Decomposition of *Cladium jamaicense, Eleocharis* spp., and *Juncus roemerianus* in the Everglades Ecotone Regions

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Abstract

An ecotone region is a habitat at the juxtaposition of two or more distinctly different habitats, or a zone of transition between habitat types. This transition region is best exemplified in the estuarine oligohaline zone where fresh water draining phosphorus-limited Everglades marshes mixes with water from the more nitrogen-limited coastal ocean. Since wetlands are detrital ecosystems, the dynamics of the decomposition process in this region is unique. This project is set to estimate the decomposition of three key macrophyte species that occur in the Everglades ecotones, *Cladium jamaicense*, *Eleocharis* spp., and *Juncus roemerianus*. The project takes place in the ecotone regions of Taylor Slough and Shark River Slough located in the Everglades National Park. Litter bags were used to study the decomposition process. Litter bags experienced three different treatments 1) open air, 2) soil surface, and 3) macroinvertebrates. Preliminary results show that for the most part there is no treatment difference in litter decomposition rates within each site, but decomposition rates vary for individual treatments among sites. This pattern is only seen for *Cladium jamaicense* and not for *Eleocharis* spp., or *Juncus roemerianus*. Also, preliminary results show that litter decomposition rates are not dependent on initial litter TP concentration. The working hypotheses for this poster are:

1. Litter exposed to the soil surface and macroinvertebrates will have a higher decomposition rate because of the enhanced microbial activity in the soil surface, and fragmentation caused by macroinvertebrates leading to an increasing in the surface area of litter for microbial activity. If litter is exposed to the soil surface or macroinvertebrates, then this litter will decompose faster than litter that wasn't exposed to either treatment.
2. Since the limiting nutrient in the Everglades ecotones is P, litter that contains the highest initial TP concentration represents a better food source for bacteria, fungi, and macroinvertebrates. If the litter from a macrophyte species or an individual site contains a higher TP concentration, then the litter of this species or site will decompose faster than the litter with a less TP concentration.

Introduction

Direct comparisons of leaf breakdown in nutrient-poor versus more nutrient rich systems have nearly always demonstrated faster breakdown in the more nutrient-rich system (Webster & Benfield, 1986). In the Everglades, water is the most important factor responsible for the formation of the existing plant communities, and when present it provides a supplement of nutrients to any given area (Steward and Ornes, 1983). Since the water in the ecotone region of Taylor Slough is P limited, due to the sequestering of P from the coastal waters by Florida Bay (Fourqueran et al., 1993), and the water of the Shark River Slough ecotone region is relatively P enriched, due to inputs from the Gulf of Mexico, the effects of these waters in their respective ecotone region will vary significantly. The purpose of this project is to measure the ecosystem process of decomposition for three predominant macrophyte species *Cladium jamaicense, Eleocharis* spp., and *Juncus roemerianus*.. Given that *Cladium jamaicense, Eleocharis* spp., and *Juncus roemerianus* are low nutrient status species (Daoust and Childers, 1999; Richardson et al., 1999), makes them good indicators to represent the effects of increasing water P on decomposition in the ecotone region of Shark River Slough when compared to the decomposition in the P limited ecotone region of Taylor Slough.

Study Area

The area of study focuses on the oligohaline ecotone regions of Taylor Slough and Shark River Slough (Figure 1). These areas show a mixing between freshwater and saltwater. Salinity in the Shark River Slough ecotone region is seasonal and pulsed by tides (Figure 2), and in the Taylor Slough ecotone region salinity is seasonal following wind patterns (Figure 3). The hydroperiod for the Shark River Slough ecotone region is intermediate with inundation time varying between 9-12 months (Figure 2). The hydroperiod for the Taylor Slough ecotone region varies with a low hydroperiod of ~6 months for the northern site (TS/PH3) to a long hydroperiod ~12 months for the southern site (TS/PH6) (Figure 3).

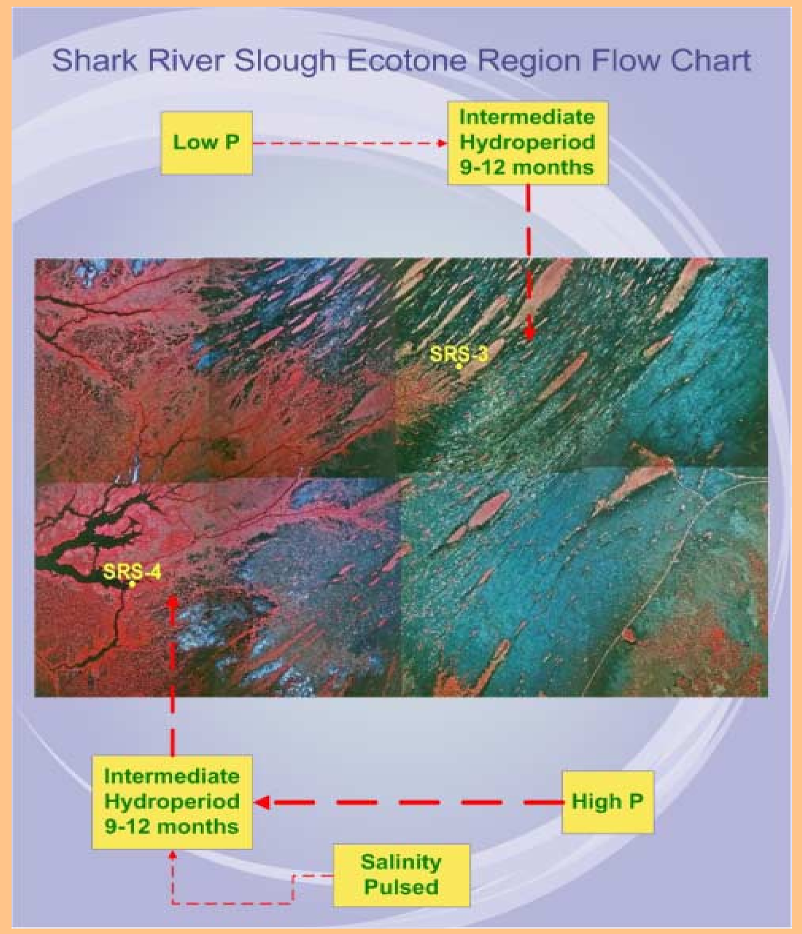

Figure 2: Shark River Slough ecotone flow chart.

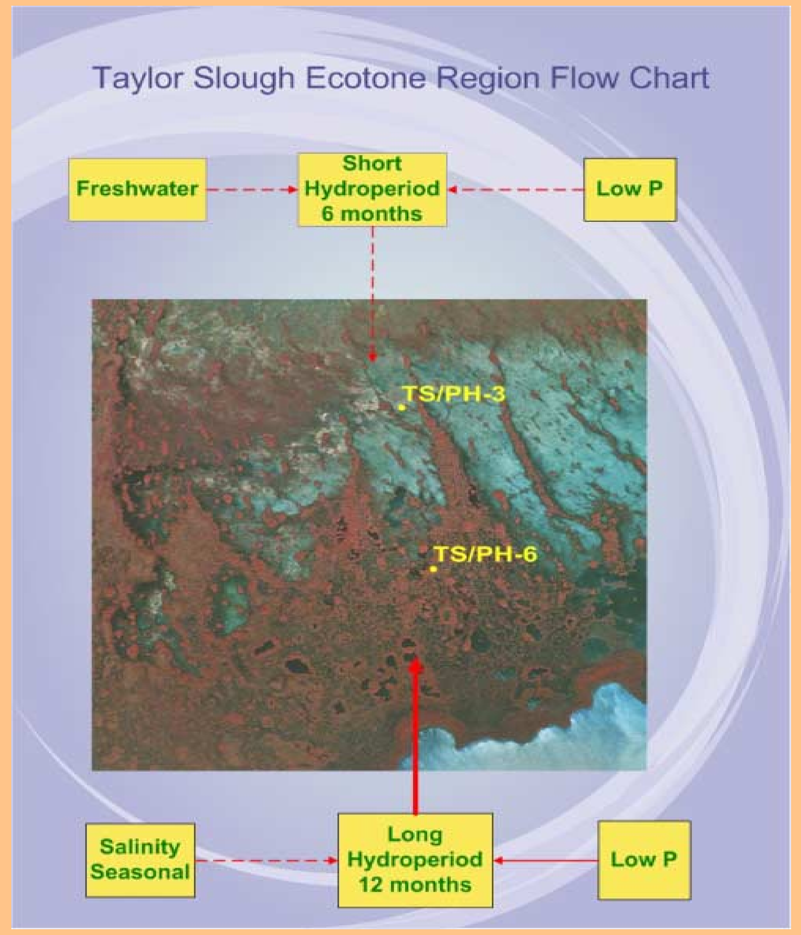

Figure 3: Taylor Slough ecotone flow chart.

Methods

Senesced *Cladium jamaicense, Eleocharis* spp., and *Juncus roemerianus* leaves that hadn't been shed by the plant were collected between the months of December 2001 and January 2002. *Cladium jamaicense* was collected at all sites, *Eleocharis* spp. was collected at all sites except SRS4, and *Juncus roemerianus* was only collected at SRS4. *Eleocharis* spp. wasn't collected at SRS4 because this species is replaced by *Juncus roemerianus* in the ecotone region of Shark River Slough (the inverse is true for TS/pH6). All leaves were air dried for more than two weeks, and 5g of leaf material was placed into a 15cm by 15cm litter bag. The small mesh (1mm) litter bags were used for the open air (Figure 4) and soil surface treatment (Figure 5), and the large mesh (6.35mm) litter bags were used for the macroinvertebrate treatment. Three random bags are going to be collected from each treatment at 1, 2, 4, 6, 12, and 18 months. Table 1 shows the distribution of plant species litter bags that were placed at each site.

Following each collection, litter bags were oven dried at 70ºC until a constant weight was obtained. Litter bags were then weighed to estimate % of original mass remaining. The % mass remaining was natural log transformed, and plotted against time using ANOVA to obtain a decomposition rate (K). After a decomposition rate was obtained for every treatment within a site, a comparison of the different rates within a site and between sites was done following Zar (Comparing Simple Linear Equations, 1996). All differences in decomposition rates were calculated using an α-value of .001.

A sub-sample from each bag was obtained, ground up, and analyzed for TP using the Solorzano and Sharp method (1980). Then, the initial litter TP of every species in each site were plotted against the decomposition rates using ANOVA.

Figure 4: Mesocosm for dry treatment

Figure 5: Placement of bags for soil surface treatment

Results

Preliminary results are presented in this poster. Table 2 shows the decomposition rates for each plant species treatment at each site, and it also illustrates the similarities and dissimilarities of the decomposition rates within each site and between sites. Preliminary results show that for a common species, predominantly no difference exists between treatments within a site. Contrary to the within site comparisons, the between site comparisons show that mainly differences exist among sites within treatments for *Cladium jamaicense* but not for *Eleocharis* spp.. Figure 7 facilitates the presentation of differences in decomposition rates among sites within treatments, and figure 6 helps describe what letters correspond to which comparisons across sites within treatments. The results from the TP vs. K regression show that K is not dependent on initial litter TP (R^2=.009, P-value=.6599, Figure 8).

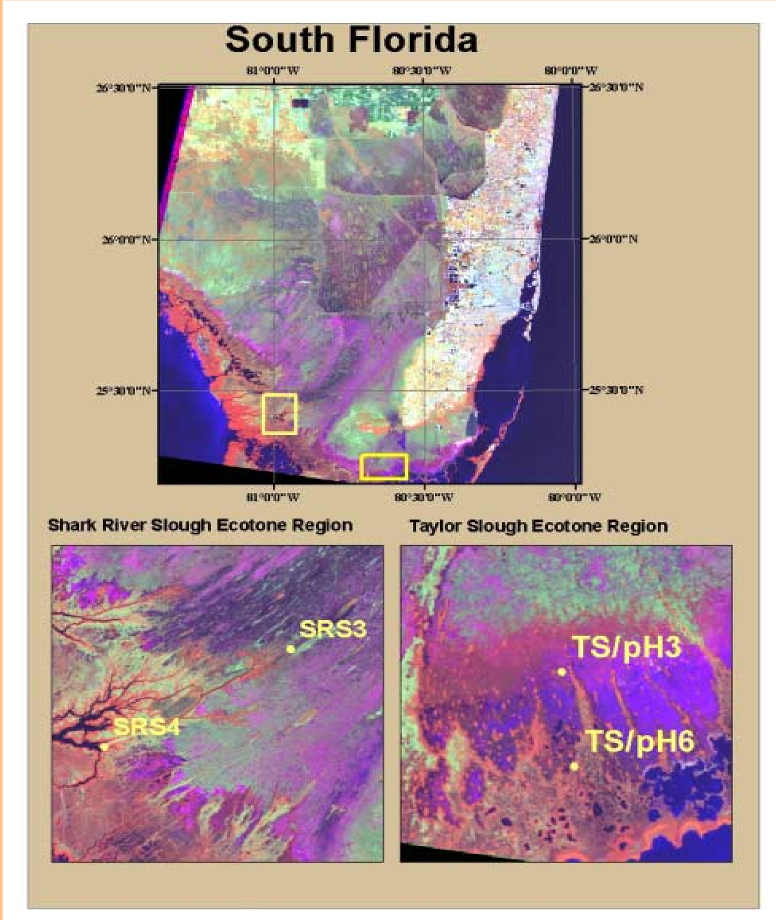

Figure 1: Landsat image of South Florida, and the ecotone regions for Shark River Slough and Taylor Slough

SITE	*Cladium jamaicense*	*Eleocharis* spp.	*Juncus roemerianus*
TS/PH3	X	X	
TS/PH6	X	X	X*
SRS3	X	X	
SRS4	X	X*	X

Table 1: Shows the distribution of plant species litterbags placed at each site. Note that X* corresponds to a litter transplant of *Juncus roemerianus* and *Eleocharis* spp. placed at TS/PH6 and SRS4 respectively. *Juncus roemerianus* litter from SRS4 was placed at TS/PH6, and *Eleocharis* spp. from TS/PH6 was placed at SRS4.

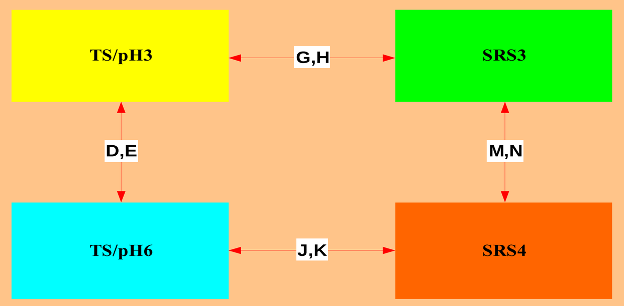

Figure 6: Shows the letters that correspond to the comparisons of decomposition rates between sites depicted in Table2

Site	Treatment	Species	K (%loss/day)
TS/pH3	Dry	Cladium	0.1293 a,d,g
TS/pH3	Wet	Cladium	0.1940 a,d,g
TS/pH3	Macroinvertebrate	Cladium	0.0575 a,d,g
TS/pH3	Dry	Eleocharis	0.1986 a,d,g
TS/pH3	Wet	Eleocharis	0.2534 a,d,g
TS/pH3	Macroinvertebrate	Eleocharis	0.2234 a,d,g
TS/pH6	Dry	Cladium	0.0655 a,d,j
TS/pH6	Wet	Cladium	0.3183 b,e,j
TS/pH6	Macroinvertebrate	Cladium	0.3781 b,e,j
TS/pH6	Dry	Eleocharis	0.1160 a,d
TS/pH6	Wet	Eleocharis	0.2748 a,d,j
TS/pH6	Macroinvertebrate	Eleocharis	0.2421 a,d
TS/pH6	Transplant	Juncus	0.2016 j
SRS3	Dry	Cladium	0.1549 a,g,m
SRS3	Wet	Cladium	0.2595 a,g,m
SRS3	Macroinvertebrate	Cladium	0.2439 a,h,m
SRS3	Dry	Eleocharis	0.1439 a,g
SRS3	Wet	Eleocharis	0.3359 b,g,m
SRS3	Macroinvertebrate	Eleocharis	0.3975 b,g
SRS4	Dry	Cladium	0.0723 a,j,m
SRS4	Wet	Cladium	0.0995 a,k,n
SRS4	Macroinvertebrate	Cladium	0.0982 a,k,n
SRS4	Dry	Juncus	0.1236 a
SRS4	Wet	Juncus	0.1263 a,j
SRS4	Macroinvertebrate	Juncus	0.1394 a
SRS4	Transplant	Eleocharis	0.1806 j,m

Table 2: Decomposition rates for each plant species treatment within a site. Letters indicate comparisons made between decomposition rates within a site and between sites. In all cases, letters a and b correspond to comparisons within a site (different treatments for the same species). Figure 6 illustrates letters chosen to represent comparisons between sites.

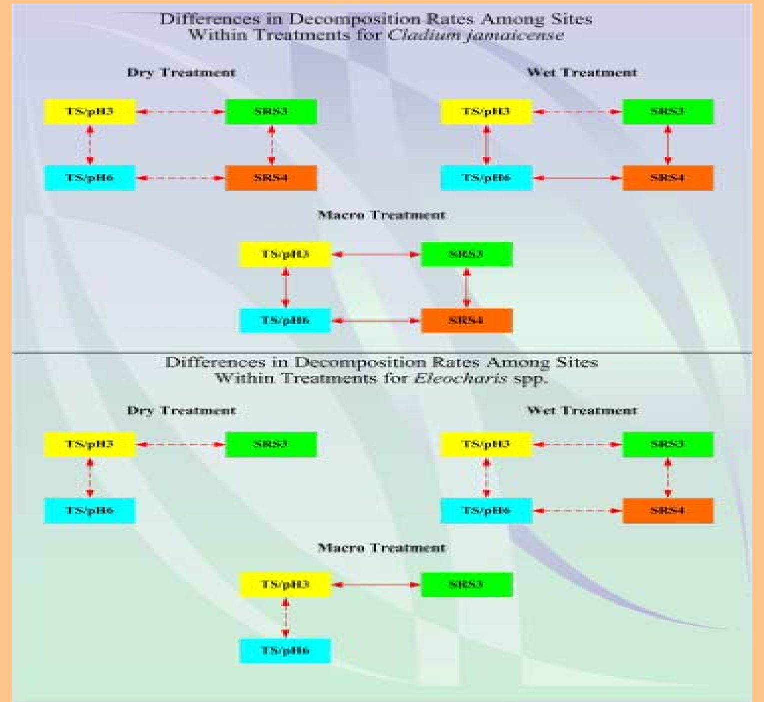

Figure 7: Graphic comparison of decomposition rates among sites within treatments. Dashed lines indicate no difference and solid lines indicate that a difference in exists decomposition rates.

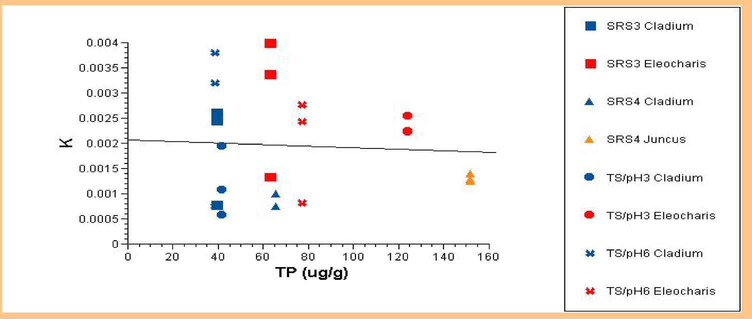

Figure 8: Regression graph for TP vs. K (R^2=.009, P-value=6599)

Discussion

Even though decomposition rates for the soil and macroinvertebrate treatments are higher, no difference exists between these and the dry treatment decomposition rates. This trend can be explained by the absence of water in the marsh from February to April 2002. It is expected that a treatment difference in decomposition rates will exist once the wet season starts and water makes itself present in the marsh. The presence of water will provide a moist environment which is suitable for primary decomposers like bacteria and macroinvertebrates.

Most often leaf breakdown has been attributed to the availability of nitrogen, and generally higher phosphorus concentrations have failed to show any acceleration in leaf breakdown (Webster & Benfield, 1986). In earlier decomposition experiments made in the Everglades, this tendency has been contradicted (DeBusk & Reddy, 1998). In the current study the fact that initial litter TP is not related to K can be accredited to the stressful environment (dry marsh) at the time for primary decomposers to proceed with their usual actions. Once water comes back to the system, microbial communities and P mobilization will be restored. Since the Everglades is a P limited system, it's still expected that litter with a higher TP concentration will provide a more suitable food source for primary decomposers.

The results presented in this poster are part of an ongoing study. Aside form the variables shown in this poster, other variables like litter TN and TC, soil nutrients, soil bulk density, soil pH, soil Eh, soil temperature, water nutrients, and water level are being collected. The ultimate goal of the experiment is to create a model for the decomposition rates of these macrophyte species based on these environmental variables collected in the Everglades ecotones.

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