Lake Michigan 2015 CSMI Field Year Overview

Paul Horvatin

U.S. EPA Great Lakes National Program Office

State of Lake Michigan Conference

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I. CSMI Overview

II. 2015 Lake Michigan CSMI Surveys

- Lake MI Tributary PCBs, Brominated Flame Retardants, OPEs, Atrazine
- GLFMSP: Integrated assessment of ecosystem status and contaminant cycling
- Distribution, abundance and movement of nutrients and biota across a nearshore-offshore gradient
- Lake Michigan Benthos

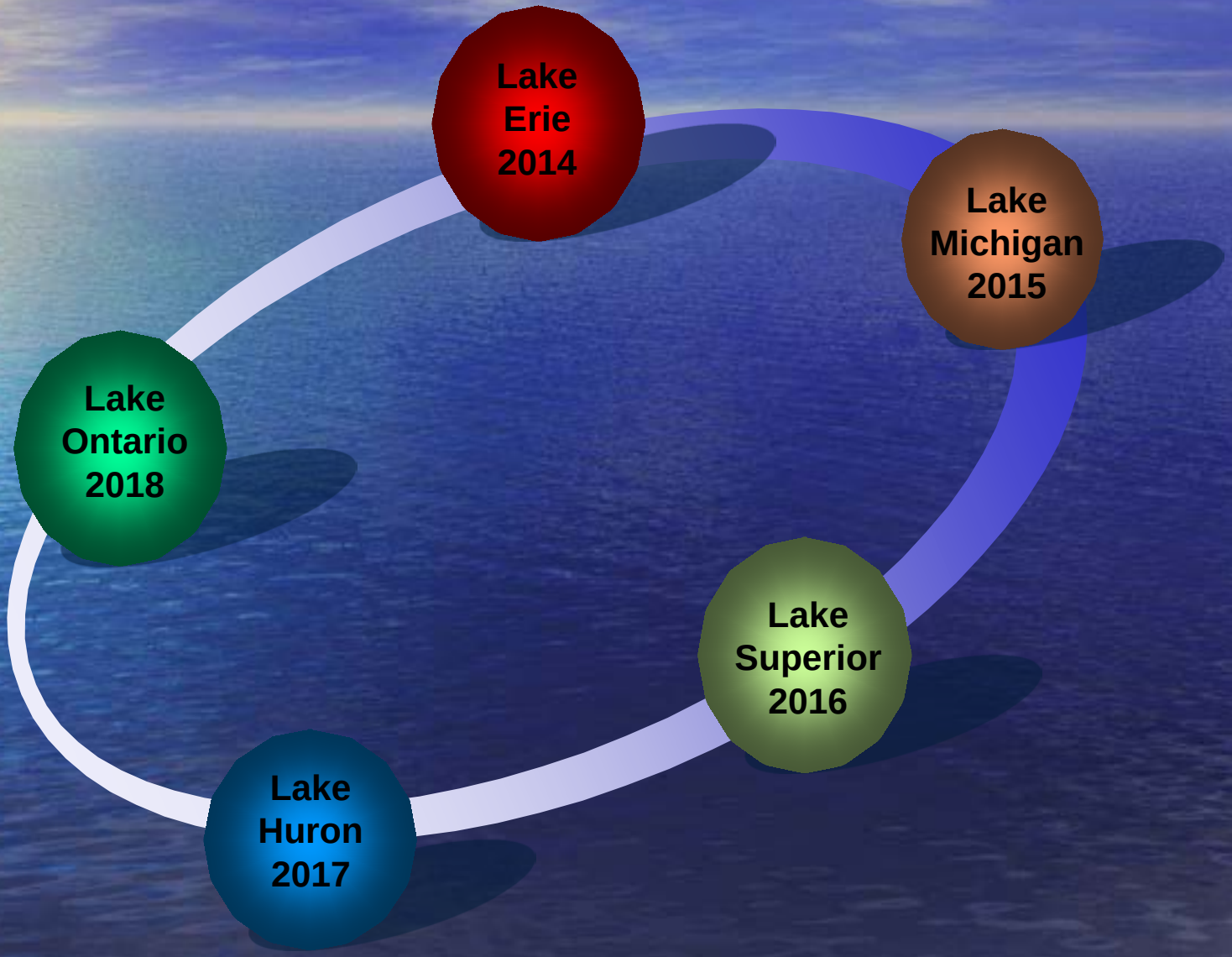
CSMI Objective

An integrated, demand-driven Great Lakes Coordinated Science Initiative based on the knowledge needs of federal departments, provinces, states, First Nations, Tribes, Municipalities, and other stakeholders.

Attending Agencies, Organizations, Programs

- U.S. EPA GLNPO
- U.S. EPA ORD Duluth
- U.S. Army Corps of Engineers
- USGS
- NOAA
- U.S. Fish and Wildlife Service
- Environment Canada
- Fisheries and Oceans Canada
- Agriculture and Agri-Food Canada
- Walpole First Nations
- Ontario Ministry of Environment and Climate Change
- Ontario Ministry of Natural Resources
- Ontario Ministry of Agriculture, Food and Rural Affairs
- Great Lakes Fishery Commission: Upper Great Lakes Management Unit
- Binational Toxics Strategy
- LAMP Coordinators
- Lake Erie Millennium Network
- LMMCC
- Council of Great Lakes Governors
- Council of Great Lakes Research Managers
- GLOS Board of Directors
- Binational Toxics Strategy
- GLEC Secretariat
- GLRRIN
- Council of Great Lakes Research Managers
- Illinois Environmental Protection Agency
- Michigan Department of Natural Resources and Environment
- Wisconsin Department of Natural Resources
- Minnesota Pollution Control Agency
- Indiana Department of Environmental Management
- New York Department of Environmental Control
- Pennsylvania Department of Environmental Protection
- Ohio EPA

5 Lake Rotational Cycle



Background

- Cooperative Monitoring Initiative (CMI) started in 2002 to coordinate monitoring
  - Simple premise: focus resources on a few key issues on one lake each year
- Expanded mandate to include research coordination with monitoring
- In 2009, connecting channels (including St. Lawrence) were added to CSMI process
  - Connecting channel addressed with downstream lake
  - Only issues that affect downstream lake will be included
- CSMI follows a 5 year rotational cycle
- CSMI does NOT set priorities

What is going on in ONE year? 2015

- **Lake Huron** –Workshop to scope out issues
- **Lake Superior** – Planning year for field year
- **Lake Michigan** – Field Year
- **Lake Erie** – Data being worked up from field year
- **Ontario** – Reporting out

2015 Lake MI Tributary PCB Monitoring Objectives

- Characterize present-day water column contaminant loads and concentrations at five (5) of the original 11 Lake Michigan Mass Balance sampling sites.
- Contaminants of concern for this work include PCB, mercury, polybrominated diphenyl ether (PBDE), and other flame retardants including organophosphate (OPE) flame retardants.
- Estimate mass loading for each of the five sampled Lake Michigan tributaries.
- Compare present-day concentration and load estimates with those for 1994-1995 and 2005-2006.

USGS science for a changing world

INDIANA UNIVERSITY

AXYS ENVIRO

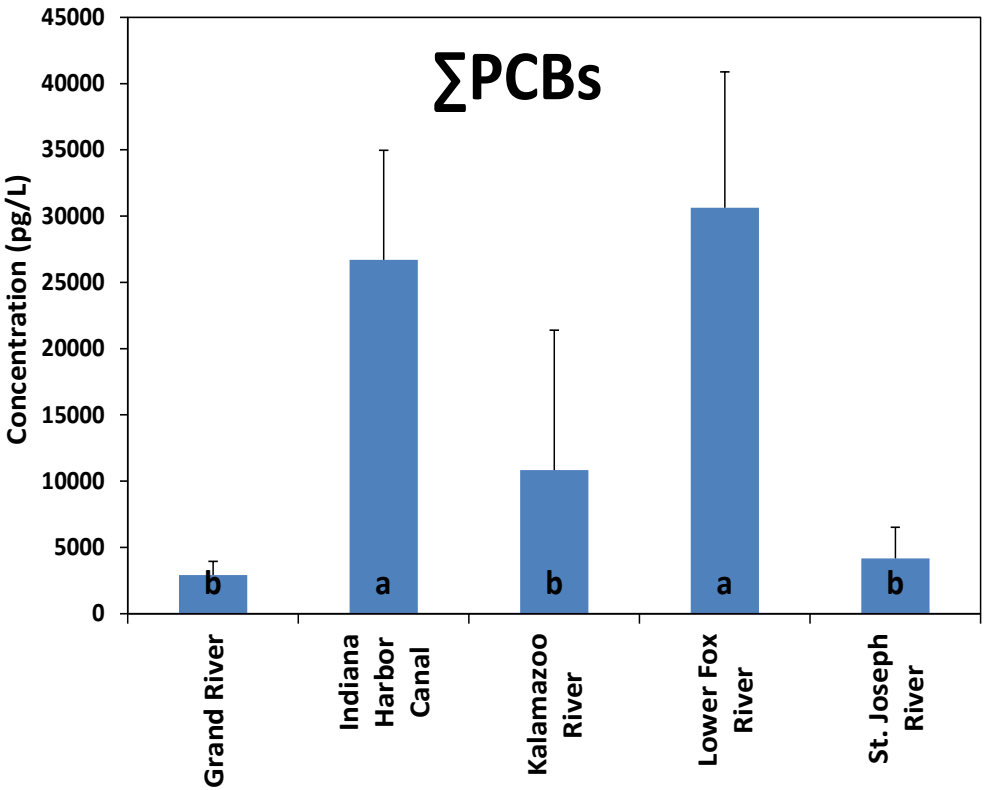
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Great Lakes RESTORATION

2015 Lake Michigan Tributary PCB Monitoring Sites

PCBs in water

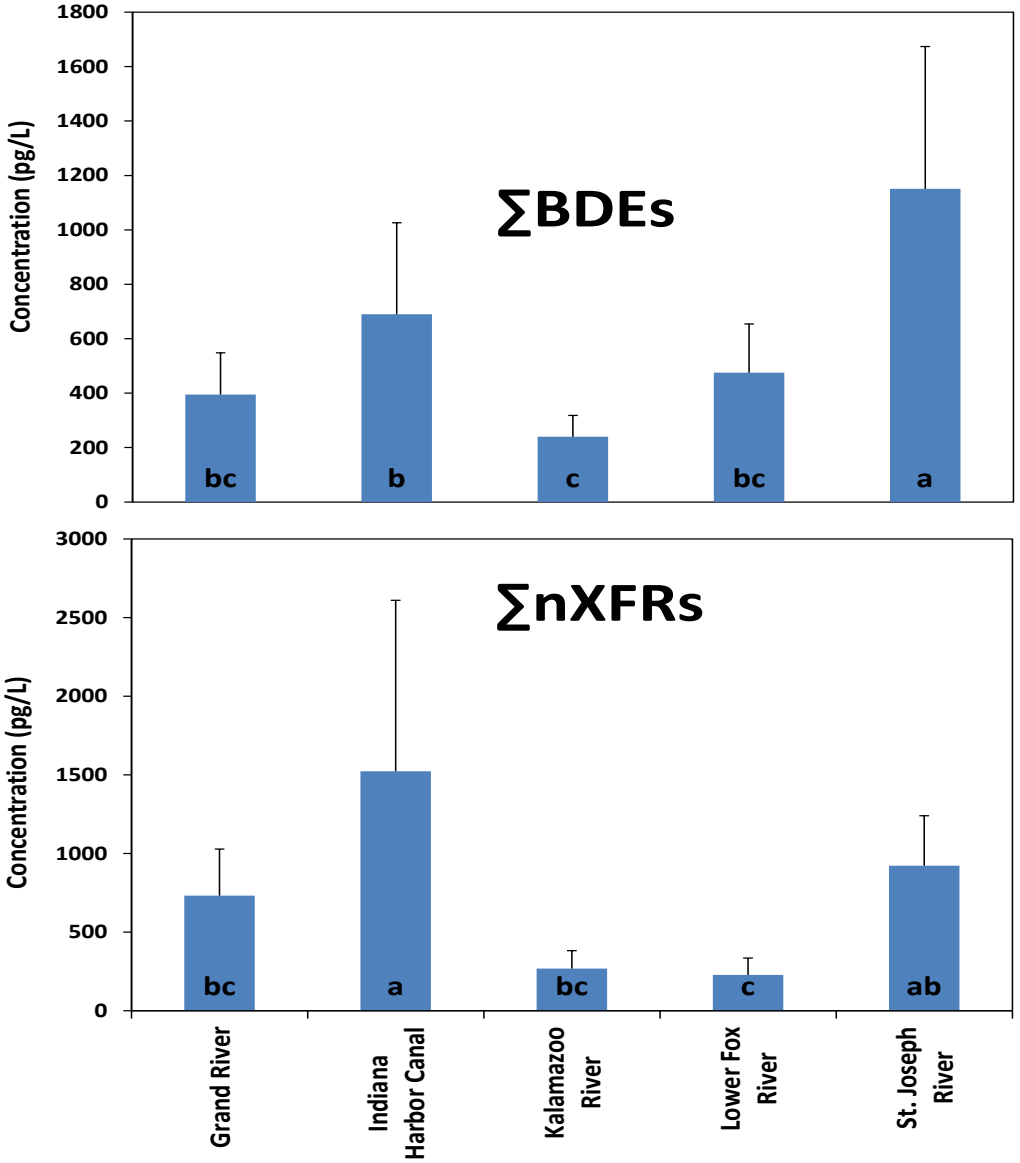
- PCBs concentrations in tributaries water ranged from 3,000 pg/L to 31,000 pg/L
- PCBs concentration are significantly higher in Indiana Harbor Canal and Lower Fox River than the other three rivers.



Note: Rivers that do not share a letter are significantly different at 95% confidence level.

Brominated Flame Retardants

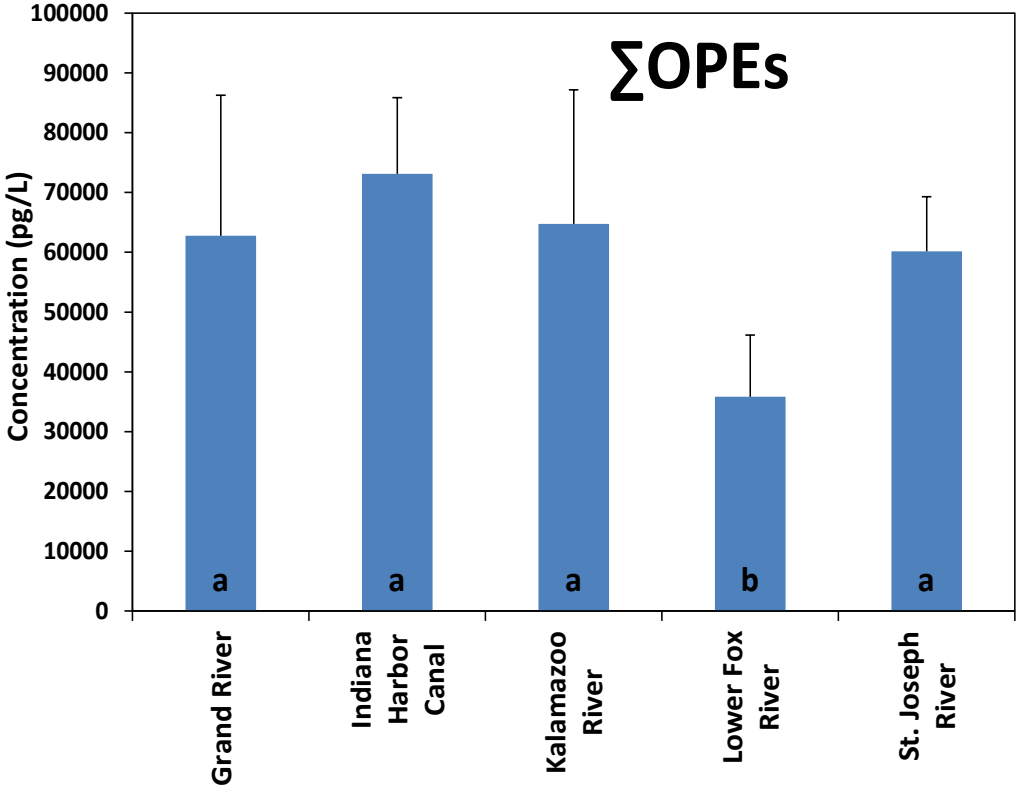
- For PBDEs, concentrations ranged from 240 pg/L to 1,150 pg/L and levels in St. Joseph river are significantly higher than in other rivers.
- For nonBDE flame retardants, the concentrations ranged from 230 pg/L to 1500 pg/L and Indiana Harbor Canal has the highest concentration



Note: Rivers that do not share a letter are significantly different at 95% confidence level.

Organo Phosphate Esters

- OPEs are very abundant in water with concentration ranged from 36,000pg/L to 73,000pg/L
- OPE concentration is significantly lower in the Lower Fox River than in the other four rivers.



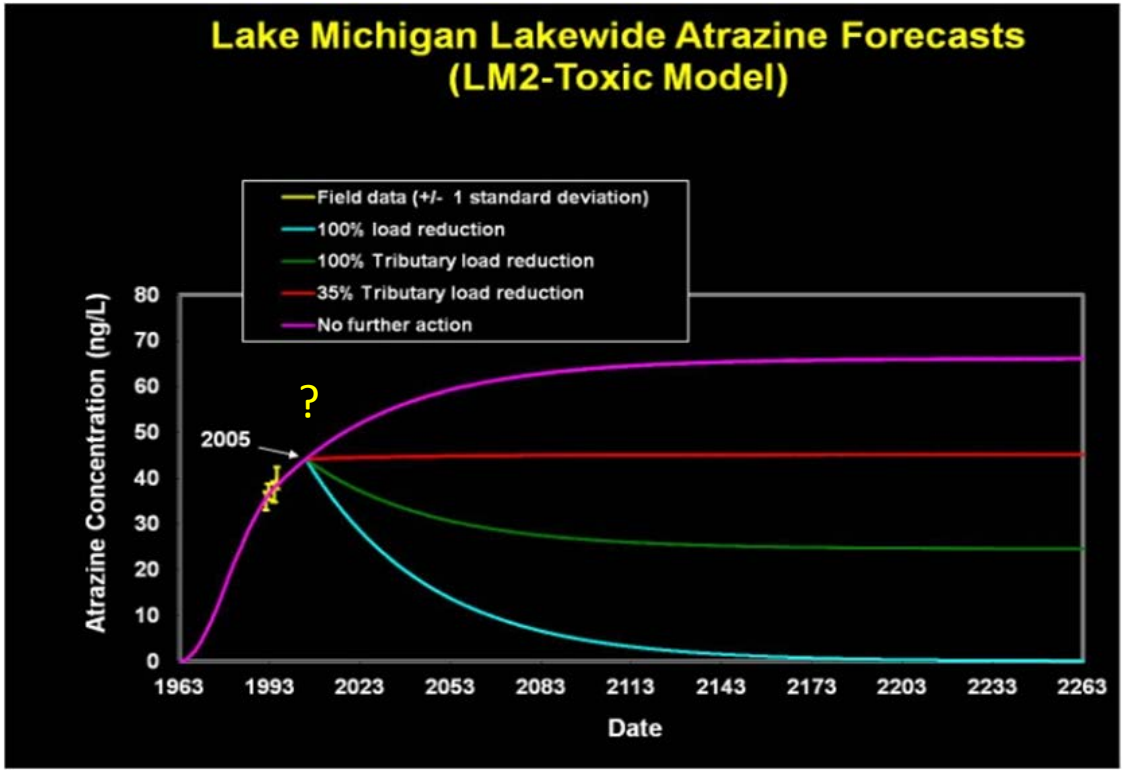
Note: Rivers that do not share a letter are significantly different at 95% confidence level.

Atrazine in open waters of Lake Michigan

<u>Objective</u>

Assess the present condition of atrazine concentrations in Lake Michigan and examine these results in comparison to model forecasts through a model post-audit.

11 EPA open water stations sampled in 2015 at 2 depths (middle epilimnion and middle hypolimnion)



GLFMSP Lake of the Year (LOY): Integrated assessment of ecosystem status and contaminant cycling

Top to bottom snapshot

Perform a detailed bioaccumulation study

- Water (dissolved and particulate)
- Phytoplankton
- Zooplankton
- Mussels
- Benthic macro invertebrates
- Forage fish
- Lake trout (individuals and composites)

Clarkson University
U.S. EPA GLNPO
NOAA Mussel Watch

U.S. EPA-ORD CSMI Participation

EPA-ORD R/V *Lake Explorer II*

- Distribution, abundance and movement of nutrients and biota across a nearshore-offshore gradient
  - Seasonal transect sampling
  - Integrated, *continuous* sampling with station sampling
  - *Along* transects using towed sensor array
  - *Among* transects using glider technology
- Characterize food web across nearshore to offshore gradient
  - Sampled zooplankton and benthos for stable isotope analysis
  - Coordinated with federal (USGS, USFWS, NOAA) and academic (Central Michigan University, Cornell University) partners
- Nearshore water quality effects from tributary loading
  - Tributary based water quality sampling for nearshore water quality modeling

Key knowledge gap: How do nutrients and biota vary nearshore (relatively understudied) to offshore?

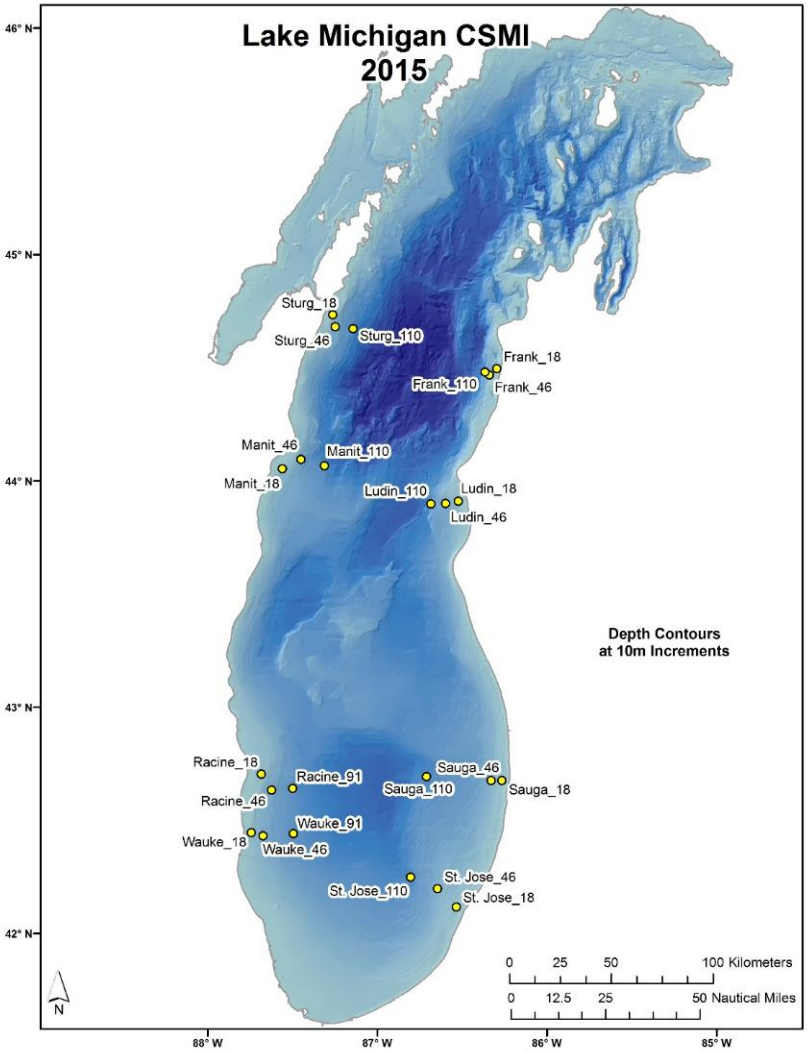
Hypotheses to test:

- ❑ **The nearshore (18 m bottom depth) is more productive (plankton, benthos, fish) than deeper (46, 110 m) sites.**

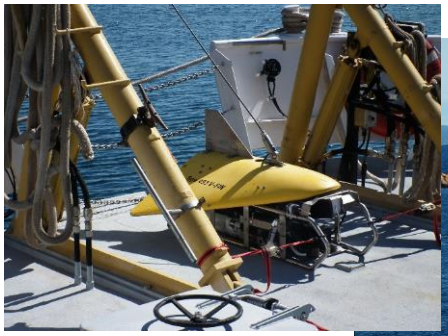
- ❑ **Among nearshore sites, those closest to tributaries with *high phosphorus input* will be more productive than other sites.**

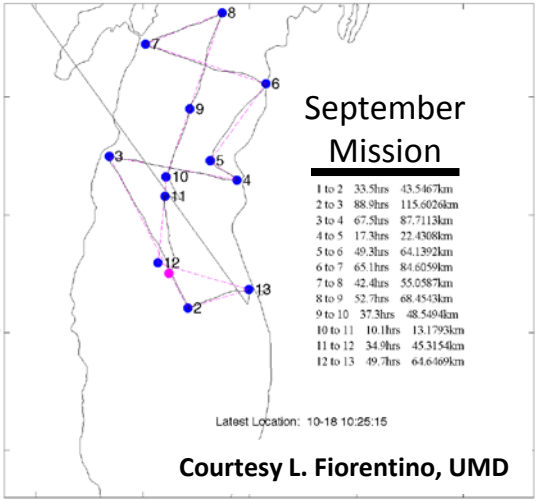
Transects

- Cooperatively sampled by GLNPO, ORD, USGS
- Three depths @ each transect: 18, 46, 110 m
- Station Sampling
  - Seasonal: May, July, September
  - Sonde profiles
  - Water quality – epilimnion, DCL, hypolimnion
    - Nutrients (cations/anions, N, P)
    - Chlorophyll a
    - Particulates (C, N, P)
  - Zooplankton (water column, discrete depths), Mysis
  - Benthos
  - Larval fish (USGS), forage fish (USGS)



Towed and Glider Sampling





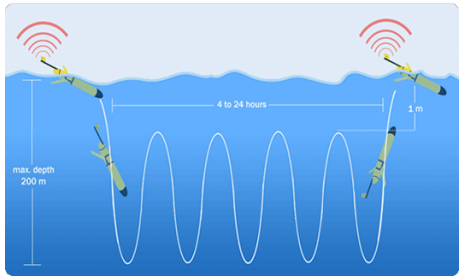
Courtesy L. Fiorentino, UMD

Tow Data:

- Dissolved Oxygen
- Conductivity
- Temperature
- Depth
- Fluorescence
- Nitrate
- Plankton abundance/biomass

Glider Data:

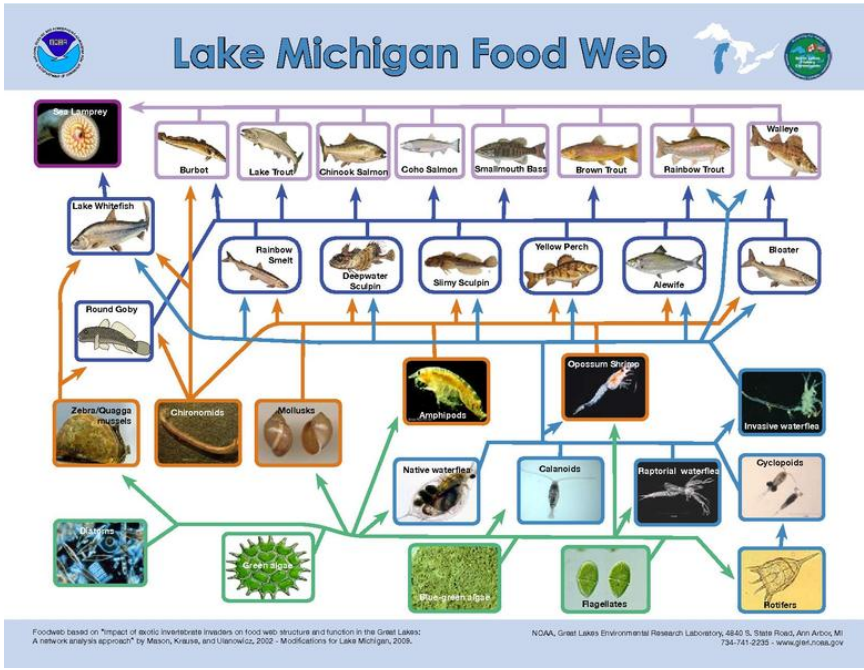
- Dissolved Oxygen
- Conductivity
- Temperature
- Depth
- CDOM
- Fluorescence
- Backscatter



http://beforeitsnews.com/alternative/2013/12/underwater-drones-us-navy-to-wage-new-war-with-sea-powered-machines-2859372.html

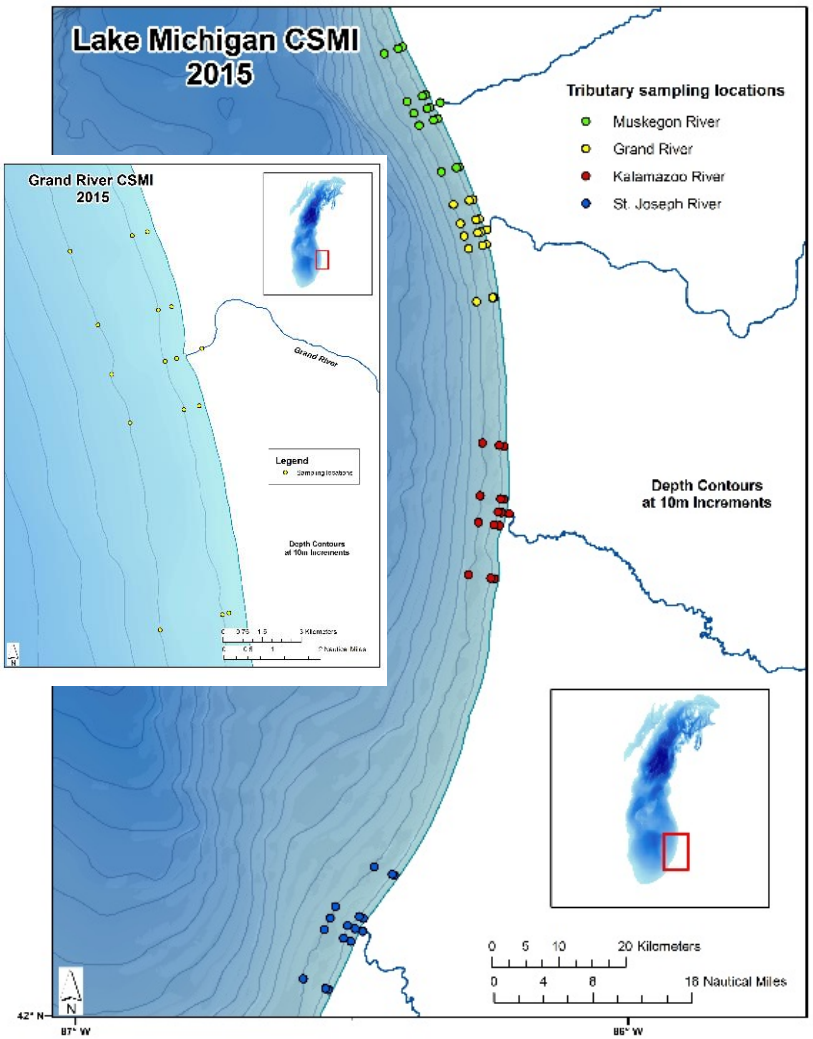
Lake-Wide Food Web Study

- Stable isotope analysis of multiple food web compartments
- Sampled at all transects/seasons + inshore locations
- Higher trophic levels: piscivorous fishes
- Mid-trophic levels: Mysis, *Bythotrephes*, prey fishes, fish larvae
- Primary consumers: zooplankton (bulk; large and small size fractions), dreissenid mussels, *Diporeia*, oligochaetes
- Primary producers: particulate organic matter



Nearshore Water Quality Model

- Surface water quality sampling to validate nearshore water quality model
- Sampled in May (high flow) and July (base flow)
- At each tributary, sampled at 0, 2 and 10 km north and south of tributary
- Measured cations/anions, N, P, chlorophyll a



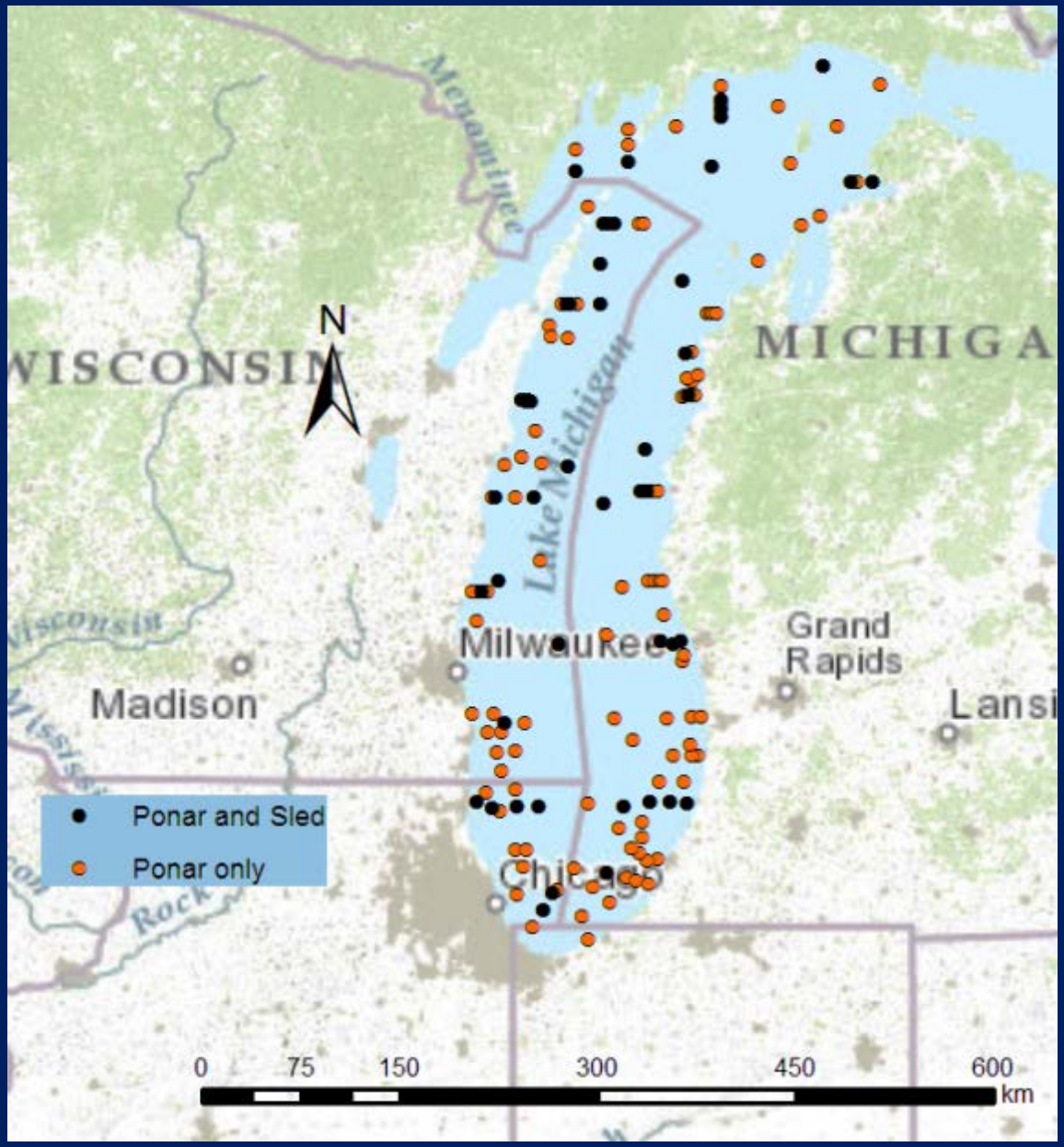
Lake Michigan benthos (sample collection):

- 469 ponar samples of benthic macroinvertebrates from 158 sites were collected in July of 2015 via collaboration of Buffalo State University (Alexander Karatayev, Knut Mehler, Lyubov Burlakova), Tom Nalepa (University of Michigan), Ashley Baldridge (NOAA-GLERL), and U.S. EPA GLNPO scientists

Sites		Samples	
Planned	Collected	Planned	Collected
130	158	390	469

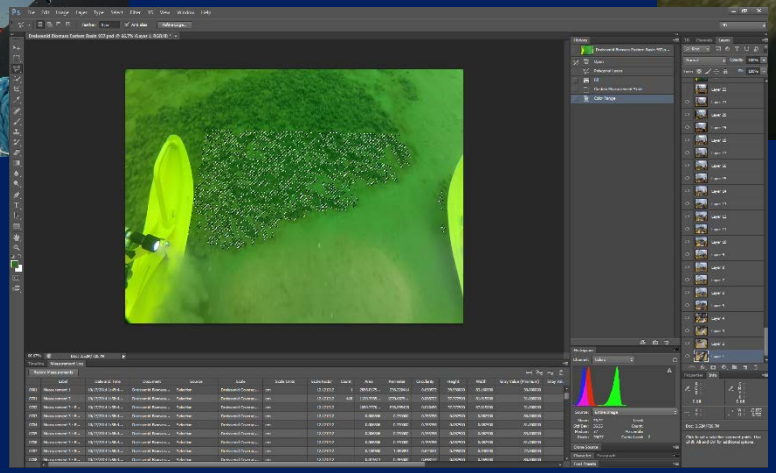
- The total number of collected samples exceeds the number of planned samples by 25%

Lake Michigan survey sites



Video images analysis:

- Objective: “Lake Michigan benthic habitat assessments will also be conducted using an underwater camera”
- Buffalo State collected > 500 videos with a Go Pro camera mounted on a ponar grab and 47 videos from a Go Pro camera mounted on a benthic sled towed behind the boat for ~500 m transect

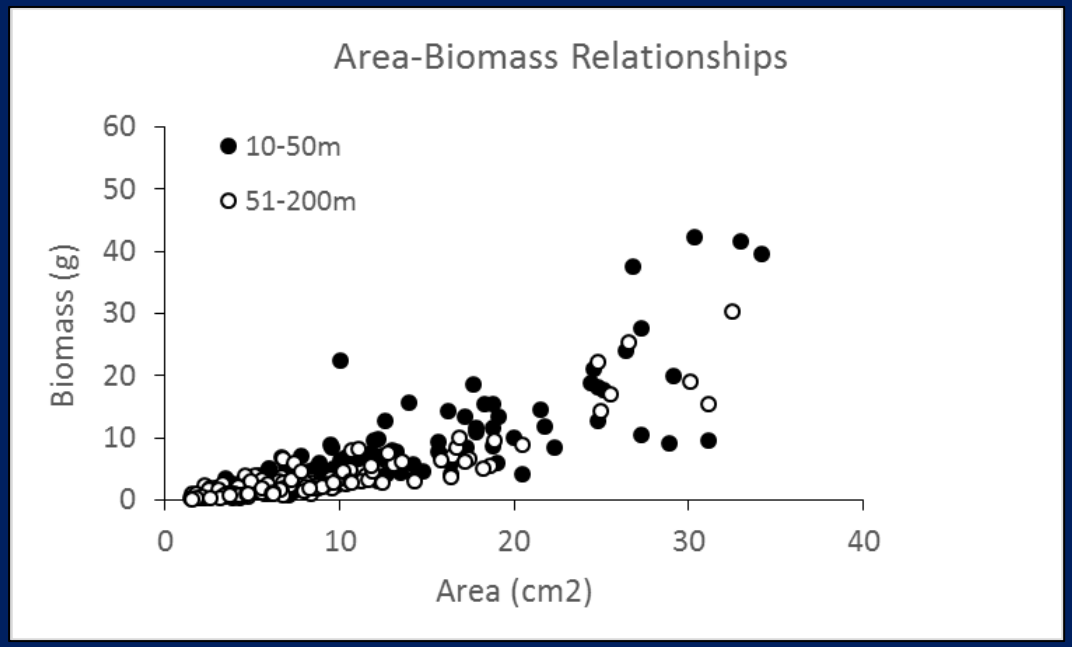


Video images analysis

To convert coverage into biomass, Buffalo State measured surface area/biomass relationship for 309 *Dreissena* druses collected from different depths in Lake Michigan

Determining wet mass of each druse

Determining surface area of each druse in Photoshop



Keep 'Em Great!