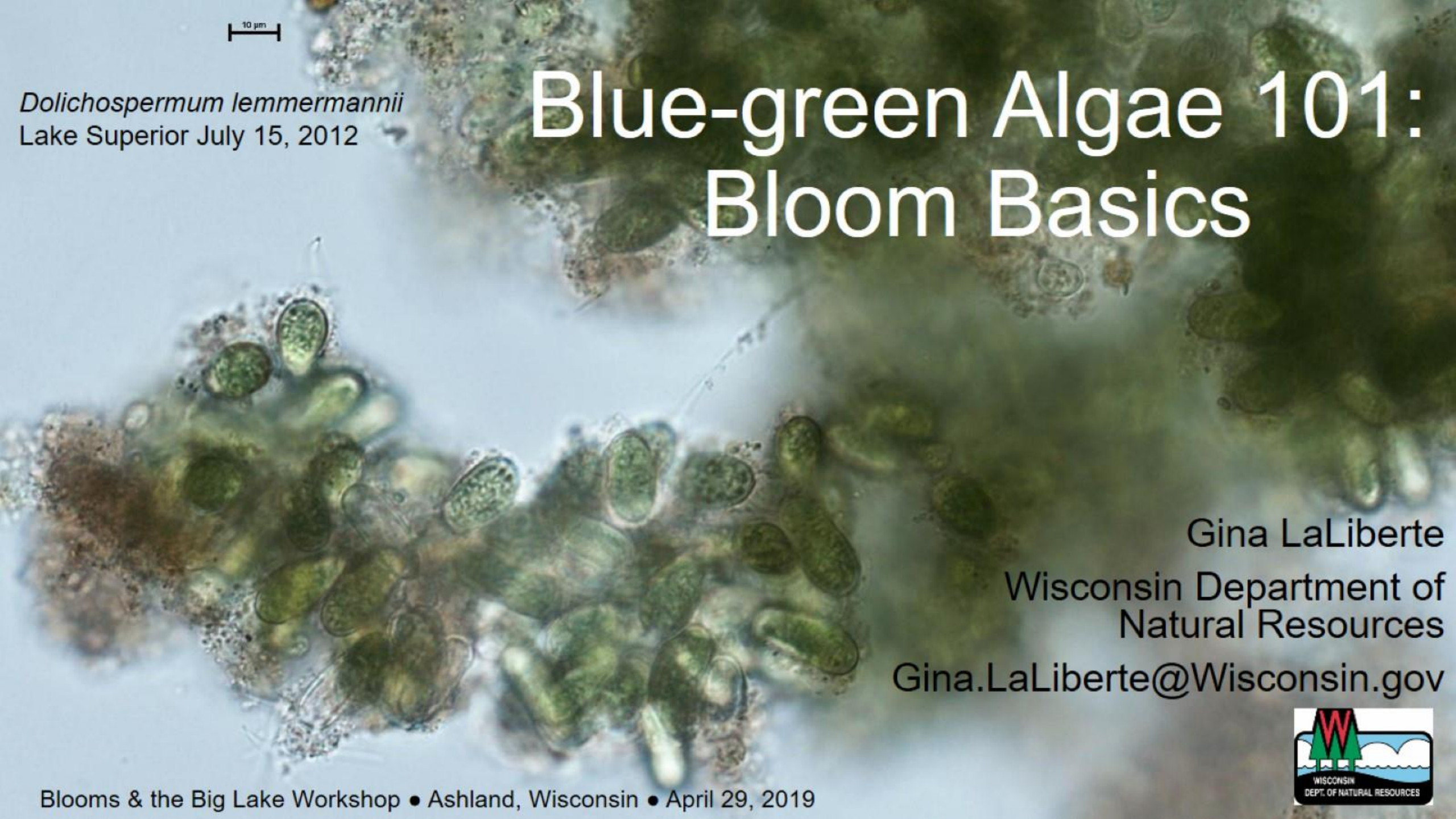
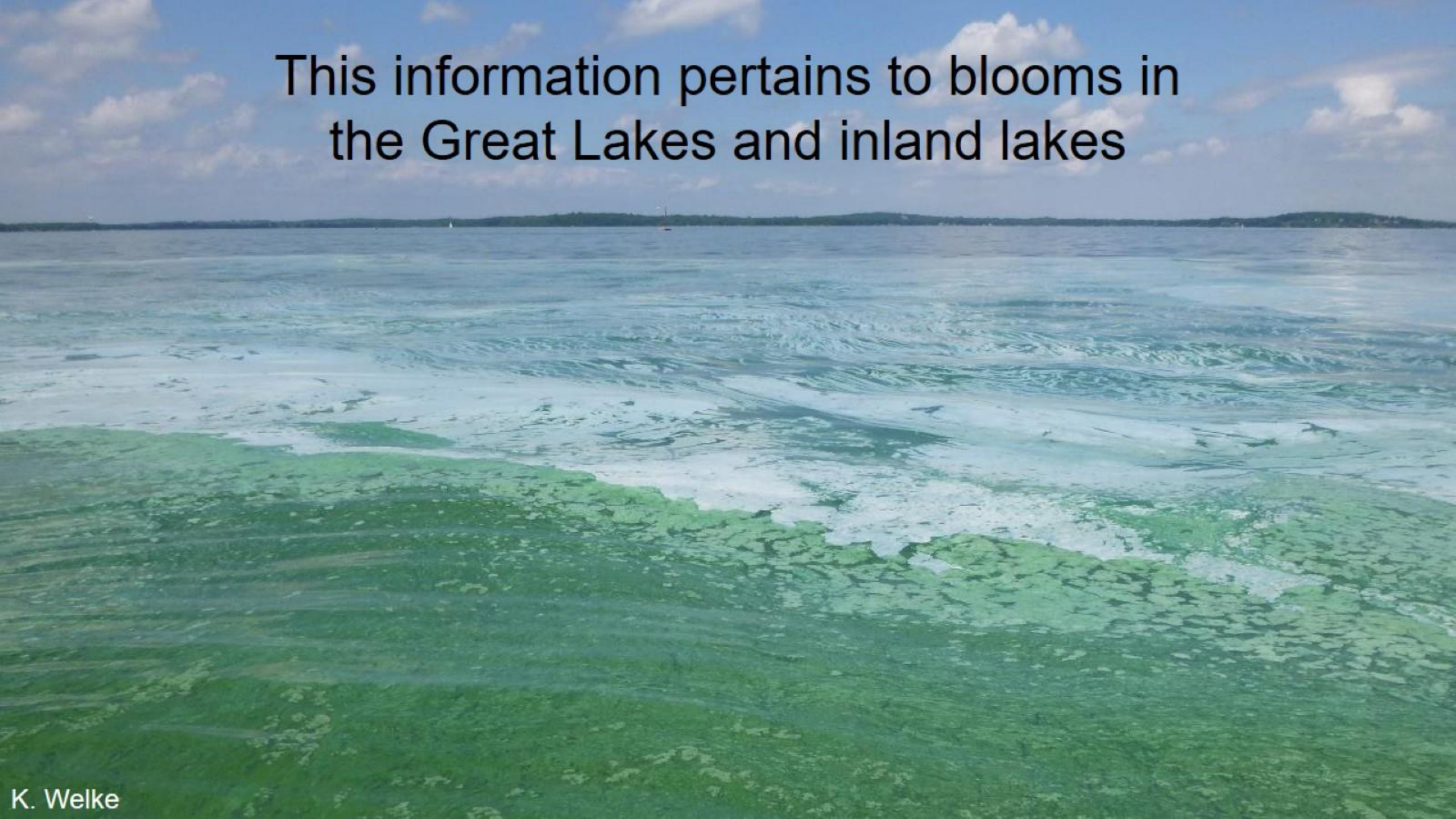


Dolichospermum lemmermannii
Lake Superior July 15, 2012

Blue-green Algae 101: Bloom Basics

Gina LaLiberte
Wisconsin Department of Natural Resources
Gina.LaLiberte@Wisconsin.gov

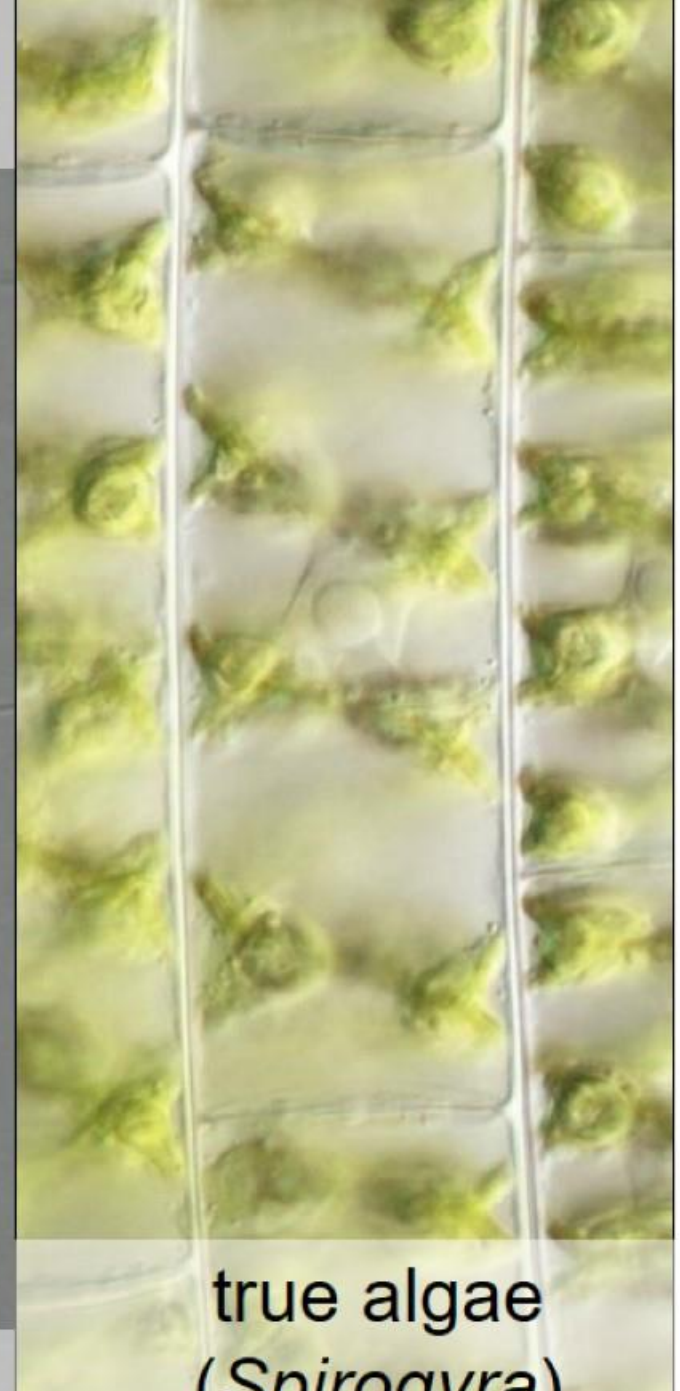
Blooms & the Big Lake Workshop • Ashland, Wisconsin • April 29, 2019


This information pertains to blooms in the Great Lakes and inland lakes
K. Welke

Blue-green Algae = Cyanobacteria

cyanobacteria

cyanobacteria



true algae
(*Spirogyra*)

What is a bloom?

Bloom = excessive growth to nuisance levels.

Harmful Algal Blooms = HABs.

No official quantification exists.

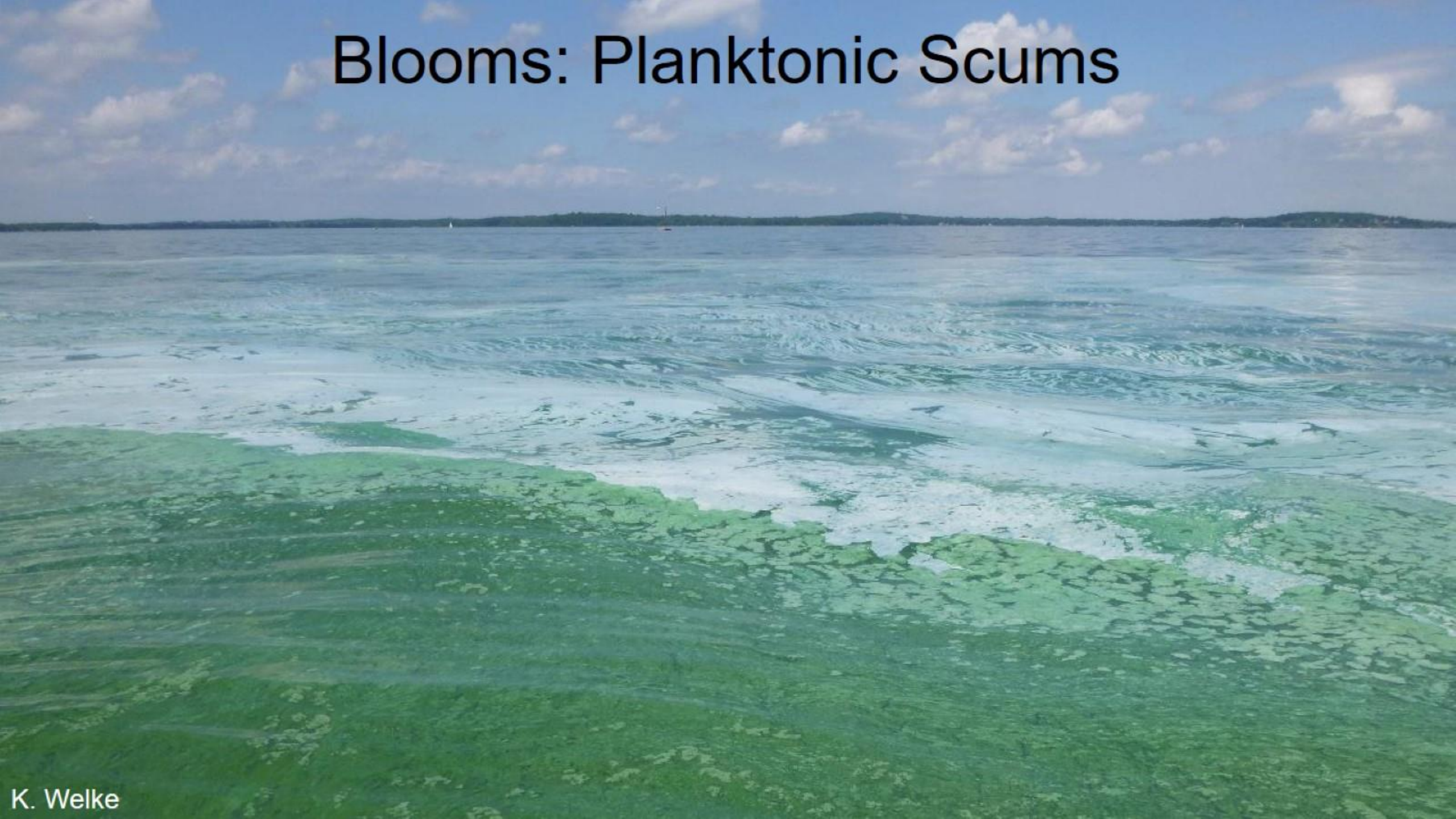
K. Welke

Blooms: Planktonic

Western Lake Erie north of Catawba Island ● September 27, 2017

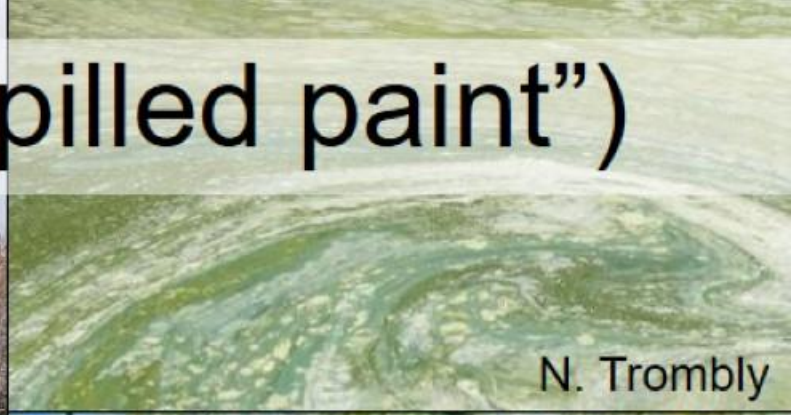
Blooms: Planktonic

Blooms: Planktonic Scums

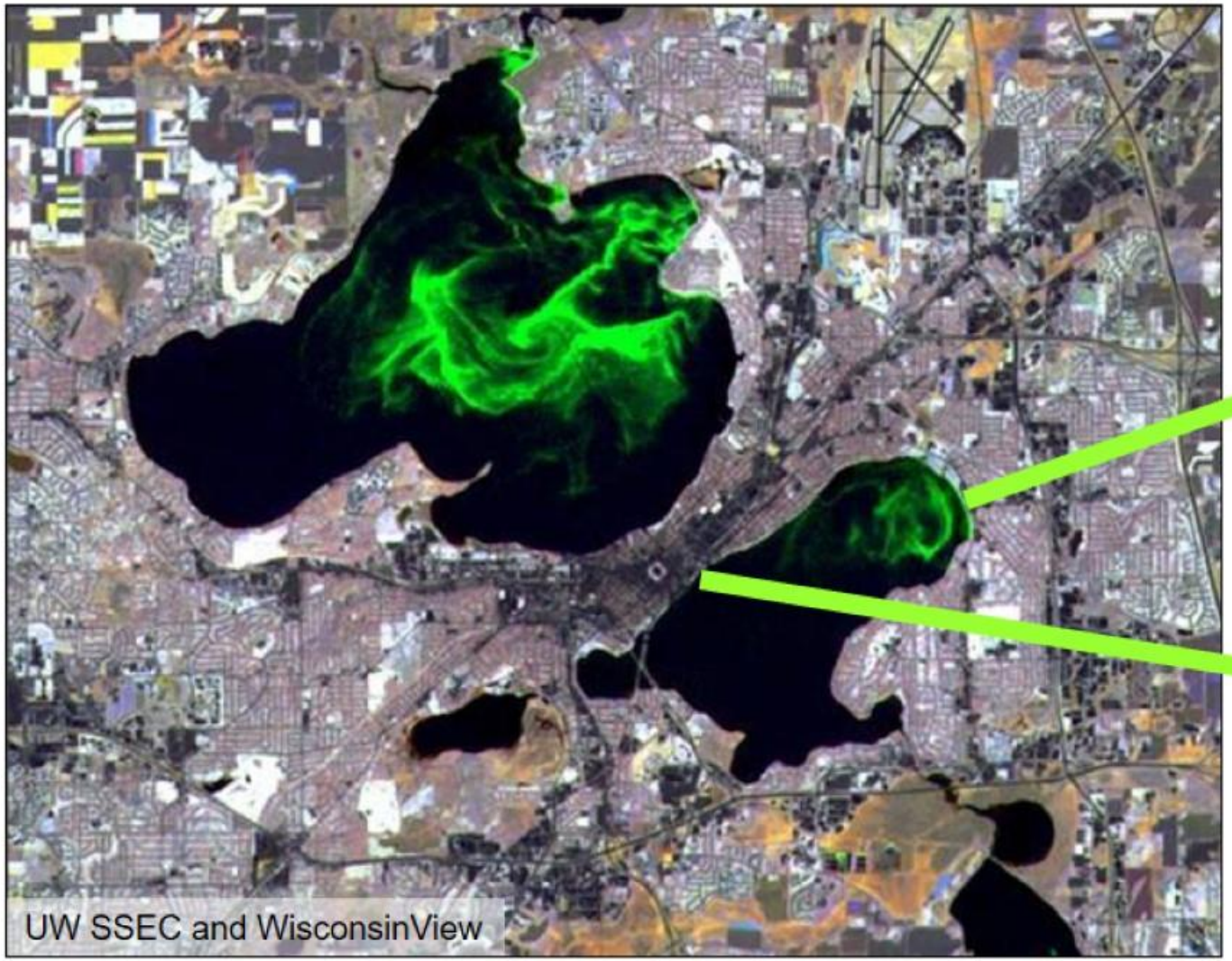


K. Welke

Blooms: Planktonic Scums (“spilled paint”)



Planktonic blooms can be patchy in time & space



Wind can create highly localized bloom conditions, even in lakes with low nutrient levels & low HAB risk.

Blooms: Wind-driven Accumulations

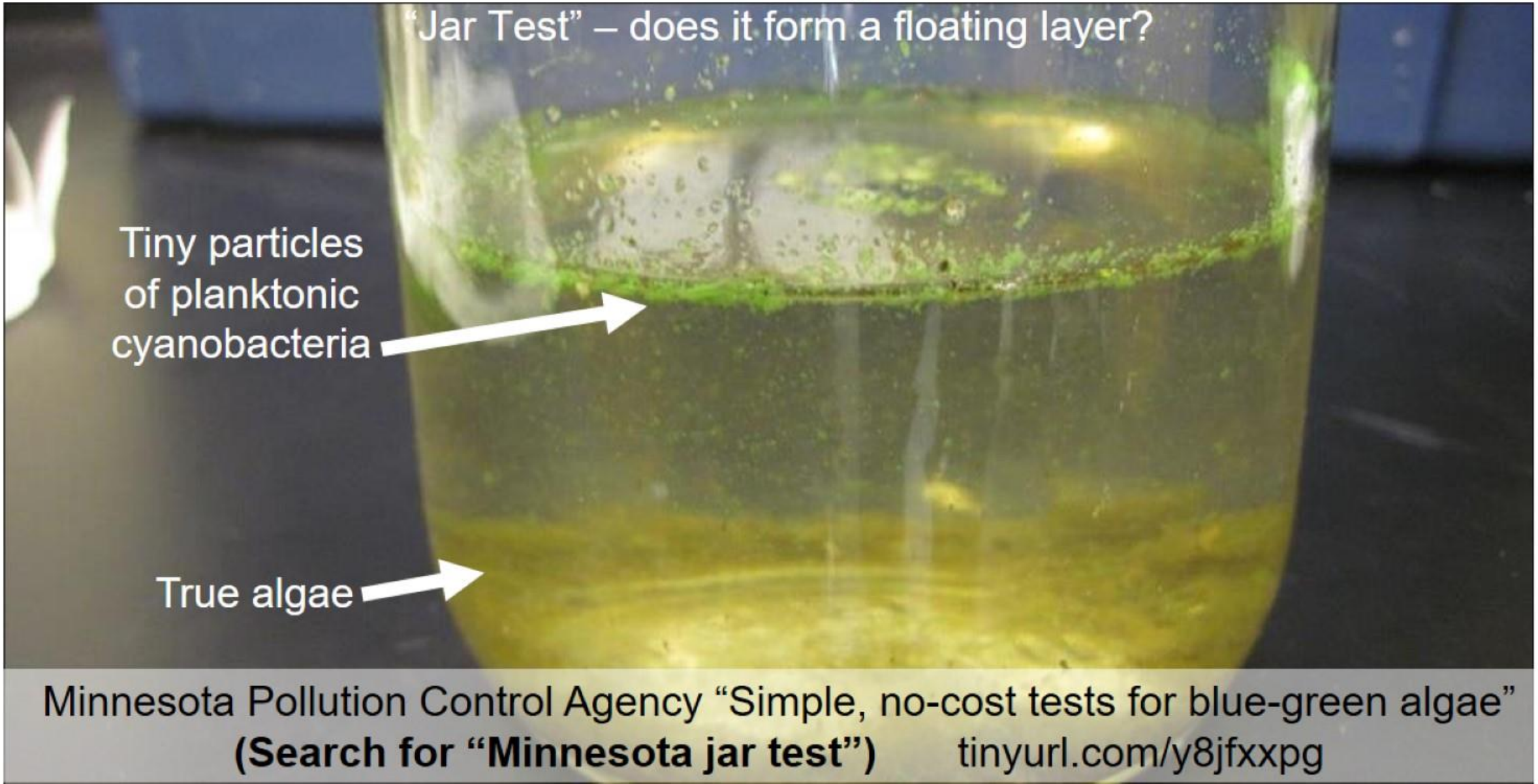
S. Prellwitz

S. Giblin

Blooms: Floating Mats from the Lake Bottom


How can you tell if what you are seeing
is planktonic **cyanobacteria**?
Look for tiny green specks in
water or green “dust” on surface
- this is **cyanobacteria / blue-green algae.**

How do I tell if I am seeing cyanobacteria or something else?

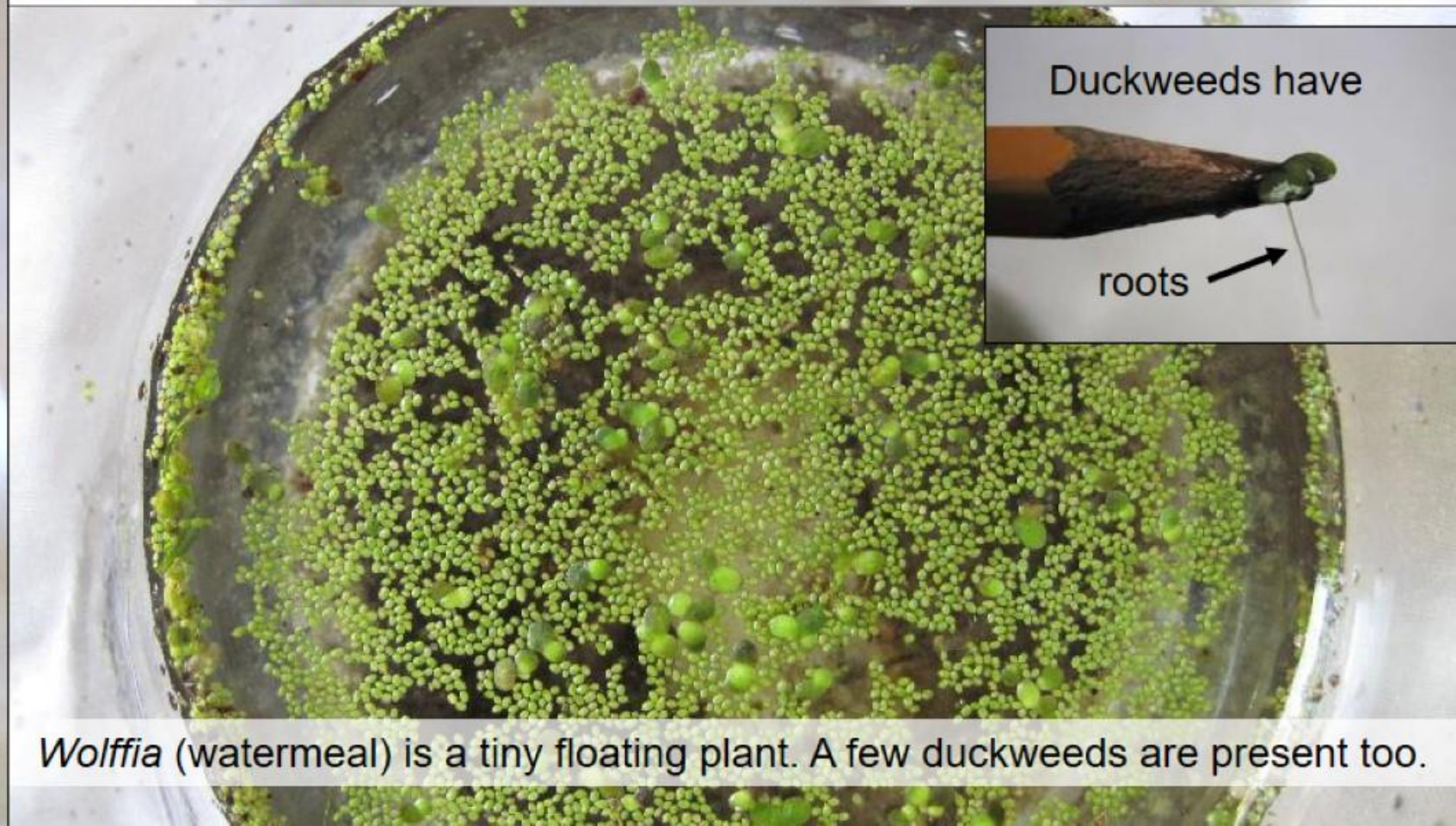


Minnesota Pollution Control Agency "Simple, no-cost tests for blue-green algae"
(Search for "Minnesota jar test") tinyurl.com/y8jfxxpg

Shake and wait –
most true algae sink.

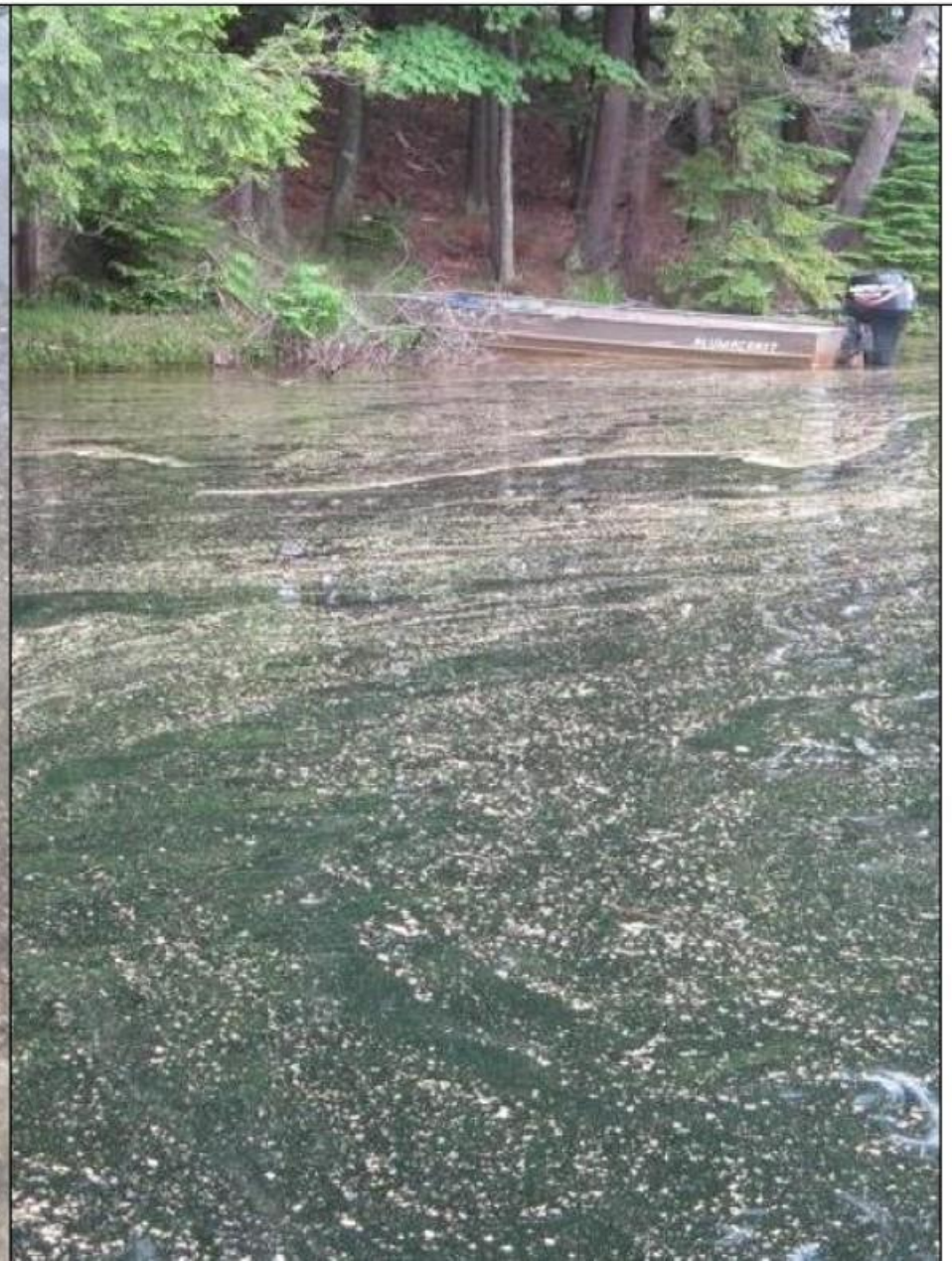
Take a close look at floating green layers

Green layer floats, but contains tiny leaf green plants with regular outlines.



Wolffia (watermeal) is a tiny floating plant. A few duckweeds are present too.

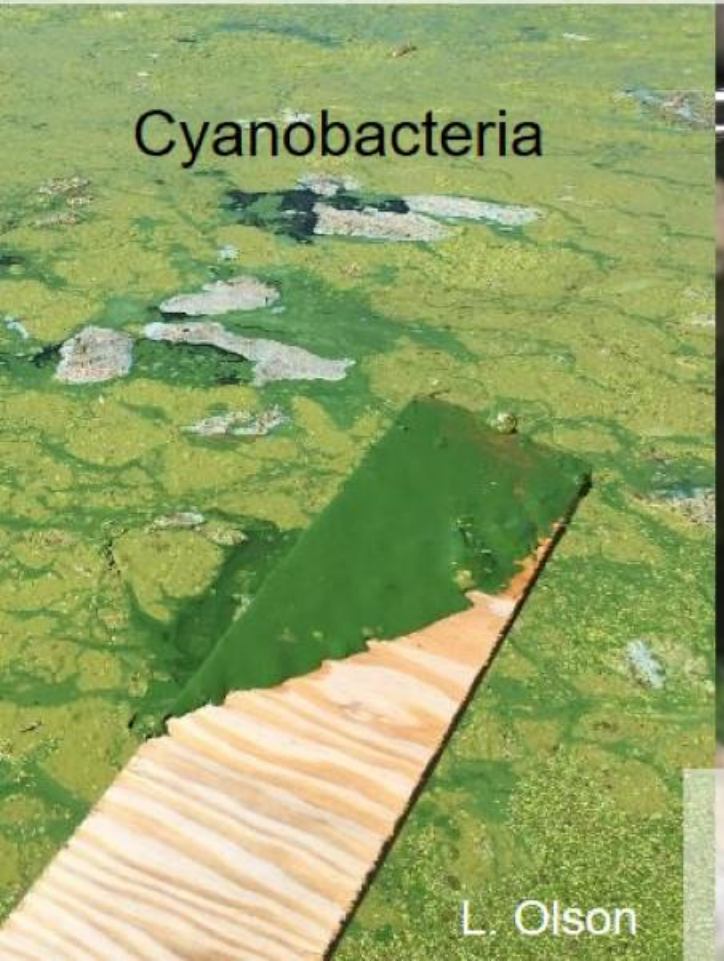
Pollen can look like cyanobacteria, but it is pale yellow,
and you will also see yellow dust accumulating on surfaces on land.




What about floating mats?

How do I tell if I am seeing cyanobacteria or something else?

"Stick Test" – does it coat a stick like paint?
Does it drape over a stick like green hair?
(There is 1 exception, so look at color.)

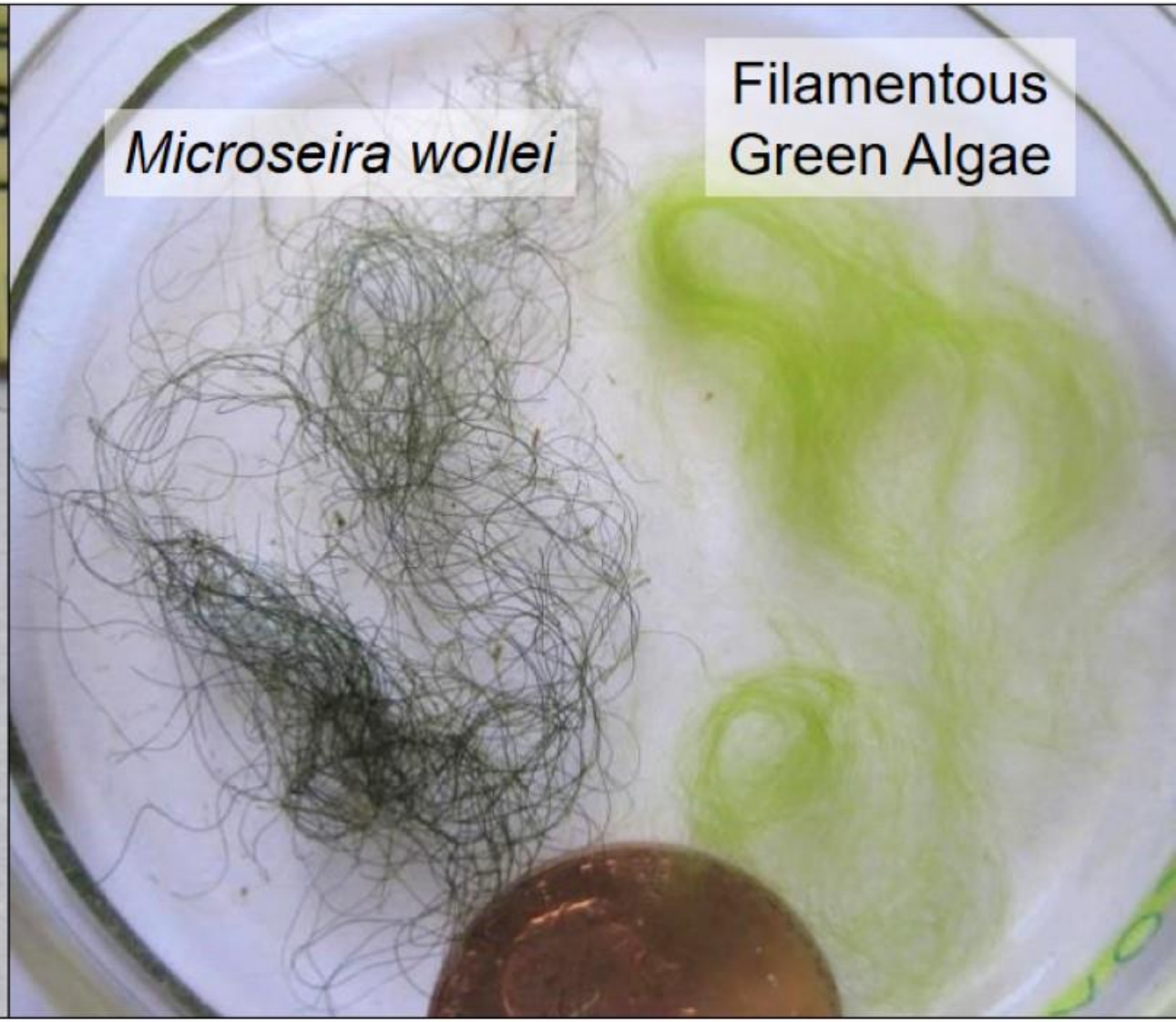


Minnesota Pollution Control Agency
"Simple, no-cost tests for blue-green algae" tinyurl.com/y8jfxxpg

The exception to the Stick Test: *Microseira wollei*

Filamentous cyanobacterium previously named *Lyngbya wollei* and *Plectonema wollei*.

HUGE for a cyanobacterial filament, up to several cm long.



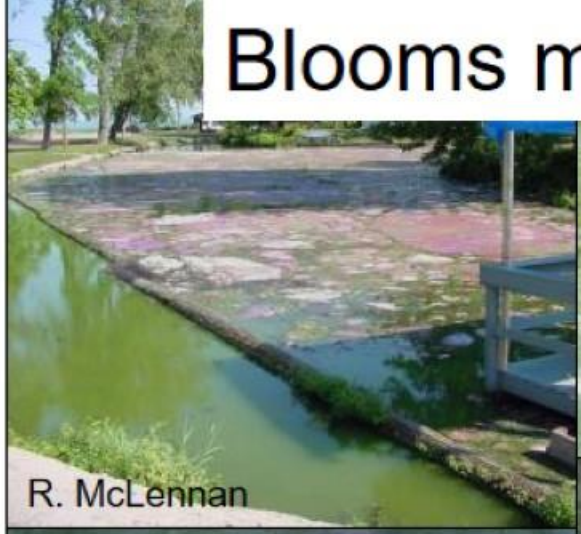
Appears black to the naked eye, vs. leaf green.


“pea soup” appearance:
cyanobacteria bloom


decomposing
pigments are released
M. Meade

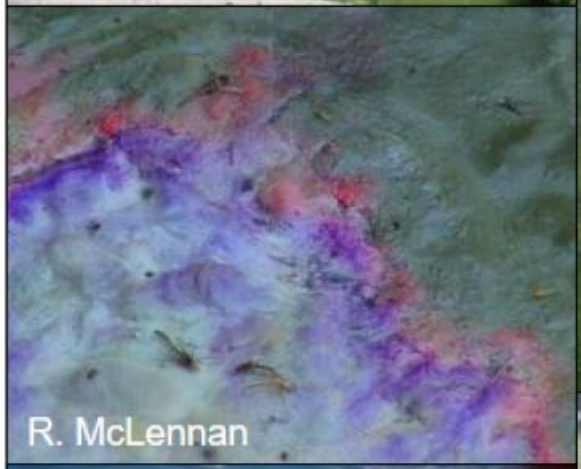

filamentous
green algae
B. Butterfield

Blooms may be many different colors.


R. McLennan


N. Trombly


T. Moris


R. McLennan


J. Williamson

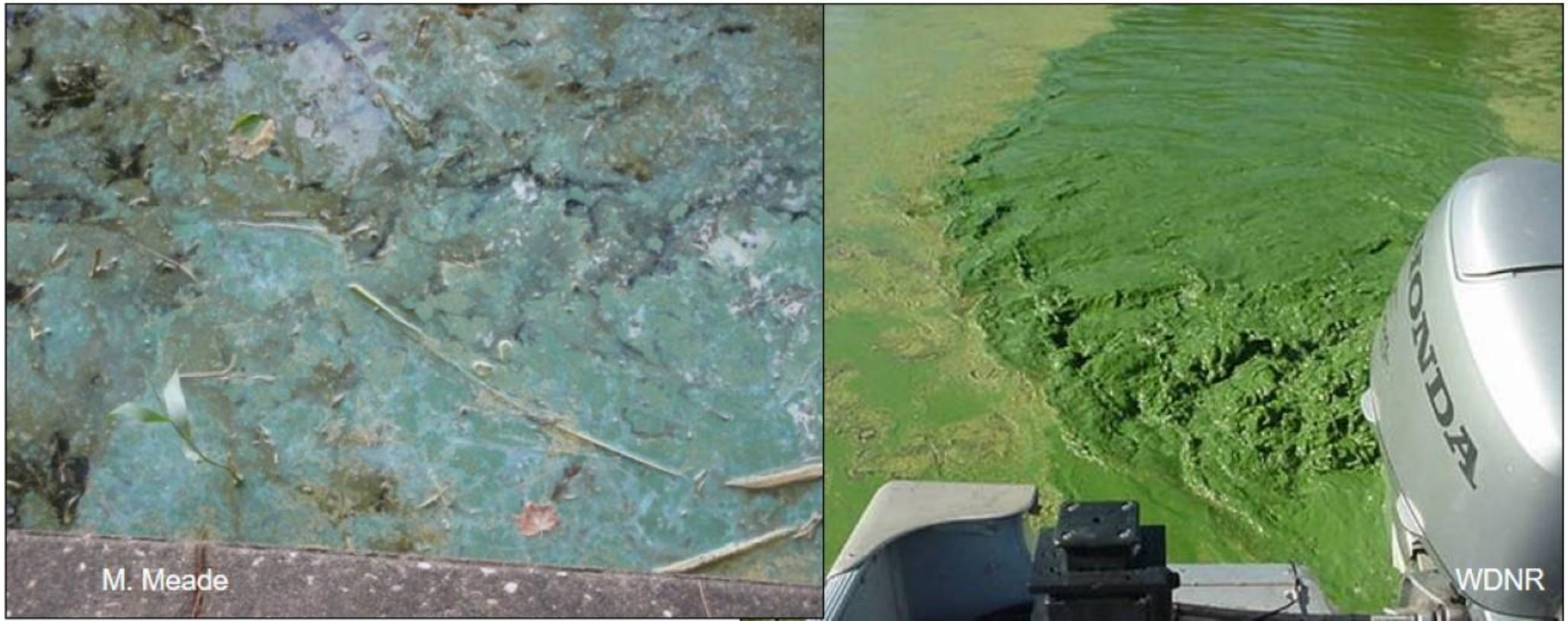

WDHS


J. Williamson

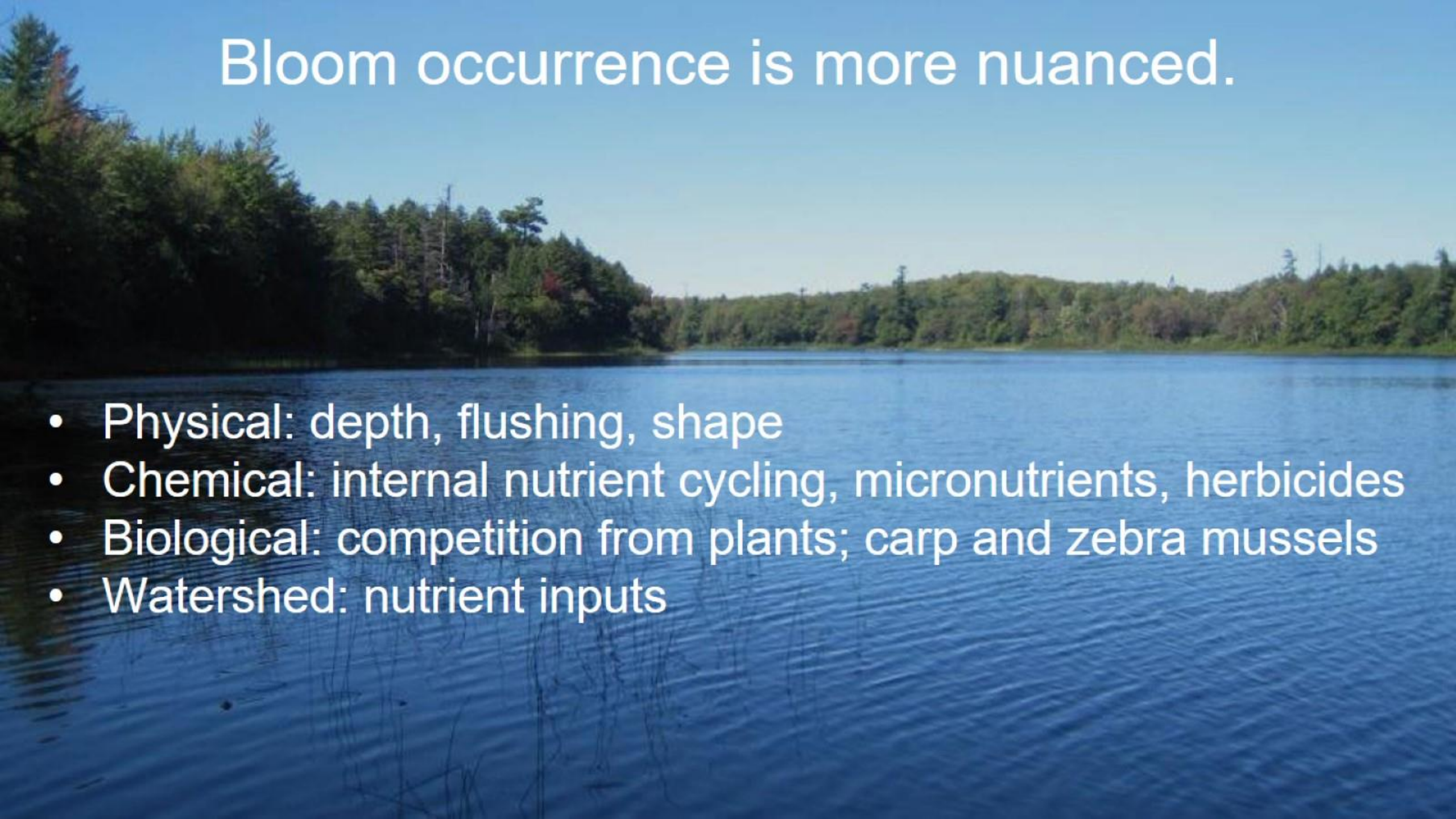

A. Dryja

What causes harmful blooms?

- Excess nutrients (P & N) fertilize growth
- Warm water and calm weather

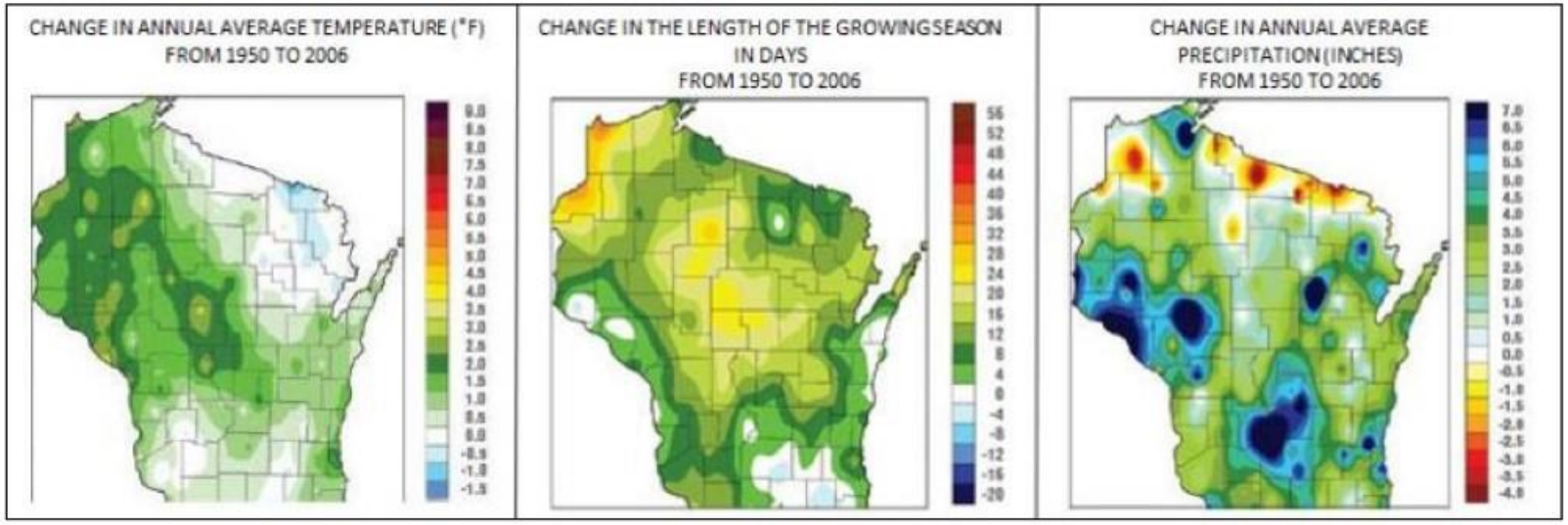


Bloom occurrence is more nuanced.



- Physical: depth, flushing, shape
- Chemical: internal nutrient cycling, micronutrients, herbicides
- Biological: competition from plants; carp and zebra mussels
- Watershed: nutrient inputs

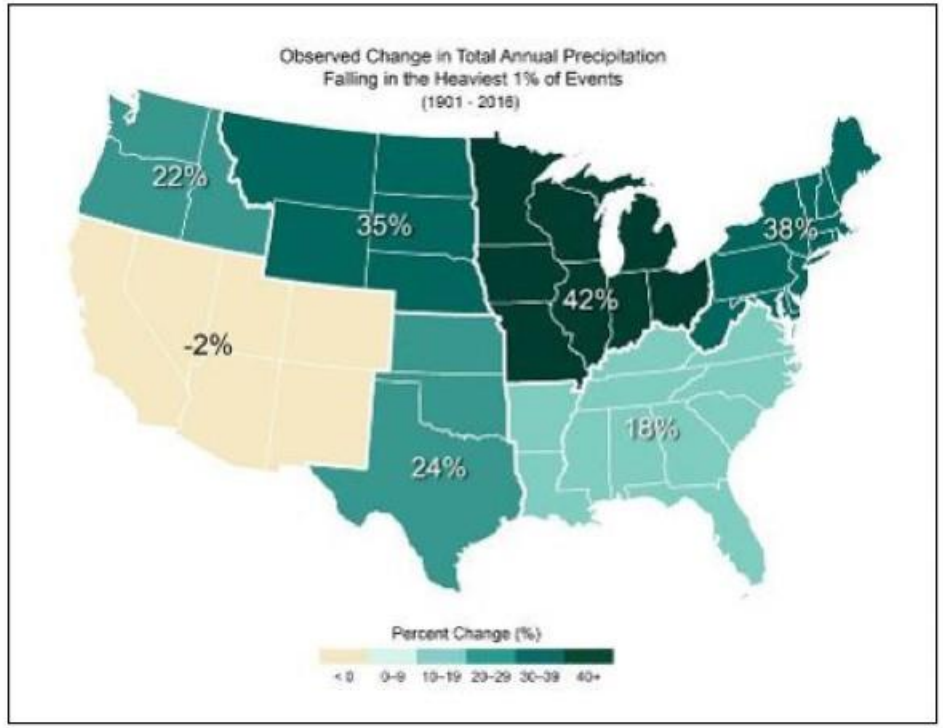
Are blooms more frequent?



- Yes – worldwide evidence
- Warmer water temperatures
- Longer ice-free growing season
- Heavy rains & snowmelt: extra nutrients

Wisconsin Initiative on Climate Change Impacts 2011:
Wisconsin's Changing Climate: Impacts and Adaptations

More rain falling in single-day events in 1986-2016 compared to 1901-1985



Midwest: **42%** increase in heaviest single-day events in past 30 years

U.S. Global Change Research Program
GlobalChange.gov

Exposure Routes & Toxins

- Ingestion, inhalation, skin exposure
- Liver toxins: microcystin & cylindrospermopsin
- Neurotoxins: anatoxins and saxitoxin
- Dermatotoxins: lipopolysaccharides
- **Not all cyanobacteria make toxins, and toxins are not made all the time.**

Fish consumption

- Not all of the health risks from cyanotoxins in fish are currently known.
- Toxins may accumulate in organs, so eating only the fillets is recommended.
- Rinse fillets well with clean water before cooking or freezing.
- Fish from waters with recurring blooms may have off-flavors from taste & odor compounds
- Oregon Heath Authority fact sheet: **https://tinyurl.com/yywwbvdp**

Exposure Routes:
Aerosolization by wind or waves?

Western Lake Erie north of Catawba Island • September 27, 2017

β-*N*-methylamino-L-alanine (BMAA)

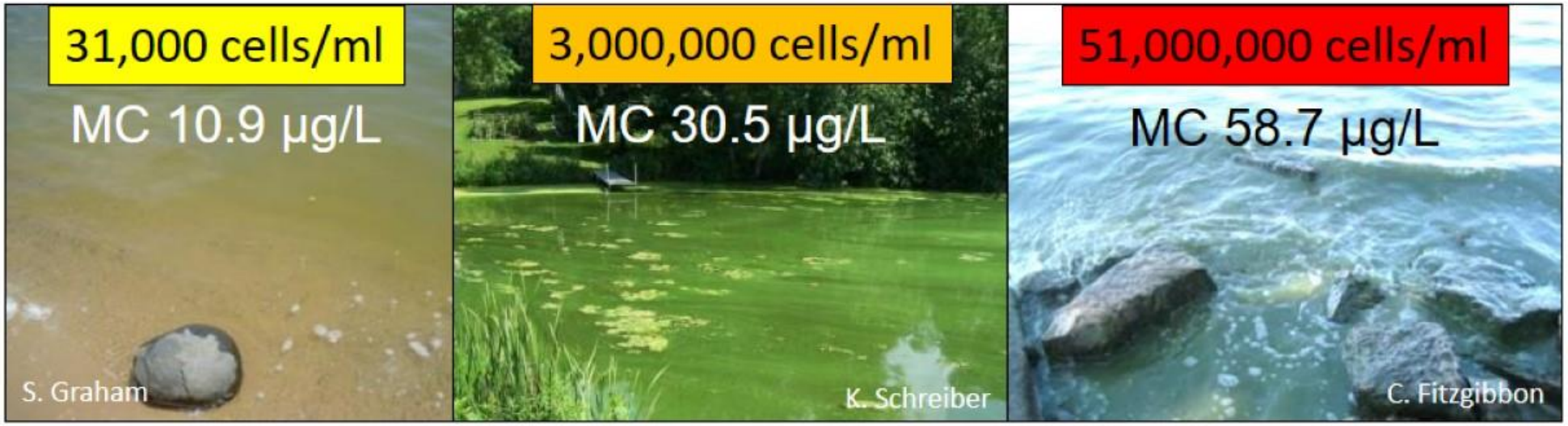
Non-protein amino acid
Hypothesized link to neurodegenerative diseases via chronic exposure.
Other environmental exposures may play a role.
There may be a genetic component to vulnerability - Cox 2009

Not all evidence supports link to neurodegenerative diseases.
Lack of verified testing methods across studies.
Exposure studies with dosing beyond environmentally relevant levels
Reviewed in Chernoff et al. 2017

WHO Recreational Guidelines*

Probability of Adverse Health Effects	Cell Density (cells/ml)	Microcystin-LR (µg/L)	Chlorophyll (µg/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*



*Based on the risks from PLANKTONIC blooms.

US EPA ***Draft*** Recreational Guidelines

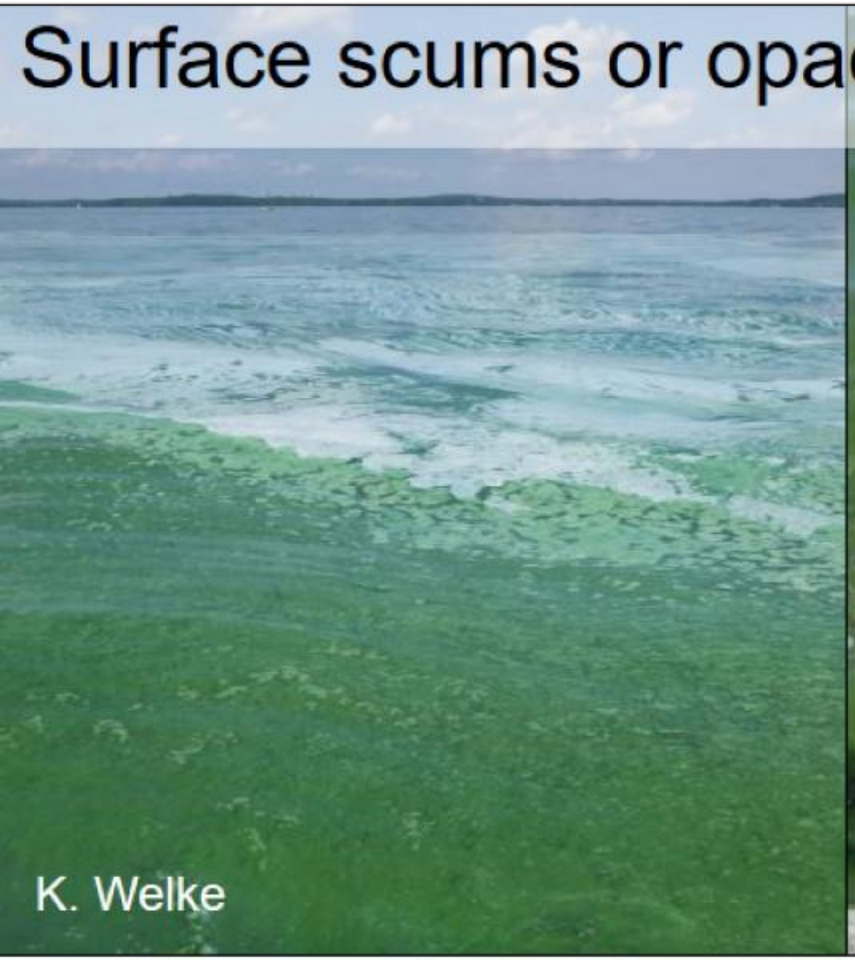
Draft Recreational Advisory Levels for Cyanotoxins	
Microcystins (MC)	**Cylindrospermopsin (CYN)**
8 µg/L	15 µg/L

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.

https://www.epa.gov/wqc/draft-human-health-recreational-ambient-water-quality-criteria-andor-swimming-advisories

You can see the blooms that are of highest concern



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!)