Harmful Algae Surveillance Program

The Wisconsin Division of Public Health (DPH) is working with the Centers for Disease Control and Prevention (CDC) to collect information about human and animal illness and death resulting from exposure to blue-green algae (also known as cyanobacteria). By studying this information, DPH staff will be able to better understand and quantify the public health problem posed by harmful algal blooms (HABs), raise awareness of these problems, and inform efforts to prevent exposures from occurring.

The HAB program is partnering with many organizations across the state, including Wisconsin DNR and Wisconsin Association of Lakes, to collect case information about human and animal illnesses or deaths. DPH staff are asking the public to notify them of any known or suspected human or animal exposures to cyanobacteria that may have resulted in illness or death. Animal illnesses can include pets, livestock or wildlife such as birds and fish.

The HAB program will be collecting information about symptoms and any treatment received or provided. They may also collect exposure information and environmental samples. Any individuals experiencing symptoms of blue-green algae exposure should seek medical attention.

For more information or to report a case, visit: **www.dhs.wisconsin.gov/eh/bluegreenalgae or call 608-266-1120.**

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Blue-Green Algae

It has been a hot summer in Wisconsin. On some lakes, remarkable smells are wafting on the breeze and beaches are closing. Sometimes the odors and green cover over the water are caused by blue-green algae, a group of algae that is making the news these days. So what exactly is this stuff?

To have a basis for talking about blue-green algae we need to put them into a basic biological and ecological context. One of the first things we learn about biology in school is that living things are made up of cells. There are two types of cells – the more ancient and less specialized cells like those in bacteria (the fancy word for them is prokaryotes) and the larger, more specialized cells like those of plants, animals, and fungi (these cell types are called eukaryotes).

Our biology teacher also told us that ecosystems have three types of organisms that interact to manipulate matter and energy. There are producers that can make their own food (usually by photosynthesis), consumers that eat pre-existing food items, and decomposers that digest dead and dying material for food. In lake systems, decomposers include bacteria and fungi while consumers are all animals from the single-celled protozoans to snails to the fish and birds. Producers are submerged or emergent plants and algae.

The term algae (which is plural, the singular is alga) is a non-technical term for a dozen or so different groups of photosynthetic organisms that are not plants. Basically, if it's a producer and a botanist doesn't call it a plant, then it's an alga. These algal groups include prokaryotes and eukaryotes and range from microscopic single-celled organisms to massive, multicellular kelps (that grow over a hundred feet in length) and seaweeds found in the ocean. Algae can contain pigments that will make it nearly any color you can think of – red, brown, green, and blue-green are the most common. A typical Wisconsin lake might have representatives of six or seven of these algal groups throughout the year.

Two of the more common algal groups in the Midwest include green algae that often accumulate in massive amounts during the summer, forming slippery, golden-brown mats in rocks and sediments that receive light; and blue-green algae that can form mats on the bottom or float free in the water column.

The blue-green algae are more precisely referred to as Cyanobacteria and they are often a major component of our lakes. They are the only prokaryote algae, and fossil evidence indicates that the process of photosynthesis first occurred in the blue-green algae about 3 billion years ago. They are the oldest group of producers on the planet and over this time scale they have adapted to nearly every habitat on Earth (fresh and salt water from frozen pack ice to boiling hot springs, soil, on/in plants, on/in rocks, on/in animals). Biologists believe several thousand species of blue-green algae may exist.

While prokaryotes are usually considered unspecialized organisms, some of the blue-green algae can produce specialized cells. One of these cells is a very resistant spore stage called an akinete. It can tolerate very harsh conditions, even those that kill the regular blue-green algal cells. The other important specialized cell is called a heterocyst and it can do a very rare thing – convert atmospheric nitrogen (nitrogen gas) into a form of inorganic nitrogen that algae and other plants can use. Nitrogen gas, while plentiful (80% of atmosphere), is inert and unusable by algae and plants. Nitrogen can be a scarce nutrient in some ecosystems and the ability to convert nitrogen gas into a usable form gives the blue-greens a substantial advantage under those conditions. These important cellular adaptations and the fact that these ancient organisms have an amazingly adaptable physiology allow them to tolerate conditions that kill most other algae and most plants.

Blue-green algae range from single-celled to colonies of cells enclosed in a sticky sheath to filaments of cells that may be branched or unbranched and may have a sheath. The sheath is important for blue-greens because critters that eat algae have a hard time digesting the material, which tends to stick in mouth parts and digestive systems. That means most animals shy away from eating blue-greens. This gives blue-green algae an advantage over other algae which do not produce such a sheath. As more easily digested algae are consumed by a lake's animals, ever larger populations of blue-green algae are left behind.

If you put all these advantages together – tolerant of extreme and variable conditions, hardy survival stage, nitrogen manipulation, adaptable physiology, and nasty sheath – you get a group of organisms that is hard to control. Under some conditions they can dominate a lake to the point of rendering it barely navigable, smelly and unpleasant to swim in, and potentially toxic. There are a variety of blue-green algal toxins and they can produce potentially serious liver and/or central nervous system problems. The first officially autopsied human death attributed to ingestion of blue-green algae toxin occurred in Dane County last year, where a teenager died after diving and splashing around in an algae-covered golf course pond.

So why aren't all lakes overrun by out-of-control populations of crazed blue-green algae? Lakes generally have enough nitrogen, but not the high amount of phosphorus that blue-green algae need. This is the one advantage we have over the blue-greens. Lakes that are low in phosphorus generally face less of a problem with blue-green algae. This advantage is lost when phosphorus runs into the lake from outside sources such as leaky septic systems, lawn fertilizers, underlying lake sediments, or other watershed inputs (agriculture, municipal, industrial). Once this advantage is lost it is hard to regain because biological systems are very good at trapping and recycling important nutrients like nitrogen and phosphorus.

A final point to remember, all lakes are destined to accumulate nutrients and sediments with increasing amounts of plant and algal growth over time and eventually most will fill in. The natural time frame for this could be thousands or tens of thousands of years if outside and/or human inputs are minimal. With human inputs accelerating the process it could be hundreds or

thousands of years instead (or less). Many of our lakes in Wisconsin have had human inputs long enough to begin showing this acceleration of lake aging, called eutrophication. Lake algal surveys (especially when combined with watershed and water chemistry analysis) provide a snapshot of where a lake is on this continuum by evaluating the type and amount of blue-green algae present in the system.

by Dr. Robert Bell, Professor and Chairman, UW-Stevens Point Department of Biology. At UWSP, a multi-disciplinary team of biology and water specialists from the Department of Biology and the College of Natural Resources work together to evaluate Wisconsin's lakes.

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Blue-Greens: Algae from Brazil Migrates Northward

Wisconsin researchers and water quality experts are gearing up this summer to monitor an exotic blue-green algae that has been migrating northward in the US, and has been detected in Madison-area lakes over the past few years.

The algae, *Cylindrospermopsis raciborskii*, or "Cylindro," was originally identified in Brazil and in recent years has been found in several southern states as well as in Illinois, Indiana, Michigan, Minnesota and Ohio. Starting in late July and extending through September, DNR and University of Wisconsin water quality experts will look for Cilyndro by collecting additional water samples from selected nutrient-rich lakes in south central, southeast, northeast, and west central parts of Wisconsin.

"While this species of blue-green algae has also been found in other Midwestern states, this is the first time we have seen what may be characterized as 'bloom densities' in Wisconsin and we'd like to find out how widespread it is," says Bob Masnado, who serves as DNR's lead representative on a state and local team of environmental and health experts involved in monitoring the algae. Blue green algae are common in Wisconsin lakes and can reach high concentrations during summer that cause smelly, nuisance blooms on the water's surface that make swimming and other water-recreation unappealing. Some of these algae can produce natural toxins. They are normally short-lived, but may pose health risks to fish, pets, livestock and even humans if they are present in high enough concentrations. Little is known about Cylindro and its effects, Masnado says, although it is receiving an increasing amount of attention from scientists throughout Europe, Australia, and the United States. The available scientific literature suggests Cylindro differs from other blue-greens because it may produce more toxins more frequently than the blue-green algae species commonly found in Wisconsin lakes. Cylindro doesn't always form visible mats of algae at the surface like other blue-greens, and can be found throughout the water column.

The Wisconsin team, which includes DNR, the University of Wisconsin-Madison, the Department of Health and Family Services, the City of Madison and the State Laboratory of Hygiene, is preparing a research and monitoring plan to help answer where Cylindro is found in Wisconsin waters and what its potential effects are. Researchers from DNR and the University of Wisconsin-Madison's limnology department routinely sample water quality in Madison-area lakes as part of a long-term monitoring project to better understand and chart what's going on in the lakes. Counts of algae are normally determined for the samples collected from Lakes Mendota and Monona and they have shown that Cylindro has been present for the past few years, although at very low concentrations. In the process of checking microscopic slides of samples

collected from Lake Wingra last summer, the species was found to be present in much higher concentrations than seen in Lakes Mendota or Monona. As a result, a Michigan firm is now examining archived algae samples collected from Lake Wingra from past years to determine whether Cylindro was present and to what extent.

Most of the work in the coming months will focus on trying to understand the distribution of Cylindro in Wisconsin's shallow, eutrophic lakes. Eutrophic lakes are those which either naturally or as a result of man-made pollution are rich in nutrients such as phosphorus, which spurs production of algae and other organic material. "We believe this is the time of year to sample based on the monitoring efforts of state agencies who have found that Cylindro is not expected to reach nuisance densities in early summer or late fall." Masnado says.

The State Laboratory of Hygiene will be working to develop a rapid screening method that would enable Wisconsin to quickly and inexpensively detect elevated Cylindro densities in Wisconsin lakes instead of having to send water samples to a Michigan laboratory for confirmation of the algae's presence. For more information contact Bob Masnado at the Wisconsin DNR, (608) 267-7662.

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