Lake Superior Monitoring
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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

Depth Stratification
- Inshore ~25% of lake area
- Offshore ~73% of lake area

WQ, Plankton (Phyto- and Zoo-), Mysis, Benthos, Fish
54 stations (with USGS)

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

537 km track along shoreline at ~15-30 m contour, 2004
In situ sensors oscillated throughout water column along entire track to provide high-resolution picture of water conditions.
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.

Lower quality fish and bird habitat in harbor associated with sparse aquatic vegetation.

Higher quality habitat associated with dense aquatic vegetation.