



# THE DEVELOPMENT OF SCIENTIFICALLY SOUND, RAPID, AND PRACTICAL METHODS FOR STATES TO USE TO ASSESS THE CONDITION OF THEIR COASTAL WETLANDS

CATHLEEN WIGAND AND RICHARD MCKINNEY (NHEERL)



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### Science Questions

- How can stressor levels, biological-response relationships, classification schemes, bioassessment methods, ecological risk assessments, and indicators be applied across U.S. surface waters to set criteria for identifying/restoring impaired waters and maintaining designed uses?
- Can relationships between anthropogenic stressors and biological responses be used to systematically assess coastal wetlands of the northeastern United States?
- Can we determine whether and how plant and soil measures vary along a gradient of increasing anthropogenic stress (i.e., watershed development and marsh landscape disturbance)?
- Can we determine the feasibility of developing rapid assessment methods to assess wetland condition?

### How Research Addresses the Water Quality MYP Goals

The research approach, design, and implementation will support the development of scientifically sound methods and tools to assess coastal wetland condition. These assessment methods and tools will allow for the reporting of the ambient condition of coastal wetland resources (compliance with Clean Water Act 305b – “State of the Nations Waters”), assist in the identification of impaired wetlands, and support the development of tiered aquatic life use support criteria for wetlands to assess the provision of designated uses.

### Research Objectives

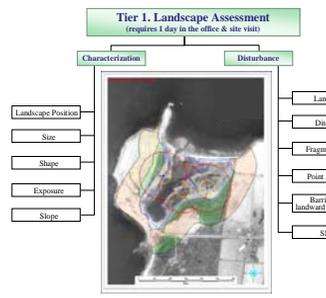
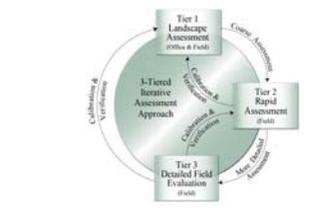
To create a scientifically-based tool that can determine the condition of New England coastal wetlands in a rapid, cost effective manner.

### Research Methods & Collaboration

- Using a 3-tiered approach (Figure 1), the coastal wetlands in New England were assessed with (1) a landscape analysis, (2) a field, rapid method, and (3) a detailed field evaluation for some targeted, reference sites. The detailed field evaluation for some targeted reference sites allows for calibration and verification of the landscape and rapid methods (Tiers 1 and 2). Over 60 wetland units were selected throughout CT, RI, and MA using a random design with sampling spread over entire ecoregions using a hexagon scheme.
- (1) The landscape analysis (Tier 1) used available inventory maps of intertidal, emergent and associated wetlands, aerial photography, and a Geographic Information System to assess condition of the wetlands and disturbances (e.g., ditching, fragmentation, barriers to landward migration) at a coarse scale.
- (2) In the second assessment tier, the condition of the wetland was described through a field evaluation using measures of hydrology, plants, and soil. The plant metrics included descriptions of communities, species, and percent cover. Soil metrics included measures of penetration resistance and macro-organic matter or peat fragment content in the surface layer of the soil. Area of disturbances such as tidal restrictions, outfalls, and invasive species were also observed on-site.
- (3) In the final tier, detailed biological (e.g., waterfowl, fish, infauna) and geochemical measurements were made at a targeted subset of reference sites of low to high watershed disturbance as indicated by land use and watershed nitrogen inputs. Upon completion of the assessment, a reference-based evaluating scheme will be developed to describe the relative condition of the coastal wetlands.

**Collaborators:** The US EPA, Atlantic Ecology Division and Region 1 are working collaboratively with the Massachusetts Coastal Zone Management, the Narragansett Bay Estuary Program, Yale University, and the University of Rhode Island to implement landscape and rapid assessments of coastal salt marshes in Rhode Island, Massachusetts, and Connecticut. These partnerships help ensure that the research results will be used by clients.

Figure 1. 3-Tiered Iterative Assessment Approach



### Research Results

**Rapid Assessments Results:**  
Preliminary analysis of CT and RI rapid assessment data collected in summers of 2004 and 2005 show a relationship between percent developed watershed (sum of residential, urban, and industrial lands) and changing plant structure (Figures 2, 3). Marshes were classified by shape in the rapid assessment, and the more expansive marshes, showed a significant relationship between the marsh landscape stressors (i.e., ditching, diking, point sources, barriers to landward migration, filling) and the plant measures (Figure 4). In preliminary principal component analyses, the rapid assessment soils data did not appear to improve the relationships of the plant measurements with the watershed or marsh landscape disturbances.

Preliminary Analysis of Tier 1, Landscape and Tier 2 Rapid Assessment Data

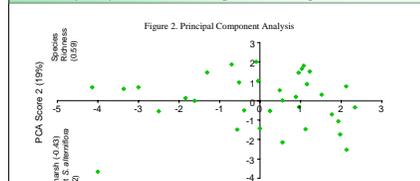


Figure 3. Marsh Landscape Stressor Scores vs. % Developed Watershed

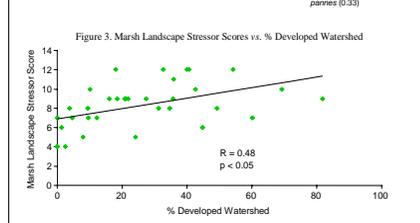
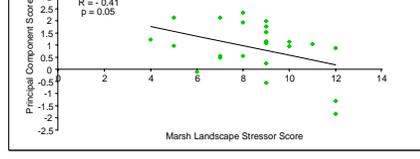


Figure 4. Marsh Landscape Stressor Score vs. Principal Component Score 1



### Tier 3: Results of Detailed Field Evaluations

Here we present some results-to-date on the changes in the plant structure (Figures 5) in reference coastal salt marshes having a range of watershed development and nitrogen loads (Table 1). These response data provide a reference data set to calibrate and verify more coarse rapid assessments used to assess over 60 coastal salt marshes in a cooperative implementation effort among New England states. Furthermore, there were significant relationships between the rapid assessment plant data and the more intensive plant field measurements at the ten reference sites, verifying the accuracy of the rapid assessment plant metrics (Figure 6).

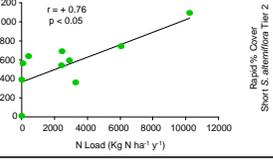
Table 1. Watershed description and calculated nitrogen loadings, for ten Narragansett Bay coastal fringe marshes.

Site	Watershed	Calculated Nitrogen Loads		
		Point	Nonpoint	Total
JEN	41	4.0	12	29
FOX	62	0.3	10	103
FOG	39	14.8	4	280
DON	2975	10.0	29	11599
PAS	314	65.4	4	9917
BRU	181	61.8	9	22344
WAT	402	56.0	2	11920
APP	1738	43.3	3	32472

- \*Sites are listed from lowest to highest marsh N-load
- JEN = Jenny Pond
- FOX = Fox Hill Salt Marsh
- FOG = Fogland Marsh
- DON = Mary Donovan Marsh
- PAS = Passaconquis Cove
- BRU = Brush Neck Cove
- BIS = Bisset Cove
- OLD = Old Mill Cove
- WAT = Watchemoket Cove
- APP = Apponaug Cove

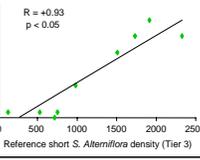
### Change in the Plant Structure

Figure 5. Relationships between watershed nitrogen loads and marsh plant structure



### Preliminary Verification

Figure 6. Rapid vs. Cover - Reference Density short S. alterniflora



### Preliminary Condition Evaluation Model

Figure 7. Cumulative % of Invasive Plants

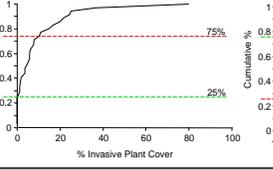
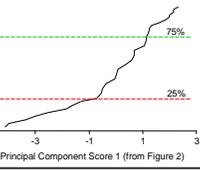


Figure 8. Cumulative Percent Relationship of Plant Metrics



### Research Conclusions & Future Directions

Analysis of the landscape, plant, and soils rapid assessment data from the summers of 2004 and 2005 are still underway. After statistical analyses of these data are completed, recommendations for improving the rapid assessment methods and future implementations will be made. The rapid assessment approach appears to be successful in detecting differences in relative plant percent cover among coastal wetlands with varying watershed development and disturbance. However, it appears from preliminary statistical analyses that the rapid methods for describing the soil penetration resistance and peat volume will need to be modified and tested further. An evaluation scheme for assessing the condition of the coastal wetlands will be developed and calibrated after data analyses are completed. Preliminary evaluation models (Figures 7, 8) based on the rapid assessment plant measures are shown.

### Interactions with Customers

Within the US EPA, the NHEERL Atlantic Ecology Division research has been carried out in partnership with NHEERL - Western Ecology Division, Region 1, and the Office of Water. The NHEERL-AED wetland scientists provide technical assistance to northeastern and mid-Atlantic states and actively participate in the New England Biological Assessment of Wetlands Work Group (NEBAWWG).

### How Research Contributes to Outcomes

These methods and approach will assist the states and tribes in adoption of a coastal wetland monitoring and assessment program. The northeastern coastal wetland project is one of a few national case studies using the three-tiered approach to assess the condition of wetlands. EPA Office of Research and Development is working cooperatively with the New England states, California, and mid-western states to develop and implement these wetland assessment methods. The three-tiered assessment approach provides inventories of wetland resources, mitigation and restoration site identifications, 305(b) condition assessments, and reports on the quality and quantity of the wetlands.