Source Tracking in the Saginaw Bay and Great Lakes Applications

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Ottawa County Water Quality Forum
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Saginaw Bay Issues

Nutrients
Light
Temperature
Physical stressors

Spirogyra

Muck
• *Spirogyra, Cladophora, detritus*
• Masses do contain bacteria
  (Whitman et al. 2003, AEM v.69)
• Aesthetic issues
• People removing it from beach

Pollutants
• Urban development
• Wetland degradation
• Wastewater discharges
• Agriculture waste
• Industrial outfalls

Dr. Juli Dyble Bréssie
Research Questions

• What are the sources of fecal pollution entering Saginaw Bay?

• What are the bacteria concentrations in Saginaw Bay across beach transects?

• How do environmental conditions relate to bacteria concentrations on the beach?
**Measuring Water Quality**

*E. coli*: Drinking and recreational water quality criteria but regrow in environment, high correlation with gastroenteritis in freshwater

*Enterococci*: Indicator of recent fecal pollution but regrow in environment, high correlation with gastroenteritis in freshwater,

*C. perfringens*: Indicator of persistent intestinal pathogens like viruses and oocysts of protozoa and long term, older inputs of fecal pollution

*Coliphage*: A good indicator of enteroviruses and recent fecal contamination

*Enterococci esp gene and Bacteroides human and bovine markers*

*Sanitary surveys and GIS*
The Beachscape

SHALLOW WATER

MUCK

SEDIMENT
Sample Sites

- Port Crescent State Park
- Caseville County Park
- Whites Beach
- Bay City State Recreation Area

<table>
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<tr>
<th>Sample location</th>
<th>Total number of samples assayed</th>
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<td>Sediment</td>
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<td>Shallow water</td>
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<td>Swimmable water</td>
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Beachscape

Analysis in SPSS:
• Linear regression
• Pearson correlations
• ANOVA
• ANCOVA

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<th>Sampling dates</th>
<th>Number of samples collected</th>
<th>Sediment samples</th>
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<th>Shallow water samples</th>
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FIB in Water

Fecal indicator concentrations in the shallow and swimmable waters

- **E. coli** exceeded standards 8 times in the shallow (235 CFU/100 ml)
- **Enterococci** exceeded standards 10 times in the shallow (61 CFU/100 ml)
FIB in Non-Water

Higher levels of fecal indicators in muck

Standards and reporting
Beachscape trends

Positive detections in each zone for *C. perfringens* and coliphage

- **Muck**
  - % *C. perfringens* positive: 80.0%
  - % positive male specific phage: 40.0%
  - % positive somatic phage: 20.0%

- **Shallow water**
  - % *C. perfringens* positive: 100.0%
  - % positive male specific phage: 50.0%
  - % positive somatic phage: 30.0%

- **Swimmable water**
  - % *C. perfringens* positive: 60.0%
  - % positive male specific phage: 20.0%
  - % positive somatic phage: 10.0%

- **Sediment**
  - % *C. perfringens* positive: 120.0%
  - % positive male specific phage: 70.0%
  - % positive somatic phage: 20.0%

Sample zone

- % *C. perfringens* positive
- % positive male specific phage
- % positive somatic phage
Prevalence of Markers

- Total esp:
  - 6% Positive
  - 94% Negative
  - n=48

- esp positives:
  - 67% Sediment
  - 33% Muck
  - n=3

- Bay City Recreation Area esp positive:
  - 83% Positive
  - 17% Negative

- Caseville County Park esp positive:
  - 71% Positive
  - 29% Negative

- Bovine and human Bacteroides not detected in 27 samples assayed
- esp not detected in swimmable or shallow water samples
Precipitation and FIB

Total 24 hour rainfall and *E. coli* concentrations in the sediment

- Rainfall decrease water quality (Whitman and Nevers 2003, AEM v.69, Boehm et al. 2002, EST v.36; Lipp et al. 2001, Estuaries v.24)
- Temperature indirectly related to *E. coli* levels
- Wind driven system
- 976 square miles of residential, forest, and agricultural land use
- 181 miles of shoreline
- 130 public beaches
- 149 inland lakes
Sample Sites

- Traverse City State Park
- West Bay Beach
- Bryant Park Beach
- Storm drains
- Mitchell Creek (8 sites)
Beach Water Quality

- Impacted by rain, wind, birds, wave height
- 6 (16%) enterococci exceedances (>61 organisms/100 ml) when *E. coli* was below EPA criteria (235 organisms/100 ml)
- Impacted by precipitation and air temperature

- 60 (54%) enterococci exceedances (>151 organisms/100 ml) when *E. coli* was below EPA criteria (575 organisms/100 ml)
Preliminary Results

1. *E. coli* exceedances in 2009
   - 1 at Bryant Park Beach
   - 1 at Milliken Park Beach
   - 552 exceedances for all of Michigan

2. Beaches: Coliphage present in similar concentrations as *E. coli* at all sites: recent pollution

3. Mitchell Creek: Coliphage higher than *C. perfringens* at all sites: recent pollution

4. Water quality decreases prior to airport (MC 5) and remains elevated through mouth of river (MC 1)
Additional Efforts

Beach protection and keeping them pristine
  – Routine monitoring program
  – Stormwater improvements
  – Sanitary surveys
Additional Efforts

Pet waste removal

Water quality results

Benthic algae survey

Ordinances prohibiting feeding waterfowl

Waste management
Additional Efforts

Community outreach and education

- Leave your worries: not your litter. Please recycle or throw away your trash.
- Takin' care of business: is every pet owner's job. Scoop it, bag it, trash it!
- Can a bird get some privacy?
  - You feed 'em on the beach, they go on the beach. Please don't feed waterfowl to help reduce E. Coli.
- The beach is not your bathroom: Please keep our beaches healthy. Take frequent bathroom trips.

Healthy Beaches
13272 S. West Bayshore Dr.
Traverse City, MI 49684
906.1914 gbay.org
Additional Efforts

Community outreach and education

Bay Day

Adopt-a-stream
Local Applications

Buck Creek Watershed

- Allegan and Kent Counties
- Part of Lower Grand Watershed

Outcomes

- Strong bovine influence
- Human sewage detected
- Stormwater runoff
- ID manure source
Local Applications

Coldwater River Watershed
- Kent, Ionia, Barry Counties
- Lower Grand River Watershed

Outcomes
- Strong bovine influence
- Human sewage detected
- Drain improvements
- Agriculture and community collaboration
Local Applications

Grand River

- Pathogen transport study
- Flow models
- Virus testing in sediment
- CSO characterization
- Human health implications
Local Applications

- MSU/MSUE
- Grand Valley State University
- The Upper Grand River Watershed Alliance
- Friends of the Middle Grand River
- West Michigan Environmental Action Council
- West Michigan Strategic Alliance
- Watershed and river councils
- Health Departments
Future Efforts

- Environmental factors impact on water quality
- ID sources of pollution
- Healthy Beaches Campaign
- Stormwater remediation
- Predictive models
- Form alliances
Thank You

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