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The Algae Blooms of 2018

Hi. I'm Jesse Schomberg and you're listening to the Sea Grant Files.

What do Lake Erie, the Gulf of Mexico and the Florida coastline have in common? If you said, "newsworthy harmful algae blooms," you answered correctly.

Lake Superior wasn't spared, either; news of its unusual 2018 algae bloom even hit the headlines of the The New York Times.

Dr. Chris Filstrup, Minnesota Sea Grant's Inland Lakes Specialist, has joined me in the studio today to talk about algae blooms in Minnesota and in Lake Superior.

Welcome to the Sea Grant Files, Chris.

Chris: Happy to be here, Jesse.

Jesse: Let's start with your thoughts on algae bloom trends in Minnesota. Are we seeing more algae blooms than average? Are they worse than average?

Chris: As you indicated, it was a big year for algae blooms in the news across the United States. Fortunately, it was a pretty light year for algae blooms in Minnesota, likely due to this year's brief summer. Colleagues at the Minnesota Pollution Control Agency say that blooms were reported on a handful of lakes in Otter Tail County and in Thief and Cannon Rivers and surrounding lakes. Lakes where we typically see algae blooms, such as Peltier Lake in the southern part of the state, experienced similar algae blooms again this year, but they commonly go unreported because they are common in these lakes.

Similar to the rest of the world, algae blooms are expected to become more common, more frequent, more severe, and more persistent in Minnesota lakes due to land use change and climate change.

In Minnesota lakes and rivers, algae blooms are primarily caused by cyanobacteria, which are also called blue-green algae. I try not to use that term because cyanobacteria are indeed bacteria … bacteria that can produce a diverse suite of potent toxins.

Because cyanobacteria thrive in nutrient-rich waters, land use practices that increase the amount of phosphorus and nitrogen getting into the water, such as agricultural intensification or urbanization, favor algae blooms. Some cyanobacteria also have competitive advantages in calm, warmer waters because they can float to the surface.

A question being asked around the world is whether algae blooms are actually becoming worse, or if they are simply being reported more frequently. Minnesota Sea Grant is funding a research project by Andy Bramburger from University of Minnesota Duluth's Natural Resources Research Institute to examine what conditions are contributing to algae blooms in Minnesota

lakes. Meanwhile, other researchers are looking at fossilized pigments in sediment cores to find out when cyanobacteria started becoming more abundant.

Jesse: How do you know if an algae bloom is toxic or if an algae bloom could turn toxic?

Chris: Unfortunately, it is difficult to tell if algae blooms are toxic simply from looking at them. The only sure way to tell if algae blooms are toxic is to measure toxin concentrations in water samples, which can be expensive and results in a time lag.

Just because cyanobacteria are present in high abundance in a lake does not mean that they are actively producing dangerous levels of toxins. If the water looks like pea soup, or if there is a blue-green scum floating on the surface, there is potential for toxins. For this reason, the Minnesota Pollution Control Agency uses the motto: "When in doubt, best keep out." Don't let your pets drink or swim in the water, either. Dogs deaths are more common than we would like. If your dog gets into a lake with an algae bloom, rinse your dog with a hose afterward.

On the flip side, toxins can be present in high concentrations after an algae bloom dies and the lake looks relatively clear. This can be particularly dangerous because if someone doesn't know the recent history of the lake, then they assume that clear water means conditions are safe.
Jesse: So, we had an algae bloom in Lake Superior this year… what can you tell us about it? Did it produced toxins?

Chris: The algae bloom that developed in Lake Superior was the most surprising algae bloom story of the year to me. The last algae bloom in Lake Superior was in 2012, but it was not as intense as this year's bloom.

In early August, UMD Large Lakes Observatory researchers and National Park Service personnel discovered an algae bloom along the south shore of Lake Superior near the Apostle Islands. For listeners familiar with the area, the algae bloom was discovered near Herbster and Cornicopia, Wisconsin. A colleague and I were on a research cruise aboard the Blue Heron on the way back from Sault Ste. Marie, Michigan, and we were able to help with sampling efforts to track the movement of the bloom. Two days after its discovery, we started seeing traces of the algae bloom near Sand Island. The densest parts of the bloom appeared to be moving along the shoreline, but we found evidence of it thousands of feet offshore.

Samples collected by the Large Lakes Observatory, as well as the US EPA Lab in Duluth, indicated that the bloom was largely composed of the genus *Dolichospermum*, which for you Prince fans, is the cyanobacterium formerly known as *Anabaena*. *Dolichospermum* is capable of producing several toxins that attack the liver and nervous system, so we were definitely concerned. Fortunately, analyses did not detect toxins in the samples.

We still do not know exactly why the bloom formed, but we think that the large storm preceding the bloom followed by relatively calm, warm conditions contributed. When you mention the last algae bloom in Lake Superior was in 2012, the first thing that residents of the Twin Ports mention are the floods of that year. Think about it like making a pot of chili. Throw in all the ingredients and simmer over medium heat.

If an influx of nutrients, warm temperatures, and calm conditions did indeed lead to the algae bloom, then this is of concern because conditions that favor cyanobacteria growth ... warm temperatures, increased storm intensity and frequency … are expected to become more common in and around Minnesota lakes, including Lake Superior. Climate change is anticipated to favor cyanobacteria.

Jesse: I'm talking to Dr. Chris Filstrup about algae blooms. Chris, can you tell us about the toxic effects of a harmful algal bloom?

Chris: Researchers still do not know exactly why cyanobacteria produce toxins but we do know that they produce diverse types of toxins that target different systems in people, pets, livestock, and wildlife.

All cyanobacteria are capable of producing lipopolysaccharides that cause inflammation and itchy skin. Often times, people confuse this itch with swimmer's itch, which is caused by a parasite; it's not.

On the severe end, cyanobacteria can produce toxins that damage vital body parts like the liver and nervous system. The well-studied toxin microcystin is one of these. It has been linked to the deaths of pets and livestock and, in 1996, to the deaths of 52 patients being treated at a dialysis center in Brazil.

Cylindrospermopsin is another very potent toxin. It attacks the nervous system and multiple organs. The range of the particular species that makes this neurotoxin has been expanding northward. In talking with colleagues, it is now the main cyanobacteria forming blooms in Missouri reservoirs. When I worked in Iowa, we began to see it in a handful of lakes on the western border in 2004, and by 2015, we found it in a third of the 138 lakes we were monitoring. Researchers at the St. Croix Watershed Research Station are looking at the timing of its arrival and distribution in Minnesota lakes using sediment cores.

BMAA, which has a long complex chemical name, is also of concern because exposure to the toxin has been linked to symptoms consistent with the ALS / Parkinson's disease complex in humans.

Jesse: What are some of the ways technology and science are helping us understand and predict harmful algae blooms?

Chris: Some of the most exciting developments are using new technologies to look at harmful algal blooms across large areas, at finer resolutions, and with more speed.

Agencies such as the National Oceanic and Atmospheric Administration are taking advantage of new remote sensing technologies to track algal blooms in oceans and lakes. Newer satellites have sensors that detect pigments only contained by cyanobacteria and researchers are attempting to attach similar sensors to unmanned aerial vehicles and drones. Colleagues and I from the University of Minnesota Twin Cities campus are hoping to improve computer algorithms to measure these same pigments in Minnesota's inland lakes.

To measure the amount of cyanobacterial toxins researchers and natural resources agencies are outfitting lakes with automated sensors. I think that there are exciting opportunities using molecular approaches to determine if a particular bloom is capable of producing toxins at all .. that is do they have the genes to produce toxins, and are those genes actively being transcribed to produce toxins? This is a critical unknown that colleagues and I are investigating. We hope that these approaches can be used to determine when toxic harmful algal blooms begin to develop so that notices can be posted to protect the public. Ideally, someday, management actions could be implemented as blooms begin to form to prevent the harmful algal bloom from occurring at all.

Jesse: Whew! Sounds like you and your colleagues have your work cut out for you! Thanks for joining us in the studio today, Chris.

Chris: My pleasure.

Jesse: Before I sign off, I want to encourage listeners to get involved in monitoring the water quality of their favorite waterbodies, especially for harmful algae blooms next summer. For ideas, contact Minnesota Sea Grant by email at seagr@d-dot-umn-dot-edu or by phone at (218) 726-8106 … ask for Marte Kitson; Marte coordinates Minnesota Sea Grant's citizen science activities.

This episode of the Sea Grant Files was produced by Sharon Moen, Chris Filstrup, Chris Harwood, KUMD and, me, Jesse Schomberg. For more information, or to listen to other episodes of the Sea Grant Files, visit Minnesota Sea Grant at w-w-w-dot-sea-grant-dot-u-m-n-dot-e.d.u. Thanks for listening!