Evaluation of Former Mangrove Restorations Using Sediment Samples as a Basis for Restoration Success and Resiliency

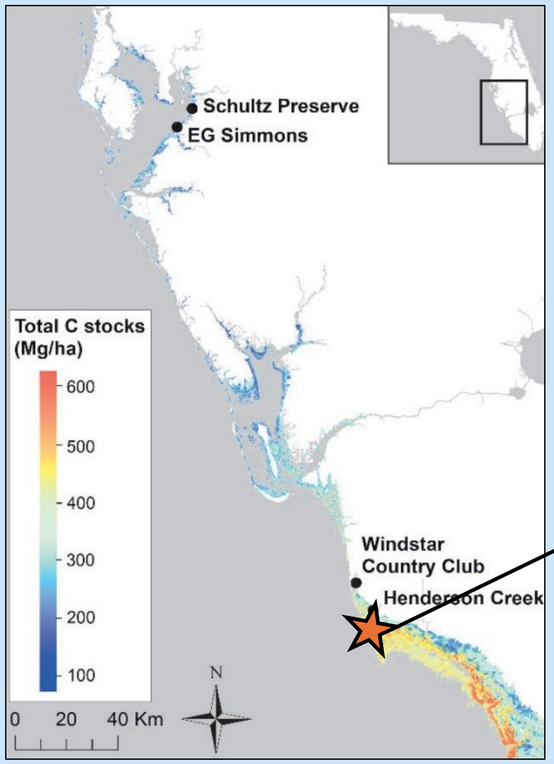
Jayna Hankin; Dr. Josh Breithaupt, and Rachel Biton

Coastal and Marine Laboratory, Florida State University

INTRODUCTION

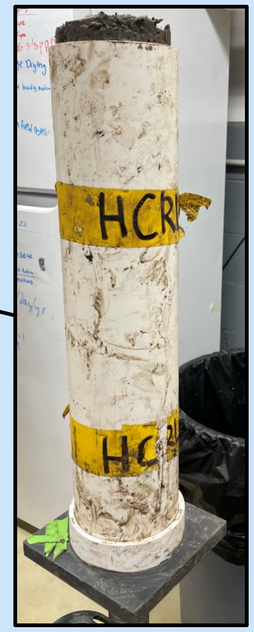
Mangrove ecosystems dominate Florida's coastline and are an important ecological resource that provide habitat to various fish and bird species, protect vulnerable coastline infrastructures during tropical cyclones, and sequester atmospheric carbon dioxide in vegetative biomass and peat soil deposits. Mangrove ecosystems are under pressure due to global sea-level rise, hurricanes, increased nutrient outflows, and hardened inland infrastructure that prevents landward migration of mangroves. **Natural mangrove ecosystems** can build soil and fight against sea-level rise, and **restored mangrove ecosystems** must also be able to be resilient to sea-level rise and excessive nutrient inputs to remain as functional and healthy ecosystems. Historically, restored mangrove ecosystems have been able to do so, but are not predicted to keep pace with the accelerating sea-level rise.

Are restored mangrove ecosystems equally effective in sequestering atmospheric carbon into above and below-ground biomass compared to natural mangrove ecosystems, reflecting their overall health and stability?

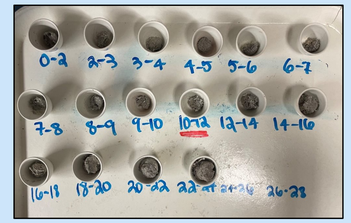


Henderson Creek, Florida
Restored and natural mangrove sites along the Florida Gulf Coast were carefully chosen based on their similar elevation profiles, ensuring comparability in environmental conditions for subsequent analyses.

METHODS



"cookie" slice



aliquots in respective crucibles

This study utilized sediment core samples obtained from natural and restored sites within Henderson Creek. We processed these samples by cutting them into "**cookie" slices** all the way down the length of the core (30-40 cm), with each slice measuring 1-2 cm in height. From these cookies, **aliquot samples** were extracted and directly placed into **crucibles**. Subsequently, the samples underwent firing at two different **Loss on Ignition (LOI)** temperatures: 550°C and 990°C. The resulting data were derived from the analysis of these samples.

RESULTS

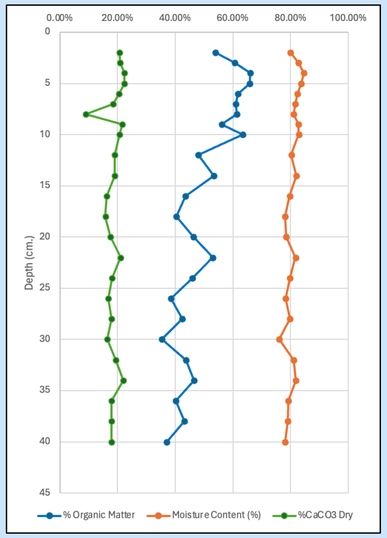


Figure 1

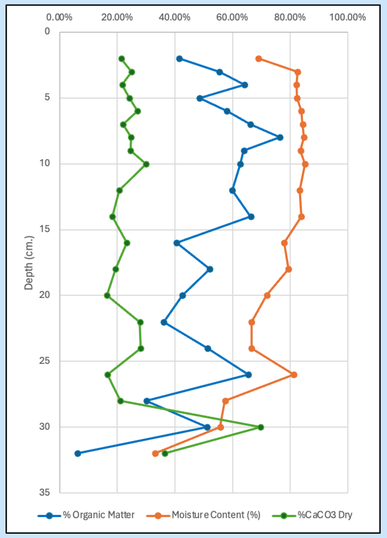


Figure 2

Figure 1 presents the average values of % Organic Matter, Moisture Content (%), and % Calcium Carbonate Dry for the **natural sites**, with corresponding depths indicated. These values demonstrate some variability down the core, with few fluctuations evident across different depths, indicating minimal variations in sediment composition and environmental conditions throughout the sediment profile.

Figure 2 illustrates the average values of % Organic Matter, Moisture Content (%), and % Calcium Carbonate Dry for the **restored sites**, with corresponding depths indicated. Notably, at shallower depths, the values appear similar to those of the natural site, indicating some consistency in sediment composition nearer to the surface. However, greater variability is observed at deeper depths, suggesting potential environmental and compositional changes with depth.

Discussion:

These results underscore the **importance and effectiveness of restoration efforts** in enhancing ecosystem health and stability. However, further studies are warranted to delve deeper into the mechanisms driving the observed variability, particularly at greater depths within the restored sites. Additionally, longitudinal studies assessing the long-term efficacy of restoration efforts and their impacts on sediment composition, biodiversity, and ecosystem functioning are essential for comprehensive understanding and informed management strategies. Overall, these findings highlight the potential for restored sites to emulate the stability and health of natural sites, contributing to the conservation and restoration of freshwater ecosystems.

Special thanks to Dr. Josh Breithaupt, Rachel Biton, Erin Tilly, Kevin Engelberdt, Haley Crawford, FSU Coastal & Marine Lab, and the Florida Restore Act Centers of Excellence Program!

Citations:

Lewis III, R. R. (2001). Mangrove Restoration – costs and measures of successful ecological restoration. *Lewis Environmental Services, Inc.*; McMahon, L., Ladd, C. J. T., Burden, A., Garrett, E., Redeker, K. R., Lawrence, P., & Gehrels, R. (2023). Maximizing blue carbon stocks through saltmarsh restoration. *Frontiers in Marine Science, 10*, 1106607. https://doi.org/10.3389/fmars.2023.1106607 ; Osland, M. J., Spivak, A. C., Nestlerode, J. A., Lessmann, J. M., Almario, A. E., Heitmuller, P. T., Russell, M. J., Krauss, K. W., Alvarez, F., Dantin, D. D., Harvey, J. E., From, A. S., Cormier, N., & Stagg, C. L. (2012). Ecosystem Development After Mangrove Wetland Creation: Plant—Soil Change Across A 20-Year Chronosequence. *Ecosystems (New York), 15*(5), 848–866. https://doi.org/10.1007/S10021-012-9551-1 ; Romero, I. C., Smoak, J., Breithaupt, J., Radabaugh, K. (Eds.). (2022). Florida Restore Act Centers of Excellence Program, Evaluation of past Florida Gulf Coast mangrove restorations as a basis for future restoration success and resiliency, by Rosenheim, B. E. (Brad E.). *Request for Proposals IV, FLRACEP-2022-1*, Full Proposal. ; Shennan, I., Long, A., & Horton, B. P. (Eds.). (2015). Handbook of sea-level research. *Wiley-Blackwell, 24*, 361-372. ; Song, S., Ding, Y., Li, W., Meng, Y., Zhou, J., Gou, R., Zhang, C., Ye, S., Saintilan, N., Krauss, K. W., Crooks, S., Lv, S., & Lin, G. (2023). Mangrove Reforestation Provides Greater Blue Carbon Benefit Than Afforestation For Mitigating Global Climate Change. *Nature Communications, 14*(1), 756–756. https://doi.org/10.1038/S41467-023-36477-1 ; Stephen, M. F. (1983). Mangrove restoration in Naples, Florida. *Coastal Engineering Consultants, Inc.*