Session 9

Implementing Great Lakes Coastal Wetland Monitoring

Dr. Donald G. Uzarski
Director of CMU Institute for Great Lakes Research
Director of CMU Biological Station
Associate Professor of Biology
Session Overview

• Session Includes Four Talks
  – All Talks Part of the Same GLRI Funded Project

1:40  A Basin-Wide Great Lakes Coastal Wetland Monitoring Program
  • Donald Uzarski, Central Michigan University

2:00  Great Lakes Coastal Wetland Monitoring Program: Support of Restoration Activities Across the Basin
  • Matthew Cooper, University of Notre Dame

2:20  Ecological Restoration Efforts in the St. Louis River Estuary: Application of Great Lakes Monitoring Data
  • Valerie Brady, University of Minnesota, Duluth

2:40  Great Lakes Coastal Monitoring Provides Baseline Plant Data for Sustainable Wetland Restoration Project
  • Dennis Albert, Oregon State University
Session Overview

• Introduce the Origin of our Project
  – Formation of the Great Lakes Coastal Wetlands Consortium (GLCWC)
  – GLCWC Partners with Great Lakes Environmental Indicators (GLEI)
  – GLRI Request for Proposals
About the Great Lakes Coastal Wetlands Consortium

• GLNPO RFP for $1.2 million (+600K Supplemental) in 2000
  – In response to SOLEC 96’ and 98’
    • Indicators of ecosystem health
  – Develop Bi-national Standardized Monitoring Program Based on SOLEC Indicators
    • Few, if any, SOLEC indicators were developed
The Great Lakes Coastal Wetlands Consortium

• 2000 Consortium was formed

• Joint facilitation GLC and GLNPO
  – 150 + Participants
    • 50 organizations (Federal, State/Provincial, Academic, NGOs)

• 2000 Consortium put out an RFP
  – Develop and evaluate metrics and protocols for measuring ecosystem health
The Great Lakes Coastal Wetlands Consortium

- Development and Evaluation Process had to Consider:
  - Cost
  - Measurability
  - Basin wide applicability
  - Data availability
  - Sensitivity to change
  - Endpoint levels
  - Statistical approach.

- Six proposals were selected by peer review.
The Great Lakes Coastal Wetlands Consortium

• Six proposals

• Conducted Pilot Studies 2002
  – Bain et al. (Ontario)
  – de Szalay et al. (Erie)
  – Ingram et al. (Ontario)
  – Timmermans et al. (Erie)
  – Uzarski et al. (Michigan & Huron)
  – Wilcox et al. (Michigan)
The Great Lakes Coastal Wetlands Consortium

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  – Wilcox et al. (Michigan)

Combined data + Uzarski et al. Superior data
The Great Lakes Coastal Wetlands Consortium

• During the Metric Development Phase
  – Parallel project with different goals
    • Great Lakes Environmental Indicators (GLEI) group

• GLEI goal:
  – To develop an integrated set of environmental indicators that can be used to assess the condition of the coastal margins of all five Great Lakes.
The Great Lakes Coastal Wetlands Consortium

• 2007 Duluth, MN- Consortium and GLEI
  – Ensure the best possible product

• Still considering
  – Cost
  – Measurability
  – Basin wide applicability
  – Data availability
  – Sensitivity to change
  – Endpoint levels
  – Statistical approach
  – …and specific to wetlands
The Great Lakes Coastal Wetlands Consortium


- GLRI- GLNPO RFP for $10M to Monitor Coastal Wetlands using GLCWC protocols 2009

- Awarded in 2010
A Basin-Wide Great Lakes Coastal Wetland Monitoring Program

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Presentation Outline

• Briefly Discuss Some Results to Date

• Data Base and Users

• Supporting Restoration and Conservation Efforts

• Supporting Additional Research Projects

• Training and Jobs Created

• Interested Parties Including China

• Post 2015
Current Research
Measure Ecosystem Health
~1039 Coastal Wetlands

- **Chemical/Physical**  Uzarski et al. 2008
- **Invertebrates**  Uzarski et al. 2004
- **Fish**  Uzarski et al. 2005
- **Plants**  Albert 2008
- **Birds**  Grabas et al. 2008
- **Amphibians**  Timmermans et al. 2008
- **Landscape**  Bourgeau-Chavez et al. 2008
Category Scores

- Extremely Degraded: (0 to 15% of possible score)
- Degraded: (>15 to 30% of possible score)
- Moderately Degraded: (>30 to 50% of possible score)
- Moderately Impacted: (>50 to 70% of possible score)
- Mildly Impacted: (>70% to 85% of possible score)
- Reference Conditions: (>85 to 100% of possible score)
Statistical Design

- maximize efficiency in detecting both
  - Status
  - Trends

- Status and Trends are conflicting goals
Statistical Design

- Status = Capture Spatial Variance
- What is the status or health of (all) GL wetlands?
Statistical Design

- Trends = Capture Temporal Variance
- How is GL wetland health changing over time?
- Sample fewer sites, repeatedly
### Design 4 - Partially Augmented Serially Alternating

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**Revisits**
- Year 2 revisit sub-panel 1A
- Year 3 revisit sub-panel 2A
- Year 4 revisit sub-panel 3A
- etc.
Chosen Design

- Randomly Selecting Wetlands to Sample
  - Re-sample Subset Two Consecutive Years

- Stratify by Region by Lake

- Design Superior to Others
  - Good Estimate of Variation in Wetland x Year Interaction.
  - Eventually Sample Many Different Sites
  - Less Impact on Wetland from Over Sampling
    - Sampling Year after Year = Disturbance
Great Lakes Coastal Wetland Vegetation Condition (draft) as Indicated by the Floristic Quality Index.
Great Lakes Coastal Wetland
Macroinvertebrate Community Condition (draft),
based on the GLCWC Wetland Macroinvertebrate IBI

- **Degraded**
- **Moderately Degraded**
- **Moderately Impacted**
- **Mildly Impacted**
- **Reference Conditions**

Kilometers
Currently Working on 5 Year $10 Million Research Project
CMU GLRI Lead

University of Minnesota
University of Wisconsin
Grand Valley State University
University of Notre Dame
Lake Superior State University
University of Windsor
Michigan DEQ
SUNY-Brockport
Environment Canada
Bird Studies Canada

GLIC-Wetland Monitoring Map: Location of Great Lakes coastal wetlands previously sampled by GLCWC and GLEI teams, 2001-2006. Locations of this proposal’s collaborating teams are also shown.
Data Base

- **Access to the Data Base**
  - **USEPA and Project Researchers**
    - Full Access to Raw and Analyzed Data with Manipulation Capabilities
  - **State and Federal Wetland Managers**
    - Full Access to Raw and Analyzed Data
  - **NGOs Working on Restoration and Conservation**
    - Full Access to Analyzed Data (and Case by Case for Raw Data)
  - **General Public**
    - Access to Summarized Analyses
Supporting Restoration and Conservation Efforts

- **Minnesota Land Trust**
  - Lower St. Louis River estuary – large-scale habitat restoration removing beneficial use impairments

- **Loyola University Chicago**
  - St. Marys & Galien River – evaluate restoration efforts of invasive species removal for biogas

- **St. Marys River Binational Public Advisory Council**
  - St. Marys River & Little Rapids area – pre-restoration monitoring and habitat assessment of Areas of Concern (AOCs)

- **US Department of the Interior, Fish and Wildlife Service**
  - Rochester Embayment Area of Concern – habitat assessment to address beneficial use impairment delisting criteria

- **US Department of the Interior, National Parks Service**

- **The Nature Conservancy**
  - Lakeview Wildlife Management Area, Sodus Bay – habitat monitoring for baseline information to assist in evaluating conservation efforts
  - Erie Marsh Preserve and North Maumee Bay – pre-restoration habitat monitoring and post-restoration habitat assessment of reconnecting the diked marsh to North Maumee Bay
Supporting Restoration and Conservation Efforts

- State of Michigan, Department of Natural Resources
  - St. Marys River & Little Rapids area – monitoring fish and benthos conditions to aid in delisting Beneficial Use Impairments in AOCs
  - William C. Sterling State Park, Lake Erie – evaluation of wetland restoration efforts especially in regards to vegetation, fish, and shorebirds
- Ducks Unlimited
  - Rochester Embayment Area of Concern, Braddock Bay – pre-restoration monitoring for restoring native sedge meadow habitat
- Minnesota Pollution Control Agency
  - Lower St. Louis River Area of Concern – large-scale habitat restoration for removing beneficial use impairments
- New York State Department of Environmental Conservation
  - Lakeview Wildlife Management Area – habitat monitoring and marsh bird data collection for the statewide Marsh Bird Monitoring Program
- Fond du Lac Environmental Program
  - Spirit Lake and Kilchliss Meadows, St. Louis River Estuary – pre-restoration monitoring for aquatic vegetation restoration and habitat improvement
- State of Wisconsin Department of Natural Resources
  - Clough Island, St. Louis River estuary – pre-restoration habitat assessment to establish baseline conditions
  - Wisconsin coast of Lake Superior – habitat monitoring especially with regards to rare species observation, invasive species detection, and climate change effects.
Uzarski Lab Spin-Off Projects

• North Maumee Bay chemical/physical characteristics and community composition of Diked vs. Un-Diked Wetlands

• Importance of coastal wetlands to offshore fishes of the Great Lakes: Dietary support and habitat utilization

• Spatial variation in macroinvertebrate communities within two emergent plant zones in Great Lakes coastal wetlands

• Functional indicators of Great Lakes coastal wetland health

• Evaluating environmental DNA detection alongside standard fish sampling in Great Lakes coastal wetland monitoring

• Impacts of drainage outlets on Great Lakes coastal wetlands

• Effects of anthropogenic disturbance affecting coastal wetland vegetation
Uzarski Lab Spin-Off Projects

• Great Lakes coastal wetland seed banks: what drives compositional change?

• Spatial scale variation in patterns and mechanisms driving fish diversity in Great Lakes coastal wetlands

• Building a model of macroinvertebrate functional feeding group community through zone succession: Does the River Continuum Concept apply to Great Lakes coastal wetlands?

• Scale dependence of dispersal limitation and environmental species sorting in Great Lakes wetland invertebrate meta-communities
Uzarski Lab Spin-Off Projects

- Larval fish use and assemblage composition between different wetland types
- Determining wetland health for selected Great Lakes Coastal Wetlands and incorporating management recommendations
- Invertebrate co-occurrence trends in the wetlands of the Upper Peninsula and Western Michigan and the role of habitat disturbance levels
- Fish species co-occurrence in northern Michigan Wetlands
Spin-off Projects Encompass a Broad Range of Ecological and Environmental Disciplines

- A biofuel research project partnered with Kettering University and Swedish Biogas
- A broad scale project comparing Great Lakes coastal wetlands with Pacific Northwest estuaries
- Comparing DNA detection with standardized monitoring techniques
- Heavy metal and toxicant loads in turtles located within coastal wetlands
- Sonar-derived estimates of plant presence and abundance
- Invasive species tracking and detection
Jobs Created/Supported

- Principle Investigators: 14
- Post-doctoral researchers: 1
- Graduate students: 30
- Undergraduate students: 52
- Technicians: 25

122 Paid Positions & 21 Volunteers
Threatened & Endangered Species

**Birds**
- Common terns (threatened in Wisconsin & Minnesota), Duluth-Superior Harbor; Allouez Bay, WI
- Least Bittern (Threatened in New York), Hebblethwaite Drian wetland Lake Erie, Ontario
- Black Tern (Endangered in New York), northern Lake Michigan; Lake St. Clair wetlands
- Nesting pairs of bald eagles (special concern), St. Louis River estuary, Allouez Bay, WI
- Common loons (special concern), Madeline Island, WI and various wetland types within island complexes
- Sandhill cranes (special concern), Allouez Bay, WI
- Sora rails (special concern), Fish Creek Wetland, WI; Hebblethwaite Drian wetland Lake Erie, Ontario
- Yellow rails (special concern), Munuscong River Delta, MI
- American white pelican (special concern)
- Wilson’s snipe (special concern)
- Wilson’s phalarope (special concern)
- Northern harrier (special concern)
- Forster’s tern (special concern)

**Vegetation**
- Michigan monkey-flower (federally threatened), Epoufette Bay
- American lotus (rare plant), western Lake Erie marshes
- Montevidense’s arrowhead (rare plant), western Lake Erie Marshes
- Several orchid species considered rare but not federally or state listed were found within several coastal wetlands: Loesel’s twayblade, rose pogonia, grass-pink, and hooded ladies’-tresses orchids
- Beck’s water marigold (species of conservation interest)
- Houghton’s goldenrod (species of special concern), Scott Point Wetland Complex
- Wild rice (special concern), Lake St. Clair wetlands; Long Point Lake Erie; White River northern Lake Michigan

**Fish**
- Grass pickerel (rare), Presqu’ile Bay Marsh, Lake Ontario

**Reptiles**
- Eastern fox snake (threatened), Point Au-Baril, Lake Erie
- Blanding’s turtle (at risk, Ontario), North Maumee Bay Lake Erie
- Eastern musk turtle (at risk, Ontario), Roberts Island and Tobie’s Bay, Honey Harbor, Ontario
Invasive Species

Vegetation
- Expansion of frog-bit (*Hydrocharis morsus-range*) in western Lake Erie, Lake St. Clair, and the St. Marys River
- Distinguishing *Phragmites australis* subspecies into native and invasive populations to improve tracking and expansion data, especially in Northern Lake Huron where the native species is predominant
- Signs of *Phragmites australis australis* control were documented in Saginaw Bay (Lake Huron), Green Bay (Lake Michigan), and the western basin of Lake Erie.
- *Phragmites* expansion in northern Lake Huron and Georgian Bay wetlands was noted
- Eurasian water-milfoil, throughout the Great Lakes basin
- Narrow-leaf cattail and hybrid cattails, throughout the Great Lakes basin
- Curly pondweed, throughout the Great Lakes basin
- Sago pondweed, Lake Ontario basin, 73% of sites
- Reed canary grass, Lake Ontario basin, 55% of sites
- Field thistle, Lake Ontario basin, 18% of sites
- Flowering-rush, Lake Ontario basin, 14% of sites
- Curly dock, Lake Ontario basin, 5% of sites
- Water chestnut, Lake Ontario basin, 5% of sites

Fish
- Round goby
- Alewife
- Eurasian carp
- White perch
- Goldfish
- Rudd
- Tubenose goby, Quarry Island, Georgian Bay Lake Huron; Lake St. Clair delta

Invertebrates
- Chinese mystery snail, Tobie’s Bay wetland
Post 2015

• Stratified Random Design
  – Allows Subsampling
    • 80-100 Sites Per Year (?)

• Sample Fewer Groups of Organisms (?)
Thank You!