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Oyster paleoecology and Native American subsistence practices on Ossabaw Island, Georgia, USA

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ABSTRACT

We examined the shell size of 3262 eastern oysters (*Crassostrea virginica*) to assess diachronic patterns in shellfish exploitation on Ossabaw Island, Georgia. These measurements taken on shell size and morphology were compared between a Late Archaic shell ring, a Late Woodland shell-filled pit, and a Late Mississippian midden-mound to evaluate changes in oyster population ecology, as it related to large scale changing environmental conditions and Native America subsistence practices over time. Our results indicate stability in oyster populations during the Late Archaic with a following decrease in oyster size through the Late Woodland into the Late Mississippian. We attribute this decrease to combination to human predation and large-scale climate fluctuations, with the latter being the primary driver of this shift in size.

1. Introduction

The consumption of shellfish by past peoples has a deep history around the globe, dating into the Pleistocene (Erlandson, 2001; Waselkov, 1987). Recently, Erlandson (2013) suggested that piles of shell resulting from the long-term and intensive consumption of mollusks might stratigraphically mark the onset of the Anthropocene. Such sites, often called shell middens, shell mounds, shell rings, among others, contain evidence of the complex relationships that humans had with past environments (e.g., Bailey, 1975; Erlandson, 1988). Researchers have considered the role of such practices in human evolution and migration events (Marean, 2014; Klein and Bird, 2016). Given the ubiquity of shell middens around the world, mollusk collection had an appreciable impact on human societies through time, especially for the last 10,000 years or so (Erlandson, 2013).

Given the prodigious consumption of mollusks in many regions it is no wonder that recent scholarship suggests that human selective pressures affected demographic growth patterns in some species of mollusk. Recent research on oyster species (Ostreidae) in both the Gulf Coast region during the Late Archaic (cal. 2000–500 BCE) and Caloosahatchee (cal. 500 BCE – 1500 CE) periods (Savarese et al., 2016) and during the Mesolithic-Neolithic transition in Europe (Milner, 2013) suggest that selective pressures from overharvesting are indicated in the decrease in oyster size over time. However, not all instances of human exploitation of oyster shell beds resulted in overfishing. Rick et al. (2016), in contrast, suggests that Native populations in and around the Chesapeake Bay sustainably harvested oysters for millennia by demonstrating an increase in valve height through time. Based on these few studies, it seems the way in which past people exploited oysters varied from region to region over time.

Along the Georgia Coast, Native Americans exploited a vast array of shellfish with the eastern oyster (*Crassostrea virginica*) being the primary taxon in the mounds and middens of the region. Thomas (2014) points out that intensive shellfishing on the Georgia Coast began as far back as the Late Archaic (ca. 3000 cal. B.C.) and that collection intensified shortly after cal. 800 CE when institutionalized hereditary positions emerged (Thomas, 2008). Thomas (2014) also posits that Native populations continued to increase and beginning around 1400 CE adopted maize agriculture; however, as Thomas points out, shellfishing offers higher return rates than maize agriculture for the Georgia Coast. This suggests that significant changes in population and social organization occurred with shellfishing, primarily oyster collection, occupying an important role in the subsistence economy over several millennia.

Thomas's (2014) model for Native demographic and population changes and their concomitant use of oysters as a part of a larger subsistence base are certainly reflected in the archaeological record. The most impressive shell midden sites are the shell rings of the Late Archaic. These are arcuate to circular shaped shell middens that represent some of the first sedentary villages in the region (DePratter, 1979; Thompson, 2007; Thompson and Andrus, 2011). The largest of these sites on the Georgia Coast is the Sapelo Island Shell Ring complex (9MC23), which has three shell rings, the largest of which (Ring I)

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measures ca. 95 m in diameter and is roughly 3 m tall at its highest point (Thompson et al., 2004). Oyster is the main shellfish taxon found in these rings, with the other taxa making up minority amounts (see Marrinan, 2010). Interestingly, shell rings are only inhabited between ca. 5000–3500 cal. B.P. (Turk and Thompson et al., 2016). This cessation in shell fishing, beginning around 3800 cal. B.P., corresponds to a possible lowering of sea level for the region that may be related to the productivity of shell beds in localized areas (Thompson and Turck, 2009; Turck, 2011).

Evidence for oyster exploitation remains fairly sparse until the Middle Woodland period (2300–1600 cal. B.P.) and gradually increases in the Late Woodland (1600–1150 cal. BP). Shellfish in these time periods are usually deposited in the form of sheet middens and large pits, with some forming of midden-mounds (DePratter, 1991). By the time we get to the Late Mississippian period (650–370 cal. B.P.) on the Georgia Coast there are large sites with hundreds of midden mounds, such as the Kenan Field site on Sapelo that has around 600 (Crook, 1986). There is also evidence that Native populations used oyster midden materials for mound construction, as can be seen in the profile of the large platform mound at the Irene site near Savannah (Caldwell and McCann, 1941; Thompson and Turck, 2009). It is unclear if these layers represent mass collection and mounding events of consumed oysters or if former midden was mined out and used, as it was elsewhere in the Southeast (Thompson et al., 2015; Thompson et al., 2016).

What should be clear from our brief discussion of the oyster consumptions patterns for the Native occupation of the Georgia Coast is that this species was an integral part of lifeways for much of this occupation (see Thomas, 2014). However, there appears to have been some sort of disruption during the terminal Late Archaic period that impacted oyster harvesting practices (Thompson and Turck, 2009; Turck and Thompson, 2016). After this disruption, oyster consumption, at least based on the frequency and size of archaeological sites, gradually increased again with intensive, large-scale, oyster harvesting during the Late Mississippian period by large populations. Our primary research objective for this paper is to examine if consumption patterns over time have an effect on the size of oysters or if environmental changes were responsible for such shifts present in the archaeological record. Put another way, we seek to identify whether the drivers behind the changes observed in the archaeological record are the effects of human activities or the result of natural processes. This is a key question in environmental archaeology and a difficult one to evaluate without time-series archaeological data that can be compared to known environmental records (see Milner, 2013; Reitz et al., 2008). To evaluate this research objective, we measured shell size for 3262 oysters (*C. virginica*) from two sites on Ossabaw Island, Georgia (Fig. 1). We then compared differences in size classes between a Late Archaic shell ring (the Ossabaw Shell Ring), a Late Woodland midden (Finley's Pond site), and a Late Mississippian midden (Finley's Pond site) to evaluate changes in oyster population ecology, as it related to large scale changing environmental conditions and Native subsistence practices over time. Our results indicate general stability in oyster populations during the Late Archaic with a following decrease in oyster size through the Late Woodland and into the Late Mississippian. In the concluding part of the paper, we consider the cause of this decrease in size and what these paleoecological patterns have for the future of oyster reefs along the Georgia Coast.

2. Oyster ecology

The eastern oyster inhabits the intertidal zone along substrates suitable to settle upon (Bartol et al., 1999:171–172). As the older oysters die they create additional substrate upon which live oysters, and many other organisms, such as barnacles and tube worms, attach themselves to. These oyster clusters create reefs that provide refuge to many species of fish that use the shells for protection or empty shells as nests for egg development. The eastern oyster acts as a key structural component to estuaries and is a primary actor in the function of estuary ecosystems (Gutiérrez et al., 2003; Dame, 2009). Oyster reefs provide habitats and refuge for a wide variety of organisms including fish and other invertebrate species (Meyer and Townsend, 2000:39–40; Gutiérrez et al., 2003:82–83). In the process of filter feeding bivalves reduce water turbidity and clarity (Newell, and I, E., 2004:53–54) and due to the spacing and construction of the oyster reef itself, act as a physical filter for larger material suspended in the water (Lenihan, 1999:269). The overall productivity and health of the estuarine ecosystem is dependent upon the presence and abundance of oyster reefs along its substrates.

The eastern oyster's physical characteristics range in size and shape. They can grow from round (least frequent shape) to oval with concentric ridges. While the eastern oyster can tolerate a wide range of salinities, the optimal salinity for growth and reproduction is somewhere between 15 and 30 practical salinity units (Shumway, 1996:648). Size of the shell depends on several variables: the age of the animal, the microenvironment of growth, and the ontogenetic growth rates (Bartol et al., 1999:171–172; Claassen, 1998). Size measurements are most often used to explore the characteristics of the growth environment to estimate season of collection (Claassen, 1998). Most importantly, the structure of the reef and the oyster's location within that reef acts as a key driver "in the biology and ecology of *C. virginica.*" (Bartol et al., 1999:180). Traditionally, it was widely accepted that a decrease in the mean size of shells in the archaeological record over time is predominantly a product of environmental change (Campbell, 2008; Claassen, 1998; Morrison and Cochrane, 2008). However, more recent studies suggest that a decrease in mean shell size can be attributed to human predation pressure (Milner, 2013; Rick et al., 2016; Savarese et al., 2016). Here, we seek to examine the influence of differential natural and cultural drivers.

3. The study area

Ossabaw Island, the third largest barrier island on Georgia's coast, measuring approximately 14 km long and 6 km wide, is a part of a larger barrier island complex along the Atlantic coast of North America. Roughly 5 to 8 km of marsh estuarine ecosystem lies between Ossabaw and the mainland. Ossabaw Island is geologically comprised of two barrier island complexes: Pleistocene beach and dune deposits of the Silver Bluff formation that formed approximately 40,000 years ago juxtaposed with Holocene barrier islands that formed approximately 4500 years ago (Hayes, 1994). The area around Ossabaw Island experienced variations in sea level (Colquhoun and Brooks, 1986; DePratter and Howard, 1981) that led to changes in coastal morphology throughout the late Pleistocene and Holocene in the form of the lateral migration of coastlines and the formation of salt-marsh and back-barrier habitats (Reed, 2002) where they can be found today. As sea level stabilized around 4500 years ago, the influx of sediment from the outpouring river systems assisted in the creation of an environment suitable for the development of brackish and salt marsh ecosystems (DePratter and Howard, 1981). It is at the nexus of the salt marsh-ecosystem and the barrier islands that many of the Native American archaeological sites, especially the larger village sites, are clustered (Thompson and Turck, 2009).

The archaeological record of Ossabaw Island mirrors much of what we see elsewhere on the Georgia Coast (see Thompson and Turck, 2009; Thomas, 2008). Pearson's (2014) cumulative research and survey of archaeological sites during the 1970s and early 1980s on Ossabaw Island provides an important index by which to gauge population growth and intensity of settlement. Pearson (2014) recorded over 200 archaeological sites for the island. By approximately 4200 cal. B.P., the area around Ossabaw Island saw the intensive, year- round occupations of Native populations at shell rings on other islands that front the now formed Holocene salt marsh and back barrier environments (DePratter and Howard, 1981; Thompson and Andrus, 2011; Turck, 2011). These