Alewife Floater

Scientific Name *Anodonta implicata* Say, 1829

Family Name Unionidae
Unionid Mussels

Did you know?
The shad restoration program on the Connecticut River increased the range of A. implicata upstream about 125 miles (Smith 1985).

Summary

Protection Not listed in New York State, not listed federally.

This level of state protection means: The species is not listed or protected by New York State.

Rarity G5, S1S2

A global rarity rank of G5 means: Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.
A state rarity rank of S1S2 means: Critically Imperiled or Imperiled in New York - Especially or very vulnerable to disappearing from New York due to rarity or other factors; typically 20 or fewer populations or locations in New York, very few individuals, very restricted range, few remaining acres (or miles of stream), and/or steep declines. More information is needed to assign a single conservation status.

Conservation Status in New York

In New York, alewife floaters are found in only the tidal Hudson River, and in the lower Delaware and Neversink Rivers, where it can be locally abundant. Historical records from elsewhere in New York appear to be misidentifications (Strayer and Jirka 1997). The species has been heavily impacted in the Hudson River estuary by the zebra mussel (*Dreissena polymorpha*) invasion.

Short-term Trends

Due primarily to the zebra mussel invasion, the population in the Hudson River estuary declined sharply (> 90%) from over 400 million individuals between 1991-1996 (Strayer and Smith 1996). Alewife floaters were recently rediscovered in 2000 in large numbers in the upper Delaware River system between Hancock and Port Jervis, including in the Neversink River tributary (Lellis 2001); this population appears more healthy, perhaps since zebra mussels have not yet invaded the Delaware River system. This rediscovery may represent a range expansion, possibly related to host fish (shad/alewife) distribution, since Strayer and Ralley (1991) found only one old dead shell in their extensive survey of the Delaware during the summer of 1990.

Conservation and Management

Conservation Overview

Freshwater unionid mussels may be North America's most imperiled animals (Lydeard et al. 2004 and Strayer et al. 2004). Of the 50 freshwater mussel species known to occur or have occurred in New York, 13 have only historical records, 5 species are state-listed as endangered, 3 species are state-listed as threatened, and an additional 15 species have been designated Species of Greatest Conservation Need by the New York State Department of Environmental Conservation. Populations of alewife floaters have declined dramatically in New York State since the introduction of zebra mussels (*Dreissena polymorpha*) to the Hudson River, which outcompete the native floater for food resources (Strayer and Smith 1996). Once estimated at over 400 million individuals, alewife floaters numbers in the Hudson River were reduced by over 90% from 1991-1996 (Strayer and Smith 1996).

Freshwater mussels are particularly susceptible to threats due to their unique life history traits. They are essentially sedentary creatures that spend their lifetime burrowed part way into a stream or river bottom. They are filter-feeders that opportunistically consume what algae, detritus, and bacteria come their way (Nichols and Garling 2000). Because of this, adults are incapable of avoiding environmental or human impacts such as floods, contaminants, habitat destruction and invasive species.

The dispersal mechanism of the young is another unique factor that makes adapting to a quickly changing environment difficult. Unionid mussels are obligate fish parasites and in order for the young to disperse they must latch on to a fish host to complete their development cycle before dropping off in a new location. Different species have varying adaptations enabling this critical transfer from female mussel to fish to occur. Some species simply broadcast larvae into the water; others release conglutinates, a larval form attractive to fish that appear as food. In many species, the adult female has lures that appear as a prey item or as another fish and in some species the female mussel may close on the fish to capture it prior to releasing the glochidia to complete the larval transfer. Availability and abundance of host fish species, which may also be in decline, may limit dispersal capabilities and juvenile recruitment, especially for mussel species that are limited to a single or few host fish species. Alewife floaters are known to parasitize a specific host fish, the alewife (*Alosa pseudoharengus*), although other species of shad such as American shad (*Alosa sapidissima*) and blueback herring (*Alosa aestivali*) are suspected hosts as well (Nedeau 2003 and Strayer and Jirka 1997). Populations of diadromous species, including many in the genus *Alosa*, have suffered and continue to suffer dramatic declines in the northeast (Limburg and Waldman 2009). Populations of alewife have declined 99.9% in several major rivers from Maine to the Chesapeake (Limburg and Waldman 2009). Bycatch at sea during Atlantic herring (*Clupea harengus*) fishing is one likely contributor to this decline (Limburg and Waldman 2009). Populations of alewife floaters in New York were likely historically reduced along with their alewife fish hosts with the construction of dams blocking fish migration from large rivers in New York to the Atlantic in the late 19th and early 20th centuries.

Conservation of New York's freshwater mussels will hinge on the abatement of current threats such as those affecting water quality and dispersal. Measures that reduce nonpoint source pollution such as stream and river buffers, sediment control, and limits on lawn chemicals and fertilizer use, as well as measures enabling host fish movement such as dam removal or installing well-designed fish passages may provide a starting point for recovery. Further inventory of known populations and less surveyed parts of rivers and stream systems is needed, as well as research into the habitat needs and thermal and water quality tolerances of individual species. If populations are unable to recover on their own due to fish host decline, impassable barriers, and poor habitat quality, a captive-release program may be a last option to assist certain species, provided proper rearing techniques, population monitoring and additional research into survival of released individuals are implemented. However, captive-release programs are expensive, can be difficult to implement and won't work for all species. Therefore, implementing strong conservation and management practices while the species still has a chance to recover is the optimal strategy.

Threats

Summary: Threats to freshwater mussels in New York include altered river flows and loss and fragmentation of habitat, especially from dams; siltation and sedimentation from dams and surface run-off; and invasive non-native mussels and clams.

Full Narrative:
The threats to freshwater mussel species in New York are numerous and daunting. Past changes to stream and river hydrology due to dams, channelization, and impoundments have isolated, fragmented, and eliminated historical populations and species. Dams turn free-flowing rivers and streams into reservoirs. These altered habitats have unnatural flow cycles, higher sedimentation, lower oxygen levels, and lower flow rates resulting in lower food availability and often loss of host fish (Kathleen O'Brien pers. comm.). Altered flow rates from dams or large water withdrawals from hydrofracking could alter water temperatures; these thermal changes can mask temperature cues inhibiting reproduction in some species (Galbraith and Vaughn 2011, Helfrich et al. 2009). More sensitive species in particular are hardest hit and often die out of the impounded sections of their range within a watershed. Changes to the flow rates and sediment budgets in streams and rivers from dams and changes in land use may also destabilize the streambed which is likely very bad for mussels (David Strayer pers. comm.).

The past impacts of dams and poor land use practices are still affecting mussel populations and species today. Current and future fragmentation is a major threat. Strayer et al. (2004), in an article discussing the current thinking in mussel conservation, wrote that "negative density dependence can cause sparse populations to continue to decline even after the original cause of decline is removed." This means that long-lived species, such as mussels, that are sedentary and need to be in proximity to reproduce, may persist in decline for many decades beyond the end of the disturbance which will ultimately cause their extinction.

Threats to the future viability of mussel species and populations still remain and require attention. High nutrient loads and contaminants from nonpoint source pollution, particularly from agriculture, are thought to be a threat to mussel survival and growth (Richter et al. 1997). Although research demonstrating a direct link between nonpoint source pollution, water quality, and mussel decline is rare and difficult to document (Strayer and Fetterman 1999), researchers still believe past and present water quality may be a major cause of decline. Bauer (1988, 1992) demonstrated that Eastern pearlshell (*Margaritifera margaritifera)* growth and survival was reduced in nutrient-rich streams in Europe. Strayer and Fetterman (1999) found a weak, but perhaps biologically significant, correlation between mussel species richness and water clarity in the Upper Susquehanna River Basin.

Sedimentation occurs when intensive land use exposes soil that subsequently washes into a nearby waterbody. Increased sedimentation may occur from agriculture, storm water discharge, and construction projects such as bridge and dam work, dredging, and bank clearing (Lisa Holst pers. comm.). The most obvious effect of sedimentation on mussels is that they may actually become buried by the sediment. Increased sediment in the water column can clog the gills of mussels suffocating them (Lisa Holst pers. comm.). An entire mussel bed could be threatened by a single rain event or flood that washes a large amount of exposed soil into an aquatic system. Particular species of mussels are also more susceptible to increased sediment in the water column or on the stream bottom.

Exotic freshwater bivalves such as the zebra mussel (*Dreissena polymorpha*), quagga mussels (*Dreissena rostriformis bugensis*), and the Asian clam (*Corbicula fluminea*) may pose significant threats primarily due to their capacity to outcompete native species for oxygen and food resources. Zebra mussels may also attach to and physically suffocate native mussels. Since zebra mussels have been introduced into the Hudson and Mohawk Rivers in New York, they have heavily impacted native mussel populations as well as other invertebrate species. Once they have infested a river system, zebra mussels are nearly impossible to stop. Both the Asian clam (*Corbicula fluminea*) and zebra mussel (*Dreissena polymorpha*) are expected to eventually invade all of New York's watersheds although some streams may be too cold or not have enough calcium for them to take hold (Strayer and Ralley 1993, David Strayer pers. comm.). The introduction of zebra mussels has caused dramatic declines in populations of alewife floaters in the Hudson River in New York (Strayer and Smith 1996).

Climate change may pose a significant threat to certain mussel species. Although some mussels have been negatively affected by cold water releases from dams causing a year of low reproduction, and warming stream temperatures have been shown to benefit some species to a degree, ultimately there is a temperature threshold where species may begin to be impacted by increased water temperature. Mussels may adapt to gradually warming streams but extreme temperatures at either spectrum is what causes large die offs (Hastie et al. 2003). Pandolfo et al. (2010) studied acute lethal thermal tolerances among several mussel species and found that even mildly increasing temperatures can lead to significantly reduced survival in some species; especially affecting glochidia. Although streams rarely reach the temperatures capable of causing large dieoffs in New York, increased temperatures have been shown to cause changes in filtration rate (Loayza-Muro and Elias-Letts 2007), immune response (Chen et al. 2007), and may cause asynchrony in the timing of life history events such as reproduction (Barnett 1972). Increased temperatures in extremes pose a risk directly to survival and minimal increases are an added stressor to declining populations.

Conservation Strategies and Management Practices

Threats must first be recognized and eliminated before populations may even begin to recover. Issues pertaining to water quality, sedimentation, altered hydrology, water temperature, invasive species, and pollution must be identified and dealt with, not only in the immediate area, but encompassing the entire stream system, perhaps especially including areas upstream from a mussel bed.

Dams can be removed or flow regimes altered to benefit mussels and fish passages can be placed to allow juvenile dispersal by their fish hosts. Of particular importance to the perpetuation and restoration of alewife floaters in the state is the unimpeded spring and fall migration of alewife from the Atlantic, up coastal waterways in the state, and back. Restoration of historic herring runs on Long Island by removing dams or installing well-engineered fishways that enable up and downstream passage, as well as maintain adequate flow, would benefit alewife and other shad species and consequently alewife floaters (Nedeau 2003). Limiting the unintentional catch, or bycatch, of alewife during ocean fishing for Atlantic herring and other species, would greatly benefit alewife numbers and would likely benefit alewife floaters as well.

Increasing and restoring vegetated stream/river buffers will have a triple benefit to New York's most imperiled animal taxa. It will help limit sedimentation, reduce runoff from nonpoint source pollution, such as agricultural waste and lawn chemicals, and provide increased shade to help offset increasing water temperatures due to global climate change.

Management of invasive species poses a significant challenge. Implementing an early detection program of zebra and quagga mussels as well as research into natural predators and other control methods would be highly beneficial. Of particular concern are the black carp (*Mylopharyngodon piceus*), a fish that eats mussels, and the non-native golden mussel (*Limnoperna fortunei*) (Strayer pers. comm.). Further research into the findings of Strayer et al. (2010) to determine the cause of the recent stabilization of native mussels in the Hudson River many years after zebra mussels were introduced is also important to advancing future control efforts. This research is critical to the perpetuation of alewife floaters and other mussel species that have been heavily impacted by zebra mussels. Early detection and boater education are both critical to keep zebra mussels from spreading and to limit potential harm from the introduction of new invasives.

Inventory of less accessible parts of streams and rivers is needed and may identify new populations. Thorough inventory, including documenting age classes, is essential to monitoring and determining population status. Sampling the whole water body may be necessary to accurately assess status due to the establishment of new populations, metapopulation dynamics, and previously overlooked populations (Strayer and Fetterman 1999). Locations in the state that require further survey work include the Hudson river above Troy, Mohawk river, and lakes and streams on Long Island that have known alewife runs (David Strayer pers. comm.).

Once threats have been abated and stream systems begin to recover, if fish hosts and quality habitat are available, dispersal is unimpeded, and mussel populations have not declined to critical levels, populations may reestablish and a species may begin to recover on its own. However, if this is not the case, then human intervention may be necessary. Recently, research into life history and rearing techniques of some species have made it possible to produce the large number of juveniles necessary for a successful captive-release program, but the implementation of such programs are in early stages of development (Heinricher and Layzer 1999, Henley et al. 2001, Strayer et al. 2004).

Development and Mitigation Considerations

Development, construction, and other activities can have deleterious impacts on freshwater mussel populations when they lead to increased sediments in the water channel; to alterations in substrate, water levels, flow velocity, or water temperature; or to disruptions to the populations and movements of host fish. Projects which could have these kinds of impacts on rivers and streams with known or potential populations of rare mussels should endeavor first to avoid these impacts. While guidelines and recommendations for specific sites or activities cannot be provided here, there are some general approaches to consider.

For activities outside the stream channel, prevent any discharge, runoff or erosion from the project site from adding sediments or chemicals to the stream, both during construction and after the project is completed. Maintain pre-project volumes and patterns of surface water runoff after the project is completed. To protect stream habitats and water quality from the cumulative effects of development, maintain and restore floodplains, riparian corridors, and forested watersheds as much as possible; minimize impervious surfaces; and locate land uses requiring applications of pesticides and fertilizers away from streams and rivers.

For activities which require work in the stream channel itself, such as work on bridge supports, maintain water flow and water levels over any mussels. For example, coffer dams to wall off the construction zone from the stream current should be deployed to wall off as small an area as possible and to keep water flowing over mussels.

Often, mussels may have been recorded upstream and downstream from a project site, but not from the stretch of stream or river where the project is located. That particular stretch often has not been surveyed for mussels, but may support rare mussels if the substrate and other habitat parameters are suitable. Project sponsors can either proceed assuming there are rare mussels present, or they can sponsor surveys. If surveys are conducted to determine the presence and distribution of mussels in the area potentially affected by a project, the surveys should be conducted by qualified biologists using standardized methods, and the area surveyed should include downstream and upstream of the project site and its impact zone (e.g., 200 meters downstream and 100 meters upstream).

If the mussel bed itself must be uncovered, then moving the mussels can be considered. However, the success rate of mussel translocation is low, often leading to high mortality, and this approach should be reserved as a last resort. Such efforts require that a suitable target site with appropriate habitat and water conditions be identified; areas where other individuals already occur are good candidates. There are no standardized transfer methods. Post-move monitoring is necessary to evaluate the success of the translocation. Moving mussels has generally been attempted with only a few individuals at a time. If a large mussel bed or many individuals will be impacted by a project, redesigning the project to avoid impacts is preferable to attempting a large-scale translocation with uncertain results.

Research Needs

There is still much to learn about this species, including diet, age and growth, and mortality factors. Details about habitat requirements (current speed, water depth, substrate grain size, substrate stability, water temperature, and water quality factors) also need work. However, Strayer et al. (1994) found that the distribution of this species was not related to these typical physical habitat qualities, but instead was related to long term stability of the substrate (i.e., flow refuges). Both large and smaller scale forces promoting the patchy occurrence of Unionid mussel beds is an active area of research (Strayer 2004).

Regional Conservation Needs

In the *Comprehensive Wildlife Conservation Strategy* (CWCS), NYSDEC has reviewed the priority conservation needs in the state and developed goals and action items to this end. The overarching goal for the conservation of freshwater unionids is to: “maintain healthy populations of all native species of freshwater bivalves throughout their historic ranges in New York (New York State 2006).” This is not likely achievable in the near future, considering the impacts of past land use, current threats, and the numerous species that were historically present but are now extirpated from the state. However, this is a strong goal to approach over the long-term.

Important objectives that would benefit freshwater bivalves from the CWCS include developing a management and monitoring program to assess the status of all species of concern throughout the state and to keep up to date with current mussel research. Other important objectives are to understand the current distributions of species across the state, to establish a baseline for trend data, as well as to understand the causes of decline. For species affected by dramatic declines such as the alewife floater, continued monitoring to assess population status is warranted and essential to the species persistence.

Actions items in the CWCS developed towards these objectives include research into the life history and habitat requirements of species of concern as well as developing methods to improve and restore habitat. More specifically, research and monitoring of flow requirements, temperature tolerances, fish hosts and food sources is needed. Implementing control measures to limit nonpoint source pollution from agricultural, residential, and industrial areas is essential as is to diminish other degradation factors. To this end, controlling livestock access to creeks and flow alteration were mentioned specifically. Also called for are an early detection program for invasives, research on exotic bivalve control through natural predators, land acquisition and/or acquisition of development rights in key locations for listed species, and research into ammonia and chemical pollutants that may pose a threat. Continued population monitoring and distribution surveys of at-risk species, and where appropriate, reintroduction efforts, are essential actions to conserving mussel diversity in New York.

Other action items relating to public education include developing a curriculum and fact sheets for public education about mussels, developing an outreach program for private landowners through the Landowner Incentive Program, and educating boaters to slow the transfer of exotic bivalves.

Regulatory and legislative recommendations in the NYS Comprehensive Wildlife Strategy benefiting native freshwater bivalves include a ban on importing fish that feed on native mussels such as the black carp and the inclusion of all life stages of mussels in testing for approval of new pesticides in NYS. Recommendations of stronger water quality regulations and enforcement that would benefit mussels include affording protected stream status to some non-navigable stream segments that include Species of Greatest Conservation Need (SGCN), exploring the issuance of general permits for regulated activities on navigable streams that provide habitat for SGCN, and working to strengthen existing support programs for local government planning and zoning boards to incorporate water quality and land side habitat protections into local regulations (New York State 2006). In addition, many of the watersheds have called for enhanced implementation and enforcement of existing water quality protections including stream buffers and other best management practices (New York State 2006).

Habitat

The alewife floater lives in the strong currents in the tidal Hudson River and among cobbles in the Neversink and smaller tributaries (Strayer and Jirka 1997).

Associated Ecological Communities

Deepwater River
The aquatic community of very large, very deep, quiet, base level sections of streams with a very low gradient. In places the water is deep enough so that light cannot reach the river bottom.

Associated Species

Eastern Elliptio (*Elliptio complanata*)
Eastern Lampmussel (*Lampsilis radiata*)
Tidewater Mucket (*Leptodea ochracea*)
Eastern Pondmussel (*Ligumia nasuta*)

Identification Comments

This mussel has a subelliptical shell that is elongate and posteriorly thin, but anteriorly thicker, often > 100 mm long. The beak sculpture is double-- looped, not nodulous. The periostracum is greenish, brownish, or blackish, sometimes with fine rays. Hinge teeth are absent. The nacre is pinkish to purplish, and the color is best seen on the anterior part of the shell (Strayer and Jirka 1997).

Identifying Characteristics

This species can be distinguished by its toothless hinge, its pink to purple nacre, shell thickness markedly increasing anteriorally, and its double looped beak sculpture (Strayer and Jirka 1997).

Best Life Stage for Identifying This Species

Adult

Behavior

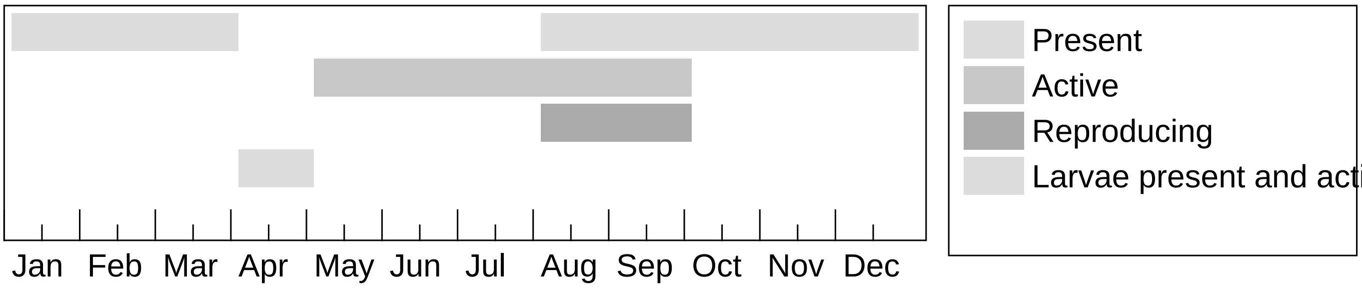
Adults of this species are sessile with only limited movement in the substrate. Passive downstream movement may occur when they are displaced from the substrate during floods. More major dispersal occurs while glochidia are encysted on their anadromous hosts. Being ectothermic, activity levels of mussels are reduced greatly during colder months of the year.

Diet

Larvae (glochidia) of this species are parasitic on the gills of Alewives (Alosa pseudoharengus). Other species of Alosa (shad) may serve as hosts as well. Adult pearly mussels are filter feeders, able to ingest a wide range of particle sizes. Algae, detritus and bacteria are all important food sources. Mussels in turn are eaten by muskrats, raccoons, fish, and birds. (Strayer and Jirka 1997).

The Best Time to See

Little is known about the activity periods of Unionid mussels but they are presumed to be greatly reduced during cold times of the year. Freshwater mussels are most often easiest to locate during late summer when water levels are lowest. Phenology information in the table below is extrapolated from the co--occurring Alasmidonta heterodon in North Carolina (Michaelson and Neves 1995) .



The time of year you would expect to find Alewife Floater in New York.

Similar Species

Creeper(Strophitus undulatus): Strophitis has a bluish--white nacre, and a concentric beak structure.

Lake Floater(Pyganodon lacustris): Pyganodon species are usually much larger and a have bluish--white nacre (as opposed to pink to purple) and thinner shells.

Giant Floater(Pyganodon grandis): Pyganodon species are usually much larger and have a bluish-- white nacre (as opposed to pink to purple) and thinner shells.

Eastern Floater(Pyganodon cataracta): Pyganodon species are usually much larger and have a bluish--white nacre (as opposed to pink to purple) and thinner shells.

Cylindrical Papershell(Anodontoides ferussacianus): Anodonta implicata can be distinguished from Anodontoides ferrussacianus by its double looped beak sculpture (A. ferrussacianus' beak is concentric)

Taxonomy

Kingdom Animalia
└─ **Phylum** Mollusks (Mollusca)
└─ **Class** Bivalves (Bivalvia)
└─ **Order** Freshwater Mussels (Unionoida)
└─ **Family** Unionidae (Unionid Mussels)

Additional Resources

Links

NatureServe Explorer
http://natureserve.org/explorer/servlet/NatureServe?searchName=ANODONTA+IMPLICATA
Google Images
http://images.google.com/images?q=ANODONTA+IMPLICATA
Unio Gallery
http://unionid.missouristate.edu/#http://unionid.missouristate.edu/
The Ohio state Division of Molluscs
http://www.biosci.ohio-state.edu/~molluscs/OSUM2/#http://www.biosci.ohio-state.edu/~molluscs/OSUM2/

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