Influence of Periphyton on Carbon Dioxide Sequestration Along Enrichment and Hydrologic Gradients in Everglades Marshes

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Abstract

Periphyton in the Everglades has some of the highest cited production values (up to 10371 g C m^{-2}). Biomass of periphyton mats in Caribbean calcareous wetlands has been found to be greater than the biomass of common emergent macrophytes (*Eleocharis cellulosa*), but can also be greater than or equal to that of robust macrophytes (*Typha domingensis* and *Cladium jamaicense*). However, even small increases in phosphorus can have dramatic changes in periphyton productivity, structure, and composition. The resulting periphyton mat disassembly after phosphorus enrichment could have dramatic impacts on carbon dioxide sequestration by periphyton. I wish to determine the cause of periphyton mat disassembly using closed-system round bottom reaction vessels. I will use high-low treatments of phosphorus to determine their effects on mucopolysaccharide production by cyanobacteria which seems to act as a glue to hold the mat together. I will use high-low treatments of antimicrobials to determine the effect of bacterial abundance on the consumption of mucopolysaccharides and carbon dioxide production by bacteria. Additionally, I will perform chamber studies in Everglades short and long-hydroperiod marshes to determine if these periphyton-dominated marshes are sources or sinks for carbon dioxide.

I. Introduction

Carbon

100 ppb increase since the Industrial Revolution making it necessary to determine if ecosystems are sources or sinks

Everglades

Aboveground net primary production

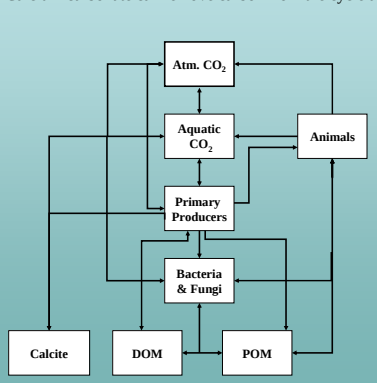
-Sawgrass 606 ± 74 g C m^{-2} y^{-1}

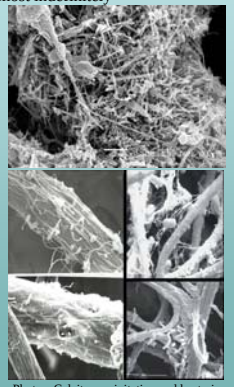
-Periphyton (~1903 g C m^{-2} y^{-1})

Everglades production values may have meaning for other carbonate wetlands in Caribbean

Periphyton: Assemblage of algae, cyanobacteria, bacteria, protozoa, aquatic plants, and invertebrates, coexisting in a matrix of mucopolysaccharides, calcium carbonate, and detritus

Calcium carbonate can remove carbon from the cycle almost indefinitely



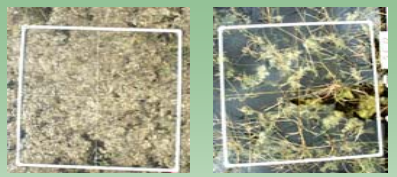


Photos: Calcite precipitation and bacteria associated with filamentous algae

II. Periphyton and Phosphorus Enrichment

Photo taken from experimental flume study analyzing the effects of different phosphorus levels on periphyton

30 ppb Treatment



Day 1 **Day 180**

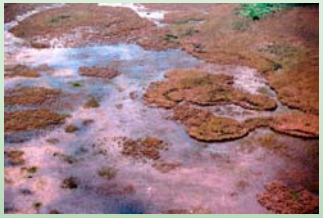
Periphyton exist in the naturally, highly oligotrophic Everglades.

Excess phosphorus input from the Everglades Agricultural Area (EAA) and urbanization is a chronic problem for periphyton-dominated marshes.

Small increases in P can cause mats to disassemble, losing biomass through alterations in structure and composition.

III. Objectives

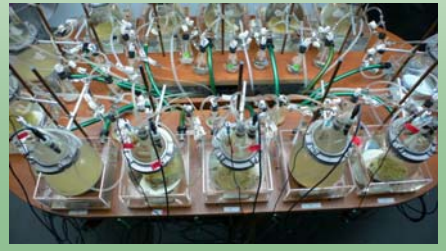
1. Determine cause of periphyton mat disassembly that results from phosphorus enrichment and the effect this event has on carbon dioxide sequestration.
2. Determine if a periphyton-dominated Everglades marsh is a source or sink for carbon dioxide.
   - -Contrast short- and long-hydroperiod marshes
   - -Contrast periphyton and macrophyte components



Top Left: TS/Ph-1

Top Right: SRS-2

Bottom: Microcosm setup



IV. Methods

Mat Disassembly:

Short term (~10 days) microcosm study to determine the sequence of changes in short and long hydroperiod mats exposed to elevated phosphorus

Setup-

13 borosilicate 5L round glass reaction vessels

Temperature controlled water baths

Adjustable lighting

Probes (Temperature, DO, pH, Conductivity)

-Measurements taken every 30 minutes/~10 days

Pre- and Post-enrichment analyses

TP, dry mass, ash-free dry weight, polysaccharide concentration, soft-algae abundance, diatom abundance, bacterial abundance, chlorophyll a

Photos will be taken at regular intervals to document mat disassembly

Marsh carbon sequestration:

Chambers

-5 chambers in FCE-LTER sites TS/Ph-1 and SRS-2

Treatments

-Light/dark

-Natural system, emergents removed, emergents and submergents removed

-periphyton removed (if feasible)

Measurements

-Abiotic C flux

-Alkalinity

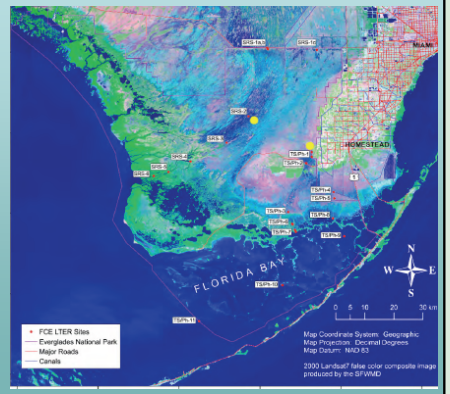
-pH

-Temperature

-Biotic C flux

-Dissolved oxygen

-Above-water surface CO_2



FCE-LTER sites represented as yellow dots