



EPA STAR Grant Progress Report, Year 2

Program: Environmental Indicators in the Estuarine Environment

Title: Atlantic Coast Environmental Indicators Consortium (ACE INC)

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Project Overview and Objectives

We have been developing and testing broadly-applicable, integrative indicators of ecological condition, integrity, and sustainability across four distinct and representative estuarine systems on the Atlantic Coast of the United States (Fig. 1). These include the Nation's two largest estuarine complexes, Chesapeake Bay, MD/VA and Albemarle-Pamlico Sound, NC, a small estuary, the Parker River, situated in the Plum Island NSF Long-Term Ecosystem Research (LTER) site in Massachusetts, and a river-dominated system in the southeast Atlantic Bight, the North River Inlet, SC. These sites are representative of three primary producer bases (intertidal marsh—Plum Island and North Inlet; plankton dominated—Chesapeake Bay and Pamlico Sound; seagrass dominated—portions of Chesapeake Bay and Pamlico Sound).

They also have ongoing, long-term water quality/habitat monitoring programs in place, serving as the data bases for indicator development and testing. These systems contain both pristine and anthropogenically-impacted waters.

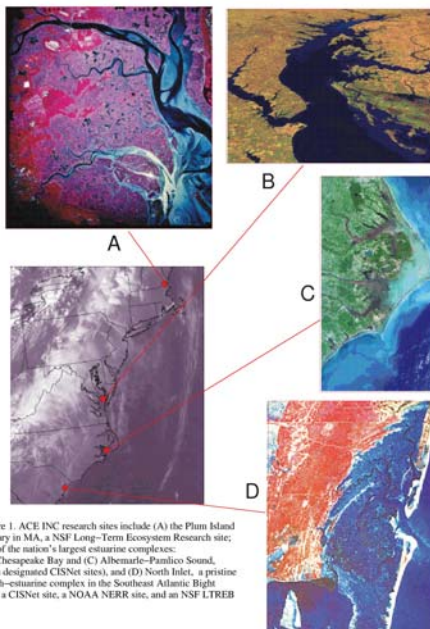
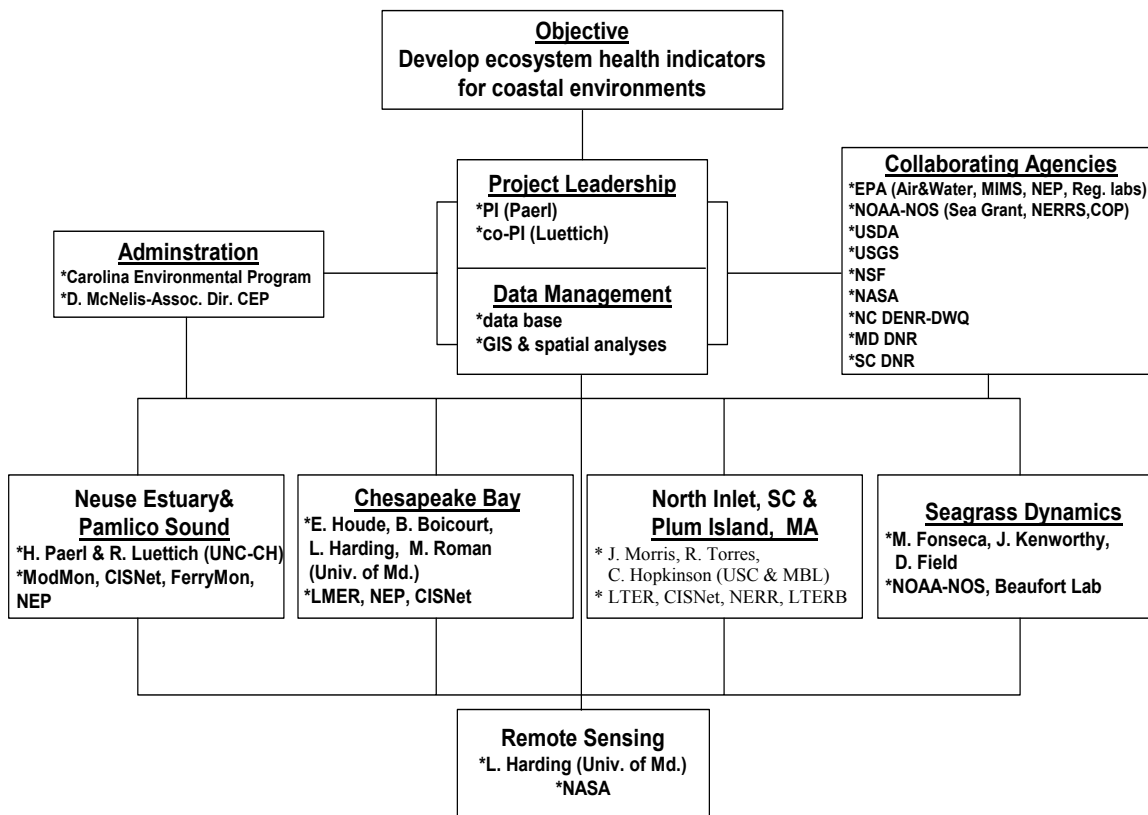


Figure 1. ACE INC research sites include (A) the Plum Island Estuary in MA, a NSF Long-Term Ecosystem Research site; two of the nation's largest estuarine complexes: (B) Chesapeake Bay and (C) Albemarle-Pamlico Sound, (both designated CISNet sites), and (D) North Inlet, a pristine marsh-estuarine complex in the Southeast Atlantic Bight (also a CISNet site, a NOAA NERR site, and an NSF-LTER site).

Atlantic Coast Environmental Indicators Consortium (ACE INC) Organizational Network



Current research activities are addressing the following primary objectives:

- **Enhance the archive of existing data for these systems with remotely sensed and time-series information on key water quality and habitat condition variables**
- **Exploit detailed knowledge of ecosystem structure and function to synthesize this archive and develop candidate indicators**
- **Test the ability of these indicators to gauge ecosystem health and unambiguously detect trends resulting from both natural variability and anthropogenic stresses in multiple estuaries.**

Key areas of research progress that will be elaborated on in this report include development of:

- **Indicators of microalgal and macrophyte functional groups controlling primary production**
- **Indicators capable of determining plankton and fish community structure (organization) and function, i.e., indices that relate to trophic transfer and sustainable higher trophic levels**

- **Biological indicators coupled to physical-chemical and remote sensing assessments of ecosystem function, trophic state and change**
- **Developing and applying indicators and assessments within a national coastal indicator framework (EPA-EaGLE Program) by establishing collaborations with other EaGLE Centers and EPA/NSF/NOAA-supported ecological indicator research efforts.**

The indicators we are examining form the backbone of ecosystem, regional and national water quality, habitat assessment and living resources monitoring and modeling efforts (Table 2). These indicators are used to calibrate and ground truth aircraft and satellite remote sensing of estuarine and coastal resources, including plant community structure, function, and ecological health. Phytoplankton, marsh and seagrass proxies are being linked with metrics of trophic structure to provide indicators of living resources status.

Quality Assurance:

In accordance with EPA regulations and institutional laboratory/field protocols, the Quality Assurance (QA) component of this project is strictly and continuously adhered to. Day-to day QA issues and updates are discussed among P.I.s via telephone conferencing, E mail or interactive website. Annual “all hands” meetings among P.I.’s and collaborators include a discussion and updating session on QA issues.

Collaborative Efforts with other EaGLE Centers and EPA Cooperative Centers

- **Development of bio-optical and ecological indicators of seagrass community productivity, structure and health (with C. Gallegos, ASC)**
- **Use of neural network analysis to predict phytoplankton community structural and function responses to hydrologic and nutrient stressors in estuaries (with P. Noble, GOM-CEER)**
- **Applying diagnostic photopigments as indicators of phytoplankton functional groups in estuarine and coastal ecosystems (with R. Axler, GLEI)**
- **Exploring the use of diagnostic photopigments as indicators of benthic and epiphytic microalgal community structure (with G. Cherr, PEEIR)**
- **Coupling estuarine phytoplankton, seagrass and turbidity indicators to Aircraft-based Advanced High Resolution Imagery (Pamlico Sound, NC) (with R. Lunetta, EPA-RTP)**
- **Molecular indicators of nitrification dynamics in coastal waters (with T. Hollibaugh, PEEIR)**
- **Statistical approaches for utilizing phytoplankton functional group as indicators of hydrologic and nutrient forcing features in estuaries (with R. Regal, Univ. Minn., Duluth, GLEI)**
- **Application of neural network analysis to classify land cover**
- **R. Torres is working with the NSF sponsored National Center for Airborne LiDAR Mapping (NCALM) to create a LiDAR DEM of the North Inlet marsh.**
- **Biomass size spectra approaches to categorize ecosystem status (with C. Rakocinski, GOM—CEER)**

Other Collaborative Products:

Special Session: American Society of Limnology and Oceanography 2003 Meetings, Salt Lake City, UT, Feb. 2003

ACE INC teamed up with GLEI (H. Paerl and G. Neimi Co-Chairs) to organize a Special Session at the 2003 American Society of Limnology and Oceanography meetings in Salt Lake City (9-14 February, 2003) “Coastal indicators of water quality and ecological condition”.

Session Abstract:

Estuarine and coastal waters are experiencing ever-increasing human- and naturally-induced (e.g., climatic) change. This session will address the development and application of indicators capable of assessing ecological condition and change in coastal waters over a range of scales from individual habitats to regions. In the US, the Environmental Protection Agency (EPA) is supporting the Estuarine and Great Lakes Ecological Indicators (EaGLE) Program, which includes the coastal Atlantic, Gulf of Mexico, Pacific and Great Lakes regions. Complimentary efforts are underway worldwide. The session will address indicators capable of addressing different levels of biological complexity, ranging from subcellular (molecular) to population, community, ecosystem and regional scales. A major objective is incorporate these indicators in long-term environmental research and monitoring programs to develop sensitive, quantitative and comparative means of measuring ecological change in response to human and natural stressors and perturbations of the coastal zone across hydrographically- and geographically diverse watersheds and receiving waters. Efforts are under way to link these indicators to remote sensing in order to “scale up” their application to large coastal regions not amenable to time- and space-intensive sampling. Development, testing, interpretation and application of these indicators will be discussed, using a range of biotic assemblages and stressors among ecosystems and regions varying in land and water use, hydrology, productivity, nutrient cycling, trophic structure and biodiversity.

41 Abstracts were submitted and accepted for oral presentation at this session, which ran for 2 days.

Relevant Website:

[Atlantic Coast Environmental Indicators Consortium \(ACE INC\)](#)

Supplemental Keywords:

phytoplankton, macrophytes, submersed aquatic vegetation, zooplankton, fish, trophodynamics, water quality, size spectrum, coastal wetlands, habitat, bio-optics & turbidity, remote sensing, primary production, HPLC, photopigments, dissolved oxygen, nutrients, hydrology, circulation, nutrient management, regional scale indicators, ecosystem and regional scale, climatology, hurricanes, TMDLs, modeling, ferry-based monitoring.