

Detecting toxic *Microcystis* in the lower Great Lakes



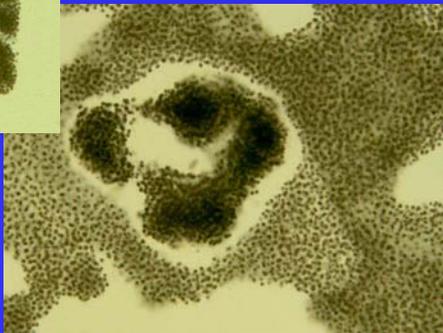
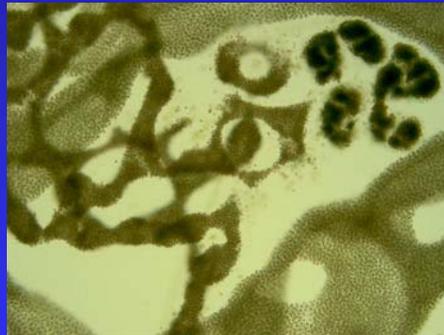
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Microcystis in the Great Lakes

- ❖ Colonial cyanobacterial HAB
- ❖ Forms blooms and scums
 - ◆ Taste/odor issues in drinking water
 - ◆ Loss of recreational and fishing value to affected waters
 - ◆ Blooms can be toxic or non-toxic



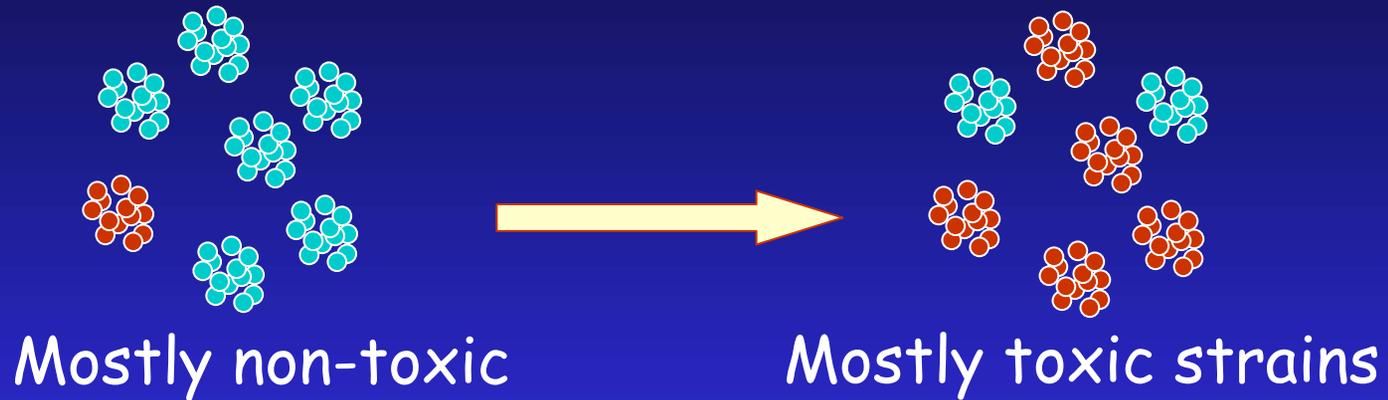
Microcystis



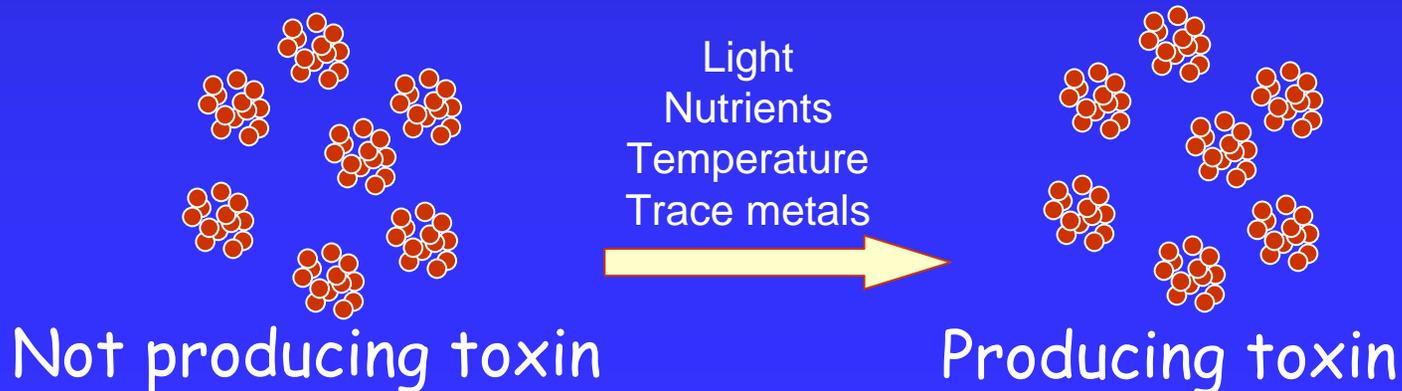
Put-In-Bay, Lake Erie

What makes a cyanobacterial bloom toxic?

- ❖ Shift in community composition

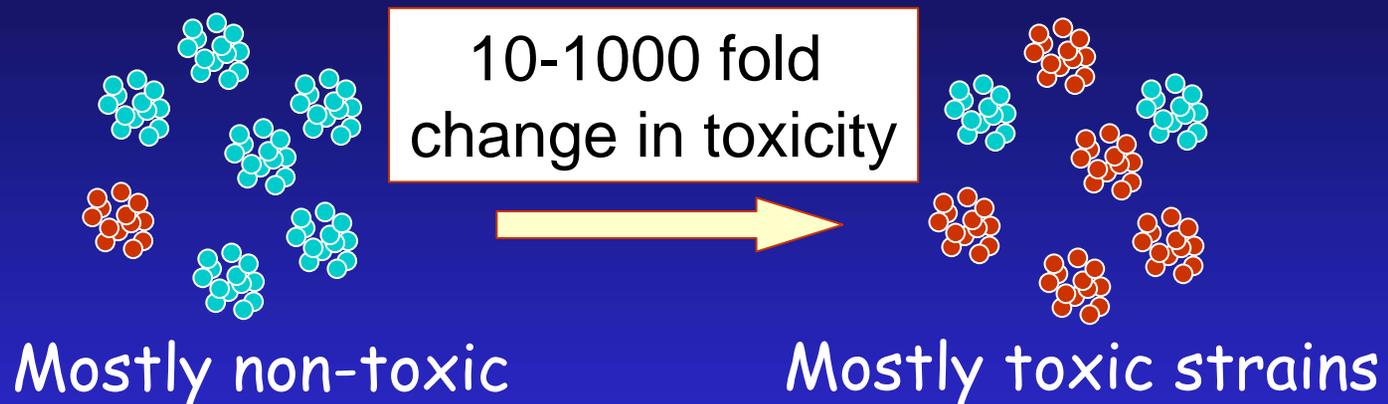


- ❖ Stimulation of toxin production by environmental factors

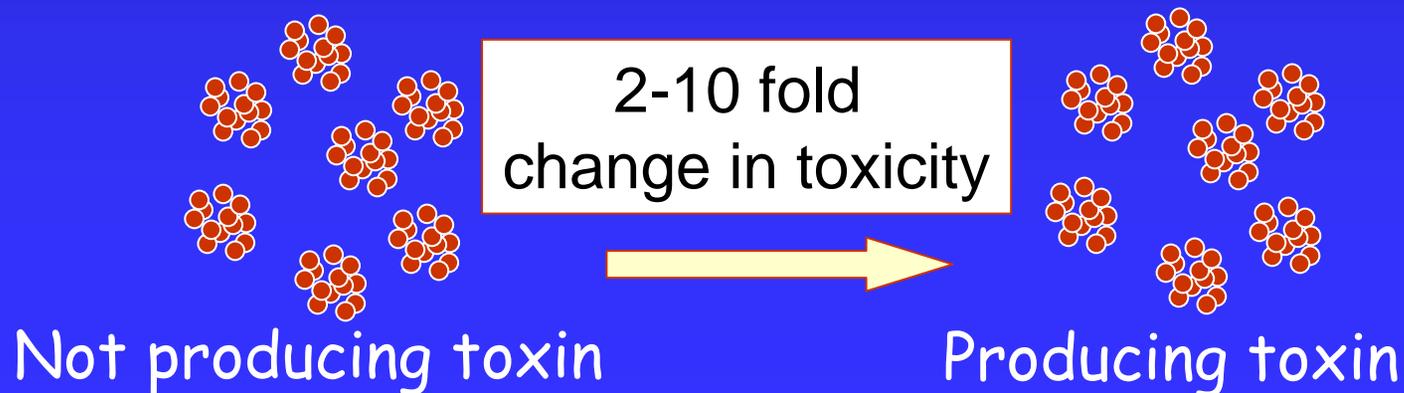


What makes a cyanobacterial bloom toxic?

- ❖ Shift in community composition

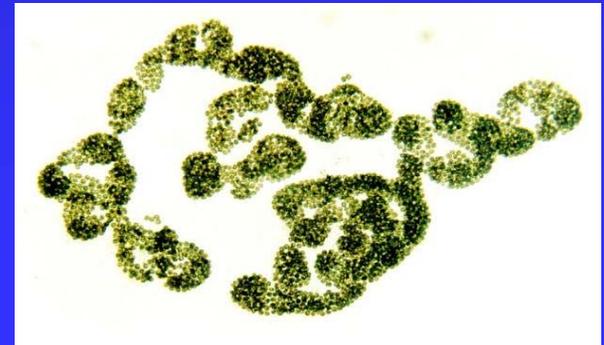


- ❖ Stimulation of toxin production by environmental factors



Current projects

- ❖ Map microcystin concentrations and *Microcystis* cell numbers in Saginaw Bay and western Lake Erie
- ❖ Identify environmental factors promoting microcystin production
- ❖ Develop rapid methods for detection of toxic *Microcystis*
- ❖ Accumulation in fish



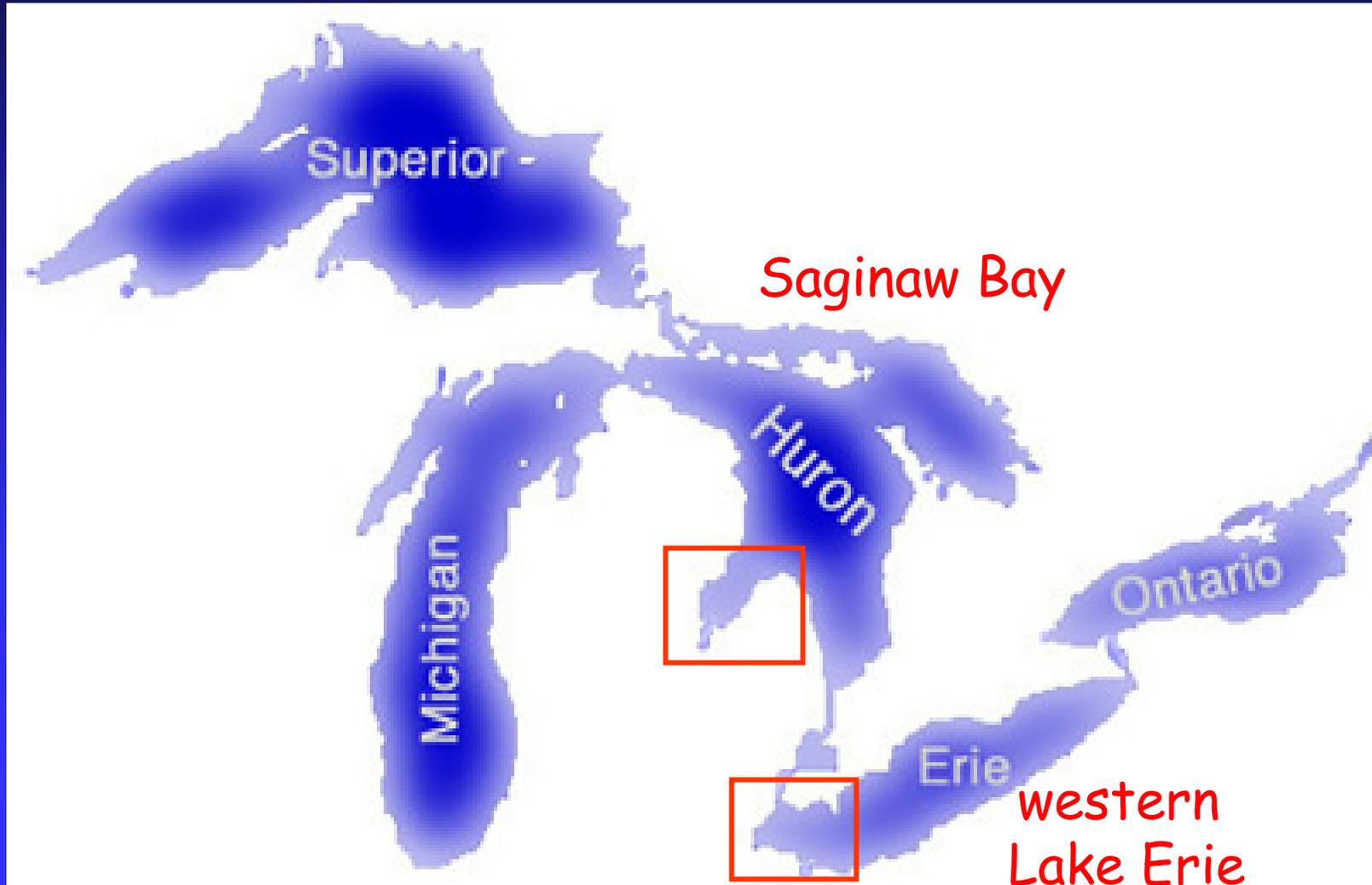
Microcystis sp.

Goal

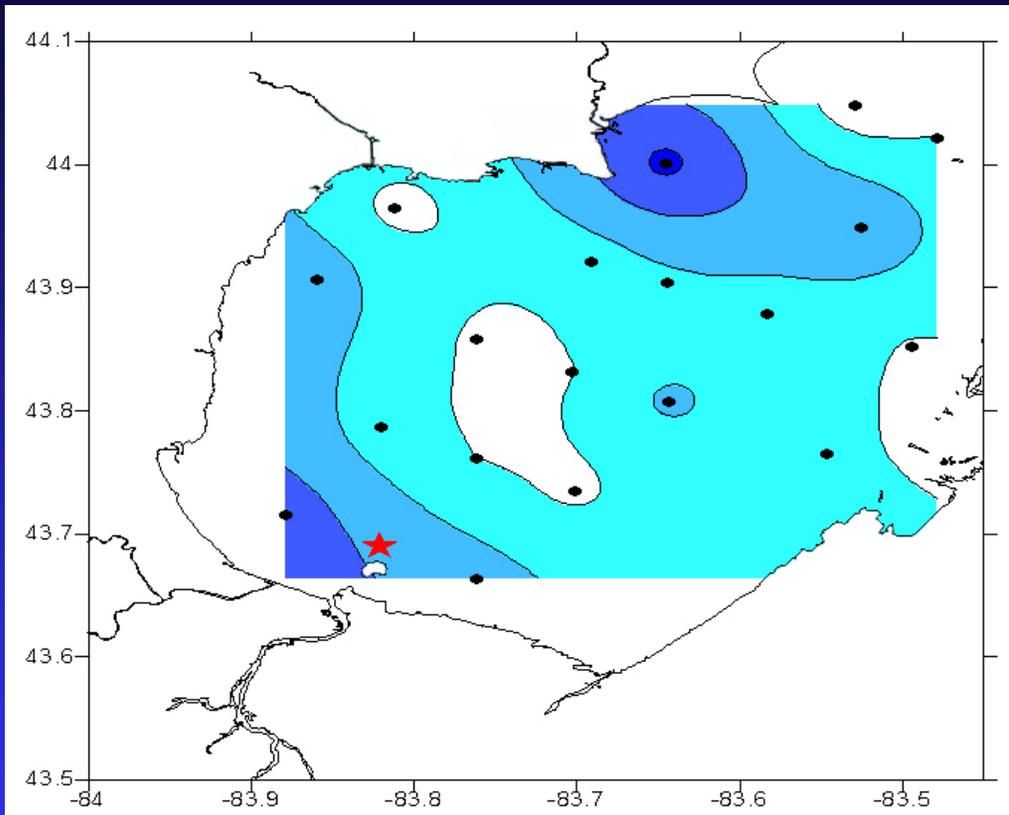
- ❖ Develop predictive capabilities for presence of toxic cyanobacterial blooms in Great Lakes recreational and drinking water supplies



Sampling sites

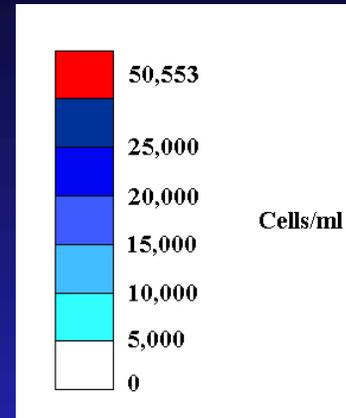


Microcystis cell abundance

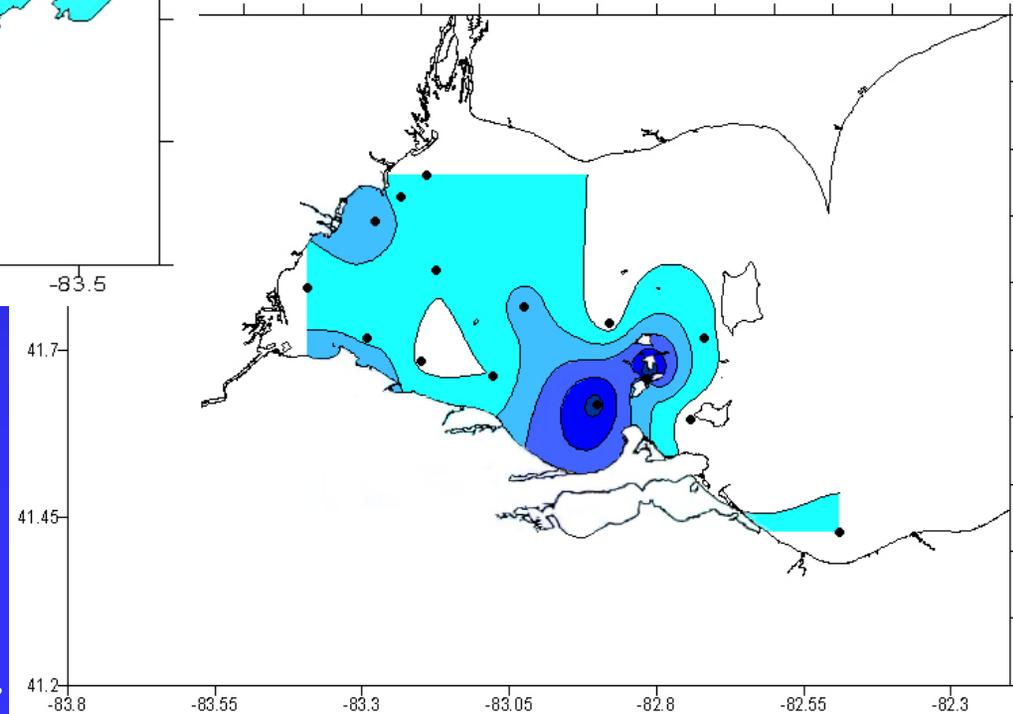


Saginaw Bay

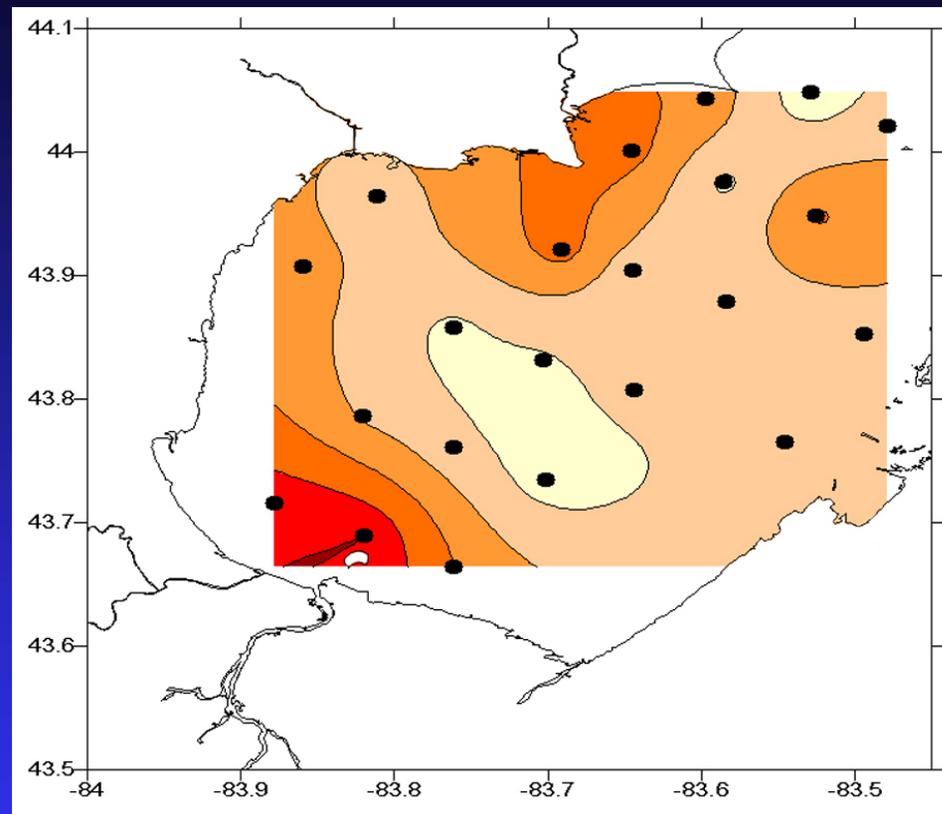
western Lake Erie



Cell counts by D. Klarer

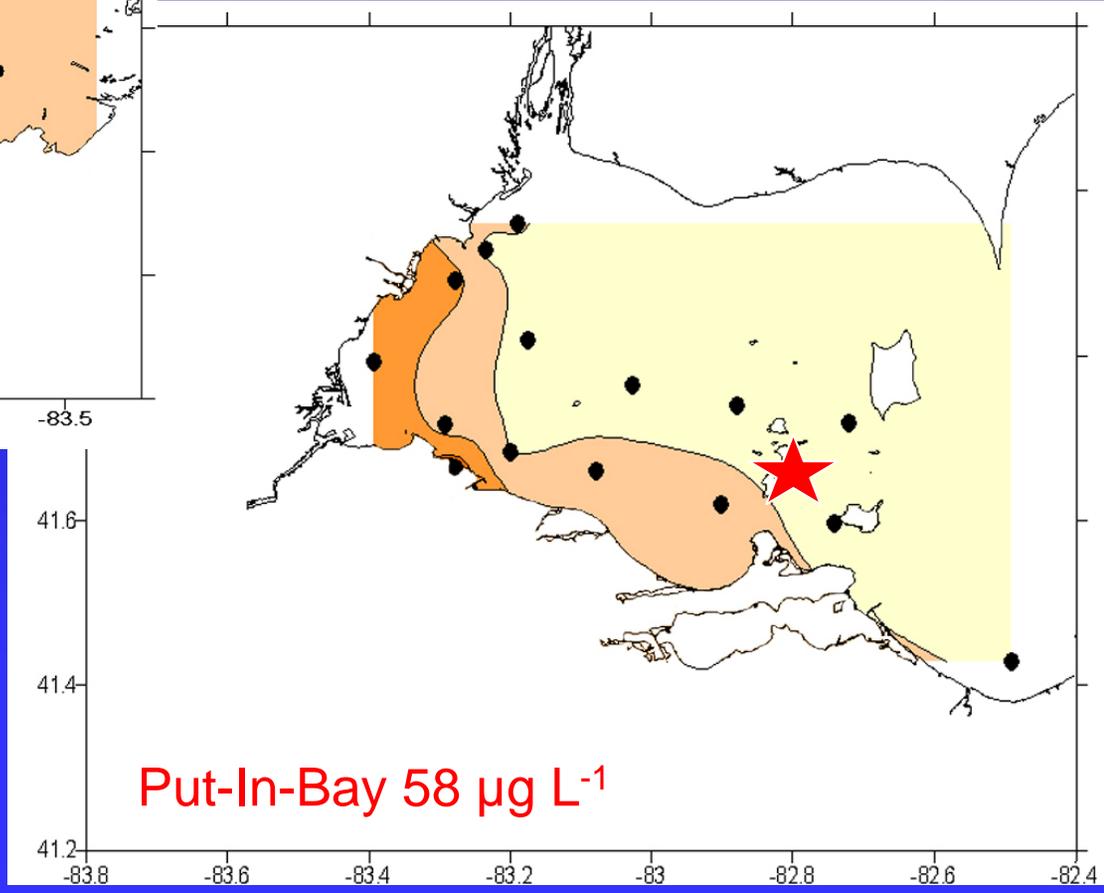


Microcystin concentrations in Saginaw Bay



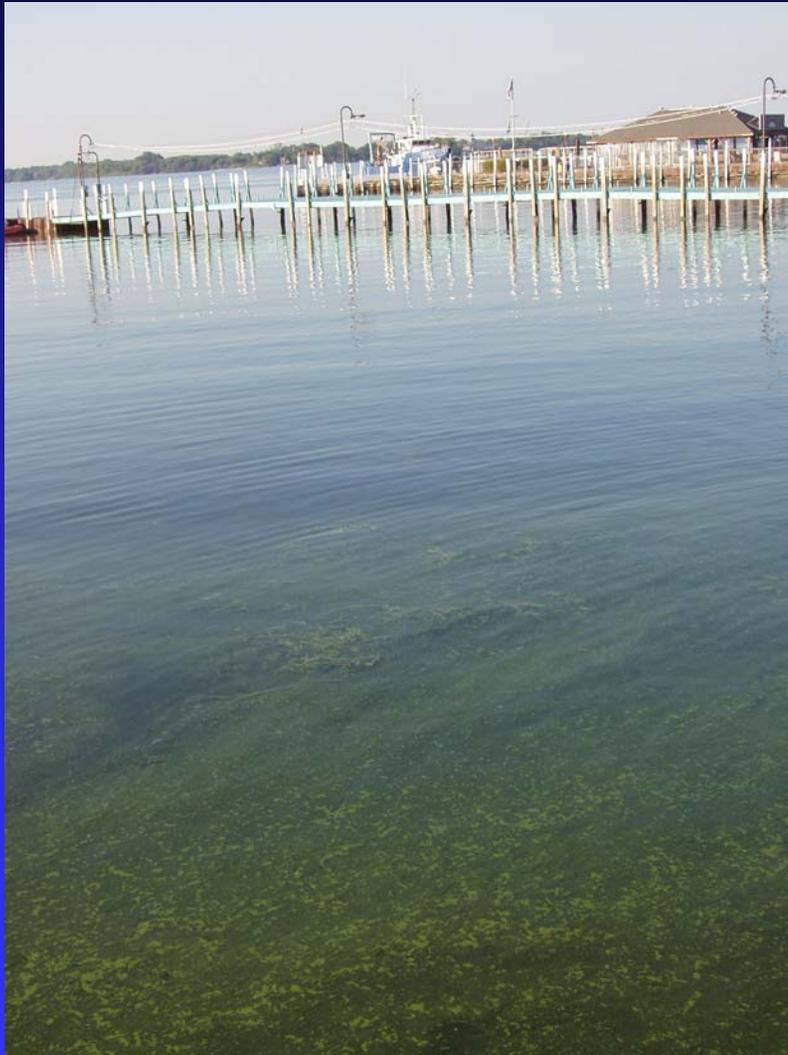
Saginaw Bay

western Lake Erie



Put-In-Bay 58 $\mu\text{g L}^{-1}$

Microcystis in Lake Erie



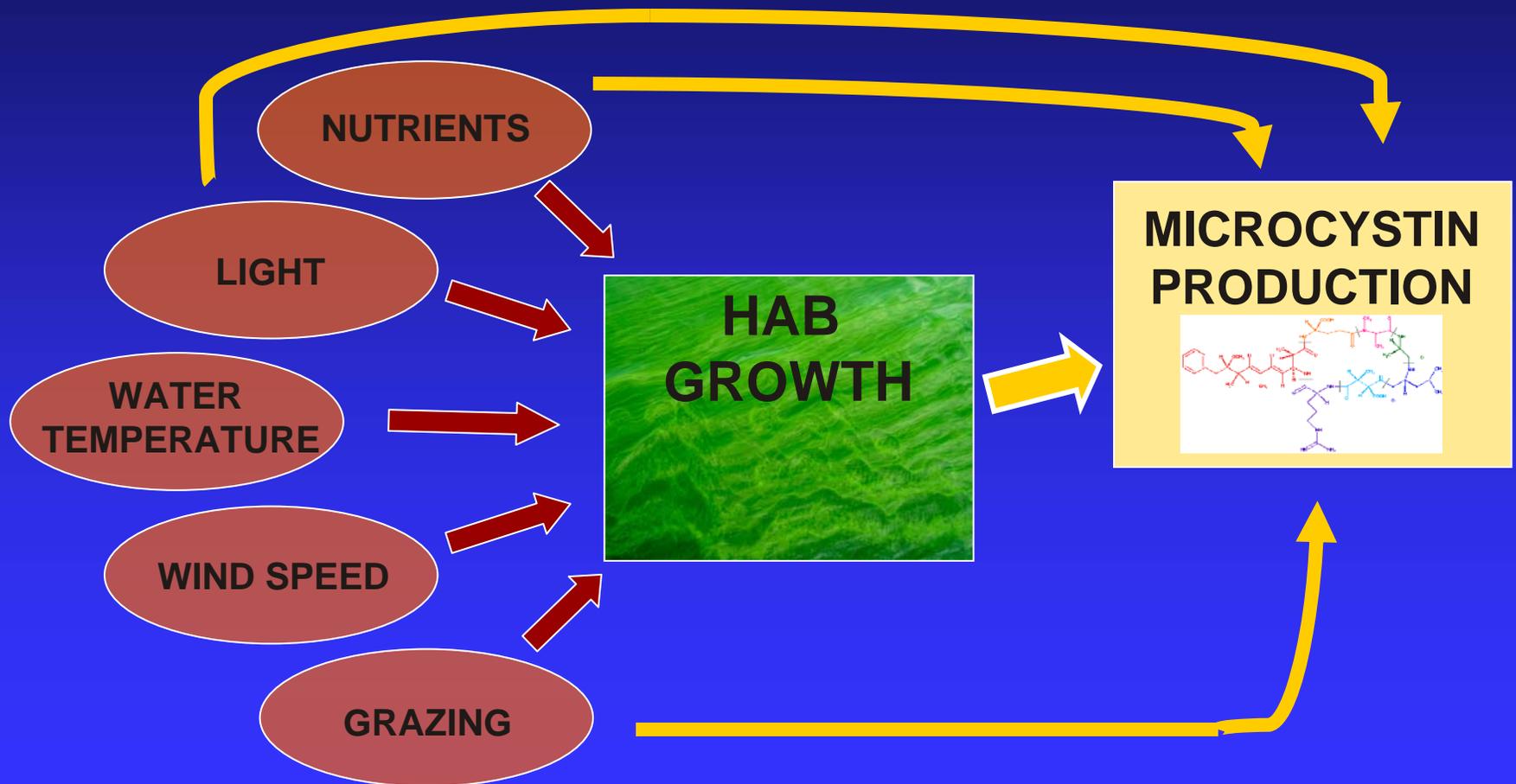
Put-In-Bay

North shore of S. Bass Island



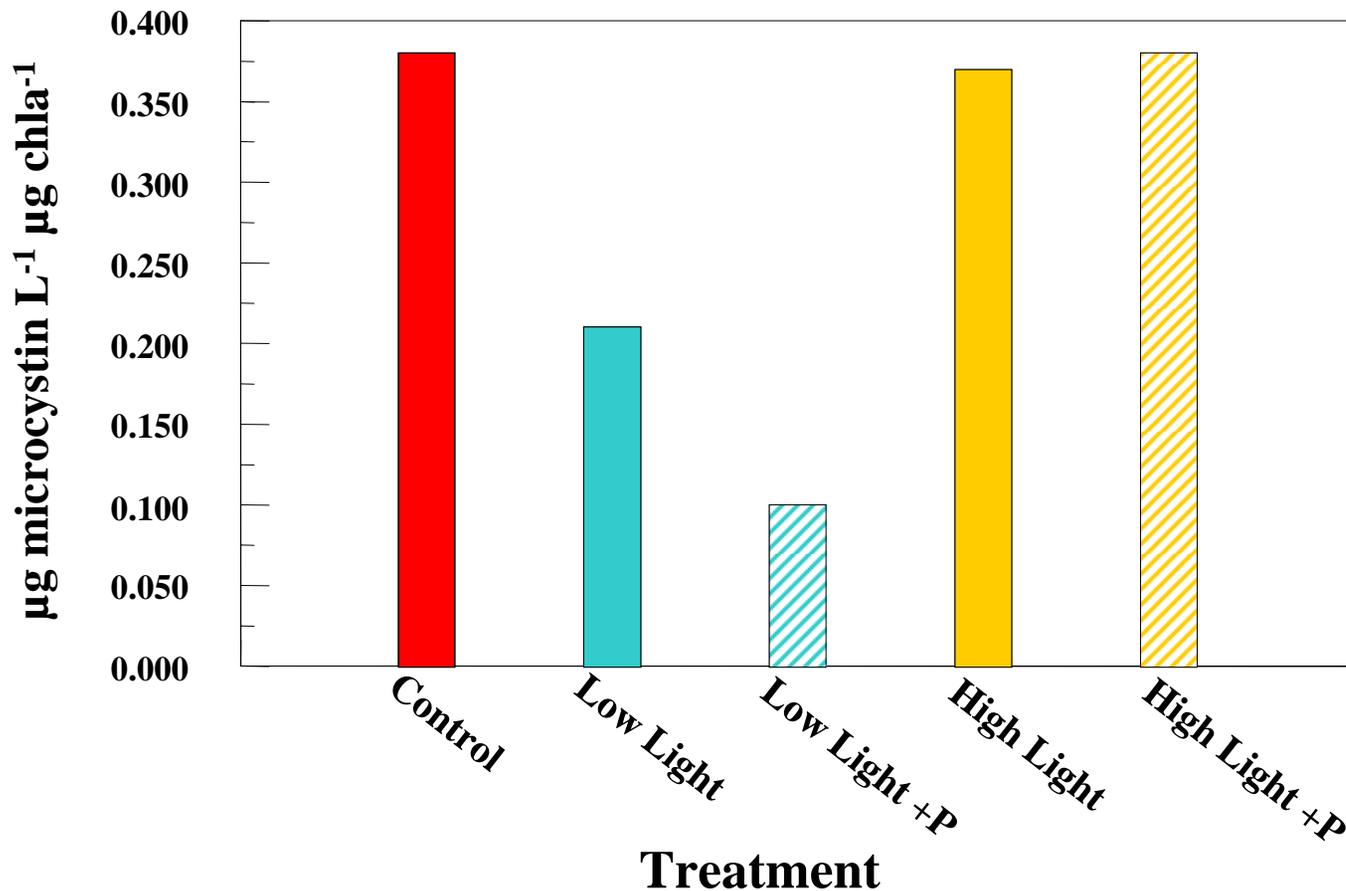
South shore of S. Bass Island

Environmental factors influencing growth and toxin production in *Microcystis*



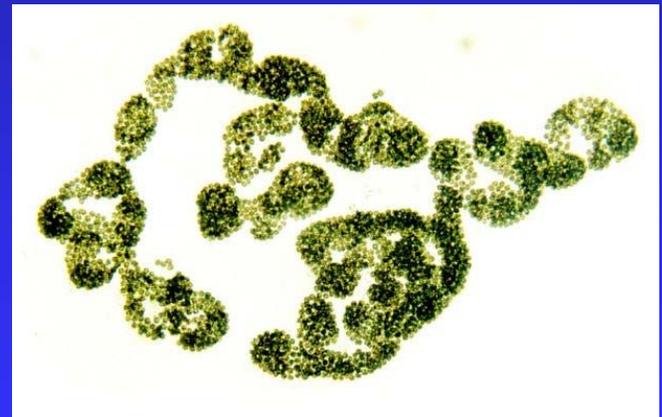
Nutrient (P) and light effects on microcystin production in *Microcystis*-dominated phytoplankton community

Preliminary data, Saginaw Bay, June 2005



Detection with genetic techniques

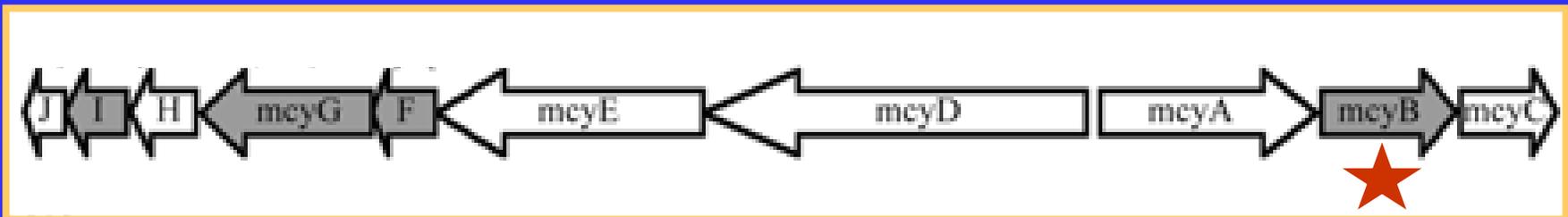
- ❖ Differentiate morphologically identical strains
 - ❖ toxic vs. non-toxic
- ❖ Track specific populations
 - ◆ Geographic origin
 - ◆ Genetic diversity
- ❖ Rapid detection
 - ◆ often faster and less tedious than microscopy



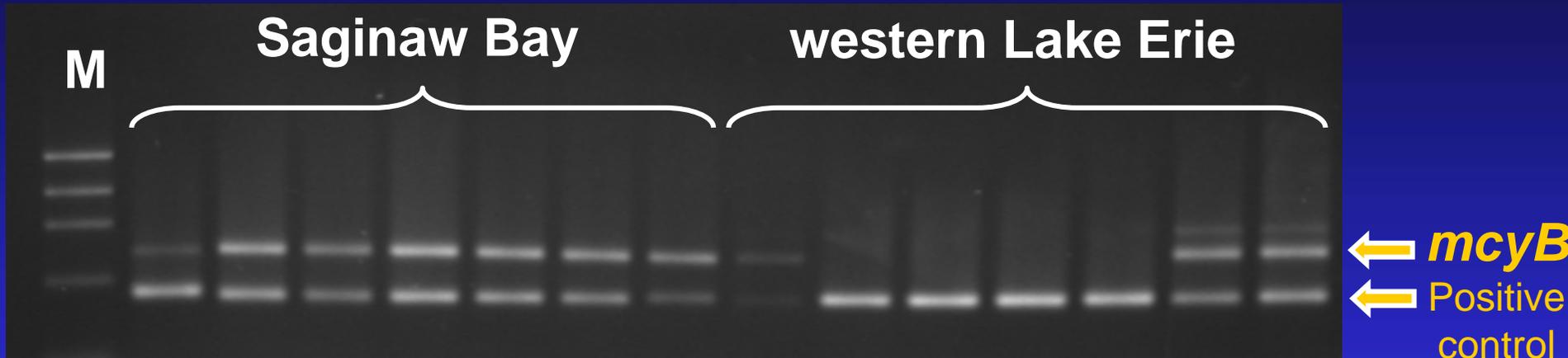
Microcystis sp.

Identifying toxic strains of *Microcystis*

- ❖ All toxin-producing strains of *Microcystis* contain genes for microcystin production: *mcyA-J*
- ❖ Presence of *mcyB* = strain able to produce toxin
Absence of *mcyB* = non-toxic



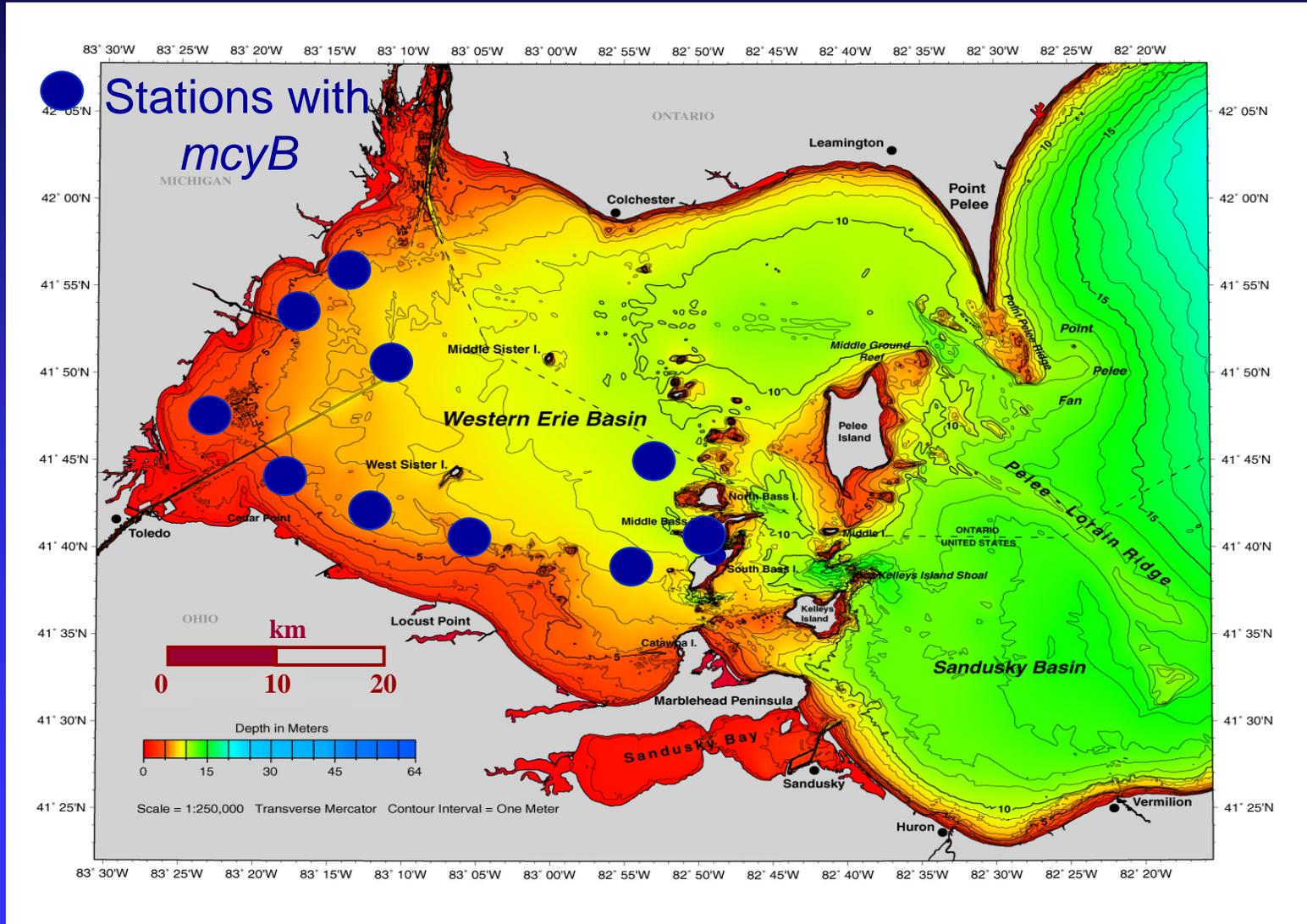
Multiplex PCR for toxic *Microcystis*



M = molecular weight marker

Basin	Number of colonies # mcyB	total	% microcystin producers
Saginaw	36	40	90%
Erie	4	16	25%

Distribution of toxic *Microcystis*



Develop a quantitative PCR assay for enumerating toxic *Microcystis* colonies

Applications

- ❖ measure temporal variation in proportion of toxic strains
 - ◆ biweekly sampling at 3 locations in western Lake Erie
- ❖ identifying conditions under which cells are actively producing toxin (expressing *mcyB*)
 - ◆ zebra mussel grazing
 - ◆ changes in nutrients and light
- ❖ Tie into circulation models to predict distribution of toxic *Microcystis* strains and forecast water quality

Thanks

- ❖ Center of Excellence for Great Lakes and Human Health (Oceans and Human Health Initiative)
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