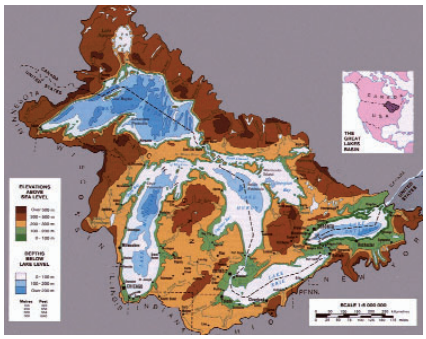
An Ecological Assessment of Invasive and Aggressive Plant Species in Coastal Wetlands of the Laurentian Great Lakes: A Combined Field-Based and Remote Sensing Approach

Office of Research and Development

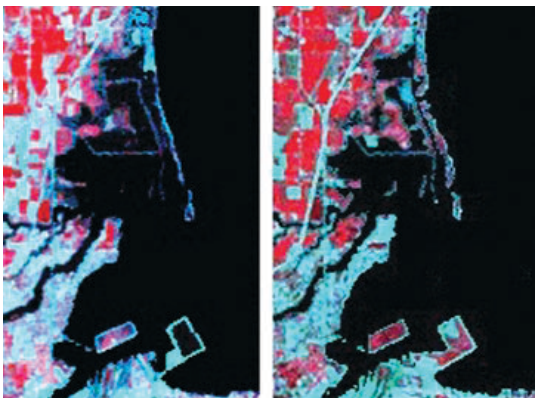
National Exposure Research Laboratory (NERL)

Environmental Sciences Division

The "Great Lakes Wetland" Project Approach



The aquatic plant communities within coastal wetlands of the Laurentian Great Lakes are among the most biologically diverse and productive systems of the world. Coastal wetlands have been especially impacted by landscape conversion and have undergone a marked decline in plant community biological diversity in the past. The loss of biological diversity in coastal wetland plant communities coincided with an increase in the presence and dominance of invasive and aggressive (i.e., native and opportunistic) plant species. The loss of biological diversity, by definition, may be the result of the increased presence of invasive and aggressive plant species, and other ecosystem research suggests that such invasive and aggressive plant species may be the result of general ecosystem stress in coastal wetlands. Thus, such losses of biological diversity in the plant communities of Great Lakes coastal wetlands may be related to changes in the frequency of landscape disturbance within a wetland or on the edges of wetlands (e.g., road fragmentation of wetlands, conversion of wetlands to agriculture, or alterations in wetland hydrology). Little is known about such ecological relationships in the Great Lakes, especially at the lake-basin and multi-basin scales. The purpose of this study is to examine some of the landscape-scale ecological relationships by quantifying the extent and pattern of invasive/aggressive plant species and testing for substantive relationships with local landscape disturbance in the past. Remote sensing technologies may offer unique capabilities to measure the extent of these invasive and aggressive species over a large area. Our approach is to use ground-based vegetation sampling to calibrate remote sensing data (i.e., obtained from satellite and airborne sensors), to develop spectral "signatures" of invasive/aggressive species that may then be used to address the ecological vulnerability of coastal wetlands. This study will focus on wetlands along the coastal regions of Lake Michigan, Lake Huron, Lake St. Clair, and Lake Erie that represent a full range of disturbance conditions in the lake basins, but may also include coastal areas of the other Great Lakes.



North Maumee Bay Coastal Marshes, Monroe County, Michigan (Landsat MultiSpectral Scanner images) where the aggressive plant species Phragmites australis was present to different extents in July 1972 (left) and August 1992 (right). Vegetation is shown in red shades and water is depicted in black.

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Measuring Wetland Disturbance

Research suggests that intensity and duration of disturbances within an ecosystem are key factors in the loss of ecological integrity. One of the potential mechanisms for the loss of ecological integrity may be the decline in biological diversity of an ecosystem, through the invasion of opportunistic species. The loss of plant biological diversity in coastal wetlands of the Laurentian Great Lakes has been widely described as a result of increased dominance of opportunistic plant species. Although not the only invasive and aggressive plant species present in the Great Lakes, the three opportunistic emergent plant species to be studied (purple loosestrife [*Lythrum salicaria* L.], common reed [*Phragmites australis* (Cav.) Steudel], and cattail [*Typha* spp.]) are frequently observed throughout many of the Great Lakes coastal wetlands. Purple loosestrife (left) was imported from Europe in the early 1800's, common reed (above) and cattails (right) are both native to North America and often dominate the vegetation of coastal wetlands. Purple loosestrife, common reed, and cattails reproduce by spreading rhizomes or stolons and by seed.

Key Project Milestones

- **Sept. 2001:** Complete 2001 field/remote sensing data collection
- **Apr. 2002:** Complete processing of remote sensing data and analysis of field data
- **Sept. 2002:** Complete the 2002 (re)sampling of field sites
- **Dec. 2003:** Complete the analysis of invasive/ aggressive patch characteristics, complete project report, develop and prepare manuscripts for referred journal articles

The Importance of Studying the Coastal Wetlands of the Great Lakes

This project is the first step needed to identify the extent of wetlands being stressed by invasive and aggressive plant species throughout the Great Lakes basin. Depending on the sensor of choice, the rate of invasion might be detectable utilizing the techniques developed during this study. If this project is successful in creating a remote sensing protocol capable of identifying the extent of these species' occurrences, this protocol could also be used for inland wetlands, as well as other coastal wetland locations. Both Great Lakes coastal wetlands and invasive species have been identified by managers and scientists within the international Great Lakes basin as important indicators of the ecological health. These indicators have been proposed at the international forum of the State of the Lakes Ecosystem Conferences and are available at the following Internet web sites:

http://www.epa.gov/glnpo/solec/98
http://www.cciw/ca/ solec/intro.html

The outcome of this study will help managers throughout the Great Lakes region target vulnerable coastal wetlands in need of restoration or protection, an important component of improving the water quality and ecological integrity of the Great Lakes Ecosystem. This project will also produce a method that could be used by environmental managers to monitor the progress/success of wetland rehabilitation and restoration projects where measures are taken to control or eradicate aggressive plant species.

Critical Support for the "Great Lakes Wetland" Project

This project is supported by the management of the USEPA Great Lakes National Program Office, the USEPA Region 5 Wetlands group, and the USEPA Region 5 Critical Ecosystems Team. Additional support has been provided by local, state, and tribal agencies.

For this effort and other NERL science projects, visit our website at http://www.epa.gov/nerl