaries will increase. Runoff from municipalities, industrial waste, sewage outfalls, golf courses, poor agricultural and silviculture land contributes to sedimentation, organic pollution, and general water quality degradation (Poole and Downing 2004). The introduction of sediment and removal of shoreline plants that is often a remnant of riparian development can decrease oxygen levels, increase turbidity and change temperature levels in surface waters (NH DES 2005). Young mussels are the most sensitive to pollutants because they burrow into and feed within the sediments. Thus sediment, particularly when low in pore-water oxygen and high in toxins, may be a major contamination pathway for mussels (Newton et al. 2003, Poole and Downing 2004).

The effect of acute pollution on freshwater mussels is well documented (Neves et al. 1997), including negative impacts from thermal pollution. Habitat destruction, pollution, and water degradation are considered the most likely causes for the decline of freshwater mussels (Neves 1997, Strayer et al. 2004).

Dams can alter stream temperatures in impoundments and downstream areas (Nedeau 2008), which can have direct impacts on mussel species and/or their host fish species. The most widely reported sources of pollution are poor agriculture practices (Neves et al. 1997, Poole and Downing 2004). Run-off from these sites and similar sites can add large amounts of warm water into an aquatic system, causing problematic low oxygen levels and bringing with it other pollutants. Although pearlshell-specific evidence has not been documented in New Hampshire, similar freshwater mussel species have been better studied. For example, 20 dwarf wedgemussels and hundreds of other mussel species were killed by waste runoff from a small farm in the Connecticut River Watershed (USFWS 2002).

List of Lower Ranking Threats:

Habitat degradation and mortality from streambank stabilization

Habitat degradation and mortality from impervious surface run-off that contains excess nutrients, sediment and toxins

Species impacts from reduction or loss of host fish from degraded habitat and species composition changes

Mortality from recreational activities within a stream that can crush mussels

Mortality from the introduction and spread of problematic diseases and parasites

Species impacts from introduced or invasive animals that result in competition, predation, and reduced habitat quality

Habitat impacts from introduced or invasive plants

Habitat impacts (fragmentation) from dams that cause inhospitable stream conditions

Habitat degradation and mortality from dams that alter hydrology upstream and downstream

Actions to benefit this Species or Habitat in NH

Restoration and management of streams and rivers, with an emphasis on reducing stream fragmentation and restoring natural flow regimes, reducing pollution and riparian disturbance.

Primary Threat Addressed: Habitat degradation and mortality from dams that alter hydrology upstream and downstream

Specific Threat (IUCN Threat Levels): Natural system modifications

Objective:
Restoration of fragmented rivers will allow increased dispersal, increasing the overall potential for persistence of mussels. As mussels are established in new habitat, linear range, re-colonization, and population size increase.

General Strategy:
Stream fragmentation, and attendant gene flow restrictions, will be reduced by removing barriers such as nonfunctional dams, where feasible, by operating dams at "run of the river" flow regimes, and by rehabilitating degraded river reaches. These measures will increase dispersal and re-colonization of mussels into rehabilitated river reaches. Mussel populations and habitats must be assessed prior to implementation. Mussels found below a dam removal site or rehabilitated river reach may appear within 3 to 5 years, but 10 to 20 years or more may be necessary to establish a viable population. Riparian protection and restoration will be a long-term effort. As additional water quality and habitat assessment information is collected, efforts can be redirected or expanded. Pollution may render stream reaches uninhabitable. Destruction and transformation of riparian corridors accelerates erosion, bank sloughing, and runoff leading to increased levels of stream toxins, sediment, and higher stream temperatures. Education should be provided to adjacent landowners about practices that contribute pollutants into nearby rivers, streams, and ponds. Protection of riparian corridors through fee simple land acquisition, conservation easements, and private landowner cooperation will reduce pollution runoff and sedimentation. Properly sized culverts will reduce sedimentation and mass mortality of mussel beds. Surveys are needed to choose long-term, quantitative monitoring sites in occupied rivers and streams to assess patterns of disturbance and pollution. Following riparian disturbance mitigation or efforts to decrease pollution, the initial response of mussel populations should be monitored with qualitative surveying. As mussel populations increase in size, quantitative methods will be used (Strayer and Smith 2003). As additional water quality and habitat assessment information is collected, efforts can be redirected or expanded. The number of reproducing subpopulations of mussels will indicate the success of the program.

Political Location:
Carroll County, Cheshire County, Coos County, Grafton County, Hillsborough County, Merrimack County, Sullivan County

Watershed Location:
Androscoggin-Saco Watershed, Upper CT Watershed, Middle CT Watershed, Lower CT Watershed, Merrimack Watershed

Direct swimming and fishing access points away from mussel beds

Primary Threat Addressed: Mortality from recreational activities within a stream that can crush mussels

Specific Threat (IUCN Threat Levels): Human intrusions & disturbance

Objective:
Reduce mortality of mussels from recreational activities within a stream or river.

General Strategy:
As additional information on mussel occurrences is collected and mapped, managers should consider ways to direct recreational activities away from sensitive mussel beds. This can include strategically placing docks, boat launches, parking areas, beaches, and trails away from documented mussel beds. This will help reduce disturbance to mussels, reduce the potential for direct mortality, and help reduce pollution and sedimentation into mussel habitat. Targeted outreach to fishermen may occur coinciding with this effort, advising that mussels not be cracked open and used for bait. This has been commonly observed during mussel surveys.

Political Location:
Carroll County, Cheshire County, Coos County, Grafton County, Hillsborough County, Merrimack County, Sullivan County

Watershed Location:
Androscoggin-Saco Watershed, Upper CT Watershed, Middle CT Watershed, Lower CT Watershed, Merrimack Watershed

Monitor mussel populations

Objective:
Conduct surveys to detect mussel populations and collect additional land use data in mussel-occupied habitats is needed to better inform management decisions and create conservation plans for the species.

General Strategy:
General distribution surveys should be focused on historic sites and areas where data is lacking. Data on population structure, age class distribution, sex ratio, recruitment, growth rates, and migration is needed, as well as distribution and abundance data on host fish. Studies may also examine the effects of predation and competition. Research is needed to determine the biological response of mussels to artificial flow regimes. Response variables include displacement of juveniles, interference of spawning success, larval release patterns, and host fish attachment success. Villella et al. used mark-recapture techniques to estimate survival, recruitment, and population growth of freshwater mussels (Villella et al. 2004), and this technique could provide valuable demographic information. Currently, much of the information on the condition of mussel populations and habitat is qualitative. Needed are quantitative studies to assess the physical habitat, including sediment type and hydrology, particularly shear, and water quality. As actions are initiated and populations potentially enlarge, mussel sites should be monitored using quantitative, statistically valid methods. Water quality monitoring stations upstream of mussel populations must be established.

Political Location:
Carroll County, Cheshire County, Coos County, Grafton County, Hillsborough County, Merrimack County, Sullivan County

Watershed Location:
Androscoggin-Saco Watershed, Upper CT Watershed, Middle CT Watershed, Lower CT Watershed, Merrimack Watershed

References, Data Sources and Authors

Data Sources
Literature review, expert review and consultation, and NH database information (Gabriel 1995). Distribution data was obtained from unpublished reports, scientific literature, and consultation with experts. Threat assessment was conducted by Mike Marchand (NHFG), Barry Wicklow (St Anselm College), and Susi von Oettingen (USFWS).

Data Quality
NHFG has kept records of all mussel occurrences reported from surveys. NHFG also maintains records of mussel species submitted through the NH Wildlife Sightings online reporting website (http://nhwildlifesightings.unh.edu). Many mussel surveys occurring in New Hampshire were monitoring projects in response to hydroelectric projects or dam impact studies. Most mussel studies are focused on endangered mussel species, but typically record all mussel species observed. New Hampshire has over 180 documented sites of eastern pearlshell in the state.

The Connecticut River main stem has been surveyed and intermittently monitored for mussels since 1988. Early surveys were conducted by canoe and snorkeling in shallow water, usually within 15 meters of the bank, and later SCUBA surveys were used to survey depths greater than 1.5 meters. The Ashuelot River downstream of the Surry Mountain flood control dam has been periodically monitored since 1991 (Gabriel and Strayer 1995).
Much of the information on the condition of eastern pearlshell populations and habitat is qualitative.

2015 Authors:
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2005 Authors:
N/A - Species was not listed as SGCN during 2005 WAP

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