Extending geohistorical baselines for oyster body size within the Guana River Marsh Aquatic Preserve.

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Background

- The Guana River Marsh Aquatic Preserve (GRMAP) and overlapping Guana Tolomato Matanzas National Estuarine Research Reserve (GTMNERR) were established in 1985 and 1999, respectively. Both managed by the Florida Department of Environmental Protection's (FDEP) Office of Resilience and Coastal Protection (ORCP) (FDNR, 1991)
- The Eastern Oyster, *Crassostrea virginica*, is a keystone species within GRMAP and GTMNERR that provides several ecosystem services, such as improved water clarity, buffering the coastline from storms and sea-level rise, and providing essential habitat for numerous species (Coen et al., 2007; OIMMP, 2019)
- Oyster harvest was banned throughout Guana River in 1985, but the southern portion was reopened to harvest in 2019 (Figure 1; FDNR, 1991)

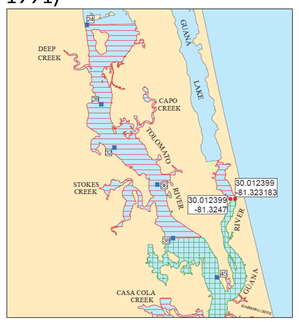

Figure 1. Shellfish harvesting area classification map #92: North St. Johns County Survey May 1, 2018. Red areas indicate prohibited harvest. Green areas indicate conditionally approved harvest. Accessed from: www.fdacs.gov

- The GTMNERR oyster monitoring program began in 2014, creating the current baseline of oyster body size (SEACAR, 2019)
- The Historical Oyster Body Size (HOBS) project successfully applied a paleoecological approach to access oyster size information from death assemblages buried within reefs (See Box 1). Pilot samples collected shells from a max of 35cm burial depth, which dated (^{14}C) back to 1999, and determined pilot oyster body size trends (Durham, 2022; Durham et al., *In Review*)
- To extend the baseline even further and investigate how the fishery closure impacted oyster size, more reefs need to be sampled to deeper depths. This study builds on the HOBS project by applying a vibracore method to access older shells buried beneath the reef surface.

GOAL: Expand historical oyster body size baselines in Guana River, both spatially and temporally, to investigate the impact of changes in harvest regulations on oysters.

Prediction

Oyster sizes were smaller in Guana River prior to harvesting being banned in 1985. Oyster size may be decreasing in southern Guana where fishing is now conditionally approved.

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Other Funding Sources:

Extending the Baseline

Core Collection and Processing

- Pilot tested vibracore method to collect deeper cores
- 3 cores collected from 5 reefs across Guana River summer 2022 (15 cores total; Figure 2)
- Cores are subsampled into 5cm samples for ease of processing and to be consistent with other core studies
- Samples washed over stacked 1mm and 2mm sieves, sorted into measurable left valves (>90% complete) and unbroken resilifers (shell hinges)
- 9 cores fully washed and described, 1 core has oyster body size measurements

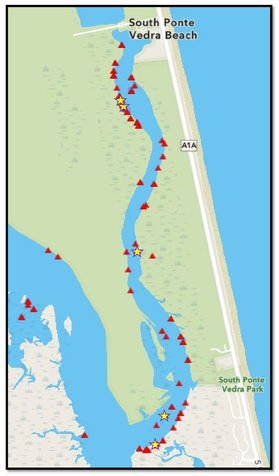

Figure 2. Map of Guana River. Red triangles indicate reefs sampled for the GTMNERR oyster monitoring program. Yellow stars indicate reefs cored for this project. Data accessed from SEACAR Data Discovery: https://data.florida-seacar.org

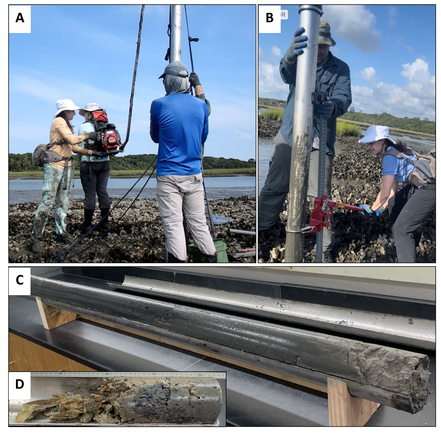

Figure 3. A) Fieldwork 2022 testing vibracoring methods. B) Core retrieval. C) The bottom half of a 10ft core after opening with a circular saw in the lab. Oyster reef material was found in the top (left) third of the core, which transitions to sandier sediments. D) Oyster reef material from the corresponding top half of the 10ft core. All reef material 70-105cm thick in total.

Core Description:

- The top 0-15cm includes the living oysters
- Cores capture the entire thickness of the reef that is oyster-rich and comprised of muddy/silty sediments
- There are no distinguishing sedimentary changes within the oyster reef samples and shells exhibit no precise orientation
- Core reef total thickness ranges from 70-105cm (Figure 4), ~3x deeper than HOBS core samples which we are confident will date pre-1985
- Cores captured sediments underlying the reef, where oysters are absent, which transitions quickly to coarser sands; occasionally pieces of vegetation are present.
- The underlying sediments also house a different, less abundant, fauna comprised of mud snails and clams including the occasional hard clam (*Mercenaria*) shell.

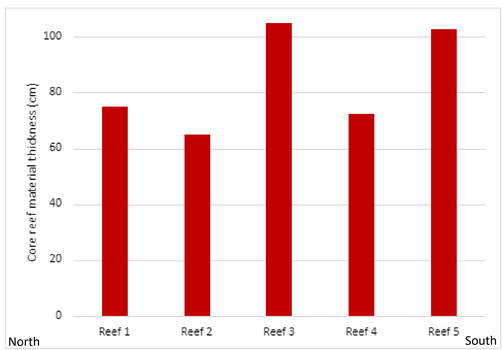

Figure 4. Reef cores collected in order (1 to 5) north to south along Guana River. Average core thickness of reef material (start to end of oyster shells) from nine cores fully processed. Average core shortening during core collection was 45.9 ± 17.5 cm.

Data Collection and Next Steps

- Plan to collect from 5 additional Guana River reefs to sample the entire N-S distribution
- Shells from samples within reef cores will be radiocarbon dated to determine age of each sample
- Left valves ≥25mm and resilifers (hinge) will be measured with calipers (Figure 5)

Figure 5. Measuring oyster left valve size with digital calipers.

- Apply Bayesian hierarchical regression to determine trends in oyster size over time while accounting for reef to reef, within core, and time averaging variation and uncertainties

Box 1: The Historical Oyster Body Size (HOBS) project

- Pilot project, funded by the Florida Coastal Management Program, collaboration between the FDEP ORCP and the Paleontological Research Institution (PRI), Ithaca, NY to address oyster monitoring information gaps using death assemblages from around Florida (Durham, 2022; Durham et al., *In Review*: SEACAR, 2019)
- Part of the FDEP ORCP Statewide Ecosystem Assessment of Coastal and Aquatic Resources (SEACAR) project aggregates and analyzes monitoring data on 5 primary habitats, including oyster reefs, for habitat managers and decision makers (Contact project manager Cheryl Clark Cheryl.p.clark@floridadep.gov for more information; https://data.florida-seacar.org)
- HOBS collected from 11 localities including in the Guana River, Matanzas River, and Pellicer Flats areas in GTMNERR
- Hand-collected cores were collected from 3 reefs in the northernmost part of Guana River

Terms

Conservation Paleobiology: applying paleontological methods and data towards modern conservation issues.

Death Assemblage: preserved shells and surrounding sediment beneath the sediment surface.

Time Averaging: mixing shells of different ages within a sample or sediment layer.

Ecosystem Services: benefits a species or community provide to humans

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