ROOTS & rakes

Exploring the Roles of Altered Hydrology and Nitrogen Cycling in Sustaining the Coastal Wetlands of Northeast Florida

Samantha Chapman
Villanova University

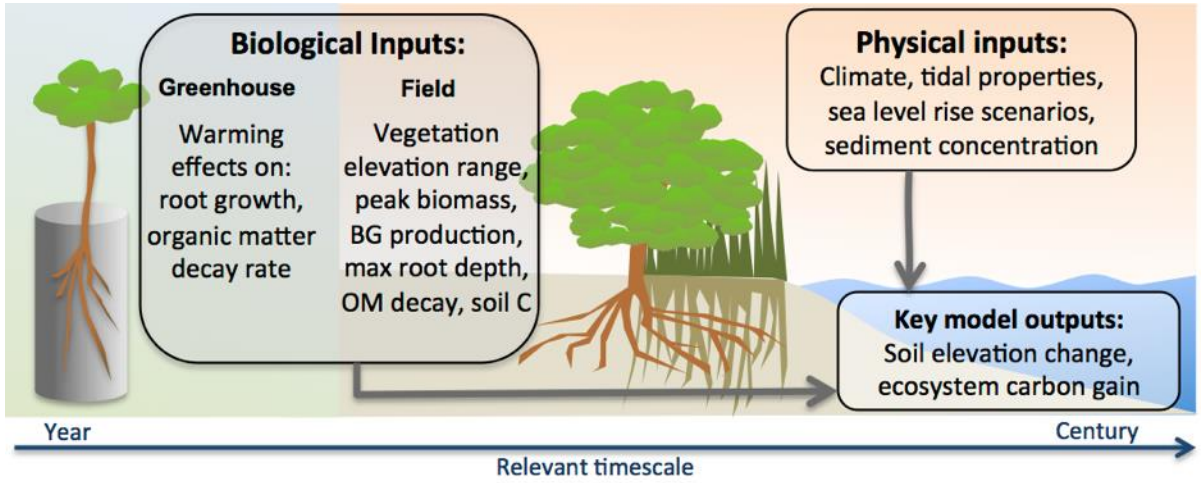
with Lisa Chambers, Adam Langley, Tess Adgie, Nikki Dix, Kaitlyn Dietz, Shannon Dunnigan, Allix North, Lia Sansom

This work supported by the Friends of the GTMNERR

GTMNERR, NE Florida – home of the Timucuan people

National Estuarine Research Reserve System Science Collaborative

Context: Will northeast FL's GTMNERR wetlands keep up with sea level rise over the next century?



FINDINGS:

Both salt marshes and mature mangroves can collapse 60-80 years from now at a moderate sea level rise scenario.

Mangroves build elevation more effectively than marshes with rising sea levels with but also go down more quickly.

Plus, coastal erosion is already happening.

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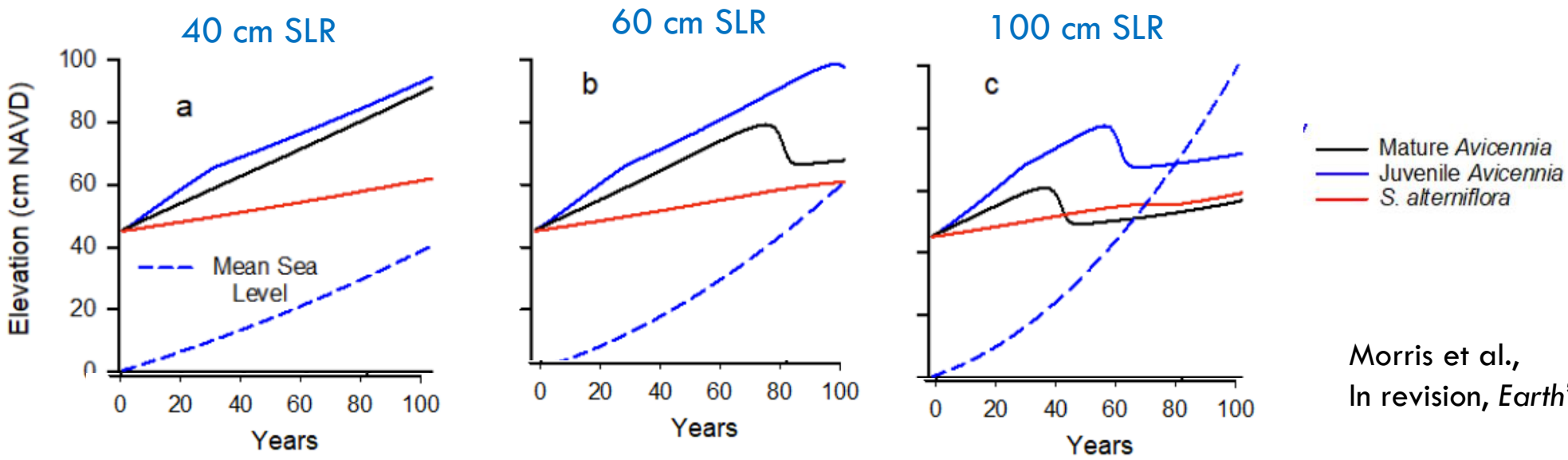
Coastal Wetland Equilibrium Model (CWEM) Results for GTMNERR with Jim Morris, University of South Carolina



Morris et al.,
In revision, *Earth's Futu*

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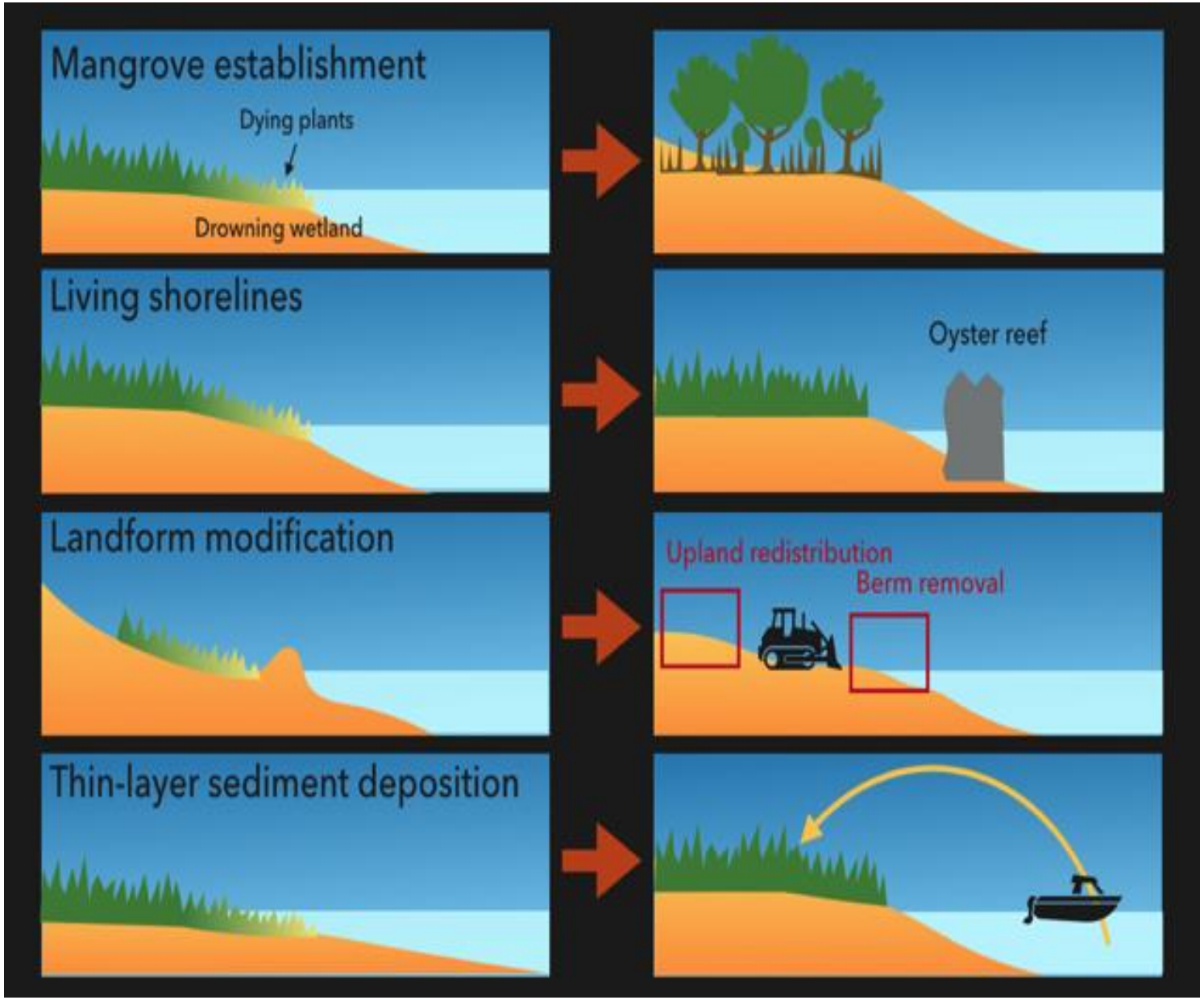
Goal 1: Identify portions of the GTMNERR that are particularly vulnerable to habitat loss due to low elevation and coastal vulnerability.

Goal 2: Engage land managers and scientists in a new collaboration to investigate management options that could potentially maintain or increase wetland surface elevation with respect to sea level rise

End Users:
GTMNERR managers and staff, FL Aquatic Preserve Managers, USACE, FL Fish & Wildlife Conservation Commission, North Florida Land Trust, County Land Managers, St. John's Management District (other WMD)



Elevation maintenance strategies

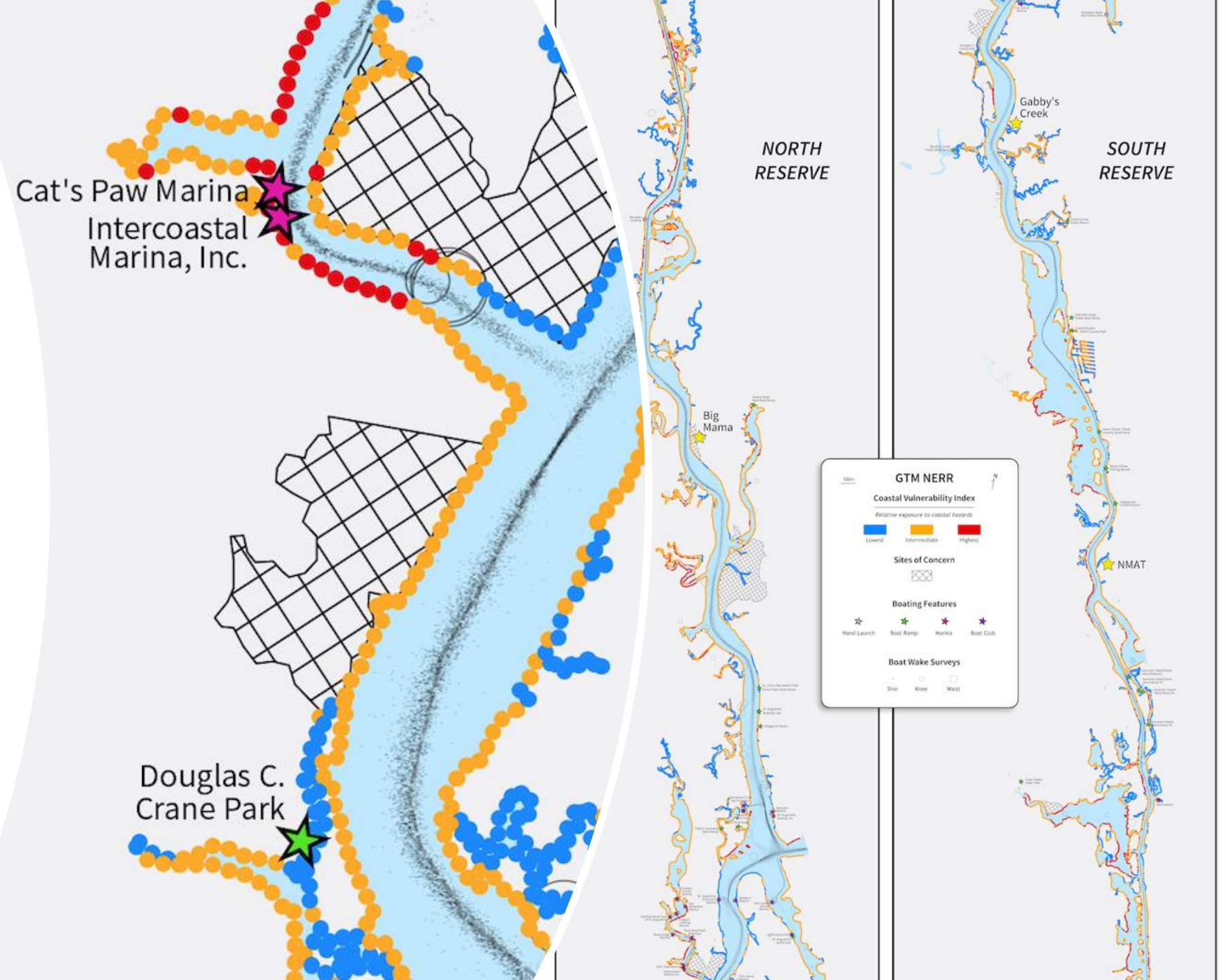
Outcome 1

Coastal Vulnerability assessment in the GTMNERR

Viewer here: http://cons.scienceontheweb.net/ewe/

PLUS influence of boat wakes story map:

Verutes et al., In review
Using InVEST model



Outcome 2

Stakeholder Workshops

February 2021-2022

Vulnerable Site Visits

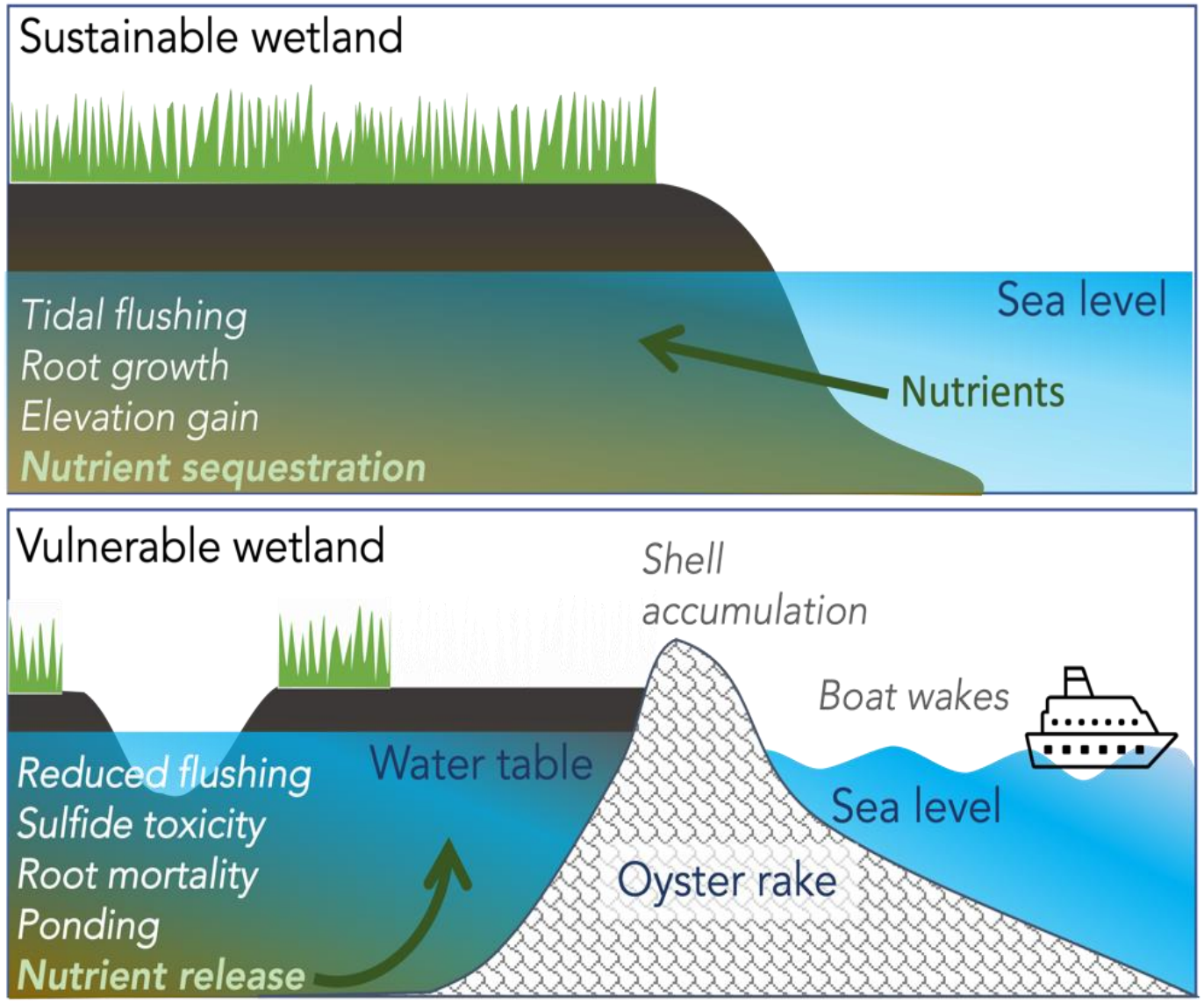
In-person working sessions on maps and flip charts on restoration strategies

Workshop 2- Emergent themes

1. Boat wakes seem to play a large role in site vulnerability
2. **Hydrological disruption (oyster rakes) may also drive coastal vulnerability/marsh stress in GTMNERR**
3. Thin layer placement may not be feasible in much of the reserve due to lack of dredging (stakeholder input debate on this point)
4. **We have knowledge gaps in terms of nutrient influences,** mangrove facilitation, and implications for other organisms
5. Habitat value from CVI may allow for GTMNERR prioritization of habitat conservation and pilot sites for restoration

Post-Workshop Recommendations Summary for Restoration strategies in NE Florida wetlands

Maintenance strategy	Definition	Location within wetland	Basic site requirements	Knowledge Gaps
Thin-layer placement	Dredge sediment is sprayed over large area of wetland to increase surface elevation incrementally[3]	Edge or interior	Close proximity to large channels for machinery access[2]; best applied when plants are dormant[1] or absent[4]; marsh dominated wetlands[2]	General long-term impacts and subsidence potential; hydrology impacts; effect on mangroves within the marsh; impacts to invertebrates/microbes/ algae/ birds/ fisheries[4]
Mangrove establishment	Mangroves are intentionally planted to allow natural accretion of sediment via mangrove root growth over time[13]	Interior[6]	Intact marsh habitat to increase seedling survival[5,8]; annual tidal inundation ~30%[6,13]; minimal natural mangrove recruitment[6]; low energy wave setting[6]	Impact of marsh species diversity[5,8]; differences in mangrove species' elevation benefits and temperature thresholds[7]; public perception of mangrove planting
Living shorelines	Stabilization of coastal wetland edge using natural materials, often oysters & vegetation[11]	Edge[11]	Oyster habitat suitability (turbidity, salinity, oxygen)[10]; appropriate substrates[9,10]; relatively low energy wave setting[11]	Suitability/ limiting conditions for different types of shorelines[10]; boat wake impacts; durability in energetic settings[12]
Landform modification/berm redistribution	Redistribution of dredge spoil or shell rakes to restore functioning hydrology in wetland habitat behind the landform[14]	Edge or interior[14]	Close proximity to large channels for machinery access; understanding of local hydrology[13,14,15,16]	Recovery time for marshes[14] vs. mangroves[13,15]; impacts on migratory birds; permitting process



ROOTS & rakes

a collaboration between Villanova University, University of Central Florida and the GTMNERR

VILLANOVA UNIVERSITY

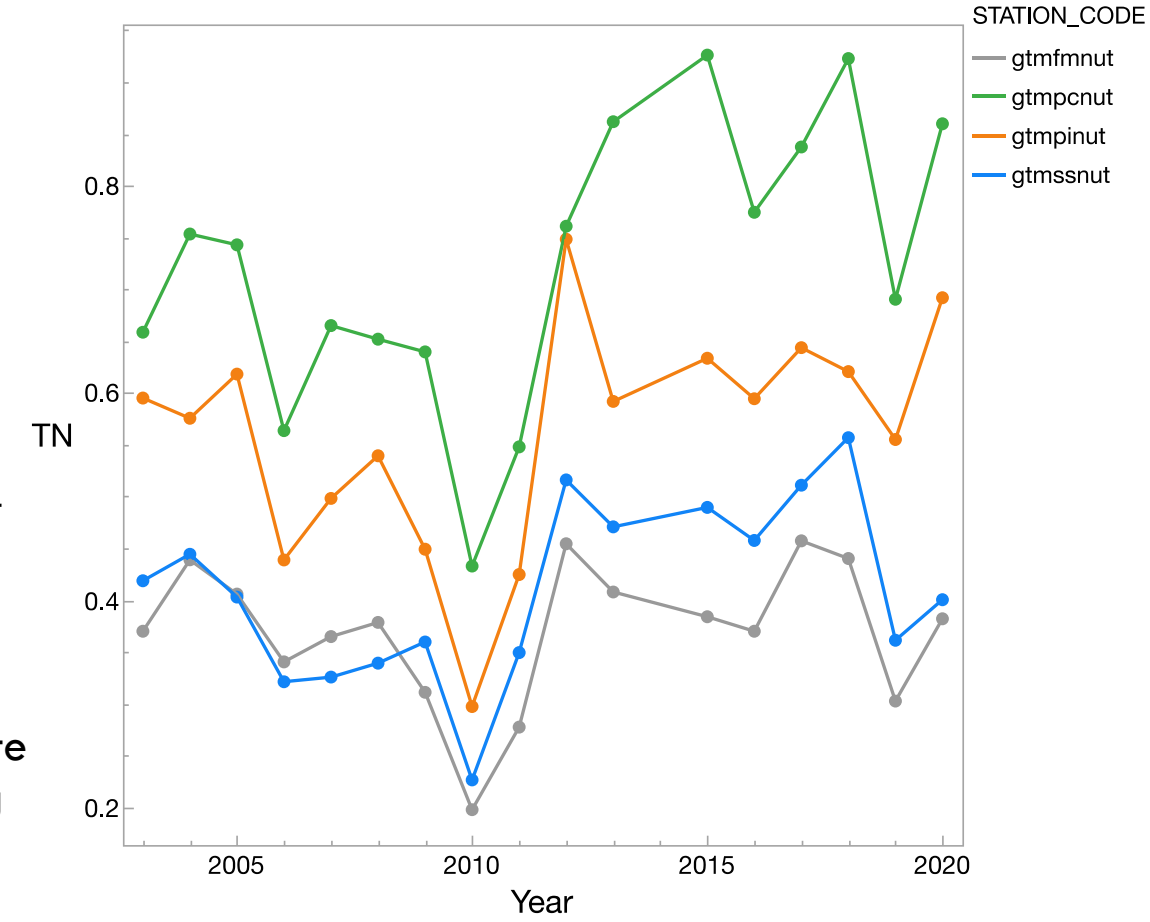
GTM

UNIVERSITY OF CENTRAL FLORIDA • 1963 •

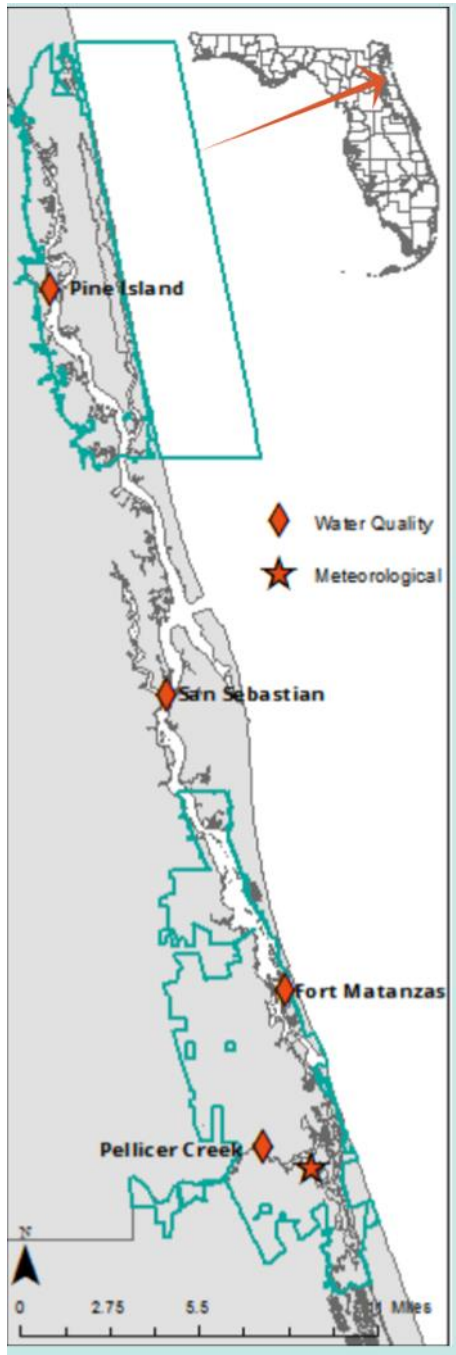
ROOTS & rakes

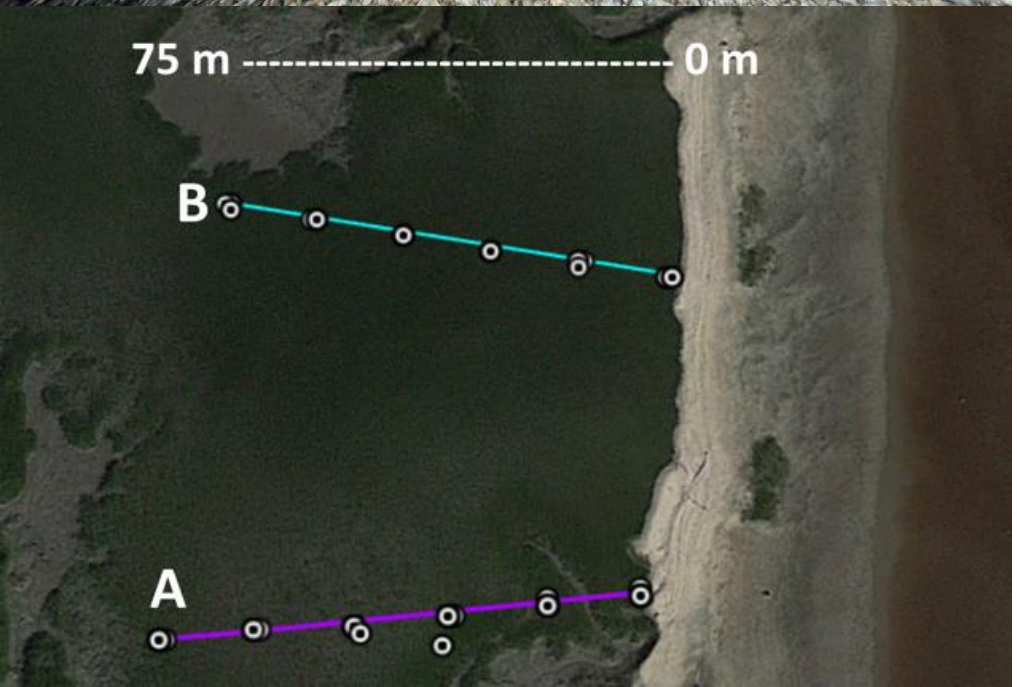
- Do rakes cause stressful conditions for the wetlands behind them?
  - Approach- At three sites with rakes, we will determine the impact of shell rakes on plant and soil stress, marsh nutrient cycling, and elevation

- Do excess nutrients in waterways contribute to the vulnerability of marshes to ponding and erosion?
  - Approach- We will integrate new water quality and nutrient data with an existing coastal vulnerability assessment to facilitate site-specific conservation and restoration planning.

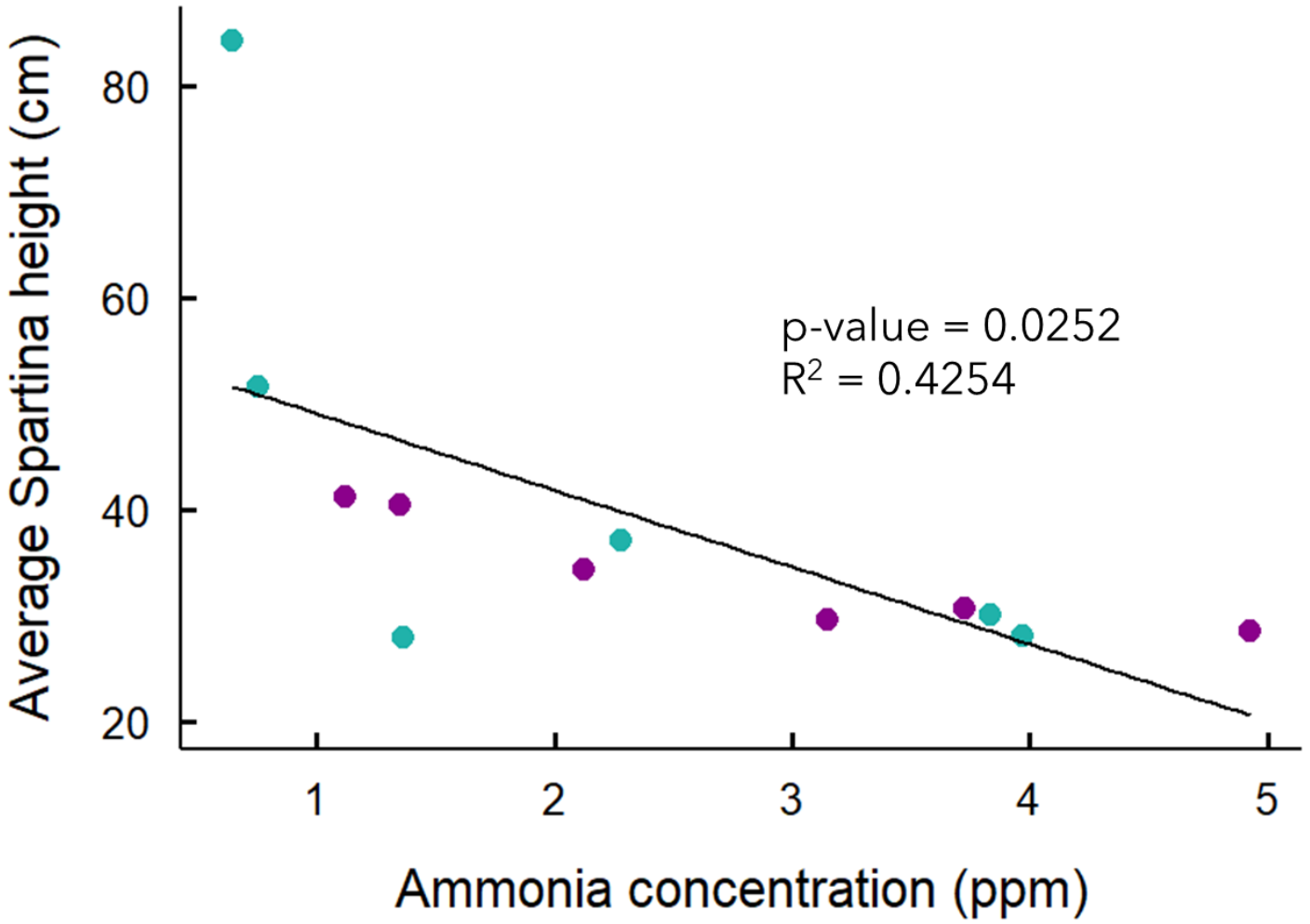


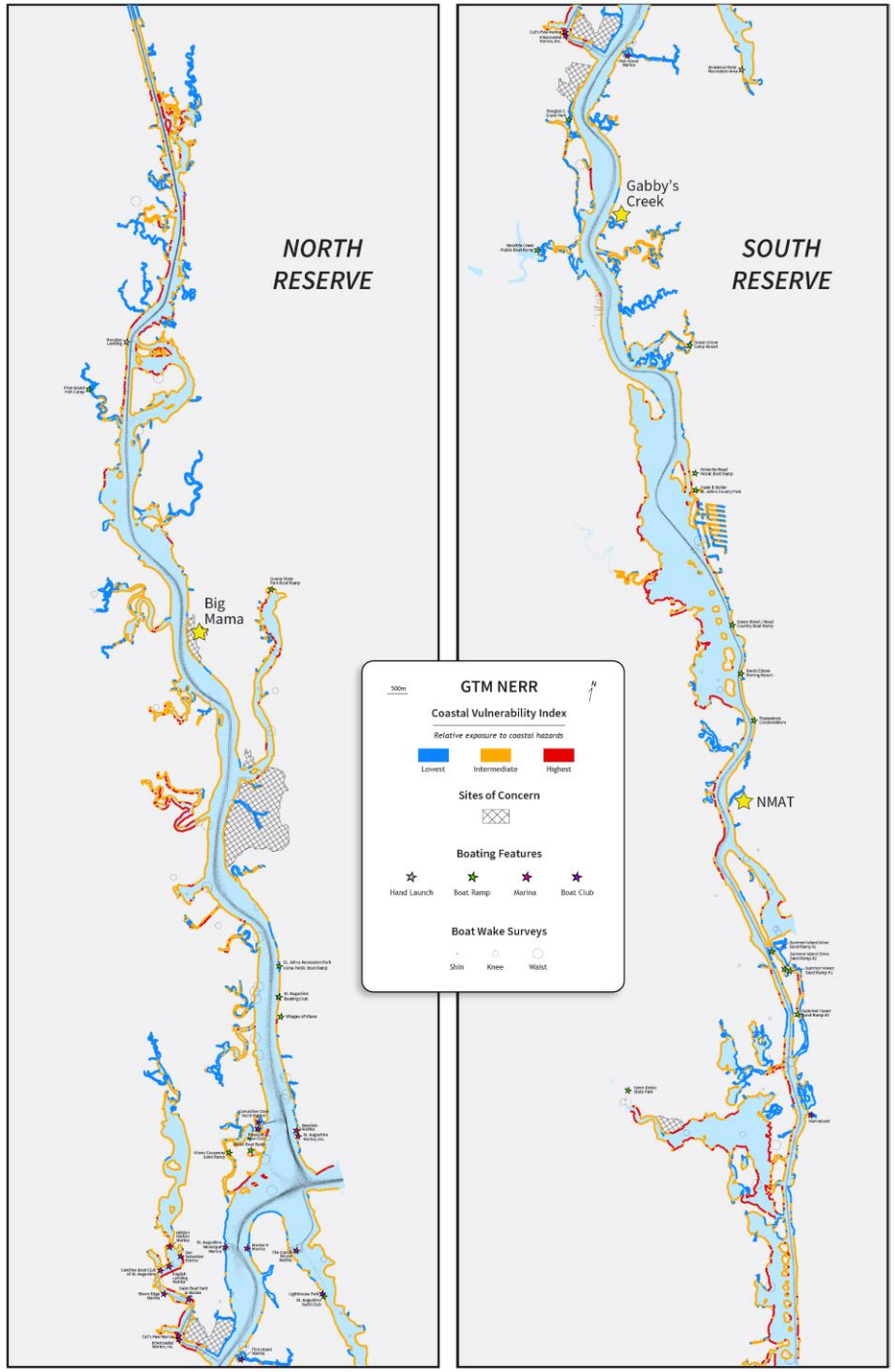
Nitrogen concentrations in the GTMNERR waterways have been increasing in recent years.





Marsh plant height behind rake negatively correlated with porewater nutrients





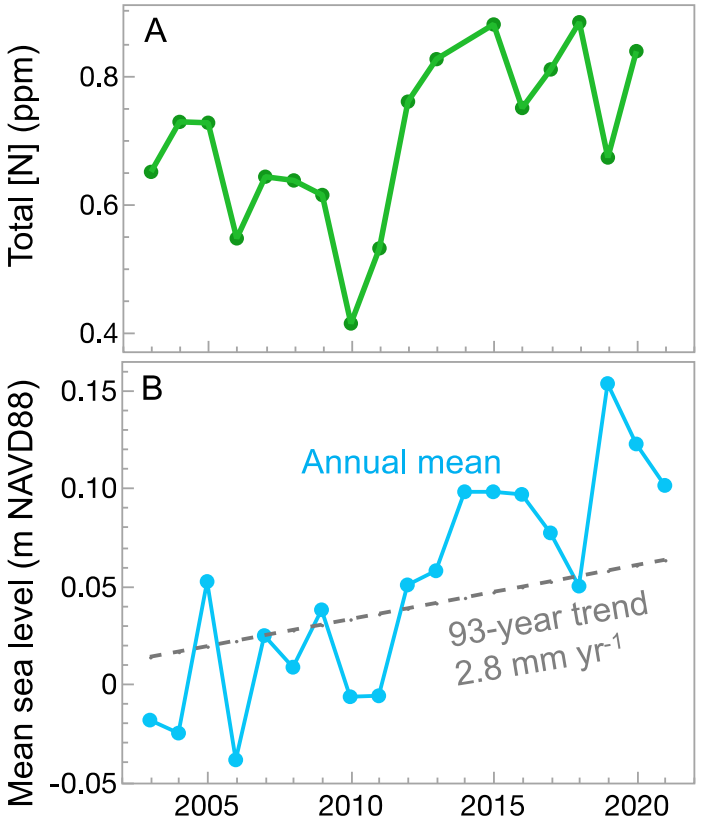
Selected vulnerable sites (from the Coastal Vulnerability Index map) to determine whether shell rakes cause stressful conditions for the wetlands behind them.

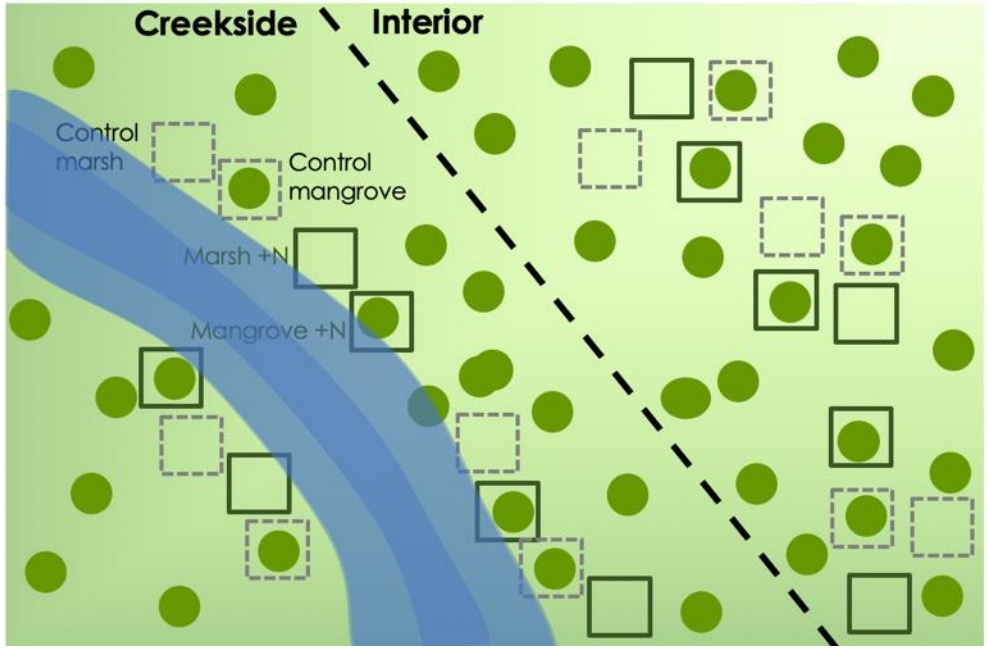
Site Visits and initial field sampling for *Roots and Rakes* happened this past Monday

Data collection variable	What will this variable tell us about marsh health behind the rakes?
Root growth	How strong is the soil? How well is it building elevation?
Bromide tracing	How much is the wetland being flushed by the tide?
Soil chemistry	How much buildup of sulfide/salinity is there in soils? Are nutrients being retained in the wetland?
Elevation	How is this site poised to keep up with rising sea levels (or not)?

Nutrient pollution and habitat declines may be linked.

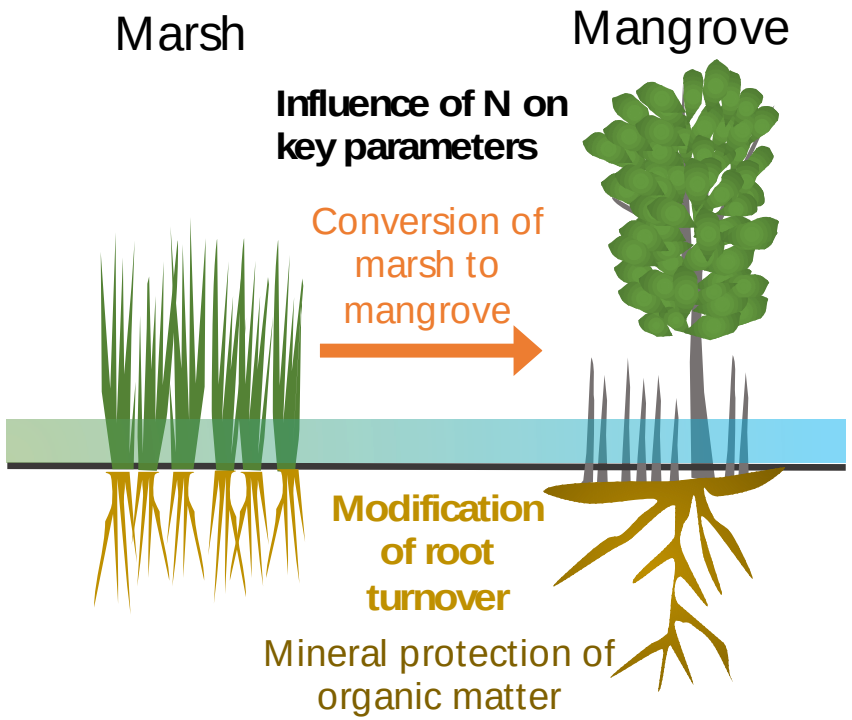
We need to find out which way the nutrients are going in the GTMNERR.





Box 1

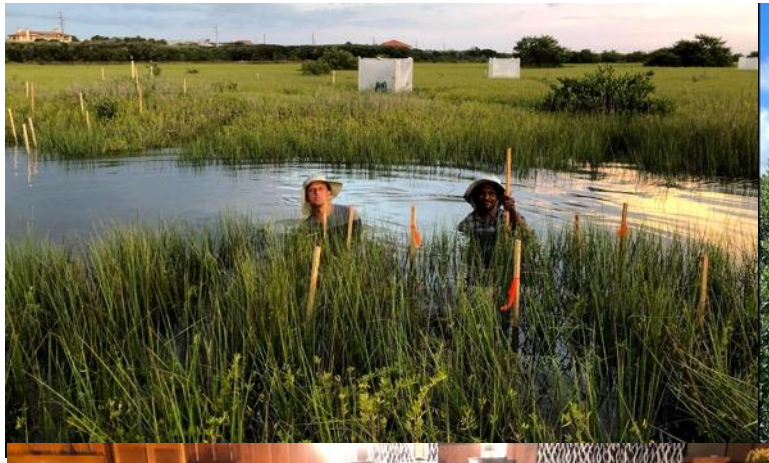
N pool	Marsh ($g\ m^{-2}$)	Mangrove ($g\ m^{-2}$)	Net N **sequestration** from marsh-to-mangrove conversion over 30 years ($g\ m^{-2}$)	Net N **release** from a 15-cm marsh collapse ($g\ m^{-2}$)
AG Biomass N	31.2	71.4	40.2	31.2
N in annual soil accretion	9.4	39.5	904.3	870.0



Samantha Chapman

samantha.chapman@villanova.edu

Collaborators to thank: Jim Morris, Kaitlyn Dietz, Tess Adgie, Nikki Dix, Gregg Verutes, Phil Yang, Abby Kuhn, Lia Sansom, Scott Eastman, Silas Tanner, Shannon Dunnigan, Pam Marcum, Adam Langley, Allix North, Ches Vervaeke, Candy Feller, my lab group, and all workshop and WETFEET project participants listed here: https://www.wetfeetproject.com/ewe



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