

Understanding the effects of eutrophication on the fate of nitrogen in a shifting marsh-mangrove ecotone



Jocelyn Bravo¹, Tess Adgie¹, Samantha Chapman¹, Lisa Chambers², Adam Langley¹
 Department of Biology, Villanova University¹
 University of Central Florida²

Background

- Coastal wetlands sequester large amounts of nitrogen (N) in both soils and biomass, but N storage imitation may differ based on marsh position (interior platform vs. Creekside).
- In some marshes added N increases *Spartina alterniflora* biomass and height and in other fertilization with N has no effect.
- Nitrogen (N) loading is persistent in Florida due to septic systems, fertilizer runoff, and untreated waste wastewater, it is unknown how nutrient enrichment may interact with the effects of mangrove encroachment.

Questions:

1. How will N fertilization and marsh positioning affect wetland plant growth metrics in the marsh-mangrove ecotone?
2. How does N enrichment affect mangrove establishment amidst marsh species competition?
3. What changes will N fertilization have on mangrove and marsh N pools at different positions in the marsh-mangrove ecotone?

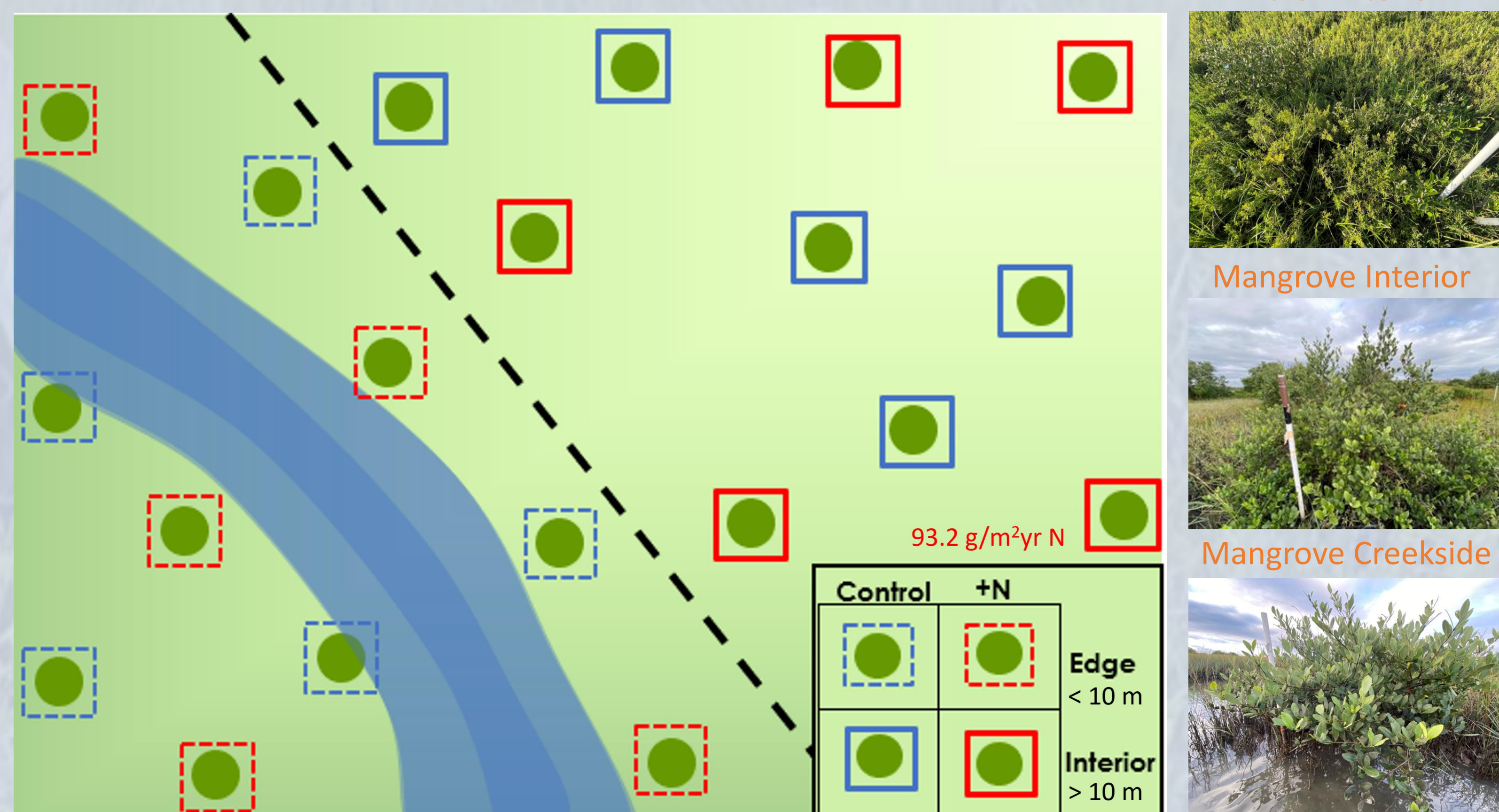


Figure 1. Experimental schematic at N fertilized site in the Guana Tolomato Matanzas National Estuarine Research Reserve. There are 20 marsh plots dominated by marsh species *S. alterniflora* and *B. maritima*. An additional 20 plots are mangrove plots with adult *Avicennia germinans* trees. Half of the plots are located along the marsh interior or creek edge. The project follows a 2 by 2 factorial design with marsh position and fertilization as the two main effects.

- Aboveground measurements: growth metrics, canopy volume, biomass
- Belowground measurements: roots, decomposition, porewater, KCl
- ¹⁵N-urea tracer: Vegetation, leaves, soil, and porewater for ¹⁵N label recovery

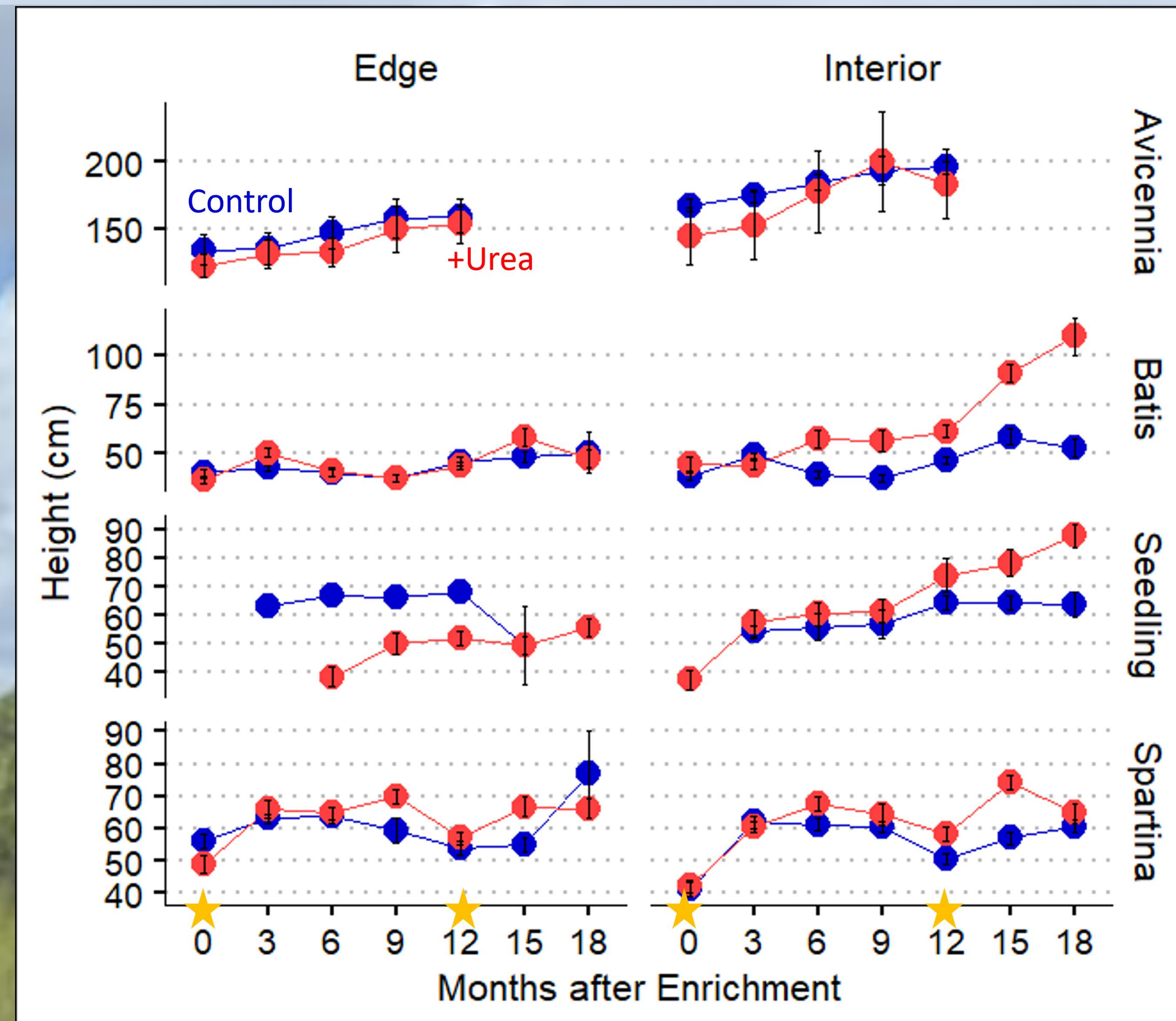


Figure 2. Plant height response to marsh position and enrichment across time. Stars on the x-axis indicate fertilization. There was no significant position or fertilization effect on adult *Avicennia* trees. *Batis* had taller stems in the enriched interior plots (position x fertilization, $P < .0001$). Increased heights for *Avicennia* in the interior enriched plots show a trending position and N effect in mangrove seedlings ($P = 0.0863$). Regardless of plot positioning, *Spartina* in the enriched plots had larger stems compared to the control plots ($P = 0.0147$).

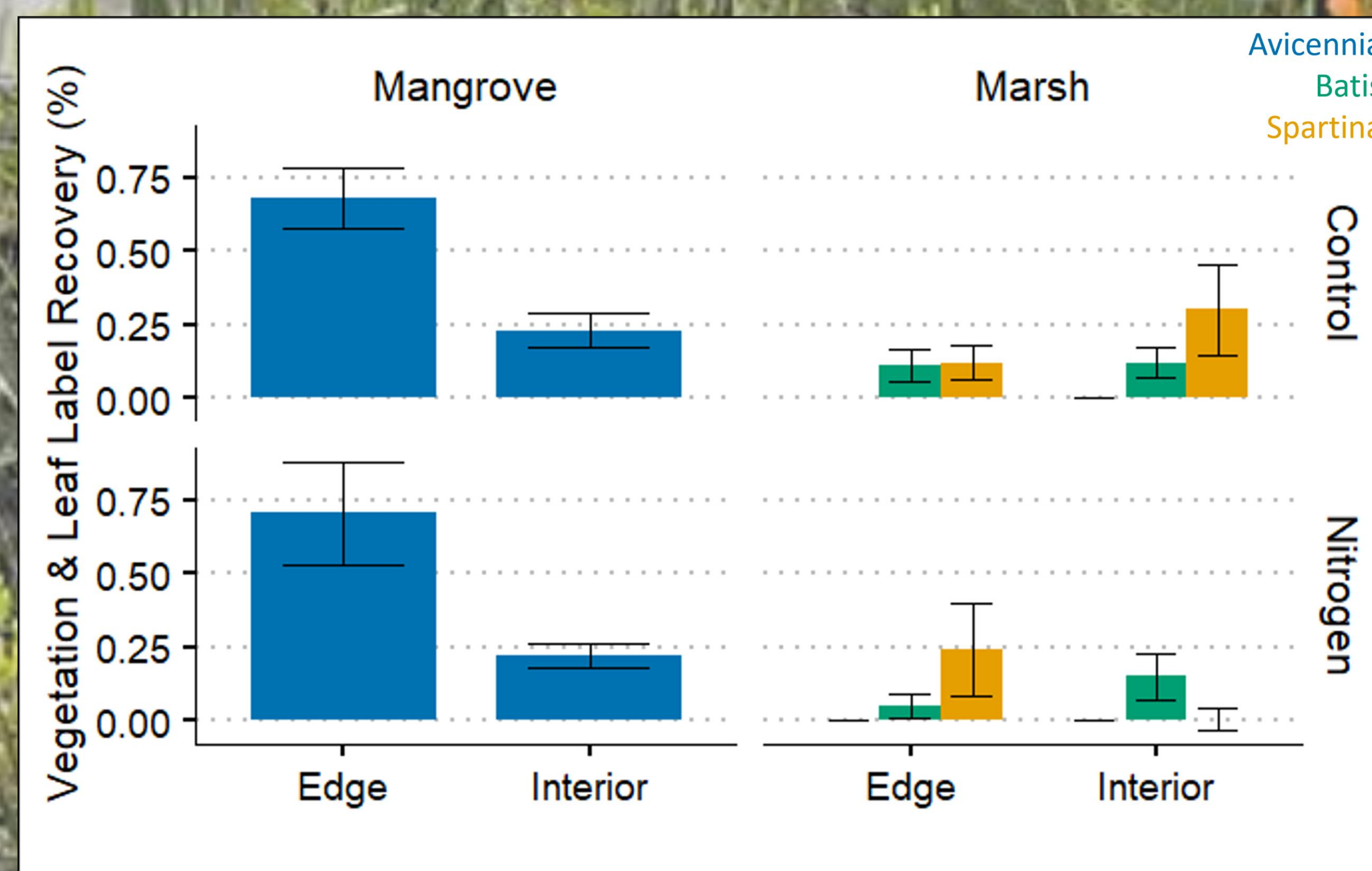


Figure 3. ¹⁵N label recovery in plant tissue for *Spartina*, *Batis*, and *Avicennia*. Values represent % recovery three months after addition of the ¹⁵N label. *A. germinans* had a 75% lower label recovery in interior plots compared to those on the edge ($P = 0.0010$). Fertilization had no effect on label recovery for mangrove leaves. There was a marginal interaction for *S. alterniflora* label recovery ($P = 0.0825$) where vegetation in the interior enriched plots had lower ¹⁵N recovery compared to the control plot. *B. maritima* had slightly higher label recovery in the interior enriched plots as well but it was not significant.

Results

Fertilization Response:

- Creek-edge mangroves with a greater percent change in canopy volume compared to control edge and fertilized interior mangroves.
- The strongest response to N was in the marsh interior plots
- Increased marsh plant height, biomass, and densities (*Batis*)
- No influence on mangrove seedling establishment, but survivorship and growth rate increased in interior enriched plots.

¹⁵N Label Recovery:

- Recovery in vegetation was higher in creek edge plots compared to the interior (no fertilization effect).
- Mangrove-dominated plots retained less of the ¹⁵N label despite accumulating greater total N mass.

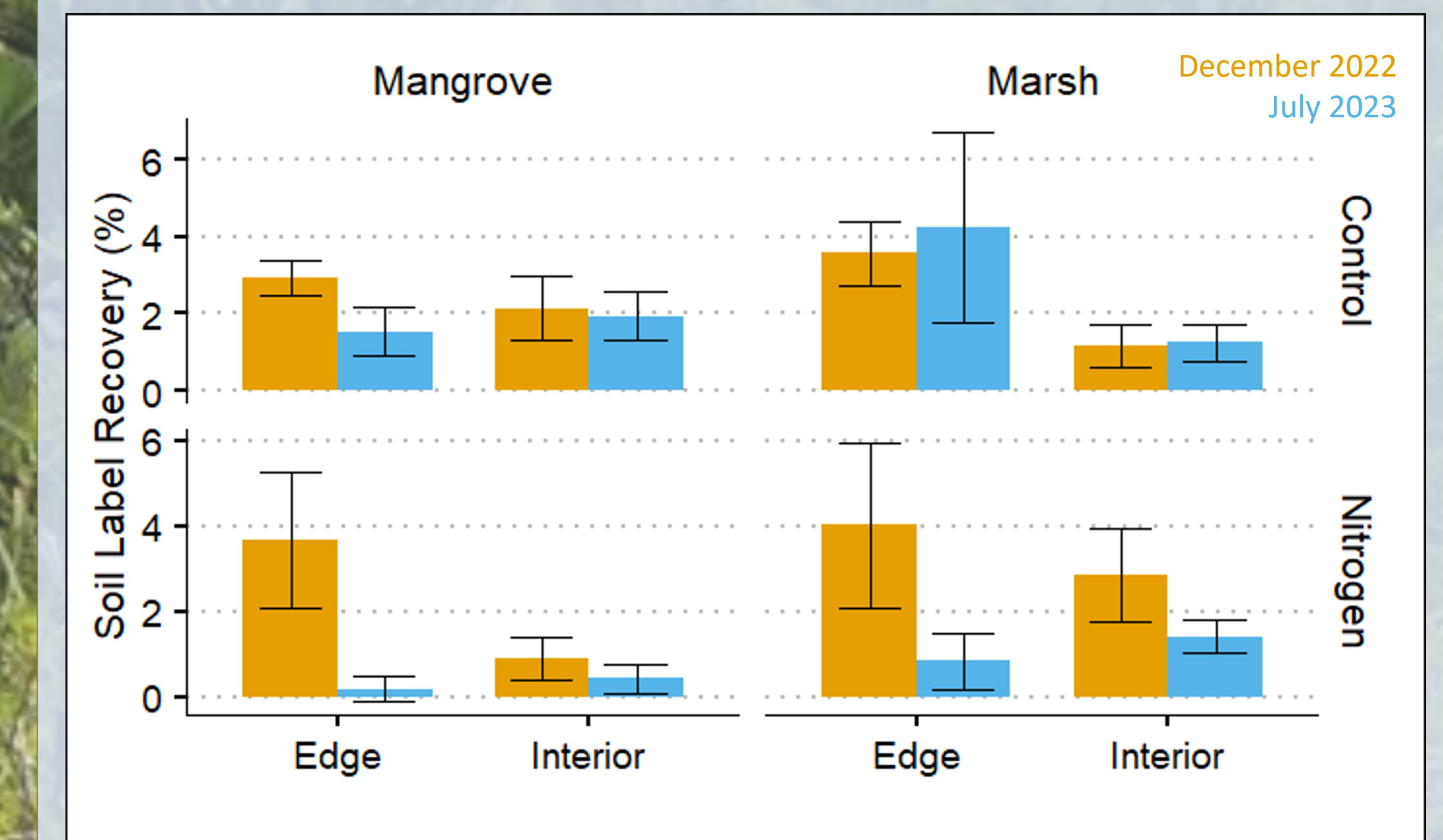


Figure 4. ¹⁵N label recovery in soil across all treatments and positions. Recovery of the label from soil samples is depicted three (December) and nine (July) months after the addition of the label. Across both time points there was significantly higher label recovery for marsh and mangrove edge plots ($P = 0.0432$). There was no N fertilization effect across plot types for December and July.

- Mangrove-dominated ecosystems may have a more open N cycle (greater fluxes of N in and out) despite having greater N demand
- Continued tracking of the ¹⁵N label will afford a refined estimate of N cycling in these rapidly transitioning ecosystems.