An update on the Saginaw Bay multiple stressors project

5 year grant
NOAA Center for Sponsored Coastal Ocean Research

NOAA Great Lakes Environmental Research Laboratory
Michigan State University
University of Michigan
University of Akron
Limno-Tech, Inc.
Western Michigan University
Michigan Department of Natural Resources
Michigan Department of Environmental Quality

Also featuring
Wayne State
Purdue
Case Western
Duke
Eastern MI
Project has several components:

- Water quality
- Fisheries
- Human dimensions
We’ve already learned a few things...

- Eutrophic
- Shallow: mean depth 5m

Data courtesy of Nathan Hawley
Real-Time Information On Web

Currents

Temperature

Saginaw River Plume

http://www.glerl.noaa.gov/res/glcfs/sb/
2009 Sampling

Benthic algae: Diving and snorkeling survey
Benthic algae:
Diving and snorkeling survey
Benthic Algae Methods

- Early season - surveyed entire inner bay
  - Mixed substrate
  - Found primarily *Chara*
  - Some macrophytes
  - Little filamentous algae growth, mostly in southwestern region
Benthic Algae Methods

- Focused efforts in southwestern inner bay
- Six transects:
  - Depths: 0.5, 1.0, 2.0, 3.0, 4.0 meters
  - Deeper if algae still present
- Surveyed all transects twice (July and August)
- Transect 11 surveyed five times between July and September
2009 Benthic Algae

Biomass by Transect Location

<table>
<thead>
<tr>
<th>Transect location</th>
<th>Weight (g/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Macrophytes</td>
</tr>
<tr>
<td>11</td>
<td>Filamentous algae</td>
</tr>
<tr>
<td>13</td>
<td>Chara</td>
</tr>
<tr>
<td>14</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
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<tr>
<td>18</td>
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</tbody>
</table>

Legend:
- Green: Macrophytes
- Red: Filamentous algae
- Blue: Chara
Transect 11 Biomass by Depth

![Graph showing mean biomass (g/m²) by depth (m) for Transect 11 with data categories: Macrophytes, Filamentous algae, Chara. Heights and colors corresponding to different categories at each depth level.]
Transect 11 Biomass over Time

Mean Biomass (g/m²)

Date (2009)

9-Jul 24-Jul 12-Aug 19-Aug 20-Sep

Data courtesy of our MSU partners
Dianna Dzieken
Kim Peters
Scott Peacor

- Chara
- Filamentous algae
- Macrophytes
Hear ye! Hear ye!

By Joint Proclamation
Henceforth and foreverafter

Saginaw Bay shall meet a target phosphorus load of:

440 tonnes/year

which probably translates to about 15 ug/L
Total Phosphorus Load vs. Time
(with uncertainty)
$p \ ( \text{annual load} > 440 \text{ metric tons/yr} )$
Total Phosphorus Concentration vs. Time
(with uncertainty)
What’s the role of the Dreissenid Mussels (zebras and quaggas)?
Saginaw Bay Phosphorus Sedimentation vs. Time (with uncertainty)
2009 Dreissenid Observations

- SCUBA divers observed that benthic algae growing on mussels appeared “healthier” and greener than algal growing on other substrate.

<table>
<thead>
<tr>
<th></th>
<th>In Saginaw Bay:</th>
<th>In Lake Michigan:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Transect 11, 3.0 m August 15, 2009</td>
<td>![Photo from Bootsma et al. 2006]</td>
</tr>
<tr>
<td>Cladophora Filament Length (cm)</td>
<td><img src="image" alt="Cladophora growing on zebra mussels" /></td>
<td><img src="image" alt="Cladophora growing on bare rock" /></td>
</tr>
<tr>
<td>On Mussels</td>
<td>Mean 3.26</td>
<td><img src="image" alt="Photo from Bootsma et al. 2006" /></td>
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<tr>
<td></td>
<td>Std.Dev. 2.03</td>
<td></td>
</tr>
<tr>
<td>On Rock</td>
<td>Mean 2.04</td>
<td><img src="image" alt="Photo from Bootsma et al. 2006" /></td>
</tr>
<tr>
<td></td>
<td>Std.Dev. 1.00</td>
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</tbody>
</table>
Saginaw Bay Dreissenid Mussel Density

Data courtesy of Tom Nalepa
Age-1 + walleye diet-fish only (% by number)

2009 Sampling
Data courtesy of Tomas Hook

Spring = May, June
Summer = July, August, September
Fall = October, November
Microcystis in the Great Lakes

- Colonial harmful algal bloom species (HAB)
- Forms blooms and scums
  - Taste/odor issues
  - Loss of recreational and fishing value to affected waters
  - Hypoxia/anoxia, may lead to mortality in benthic invertebrate community and fish kills
Summary
Some Surprises
  - Mussel densities down
  - Mix of benthic algae – seasonal progression?
  - Periodic vertical stratification

Still some big unknowns
  - Do mussels supply phosphorus to benthic algae?
  - Link between water levels and muck?

Plans for this year
  - Ambient Water Quality Survey
  - Fishery Survey
  - Buoy and sensor deployment
  - Current meter deployment
  - Benthic algae survey
  - Mussel Survey
  - Experiments on mussel/phosphorus interactions
What can we do?

Revisit expectations
- Broken vs. Fixed – old view
- Lake continuously change and adapt
- Recognize uncertainty
- Improvements may be gradual

Support those who must adapt

Support long-term monitoring