Lake Superior Monitoring

November 2014

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Development of New Monitoring Approaches

- **Lakewide Surveys, Cooperative Science and Monitoring Initiative**
- **New Technologies for Water Quality/Plankton Monitoring**
- **Case Studies on Aquatic Invasive Species, Early Detection Monitoring**
- **Special Studies in Duluth-Superior Harbor/St. Louis River**

Lakewide Surveys,
Cooperative Science and Monitoring Initiative

Integrated Assessment

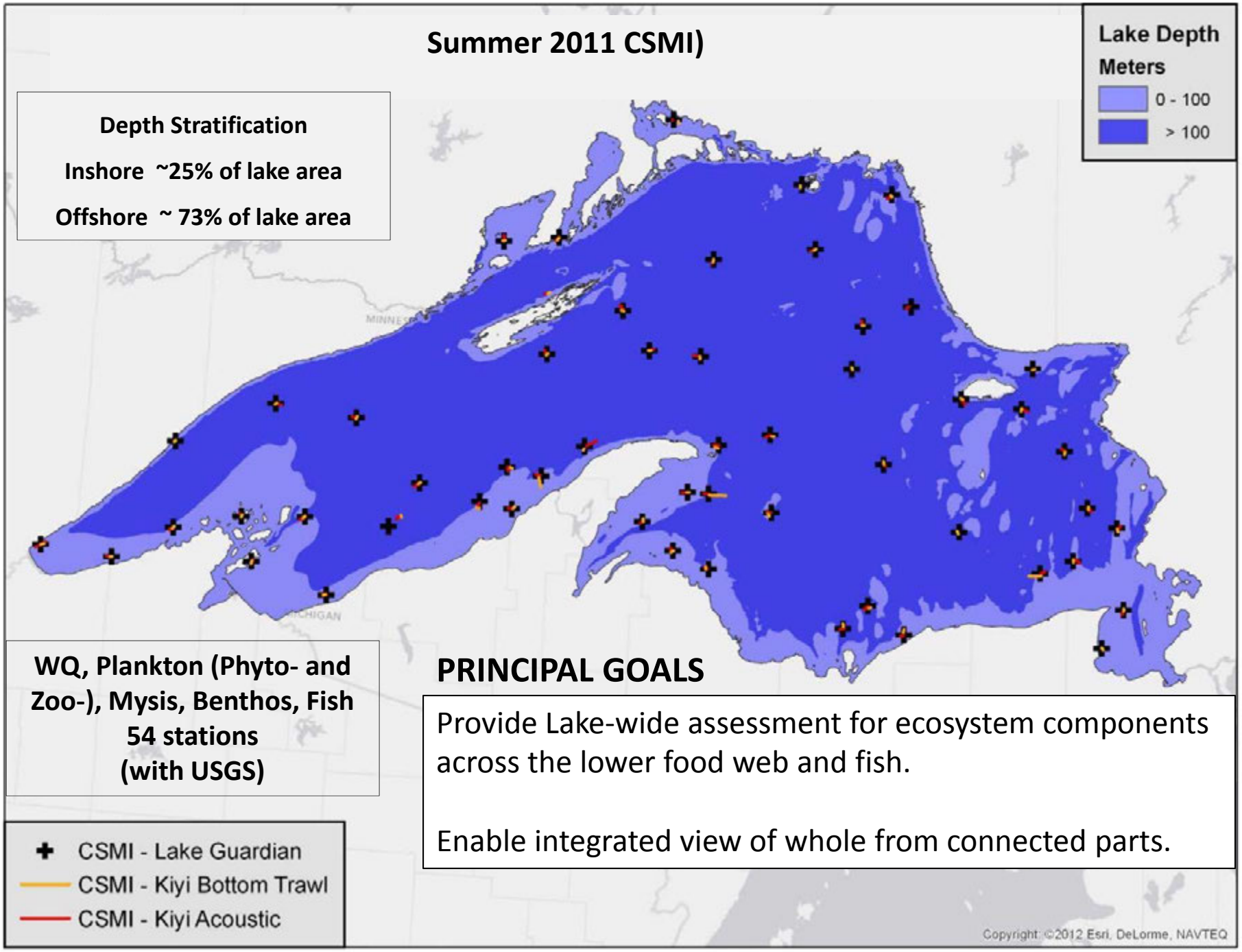
(physical structure →water quality →lower food web →fish)

2005/06 and 2011 with USGS, DFO/EC (Canada) and others

-*Ecology of Lake Superior* (Special issue, 2011, AEHMS journal); other journal articles

-Contributions to SOLEC and GLFC State of Lake Superior Reports

-Coordination of periodic conferences and workshops on science and management, with Lake Superior Working Group/LAMP


Summer 2011 CSMI)
Lake Depth
Meters
0 - 100
> 100
Depth Stratification
Inshore ~25% of lake area
Offshore ~ 73% of lake area
WQ, Plankton (Phyto- and Zoo-), Mysis, Benthos, Fish
54 stations
(with USGS)
CSMI - Lake Guardian
CSMI - Kiyi Bottom Trawl
CSMI - Kiyi Acoustic
PRINCIPAL GOALS
Provide Lake-wide assessment for ecosystem components across the lower food web and fish.
Enable integrated view of whole from connected parts.
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New Technologies for Water Quality/Plankton Monitoring

High Resolution Mapping over Distance and Depth

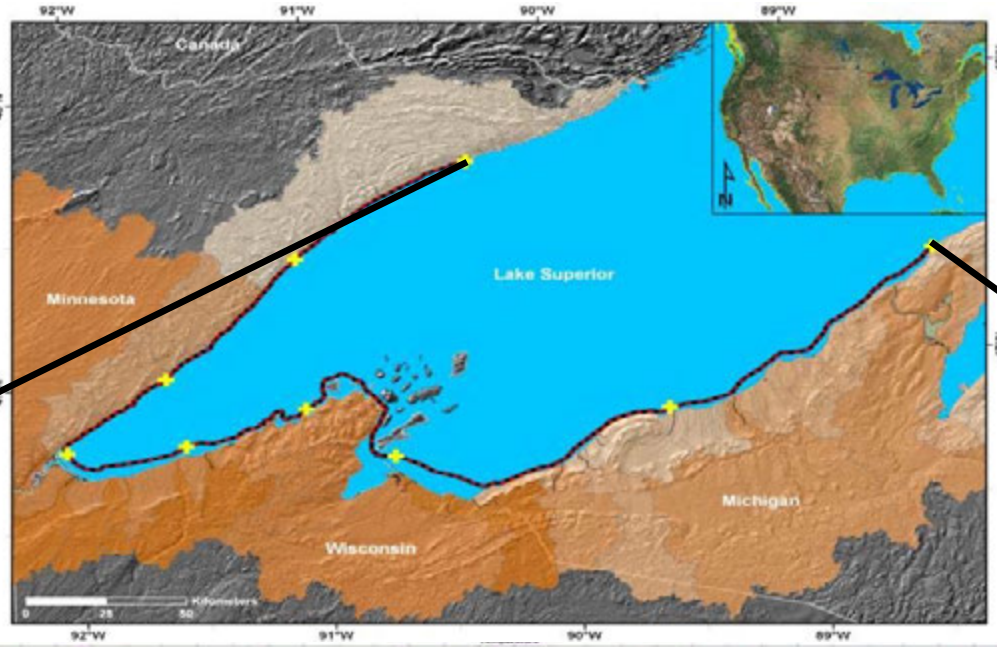
Towed *in situ* sensors focused on:

a) Extensive nearshore surveys (2001-2005) to link conditions with watersheds

b) Compliment to lakewide assessments (2004-2006, 2011)

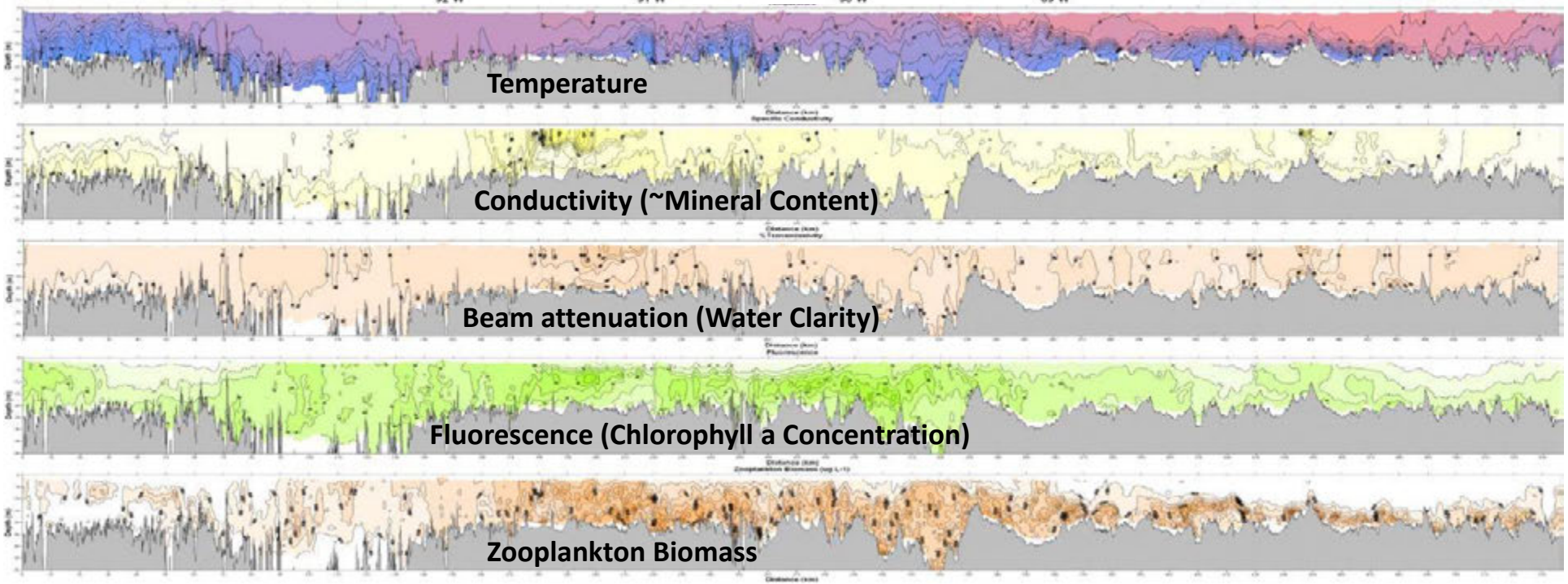
537 km track along shoreline at ~15-30 m contour, 2004

In situ sensors oscillated throughput water column along entire track to provide high-resolution picture of water conditions



Grand Marais MN

Gratiot River MI



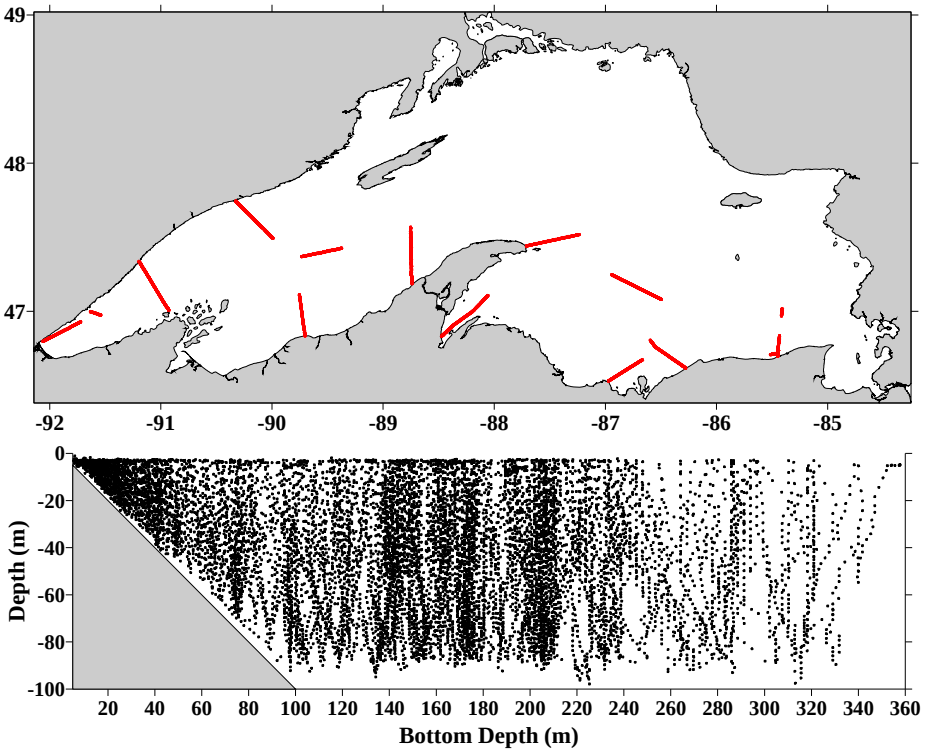
Duluth/Superior

Bayfield WI

Ontonagon MI

Lake Superior, 2011

Towed in situ sensors through US waters



Continuous Profiling on 5-30 km Transects

Temperature

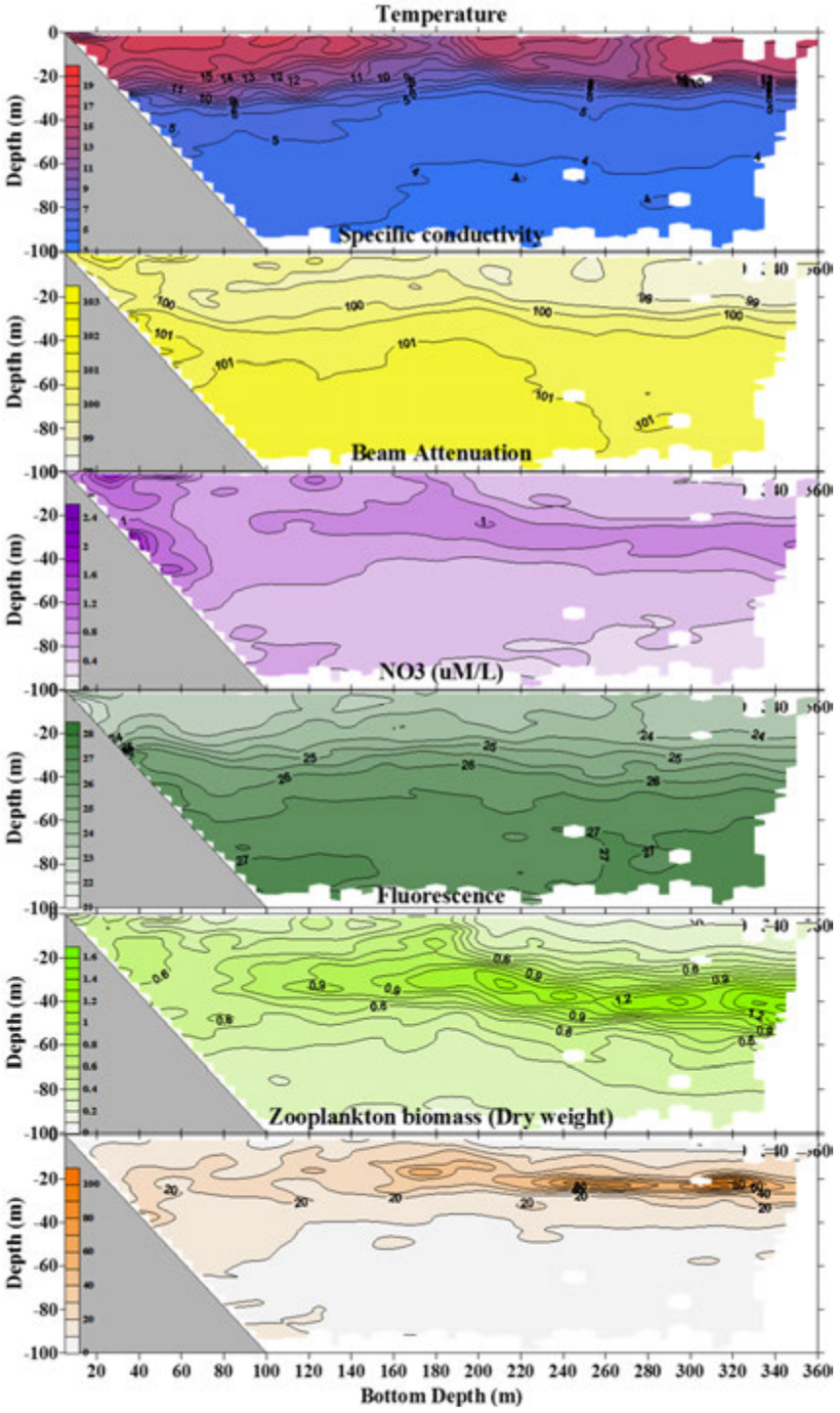
Conductivity (~Mineral content)

Beam attenuation (Water clarity)

Nitrate Concentration

Fluorescence (~Chlorophyll a concentration)

Zooplankton biomass



Case Studies on Aquatic Invasive Species

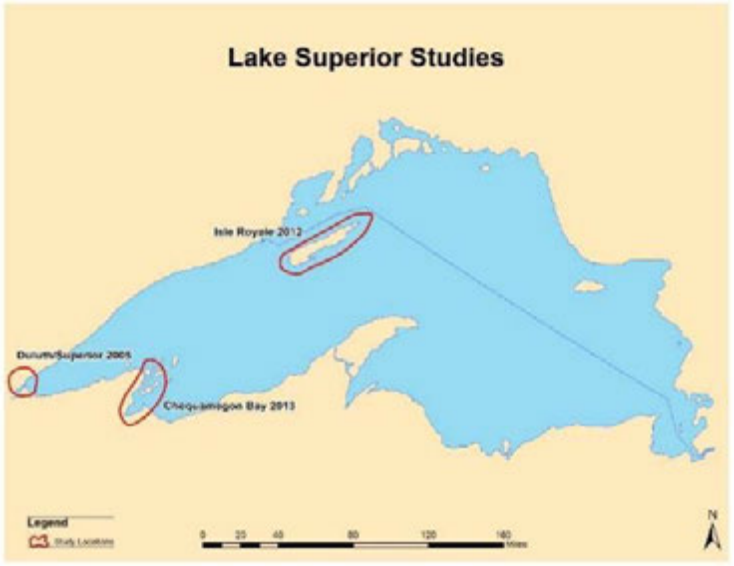
Early Detection Monitoring

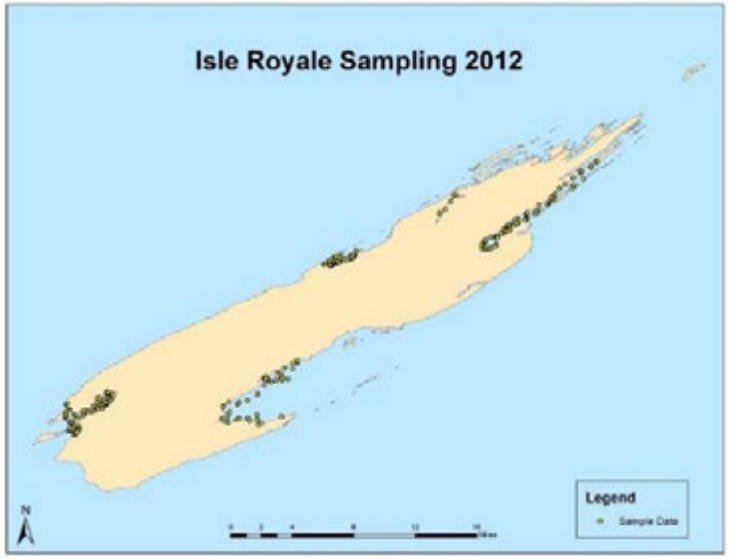
Intensive Biological Assessments, Species Identification

Duluth-Superior Harbor (2005-2013): Adult and larval fish, benthic invertebrates

Isle Royale embayments (2012): Adult fish and benthic invertebrates

Chequamegon Bay/coastal area from Bayfield to Ashland (2013): Benthic invertebrates



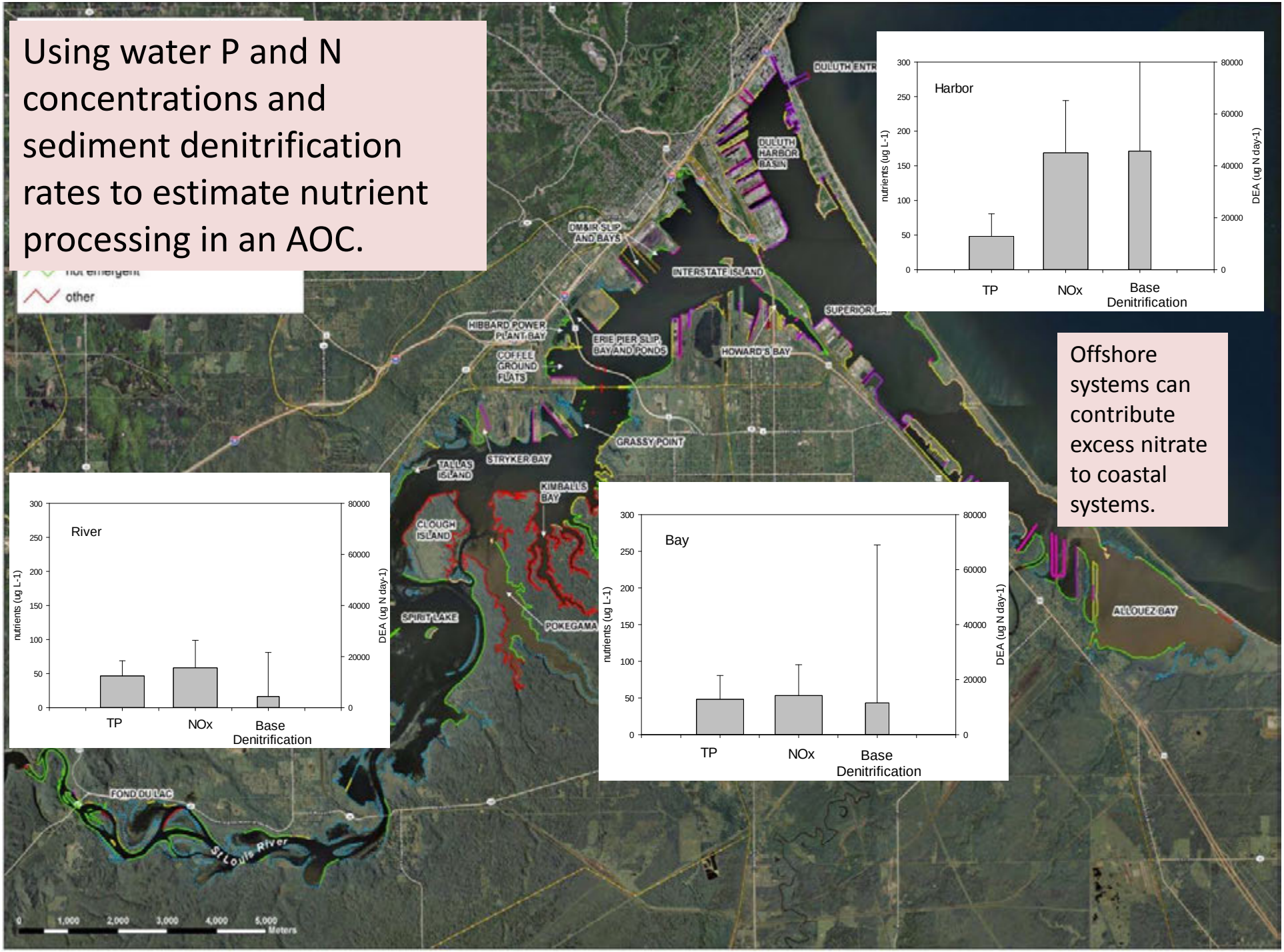


Samples are being used to build a DNA Barcode Library of Lake Superior specimens

Other Intensive Studies

- **Duluth-Superior Harbor/St. Louis River (2009-2013)**
  - **Water Quality**
  - **Physical Habitat**
  - **SAV**
  - **Denitrification**
  - **Benthos**

Using water P and N concentrations and sediment denitrification rates to estimate nutrient processing in an AOC.



Offshore systems can contribute excess nitrate to coastal systems.

Using hydroacoustic and field vegetation surveys to assess whether biota is constrained by the availability and quality of habitat.