COLLABORATIVE SCIENCE FOR ESTUARIES

WEBINAR SERIES

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Experimenting with Elevation

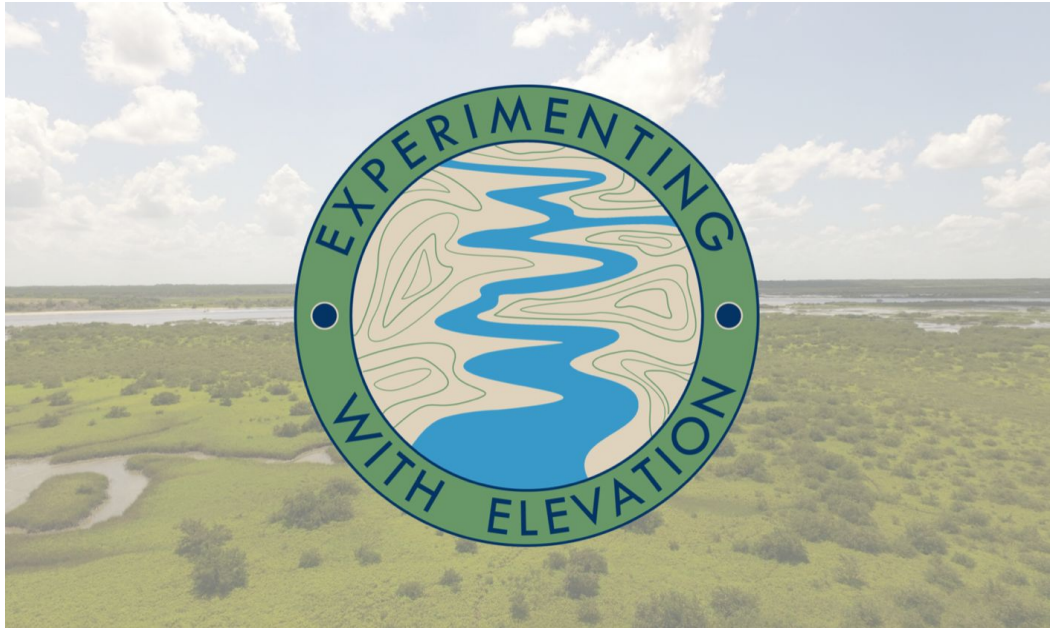
Building a New Collaboration to Explore Management Options for Wetland Elevation Maintenance

National Estuarine
Research Reserve System
Science Collaborative

Date: Tuesday, January 17, 2023
Time: 3:00pm-4:00 pm EST

Experimenting with Elevation

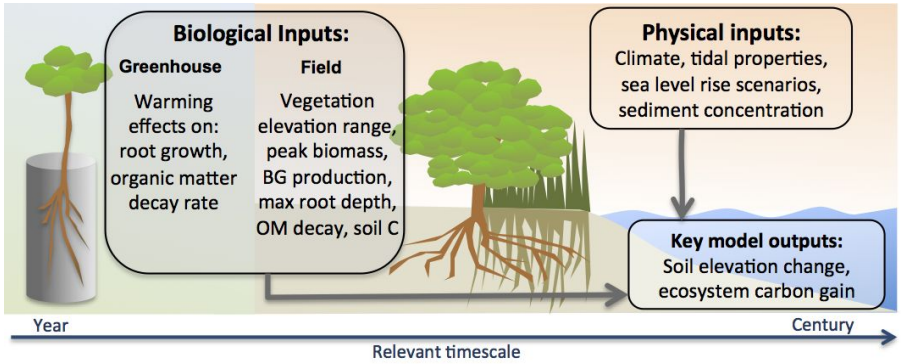
A collaboration exploring management options for wetland elevation maintenance



GTM WETFEET VILLANOVA UNIVERSITY NOAA National Estuarine Research Reserve System Science Collaborative

GTMNERR – home of the Timucuan people

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



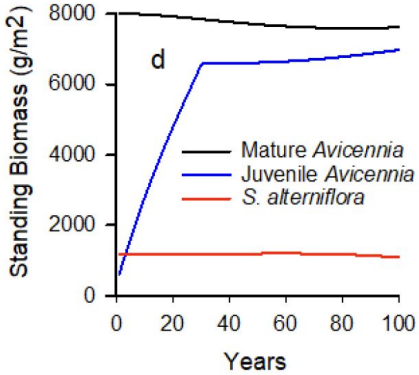
FINDINGS:

Mangroves build elevation more effectively than marshes with rising sea levels.

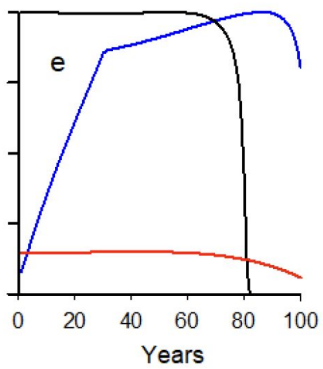
Both mangroves and marshes collapse 60-80 years from now at a moderate SLR scenario with mangroves going down more quickly

Coastal Wetland Equilibrium Model (CWEM) with Jim Morris, USC

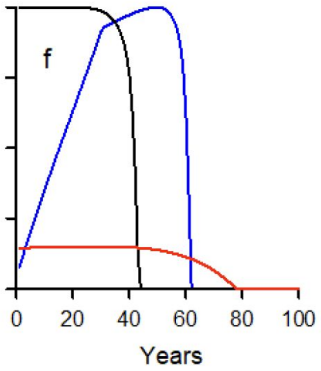
40 cm SLR



60 cm SLR



100 cm SLR



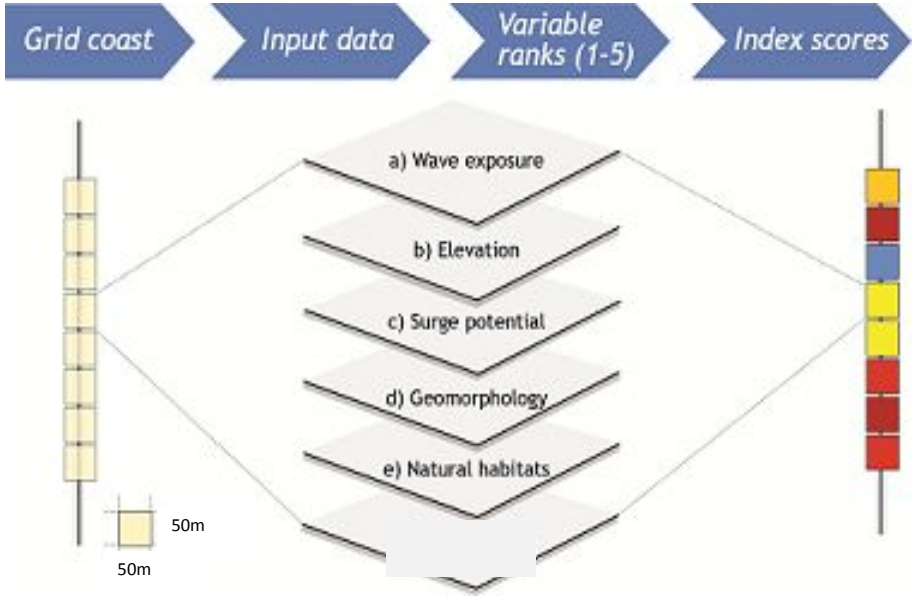
Morris et al.,
In revision *Earth's Future*

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

End Users:
GTMNERR managers and staff, FL Aquatic Preserve Managers, USACE, FWC, North Florida Land Trust, County Land Managers, Local Water Management Districts

Approach:
Coastal Vulnerability Index coupled with stakeholder discussion and field elevation measurements and site visits.

Outcome: InVEST Model producing Coastal Vulnerability Index

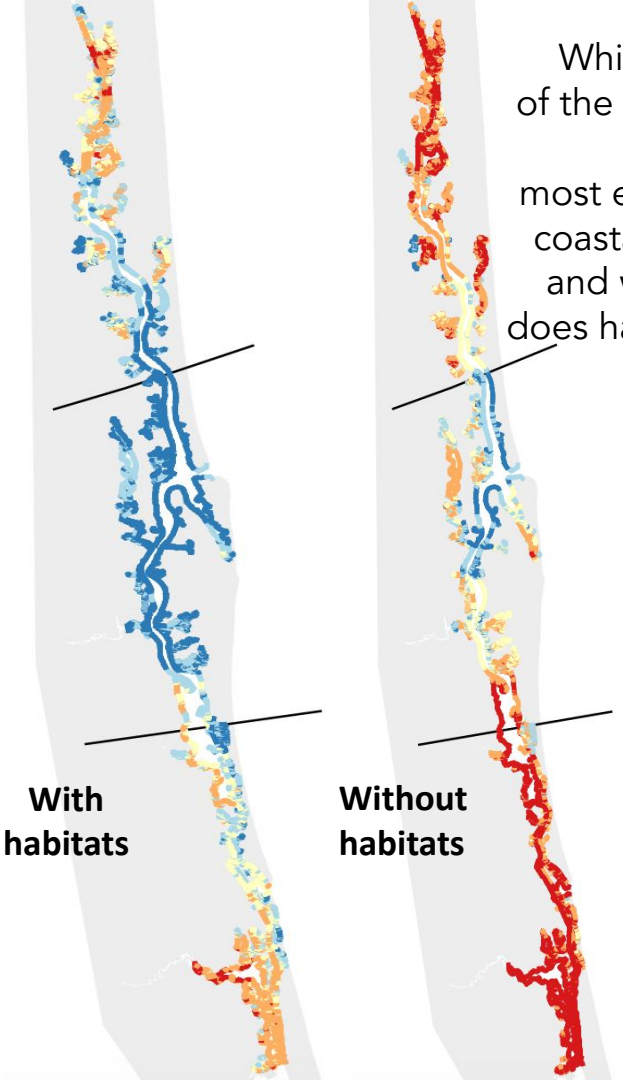


COASTAL VULNERABILITY INDEX

Relative exposure to hazards

Lowest — Intermediate — Highest

Verutes et al., In prep.



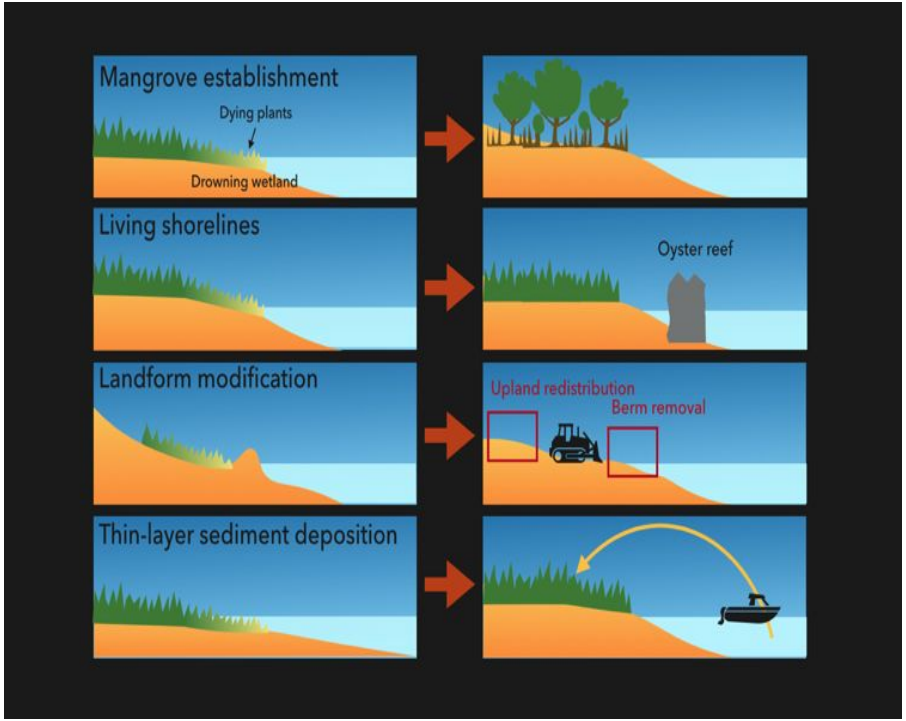
Which areas of the GTMNERR are most exposed to coastal hazards and what role does habitat play?

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

Approach: Two workshops that bring together a unique regional team to engage in communal restoration planning

Proposed Outcomes:

Survey results, Restoration stories, Site prioritization homework, Science gaps identified Workshop 2 planning

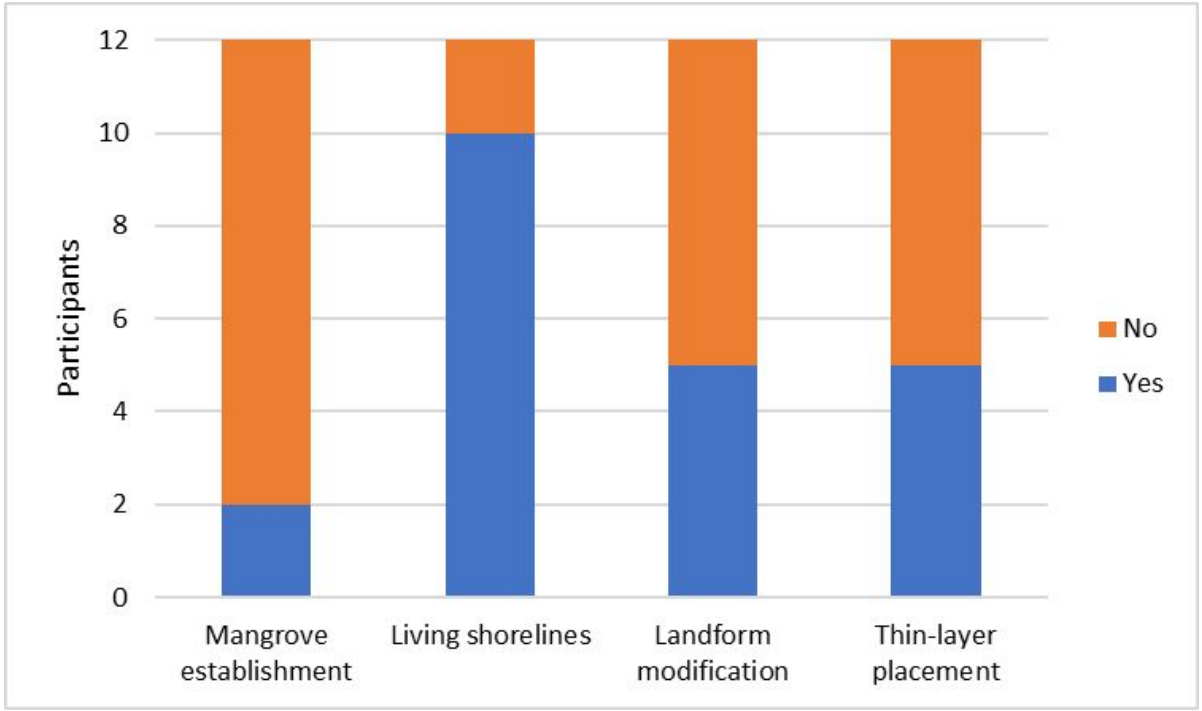


Elevation maintenance strategies

Stakeholder surveys – January 2021

<u>Survey results:</u> Stakeholders had less experience with restoration techniques and monitoring than expected

<u>Follow-up interviews:</u> Need for science informed practice, resource availability, and public perception/involvement in restoration projects

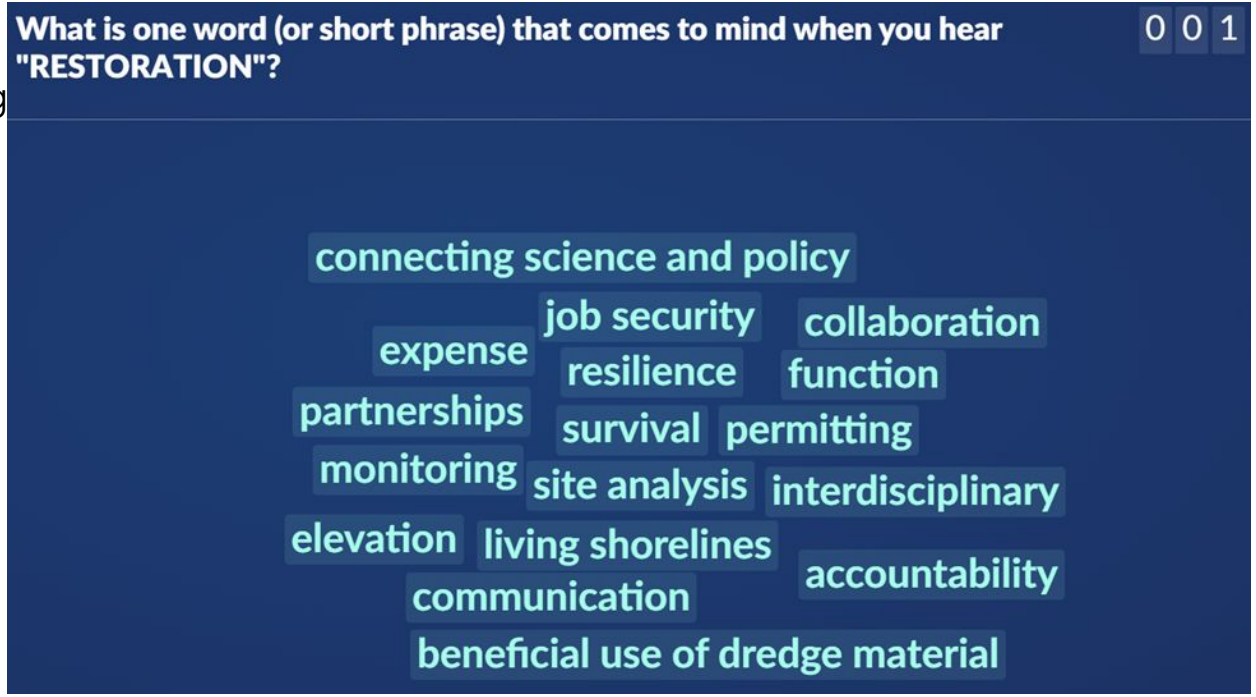


Workshop 1- February 2021

We brought together a unique regional team to engage in communal restoration planning

We identified knowledge gaps for restoration planning based on surveys and interviews we had done with EWE stakeholders.

At the workshop, we heard restoration stories from NE Florida and discussed action items for filling gaps.



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Workshop 1 - February 2021

Primary Goal of the CVI…

To assess the **role of natural habitats in protecting coastal assets** of GTM NERR

SALT MARSHES

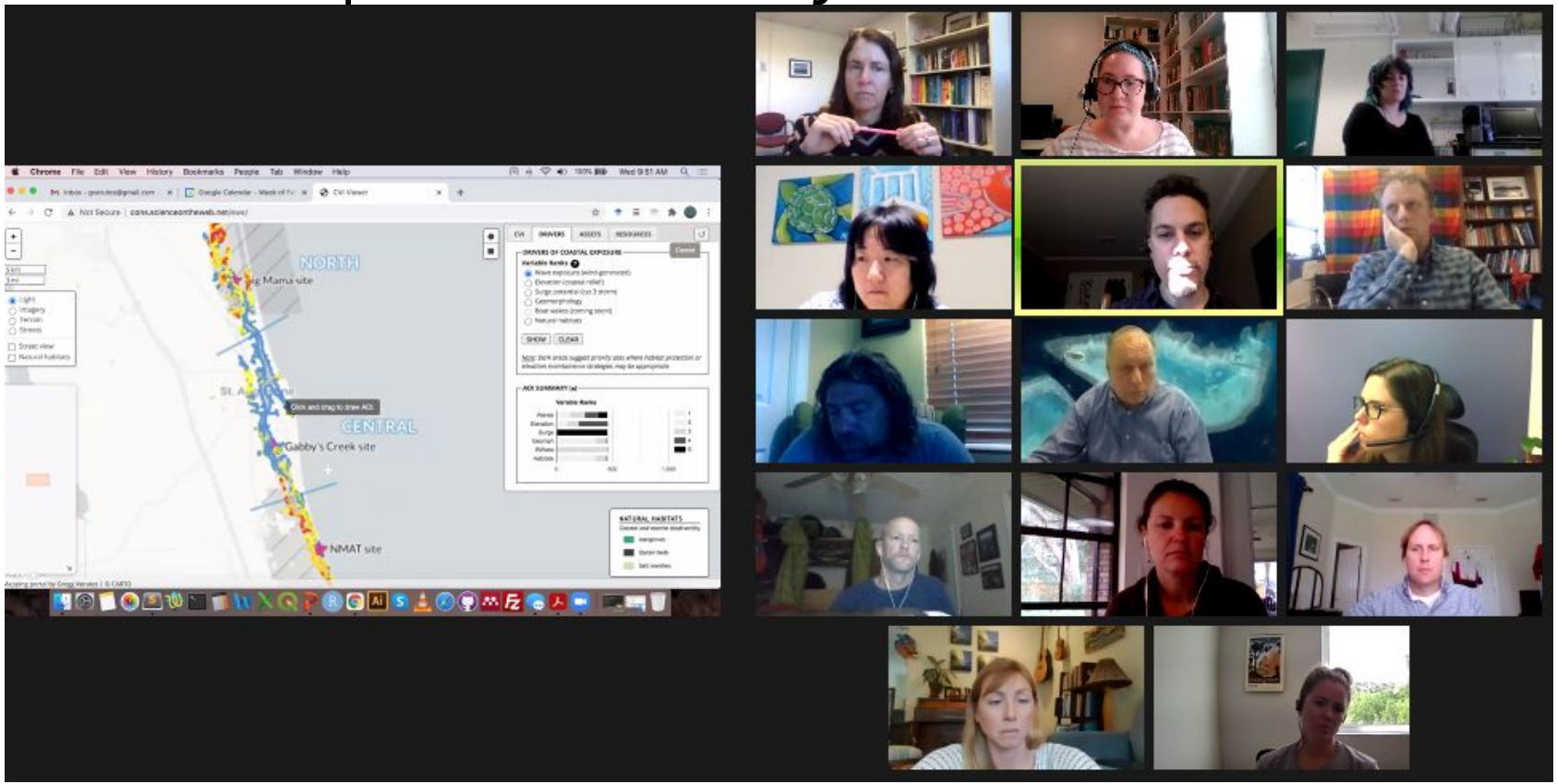
OYSTER BEDS

MANGROVES

Table 1. Summary of existing habitats known to attenuate (buffer) wave energy, their potential in terms of coastal protection and co-benefits, and major threats.

Habitat name	Wave attenuation	Potential co-benefits	Threats in GTMNERR
Mangrove forests	Highest	Fisheries, blue carbon, water purification, habitat for flora & fauna	Hardening of shoreline, dredging of channels, sea level rise (SLR), freeze events, boat wakes
Salt marshes	Medium	Blue carbon, recreation, habitat for flora & fauna, fisheries, aesthetics	Coastal development, mangrove encroachment, SLR, marsh die backs, boat wakes, dredging
Oyster reefs	Medium	Water purification, fisheries, habitat for flora & fauna, commercial and recreational harvest, blue carbon	Boat wakes, dredging of Intracoastal Waterway, unsustainable harvest, degradation of food quality via water pollution, increasing water levels due to SLR and storm events

Workshop 1 - February 2021

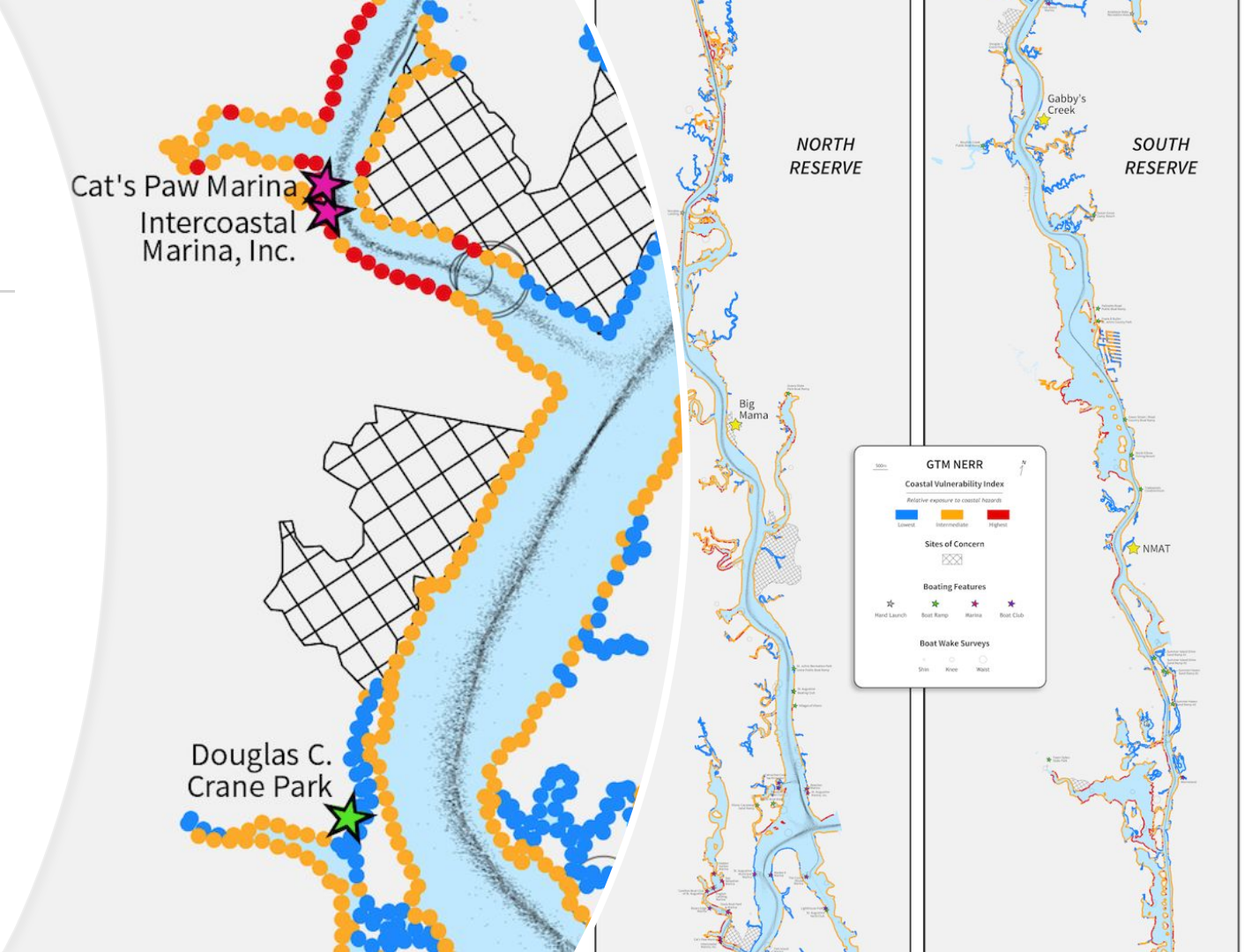


Outcome between workshops: Coastal Vulnerability assessed in the GTMNERR

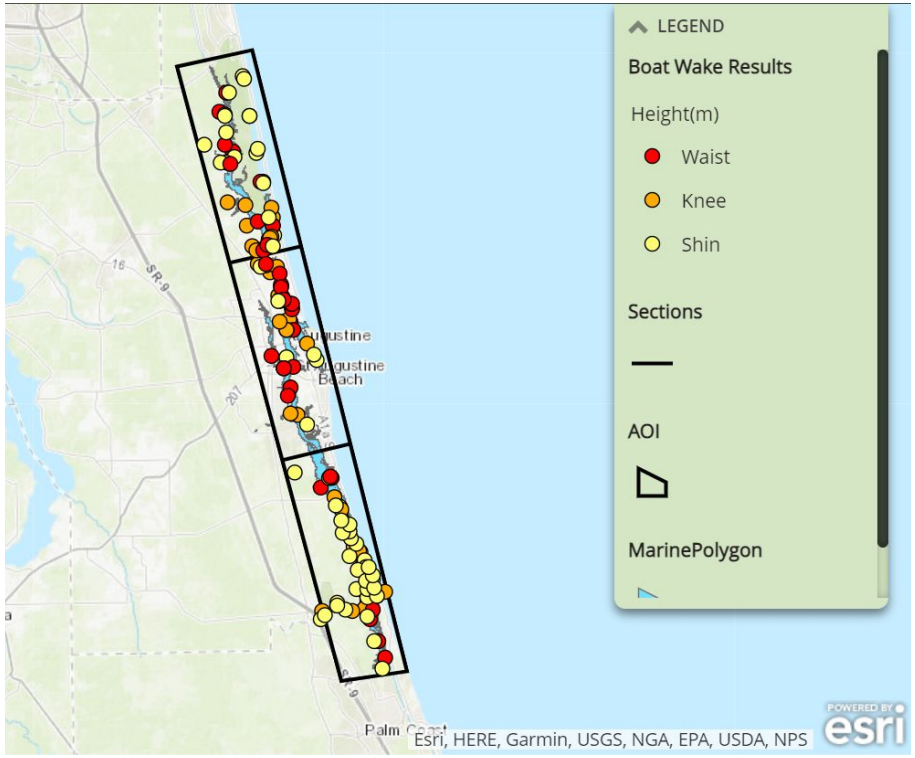
Viewer here: http://cons.scienceontheweb.net/ewe/

PLUS influence of boat wakes story map: https://villanova.maps.arcgis.com/apps/MapSeries/index.html?appid=090d7618677e433faf9fda3b6a18923e

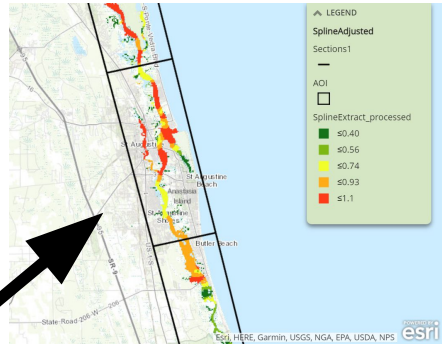
Verutes et al., In prep.



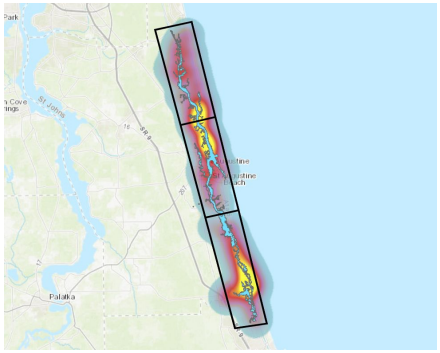
Quantifying boat wakes



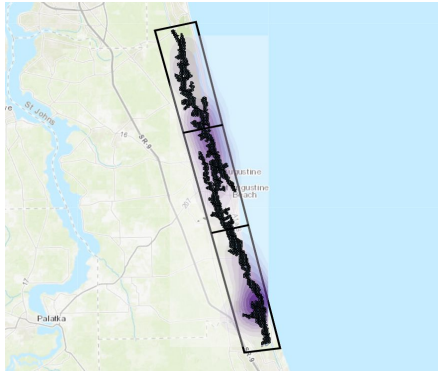
Survey results



Interpolation



Heat map



CVI integration

Workshop 2

February 2022

Morning- Site Visits

Afternoon- in-person working session

Workshop 2 Revisiting Goal 1: Identify portions of the GTMNERR that are particularly vulnerable to habitat loss due to low elevation and coastal vulnerability.

How did we determine vulnerable sites?

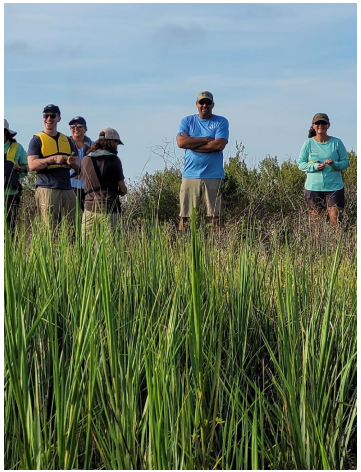
Screen for vulnerable sites using CVI

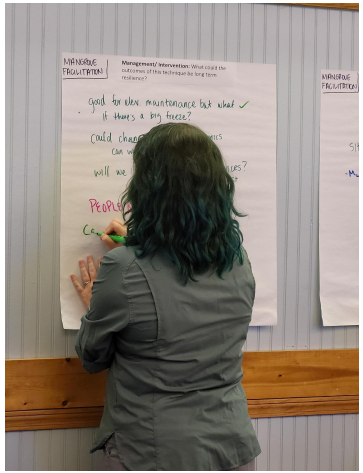
Expert opinion-based screening

Where is there overlap?

Choose vulnerable sites for field-based investigation of elevation vulnerability

Workshop 2 Outcomes



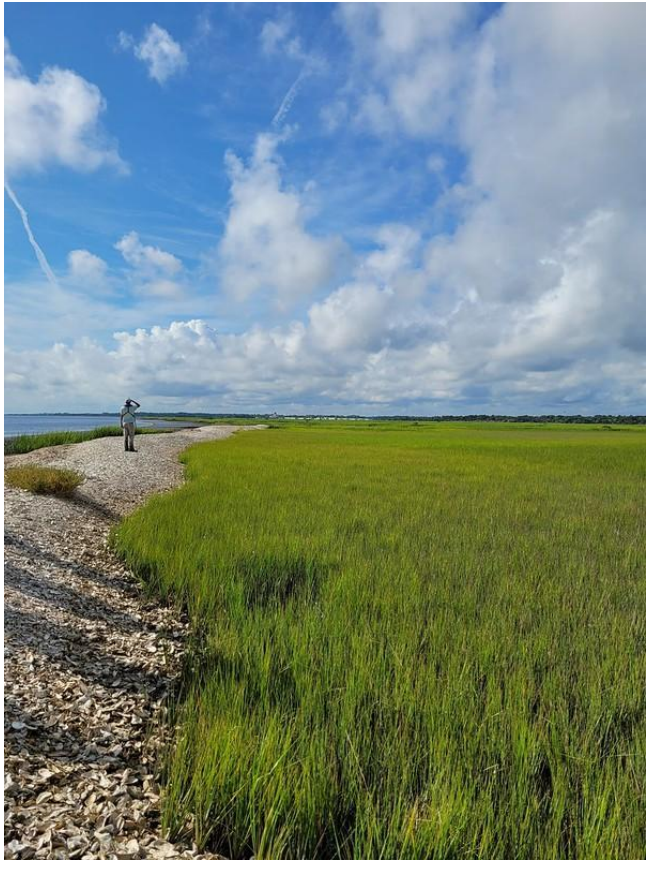


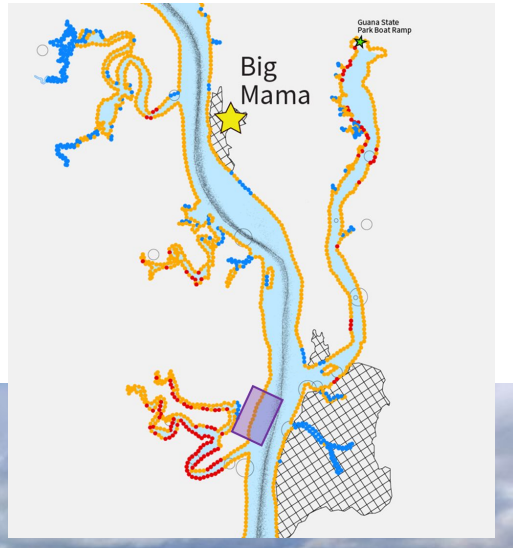
1. Field visit- saw sites identified as vulnerable by CVI and GTM leadership.
   - Discuss site imagery history, vulnerability drivers, logistics for restoration
2. Site identification
   - Areas of concern and prioritization selected on maps of CVI
   - Explore drivers of vulnerability- both via CVI and through discussion
3. Explore four restoration strategies for vulnerable sites
   - Spend eight minutes on each strategy in a flip chart activity discussing outcomes from previous restoration efforts, logistics for deployment in GTMNERR, and implications for use of each restoration strategy in NE FL

Workshop 2- Emergent themes

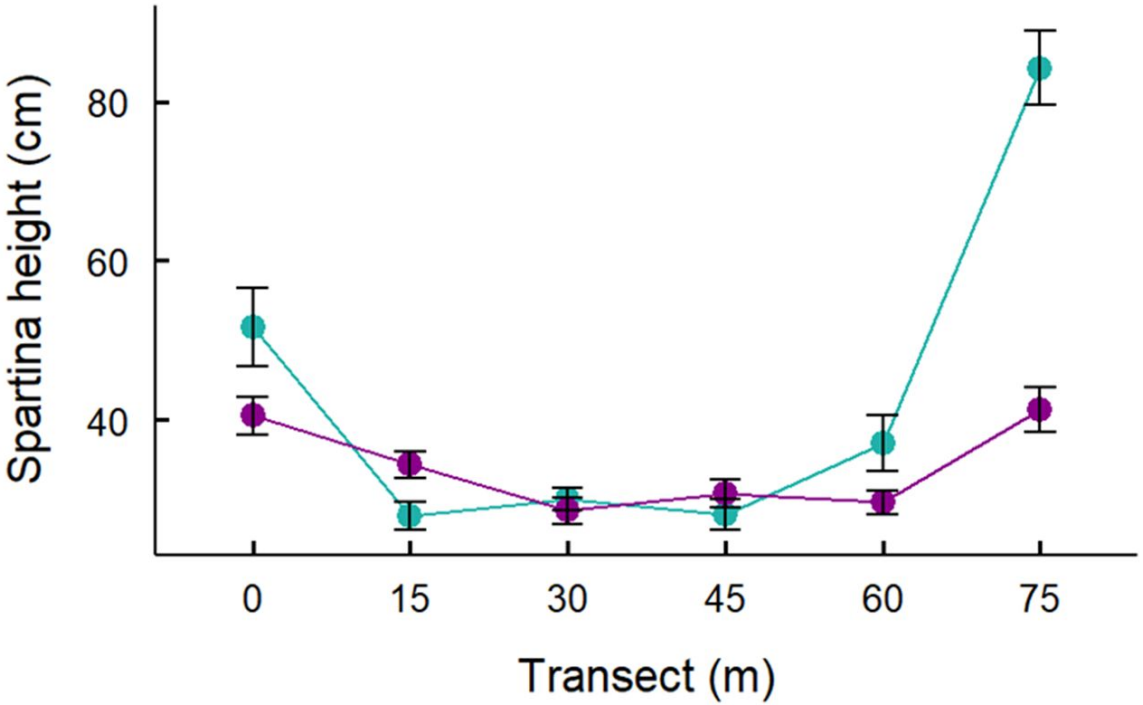
1. Boat wakes seem to play a large role in vulnerability
2. Hydrological disruption (oyster rakes) may also drive coastal vulnerability/marsh stress in GTMNERR
3. TLP may not be feasible in much of the reserve due to lack of dredging (ACE stakeholder)
4. We have knowledge gaps in terms of nutrient influences,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

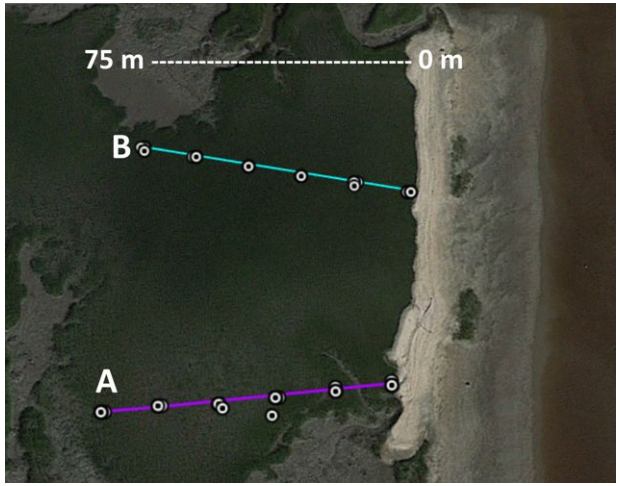
Site Visits and Field Sampling





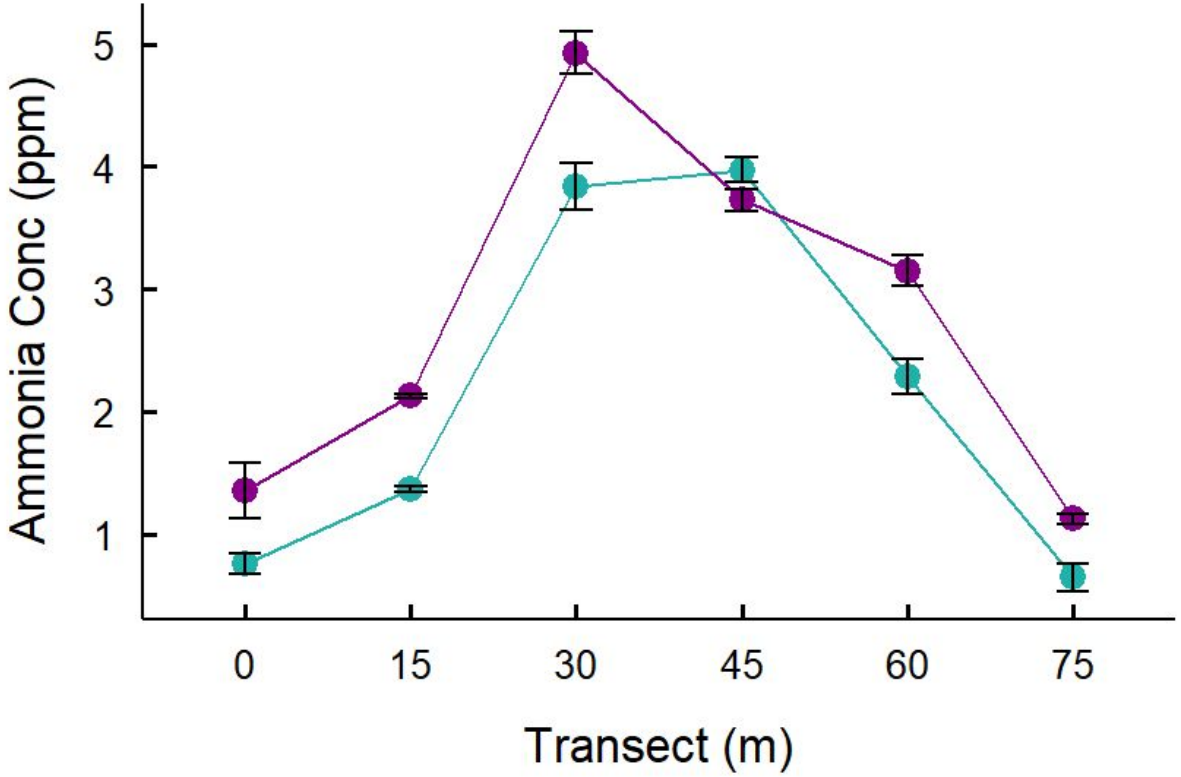
Data Collection: Results

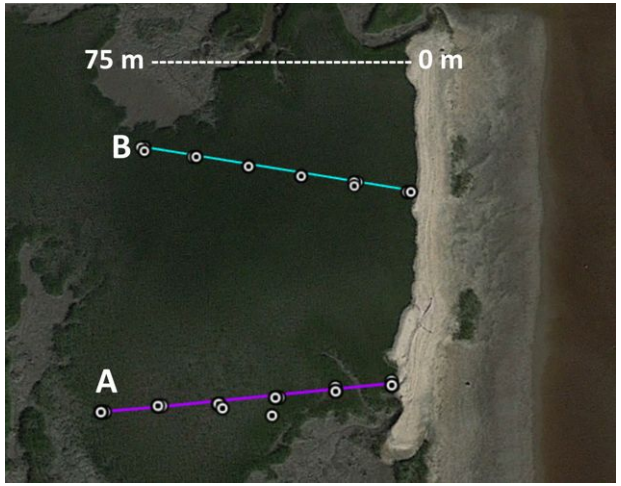




EXPERIMENTING WITH ELEVATION

Data Collection: Results





EXPERIMENTING WITH ELEVATION

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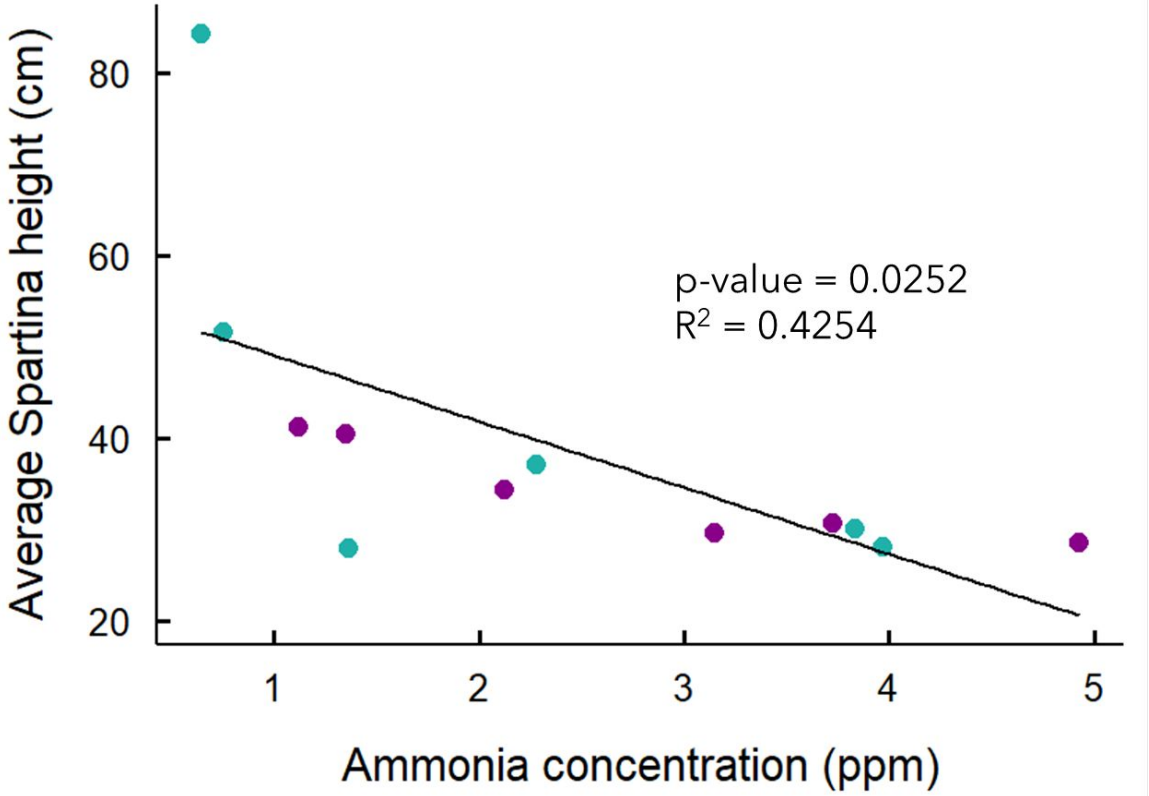
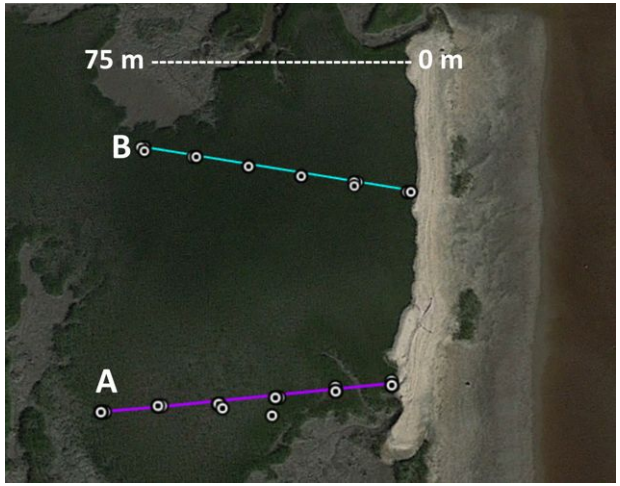




EXPERIMENTING WITH ELEVATION

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

Goals and Outcomes of EWE Project

Goal 1

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

Outcomes:

Coastal Vulnerability Index model and maps

Field data on vulnerability from selected sites

Goal 2

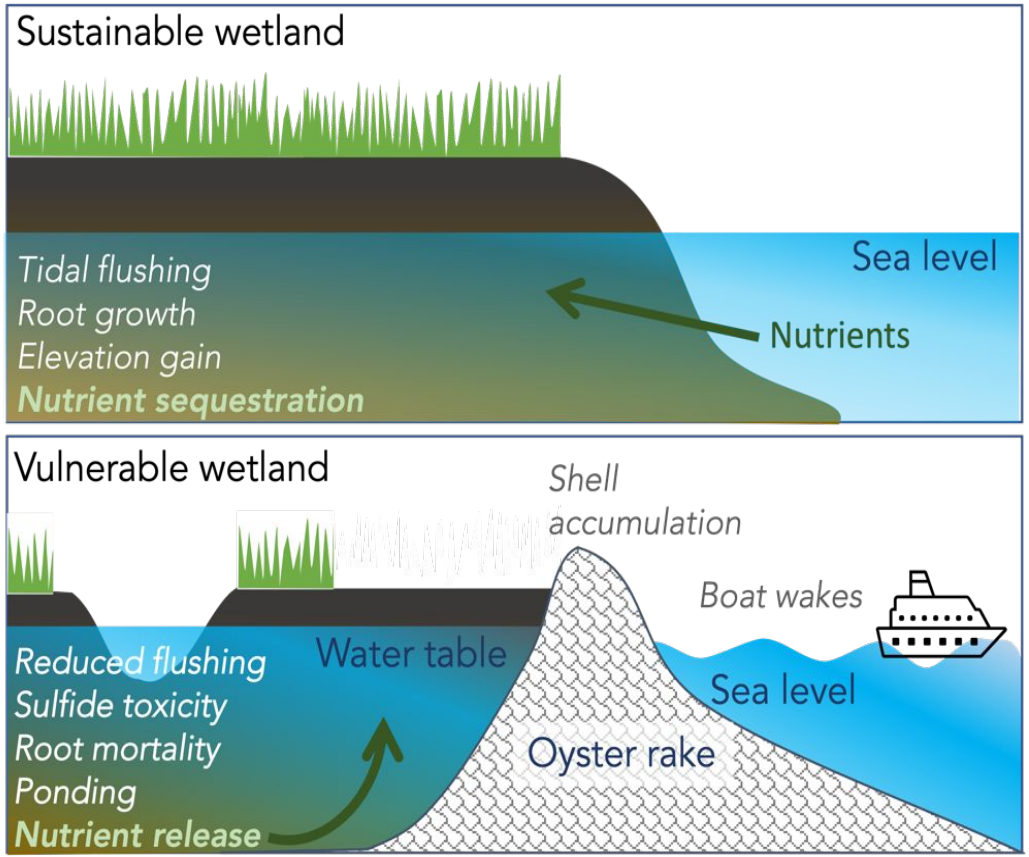
Engage land managers and scientists in a new collaboration to investigate management options that could potentially maintain or increase wetland surface elevation with respect to sea level rise

Outcomes:

Workshops 1 &2

Table that details the literature and community perspectives on potential restoration strategies for the GTMNERR

Wrap-up Meeting (October 2022)



What's next?...

ROOTS & rakes

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

VILLANOVA UNIVERSITY

GTM

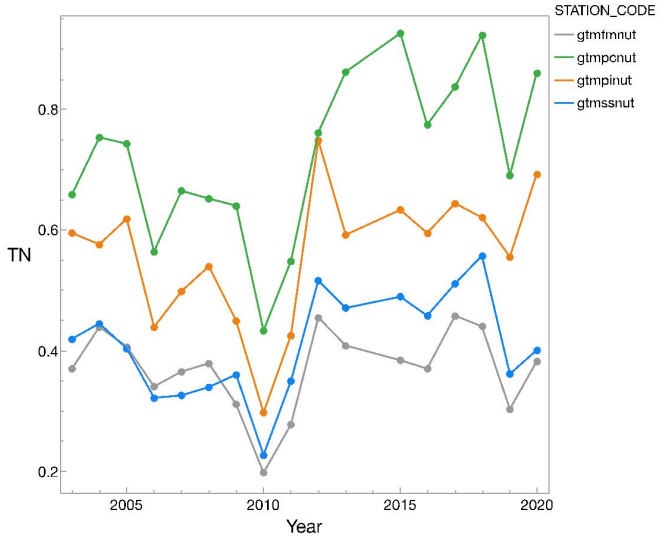
UNIVERSITY OF CENTRAL FLORIDA 1963

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 marsh nutrient cycling, plant and soil stress, 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.

- Do marshes in the GTMNERR act as sinks for nutrients and to what extent is this ecosystem service changing with marsh degradation?



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

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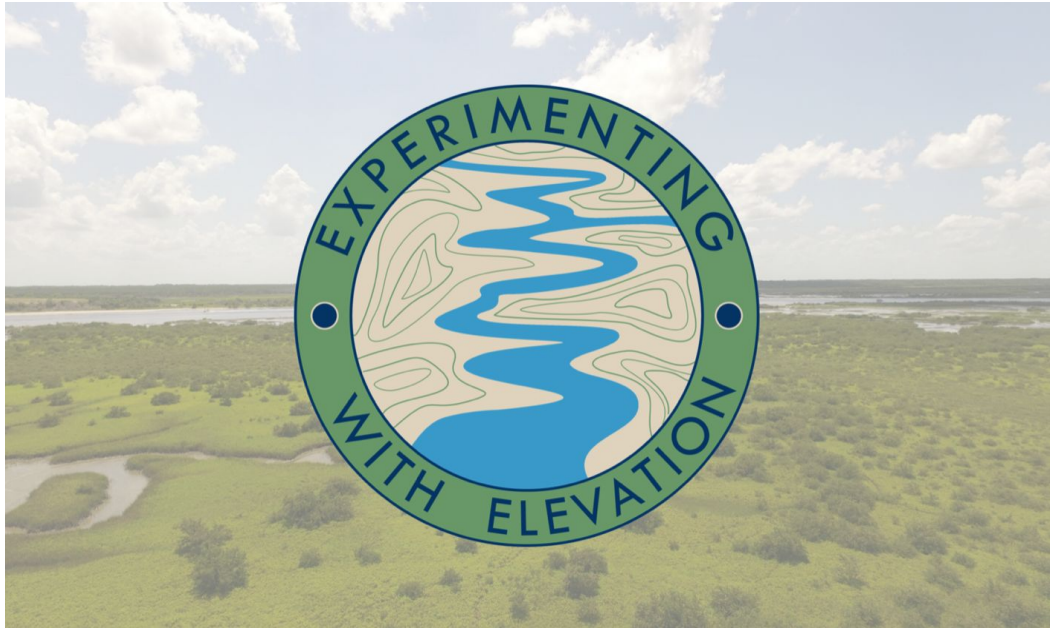

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National Estuarine Research Reserve System Science Collaborative

Q&A

- **Q: Given that measuring elevations accurately in squishy coastal environments is technically challenging, have you done a sensitivity analysis to see how sensitive the CWEM model results are to the starting input elevations?**
    - **A:** Measured using RTK and laser leveling. Luckily GTM has great surface elevation tables (SETs) that can tie into sites as well. We've actually looked at CWEM model results alongside the SET data. We did do a sensitivity analysis in CWEM by itself. It turns out the model is most sensitive to processes such as root turnover. So while these processes are impacted by sediment, they're very organically driven as well.

- **Q: Great and exciting work all around! Are you exploring restoration work to curb mangrove migration/encroachment into emergent tidal wetland habitat? Will this migration help build overall tidal wetland resiliency to sea level rise? (Lots of ecosystem service trade-off I imagine.)**
    - **A:** There's been some great work done by other groups on habitat tradeoffs with mangrove encroachment into marshes and recent freeze events. What we've seen so far, in the freeze events we've observed, the *Avicennia* has been pretty resilient and have re-sprouted but I know that's not the case in all sites. Thinking about mangroves as a restoration strategy, I think it's worth thinking about and talking about even if there are potential ethical and ecosystem drawbacks.

- **Q: What's next with the restoration strategies?**
    - **A**: More workshops to start. Particularly, an upcoming workshop supported through a NERRS Science Collaborative Capacity Building Grant. The goal is to develop next steps, including ideas for upcoming funding opportunities.

Q&A

- **Q: How extensive are other wetlands outside the reserve that these findings will apply to?**
  - **A:** I don't think these wetlands are vastly different from other parts of the east coast wetlands although the hydrology can be different; e.g., sandier soil, different drivers of elevation, prevalence of oyster rakes, etc. A good place to start is the table on slide 22.

- **Q: What influence does urbanization of the coastline play on the resilience of a fluctuating waterline? Will the waterline's movement outpace the vegetation's ability to colonize more inland/upland because of the nature of man-made structures and landscapes being constructed right up against native areas? Does this constrict the resilience of coastlines?**
  - **A**: I certainly think the hardening of coastlines and urbanization near wetlands provides them with less resilience for adapting to higher sea levels, bigger storm surges etc. In some places they have nowhere to move and so ensuring migration corridors exist around urban areas is so important! Further preventing urbanization near wetlands is also key both for wetland migration and for the fate of the urban area would seem like a wise course of action.