Regional Controls of Population and Ecosystem Dynamics in an Oligotrophic Wetland-dominated Landscape - The New Florida Coastal Everglades LTER Project

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ABSTRACT

We introduce a new coastal Everglades LTER project in which we are investigating how variability in climate, freshwater inputs, and disturbance affect land-marine ecosystems. The coastal Everglades landscape is oligotrophic and is the focus of a large watershed restoration effort. Freshwater flow is differentially controlled by the highly variable precipitation regime and water management. We are testing our hypotheses along two freshwater to marine gradients. This transect design is LaGuajira in that we follow water parcels as they flow through freshwater and mangrove forests to estuaries. Along the way, we are quantifying patterns and processes in the water and the wetlands using long-term sampling and short-term mechanistic studies. A clear productivity peak characterizes the oligotrophic edge of one transect but not the other. This peak is likely the result of low P, high N freshwater meeting higher P, lower N estuarine water. We suspect that nutrient regeneration from DOM largely controls this oligotrophic productivity peak, and that the resulting stimulus of microbial loop processes enhances estuarine secondary production. This new coastal Everglades LTER thus focuses on how changes in freshwater flow and climate, and disturbance affect population and ecosystem level dynamics along Everglades drainage basins with a focus on the oligotrophic zone.

INTRODUCTION

The Everglades is an oligotrophic wetland landscape, with P limiting ecosystem productivity (Amador and Jones, 1993). Since the turn of the century, humans have drastically altered patterns of flow, translation, and delivery in the Everglades. Now, the Everglades is the focus of a large watershed restoration effort seeking to restore the quantity, quality, timing, and distribution of water flow to the Everglades. Our research will evaluate how long-term changes in freshwater flow, climate, and disturbance affect population and ecosystem level dynamics along Everglades drainage basins with a focus on the oligotrophic zone.

PRIMARY RESEARCH HYPOTHESES

In nutrient-poor coastal systems, long-term changes in the quantity or quality of organic matter inputs will exert strong and direct control on estuarine productivity, because inorganic nutrients are at such low levels. Interannual and long-term changes in freshwater flow control the magnitude of nutrient 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. Long-term changes in freshwater flow (manifest through management and restoration in the coastal Everglades) will interact with long-term changes in the climatic and disturbance regimes to modify ecological pattern and process across coastal landscapes.

PRIMARY RESEARCH QUESTIONS

Our research will focus on these long-term scenarios:

1. How are the patterns and magnitudes of primary production controlled by freshwater flow and the concentrations and characteristics of nutrients and organic matter in the source water?

2. How does freshwater flow or the content of source water control secondary production and trophic dynamics?

3. How do changes in freshwater flow or the content of source water control organic matter accumulation in freshwater and mangrove wetlands?

4. How is the quality and/or quantity of DOM or the quantity of inorganic nutrients in source water altered by changing freshwater flow versus internal processes occurring at a given location in the landscape? How are local ecosystem processes controlled by changes in source water DOM or inorganic nutrients (e.g., microbial loop dynamics)?

5. How do long-term changes in freshwater flow interact with long-term changes in the climatic and disturbance regimes to modify ecological pattern and process across coastal landscapes?

THE CENTRAL CONCEPT: DIFFERENTIAL OLIGOTHELINE PRODUCTIVITY PEAK

The productivity peak in the oligotrophic region of the SRS transect is not found in the TSPH transect. This occurs because the Florida Bay estuary scavenge all available P from coastal waters before it reaches this oligotrophic zone (Fourqurean et al., 1993; Boyd et al., 1999).

PROJECT SYNOPSIS

The new coastal Everglades LTER project is investigating how long-term changes in climate, freshwater flow, and disturbance affect the oligotrophic coastal Everglades landscape. We are testing our primary research hypotheses in Shark River Slough and the Taylor Slough/Panhandle region by following water parcels as they flow through freshwater and mangrove wetlands to estuaries and quantifying patterns and processes along the way. The project will be conducted in a shallow subtidal estuary (Florida Bay) that is adjacent along the Shark River Slough transect. The oligotrophic region of the Shark River Slough transect exhibits a productivity peak. This peak is likely the result of low P, high N freshwater meeting higher P, lower N marine water. The Taylor Slough transect lacks this peak, since Florida Bay scavenge all available P from coastal waters before it reaches the oligotrophic zone (as per the above figure). We expect changes in freshwater quality and quantity to modify the productivity peak along the salinity gradient and influence population and ecosystem dynamics, as per the following long-term scenarios.

HYPOTHEZIZED LONG-TERM SCENARIOS

Our primary research questions will focus on these long-term scenarios:

1. Increased freshwater flow

2. Increased freshwater flow plus increased marine nutrient inputs

3. Increased freshwater flow plus increased DOM inputs

LITERATURE CITED


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