

## Zebra Mussels and the Hudson River

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

A team of scientists at the Cary Institute of Ecosystem Studies has been researching the Hudson River ecosystem since 1986. Many changes have occurred along the river during this time, from economic development to the arrival of new species. Scientists have investigated how these changes affect the river and its aquatic life. Their research makes the Hudson River one of the most analyzed rivers in the world.



### **LOOK CLOSELY**

*A scuba diver collected this rock from the bottom of the Hudson River. It's covered with zebra mussels! How many do you think there are?*

Zebra mussels were transported to the U.S. in the water in the bottom compartments of cargo ships traveling from Europe to the Great Lakes. Waterways connect the Hudson River to the Great Lakes, so the Cary Institute scientists knew it was just a matter of time before zebra mussels would show up in the Hudson River. And since they had already begun collecting data on the river, they were in a unique position to understand the impact of the invasion. (Scientists don't usually have data about a lake or river until after the new species appears.) Their approach was to study the whole

*See the chart on page 3 to learn more about biotic and abiotic factors in the river.*

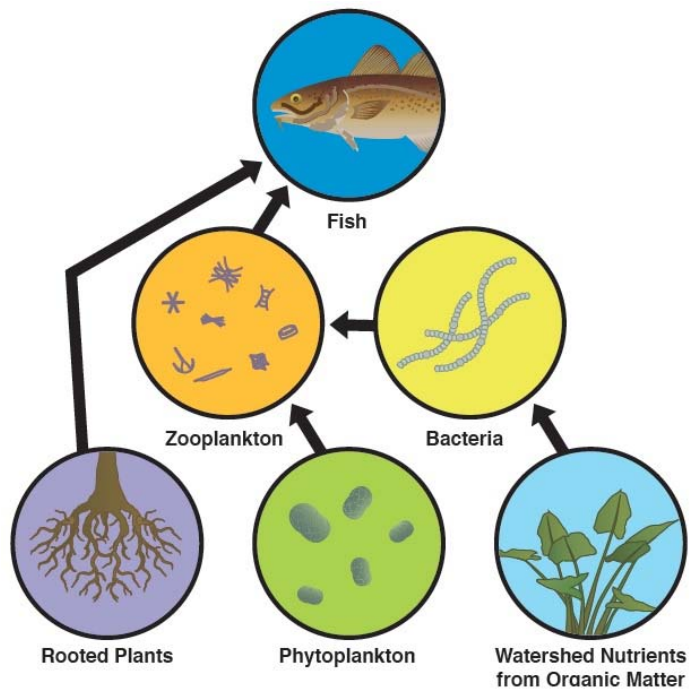
Hudson River ecosystem — both biotic (living) and abiotic (non-living) factors and the interactions between them.

### **POWERED BY THE SUN**

*Photosynthesis is the chemical process in which green plants and phytoplankton make food from carbon dioxide and water using sunlight or light as an energy source.*

## Making Predictions

Based on the Hudson's water chemistry, its river bottom, and other conditions, scientists predicted zebra mussels would thrive in the river. But the bigger question was: How would these zebra mussels affect the food web? Based on previous studies, scientists estimated how much plankton the zebra mussels could filter out of the water. (Phytoplankton and zooplankton are microscopic organisms that are two critical components of the river's food web.) The numbers suggested the impact of zebra mussels on the river could be huge.



### HUDSON RIVER ECOSYSTEM FOOD WEB

*This web shows how different parts of the Hudson River ecosystem interact with one another. Anything that happens to part of the web has an effect on the whole ecosystem.*

## Monitoring the River

Scientists have combined two approaches to studying the river's ecosystem:

- **A spatial approach**, in which water samples are taken from a transect of the river. A transect is a group of closely spaced locations along the river. This data helps scientists analyze how changes relate to geography.
- **A temporal approach**, in which samples are taken from the same six locations 4-6 times from May through October. (This is the "growing season" when organisms are most active.) Data is also collected from one location during winter months. By collecting data from the same locations for over 20 years, scientists can study changes over time.

**BIOTIC FACTORS****phytoplankton**

These tiny drifting organisms use photosynthesis to make food. They form the base of the ecosystem's food web. Like other producers, phytoplankton use chlorophyll for photosynthesis. To determine the amount of phytoplankton, scientists measure the amount of chlorophyll in the water.

**zooplankton**

These tiny animals drift in water, feeding on phytoplankton and other zooplankton. Scientists measure their abundance by filtering river water through mesh nets and then counting them under a microscope. Different mesh sizes are used to sample small and large zooplankton.

**watershed nutrients from organic matter**

Organic particles from soil, dead leaves, and other materials wash into the river from the watershed (the surrounding land). This organic matter feeds many organisms, especially bacteria.

**fish**

Fish are the top predators of the river's food web. Fish eat zooplankton, invertebrates, or other fish. Scientists divide fish into two groups: pelagic fish, which live in open, deeper water; and littoral fish, which live in shallow water with plants.

**plants**

Some plants grow where water is shallow and clear enough for sunlight to reach the bottom. (Most of the river is too deep and turbid.) Scientists have found grass-like plants called water celery in 6 percent of the Hudson. They produce organic matter for the food web.

**zebra mussels**

Scuba divers collect rocks from hard areas of the river bottom. In the lab, zebra mussels are removed from the rocks, counted, and their shells measured. In "soft-bottom" areas, scientists use a device called a benthic grab to collect material. They count the mussels they find in these samples too. They combine data from both areas to estimate the total number of mussels in the river.

**ABIOTIC FACTORS****water temperature**

Temperature affects an organism's metabolism — the internal chemical reactions that affect its health and growth. Air and water temperatures vary with changes in weather, season, and the global climate. Scientists have found that temperature changes can also affect an organism's life cycle.

**dissolved oxygen**

Oxygen is dissolved in water, but water doesn't hold as much oxygen as air in the atmosphere. Dissolved oxygen refers to molecules of oxygen gas (O<sub>2</sub>) — which is different from the oxygen in a water molecule (H<sub>2</sub>O). Even though aquatic animals can survive on lower concentrations of oxygen (O<sub>2</sub>), they are threatened when O<sub>2</sub> levels are too low. Both producers and consumers (like zebra mussels) take up oxygen during respiration, causing oxygen levels to drop. Zebra mussels also reduce oxygen levels by eating producers (like phytoplankton) that release O<sub>2</sub> during photosynthesis.

**suspended solids**

The solid particles suspended in water affect its clarity and quality. These particles — measured as total suspended solids (TSS) — can be both biotic (like phytoplankton) and abiotic (like silt and clay). Scientists measure water's TSS by pouring a sample through a filter. The suspended solids are any particles that are too large to pass through. Zebra mussels filter huge amounts of suspended solids, clearing large bodies of water. Since suspended solids block sunlight in the water, lower TSS means more light for producers.

The team gathers data from a small motorboat. They lower probes into the river to measure abiotic (chemical or physical) factors such as the water's temperature, oxygen and pH levels, current speed, and cloudiness of the water (called turbidity). They also collect water and zebra mussels to test back in the lab. There, they measure the amount of sediment in the water as well as biotic factors — the living organisms in the water. Along the Hudson, the key biotic factors are phytoplankton, zooplankton, bacteria, crabs, fish, and, of course, the zebra mussels.

**SCIENTISTS AT WORK**

*These scientists are collecting samples of tiny zooplankton from the river using long, fine mesh nets. They also collect data about each location using probes that measure temperature, oxygen, and other important factors.*

Name: \_\_\_\_\_ Date: \_\_\_\_\_

1. This article discusses a group of scientists who are studying an ecosystem. What ecosystem are the scientists studying?

- A the Hudson River ecosystem
- B the Great Lakes ecosystem
- C the Erie Canal ecosystem
- D the East River ecosystem

2. What is one effect zebra mussels could have on the river's ecosystem?

- A The river's water temperature could rise.
- B The river's water temperature could drop.
- C The amount of solids suspended in the river could rise.
- D Oxygen levels in the river could drop.

3. Read these sentences from the text.

"Based on previous studies, scientists estimated how much plankton the zebra mussels could filter out of the water. (Phytoplankton and zooplankton are microscopic organisms that are two critical components of the river's food web.) The numbers suggested the impact of zebra mussels on the river could be huge."

What conclusion can be made about the amount of plankton zebra mussels could filter out of the water?

- A Zebra mussels could probably filter out a very large amount of plankton.
- B Zebra mussels could probably filter out a small amount plankton.
- C Zebra mussels could probably filter out a lot of zooplankton, but no phytoplankton.
- D Zebra mussels probably could not filter out any plankton at all.

4. In an ecosystem, what can have an impact on the food web?

- A only biotic factors
- B only abiotic factors
- C only some biotic factors
- D both biotic and abiotic factors

5. What is the main idea of this article?

- A Scientists have been studying changes in the Hudson River ecosystem since before the arrival of zebra mussels.
- B Phytoplankton and zooplankton are the most important parts of the food web in the Hudson River ecosystem.
- C Scientists are combining two approaches to collecting data about different factors in the Hudson River's water.
- D Scientists are studying biotic and abiotic factors in the Hudson River to see how zebra mussels affect the ecosystem.

6. Read these sentences from the text.

"Scientists have combined two approaches to studying the river's ecosystem:

- A spatial approach, in which water samples are taken from a transect of the river. A transect is a group of closely spaced locations along the river. This data helps scientists analyze how changes relate to geography.
- A temporal approach, in which samples are taken from the same six locations 4-6 times from May through October."

Based on these sentences, what does the word "approach" most nearly mean?

- A a reason to do something
- B a way of doing something
- C a measure of distance
- D a nearby location

7. Choose the answer that best completes the sentence.

Scientists were in a unique position to understand the impact of the zebra mussel invasion on the Hudson River \_\_\_\_\_ they had already begun collecting data on the river.

- A although
- B however
- C because
- D as a result

8. What are three biotic factors that scientists are monitoring in the Hudson River to study the impact of zebra mussels?

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9. One abiotic factor that scientists are studying in the Hudson River is the amount of dissolved oxygen. Describe how two different factors can impact the amount of dissolved oxygen in the river.

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**10.** Why might it be important for scientists to monitor so many different biotic and abiotic factors as they try to observe the impact of zebra mussels? Use evidence from the text to support your answer.

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