

Proposed plans for monitoring and experimentation to assess water quality



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Ecosystem Stressors

- Land & Resource use
- Climate Change
- Invasive Species

Ecosystem Characterization

- Watershed model
- Hydrodynamic model
- Biophysical data and processes

Ecosystem Models

Simple statistical (e.g. regression)	Artificial Neural network	Empirically based (Bayesian)	Coupled bio-physical 3D models
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Socio-economic integration to guide management

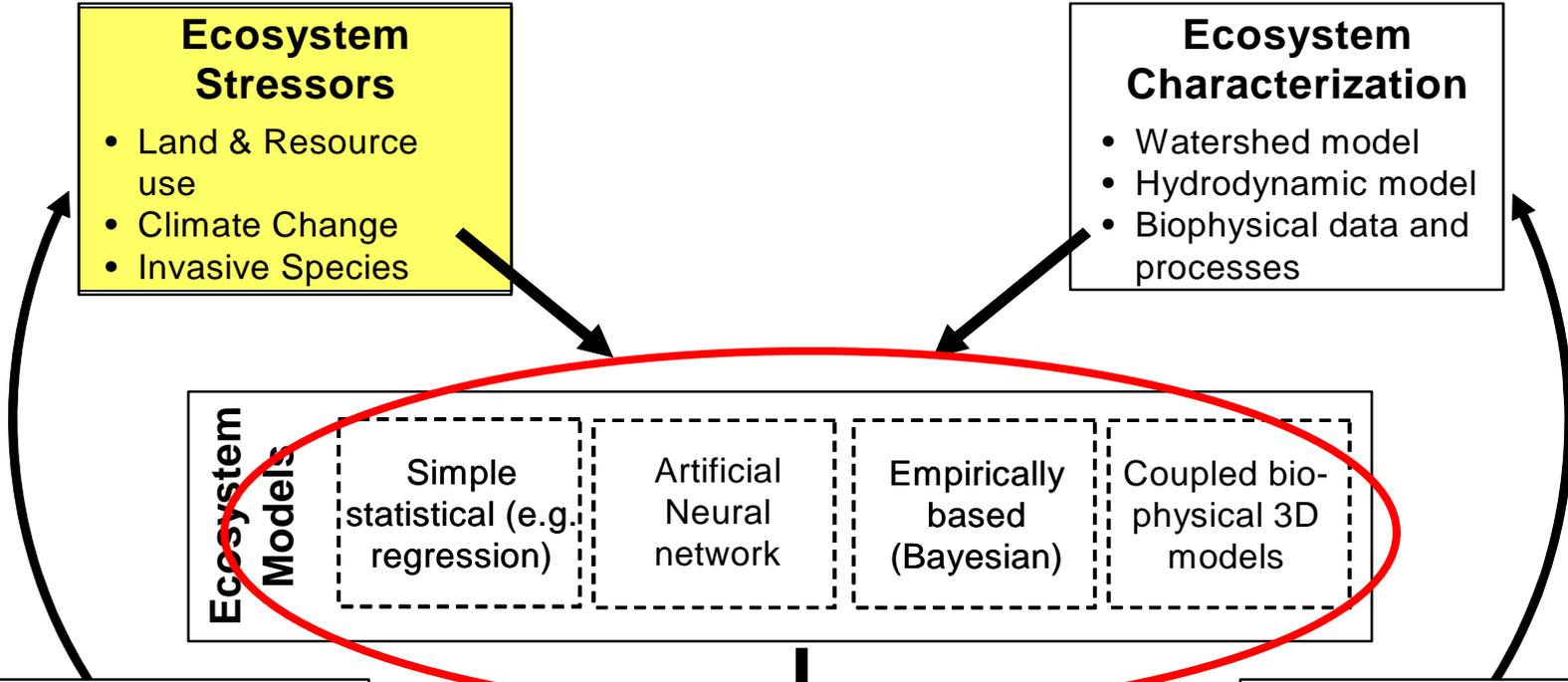
- Economic models
- Public preference
- Workshops

Ecosystem endpoints

Fish community dynamics	Water quality & Human health
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Recommendations for ecosystem characterization

- Experimental
- Monitoring
- Synthesis



Input into models

Statistical modeling

- as much current and historical water quality data as possible

Neural nets

- as much current and historical water quality data as possible

Bayesian

- muck survey (source, main constituents)
- relationship between mussels and algae
- P availability from mussels
- PAR measurements, esp nearshore

Inputs into models

Bio-physical model (SAGEM2)

- Nutrients (water column and sediment)
 - total P, DIP, NO₃, NH₄, TKN/DKN, POC, DOC
 - conc and fluxes from sediments
- Physical
 - flow, TSS, VSS, turbidity, temp, Secchi, DO, wind speed and direction
 - CTD and LISST (particle size) profiles of water column
- Biological
 - chl a, phyto and zoop species enumeration and biovolume
 - dressenids: density, length, nutrients
 - Cladophora*: biomass, distribution, nutrient content

Hydrodynamics

- current measurements (ADCP, drifters)
- meteorological data (wind, humidity, temp, waves)

P load model

- frequent spatial and temporal phosphorus concentrations

Modeling

Water Quality

Monitoring

- Current and historical data on basic water quality parameters

Experimentation

- Answer key knowledge gaps
- Responsive to management needs

Management

- Using modeling outputs to make decisions



Water Quality Group

Top Management Objectives



- Predict and manage:
 - **muck** deposition on beaches
 - *E. coli*/**pathogens**
- Identify management efforts or policy changes that would reduce the impacts of **contaminants**
(i.e. dredging of hot spots)
- Manage **sediment loading**
- Understand and manage the impacts of **agriculture**
(i.e. nutrient loads, sedimentation, *E. coli*)

Research Priorities

Water Quality

What are the factors controlling beach muck?

- benthic algal growth
- transportation

What is the nutrient load to Saginaw Bay?

- watershed loading
- sediment resuspension and nutrient flux
- recycling by dreissenid mussels

Additional concerns

- pathogens
- contaminants
- HABs

Water Quality Research

Monitoring

Juli Bressie

Experimentation

- What are the factors controlling beach muck?

- benthic algal growth
- transportation

Scott Peacor

Nathan Hawley

- What is the nutrient load to Saginaw Bay?

- watershed loading
- sediment resuspension
- nutrient flux from sediments
- recycling by dreissenid mussels

Nathan Hawley

Donna Kashian

Donna Kashian

Management

Bruce Walker

2008 Monitoring

12-15 May 2008



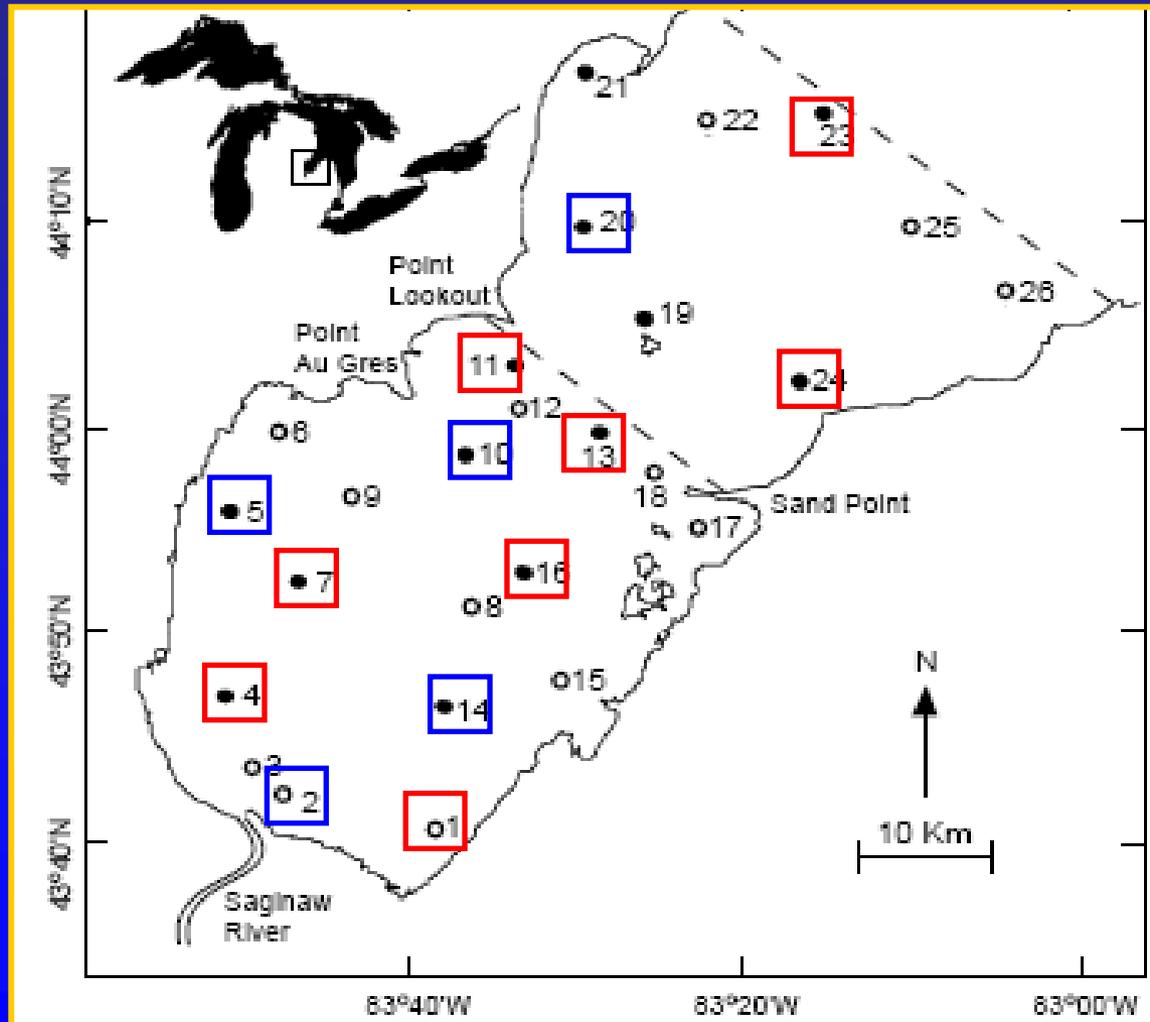
21-24 July 2008



9-10 Sept 2008



Sampling stations



Blue: Master (5)
Red: Basic (8)

2008 Sampling

Physical

- CTD cast
- Secchi

Water quality

- Nutrients:
total P, SRP, TDP, particulate CN, DOC, NO₃, NH₄, SiO₂, Cl

Phytoplankton

- chlorophyll *a*
- phytoplankton groups by HPLC
- phytoplankton preserved for counting

Microzooplankton

- 1 formalin preserved and 1 Lugol's preserved (2%)

At every station (1m water only)

2008 Sampling

Additional sampling at 5 Master stations:

Phytoplankton

- microcystin
- genetics

Zooplankton

- vertical net tows

(also collected water from 1m above bottom for all analyses)

2008 Sampling

Benthic algae:
Diving and snorkeling survey



2008 Sampling

Muck survey:

- limited sampling
- citizen surveys

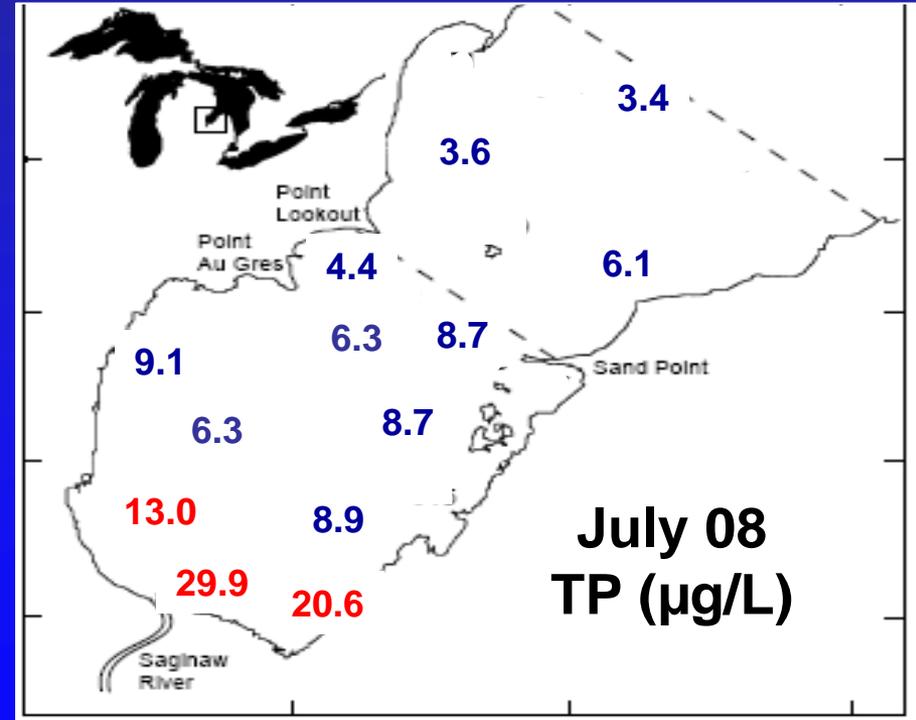
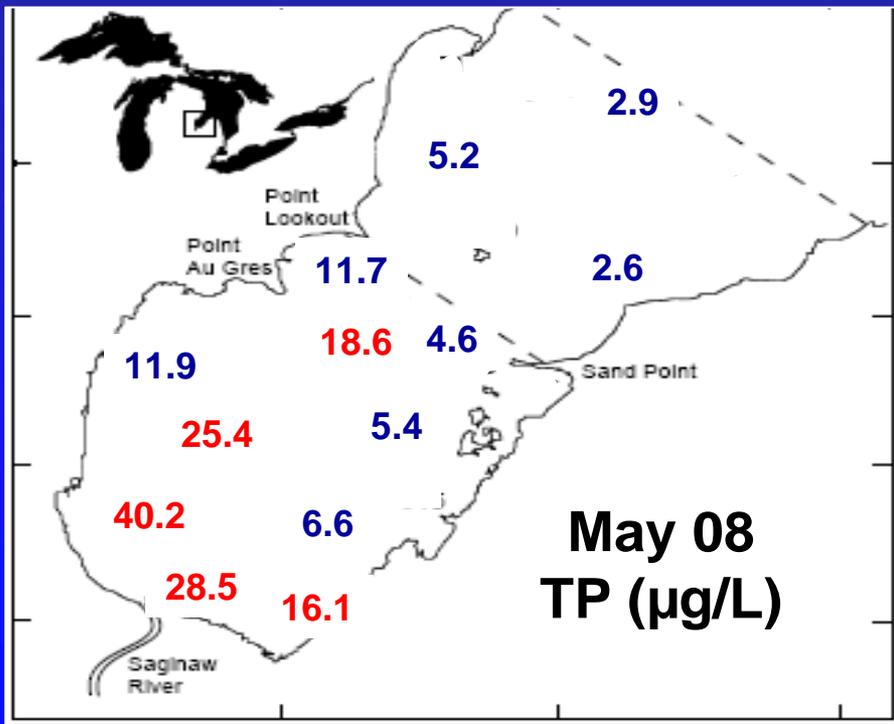


2008 Nutrient data

Water quality

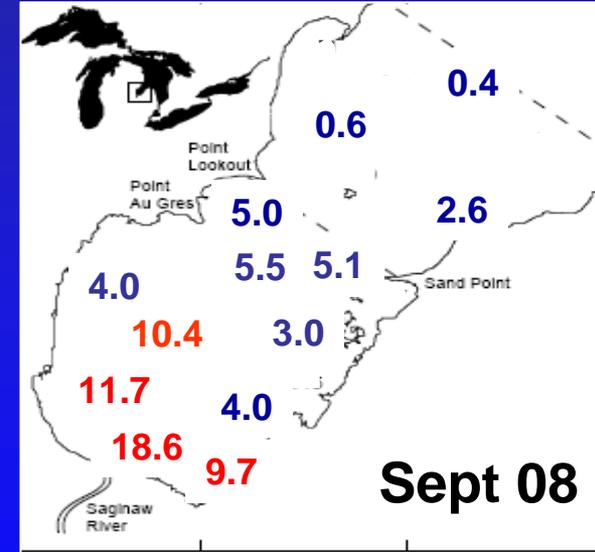
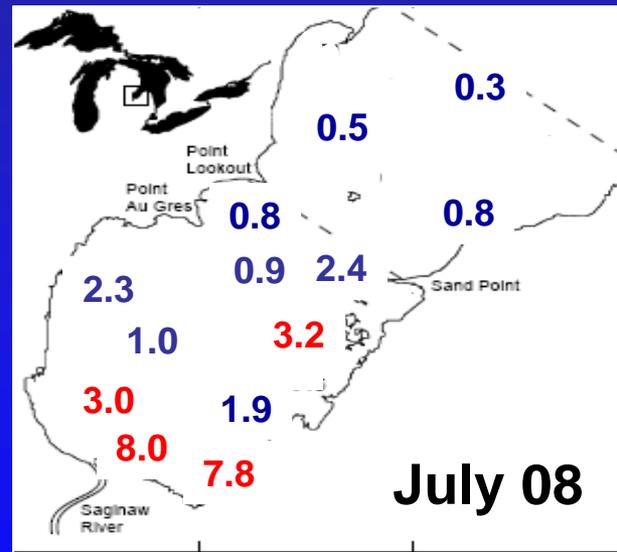
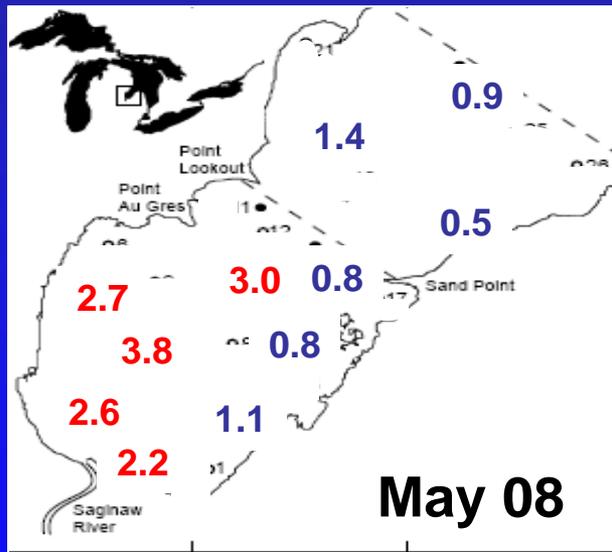
- Nutrients:

total P, SRP, TDP, particulate CN, DOC, NO₃, NH₄, SiO₂, Cl



Target concentration 15 $\mu\text{g/L}$

Chlorophyll *a* ($\mu\text{g/L}$), surface



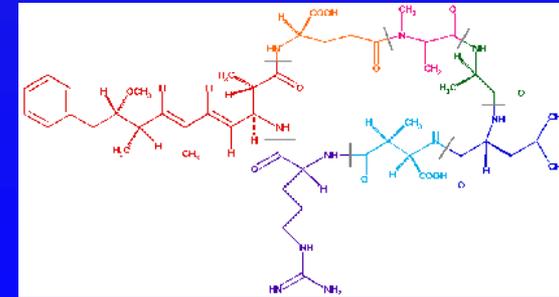
2009 plans

Monitoring

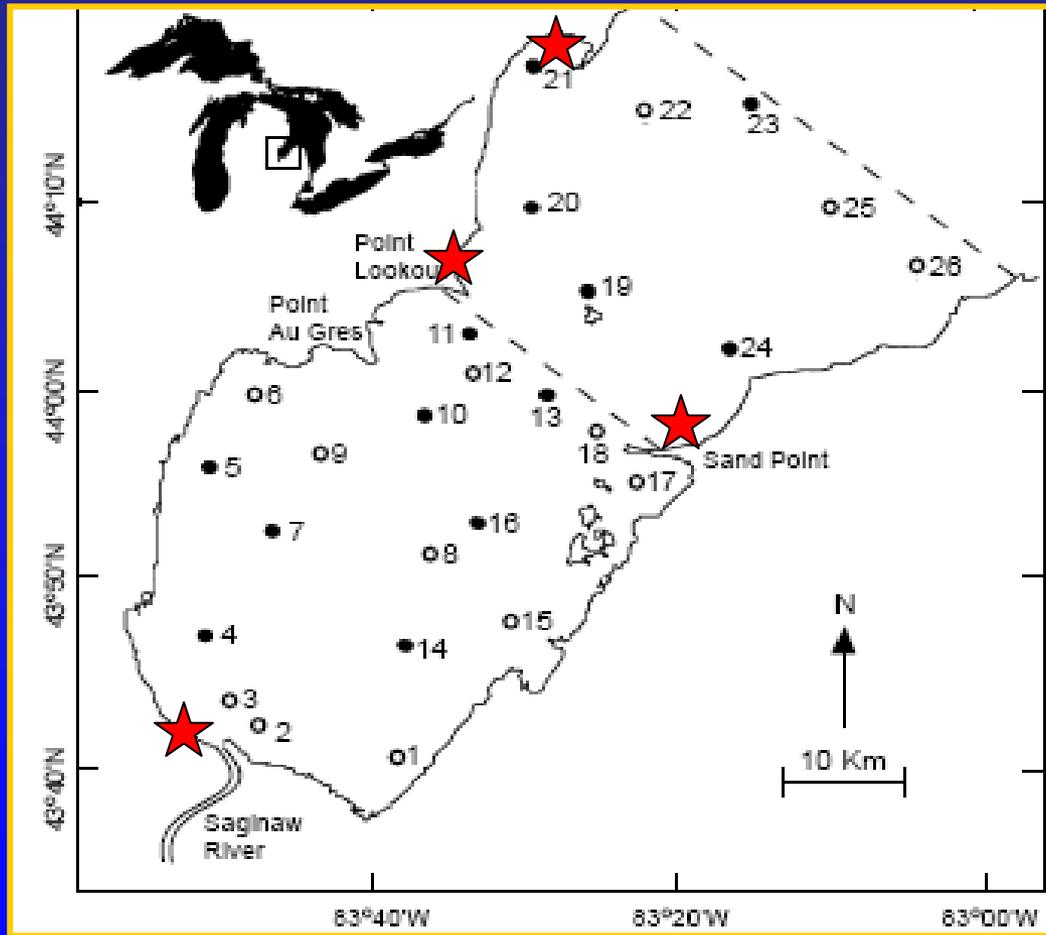
- same parameters as 2008, monthly

Experimentation

- benthic algal growth
- P flux from sediments
- P recycling by dreissenids
- sediment transportation and resuspension
- HABs – *Microcystis* toxin production, drinking water supplies



2009 plans



Drinking water intakes

- Bay City
- Whitestone Point
- Tawas
- Caseville

2009 plans

Monitoring

- same parameters as 2008, monthly

Experimentation

- benthic algal growth
- P flux from sediments
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Management

- further development of various models