Photogrammetric Modeling of Artificial Reefs to Measure Reef Accretion

Iliza Aguiar*, Brentley Durham*, Shannon Murphy**, Lillie Bradshaw*, Lauren Calvin*, Sandra Brooke PhD*, & Andrew Shantz PhD***
*Florida State University, **University of Rhode Island, ***University of Hawai'i

BACKGROUND

- Apalachicola Bay, an estuarine system, located in the northeast Gulf of Mexico on the Florida Panhandle, is the center of a nationally-known and significant oyster fishery
- In 2013, the oyster population collapsed and was declared an environmental disaster causing FWC to place a moratorium on the commercial harvesting of oysters in 2020 (Brooke 2022)
- The Apalachicola Bay System Initiative (ABSI) seeks to gain insight into the root causes of the decline of the bay's oyster population and develop management and restoration plans for the oyster reefs and overall health of the bay

INTRODUCTION

- This project utilizes artificial reef structures termed "reef balls" (Figure 2) to better understand the effects of various environmental conditions influencing habitat use and recovery of associated oyster reef populations throughout Apalachicola Bay
- The goal of this project is to identify oyster reef sites in the bay that show positive accretion rates for potential future restoration projects
- Accretion of oysters and other benthic sessile organisms on these structures will be used as a proxy for reef growth on these historically productive oyster reefs

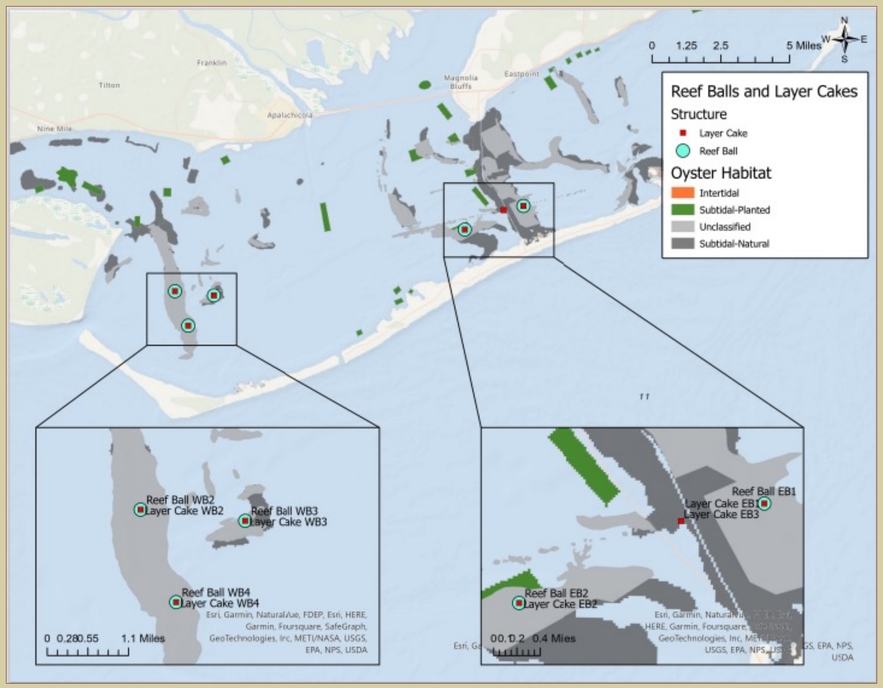

Figure 1: Map of Apalachicola Bay and reef ball sites

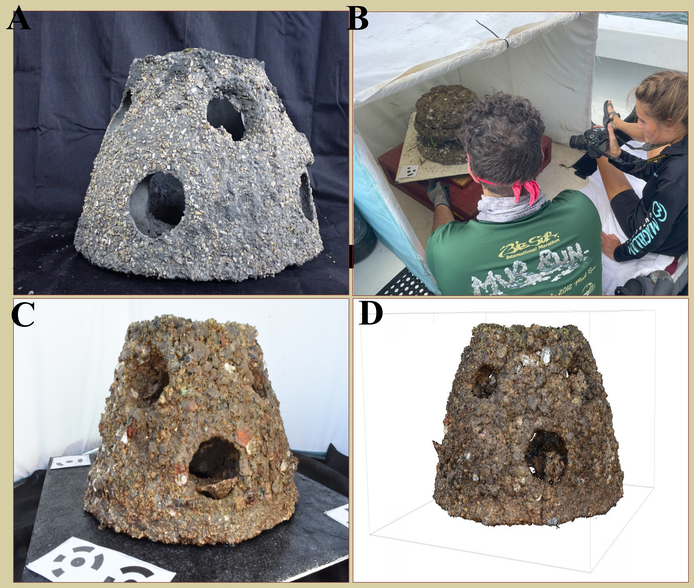

Figure 2: Reef Ball photogrammetric development
A: Photo of Reef Ball Pre-deployment
B: Scientists photographing the Reef Balls
C: Photo of Reef Ball six months after deployment
D: Textured 3D model of a Reef Ball

METHODS

- Fabricated from a concrete and calcium carbonate mixture to mimic the natural properties of oyster reef bars
- Structures are deployed at 5 historical oyster bars spanning the bay (Fig. 1) beginning April 2022 and are surveyed every six months until April 2024
- Placed perpendicular to the dominant water current direction to limit disruptions to the structure
- Retrieved via SCUBA and photographed from 4 pre-determined angles using a Nikon D7200 DSLR
- Dissolved oxygen, light, temperature, conductivity and salinity are monitored across sites using HOBO and MiniDOT loggers
- Photogrammetric 3D modeling with Agisoft Metashape is used to calculate precise volume and surface area
- Volumetric changes obtained from 3D models for each individual structure over the two-year deployment will be analyzed in R studio to observe accretion

REFERENCES

Brooke, Sandra. (2022). Annual Report to Triumph Gulf Coast inc. Florida State University. https://marinelab.fsu.edu/media/5316/absi-annual-report-2021-2022-final.pdf

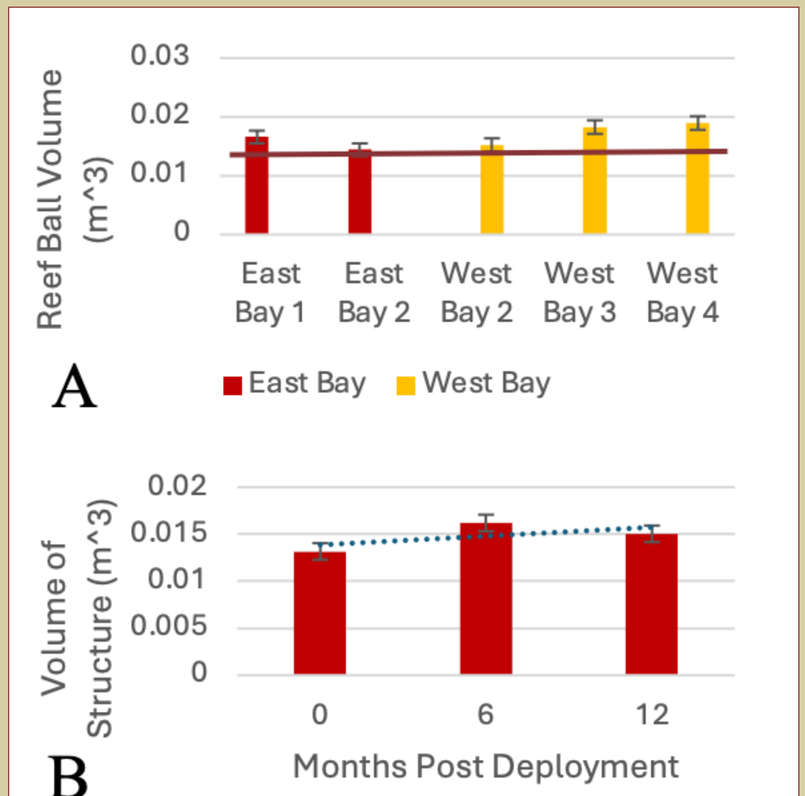

Figure 3: Preliminary Reef Ball Accretion
A: Average Reef Ball volume after 6 months of growth across all sites, red line represents average initial volume of 0.013m^3
B: Average Reef Ball growth over 12 months at Western Bay site 3

CONCLUSION

- Preliminary data visualization portrays positive accretion at our sites however accretion loss is observed at 12 months at one site (Fig. 3)
- Final sampling of the reef structures will occur in April 2024 upon which we will analyze the two years of accretion data amongst all sites

ACKNOWLEDGEMENTS

- Funded by the FSUCML Board of Trustees and Triumvirate Environmental
- FSUCML Boating & Diving Safety Operations Team and Shannon Hartsfield
- ABSI and FSUCML Research Team : Jenny Bueno, Adin Domen, Jazzy Jones, Adam Alfasso, Donaven Baughman, Haley Crawford, Emily Fuqua, Morgan Hawkins, Natalie Horn, Betsey Mansfield, Cullen Morris, Chris Peters, Rand Romas, Reid Tilly, Alek Valles, and Peiyao Wang