

Responses to Student Questions Concerning Zebra Mussels

Interview 1

1) How did the zebra mussel problem begin?

There is no proof of how zebra mussels came to North America. Most scientists agree that it was most likely in the ballast tanks of large ships from Europe and Asia. As the ships take on cargo in the Great Lakes, they must dump some of the ballast water or the ship will sit too low in the water.

From where did it originate?

Zebra mussels originated in the Balkans, Poland, and the former Soviet Union. In 1769, Pallas first described populations of this species from the Caspian Sea and Ural River in Russia.

2) What are water companies doing to counteract the problem of zebra mussels clogging the intake pipes?

There are several ways that water companies are dealing with zebra mussels. Treating with chlorine is the most effective way to kill them. Other chemicals called "molluscicides" are also effective. Zebra mussels can also be killed without chemicals by passing the water through different methods such as electrical current, carbon dioxide, ultraviolet light, acoustical vibration, and heating the water. Some facilities use screens and filters fine enough to stop the small larvae from getting through. Clogged pipes can be dewatered so that the zebra mussels dry up and die, but that can take too much time if there is not an alternate pipe which can be used while the clogged one is shut down. Some facilities have installed pipes made from copper, brass, or galvanized metal which zebra mussels do not like. But that can be expensive if you have a lot of pipes. The insides of pipes can be painted with copper or zinc based paints which again zebra mussels do not like. They also do not like silicone based paints because it makes it difficult for them to attach to the slick surface.

3) What problems are the mussels causing to the food chains of the ecosystems they're invading?

Most of the biological impacts of zebra mussels in North America are not yet known. However, information from Europe tells us that zebra mussels have the potential to severely impact native mussels (also known as clams) by interfering with their feeding, growth, locomotion, respiration, and reproduction. Researchers are observing some of these effects as they study interactions between zebra mussels and native mussels in the Great Lakes. In one study they determined that where zebra mussel densities were highest in Lake St. Clair and in the western basin of Lake Erie, the number of native mussels had dramatically declined. This difference was seen after only two years of zebra mussel colonization. Other studies have shown an inverse correlation between

zebra mussel biomass and native mussel density. Scientists in the Great Lakes region have been using models that may predict the degree of native mussel mortality based on zebra mussel densities. Unfortunately, research shows zebra mussels prefer to attach to live native mussels rather than to dead ones or to rocks. Some native mussels have been found with more than 10,000 zebra mussels attached to them. This represents a tripling or even a quadrupling of the native mussel's own weight. Native mussels may not survive if zebra mussels continue to colonize Lake St. Clair. The St. Croix River, a federally designated wild and scenic river in the upper Mississippi River basin, is being heavily guarded by the National Park Service because it contains the only known viable population of the winged mapleleaf clam (*Quadrula frugosa*). Zebra mussels could wipe out these clams if they become established in the river. Placing the native mussels in temporary refugia or transplanting them in waters absent of zebra mussels is being used as an alternative to try and save them. Another exotic invader, the quagga mussel (*Dreissena rostriformis bugensis*), probably arrived at the same time as the zebra mussel. Although the quagga mussel closely resembles its cousin, it is not expected to have as great an impact on native mussels because it does not show a preference for native mussels as substrates.

According to early studies, zebra mussels are having a minimal effect on fish populations in the Great Lakes. It may be too soon to determine some of the effects which may take more time to develop. However, there has been a striking difference in water clarity improving dramatically in Lake Erie, sometimes four to six times what it was before the arrival of zebra mussels. With this increase in water clarity, more light is able to penetrate deeper allowing for an increase in macrophytes (large aquatic plants). Some of these macrophyte beds have not been seen for many decades due to changing conditions of the lake mostly due to pollution. The macrophyte beds that have returned are providing cover and acting as nurseries for some species of fish. There also have been changes in the zooplankton species, some species are far outnumbering others. This shift seemed to coincide with the population explosion in zebra mussels.

4) In the future, do you think it's possible that zebra mussels will overwhelm the Great Lakes? How will that affect the environment?

Zebra mussels are already overwhelming the Great Lakes. In Lake Erie, scientists have recently discovered a large portion of the lake seems to be devoid of much oxygen. Of course this is not good for anything trying to live in the lake. Scientists are studying this phenomenon but their first suspect is the zebra mussel. When large numbers of any organisms die, they use up oxygen as they decay. This may be contributing to the problem.

5) Are there any predators of zebra mussels that can be introduced to the invaded waters to control the population? If so, will these predators cause additional problems?

Zebra mussels have natural predators in their native name in Asia such as fish and ducks. But it would be dangerous to introduce those predators here as they may find

North American species more to their taste. Some fish here such as the round goby (which came here from the same place in Asia as the zebra mussel), carp, catfish, and drum have been known to eat zebra mussels. A few species of diving ducks also have been eating them here in the Great Lakes. But they are not enough to control the population. The round goby which also arrived here accidentally from Asia is multiplying very quickly, especially in Lake Erie. I am certain its impacts will be revealed sometime soon.

Unfortunately we will have to learn how to live with the zebra mussel. Hopefully it will come into balance with its environment sometime in the near future and not be such a problem. But until then, we need to be aware of where they are and learn how not to spread them from one infested waterbody to another.

Interview 2

1. Will zebra mussels ever affect us so much that our water that we drink will be affected?

Yes, it may be possible that zebra mussels may affect our drinking water. They may promote the growth of a blue-green algae that produces a toxin harmful to people and animals.

2. Will zebra mussels start causing more problems than they already have in the years to come?

I am certain they will cause more problems. It may just take more time for the problems to develop or for us to realize that zebra mussels are the cause.

3. In the Great Lakes area they are trying to clean PCB from the water. Can Zebra Mussels help at all in cleaning the toxins from water?

They can absorb PCBs, but then you have toxic zebra mussels which could be eaten by fish and ducks. If people eat those fish, the contaminants get passed up the food chain.

4. What are some things that have been tried to stop the impact of zebra mussels, and why or why not have they worked?

In enclosed situations like in a power plant, zebra mussels are more easily controlled by chemicals such as chlorine and using filters. But in open environments like lakes and rivers, there is little we can do to control them. We cannot treat with chemicals in those situations. That is why it is so important not to spread zebra mussels by boats or any others means. Once there, they are impossible to eliminate. Unfortunately we are going to have to live with them.

5. Where else in the world are zebra mussels living?

Zebra mussels are native to eastern Europe and western Asia. They have now spread throughout western Europe including Great Britain. Once the canal system was built connecting most of Europe, zebra mussels spread quickly.

6. Do zebra mussels keep transferring from object to object, or do they latch to something and stay there forever?

Zebra mussels can detach and move, but it is difficult once they form a large mass.

7. Are zebra mussels directly harmful to humans?

They are not harmful to people or most animals. However, they will attach and grow on native mussels and kill them by unintentionally smothering them.

8. Are there any ways that one can spot that zebra mussels have infested water, or any signs in the water that will tell you they have been there?

You can try looking for empty shells that have washed up on the shoreline without having to get in the water. But the best way is to get in the water and look for them attached to docks or bridge pilings. If there are no manmade structures, you can look on rocks at the bottom of the water. The very young zebra mussels (before they grow a shell) are too small to see with the naked eye, you need a microscope. Because of this, they can be in a small amount of water, such as in a boat or a fisherman's bait bucket, without anyone knowing. If that little bit of water gets dumped to another lake without zebra mussels, a new population could start there.

9. Where have zebra mussels impacted the environment the most? Somewhere in Illinois?

They have mostly impacted the Great Lakes by changing what kind of animals are the most numerous. There are zebra mussels in the Illinois River, but they do not do well because of the poor water quality there.

Interview 3

1. Can you tell me a little about your job and how long you have had it and what you have done with Zebra mussels?

My job is to manage a database that contains information on most all exotics species found in the waters of the United States. I am not conducting research on zebra mussels, but I am tracking their spread across the country and keeping the information about their biology, ecology, and impacts.

2. *Where did you get your education/ professional development regarding the biology of these creatures?*

I have Bachelor's and Master's degrees in biology from a large university. Most of the knowledge I acquired on exotics species, however, came from on-the-job training in my current position as a fishery biologist with the U.S. Geological Survey.

3. *Since zebra mussels were introduced to North America, the water clarity has gone up dramatically causing more sunlight to reach the bottom of the Lakes creating more oxygen, therefore more animals and a higher Bio-chemical oxygen demand. So, how are the zebra mussels contributing to the clarity of the water?*

Zebra mussels are filter-feeders. They primarily feed on algae which is drawn in through their inhalant siphon. So they are simply clarifying the water by removing algae.

4. *Not too much information is present about what role zebra mussels are playing in North America's ecosystem and how it is affecting it. So what, if anything, do you know about the biological impact zebra mussels are having on North America?*

Most of the biological impacts of zebra mussels in North America are not yet known. However, information from Europe tells us that zebra mussels have the potential to severely impact native mussels (also known as clams) by interfering with their feeding, growth, locomotion, respiration, and reproduction. Researchers are observing some of these effects as they study interactions between zebra mussels and native mussels in the Great Lakes. In one study they determined that where zebra mussel densities were highest in Lake St. Clair and in the western basin of Lake Erie, the number of native mussels had dramatically declined. This difference was seen after only two years of zebra mussel colonization. Other studies have shown an inverse correlation between zebra mussel biomass and native mussel density. Scientists in the Great Lakes region have been using models that may predict the degree of native mussel mortality based on zebra mussel densities. Unfortunately, research shows zebra mussels prefer to attach to live native mussels rather than to dead ones or to rocks. Some native mussels have been found with more than 10,000 zebra mussels attached to them. This represents a tripling or even a quadrupling of the native mussel's own weight. Native mussels may not survive if zebra mussels continue to colonize Lake St. Clair. The St. Croix River, a federally designated wild and scenic river in the upper Mississippi River basin, is being heavily guarded by the National Park Service because it contains the only known viable population of the winged mapleleaf clam (*Quadrula frugosa*). Zebra mussels could wipe out these clams if they become established in the river. Placing the native mussels in temporary refugia or transplanting them in waters absent of zebra mussels is being used as an alternative to try and save them. Another exotic invader, the quagga mussel (*Dreissena rostriformis bugensis*), probably arrived at the same time as the zebra mussel. Although the quagga mussel closely resembles its cousin, it is not expected to have as great an impact on native mussels because it does not show a preference for native mussels as substrates.

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5. There are many ways of controlling the population of zebra mussels; what way do you believe is the best?

There are several ways that power and water companies are dealing with zebra mussels. Treating with chlorine is the most effective way to kill them. Other chemicals called "molluscicides" are also effective. Zebra mussels can also be killed without chemicals by passing the water through different methods such as electrical current, carbon dioxide, ultraviolet light, acoustical vibration, and heating the water. Some facilities use screens and filters fine enough to stop the small larvae from getting through. Clogged pipes can be dewatered so that the zebra mussels dry up and die, but that can take too much time if there is not an alternate pipe which can be used while the clogged one is shut down. Some facilities have installed pipes made from copper, brass, or galvanized metal which zebra mussels do not like. But that can be expensive if you have a lot of pipes. The insides of pipes can be painted with copper or zinc based paints which again zebra mussel do not like. They also do not like silicone based paints, it makes it difficult for them to attach to the slick surface. In open lakes and rivers, there is not one remedy to eliminate zebra mussels. Chemicals are certainly not the answer. Reservoirs can be drawn down to dry them out. Rivers and natural lakes are a different story. We are stuck with zebra mussels I'm afraid. We will never be able to totally eliminate them from our lakes and rivers. But we are controlling them in closed situations such as power plants.

Zebra mussels do have natural predators in their native range in Asia such as fish and ducks. But it would be dangerous to introduce those predators here as they may find native North American species more to their taste. Some fish here such as the round goby (which came here from the same place in Asia as the zebra mussel), carp, catfish, and drum have been known to eat zebra mussels. A few species of diving duck also have been eating them here in the Great Lakes. But they are not enough to control the population. The round goby which also arrived here accidentally from Asia is multiplying

very quickly, especially in Lake Erie. I am certain its impacts will be revealed sometime soon.

6. It seems like zebra mussels are very tolerable to most pollutants and temperatures, have they gone through any type of structural adaptation to get this way?

That is a very good question, but as far as I know they have not.

7. In anyway have they changed their behavior since moving to North America?

Zebra mussels are tolerating warmer water temperatures here in the U.S. I believe they are also colonizing soft bottom (mud, sand, silt) lakes as opposing to only hard bottom lakes where they can easily attach to rocks.

8. Zebra mussels are starting to eat the native mussels' food in lakes and rivers all over, what is the food that they are eating?

As I mentioned above, they feed on algae which is a shared food resource with native mussels.

Interview 4

1. How do these exotic organisms enter the ecosystem?

Many new organisms have entered the US in the water compartments (called ballast) of ships which are used to help balance the ship at sea.

2. What allows zebra mussels to attack?

Zebra mussels do not attack. You may be confusing it with the word "attach". They attach to surfaces using a specialized organ called a byssus. It is made up of many thread-like structures which have a kind of adhesive material on the end of each one.

3. How can we help lessen the amount of them?

It is basically impossible to keep them from reproducing in lakes and rivers. The only thing we can do is to stop spreading them from one waterbody to another.

4. What do zebra mussels eat? What eats them?

Zebra mussels are filter feeders, which mean they filter algae from the water to eat. Some species of ducks and fishes will eat zebra mussels, but there are far to many zebra mussels for the predators to make a difference.

5. What could be the long term effects if zebra mussels are not "taken care of?"

They could eliminate native animals through competition for food and space. They also could impact water quality making it difficult for native animals to adapt.

6. What was the first (or one of the first) issues that caused scientists to turn their attention towards the attack of zebra mussels on an ecosystem?

They were attaching to native mussels in the Great Lakes, inadvertently smothering and eventually killing them.

7. What has currently been done to help reverse the damage of zebra mussels?

It is not that simple. In rivers and large natural lakes where they are well established, nothing can really be done. They are now a part of the ecosystem and only through research can we unravel the complex detrimental impacts they are bound to have. Inside power plants where they are known to clog pipes and stop the flow of water. In small closed environments like pipes, chemicals and filters can be used to kill zebra mussels. We cannot use those same methods in the outside ecosystems because the environment is too large to treat with chemicals and filters.

8. What climate/conditions are necessary for the survival of zebra mussels?

They prefer the cooler climate in the northern half of the US. However, they can survive in the southern half of the US but do not reproduce as well in warmer waters.

9. What is the reproduction rate of zebra mussels and what effect on the environment does this have?

They can produce one million eggs over the course of a spawning season.

10. Would there be any disadvantages to getting rid of ALL zebra mussels?

None whatsoever, they are not beneficial to the ecosystems in the United States.

Source: U.S. Geological Survey, June 2017