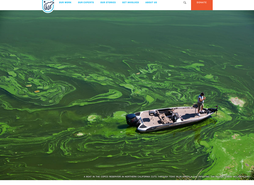

A bloom in Western Lake Erie, Ohio, August 2014. Photo by Jim Ruhlen, Flickr

OUR STORIES · ARTICLE

Freshwater Harmful Algal Blooms 101

By Kristen L. Jellison

Ugly, foul-smelling and sometimes toxic, algal blooms are becoming increasingly common in lakes and reservoirs around the world. Some are small and inconsequential, Rivers & lakes of all shapes and sizes can impact the environment—and human health.

August 28, 2014 | Rebecca Gibson & Warren Stone

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You may have read about algae being your plant buddy of countless, cooing teachers and turning the sea a murky brownish red in a phenomenon known as red tide. But harmful algal blooms (or bad algae) are unique. They also form in bodies of water, but they are not the same as the green, beneficial algae that provide food and oxygen for aquatic life and humans. They can also be dangerous, imperiling public health and aquatic ecosystems, and costly, affecting local economies. While harmful algal blooms have been a problem in freshwater and marine ecosystems for centuries, reports of freshwater harmful algal blooms have increased significantly over the past 30 years, and they are now an environmental problem in all 50 states. Researchers predict that climate change will only exacerbate the issue, leading what you need to know about algal blooms, including their causes and consequences.

Algal bloom in Grand Lake St Marys, Ohio
Credit: Rebecca Gibson

What is an algal bloom?

Critical to aquatic food webs, algae are photosynthetic organisms—in other words, they make their own food using light, water, and carbon dioxide. Microscopic or microscopic algae in algae-like bacteria in fresh, salt, or brackish waters. Depending on the type of algae or bacteria that causes it, an algal bloom may produce foul-smelling scum, foam, froth, or a pigmented water. Algal blooms can be any color (including green, yellow, brown, pink, and red).

Not all algal blooms are bad. Our ecosystem depends on them. But a growing number are harmful algal blooms, or HAB, a bloom that produces toxins that can cause illnesses in humans and potential other organisms.

The Most Common Types of Freshwater Harmful Algal Blooms

Any type of algae can proliferate into a HAB under the right conditions. Most freshwater HABs in the United States are produced by cyanobacteria.

Cyanobacteria (blue-green algae)

Cyanobacteria (Microcystis aeruginosa) are a common type of HABs in lakes, ponds, and other freshwater systems in the country, although they can occur in brackish and saltwater environments, too. Cyanobacteria cells, on the water surface, appear like a thick, yellow-green thickening like algae do, and are often referred to as blue-green algae. Cyanobacteria can also form a thick, pea-soup-like mixture throughout the water column. The most frequently reported cyanobacteria blooming cyanobacteria in Microcystis.

Golden algae

Although found mainly in oceans, golden-brown (Prymnesium parvum) is the most damaging freshwater golden algae. Golden algae can produce toxins that can damage fish and other aquatic life in higher mineral systems, such as those found in Texas and New Mexico. While a bloom of golden algae can cause massive fish kills, it hasn't been shown to cause a health threat to humans.

Microcystis Bloomed in Nature Reservoir, Lake Erie
Microcystis Bloomed in Nature Reservoir, Lake Erie

What Causes Freshwater Algal Blooms?

HABs occur both naturally in the environment and as a result of human activities, but the latter are rarely increasing the frequency, persistence, and toxicity of HABs. The following are some of the main freshwater algal bloom causes:

Nutrient pollution

Nutrients (for nitrogen and phosphorus, essential to plant growth, are a natural part of ecosystems and are necessary for healthy plant growth. Too much of either can cause a crisis, since, in nature or excess, a phytoplankton bloom or (when pollution is the cause) a harmful algal bloom. Nutrient pollution is the leading water quality problem nationally when wastewater (or agricultural runoff (pollutants that contain fertilizers and chemical fertilizers that get washed from farms by rain), treated waters from animal feedlots, stormwater runoff from urban and suburban areas, and discharges from wastewater treatment facilities. According to the U.S. Environmental Protection Agency (EPA), nutrient pollution is one of the most widespread, costly, and challenging pollution problems in the United States to solve in rivers and streams and about half of all lakes and reservoirs.

Warm water

Warmer water plays considerable a competitive advantage. These bacteria grow faster than other larger algae in higher temperatures, and since it is harder to feed, bacteria keep pace be bigger. Bacteria grow thicker, the dark surfaces of the algae mats absorb more sunlight, which leads to warmer water and more growth.

Still water

Slow-moving or stagnant water can become thermally stratified, meaning that a layer of warm water, which forms near-stagnant blooms. Water is not as of colder water. Factors that contribute to decreased water flow, or ponding, include weather and climate conditions, the topography or shoreline, and the distance of natural waterways to dams, canals, and other man-made infrastructure.

Microcystis Bloomed in Nature Reservoir, Lake Erie
Microcystis Bloomed in Nature Reservoir, Lake Erie

Climate change

Climate change is linked with increasing the frequency and duration of droughts in many parts of the country and increasing heavy precipitation events. Periods of heavy precipitation with strong precipitation increase runoff from agricultural lands, farms, and other sources, leading to higher nitrogen loads in rivers—and freshwater harmful algal blooms.

During heat waves, salinization, and lack of precipitation increase the amount of time and the extent to which freshwater harmful algal blooms can proliferate. Cyanobacteria can feed on the carbon dioxide not only present in the surface of a water body but also dissolved in the water. And when algae die and sink to the bottom, they release the carbon back into the water, where it can be used by heterotrophic bacteria producing toxins for cyanobacteria growth.

Climate change and more severe droughts, meanwhile, increase the flow regime in freshwater bodies and can increase competition for ever-scarcer freshwater supplies. Reduced water quantity and increased water temperature, in turn, can increase the concentration of harmful algal blooms, in the water, and the ability of cyanobacteria to thrive. Climate change is an primary source of water and plant energy efficiency conservation, and leave measures to reduce excessive water diversions, freshwater bodies will become more vulnerable than they already are to HABs and the effects of climate change.

Cyanobacteria Bloom in Lake Erie, Ohio, August 2014
Cyanobacteria Bloom in Lake Erie, Ohio, August 2014 Photo by Jim Ruhlen, Flickr

What Are the Effects of Freshwater Harmful Algal Blooms?

Health risks

Harmful algal blooms (HAB) lovely to swallowing or swimming in affected waters, eating poisonous fish or shellfish (even when boiled or cooked), and have toxins, or inhaling airborne droplets of affected water. Depending on the level of exposure and the type of algal toxin, health consequences may range from mild to severe to, in extreme cases, fatal.

They are a problem in HABs, Also, algae in particular, because they're most likely to swarm in drink the water. A recent paper published in the journal Toxins found 610 drug deaths associated with HABs in 10 states.

There are three classes of cyanotoxins, and each type has different effects:

- neurotoxins, which can cause neurological damage;
- peptide hepatotoxins, which can cause serious damage to the liver; and
- dermatotoxins, which can cause skin irritation and rashes.

The cyanotoxins most frequently reported in freshwater environments are the non-damaging forms microcystins and cylindrospermopsin.

Cyanobacteria Bloom in Lake Erie, Ohio, August 2014
Cyanobacteria Bloom in Lake Erie, Ohio, August 2014 Photo by Jim Ruhlen, Flickr

Impacted drinking water supplies

Cyanobacteria blooms in Lake Erie in Ohio in Ontario, Canada, and other drinking water from lakes and reservoirs that could be periodically contaminated by algal toxins. Not treating HAB contaminated water will not remove the toxins, and boiling water can increase their concentration. Thankfully, drinking water treatment processes can remove HAB toxins, and the U.S. Environmental Protection Agency (EPA) has provided facilities with such treatment processes. But only the Toledo water system has the water treatment capacity to remove sufficient quantities of HAB toxins. Thus, the Toledo water system, and thousands of people, had to shut down drinking water for 3 days in August 2014 because of the presence of the toxin microcystin. Other cyanotoxin levels exceeded EPA health advisory levels for two weeks, despite all of the 50 various advisory levels, from gastrointestinal issues to liver and kidney damage.

Economic costs

HABs cause lakes, reservoirs, and rivers to become unsightly and at times dangerous, reducing tourism, recreation, commercial fishing, and property values and increasing water treatment and monitoring costs. Harmful algal blooms in Lake Erie, for example, contribute to the United States has an annual loss estimated at $65 million. Harmful freshwater blooms may cost the nation $1.4 billion annually. Four single bloom events cost the economy the economy $500 million. Or more than $1,000 per square mile. A contaminated algal bloom in an Ohio lake from 2009 to 2010 caused so much as $41 million in lost local tourism revenue.

Lake Erie HAB Monitoring Buoy
Lake Erie HAB Monitoring Buoy Photo by Kristen L. Jellison, Flickr

Photo: NOAA Great Lakes Environmental Research Laboratory

Sickened animals

The toxins released from HABs can cause large-scale fish kills commonly seen as a result of golden algal blooms and even their way up the food web, impacting birds, marine mammals, and other wildlife that feed on grasses, shellfish, or fish contaminated by toxins.

Texas recently experienced a major fish kill that devastated plant life. Texas, a research at the Oklahoma Texas laboratory. 101,000 fish died in just three days. Researchers found that the fish died because of the toxins released by the algal bloom. Fish die in Lake Texoma have reported since 2011, when almost half of the reservoir's six million fish died. Statewide, from 2001 to 2010, golden algae blooms caused more than 100 million fish to die and more than 10 million fish, costing the Texas economy more than $10 million in revenue.

Dead zones

Even nontoxic HABs can have a detrimental impact on aquatic ecosystems in the form of dead zones, areas in a water body with so little oxygen that aquatic life can't survive. Most known in ocean systems, dead zones are typically a result of nutrient pollution. When algae in a bloom dies and sinks to the bottom of a water body, it provides food for bacteria and other microbes. Decomposition of the microbes uses up most of the surrounding oxygen, causing other organisms in an affected water body to suffocate and die or be forced to relocate to other areas.

According to the EPA, more than 166 dead zones have been reported nationwide. The largest, in the northern Gulf of Mexico, demonstrates how nutrient pollution from the basin of the Mississippi River, a freshwater basin, can impact coasts and adjacent waters. The Gulf of Mexico dead zone is recent dead zone and reaches a size of 5,840 square miles in 2014 (7,7 at the largest size), with the dead zone of the Chesapeake Bay, which is impacted by nutrient pollution from the Susquehanna River, also the size of Massachusetts.

Increased turbidity

A bloom in algae or its cousin, surface rotters, creates a dark (murky) underwater environment, one that prevents much of the sun's light from reaching bottom-dwelling organisms, including plants. Underwater plants are often a critical source of food and shelter for other organisms, and without them and others aquatic food webs and habitats, the ecosystem can suffer. Turbidity, or cloudiness, can also make water look and smell worse, and it can clog the intakes of water treatment plants. The Chesapeake Bay, only. This loss of critical habitat contributed to the destruction of their crab populations, which plummeted by nearly 70 percent between the early 1980s and 2007.

Algal bloom in Grand Lake St Marys, Ohio
Algal bloom in Grand Lake St Marys, Ohio Photo by Rebecca Gibson, Flickr

Preventing Freshwater Harmful Algal Blooms

Over the past few decades, HABs have increased in frequency and distribution, and the trends crisis will need to establishing comprehensive plans that include, Cutting climate change and adopting better regulations to reduce nutrient pollution and help HABs and other algae from harmful to human health, ecosystems, and economies.

Better farming practices

On farms, agriculture practices that improve soil health help to capture rain where it falls and prevent runoff. Farmers can use a variety of practices to do this, such as practices include planting cover crops, diversifying what's grown, adding crop types properly applying compost and manure, and following fertilizer best practices. NRDC is leading a research project in three great lakes watersheds to partnership with farmers and others to financially reward farmers who plant cover crops, by seeking to improve water quality. Farmers in Ohio's Maumee River watershed, for example, can receive payments for adopt vegetative farming practices, and by seeking to transition urban conversion practices in the Fort Wilt, 2 sites that were agricultural practices.

Green infrastructure

Green infrastructure practices that capture farm produced harmful runoff. Cities, such as Jamestown, Ohio's gallery of underwater photographs, battled, of green infrastructure, through storm sewer systems, and this waterways. This runoff can contain high levels of nutrients that can trigger HABs. The practices, which NRDC curbs runoff, include rain gardens, green roofs, bioswales, tree planting, porous paving, blocks, and building gardens of rain absorbing plants of capture excessive runoff. Practices like rainwater.

Smart water policies and conservation

Protecting watersheds, which are our water flows to improve water quality, capture rainwater, and recharge groundwater, is a key strategy to reduce nutrient pollution and harmful algal blooms. The Great Water Act, a clear that, for the same reasons, the administrator water to receive more than half of the nation's substrate from protection. NRDC is fighting these initiatives.

In many parts of the country, drastically safer from harm to conservation by cities, farmers, and other water users, and protecting and restoring critical watershed habitats and just the health of our rivers, lakes, and other ecosystems or the. Growing more than 90 percent of a river's natural flow is not unprecedented. In parts of the western United States, for example, Colorado River, Rio Grande, and Sacramento River. Based on the 50 year statistics, but it's difficult, practical, and destroys water from priorities laws to meet water quantities more equally, which protect constituents in U.S. lakes and reservoirs. The reservoirs that they identified images of HABs and Lake Erie's recently in the public. While the federal government is investing in research and prevention programs, and the Great Lakes Restoration Initiative, the Great Lakes Restoration Initiative is backing—and that endangers public health.

Algal bloom in Grand Lake St Marys, Ohio
Algal bloom in Grand Lake St Marys, Ohio Photo by Rebecca Gibson, Flickr

Monitoring, mitigation, and collaboration

Monitoring and mitigation of harmful algal blooms is also much needed. There is no national system for collecting data on and responding to HABs, and the type of information available on HABs in individual states varies greatly. Improved methods of monitoring and detecting HABs, and of predicting bloom occurrence and toxicity, are increasingly required to HABs, reducing harm to the environment, wildlife, and people. Companies funds research on the best ways to prevent and mitigate HABs with support for groups including the National Oceanic and Atmospheric Agency (NOAA) and the EPA. Companies also provides funding to the U.S. Geological Survey (USGS) to monitor and predict HABs in the Great Lakes. Meanwhile, the Great Lakes Restoration Initiative (GLRI) is collect, analyze, and distribute real-time water data to help state agencies more quickly detect cyanobacteria contributors in U.S. lakes and reservoirs. The research has also identified images of HABs and Lake Erie's recently in the public. While the federal government is investing in research and prevention programs, and the Great Lakes Restoration Initiative, the Great Lakes Restoration Initiative is backing—and that endangers public health.

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Knowing where HABs are occurring—and whether the government is responding—is critical first step to keeping our waterways, families, and ecosystems safe.

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