



CINCINNATI, OHIO JANUARY 2006

# RESOLVING RESPONSES OF COASTAL RECEIVING SYSTEMS TO LANDSCAPE STRESSORS

## Approaches in Support of Nutrient Criteria Development in Regional Settings

J. R. Kelly<sup>1</sup>, M. E. Sierszen<sup>1</sup>, J. A. Morrice<sup>1</sup>, J. A. Thompson<sup>1</sup>, A. S. Trebitz<sup>1</sup>, J. S. Latimer<sup>2</sup>  
Mid-Continent Ecology Division (NHEERL)<sup>1</sup>, Atlantic Ecology Division (NHEERL)<sup>2</sup>



LTG 1 Poster 06

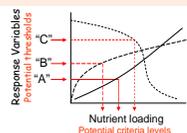
### Science Questions

**Long Term Goal 1: Provide the approaches and methods to develop and apply nutrient and other aquatic life criteria that will support designated uses for aquatic systems.**

What are the best ways to classify ecosystems, landscapes, and watersheds to enable efficient and scientifically-sound development and application of water quality criteria?

### How Research Addresses the Water Quality MYP Goals

NHEERL research attempts to connect landscape-level nutrient loading to ecological responses in coastal receiving systems *with sufficient resolution* to be a basis for developing quantitative criteria using ecosystem responses.



### Research Objective

Test and develop general methodologies for resolving nutrient loading—response relationships, as a basis for developing regional criteria guidance for coastal systems.

### METHODS and RESULTS

#### Establishing landscape gradients for loading—response studies

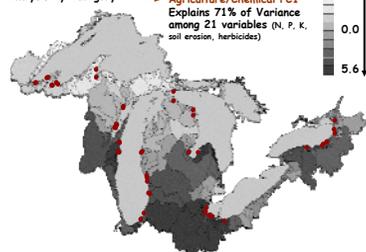
Study Area: U.S. Coastline, 762 coastal watersheds

Stressor Characterization ~200 Environmental Variables

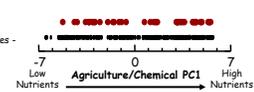
7 Stressor Categories - Atmospheric Deposition - Land Cover - Point and Non-Point Sources - Population and Development - Agriculture/Chemical - Soil Characteristics - Shoreline Modifications

Principal Components (PC) Analysis by Category

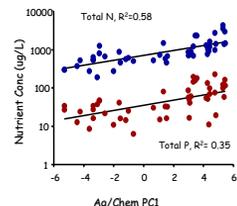
Agriculture/Chemical PC1 Explains 71% of Variance among 21 variables (N, P, K, soil erosion, herbicides)



Great Lakes basin-wide gradients in U.S. coastal watersheds were identified using GIS and publicly available data

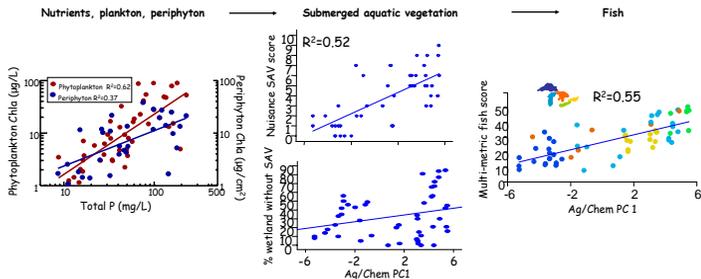


Stratified random selection; supplemental sites to fill range



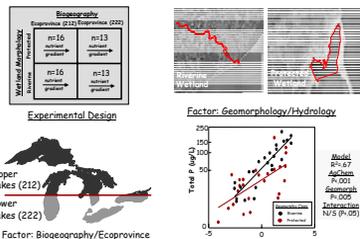
Ag/Chem PC1: a nutrient-specific loading indicator

#### Determining loading—response patterns: results across a response cascade

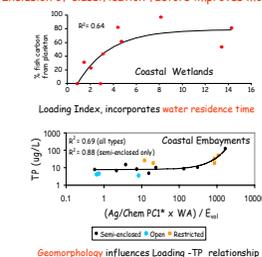


#### Improving resolution by considering classification factors

Tests for significance of classification factors

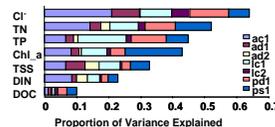


Inclusion of classification factors improves models

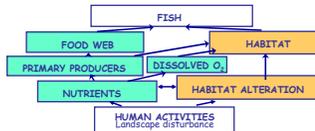


Geomorphology influences Loading -TP relationship

#### Recognizing other challenges



Response to multiple landscape stressor categories (underlies most field studies)



Multiple pathways — different stressor categories (embedded in responses)

Resolution of multivariate issues addressed by analysis with full landscape characterization and combined set of nutrient/habitat measurements in field

### CONCLUSIONS AND FUTURE DIRECTIONS

- Study demonstrates an effective regional strategy to select and sample sites using a landscape disturbance gradient to establish a nutrient gradient across coastal aquatic ecosystems.
- The resulting nutrient gradient can be used to develop first-order nutrient loading—response curves.
- Geomorphic, biogeographic, and hydrologic factors were tested; can improve resolution of responses.
- Results can guide a next level of method development for aquatic stressors in other coastal regions.

### Interactions: collaborators and customers

NHEERL scientists have worked with numerous research collaborators and also with Local, State, Regional, and EPA Program offices to formulate and conduct landscape-level nutrient loading—response studies.

Major Partners  
EPA STAR Funded: Great Lakes Ecological Indicators (GLEI) Project

EPA Office of Water, Nutrient Criteria Team  
Great Lakes National Program Office  
State of the Lakes Ecosystem Conference  
Lake Michigan Monitoring Coordination Council  
Friends of South Shore Wetlands  
MN Seagrass (Outreach)  
U.S. EPA Regions 5, 1, 2  
States of MA, CT, RI

### How Research Contributes to Outcomes

The impact is improved coastal nutrient criteria guidance to EPA Office of Water, Regions, States, and Tribes in terms of development of:

- a) a methodology for resolving nutrient loading—response relationships in support of regionally-based nutrient criteria development;
- b) a generic approach to build upon for other coastal areas, applicable generally to aquatic life criteria development, not just nutrients; and
- c) comprehensive and consistent regional databases (for poorly-characterized coastal systems) that can aid criteria development.