Great Lakes Monitoring Programs

U.S. Environmental Protection Agency

Great Lakes National Program Office (GLNPO)

Office of Research and Development, Midcontinent Ecology Division

Great Lakes Water Quality Agreement of 1978 as amended by Protocol 1987 – the old agreement

- Annex 11 – Surveillance and Monitoring
  - Surveillance and Monitoring activities shall be undertaken for the following purposes:
    - (a) Compliance…
    - (b) Achievement of General and Specific Objectives
    - (c) Evaluation of Water Quality Trends

Great Lakes Water Quality Agreement, 2012

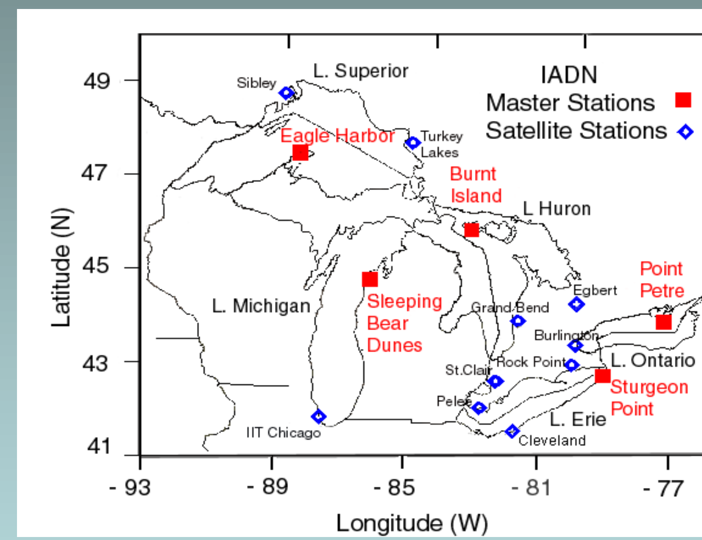
- MONITORING
- The Parties shall monitor environmental conditions so that the Parties may determine the extent to which General Objectives, Lake Ecosystem Objectives and Substance Objectives are being achieved.
- .
- Annex 10 – Science
  - B. Programs and Other Measures
    - 2. undertake monitoring and surveillance to anticipate the need for further science activities to address emerging environmental concerns;
  - E. Lake-Specific Science and Monitoring

GLNPO Monitoring

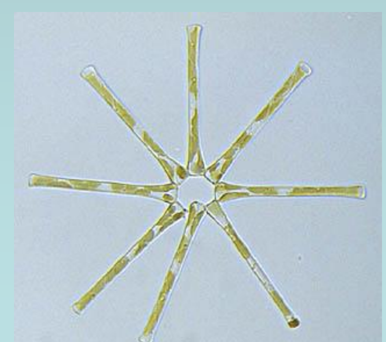
- Responsibility under GLWQA
- Long-term trends
- Indicators
  - SOLEC
  - LaMPs

Nutrients

Contaminants



Biological Indicators Program




LAKE GUARDIAN
UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY

GLNPO Open Lake Monitoring

When?

Annual Monitoring Program

Surveys Biannually

- Spring - begins in late March/early April
- Summer - begins early August

Survey Years

- Michigan, Huron, Erie – 1983
- Ontario - 1986
- Lake Superior - 1992 Water Quality
  - 1996 Biology

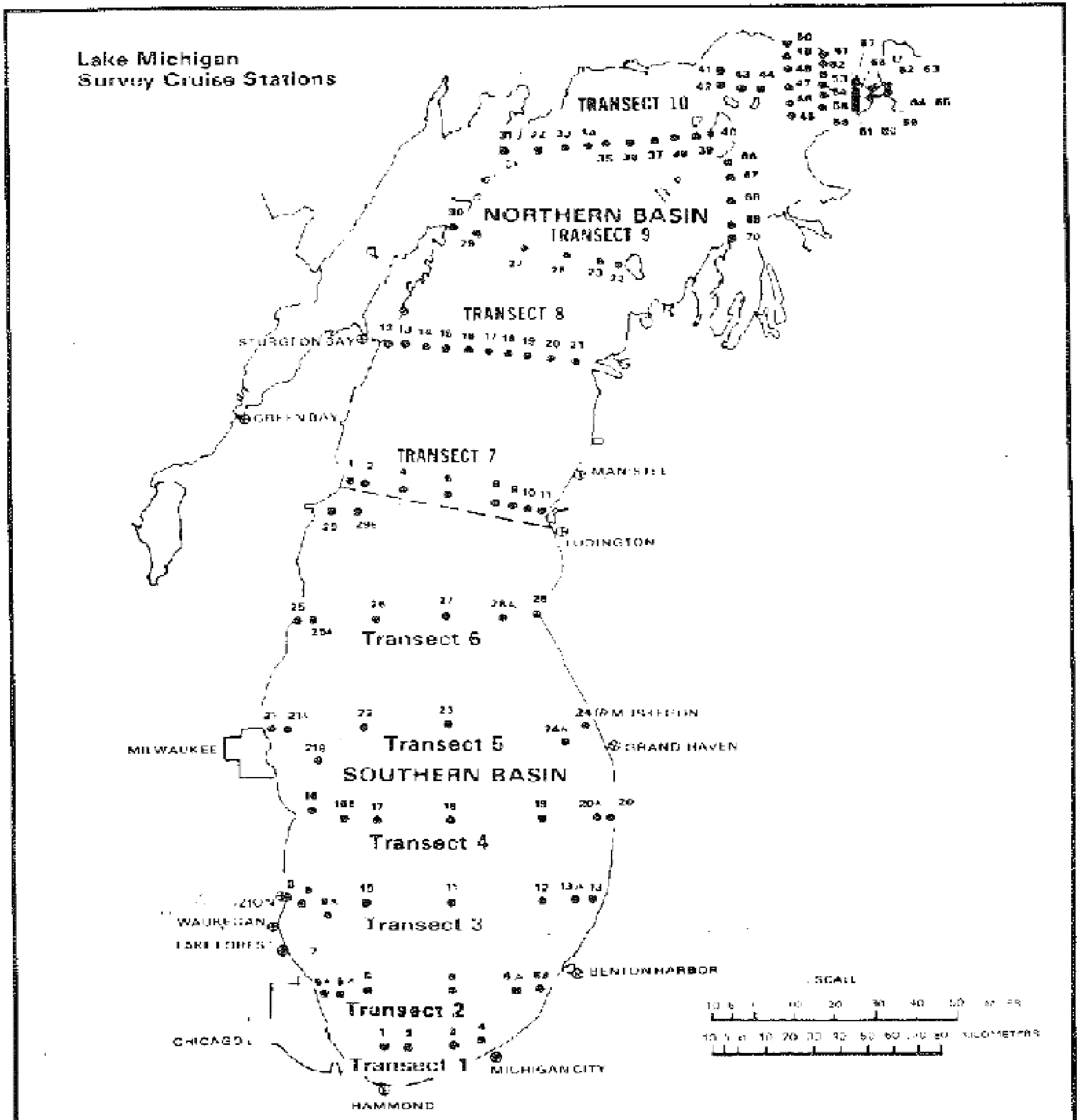
United States
Environmental Protection
Agency

Great Lakes National
Program Office
536 South Clark Street
Chicago, Illinois 60605

EPA-905/4-80-003-B

EPA

Lake Michigan Intensive Survey 1976-1977 - Management Report


Lake Michigan
Survey Cruise Stations
TRANSECT 10
NORTHERN BASIN
TRANSECT 9
TRANSECT 8
STURGEON BAY
GREEN BAY
TRANSECT 7
MANISTEE
LUDINGTON
Transect 6
MILWAUKEE
Transect 5
GRAND HAVEN
SOUTHERN BASIN
Transect 4
ZION
WAUKEGAN
Transect 3
BENTON HARBOR
SCALE
KILOMETERS
Transect 2
CHICAGO
Transect 1
MICHIGAN CITY
HAMMOND

Great Lakes National Program Office EPA

GLNPO's Water Quality Survey Sampling Stations

Where?

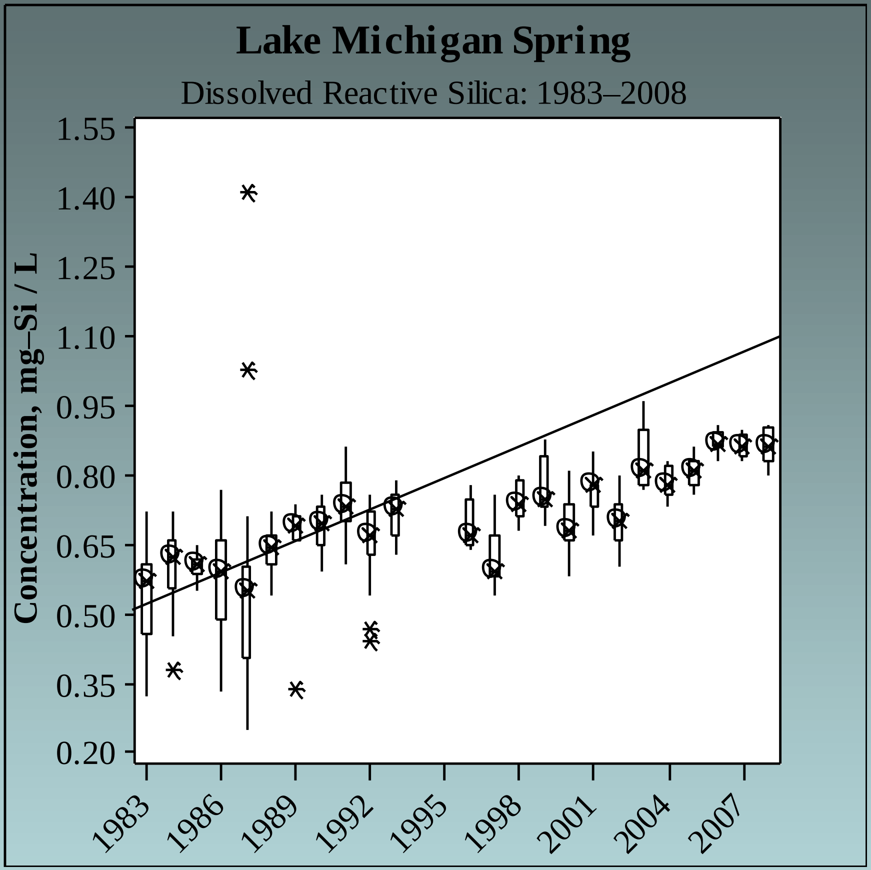
Water Quality

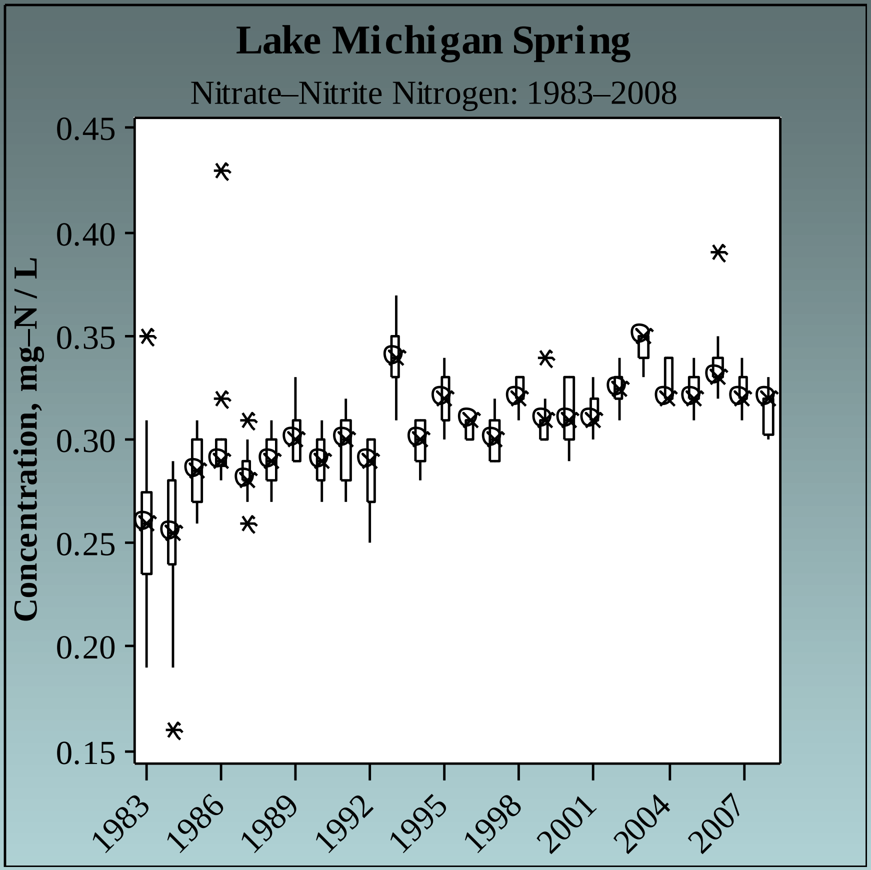
What?

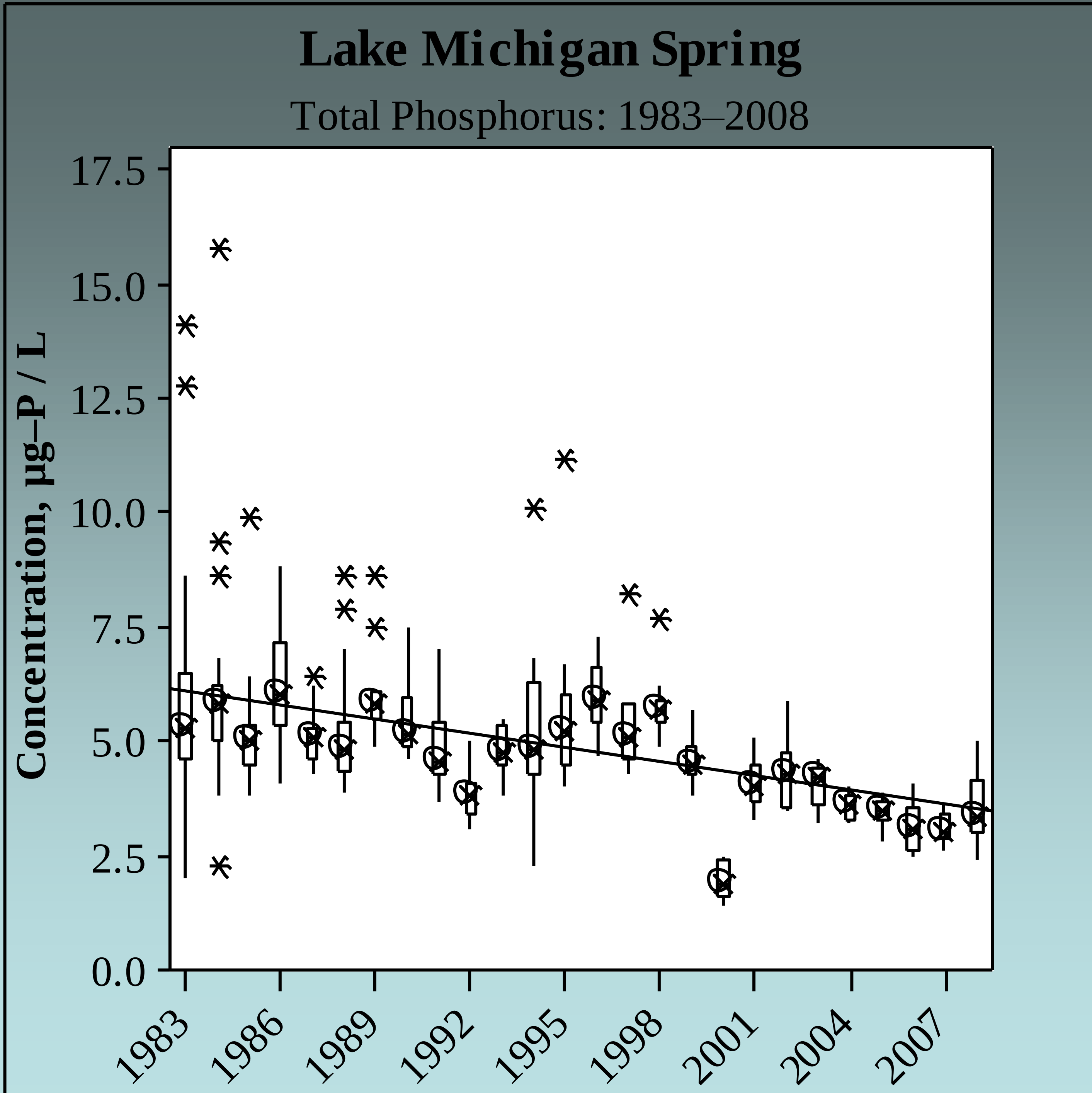
Nutrients

- Total Phosphorus
- Total Dissolved Phosphorus
- Soluble Reactive Phosphorus – L. Erie, L. Michigan
- Nitrite + Nitrate
- Total Nitrogen (new in 2014)
- Soluble Reactive Silica
- Particulate C,N,P

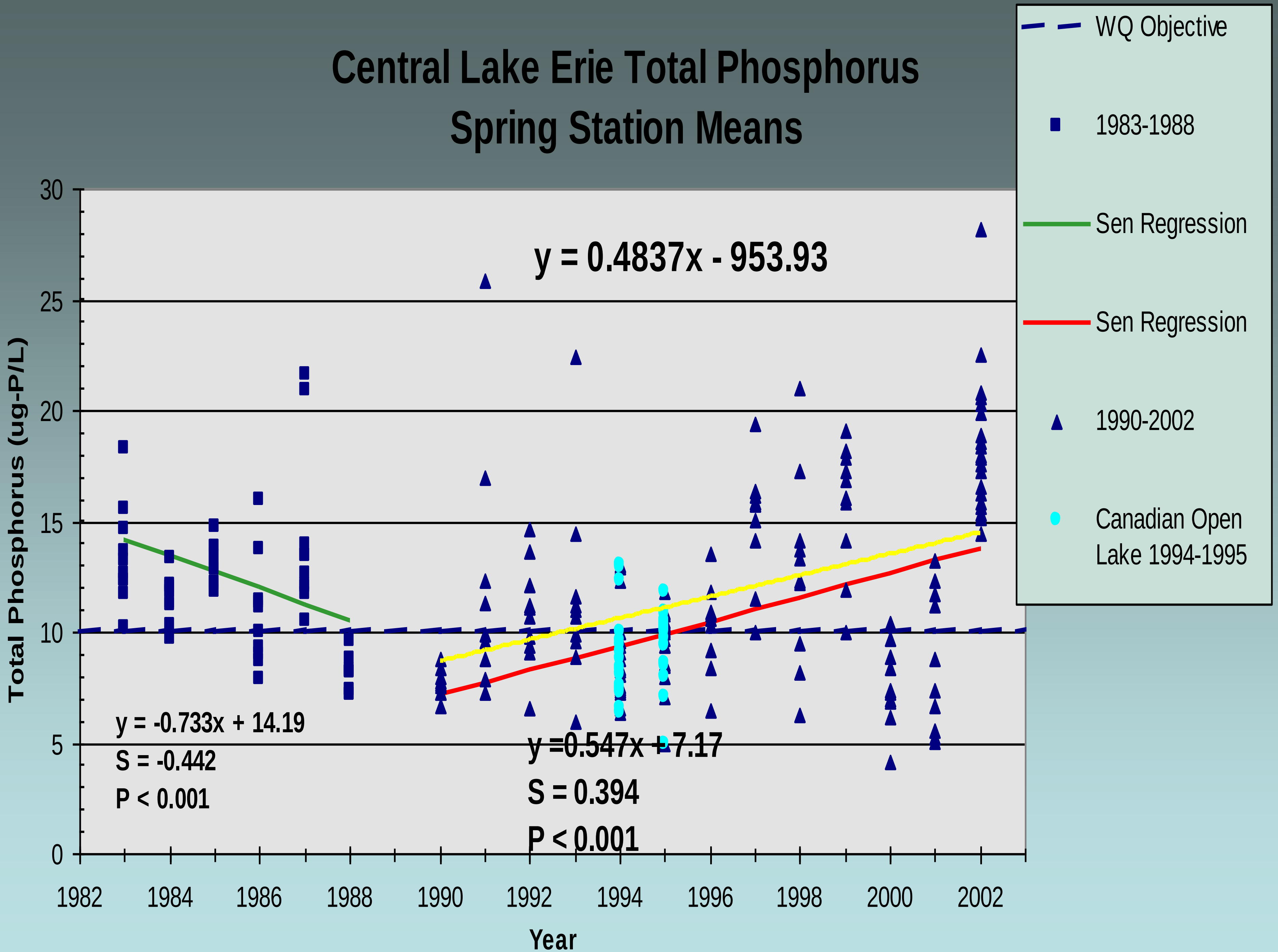
Conventionals – pH,turbidity,alkalinity,specific conductance


Lake Michigan Spring
Dissolved Reactive Silica: 1983–2008
Concentration, mg–Si / L
1.55
1.40
1.25
1.10
0.95
0.80
0.65
0.50
0.35
0.20
1983
1986
1989
1992
1995
1998
2001
2004
2007

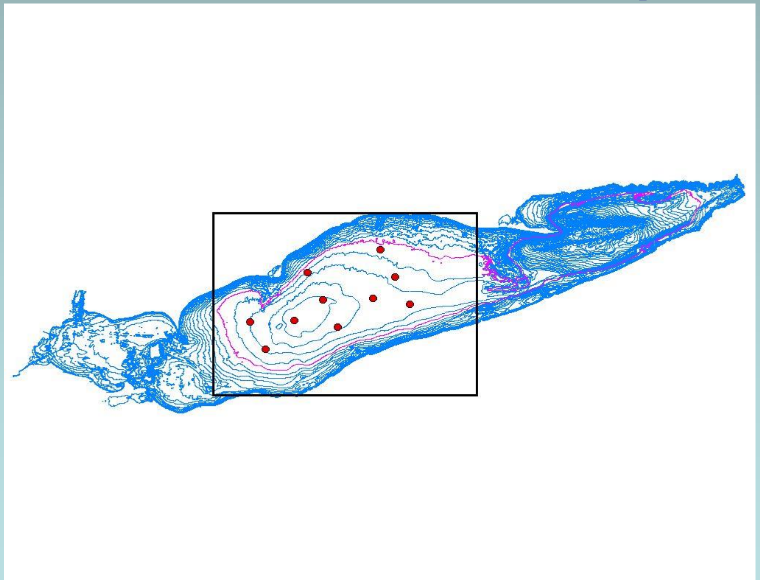

Lake Michigan Spring
Nitrate–Nitrite Nitrogen: 1983–2008
Concentration, mg–N / L
0.45
0.40
0.35
0.30
0.25
0.20
0.15
1983
1986
1989
1992
1995
1998
2001
2004
2007


Lake Michigan Spring
Total Phosphorus: 1983–2008
Concentration, µg–P / L
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
1983
1986
1989
1992
1995
1998
2001
2004
2007

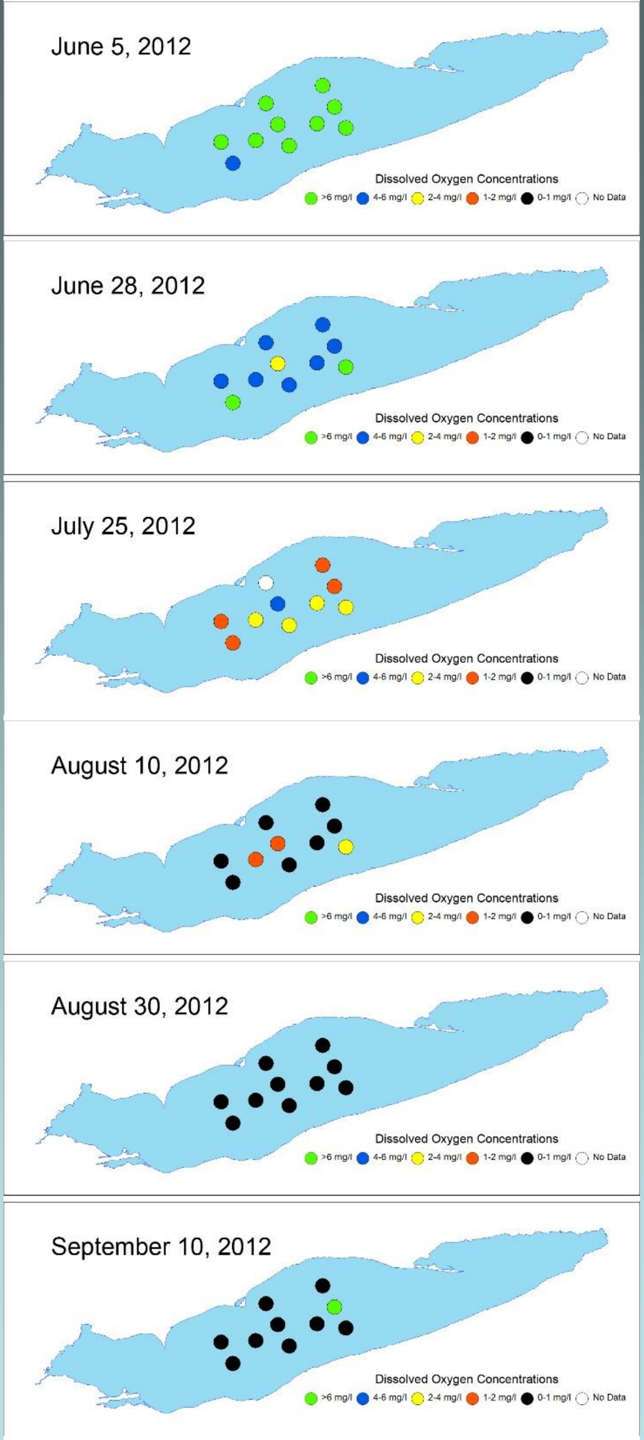
Central Lake Erie Total Phosphorus
Spring Station Means

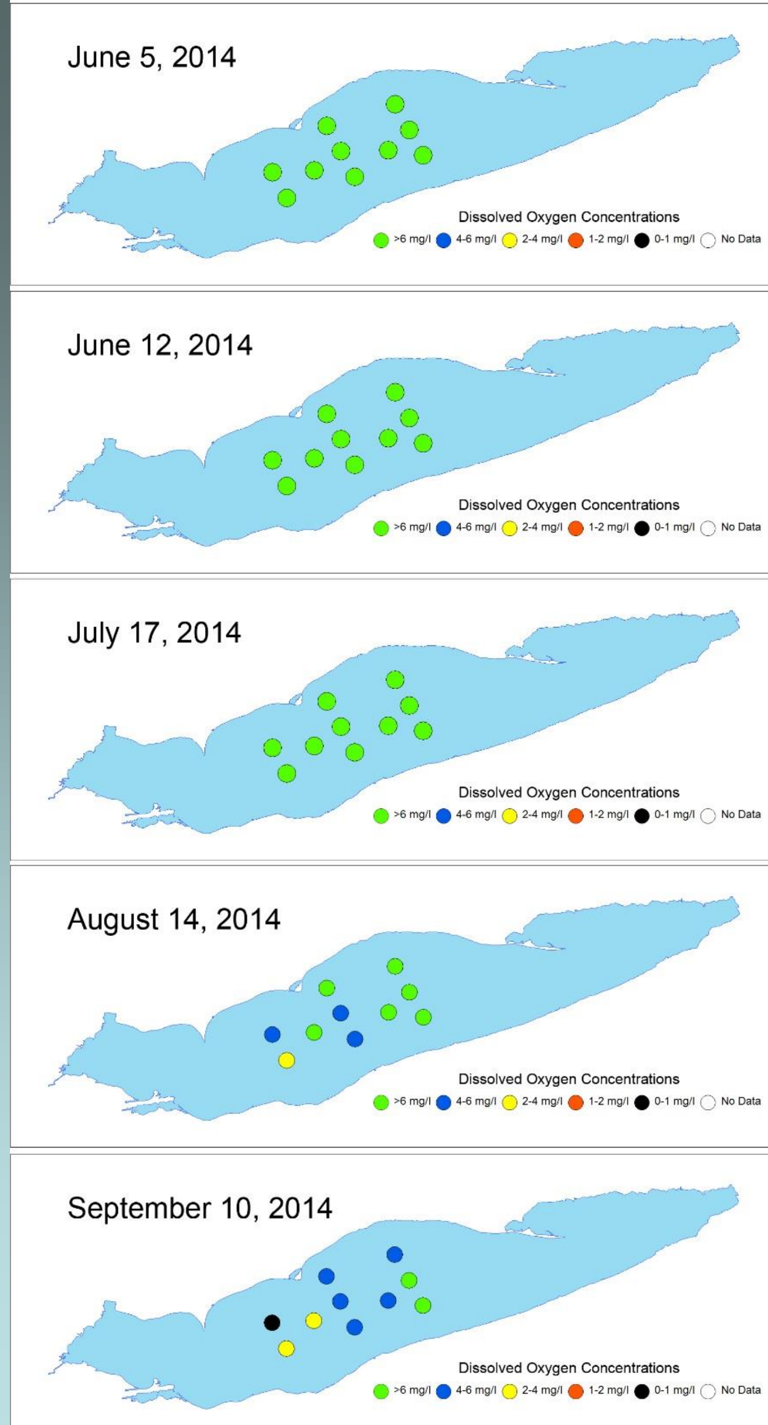


Lake Erie Central Basin Dead Zone and DO Depletion Rate *(1983-89, 1991-1993, 1997-2014)*

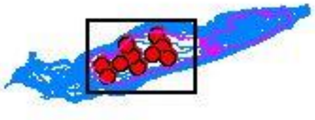


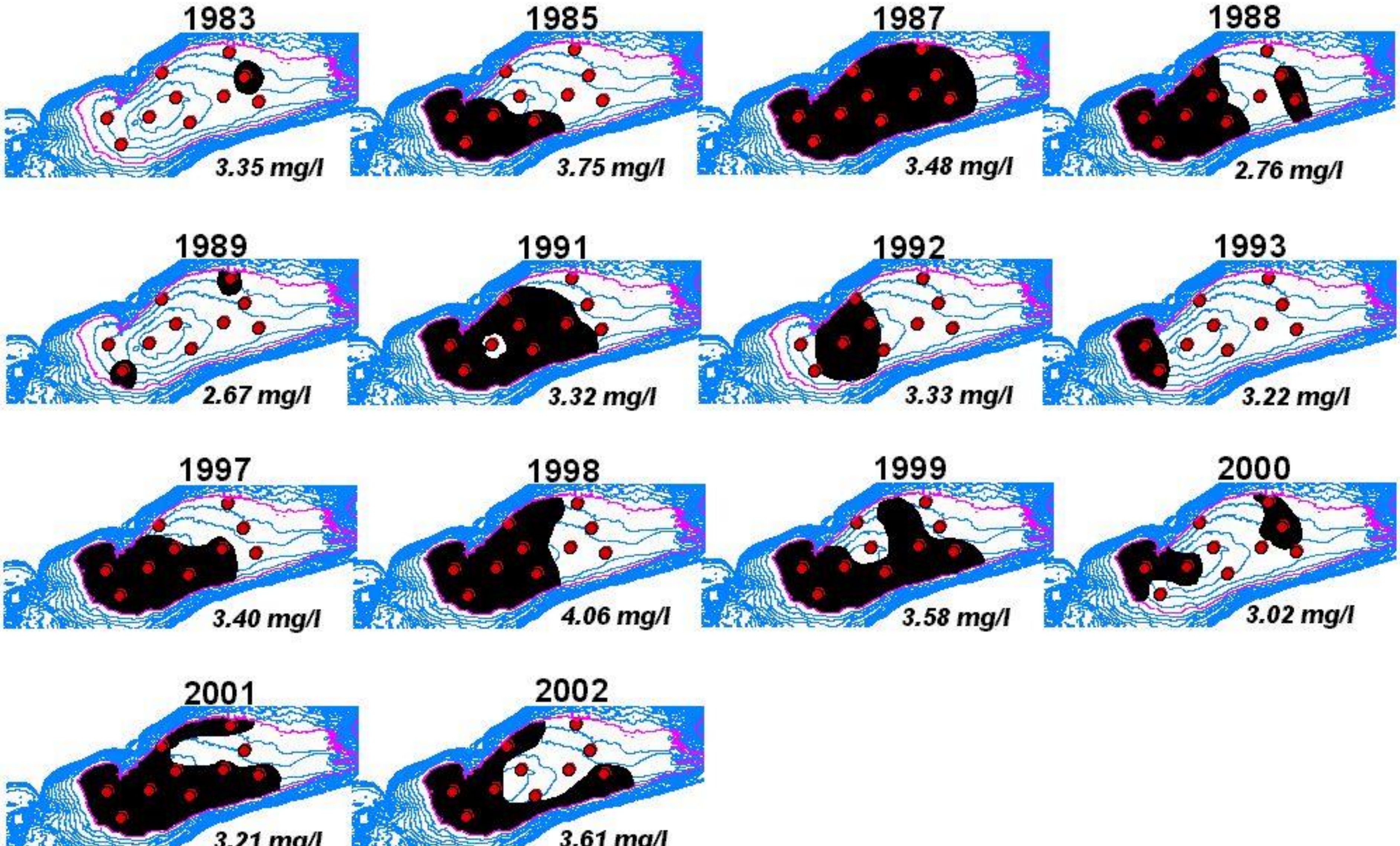
Maps created by:
Martha Avilés-Quintero
ORISE Research Associat
USEPA-GLNPO


June 5, 2012
Dissolved Oxygen Concentrations
>6 mg/l 4-6 mg/l 2-4 mg/l 1-2 mg/l 0-1 mg/l No Data
June 28, 2012
Dissolved Oxygen Concentrations
>6 mg/l 4-6 mg/l 2-4 mg/l 1-2 mg/l 0-1 mg/l No Data
July 25, 2012
Dissolved Oxygen Concentrations
>6 mg/l 4-6 mg/l 2-4 mg/l 1-2 mg/l 0-1 mg/l No Data
August 10, 2012
Dissolved Oxygen Concentrations
>6 mg/l 4-6 mg/l 2-4 mg/l 1-2 mg/l 0-1 mg/l No Data
August 30, 2012
Dissolved Oxygen Concentrations
>6 mg/l 4-6 mg/l 2-4 mg/l 1-2 mg/l 0-1 mg/l No Data
September 10, 2012
Dissolved Oxygen Concentrations
>6 mg/l 4-6 mg/l 2-4 mg/l 1-2 mg/l 0-1 mg/l No Data


June 5, 2014
Dissolved Oxygen Concentrations
>6 mg/l 4-6 mg/l 2-4 mg/l 1-2 mg/l 0-1 mg/l No Data
June 12, 2014
Dissolved Oxygen Concentrations
>6 mg/l 4-6 mg/l 2-4 mg/l 1-2 mg/l 0-1 mg/l No Data
July 17, 2014
Dissolved Oxygen Concentrations
>6 mg/l 4-6 mg/l 2-4 mg/l 1-2 mg/l 0-1 mg/l No Data
August 14, 2014
Dissolved Oxygen Concentrations
>6 mg/l 4-6 mg/l 2-4 mg/l 1-2 mg/l 0-1 mg/l No Data
September 10, 2014
Dissolved Oxygen Concentrations
>6 mg/l 4-6 mg/l 2-4 mg/l 1-2 mg/l 0-1 mg/l No Data

Lake Erie Central Basin Dead Zone and DO Depletion Rate





Great Lakes RESTORATION

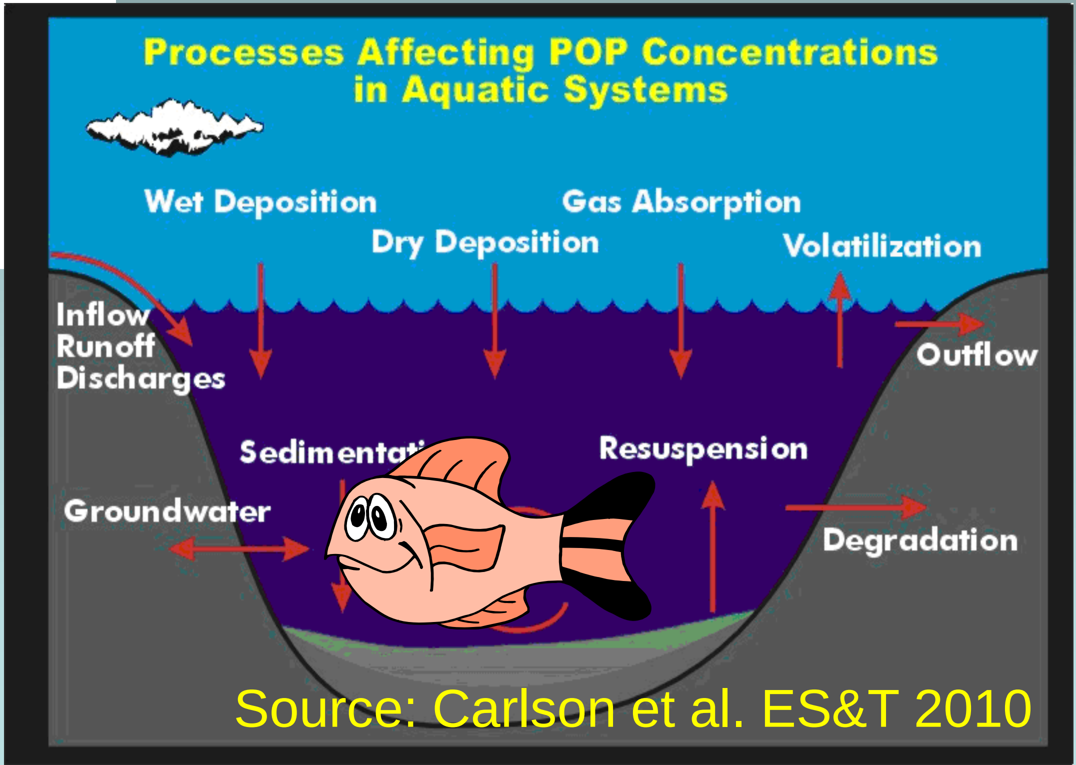
The Integrated Atmospheric Deposition Network (IADN) and Great Lakes Sediment Surveillance Program (GLSSP)

July 16, 2014

Why air? Why toxic contaminants?

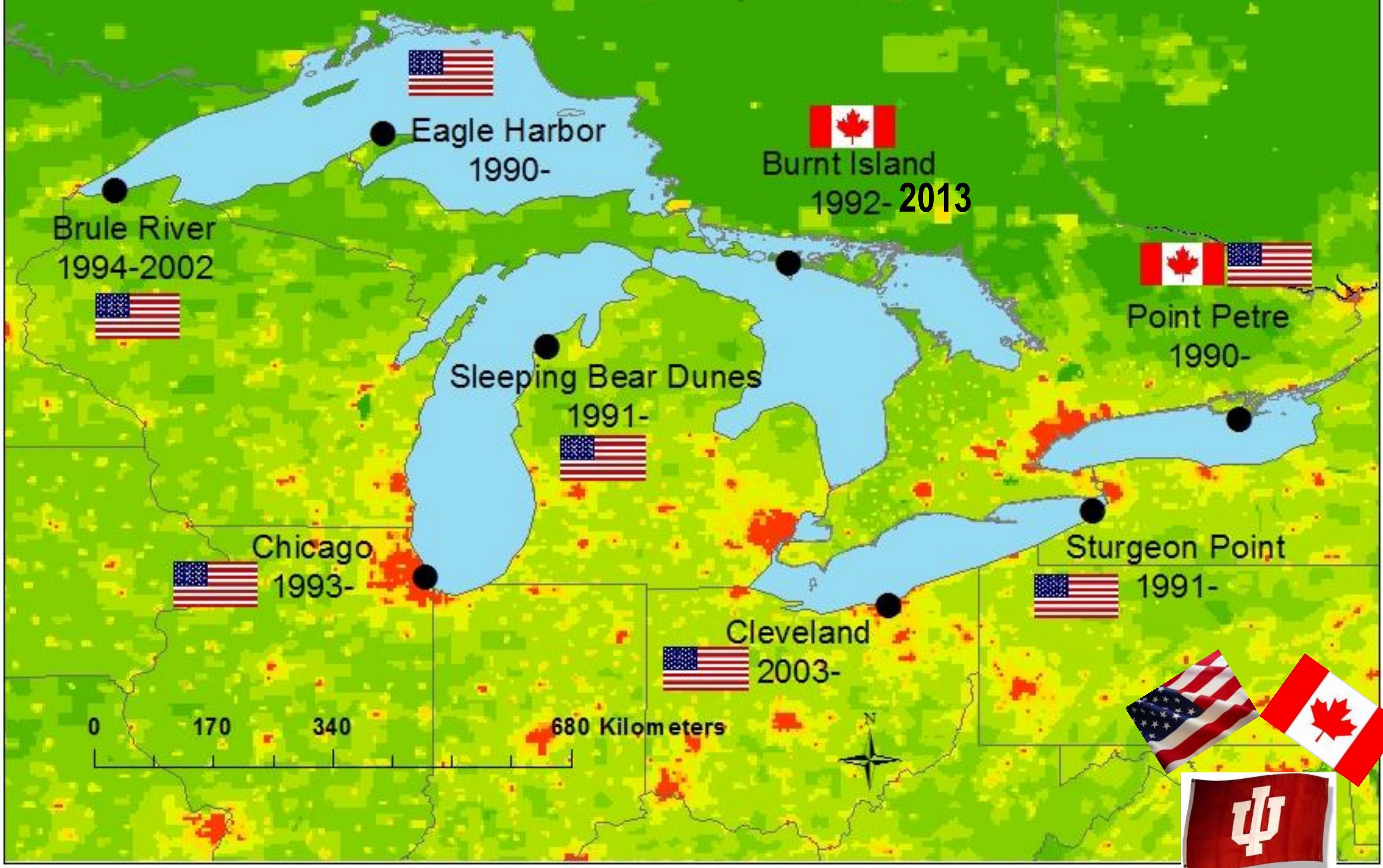
- Fish consumption advisories still exist
- Primary pathway for input to the Lakes

- Air concentrations respond rapidly to changes in emissions

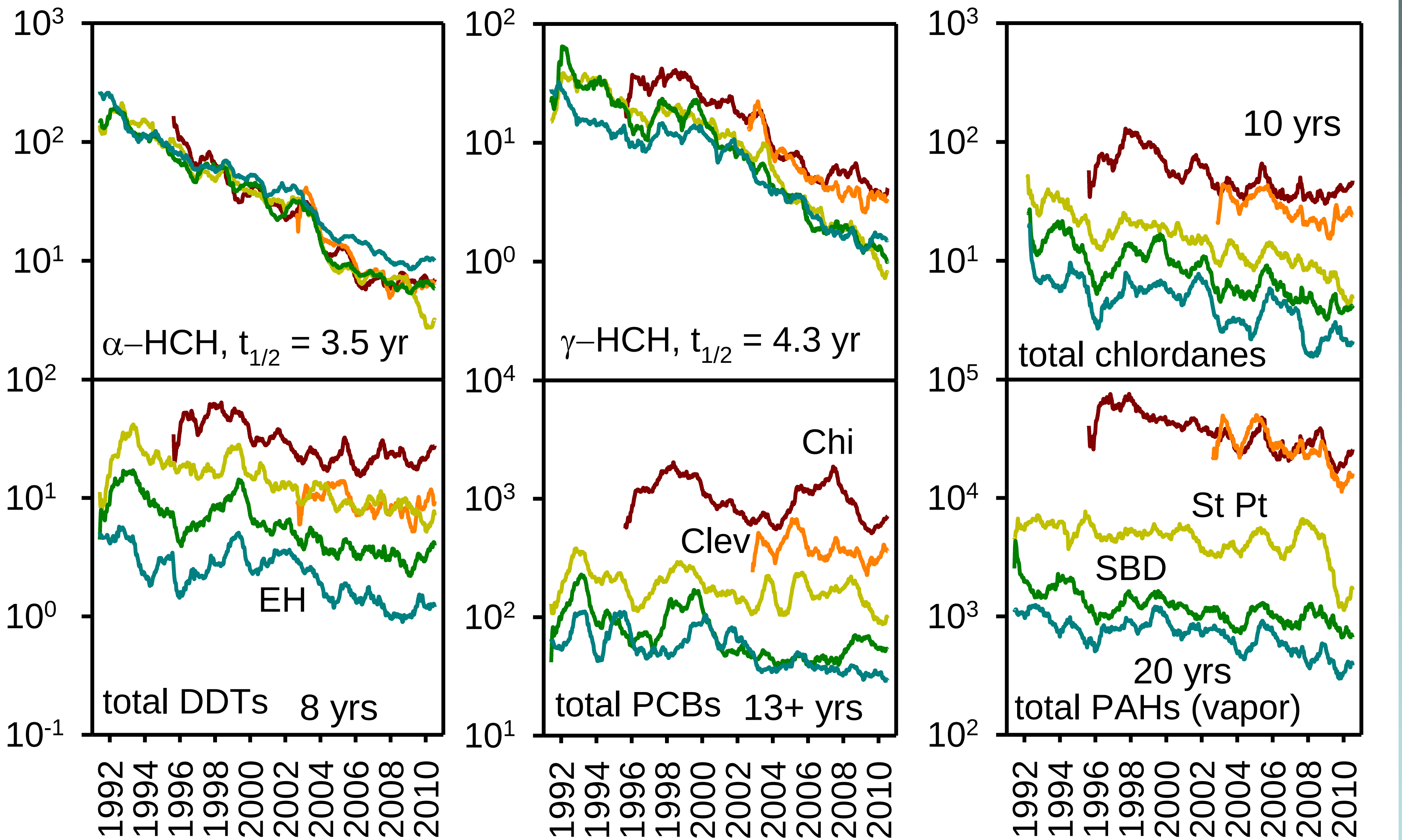


Source: Carlson et al. ES&T 2010

Integrated Atmospheric Deposition Network sites, 1990-2014



Concentrations (pg/m³), geometric-average smoothing over 348 days, all sites

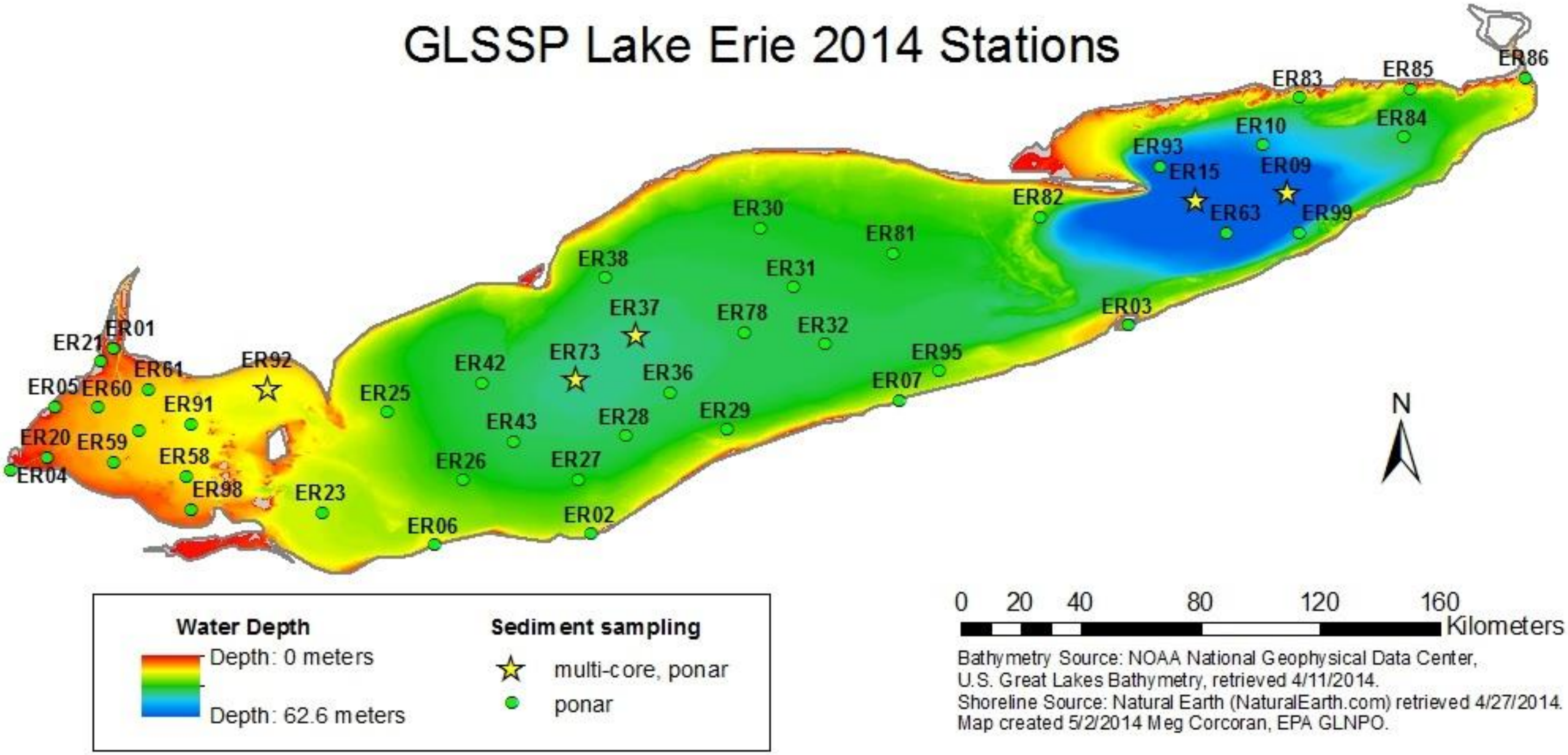


Slide courtesy Ron Hites, Indiana University

Great Lakes Sediment Surveillance Program

Great Lakes
RESTORATION

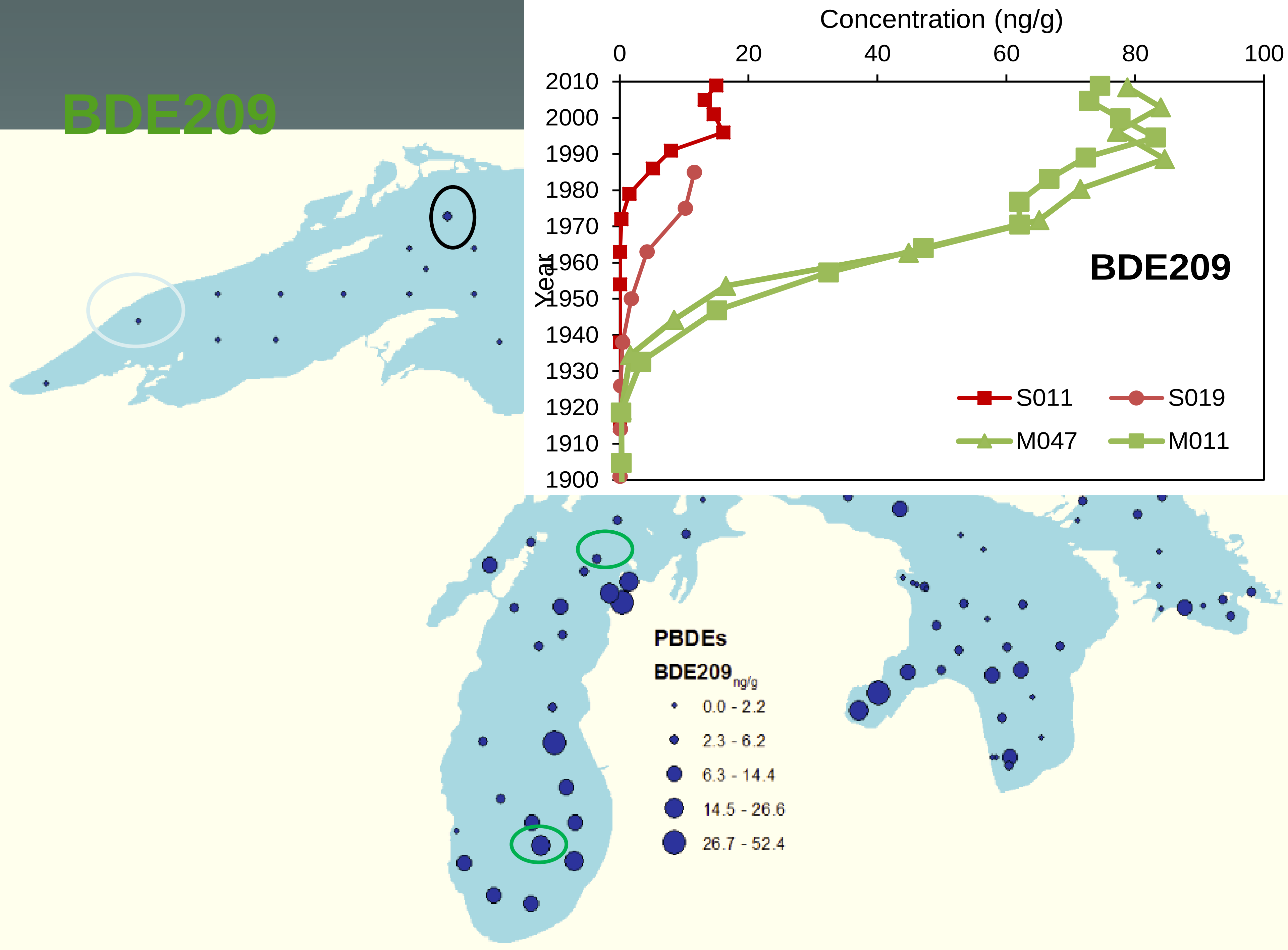
GLSSP Lake Erie 2014 Stations



Target chemical analytes

Group	Analytes	Surrogates	Internal Std.	Cleanup Fractions	Method
PCDD/Fs	polychlorodibenzo-p-dioxins polychlorodibenzofurans	PCB52L Floranthene-d10	PCB205L	F-2	GC/EI-QQQMS
PCBs	polychlorobiphenyls	PCB209L, PCB52L	PCB47L, PCB205L	F-1, F-2	GC/EI-QQQMS
PCDEs	polychlorodiphenyl ethers	PCB209L, PCB52L	PCB47L, PCB205L	F-1, F-2	GC/EI-QQQMS
PCNs	polychloronaphthalenes	PCB209L, PCB52L	PCB47L, PCB205L	F-1, F-2	GC/EI-QQQMS
OCPs	organochlorine pesticides	PCB52L Floranthene-d10,	PCB47L, PCB205L	F-1, F-2, F-3, F-4	GC/EI-QQQMS
XFRs	halogenated flame retardants	F-BDE69 BeP-d12 Cl-BDE208	PCB205L BB209	F-1, F-2, F-3	GC/EI-QQQMS GC/ECNI-MS
MFs	musk fragrances	Floranthene-d10 BeP-d12	fluorene-d10, PCB205L	F-2, F-3	GC/EI-QQQMS
OPFRs	organophosphate flame retardants	TBP-d27	TPP-d15	F-4	GC/EI-QQQMS
PFCs	Perflourinated compounds and total and extractable fluorine				LC/MS-MS

BDE209



Concentration (ng/g)
0
20
40
60
80
100
Year
2010
2000
1990
1980
1970
1960
1950
1940
1930
1920
1910
1900
BDE209
S011
S019
M047
M011
PBDEs
BDE209 ng/g
0.0 - 2.2
2.3 - 6.2
6.3 - 14.4
14.5 - 26.6
26.7 - 52.4

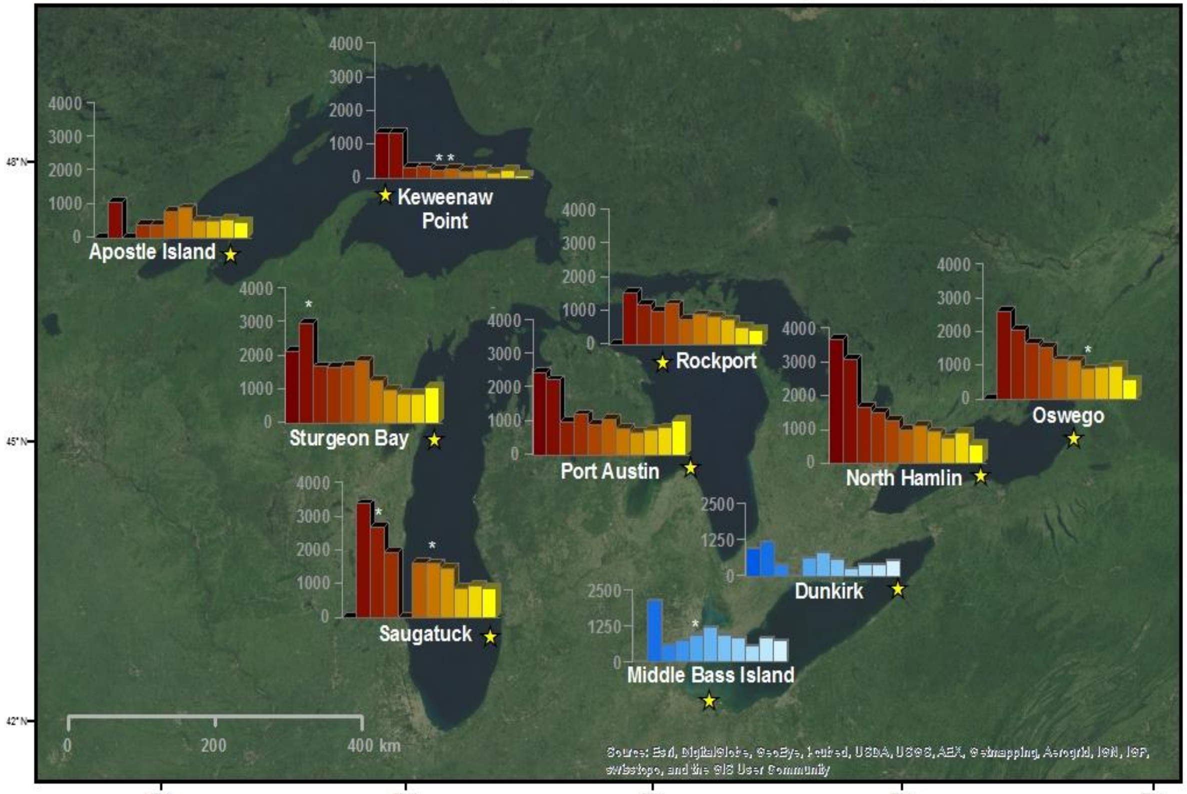
Great Lakes Fish Monitoring Program

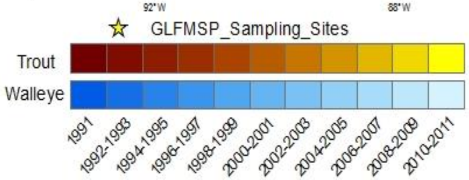
Great Lakes Fish Monitoring and Surveillance Program (GLFMSP)

A quick overview

- Chemical monitoring and surveillance program in whole top predator fish
  - Legacy Chemicals – *1970 - Present*
  - Sport Fish fillet – *1980 - 2007*
  - Emerging Contaminant Surveillance – 2007 - Present
- Top Predators chosen because they are good integrators
  - Lake Trout
  - Walleye
- 2 collection sites per lake, alternating annually
- 50 fish per site analyzed as 10 5-fish composites
- Consistent size range with assumed age
- Long-term archive
- Corresponding program in Environment Canada
- Competitive Cooperative Agreement

Great Lakes Fish Monitoring and Surveillance Program
Mean Total PCB Concentration (ppb) in Lake Trout/Walleye from 1991 through 2011

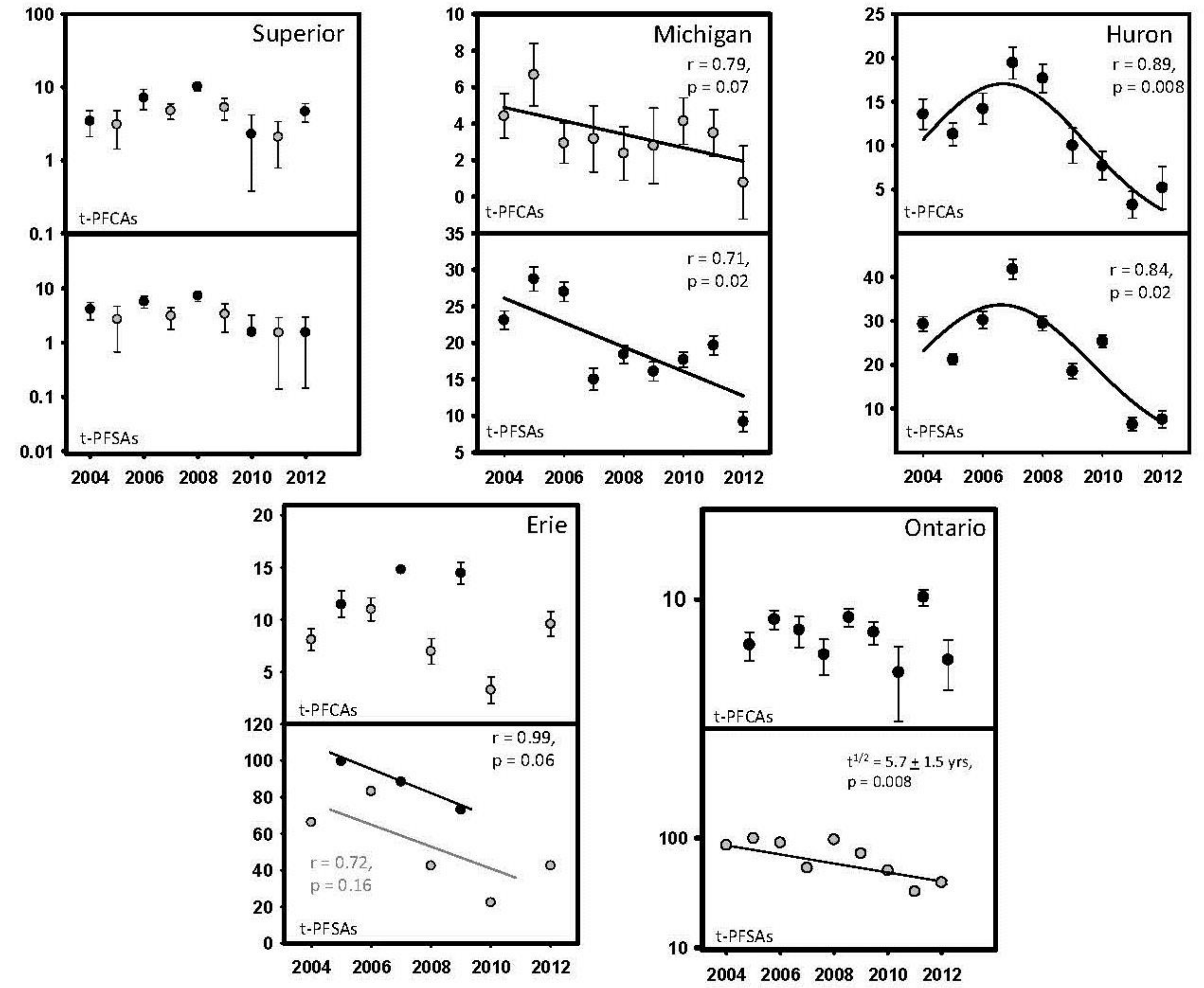




Stations are not representative of entire lake.
*Sampling period is typically comprised of 10 composites but varies between 3 and 10.
An asterisk indicates less than 5 composites are included in the sampling period.

Map Date: 02/12/2014. Projection: Albers Equal Area
Data Source: U.S. EPA Great Lakes National Program Office

EPA United States Environmental Protection Agency



Total PFOS and PFSA geometric mean concentrations 2004 - 2012

Crimmins et al in preparation

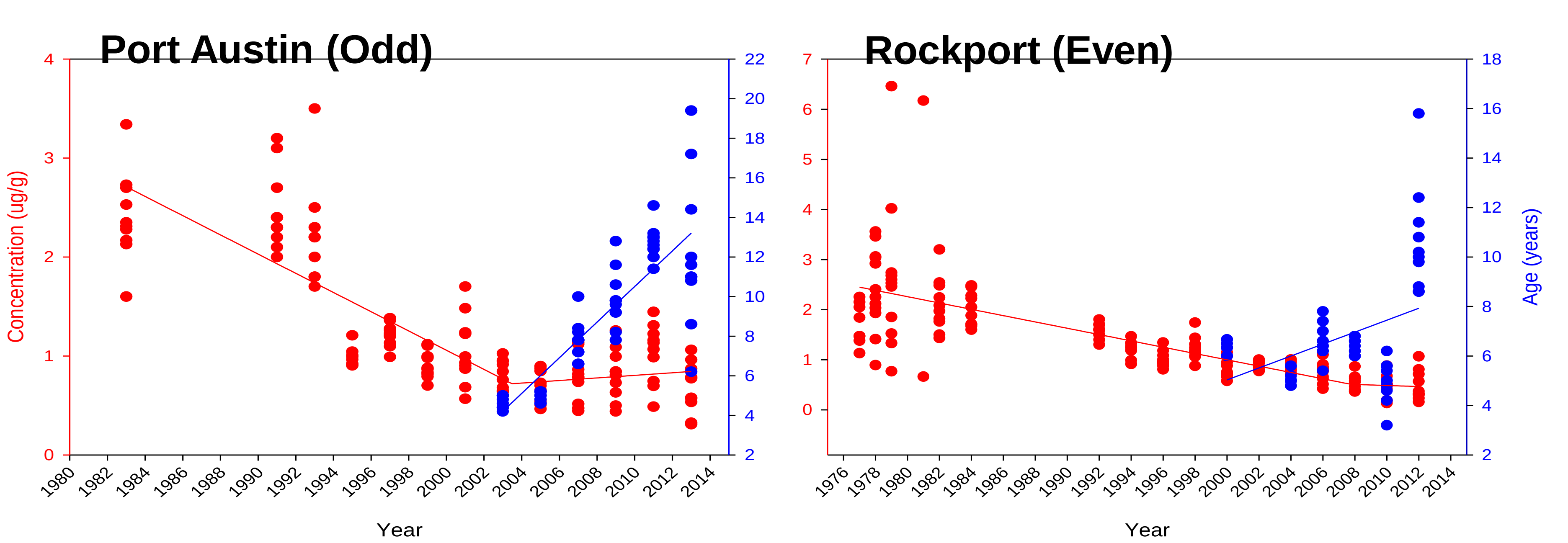
Emerging Contaminants in the Great Lakes *– An evolving list of chemicals for surveillance and monitoring*

- Polychlorinated napthalenes
- Fluorotelomer alcohols
- Non-PBDE flame retardants
- Perfluorinated compounds
- Br / Cl compounds
- Non-halogenated compounds

- Organometallic compounds
- Halogenated Compounds
- Siloxanes
- Pharmaceuticals & Personal care products (PPCPs)
- Degradation Products

- Priority Chemicals for
  - OST
  - Canadian Partners
  - States & Tribes

Total PCB concentration as a function of **average** age in target size fish

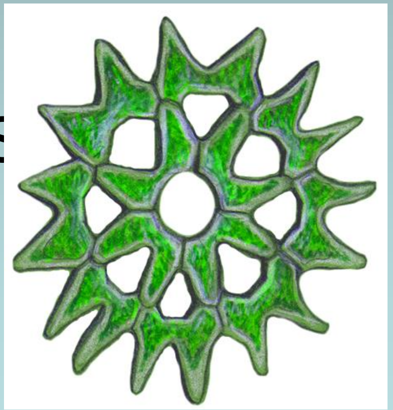


Great Lakes biological monitoring program – phytoplankton

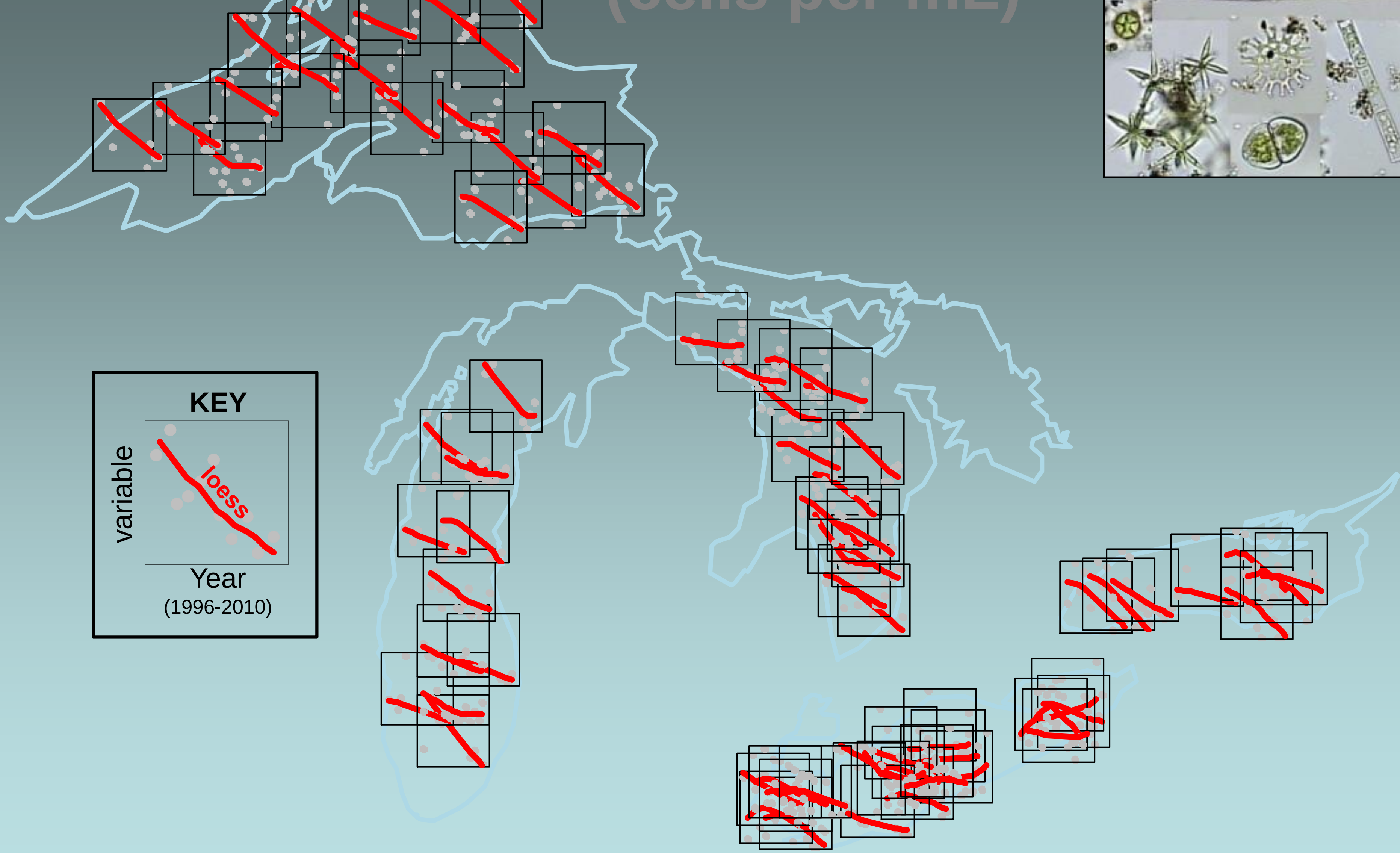
Euan D. Reavie
– University of Minnesota Duluth

Why do we monitor algae?

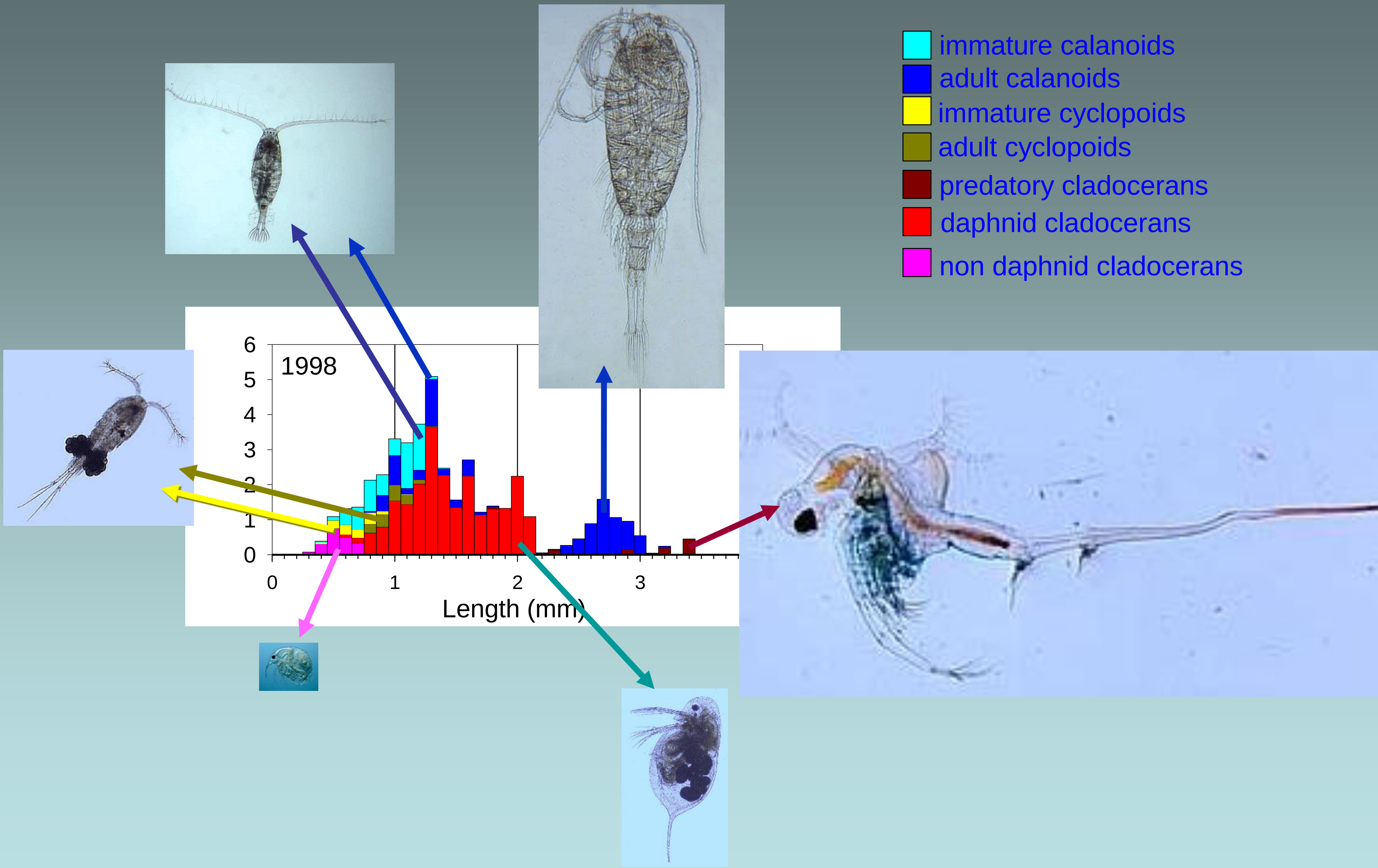
- First responders to bottom-up water quality changes
- An important component of the food web
- Integrating indicators of quality
- Bloom tracking
- Invasive species (and their effects)
- Biodiversity monitoring
- Applications to paleolimnology



Total spring phytoplankton (cells per mL)

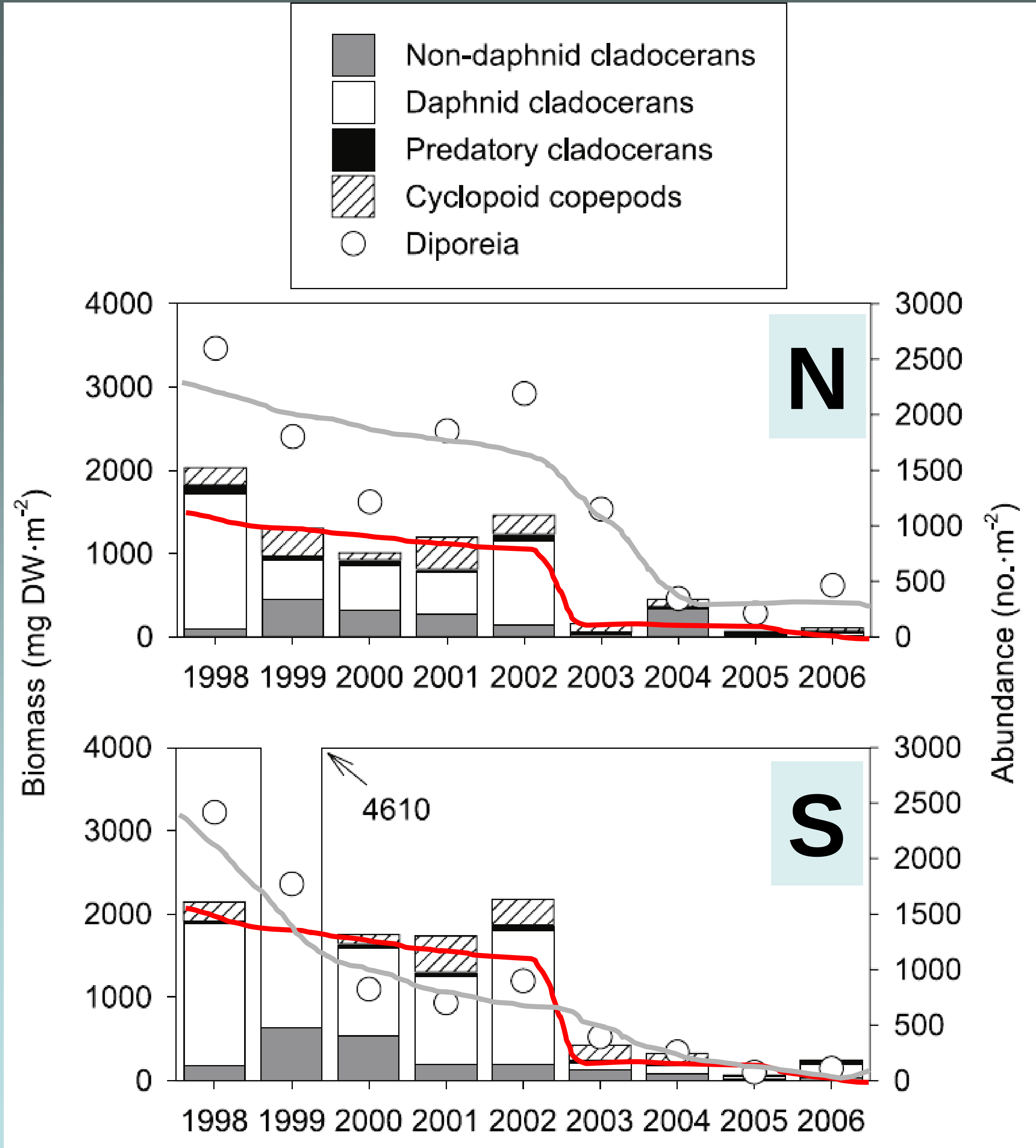


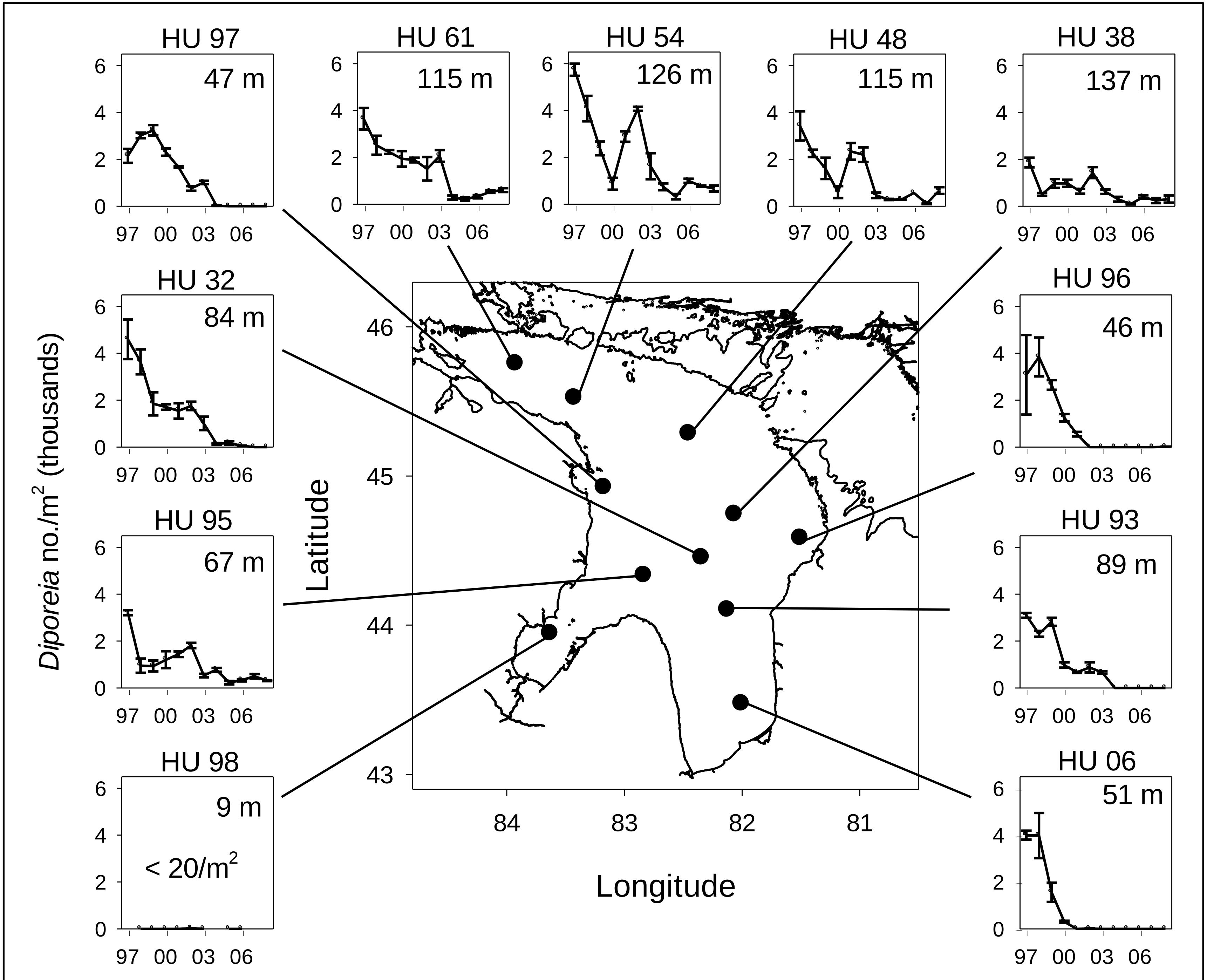
Crustacean Categories



Huron clodoceran and Diporeia trends

(Barbiero et al. 2009)




HU 97
47 m
HU 61
115 m
HU 54
126 m
HU 48
115 m
HU 38
137 m
HU 32
84 m
HU 96
46 m
HU 95
67 m
HU 93
89 m
HU 98
9 m
< 20/m²
HU 06
51 m
Diporeia no./m² (thousands)
Latitude
Longitude
97 00 03 06
0 2 4 6
46 45 44 43
84 83 82 81

Convergence of trophic state and the lower food web in Lakes Huron, Michigan and Superior

Richard P. Barbiero [a],*, Barry M. Lesht [b], Glenn J. Warren [c]

[a] CSC and Loyola University Chicago, 1359 W. Elmdale Ave. Suite 2, Chicago, IL 60660, USA
[b] CSC and Department of Earth and Environmental Sciences, University of Illinois at Chicago, 845 W. Taylor St., Chicago, IL 60607, USA
[c] USEPA Great Lakes National Program Office, 77 W. Jackson Boulevard, Chicago IL 60604, USA

Article Info

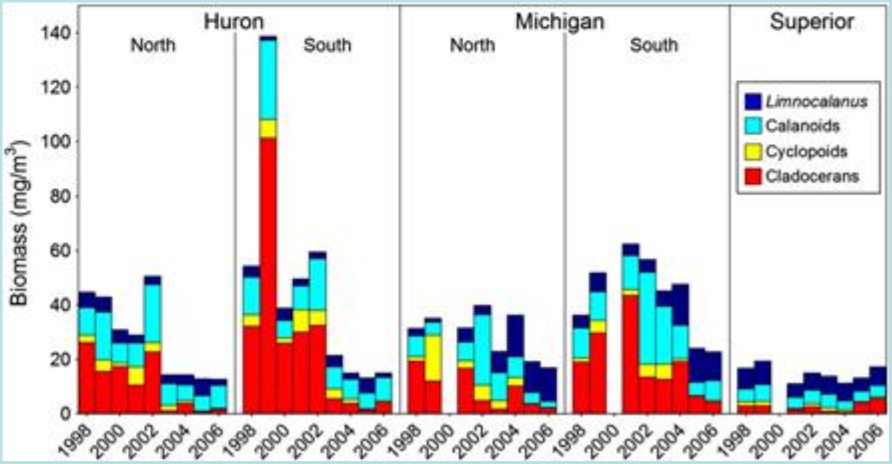
Article history:
Received 9 November 2011
Accepted 19 March 2012
Available online 18 April 2012

Communicated by Lars Rudstam

Index words::
Oligotrophication
Trophic state
Nutrients
Phosphorus
Chlorophyll
Zooplankton

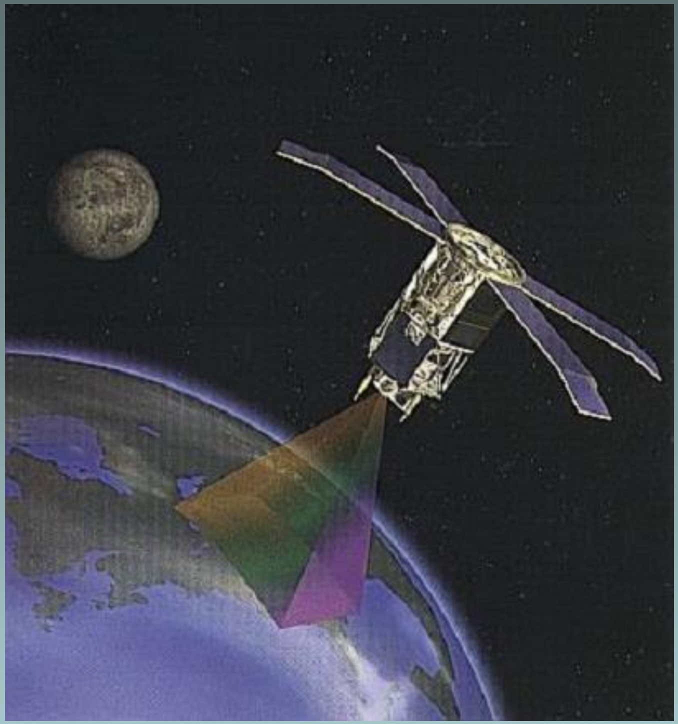
Abstract

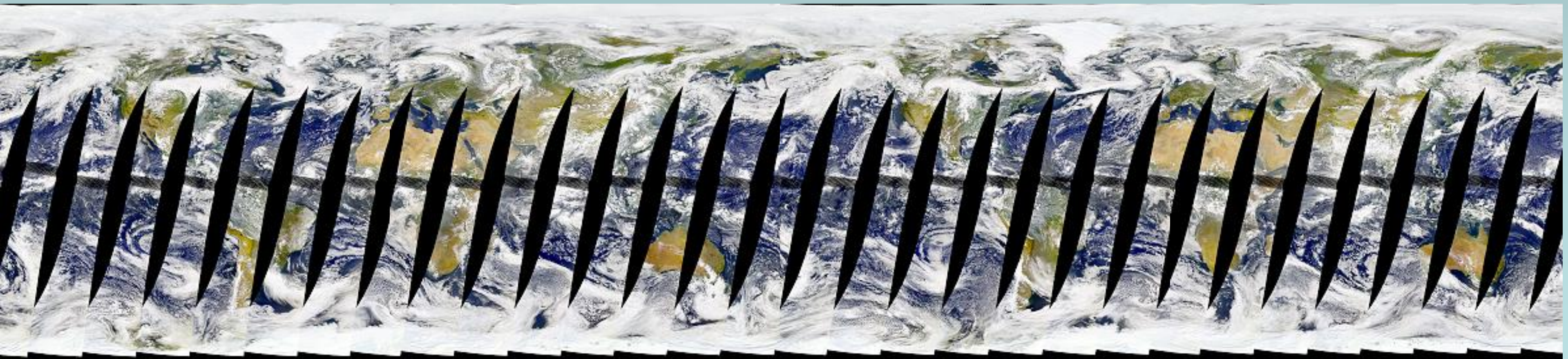
Signs of increasing oligotrophication have been apparent in the open waters of both Lake Huron and Lake Michigan in recent years. Spring total phosphorus (TP) and the relative percentage of particulate phosphorus have declined in both lakes; spring TP concentrations in Lake Huron are now slightly lower than those in Lake Superior, while those in Lake Michigan are higher by only about 1 μg P/L. Furthermore, spring soluble silica concentrations have increased significantly in both lakes, consistent with decreases in productivity. Transparencies in Lakes Huron and Michigan have increased, and in most regions are currently roughly equivalent to those seen in Lake Superior. Seasonality of chlorophyll, as estimated by SeaWiFS satellite imagery, has been dramatically reduced in Lake Huron and Lake Michigan, with the spring bloom largely absent from both lakes and instead a seasonal maximum occurring in autumn, as is the case in Lake Superior. As of 2006, the loss of cladocerans and the increased importance of calanoids, in particular Limnocalanus, have resulted in crustacean zooplankton communities in Lake Huron and Lake Michigan closely resembling that in Lake Superior in size and structure. Decreases in Diporeia in offshore waters have resulted in abundances of non-dreissenid benthos communities in these lakes that approach those of Lake Superior. These changes have resulted in a distinct convergence of the trophic state and lower food web in the three lakes, with Lake Huron more oligotrophic than Lake Superior by some measures.



Sea-viewing Wide Field-of-view Sensor

- NASA – 1998-2010
- 8 channels in visible and near IR
- 2800 km swath
- 1.1 km pixel size
- Provides daily, synoptic coverage





A band-ratio algorithm for retrieving open-lake chlorophyll values from satellite observations of the Great Lakes

Barry M. Lesht [a,*], Richard P. Barbiero [b], Glenn J. Warren [c]

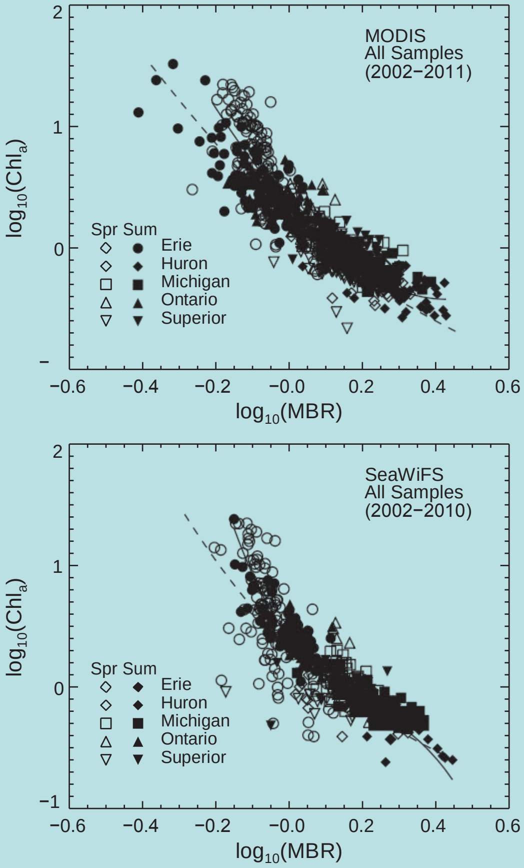
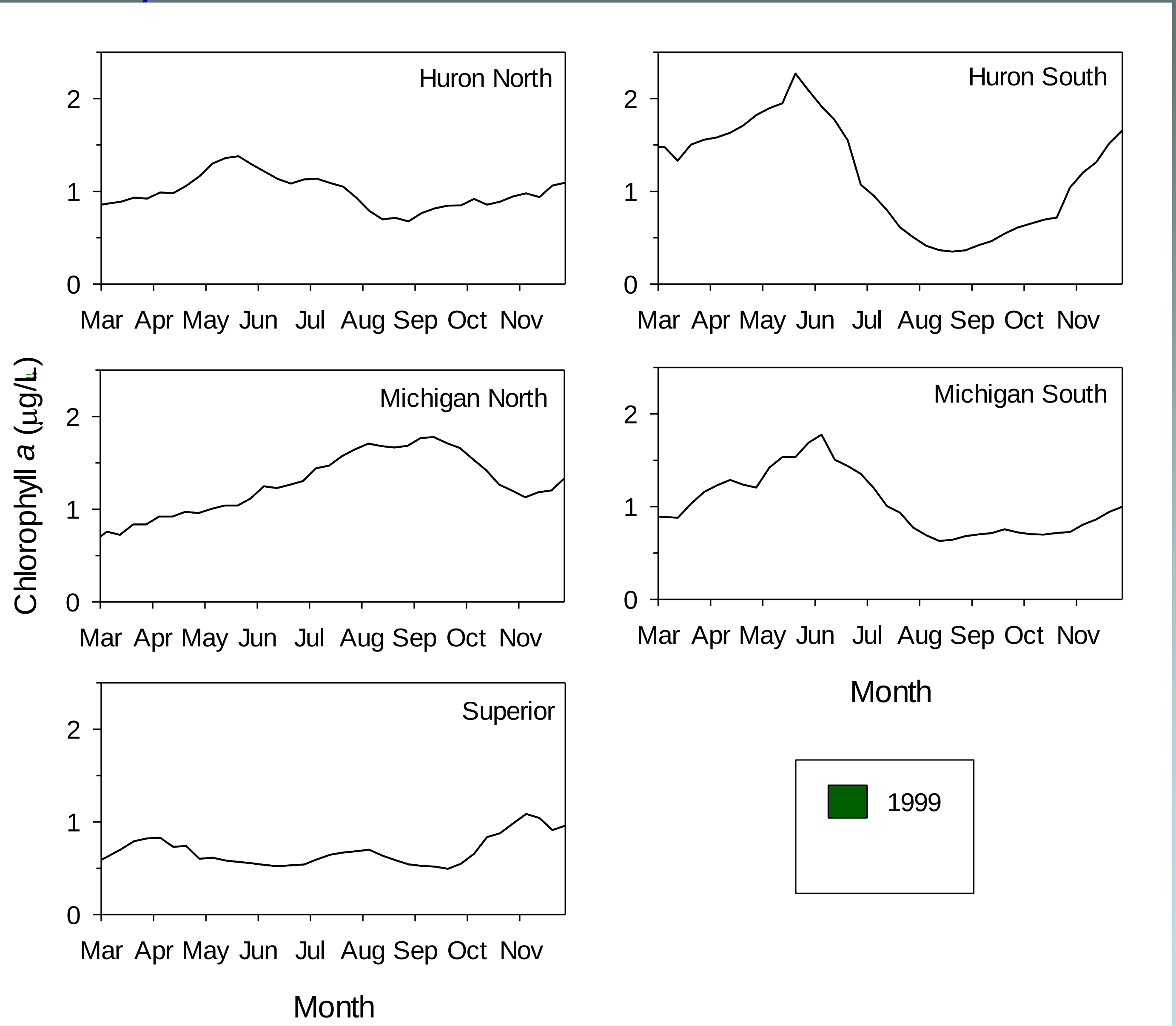
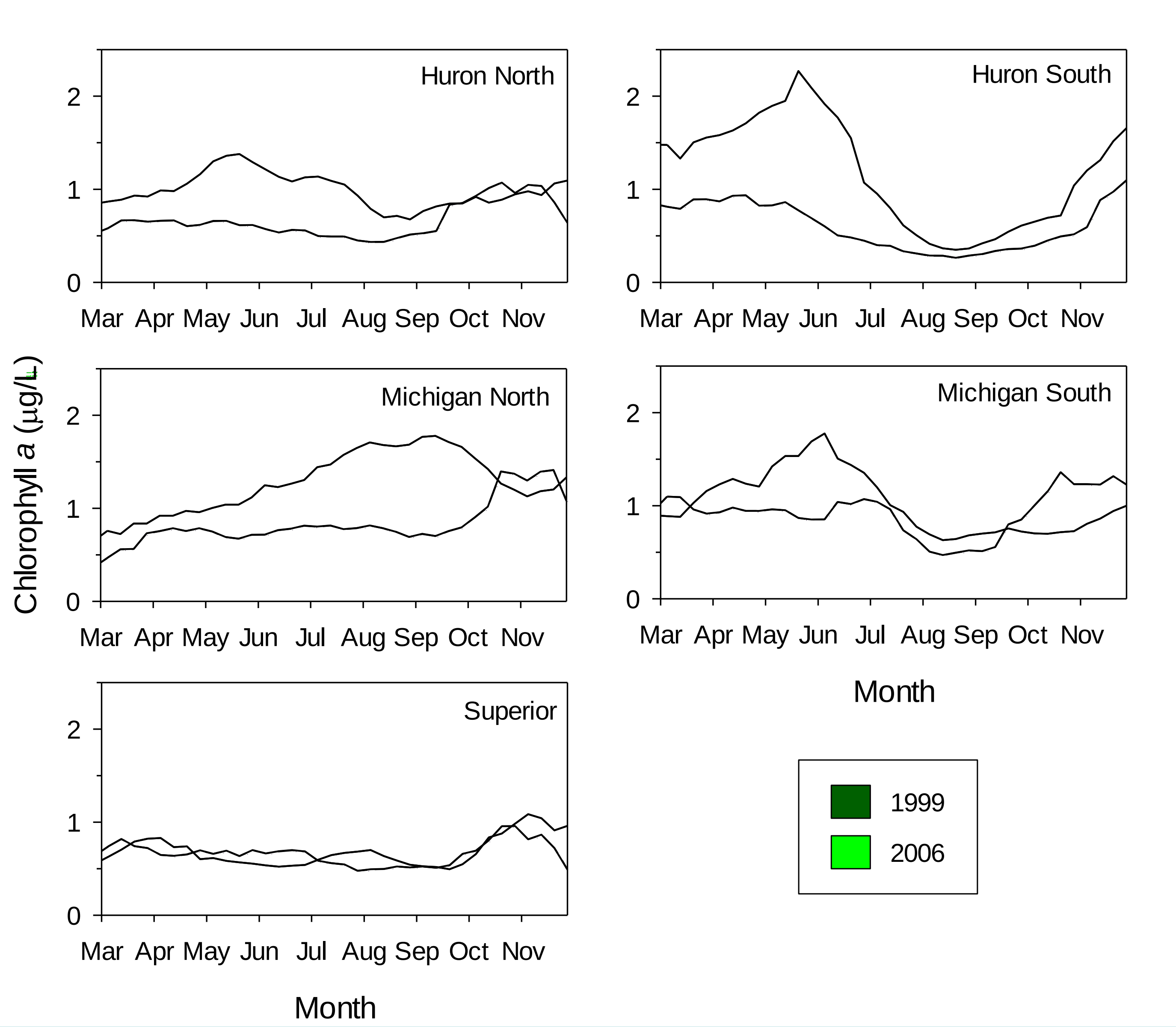


Fig. 3. $\log_{10}$(observed chlorophyll) vs. $\log_{10}$(maximum band ratio) for MODIS (top panel) and SeaWiFS (bottom panel). Dashed lines show the standard NASA algorithms. The GLF model for each set is shown by the solid lines.

Seasonality of Chlorophyll in Upper Lakes 1999, 2006



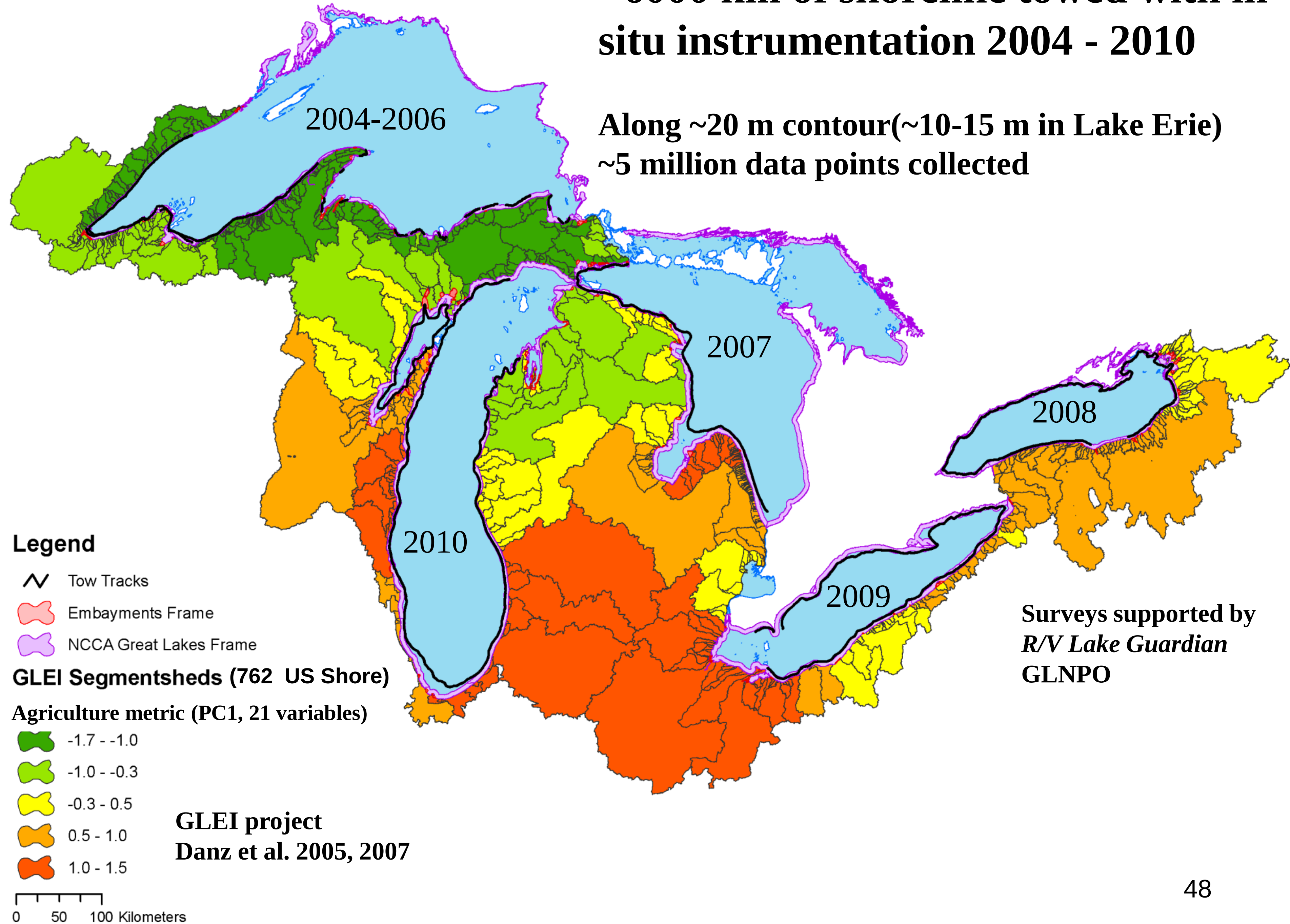
Seasonality of Chlorophyll in Upper Lakes 1999, 2006



MED Research and monitoring

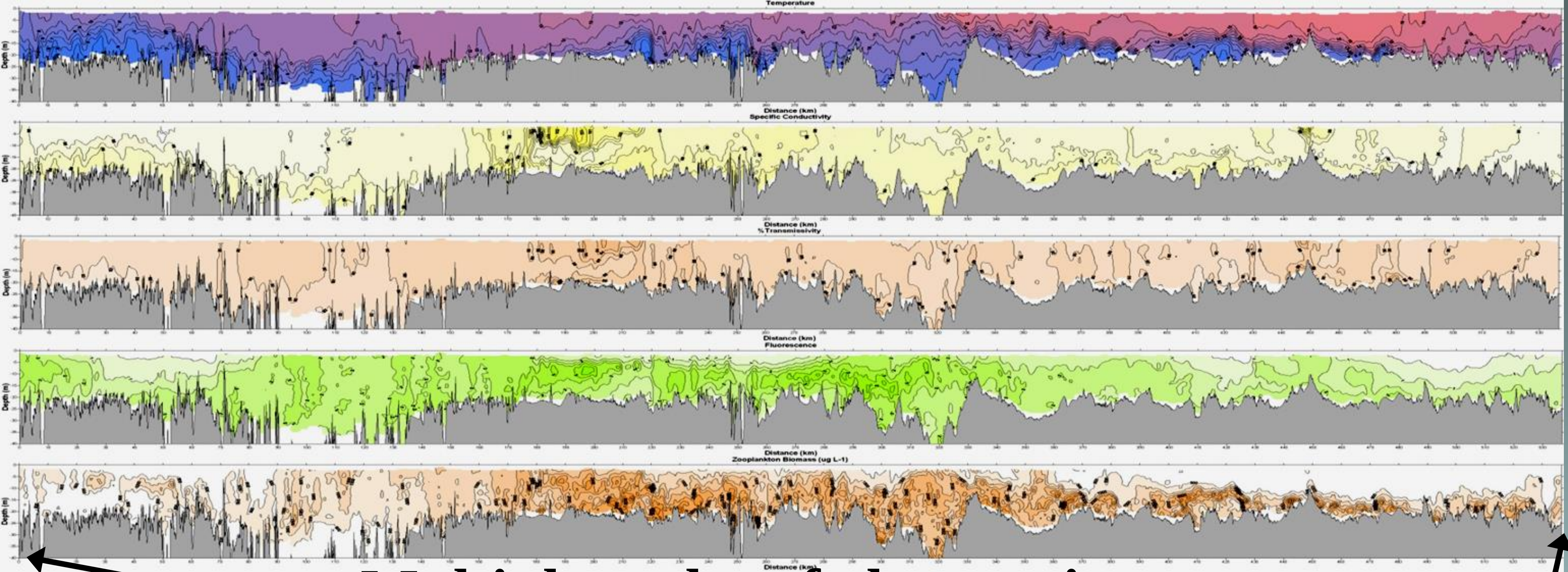
>6000 km of shoreline towed with in situ instrumentation 2004 - 2010

Along ~20 m contour(~10-15 m in Lake Erie)
~5 million data points collected

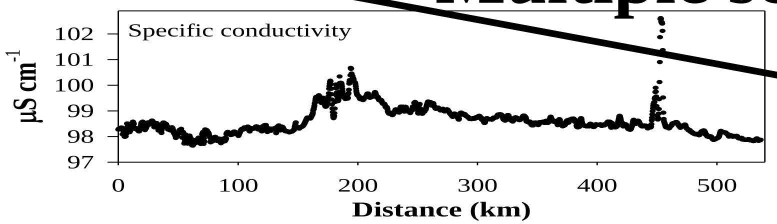


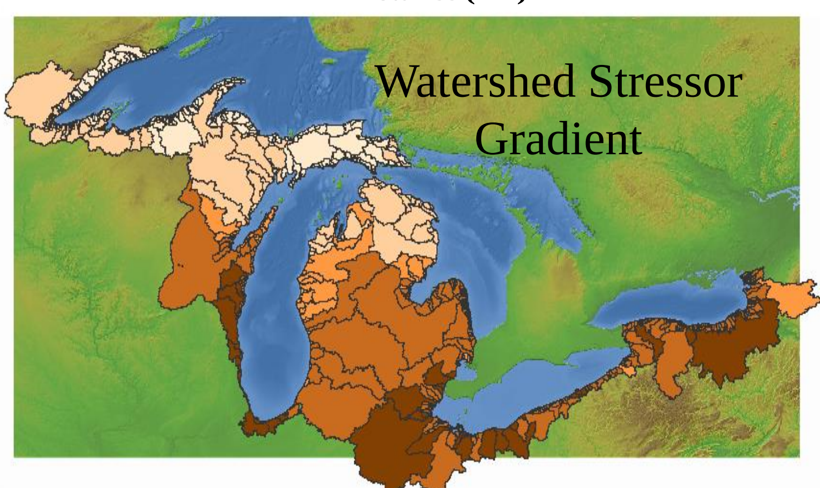
GLEI project
Danz et al. 2005, 2007

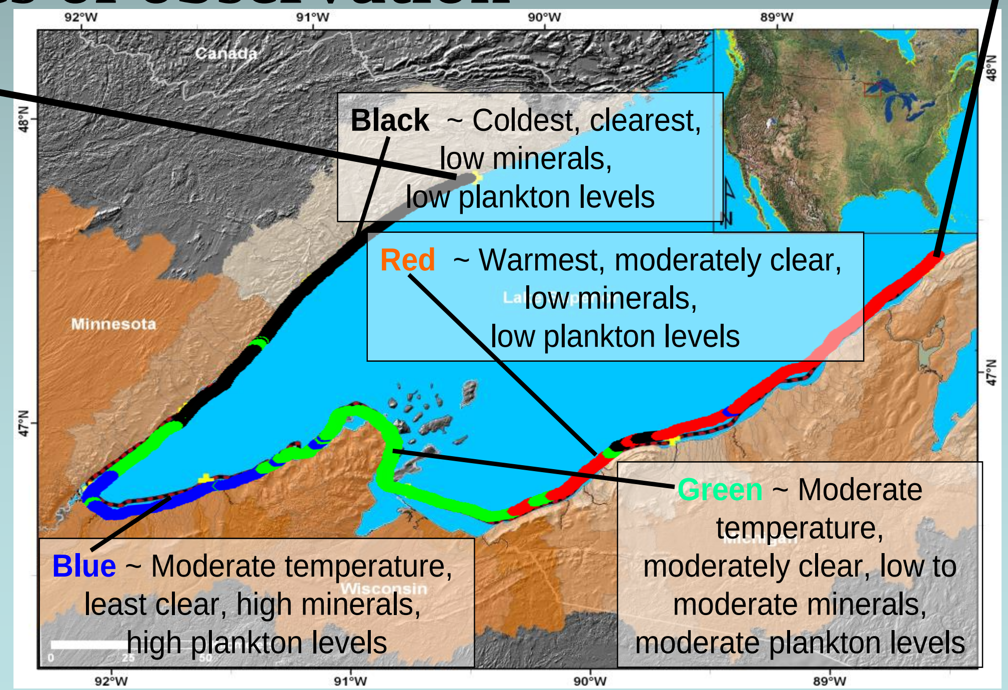
Surveys supported by
R/V Lake Guardian
GLNPO



Multiple scales of observation



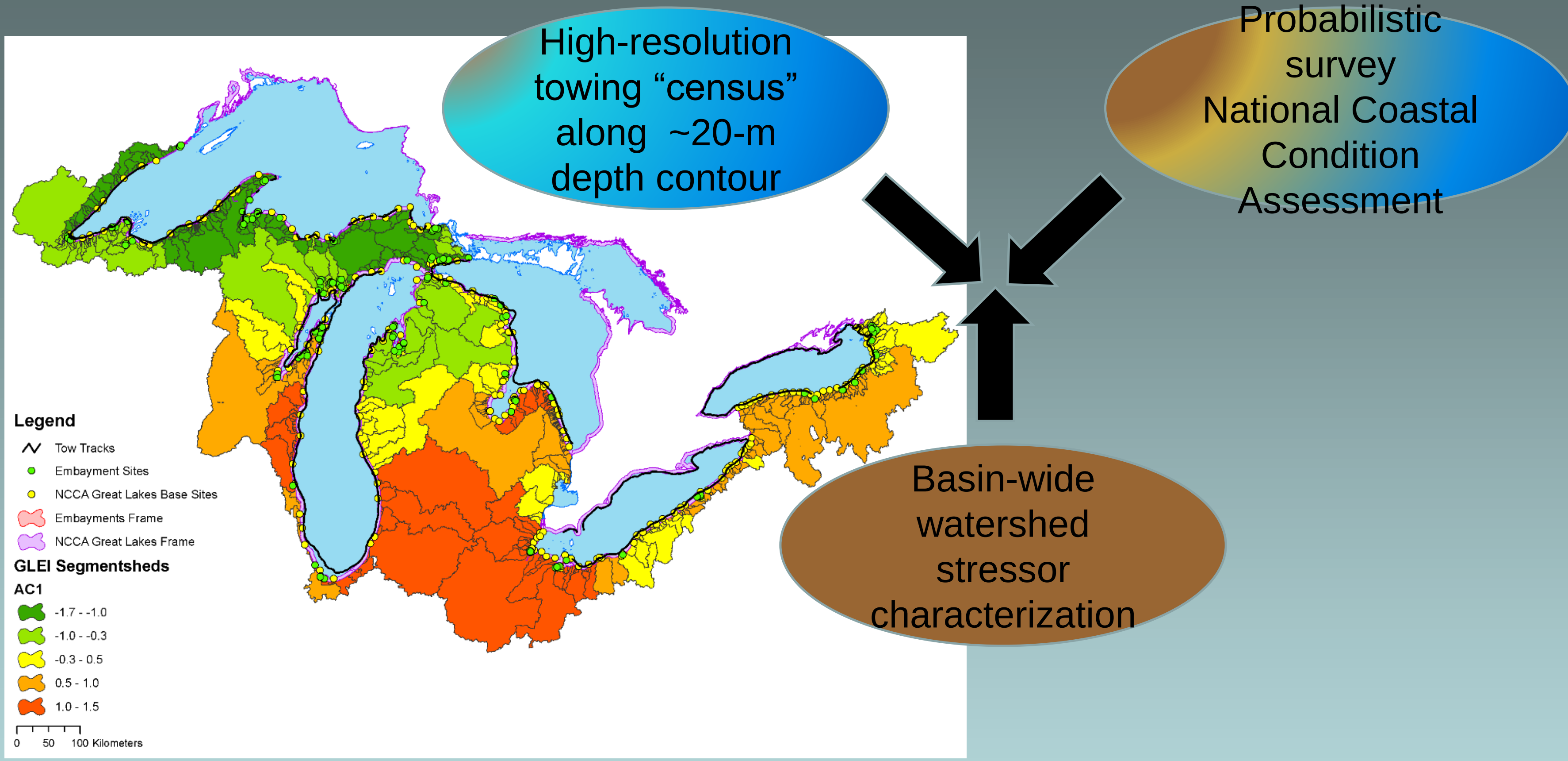




Nearshore Assessment - Triaxus

Follows CSMI cycle, during and one year prior to intensive field year

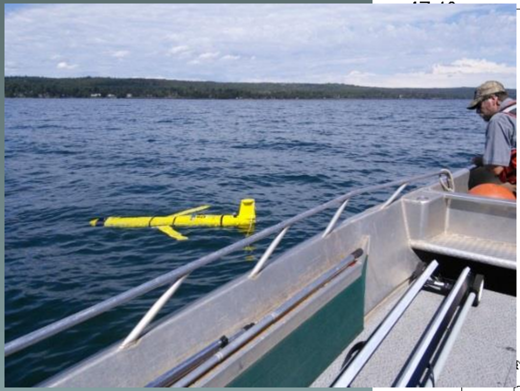
Nearshore Assessment Triad

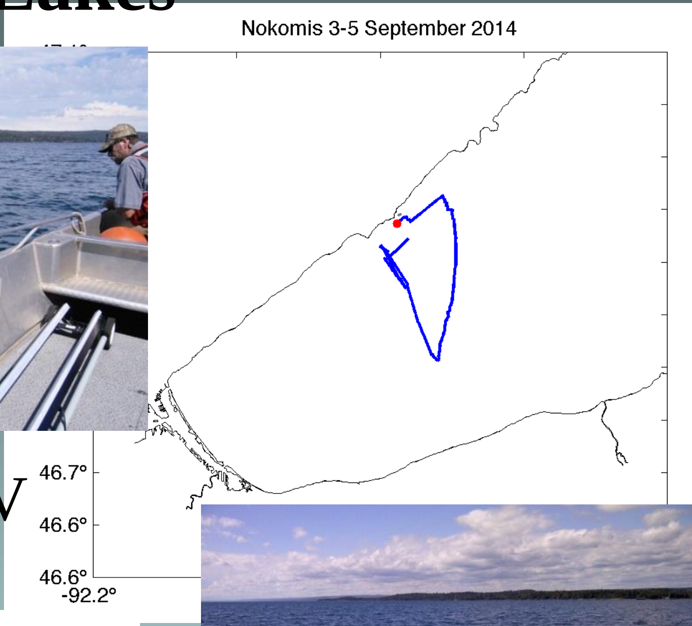


Elements of Integrated Coastal Observing/Assessment System

- Can efficiently characterize nearshore water quality and plankton
- Link watershed and nearshore conditions
- Identify scales and conditions (watershed to lakewide) at which we may confidently comment on stressor-response/thresholds related to landscape disturbances

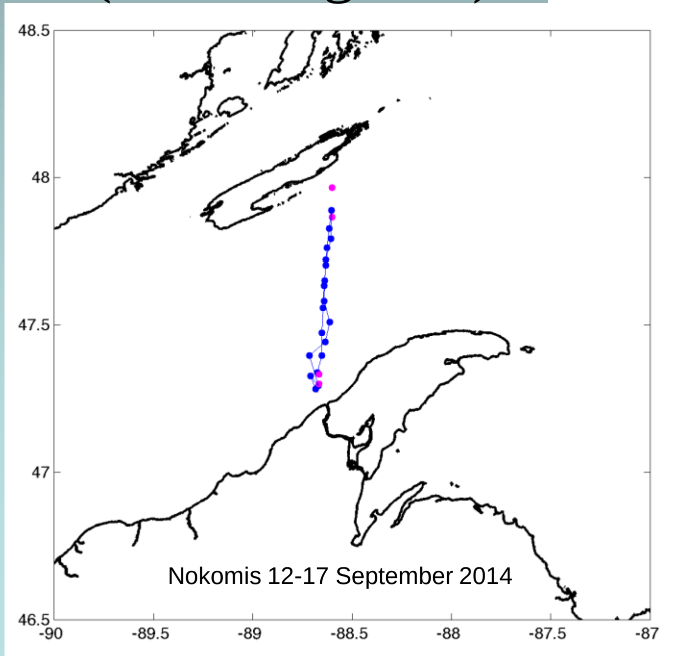
Development of AUV tools for monitoring the Great Lakes

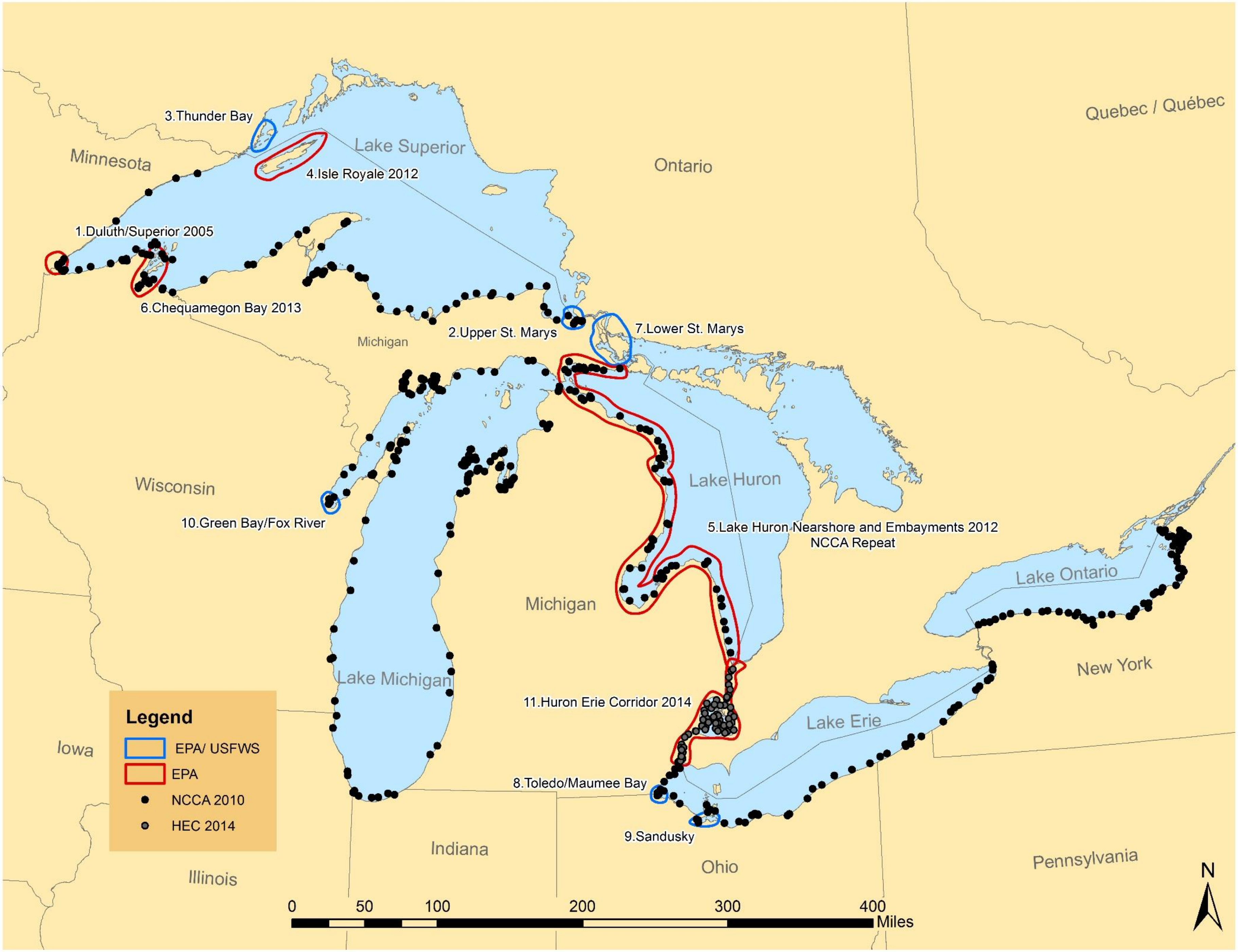




Initial testing of AUV (Slocum glider)

Cooperative effort of GLNPO, MED and UMN-Duluth (Drs. Jay Austin and Laura Fiorentino post doc)

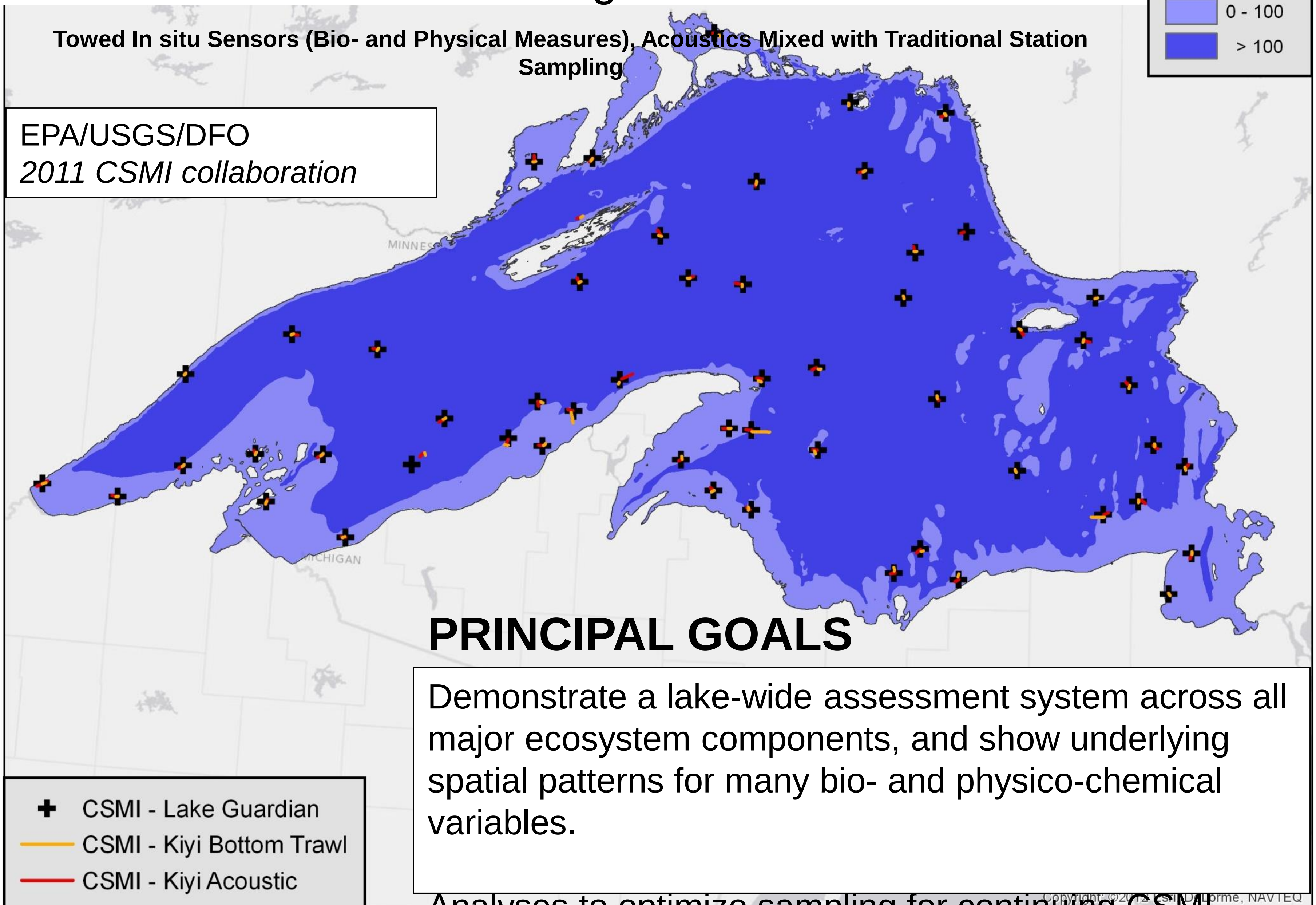



Quebec / Québec
3.Thunder Bay
Lake Superior
Minnesota
4.Isle Royale 2012
Ontario
1.Duluth/Superior 2005
6.Chequamegon Bay 2013
2.Upper St. Marys
7.Lower St. Marys
Michigan
Wisconsin
10.Green Bay/Fox River
Lake Huron
5.Lake Huron Nearshore and Embayments 2012
NCCA Repeat
Lake Ontario
Michigan
Lake Michigan
New York
11.Huron Erie Corridor 2014
Lake Erie
Legend
EPA/ USFWS
EPA
NCCA 2010
HEC 2014
Iowa
8.Toledo/Maumee Bay
9.Sandusky
Indiana
Ohio
Pennsylvania
Illinois
0 50 100 200 300 400
Miles
N

Lake Superior Integrated Lake-wide Assessment Design

Towed In situ Sensors (Bio- and Physical Measures), Acoustics Mixed with Traditional Station Sampling

EPA/USGS/DFO
2011 CSMI collaboration



PRINCIPAL GOALS

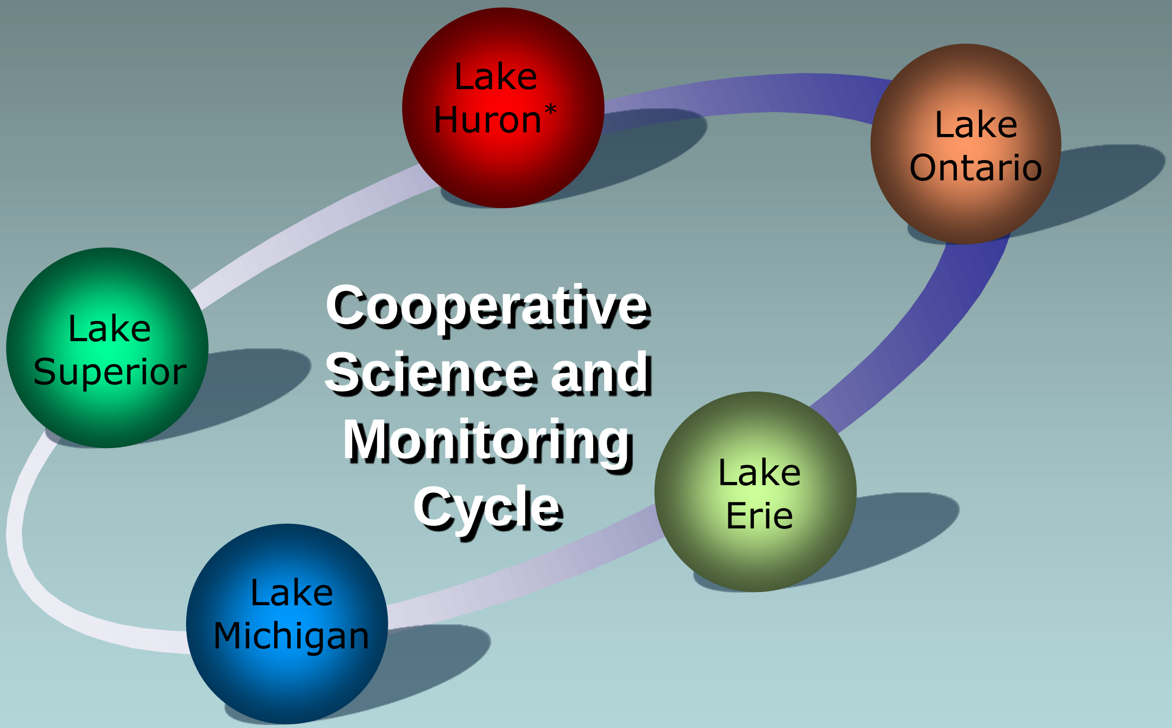
Demonstrate a lake-wide assessment system across all major ecosystem components, and show underlying spatial patterns for many bio- and physico-chemical variables.

Analyses to optimize sampling for continuing CSMI,

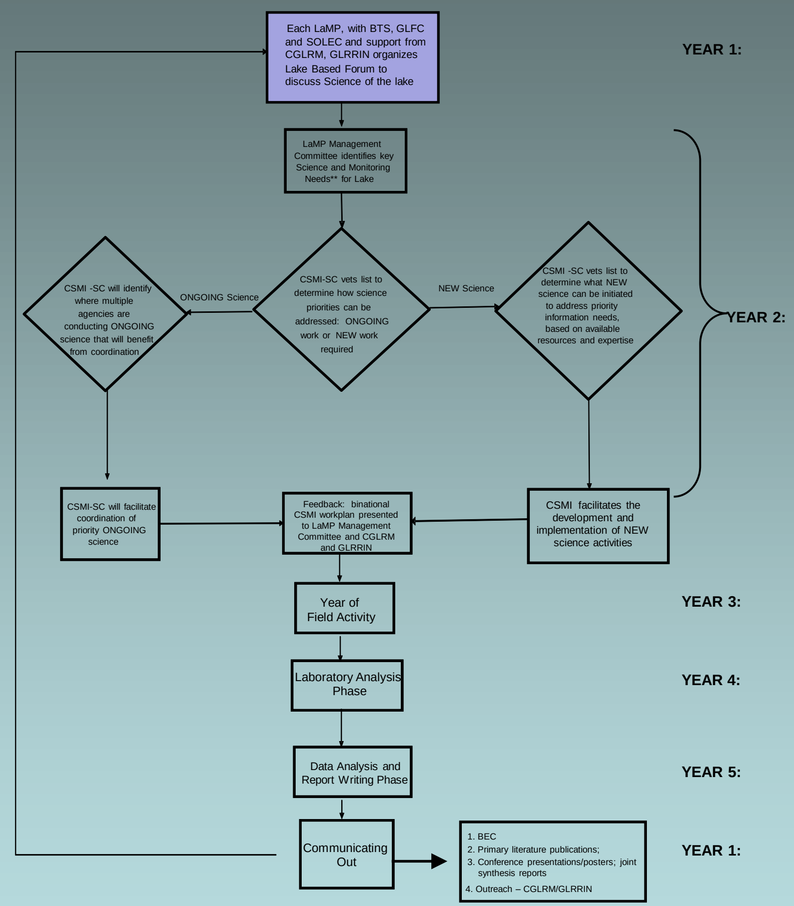
Special Studies

- Cooperative Science and Monitoring Initiative
- Green Bay Mass Balance Study
- Lake Michigan Mass Balance Study

Rotational Cycle



Cooperative Science and Monitoring Initiative Process



Information gaps from 2010 Synthesis:

1. Nearshore (<20 m) data sets.
2. Understanding mechanisms underlying changes (declines, community composition) to the benthic invertebrate and zooplankton community.
3. Connections between nearshore and offshore regions.
4. Overwinter survival of age-0 fishes.
5. Understanding/describing winter primary production and its impact on overall lake productivity (and future climate change effects on this).
6. Feedback between contaminant loading and fish body burdens.
7. Data gaps in emerging chemicals/contaminants.
8. Poor understanding of linkage between water level regime and fish and wildlife habitat in coastal zone.

Huron 2012 Coordination

Goal: Confirmation that 2012 Lake Huron sampling missions have maximized geospatial, temporal and parameter opportunities.

Objectives:

1. Identify planned research by each agency team: What hypotheses or research questions will be addressed? To that end, what parameters will be sampled at a given spatiotemporal scale?
2. Identify parameter gaps by location.
3. Identify opportunities to modify sampling schemes to maximize science and monitoring and avoid unnecessary duplication.

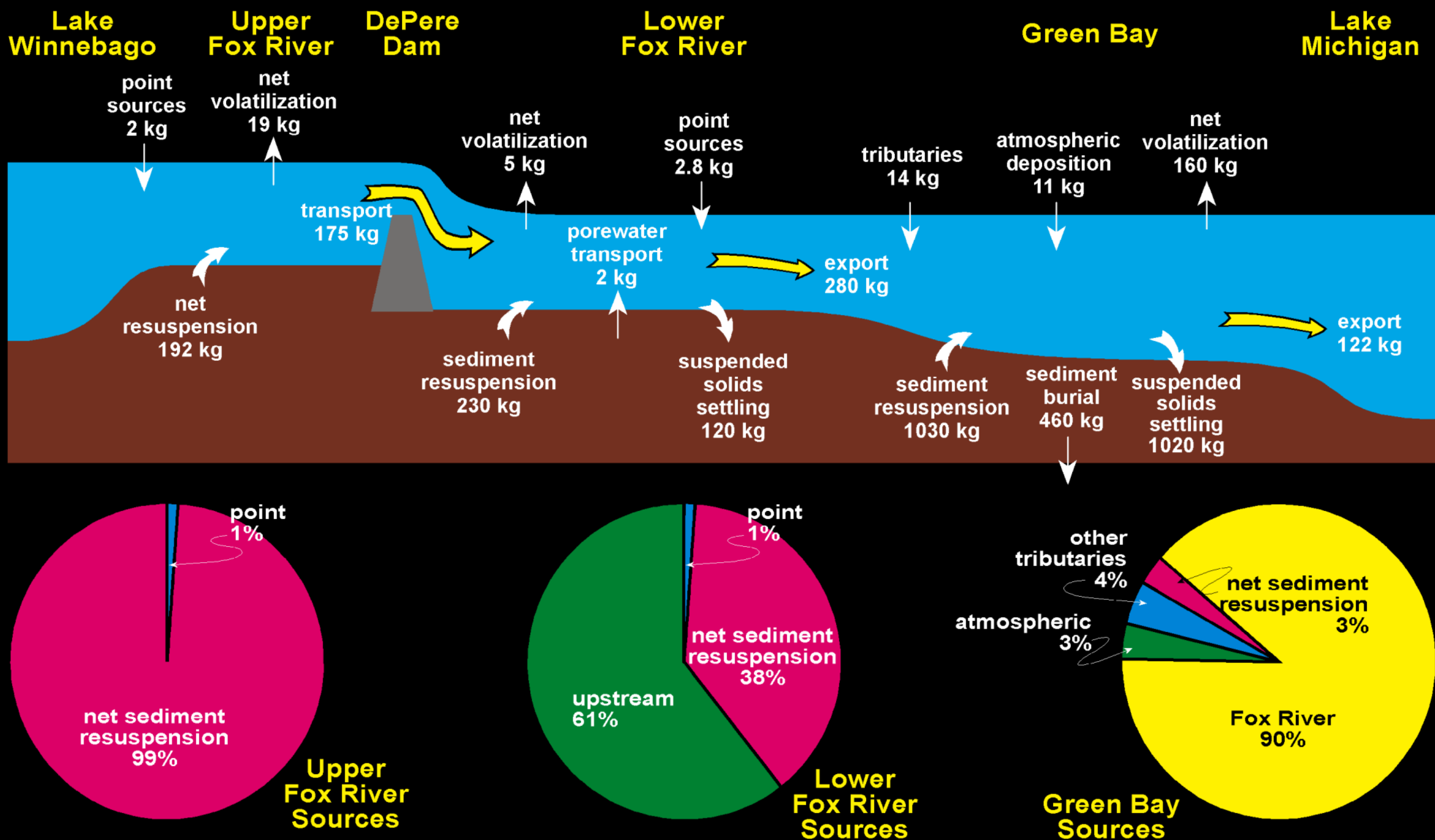
Lake Huron CSMI Projects 2012				
Project Description	**Cooperators**	**Types of Samples**	**Questions Addressed**	**Time and Space Scales**
Food Web Spatial Structure Projects	USGS, NOAA, Dept. Fish. Oceans Canada, EPA	Nutrients, phytoplankton, zooplankton, benthic invertebrates, larval fish, prey fish, stable isotopes, primary productivity, continuous (towed instruments)	Spatial and temporal distribution of nutrients, pelagic and benthic food webs, productivity and processes for: understanding of changing spatial distribution of production and biomass - for model updates and fisheries	Monthly - weekly sampling along transects off Alpena, MI, Port Sanilac, MI and Goderich, Ontario
Nearshore Project	Michigan DNR	Fish - bottom trawls, beach seining, gill netting (large and small mesh), trap netting	Distribution, growth and survival of fish	Transects between 3 m and 18 m depth
Tributary Monitoring	USGS	Contaminants - PCBs, Hg, chemicals of emerging concern, sediment loads, nutrients, bacteria, protozoa and viruses, turbidity, conductivity	Loads of various chemicals, USGS methodology studies	Automated sampling - continuous, year round
River Mouth Project	USGS, EPA, MDNR, NOAA Marine Sanctuary?	Water velocity and direction, tracer chemicals, water levels, water quality, sediments, wetland plants, benthos, larval fish	Quantify nutrient dynamics in river (reservoirs), water movement, hydrodynamic model data	Thunder Bay River - lower river, river mouth and nearshore. Frequency?
Benthos assessment	NOAA, EPA, EC, OMNR	Benthic grab samples for invertebrates	Five-year assessment of benthic community at 80 stations throughout Lake Huron	Late July

Annual Fish Assessment	USGS	Bottom trawling, hydroacoustic census, midwater trawls for prey fish, Mysis	Annual assessment of fisheries in Lake Huron	Fall
Annual Open Lake Surveys	EPA	Nutrients, conventional water quality parameters, zooplankton, benthic invertebrates, Mysis	Long-term trend assessment of lake health	Spring, Summer
Nearshore Assessment	EPA	Triaxus towed sensor survey- plankton, chlorophyll, chemistry	Assessment of nearshore of Lake Huron - at 20 meter depth contour	Summer
Sediment Core Study - Saginaw Bay	NOAA	Box core samples in Saginaw Bay and Lake Huron	Assess the changes in phosphorus loading from Saginaw Bay into the Lake	Spring/Summer
AUV and Glider Surveys	GLOS	AUV and Glider deployment in conjunction with other work	Shallow nearshore, shallow bay sampling	Summer
Sediment Contaminants Survey	Univ. Ill. - Chicago, EPA	Sediment core and surface grab samples for current and historic contaminant analysis; cores analyzed for some legacy and emerging chemicals including PFCs, BFRs, fragrances.	Core Samples in depositional basins, surface grab samples across rest of lake to assess overall spatial trends of contaminants in surface sediments	Summer
Food Web Contaminants Survey	Clarkson University, EPA	Lower pelagic and benthic food web samples, fish	Develop bioaccumulation information and provide data to mass budget of contaminants	Summer
Atmospheric Deposition (IADN)	EC and EPA	Air, particles, and precip will be collected at Burnt Island as part of IADN and analyzed for suite of PCBs, OC pesticides, PAHs, trace metals, and PBDEs	Long-term trends of atmospheric loads of contaminants to Lake Huron	Year-round

Nearshore Biological Assessment	MOE	Benthic Algae (periphyton and macro algae) sampling along two transects	Biological assessment as it informs shoreline nuisance algal issues. Repeat of 2010 transect work	Summer – two transects near Kincardine on Lake Huron
Fish Contaminants	EC	Sampling for fish (Trout and forage fish) and lower food web for contaminants	Long term contaminant trends for legacy, CMP and SOLEC classes (OCs, Hg, BFr's, PFCs) of chemicals	North Channel and Goderich areas
Contaminants in Sediment Cores	EC	Sediment cores in Lake Huron and Georgian Bay (4-5 sites) for legacy and CMP chemicals including BFr's, Siloxanes and Perfluoros.	Samples will be collected in the open lake	Summer
Understand the physical, hydrological, and water quality processes occurring at beaches	EC	Sampling for nutrients, metals, E. coli, pathogens.	Assessing the quality of the groundwater below the beaches and the impact of human development	Sauble Beach and Ashfield Township Beach on Lake Huron, and several beaches in southern Georgian Bay (the beaches of Tiny Twp)
Status of Lower Food Web	DFO	Sampling mysids and zooplankton	Status of the lower food web to see if things are continually changing. Sampling at approximately 20 sites in Huron and GBay .	Summer/Fall in Huron and GBay

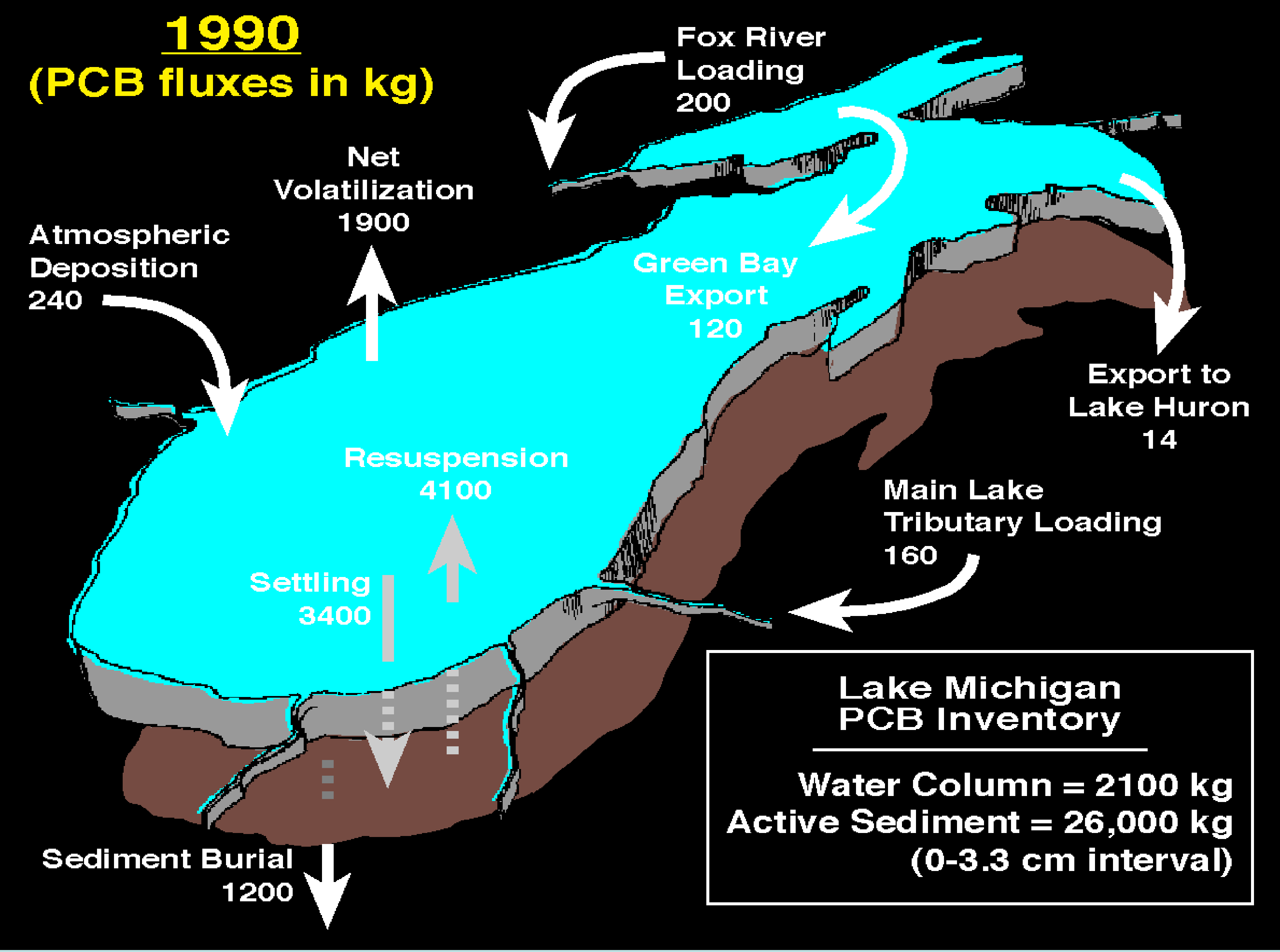
Possible additional surveys: MDEQ/EPA-sediment core samples for dioxins - Saginaw Bay and Lake Huron; NOAA- Structure and Function of Benthos Communities on Hard Substrates; NOAA- Direct and indirect effects of Bythotrephes and quagga mussels on larval fish; NOAA - Lake Huron physics.

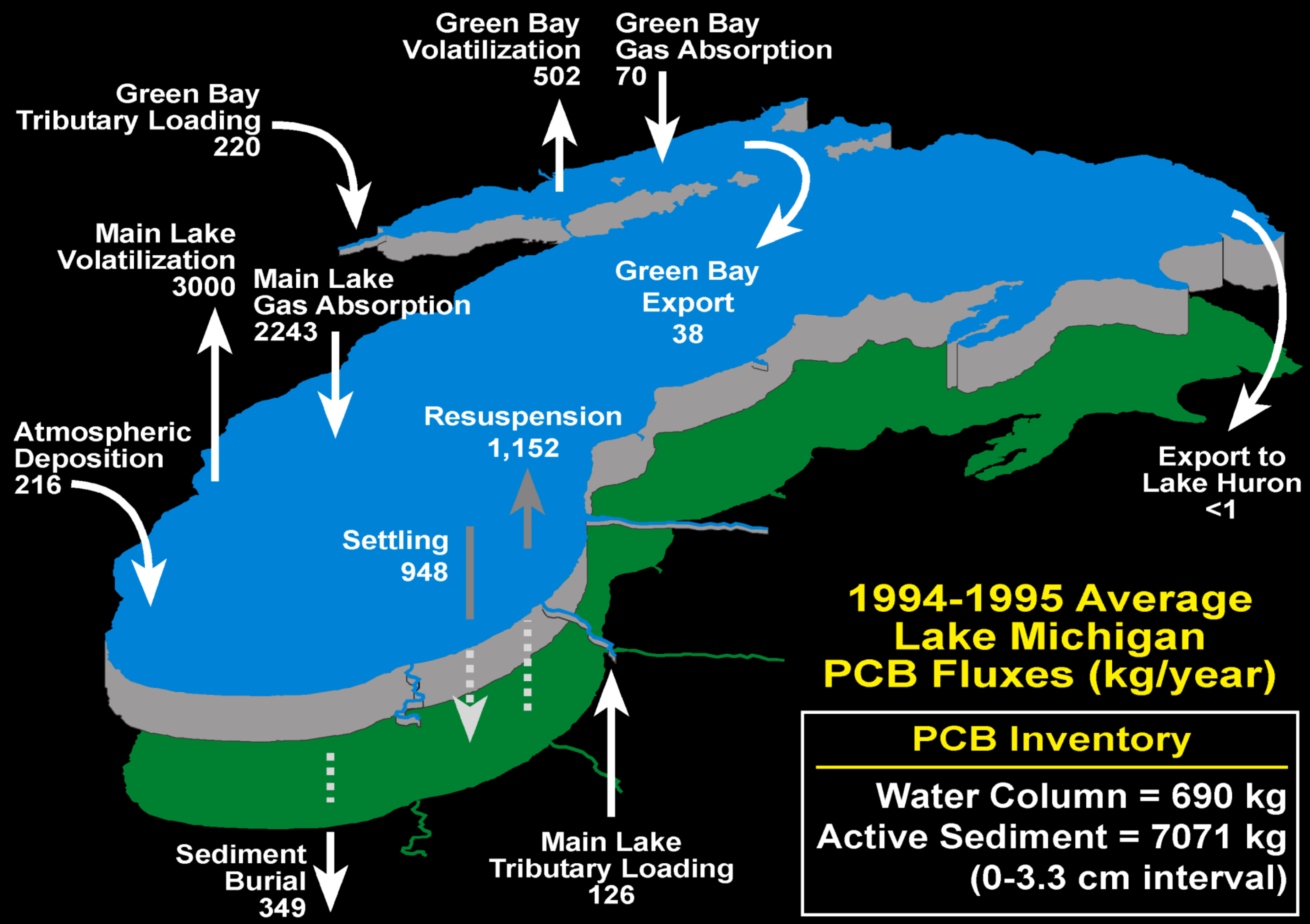
PCB Mass Balance Fluxes for 1989



Lake Michigan Mass Balance Study Goal

- to develop a sound, scientific base of information to guide future toxic load reduction efforts at the Federal, State, Tribal, and local levels


1990
(PCB fluxes in kg)
Fox River Loading 200
Net Volatilization 1900
Atmospheric Deposition 240
Green Bay Export 120
Export to Lake Huron 14
Resuspension 4100
Settling 3400
Main Lake Tributary Loading 160
Sediment Burial 1200
Lake Michigan PCB Inventory
Water Column = 2100 kg
Active Sediment = 26,000 kg
(0-3.3 cm interval)


Green Bay
Volatilization
502
Green Bay
Gas Absorption
70
Green Bay
Tributary Loading
220
Main Lake
Volatilization
3000
Main Lake
Gas Absorption
2243
Green Bay
Export
38
Resuspension
1,152
Atmospheric
Deposition
216
Settling
948
Export to
Lake Huron
<1
1994-1995 Average
Lake Michigan
PCB Fluxes (kg/year)
PCB Inventory
Water Column = 690 kg
Active Sediment = 7071 kg
(0-3.3 cm interval)
Sediment
Burial
349
Main Lake
Tributary Loading
126

Great Lakes Restoration Initiative (GLRI)

- Obama Administration Initiative
  - FY10: $475 million
  - FY11: $300 million
  - FY12: $300 million
  - FY13: $284 million
  - FY14: $300 million
  - FY15: $275 million*

GLRI Action Plan I Focus Areas

1. Toxics Substances and Areas of Concern
2. Invasive Species
3. Nearshore Health and Nonpoint Source Pollution
4. Habitat and Wildlife Protection and Restoration
5. Accountability, Education, Monitoring, Evaluation, Communication and Partnerships

EPA-funded projects FY13: Lake Erie CSMI

- WLEB nutrient dynamics (Ohio Lake Erie Commission)
  - Quantify of internal nutrient loads to the water column
  - Evaluate role of river hydrology and/or seasonality of P loads to HAB formation and dynamics
  - Develop a nutrient mass budget

- Huron-Erie corridor monitoring (EPA's Great Rivers and NCCA sampling approaches)

GLRI Priority Watersheds