

2004 Progress Report: Development and Assessment of Environmental Indicators Based on Birds and Amphibians in the Great Lakes Basin

EPA Grant Number: R828675-04

Title: Development and Assessment of Environmental Indicators Based on Birds and Amphibians in the Great Lakes Basin

Subproject: *This is subproject number 04, established and managed by the Center Director under grant R828675*

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

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

Investigators: Robert Howe¹, JoAnn Hanowski², Charles Smith³

Institutions: ¹University of Wisconsin, Green Bay, ²Center for Water and the Environment, Natural Resources Research Institute, University of Minnesota Duluth; ³Cornell University

EPA Project Officer: Barbara Levinson

Project Period: January 10, 2001 to January 9, 2005 (Extended to January 9, 2006)

Project Period Covered by this Report: January 11, 2004 to January 9, 2005

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

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

Description:

Objective: Specific objectives are the following:

1. develop a suite of scientifically robust, cost-effective indices of bird and amphibian assemblages that reflect ecological condition of the Great Lakes;
2. quantify the extent to which these indices are related to environmental pressure indicators such as land use characteristics, water quality, presence of exotic species, and hydrological modifications;
3. derive predictive models based on statistical relationship between pressure indicators and indices of bird/amphibian diversity and abundance;
4. use these models to infer ecological conditions at local and regional scales and to establish or improve the baseline for environmental monitoring programs;
5. develop a quality assurance/quality control infrastructure for future assessments of bird and amphibian communities; and, ultimately,
6. provide scientific recommendations for improving and monitoring the ecological health of the Great Lakes basin.

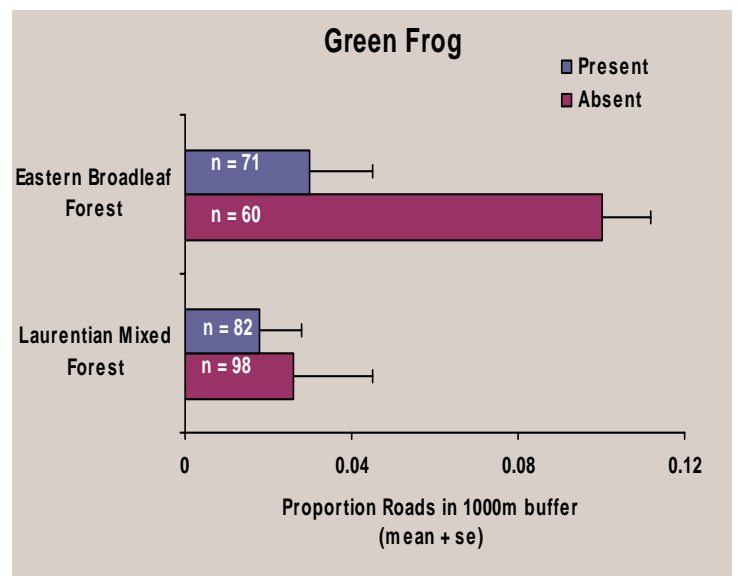
Progress Summary: Our efforts in the past year have centered on four major tasks. First, we collaborated with GIS personnel and completed the final QA/QC of all field data, sample locales, and determined boundaries of sampling complexes and watersheds. Secondly, we quantified variation in bird community metrics and species data that could be attributed to geographic location of the sampling points (lake, ecoprovince, and wetland geomorphic type). Third, we developed stressor relationships between amphibian and bird community metrics and measures of disturbance at four different buffer distances from wetland sample point. Finally, much effort was directed toward project outreach, including presentations at scientific meetings, graduate theses, and peer-reviewed articles.

Indicators and Stressors

Our analysis of indicators and their relationships to stressors has thus far concentrated on stressor gradients defined in the original site selection. For example, we have completed simple correlations of bird and anuran indicators with the principal component axes from the seven principal components for the LMP (with 2002 data). In addition, land cover from 4 different buffer widths were also correlated with both amphibian and wetland bird metrics. Results thus far are preliminary, but will help us focus on the most promising indicator metrics and potential stressors that birds and amphibians will likely respond to.

In the development of biotic indicators of Great Lakes coastal wetland condition using breeding bird community data, we examined how geographic distribution of birds and their potential affinities to wetlands of three geomorphic types would affect the scale at which we developed indicators for this large region. We completed 385 breeding bird surveys on 222 wetlands across the U.S. portion of the basin in 2002 and 2003. Analyses showed that wetlands within two ecoprovinces (Laurentian Mixed Forest and Eastern Broadleaf Forest) had different bird communities. Bird communities were also significantly different among the five lakes (Superior, Michigan, Huron, Erie, and Ontario) and three wetland types (lacustrine, riverine, and barrier-protected). Indicator values illustrated species with high affinities for each group. Species with restricted geographic ranges, such as Alder and Willow Flycatchers (*Empidonax alnorum* and *E. traillii*) had significant affinities for ecoprovince. Ten bird species had significant affinities for lacustrine wetlands. Analyses on guild metrics showed that Lake Ontario had fewer long-distant migrants and warblers than the other lakes. Numbers of short-distant migrants and individuals were higher in the Eastern Broadleaf Forest ecoprovince. Number of flycatchers and wetland obligate birds were not different among provinces, lakes or wetland type. Our results indicate that we need to develop separate indices for at least two geographic regions (the two ecoprovinces). In addition, we will need to consider local habitat characteristics and landscape composition in the next steps of indicator development.

Results from our correlation analyses with land cover data in buffers surrounding wetland sample points indicated that animal presence/absence in wetlands is associated with disturbance in the surrounding areas. In the example shown for Green Frog, we found that presence of this species in a wetland is dependent upon the amount of road surface within a 1000m buffer of the wetland. In addition, the response of this species to road density is different in the two ecoprovinces. In the Eastern Broadleaf Forest, the species was present when less than 5% of the surrounding landcover contained roads. The threshold value for Green Frog presence in the Laurentian Mixed Forest Province was about 2%.



Future Activities: We will begin statistical analyses of all data when we have the entire site “quality” information (relevant stressor data) from the GIS team. Results of our work will be presented at national meetings this coming summer and four theses will be completed based on this investigation. Work has also begun on peer-reviewed publications from this project as well as from the overall GLEI project.

Completed or Ongoing Theses

Effects of anthropogenic development on breeding bird abundance and communities. Christina Marie Miller. University of Minnesota Duluth. Finished February 2003.

Landscape factors affecting productivity of breeding birds in Great Lakes coastal wetlands. David Grandmaison. University of Minnesota Duluth

Anuran-habitat associations in coastal wetlands of the western Great Lakes. Steven Price. University of Wisconsin-Green Bay. 2003. 85 pp.

Habitat and landscape associations of breeding birds in Great Lakes coastal wetlands. David Marks. University of Wisconsin-Green Bay. 2003 123 pp.

Evaluation of the Ohio rapid assessment methods on wetlands of the Great Lakes basin: a comparative analysis of bird assemblages and wetland quality. Anna Peterson. University of Minnesota Duluth. In preparation.

Publications and Presentations:

<u>Type</u>	<u>Citation</u>
Journal	Price, S. J., D.R. Marks, R.W. Howe, J. Hanowski, G.J. Niemi. 2005. The importance of spatial scale for conservation and assessment of anuran populations in coastal wetlands of the western Great Lakes. <i>Landscape Ecology</i> 20. In press
Journal	Hanowski et al. Species-specific sampling effectiveness of calling anuran surveys in Lake Superior wetlands. In review in <i>Copeia</i>
Journal	Hanowski et al. Quantifying sources of variability in wetland breeding bird surveys; effects on sampling design. In prep.
Journal	Hanowski et al. Consideration of geography and wetland geomorphic type in the development of Great Lakes coastal wetland bird indicators. In review in <i>Ecohealth</i>
Journal	Howe, R.W., R.R. Regal, G.J. Niemi, N.P. Danz, J. M. Hanowski. A probability-based indicator of ecological condition. In preparation.

- Presentation Hanowski J. R. Howe, C. Smith, D. Marks, S. Price. What can birds and amphibians indicate about the ecological condition of coastal ecosystems? Eighty-eighth Annual meeting of the Ecological Society of America. Savannah, GA. 1-8 August.
- Presentation Miller, C., K. Stroom, C. Richards, G. Niemi, J. Hanowski, Negative Response of Bird and Aquatic Macroinvertebrates to Urban Development in Western Lake Superior. IAGLR 2003.
- Presentation Grandmaison, D., G. Niemi and J. Hanowski. Landscape factors affecting productivity of breeding birds in Great Lakes coastal wetlands. IAGLR 2003.
- Presentation Howe, R.W. and G. J. Niemi. 2003. Defining and applying environmental indicators in coastal ecosystems. A symposium presented at the 88th annual meeting of the Ecological Society of America, Savannah, Georgia.
- Presentation Howe, R.W., J. R. Karr, and A. T. Wolf. 2003. Historical and recent approaches to the assessment of ecological condition. A paper presented at the 88th annual meeting of the Ecological Society of America Annual Meeting, Savannah, Georgia.
- Presentation Price, S.J., D.R. Marks, R.W. Howe, J.M. Hanowski, and G.J. Niemi. 2003. The effects of spatial scale on indicator development for amphibians and birds in Great Lakes coastal wetlands. Poster Presentation. Third annual conference of the Estuarine and Great Lakes Initiative, U.S. Environmental Protection Agency Science to Achieve Results (STAR) Program. Bodega Marine Laboratory, Bodega, CA.. 4-7 December.
- Presentation Price, S.J., D.R. Marks, R.W. Howe, J.M. Hanowski, and G.J. Niemi. 2003. The effects of spatial scale on indicator development for amphibians and birds in Great Lakes coastal wetlands. Poster Presentation. Third annual conference of the Estuarine and Great Lakes Initiative, U.S. Environmental Protection Agency Science to Achieve Results (STAR) Program. Bodega Marine Laboratory, Bodega, CA.. 4-7 December.
- Presentation Price, S. J. 2003. Anuran-habitat associations in coastal wetlands of the western Great Lakes: The role of habitat and scale in biological indicator development. Poster Presentation. Seventeenth annual meeting of the Society for Conservation Biology. Duluth, Minnesota. 29 June - 2 July.
- Presentation Hanowski J. R. Howe, C. Smith, D. Marks, S. Price. Breeding birds and amphibians: are they useful in defining condition of Great Lakes coastal wetlands? Society of Wetland Scientists, Seattle, Washington 19-23 July 2004.

- Presentation Howe, R.W. 2004. Monitoring the ecological health of North America's Great Lakes. Inaugural Lecture of UW-Green Bay Downtown Lecture Series. Green Bay, WI. 23 March 2004.
- Presentation Howe, R.W., J.M. Hanowski, C.R. Smith, G.J. Niemi. 2004. Birds and amphibians as ecological indicators in Great Lakes watersheds. 47th Annual Meeting of the International Association of Great Lakes Research (IAGLR), University of Waterloo, Waterloo, Ontario. 28 May 2004.
- Presentation R.W. Howe, R.R. Regal, G.J. Niemi, J. A. Hanowski, N.P. Danz. 2005. A new approach for developing indicators of ecological condition in Great Lakes coastal wetlands. 10th Annual Wetland Science Forum. Wisconsin Wetlands Association. Green Bay, WI. 26 January 2005.

Supplemental Keywords: *environmental indicators, birds, amphibians, Great Lakes coastal zone, Great Lakes, coastal wetlands*

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