Cary Institute of Ecosystem Studies

Changing Hudson Project

Zebra Mussel Fact Sheet

The zebra mussel (*Dreissena polymorpha*) is a small bivalve originally native to the area near the Caspian Sea. It reached North America in the mid-1980s in the ballast water of a ship. It rapidly became established in the Great Lakes and the waters draining them. Zebra mussels will eventually colonize most of the waters in North America except for places that are too saline or too warm for their survival. The zebra mussels eat by filtering small organisms and organic particles. They filter at very high rates.

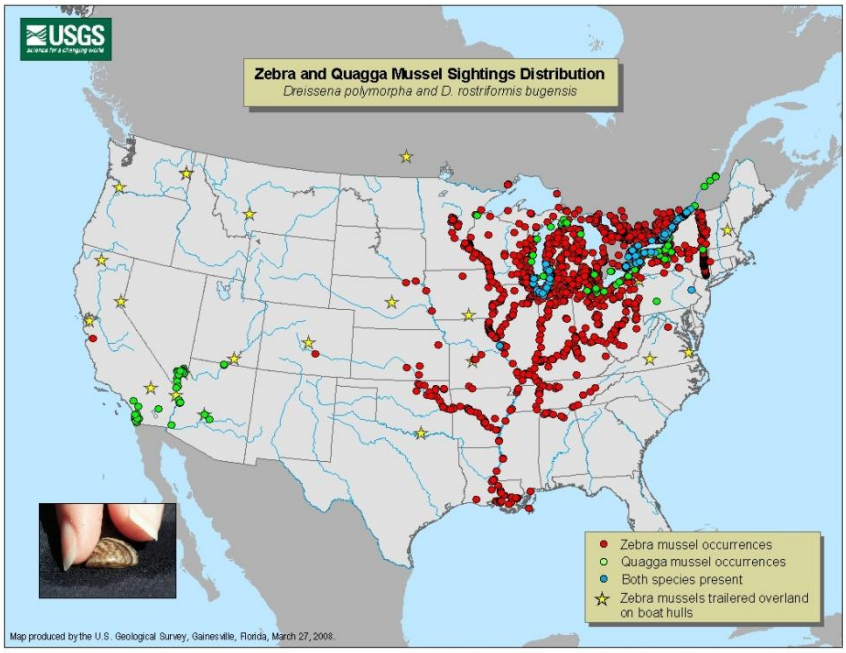
This photo shows a rock covered with zebra mussels. Photo: H. Malcom.

The Invasion

The zebra mussel was first discovered in the Hudson at very low densities in 1991. By the end of 1992, they had spread throughout the river, and their biomass was greater than the combined biomass of all other consumers (fish, zooplankton, zoobenthos, bacteria) in the river. Their densities can reach over 1000 individuals per square meter. Since there are so many of them, they are able to filter the entire freshwater part of the Hudson River every 2-4 days! Before the invasion, the native mussels filtered the water only every two or three months. While some might think that filtering the water is a positive thing, the words "filter" and "clean" are not synonymous. Zebra mussels are suspension feeders, eating phytoplankton, small zooplankton, large bacteria, and organic detritus by filtering the water and straining out the edible material. Phytoplankton and zooplankton form the base of the aquatic food web, so lots of animals depend on them for survival.

Effects on the Hudson Ecosystem

The zebra mussel invasion has had profound effects on the Hudson River ecosystem. The alteration of the food web by the mussel is of comparable magnitude to disturbances in other aquatic ecosystems caused by toxins, nutrient pollution, or acid rain. Look at the map below to see where the zebra mussel (in red), and the quagga mussel (in green) have been found. The quagga mussel is another invasive, closely related to the zebra mussel. Notice the stars in the middle of the country, indicating new invasion areas. These mussels were most likely brought to those areas by careless human activity.



As a result of the zebra mussels' huge appetite, populations of plankton in the Hudson River have fallen sharply. The population of phytoplankton has decreased by 80%, along with the microzooplankton (like the rotifer pictured at the right), which have declined by 70%. This means there is a lot less food available for fish, native mussels, and smaller organisms in the river. Water intake pipes provide an ideal habitat for the zebra mussel because they provide protection, and the constant flow of water through the pipe provides a constant supply of food (and removes waste at the same time). Once zebra mussels are attached to a surface in an ideal environment, they multiply rapidly and form densely packed colonies. Companies that use Hudson River water have to spend a lot of money making sure their pipes are clear of zebra mussels.

Many native mussel populations have decreased to the point of being threatened or endangered (because they are also filter-feeders). Other animals, including fish like shad (at left) and herring that live in the open water, also suffered. Dissolved oxygen levels have decreased, which can have different effects on different species. Besides the ecological changes, zebra mussels have caused a lot of direct economic damage, because they attach to hard substrates like drinking water intake pipes and power plant equipment. However, some things have improved with the zebra mussels, such as the increase in the fish that live in the vegetated shallows of the river (like the redbreasted sunfish on the right). Scientists think this happened because the clarity of the water improved due to the excess filtration, allowing more sunlight to reach the plants. With more light, the plants are able to grow more, and thus can provide more shelter for the organisms that the fish like to eat.

Glossary

Alien species: a species that was moved outside of its native range by human activities (also called exotic, non-native, non-indigenous, introduced). This does not apply to domesticated species.

Byssal fibers: thread-like strands adult zebra mussels produce to attach to firm objects

Detritus: bits of vegetation, animal remains or waste, and other organic material that form the base of food chains in many ecosystems

Drainage basin: a region including land and water which drains to a particular point; also called a watershed

Ecosystem: a system of interrelated organisms together with their physical and chemical environment

Food chain: the sequential transfer of food energy from one species to another. Higher species in the chain consume lower species in the chain.

Invasive species: a non-native, or alien species, that is aggressive and displaces native species

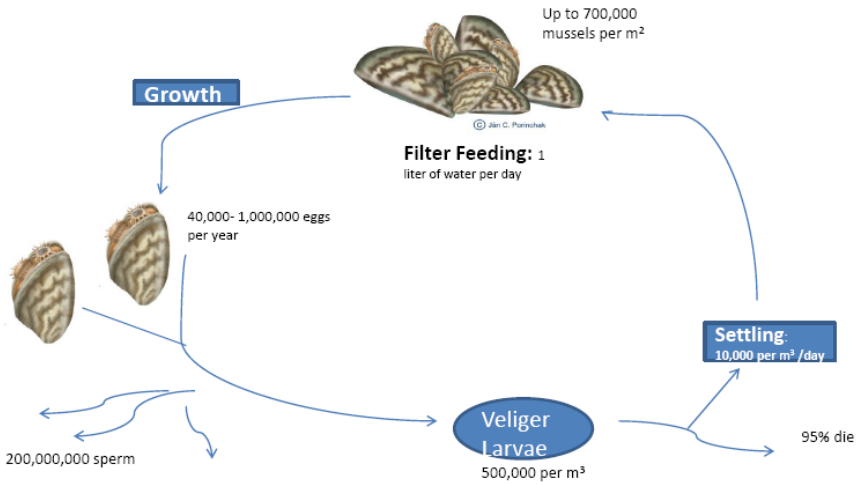
Mollusk: a soft-bodied aquatic animal, typically protected by a hard shell, such as a snail, clam, or mussel.

Plankton: small, usually microscopic, plants and animals that float in the water

Predator: an animal species that captures other animals, its prey

Veliger: microscopic juvenile stage of the zebra mussel

General Zebra Mussel Life Cycle



Zebra Mussel Life Cycle

On average, zebra mussels live 2-5 years and can reproduce by their second year. Each year, a mature female zebra mussel may release up to one million eggs while the male may release more than two hundred million sperm into the water where fertilization takes place. In approximately two days, the fertilized eggs develop into free-swimming larvae called veligers which can be transported over long distances by water currents. Within 2-3 weeks, the veligers begin to 'settle-out' in the water under the weight of their forming shells and attach to firm, underwater surfaces.

Zebra mussels cling to surfaces by using thread-like strands called *byssal fibers* tipped with a strong, sticky substance. As many as seven hundred thousand mussels can occupy a square meter. Once attached, they generally stay in one place, but can detach and crawl to a new location if environmental conditions change. In addition to water currents, zebra mussels can be transported by hitch-hiking on boats, boat trailers, sea planes, and other aquatic equipment. Adult zebra mussels feed by filtering large amounts of plankton and *detritus* from the water. Each mussel can filter one liter of water per day!

Zebra mussels thrive in nutrient-rich water which supports healthy populations of *plankton*. Substantial levels of calcium are required for shell production as are firm surfaces to which the mussels can attach. They like slightly alkaline water with temperatures between 68-77˚ F, but can survive more extreme ranges. Recent research has shown that zebra mussels may be susceptible to predation from fish and crabs in the Hudson River. Scientists are trying to figure out which types of animals eat the zebra mussels, and how this affects their population in the river.