Using Sclerochronology on Caribbean *Codakia orbicularis* to Determine Season of Capture

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Introduction

Reconstructing the settlement patterns and daily practices of prehistoric people are persistent matters encountered in archaeology. One group of people that have left many archaeologists perplexed is the Lucayans, the native inhabitants of The Bahamas. On Long Island, The Bahamas, Lucayan sites have given us a glimpse into the lives of the Lucayan people, but evidence to establish their seasonal activities is nearly nonexistent. The uncovering of a more complete depiction of the Lucayan's seasonal activities would allow for a more accurate representation of their habitation patterns and mobility patterns.

One way that seasonality can be determined is through the observation of the incremental growth bands in the marine bivalve *Codakia orbicularis*. This bivalve was selected because it occurs in large numbers at Lucayan sites spanning a 400-year period of occupation. Shells collected from different archaeological sites, different time periods, and Atlantic versus lee-shore (Bahamas Banks) locations provide the potential to reconstruct environmental histories in several different contexts.

Bivalve mollusks grow by increasing their shells size through the addition of calcium carbonate ($CaCO_3$). Earlier research performed by Jones et al. (1996) demonstrated that environmental factors strongly influence this process of accretionary shell growth. Investigating these paleoenvironmental conditions and determining season of capture require the relatively new techniques of sclerochronology to be deployed.

Methodology

Standard archaeological field methods of excavations were employed to collect several hundred samples of *Codakia orbicularis*. The collection of these shells occurred between the two archaeological sites, Wemyss (LN-8) and Wemyss South (LN-104), on Long Island, The Bahamas. All samples were sorted by site and respective stratigraphic level. Modern comparative specimens were collected from tidal creeks enclosed by Newton Cay.

Concepts of sclerochronology were deployed to determine the population dynamics and seasonal trends associated with *C. orbicularis* as well as reconstruct the environment they once inhabited. This process was completed by evaluating both the variations in oxygen and carbon isotopes and incremental shell structures on the modern and archaeological shells.

Results

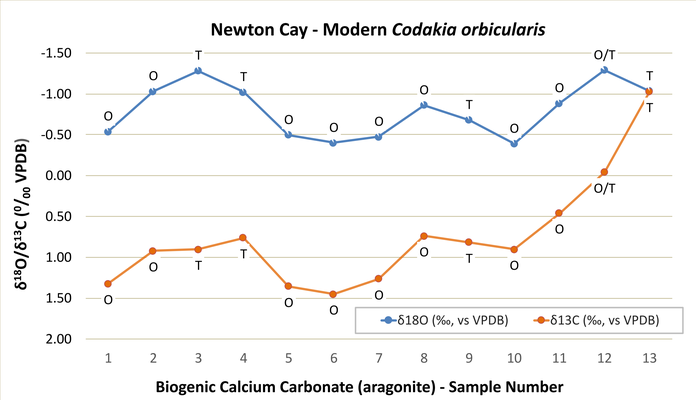

Figure 1. Plotted $\delta^{18}O$ and $\delta^{13}C$ values from modern *Codakia orbicularis*.

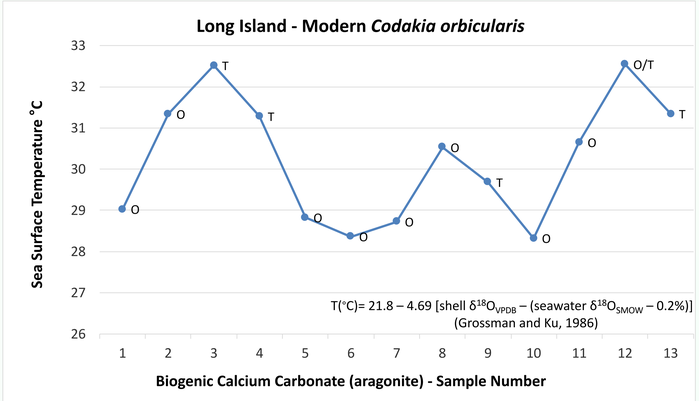

Figure 2. Plotted SST associated with modern *Codakia orbicularis* from Long Island.

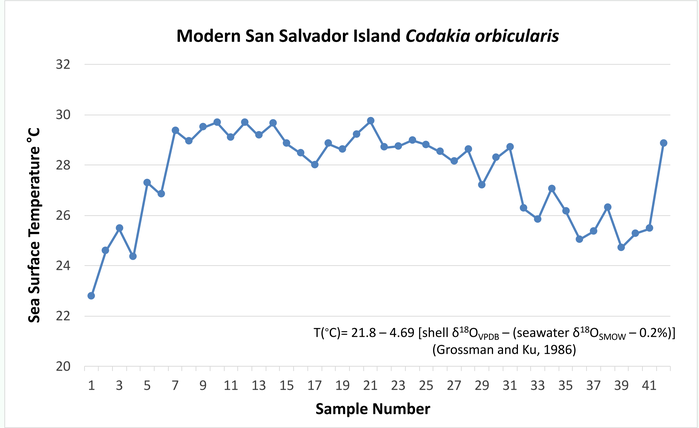

Figure 3. Plotted SST associated with modern *C. orbicularis* from Cerajewski (2002).

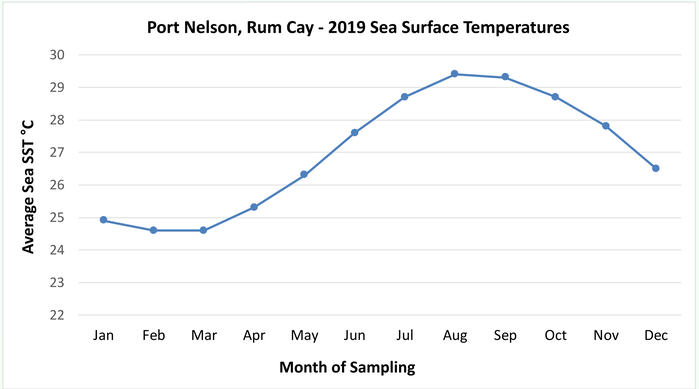

Figure 4. Plotted SST collected from Port Nelson, Rum Cay, The Bahamas.

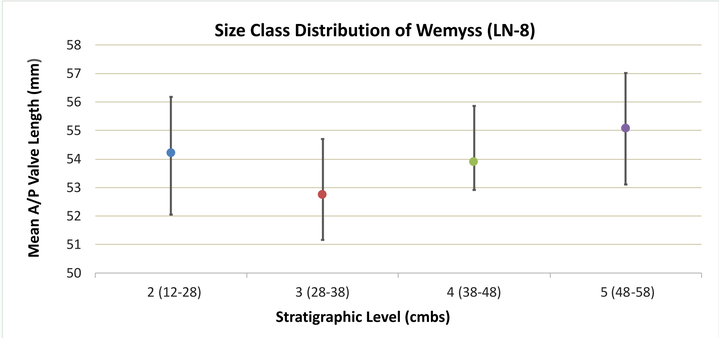

Figure 5. Plotted mean valve lengths and 95% confidence interval for LN-8 site.

Discussion

The isotope analysis data from the modern specimen supported the notion that the formation of the growth increments corresponds with seasonal change. One indicator of this was the covariance between the $\delta^{18}O$ and $\delta^{13}C$ profiles (Fig 2). Another indicator was a visible fluctuating trend in the $\delta^{18}O$ profile. The $CaCO_3$ samples collected from the translucent growth increments appear more frequently in warmer water, while the samples from the opaque bands occur more often in colder water (Fig 2). The samples were also collected in ontogenetic sequence so it can be inferred that the convergence of $\delta^{18}O$ and $\delta^{13}C$ at the last data point is indicative of the organism's demise (Fig 1). Sea surface temperature (SST) were also calculated using the specimen's $\delta^{18}O$ values. and compared to SST from Cerajewski (2002) and current SST from Rum Cay. The former indicated an increase in SST and the latter reaffirmed the SST calculated in this study.

Archaeological specimens underwent descriptive statistics to address if this species experienced harvesting pressure due the Lucayans. No change in size class was observed within each site, but the 95% confidence intervals at both sites overlapped. These observations indicate, respectively, that there was no anthropogenic or environmental impact on the resource and that the specimens could have been drawn from the same population. These inferences support the notion that the Lucayans occupied these sites for only a short duration rather than maintaining a long-term occupation.

Conclusions

- Opaque and translucent shell growth increments found within *C. orbicularis* reflect seasonal shell growth (Fig 1).
- The concentrations of the Oxygen Isotopes (18O: 16O) show that *C. orbicularis* faithfully records annual changes in seawater temperature. This bivalve species may be regarded as a bio-recorder of its life and times in the sea (Fig 1 & Fig 2).
- The isotope $\delta^{18}O$ profile can be used to determine season of capture (Fig 1).
- Measured *C. orbicularis* samples (Anterior/Posterior Valve Length (mm)) show no temporal changes that would result from anthropogenic harvesting pressure (Fig 5).
- Possible increase in SST (Fig 2, Fig 3, & Fig 4).

Future Work

The observed rising SST could be confirmed or denied by eliminating freshwater input as a factor. This process would call for further research on the water composition of Newton Cay. If this increase in SST is confirmed, the question arises whether or not this increase has played a role in the seemingly reduced amount of live *C. orbicularis* present on Long Island, The Bahamas. Further, a more robust data set would be used to refine the mobility patterns of the Lucayans by verifying the size classes and population dynamics found in this study.

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