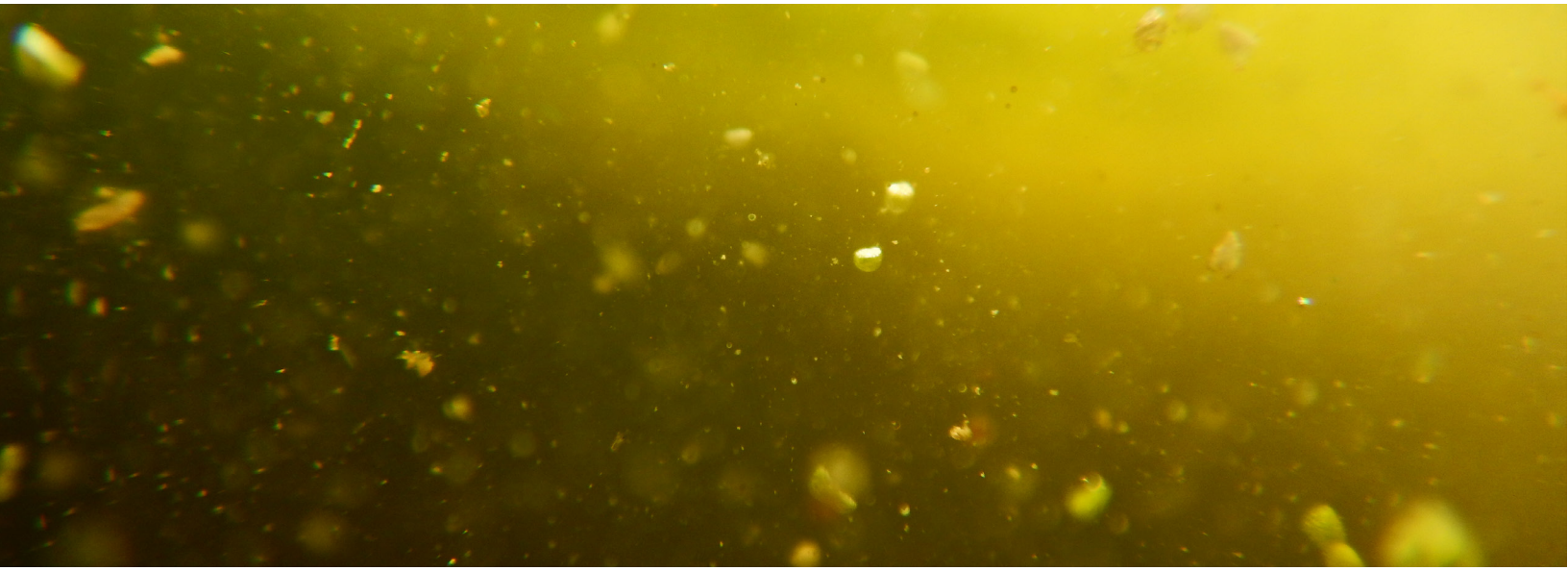
Medora Corporation

Harmful Algal Blooms (HABs)



Life on our planet is very dynamic. There are not many stagnant environments, and fewer organisms that prefer such habitats. In the aquatic realm, stagnation can temporarily occur in water bodies during periods of strong thermal stratification (typically during summer months) when there is also an absence of outside forces such as wind or hydraulic movements from tributary input. From puddles to ponds to wind-protected areas of large lakes, stagnation of surface waters can occur for days or even weeks.

Most planktonic algae do not do well in stagnant waters because they tend to settle out of the photic zone into dark, bottom waters where they can no longer photosynthesize or survive. Nutrient depletion occurs more rapidly in stagnant waters, further inhibiting algal growth. However, there are two groups of algae that have evolved to thrive under such stagnant conditions, namely: 1) the prokaryotic cyanobacteria (Cyanophyceae, or blue-green algae, which gets its name from the color of its cyanopigments) in primarily freshwater systems, and 2) the eukaryotic dinoflagellates (Dinophyceae, e.g., Gonyaulax, one of the species that causes “red tides”) primarily in estuarine/marine systems. Both types of algae are characterized by high vertical mobility and species with very potent toxicity. During episodes of high growth they create what is commonly known as harmful algal blooms (HABs).

Unlike other algae, both HAB phytoplankton groups can rapidly orient their position in the water column in response to changing light and nutrient availability. Cyanobacteria contain intracellular gas vesicles that are used to regulate buoyancy for rapid vertical migration. Daytime migration to the surface gives cyanobacteria a competitive advantage for sunlight and carbon dioxide, as well as nitrogen for those species that are able to “fix” or incorporate atmospheric nitrogen (N2) using specialized cells called heterocysts. Some cyanobacteria species have been known to move up to 140 m day^{-1}. At night, cyanobacteria can sink back down into more nutrient-rich waters. Dinoflagellates use flagella for swimming to regulate their vertical position in the water column, with reported rates up to 20 m $day^{-1.}$

Both HAB phytoplankton groups are also characterized with species that may contain some very nasty toxins, presumably to help discourage predation. The three types of toxins from cyanobacteria that are of most concern are heapatotoxins (liver toxins, e.g. microcystins), neurotoxins (affecting the nervous system), and dermatotoxins (affecting the skin).

These toxins are different from MIB and geosmin, also produced by some cyanobacteria, which can cause earthy/musty taste and odors but are not a health risk. Powdered activated carbon, ozone and reverse osmosis are among the ways water treatment plants keep algal by-products from your faucet. Several species of dinoflagellates also produce powerful neurotoxins that can cause red tides and paralytic shellfish poisoning. It is interesting that the shellfish and some fish that consume these dinoflagellates are not necessarily harmed, but vertebrates (including humans) that eat these shellfish are poisoned and may die. Perhaps the earliest reference to a red tide comes from the Bible: “All the waters that were in the river turned to blood. And the fish that was in the river died; and the river stank, and the Egyptians could not drink the water in the river” (Exodus 7: 17).

The Biblical passage above brings up another characteristic of HABs – they produce truly noxious, eye-watering odors when they die. And because of their gas vesicles, cyanobacteria form a surface scum that can get wind blown to different parts of a lake or on to shores – stinking up the areas where they end up. Microcystis is a common HAB-forming cyanobacteria that looks like green paint when it blooms, and creates horrific odors when the algae die. But it is important to appreciate that not all “surface scum” is made up of cyanobacteria. Often, particularly in early summer, filamentous green algae (Chlorophyceae) can cover shallow ponds with thick mats. Although not visually appealing, these filamentous algae are not toxic, are edible to some fish and waterfowl, and do not produce noxious odors.

Cyanobacteria and dinoflagellates have been around for a very long time, as far back as 2+ billion years ago in the earth’s primordial seas. These algae are well adapted to warm, stagnant waters rich in soluble organic matter and algal nutrients. Once beneficial as a primary source of photosynthetically-produced oxygen during the earth’s early years, these organisms are now the poster children for undesirable eutrophication. They are not easily consumed by aquatic biota, and do not meaningfully contribute to the food chain of a lake’s fishery. Instead, they poison the environment for other aquatic life thus reducing biodiversity, and upon death and decomposition they create noxious odors at the lake surface and oxygen depletion in bottom waters. In the last decade there has been a rapidly growing appreciation that HABs are arguably the most serious ecological and public use threat to lakes and reservoirs worldwide. Lakes are wonderful ecosystems and July is a great month to appreciate them, but do not let loved ones (including pets) swim or drink in a lake that may be experiencing a HAB.

About Medora Corporation

Cyanobacteria and their associated toxins continue to be one of the largest threats to water quality across the world.

GridBee® and SolarBee® brand equipment provide solutions for difficult problems across the water quality spectrum including lakes, drinking water, and stormwater applications. Please contact us to discuss how we can help you make water better.