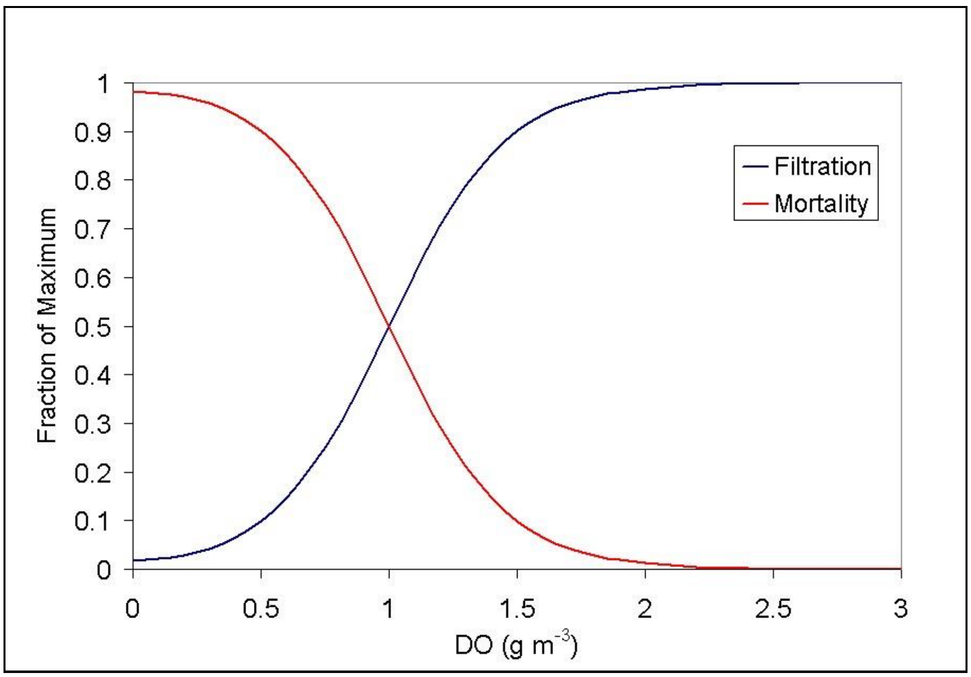
Top-down Control of Algae Blooms

An algae bloom is a rapid growth and accumulation of one or more phytoplankton organisms in a water body. Algae blooms can significantly reduce the dissolved oxygen in the water, resulting in a massive fish kill as well as for other marine species. In the spring of 2015, thousands of fish died in Peconic Bay, NY, situated between the two forks of eastern Long Island, as dissolved oxygen concentrations reached extremely dangerous levels (Semple, 2015). Dissolved oxygen is the amount of oxygen present in the water and is measured in milligrams per liter (mg/L).

Figure 1: Effect of Dissolved Oxygen on Filtration and Mortality (Cerco & Noel, 2005)



As shown in Figure 1, oysters are highly affected by the concentrations of dissolved oxygen in the water. Like many other marine species, mortality rates are very high when the concentrations are very low (Cerco & Noel, 2005). A massive algae bloom, resulting in decrease dissolved oxygen, could then severely impact oyster populations. This was the case in the 1940s when brown tide algae decimated oyster populations in the Great South Bay (Kassner, 2008).

Oysters can provide significant top-down control of algae blooms and can help mitigate the harmful effects of nutrient runoff and sewage entering the waterways (Coen et al., 2007). After all, oysters feed on phytoplankton and, through filtering, can reduce the excess nutrients in the water that cause the rapid growth of the algae bloom. However, as shown in Figure 1, filtration rates are also affected by the concentrations of dissolved oxygen in the water. Filtration rates for oysters are at their lowest when concentrations are very low.

This low filtration rate illustrates the limitations of the top-down control of algae blooms. Oysters filter less efficiently when dissolved oxygen levels decrease. Unfortunately, this is exactly when oysters are needed the most in order to consume the phytoplankton and reduce the excess nutrients causing the bloom. In this case, the rapid growth and accumulation of the algae is too fast and overwhelms the filtering control of the oysters (Cerco & Noel, 2005).

Another limitation of this control is that oysters in northern climates do not filter at the same rate throughout the year due to varying water temperatures (Pomeroy et al., 2006). The Great South Bay and New York Harbor both reside in this type of climate. Oyster filtration rates decrease dramatically during the winter months when water temperatures drop. When an algae bloom begins in the early spring, oysters can still be filtering at close to winter rates. In this sense, the bloom has a temporal advantage over the oysters' top-down control (Pomeroy et al., 2006). By the time water temperatures rise high enough for the oysters to filter at their peak rates, the algae bloom has already had too much of a head start for the oysters to control.

A growing misunderstanding, then, is that oysters alone are the solution for the harmful algae blooms that are increasing in intensity and regularity along the U.S. coastal waters. Some restoration advocates have argued that once one billion oysters have been restored to the Great South Bay, there will not be any further algae growth explosions (Dooley, 2015). While oysters do provide significant top-down control of algae blooms, this control has its limitations and can be overwhelmed even with very large oyster populations. Algae blooms can adversely affect the mortality rate of oysters by reducing dissolved oxygen and by releasing toxins in the water which are harmful to oysters (USACE, 2012).

Algae blooms are primarily caused by excess nutrients, sewage, and fertilizers in the water. In the Great South Bay, runoff from landscaping, septic systems, and farming has been the main culprit. While oysters can be very effective in improving water quality through filtering the excess nutrients, this control is essentially a remediation approach. Remediation is a process to reduce or clean-up the harmful effects of a problem. A mitigation strategy, on the other hand, helps to reduce or eliminate the causes of a problem. Remediation and mitigation are generally employed together in order to address both the causes and effects of a problem. For algae blooms, then, the excess nutrients, sewage, and fertilizers entering the water must be addressed.

Oyster restorations should be combined with strategies to reduce excess nutrients, sewage, and fertilizers from entering the water.

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