Additive effects of nutrient enrichment on marsh species composition and mangrove encroachment

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Background

- Nitrogen (N) loading is in increasing in Florida due to septic systems, fertilizer runoff, untreated waste wastewater, but we don't know how it will affect plant communities and ecosystem processes in coastal wetlands.
- In a Louisiana wetland mangrove seedling establishment suppressed with added N when *Spartina alterniflora* was present (McKee & Rooth 2008).
- N stimulated *Avicennia germinans* more than *S. alterniflora* (Weaver & Armitage 2018)
- Mortality of planted mangrove seedlings was higher in *S. alterniflora* than in *B. maritima* communities (Adgie & Chapman 2021).
- In a brackish salt marsh, root accumulation increased when higher rates of N were applied (Graham & Mendelssohn 2015).

Methods

- 93.2 g/m^2 of N in the form of urea added to each plot (including mangrove plots at the same site)
- Edge Plots > 10 m from creek
- Interior Plots < 10 m from creek

- Aboveground: height, density, % cover, biomass, foliar C:N
- Belowground: root productivity, decomposition, root C:N
- Ammonium concentration in porewater and soil
- Tracing the fate of N with ^{15}N labeled urea

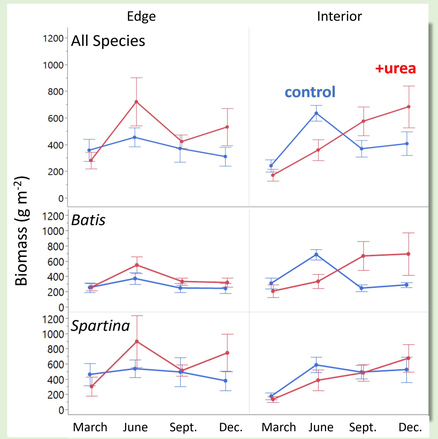

Figure 1. Marsh species biomass in enriched and control plots. The addition of nitrogen increased total plant biomass (p = 0.0499) and *Batis* biomass (p = 0.0371). *Spartina* biomass did not show a treatment effect, however there was an increase in biomass from September to December in the enriched plots.

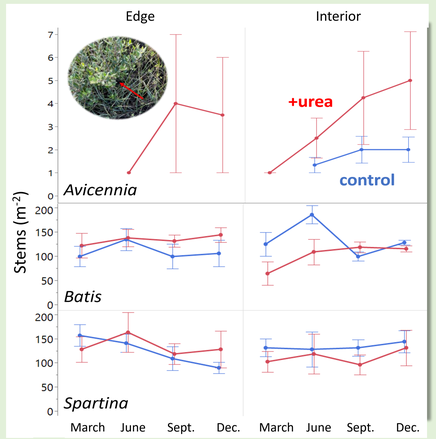

Figure 2. Species density in edge and interior experimental plots. Within the interior plots mangrove density has a stronger treatment effect as more seedlings have begun to establish in the plots. Enriched edge plots have a higher density for *Batis* and *Spartina* than interior plots.

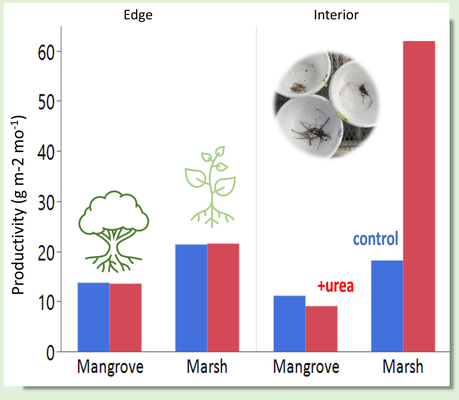

Figure 3. Marsh and mangrove root productivity. Marsh plots composed of Batis and Spartina had higher root productivity compared to the mangrove plots regardless of treatment. Plots with coarse roots (>2mm) had higher root productivity with the addition of N.

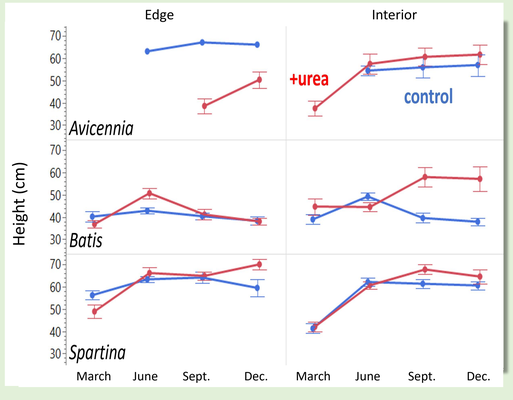

Figure 4. Species height across enriched and control plots along creek edge and interior. Mangroves in enriched edge plots from September to December grew more than those in control plots. Interior enriched plots have the strongest treatment effect as *Batis* height continually increases even after the growing season. In December, there was an increase in Spartina height in the edge enriched plots.

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Questions:

1. How will nutrient enrichment affect species communities in the marsh-mangrove ecotone?
2. Will competition affect mangrove establishment during a eutrophication event?
3. How are ecosystem processes (i.e. decomposition and nutrient cycling) altered by shift in species composition?

Results/Discussion

- Stem heights and biomass in the enriched plots increased to the end of the growing season (September) while vegetation in control plots senesce.
- *B. maritima* and *S. alterniflora* had higher biomass in N-enriched plots (693 and 675 g/m^2) compared to unenriched plots (288 and 526 g/m^2).
- N-enriched plots also showed 66% higher root productivity compared to other plots.
- Regardless of location, enriched plots had higher mangrove seedling density (p = <0.001).
- The strong N response of *B. maritima* growth and mangrove seedling density suggests these plants may be more N limited in the interior.
- Nitrogen is allowing mangroves to grow quickly in areas dominated by Spartina and Batis but seem to be limited to interior areas of the marsh. Following these seedlings will reveal how N eutrophication can alter mangrove encroachment in this N limited ecotone.

Ongoing experimentation will help determine how abiotic stressors, hydrological position, and nutrient accessibility influence plant community composition and wetland integrity.