

# **Blue-green Algae in Wisconsin's Lakes**

**2018 Wisconsin Lakes Partnership Convention**

**Gina LaLiberte**

**Wisconsin Department of Natural Resources**

**[Gina.LaLiberte@wisconsin.gov](mailto:Gina.LaLiberte@wisconsin.gov)**

All photos by Gina LaLiberte unless otherwise attributed.



# Blue-green algae



What are they & what do they look like?

When are they a problem?

What are the health impacts of their toxins?

How can I tell if the water is safe?



# What are blue-green algae?

- Photosynthetic bacteria (cyanobacteria)
- In all lakes & rivers in Wisconsin
- Buoyancy: they regulate position
- Temperatures: they like it hot
- Toxins: produced by some species



Look for tiny green specks in water or green “dust” on surface





# Don't mistake duckweeds, watermeal, or pollen for blue-green algae

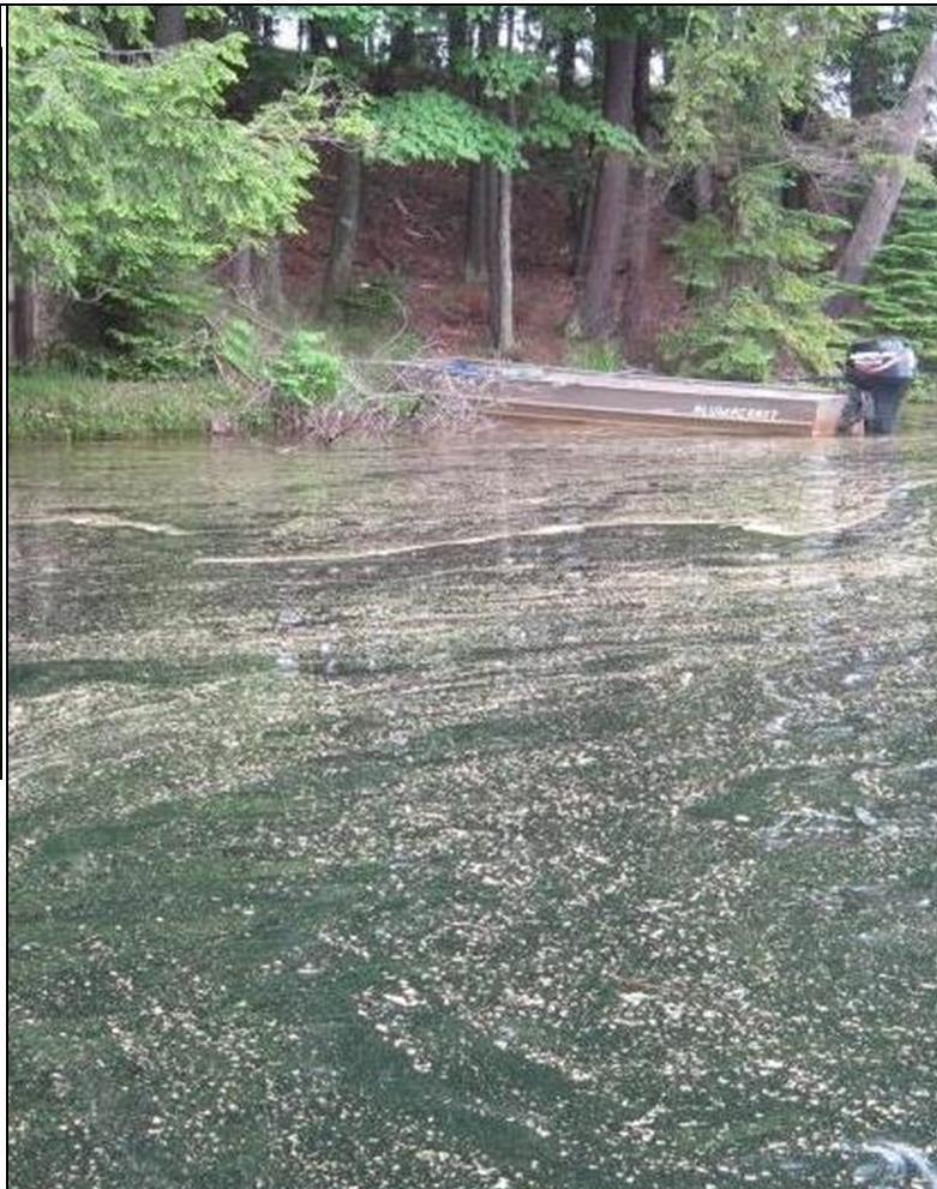
*Lemna*, *Spirodela*, *Wolffia*  
has roots    has roots    no roots



Virginia Tech Weed I.D. Guide



Watermeal (*Wolffia*)  
Tiny, firm, grainy



Look for similar yellow "dust" on land, especially on cars parked under trees



Duckweed



Blue-green algae





# Don't mistake filamentous green algae for blue-green algae

## *Spirogyra* & relatives

slippery texture, hairlike, unbranched



## *Cladophora* & relatives

wet cotton texture, usually branching



S. Pfeiffer

Long, GREEN, and hair-like : not blue-green algae



First glance: bloom?

filamentous  
green algae



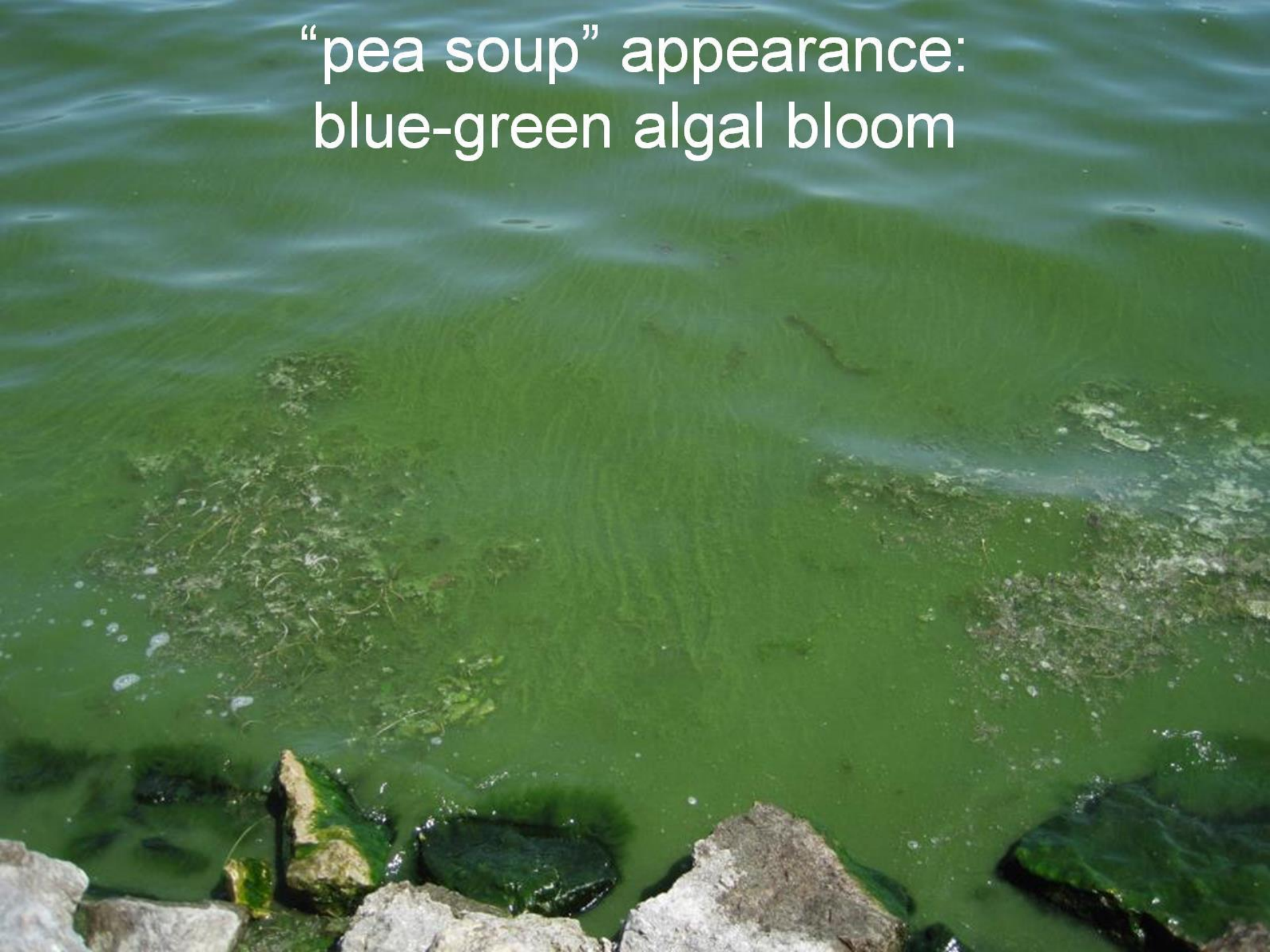
duckweed



Look closer... not blue-green algae



“pea soup” appearance:  
blue-green algal bloom





# “Blue-green” is misleading



J. Williamson



N. Trombly

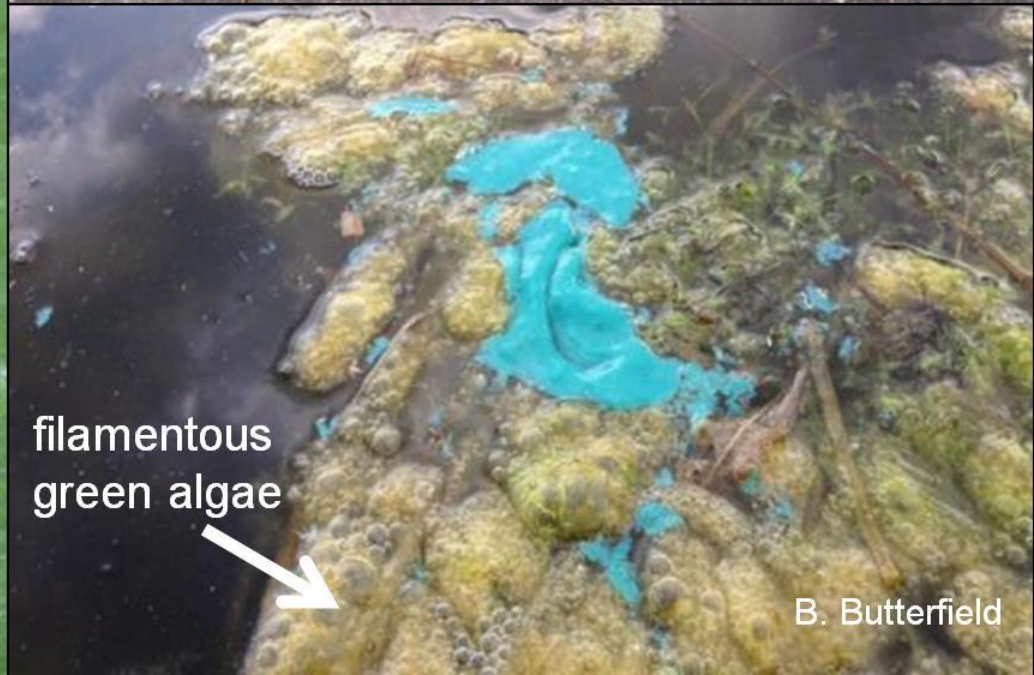


Intact blooms are most often green in color.

S. Greb

E. Heath









Blue pigments might only be noticeable on shore



# Blooms may be many different colors.



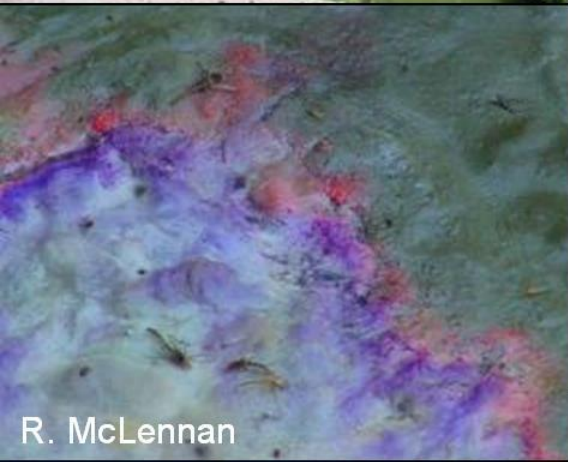
R. McLennan



N. Trombly



T. Moris



R. McLennan



J. Williamson



WDHS



J. Williamson



A. Dryja



# Planktonic bloom-forming cyanobacteria

Small; green or other colors (khaki or tan to olive green)

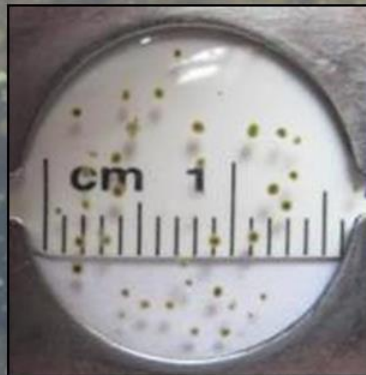
Most require microscopic examination for identification







*Gloeotrichia*  
Pinhead-sized balls  
Can bloom in  
oligotrophic &  
mesotrophic lakes



*Aphanizomenon*  
Tiny “grass clippings”



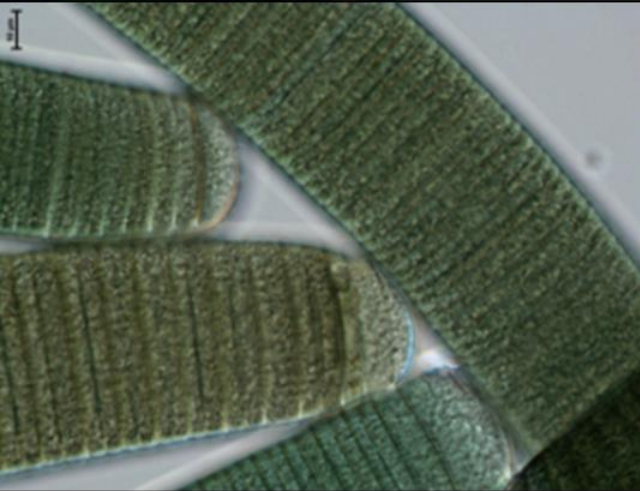
# Bottom-dwelling cyanobacterial mats... that float



D. Daulton



J. Klosiewski



P. Tikusis



J. Masterson

Need sunlight on the lake bottom.  
Brightly colored pigments in some species help them to grow in low light levels.



Filaments are usually very narrow and short, less than a quarter inch in length.





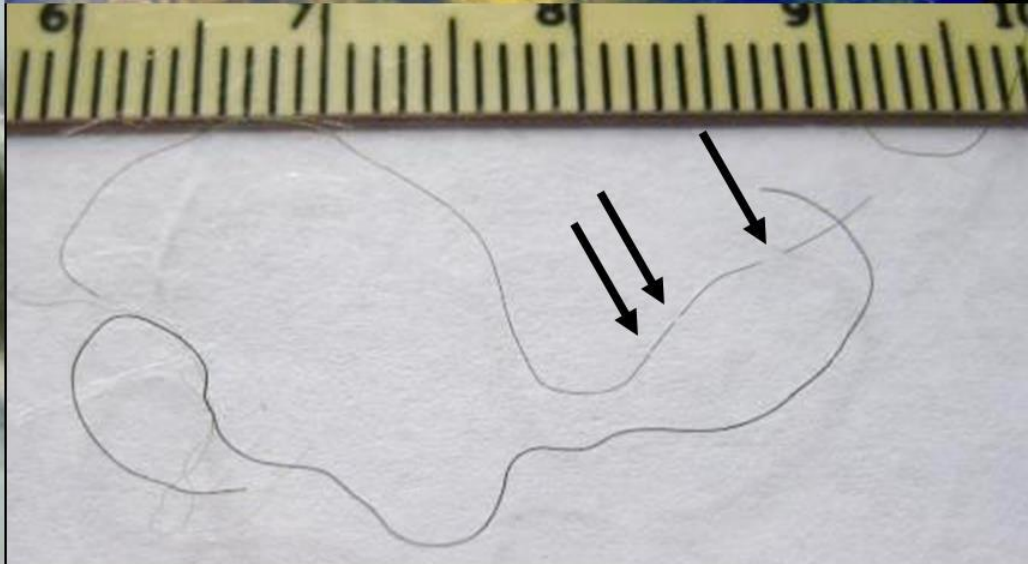


*Oscillatoria princeps* mats

E. Evensen



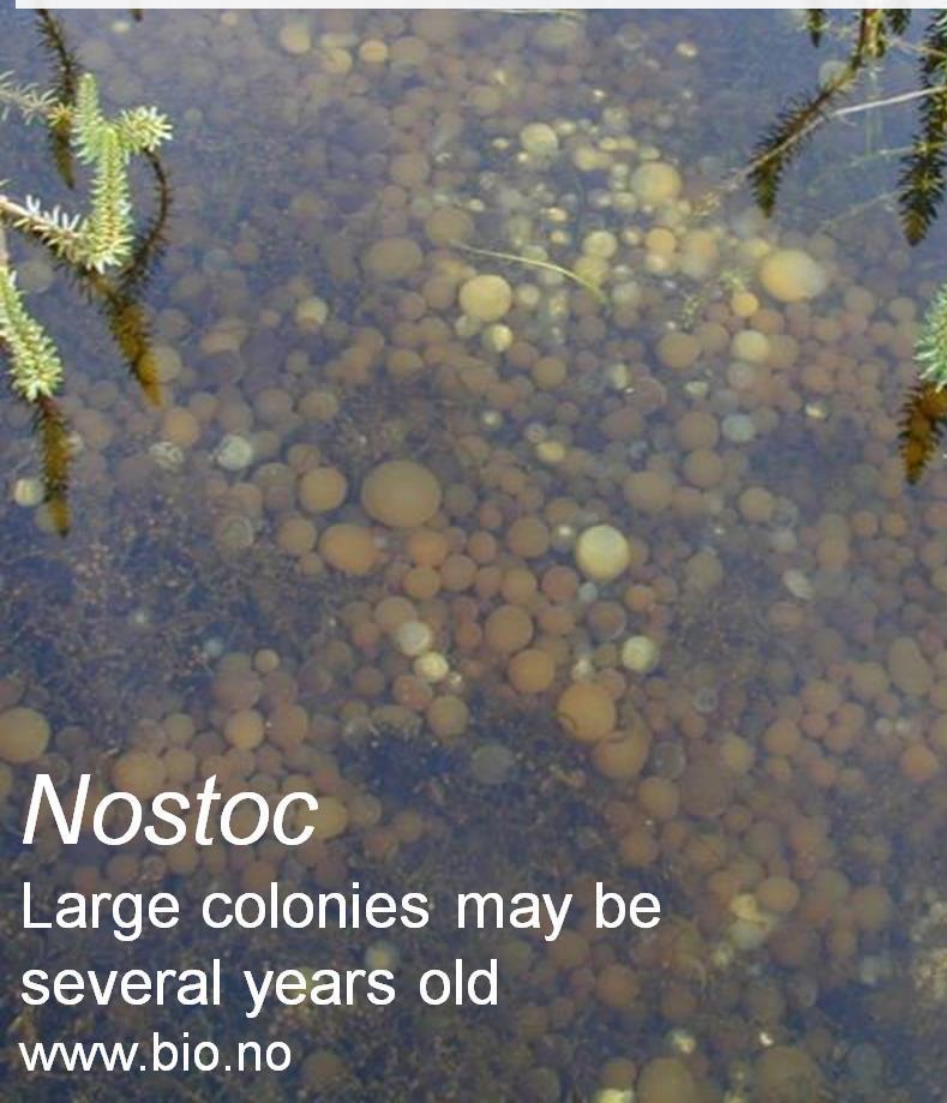




The length exception... *Lyngbya wollei* (AKA *Microseira*)  
Long black "hairs," some with "breaks" visible



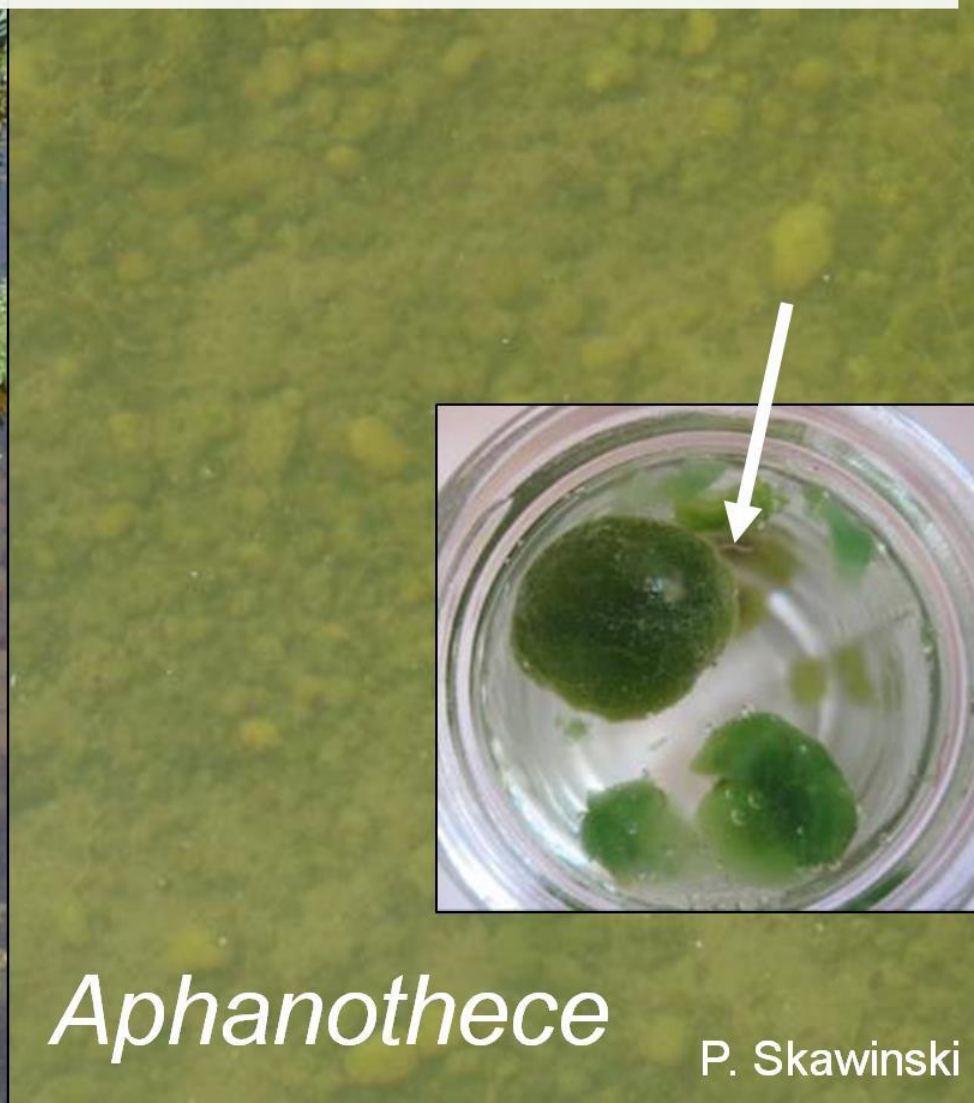
Bottom-dwelling cyanobacterial colonies  
May occasionally float to the surface  
Need sunlight on the lake bottom & clear water



*Nostoc*

Large colonies may be  
several years old

[www.bio.no](http://www.bio.no)



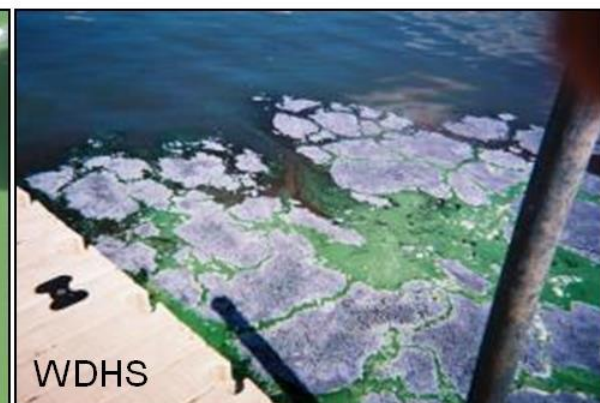
*Aphanothece*

P. Skawinski



# Hazards of cyanobacterial blooms

- Impact aquatic food webs and oxygen levels.
- Some species can make liver, cell, or nerve toxins if conditions are right.
- Swallowing or inhaling toxins in water droplets can cause illness; they may irritate the skin in sensitive individuals.
- **Not all cyanobacteria make toxins, and toxins are not made all the time.**





# What causes harmful blooms?

- Excess nutrients (P & N) fertilize growth
  - Warm water and calm weather
- The details are complicated...

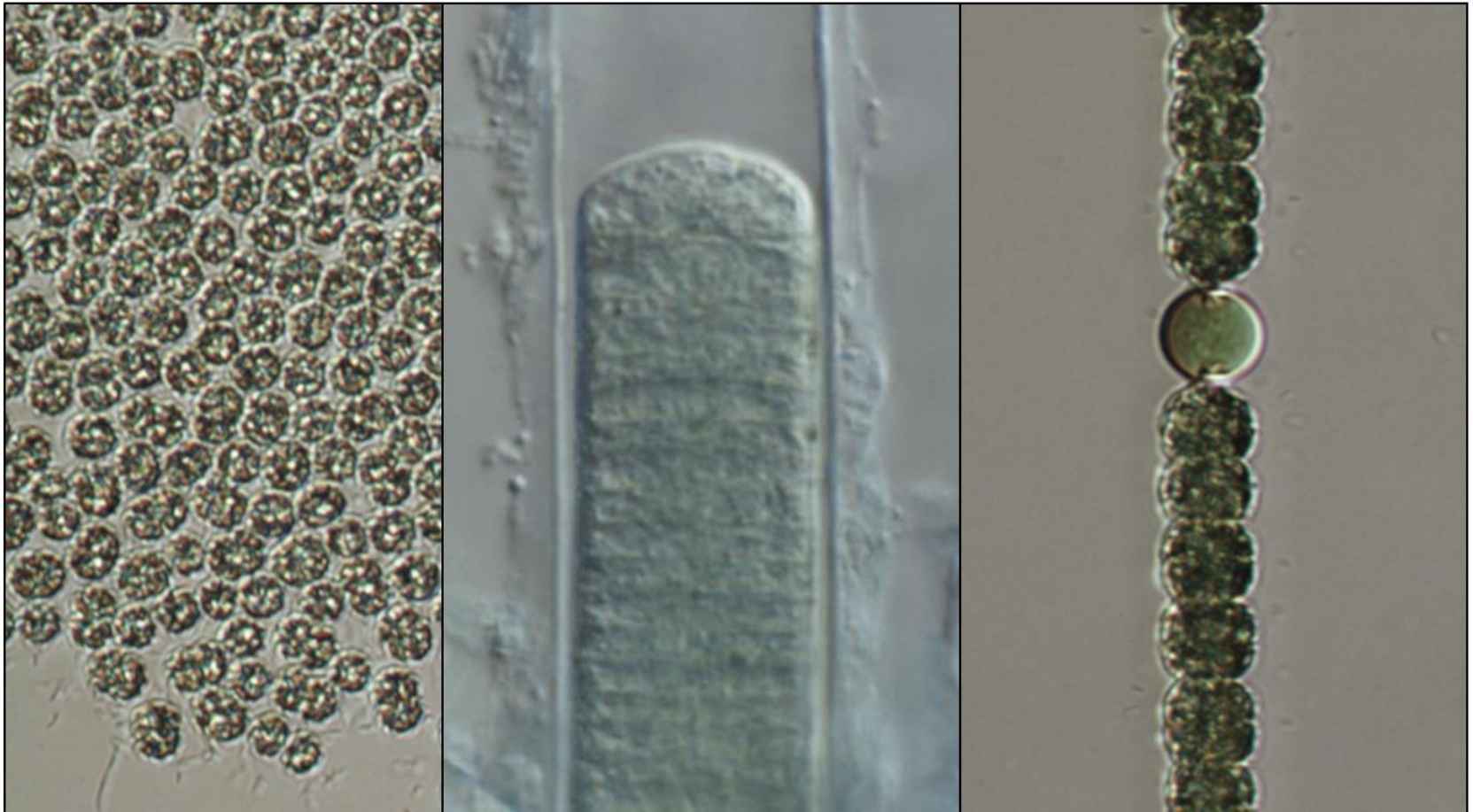




# Bloom details are complicated:

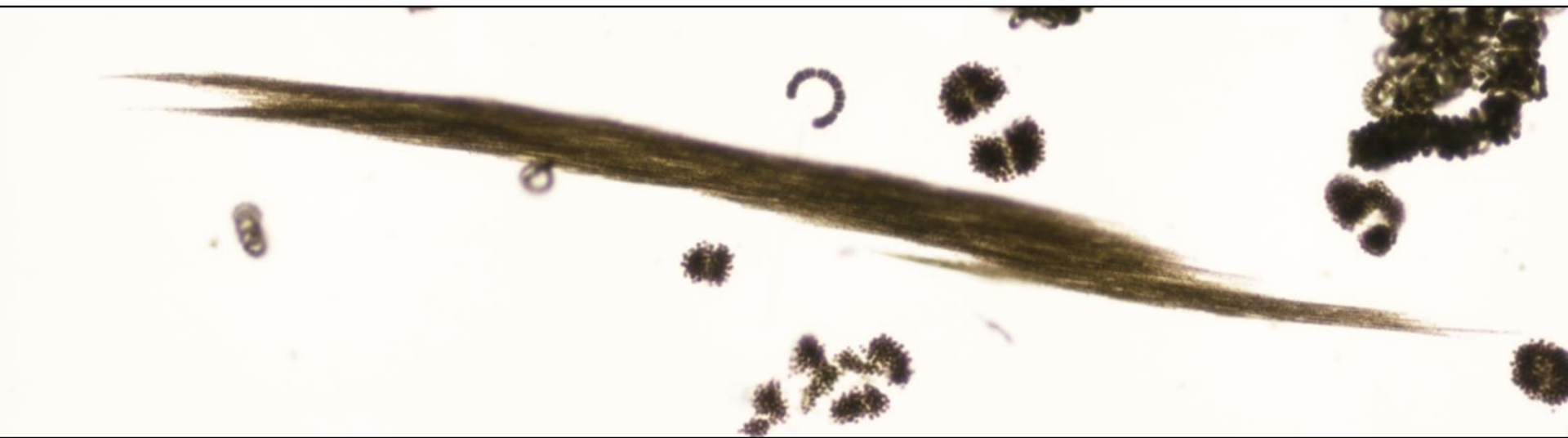
## Cell level

- Species & strains
- Cell biochemistry





# Bloom details are complicated: Population characteristics



- Community composition
- Nitrogen fixation
- Effects of non-cyanobacterial organisms



# Bloom details are complicated: Lake characteristics

- Physical: depth, flushing, shape
- Chemical: internal nutrient cycling, iron, dissolved carbon, herbicides
- Biological: competition or allelopathy from plants, zebra mussels, carp



# Bloom details are complicated: What's happening outside the lake?

- Watershed: nutrient inputs
- Weather: precipitation intensity, turbulence from wind, temperature
- Climate change: more precipitation per event, longer ice-free season, higher temperatures



# Monitoring Blooms for Recreation

- Most likely at public beaches, not other areas of lakes.
- Blooms may change significantly between time of sample collection and when testing results are available.
- Posting advisories should be left to public health officials.



# Who issues advisories or closes beaches in Wisconsin?

Chapter 254.46 Beaches. The department or a **local health department** shall close or restrict swimming, diving and recreational bathing if a human health hazard exists in any area used for those purposes on a body of water and on associated land and shall require the posting of the area.



**DNR has the responsibility for advisories and beach closures at State Park and State Forest properties.**



# US EPA *Draft* Recreational Guidelines

Draft Recreational Advisory Levels for Cyanotoxins	
Microcystins (MC)	Cylindrospermopsin (CYN)
4 µg/L	8 µg/L

Swimming Advisory: not to be exceeded on any day  
(also dually proposed as Ambient Water Quality Criteria)

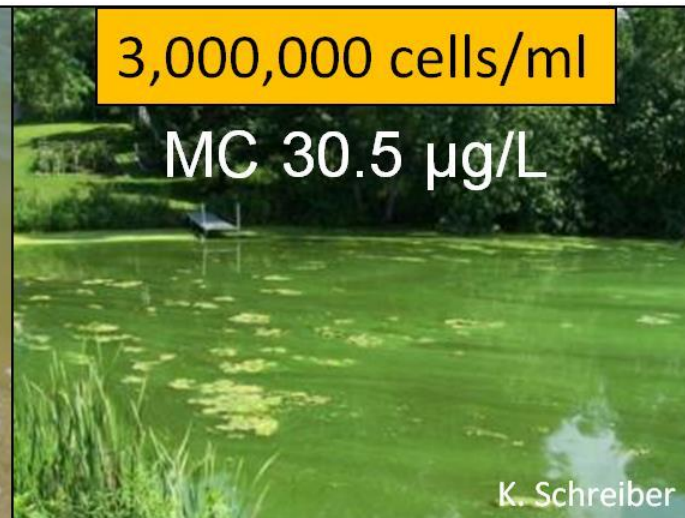
- Based on toxins' **chronic** effects on target organs (liver, kidney), not on **acute** effects (e.g., allergic reactions, vomiting, diarrhea).
- Take children's smaller size into account.
- Not enough data to determine cell densities or pigment levels (chlorophyll or phycocyanin) correlated with these toxin concentrations.



# WHO Recreational Guidelines

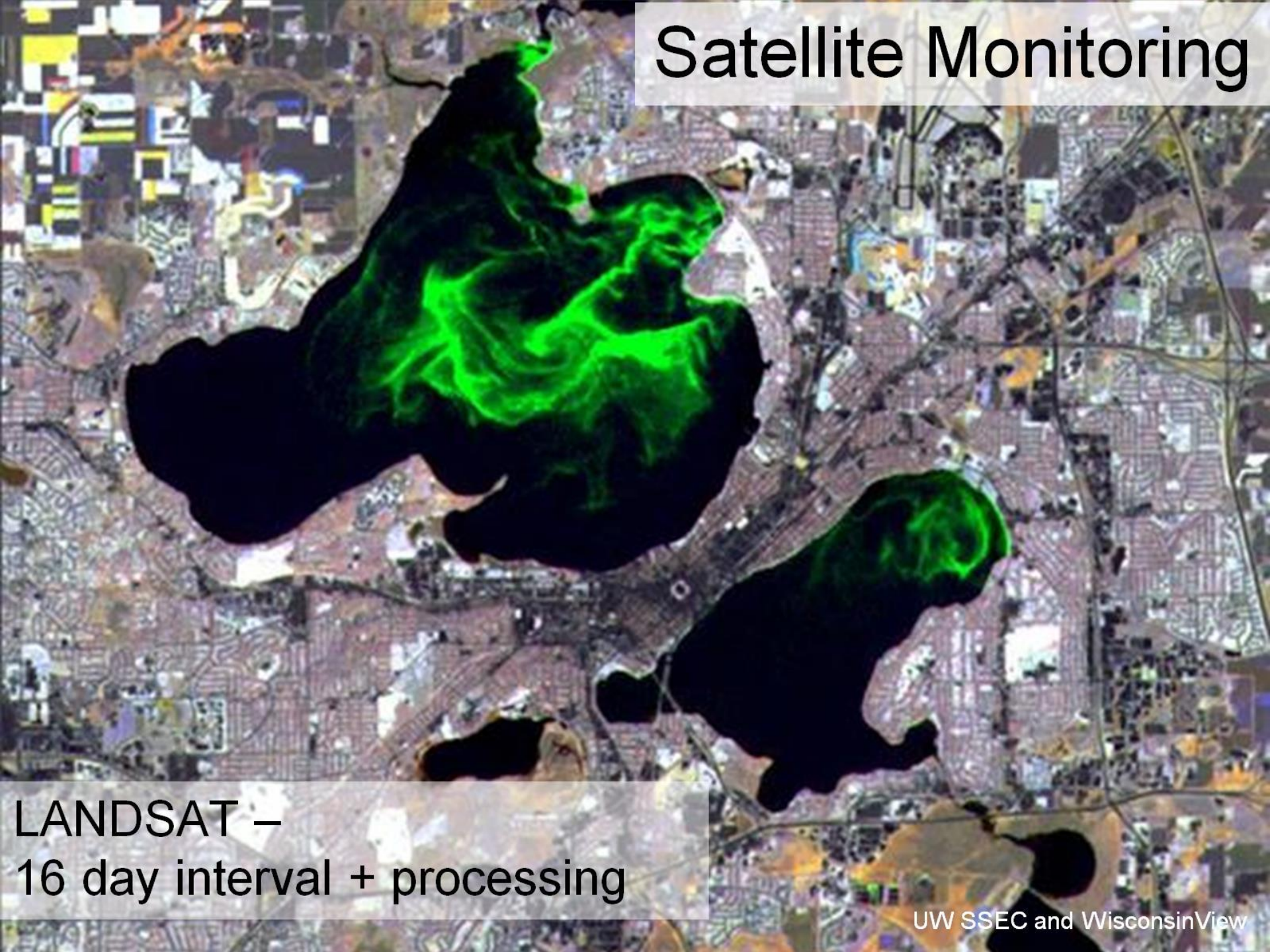
Probability of Adverse Health Effects	Cell Density (cells/ml)	Microcystin-LR ( $\mu\text{g/L}$ )	Chlorophyll ( $\mu\text{g/L}$ )
Low	< 20,000	< 10	< 10
Moderate	20,000-100,000	10 – 20	10 – 50
High	100,000-10,000,000	20 – 2,000	50 – 5,000
Very High	> 10,000,000	> 2,000	> 5,000

Graham *et al.* 2009, based on WHO 2003 *Guidelines for Safe Recreational Water Environments*





# Satellite Monitoring



LANDSAT –  
16 day interval + processing



# Lake Erie Harmful Algal Bloom Forecast



## Lake Erie Harmful Algal Bloom Bulletin

25 September, 2017, Bulletin 22

The *Microcystis* cyanobacteria bloom continues in the western basin along- and offshore the Michigan and Ohio coasts from Maumee Bay east into the central basin, and northeast to the Ontario coast. Observed winds since Thursday (9/21-9/25) caused an increase in surface concentrations. Scums were visible within Maumee Bay extending northeast to the Ontario coast. Measured toxin concentrations are below recreational thresholds throughout most of the bloom extent, but concentrations can exceed the threshold within Maumee Bay and in the western basin extending towards the Ontario coast where the bloom is most dense (appearing green from a boat).

Forecast winds (2-5kn) today through Wednesday (9/25-9/27) may increase the potential for scum formation. Forecast winds today through Thursday (9/25-9/28) may limit the transport of remaining *Microcystis* concentrations.

Please check Ohio EPA's site on harmful algal blooms for safety information: <http://epa.ohio.gov/habalgae.aspx>. Keep your pets and yourself out of the water in areas where scum is forming. NOAA's GLERL provides additional HAB data: [https://www.glerl.noaa.gov/res/HABs\\_and\\_Hypoxia](https://www.glerl.noaa.gov/res/HABs_and_Hypoxia). The persistent cyanobacteria bloom in Sandusky Bay continues. -Davis, Laline

The images below are "GeoPDF". To see the longitude and latitude under your cursor, select "Tools > Analyze > Geospatial Location Tool".

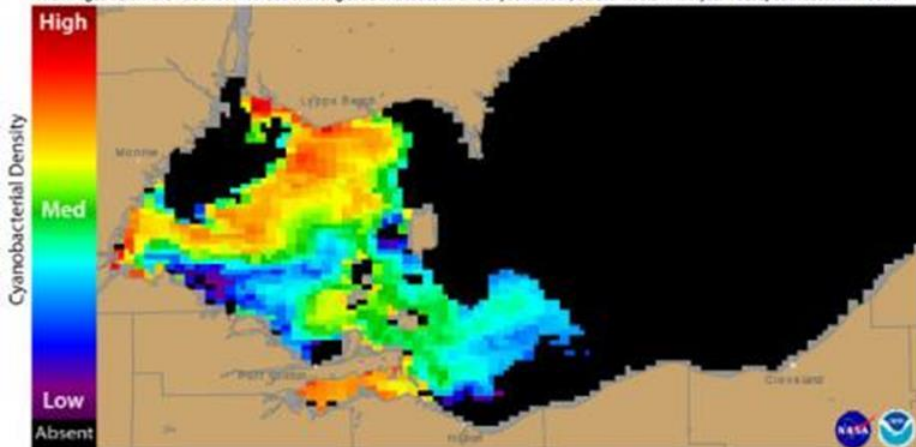
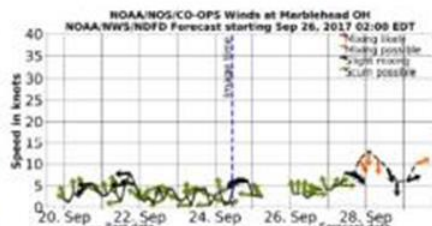


Figure 1. Cyanobacterial index from NASA MODIS-Terra data collected 24 September, 2017 at 11:55 EST. Grey indicates clouds or missing data. The estimated threshold for cyanobacteria detection is 20,000 cells/mL.



Figure 2. Cyanobacterial Index from NASA MODIS-Terra data collected 24 September, 2017 at 11:55.



Wind speed and direction from Marblehead, OH. Blooms mix through the water column at wind speeds greater than 15 knots (or 7.7 m/s).

For more information and to subscribe to this bulletin, go to: <https://tidesandcurrents.noaa.gov/hab/lakeerie.html>

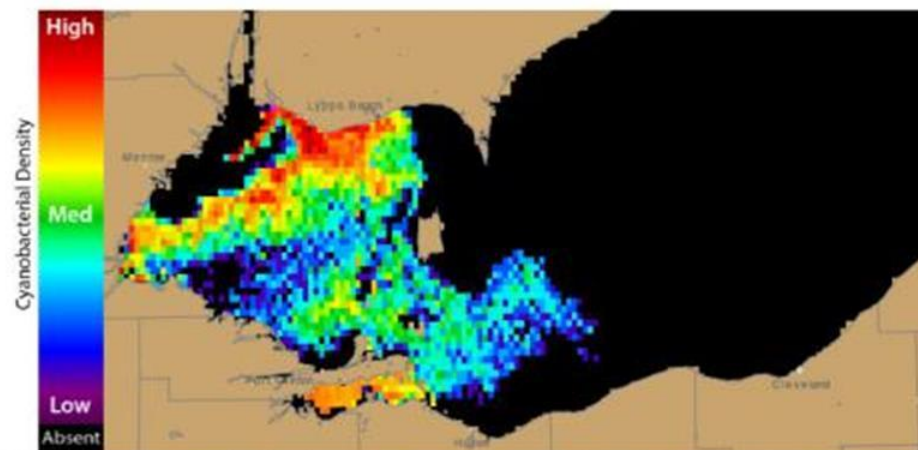


Figure 3. Nowcast position of bloom for 25 September, 2017 using GLFS modelled currents to move the bloom from the 24 September, 2017

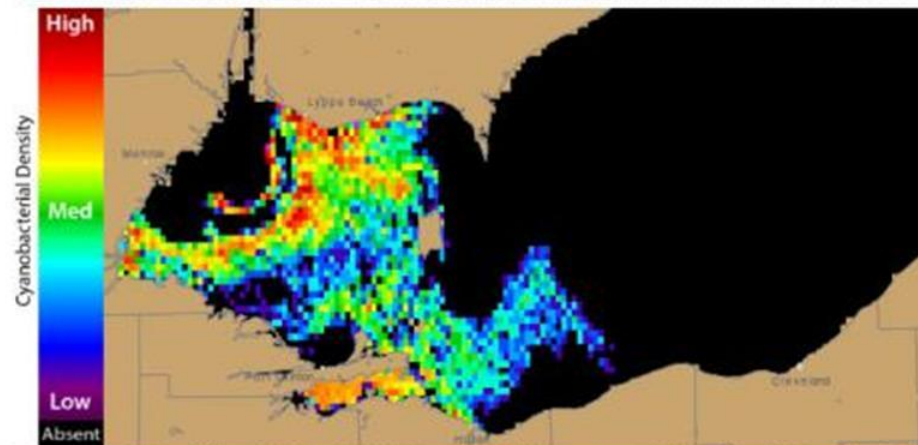
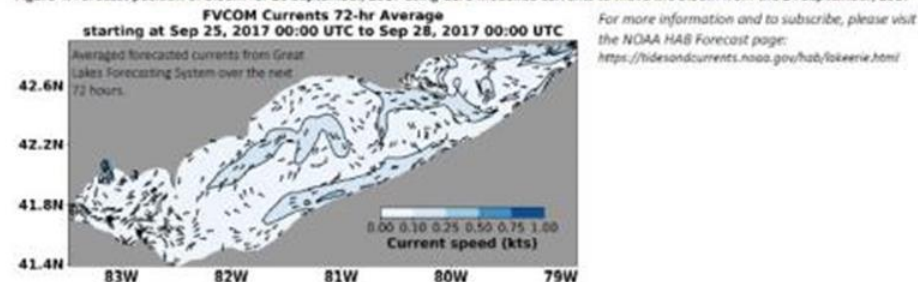


Figure 4. Forecast position of bloom for 28 September, 2017 using GLFS modelled currents to move the bloom from the 24 September, 2017



For more information and to subscribe, please visit the NOAA HAB Forecast page: <https://tidesandcurrents.noaa.gov/hab/lakeerie.html>



# Cyanobacteria Assessment Network



EPA, NASA, NOAA, & USGS

Data from NASA/USGS  
LANDSAT & European Space  
Agency Sentinel satellite  
missions

Most inland lakes are too  
small for satellite monitoring.

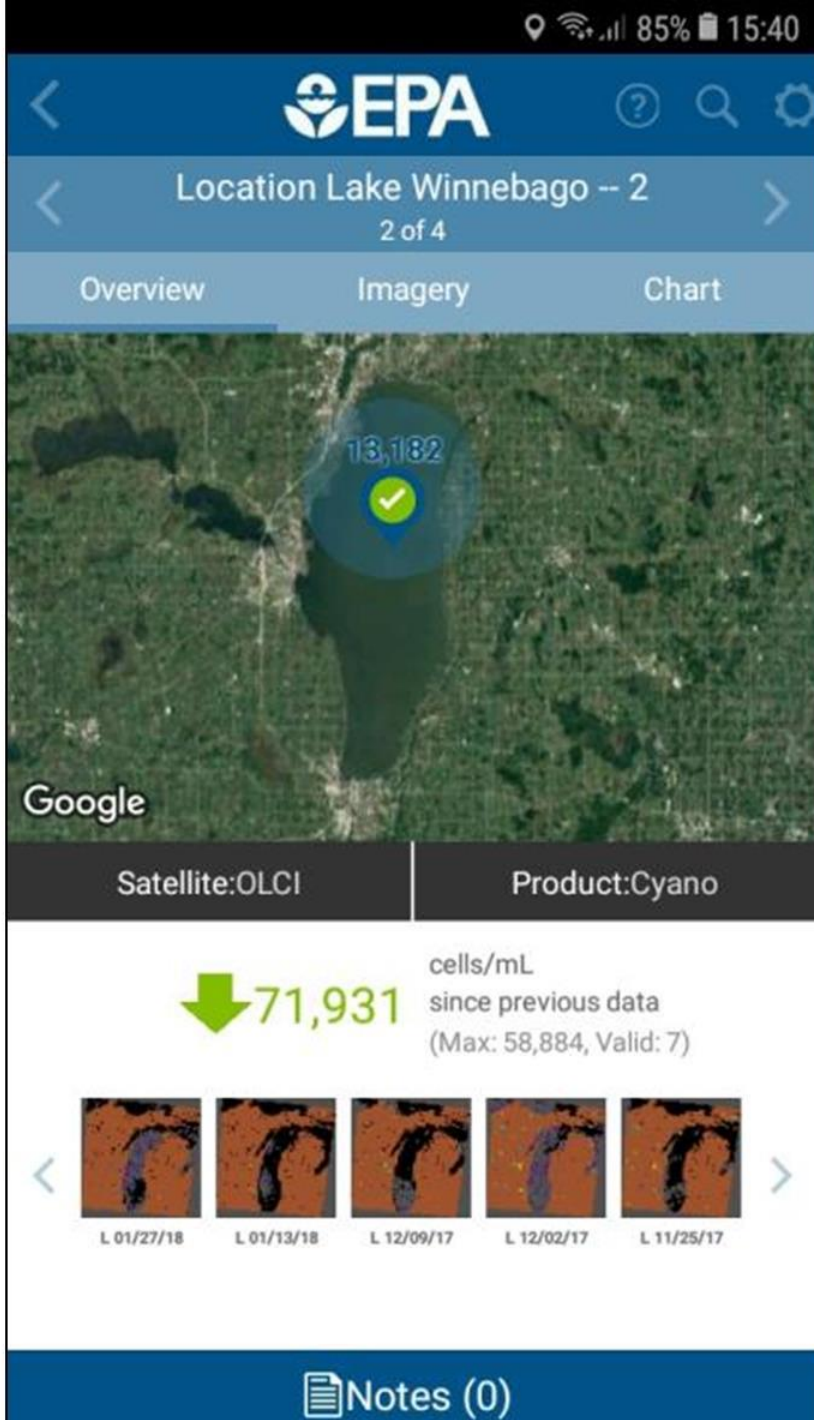
**Toxins cannot be detected  
via remote sensing.**

Android app in beta testing.

D. Gurlin

<https://www.epa.gov/water-research/cyanobacteria-assessment-network-cyan>





Composite cyanobacteria cell count maximums (over 1 week) updated weekly

Known issues:

Lag in data availability from ESA

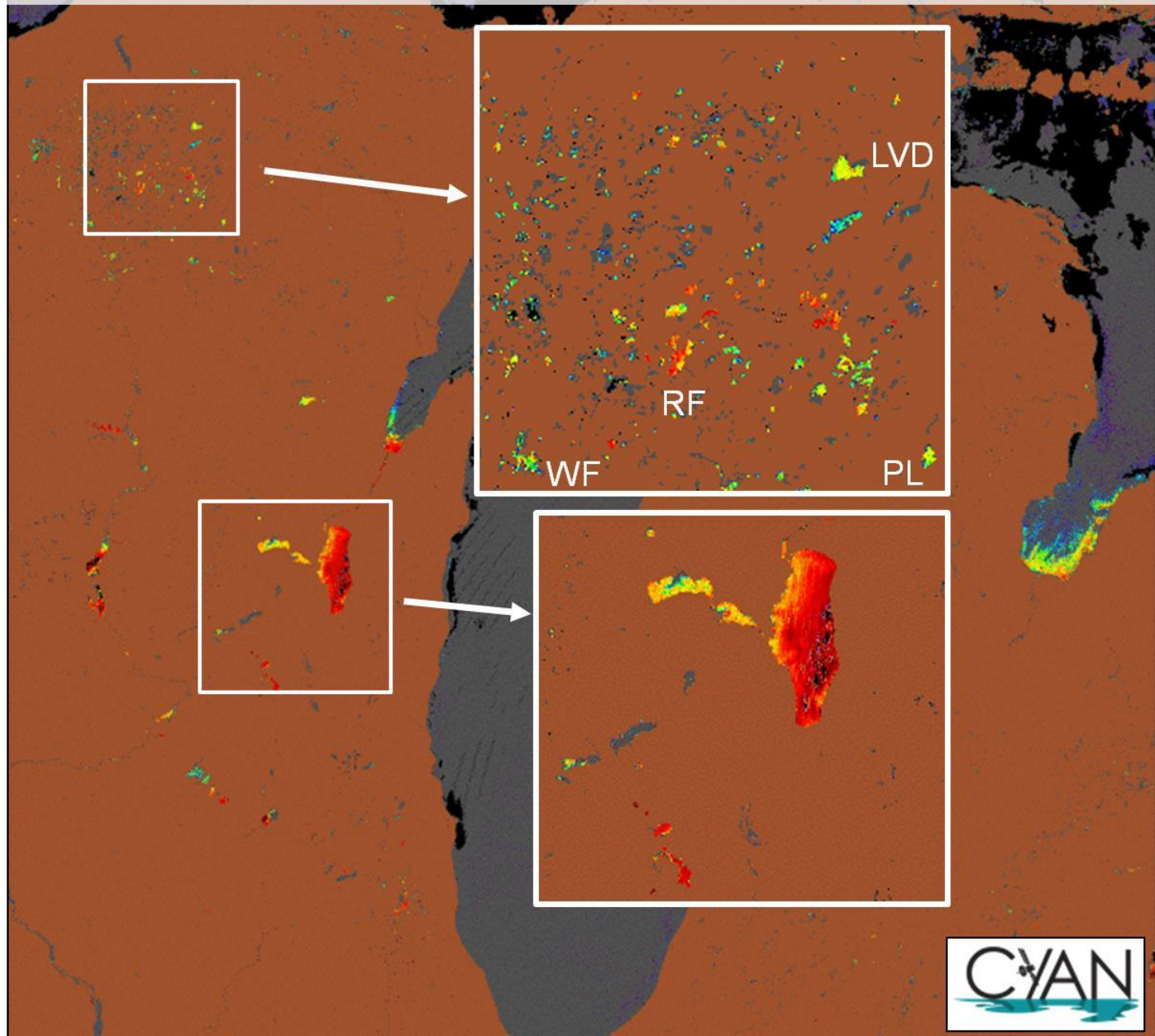
Ice & thin clouds may register as blooms

Data better for lakes > 900m (0.56 mile)

Should be considered a research level tool



7-day composite value from August 27, 2017 through September 2, 2017





# If there's no public health testing, how can you stay safe?

Learn what to look for.

Use common sense.

Avoid submerging your head if water contains lots of particles or debris.

This will help to protect you from other bacteria, viruses, and parasites.

Keep water out of your mouth!

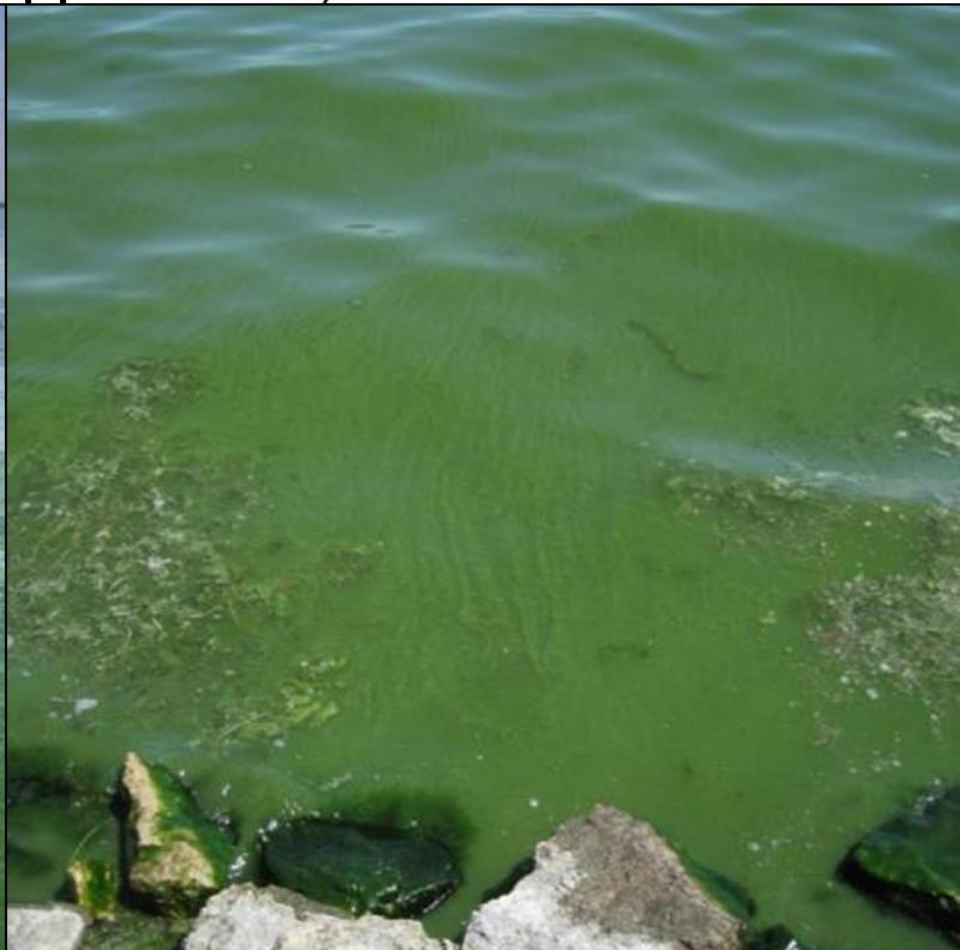
10  $\mu\text{m}$

A microscopic image showing a large number of rod-shaped bacteria, likely Bacillus or Clostridium species, scattered across the field of view. The bacteria are of various lengths and orientations. A vertical scale bar on the right side of the image indicates a length of 10 micrometers.



# You can see the blooms that are of highest concern

Planktonic (free-floating) blooms are visible either as surface scums or mixed into water in high concentration (“pea soup” appearance)



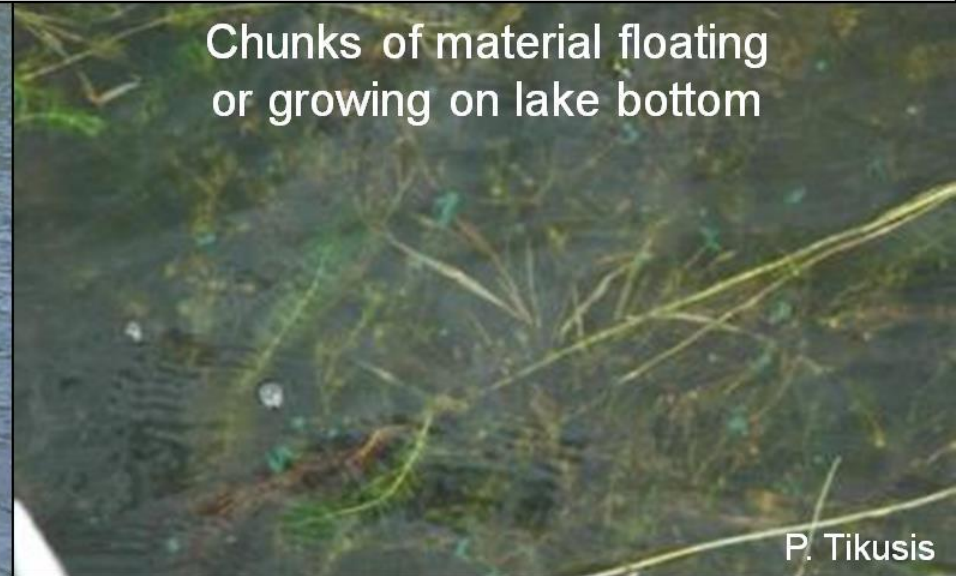


# What about other situations?

Blooms patchy or in small areas

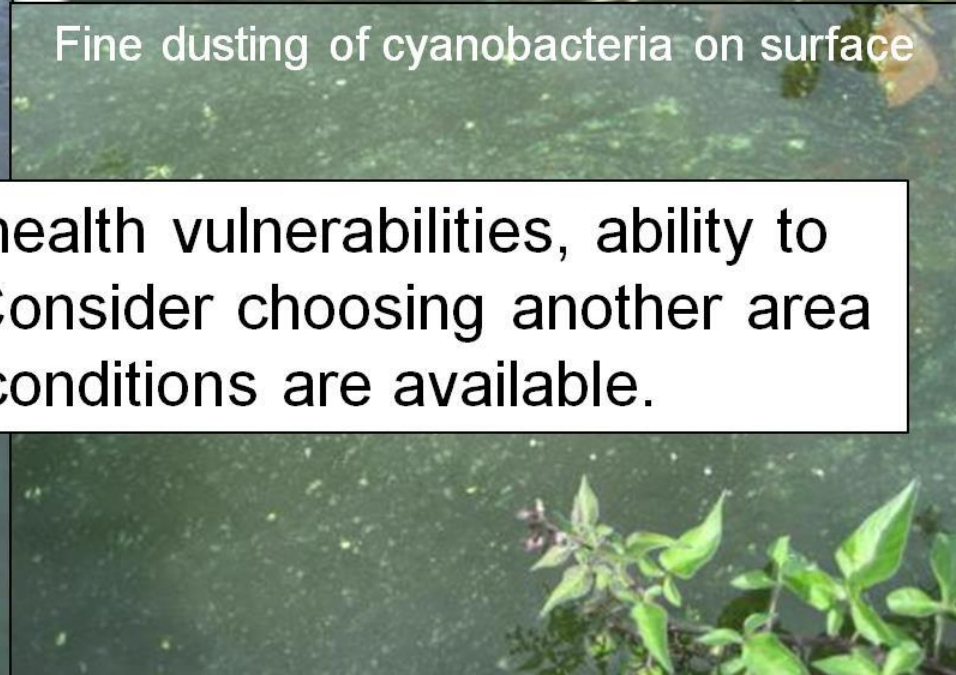


Chunks of material floating or growing on lake bottom



P. Tikusis

Fine dusting of cyanobacteria on surface



Judgment call – account for health vulnerabilities, ability to keep water out of the mouth. Consider choosing another area for recreation if better conditions are available.



# How to be safe?

- Avoid swimming in and boating through blue-green algal scums and “pea soup” water.
- **Can you see your feet in knee-deep water?** If not, avoid ingesting any water.
- Choose the **clearest** water possible for small children and pets.
- Always shower after swimming in a lake, river, or pond.
- Try to avoid swallowing water, no matter how clean it looks (especially after a rainstorm!)



K. Schreiber, WDNR



**When in doubt,  
keep out!**



# Keep your pets safe!

- Animals don't instinctively know if water is safe.
- Provide clean drinking water.
- Keep pets out of scummy water, and wash them off immediately after they swim.
- Don't allow dogs to eat dried scum on shore or floating mats.





Business Licenses & Regulations Recreation Env. Protection Contact Join DNR

## Blue-Green Algae

General Humans & Animals Drinking Water Recreation Protect Yourself Resources

### Contact and General Information

**If you think you are experiencing symptoms** related to exposure to blue-green algae (e.g., stomach cramps, diarrhea, vomiting, headache, fever, muscle weakness, difficulty breathing), contact your doctor or the Poison Information Hotline (800-222-1222) right away.

**If your pet displays symptoms** such as seizures, vomiting, or diarrhea after contact with surface water, contact your veterinarian right away.

**Report a Case** with potential health effects caused by blue-green algae, visit the [Department of Health Services \(ask user\)](#), or contact the Bureau of Environmental and Occupational Health at 608-266-1120.

For more information about contacting your local health department, check the [Department of Health Services Web site \(ask user\)](#).

If you are (or your local community is) interested in collecting samples for analysis, please contact the **Wisconsin State Laboratory of Hygiene** at **(800)442-4618**. The Wisconsin Department of Natural Resources is not currently conducting any routine monitoring for blue-green algae or blue-green algal toxins.

### What are blue-green algae?


Blue-green algae, also known as Cyanobacteria, are a group of photosynthetic bacteria that many people refer to as "pond scum." Blue-green algae are most often blue-green in color, but can also be blue, green, reddish-purple, or brown. Blue-green algae generally grow in lakes, ponds, and slow-moving streams when the water is warm and enriched with nutrients like phosphorus or nitrogen.

When environmental conditions are just right, blue-green algae can grow very quickly in number. Most species are buoyant and will float to the surface, where they form scum layers or floating mats. When this happens, we call this a "blue-green algae bloom." In Wisconsin, blue-green algae blooms generally occur between mid-June and late September, although in rare instances, blooms have been observed in winter, even under the ice.

Lake Name:

### Lakes

#### Find a lake.



Blue-green algae blooms appeared earlier and in more lakes this summer than usual. Learn more about these blooms and the health risks they can pose.

#### Contact information

For information on Lakes in Wisconsin, contact:

[Wisconsin DNR Lakes](#)  
Division of Water  
Bureau of Water Quality

[Blue-Green Algae Contacts](#)

For more information:  
[dnr.wi.gov](http://dnr.wi.gov)  
 Search for "algae"

Find me in the  
 blue-green algae contacts



- DNR and DHS are tracking blooms and related illnesses.

**Please let me know about bloom events!**

[Gina.LaLiberte@wisconsin.gov](mailto:Gina.LaLiberte@wisconsin.gov)

- DNR cannot test for each bloom, but knowledge of blooms helps us to track where HABs are a public health burden.
- Most bloom-tracking apps/websites DO NOT report to DNR.
- The exception is bloomWatch: <https://cyanos.org/bloomwatch/> BUT follow-up information by states to bloom reporters is not supported.



The screenshot shows the Wisconsin Department of Health Services website. The header includes the DHS logo and a search bar. The main navigation bar lists various services: About DHS, Data & Statistics, Diseases & Conditions, Health Care & Coverage, Long Term Care & Support, Prevention & Healthy Living, Partners & Providers, and Certification, Licenses & Permits. Below this is a breadcrumb trail: Prevention & Healthy Living > Environmental Health > Blue-Green Algae. The page title is "Blue-Green Algae". The content area includes a sidebar with links like "Understanding Algae", "Health Concerns", "Algal Bloom Photos", "Keeping our Lakes Clean", "Resources and Links", and "Contact Us". The main text explains that the Wisconsin Division of Public Health collects information about human and animal illness resulting from exposure to blue-green algae. It includes a photo of a green algal bloom in water and a call to action: "Please report any blue-green algae blooms and related human or animal illnesses to the Wisconsin Harmful Algal Blooms Program by calling 608-266-1120 or completing the online form Harmful Algae Bloom (HAB) Illness or Sighting Survey, F-02152." A grey box at the bottom of the page says "When in doubt, stay out!".

To **report illnesses** in people or animals:  
[dhs.wisconsin.gov](https://dhs.wisconsin.gov)  
Search for “algae”  
Or call 608-266-1120

- DNR and DHS are tracking blooms and related illnesses.  
**Please report illnesses in people or animals at the DHS website!**
- Timely reporting is essential for follow-up sampling & testing.
- We may not be able to sample and test for each case, but knowledge of blooms helps us to track where HABs are a public health burden.
- *Sampling & testing are not intended for routine monitoring purposes.*