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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

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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

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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

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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

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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.

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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)

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The Great Lakes Coastal Wetlands Consortium

- Six proposals

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  - Timmermans et al. (Erie)
  - Uzarski et al. (Michigan & Huron)
  - Wilcox et al. (Michigan)

Combined data
+ Uzarski et al. Superior data

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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.

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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

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The Great Lakes Coastal Wetlands Consortium

- Consortium Submitted Final Product to US EPA March 2008.
- http://www.glc.org/wetlands/
- GLRI- GLNPO RFP for $10M to Monitor Coastal Wetlands using GLCWC protocols 2009
- Awarded in 2010

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A Basin-Wide Great Lakes Coastal Wetland Monitoring Program

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

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

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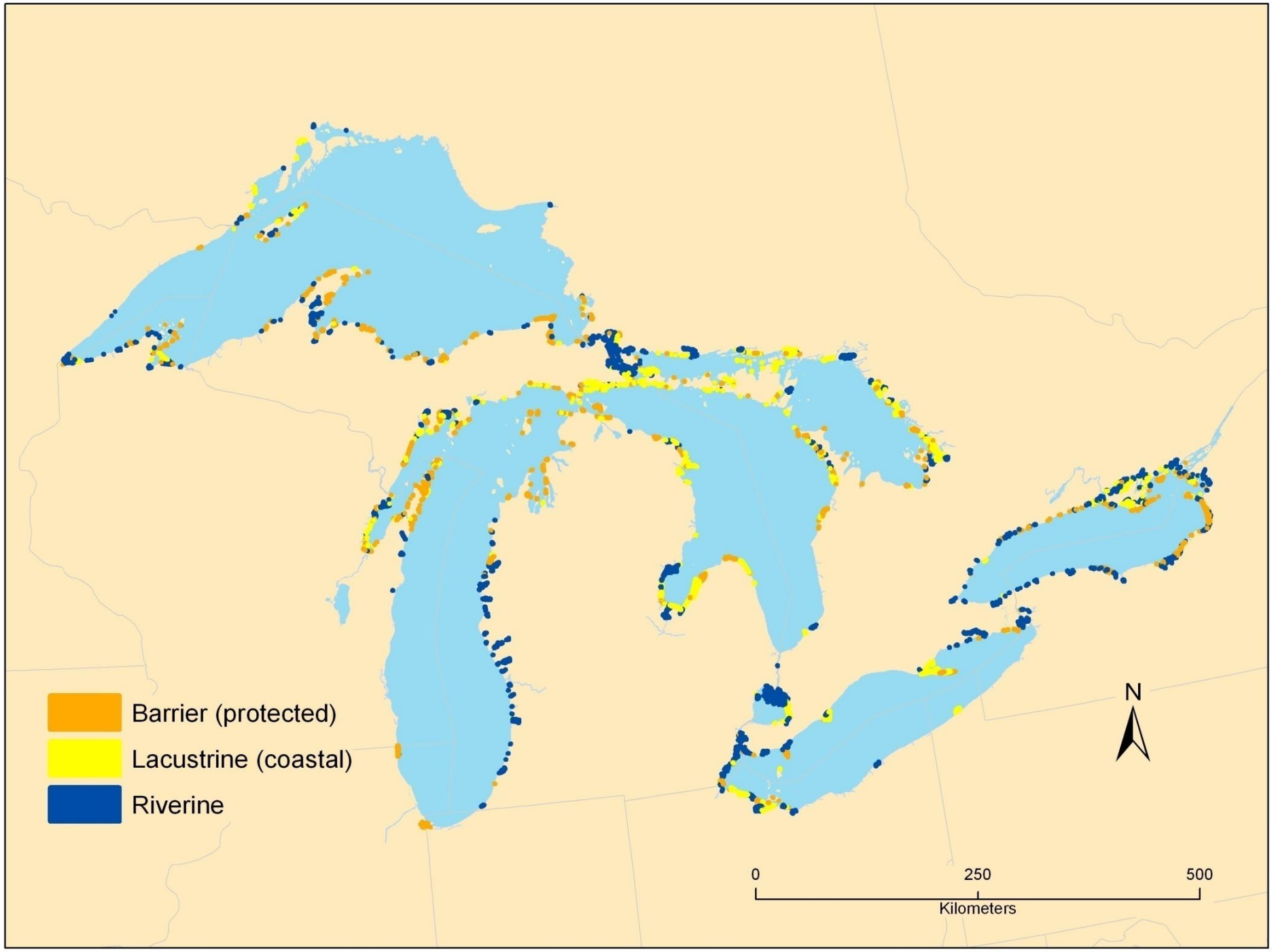
Current Research
Measure Ecosystem Health
~1039 Coastal Wetlands

- 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)

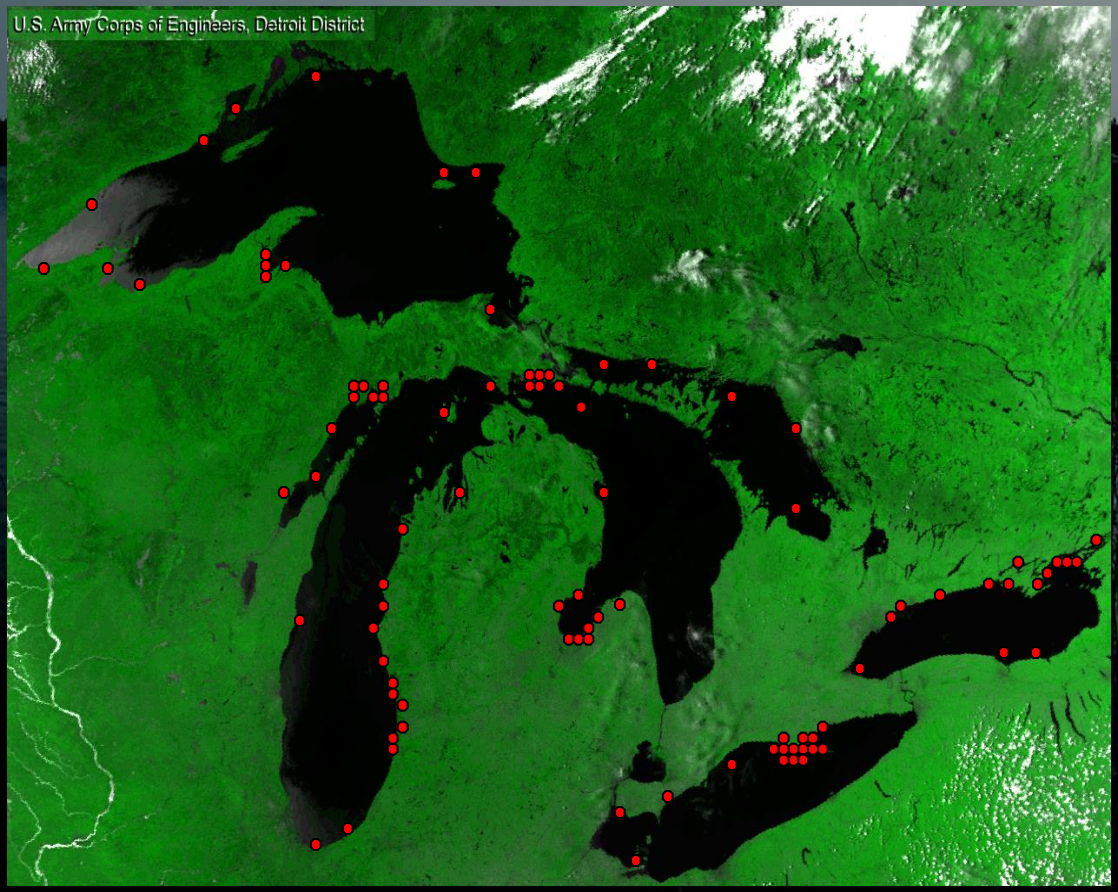

Barrier (protected)
Lacustrine (coastal)
Riverine
N
0
250
500
Kilometers

Statistical Design

- maximize efficiency in detecting both
  - Status
  - Trends
- Status and Trends are conflicting goals

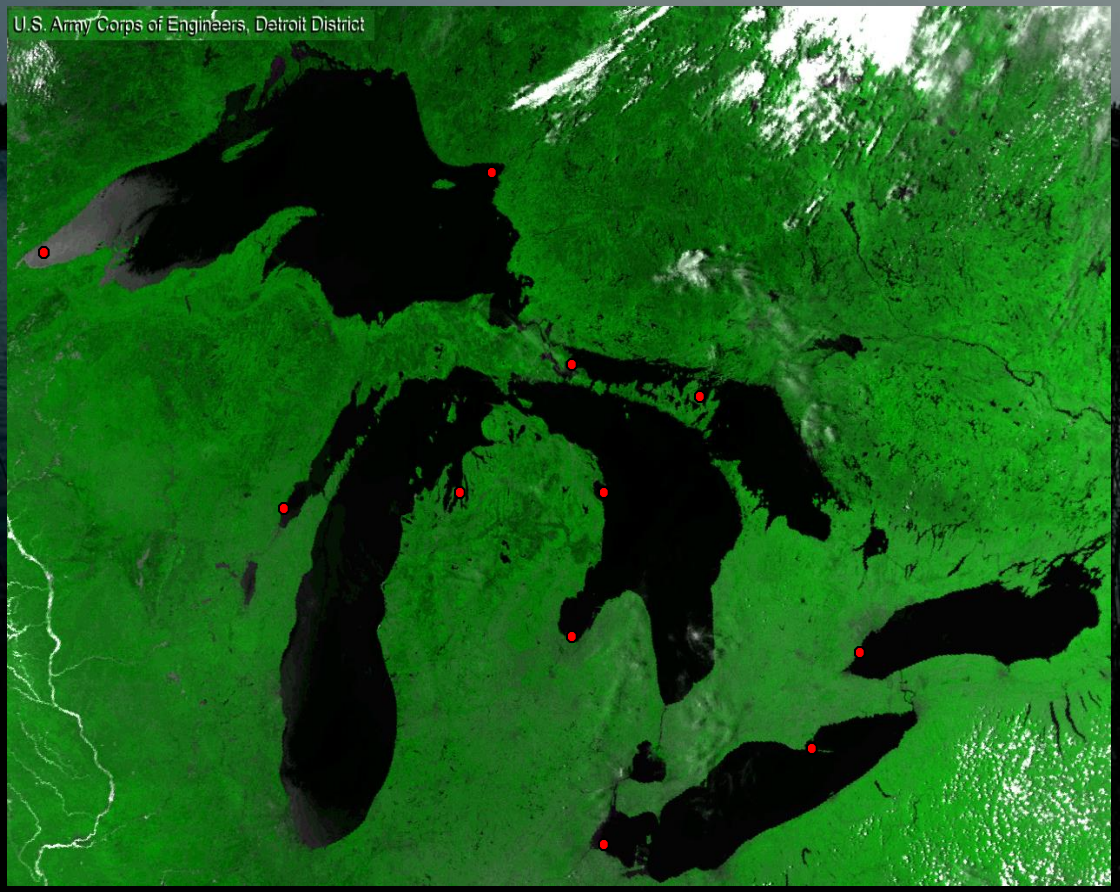
Statistical Design

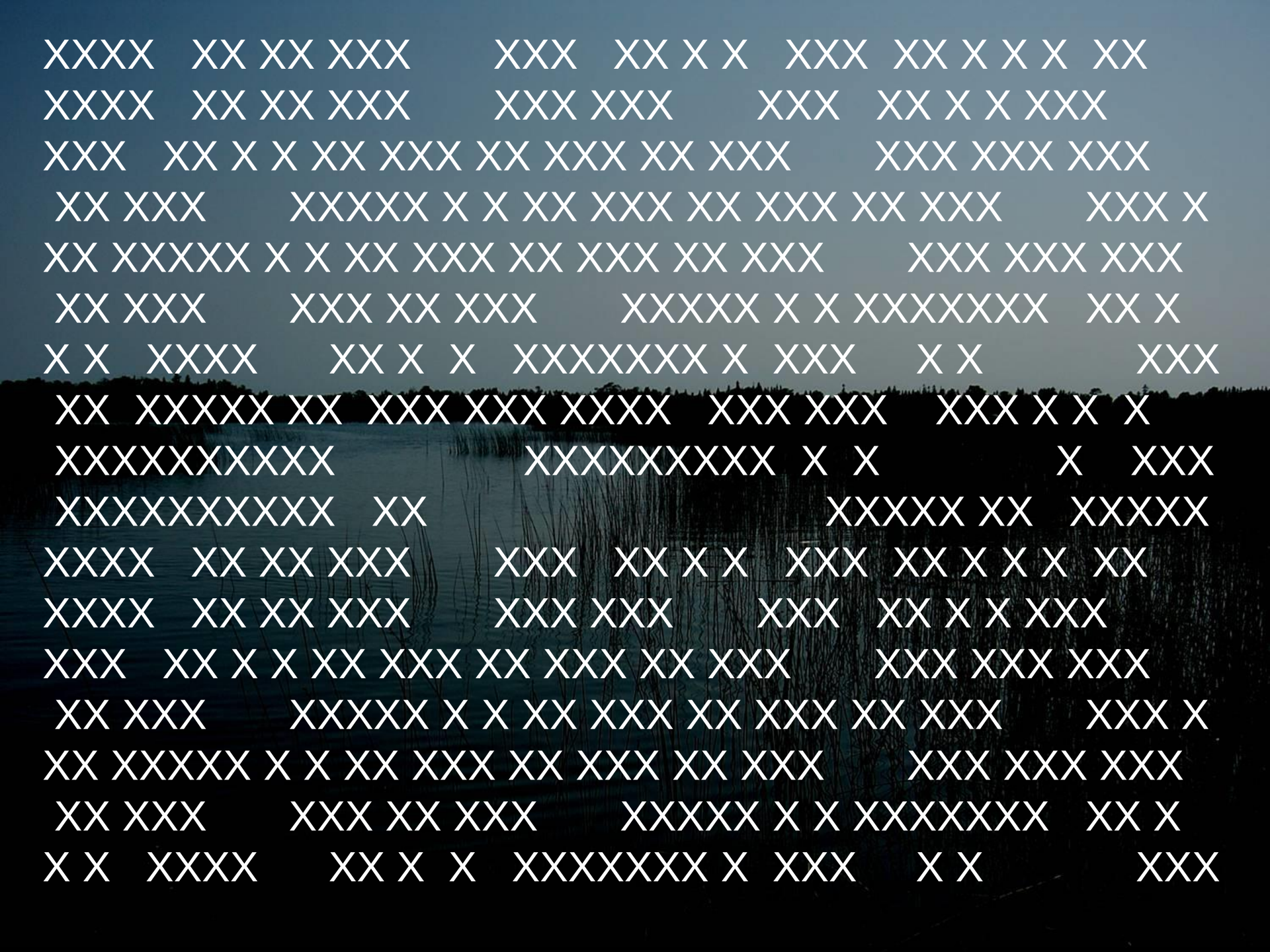
- Status = Capture Spatial Variance
- What is the status or health of (all) GL wetlands?



Statistical Design

- Trends = Capture Temporal Variance
- How is GL wetland health changing over time?
- Sample fewer sites, repeatedly

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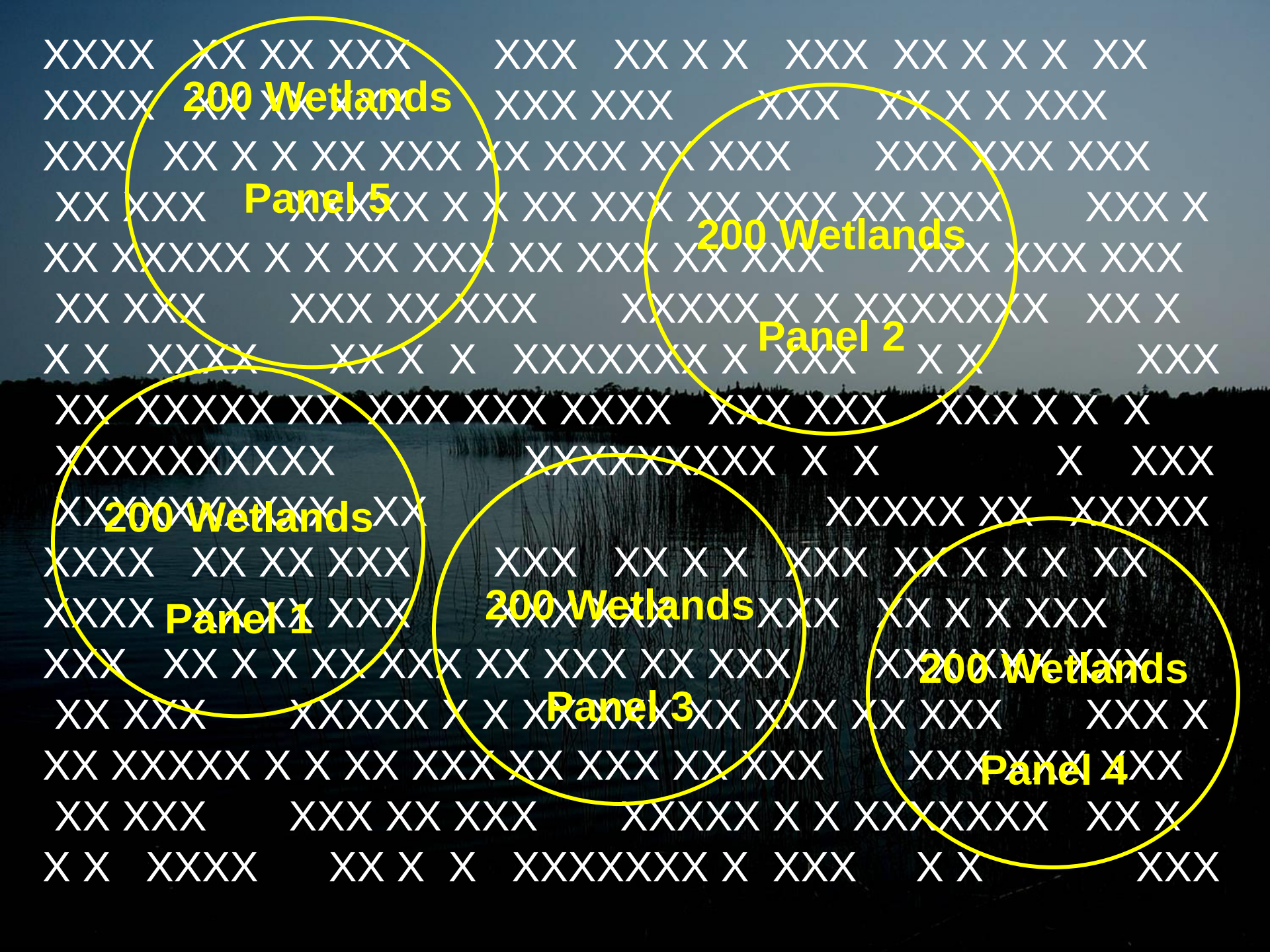
200 Wetlands
Panel 5
200 Wetlands
Panel 2
200 Wetlands
Panel 1
200 Wetlands
Panel 3
200 Wetlands
Panel 4


J=20
I=20
H=20
G=20
F=20
E=20
C=20
A=20
D=20
B=20
J=20
I=20
H=20
G=20
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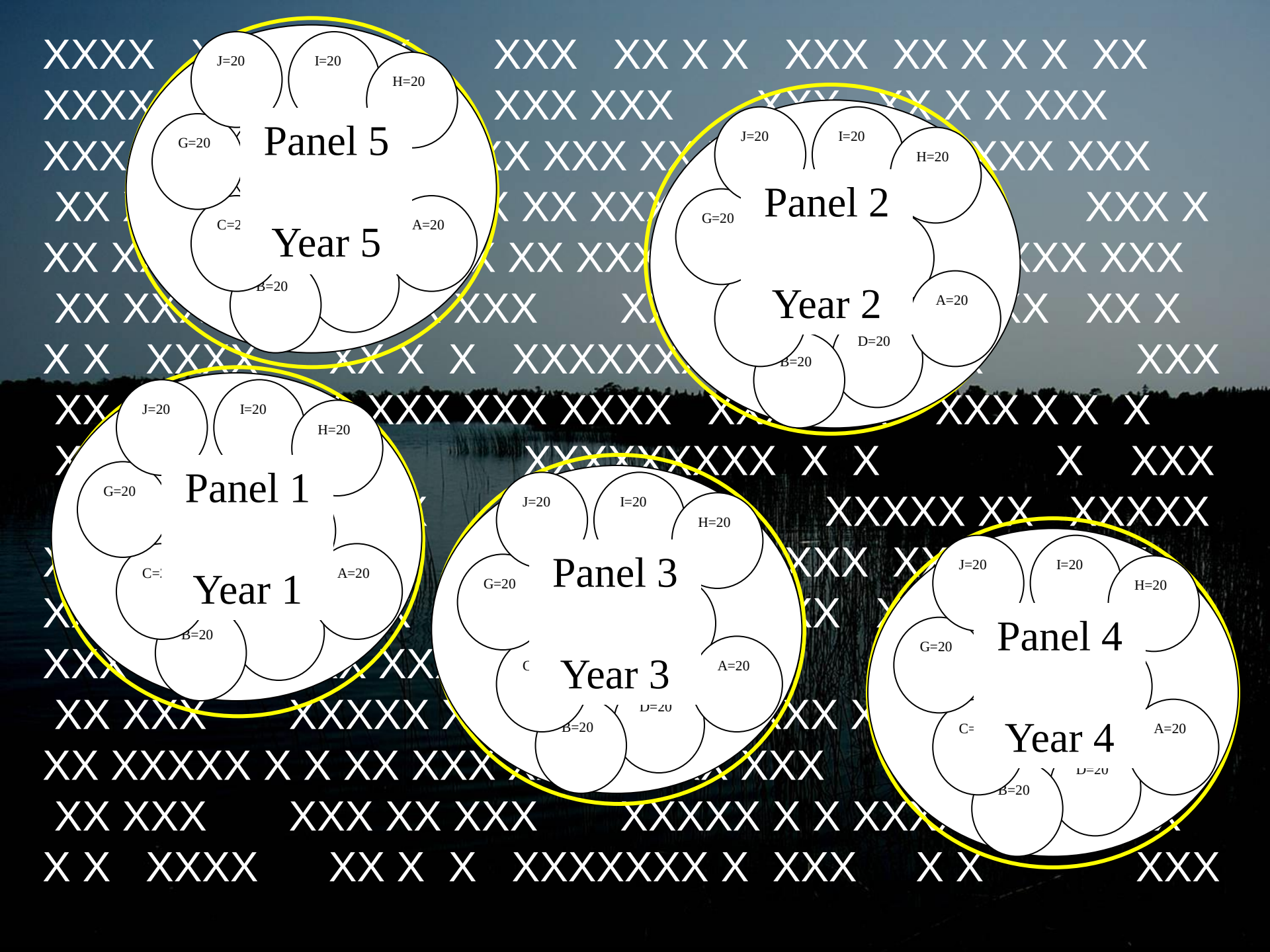

Panel 5
Year 5
J=20
I=20
H=20
G=20
A=20
B=20
Panel 2
Year 2
J=20
I=20
H=20
G=20
A=20
D=20
B=20
Panel 1
Year 1
J=20
I=20
H=20
G=20
A=20
B=20
Panel 3
Year 3
J=20
I=20
H=20
G=20
A=20
B=20
Panel 4
Year 4
J=20
I=20
H=20
G=20
A=20
B=20

Design 4 - Partially Augmented Serially Alternating

1 = Panels

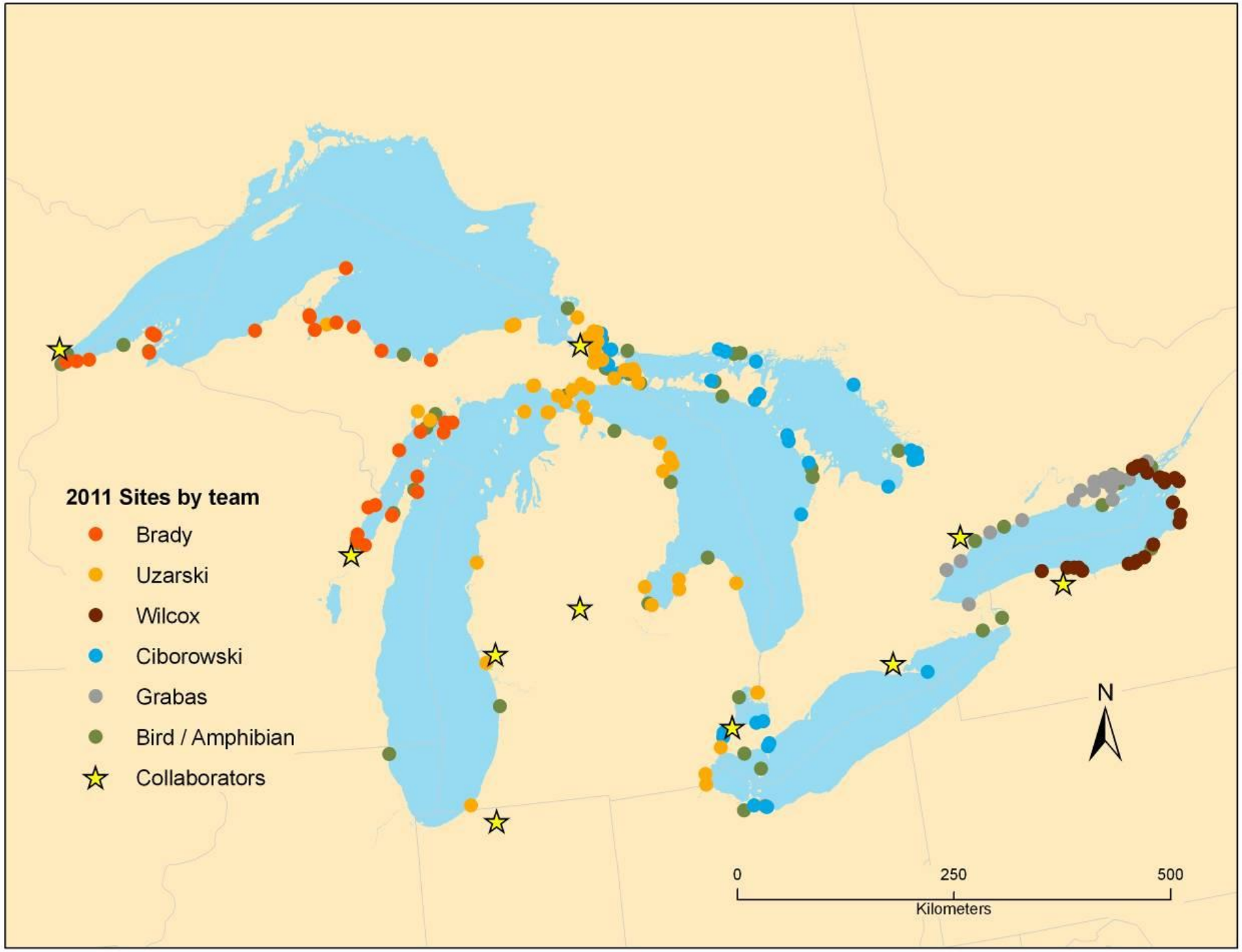
A-J = Sub-Panels

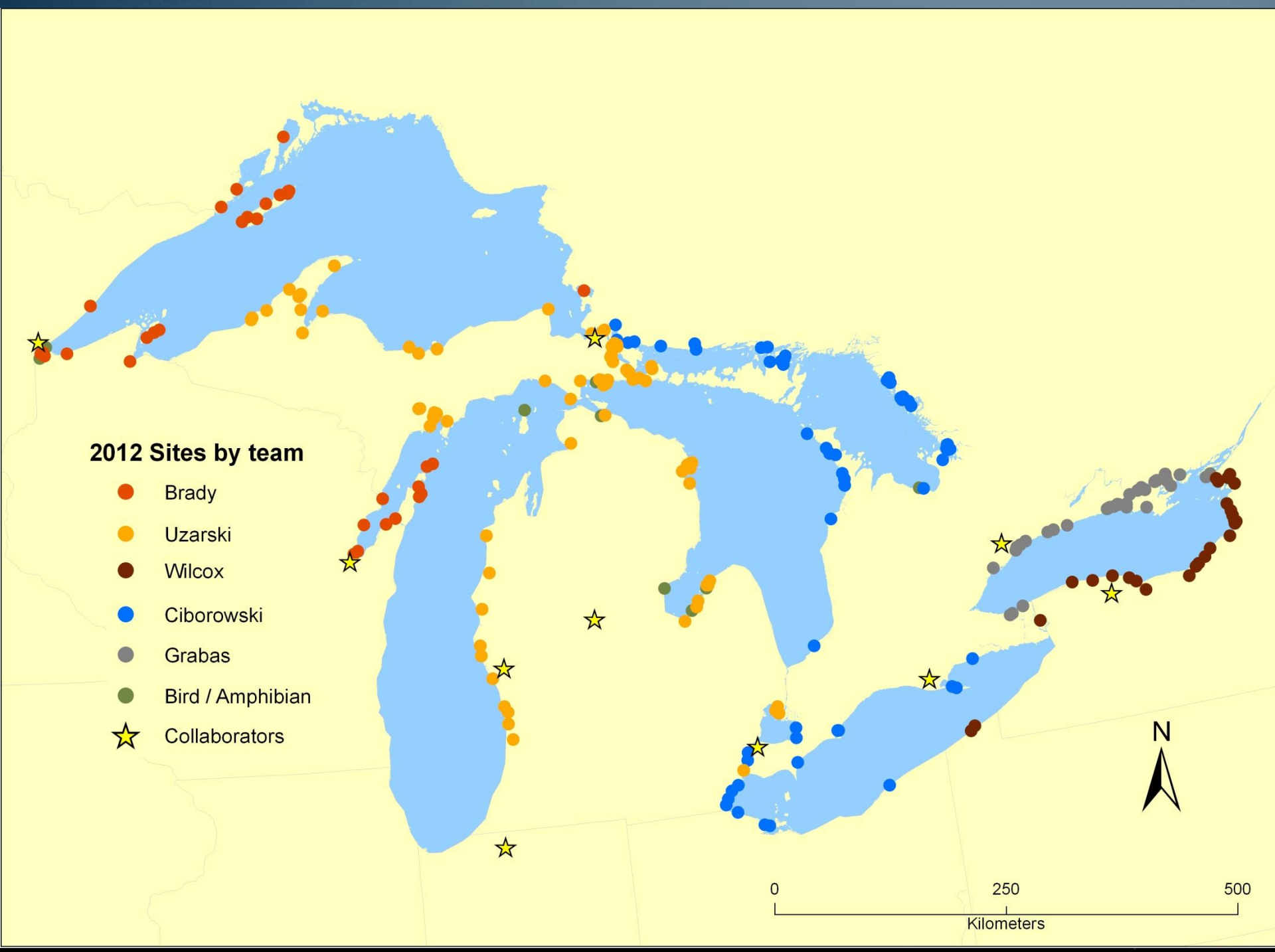
	# OF SITES	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	YEAR 11	YEAR 12
1		X				X				X			
2			X				X				X		
3				X				X				X	
4					X				X				X
1A		X	X			X				X			
2A			X	X			X				X		
3A				X	X			X				X	
4A					X	X			X				X
1B		X				X	X			X			
2B			X				X	X			X		
3B				X				X	X			X	
4B					X				X	X			X
1C		X				X				X	X		
2C			X				X				X	X	
3C				X				X				X	X
4C					X				X				X
1D		X				X				X			
2D			X				X				X		
3D				X				X				X	

- 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


2011 Sites by team
Brady
Uzarski
Wilcox
Ciborowski
Grabas
Bird / Amphibian
Collaborators
N
0
250
500
Kilometers


2012 Sites by team
Brady
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Wilcox
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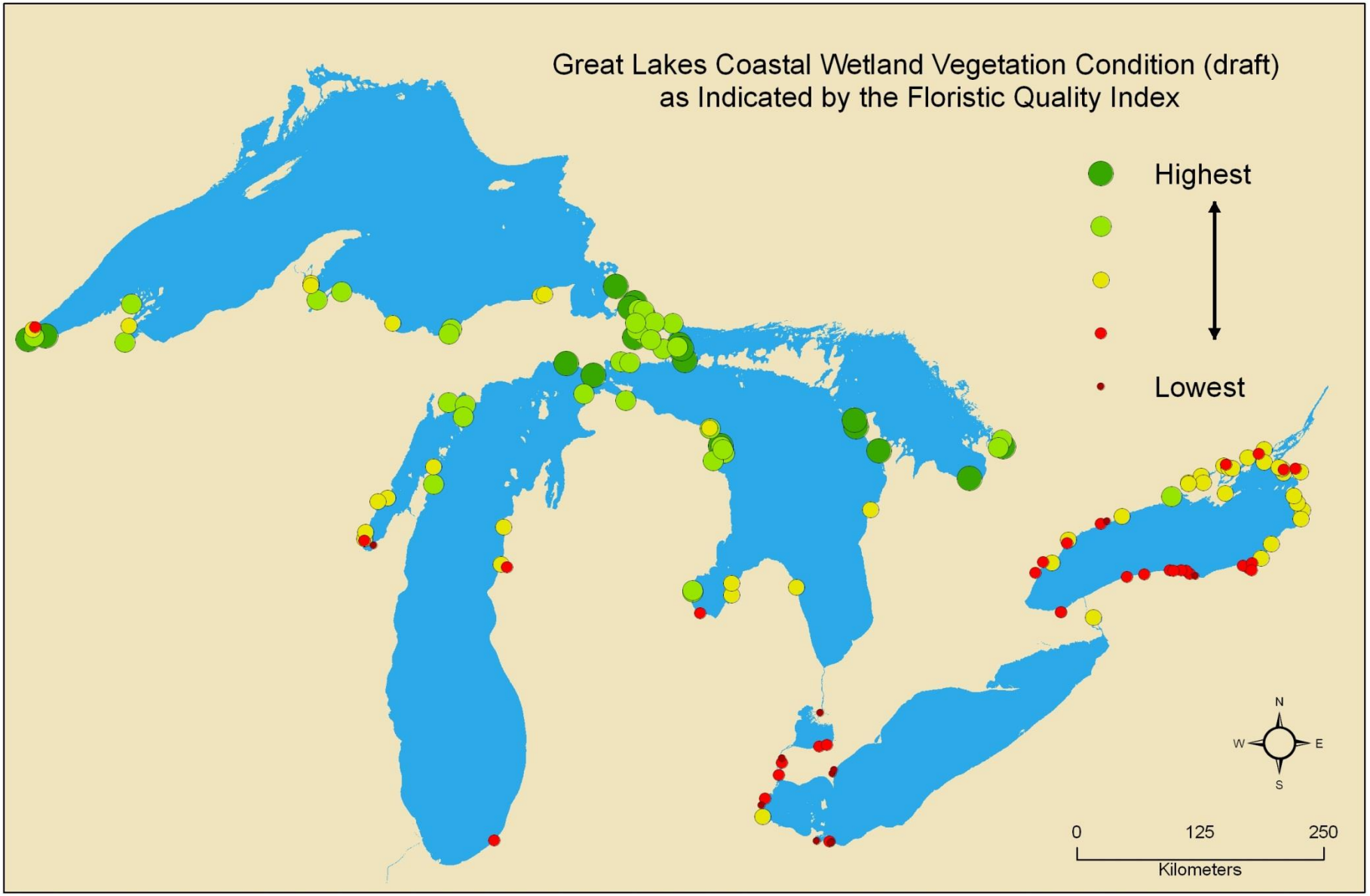
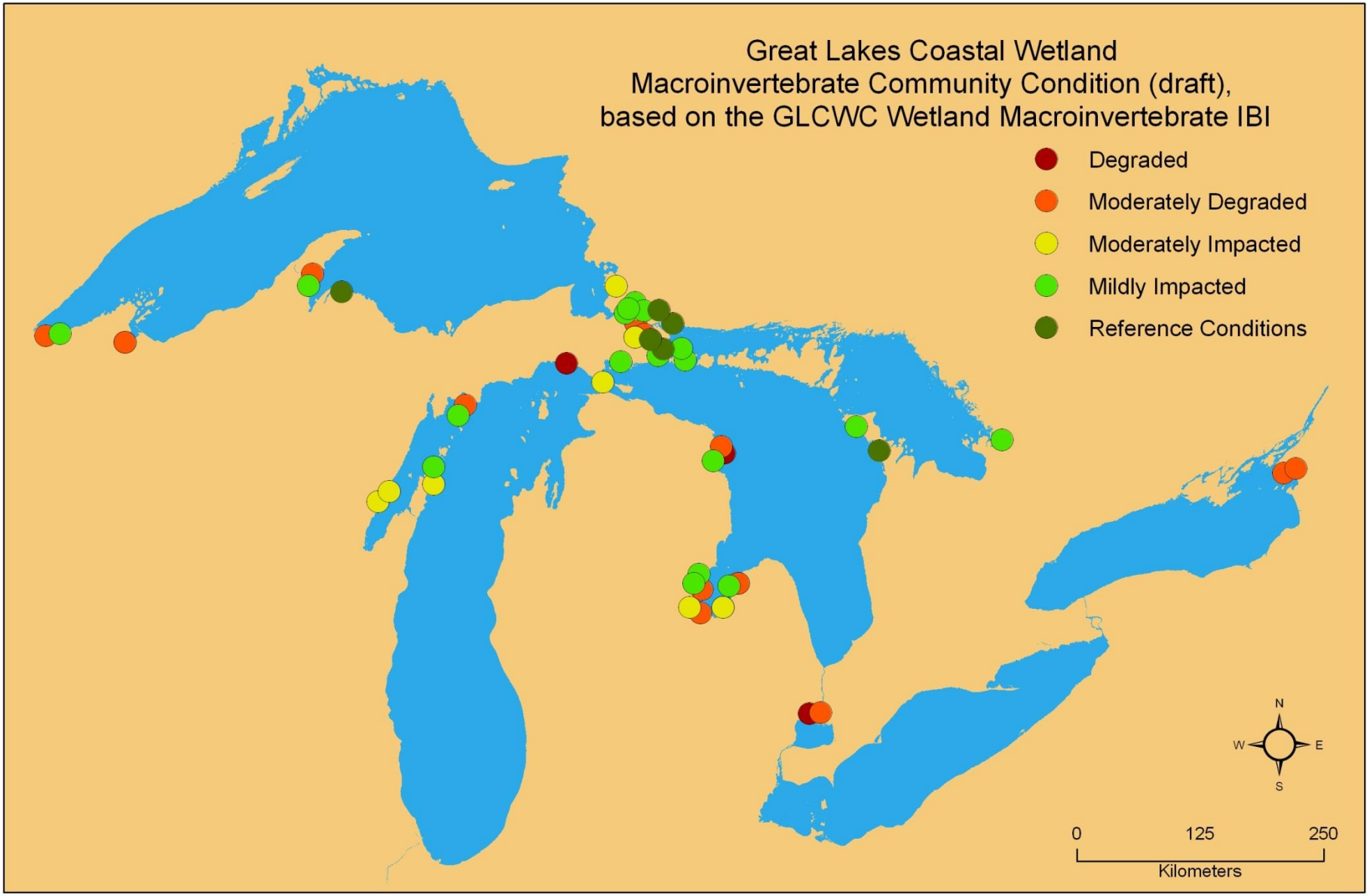
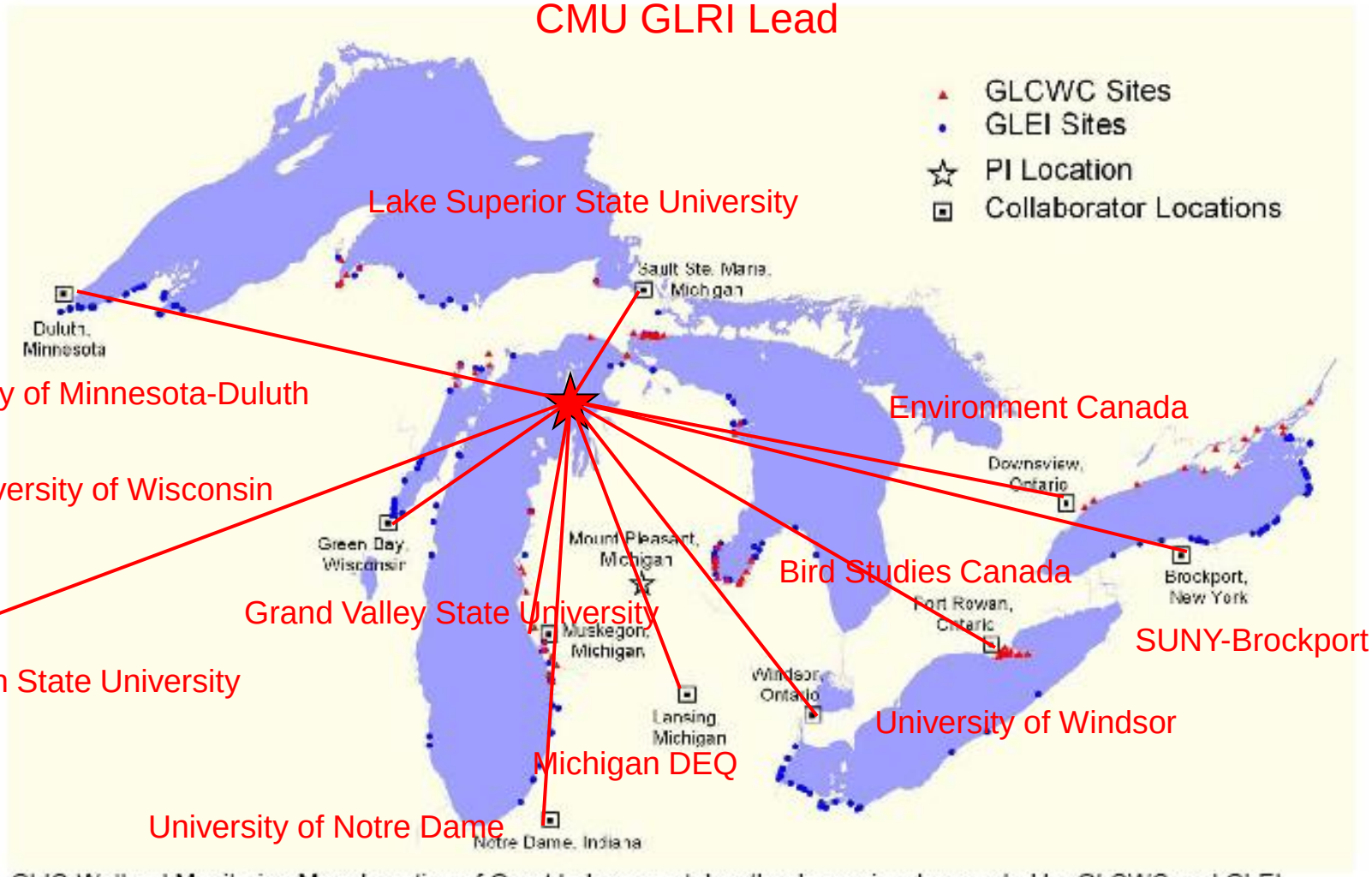
Grabas
Bird / Amphibian
Collaborators
N
0
250
500
Kilometers


Great Lakes Coastal Wetland Vegetation Condition (draft)
as Indicated by the Floristic Quality Index
Highest
Lowest
N
W
E
S
0
125
250
Kilometers


Great Lakes Coastal Wetland
Macroinvertebrate Community Condition (draft),
based on the GLCWC Wetland Macroinvertebrate IBI
Degraded
Moderately Degraded
Moderately Impacted
Mildly Impacted
Reference Conditions
N
W
E
S
0
125
250
Kilometers

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



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

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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
  - Apostle Islands National Lakeshore, Isle Royale National Park, Pictured Rocks National Lakeshore, Sleeping Bear Dunes National Lakeshore, and Indiana Dunes National Lakeshore – assessing wetland condition and identifying restoration needs
- 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 *Phagmites 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 (?)


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