Phosphorus Mineralization and Accumulation during Litter Decomposition in Seasonally Flooded Tree Islands of the Southern Everglades

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Introduction

Tree island communities are a unique component of the Everglades landscape. The existence of these islands increases habitat complexity, and consequently, increases the diversity of the Everglades flora and fauna. Hydrologic restoration of the Everglades landscape is currently underway, and the effects of increased freshwater flow on Everglades biotic communities, including tree islands, are unknown. Wetland ecosystem studies are complex, but necessary to understand how ecosystems will respond to landscape-scale perturbations. With this project, we have established an ecosystem experiment to characterize the ecological structure and function of wetland tree islands and their ecosystem response to increased freshwater flow in the southern Everglades.

The primary objectives of our research are: 1) to describe the ecosystem properties of seasonally flooded tree islands and 2) to determine the effects of hydrologic restoration (increasing water flow and nutrient inputs) on the structural and ecosystem properties of tree islands in the southern Everglades. We are addressing our objectives by testing several hypotheses guided by a prominent theory in wetland ecology that increased freshwater flow is a subsidy to forested wetland communities, oxidizing wetland soils and increasing nutrient supply (Odum et al., 1979).

Methods

In the southern Everglades, the C-111 levee was removed in 1997 to restore freshwater inputs to the downstream marsh and to Florida Bay. We selected nine islands downstream of or adjacent to the levee removal segment of the C-111 canal. We measured decomposition rates with a litter bag technique. We utilized cocoplum leaf litter, and followed decomposition for 64 weeks. We assessed litter decomposition in walled, flow, and no flow treatments. We also allowed cocoplum litter to decompose in the marl marsh of the C-111 Basin just downstream of the tree islands. We performed total phosphorus analysis of initial and decomposing leaf litter of each litter collection. We estimated mass loss and change in phosphorus content of the decomposing litter. Here, we present the preliminary findings from this cocoplum leaf litter decomposition experiment.

Three treatment groups:

1) **"Flow"**- islands encounter both flow and nutrient effects of canal water delivery
2) **"Walled"** - sheetflow is reduced by experimental manipulation, but island experience similar hydroperiod as flow islands
3) **"No Flow"**- islands are located in an area of the marsh where levee removal has not been implemented and therefore have greatly reduced flow and nutrient effects

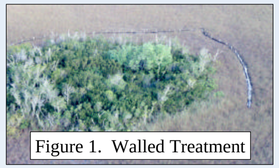

Figure 1. Walled Treatment

Figure 2. Flow Treatment

Experimental Design

★ Our study area corresponds to LTER sites TS/Ph 4 and TS/Ph 5

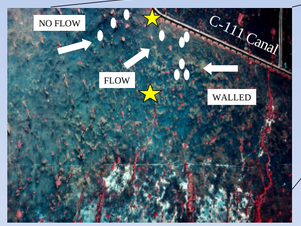

Figure 3.

Results and Discussion

Our cocoplum leaf litter decomposition experiment showed that after 64 weeks, leaf litter decomposing in tree islands lost approximately 25% of its initial mass (Figure 4).

There were no treatment effects on mass loss of leaf litter in seasonally flooded tree islands of the C-111 Basin.

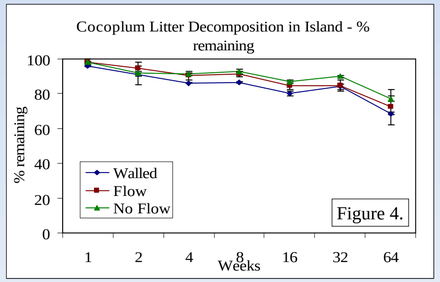

Figure 4.

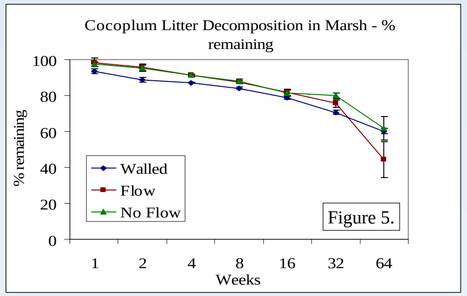

Figure 5.

Cocoplum leaf litter that becomes deposited in the marsh after leaf drop appears to exhibit higher mass loss over the 64 week period than leaf litter decomposing in tree islands (Figure 4).

Mass loss also varied with treatment. Mass loss approximated 40% in walled and no flow treatments, while leaf litter decomposing in the marsh of the flow treatment lost about 55% after 64 weeks.

We determined the amount of phosphorus in litter material to estimate mineralization and accumulation of phosphorus by multiplying the total phosphorus content (ug TP) by the percent of decomposed leaf material for each collection (Figure 6).

We found that leaf litter decomposing in the islands of the flow treatment released more phosphorus after 1 week of decomposition. We also found that litter from this treatment accumulated more phosphorus after 64 weeks.

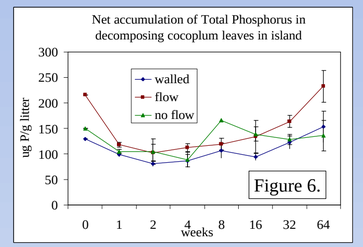

Figure 6.

Cocoplum leaf litter deposited onto the marsh surface accumulated more phosphorus than walled or no flow treatments after 64 weeks despite the fact that this litter underwent greater mass loss (Figure 7).

Overall, litter decomposing in the islands accumulated phosphorus while litter decomposing in the marsh released phosphorus after 64 weeks of decomposition.

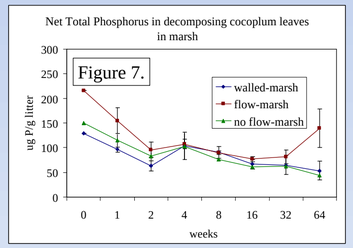

Figure 7.

Conclusions

Preliminary findings from our cocoplum leaf litter decomposition experiment reveal that litter mass loss in tree islands was not affected by increased water flow after 64 weeks of decomposition. However, leaf litter decomposing in the marsh where freshwater flow had been increased did undergo greater mass loss. This effect may result in greater organic matter mineralization from tree island litter deposited into surface water of marl marshes with increased freshwater flow.

Cocoplum leaf litter accumulated phosphorus when decomposing in tree islands, and released phosphorus when decomposing in the marsh suggesting a differential P availability in these two ecosystems. It may be that characteristics of short hydroperiod marshes enhance the decomposition of terrestrial inputs of organic matter due to greater light penetration and higher water temperatures. However, increased flow also appeared to increase phosphorus release from litter deposited into the marsh, but to a lesser extent than in areas with lower freshwater flows. Mass loss of ocoplum leaf litter decomposing in the C-111 marsh exceeded that of sawgrass decomposing in peat marshes of the Everglades Davis (1991) .

Cocoplum leaf litter may thus be a source of P in C-111 marshes, and this effect appears to vary with increased freshwater flow, while increased freshwater flow may allow more P to be accumulated in tree island soils.

References

Davis, S. 1991. Growth, decomposition, and nutrient retention of *Cladium jamaicense* Crantz and *Typha domingensis* Pers. In the Florida Everglades. Aquatic Botany 40: 203-224.

Odum, E., J. Finn, and E. Franz. Perturbation theory and the subsidy-stress gradient. Bioscience 29: 349-352.