PROJECT SUMMARY

Estuaries and coastal landscapes experience a range of stresses, both natural and anthropogenic. Among these, cultural eutrophication affects most U.S. coastal ecosystems. As a result, most coastal ecological research--including both LTER and LMER projects--has been conducted in systems that are [to some degree] eutrophic. In this coastal Everglades LTER, we propose to investigate how variability in regional climate and freshwater inputs, disturbance, and perturbations affect land-margin ecosystems. A coastal Everglades LTER is particularly appropriate for studying these questions because the entire system is oligotrophic, it is the focus of the largest watershed restoration effort ever implemented, and the regional climate facilitates study of how coastal ecosystems are controlled by a highly variable environment. Our long term research program will focus on the following central idea and hypotheses:

Regional processes mediated by water flow control population and ecosystem level dynamics at any location within the coastal Everglades landscape. This phenomenon is best exemplified in the dynamics of an estuarine oligohaline zone where fresh water draining phosphorus-limited Everglades marshes mixes with water from the more nitrogen-limited coastal ocean.

Hypothesis 1: In nutrient-poor coastal systems, long-term changes in the quantity or quality of organic matter inputs will exert strong and direct controls on estuarine productivity, because inorganic nutrients are at such low levels.

Hypothesis 2: Interannual and long-term changes in freshwater flow controls the magnitude of nutrients and organic matter inputs to the estuarine zone, while ecological processes in the freshwater marsh and coastal ocean control the quality and characteristics of those inputs.

Hypothesis 3: Long-term changes in freshwater flow (primarily manifest through management and Everglades restoration) will interact with long-term changes in the climatic and disturbance (sea level rise, hurricanes, fires) regimes to modify ecological pattern and process across coastal landscapes.

We will test these hypotheses along freshwater to marine gradients in two Everglades drainage basins. We have observed a clear productivity peak in the low salinity zone of one but not the other, and this peak appears to be the result of low phosphorus freshwater meets higher phosphorus marine water. We will quantify nutrient regeneration from dissolved organic matter (DOM), and expect this to be a major contribution to this oligohaline productivity peak. We will also examine how this stimulus of the microbial loop affects secondary production. This LTER will thus focus on how changes in freshwater flow and climatic variability control the relative roles that nutrients and organic matter play in regulating estuarine and coastal productivity. Our transect design is conceptually analogous to a Lagrangian approach in which we follow parcels of water as they flow through freshwater marshes and mangrove estuaries to offshore. Along the way, we will quantify patterns and processes in the water and in the wetlands through which it is flowing using long-term sampling and short-term mechanistic studies. We will quantify: 1) primary productivity; 2) concentrations and turnover dynamics of inorganic nutrients and organic matter (particularly DOM); 3) organic matter accretion and turnover in soils and sediments, and; 4) consumer dynamics and productivity. We will use process-based simulation models to link key components, such as the relationships between DOM quantity and quality, microbial loop dynamics, and higher trophic levels. Data synthesis will also include hydrologic models to simulate water residence times along the transects, and and a GIS-based project database that will integrate data from this LTER research with information from other related projects. The GIS database will be linked to a COERCE LTER web site to maximize the exchange and dissemination of information within the LTER Network and with the scientific community in general.