

How shellfish can help improve water quality



Why do we care about nutrients?

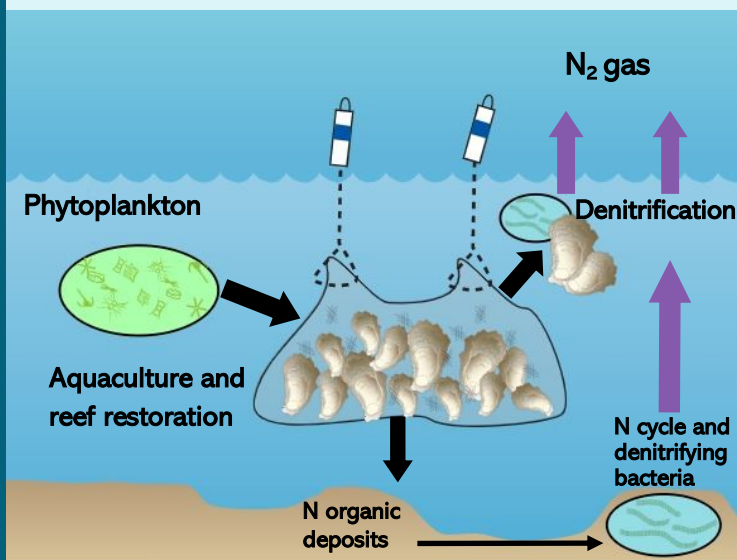
Nutrients are essential components of functioning ecosystems and human bodies. Nutrients, like nitrogen and phosphorus, are only a problem when in excess. Excess nitrogen is the primary nutrient of concern for many coastal waterbodies. Too much nitrogen in the water causes algae to grow faster than ecosystems can handle. Algae blooms can harm water quality, marine plants and habitats, decrease the oxygen that fish and other aquatic life need to survive, and can result in closure of waterways for recreational use and shellfish harvesting. The major human sources of nutrients are fertilizers, wastewater, and deposits from air pollution.

How do shellfish improve water quality?

Oysters and other shellfish remove nitrogen from the marine environment in two ways. Bivalves, like oysters and clams, feed on the nitrogen-rich phytoplankton in the water column. They use some of the nitrogen to build their shell and add to their body mass. **Bioextraction** is the removal of nitrogen via harvesting of bivalves in aquaculture and wild harvest. Since shellfish accumulate nitrogen in their bodies and shells, harvesting removes nitrogen from the system. Bioextraction also supports local shellfish industries and provides a tasty protein source for consumers.

Denitrification is the process of removing nitrogen in the form of nitrate from the environment, converting it into nitrogen gas that is permanently released into the air. Nitrate is a reactive form of nitrogen that is often associated with algal blooms. Nitrogen is broken down by bacteria on the sea bottom where the waste products fall and in the guts and on the shells of the shellfish. These bacteria change the forms of nitrogen to eventually release nitrogen as gas out of the water. Denitrification is a valuable process for cleaning up our waterways because it is the only nitrogen removal method that permanently removes nitrogen from the water column without removing shellfish from the water.

Scientists are doing research to better quantify how much nitrogen individual bivalves remove through denitrification. These numbers will help in standardizing denitrification amounts for nutrient credits for shellfish aquaculture and reef restoration in cleaning up waterbodies that are over enriched with nutrients. Currently, this is being explored in Cape Cod, Massachusetts, and in the Chesapeake Bay.



Simplified diagram of the influence of shellfish on the conversion of nitrate to nitrogen gas, or denitrification.

Graphic adapted from images from Integration and Application Network, University of Maryland Center for Environmental Science (ian.umces.edu/imagelibrary/)

What can you do?

Tackling the challenge of excess nutrients is a community effort that we can all contribute to. Supporting shellfish farmers and restoration efforts in your coastal community both supports your local economy and protects local water quality. Along with protecting the environment, reducing nutrients helps to ensure continued recreational access to the water. Finally, **buying shellfish from local aquaculturists and shellfish farmers and supporting efforts at shellfish restoration** will further efforts to use shellfish to remove excess nutrients.

While farming shellfish removes excess nitrogen from the environment that has already reached water bodies, there are also ways to minimize our contributions of nutrients to the water and soil. As fertilizers for plants and landscaping are one major source of nutrients, reducing excess fertilizer application is one way we can help reduce nutrient inputs that eventually run into the water.



Did you know?

Location, season, and growing method play a large role in the amount of nitrogen capable of being removed by oysters.

In New England waters, an entire 3-inch oyster is made up of about 8.25% nitrogen.



Water quality and beyond: Benefits of oyster aquaculture and reef restoration

Shellfish farms and reef restoration bring thousands (or even millions!) of oysters, clams, and other bivalves to coastal waterbodies. Each bivalve feeds on phytoplankton from coastal waters, thereby improving water clarity and reducing nitrogen in the waters. While in the water, shellfish provide surfaces in their guts and shells for denitrifying bacteria. Even the nondigested material that shellfish release helps to remove nitrogen through denitrification. When the shellfish farmers harvest the bivalves, the nitrogen in the shells and bodies of the animals are removed from the waters.

Oysters remove nitrogen from the water column through their filter feeding activity. Oysters harvested from commercial aquaculture farms are safe to consume. Before collecting oysters recreationally from local waters check with your local shellfish warden.

For more information, see Reitsma et al., 2017 and Rose et al., 2014.

