Belowground Primary Productivity and Dynamics in the Oligohaline Ecotone of the Florida Everglades

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INTRODUCTION

- Primary productivity is the rate at which energy, usually measured in terms of biomass, is accumulated in plants by photosynthetic processes.
- Under optimal foraging theory, plants allocate their energy resources so that all are equally and concurrently limiting.
  - At all sites, nutrients are more limiting than light, therefore plants will allocate more of their biomass to belowground structures (as shown in Figure 1).

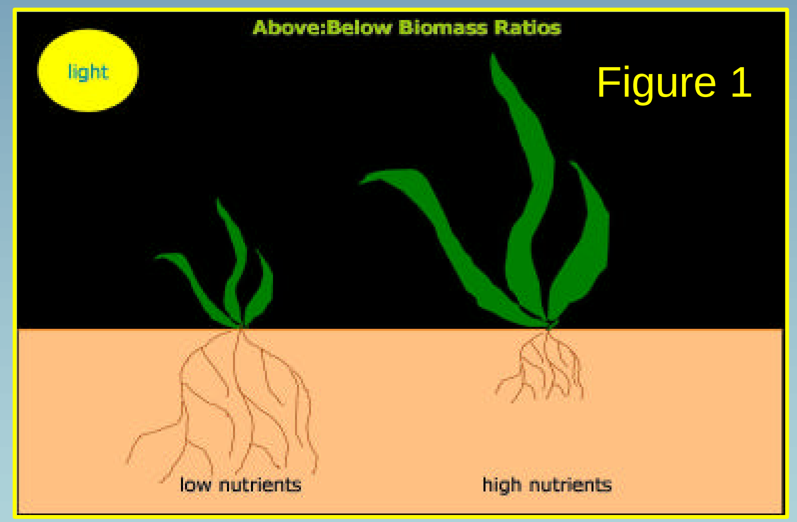

Figure 1

SITE DESCRIPTION

- The Everglades is characterized by its two major drainages, Taylor Slough and Shark River Slough, which flow southward into Florida Bay and the Gulf of Mexico respectively.
- The oligohaline ecotone (see Figure 2 red circle) is characterized by the interactions between freshwater ecosystems (sawgrass dominated) and a frontal boundary saltwater ecosystem (mangrove forest).
- Primary productivity is enhanced in this ecotone due to dilution of sea water from freshwater inputs, as well as biotic and abiotic processes, such as dissolution of particulates, chemical precipitation, biological assimilation and mineralization.

Figure 2: Landsat image showing locations of four sampling sites and general location of oligohaline ecotone

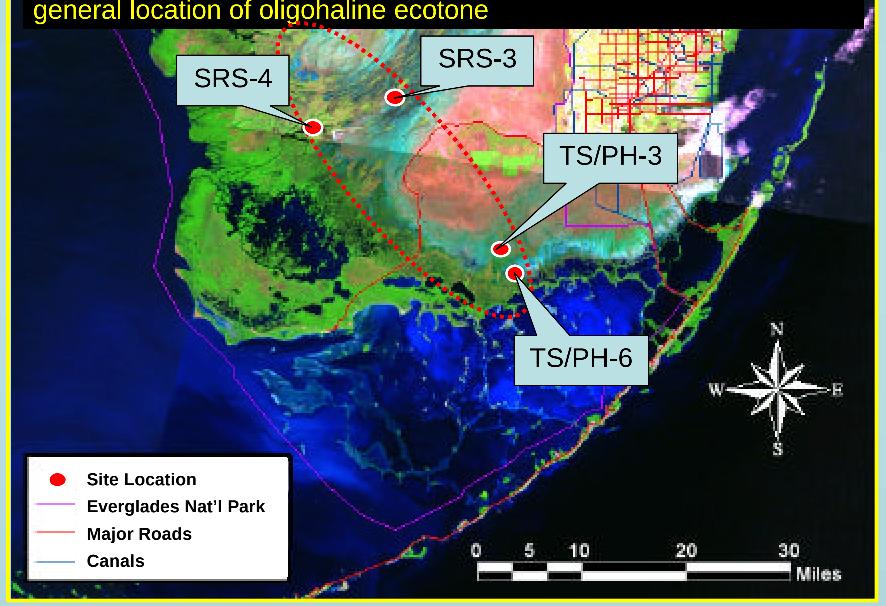

TABLE 1: GENERAL SITE DESCRIPTIONS FOR THE FOUR PROPOSED SAMPLING SITES

	TS/PH-3	TS/PH-6	SRS-3	SRS-4
Watershed	Taylor Slough	Taylor Slough	Shark River Slough	Shark River Slough
Physiography	Flat wetland	Flat estuarine wetland	Flat wetland	Flat estuarine wetland
Hydroperiod	About 10 months	About 12 months	Varying b/w 9-12 months	Varying b/w 9-12 months
Hydrography	Seasonally driven sheetflow	Seasonally driven freshwater inputs and wind-driven estuarine inputs	Seasonally driven sheetflow	Seasonally driven freshwater inputs and tidally driven oceanic inputs
Topography	Flat	Flat, with tidal creek topography	Flat, w/ ridge & slough microtopography	Flat, w/ tidal creek topography
Geology	Limestone bedrock	Limestone bedrock	Limestone bedrock	Limestone bedrock
Soil	Wetland marly peat, 1m	Wetland peat, > 1m	Wetland peat, > 1m	Wetland peat, > 1m
Vegetation	Sparse sawgrass marsh	Mangrove forest interspersed w/ sawgrass stands	Sawgrass dominated marsh interspersed w/ *Eliocharis*	Mangrove forest interspersed w/ sawgrass stands
Habitat	Freshwater wetland	Mangrove wetland, low/dwarf stature	Freshwater wetland	Mangrove wetland, low/dwarf stature

**All site characteristics taken from Florida Coastal Everglades LTER website (http://fcelter.fiu.edu/maps/)*

PURPOSE

- Primary productivity in the Everglades has been routinely estimated using only aboveground plant biomass.
- Very few belowground productivity estimates are available for Everglades ecosystems, with no such estimates documented for sawgrass in the ecotone regions of Taylor and Shark River Slough.
- This experiment estimates a value for belowground primary productivity for sawgrass in the oligo-haline ecotone of the Everglades.
- **Because of the enhanced primary productivity at the oligohaline zone and large proportion of total production that occurs underground, estimating belowground productivity values in this area is critical to quantifying Everglades productivity as a whole.**

OBJECTIVES & HYPOTHESES

Objective 1: Estimate belowground primary productivity values for sawgrass in the oligohaline ecotone of the Everglades.

Objective 2: Investigate variation in belowground productivity due to: seasonality, salinity, and landscape location among sites and between Taylor and Shark River Sloughs.

Hypothesis 1a: Sawgrass belowground productivity will show seasonal differences, with relatively lower productivity during the dry season.

Hypothesis 1b: Sawgrass belowground productivity will decrease as salinity increases along the salinity gradient.

Hypothesis 1c: Sawgrass belowground productivity will be relatively lower in Shark River Slough compared to Taylor Slough due to increased nutrient availability in Shark River Slough.

Objective 3: Establish an aboveground to belowground biomass model for sawgrass in the ecotone of both sloughs.

Hypothesis 2: Sawgrass above:belowground biomass ratios will be relatively higher in Shark River Slough compared to Taylor Slough due to increased nutrient availability in Shark River Slough.

METHODOLOGY

- *Estimating Belowground Standing Stock Biomass*
  - 15.24 cm-diameter soil cores were inserted 30 cm into the soil (Figure 3) and divided into three 10 cm layers.
  - Roots were separated from soil in the field by washing through 1mm sieves.
  - Live roots were separated from necromass through visual inspection using a self-created key based on root flexibility, color, and tensile strength.
  - All necromass was then placed in a 11% Ludox (colloidal silica) solution to further separate any living roots missed in hand-sorting.
  - Once all live roots were isolated, samples were re-washed, dried, and weighed.
  - Belowground biomass is reported as average dry root mass in each 10 cm segment and entire 30 cm core.
- *Estimating Productivity from Root Ingrowth Cores*
  - Soil cores removed and replaced with an equal diameter mesh bag filled with mixture of commercially available sphagnum moss and humus peat.
  - Sets of ingrowth bags will be removed and replaced every 3 and 6 months for 1 year. Another set will be removed without replacement after 1 year.
  - Subsequent growth of roots into bags over each sampling period provides estimate of belowground productivity.
  - Ingrowth cores will be sorted as described above. Productivity will be reported as average dry mass accumulated over each time interval.
- *Establishing an Above to Belowground Biomass Ratio*
  - Prior to inserting core, all living *Cladium* culms within the core diameter were cut at the soil surface. All living shoots and leaves were collected, dried, and weighed to establish aboveground biomass.


Figure 3

RESULTS . . . *thus far*

- All sampling began in late January, 2004.
- No productivity data is available yet, only standing stock above and belowground biomass for the 2 Taylor Slough sites.
- Standing stock belowground biomass was higher at TS/PH-3, which is expected due to the relatively lower belowground nutrient availability at 3. (Figure 4)
- Standing stock aboveground biomass was higher at TS/PH-6, which is as expected as less resources need to be allocated to belowground structures when nutrient availability is relatively higher. (Figure 4)
- Above to belowground ratio was 0.25 for TS/PH-3 and 0.37 for TS/PH-6.
- Root Density was estimated as 5049 g/m^3 at TS/PH-3 and 3957 g/m^3 at TS/PH-6.
- 56% of the total root biomass was found in the top 10cm of soil at TS/PH-3, compared to 66% at TS/PH-6. (Figure 5)
- All differences in belowground biomass, aboveground biomass, and root density between sites are non-significant .

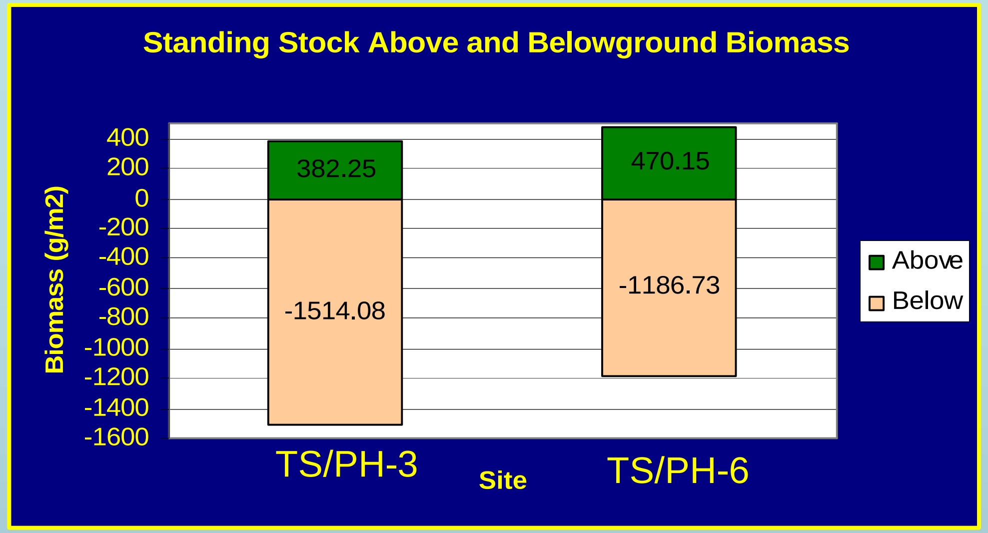

Figure 4

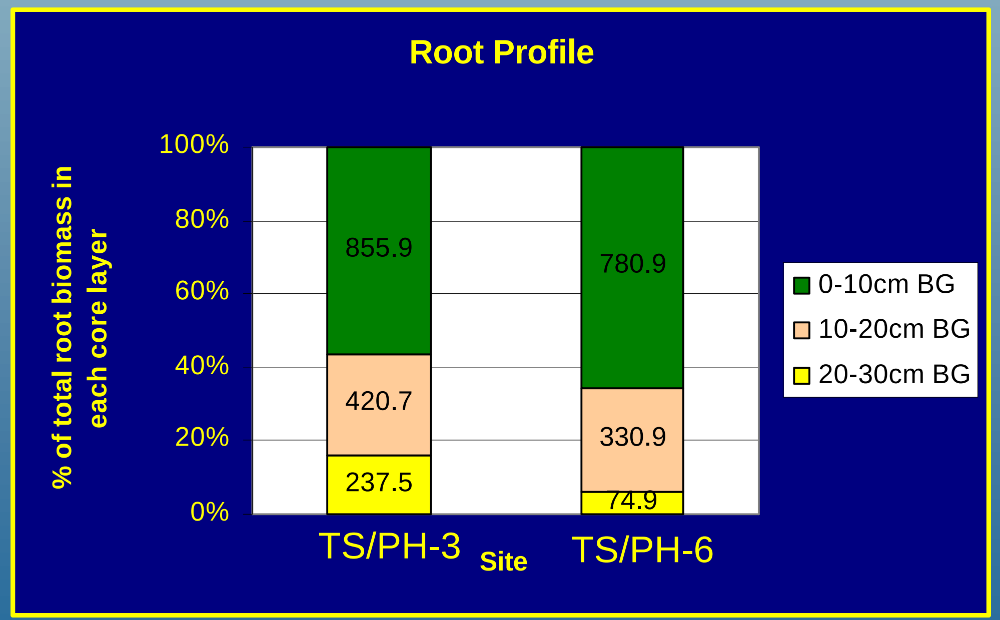

Figure 5