

2003 Progress Report: Vegetative Indicators of Condition, Integrity, and Sustainability of Great Lakes Coastal Wetlands

EPA Grant Number: R828675-02

Subproject: *This is subproject number 02, established and managed by the Center Director under grant R828675*

Center: [Great Lakes Environmental Indicators Project](#)

Center Director: [Gerald J. Niemi](#)

Title: Vegetative Indicators of Condition, Integrity, and Sustainability of Great Lakes Coastal Wetlands

Investigators: [Carol A. Johnston](#)¹, Barbara L. Bedford², Joy B. Zedler³

Cooperators: John Kelly⁴, Mary Moffett⁴

Institutions: ¹South Dakota State University; ²Cornell University; ³University of Wisconsin, Madison; ⁴US EPA Mid-Continent Ecology Division, Duluth

EPA Project Officer: Barbara Levinson

Project Period: January 10, 2001 to January 9, 2005

Project Amount: \$6,000,000

RFA: [Environmental Indicators in the Estuarine Environment Research Program \(2002\)](#)

Research Category: [Ecological Indicators/Assessment/Restoration](#)

Description:

Objective: Specific objectives of this subproject are to: 1) identify vegetative indicators of condition of Great Lakes coastal wetlands that can be measured at a variety of scales, 2) develop relationships between environmental stressors and those vegetative indicators, and 3) make recommendations about the utility and reliability of vegetative indicators to guide managers toward long-term sustainable development.

Progress Summary: During the 2003 field season, the GLEI Wetland Vegetation subproject completed its field sampling. A total of 86 wetland complexes were sampled during the 2001-2003 field seasons. Sampling areas were distributed among the research groups by location: the Cornell University group did sites in Lakes Ontario and Erie, the University of Wisconsin-Madison (UW) group did sites in Lake Michigan, and the Natural Resources Research Institute (NRRI) group did sites in Lakes Superior and Huron. The graduate students on the project also sampled additional areas in conjunction with their thesis research:

University of Wisconsin-Madison - Christin Frieswyk collected seed bank samples from wet meadow and Typha communities in each of five Green Bay wetlands, segments 294, 299, 302, 303 and 304. These samples will be used to investigate the differences between seed banks from these two communities under different water levels.

Cornell University - Lynn Vaccaro worked independently collecting data for her master's thesis, comparing the growth and decay of Typha in 6 Lake Ontario wetlands. Additional segments sampled were 721, 725, and 740.

NRRI - Michael Bourdaghs did a series of nested plots for his master's thesis research on the Floristic Quality Index.

All collected plant specimens have been identified, and all data entry has been completed. Data

analysis is ongoing.

In preparation for field work, the subproject held its third annual field camp in Madison, WI, on June 6-7, 2003. The field camp is the only time during the year when *all* subproject personnel assemble in one location. Field exercises are conducted to ensure that all field personnel are consistent in their visual cover estimation.

The GLEI Vegetation subgroup participated in several meetings related to GLEI:

- March 13, 2003 Lake Ontario Interdisciplinary Science and Management Conference. New York Great Lakes Research Consortium. Syracuse, NY.
- May 14, 2003 Great Lakes Coastal Wetlands Consortium Inventory and Classification Workshop. Ann Arbor, MI.
- November 3-5, 2003 Fourth GLEI All Hands Meeting, Duluth MN, subproject report by Carol Johnston
- December 3-6, 2003 Third All EaGLE Meeting, Bodega Bay CA, attended by Carol Johnston

Carol Johnston and Joy Zedler organized a special symposium, entitled "Coastal Wetland Vegetation as a Harbinger of Environmental Change," held at the Society for Conservation Biology Annual Meeting in Duluth MN on June 29-July 2, 2003. All five symposium speakers are EaGLE researchers: Mark Brinson (Atlantic Slope Consortium), Christin Frieswyk (GLEI), Carol Johnston (GLEI), James Morris (ACE INC), Dennis Whigham (Atlantic Slope Consortium).

Lynn Vacarro (Cornell) received several awards in 2003 in support her graduate research initiated under the GLEI project:

- Biogeochemistry and Environmental Change Small Grant Program, "Evaluating interactions between road salt and nutrient availability as a mechanism promoting *Typha glauca* dominance of freshwater wetlands." \$4000.
- Andrew W. Mellon Student Research Grants, \$700
- NSF Graduate Fellowship, Cornell Science Inquiry Partnerships, tuition and stipend

Several students trained under this award have obtained full-time employment in the environmental sciences. Michael Bourdaghs' graduate training and on-the-job experience led to a job working as a plant specialist to develop indicators in wetlands for the Minnesota Pollution Control Agency, so his GLEI work will immediately be put to use by a management agency!

STUDENT	EMPLOYER
Michael Bourdaghs	Minnesota Pollution Control Agency, St. Paul, Minnesota
Ken Iverson	National Imagery and Mapping Agency, Washington DC
Charlene Johnson	Research Assistant, All Hazard Mitigation Plan, City of Superior, WI

Future Activities:

All three of the 2003 field team leaders are pursuing graduate degrees, conducting research related but not identical to the aims of the GLEI Wetland Vegetation subproject. Their tentative plans are described below.

Michael Bourdaghs (NRRI), *Properties and Performance of the Floristic Quality Index In Great Lakes Coastal Wetlands*. The Floristic Quality Index (FQI) is a biotic, or content based index that has been proposed as a tool that can identify areas that have high conservation value, monitor sites over time, assess the anthropogenic impacts of an area, and ultimately, measure the ecological condition of an area. FQI is based on a measurement called the Coefficient of Conservatism, which is a numerical score assigned to each plant species in a local flora that ranges from 0-10, and reflects the likelihood that a species is found in natural habitats. FQI is computed by multiplying the mean Coefficient of Conservatism by the square root of species richness for an observational unit. Great Lakes coastal wetlands were used to assess the performance, particularly as ecological indicators, and properties of various species richness, Coefficient of Conservatism, and Floristic Quality indices. Michael presented a thesis seminar on 20 February 2004, and is expected to defend during Spring 2004.

Christin Frieswyk (UW), *Ecosystem Resilience and the Behavior of Typha Species in Lake Michigan Coastal Wetlands*. Christin is addressing the idea of resilience in coastal wetlands. A loss of resilience might be indicative of future changes in wetland composition and structure and could then serve as a red flag for a change in wetland health. Thus, lowered resilience has implications for both management and restoration of coastal wetlands. In naturally resilient coastal wetlands the extent of Typha was historically limited by water level fluctuation, but in Lake Michigan Typha stands appear to be growing despite highly fluctuating water levels. This research will: a) explore the nature of resilience in these wetlands, recent deviations from the historic cycle of vegetation change, and nearby development using aerial photographs, b) describe the nature and extent of Typha dominance in Lake Michigan wetlands, especially among Typha species, and relationships with diversity of native plants, and c) determine the ability of Typha dominated coastal wetlands to regenerate via the seed bank.

Lynn Vaccaro (Cornell), *Patterns of cattail dominance and implications for vegetation structure and function in Great Lakes wetlands*. *Typha glauca* dominated many of the wetland sites surveyed in the southern eco-province of the Great Lakes, potentially confounding efforts to develop plant community based indicators. Typha's high productivity and pattern of senescing in an upright position may influence plant community composition and habitat structure, particularly in wetlands with dampened hydrologic fluctuations. This work investigates 1) the distribution of Typha species across the Great Lakes in relation to a variety of landscape characteristics, 2) the influence of Typha litter on species composition and 3) the dynamics of Typha live and dead biomass in two different wetland settings. GLEI survey data indicate that the coverage of litter is greater and less variable in wetlands with a greater coverage of Typha species. To evaluate the direct effect of Typha biomass on species composition, we conducted an experimental manipulation of Typha litter. Results of litter addition and removal treatments show that a persistent litter layer negatively influences the establishment of other species.

The build-up of dead plant material may be one mechanism by which Typha influences the plant

community, and may contribute to a wetland's vulnerability to *Typha* dominance. To better understand what controls the persistence of a thick litter layer, I compared *Typha*'s pattern of production, senescence and decomposition in different wetland settings. I hypothesized that a wetland's connection to Lake Ontario and its resulting seasonal hydrologic regime affects the break down, decomposition and nutrient release from standing and fallen litter. To test this hypothesis, I measured plant species composition, biomass production, standing and fallen litter pools, decomposition, and tissue nutrient concentrations in wetlands hydrologically open and closed to Lake Ontario. Ultimately, data will be synthesized to address the question of whether *Typha*'s "functional role" differs markedly between connected and unconnected wetlands, providing a better understanding of how *Typha* species influence wetland vegetation structure and function.

Publications and Presentations: Total Count: 14

<u>Type</u>	<u>Citation</u>
Journal Article	Johnston, Carol A., and Paul Meysembourg. 2002. Comparison of the Wisconsin and National Wetlands Inventories. <i>Wetlands</i> 22:386-405.
Thesis	Johnson, Charlene. 2003. Predicting the Vegetational Composition of a Wetland Created from Dredged Material in Duluth-Superior Harbor. MS thesis. University of Minnesota Duluth.
Journal Article	Kercher, Suzanne M., Christin B. Frieswyk, and Joy B. Zedler. 2003. Quality Control Approaches Reveal Effects of Sampling Teams and Estimation Methods for Assessing Plant Cover in Temperate Herbaceous Wetlands. <i>Journal of Vegetation Science</i> 14:899-906.
Journal Article	Johnston, Carol A. 2003. Shrub species as indicators of wetland sedimentation. <i>Wetlands</i> 23:911-920. (Funded by completed EPA Grant No. R804823, but related to the current research).
Journal Article	Danz, N.P., R.R. Regal, G.J. Niemi, V.J. Brady, T. Hollenhorst, L.B. Johnson, G.E. Host, J.M. Hanowski, C.A. Johnston, T. Brown, J. Kingston, and J.R. Kelly. Environmentally stratified sampling design for the development of Great Lakes environmental indicators. <i>Environmental Monitoring and Assessment</i> . In press.
Journal Article	Frieswyk, Christin B., Carol A. Johnston, and Joy B. Zedler. Measuring Dominance among Co-occurring Plants. Submitted to <i>Ecology</i> .
Oral Presentation	Lynn Vacarro. 2003. Plant functional diversity in wetlands and the potential impacts on decomposition and nutrient cycling. Natural Resources Graduate Student Association Symposium, Cornell University, Ithaca, NY. 24 January.
Oral Presentation	Johnston, C.A., P. Meysembourg, and T. Hollenhorst. 2003. GIS-derived

indicators of environmental stressors and ecosystem responses of Great Lakes coastal wetlands. 17th Annual Meeting of the Society for Conservation Biology. Duluth, MN. 28 June - 2 July.

Oral Presentation Frieswyk, Christin B., and Joy B. Zedler. 2003. Many Types of Dominance. 17th Annual Meeting of the Society for Conservation Biology. Duluth, MN. 28 June - 2 July.

Poster Bourdaghs, Michael. 2003. The relationship between sampling area, species richness, and the Floristic Quality Assessment Index. 17th Annual Meeting of the Society for Conservation Biology. Duluth, MN. 28 June - 2 July.

Oral Presentation Johnston, C.A., B.L. Bedford, M. Bourdaghs, T. Brown, C. Frieswyk, L. Vaccaro, and J. Zedler. 2003. Plants as environmental indicators in Great Lakes coastal wetlands. 88th Annual Meeting of the Ecological Society of America., Savannah, Georgia. 3-8 August.

Oral Presentation Danz, N.P., L.B. Johnson, G.J. Niemi, R.R. Regal, J. Schuldt, V. Brady, J. Brazner, M. Bourdaghs, C. Johnston, T. Brown, and J.M. Hanowski. 2003. Integrating a fish, bird, and plant wetland indicator using regional ecological normalization. EPA All-EaGLes Meeting, Bodega Bay, CA. 3-6 December.

Oral Presentation Wolter, P., G. Niemi, and C. Johnston. 2003. Development of environmental indicators for the U.S. Great Lakes basin using remote sensing technology. EPA All-EaGLes Meeting, Bodega Bay, CA. 3-6 December.

Poster Niemi, G., R. Axler, V. Brady, J. Hanowski, G. Host, L. Johnson, C. Johnston, J. Kingston, R. Regal, C. Richards, D. Swackhamer, R. Howe, J. Ciborowski, and S. Bradbury. 2003. Development of environmental indicators for the U.S. Great Lakes coastal region. EPA All-EaGLes Meeting, Bodega Bay, CA. 3-6 December.

Poster Bourdaghs, Michael, and Carol A. Johnston. 2003. The relationship between sampling area, species richness, and the Floristic Quality Assessment Index. EPA All-EaGLes Meeting, Bodega Bay, CA. 3-6 December.

Supplemental Keywords: *vegetative indicators, coastal wetlands, floristic quality assessment index, ecosystem resilience, aquatic acrophytes, Great Lakes, environmental indicators*

Relevant Websites: <http://glei.nrri.umn.edu>