Anthropogenic Change in the Chesapeake Bay

Archaeology and Historical Ecology of the Eastern Oyster (*Crassostrea virginica*)

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Big Picture: The Chesapeake Bay is the largest estuary in the United States. For well over a century, the Bay has been devastated by overfishing, pollution, agricultural runoff, and climate change. Anthropogenic environmental change is well documented in contemporary records, especially the collapse of the Bay's oyster fishery and associated changes in ecosystem structure. Questions remain about the nature of the oyster fishery in prehistoric times, when Native Americans intensively harvested oysters and other bay resources for millennia. How intensively were oysters harvested compared to other shellfish and fauna? What were the baselines of oyster populations like prior to Historical over-exploitation? How did prehistoric harvesting affect the age and size distribution of ancient oyster populations? These questions related to shifting biodiversity baselines can be addressed using archaeology (Erlandson and Rick 2010). We use archaeology to introduce a prehistoric perspective on the ecology of the Chesapeake Bay and to analyze how Native peoples may have influenced its structure and ecology, most notably by intensive harvesting of the Eastern oyster (*Crassostrea virginica*).

Site: The Chesapeake Bay has a long history of human occupation spanning the Holocene and terminal Pleistocene, making it an ideal site for investigating ancient human-environment interactions. Excavations were carried out at a number of shell middens at Fishing Bay on Maryland's Eastern Shore (figure 1). We focus on a site (18-DO-35) on Elliot's Island in the southern part of Fishing Bay. This is an area with large and dense shell middens that provide evidence for focused and likely seasonal harvest of the Eastern oyster. Site 18-DO-35 (figure 2) dates from AD 1460-1510, part of the Late Woodland period and just prior to initial contact with Europeans. The site is located 1-2 m high on a terrace on the southwestern side of the island and covers approximately 50m along the sea cliff and 20-30 m inland. Oyster shell and small amounts of pottery are visible on the site surface and eroded along the shore.

Figure 1: Satellite image of the Chesapeake Bay

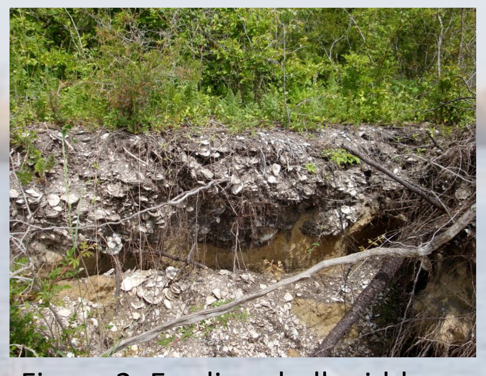


Figure 2: Eroding shell midden in sea cliff at 18-DO-35

Methods: A 1 x 0.5 m unit, a 50 x 50 cm unit, and a 25 x 25 cm column sample were excavated in intact deposits in the sea cliff at 18-DO-35 in Spring 2010. We identified and sorted all materials (1/8-inch residuals) from the surface (0-5 cm) and levels 1-3 (each 10 cm in depth) into specific taxonomic categories. We then weighed this sorted material. Additionally, we determined the age of individual oysters at capture for levels 1-3 and collected metric data including shell and hinge dimensions (figure 3) (Kent 1988). Our aging methods included counting growth bumps on the hinge portion of the left valve after sectioning through the valve with a diamond saw (figure 4). Using this method, growth bands and bumps on the ligament are more easily visible (figure 5), allowing us to age the oysters with relative accuracy.

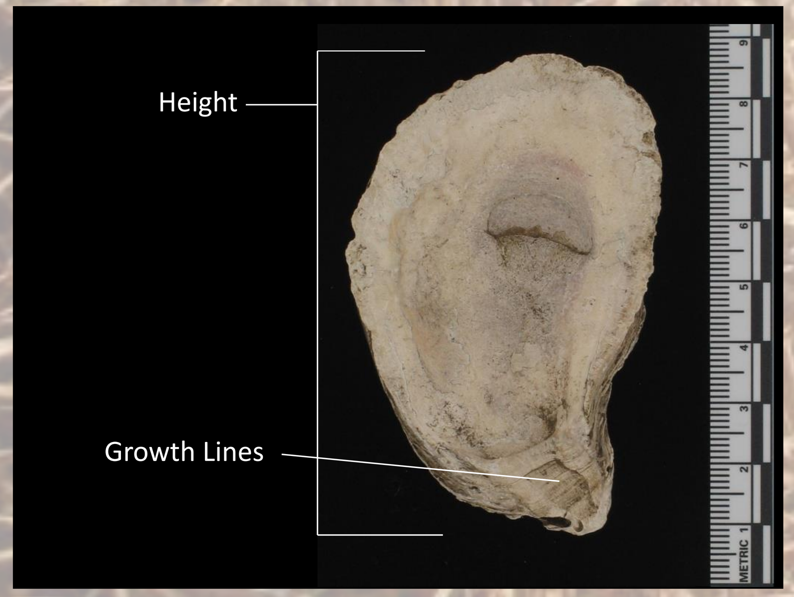


Figure 3: Dimensions and data taken from each left oyster valve

Figure 4: Sectioning valves using the diamond saw

Figure 5: Section through ligament that allows counting of age bumps

Subsistence Strategies and Human Harvest of Eastern Oysters

Excavation of 18-DO-35 produced large amounts of oyster shell, including whole valves and fragments, and a small number of artifacts, other shellfish, and vertebrate remains (figure 6).

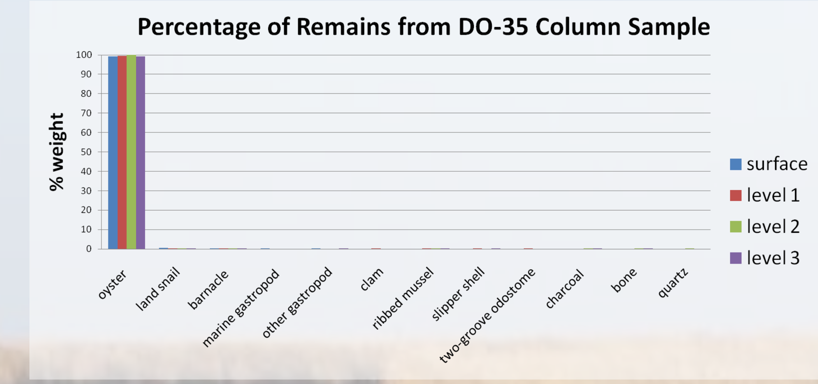


Figure 6: Oyster remains made up 99.8% of material from the column samples, while ribbed mussel, clam, land snails, two-groove odostomes, barnacle, slipper shells, and other materials combine for less than 1% of the assemblage. These data demonstrate that the people who occupied 18-DO-35 were focused on the harvest of oysters.

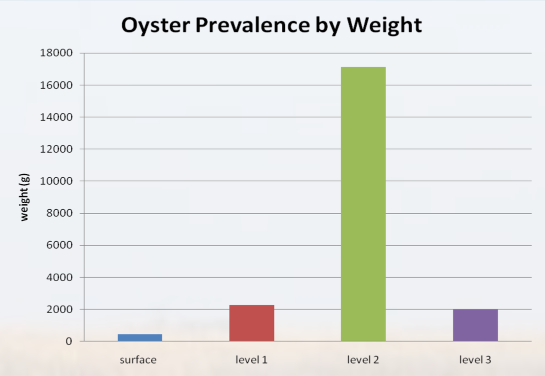


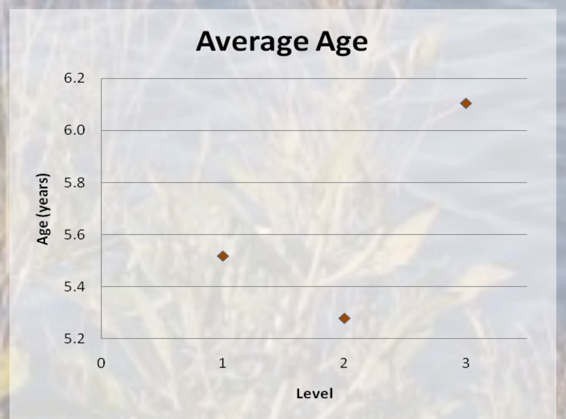
Figure 7: Level 2 has the greatest prevalence of oyster shells. This is likely related to depositional factors and an increase in the intensity of oyster harvesting from level 3 to level 2, which is then followed by a drop-off in level 1. This may be due to an increase in other forms of subsistence, ecological changes induced by this harvesting pressure, and/or by depositional factors (e.g. erosion and settling of deposits).

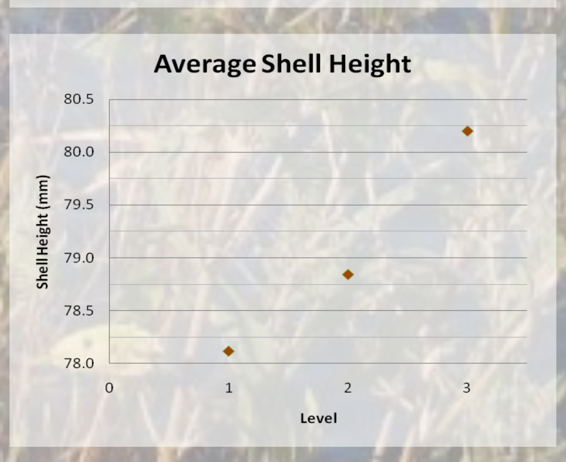
Since 99.8% of the sample were oyster shells, we looked at the effects of this focused predation on the age (figure 8) and size (figure 9) distribution of oysters over the roughly 60 years (AD 1450-1510) represented by our sample.

Level 3 contains the earliest deposition of oyster hinges, while level 1 represents the most recent.

Intensively harvesting these shellfish may have affected the quantity of larger, older oysters available for subsistence, thus resulting in the observed drops in average age and height. However, where the age distribution increases slightly in level 1 , the height does not, suggesting a possible drop in the growth rate due to sustained and focused predation, a change that is more significant than age or size distributions alone.

Figures 8 & 9: The age of oysters collected from the midden decreases over time between levels 3 and 2, followed by a recovery in level 1, while the size (determined by height) experiences a continual decrease that is sharpest between levels 3 and 2.





Conclusions and Implications: Oyster harvesting at 18-DO-35 was a very focused activity. Within a span of only 50-60 years, we can demonstrate a change in age and size distributions of oysters harvested from the Chesapeake Bay due to intense human predation. Our next step is to perform stable isotope analysis of the oyster remains and investigate the midden at 18-DO-439 on Elliot's Island, which represents a period of occupation just prior to 18-DO-35. This broader time scale will enable a diachronic analysis of the development of seasonal subsistence on oysters in Fishing Bay.

Figure 10: Initial soil sampling and excavation at 18-DO-35

Figure 11: Midden 18-DO-439 on Elliot's Island, Fishing Bay

Today, large oysters are rare in much of the Chesapeake, though they were once an abundant resource as evidenced by the middens at Fishing Bay (figure 11) and through historical catch data. Native Americans influenced oyster populations of the Bay and therefore the structure of the ecosystem well enough before European contact to indicate that records and studies of biodiversity baselines need to be pushed back in time. Our work complements recent studies that use archaeological data to understand Historic period oyster harvest in the Bay (Harding et al. 2008, 2010; Kirby and Miller 2005), but indicates that we need to investigate these patterns deeper in time as much of the Bay was influenced by human activities well prior to the contact period that began in the early 1600s. By contributing to an understanding of prehistoric human land and ocean use, this work also has the potential to aid conservation efforts at estuarine and coastal environments suffering from degradation and shifting biodiversity baselines.

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