Phase 1 Design Plan

"Scaling Up of Bamboo Stockade Experimental Treatment to Protect Seagrass Habitat in St. Andrew Sound"

East Bay Living Shoreline and Seagrass Project
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Site History

The enlargement of the St. Andrew Sound inlet in 1999 led to the rapid recession of the main shoreline of Buck Beach immediately landward of the inlet (**Fig. 1**). Preliminary analysis of historical satellite imagery shows shoreline accretion immediate east and west of the inlet along Buck Beach. This morphology pattern of shoreline erosion immediately behind the inlet with simultaneous accretion to the east and west suggests the inlet hydrodynamics are mobilizing sediment from the center of Buck Beach and towards the hydraulically shadowed areas to the east and west. **Figure 1** shows the recession of the shoreline (as indicated by the waterline on aerial imagery) for two transects from 1994 through 2020 relative to the shoreline position in 1994. Wave diffraction through the inlet and with wave focusing on the central shoreline of Buck Beach is shown in the satellite imagery from 2012 below (**Fig. 2**). Sheltering of the eastern and western shorelines by the barrier islands is also visible in **Fig. 2**. Wave energy on the shoreline behind the inlet is potentially resulting in continued erosion along this stretch of the beach.

The historical shoreline behind the inlet served to refract waves entering St. Andrew Sound and, as erosion evolved, that shoreline feature became submerged and colonized by seagrass as seen in aerial photographs starting in 2004 (**Fig. 1**). The density of seagrass within St. Andrew Sound varies from year to year. Available aerial photographs show the density of the seagrass located in the former shoreline feature footprint increasing from 2004 to 2010 such that most of this feature (that extending ~ 150 feet offshore) is covered with vegetation.

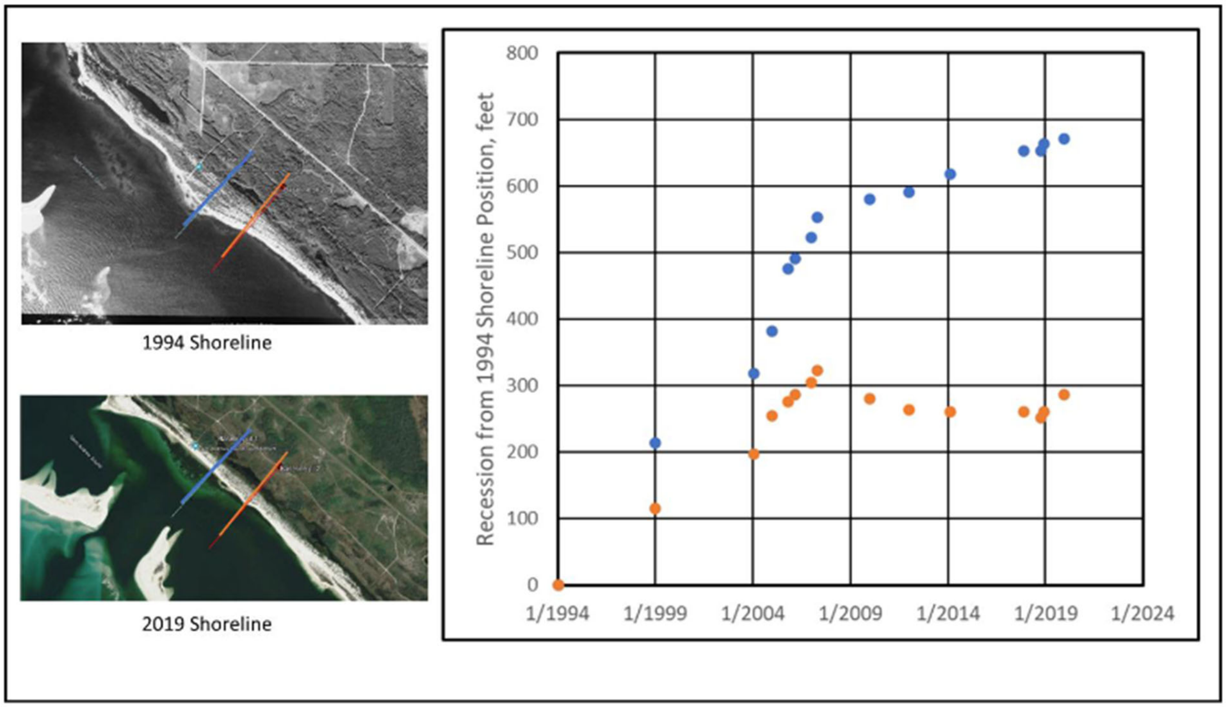

Figure 1. Historical Shoreline Position at Buck Beach. Image credit: Jacobs Solutions.

Figure 2. Satellite image from 2012 (Dec) showing wave diffraction through the inlet mouth with focusing of these waves at the center shoreline of Buck Beach while the eastern and western shorelines are sheltered from the wave energy.

Loss of Seagrass Habitat (UF 2022 to NRL 2024)

The seagrass meadow edge on the submerged shoreline feature has been retreating since Hurricane Michael hit the area in 2018. The seagrass meadow edge migrated inland from 2022 to 2024 with an average retreat of 89 ft ± 38 ft st dev (**Fig. 3**). Horizontal loss was most notable in the area immediate landward of the inlet while the edge appeared stable behind the barrier island spits but loss was observed eastward and westward of the stable regions. The largest change (143 ft) occurred at the eastern end of the survey area while the central meadow section directly behind the inlet and between the stable edge points averaged a loss of 40 ft ± 17 ft st dev. Overall, the seagrass meadow lost approximately 1.56 hectares (± 0.24 hectares of uncertainty) between 2022 and 2024. Note the uncertainty value in the surface area calculation was derived from the maximum combined horizontal uncertainty of the methods used in 2024 (DGPS with sidescan sonar) and 2022 (RTK GPS via walking and snorkeling).

Changes in SAV coverage can be due to grazing (for example, by sea urchins), wasting (disease), erosion, or deposition (which could result in burial of SAV). Observed changes are likely due to a combination of these factors. The trend seen in the data for the position of the seaward extent of SAV, and cliffs observed *in situ* on the meadow edge, suggests ongoing erosion is a contributor, and that the submerged shoreline feature behind the inlet is continuing to recede and/or lose elevation, limiting the area on which the SAV can establish.

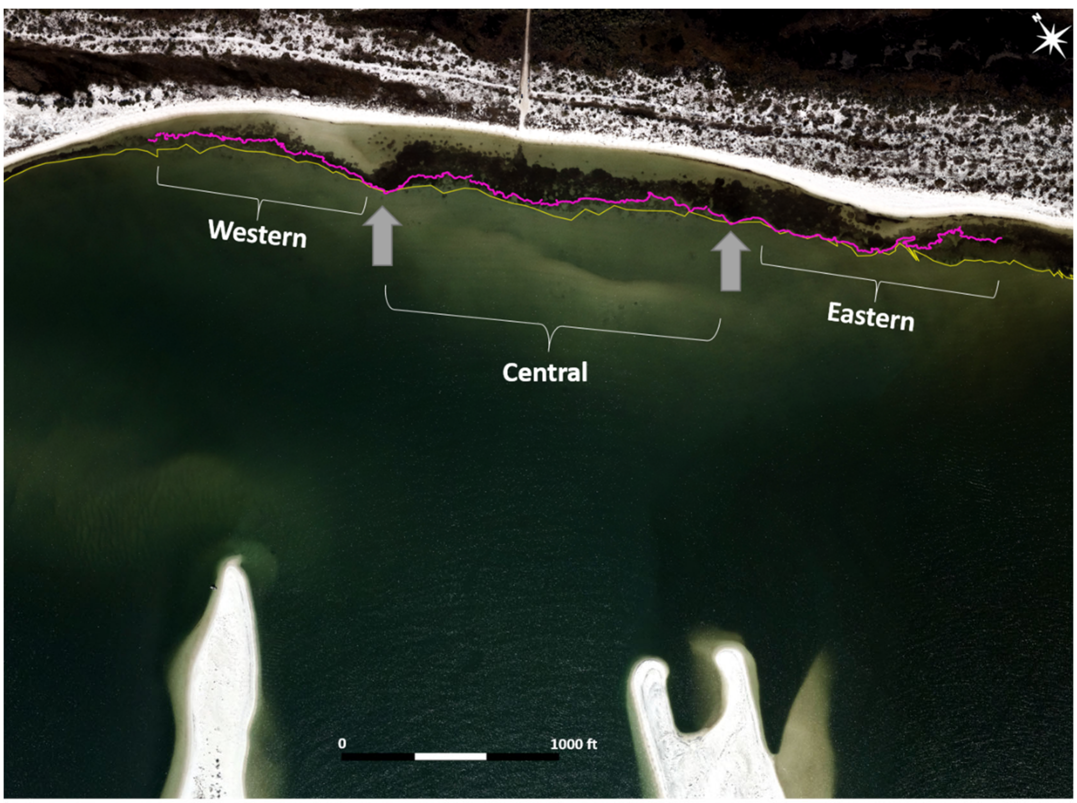

Figure 3. Seagrass extent mapped in 2022 by UF using RTK GPS via walking and snorkeling (yellow line) with 2024 extent mapped by NRL using DPGS and sidescan sonar (pink line). Basemap imagery is 2022 3 band satellite imagery (Landsat 8). Stable points are indicated by the grey arrows while regions of loss are denoted by brackets and rough compass direction in relation to the access road.

Proposed Seagrass Habitat Enhancements

The offshore edge of the meadow presents grazing, likely by turtles and manatees (Marin-Diaz, personal observations and communications with fishers and turtle researchers in the area). Bamboo stockades can deter these seagrass mega grazers and allow seagrass recovery (Marin-Diaz et al., in prep.). By preventing seagrass grazing on the eroding edge of the meadow, seagrass may be able to resist better the sediment dynamics occurring at the edge (e.g., resist burial and erosion) and slow down seagrass retreat.

*Disclaimer: This proposed design is based on success in preliminary trials of the method at small scale (1 x 1m). Preliminary trials were authorized via Florida Fish and Wildlife Conservation Commission Special Activity License no. SAL-22-2479A-SR. Results documented during those trials indicate seagrass blade length and percent cover recovery within areas where bamboo stakes were placed (Marin-Diaz, in prep). The method has not yet been established a large scale however, and so this proposed design includes elements such as replicated treatment and control plots, as well as high-resolution monitoring, for validation of the treatment across an approximately 0.5 linear mile stretch of eroding seagrass habitat in St. Andrew Sound, adjacent to Tyndall Air Force Base in Bay County, Florida.

The proposed bamboo stockade will consist of a 1 m wide belt along the seaward edge of seagrass habitat. A grid of bamboos will be placed with 10 cm separation (**Fig. 4**). The seagrass seaward bed edge has areas that are scoured with a slight drop off in elevation as well as areas that are heavily grazed. Stockades will be installed in front of the seagrass edge cliff, or in the grazed seagrass in front of the ungrazed edge, but not in the ungrazed seagrass (**Fig. 4**).

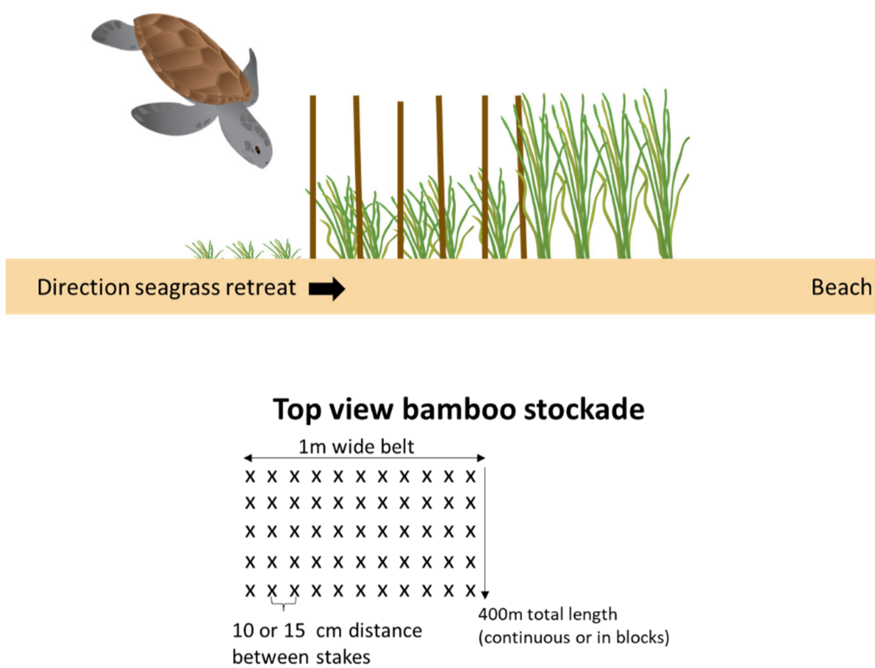

Figure 4. Stockade diagram

Proposed set-up

The area will be divided into 5 plots with the bamboo stockade treatment and 5 control plots to be able to monitor the effects. Plots will be 80 m long, resulting in a total stockade treatment length of 400 m (0.25 mi), which is the RESTORE goal (**Fig. 5**).

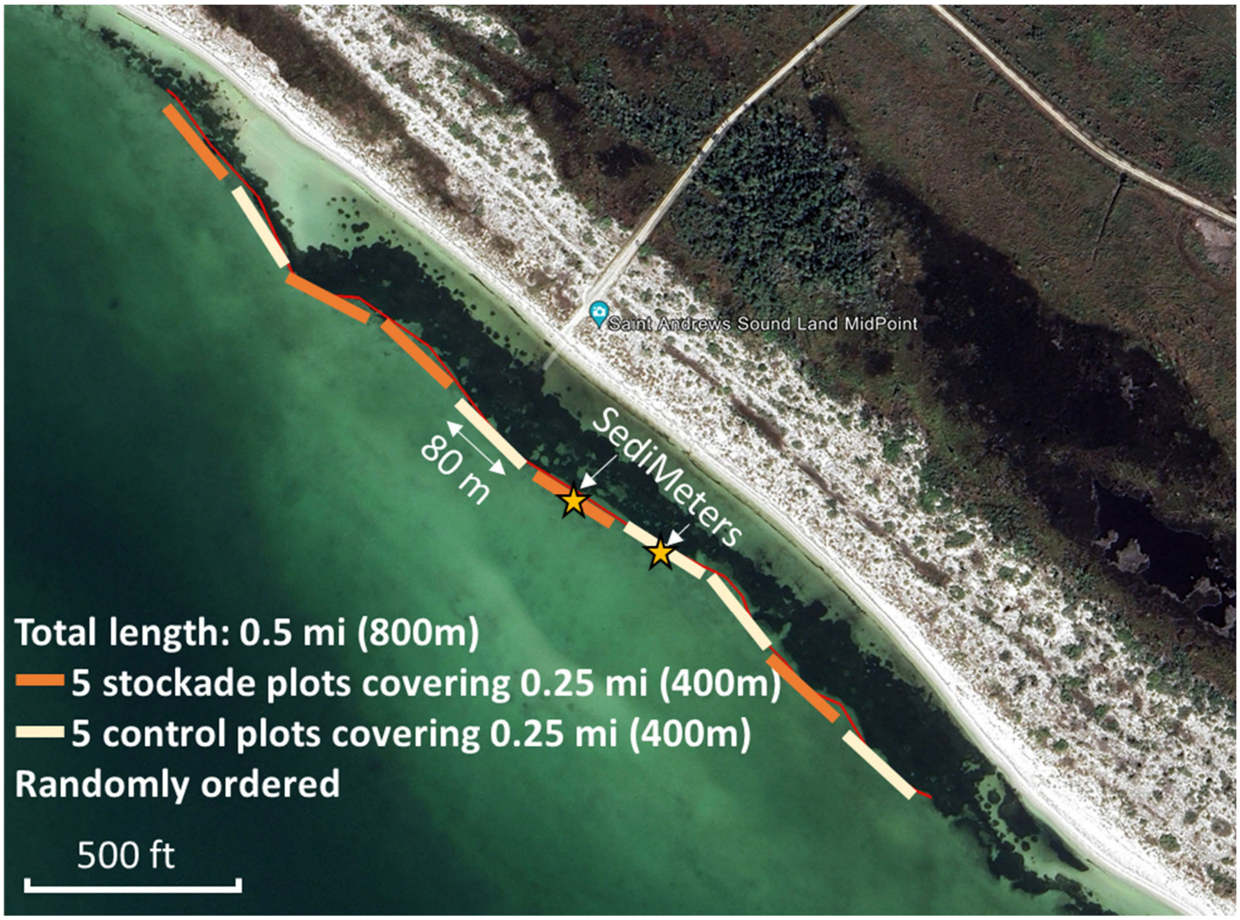

Figure 5. Proposed set-up spans 0.5 linear miles and includes 5 stockage plots (0.25 total linear miles) and 5 control plots (0.25 total linear miles).

Proposed Monitoring of Experimental Treatment

The monitoring will evaluate differences between plots (control vs stockade) and interior vs exterior of each plot, to account for treatment effect and for variability in the system. For this, 5 monitoring points will be within the plot, and used for the comparison between plots, and 2 extra monitoring point will be next to the corner of the plot and will be used to compare to the corner within the plots. In summary: 7 monitoring points per plot marked with PVC placed on the seaward side of the plots; with 5 of the points within the plot, and 2 points next to the corners **(Fig. 6**).

<u>Monitoring of seagrass retreat:</u>

- Option "only divers": Measure the distance from the monitoring points marked with PVCs to 1) the grazed meadow edge (if present) and 2) to the ungrazed meadow edge. Therefore, two initial values will be recorded for each PVC. Subsequent measures will have positive values if any of the edges have expanded, negative values if any of the edges have retreated, and zero if the edges have not moved.

- Option “Side-scan Sonar (SSS) + Multi-beam Echo-sounder (MBES)”: Scan the seagrass edge before and after the stockade (higher resolution, works if water is turbid). SSS will detect the seagrass edge and MBES will detect seagrass edge, canopy height and % cover.

Monitoring of sediment dynamics:

- Measure the length of each PVC and/or measure the depth of deployed sediment plates (per Bell et al. 1999)
- Install two SediMeters coupled with tilt current meters: one set within a stockade plot and one set within a control plot (**Fig. 5**). The two sets will be deployed in two plots and changed to a different pair of plots after a month, to be able to collect data from different areas.

Monitoring of seagrass response:

- Seagrass measurements to be completed *in situ* by divers, next to each PVC, within the plot:
    - Within 15 cm diam. ring:
        - Shoot density
    - Within 1 x 1 m quadrat:
        - Canopy height (10 shoot lengths)
        - % seagrass cover by species
        - % algae cover
- State of the seagrass: Qualitatively assess evidence of erosion, grazing, exposed rhizomes, etc.
- Sonar system (SSS and MBES) to map seagrass bed edge. The sonar systems will also capture canopy height and % cover.

Monitoring of bamboo stability and rate of degradation:

- Assess state of bamboos next to each PVC (% broken or gone or fallen / m2), and from the side-scan sonar + MBES data.

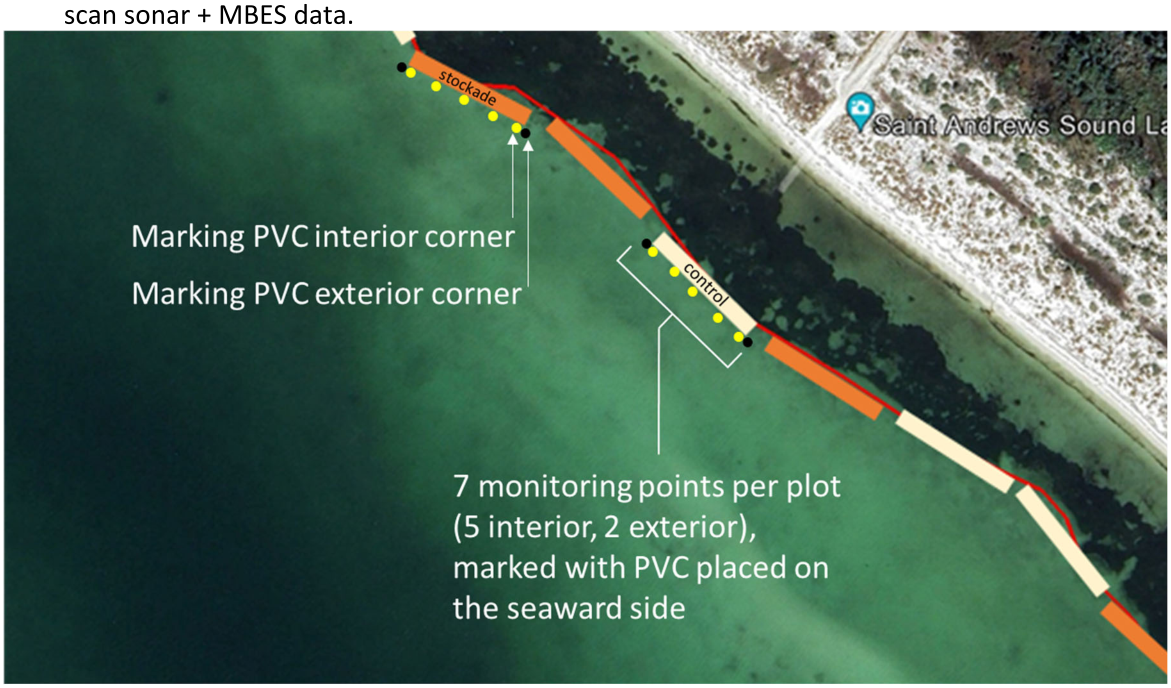

Figure 6. Example of monitoring points in a stockade and control plot.