

Freshwater Mussels

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What are Freshwater Mussels?

Freshwater mussels are members of a large group of animals called **mollusks**, which also includes saltwater mussels and clams, snails, squid, slugs, and even octopuses. Although mussels are found worldwide, North America hosts an extraordinary diversity of these organisms. According to the U.S. Fish and Wildlife Service (USFWS) there are nearly 300 native freshwater mussel species currently in North America, compared to 12 in Europe. Most of these live in the vast Mississippi River watershed, but eight species are **extant**, or currently living, in Rhode Island (Raithel and Hartenstine, 2006). Freshwater mussels are part of the **benthos**, which is the community of organisms that occupies the bottom of a waterbody. Therefore, processes that change the bottom, such as **sedimentation** (the buildup of sediments from runoff into a waterbody), often harm mussel populations.

Mussels in Freshwater Ecosystems

Mussels play many important roles in freshwater ecosystems, particularly in cool, flowing streams. Some mussel species also live in lakes and ponds, where they are indicative that the pond has relatively high water quality. They feed by filtering water through their siphons, which allows them to transfer nutrients from the water column to the sediment below. Mussels filter algae out of water, but may filter at a slower rate if the water is dominated by blue green algae, or **cyanobacteria** (Stuart et. al., 2001). They can also use tiny appendages called **cilia** to sweep up sand or silt from below them to be filtered (Vaughn, et. al., 2008). Mussels consume zooplankton, **detritus** (dead and decaying matter), and algae. Therefore, they help maintain the proper balance of organisms typical of waterbodies that are **oligotrophic** or **mesotrophic** (have a low or medium level of nutrients). The mussels themselves serve as a food source for fish and other wildlife.

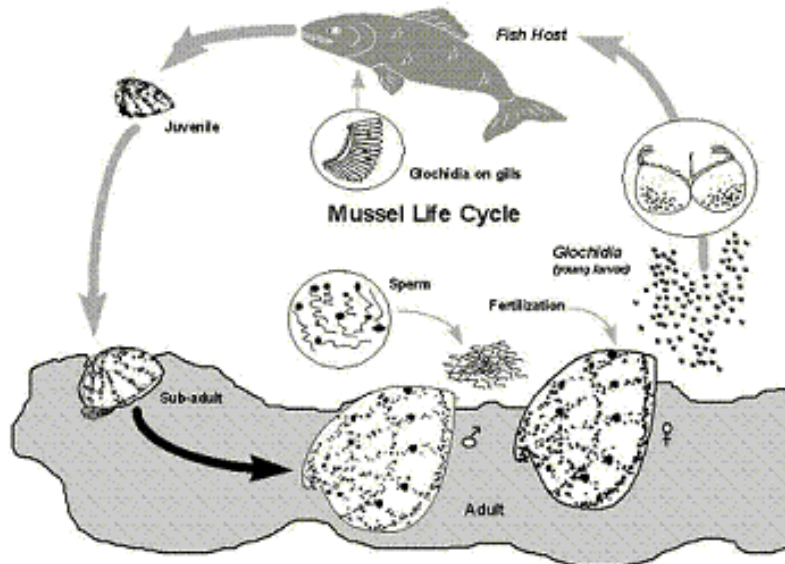
One study (Vaughn and Spooner, 2006) found that the density of mussels in streambeds affects the variety of other **macroinvertebrates**, or small aquatic animals that lack backbones, present. Mussels create a more favorable habitat for other aquatic life by stabilizing streambeds, introducing more dissolved oxygen into the substrate by burrowing, moving nutrients from the water column to the benthos, and providing a surface on which **periphyton**, or a mixture of algae and microorganisms that attaches to submerged surfaces, can grow.

Fig 1 (below): The process of sedimentation harms freshwater mussels by burying them if they are unable to move to a new area quickly and by making filter feeding more difficult (Credit: USFWS)



Fig 2 (above): Freshwater mussel beds increase the surfaces in a waterbody on which periphyton can grow (Credit: USFWS; Mike Davis, Minnesota Department of Natural Resources)

Life Cycle of the Freshwater Mussel



Source: *Freshwater Mussels of Iowa, 2002*, life cycle diagram: *Mississippi River, Lower St. Croix Team, Wisconsin Dept. Natural Resources*

Fig 3 (above): Native freshwater mussels are all dependent on their fish hosts to mature from glochidia to juvenile mussels. Glochidia do not harm their host fish while encysted (Credit: USFWS)

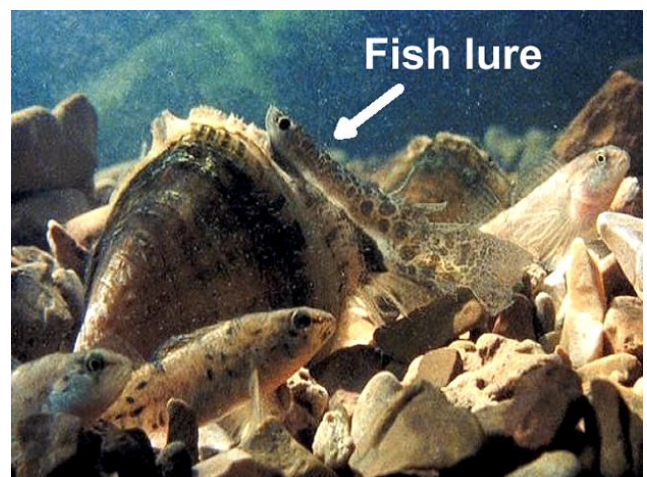
Fig 4 (below, right): This broken-rays mussels attracts its host fish by using a lure similar in appearance to the native fish surrounding it. (Credits: USFWS; Chris Barnhart, Unio Gallery, Missouri State University)

Mussel Fun Facts

- Some freshwater mussels can grow as big as a pie plate!
- The eastern pearlshell mussel can live to be 100 years old.
- The lures of different mussel species can resemble minnows, crayfish, flies, or worms. Some even glow in the dark!
- Freshwater mussels can form pearls, and tiny pieces of freshwater mussel shell are used as “seeds” to help commercially farmed saltwater mussels form pearls.
- In the early 1900s, freshwater mussels were harvested so that their shells could be used to make buttons.

The fascinating lifecycle of the freshwater mussel is closely tied to the movement of fish populations. Mussels are largely **sessile** organisms, which settle into the bottom sediments of a lake or stream and move using their single **foot** only when necessary. To breed, a male mussel releases sperm into the water column, where a female can siphon it in and fertilize the eggs within her body. In a few mussel species, the same animal is both male and female. The eggs develop within the mother’s gills until they are released into the water column as tiny larvae called **glochidia**.

Once the glochidia have left the safety of their mother’s gills, they must quickly find a fish on which to **encyst**, or form an enclosed sac, in order to complete their development. The tiny cysts do not harm their host fish. Although some types of mussels can encyst on many fish species, others need to find a specific host fish in order to survive to adulthood. Therefore, when a host fish species declines in a waterbody, the mussels that are dependent on it will decline as well. Some female mussels can attract hosts for their glochidia by creating lures that mimic the host’s favorite prey. For example, the pocketbook mussel uses a flap on its **mantle** to simulate the shape of a minnow. This attracts its host fish, the bass. When the bass bites the lure, the mussel injects its glochidia into their new home (Freshwater Mussel Conservation Society, molluskconservation.org).



Freshwater Mussel Species in Rhode Island

A thorough 2006 survey of shallow freshwater areas in Rhode Island found eight mussel species present in the state (Raithel and Hartenstine, 2006). The Pawcatuck River basin was the only watershed in the state to support all 8 species, and only the Pawcatuck and Pawtuxet River basins supported what researchers consider to be a high degree of species richness (Raithel and Hartenstine, 2006). The eastern elliptio, *Elliptio complanata*, was by far the most common mussel species; it was found at 58% of the sites that had any mussels present, including many lakes and ponds. In contrast, the eastern pearlshell, *Margaritifera margaritifera*, which is a state-listed endangered species, was found only in very healthy riffle areas in the Pawcatuck River basin's headwater streams. *Adonanta implicata*, the Alewife Floater, is found in the Pawcatuck River and recently expanded its range by traveling on host fish during herring runs.

In contrast to the Pawcatuck and Pawtuxet, the Blackstone River in Rhode Island hosts only the three most widespread mussel species. Water quality in the Blackstone has been degraded by the river's industrial history, and dams have slowed the spread of host fish (Raithel and Hartenstine, 2006). Like mussels throughout the country, freshwater mussels in Rhode Island face increasing pressure from human-caused changes to the waterbodies that they inhabit.

URI Watershed Watch volunteer monitoring data was used for a study on the growth rate of the eastern elliptio in Yawgoo, Tucker, and Worden Ponds (Kesler et al., 2007). The research showed that a mussel's growth rate is dependant upon the pond it resides in, and that mussels will preferentially allocate their energy to survival and reproduction before devoting energy to growth.

Fig 6 (below): The Asian clam, *Corbicula fluminea*, is a small, invasive bivalve that has been found in Rhode Island since the 1990s (Credit: Molly Hunt)



Fig 5 (above): Zebra mussels can quickly colonize any surface in their habitats, including the shells of native freshwater mussels like those above have done

Are Any Freshwater Mussels Invasive?

The most infamous freshwater mussel in the U.S. is *Dreissena polymorpha*, or the zebra mussel. Unlike the freshwater mussels found in Rhode Island's inland lakes and streams, the zebra mussel and its relative the quagga mussel are native to eastern Europe and western Russia. Zebra mussels were discovered in the Great Lakes in the late-1980s, and have since spread throughout much of the United States. At 0.25 to 1.5 inches they are much smaller than native mussels, and have free-swimming larvae called **veligers** that do not have to colonize a fish host. Zebra and quagga mussels are the only freshwater mussels in the United States that attach to solid surfaces instead of burrowing into sediments. This allows them to clog intake pipes, jam boat motors, and suffocate native mussels by binding to their shells (Minnesota Department of Natural Resources).

Although zebra mussels have yet to be found in Rhode Island's waters, another invasive freshwater bivalve, the Asian clam, has. The Asian clam, *Corbicula fluminea*, was likely introduced from recreational boats or emptied aquariums. *C. fluminea* was originally found in Rhode Island by Watershed Watch volunteers and reported to the USGS by Watershed Watch's Elizabeth Herron (E. Herron, personal communication). It has been documented in at least four Rhode Island waterbodies, including Worden Pond and Lake Tiogue, but has yet to reach destructive population levels in any of them (Mulvaney, 2007). Still, if it expands its range it will compete with native freshwater mussels for both space and resources. Rhode Island waters tend to be low in calcium, which zebra mussels, quagga mussels and Asian clams need to flourish (Mulvaney, 2007). However, vigilance from those who work or play on the water can help ensure that these destructive invaders do not have a chance to become established locally.

What Can I Do to Protect Freshwater Mussels?

- Join your local lake or watershed association. For a list of some organizations in Rhode Island, visit <http://www.uri.edu/ce/wq/ww/Partners.htm>
- If you live next to a waterbody, preserve natural vegetation in a "buffer zone" along its border to reduce sedimentation.
- Educate fellow beachgoers, especially children, that freshwater mussels are important animals that should be respected, not removed from the water or injured.
- Thoroughly clean your boat, waders, and fishing gear after visiting an area infested with zebra mussels, quagga mussels, or Asian clams. According to the U. S. Department of the Interior, invasive mollusks and their larvae can be killed by a solution of 1/2 oz. of chlorine bleach per gallon of water allowed to remain in contact with equipment for ten minutes.
- Volunteer to educate boaters about proper boat cleaning at your local boat ramp.



Mussels as Indicators of Water Quality

The U.S. Environmental Protection Agency (EPA) classifies freshwater mussels as **biomonitors** because they react to changes in the surrounding environment. Like many other freshwater macroinvertebrates, they are considered **indicator organisms** because they can show changes in the environment not shown by other organisms. Mussels have a range of tolerances to changes in water flow, changes in the substrate, increased silt, low dissolved oxygen, and intrusion by invasive species. Changes in mussel populations can be an early indicator of harmful impacts to a waterbody, such as industrial runoff or sedimentation caused by erosion. Furthermore, since mussels are filter feeders, they **bioaccumulate** metals and other contaminants in their bodies and shells (U.S. EPA). After mussels die, their spent shells leave behind a historical record of their presence that can be analyzed by researchers.

Fig 7 (left) Mussel populations declined in the 1800s and early 1900s because they were harvested for natural pearls (left; credit USFWS and Mississippi River Pearl Jewelry Co.)



*Fig 8 (above, right) The eastern elliptio, *Elliptio complanata*, is the mussel most likely to be found in Rhode Island (shown approximately full size)*

For More Information:

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