Assessing Paleoenvironmental Change of a Boca Raton Inlet Through Midden Artifact Analysis

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Introduction

- In this archeological study of a shell midden, we evaluate possible environmental and cultural changes that occurred through time by performing a quantitative analysis of shell artifacts of Common Atlantic Oyster (*Crassostrea virginica*) collected from the shell midden.
- These shell artifacts allows us to ascertain environmental change, such as changes in salinity, presence of sea level rise, and changes in aquatic substrate (Silva et al, 2017, Hesterberg et al., 2020, Georgopoulos, 2014).
- Previous study has reported a sign of dwarfism happening in Common Atlantic Oysters in the Gulf coast, where there is a loss of largest oysters in that region when compared to elsewhere in North America, the causes are unknown, but it could be due to overharvesting or possible environmental change (Hesterberg et al., 2020).
- Another study in the east coast reported that studying the large-scale harvesting of oysters in the past is important to understand which parts of the cost are in danger and these types of studies can be key to understand environmental forces that could be affecting oyster growth. (Thompson et al., 2020).

Methods

Methods for this research include:

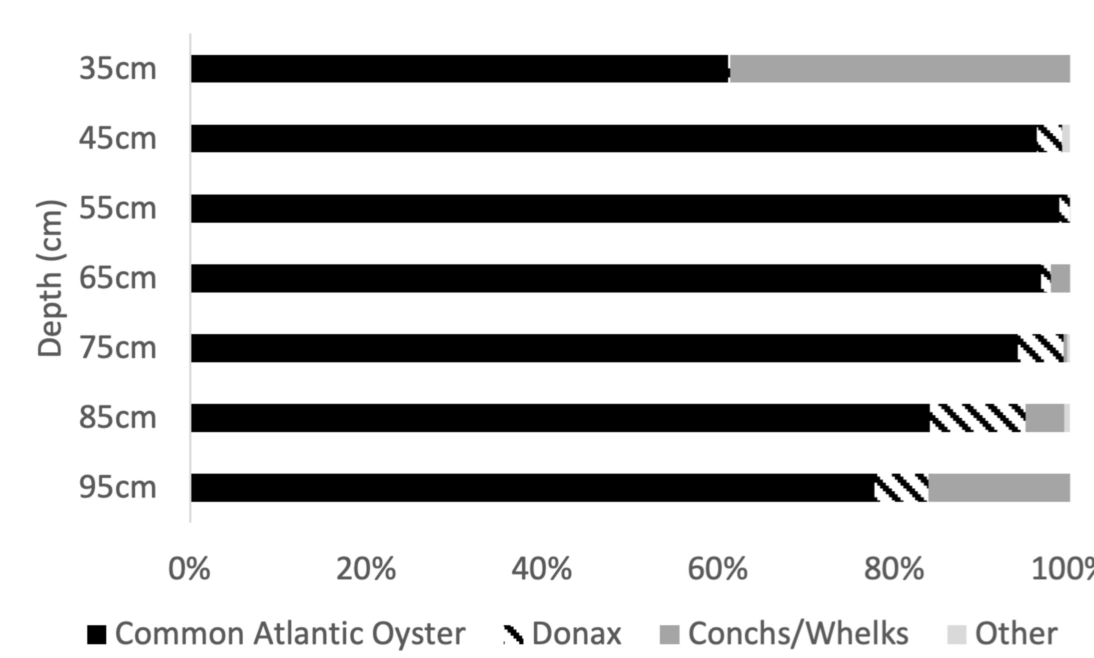
- Excavation test unit was 1m^2 with a depth of 1m in 10cm levels.
- Weighed the samples using a scale.
- Measurements for valve height, valve length and scar height were taking using a caliper.
- T-test to determine the significance of change with time:
  - Null Hypothesis the slope of the line is equal to zero.
  - Alternate Hypothesis the slope of the line is different from zero (p-value ≤ 0.05 indicating there were changes with time.
- Sponge borehole patterns analyzed as per (reference)
- Ecology metrics (richness, diversity, & evenness) calculated for each level.

Discussion

- Generally, changes across the metrics measured (oyster size, diversity analysis, height length ratios, and sponge borehole patterns indicate either salinity changes in the local environment or harvesting strategies
- Salinity change scenario:
  - Sponge borehole data indicates that the environment was brackish, then becoming fresher before becoming more saline.
  - Diversity decreases from the deeper depths towards the shallower depths, with more oyster dominance, probably because oysters can withstand a larger range of salinities
  - HLR maximum values indicate that Oysters started as mostly bed oysters then reef oysters appear which corresponds with the dominance of oyster in the assemblage, HLR then decreases back to bed oysters as oyster dominance decreases again.
- Harvesting change scenario:
  - Sponge borehole data suggests that in they started harvesting from brackish water environment, later changing to the inlet near beaches (more saline conditions) and going back to brackish water.
  - Diversity data could indicate a change in their diet or ability to find species, where generally older levels show higher diversity, than moving to less diverse environments.
  - HLR data indicates they were harvesting from primarily sand oysters with some reef oysters in the middle levels
  - Oyster length maximum value indicates that they were finding largest shells in the older level and an overharvesting of this species would decrease length in the shallower (newer) levels
- Results could also indicate a there was a harvesting pressure during periods of times where shell sizes were smaller.
- The evidence of reef oysters can also be linked with evidence of attachment in samples.
- The findings in this research provide insights for evidence of human and environmental influence occurring in South Inlet Park in Florida. Through cohesive analysis of the oyster effects of environmental changes and harvesting techniques are clearly present.

Results

Figure 1 (Right): Bae graph of the assemblage data with the diversity information. 35cm depth seems not to be part of the midden due to the disparity when compared to other depths. Common Atlantic Oysters is the most common species in the midden. At the three deepest levels the Donax appear to be more present. Generally, abundance and diversity seems to get bigger by depth.



Abundance	Richness	Diversity	Evenness
94	4	0.26	0.19
136	4	0.24	0.18
880	5	0.05	0.03
1979	6	0.15	0.08
1468	9	0.51	0.23
1413	9	0.65	0.30
1178	6	0.56	0.31

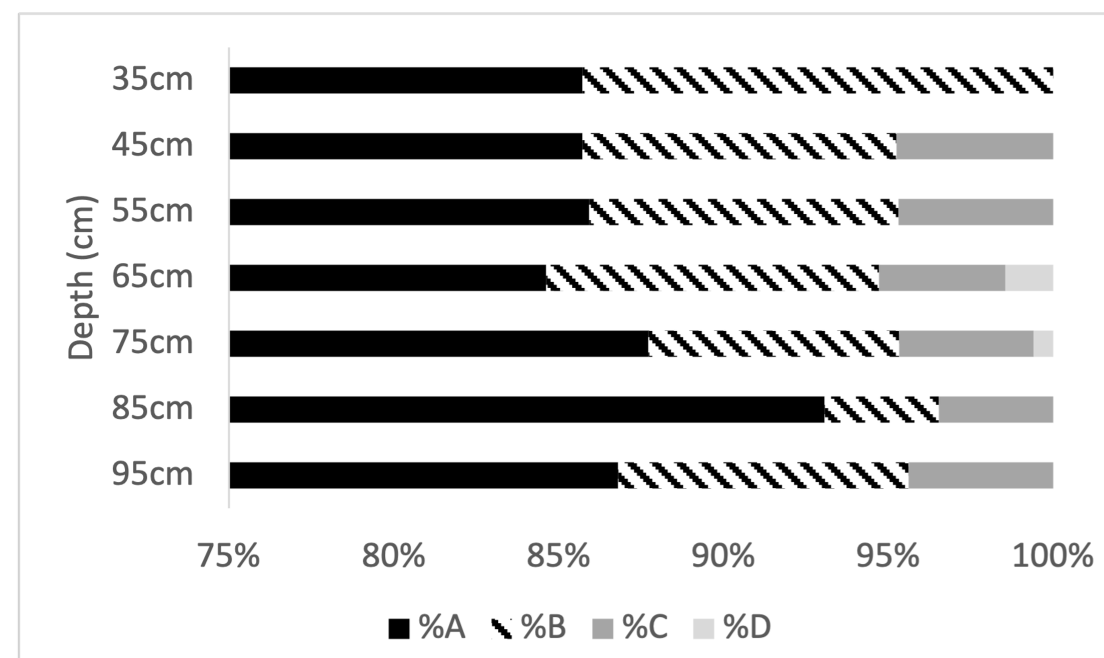


Figure 2 (Above): Sponge borehole patters percentages. Water seems to start fresher in 95cm depth, and it gets saltier in depth 85cm, 75cm, and 65cm with the appearance of borehole patter type D. As the depth gets younger the salinity levels seams to decrease.

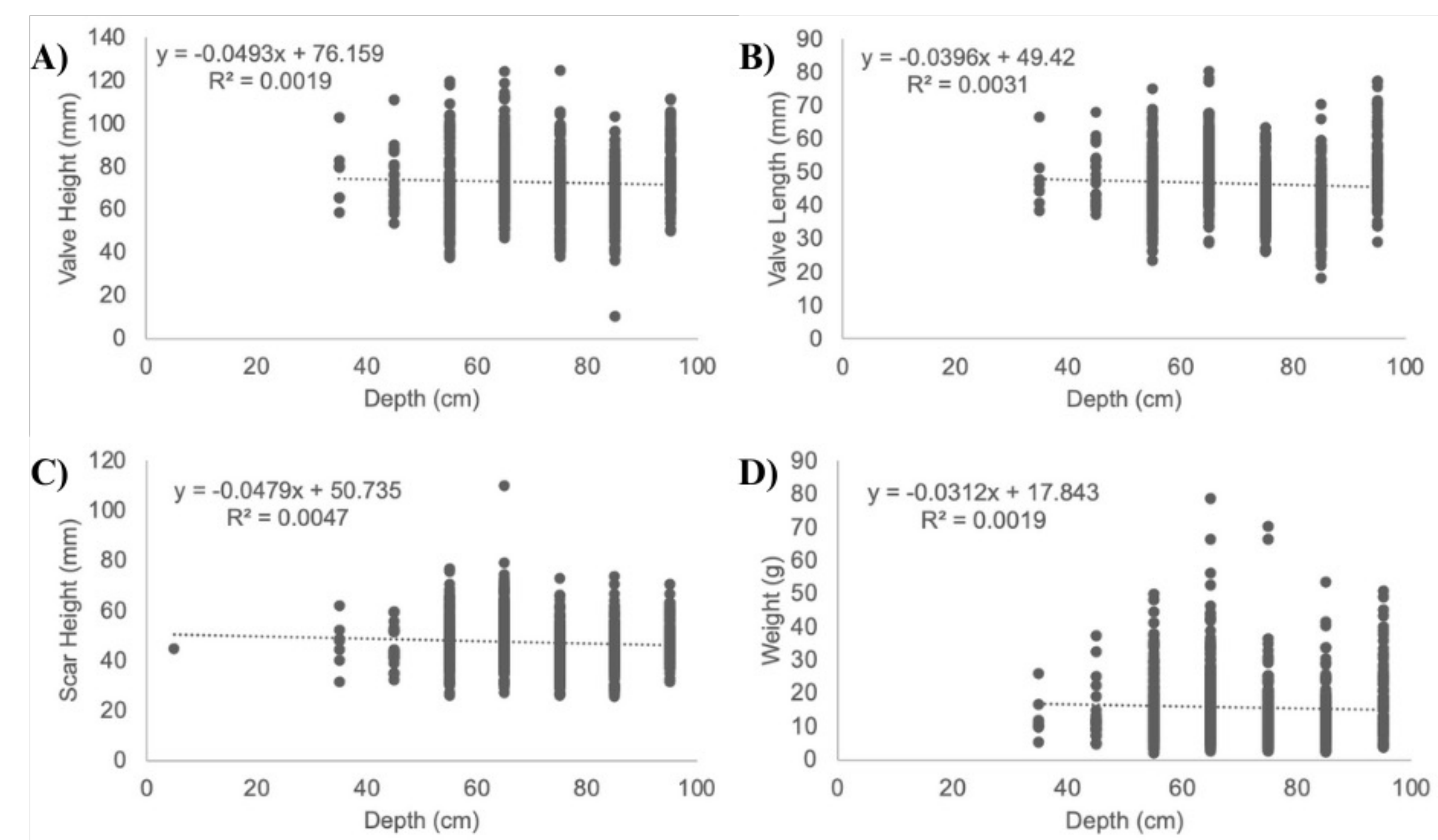


Figure 3 (Above): Common Atlantic Oyster measurements. A) valve height (p-value = 0.09) B) valve length (p-value = 0.02) C) scar height (p-value = 0.02) D) weight (p-value = 0.12). Generally, the shells started with large maximum values at level 10 (95 cm) and had a shift in level 9 (85 cm) and level 8 (85 cm) where the maximum values go lower. Then the maximum values increase again in level 7 (65 cm) and level 8 (55 cm), and in level 5 (45cm) and level 4 (35 cm) maximum oyster size decreases.

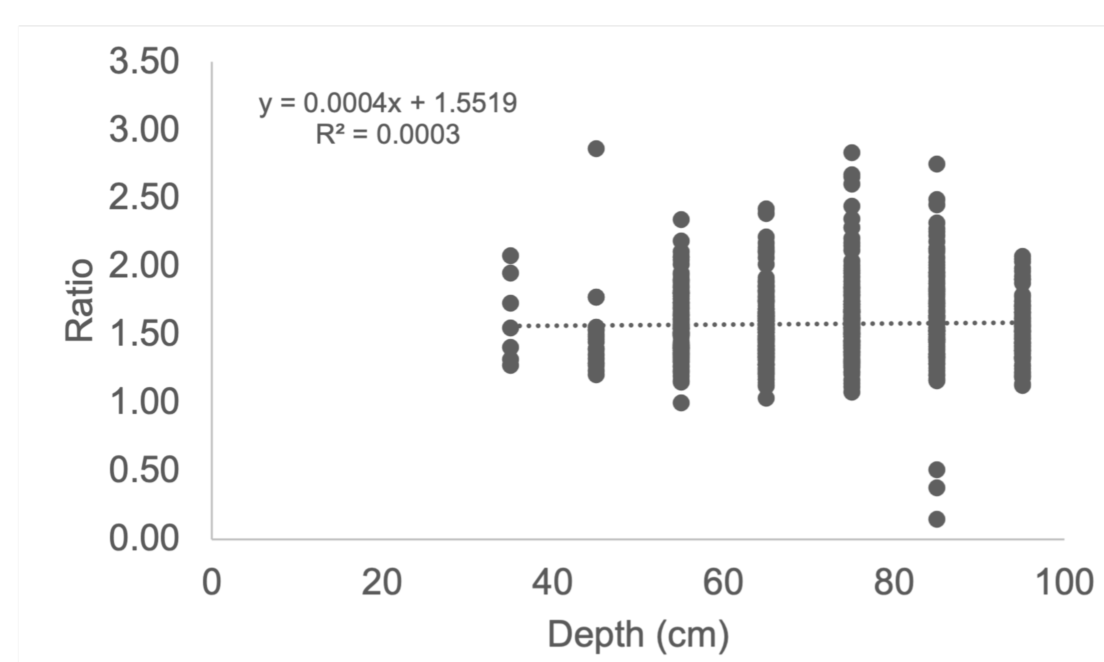


Figure 4 (Above): Height Length Ratio (HLR) measurements. The ratio of oysters on level 5 (45 cm) indicates that most of the HLR is under 1.3 mm which shows that most of them were sand oysters located on intertidal or in shallow water. There is an increase of the values for level 6 (55 cm) (2.3-1.0 mm) and level 7 (65 cm) (2.4-1.0 mm) the shells that have a HLR above 2.0 show that they are reef oysters and located in intertidal waters. Level 8 (75 cm) (2.8-1.1 mm) and level 9 (85 cm) (2.8-0.1 mm) show an increase in the maximum values when compared to level 7, both levels show reef oysters and sand oysters as well as bed oysters with an HLR between 1.3 and 2.0. When looking at level 10 (95cm) (2.1-1.1 mm) there is a decrease on the ratio when compared to level 8 and level 9 (Kent, 1989).

References

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