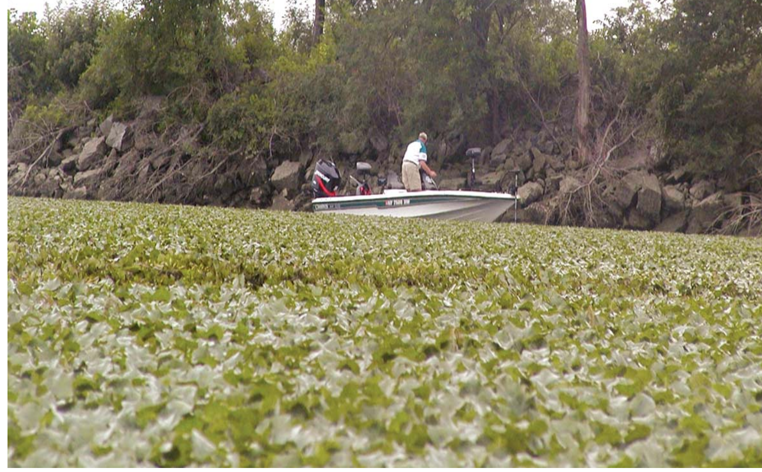
“Grinches” of the Hudson:

They stole the habitat, native clams, and the oxygen too!



Above: Floating *Trapa* beds choke open water areas of the Hudson. Photo by Nina Caraco. Left: The rather “Seussian” spines of the plants are also called “devil’s horns.” Photo by Paul C. Focazio

When exotic species invade native ecosystems they can bring about big changes. They can alter the habitat, displace native species, and make radical changes in the food web and the way nutrients cycle in that habitat. For the Hudson River, two species—the zebra mussel and European water chestnut—clearly have had significant impacts. The invading zebra mussel (*Dreissena polymorpha*) has clogged intake pipes, fouled equipment, killed off native clams, and had other negative impacts. European water chestnut (*Trapa natans*) covers extensive areas of Hudson River embayments. This exotic plant with its large floating leaves has displaced native species and choked open water areas. Its hard, nut-like fruit possesses sharp spines–a hazard to bathers.

Recent studies have identified another impact of these alien invaders, one that had not been widely recognized. These invaders reduce the **dissolved oxygen** levels (DO) in the water. For most life on Earth, oxygen is a critical element for survival; fortunately for terrestrial life, oxygen is abundant in the atmosphere. However, in the aquatic environment, oxygen is less abundant because it is not very soluble in water. Due to this much lower abundance, oxygen can and often does become very scarce in water, a condition known as **hypoxia**. In extreme situations, DO levels can reach zero. Some of the ways dissolved oxygen gets back into the water are through diffusion from the atmosphere, a process aided by wind (A) and from photosynthesis from submerged aquatic plants and algae (see diagram below).

Through their extensive research and monitoring, scientists at the Institute of Ecosystem Studies discovered a decline in average DO in the freshwater tidal Hudson River. In a NYSG-funded study, researchers **Dr. Jonathan Cole** and **Dr. Nina Caraco** systematically measured dissolved oxygen content in portions of the river from Poughkeepsie to Troy. Synthesizing their data with existing and historical data on freshwater flow and regional wind speed, they created a model of the DO dynamics in the river.

What they found was that the respiration of a growing population of the river’s zebra mussels (B) caused DO declines. Another finding showed that water chestnut beds (C) also have low to zero DO levels, especially during ebbing tides. Water chestnut depletes DO because its leaves cover the water’s surface, cutting it off from atmospheric oxygen; the plant’s photosynthesis releases oxygen back to the air instead of the water. Contrast this to the native water celery (D) (*Vallisneria americana*) whose leaves are submerged and release oxygen from photosynthesis directly into the water.

The researchers’ model allows them to predict DO levels in beds of water chestnut, water celery, and in the main channel of the river. (Below, A and D increase DO; B and C decrease it.) Their research and modeling have shown that changes in the food web caused by exotic species can cause DO declines. This is a little-considered factor compared to other sources of DO declines such as organic pollution. With the presence of zebra mussels and water chestnut beds, the Hudson River can handle less organic loading than it otherwise might. There needs to be consideration of the compounding effects of exotic species’ respiration, and the nutrient and organic loading that create hypoxic conditions which is harmful to much of the river’s aquatic life. The Caraco-Cole model may be useful for environmental managers who plan strategies for maintaining adequate dissolved oxygen levels in the river.

— Lane Smith