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ALGAE: LITTLE PLANTS WITH BIG IMPACTS

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A tremendous variety of microscopic plants and plant-like microorganisms are referred to collectively as "algae." Although algae serve as the base of the food chain in most freshwater habitats and throughout the oceans, they can and often do cause environmental calamities involving fish, birds, marine mammals, and even humans.

Fish kills in bayous, streams, and other freshwater habitats are often caused by oxygen depletion associated with excessive levels of fertility and algae. As nutrients are introduced into an aquatic environment, some are tied up directly in the bottom mud but most dissolve in the water. Most nutrients in fresh- and saltwater are taken up by algal communities, collections of microscopic single-celled plants and plant-like microorganisms suspended in the water.

Like most plants, many algae produce oxygen during the daylight as a by-product of photosynthesis. At night these algae consume oxygen, but usually much less than was produced during the daylight. Many common situations, however, can reduce the amount of oxygen a bloom produces without reducing its night-time oxygen demand. Extremely calm or cloudy days may reduce photosynthesis and oxygen production. This type of oxygen depletion may kill fish directly or weaken their immune systems through prolonged stress.

Temperature also influences algae and oxygen dynamics. As water becomes warmer, its capacity to hold dissolved oxygen decreases. During warm weather algae populations usually increase but much of the oxygen they produce during daylight may be lost to the atmosphere, resulting in insufficient carry-over to meet the night-time needs of fish and algae. The freshwater algae most associated with oxygen depletion are known as blue-greens. Blue-green algae generally thrive in shallow, calm, fertile, warm, brightly lit waters. Blue-greens are poor oxygen producers with significant night-time oxygen demands. They often exhibit population explosions and abrupt die-offs, also resulting in oxygen deficits.

Apart from killing aquatic life indirectly through oxygen depletion, blue-green algae—and some other types of algae as well—can cause more direct harm. While some blue-greens are currently being touted

for their nutritional benefits and medicinal value in health food markets, other varieties are known to be poisonous to fish, animals, and humans through toxic impacts on the nervous system, skin, respiratory tract and liver. Occasional livestock losses are attributable to blue-green toxins in stock ponds, and some people may have extreme allergic reactions to toxins produced by these algae.

In marine waters, fish, manatees, sea lions, dolphins, whales, pelicans, and many other forms of wildlife are targets of other toxic algae. One widespread group is known as the dinoflagellates. Although they generally fall under the broad heading of "algae," dinoflagellates are single-celled organisms with characteristics somewhere between those of plants and animals, belonging in a group scientists call the "protists." While most are important components of aquatic food chains, a small number of the thousands of dinoflagellate species (including those responsible for red tides) are toxic to fish and many other animals.

Toxins produced within these microorganisms can become concentrated by animals that feed on them, such as shellfish and other filter-feeders. This "bioconcentration" can affect humans if contaminated shellfish are accidentally consumed. Monitoring programs and regular shellfish inspections, however, generally prevent such occurrences. Toxins can also be released directly into the environment when a dinoflagellate bloom dies back. An estimated 14 million fish were killed during a red tide outbreak in Texas in September and October 1997. Airborne toxins in sea spray can irritate the eyes and respiratory systems of humans.

Noxious dinoflagellate blooms appear to be occurring more frequently in poorly flushed bays and lagoons in many parts of the world, although some have been occurring regularly for hundreds of years. The red tide organism relies on upwelling of fertile off-shore waters to initiate a bloom, and subsequent currents and winds to push it into near-shore areas. Nutrient run-off from urban and agricultural sources can sustain a red tide outbreak in near-shore areas for an extended period until weather and current conditions can dissipate the bloom.

Another toxic dinoflagellate in the news recently is the particularly sinister *Pfiesteria* (pronounced "Fi-steer-ia") *piscicida*. Rather than producing its food through photosynthesis, *Pfiesteria* prefers to feed directly on tissues from fish and other aquatic animals. *Pfiesteria* produces two distinct toxins—one damages the nervous system of fish passing nearby, partially or completely stunning them. Another causes lesions, producing blood and sloughed tissue for the protists to feed on. Both these toxins can adversely affect people who come into contact with them.

Diatoms are another group of algae with several toxic species, indirectly killing anything from pelicans to humans that may consume shellfish containing their toxins. Of roughly 4,400 known species of marine algae, only about 50 produce toxins, but many can produce localized oxygen depletions similar to those caused by blue-green algae in freshwater habitats. Heavy blooms in coastal waters in Texas following the 1989 freeze were determined to cause a 20 percent loss of sea grass beds simply shaded because they shaded the sea bottom. Decomposition of fish and other animals killed by the freeze was suspected as the source of fertilizer for the bloom.