

Great Lakes Cooperative Science and Monitoring Initiative

Michele Wheeler
Lake Superior Bi-National Program Coordinator
Wisconsin Department of Natural Resources

National Water Quality Monitoring Council
November 18, 2014

Today's talk...

- Great Lakes Water Quality Agreement - Context for CSMI
- Overview of the CSMI program
- Highlights and common topics across the lakes



Great Lakes Water Quality Agreement

- Restore and maintain chemical, physical and biological integrity
- General Objectives
- Lake Ecosystem Objectives



Great Lakes Water Quality Agreement

- Restore and maintain chemical, physical and biological integrity
- General Objectives
- Lake Ecosystem Objectives
- Annexes
 - 2 – Lakewide Action & Management Plans (LAMPs)
 - 4 – Nutrients
 - 10 – Science

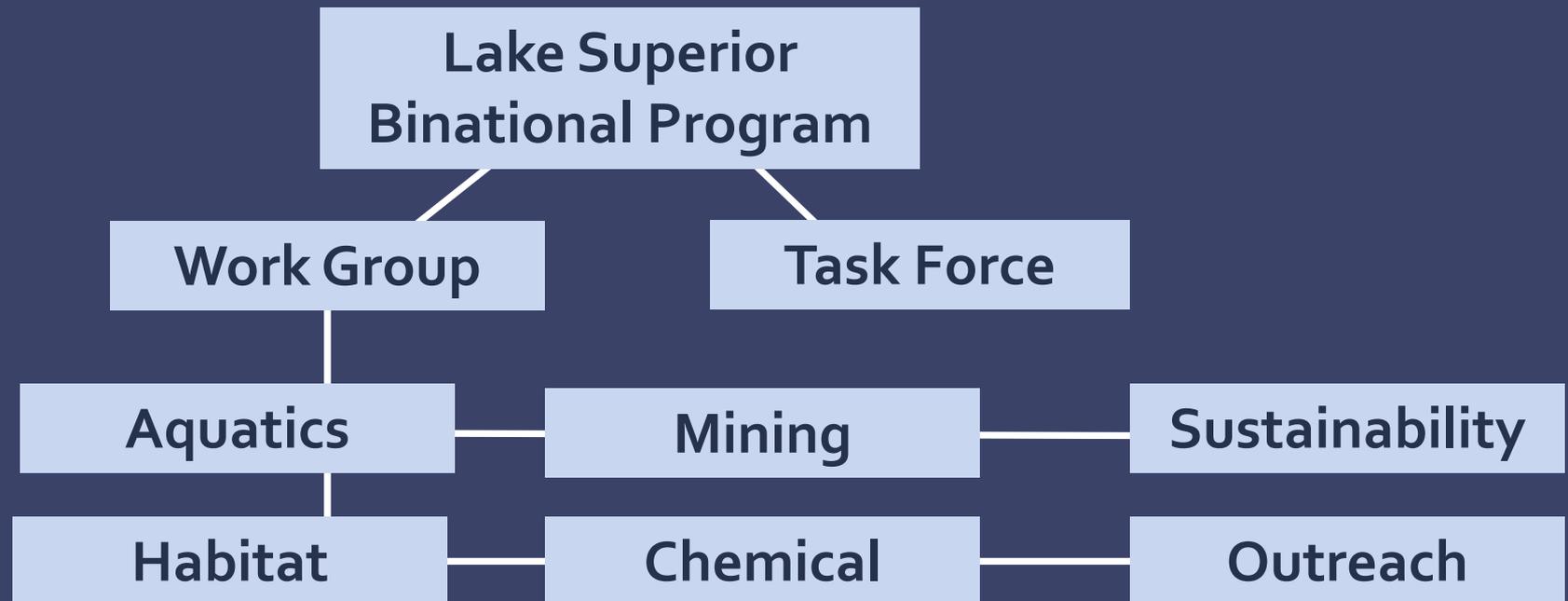


Annex 2 - Lakewide Action and Management Plans

- Developed every 5 years
- Involvement from working group and leadership

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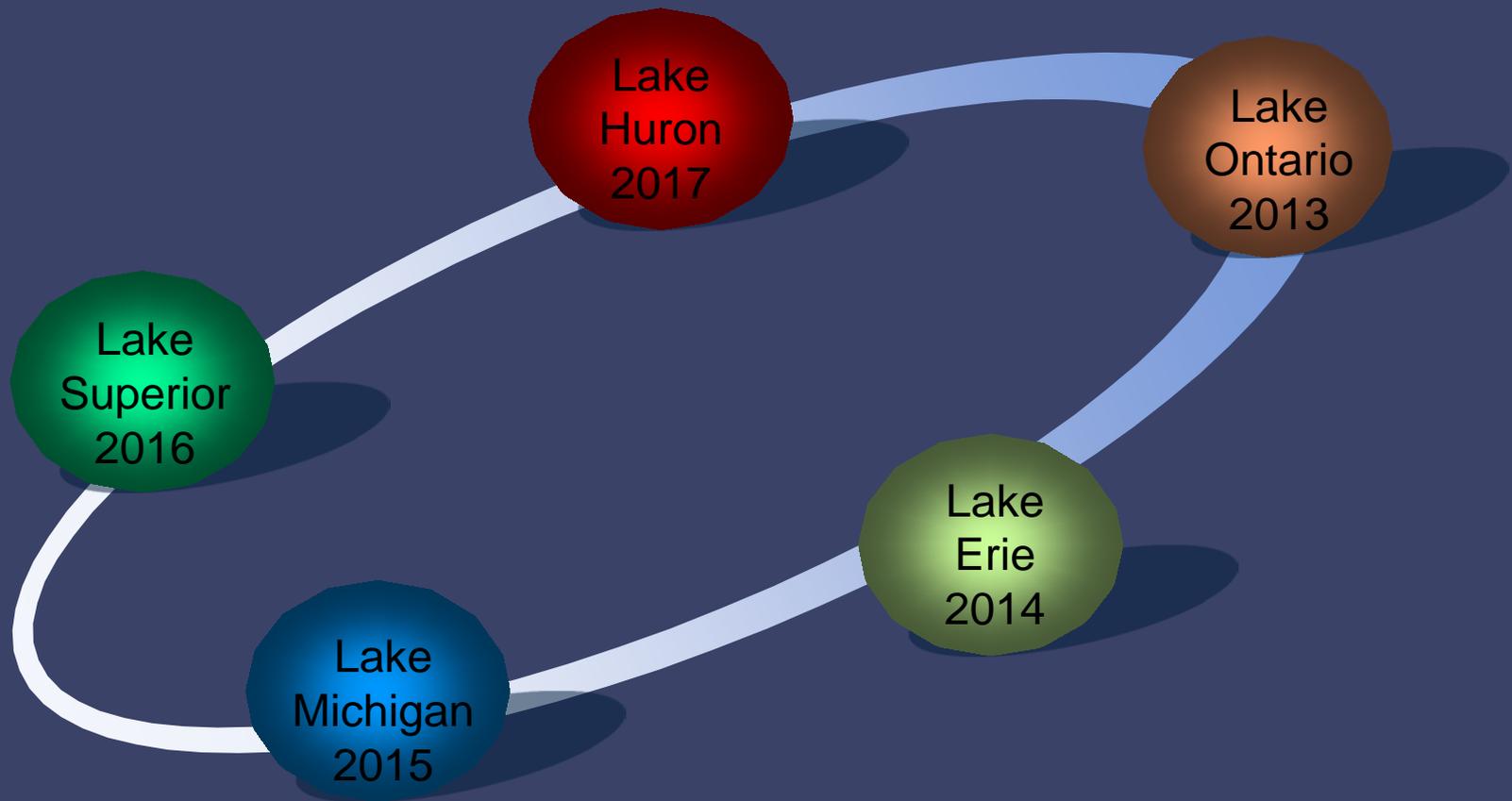




Annex 10 - Science

- Enhance coordination and integration of science activities
- Calls for Cooperative Science and Monitoring Initiative
 - greater awareness
 - improved reporting
 - project design
 - efficiencies
- Priorities identified through LAMP management process

CSMI Overview



Concentrated field effort on one of the Great Lakes each year



More than just a field year

Five Year Cycle:

- 1: Identify science needs
 - 2: Develop workplan
 - 3: Conduct field work
 - 4: Analysis and compile results
 - 5: Report results
- 



More than just a field year

Five Year Cycle as of 2014:

1: Identify science needs

L. Superior

2: Develop workplan

L. Michigan

3: Conduct field work

L. Erie

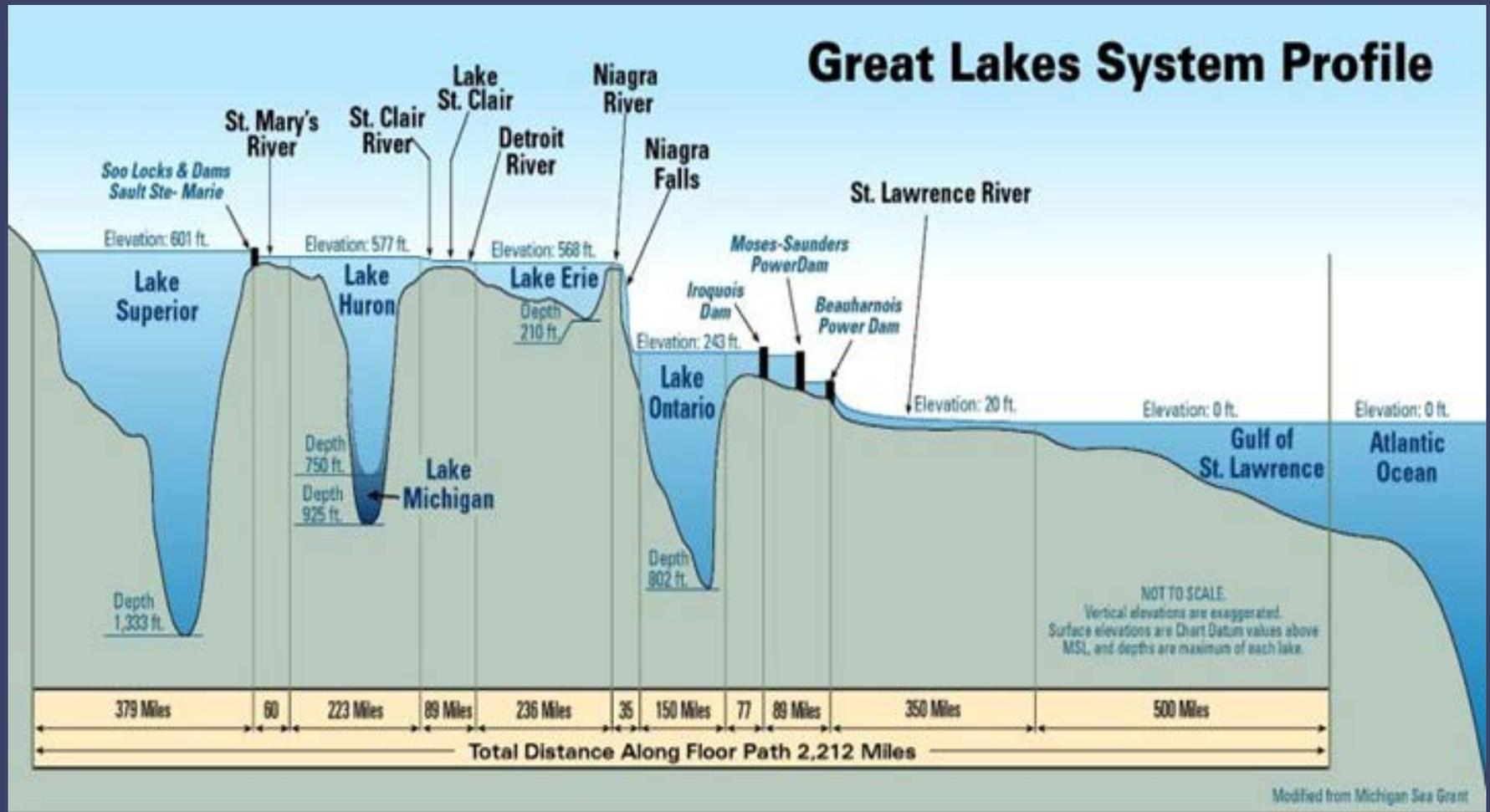
4: Analysis and compile results

L. Ontario

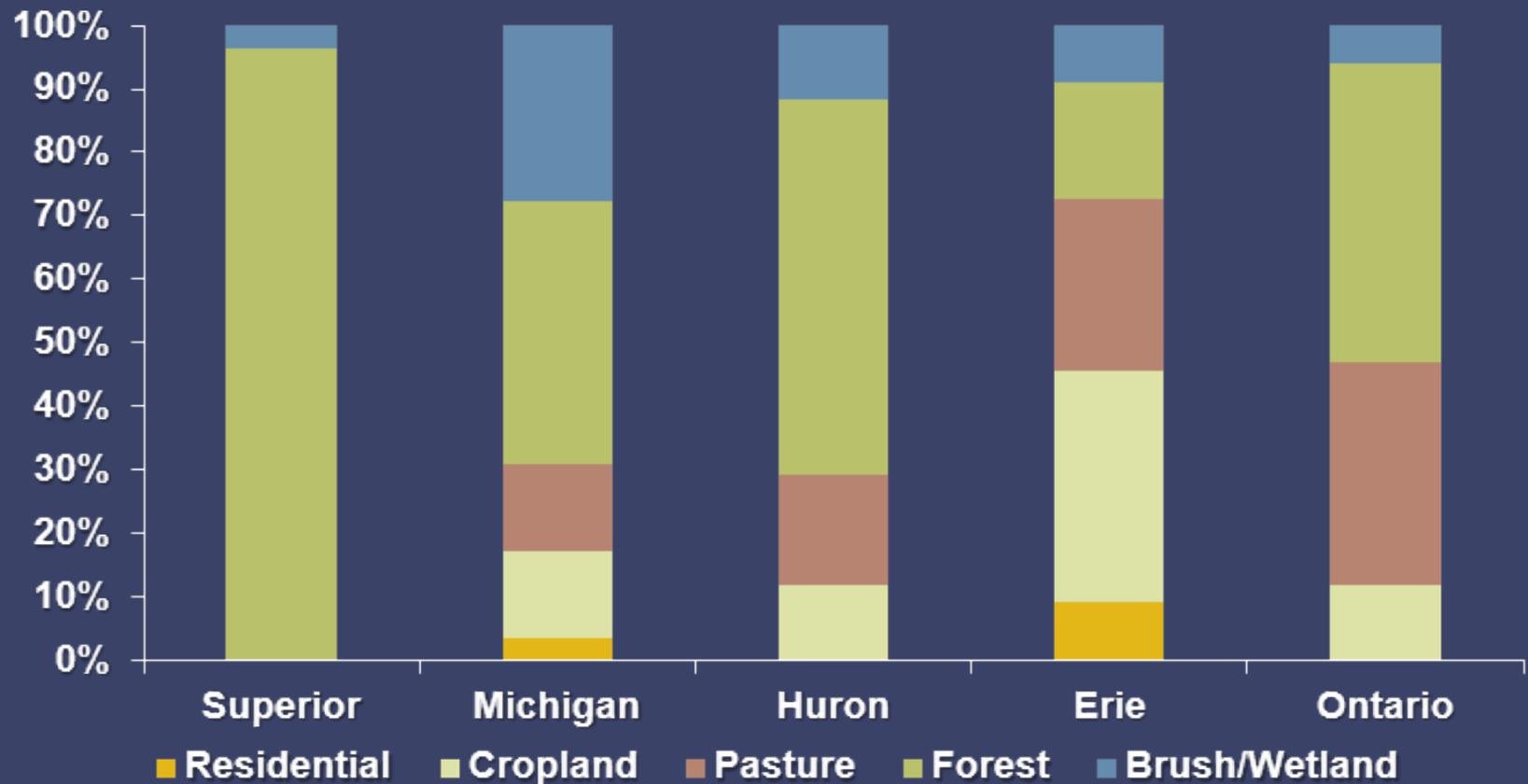
5: Report results

L. Huron

Differences among lakes



Differences among lakes



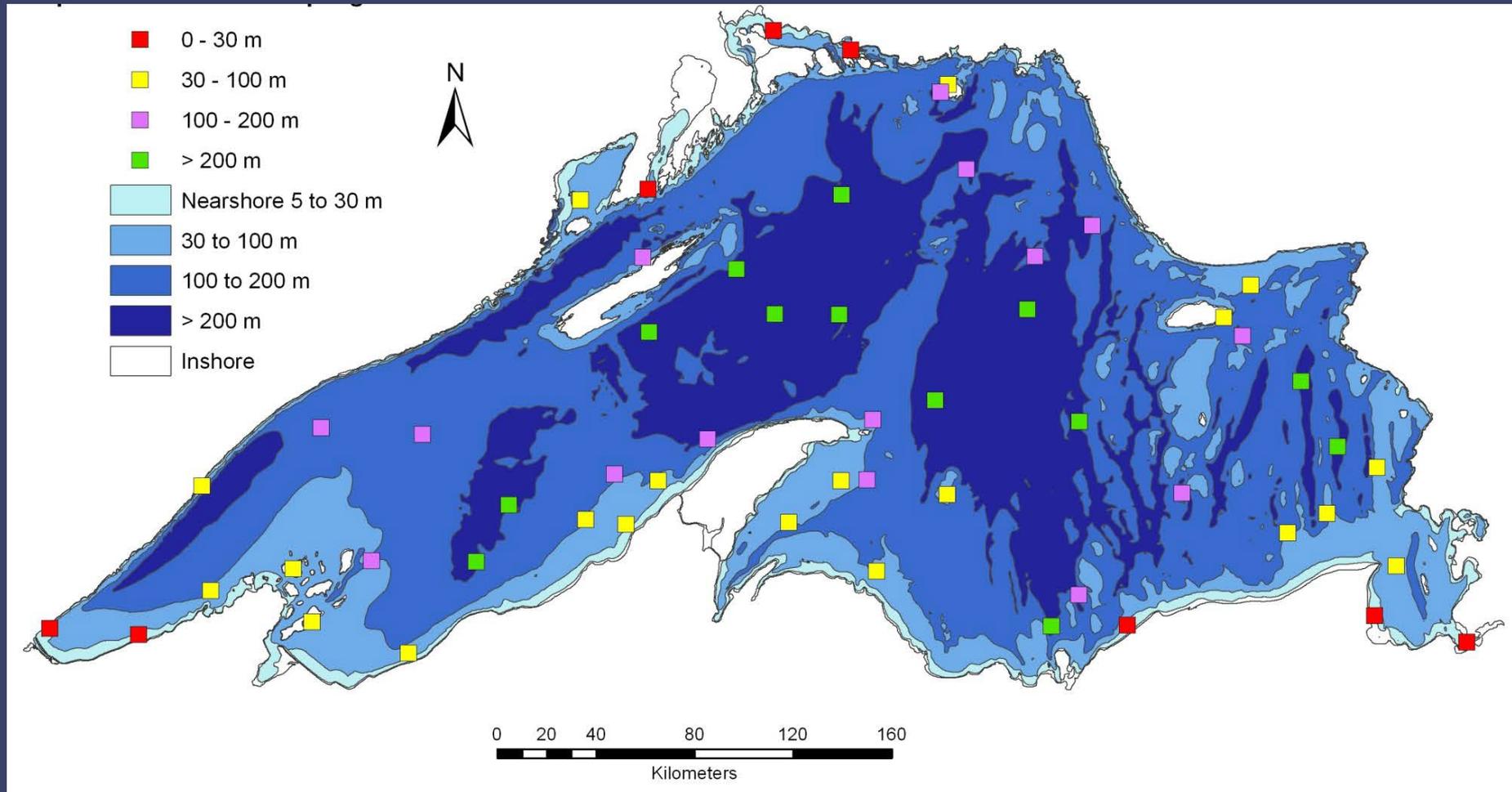
From Jeff Reutter, Ohio Sea Grant Lake Erie Update 2013

CSMI Lakewide Surveys

Most extensive effort in open waters of the lakes

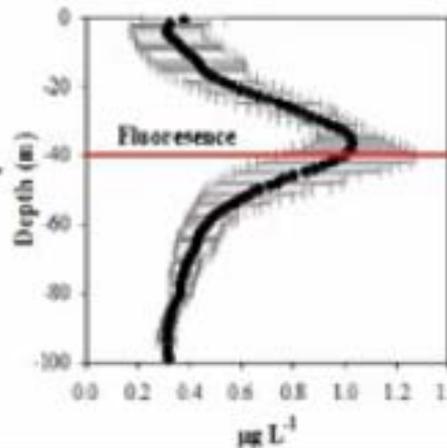
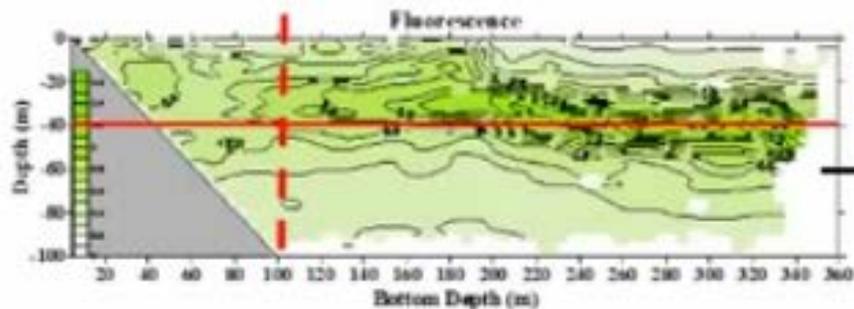
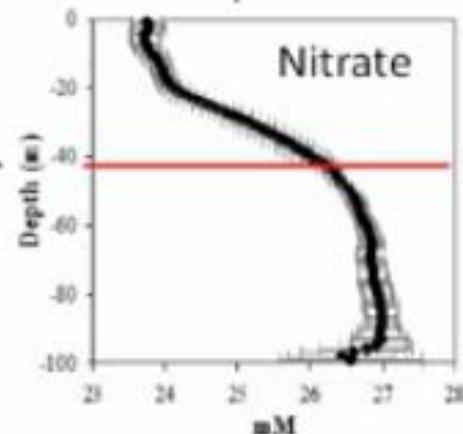
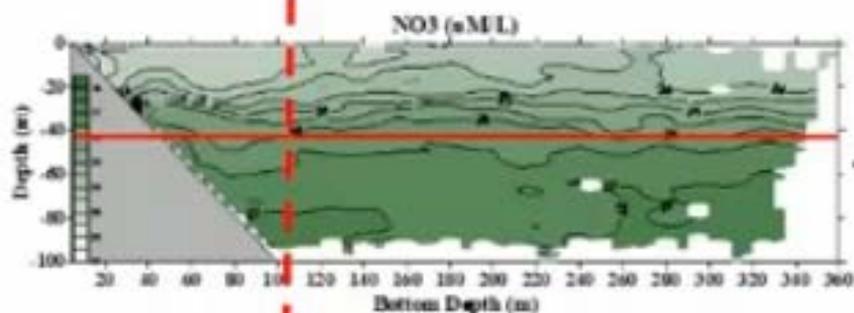
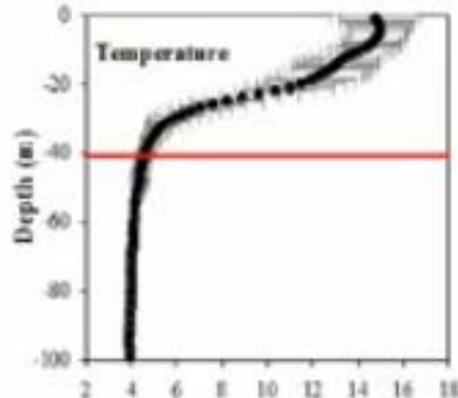
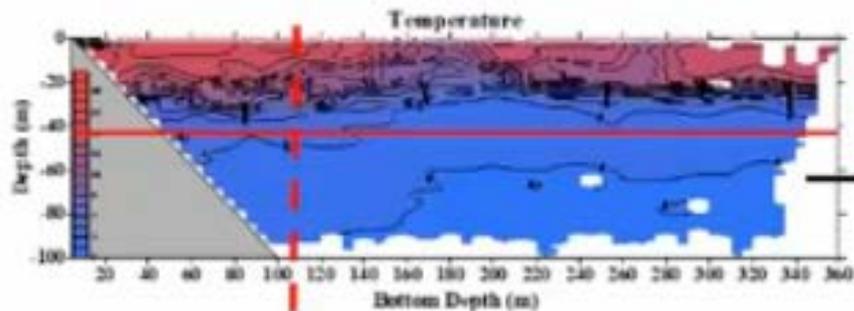


Lake Superior CSMI 2011



Inshore

Offshore



Slide from
Jack Kelly, GLFC



Lake Superior CSMI 2011

- Physical processes in Lake Superior
- Juvenile Lake Sturgeon Index Survey
- Herpetofaunal Inventory and Monitoring
- Baseline water quality monitoring in selected potential future mining sites
- Lakewide Tributary Flow Trends



Lake Superior CSMI

Tributary flow trends

- Annual precipitation decreased by up to 25%
- April/May/June flows, annual mean flows, and 7-day low flows have decreased
- Peak flows have likely increased
- Nutrient/contaminant transport
- Effects on nearshore ecological processes

Lake Superior CSMI - 2016

- Is the lower food web of LS stable and healthy?
- Can FCO be met and maintained?
- How can we improve the ecological models to better integrate across multiple trophic levels?

Annex 4 - Nutrients

Interim TP Concentration
in Open Waters ($\mu\text{g/L}$)

L Superior	5
L Huron	5
L Michigan	7
L Erie	10 – 15
L Ontario	10

Interim Load Targets
(metric tonnes TP/yr)

L Superior	3,400
L Huron	3,400
L Michigan	5,600
L Erie	11,000
L Ontario	7,000

Lake Superior CSMI - 2016

- What are the top sources/locations of nutrient delivery to Lake Superior?
- And how much nutrient load are they delivering?
- What locations are most susceptible to eutrophication?

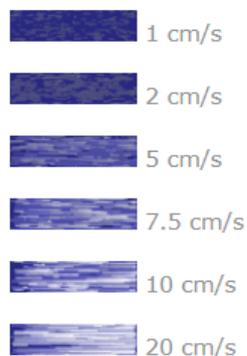


NOAA/GLERL Great Lakes Surface Currents Map

See Additional Currents: [Latest Depth-Averaged](#) | [3hrs Previous Depth-Averaged](#) | [Latest Surface](#) | [3hrs Previous Surface](#)
Updated four times per day at 3 and 9 Eastern Time

Valid:
2014-11-14
18:00 GMT

top speed: **44.7 cm/s**
average: **10.6 cm/s**



Monthly Depth-Averaged Currents for 2010-2013



Click on map to zoom; click and drag to pan. This animation may not work on all browsers.

The flow patterns depicted in these visualizations of lake currents are based on simulations from the

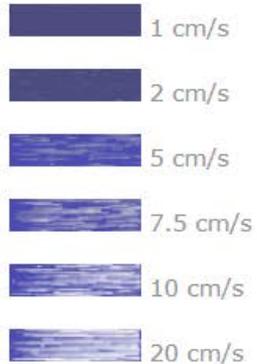


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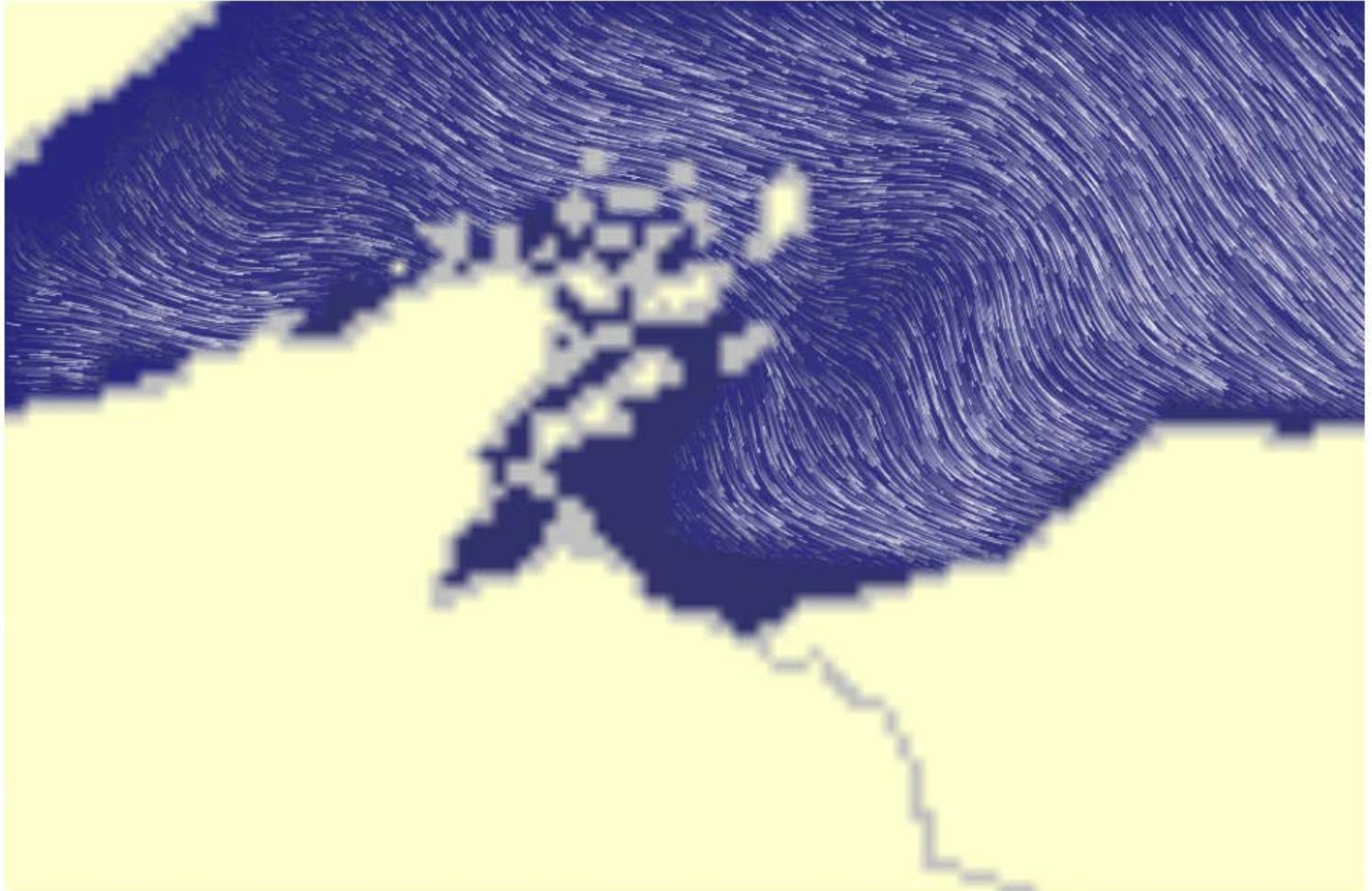
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Unzoom

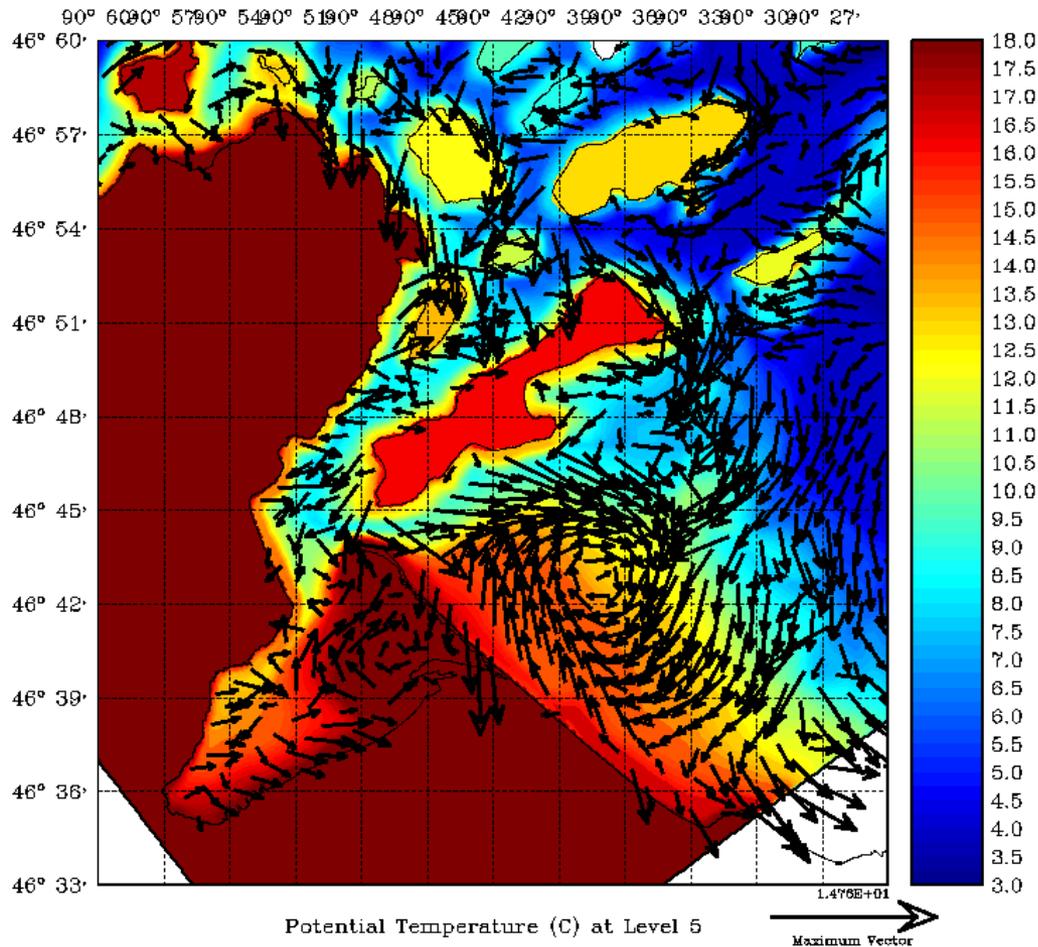
Monthly Depth-Averaged
Currents for 2010-2013



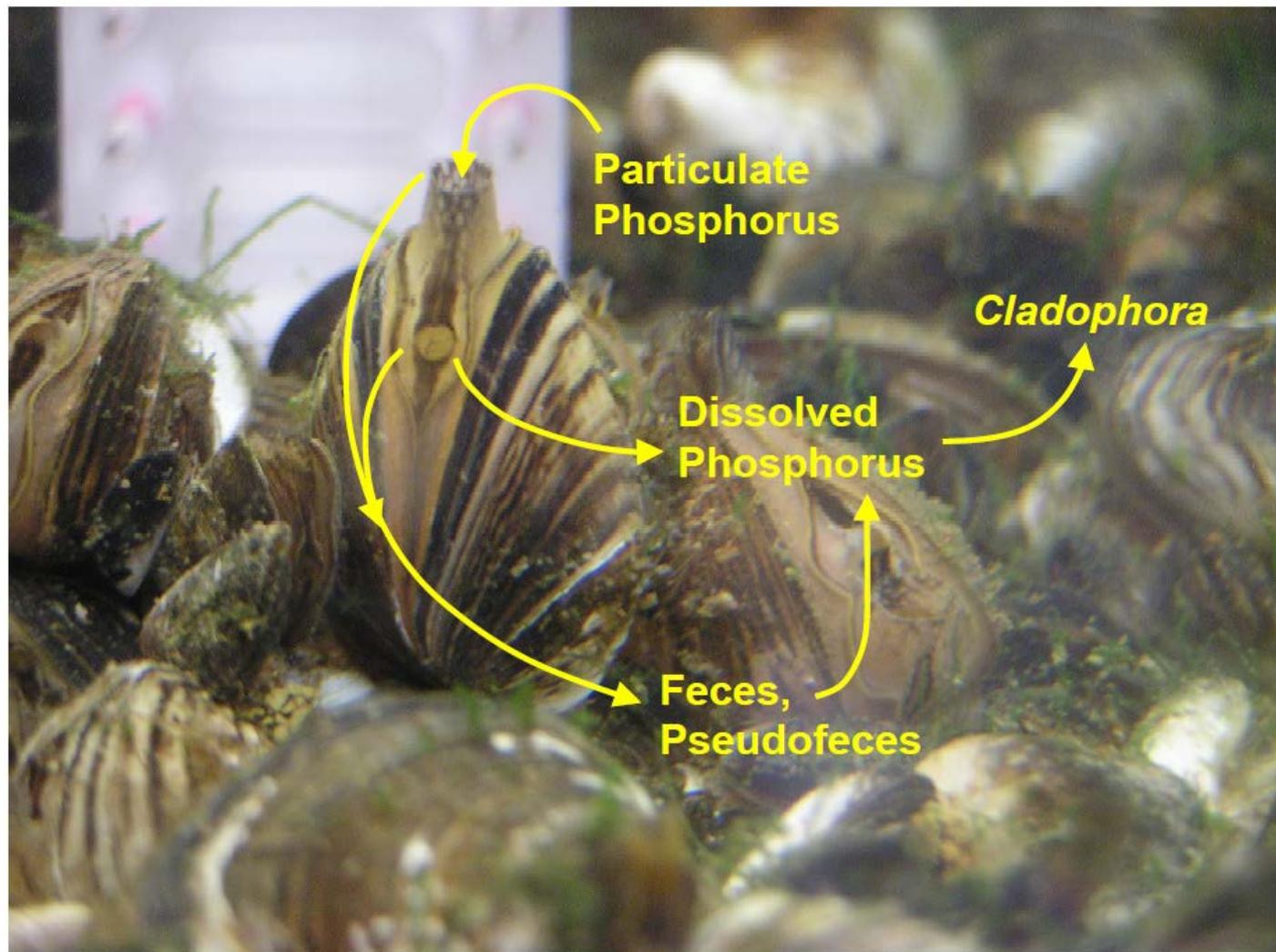
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Hydrodynamics at management scales



Lake Michigan CSMI - 2015

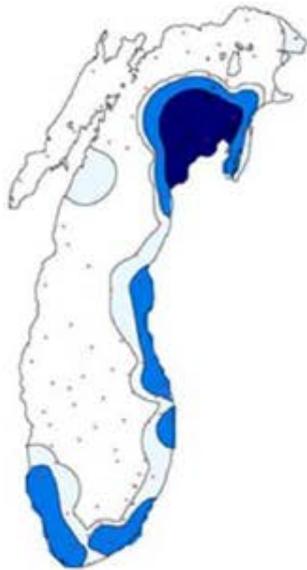


Slide from Harvey Bootsma

Lake Michigan CSMI - 2015

Zebra Mussel

1994/95

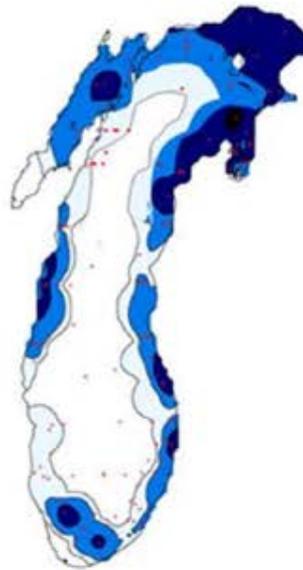


10^1 10^2 10^3 10^4 10^5



Density (No. m^2)

2000

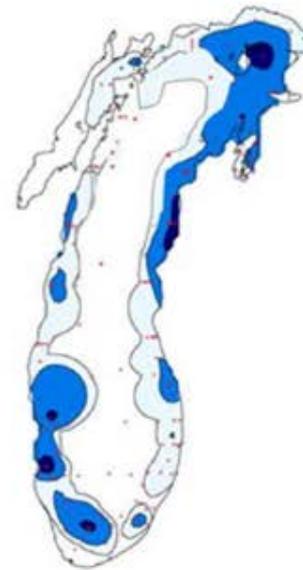


10^1 10^2 10^3 10^4 10^5



Density (No. m^2)

2005

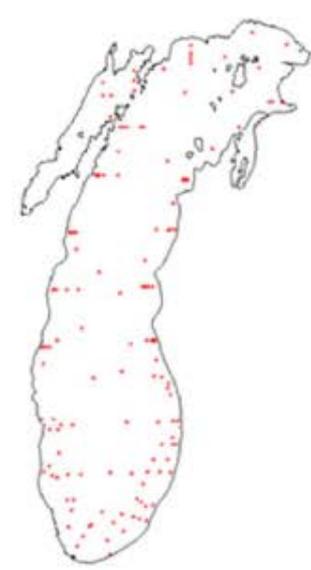


10^1 10^2 10^3 10^4 10^5



Density (No. m^2)

2010



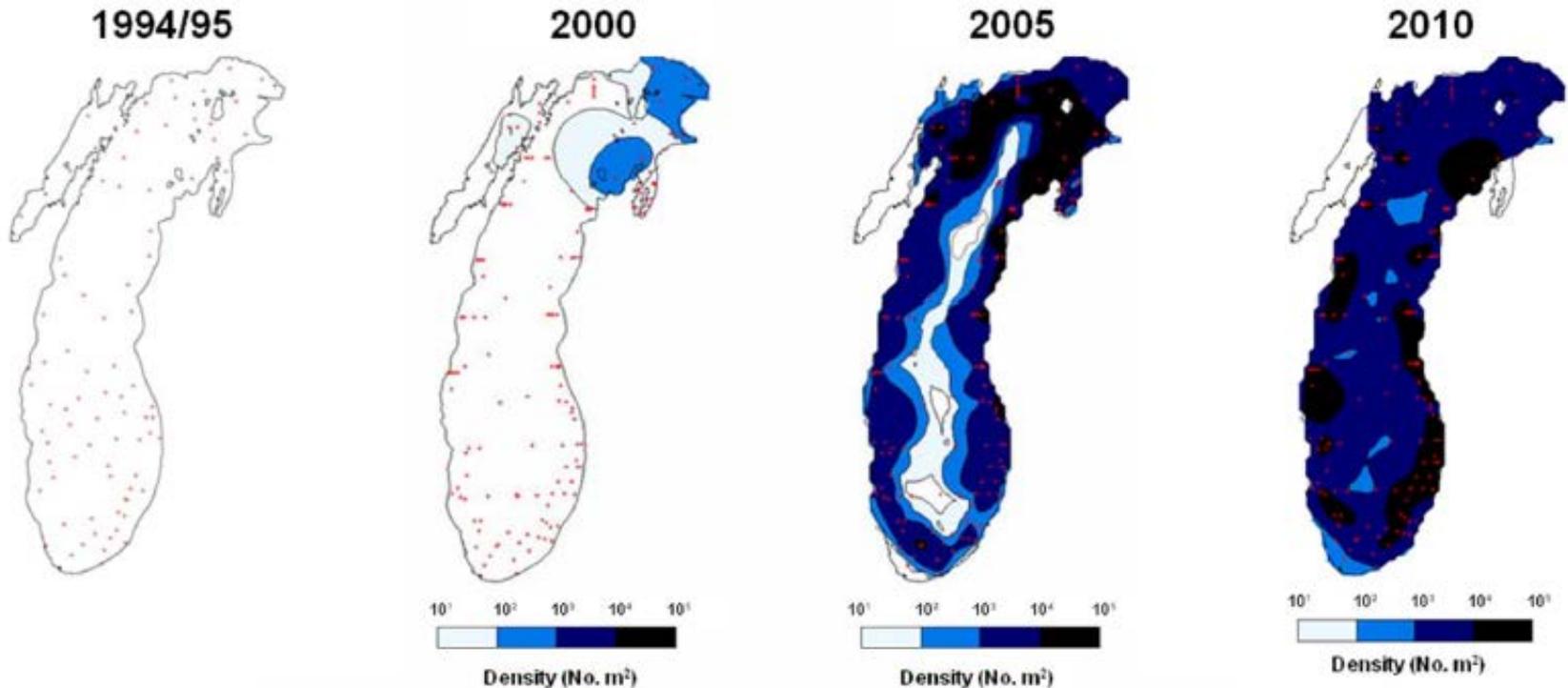
10^1 10^2 10^3 10^4 10^5



Density (No. m^2)

Lake Michigan CSMI - 2015

Quagga Mussel





Lake Michigan CSMI - 2015

How is nearshore P concentration related to P loading?

What is the optimal loading rate? Where is P coming from?

- Temporal and spatial coupling of nutrients and food web — microbes to fish
- Develop nutrient/Cladophora/quagga mussel interaction model
- Nutrient input from tributaries
- Benthic Survey



Lake Ontario CSMI - 2013

- amount of phosphorus and nitrogen entering the lake and how these nutrients move through the food web
- biological connections between nearshore and offshore areas of the lake
- fish population changes, diets and distribution in different areas of the lake



Lake Ontario – Improvements for 2018

- 1) addressing questions using multiple agency databases providing broad spatial perspective and
- 2) seeking outside data management funding.



CSMI general focus

- Food Web Structure
- Tributary monitoring – loads various chemicals
- Describe nutrient dynamics and hydrodynamics, particularly in the nearshore

A satellite-style map of the Great Lakes basin in North America, showing the five Great Lakes (Superior, Michigan, Huron, Erie, and Ontario) and the St. Lawrence River. The land is depicted in shades of green and brown, while the water bodies are in various shades of blue and cyan. The text "Questions?" is overlaid in white in the upper right quadrant.

Questions?