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Paper 1

The presence of exotic species, such as zebra mussels, can often become problematic when introduced into already-established ecosystems because of the competition it creates with native species. A few species just do not have what it takes to survive under a new set of conditions, exotic species sometimes eliminate a native species altogether. Functionally healthy and established environmental communities seem more resistant to invasion and disruption. Ecosystems already altered by humans are more easily invaded and upset by exotic species.[1]

The most successful exotic species are those that are abundant in their homelands, have short generation times and high genetic variation, are larger than their most closely related species, and have wide environmental tolerance in general. One exotic species that has been particularly successful in freshwater lakes and rivers is the zebra mussel (Dreissen polymorpha).[2]

Zebra mussels get their name from a striped pattern which is commonly, but not always, seen on their shells. Zebra mussels have a distinct D shape on their shell and are usually about the size of a fingernail, but can grow up to a maximum length of nearly two inches. The shape of each shell varies from mussel to mussel. Their byssal threads allow them to attach to all sorts of things in water.[3] These sting-like threads come from inside the zebra mussel's shell and

[1] "Dreissena polymorpha (Pallas, 1771)." May 22, 1998.http://nis.gsmfc.org/nis_factsheet.php?toc_id=131 (accessed September 30, 2009).

[2] Ibid.

[3] "Zebra Mussel FAQs." http://fl.biology.usgs.gov/Nonindigenous_Species/Zebra_mussel_FAQs/zebra_mussel_faqs.html (accessed September 29, 2009).

are very difficult to remove once they become attached to other objects. Zebra mussels are filter-feeding organisms they remove particles from the water, which increases water clarity and reduces pollution. Lake floor food supplies become enriched by zebra mussels as they filter pollution out of the water. This biomass becomes available to bottom feeding species and to the fish that feed on those species.[4]

Zebra mussels live four to five years. Female zebra mussels start to reproduce at the age of two. When it comes to reproduction, zebra mussels are among the most abundant of all animals. A female Zebra mussel produces between 30,000 and one million eggs per year. Spawning usually begins in the months from late spring to early summer by free-swimming larvae. Because many other species prey on zebra mussels, only two percent of the exotic species reach adulthood. One example of the numerous predators zebra mussels have is crayfish, which consume zebra mussel in large quantities. The rate at which predation occurs for the Zebra mussels is greatly reduced in colder waters. Despite the many predators of the Zebra mussels, they still have large quantities which cover the bottoms of lake and river floors.[5]

The Zebra mussel came to the United States from Eurasia, most likely originating from Ukraine. The species was brought to the Great Lakes in the ballast of ships. Water pumped into lightly loaded ships is used as ballast or weight to give ships stability. Ships that filled up with water in Ukraine routinely emptied that water into the Great Lakes, and in that water were zebra mussel larvae. They soon established themselves and grew into adult mussels,

[4] Ibid.

[5] "Zebra Mussels." http://www.nationalatlas.gov/articles/biology/a_zm.html (accessed September 29, 2009).

spreading throughout the Great Lakes, and are now found in freshwater ecosystems throughout much of the United States, including the Hudson River.[6]

Zebra mussels first appeared in the Hudson River near the Catskill area in May 1991, most likely because of an accidental introduction by humans. Fisherman and recreational boaters may inadvertently transported zebra mussels from infested waters into uninfested waters. Mussel larvae can be carried in boat bilge water, bait buckets, and engine cooling water systems. Young and adult mussels can attached to boat hulls, engine drive units, and boat trailers. Kept wet, but not submerged in water (for example in bilges, live wells, inside trailer frames), adult zebra mussels may survive out of water for more than a week. Since adult zebra mussels can survive out of water for more than a week if the temperature is low and humidity is high, chain lockers provide temporary refuge for clusters of adult mussels that could easily be released when transoceanic ships drop anchor in freshwater ports.[7]

The zebra mussel has the potential to inhabit most of the fresh waters of the United States and may even impact a variety of native aquatic species and eventually entire ecosystems. Since September 1992, zebra mussels have been dominant in the Hudson River, constituting more than half of heterotrophic biomass. Zebra mussels feed by pumping water into their bodies through an intake siphon, filtering out particles of food and then pumping the water back out. This is leaving nothing for other native mussels to the Hudson River, such as phytoplankton and

[6] "Zebra Mussels in the Hudson: A Guide For Educators." 1994.http://library.marist.edu/diglib/EnvSci/archives/alienspe/nyseag/guideforeducators.html (accessed September 29, 2009).

[7] Ibid.

zooplankton. Phytoplankton biomass fell by 80% and the zooplankton by 70% as a direct result of consumption habits of the dominant Zebra Mussels.[8]

Zebra Mussels pose many threats to human activity as well as the ecosystem they inhabit. Many New York State towns, and the industries they house, rely on fresh water from the Hudson River to function. The Zebra Mussels pose a large threat to these businesses and communities because they can clog pipes that power plants and water suppliers utilize. Zebra mussels infiltrate interior plant structures, causing obstruction of pump valves and leading to failures of vital plant components.

In the summer of 2009, the Buffalo Water Department faced a multi-million dollar problem: divers from the Buffalo police Underwater Recovery Unit discovered a giant mound of dead Zebra mussels piling nearly eight feet high, clogging the opening of a Lake Erie pipe that supplies water to homes and business throughout Buffalo. The pipe is currently not working at full capacity because more than two thirds of the opening is blocked off by the dead mussels. “There’s nothing more expensive than divers in the construction business,” said City Engineer Peter J. Merlo.[9] Even though the problem is not an immediate problem, it has the potential to be one if a solution is not found.

The zebra mussel infestation has also has had a major impact on recreational water use. Boat and dock owners have been forced to find ways to remove the mussels covering their boat hulls, piers, and moorings. Boats could overheat due to Zebra Mussels blocking boat’s engine cooling water intake. In addition to this, mussels attached to hulls can increase drag, therefore increasing fuel consumption. Furthermore, in recreational areas, the smell of dead, rotting

[8] Ibid.
[9] Meyer, Brian. "Zebra mussels clog city's water intake pipe." July 21, 2009.http://www.buffalonews.com/home/story/739629.html (accessed September 29, 2009).

mussels has driven beachgoers away. The Zebra Mussel has a very sharp shell to it and because of its size hard to see. Sometimes on shorelines, people step on the mussels and cut their feet open. Instances like these turn off potential visitors and cause abandonment of beaches. [10]

When it comes to the problem they pose to the ecosystem they inhabit, the Zebra Mussels can attach themselves to the shells of other organisms such as native, fresh water mussels, making it impossible for the native species to feed. Zebra mussels can also consume so much phytoplankton in a given area that it upsets the current food web. Zebra Mussels also may contain high concentrations of toxic materials that could possibly harm or kill fish and wildlife that consume them.

Dr. David L. Strayer of the Institute of Ecosystem Studies (IES) comments of the effects of Zebra Mussels on species of fish that once were considered common to the Hudson River, "The changes we observed may lead to fewer adults of species such as American shad, and more adults of species such as redbreast sunfish in the Hudson. Maintaining a sustainable fishery for species… in the face of sharp population reductions will be challenging." Strayer continued, "When a river's ability to support young fish changes, it becomes more difficult to develop and evaluate sound management strategies."[11]

Once an exotic organism like the Zebra Mussel is introduced to an ecosystem, it is nearly impossible to eradicate them. Many solutions to the infestation of the Zebra Mussels have limitations and drawbacks to them. Trying to alter the habitat for them or even poisoning them to

[10] "Zebra Mussels." 2003.http://www.gma.org/surfing/human/zebra.html (accessed September 29, 2009).

[11] Quillen, Lori M.. "Muscling Their Way Into the Food Chain: Zebra Mussels Alter Fish Populations in the Hudson River." August 18, 2004.http://www.innovations-report.com/html/reports/environment_sciences/report-32479.html (accessed September 30, 2009).

limit the numbers has severe repercussions on other native species. Other solutions such as introducing a predator of the Zebra mussels to the ecosystem where they are predominant could invite even more problems. Boaters have a major role to play when it comes to spreading the Zebra Mussels from infested waters to uninfested waters. Boaters have to keep their boats and equipment clean when going from one place to another. This will avoid inadvertent transportation of the Zebra Mussels to other areas.

The regions infected by the zebra mussels' infestation need to take a proactive stance in order to research and study the exotic species. If zebra mussels do not stop infesting precious areas which dictate the success of surrounding communities, it will have an immensely negative effect on not only the economy of said region, but also the health of the community. With the right mixture of research and technology, scientists can help prevent attacks, and perhaps even predict where and when zebra mussels will spread to the area of a water facility. Zebra mussels can cause major damage to our world, and that is precisely why we must take action to prevent threats to human activity and disrupting ecosystems.

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