Macrophyte Decomposition Rates in the Tres Rios Constructed Treatment Wetland: Preliminary Results

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Introduction

Plant decomposition is a critical process in wetland ecosystems (Mitsch & Gosselink 2000). It leads to a recycling of nutrients to fuel new productivity, and the process is largely mediated by a soil microbial community that is responsible for other functions. In oligotrophic wetlands, such as the Florida Everglades, decomposition is a critical control on availability of the limiting nutrient, phosphorus (Rubio & Childers 2006) and is an important mediator of plant community composition (Troxler & Childers 2009). But plant decomposition is also an important process in high-nutrient wetlands, such as those associated with municipal wastewater treatment.

Constructed treatment wetlands perform important ecosystem services in many cities by acting as tertiary wastewater treatment. We are investigating ecosystem functions related to important water treatment services at the City of Phoenix' Tres Rios constructed treatment wetland (Figure 1). This wetland produces more than 600 metric tons of plant biomass every year, all of which senesces in the winter. Critical questions that we are pursuing with this macrophyte decomposition experiment include: 1) How rapidly is plant biomass decomposing? 2) What is the fate of the nutrients bound up in this decomposing biomass?

The results we present here are preliminary, as the experiment began in July 2012 and will not be complete until late 2013. For this reason, in this poster we are using our preliminary data to address questions about the future statistical analysis of our results, including: ***How should we use our factorial design to best address replication in the Tres Rios treatment wetland ecosystem?***

Figure 1A: Aerial photo of the treatment flow cell

Figure 1B: Location of experimental transects

Experimental Design and Field Sampling

- Our experimental design follows a 3X3 factorial format, with 3 transects located along the primary flowpath of the system (Figure 1B) and 3 sites along each transect, from near the open water to near the shore.
- We divided the 6 primary plant species in the system into 3 morphotypes: 1) *Typha latifolia* + *T.domingensis*; 2) *Schoenoplectus acutus* + *S.tabernaemontani* + *S.californicus*; 3) *Schoenoplectus americanus*.
- At each of the 9 locations we deployed 8 litterbags for each morphotype, with approximately 15-20 gdw of senesced plant material (Figure 2A), for a total of 216 bags initially deployed (Figure 2B). One bag from each was harvested after 1, 2, and 4 months in the field, and we will continue to harvest the bags every 2 months.
- We analyzed our preliminary data across the three transects and by within-transect location, to parse overall variability into whole system variance (Inflow to Outflow) and within-marsh variance (Open Water to Shore).

Figure 2A: Mesh litterbag (empty)

Figure 2B: Deploying litterbags in July 2012

Results & Discussion

Our preliminary analyses focus on comparing variance in % weight loss: a) within the vegetated marsh itself, along our marsh transects (Figure 3A); b) across the whole wetland ecosystem, or across our transects (Figure 3B), and; c) among our three plant morphotypes (Figure 3):

1. Our preliminary results show rapid weight loss in the first month of up to 25-30%. There is some early evidence that litter from the Schoenoplectus sp. morphotypes may be decomposing slightly faster than Typha sp. litter (see middle and lower panels in Figure 3 compared with top panels).
2. The first 3 months of data suggest that decomposition rates may be higher in marsh locations closest to the open water, compared with more interior marsh locations (Figure 3A). This is likely because the open water is the source of nutrients, and greater nutrient availability is expected to stimulate litter decomposition rates.
3. We found no evidence that initial decomposition rates are higher closer to the inflow point, suggesting that the inflow → outflow nutrient gradient may be less important than the within marsh (water → shore) nutrient gradient.
4. The first 3 months of litter decomposition data suggest that it is more logical to use our 3 locations along the transects as replicates and analyze decomposition rates using the transects themselves as experimental units.

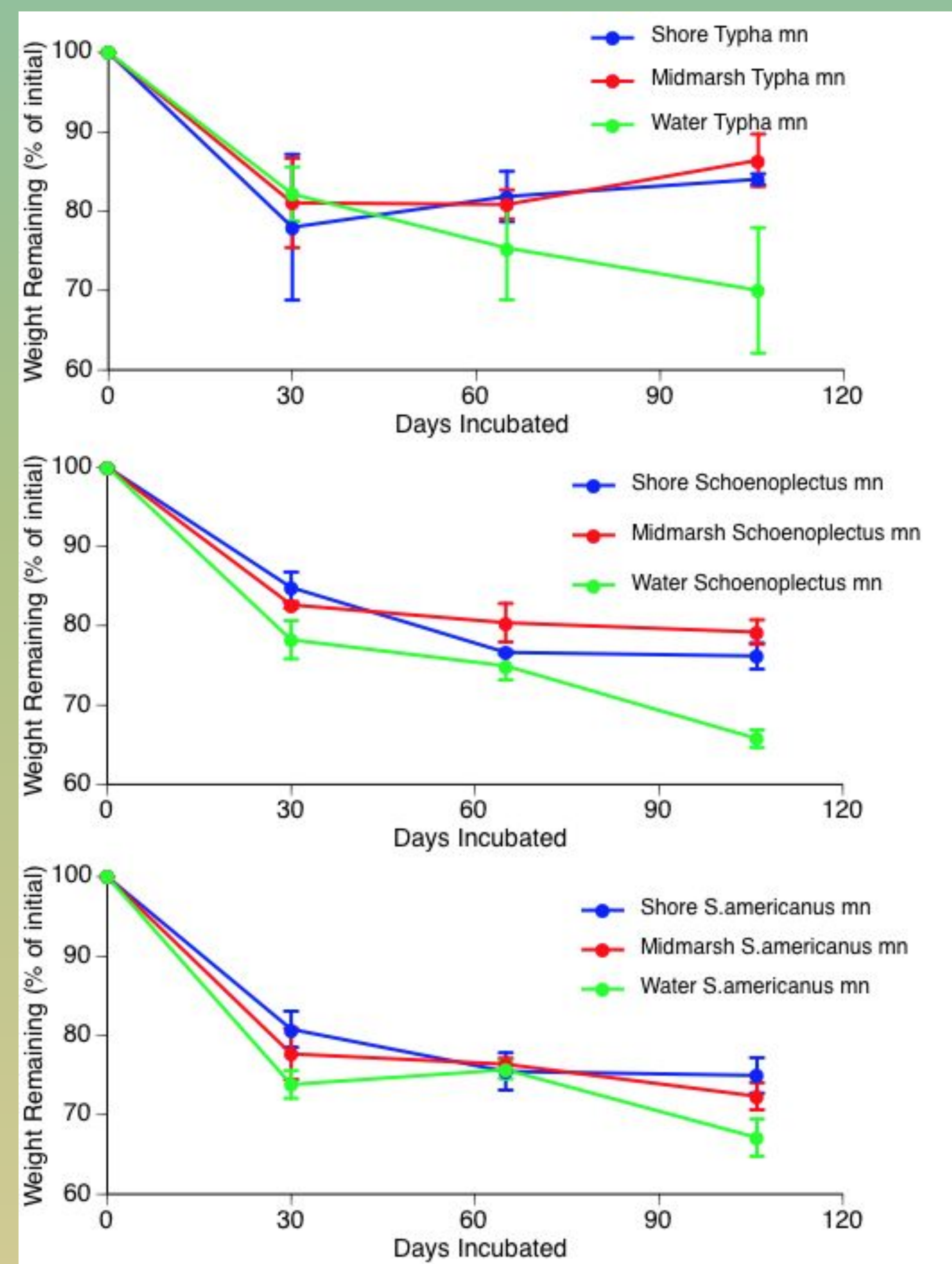

Figure 3A: Preliminary litter weight loss for the 3 plant morphotypes by location along the 3 marsh transects.

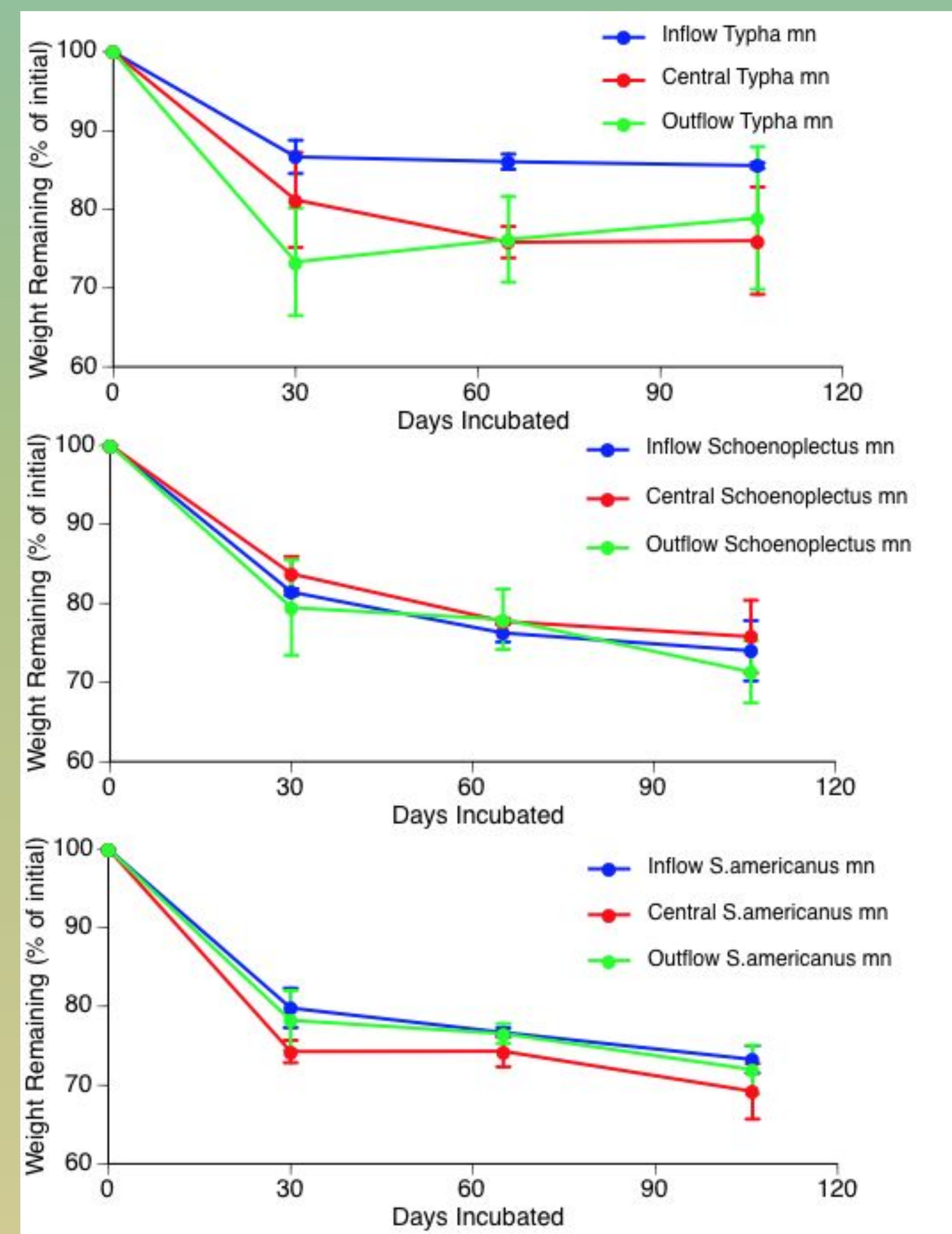

Figure 3B: Preliminary litter weight loss for the 3 plant morphotypes by location within the treatment wetland system.

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Literature Cited

Mitsch, W.J. and J.G. Gosselink, 2000. Wetlands, Third Edition. Van Nostrand Reinhold, New York NY.

Rubio, G. and D.L. Childers, 2006. Decomposition of *Cladium jamaicense*, *Eleocharis* sp., and *Juncus roemerianus* in the estuarine ecotones of the Florida Everglades. Estuaries 29(2):1-12.

Troxler, T.G. and D.L. Childers, 2009. Litter decomposition promotes differential feedbacks in an oligotrophic southern Everglades wetland. Plant Ecology 200:69-82.