

Muskegon Lake AOC

Evaluating targets for two BUIs:

loss of fish habitat & degradation of fish populations

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- MLWP and WL-PAC

Muskegon Lake Impairments (RAP 1987)

- Direct discharge:
 - Industrial process wastewater
 - Municipal wastewater effluent
 - Storm sewer overflows & urban runoff
- Degraded water & habitat quality:
 - Caused algal blooms & ↓ [O₂]
 - Tainted fish & contaminated sediments
- Petroleum, chemical & heavy industries contaminated groundwater

Remediation

- Wastewater treatment facility (1973)
 - Improved water quality
- Clean-ups of contaminated sediments

Muskegon Lake: Fish Populations

- Excellent fishery (RAP 1987)
- Good-to-excellent fishing (O'Neal 1997)

Other Fish Population Issues

- Walleye are stocked
- Native fish extirpated or threatened





<http://www.dnr.ohio.gov>


Setting Targets

Goals:

- Quantitative target
- Use existing data

Approach:

- Use AWRI data (2004-2006)
- IBI



What is an IBI?

- Multi-metric index
 - Species richness & composition metrics
 - Indicator species metrics
 - Trophic function metrics
- Score = sum of metrics
 - ↓ score = “degraded” ecosystem
 - ↑ score = “healthier” ecosystem

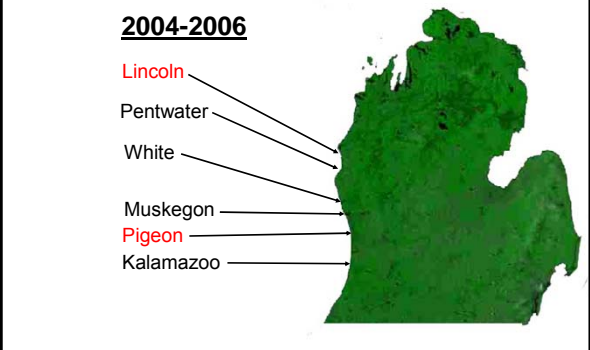
Strengths of IBI Approach

- Focus on fish community
- Indicator of ecosystem health
- Reveals episodic & cumulative disturb.
- IBI for coastal wetlands (Uzarski *et al.* 2005)
- Use available data

Study Sites:

2004-2006

- Lincoln
- Pentwater
- White
- Muskegon
- Pigeon
- Kalamazoo



Use of IBI for Target Setting

- 2004: Calibrate IBI
- 2004-2006: Use for target setting

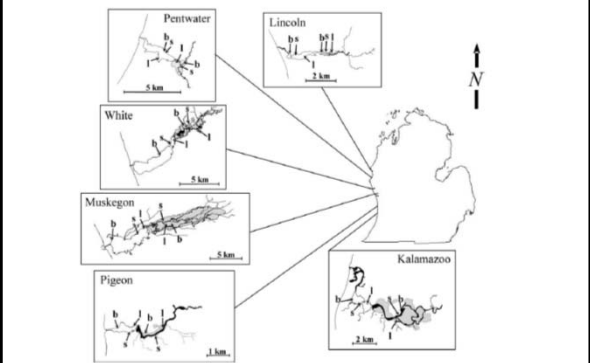


FIG. 1. Map of study locations in six Lake Michigan drowned river mouth systems. Within each system, we sampled lily (l), SAV (s), and bare sediment (b) microhabitats in both the lakes and adjacent wetlands. The small arrows indicate microhabitat sampling locations. The shaded areas in each inset indicate herbaceous wetland.

Cooper *et al.* (2007)

Drowned River Mouth Lake IBI: SAV Habitat

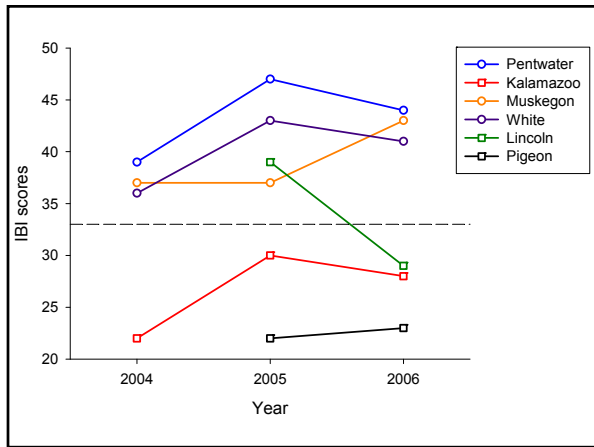
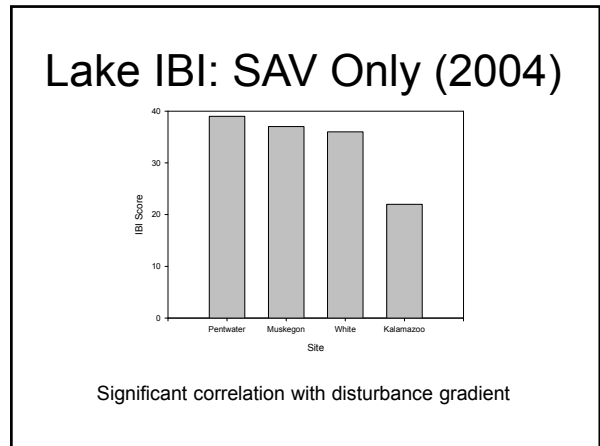
7. Centrarchidae richness:
 0 to 1 score = 0 >1 to 3 score = 3 >3 score = 5

8. Mean evenness:
 <0.2 score = 0 0.2 to 0.6 score = 3 >0.6 score = 5

9. Rock bass (*Ambloplites rupestris*) catch per net night:
 0 to 1 score = 0 >1 to 5 score = 3 >5 score = 5

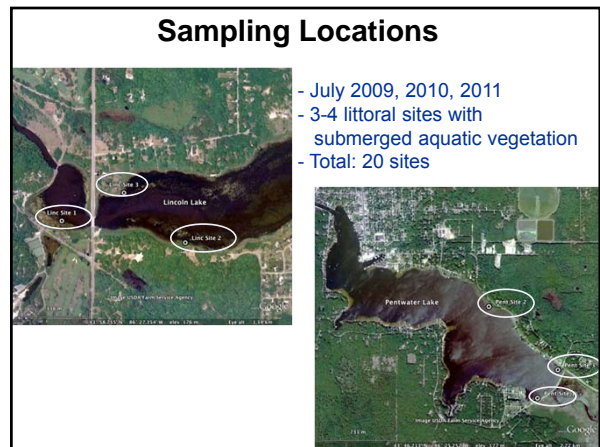
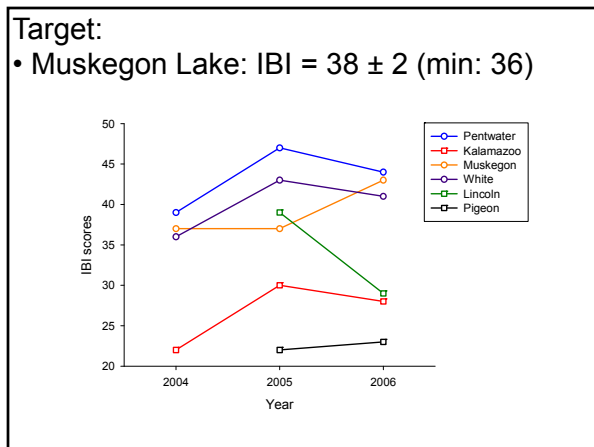
10. Bluegill (*Lepomis macrochirus*) catch per net night:
 0 to 3 score = 0 >3 to 20 score = 3 >20 to 30 score = 5 >30 score = 7

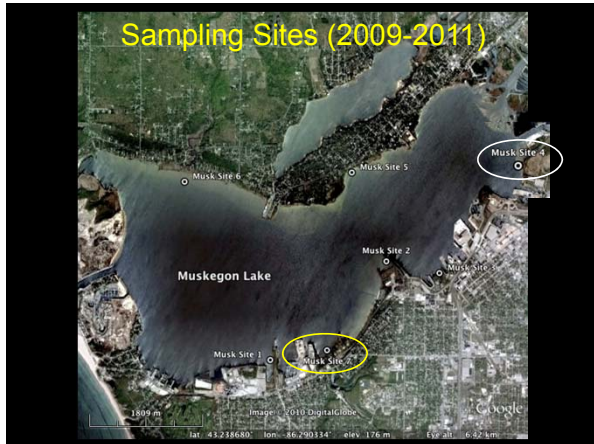
11. *Lepomis* catch per net night:
 >50 score = 0 >20 to 50 score = 3 >5 to 20 score = 5 0 to 5 = 7



Delisting Target

- To maintain or improve the lake's ecosystem health over a 3-yr period (2009-2011)
- Average IBI score \pm 1 SD





Fish Community Sampling




Habitat & water quality variables

- Latitude, longitude
- Temperature
- Specific Conductivity
- pH
- ORP
- Dissolved oxygen
- Organic Sediment Depth
- Depth
- Macrophyte coverage
- Soluble reactive Phosphorus
- Chloride
- Sulfate
- Nitrate

