

Cyanobacteria

Monitoring Protocols and Detection Methods in Northeast Lakes

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January 13, 2010

Cyanobacteria Workshop





**Monitoring begins with the public;
those who visit the lake frequently.**

CAUTION

Toxic Algae Bloom

Recent water testing has shown the presence of a toxic algal bloom in Laurelhurst Pond. In high enough concentration a blue green algae, *Microcystis*, produces a toxin that can be dangerous to the health of humans and animals.

- **Avoid contact with pond water**
- **Keep pets out of pond**
- **Do not allow your pets to drink pond water**

For more information about *Microcystis* please contact a Oregon Department of Human Services Environmental Health Specialist at:









The occurrence of blooms is often unpredictable

Accumulations of cyanobacteria are often reported along the shore

Cyanobacteria concentrations may become severe and a potential threat to public health, even in northeast lakes which typically appear clear of blooms.





Monitoring of cyanobacteria is, typically, based on public reports and record keeping of bloom occurrences as they are sighted.

It is not common to routinely test for cyanotoxins.

Examples of monitoring agendas for the Northeast:

- New Hampshire: if > 50 % cyanobacteria in bloom, advisories are posted/ lake closes.
- Maine: public reports blooms. Lakes with SDD < 2 m caused by algae are considered impaired.
- Massachusetts: blooms are reported and if counts exceeds 70,000 cells ml⁻¹, warnings are posted at the lake to advise the public.



WILLAND POND DOVER/SOMERSWORTH

Report suspected cyanobacteria blooms to local officials and water operators

TOP BOAT ACCESS FACILITY DOVER, NEW HAMPSHIRE

THIS PUBLIC PROJECT IS A COOPERATIVE EFFORT OF THE U.S. FISH AND WILDLIFE SERVICE-FEDERAL SPORT FISH RECREATION PROGRAM AND

NOTICE

THIS BEACH AREA MAY NOT BE SUITABLE FOR SWIMMING DUE TO HIGH LEVELS OF POTENTIALLY TOXIC BLUE-GREEN ALGAE


Per Commissioner
NH Department of Environmental Services

Please:

- Do not wade or swim in water containing visible blue-green or greenish scums!
- Do not drink the water or let children drink the water!
- Do not let pets or livestock into the water!

Exposure to blue-green algal scums may cause various symptoms, including nausea, vomiting, diarrhea, mild fever and general malaise. Anyone who comes in contact with algal scum should rinse off with freshwater.

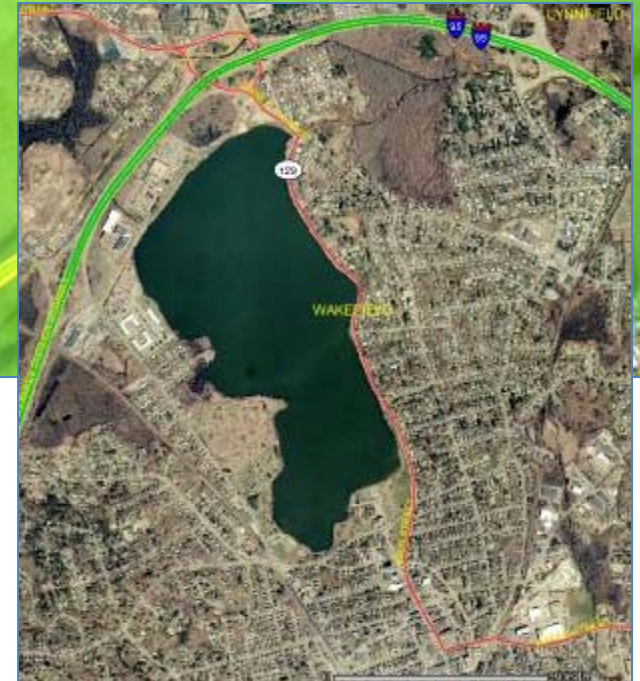
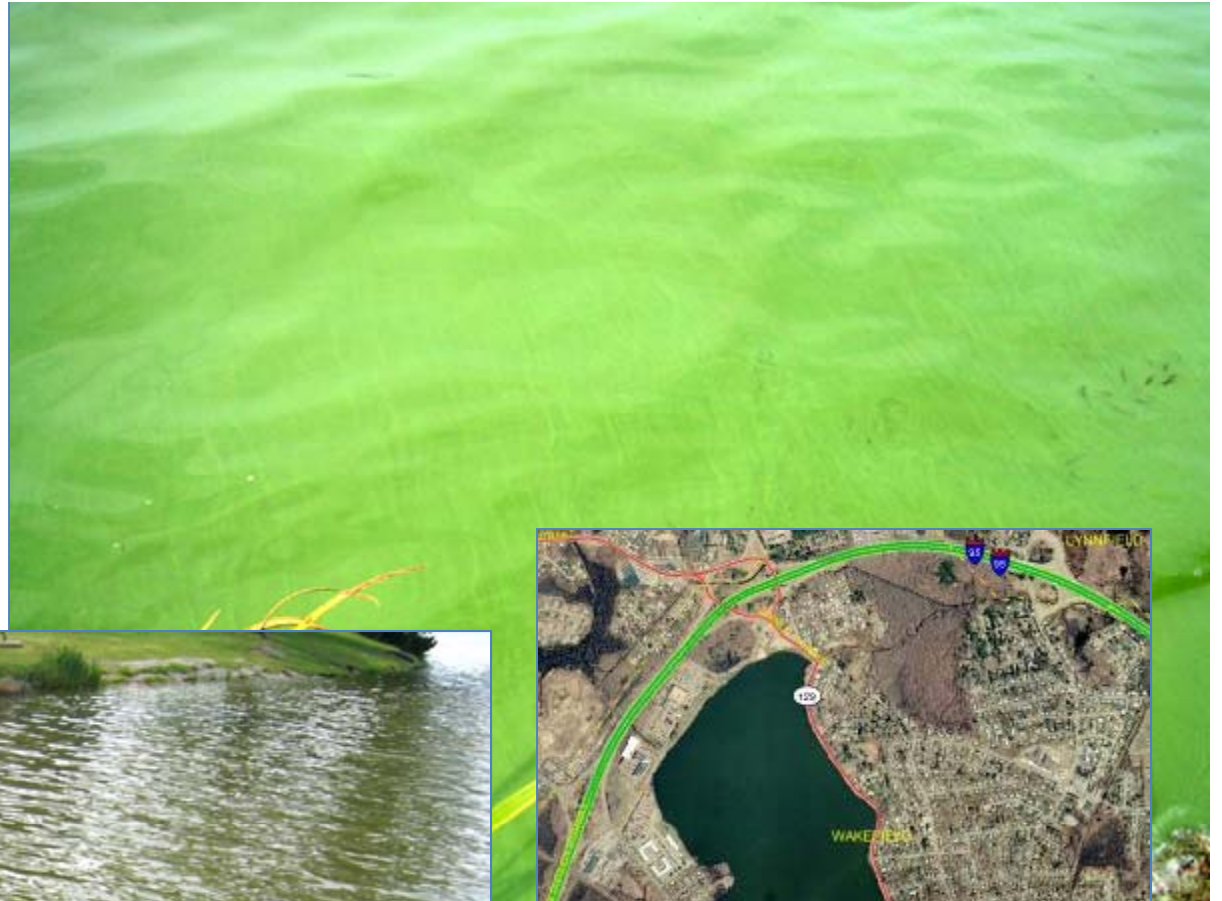
For more information contact:
NHDES
Biology Section
PO Box 98, 20 Hazen Drive
Concord, NH 03302-0098
603-271-3003 or 603-271-3444



Example:

Lake Quannapowitt, Wakefield MA

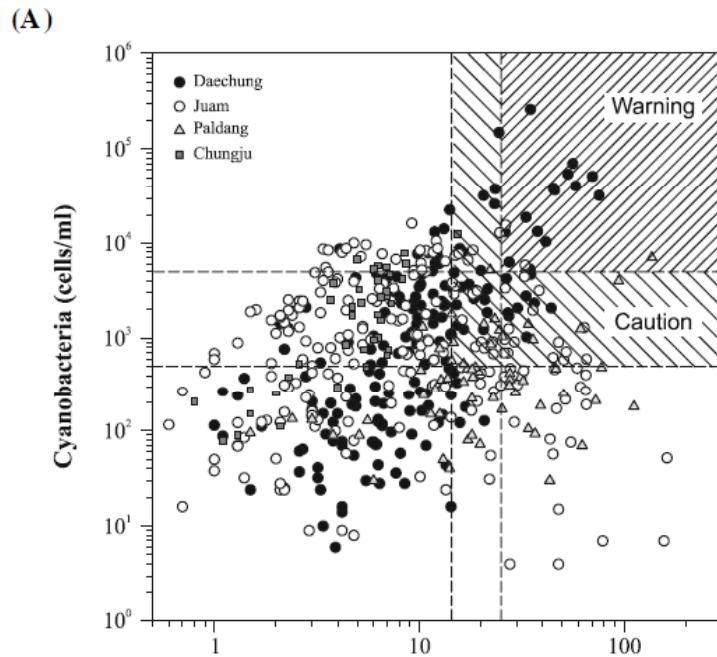
Frequent sampling of this lake is necessary since it is almost always dense with algal blooms containing potentially toxic cyanobacteria



Photos of blooms by: Roger Frymire

Bloom photos can be accessed through the UNH CFB, Phycokey link at cfb.unh.edu

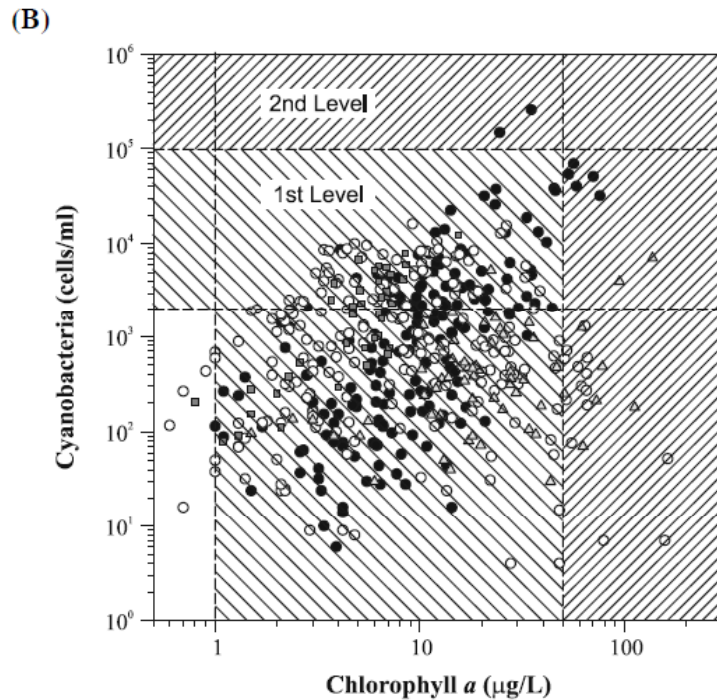
Algal Alert Systems



Graphs A & B show the relationship between cyanobacteria and chlorophyll *a* in four Korean reservoirs

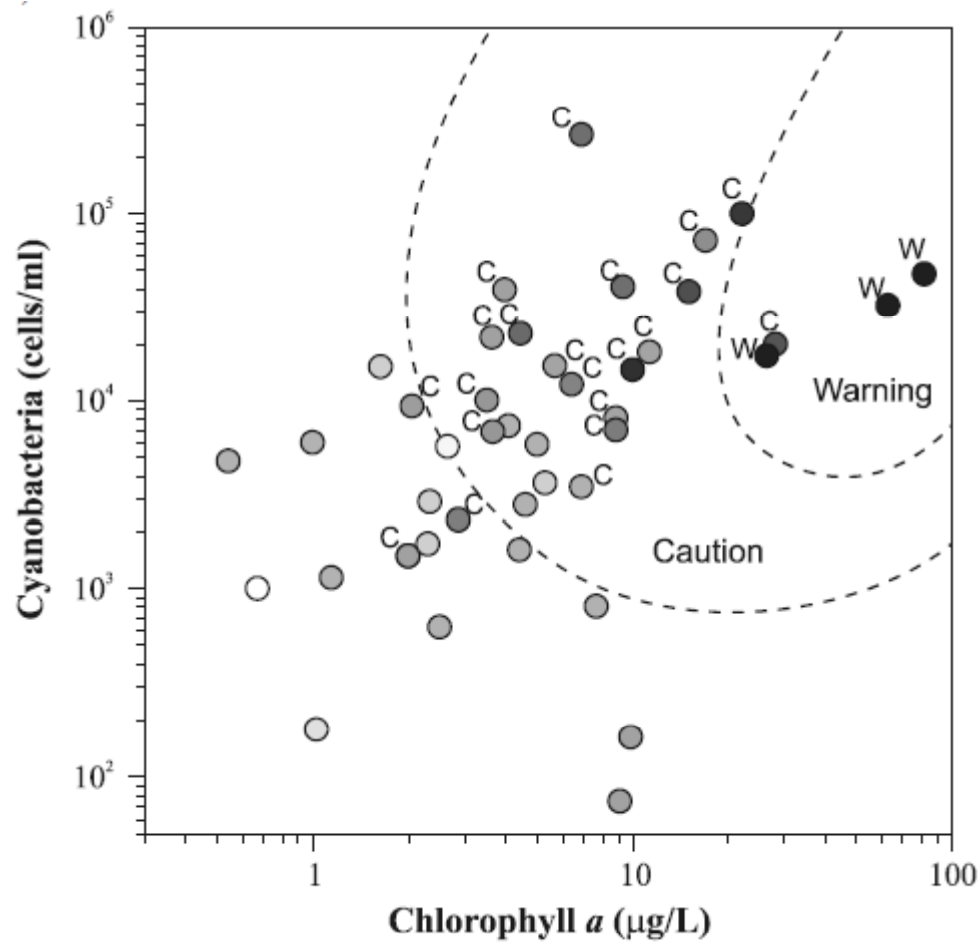
As defined by the algal bloom alert systems for

Korea (A)



And

Australia (B)



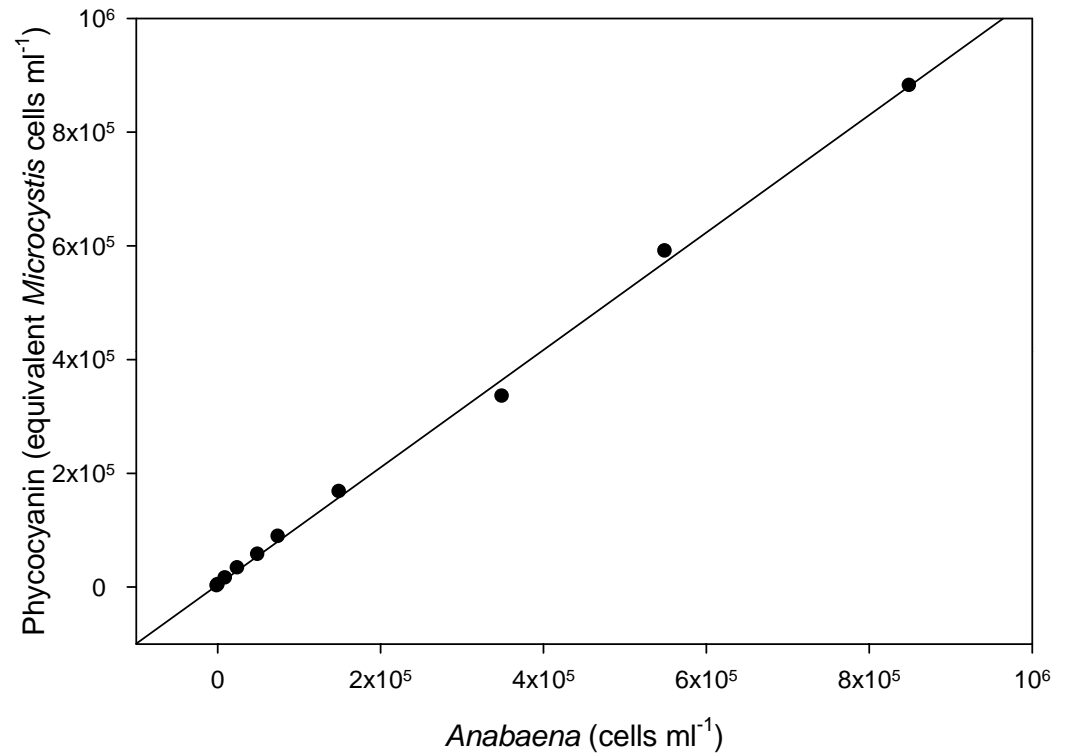
The use of phycocyanin fluorescence is being tested and considered as a measurement for monitoring cyanobacteria. Ahn et al. (2007) proposes that the Korean algal alert system also include phycocyanin levels.

Phycocyanin; unique pigment to cyanobacteria



Adj. $R^2 = 0.998$

$p < 0.001$



Phycocyanin fluorescence (equivalent *Microcystis* cells ml^{-1}) = $3837.5 + (1.03 * \textit{Anabaena} \text{ cells } \text{ml}^{-1})$.



www.ysi.com

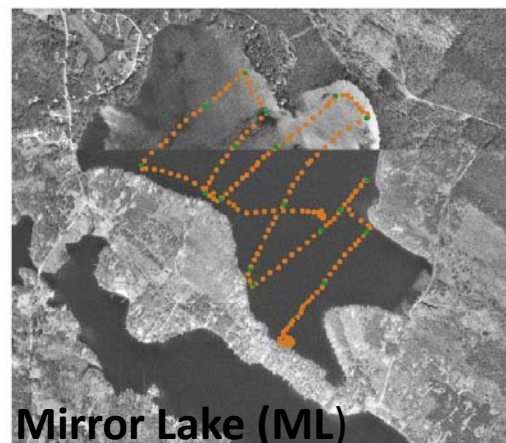
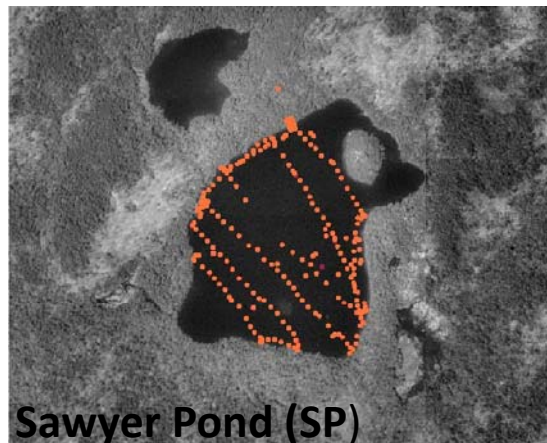
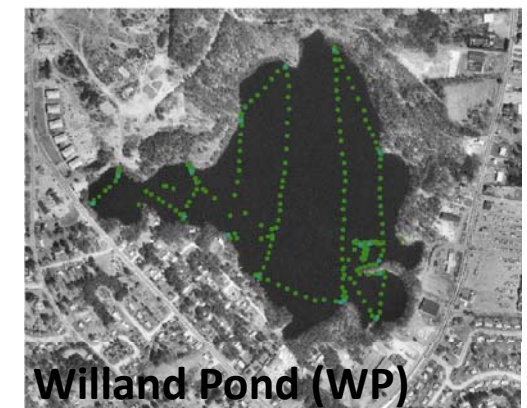
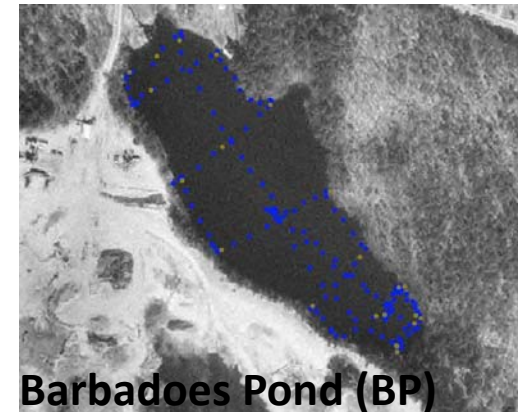


Yellow Springs Instruments design, 6131
Phycocyanin, blue-green algae sensor

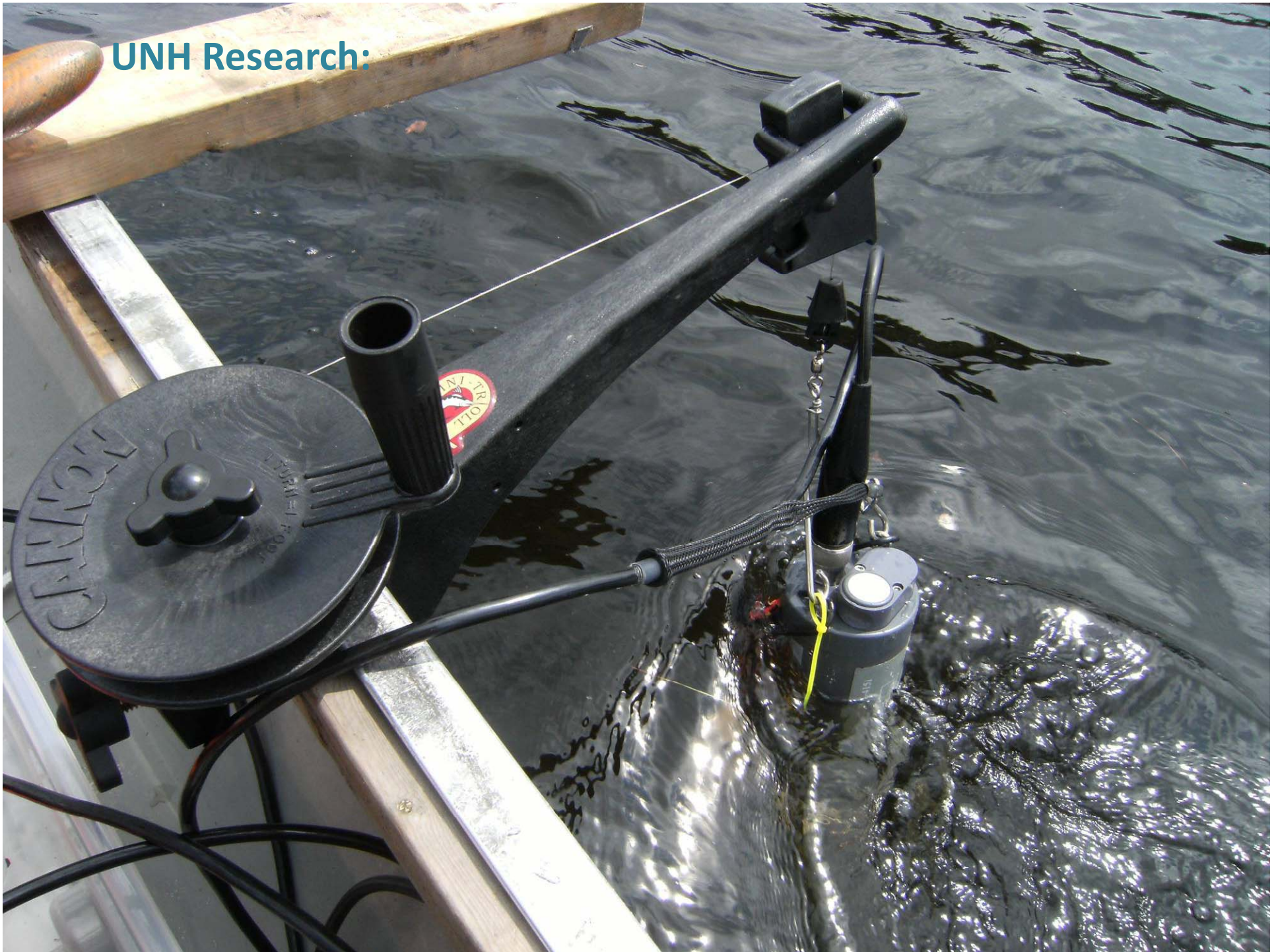
Phycocyanin sensor is calibrated with cultured *Microcystis aeruginosa*

Fluorescence of chlorophyll and other pigments may be used for detecting and/ or differentiating algal groups

Sampling problems arise because the distribution of cyanobacteria can vary significantly both horizontally and vertically throughout the water body.

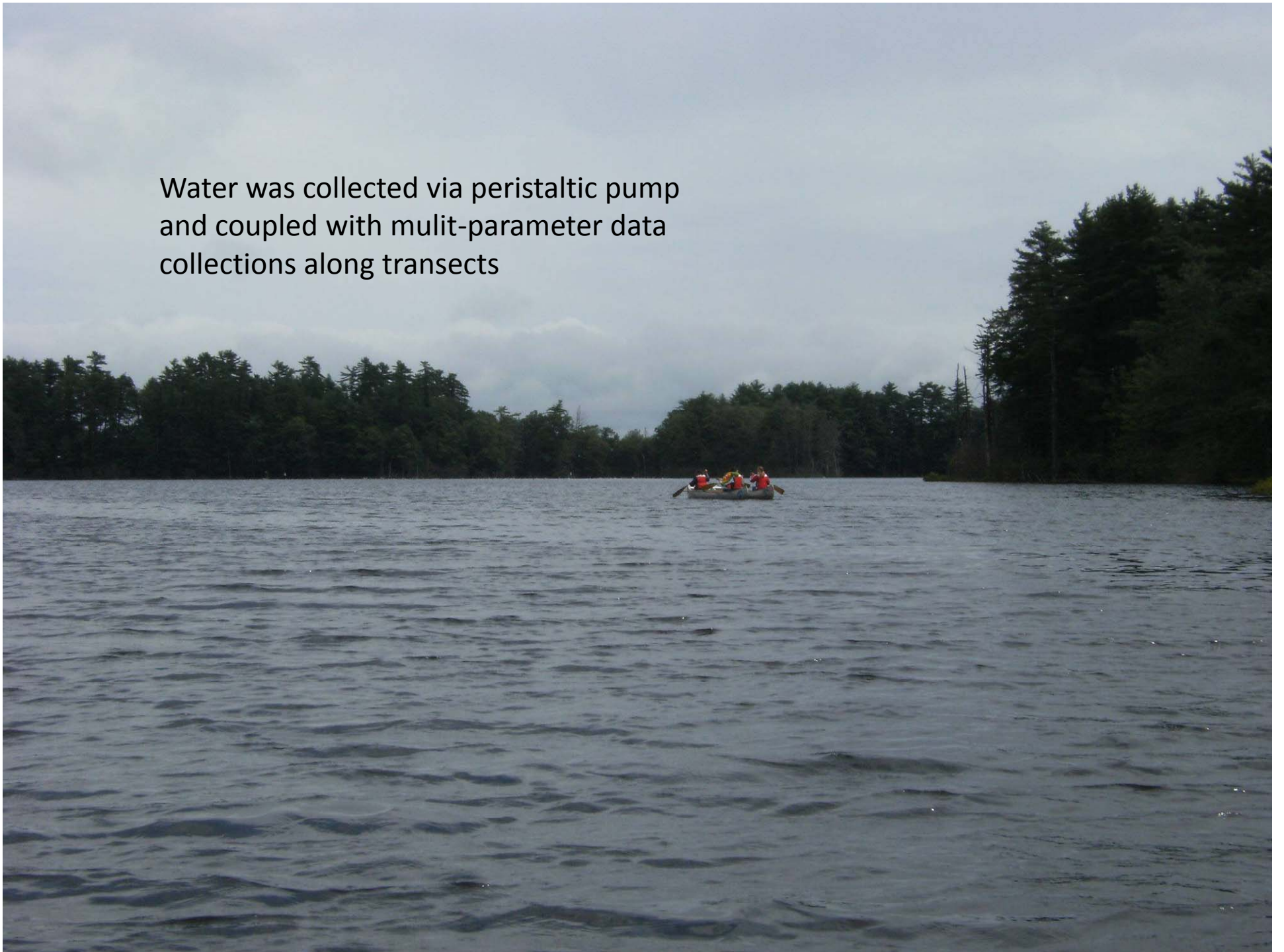


UNH Research:

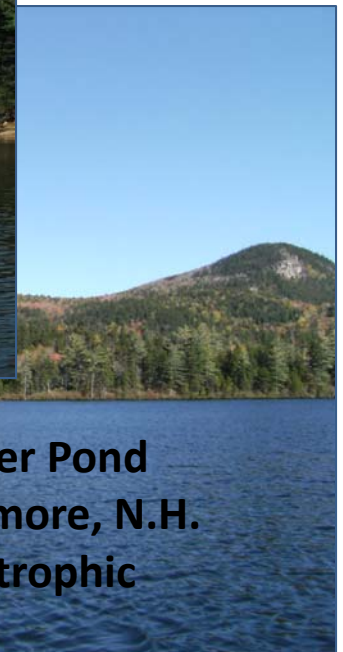
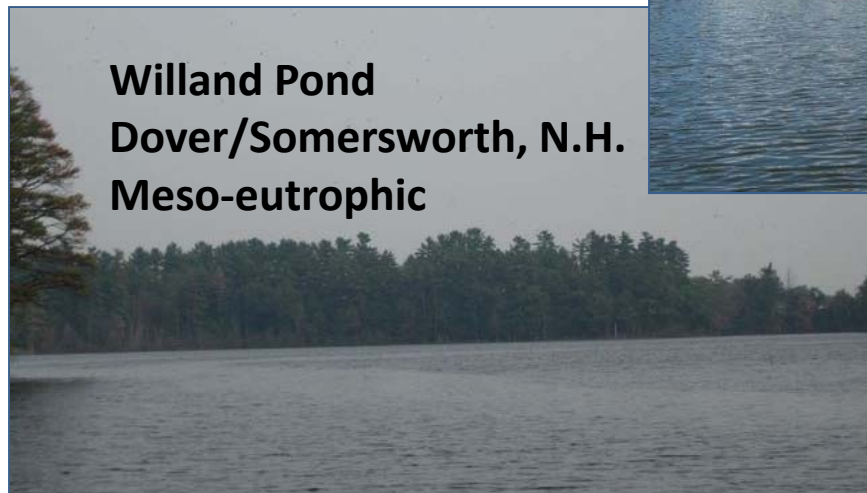
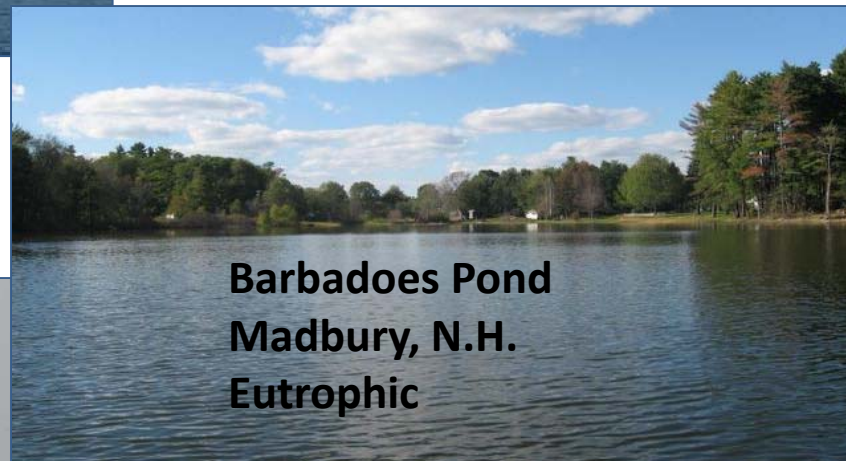




Water was collected via peristaltic pump
and coupled with multi-parameter data
collections along transects



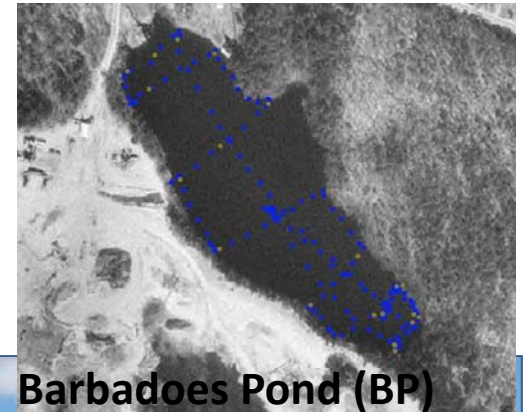
Study Lakes



Representing lakes from the seacoast, lakes region, white mountains and southern N.H.

Barbadoes Pond is used for fishing and recreation

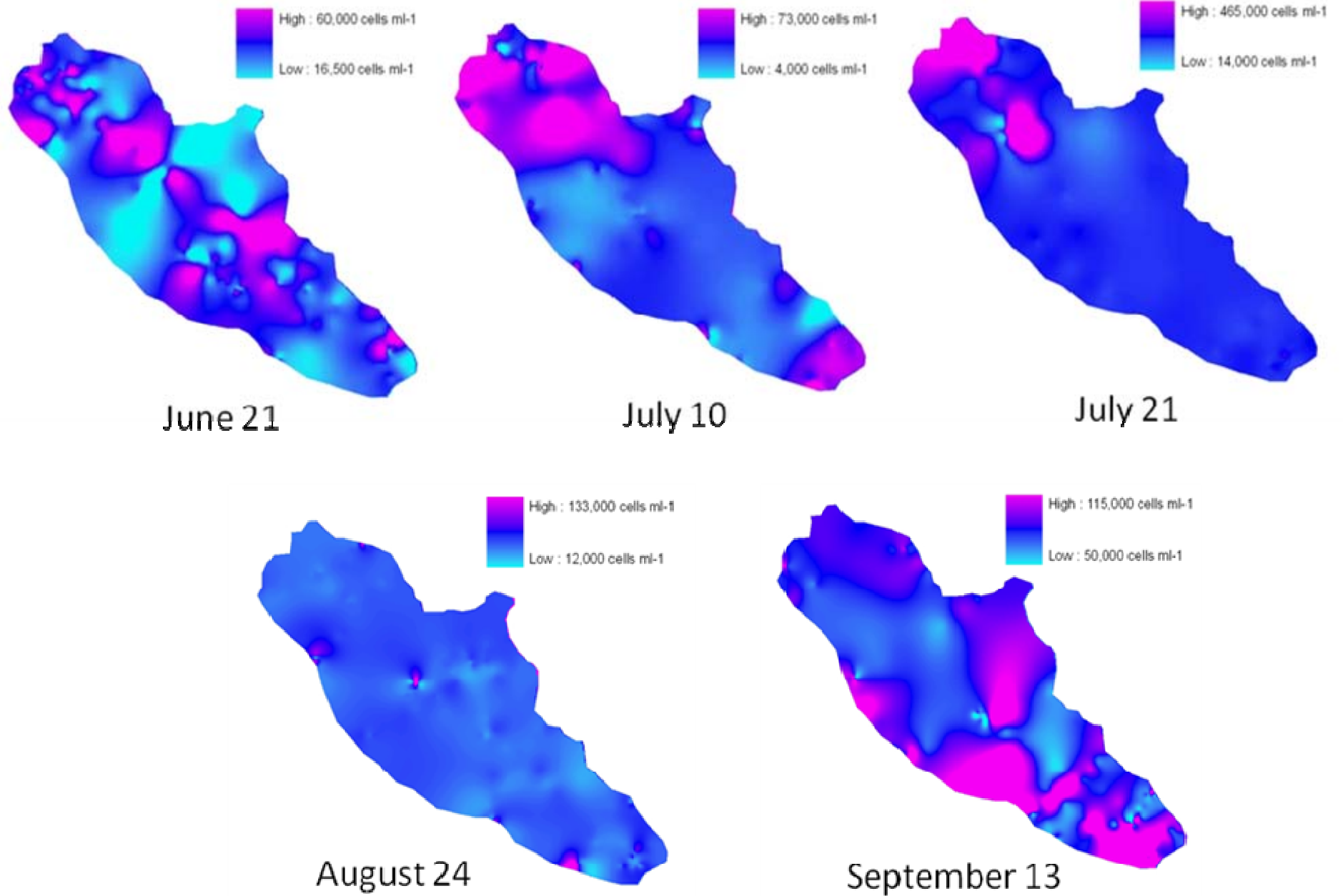
however, persistent blooms are seen each summer and fall



Potential exposure needs to be differentiated between drinking water, recreation and exposure through agriculture and aquaculture.

Barbadoes Pond

Arcmap compilation of phycocyanin fluorescence data



Case Study: Willand Pond, Summer 2009



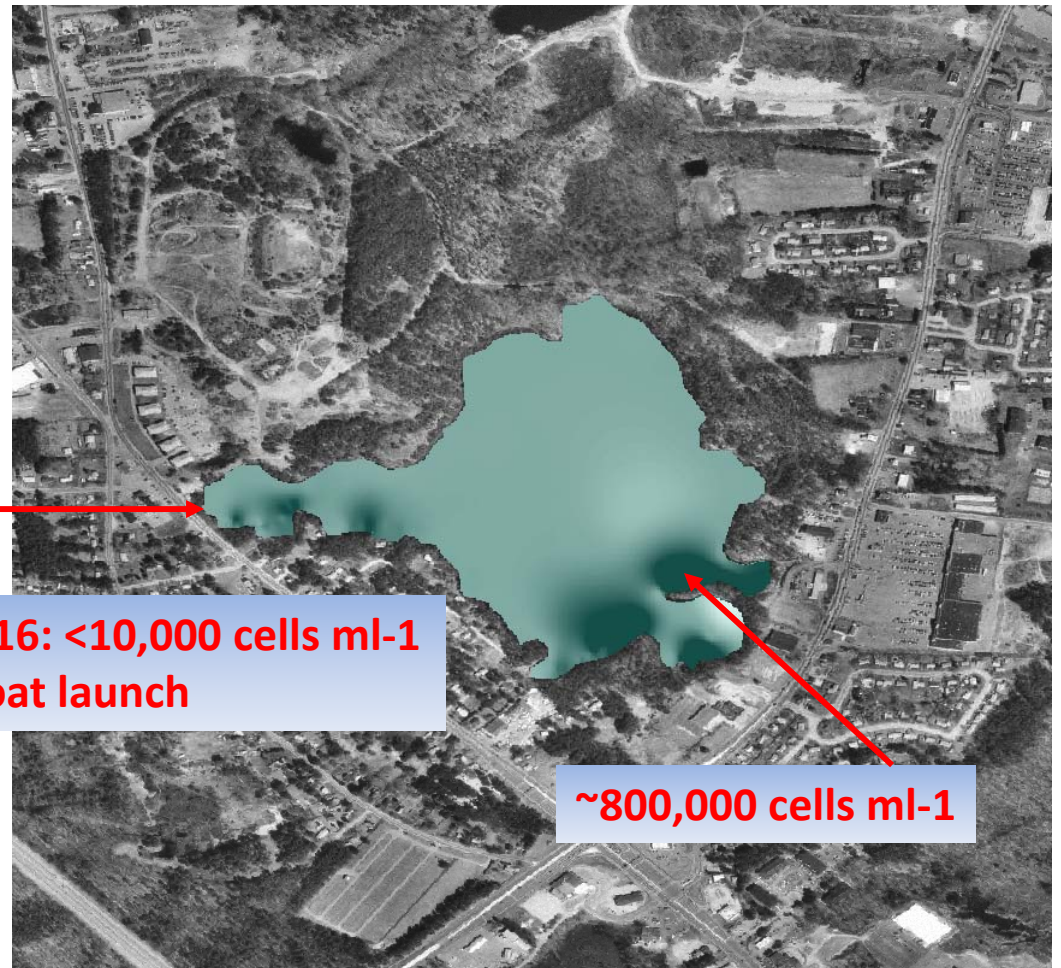
July 11: Lake closed for recreational use

Reported Cyanobacteria Bloom (> 50%)



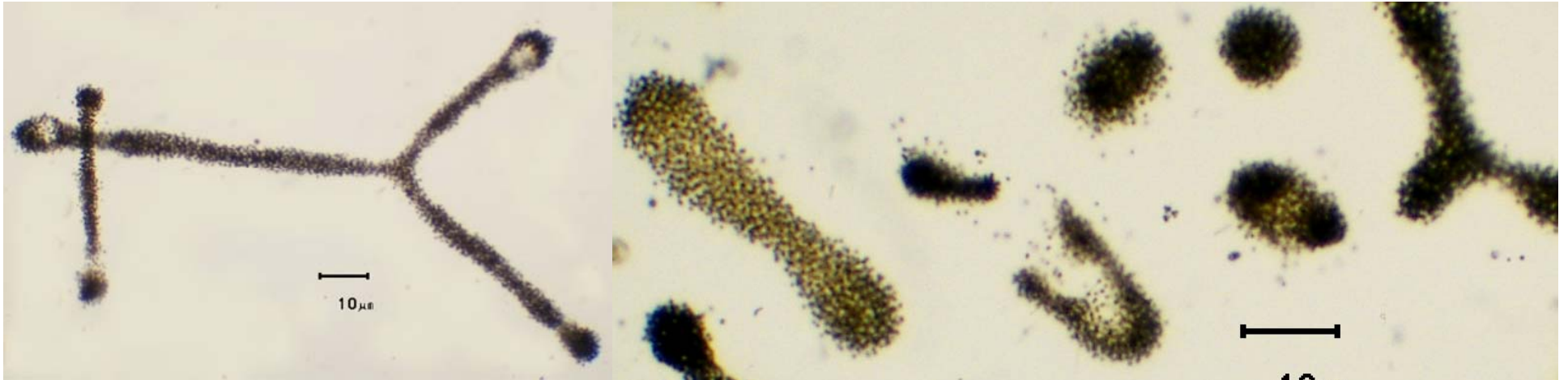
July 16: Lake Re-opened for recreation

Horizontal distributions of cyanobacteria
as measured by phycocyanin fluorescence

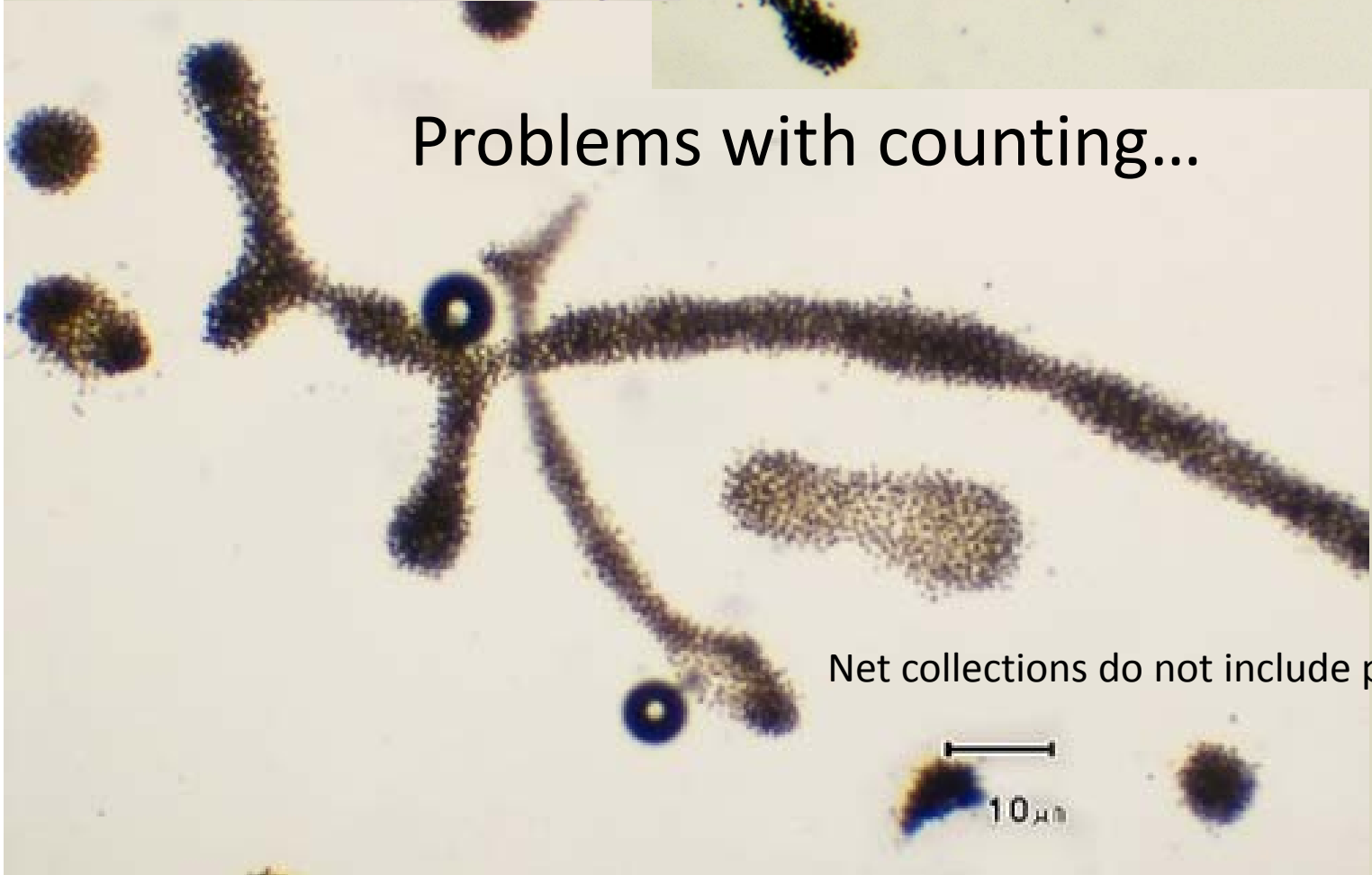


**July 16: <10,000 cells ml-1
at boat launch**

~800,000 cells ml-1

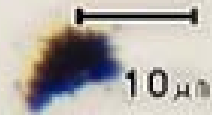


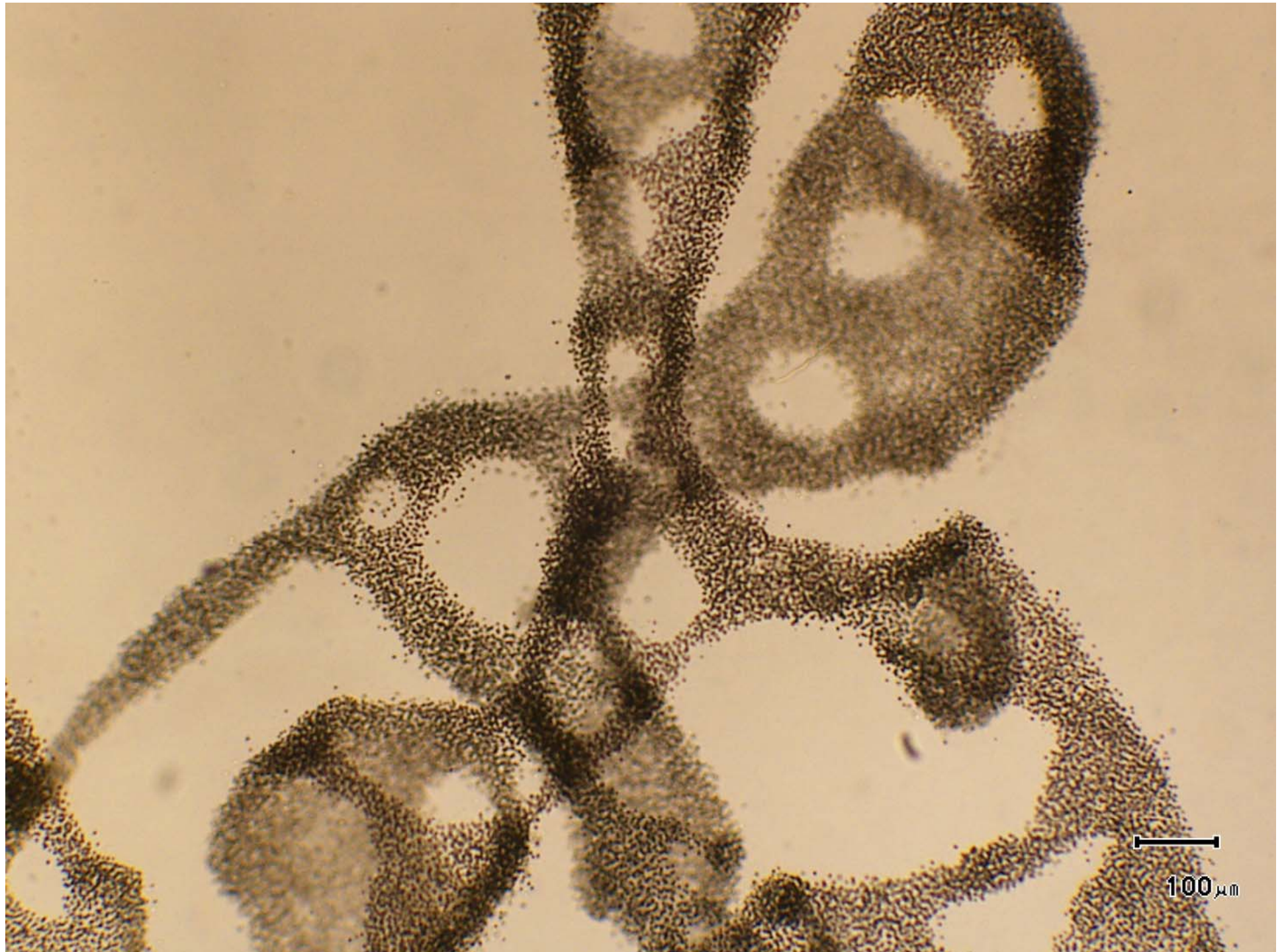
Problems with counting...

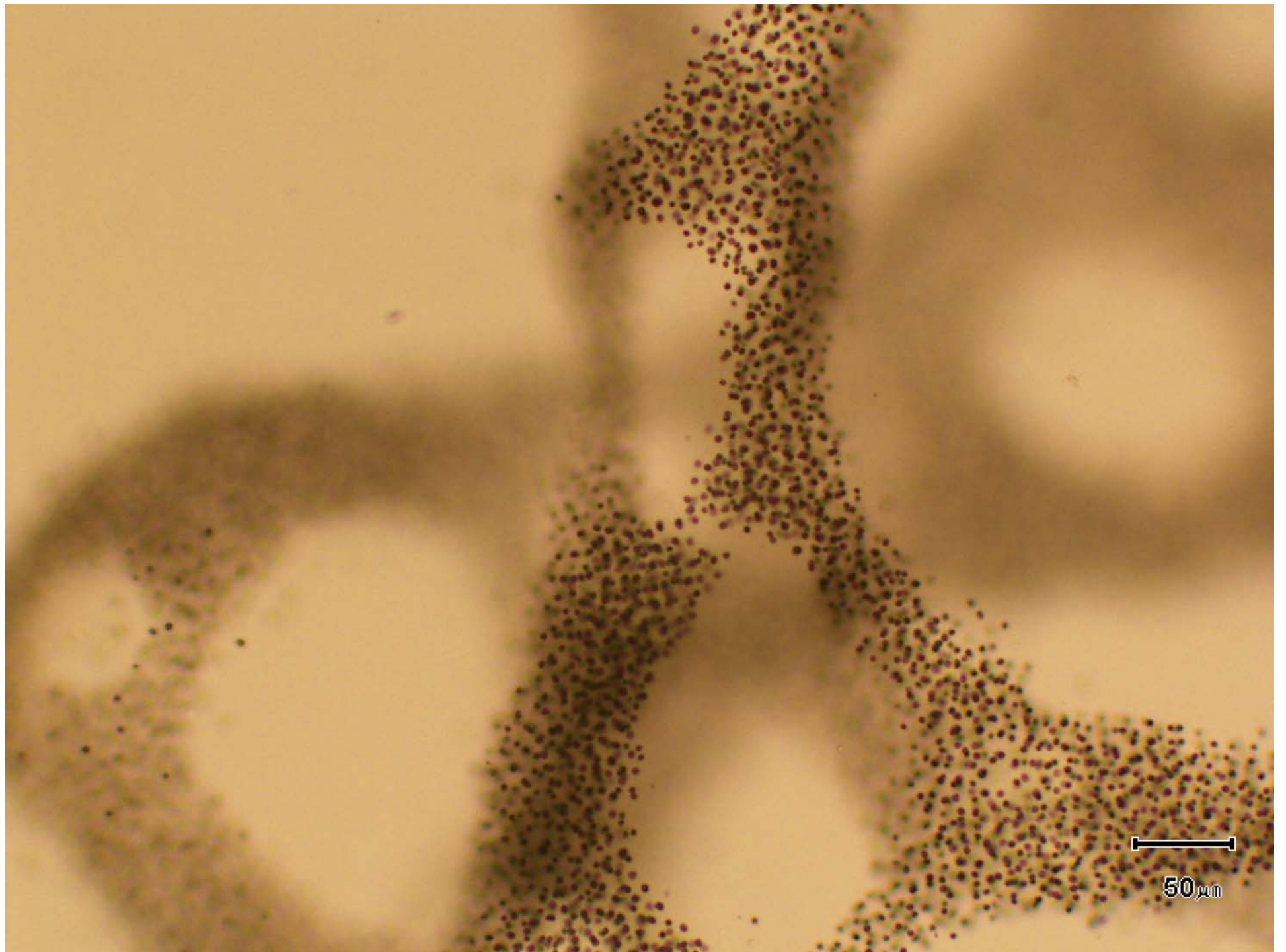


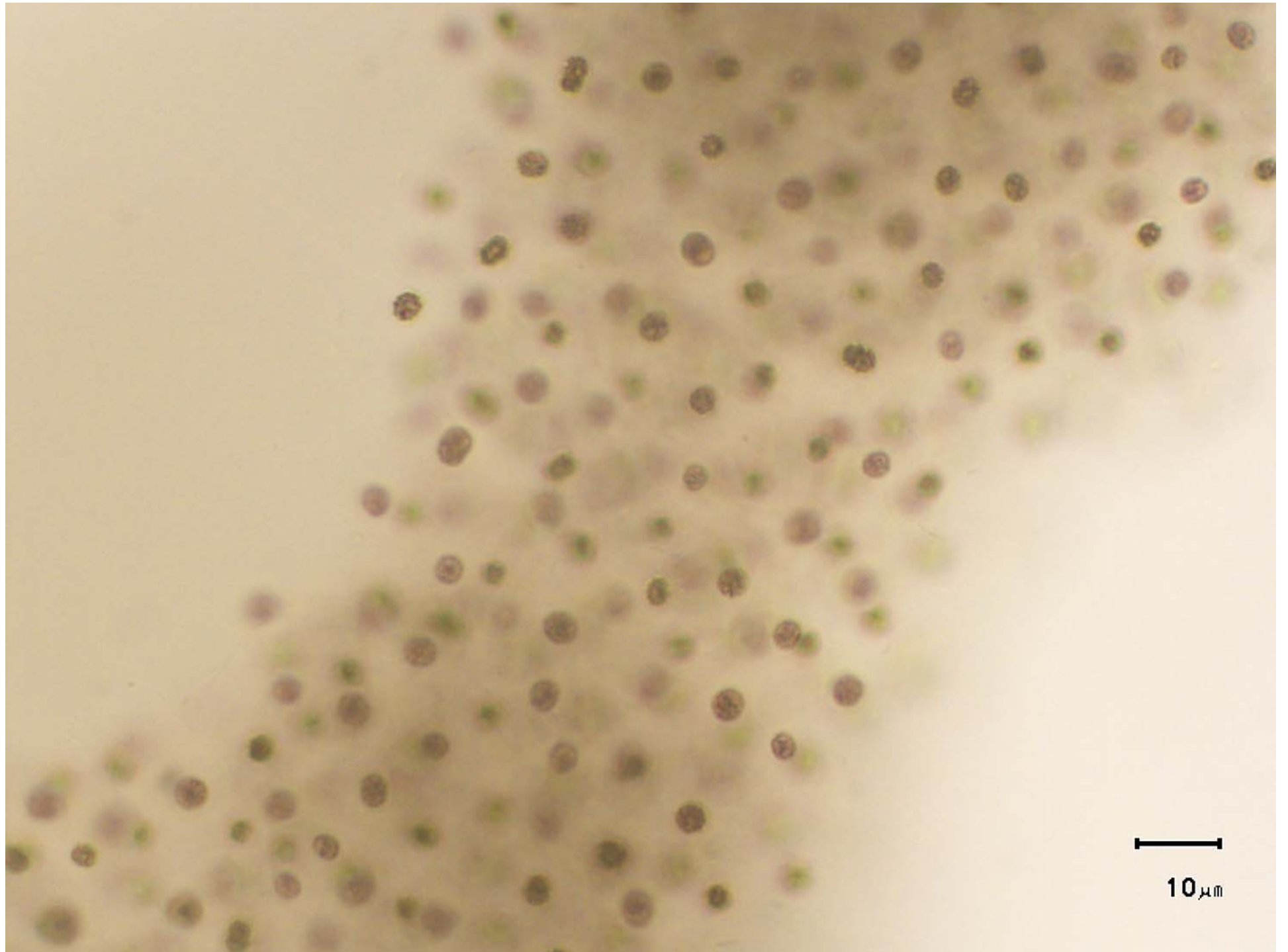
Microcystis, for example, has many colonial forms

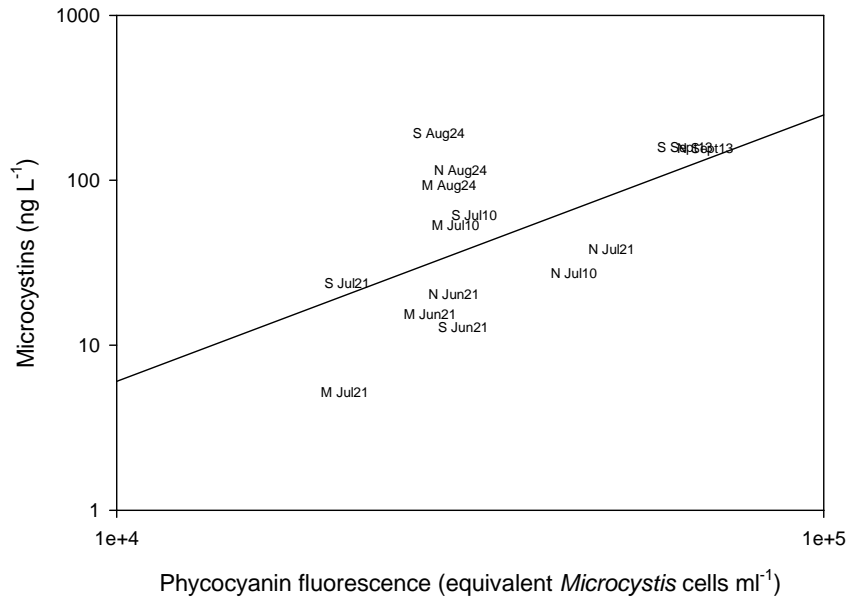
Net collections do not include picocyanobacteria



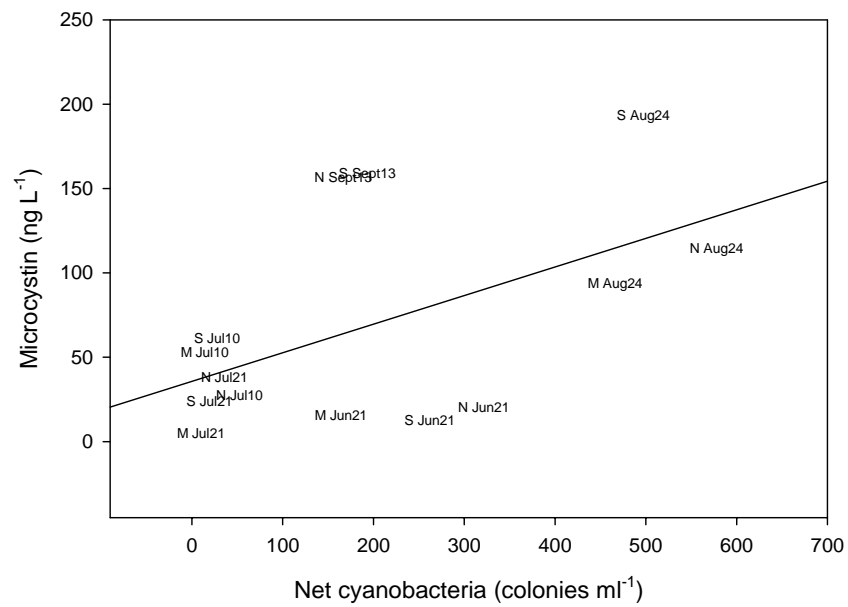








(Adj. R²= 0.227, p=0.049).



(Adj. R²= 0.222, p=0.051).



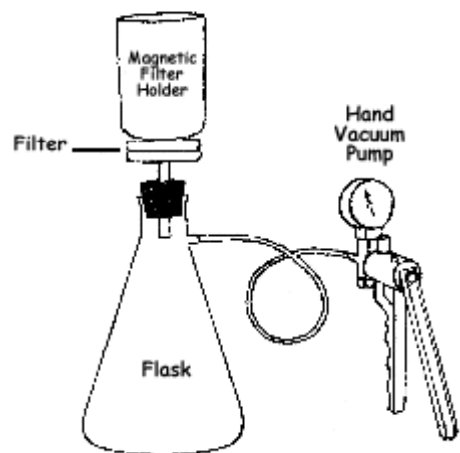
UNH Research:

Further potential detection methods for monitoring cyanobacteria and cyanotoxins

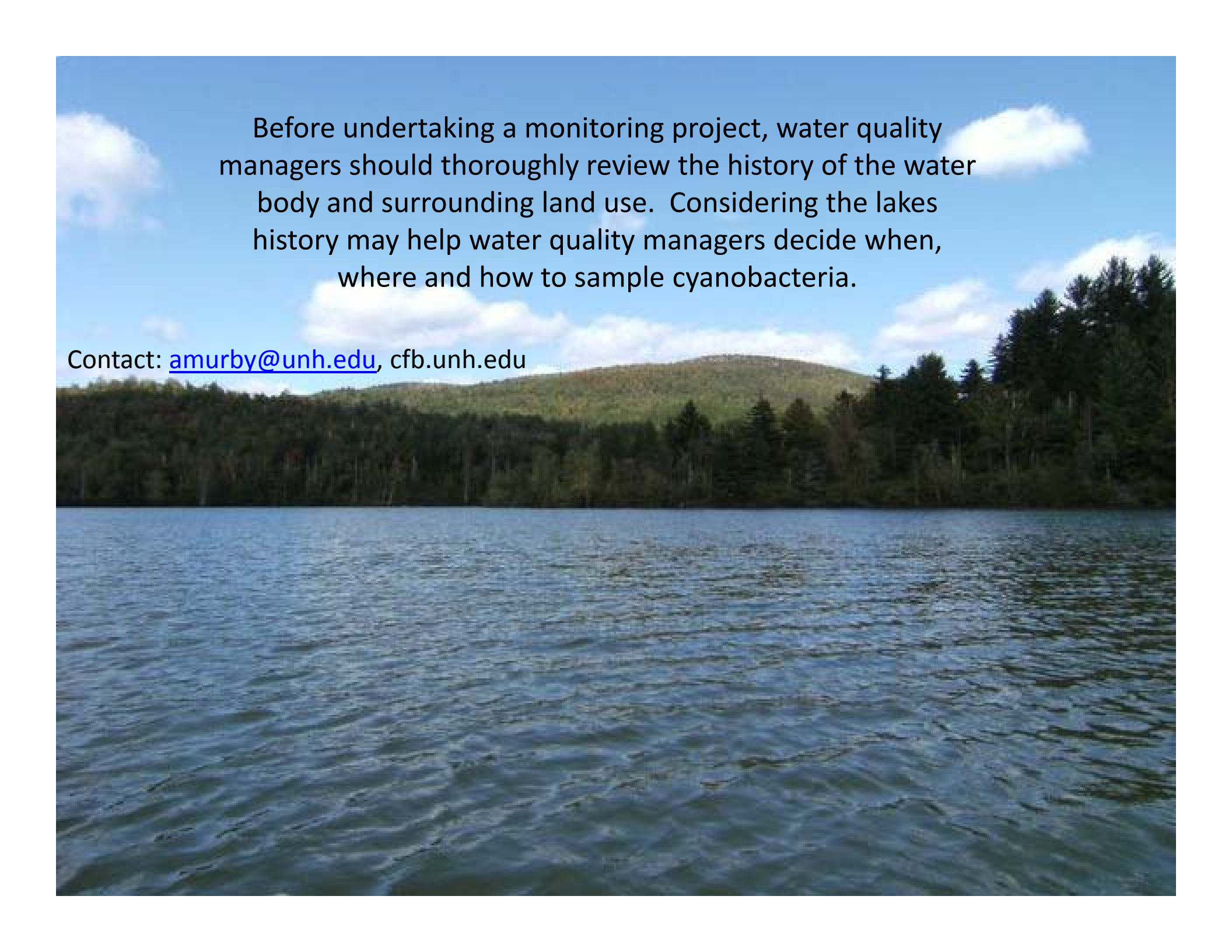
1. Filter, hole-punch method: method involves sub-sampling chlorophyll filters and testing for cyanotoxins such as microcystin using ELISA.

Preliminary testing has supported that filters could have a dual purpose and would not require extra sampling for monitors

Chlorophyll Filtration Apparatus



2. Hyperspectral analysis: topic will be discussed by Shane Bradt, UNH

A scenic view of a lake with a forested shoreline and a blue sky with clouds. The water is dark blue with gentle ripples. The shoreline is lined with dense green trees, and a small hill is visible in the background under a bright blue sky with scattered white clouds.

Before undertaking a monitoring project, water quality managers should thoroughly review the history of the water body and surrounding land use. Considering the lakes history may help water quality managers decide when, where and how to sample cyanobacteria.

Contact: amurby@unh.edu, cfb.unh.edu