Cyanobacteria Monitoring:

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Monitoring Objectives:
1. Assess Events (e.g. blooms)
2. Identify trends and changes
3. Explain Causal Relationships
4. Other?

Cyanobacteria

- Problem world wide: people are cyanos best friends
- "Natural" component of lakes
- Increasing understanding of complexity of problem

Cyanobacteria blooms
Can be dangerous!

Microcystin in "scum" in New Hampshire lake <20 ml (5 ml/teaspoon) = LD_{50} for Child

Ecological Considerations **Cyanobacteria:**

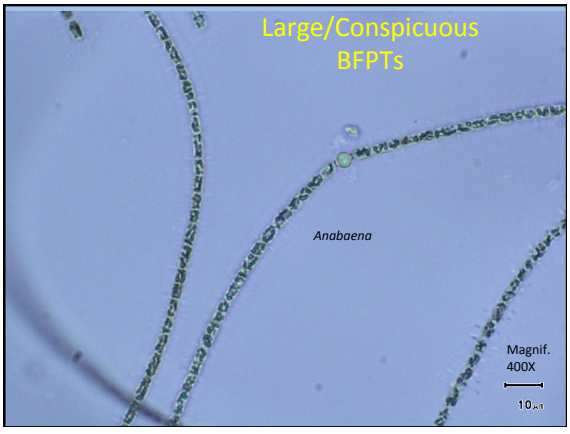
1. Size
2. Distribution
3. Toxicity

SIZE & Visibility

A. Large/Conspicuous Cyanobacteria: form surface blooms and often produce toxins (BFPTs): Bloom-forming, potentially toxigenic

B. **Medium/Inconspicuous** Cyanobacteria, often below surface

C. **Small/Invisible** Cyanobacteria, requiring special techniques to visualize



Microcystis

BFPTC Monitoring Objectives

- **Trend Tracking:** monitor the abundance of BFPTCs
- **Bloom Watching**: monitoring the location and composition of BFPTCs

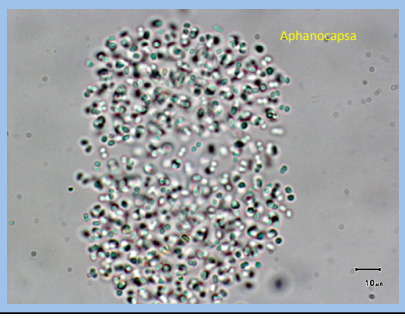
  Benefits: addresses phenomenon of public concern

  Disadvantages:

  – does not provide data on lake population of cyanobacteria

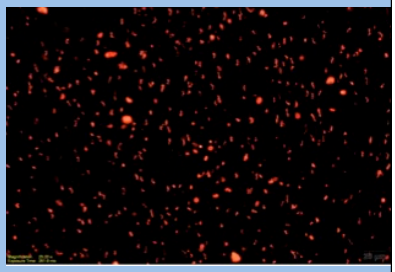
  – Highly ephemeral and weather dependent

Middle/Inconspicuous



Small/Invisibles

Seen with epifluorescense



Monitoring Responses

- BFPTs
- Monitoring Techniques
  - Bloom Watch

  Microscope counts

Medium/Inconspicuous Cyanobacteria

Rarely monitored, included in some microscope counts, need vertically integrated samples, included with fluorescence counts

Small/Invisible Picocyanobacteria

Included in PC fluorescence counts

Direct microscope counts counts use auto-fluorescence

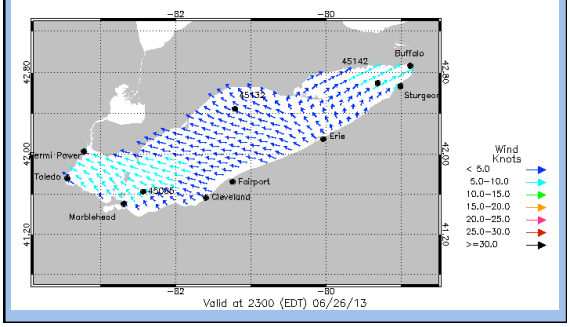
Distribution: Patchiness

- Surface Blooms Greatest Heterogeneity
  - Wind-generated currents: eddies and circulation

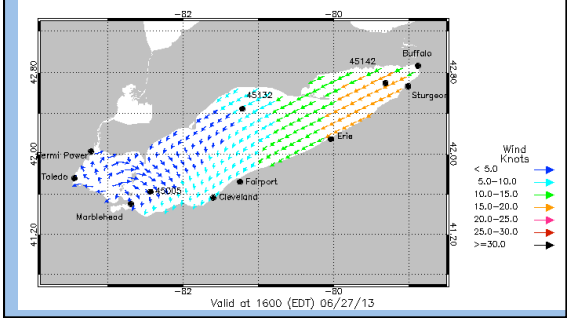
BFPTs have gas vessicles

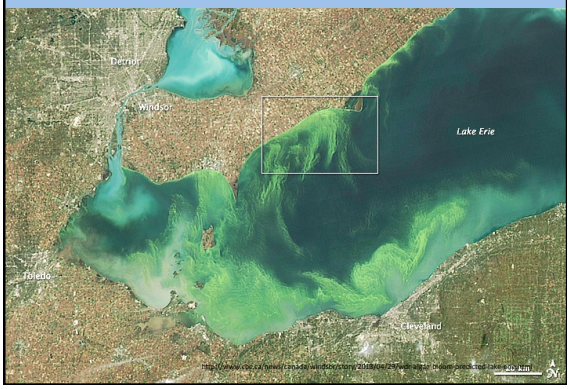
Hammer Expt:
Surface Blooms &
Gas Vessicles

Lake Erie: predicted winds 10 m above water

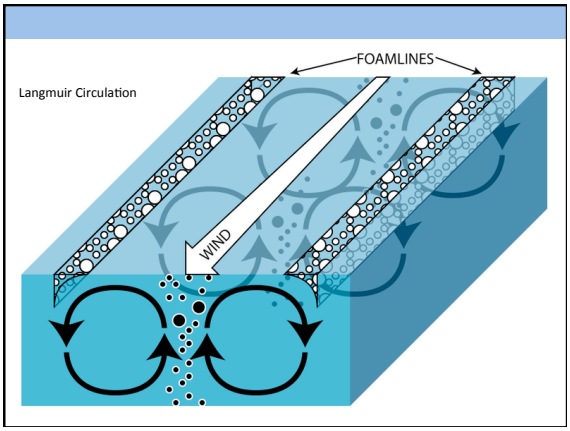


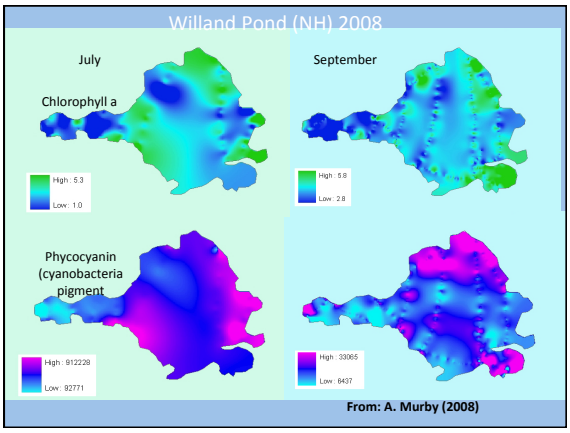
Large lakes: Lake Erie





Small Lakes





Sampling Design Important

Cyanobacteria Toxicity

Toxin Concentrations

Phytoplankton Toxicity

Which Cyanotoxin?

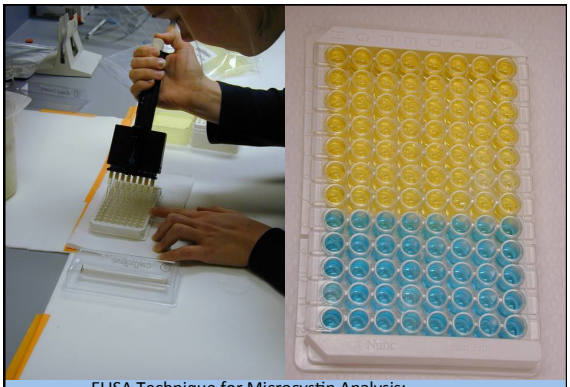
Candidate Cyanotoxins

Toxin	Type	NZ Drinking Water (ug/L)	LD_{50} (ug/Kg)
Microcystins	Hepotatoxin	1	20-60
Nodularins	Hepatotoxin		
Cylindrospermopsin	Hepatotoxin	1	300
Anatoxin-a	Neurotoxin	6	200 20 (Anatoxin aS)
BMAA	Neurotoxin		
Saxitoxin (Neosaxitoxin)	Neurotoxin	3	10

Cyanobacteria	Toxins produced
Anabaena	Anatoxins, Microcystins, Saxitoxins
Anabaenopsis	Microcystins
Aphanizomenon	Saxitoxins, Cylindrospermopsins
Cylindrospermopsis	Cylindrospermopsins, Saxitoxins
Hapalosiphon	Microcystins
Lyngbya	Aplysiatoxins, Lyngbyatoxin a
Microcystis	Microcystins
Nodularia	Nodularin
Nostoc	Microcystins
Phormidium (*Oscillatoria*)	Anatoxin
Planktothrix (*Oscillatoria*)	Anatoxins, Aplysiatoxins, Microcystins, Saxitoxins
Schizothrix	Aplysiatoxins
Trichodesmium	yet to be identified
Umezakia	Cylindrospermopsin

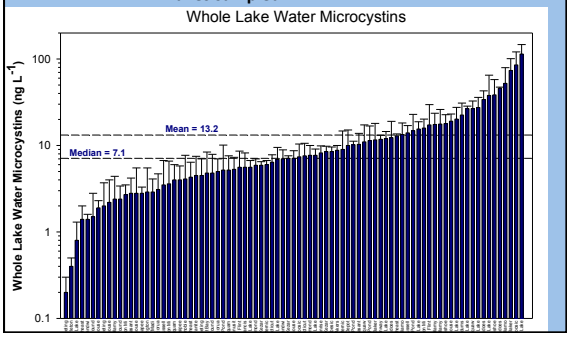
Lake Monitoring Requires Collection of Data!

Methods must be sensitive:
LOD critical

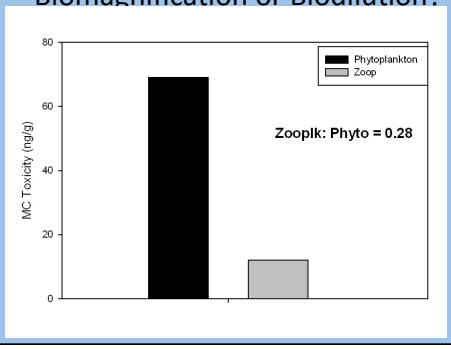


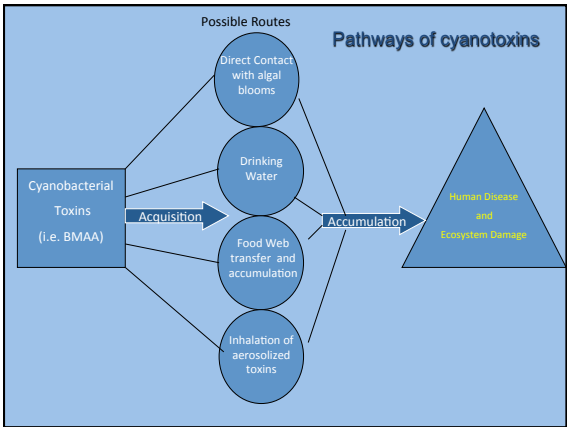
ELISA Technique for Microcystin Analysis:
High sensitivity method for lake monitoring

NH Lakes Microcystin Survey: microcystins detected in all lakes sampled



Microcystins: Biomagnification or Biodilution?





Future Monitoring Directions?

Aerosols & Biomagnification