Eutrophication is another major problem that is associated with algal blooms in lakes that are receiving large inputs of nutrients through sewage disposal or the runoff of agricultural fertilizers. Eutrophication can result in severe degradation of the aquatic ecosystem when large quantities of algal biomass sink to deeper waters and consume most of the oxygen during their decomposition. The anoxic (deficiency in oxygen) conditions that develop are lethal to the animals that live in the sediment and deep waters, including most species of fish. Because the primary limiting nutrient in fresh waters is usually phosphate, inputs of this nutrient can be specifically controlled by sewage treatment, and by the banning of detergents containing phosphorus. This has been done in many areas in North America, and eutrophication is now less an environmental problem than it used to be.

So-called hypoxic "dead zones" are a routine phenomena in hundreds of bodies of water around the world. Within U.S. waters, significant dead zones are routinely identified in the Gulf of Mexico and Chesapeake Bay. The size and extent of the dead zones varies which each occurrence. In the Gulf of Mexico the dead zone appears annually.

The dead zones are characterized by diminished oxygen levels in the water due to elevated levels of algae caused by elevated levels of nitrogen and nutrients from runoff of fertilizers and other chemicals. The source of the nutrient pollution is often remote from the location of the dead zone. For example, nitrogen runoff from the length of the Mississippi River ultimately drains into the Gulf of Mexico. Since scientists began measuring the extent of the dead zones in the 1960s, the number of dead zones has doubled every ten years. Dead zones may vary in size from slightly less than half a square mile (about 1 square km) to 28,000 square miles (70,000 sq km) and may be transient (appearing or disappearing with seasons or over a course of years).

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Algal blooms

An algal bloom is a sudden increase in the population of algae in a freshwater or marine habitat.

An algal bloom is caused by an enrichment in the nutrient content of the water known as eutrophication. High levels of nitrogen and phosphorus in atrophic waters encourage the growth of algae. Eutrophication, and the accompanying algal blooms, are often a sign of water pollution, occurring when detergents, fertilizers, or sewage enter a river, lake, or sea. Algal blooms make water cloudy and create unpleasant odors. Some algae produce toxins that poison fish and other aquatic organisms.

The photosynthetic activity of the algae and their eventual death encourages the growth of oxygen-consuming bacteria called decomposers. Thus, the biochemical oxygen demand (BOD) of the water tends to increase where algal blooms are present.

A bloom generally looks like a scum on the surface of the water and may color it blue-green, red, or yellow, depending upon the species of algae involved. Algal blooms of different colors are increasingly common in slow moving rivers, estuaries, and bays around the world. They may be also be found in the ocean, near the shore.

An algal bloom is an overgrowth of phytoplankton, which are the single-celled algae lying at the bottom of freshwater and marine food chains. These organisms support organisms above them in the chain through photosynthesis. They contain chlorophyll and other photosynthetic pigments, which give an algal bloom its distinctive color. The two phyla of phytoplankton usually found in algal blooms are diatoms and dinoflagellates. A phylum is the major biological classification within a kingdom and will include many different species. Algae form the kingdom known as the

protists, but were formerly classed as plants. The diatoms have cell walls containing silica that divide the organism into two distinct halves. Dinoflagellates have a rigid cell wall that also contains silica and have two tiny whiplike structures known as flagellae to propel them through the water. Dinoflagellates are responsible for red tides. Algal blooms may also involve blue-green algae that are actually not algae at all, but belong to a phylum of bacteria known as the cyanobacteria. An algal bloom may contain as many as a million organisms per milliliter.

Algal blooms tend to occur where water is slow-flowing or stagnant, which is most likely during hot summers and when rainfall is reduced for any reason. Such conditions are most likely to be found in wetlands, dams, and rivers. Slow moving or still waters become stratified, with a warm layer near the top. Algae like to grow in such surface layers where they can soak up maximum sunshine for photosynthesis. They do not grow nearly as well in fast-moving or turbulent water, so algal blooms are far less likely in such locations.

The other major factor encouraging the growth of algal blooms is eutrophication of the water. Eutrophication is an enrichment of the water in various nutrients, particularly nitrogen and phosphorus. These two elements are found, as nitrate and phosphate, in various sources of pollution such as detergents, fertilizers, paper pulp, food waste, and sewage. They enter watercourses through storm water, land runoff, or direct dumping. Marine eutrophication zones have been noted in recent years in the Gulf of Mexico, the Caspian Sea, the Baltic, and elsewhere around the world.

Algal blooms and dead zones

Dead zones in oceans and lakes are characterized by diminished oxygen levels in the water due to elevated levels of algae. In dead zones, elevated nitrogen and other nutrient levels attributed to fertilizer runoff and other human activities stimulate algae growth that deplete oxygen available to fish and other marine life. Since scientists began measuring the extent of the dead zones in the 1960s, the number of dead zones has doubled every ten years and more than 150 dead zones exist in locations around the world. Dead zones may vary in size from slightly less than half a square mile (about 1 square km) to 28,000 square miles (70,000 km^2 and may be transient (appearing or disappearing with seasons or over a course of years).

Within U.S. waters, dead zones are frequently identified in the Gulf of Mexico and Chesapeake Bay. The source of the nutrient pollution is often remote from the location of the dead zone. For example, nitrogen runoff from the length of the Mississippi River ultimately drains into the Gulf of Mexico.

Blooms

Algal blooms have various impacts on freshwater and marine ecosystems. First, they make the water cloudy and reduce the depth to which sunlight can penetrate the surface layers. Their sheer number may irritate and block the gills of fish. Algal blooms and eutrophication tend to increase the population of oxygen-consuming bacteria called decomposers that feed on dead algae. The presence of such organisms increases the biochemical oxygen demand (BOD) of the water, a measure of the amount of dissolved oxygen they consume. The higher the BOD, the less dissolved oxygen is available for other organisms, so it is a measure of pollution. The level of dissolved oxygen in water determines the population of its ecosystem. Above six parts per million (ppm) oxygen, fish populations thrive, while below two ppm, bacteria and worms dominate. Therefore, an increase in BOD can cause profound changes in the aquatic ecosystem.

Most algal blooms are not harmful in themselves, but some do produce unpleasant odors and toxins that can affect fish and humans. So-called harmful algal blooms (HAB) are those that have negative effects upon human health, the environment, and the economy. HABs can, for instance, lead to the closure of local waterways and loss of fishing, boating, swimming, and other recreational and tourism facilities. Blooms may form in drinking water storage systems, such as reservoirs or dams, where they cause musty tastes and produce dangerous toxins. During red tides, shellfish may begin to filter feed on toxic algae. The shellfish are not always affected but may be consumed by humans, who may then become ill. On average, more than 100 deaths are caused by such shellfish poisoning around the world every year.

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