The Short-Term Impact of the Zebra Mussel Invasion

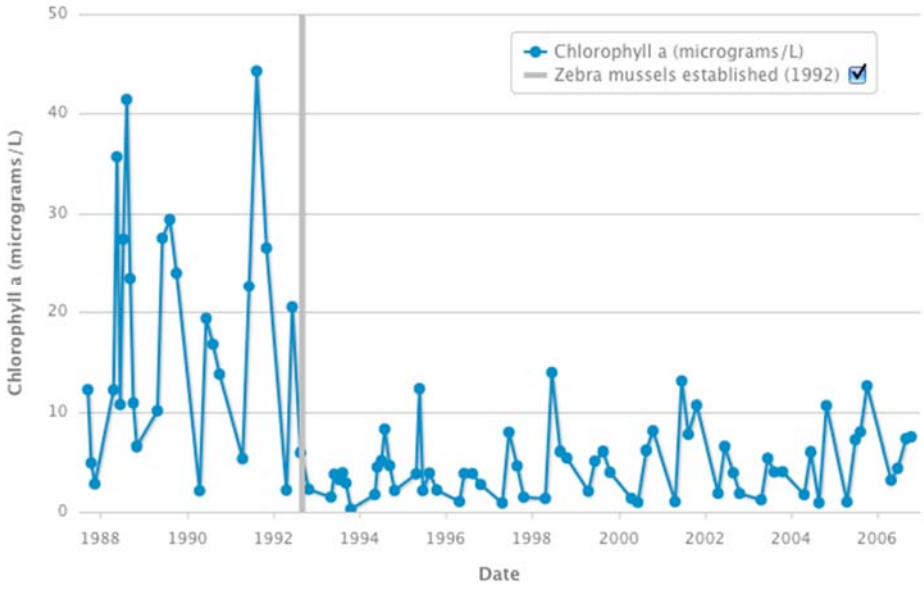
This article is provided courtesy of the American Museum of Natural History.

Zebra mussels first appeared in the Hudson River in May 1991. Within a year, scientists estimated their numbers had reached 500 billion, an enormous amount! In fact, if you had a huge balance and put zebra mussels on one side, they would outweigh all the other consumers in the ecosystem combined: all the fish, zooplankton, worms, shellfish, and bacteria.

An estuary is a dynamic body of water where freshwater and saltwater meet. The Hudson River is more than a river: it's a tidal estuary, where the saltwater from the Atlantic Ocean meets the freshwater running off the land.

Phytoplankton and zooplankton populations drop sharply

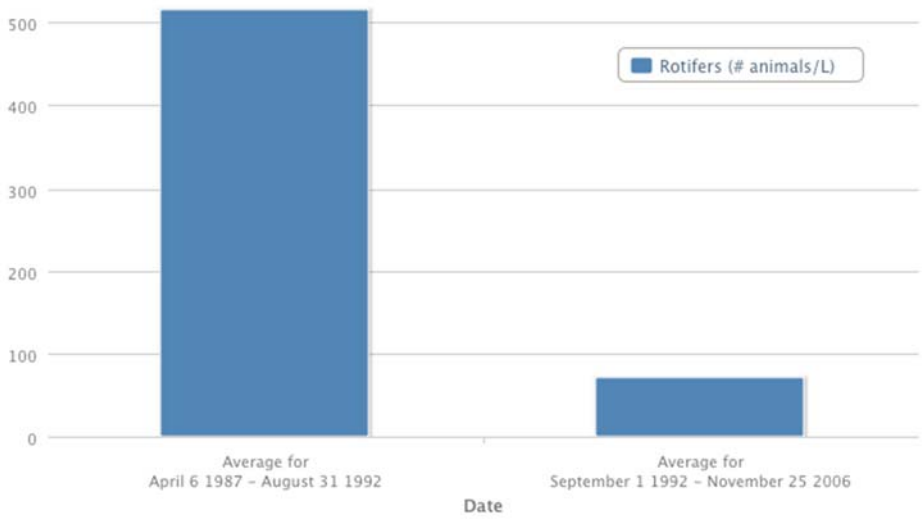
Before the invasion, scientists developed computer models to predict the effect of the zebra mussels. But they were still surprised by what happened. By 1992, there were so many zebra mussels, scientists estimate they were filtering a volume of water equal to all of the water in the estuary every 1–4 days during the summer. In the years right after the invasion, phytoplankton fell by 80 percent. Zooplankton (which eat phytoplankton) declined by half. And the smallest zooplankton (called micro-zooplankton), fell by about 90 percent.



WATCH WHAT HAPPENS

This graph shows the change in the amount of phytoplankton (represented by the blue line) over 18 years in the Hudson River. (The amount of phytoplankton is measured by the amount of chlorophyll they contain.) Look at the gray line above: there's a big change in the blue line when the zebra mussels first arrived in the river. What do you think happened?

By 1994, scientists hypothesized that zebra mussels were responsible for these changes. The mussels were filtering huge amounts of phytoplankton from the water. Less phytoplankton meant less food for zooplankton, so their numbers were shrinking too. Competition was taking place and the zebra mussels seemed to be winning.



A BIG CHANGE
This bar graph shows the change in the average number of rotifers (a type of zooplankton) in the Hudson River before and after the zebra mussels became established in 1992.

The food web changes

In the next few years, the data supported their hypothesis. Scientists made other findings too. They observed that the decrease in phytoplankton and zooplankton had effects that rippled throughout the food web. With less food available, there were fewer — and smaller — fish in the open river. The population of native mussels, which also eat plankton, shrank from more than one billion to almost none.

ALONG THE RIVER
The Hudson River flows 315 miles (507 km) through New York with over 1,000 cubic feet of water passing by every second (or 600 cubic meters per second). Scientists want to understand how the river changes over time and space.

But some populations increased — likely due to the change in the river's turbidity, or cloudiness. With far less phytoplankton, the water got clearer. During the summertime, visibility went from 3–4 to 4–8 feet. Since sunlight reached deeper into the water, rooted aquatic plants such as water celery increased by up to 40 percent. Populations of fish living in these shallow weeds increased. Another surprising result was that dissolved oxygen in the river fell by about 15 percent. The drop wasn't enough to endanger any

aquatic animals, but it was still a huge amount of oxygen. Scientists think the enormous zebra mussel populations were consuming a lot of oxygen very quickly. At the same time, the mussels were removing the phytoplankton that produce oxygen.

Questions about the long-term impact

What happens once an invasive species becomes established in an ecosystem? The invader's population might evolve to adapt to its new home. Or native species might evolve to better tolerate or even feed on the invader. Or other species might arrive that are more resistant to the effects of the invasion. Once scientists had a clear picture of the invasion's immediate impact, they started to wonder about long-term consequences like these.