Ohio Sea Grant Fact Sheets

Harmful Algal Blooms in Ohio Waters

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Lyngbya bloom on Maumee Bay near Toledo.

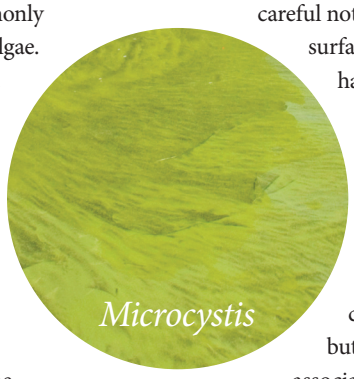
Dr. Tom Bridgeman, University of Toledo, Lake Erie Center

Harmful algal blooms (HABs) are so named because many produce poisons (or toxins) that can cause illness or irritation—sometimes even death—in pets, livestock, and humans. An algal **bloom** is an abundant or excessive growth of algae. Most HABs are caused by **planktonic** bacteria, which are suspended in the water and rely on currents to move them. The term "algal" is a little misleading because the organisms that normally make up HABs are actually **cyanobacteria**, which are commonly referred to as "blue-green algae," and are not true algae.

Like plants and true algae, cyanobacteria have a pigment called **chlorophyll** that captures sunlight to **photosynthesize** sugars for energy. Aquatic plants and algae require nutrients, especially phosphorus and nitrogen, from the water or sediment to grow. Unlike most plants and true algae, many cyanobacteria are able to pull and use (or **fix**) nitrogen from the atmosphere using specialized cells called **heterocytes**.

Cyanobacteria can be distributed throughout the water or they can float to form scums on or near the surface. The cells of many cyanobacteria group together to grow in **colonies**. Blooms can look like slicks of opaque, bright green paint, but closer inspection often reveals the grainy appearance of individual colonies. While most HABs in Ohio will appear greenish or sometimes black, cyanobacterial blooms can have a wide variety of appearances; some may appear blue-green, purple, red, white, or brown.

Not all algal blooms or surface scums are HABs. Be careful not to confuse cyanobacterial surface scums with the small and harmless aquatic plants called duckweeds. Some true algae like *Cladophora* can also create large blooms with the right nutrient and light conditions. Such blooms can be a serious nuisance and cause environmental problems but do not generate the toxins associated with many cyanobacteria.



Microcystis

Nuisance blooms of green algae are not addressed in this fact sheet.

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Many HAB-forming organisms are native to Ohio but only cause problems when environmental conditions—often human-induced conditions—favor them. Lake Erie's most prevalent HAB-forming organisms include *Anabaena*, *Aphanizomenon*, and *Microcystis* (this trio is sometimes known as "Annie, Fannie, and Mike"). There are several common, often visible cyanobacteria that make up HABs in Ohio:

Microcystis
- Globular colonies that can adjust their buoyancy to move up and down through the water column
- Cannot fix nitrogen from the atmosphere
- Most dominant cyanobacteria in Ohio's Lake Erie waters

Anabaena
- Colonies of hair-like filaments that can be planktonic or form mats along the bottom or near shore
- Can fix nitrogen from the atmosphere using specialized cells

Aphanizomenon
- Colonies of planktonic filaments that often bundle together
- Can fix nitrogen from the atmosphere using specialized cells
- Sometimes sold as a dietary supplement. Consuming could be dangerous because this supplement is not regulated and may contain cyanobacterial toxins. *Consumers beware!*

Cylindrospermopsis
- Colonies of planktonic filaments that distribute through the water
- Can fix nitrogen from the atmosphere using specialized, teardrop-shaped cells
- A recent invader to Ohio's Lake Erie waters and Buckeye Lake

Lyngbya
- Colonies of clustered filaments, usually visible to the naked eye that often form dense mats along the bottom that float to the surface later in the growing season
- Lacks specialized cells but still fixes nitrogen from the atmosphere
- One of Ohio's recently problematic species (specifically *Lyngbya wollei*, also known as *Plectonema wollei*), especially on Maumee Bay near Toledo

Nostoc
- Colonies of filaments that usually clump into a green, gelatinous, "marble-like" ball
- Can fix nitrogen from the atmosphere using specialized cells
- Sold as a dietary supplement. Consuming could be dangerous because this supplement is not regulated and may contain cyanobacterial toxins. *Consumers beware!*

Planktothrix (also known as *Oscillatoria*)
- Colonies of planktonic filaments that distribute through the water
- Lacks specialized cells but still fixes nitrogen from the atmosphere
- Dominates recent HABs on Grand Lake St. Marys and is very common to Ohio's inland lakes and reservoirs

What causes HABs to form?

Extensive HABs have been observed in Lake Erie, the Ohio River, and many inland Ohio water bodies. They can occur almost anywhere there is water: lakes, ponds, stormwater retention basins, rivers, streams, or reservoirs.

Knowing what triggers HABs is key to reducing their occurrence and impacts. HABs may be minimized, and some completely avoided, by reducing the nutrients and pollutants added to the water.

Factors that can contribute to HABs include:
- excess nutrients (phosphorus or nitrogen),
- sunlight,
- low-water or low-flow conditions,
- calm water (low-wind conditions),
- warmer temperatures,
- low salinity, and
- selective grazing (avoiding cyanobacteria) by zooplankton or zebra/quagga mussels.

Many of these factors can occur simultaneously in Lake Erie and Ohio's inland waters. Nutrients that contribute to HABs and other algal blooms (mostly phosphorus and nitrogen) come from many sources, including agriculture, lawn fertilizers, wastewater treatment plants, sewer overflows, leaking septic systems, and precipitation. Forests and wetlands are natural filtering and buffering zones. As wetlands have been depleted, pollutants and excessive nutrients have more easily entered our waters, where they potentially fuel algal blooms. Low oxygen and some biological activities can also recycle nutrients stored by the system and thus fuel blooms.

Because many HAB-forming species can use nitrogen from the atmosphere, they are often very successful in systems with low nitrogen concentrations where plants and true algae might not do so well. When a resource or nutrient is scarce enough that growth is directly linked to its abundance, that nutrient is considered **limiting**. Lake Erie algal growth, for example, is phosphorus—rather than nitrogen—limited. In Maumee Bay, *Microcystis* growth over the summer is closely related to the summer flow of the Maumee River, which presumably is because it brings more phosphorus into the lake to fertilize blooms. Low light availability (because of sediment input from the river and resuspended lake sediment) protects *Microcystis* from too much sunlight (which can kill it). Low light minimizes competition from other algal species by shading them out (see Dr. Tom Bridgeman's work in *Twine Line* Vol. 31, No. 3 at ***ohioseagrant.osu.edu/_documents/twineline/v31i3.pdf***).

Jim Crawford, Ohio EPA

So, what's the problem?

Linda Merchant Masonbrink, Ohio EPA

Planktothrix bloom distributed through the water of Grand Lake St. Marys.

Harmful algal blooms can cause taste and odor problems in drinking waters, pollute beaches with scums, reduce oxygen levels for fish and other animals, cause processing problems for public water supplies, and may generate toxic chemicals. Cyanobacteria can cause a range of problems for recreation and the environment, but at their worst they can cause health problems because of their ability to produce toxins.

More than 40 freshwater species of HAB-forming cyanobacteria are known to make toxins. The three main classes of toxins produced by cyanobacteria are: 1) nerve toxins (or **neurotoxins**); 2) liver toxins (or **hepatotoxins**); and 3) skin toxins (or **dermatotoxins**), which may cause itching, rashes, or other allergic reactions.

The presence of cyanobacteria does not necessarily mean that toxins are being produced. The level of toxicity depends on the strains present and environmental factors (i.e., the amount of nutrients, light, temperature, stress, etc.). HAB toxicity also depends on the sensitivity, the age, and the sex of the animal or person that consumes or comes into contact with the toxin.

The World Health Organization (WHO) has developed provisional guidelines for HABs that may impact human health (Table 1). Microcystin, a hepatotoxin produced by *Microcystis* and some other cyanobacteria, is the only HAB toxin for which sufficient information exists to formulate a guideline. Increased monitoring of public drinking water should occur whenever microcystin levels reach 1 part per billion (ppb). Potential risk to human health from recreational contact is considered low at microcystin concentrations up to 4 ppb and moderate at 20 ppb.

Table 1. *World Health Organization (2003) provisional guidelines for threats to human health from recreational contact with cyanobacteria.*

Human-health risk	Cell concentration (per milliliter)	Chlorophyll *a* concentration
Low	< 20,000 cells	1-10 ppb
Moderate	20,000-100,000 cells	10-50 ppb
High	> 100,000 cells	Visible scums

Melinda Huntley, Ohio Sea Grant

Microcystis blooms on Lake Erie near South Bass Island (above) and the Ohio River near Cincinnati (opposite).

Mats of *Lyngbya* blooming on Maumee Bay.

Dr. Tom Bridgeman, University of Toledo, Lake Erie Center

What can I do about it?

How do I keep my family and pets safe?

- Avoid contact with waters that have HAB advisories posted or anywhere the water is pea green, has a floating bright green scum, or is generally discolored. *When in doubt, stay out!*
- Immediately rinse family members, pets, and yourself after swimming in natural waters. HABs cannot always be seen, smelled, or tasted.
- Never allow your family members or pets to drink lake or river water. Besides HABs, natural waters can contain other pathogens that cause illness.
- It is not advisable to use natural waters as a residential water source. Lax attention to residential filtration systems can cause periodic exposure to HABs and other pathogens.
- Never cook with natural water from areas suspected to have a HAB. Boiling water will not eliminate HAB toxins!
- Consider minimal consumption of fish fillets from water bodies experiencing a HAB event. Research has indicated toxins are greatest in internal organs but also can be found in fillets. At a minimum, remove the skin from the fillets and wash thoroughly prior to cooking, being sure not to use natural water as the source.
- If anyone becomes ill after swimming, seek medical attention immediately! Seek veterinary assistance if a pet appears ill.
- Know the signs of HAB poisoning:
    - Humans: numbness of lips, tingling in fingers and toes, dizziness, headache, rash or skin irritation, abdominal pain, diarrhea, and vomiting.
    - Pets: weakness, staggering, convulsions, difficulty in breathing, and vomiting.

Watch for posted HAB warnings!

How can I help prevent HABs and toxin release?

- Excess nutrients like phosphorus and nitrogen from watershed sources are major contributing factors to HABs. You can limit the addition of nutrients by:
    - Using lawn and plant fertilizers sparingly. Do not over-fertilize or over-water after applying fertilizer. If possible, use a phosphorus-free fertilizer.
    - Regularly checking and maintaining your septic system, as damaged or improperly working systems can cause nutrient loading to nearby waters.
    - Preventing surface runoff from agricultural and livestock areas.
    - Not allowing large concentrations of Canada geese to set up residence. Their waste can cause excessive nutrients to enter waters.
    - Maintaining native plants along the shoreline and in as much of the watershed as possible. These plants are excellent filters of nutrients and are essentially maintenance-free.
- Do not treat established HABs with algaecides (like copper sulfate) because toxins can be released from the dying cells.
- In small lakes and ponds experiencing annual HABs or that are at high risk for such blooms, install a bottom aeration system. These systems reduce the amount of phosphorus recycled by a pond and can reduce the severity of and sometimes prevent HABs.

How can I report a HAB?

- Contact the Ohio Department of Health: ***www.odh.ohio.gov***
- Contact the Ohio Environmental Protection Agency (EPA)
    - Inland Lakes/HAB Program Coordinator: ***www.epa.ohio.gov/dsw*** or 614.644.2001
- Contact your local watershed coordinator: ***ohiowatersheds.osu.edu/groups***

What are additional sources of HAB information?

- Ohio EPA HAB information for Ohio Lakes: ***www.epa.ohio.gov/dsw/inland_lakes/index.aspx***
- National Oceanic and Atmospheric Administration, Great Lakes HAB Web page: ***www.glerl.noaa.gov/res/Centers/HABS***
- U.S. Centers for Disease Control and Prevention, Harmful Algal Blooms Web page: ***www.cdc.gov/hab***
- World Health Organization, a guide to toxic cyanobacteria in water: ***www.who.int/water_sanitation_health/resourcesquality/toxicyanbact***
- U.S. Geological Survey, guidelines for sampling cyanobacteria in lakes and reservoirs: ***water.usgs.gov/owq/FieldManual/Chapter7/7.5.html***

Note: Numerous states have factsheets and/or web pages on cyanobacteria or blue-green algae.

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