

## PASSAGE ONE

***An Unwelcome Newcomer*****Invasion of the Zebra Mussel**

The Great Lakes form the largest group of freshwater lakes on Earth. Rivers and canals connect the five lakes to each other and to the Atlantic Ocean and the Gulf of Mexico. Ocean-going vessels reach these inland seas via artificial waterways (the St. Lawrence Seaway and the Great Lakes Waterway), which are vital shipping corridors.

Zebra mussels are an invasive species: one that has been transported from its native range, establishes itself in the new ecosystem, and causes ecological or economic harm. Named for the striped pattern of their shells, zebra mussels were accidentally carried from Eurasia to the Great Lakes in the mid-1980's, probably in the ballast water of ships. Just one year after they were first seen, their population was estimated at densities of up to 100,000 per square meter (about 10,000 per square foot). Within a few years, the mussels had spread from Wisconsin to Arkansas.



Zebra mussels pump water through their gills to filter out particles of food (primarily phytoplankton).

Females can lay over one million eggs in a spawning season, and populations can reach astonishing levels of 100,000 per square meter (about 10,000 per square foot) — or higher. They attach themselves firmly to

hard surfaces on the riverbed with a mass of thread-like strands called a byssus, which makes them hard to dislodge. They also attach to pipes, the bottom of boats, and even to

native mussels, which die because they cannot feed.

Zebra mussels are filter feeders. They pump water through their gills to filter out particles of food (primarily phytoplankton). Non-food particles are wrapped in mucus and spit out. These particles are deposited on the bottom of the river or lake where the mussels live, along with the mussels' feces. This feeding habit removes food for fish and invertebrates and can have a dramatic effect on ecosystems. Humans are also affected. Zebra mussels clog water pipes, for example, and power plants and businesses that use river or lake water have had to spend millions of dollars on removing them from the pipes. Zebra mussels can rapidly filter entire bodies of water, even large lakes and rivers.

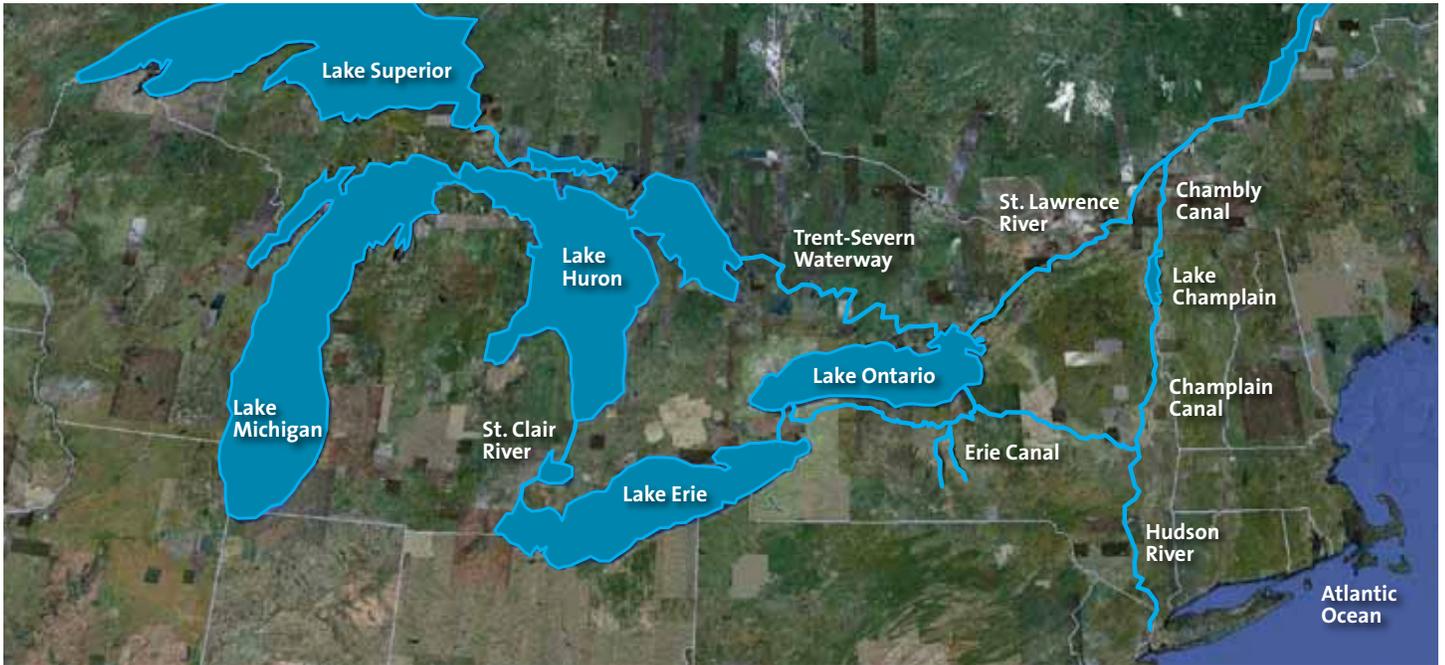
**The Hudson River**

The Hudson River flows south about 520 km (315 miles) from the Adirondack Mountains to New York Harbor. Scientists have been monitoring the Hudson's tidal freshwater ecosystem since 1986. At that time, there were no zebra mussels in the Hudson River, but the chances of an invasion via the Great Lakes Waterway were high.

A long portion of the Hudson River is tidal, unlike the Great Lakes. The tidal freshwater portion extends about 180 km (110 miles) from the Troy Dam north of Albany to Haverstraw Bay, 40 miles north of New York City. The tide can rise as much as 1.6 m (5.2 feet), and when it floods in from the Atlantic Ocean the river actually reverses direction and flows north for several hours. Much of its currents do not come from downhill flow but instead from these twice-daily tides.

These tidal currents keep the river water well mixed from top to bottom, resulting in high concentrations of suspended silts and clay. This is very different from many lakes that stratify seasonally into warmer layers above cooler depths.

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*An Unwelcome Newcomer*

The Hudson River connects to the Great Lakes through artificial waterways, including the Erie Canal and the St. Lawrence River.

With an average depth of 9.4 meters (31 feet), the Hudson's water is high in nutrients, fairly turbulent (or well-mixed), and quite cloudy. The tides also stir up silt from the watershed and the river bottom, which limits the amount of sunlight that penetrates the water and reduces phytoplankton growth.

The lower portion of the Hudson River from near Newburgh, New York to the southern tip of Manhattan is an estuary, where salty seawater mixes with freshwater. Some organisms, like the zebra mussel, can't survive in salty or brackish water. They live only in the upper, freshwater portion of the river.

Scientists wondered how a zebra mussel invasion might affect the Hudson River ecosystem, which is very different from the Great Lakes.

***Stop and Think***

1. What effect do you think a zebra mussel invasion might have upon the Hudson River ecosystem?
2. In order to investigate this question, what data about the river might scientists collect?