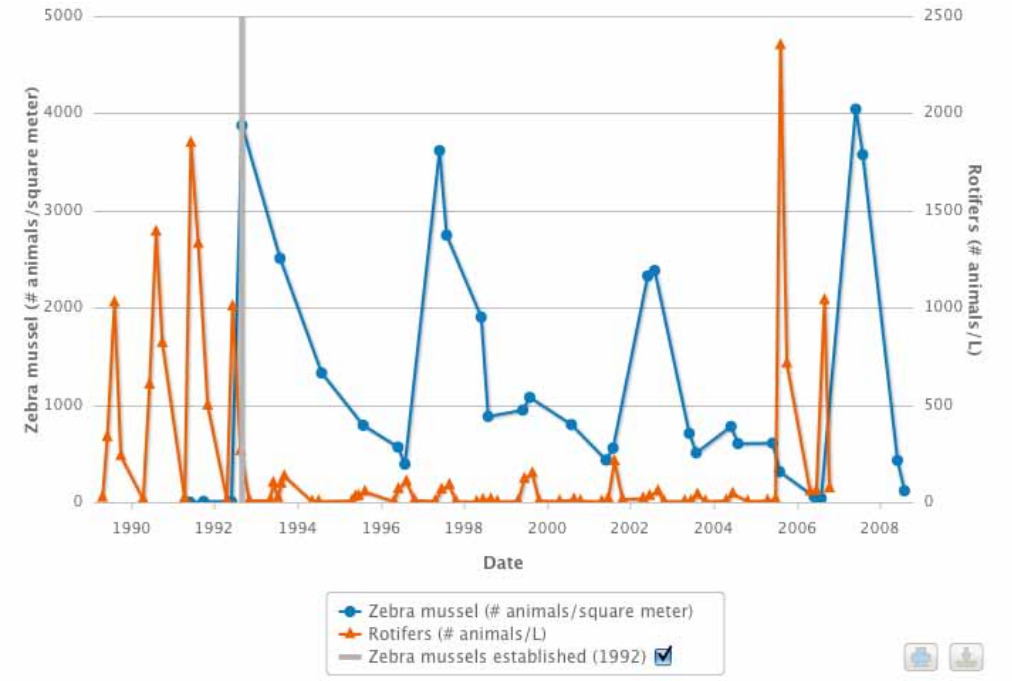
PASSAGE FOUR

Long-Term Monitoring of the Hudson River

A Puzzling Reversal

In 2005, 14 years after the first sighting of zebra mussels, Cary Institute scientists noticed a change in the Hudson River. Their data showed that levels of zooplankton had returned to pre-invasion levels. This was an unexpected observation. Why weren't the zebra mussels eating as much zooplankton?



This graph shows the relationship between the abundance of rotifers (orange line/triangles) and zebra mussels (blue line/circles) between 1989 and 2006 at Poughkeepsie station.

Then the scientists observed a change in the zebra mussels they were sampling. Zebra mussels are grouped into three size classes: small (<10 mm), medium (10–20 mm), and large (>20 mm). While zebra mussels continued to be abundant, they were on average much smaller. The decline was steepest in the largest size class – the oldest mussels. Zebra mussels have a maximum life span of six or seven years, and it now appeared that most were dying after one or two years. When zebra mussels first came into the Hudson River, survival rates were about 50 percent per year. In other words, an adult zebra mussel had about a 50/50 chance of surviving a given year. The annual survival rate had dropped to less than one percent.

Zebra mussels can collectively filter a large spectrum of particles, ranging in size from bacteria to small zooplankton. However, feeding ability varies with size. Larger mussels (> 20 mm) feed more effectively on larger food such as zooplankton, while smaller mussels are restricted to smaller food particles such as phytoplankton. It made sense that zooplankton populations were rebounding as the number of large mussels decreased. As at the beginning of the invasion, these new effects rippled through the food web. In addition to zooplankton, native mussels and clams started to recover. Scientists anticipate that some fish species will respond to the increased abundance of food, although that has yet to be documented. Scientists couldn't fully explain what caused the steep decline in zebra mussels, although they knew blue crabs were eating some of them.

Early on, as Cary Institute scientists had predicted, zebra mussels survived and thrived, with huge consequences for the ecosystem's food web and native species. Almost two decades later, their survival rate plummeted and parts of the

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ecosystem started to return to pre-invasion levels. But is this the final phase of the invasion? Could these be the first two stages of a far longer process? Scientists don't yet know.

More Time, More Data, More Answers – and More Questions

Long-term comprehensive monitoring of the Hudson River has enabled Cary Institute scientists to better answer their original question: How might a zebra mussel invasion affect the Hudson River ecosystem? As it grows, this long-term dataset allows scientists to track any significant changes in the river — whether from pollution, weather, sea level rise, invasive species, or human activity — and to pose new questions. This broad approach uniquely positions the Cary Institute to investigate the consequences of almost anything that might affect the Hudson River ecosystem in the future.

Stop and Think

1. How does the investigation of the Hudson River ecosystem exemplify the understandings about scientific inquiry and the nature of science?

Understandings About Scientific Inquiry and the Nature of Science (from NSES)

- Different kinds of questions suggest different kinds of scientific investigations.
- Current scientific knowledge and understanding guide scientific investigations.
- Mathematics is important in all aspects of scientific inquiry.
- Technology used to gather data enhances accuracy and allows scientists to analyze and quantify results of investigations.
- Scientific explanations emphasize evidence, have logically consistent arguments, and use scientific principles, models, and theories.
- Science advances through legitimate skepticism.
- Scientific investigations sometimes result in new ideas and phenomena for study.