ZEBRA MUSSEL

COMMON NAME: Zebra Mussel
The zebra mussel gets its name from the dark and light stripes on its shell that resembles those on a zebra.

SCIENTIFIC NAME: *Dreissena polymorpha*
Zebra mussels are in the Dreissenidae family, the false mussel and zebra mussel family.

DISTRIBUTION: Natively the zebra mussel inhabits parts of western Russia near the Caspian Sea and the Ural River. From its native origin, the species has spread to the point where the zebra mussel now affects the waters of most of Europe. The Canadian provinces of Quebec and Ontario have confirmed populations. As of 2005, sightings have been received from the following states: Alabama, Arkansas, Connecticut, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New York, Ohio, Oklahoma, Pennsylvania, Tennessee, Vermont, Virginia, West Virginia, and Wisconsin. For the latest distribution of zebra mussels in the United States, please visit the following website:
http://nas.er.usgs.gov/taxgroup/mollusks/zebramussel/maps/current_zm_map.jpg

Indiana: To view a list of the known bodies of water in Indiana that contain zebra mussels, please visit:
http://www.in.gov/dnr/invasivespecies/zebra_mussels_sightings.pdf

DESCRIPTION: Zebra mussels have a triangular shaped shell that rarely exceeds 1.5 inches in length. Their shell is bivalve meaning it has two halves. Usually the shell will have alternating dark and light bands resembling the stripes of a zebra, hence their name. However, not all zebra mussels will have this characteristic coloring pattern, some may

be entirely dark or light. The most distinguishing characteristic to look for would be the tuft of fibers called the byssal threads that grow from the foot and through the hinge of the mussel. These threads allow the mussel to attach to any hard surface. A similar species that may be confused with the zebra mussel is the quagga mussel, another exotic species.

LIFE CYCLE BIOLOGY: Zebra mussels are able to reproduce their second year. Over one spawning season a single female zebra mussel is capable of releasing one million eggs. The eggs will be fertilized when the male and female expel their gametes at the same time. Fertilized eggs develop into larvae called veligers. These veligers are not visible to the naked eye and are about the width of a human hair. They can remain suspended in the water for 3 to 4 weeks before they find a hard surface to attach to; those that don't find a substrate to attach will die. Once attached it takes one year for it to grow one inch and become sexually mature. The maximum age reported in the U.S. is 3 years while in Europe they have been reported to live 4 to 6 years.

Their ability to attach to hard surfaces is due to the tuft of fibers located at the hinge of their shell called byssal threads. These threads produce a powerful glue that anchors the mussel in place. Any hard surface is a suitable place for a mussel to live such as rock, metal, wood, vinyl, glass, rubber, fiberglass, paper, plants, other mussels, and the bodies of slow moving animals like crustaceans and turtles. Zebra mussels will layer over each other forming a dense covering over the substrate. Juveniles have the ability to break their attachment and generate new threads which allows them to drift downstream and find a new home.

Zebra mussels are filter feeders and can filter one liter of water per day. Almost all matter in the water is filtered. Zebra mussels feed on phytoplankton and some small zooplankton. Other matter filtered is expelled as pseudofeces. The zebra mussel has some limiting factors such as water temperature, calcium, pH, substrate, salinity and nutrients. Zebra mussels can only tolerate temperatures from 32 °F to 96°F. They need a temperature of at least 54°F. to reproduce. A calcium level of more than 20 parts per million is necessary in order to survive. The zebra mussel needs an alkaline environment as well with a pH from 7.2 to 9.0. They do best in water where there is an abundance of hard substrate, but they can proliferate in soft sediments. They like freshwater environments with a salinity level of less than 4 parts per thousand. Zebra mussels also do not do well in water that has a high nutrient content.

PATHWAYS/HISTORY: From its native range in the Caspian Sea, the zebra mussel invaded Eastern Europe through a series of shipping canals that were built in the late 1700's and early 1800's. Most of Europe was invaded by the mollusk by 1830. The first zebra mussel sighting in the United States was in 1988 in Lake St. Clair. This lake connects Lake Huron to Lake Erie.

DISPERSAL/SPREAD: It is believed that the zebra mussel arrived in Lake St. Clair via the ballast water of transoceanic ships. It did not take long for the zebra mussel to spread. By 1990, they could be found in all of the Great Lakes. In 1991, zebra mussels

had found their way into the Illinois and Hudson Rivers. From here they had even more access to other rivers and to disperse ever further. Just one year later, established populations were found in the Arkansas, Cumberland, Hudson, Illinois, Mississippi, Ohio and Tennessee Rivers. It was only a matter of time before the zebra mussel made its way into the inland waters of some states. Populations are now known from at least 23 states, primarily within the Great Lakes and Mississippi River watersheds. To see a progression of the invasion of the mollusk in the United States you may visit the following website: http://cars.er.usgs.gov/Nonindigenous_Species/ZM_Progression/zm_progression.html

Both the movement of adult zebra mussels and the larval form, known as veligers, can infect other bodies of water. If an adult zebra mussel attaches to a boat it has a free ride to new water by individuals who trailer their boats from one body of water to another. Adult zebra mussels are able to close their shell and survive for several days in cool, moist conditions. In its veliger stage of life a zebra mussel is able to hitchhike to other lakes and streams in water being held in the bilge, live wells, or bait buckets, or they may cling to plant fragments, the boat or trailer, or any other equipment or recreational items coming into contact with water. Once in a new body of water, their prolific breeding allows them to easily establish a viable population. Once a population is established the downstream waters are at risk of infestation since veligers can float downstream for 3 to 4 weeks in search of a hard object to settle on.

RISKS/IMPACTS: Ecologically, the zebra mussels cause many problems. One such problem is that they need to attach to a hard surface to survive, and these hard surfaces could be anything from many manmade objects to other animals. Zebra mussels will attach to crayfish, turtle shells as well as other mussels. When a native mussel has zebra mussels attached, the native mussel loses its ability to move, feed, breath, and breed. Eventually this will lead to the death of the native mussel. In Lake St. Clair and Lake Erie, the native mussel populations have been severely reduced due to the dense populations of zebra mussels. This dramatic drop happened only two years after the zebra mussel was discovered in the Great Lakes. This sends up a red flag for Indiana managers. With many of Indiana's native mussels already on state or federal endangered and threatened species list, zebra mussels could spell eventual extinction.

Zebra mussels have the ability to filter up to 1 liter of water per day. They eat the phytoplankton that is suspended in the water, which is in competition with the nearly microscopic animals called zooplankton. The food chain is very delicate and the zebra mussels could be disrupting it by taking out the very bottom link, the phytoplankton. This affects all the higher organisms including the fishes

Because zebra mussels filter large amounts of water, infested lakes have become clearer. While this may sound like a good thing, this can cause problems as well. With clearer water, sunlight penetrates to deeper water; this allows for more vegetative growth. This vegetation can become so thick that it could hinder swimming and boating.

While zebra mussels feed on phytoplankton, they do not eat blue-green algae. Because the blue-green algae are not being eaten, there is a competitive advantage over other algae resulting in a blue-green algae bloom. Such blooms occur in Lake Huron and Lake Erie much more frequently than ever before. Some forms of blue-green algae produce toxins. If enough blue-green algae toxin is produced, harm can occur to fish, waterfowl and any other animals that drink the water, including humans.

Yet another ecological impact that the zebra mussels impose on our native fauna is the fact that they are bioaccumulators. Any contaminant in the water is multiplied up to 10 times the water concentration in the zebra mussels. When the mussels are eaten, the contaminant concentration increases through the food chain. As zebra mussels become more prevalent more animals will eat them increasing the chance that higher levels of toxins will be accumulated throughout the food chain.

The zebra mussel is also economically detrimental. The mussel's need to attach to hard surfaces creates problems. Water intake structures are prime locations for attachment. These intakes provide a continuous flow of water and protection from predators. Once inside a pipe the zebra mussels layer on top of each other eventually causing reductions in pumping capabilities and even complete blockages. Industrial water pipes are not the only ones at risk. Residents whose cottages rely on lake water could see clogging of their supply lines. These pesky mussels get into engine cooling systems on boats, increase the deterioration of piers, increase the corrosion of steel and concrete, they have even sunk navigational buoys because the buoy could not support the additional weight. Beaches can become covered in the sharp zebra mussel shells and the odor given off by decaying mussels can be unpleasant, both of which result in reduced recreation. There is not just one problem associated with zebra mussels, as you can see they create a complex web of problems that are not easily fixed.

MANAGEMENT/PREVENTION: Once a population of zebra mussels has become established it is impossible to eradicate them without complete destruction of everything else that also lives in the water.

Research is ongoing in an attempt to find a way to disrupt the reproductive cycle of zebra mussels. Researchers are looking to try to mimic male hormones that trigger females to release their eggs. If successful, they can disrupt the breeding of the mussels by having the males and females release their gametes at different times, preventing fertilization.

Introducing natural predators, parasites, or diseases of the zebra mussel into an infested body of water is another way of lowering a population. This is know as biological control. Native Indiana predators of zebra mussels include waterfowl, sturgeon, yellow perch, freshwater drum, catfish, and sunfish. The exotic round goby, present in all of the Great Lakes and some of its tributaries, also has quite a liking for zebra mussels. One laboratory study observed one round goby eating 78 zebra mussels in a day. Unfortunately, anything that feeds heavily on zebra mussels will build up high levels of contaminants in its body. Due to the high reproductive capacity of zebra mussels, it is unlikely that predation will have a profound effect on reducing the nuisance caused by the invasive mussels.

There have been some successful procedures developed to prevent the invasive mussels from clogging water intakes. These include using molluscicides to kill mussels

at the entrance of water intake pipes, physically removing the mussels by scrapping, pigging, or high pressure washing, hot water or steam injection into infested pipes, and using toxic coatings containing copper or zinc on screens of intake pipes and boat bottoms to discourage attachment.

Many states have regulations prohibiting the import, transport, or possession of this species in order to limit the spread. In Indiana, it is illegal to possess live zebra mussels, quagga mussels, or Asiatic clams (312 IAC 9-9-3).

Most management efforts are geared at preventing any further spread of the zebra mussel. Spread is mainly caused by human recreational activities like boating, fishing, and diving. Some simple steps can be taken to help prevent spreading zebra mussels.

- ✓ Remove all plants and animals from your boat, trailer, and accessory equipment before leaving the access area.
- ✓ Drain live wells and bilge water before you leave the access site.
- ✓ Empty bait buckets on land rather than in the water.
- ✓ Wash your boat, tackle, downriggers, and trailer with hot water (above 104°F) when you get home. Flush your motor's cooling system, live wells, bilge and other boat parts that get wet. Let all equipment dry for at least five days before transporting your boat into a new body of water. If planning to move to another body of water sooner, you should disinfect everything that came into contact with water using a 5% bleach solution.
- ✓ Learn to identify the zebra mussel so you can report new sightings. If you find a zebra mussel in a lake that is not currently identified as an invaded lake, preserve the mussel in rubbing alcohol or freeze it, and contact the fisheries biologist in your area for positive identification. Visit the following website to locate your district fisheries biologist: http://www.in.gov/dnr/fishwild/fish/fishing/fishbiol.htm

If you want to find out if there are zebra mussels in a body of water, you can monitor for adults by immersing hard substrate, such as a concrete blocks, in different areas around the lake and check them periodically during summer and fall for attached mussels. You can check any submerged portions of your boat, dock supports, floats, etc. for attached zebra mussels as well.

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Photos courtesy of Sea Grant Great Lakes Network

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