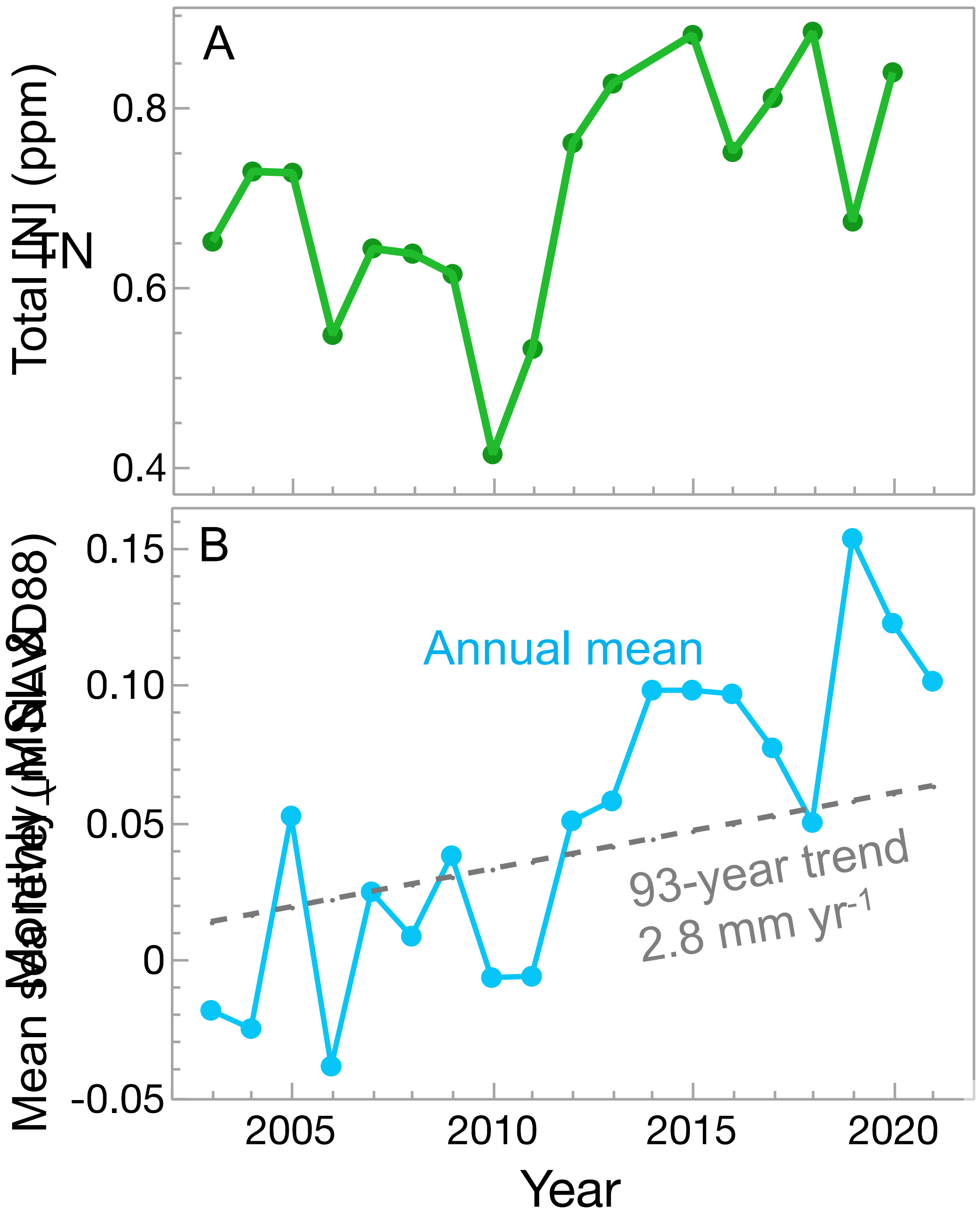
# Nitrogen Limitation of Mangroves Encroaching into Marshes Depends on Hydrological Positioning

Samantha Chapman

With: Morgan Mack, Jocelyn Bravo, Tess Adgie, Lisa Chambers, Nikki Dix, Candy Feller, & Adam Langley

# Some of the WETFEET team

# Sea level rise and excess nitrogen impacts on coastal wetlands

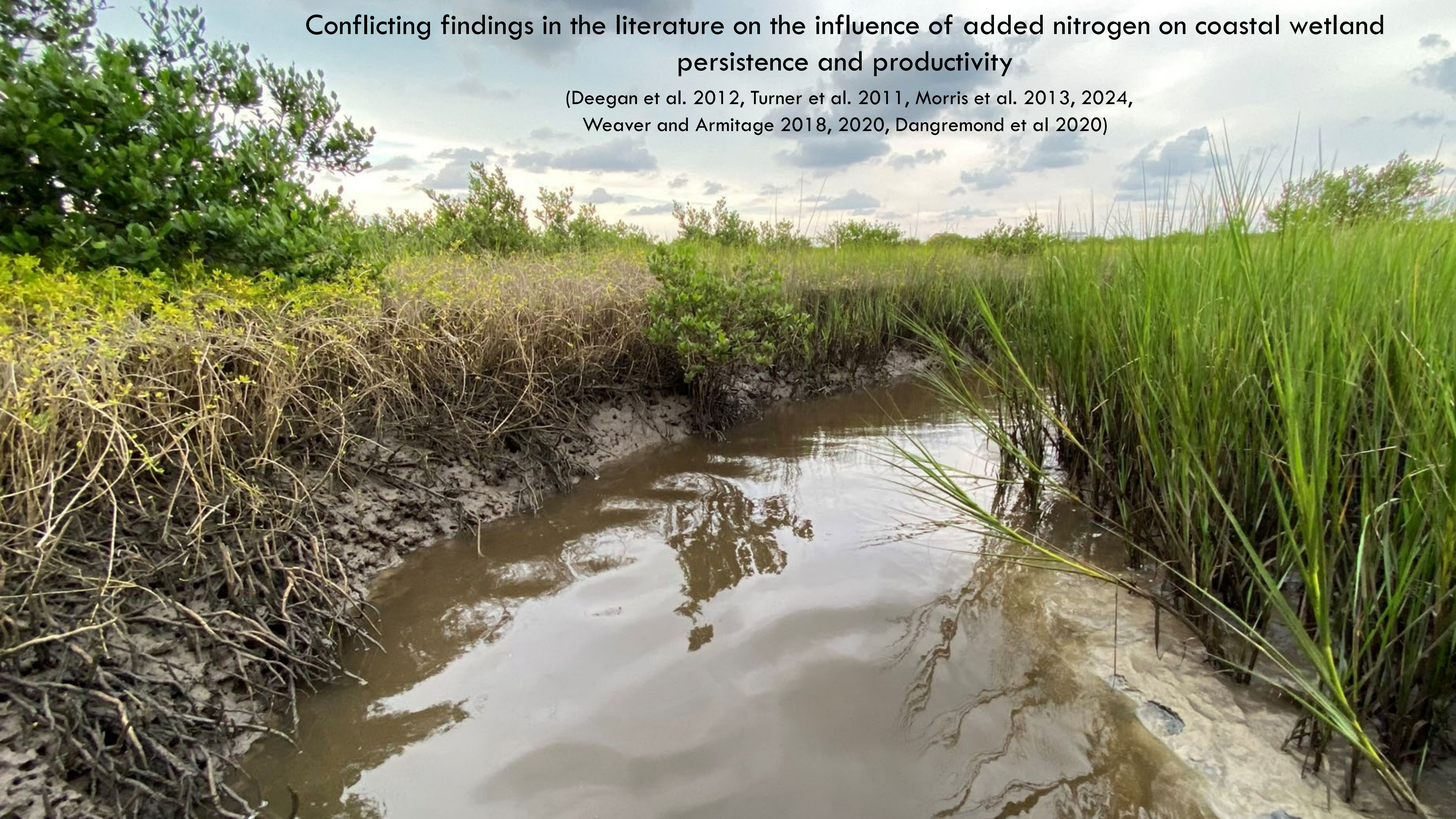



Coastal wetlands in Northeast Florida, USA

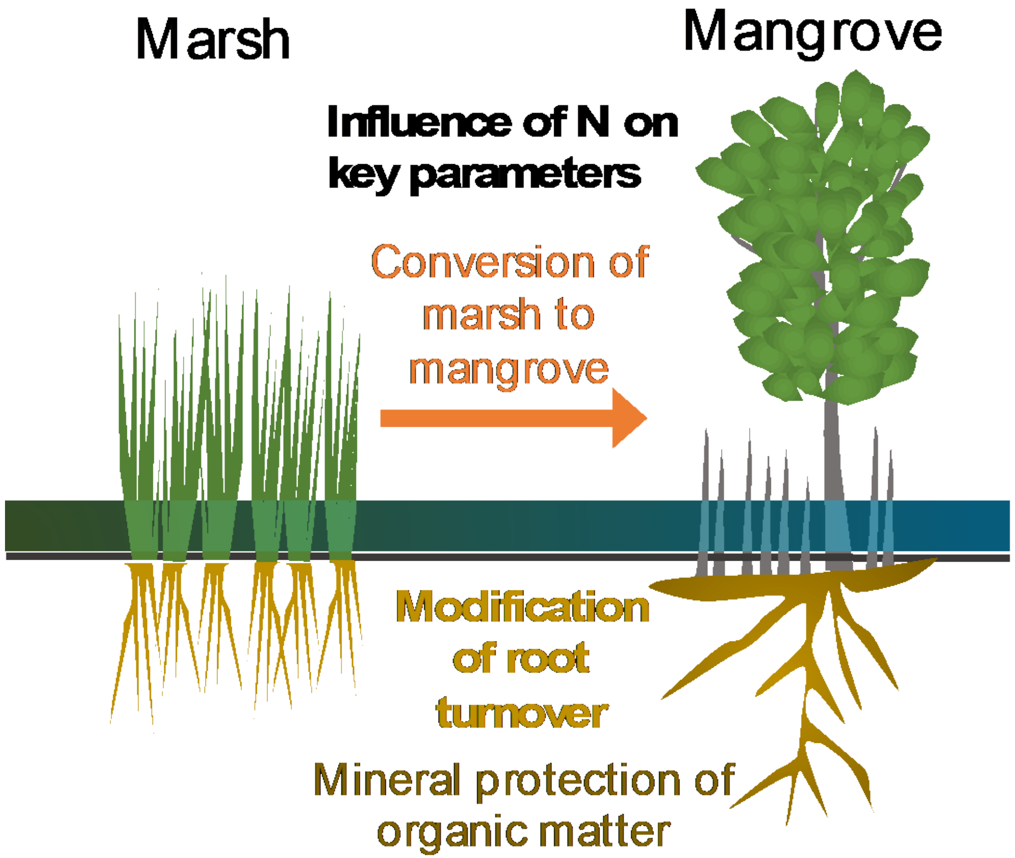
Mangroves and marshes co-occur due to mangrove encroachment.

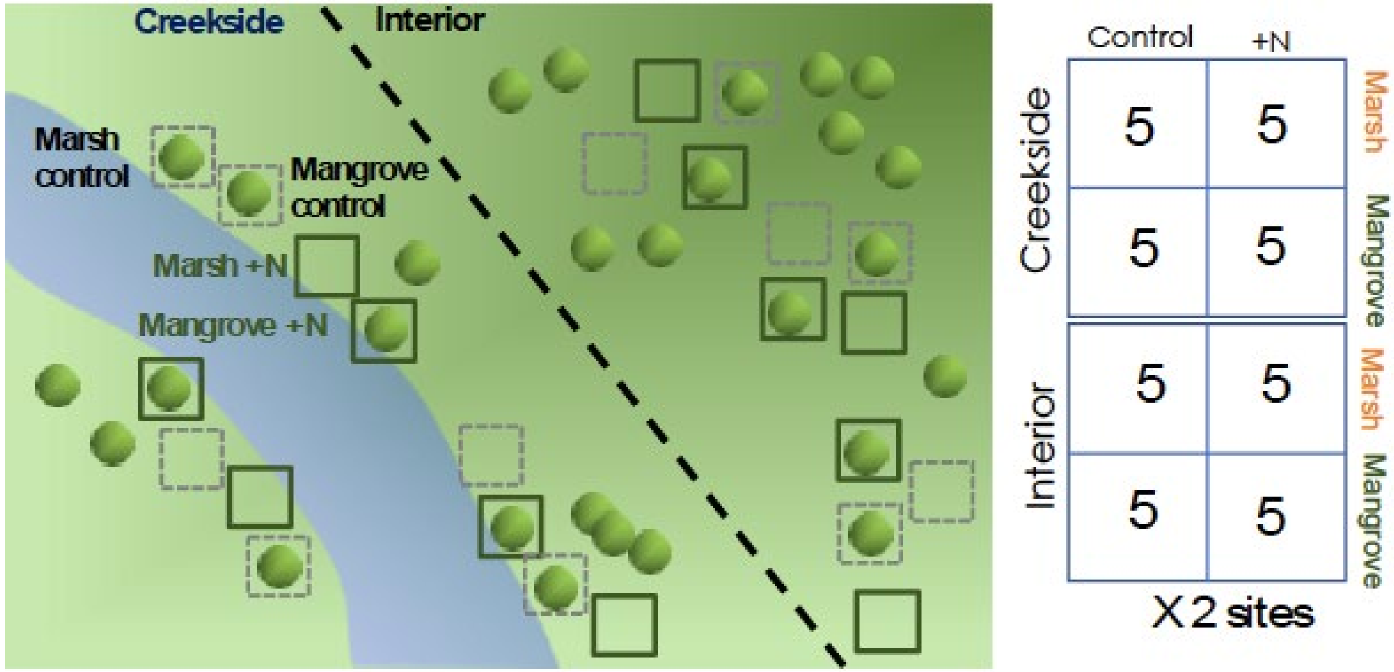
# Conflicting findings in the literature on the influence of added nitrogen on coastal wetland persistence and productivity

(Deegan et al. 2012, Turner et al. 2011, Morris et al. 2013, 2024, Weaver and Armitage 2018, 2020, Dangremond et al 2020)



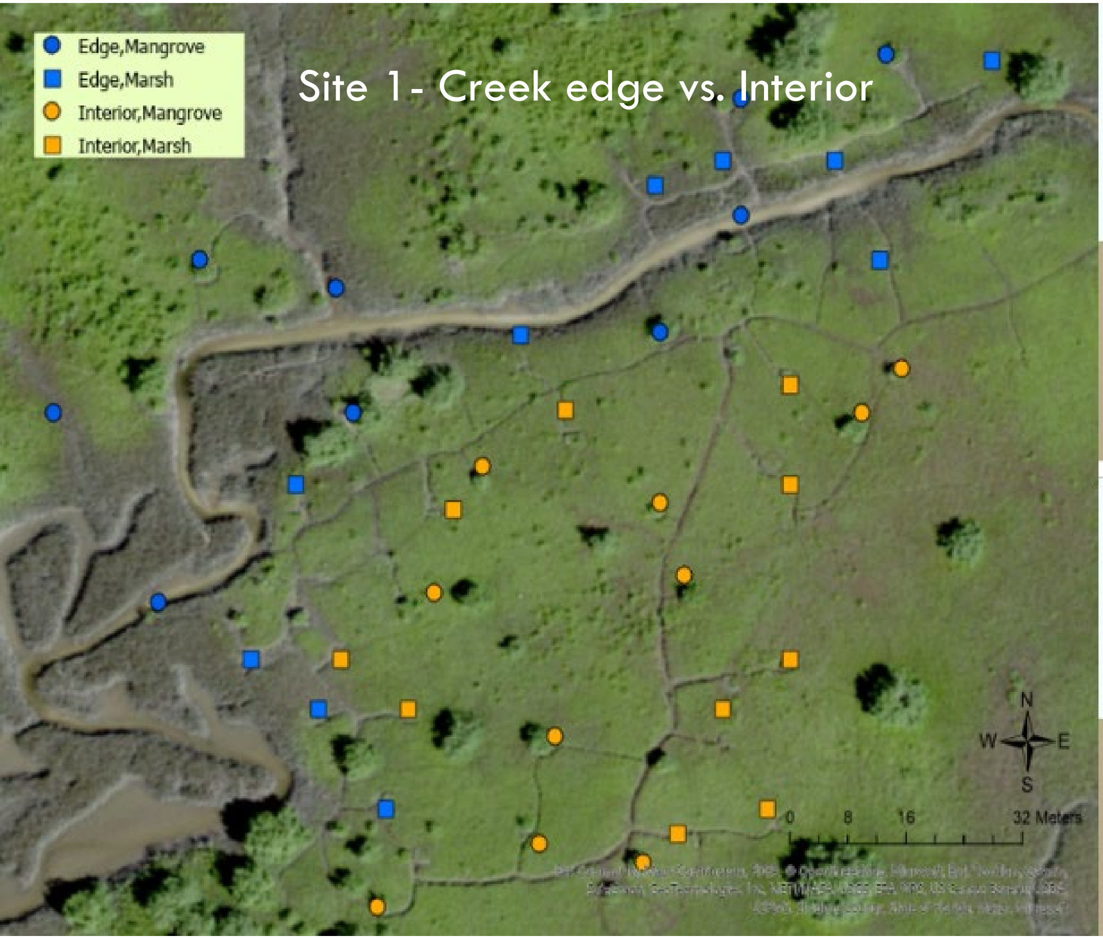
# How does nitrogen limitation of mangroves and marsh plants shift across hydrological environments in coastal wetlands?

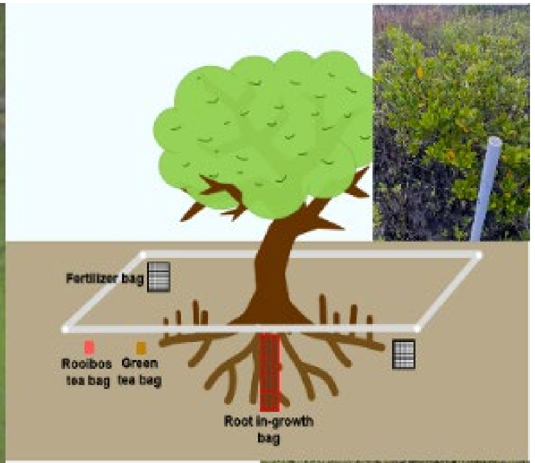


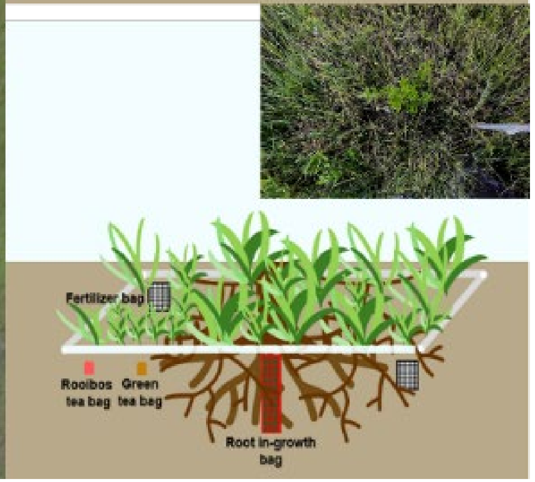



# WETFEET Nitrogen fertilization x hydrological position experiments

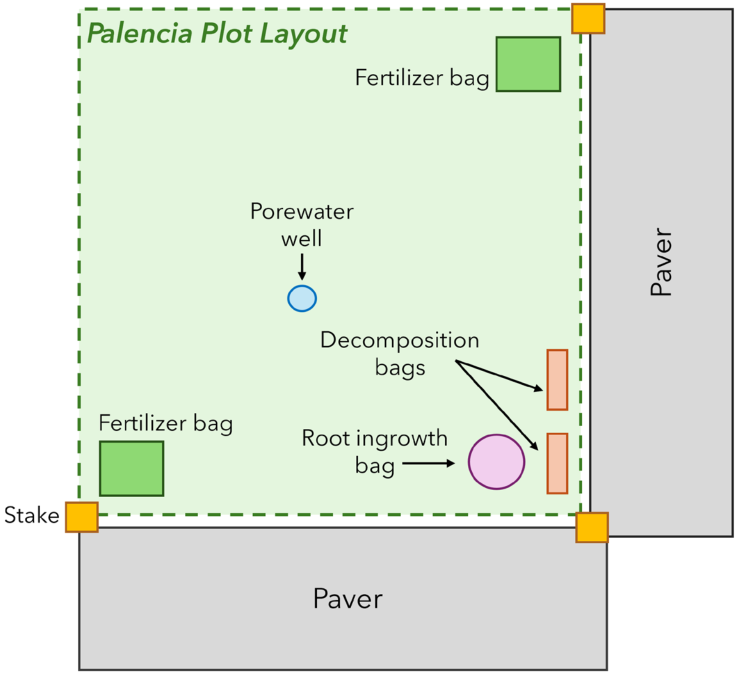
*2 sites in northeast Florida*



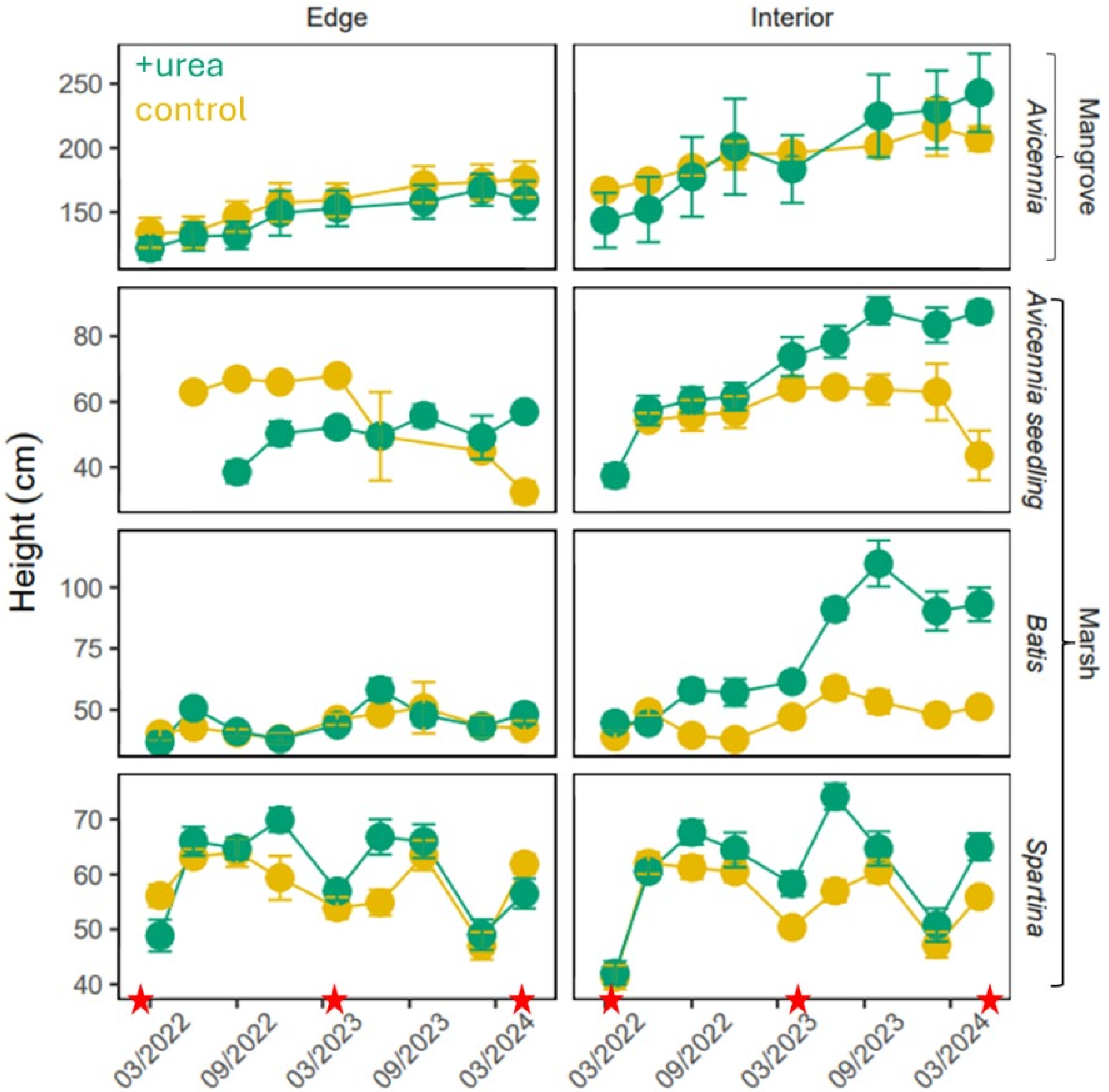







# Aboveground plant growth

Jocelyn Bravo and Morgan Mack, Villanova




Mangrove seedlings and marsh plants grew more in response to excess N in the interior of wetlands.

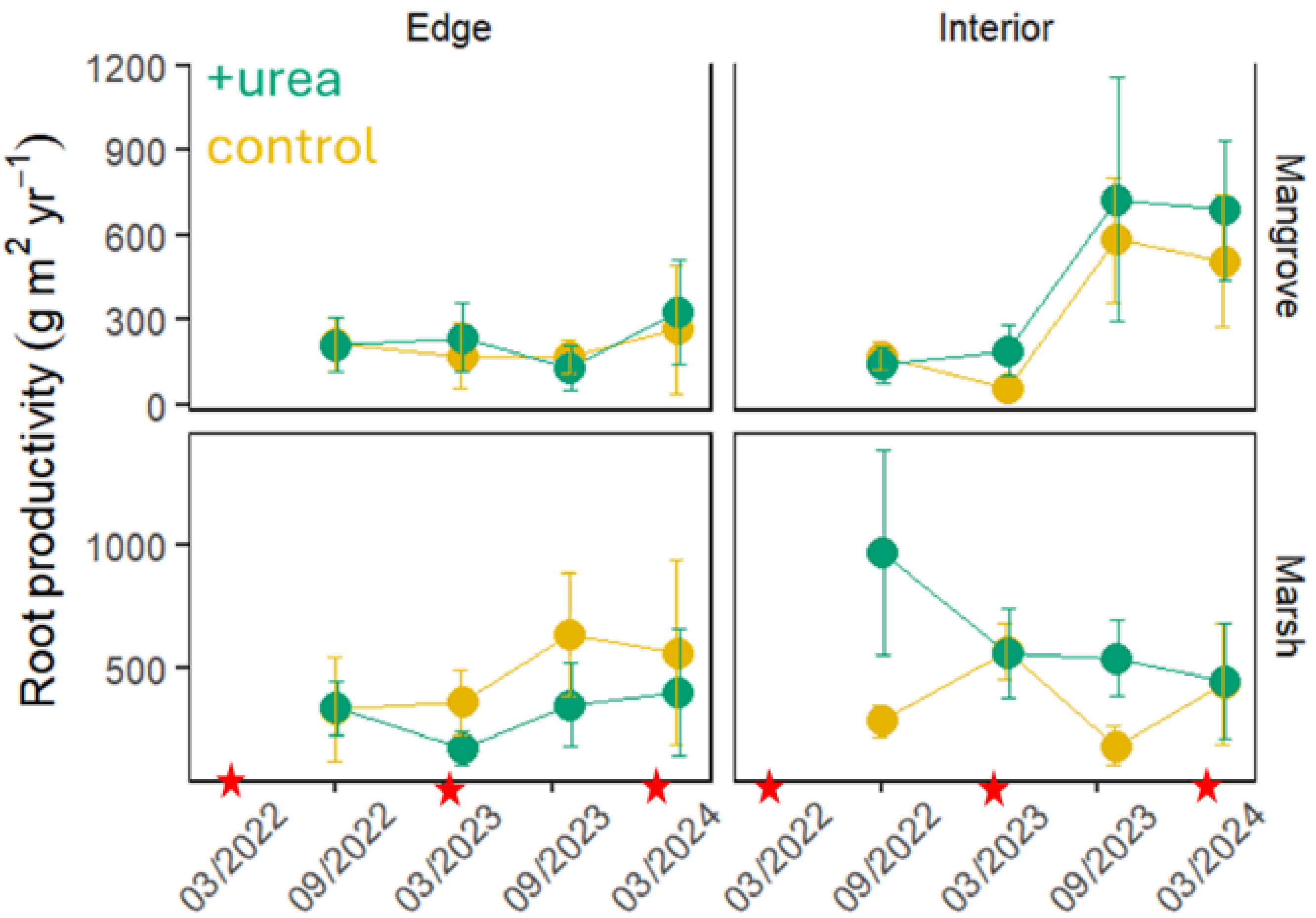
*S. alterniflora* density is declining with added N on the creek edge (data not shown).

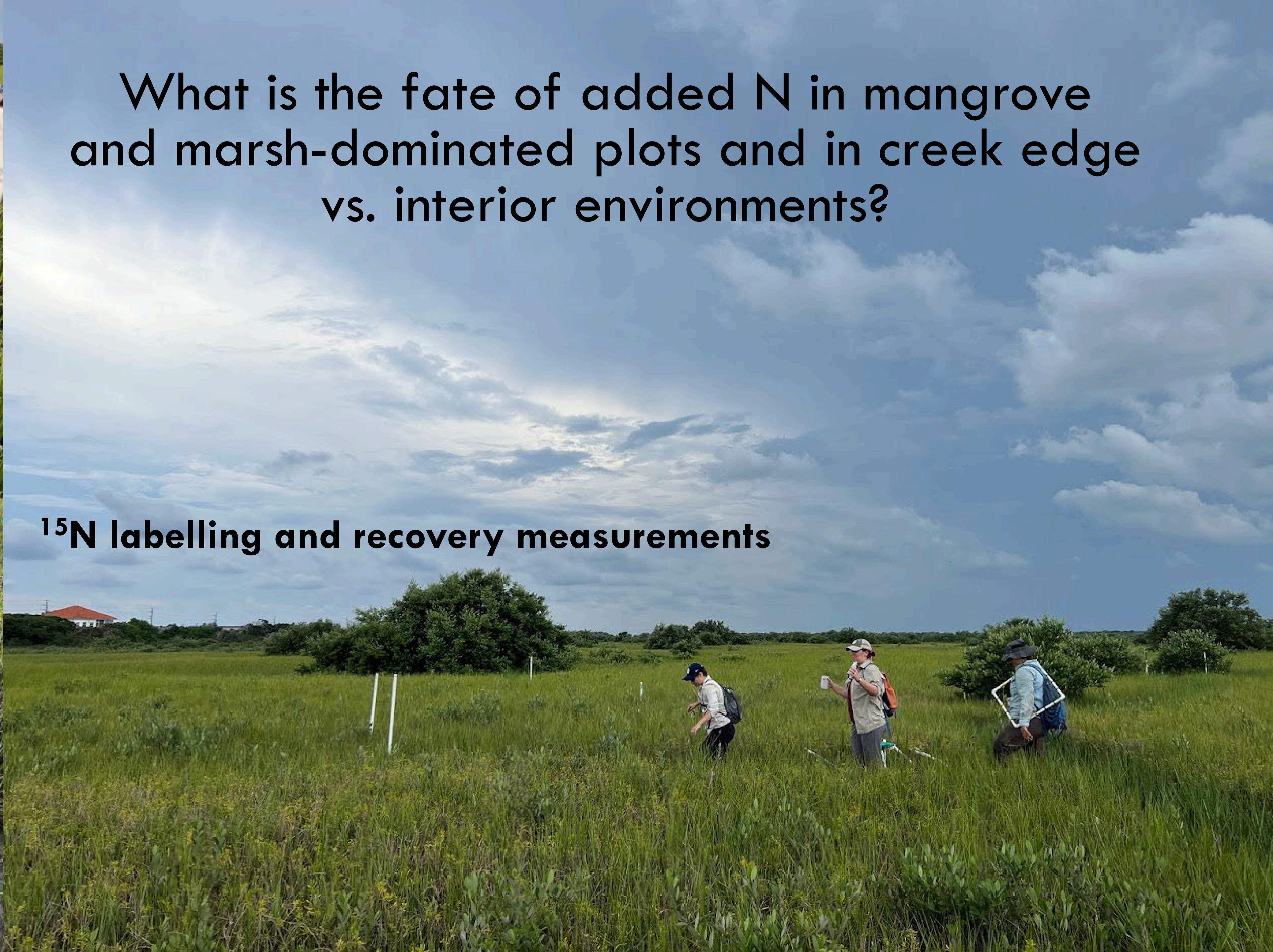
# Root productivity

Jocelyn Bravo and Morgan Mack, Villanova

Mangrove-dominated plots and interior plots had higher root productivity.

Marsh plot root growth responded more to excess N in the interior of wetland than in the interior.

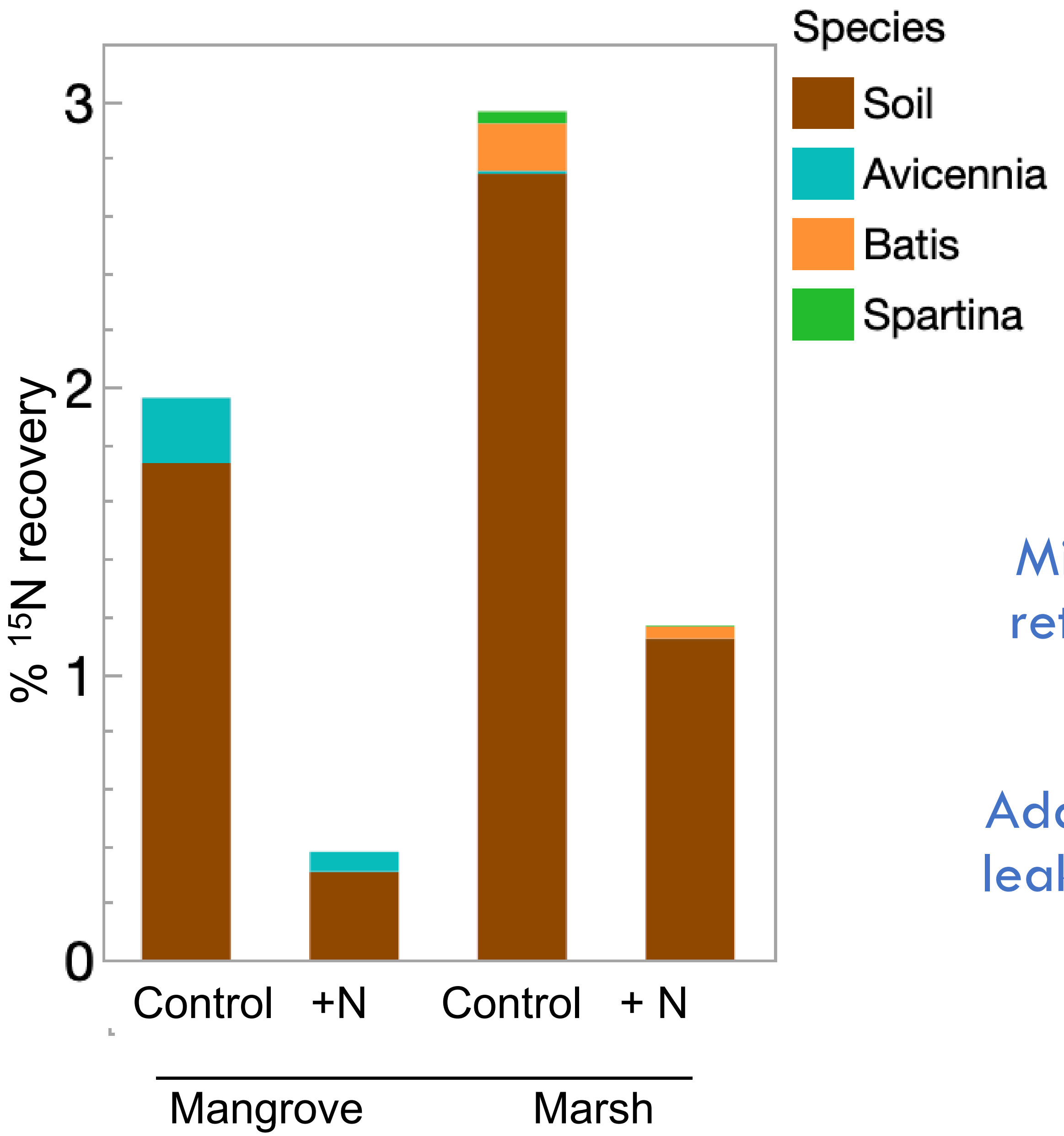





# What is the fate of added N in mangrove and marsh-dominated plots and in creek edge vs. interior environments?

**$^{15}$N labelling and recovery measurements**

# Nitrogen retention in wetland plants and soil




Minimal amounts of nitrogen (N) as $^{15}$N are retained in the vegetation. Most added N is being retained in soil.

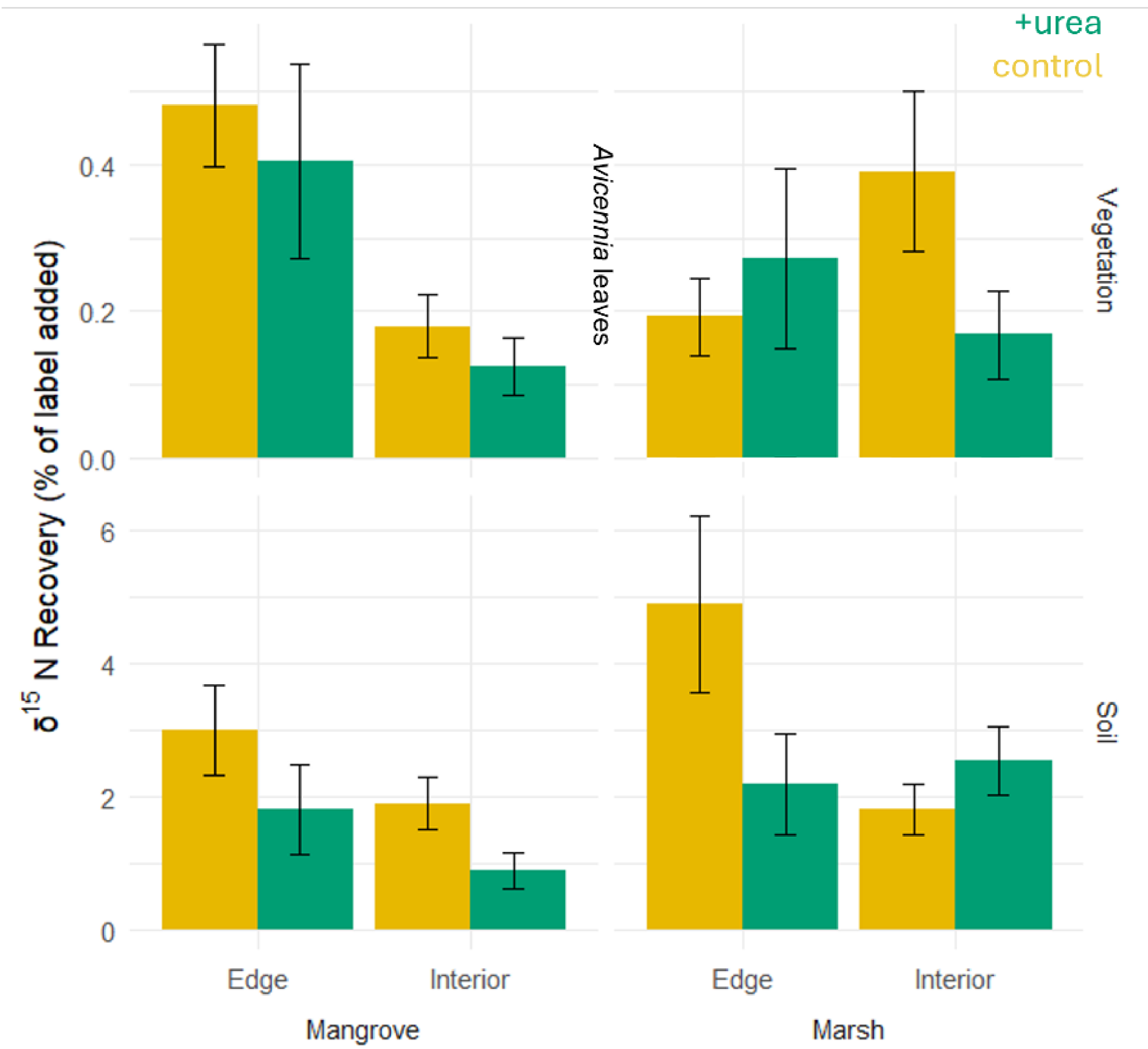
Adding N tends to make soil N retention more leaky in both mangrove and marsh dominated plots.

# Hydrological influences on nitrogen retention

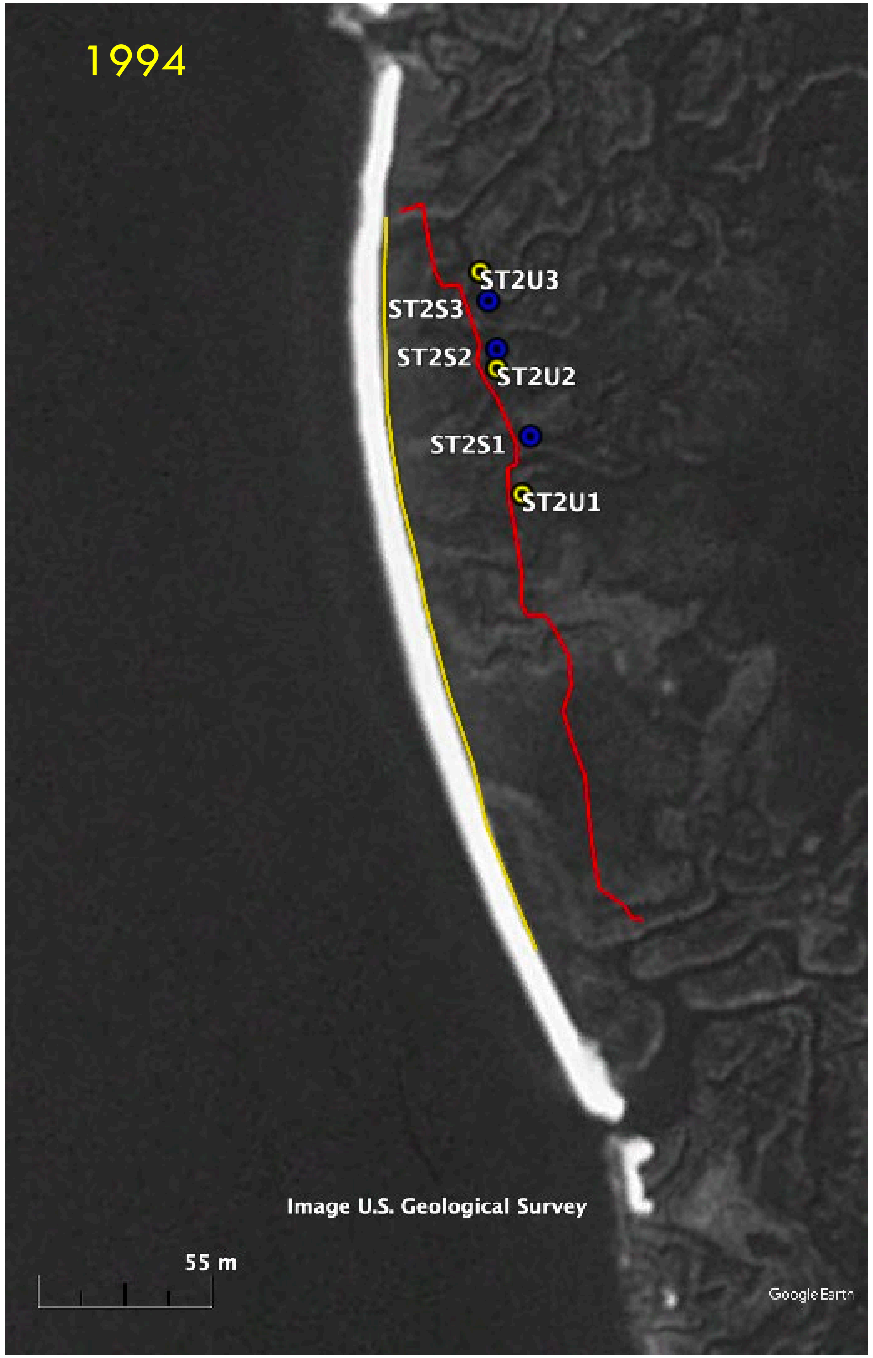
Mangrove leaves retain the most $^{15}N$ in creekside (edge) environments where we know N limitation is less. Marsh vegetation seems to retain more N in the interior but not when N is added

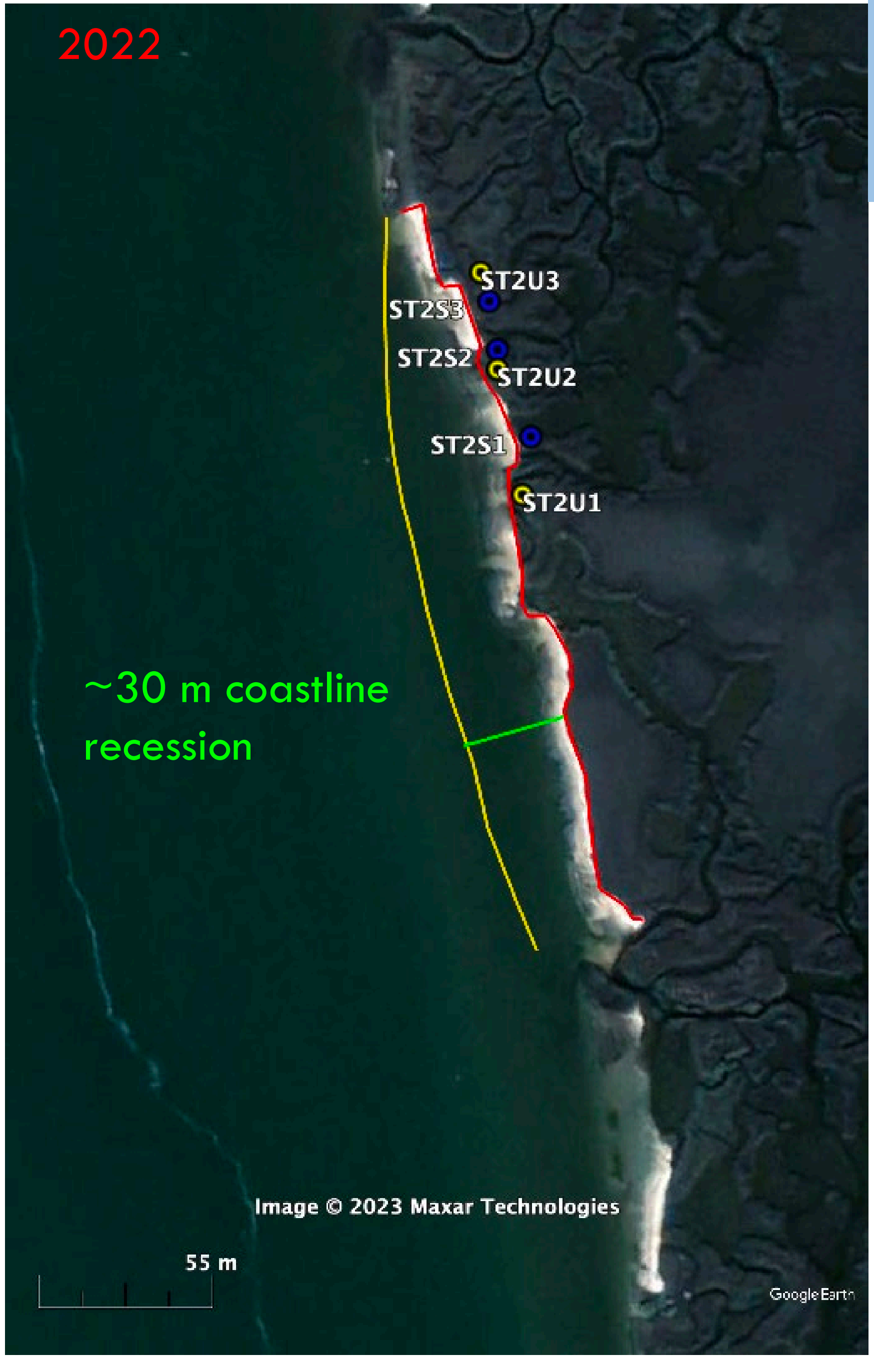
Edge soils retain more $^{15}N$ than interior soils in control plots. Added N seems to decrease this retention.

*see Mercedes Pinzon-Delgado's talk for MAOM results

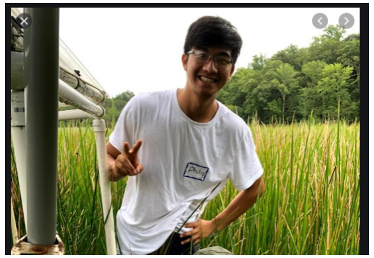


# Land Loss in the GTMNERR



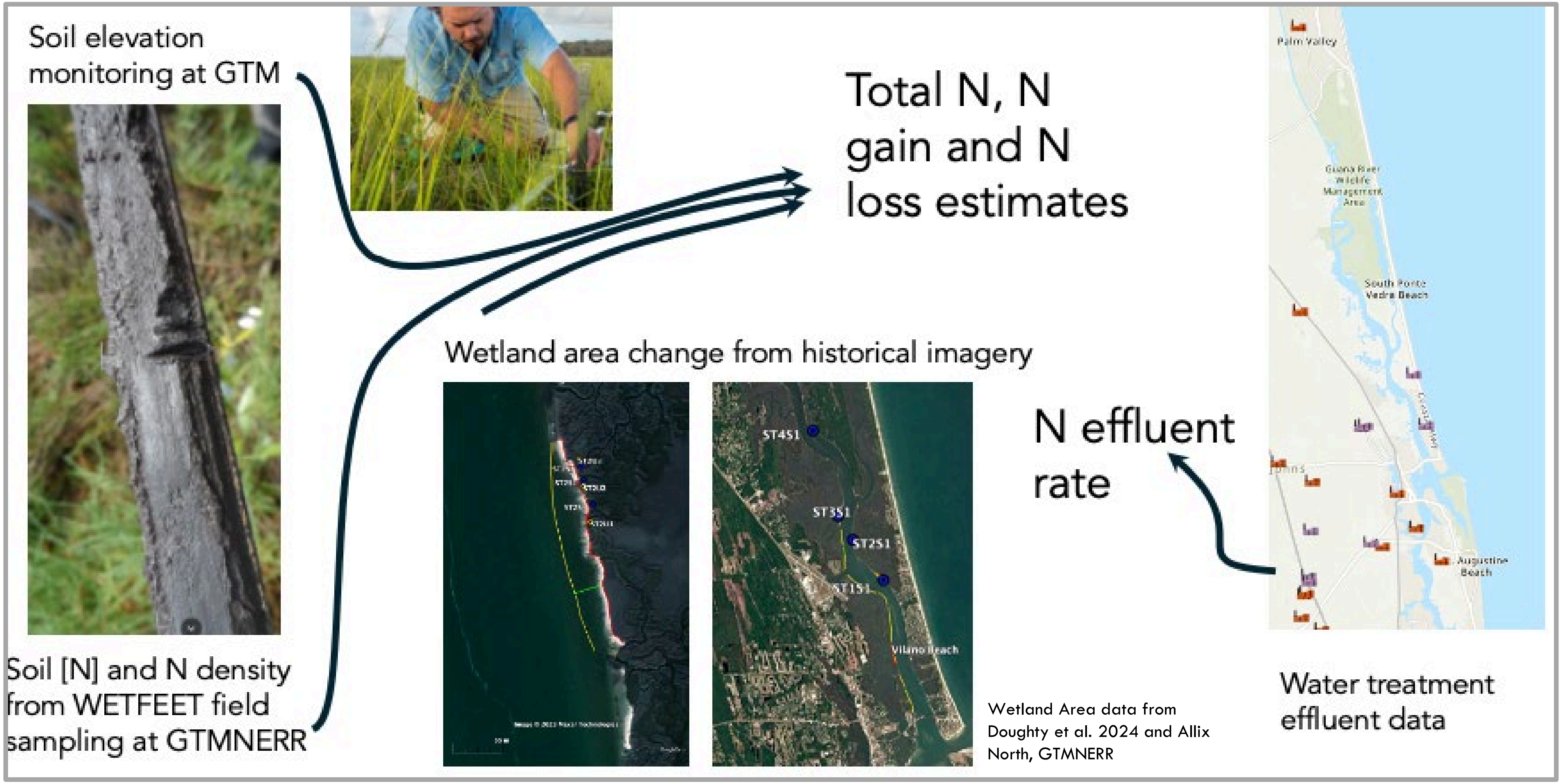

Most land is being lost on the edge from a combination of boat wakes and sea level rise. GTMNERR has lost 6% of wetlands in the last 10 years



Aaron Freeman and Philip Yang, Villanova

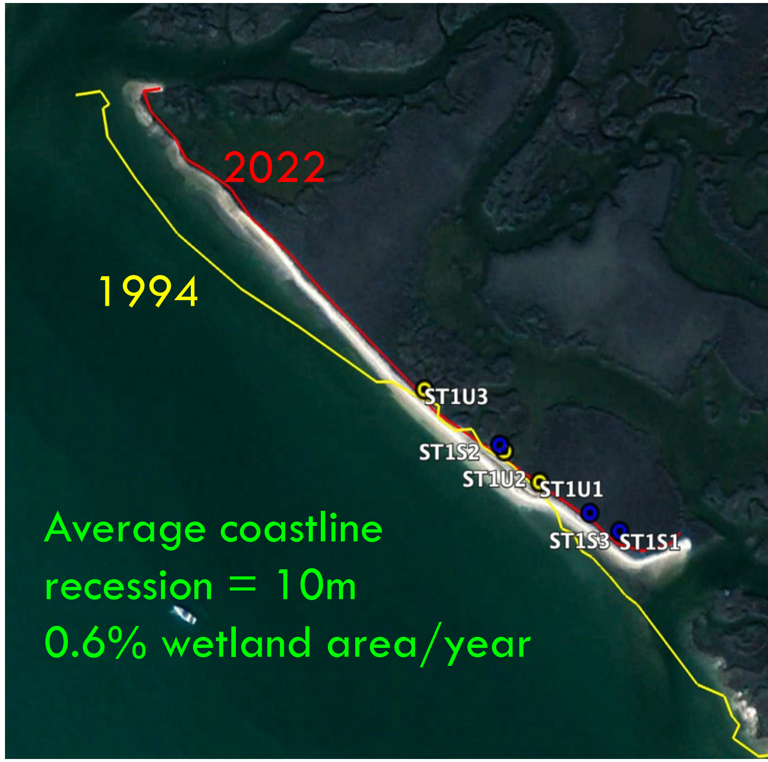
ROOTS & rakes

# Can we create a nitrogen budget for the region as coastal erosion continues?

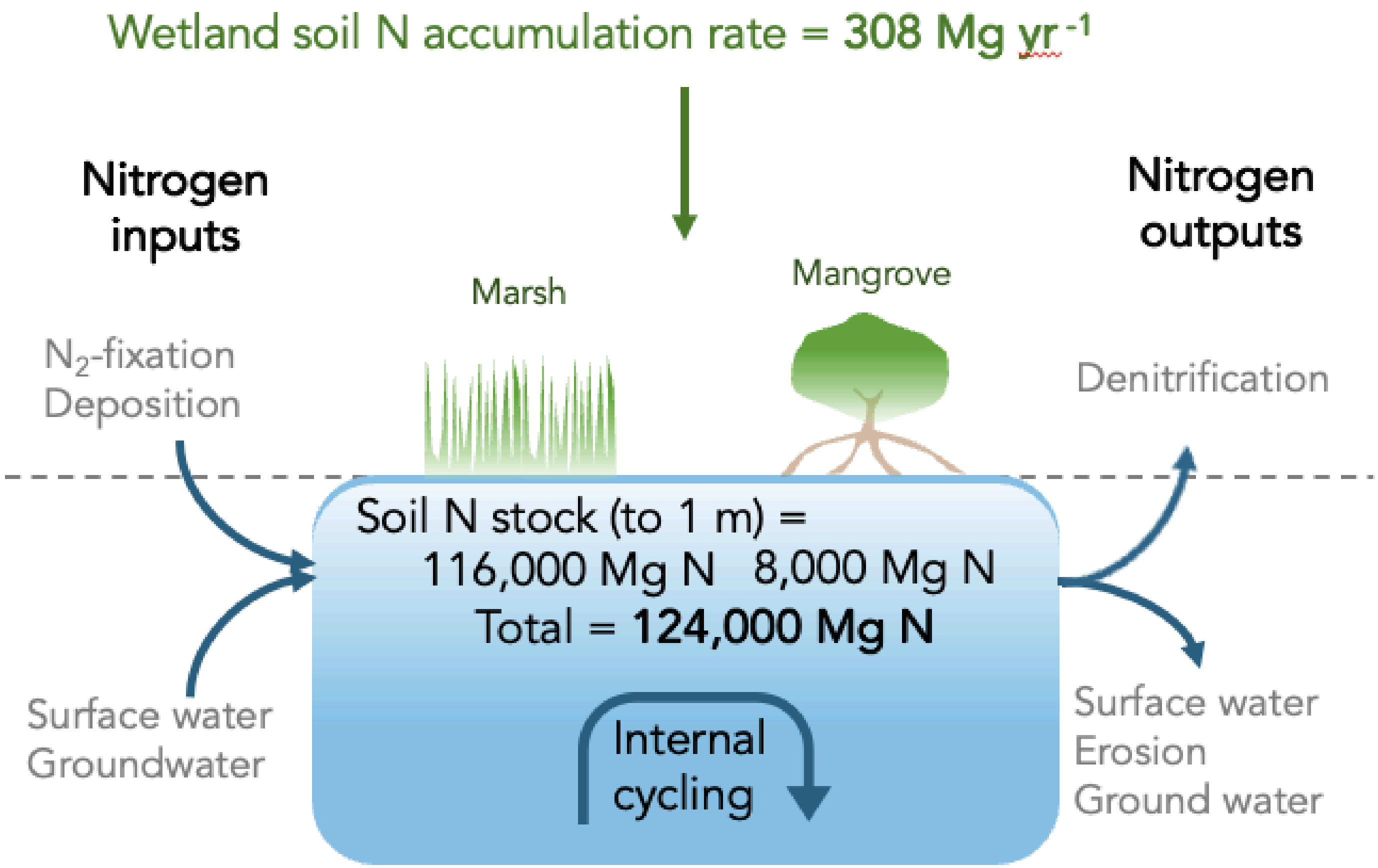



Wetland Area data from Doughty et al. 2024 and Allix North, GTMNERR

# Current coastal nitrogen sequestration and change in the GTMNERR, Northeast FL, USA




Wastewater effluent= 163 Mg $yr^{-1}$




Loss from wetland erosion 543 Mg $yr^{-1}$

**But mangrove sites may be resisting erosion on the edge

# Nitrogen Budget- *N accumulation and release from coastal wetlands*

| | Wetland area (ha) | Current elevation gain (mm yr-1) | N density of soil (mg N cm-3) | Areal NAR- Nitrogen accumulation rate per area (g N m-2 yr-1) | Soil N per area (g N m-2) to 1 m depth | Soil N in GTM wetlands (Mg N) | Total NAR- nitrogen accumulation rate for existing area (Mg yr-1) | Proportional change in wetland area (% per year) | Annual rate of change in area (ha yr-1) | N loss due to wetland soil erosion (Mg yr-1) (assuming 50 cm of soil lost) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Reference or formula** | From Allix North's estimates for 2021 | Wetland elevation monitoring at GTM from 2013-2023, 2 of the 6 sites have mangroves allowing us to estimate rates for marsh and mangrove separately | Chapman, unpublished data from soil cores at three sites down to 45 cm | Elevation gain x N density of wetland soil | N density x soil depth | Soil N per area x area of GTM | NAR per area x area of wetland | Change in marsh and mangrove area as a proportion of total wetland area in 1988, Allix North | From Allix North's estimates for 1988-2021 which are linear | Soil N density x 50 cm depth x rate of area change |
| Marsh | 3,927 | 2.30 | 2.96 | 6.8 | 2960 | 116,239 | 267 | -0.82 | -45 | -659 |
| Mangrove | 289 | 5.12 | 2.73 | 14.0 | 2730 | 7,890 | 40 | 0.16 | 9 | 116 |
| **Total** | 4,216 | | | | | 124,129 | **308** | **-0.66** | -36 | **-543** |

Note that these estimates are based on wetland soil nitrogen. Plants only account for about 5% of the total ecosystem stock of nitrogen.