Triangle Floater

Alasmidonta undulata

Federal Listing	N/A
State Listing	SGCN
Global Rank	G4
State Rank	S4
Regional Status	High

Photo by Ethan Nedeau

Justification (Reason for Concern in NH)

Freshwater mussels have declined dramatically in diversity, abundance, and distribution within the last 200 years and are considered the most imperiled fauna in North America (Richter et al. 1997, Lydeard et al. 2004). Triangle floaters are listed as a Regional Species of Greatest Conservation Need due to the high regional responsibility and high concern for this species. Maine conducted a status review of triangle floaters in 2006, and determined their populations were not warranting special concern listing (Nedeau 2008). The triangle floater seems to be declining in its southern range, such as in Maryland where it is endangered (Nedeau et al. 2000). Triangle floaters can tolerate non-flowing water so it is less sensitive to the effects of dams compared with many other freshwater mussels. Still, as filter feeders, triangle floaters are especially sensitive to pollutants, oxygen levels and temperature levels, making them important indicators of waterbody health.

Distribution

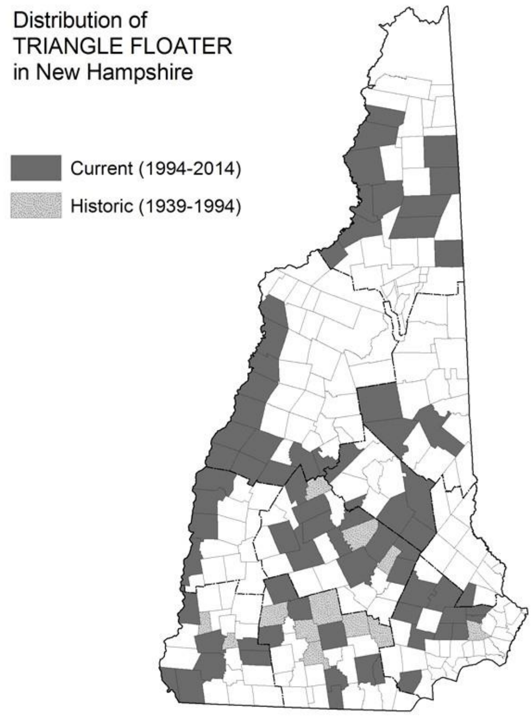
More populations of triangle floaters exist in New England than anywhere else throughout its known range along the Atlantic coast (Cordeiro 2011). Triangle floaters can be found in most major watersheds in the northeast, although are never common (Nedeau et al. 2000). It occupies the entire Connecticut River mainstem, and many of its minor and major tributaries, becoming more common going from south to north (Nedeau 2008). New Hampshire has over 295 documented sites where triangle floaters occur. Populations seem to be scattered statewide, reaching as far north as the Umbagog Lake region and the Upper Ammonoosuc River. Triangle floaters are usually at lower population densities in lakes and reservoirs than in rivers (Nedeau 2008).

Habitat

The triangle floater is a freshwater mussel that can be found in streams, rivers and lakes with sand or gravel substrates. It is most common in flowing water, but can tolerate a range of flow conditions and substrate types, and seems to prefer low-gradient rivers with low to moderate flow velocities (Nedeau 2008). 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. Triangle floaters use a range of host fish including the common shiner (*Luxilus cornutus*), white sucker (*Catostomus commersonii*), and large-mouth bass (*Micropterus salmoides*), and thus will occur in habitats where these fish are commonly found.

NH Wildlife Action Plan Habitats

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



Distribution Map

Current Species and Habitat Condition in New Hampshire

Although the triangle floater is widely distributed in the state, it seems to be rarely abundant. It is expected that the species is experiencing declines particularly in southern parts of its range, and many states are currently gathering data to assess the distribution and abundance of the species (Nedeau et al. 2000). About 15% of NH surveys detected over 10 triangle floaters at a site, although several sites on the Ashuelot River had 100 or more triangle floaters present. Thirty-five percent of surveys consisted of 5 or fewer observations of triangle floater at a site. A small fraction (about 5%) of NH surveys reported numerous dead triangle floaters, but the cause of death is unknown (NH Survey Data).

Population Management Status

There is no targeted management for triangle floater populations in New Hampshire. Historically, surveys have focused on mussel species that more endangered, and thus have not adequately described the habitat, distribution and abundance of triangle floater in the state.

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 triangle floater populations have not been assessed and ecological attributes have not been measured. Although triangle floaters are capable of using a wide range of host fish, research on triangle floater larvae attachment to fish in natural populations has not been conducted. NH DES conducted an assessment of water quality in the Connecticut River mainstem in 2004. The assessment looked at dissolved oxygen content, pH, conductance and water temperature at 45 locations along the river. Of these 45 test locations, 14 areas did not meet state water quality standards, 13 areas had inconclusive results, and the remaining 18 areas met state water quality standards for dissolved oxygen content and pH (CRJC 2004). Bacterial problems have been noted in some areas of the mainstem and several tributaries (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 Shoreland Protection Act (NHDES).

Habitat Management Status

Currently there are no management or restoration efforts targeting triangle floater 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.

Mortality from drawdowns for plant control and waterbody management (Threat Rank: Medium)

Drawdowns and the associated dewatering expose mussels to heat, desiccation, and opportunistic predators. Cycles of extreme 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). Predator foraging efficiency increases with decreasing depth.

In New Hampshire, drawdowns typically occur in winter months for maintenance and flood control purposes, and occasionally for aquatic plant control. Drawdowns conducted under certain conditions allow drying and freezing of the sediments that become exposed, causing damage or death to certain aquatic weed species. Following a drawdown event, aquatic vegetation and organisms may exhibit changes in species composition and density by causing direct mortality to species and changes to habitat suitability.

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

Cycles of extreme episodic flooding and dewatering use 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.

Road stream crossings are extremely common and can impact habitat conditions and have negative impacts on aquatic life. Undersized culverts can be problematic in times of high flow or storm conditions, where flooding may result. 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.

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 impacts and disturbance from development of riparian habitats that increases stream temperature

Habitat degradation and mortality from development of shorelines

Mortality from chemical treatments for nuisance plant control in waterbodies

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 recolonization 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:
Statewide

Watershed Location:
Statewide

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. (2004) used mark-recapture techniques to estimate survival, recruitment, and population growth of freshwater mussels,

and this technique could provide valuable demographic information. Currently, much of the information on the condition of mussel populations and habitat is qualitative.

Political Location:
Statewide

Watershed Location:
Statewide

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, river or pond.

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:
Statewide

Watershed Location:
Statewide

References, Data Sources and Authors

Data Sources

Literature review, expert review and consultation, and NH mussel survey data.
Distribution data was obtained from unpublished reports, scientific literature, and consultation with experts. The threat assessment was conducted by Michael 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 are monitoring efforts in response to hydroelectric projects or dam impact studies. Most mussel studies are focused on endangered mussel species, but usually record and report all mussel species observed. 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. Much of the information on the condition of triangle floater populations and habitat is qualitative.

Needed are quantitative studies to assess the physical habitat, including sediment type and hydrology, particularly shear, and water quality. Also needed are data on population structure, age class distribution, sex ratio, recruitment, growth rates, and migration. Studies that examine the effects of predation and competition would be helpful.

2015 Authors:
Loren Valliere, NHFG

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

Literature

Cherry, D. S., T. W. Valenti, R. J. Currie, R. J. Never, J. W. Jones, R. A. Mair, and C. M. Kane. 2005. Chlorine toxicity to early life stages of freshwater mussels.

Cordeiro, J. 2011. *Alasmidonta undulata*. The IUCN Red List of Threatened Species. Version 2014.3. <www.iucnredlist.org>. Downloaded on 27 March 2015.

CRJC (Connecticut River Joint Commissions, Inc.). 2008. Water Resources: Connecticut River Management Plan, riverwide overview. Produced in Charlestown, NH. Accessed online: http://crjc.org/pdffiles/WATER.final.pdf.

Hardison, B.S., J.B. Layzer. 2000. Relations between complex hydraulics and the localized distribution of mussels in three regulated hydraulics and the localized distribution of mussels in three regulated rivers. Regulated Rivers: Research and Management.

Layzer, J.B., L.M. Madison. 1995. Microhabitat use by freshwater mussels and recommendations for determining their instream flow needs. Regulated Rivers: Research and Management. 10:329-345.

Layzer, J.B., M.E. Gordon, and R.M. Anderson. 1993. Mussels: The forgotten fauna of regulated rivers. A case study of the Caney Fork River. Regulated Rivers: Research and Management. 8:63-71.

Levine, J. F., A. E. Bogan, K. H. Pollock, H. A. Devine, L. L. Gustafson, C. B. Eads, P. P. Russell, E. F. Anderson. 2003. Distribution of Freshwater Mussel Populations in Relationship to Crossing Structures. North Carolina State University, College of Veterinary Medicine, Joint Environmental Research Program Final Report.

Locke A., J.M. Hanson, G.J. Klassen, S.M. Richardson, C.I. Aube. 2003. The damming of the Petitcodiac River: Species, populations, and habitats lost. Northeastern Naturalist. 10:39-54.

Mattrick, C. 2002. Managing Invasive Plants: Methods of Control. Conservation Notes of the New England Wild Flower Society [Internet]. [cited 2015 April 6] 20-23. Available from: https://extension.unh.edu/resources/files/Resource000988_Rep1135.pdf.

Naimo, T.J. 1995. A review of the effects of heavy metals on freshwater mussels. Ecotoxicology. 4:341-362.

Nedeau, E. J. 2008. Freshwater Mussels and the Connecticut River Watershed. Connecticut River Watershed Council, Greenfield, Massachusetts. xvii+132 pp.

Nedeau, E. J., M. A. McCollough, B. I. Swartz. 2000. The Freshwater Mussels of Maine. Maine Department of Inland Fisheries and Wildlife. 118 pp.

Neves, R.J., A.E. Bogan, J.D. Williams, S.A. Ahlstedt, P.W. Hartfield. 1997. Status of aquatic mollusks in the southeastern United States: A downward spiral of diversity Pages 43-85 in Bens G.W., D.E.

Newton, TJ., JW. Allran, J.A. O'Donnell, M.R. Bartsch, and W.B. Richardson. 2003. Effects of ammonia on juvenile unionid mussels (*Lampsilis cardium*) in laboratory sediment toxicity tests.

NH DES. 2010. Environmental Fact Sheet: Zebra Mussels [Internet]. Concord (NH): New Hampshire Department of Environmental Services; [cited 2015 April 6]. Available from: http://des.nh.gov/organization/commissioner/pip/factsheets/bb/documents/bb-17.pdf.

Parmalee, P.W., M.H. Hughes. 1993. Freshwater mussels (Mollusca; Pelecypoda: Unionidae) of Tellico Lake: twelve years after impoundment of the Little Tennessee River. Annals of the Carnegie Museum. 62:81-93.

Poole, K.E., J.A. Downing. 2004. Relationship of declining mussel biodiversity to stream-reach and watershed characteristics in an agricultural landscape. Journal of the North American Benthological Society. 23:114-125.

Richter, B.D., D.P. Braun, J.A. Mendelson, L.L. Master. 1997. Threats to imperiled freshwater fauna. Conservation Biology. 11:1081-1093.

Starliper, C.E. 2011. Pathogens and Diseases of Freshwater Mussels in the United States: Studies on Bacterial Transmission and Depuration. In R.C. Cipriano, A.W. Bruckner, & I.S. Shchelkunov (Eds.), Bridging America and Russia with Shared Perspectives on Aquatic Animal Health (pp. 47-55). Proceedings of the Third Bilateral Conference between Russia and the United States, 12-20 July, 2009, held in Shepherdstown, West Virginia. Landover, Maryland, USA. Accessed online: http://www.lsc.usgs.gov/files/Starliper%202011.pdf.

Strayer, D.L. 1999. Effects of alien species on freshwater mollusks in North America. Journal of the North American Benthological Society. 18:74-98.

Strayer, D.L., J.A. Downing, W.R. Haag, T.L. King, J.B. Layzer, T.J. Newton, S.J. Nichols. 2004. Changing Perspectives on Pearly Mussels, North America's Most Imperiled Animals. BioScience. 54: 429-439.

Strayer, D.L., S.J. Sprague, S. Claypool. 1996. A range-wide assessment of populations of *Alasmidonta heterodon*, an endangered freshwater mussel (Bivalvia: *Unionidae*). Journal of the North American Benthological Society. 15:308-317.

Vaughn, C., C.M. Taylor. 1999. Impoundments and the decline of freshwater mussels: a case study of an extinction gradient. Conservation Biology. 13:912-920.

VT DEC (Vermont Department of Environmental Conservation). 2015. Watershed Management Division: Shoreland Permitting. http://www.watershedmanagement.vt.gov/permits/htm/pm_shoreland.htm. Accessed March 27, 2015.

Watters G.T. 1996. Small dams as barriers to freshwater mussels (Bivalvia, Unionoida) and their hosts. Biological Conservation. 75:79-85.

Watters, T. 1999. Freshwater mussels and water quality: A review of the effects of hydrologic and in-stream habitat alterations. Proceedings of the First Freshwater Mollusk Conservation Society Sympo-sium, 1999. Ohio Biological Survey, Columbus Ohio. Page 261-274.

Zankel, M. 2004. A land conservation plan for the Ashuelot River Watershed. The Nature Conservancy, Concord, New Hampshire.