5-2021

Archaeology Saves the Bay: The Sustainability of the Chesapeake Bay Oyster Fishery

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A thesis submitted in partial fulfillment of the requirement
for the degree of Bachelor of Arts / Science in Department from
William & Mary

by

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Accepted for High Honors
(Honors, High Honors, Highest Honors)

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May 12, 2021

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Acknowledgments

I owe a great deal to everyone that contributed to this project. I would particularly like to thank my advisor, Martin Gallivan, for his guidance and support. Over the past four years, I have learned so much from my work in his lab. Dr. Gallivan's willingness to spend hours teaching me proper laboratory techniques and statistical analysis largely inspired me to pursue an honors thesis. Without his support, this project would not have been realized. I would also like to thank my committee members, Jennifer Kahn and Rowan Lockwood, for their feedback and support throughout this process. I want to extend substantial thanks to the James River Institute for Archaeology, specifically Nicholas Luccketti and Sean Romo, for providing my research materials. I would also like to thank Jessica Jenkins for her mentorship.

In addition, I would like to thank all my friends, especially Caroline Lehman, for their constant encouragement and willingness to listen to me talk about oysters, as well as the plethora of "oyster swag" they have gifted me over the past two years. Lastly, I would like to thank my family, who have always supported me through all my endeavors. From digging up rocks in the backyard to conducting real archaeological field work, you have always urged me to pursue my interests. Again, thank you all so much for your unwavering encouragement. Without each person listed above and so many more, I would never have made it to where I am today, let alone completing this Senior Honors Thesis.

Abstract

This paper addresses the progression of oyster harvesting practices in the Chesapeake Bay watershed through three distinct periods—the Late Archaic, Middle Woodland, and Historic—framed within ideas derived from historical ecology, resilience theory, and sustainability. A critical examination of approximately 4000 oyster shells from Site 44YO0797, an archaeological site located along the York River, indicates that Native fishers harvested Chesapeake oysters sustainably on a millennium timescale. Common resource management practices allowed Native oysterers to actively foster resilience within the fishery through harvest habitat variation over time (i.e., focus shifting from offshore to nearshore reefs). The Chesapeake oyster fishery thrived until the onset of Colonization, when intensified oyster ventures drove the fishery to collapse. For this analysis, five key attributes were measured on every complete left valve in the collection to access for reef health and harvest location: height, height-to-length ratio (HLR), percent parasitism, percent attachment scars, and left valve concavity (LVC). The results indicate larger offshore oysters were found most often in the Archaic period and smaller, nearshore oysters in the Middle Woodland period. The Historic period provided mixed results, with the presence of both offshore and nearshore oysters, presumably due to the large yields demanded by the commercial fishery. Native Americans more actively harvested nearshore oysters, leaving offshore oysters for limited harvest, only for special feasting events, so they could regrow and replenish other reef structures. Moving into the Historic period, the focus of harvest shifted from quality to quantity; harvest location became less important. This attitude and a lack of communal management was a crucial cause of the early 20th-century oyster fishery collapse. Oysters are a species critical to ecosystem resilience, yet at the rate, human harvesting is progressing, soon the species will go extinct. My research reflects that current management initiatives need to recognize the implications that past practices and environmental conditions have for future oyster reef restoration.

Introduction

The following paper details the analysis of archaeologically recovered eastern oyster shells (*Crassostrea virginica*) from Site 44YO0797, an archaeological site located along the York River. The project builds on and contributes to ongoing efforts to investigate the historic oyster fishery to advise current oyster restoration initiatives. Traditional, long-held beliefs marked non-Europeans as simple-minded and primitive peoples, a perspective rooted in the idea that indigenous people were unchanged, as Eric Wolf coined, “people without history” (Wolf 2010). In contrast, new research (i.e., Rick et al. 2016; Thompson et al. 2020) has shown the strong impact indigenous peoples had on their environment. Disciplines such as archaeology, paleobiology, cartography, geology, etc. reveal long-hidden records of the ecological past and develop historical baselines that document processes responsible for changes in coastal ecosystems, including events such as the collapse of the Chesapeake Bay oyster fishery.

Critical to reconstructing historical baselines is identifying core social and environmental processes responsible for resource depletion over time. While many disciplines offer ways to identify ecological causes, archaeology stands alone in its ability to “people the past.” Archaeology informs the environmental as well as human social, political, and ceremonial processes that change and shape natural environments over millennia. Gone are the notions of the “ecologically noble savages” who lived in harmony with the environment (Hames 2008) and the “pristine environments” inhabited by indigenous peoples (Thompson et al. 2020). These beliefs claimed indigenous people had little-to-no impact on their surrounding environment, allowing ecosystems to flourish naturally until the onset of Colonization (Hames 2008). The application of these debates to indigenous communities “denies the realities of native people’s lives, reducing the rich diversity of their beliefs, values, social relations, and practices to a onedimensional caricature" (Nadasdy 2005: 293). Conversely, the Chesapeake Bay ecosystem evolved simultaneously with the human use of estuarine and terrestrial resources for thousands of years. This study seeks to underscore these outdated concepts by offering evidence of highly resilient patterns of oyster harvesting practices and reef management techniques utilized by indigenous peoples living in the Chesapeake Bay watershed in contrast to the destructive nature of post-Colonial oyster ventures.

The Chesapeake Bay watershed spans roughly 166,000 km^2, making it the largest estuary in the continental United States and the source of many thriving commercial fishery ventures (Rick et al. 2016). However, before modern occupation, the Bay had a deep history of human settlement and subsistence. The archaeological record of the Bay spans from as early as the Paleoindian period (B.C. 12,000 - 10,000) through the 20^{th} Century. It served as Native Americans' primary estuarine resource along the mid-Atlantic coast for epochs due to its rich abundance of natural resources. Native people historically made widespread use of the Bay, most commonly leaving archaeological evidence behind in the form of shell middens or shell rings. The earliest record of a thriving oyster population in Chesapeake region dates to the Pleistocene period (2.58 mya - 1,700 years ago), during the development of the proto-Chesapeake Bay (Kusnerik et al. 2018). Early Native Americans utilized these fisheries as food sources and construction material to build monumental shell rings. Intensive human harvest of oysters in the mid-Atlantic began to pick up around the Late Archaic period (2500 - 1200 B.C.) as extensive shell midden deposits materialize in the archeological record (Thompson and Worth 2011). The eastern oyster (*Crassostrea virginica*) typically dominates archaeologically recovered shell middens in the Chesapeake watershed (Jansen 2018).

Shellfish have a deep history worldwide, in both human and environmental contexts, dating back to the Pleistocene period (Waselkov 1987). As a keystone species, oysters perform vital roles in the Chesapeake Bay and mid-Atlantic ecosystem. They help build habitats for fish and other vertebrate species, filter water and represent a crucial component in the food chain (Kusnerik et al. 2018). Regrettably, decades of post-Colonial overharvesting, pollution, disease, and perturbation have left oyster populations in a dramatic state of decline (Rick et al. 2016). With the onset of colonization and into the following centuries, anthropogenic habitat modification to the Chesapeake Bay (i.e., habitat destruction and removal, intensive harvesting and fishing practices, and nutrient runoff) fundamentally changed the ecosystem of the Bay (Harding et al. 2008). These environmental changes gave rise to eutrophication, disease, species decline, and eventual collapse.

By the mid to late 1800s, 400 to 600 thousand oysters were being harvested from the Bay annually for canning and commercial consumption, quickly depleting resources (Thompson et al. 2020). Harvests decreased as much as 50 percent by the early 1900s and 98 percent by the early 1990s. Modern Maryland oyster populations are estimated to represent less than one percent of their historical abundance, and Virginia follows close behind. These precipitous declines cause difficulty in establishing baselines for restoration, adding to the already complicated task of restoring a healthy and sustainable fishery with ever-present eutrophication, sedimentation, disease, and ongoing harvest (Rick et al. 2016). These challenges have brought new, interdisciplinary perspectives to studying ecosystem health to the forefront of academia (Thompson et al. 2020).

Rick et al. (2016) suggests a key element missing from the discussion of historic oyster abundance, and population structure is a comprehensive understanding of the fishery before historical overfishing. The lack of excavated and dated Chesapeake shell middens leaves a gap in our knowledge of the antiquity and evolution of human estuarine resource usage, broader settlement and subsistence strategies, and responses to rising sea levels and changing environmental dynamics (Rick et al. 2016). Archeological studies of shell midden and coastal sites provide a deeper historical perspective into explanations of oyster collapse and help inform policy makers about places to concentrate oyster revitalization efforts (Jenkins 2017). Their results shed light on the variable ways that humans have transformed natural landscapes during the Anthropocene (a term some researchers have proposed for the current geological age) (Crutzen and Stoermer 2000). Understood as a period when activity has been the dominant influence on the climate and environment, the Anthropocene has become a growing focus in archaeological studies focusing on the long-term histories of human-environmental relations. Oysters, along with other shellfish and mollusks, act as valuable proxies for past human-induced and ecological change, even being utilized by some researchers as a marker of the Anthropocene (Thompson et al. 2020).

Previous research (e.g., Harding et al. 2008; Rick et al. 2016; Reeder-Myers et al. 2016; Lulewicz et al. 2017; Jansen 2018; Jenkins and Gallivan 2019; Thompson et al. 2020) demonstrated that Native Americans in the Chesapeake harvested oysters sustainably, on a millennial time scale, a remarkable pattern considering that the 19th century Chesapeake oyster fishery collapsed following only 200 years of post-colonial harvesting (e.g., Kusnerik et al. 2018). Archaeological evidence displays that the precontact oyster fishery fostered resilience through Native harvesting practices centered on oyster collection from shallow water, nearshore reefs (Jenkins and Gallivan 2019).

Many other studies have shown the ingenuity of Native coastal dwellers over time. Using height as a proxy for oyster health, Rick et al. (2016) suggests Native Americans living in the Chesapeake watershed maintained a sustainable oyster harvesting system for millennia by demonstrating an increase in valve height through time. Thompson et al. (2020) display growth in oyster size from the Late Archaic period through the Mississippian period (ca. 1000 to 500 cal. BP), implying localized increases in ecosystem productivity, either through human management practices or environmental change. They suggest that when Native American usage of oyster reef ecosystems intensified, territoriality of fishing rights developed to manage populations. Mississippian societies maintained considerable hierarchical control over oyster reef harvesting, acting as a management system for common-pool resources to reduce harvest threats by one person or group. These territorial practices may have started much earlier, perhaps parallel to ethnographic and archaeological evidence from fisher-hunter-gatherers elsewhere in the world (Thompson et al. 2020).

Jenkins and Gallivan (2019) also see an increase in mean oyster height from the Late Archaic through the Middle Woodland I period, evidence of possible oyster reef cultivation, and maricultural practices such as shelling and culling (i.e., the practice of returning oyster shells to the water to build up reef habitat for future growth) (Jenkins 2017; Jenkins and Gallivan 2019). They show the state of the Native oyster fishery was not only sustainable but also resilient (i.e., “the capacity of a system to recover in size, structure, and diversity after strain caused by stress”) through a significant decrease in shell height from the Middle Woodland I phase (500 B.C. to A.D. 200) to the Middle Woodland II phase (A.D. 200 to 900) (Jenkins and Gallivan 2019: 18). These trends coincide with substantial increases in population size and resource demands, as well as sedentism. With Native American management, oyster height increased again at the onset of the Late Woodland period, returning to previous measures and continuing to remain at a constant size through European contact (Jenkins and Gallivan 2019).

Patterns show that oyster populations in the Chesapeake Bay remained relatively stable until the onset of Colonization in the early 1600s. Harding et al. (2008) observed a decline in oyster height (longer measure) between oysters harvested by Jamestown settlers from 1611 to 1612 and modern oyster populations at the same age. They conclude oysters at the onset of Colonization were larger, in a better state of health, and had significantly faster growth than modern oyster populations. Unlike historic oyster populations, modern James River oysters have faced severe degradation by years of exposure to diseases such as Dermo and MSX as well as other chronic environmental stresses (i.e., pollution, dredging, eutrophication), negatively impacting growth and reproduction (Harding et al. 2008).

Understanding this past provides a lens through which we can look towards the future. Through this study, I add to conversations surrounding future restoration goals and initiatives for the Chesapeake Bay oyster fishery by offering examples of practices utilized by Native Americans in Tidewater, Virginia, to produce a long-term, sustainable, and resilient oyster fishery before European contact and specifically highlight the changes that lead to the 20^{th}-century collapse. Drawing from foundational studies of historic oyster populations in the Chesapeake, including works done by Gregory Waselkov (1987), Bretton Kent (1989), and Torben Rick (Rick et al. 2011; Rick et al. 2012; Rick et al. 2016), I investigate shifts in oyster harvesting and reef management techniques through three distinct periods (i.e., the Late Archaic, Middle Woodland, and mid-1800s) at an archaeological site located along the York River. These pioneering studies enhanced archaeologists' perception of Ecofacts such as the oyster, an "artifact" traditionally regarded as "trash" (hence the term midden meaning trash pile).

For this study, analysis primarily concerns determining the location of harvest (i.e., offshore or nearshore) to underscore harvesting techniques associated with each habitat. I will base the methods used to determine the habitat of oyster harvests on two early oyster shell studies (i.e., Lawrence 1988; Kent 1989). Both studies derived their models from data collected in the lower portion of the Chesapeake Bay estuary, creating a solid basis for comparing the York River site considered for the following study. The five shell attributes examined to determine the harvest location were derived from Jenkins and Gallivan's (2019) model. The two harvest habitat regions considered are nearshore and offshore zones (following terminology established by Rick et al. 2016). Nearshore reefs are those accessible by foot along the water's edge, near areas of tidal shifts. Offshore reefs represent those completely submerged underwater past the tidal zone and requiring access via a watercraft (i.e., canoe). The overarching goal of this study is to provide data that informs the current Chesapeake Bay oyster preservation policy of both beneficial and detrimental management techniques used throughout time. I focus on three interrelated questions:

- Did oyster height (and other morphological characteristics) vary among the Late Archaic, Middle Woodland, and Historic (i.e., the 1800s) periods?
- How were the pre-contact Native Americans able to maintain a sustainable oyster fishery in the Chesapeake for millennia while colonists collapsed the oyster fishery in a few hundred years?
- How can archaeological studies inform the restoration and conservation of modern oyster fisheries?

Knowledge of these past dynamics help us prepare for future oyster reef ecosystem management and restoration.

Analysis of coastal shell middens offers a unique perspective into the oyster harvesting techniques of Native Americans, helping to explain how they maintained a sustainable oyster fishery over an extended period. Archaeologically recovered shells present long-term shell size and habitat data that instruct assumptions of Native oyster harvesting practices (Rick et al. 2016;

Jenkins and Gallivan 2019). I hypothesize Native American oyster harvesters in the Late Archaic period primarily harvested the offshore oysters for their superiority in both taste and social prestige . However, with growing population sizes and the onset of village life during the Middle Woodland period, common resource management intensified. Villages and other more extensive, sedentary groups were dependent, to a large extent, on local resources, and likely enacted practices to encourage the health and productivity of nearby reefs. These practices included seeding reefs with old oyster shells (i.e., Mariculture) and/or shifting harvesting initiatives from offshore to nearshore, fostering resilience within the oyster fishery (Thompson et al. 2020). Both the oyster harvesters in the Late Archaic and Middle Woodland periods were capable if harvest offshore oysters. However, during the Middle Woodland period, Natives consciously decided to shift harvesting initiatives away from overused areas to increase the resilience of the fishery and preserve the sustainability of the reefs. At the onset of Colonization, oyster harvesting enterprises again set their targets on the high-quality, more profitable offshore oysters. However, with no common pool resource management in place, collection exponentially intensified until the rate of oyster collection exceeded the rate of oyster reproduction, condemning the fishery to depletion and near extinction.

Coastal environments offer a unique perspective on early human estuary usage and subsistence practices. They do more than simply define societies' food sources; they influence factors ranging from long-term history, culture, kinship, political organization, and architecture to resilience and colonization experience. Studying coastal sites offers researchers insight into the emergence of nonagricultural economic systems and a contrasting historical trajectory to traditional interior societies. In the southeast, indigenous coastal sites have the potential to reveal evidence regarding complexity in nonagricultural societies and the experiences of Native

Americans during the early days of colonization, as the southeastern coast served as an entry point for most early colonial endeavors.

History of the Oyster Fishery

As this study builds a narrative of shifting oyster harvesting practices at Site 44YO0797, it is essential to address the climatic shifts leading to the development of the oyster fishery utilized by the Native Americans and destroyed by the Colonists. The Archaic period coincides with a geologic epoch known as the Holocene. The Holocene dates to about 12,500 B.P, the end of the last glacial maximum. For coastal regions, the Holocene was a time of climate change and increasing ecological complexity. As the last "ice age" was coming to an end, the climate was quickly warming, and sea levels were rising due to melted glacial ice flowing back into the ocean (Dame 2008). With rising sea levels, intertidal and shallow coastal habitats were continually changing as they were submerged or forced up-slope. By about 6000 B.P., sea-level rise had slowed, and deltas of accumulated sediment began to appear in submerged river valleys and drainage basins. As sea level stabilized, modern coastlines started developing along the east coast of North America (Thompson and Worth 2011). The freshly submerged areas transformed into estuaries, which became the habitats of thriving bivalve and shellfish populations (Dame 2008). The estuarine systems rapidly accumulated some of the most productive natural ecosystems on the planet, and the native people of the coastal southeast took full advantage of these resources. The rich estuaries of the Late Archaic fostered a complex food web centered on the presence of shellfish, like the eastern oyster (*Crassostrea virginica*) (Dame 2008).

Sporadic evidence exists for coastal archaeological sites in North American before 4500 B.P. (Russo 1996). These sites generally consisted of relatively small population numbers and were localized in Florida, Georgia, and South Carolina (Anderson et al. 2007). We have little knowledge of early coastal adaptations; however, this is primarily a result of poor site visibility and accessibility due to sea-level rise rather than an ability of coastal peoples to exploit available resources (Anderson et al. 2007). Around 4200 B.P., archaeologists noted apparent population growth and increased site distribution and complexity correlated with evidence of human utilization of shellfish and other estuarine resources along the Atlantic coast. The increases in coastal settlement around 4200 B.P. match general trends in sea-level rise and their effects on estuarine resources, especially the greater availability of shellfish.

Many researchers deemed environmental conditions earlier than 4200 BP very unstable (i.e., high salinity) and unable to support the substrates necessary for shellfish to settle (Thompson and Worth 2011). However, after sea conditions stabilized, coastal sites on the Atlantic seaboard were highly occupied from 4200 B.P. until about 3800 B.P., when significant sea-level fluctuations began (Thompson and Worth 2011). Southeastern North America experienced rapid climate change from about B.P. 4500 to 3000 (Dame 2008). During this interim period of instability, more sedentary sites along the coast appeared in the archeological record. The coastal Native Americans took full advantage of the higher productivity of the estuarian ecosystems to develop a denser, more sedentary culture exemplified by constructing monumental shell rings and extensive shell middens throughout the coastal southeast. Some research even claims possible overexploitation of shellfish stocks by Native Americans during the Late Archaic period because the organisms in these ecosystems were easily accessible (Dame 2008).

Around 3000 B.P., the Atlantic coast experienced a significant period of climatic cooling, increased precipitation, flooding, and falling sea levels. Coinciding with these climatic fluctuations, coastal site numbers began dwindling. No new sites dated between c. 3800 – 3200

B.P., and by 3000 B.P., shell ring and midden sites mainly had been abandoned. Some areas indicate a shift toward a terrestrially based settlement system with greater emphasis on hunting than collecting estuarine resources (Thompson and Worth 2011). Around 2400 B.P., sea levels on the Atlantic coast returned to a high stand (i.e., high sea level), close to the levels before 3800 B.P. Groups who previously occupied coastal areas during the Late Archaic began to resettle, resulting in a new cultural tradition of coastal dwellers around 2400 B.C. (Thompson and Turck 2009). Overall, there is a general agreement that there was a high stand at the beginning of the Late Archaic period on the Atlantic coast, lower sea levels during the Early Woodland period, and a return to high stand after that point (Thompson and Worth 2011). However, the exact timeframe is up for considerable debate. Scientists propose at least seven small-scale sea-level fluctuations over the past 5000 years, three of which occurred after the Early Woodland low stand (Colquhoun and Brooks 1986). For this study, I follow the reconstruction of higher sea levels during the Late Archaic period (2,500–1,200 B.C.), lowering of sea levels into the Early Woodland period (1,200–500 B.C.), followed by rising sea levels moving into the Middle Woodland period (500 B.C.–A.D. 900) and beyond. Even today, the Chesapeake Bay sea levels have risen 0.9 meters (three feet) since John Smith first arrived in the early 1600s.

Chesapeake Regional History

Native American habitation of the Chesapeake Region began somewhere between the Paleoindian period (15000 to 8000 B.C.) and the Early Archaic period (8000 to 6000 B.C.) (Dent 1995). However, archaeological remains of these periods are relatively scarce due to sea-level rise following the end of the Pleistocene Epoch (2.6 million to 11,700 years ago) (Egloff and Woodward 2006). The precontact period, or time before European arrival in North America, is typically divided into three distinct periods: the Paleoindian (15000 to 8000 B.C.), the Archaic

(8000 to 1200 B.C.), and the Woodland (1200 B.C. to A.D. 1600). The Paleoindian period holds little relevance to this study, so only the Archaic and Woodland pre-contact periods are covered moving forward. The Archaic period is further divided into the Early (8000 to 6000 B.C.), Middle (6000 to 2500 B.C.), and Late (2500 to 1200 B.C.) subperiods. The Woodland period is similarly divided into Early (1200 to 500 B.C.), Middle (500 B.C. to A.D. 900), and Late (A.D. 900 to 1607) (DVHR 2018).

The Archaic Period

The Archaic period coincided with the end of the Pleistocene Epoch as the local area established a temperate ecosystem. Southeastern Virginia's climate shifted from moist, cool to a warmer, drier environment, and the vegetation, from a largely boreal forest to a mixed conifer-deciduous forest. These changes defined the formation of the Chesapeake estuary (Dent 1995). The Archaic period a time of adjustment to the rapidly changing landscape and culminated in a time defined by social experimentation and redirection of human prehistory in the Chesapeake Region. With the climatic changes came a more significant seasonal availability of resources, allowing for a greater reliance on seasonally-geared mobility. Archaeological evidence most directly displays Archaic populations as band-level groups of hunter-gatherers who moved seasonally based on the availability of resources (Romo et al. 2021). The Archaic hunter-gatherers frequently left behind chipped and ground stone artifacts but notably appeared to maintain no ceramic tradition (Dent 1995). They occupied relatively large regions, living in base camps during the year and dispersing seasonally into smaller microband camps for resource procurement (Romo et al. 2021).

While the Archaic period was a time of drastic change in the Chesapeake Region, this study focuses primarily on the Late Archaic period (2500 – 1200 B.C.). The Late Archaic period spans the Atlantic/Sub-boreal transition, when warm, dry periods allowed for the establishment of open grasslands and expanded oak-hickory forests. Along the Virginia coast, mixed oak-pine forests and plant species similar to those of the modern climate began to develop (Romo et al. 2021). The stabilized sea levels resulted in new estuaries and various unique marine resources available for exploitation (Dame 2008).

Researchers classified Late Archaic sites into large vs. small settlements, with large sites associated with increasing sedentism, collective group activity, and small sites with temporary camps used for resource extraction. This dichotomy can be misleading as macroband sites may represent the reoccupation of one site over a substantial period rather than a singular, large, year-round site (Dent 1995). However, the classification offers a basis for dividing archaeological sites dating to the Late Archaic period into three broad categories: macro-band settlements (large sites occupied in the winter), base camps (smaller sites used in the summer), and transient camps (short-lived sites used year-round but particularly in the spring and fall for resource procurement) (Romo et al. 2021). Late Archaic base camps would likely contain hearths, structural remains, and heavy woodworking items, as well as the remains of typical lithic reduction. Sites located near water often showed evidence of fish processing and/or small globular pits or middens for steaming open shellfish (Dent 1995).

During much of the Archaic period, pre-contact Native American groups lived in relatively mobile, small hunting bands. However, as the environment stabilized and resources became more abundant, Native American groups in the Chesapeake developed new adaptive strategies coinciding with population increases and mobility decreases. As the Late Archaic transitioned into the Early Woodland period, small hunting bands transitioned into larger, semi-sedentary groups (Gallivan 2011). The climate became hotter and drier as riverine and estuarine settings provided an abundance of new plants and animals to harvest. Previously submerged floodplains now provided coastal Native Americans with a regular supply of estuarine resources, especially shellfish. Native Americans developed new technologies that enhanced their ability to collect and utilize food resources gathered from riverine and estuarine environment. New technologies includes large stone knives, darts, and spear points with stemmed hafts, cooking slabs made of soapstone, new vessel types, and Late Archaic tool kits (i.e., atlatl weights, grooved stone axes, metates and stone drills). As a result of these new technologies and more ecologically rich environments, there was less need to travel long distances to collect resources. Native groups now had the opportunity to remain in one area and more consistently harvest local resources (Dent 1995). This reinforced sedentism and population growth, stimulating a lifestyle dependent on resource procurement expeditions collecting and returning resources to a central location rather than consuming them at the collection location (Romo et al. 2021).

The Woodland Period

The Woodland period is most notably characterized by the introduction of ceramic technology, the increased dependence on horticulture, and the heightened tendency of Native groups towards sedentism. As stated above, the Woodland period is divided into three subperiods (Early, Middle, and Late) based on the stylistic and technological variations in ceramics, projectile points, and settlement patterns. The Early Woodland period began around 500 B.C. Early Woodland sites in the Chesapeake Region typically consisted of small to medium camps located along small bodies of water such as streams or rivers. In many of these locations, occupation continued and grew into the later Woodland periods. Researchers have identified relatively few sites dating to the Early Woodland period in coastal Virginia, likely due to the lower sea levels present during this period (Thompson and Worth 2011). The majority of those identified have been relatively small and appear to represent short-term camps (Romo et al. 2021). For those reasons and the lack of archaeologically recovered material dating to the Early or Late Woodland periods, I will only directly address the Middle Woodland period in this study.

The Middle Woodland period defined a noticeable change in material culture, social organization, and settlement practices of Native groups living along the Virginia coast. These changes included variations in ceramic and projectile point technologies, primarily sedentary-style settlements, an increase in population size, better defined social and regional identities, interregional spheres of interaction and trade, and the appearance of ranked societies (Dent 1995). Ceramic style and manufacturing became increasingly crucial as Native people adopted their vessels as a mainstay of cooking and storage activities in the region. The two major ceramic wares of the Middle Woodland period in the Chesapeake region were Popes Creek—net marked, sand tempered—and Mockley—shell tempered, net-and-cord-marked. The two types marked a division in the Middle Woodland period. First, the Middle Woodland I phase (500 B.C. to A.D. 200) was characterized by a dominance of Popes Creek ceramics and the appearance of sites with shell middens and pit features along the mid-Atlantic Coast. Mockley ceramics rose in popularity at the onset of the Middle Woodland II phase (A.D. 200 to 900) as new Native groups (i.e., Algonquian-speaking peoples) moved into the area bringing with them new pottery traditions (Blanton 1992; Gallivan 2003). By the end of the Middle Woodland period, Algonquian-speaking tribes controlled the majority in the Coastal Plains region of Virginia.

Subsistence strategies during the Middle Woodland period emphasized hunting (i.e., deer and other land mammals) and gathering (i.e., fish, shellfish, starchy roots, tubers, and other local plants (Stewart 1992). By this time, archaeologists speculate many Native American groups had developed relatively sedentary settlement patterns, choosing to reside in moderately sized "villages" or "macroband camps." Archaeologically, these sites manifest as low-density middens in coastal environments. Restricted wondering, the intentional movement of people in search of resources, was believed to be actively practiced by some communities. Small groups, possibly family units or specialized task forces, would separate from the core aggregate for a short period (up to several weeks) and establish microband camps to collect resources to bring back to the "village" (Stewart 1992; Blanton 1992).

By the Late Woodland period (A.D. 900 – 1607), agriculture was widely used as Native peoples' primary source of subsistence. The adoption of agriculture immensely changed earlier forms of settlement patterns for Native people living in the Chesapeake region. Instead of coastal proximity, fertile, arable land became the dominant factor for selecting settlement locations. During the Late Woodland I phase (A.D. 900 – 1200), settlements were medium in size. Moving into the Late Woodland II phase (A.D. 1200 to 1500), settlements grew into large, nucleated, and sometimes palisaded communities. Following the Woodland period, the Protohistoric phase (A.D. 1500 to 1607) marked the arrival of the first European in the Chesapeake region (Gallivan 2003).

The Historic Period

During the Late Woodland and Early Colonial periods, the southern shore of the York River was home to a sizeable group of Algonquian-speaking Native Americans. Their principal village, Kiskiak, contained around 200 men, women, and children and was located east of Indian Field Creek, nine miles downriver from Site 44YO0797 (Romo et al. 2021) (Figure 2). Kiskiak was an original member of the Powhatan Chiefdom—one of the most powerful political entities in the mid-Atlantic region—led by Wahunsenacawh, or Chief Powhatan (Gallivan 2003). John

Smith had limited interactions with the village of Kiskiak upon his first arrival to the Americans in May of 1607. However, contact increased over time, and eventually, the people of Kiskiak were forced off their ancestral homelands by the pressure of European expansion. In 1644, one final conflict between the colonists and Native Americans sealed the fate of the dying Native empire. Opechancanough, Wahunsenacawh's brother and leader of the Powhatan Chiefdom since 1618, led a final organized assault against the European colonists (Gallivan 2003). The assault was unsuccessful, and Opechancanough was captured and killed by English colonists. Opechancanough's successor signed a treaty with the English that ceded Powhatan sovereignty and relinquished their control over all of the land between the York and Blackwater Rivers. The loss marked the end to the mighty Powhatan Chiefdom (VDHR 2018) and allowed the Europeans to take complete control of Powhatan land, including where Site 44YO0797 sits.

Moving into the 18th and 19th centuries, Site 44YO0797 merged into a York River plantation, Capahosic, named for the stream which ran along its southern boundary. The earliest recorded land patent for the project area was granted to William Bauldwin in October of 1652, encompassing approximately 600 acres of land. By the 1690s, Captain Baldwin Matthews had taken up residence at Capahosic. Little is known about Matthews, but his obituary stated he owned enslaved African Americans who likely resided on the plantation (Romo et al. 2021). After Matthew's death, the property was listed for sale in several editions of the *Virginia Gazette*. After changing hands several times and expanding to roughly 1756 acres, Capahosic plantation came into Francis Willis IV's possession in 1755. Willis managed the York County property as a plantation quarter, with a substantial number of enslaved people living and working there under the direction of an overseer. Bruton Parish baptism records listed at least 15 children and five adults belonging to Francis Willis IV between June 1762 and July 1768 (Romo et al.

2021: Vogt 2004:11-56). In 1765, Francis Willis IV mortgaged his 1,756-acre York County plantation and its associated holdings. The mortgage deed listed records of at least 50 enslaved men, women, and children (Romo et al. 2021: YCDB 7:116).

In early April 1767, Francis Willis IV placed a notice in the *Virginia Gazette* advertising the sale of his York County plantation. As described by Willis, this "commodious and very valuable tract of land" was still home to 31 of the enslaved African Americans enumerated in the 1765 mortgage and included a "good dwelling house," perhaps the former residence of Captain Baldwin Matthews, or possibly a newer dwelling occupied by an overseer (Romo et al. 2021: Virginia Gazette, 2 April 1767:3). A map of the Williamsburg area by French cartographer Alexandra Berthier in 1781 indicated a cluster of buildings immediately to the north of the convergence of the York River and Carters Creek, suggesting that the "dwelling-house" Bland advertised was located within archaeological Site 44YO0270, only a short distance to the northeast of Site 44YO0797.

In 1785, Bland finally sold Capahosic to an acquaintance, Henry Tazewell, a distinguished Virginia politician. According to 1785 personal property tax rolls, Henry Tazewell's York County holdings included 21 enslaved African Americans under overseer Silvanus Prince, many of whom are presumed to have lived at Capahosic plantation. By 1810, Tazewell's heirs had sold the 1,447-acre property to John Waller, Tazewell's brother-in-law. Waller took up residence on the property, along with more than 20 enslaved African Americans. A description of the property in the county land books indicated the property sat at a point of land bounded by the York River to the north and the marshes of Capahosic (Carter) Creek to the south (Romo et al. 2021: York County Land Books [YCLB] 1810, 1816; York County Personal Property Tax Book [YCPP] 1812; York County Will Book [YCWB] 10:92).

Waller farmed Capahosic as a plantation quarter under the direction of an overseer. According to the 1828 personal property tax rolls, he then held nine enslaved African Americans in York County. His enslaved numbers increased over the following year so that by 1835 he owned 27 slaves over the age of 12, all of whom lived at Capahosic near or on what is now Site 44YO0797 (Romo et al. 2021). After changing hands several more times in the following years, Capahosic plantation finally fell into the trust of William S. Peachy in May 1851, who managed the plantation by overseers. During this time, two coastal survey charts of the York River were made, including a detailed account of the Capahosic plantation, previously not done since the American Revolutionary War. The main domestic complex was shown in the location of modern Site 44YO027. Site 44YO0797 consisted of land located directly along the marshy coasts of Carters Creek, designated as the location of the enslaved peoples' quarters (Romo et al. 2021).

After Peachy died in 1884, his executors sold the 1,229-acre property to Henry H. Gable. Eventually, the land was absorbed into the unincorporated township of Magruder, a primarily African American small aggregate occupied primarily by formerly enslaved peoples (Harris 2019). The majority of the residents of Magruder were farmers and oystermen, as the most significant source of income and most readily available resources for the residents came from the land and the water. The inhabitants of Magruder prized their ability to live off the land and their strong community ties to the area (Harris 2019).

In August of 1942, amid World War II, the US Navy declared a need for a new training camp to accommodate 50,000 "Seabee" recruits. The search for a location began and quickly focused on the coast of the York River. The Navy rapidly acquired 11,000 acres in York County, including the Site 44YO0797, displacing the primarily African American residents of the town of Magruder and numerous other farming families. The then-current owners of Capahosic plantation deeded the property to the U.S. government for inclusion in the U.S. Naval Construction Training Center in August 1943. Since that time, the property has remained part of a disclosed government facility (Romo et al. 2021).

The Study Site

The study site, termed Site 44YO0797, occupies the southern margins of a broad, relatively level terrace bounded by Carter (previously Capahosic) Creek and marshes and drainages near the confluence with York River (Romo et al. 2021). It is situated about nine miles upriver from the Powhatan village of Kiskiak (Jenkins and Gallivan 2019) (Figure 2). Site 44YO0797 is termed a "Second Order" site by William & Mary Center for Archeological Research's (WMCAR) site classification system. "First order" sites are considered large-scale, sedentary villages such as the Late Woodland/Contact period settlements of Kiskiak and Werowocomoco. Semi-sedentary, resource procurement settlements of the Middle and Late Woodland like 44YO0797 are usually only classified as "Second Order." However, these sites are highly abundant in the area and hold value in explaining the early regional and local history. Middle Woodland sites contain essential evidence of native lifestyles before English contact and act as a base comparison for the benchmark of cultural changes occurring afterward (Blanton et al. 1997). This means archeological research on sites like 44YO0797 is beneficial not only at establishing baselines for ecological change but also cultural and historical change.

The excavation at Site 44YO0797 was a Phase III archeological excavation completed by the JRIA (James River Institute for Archaeology), a local contract archeology team, from August 2015 to February 2016. The project recovered data from a central, approximately 3.1-acre portion of the site before construction. The data recovery transpired in three successive stages: 1) test unit excavation/soil chemistry sampling, 2) mechanical soil removal, and 3) feature excavation. The test unit excavation took a stratified, systematic sample of plowzone artifacts and soil chemistry samples from the impacted site area ahead of mechanical stripping. Test units were situated in a grid pattern across the site and excavated by hand excavated in arbitrary 10 cm levels within the natural soil layers. All soil removed from a test unit was screened through ¼ inch wire mesh, from which all historic (ca. 1600 - 1965) and prehistoric (pre-1600) artifacts were collected. The excavation consisted of a total of 145 test units. To ensure sufficient soil samples for analysis, samples were taken from shovel test pits excavated every 20 ft within the wooded portion of the site (Romo et al. 2021).

Based on the test unit excavation results, which revealed areas with significant artifact concentrations and/or features, five regions were selected for mechanical stripping, for a total of 35,992.5 ft^2. During mechanical excavation, topsoil was removed in shallow layers down to the surface or the E Horizon. Archaeologists directed the depth and extent of digging. Excavations halted when potentially significant cultural features emerged, and features were marked for further analysis. After mechanical excavation, archaeologists cleared and identified all features. A total of 91 features were identified, of which 39 were completely excavated. Artifacts recovered from the features were bagged and retained for further analysis. Flotation samples were collected from features deemed likely to yield botanical remains, such as sub-floor pits, trash pits, and roasting pits (Romo et al. 2021).

Site 44YO0797 contained two different stratigraphy zones, an open field in the northern end of the area and a wooded area in the southern portion. The soil encountered in the wooded area consisted of two A Horizon layers—recent topsoil and earlier topsoil—on top of an E

Horizon. Both levels of A Horizon appeared to be a plowzone (i.e., soil that has become homogenized through plowing), likely caused by historic plowing during the Capahosic plantation occupation. Plowing mixes soil layers and erases boundaries between occupations, resulting in a singular, uniform soil layer. This often destroys upper portions of deeper features and can completely erase shallower ones. Plowing also affects artifact distributions by breaking them down into small pieces and/or shifting and mixing artifacts from different periods into unrelated conglomerations. The open field to the north of the woods also contained plowzone and E Horizon deposits. However, the stratigraphy in that area was far more complex and much more disturbed than in the wooded area. The open field was subject to two different periods of plowing while the wooded area experienced minimal plowing. The fielded area faced disturbance by significant historic plowing and 20th-century construction, while the wooded area along the southern coast of Carter Creek showed very little evidence of large-scale disturbance and produced more reliable stratigraphy. Fortunately, most of the excavations happened within the wooded area (Romo et al. 2021).

Within the precontact occupation, of the identified 27 precontact roasting pits, 15 of them were entirely or partially excavated. Those are the pit features referred to in the remainder of this study. All the roasting pits represented deposits of densely packed shells cut into the surrounding A and E Horizons. The oyster shells primarily concentrated in the A Horizon near the marshy southern edge (Romo et al. 2021.) (Figure 6). The discontinuous nature of the densest parts of the midden suggests that it was an accretional midden, developed from repeated, separate depositions of shells in the same location over a long period (Waselkov 1987:116), indicative of a continuously used resource procurement camp. The fifteen individual deposits overlapped and blended, appearing as a single midden due to continuous use over a few thousand years.

The roasting pits' layouts varied considerably. Length ranged from about 0.27 to 1.31 meters, with an average of 0.57 meters. Widths were between 0.21 and 1.04 meters, with an average of 0.45 meters. Archaeologists fully excavated fourteen roasting pits with depths ranging from 0.09 to 0.381 meters, with an average of 0.17 meters (data originally given by Romo et al. 2021 in imperial and transferred to metric by researcher). These were the fourteen features considered in this study. All oyster shells from the pits were removed, washed, and bagged for later analysis. The roasting pits contained almost entirely oyster shells, with a few additionally holding sherds of Native American pottery—specifically Popes Creek, Mockley, and Townsend—and small fragments of animal bone. Along with the shells, all the features had charred material indicating the act of heating or firing (Romo et al. 2021).

Two different types of precontact roasting pits were identified at Site 44YO0797—Type 1 and Type 2. Type 1 roasting pits showed obvious signs of fire or heating, while Type 2 roasting pits did not. Originally, excavators only recognized Type 1 roasting pits as oyster roasting pits rather than hearths due to their evidence of heating and the presumed usage of the site as a resource procurement facility. Type 1 roasting pits included features 1003, 1060, 1061, 1079, 1083, and 1085. The evidence for the firing/heating pits differed between the six features. Feature 1003 comprised a central core of soil and burned oyster shells, surrounded by a large patch of thermally-altered E Horizon. Feature 1079 was comprised of a core of oyster surrounded by thermally-altered E Horizon but contained no burned shell. All of the remaining roasting pits were classified as Type 2. Initially, it was assumed they represented shell-processing pits due to their lack of heating (Romo et al. 2021). Shell-pits such as these at other sites have been interpreted as food processing pits or refuse pits for the remains of meals (Wells 2002). Ultimately, the Type 2 pits were classified as roasting pits due to their identical size and appearance to the Type 1 roasting pits and the presence of charcoal and charred remains within them (Romo et al. 2021).

The historic occupation related to Capahosic plantation spanned from approximately 1751 to 1884. Artifacts and features recovered dating to this time indicate that Site 44YO0797 was home to an enslaved African American occupation from the end of the 18th century into the mid-to-late 19th century. Seventeen historic features date to this period, most of which are sub-floor pits or borrow pit. All of the historic features were fully excavated. The sub-floor pits were assumed to be associated with 18th and 19th-century structures occupied by African Americans and used for several different functions (i.e., borrow pits for clay, "hidey holes" for stolen or contraband goods, food storage pits, personal storage pits, and possibly even religious shrines). The 11 sub-floor pits identified were spread across the site in small clusters, each likely to represent different structures. One of the most common uses of sub-floor pits across cultures is food storage (Samford 2000). Within many sub-floor pits, macrobotanical remains of food were found, including many oyster shells.

The other type of historic feature common to Site 44YO0797 was the borrowing pit. Borrow pits encountered outside of buildings were typically sizable, crudely excavated holes from which clay was extracted. Borrowing pits are relatively common in these types of archaeological sites, especially near dwelling structures. All of the borrow pits contained food remains, especially animal bones and copious shellfish valves (Romo et al. 2021). Two of the 15 historic pits—1001 and 1057—were analyzed for this study due to their sheer size and abundance of oyster shells compared to the other features. Feature 1001 was a vast and deep sub-floor pit associated with the presumed location of Building 2, one of the enslaved families' dwelling. Feature 1057 was a considerable borrow pit consisting of several distinct deposits that shared many similarities with feature 1001 (Romo et al. 2021).

The results of the excavations revealed Site 44YO0797 was occupied by both Native American and African American groups. The Native American occupation encompassed groups from the Middle Archaic, Late Archaic, Middle Woodland, and Late Woodland periods. These occupations were represented by projectile points, fire-cracked rock (FCR), debitage from lithic reduction, many types of ceramics, and a large number of features, including several sizeable shell middens. The African American occupation was associated with Capahosic plantation and likely dated between 1777 and 1845. It was represented by many domestic and architectural artifacts and several food-remain-filled sub-floor pits and borrow pits. The sub-floor pits marked the location of several structures, likely slave quarters (Romo et al. 2021).

Theoretical Paradigm

Historical Ecology

I suggest this study can be understood best through the lens of historical ecology. As a relatively new research paradigm, historical ecology emerged in response to previous frameworks that sought to understand human-environment interaction, most notably cultural ecology. Traditional perspectives on human-environment relations separate and oppose people and nature. Humans were said to either co-exist in harmony with nature or overexploit and degrade nature, as human cultures "determined" by their environment (Erickson 2008). The environment was "an immutable given or a fixed entity to which human societies adapt (or do not, and thus, fail and disappear)" (Erickson 2008: 157). Cultural ecology emphasized the linear nature of human societies that pass through a sequence of evolutionary stages, from simples to complex, in advancement towards “civilization.” Julian Steward (1955) claimed these changes were induced by necessary adjustments to a fluctuating environment (Richmond 2016). Each phase of development related to the apparent complexity of human-environmental relations (i.e., poor environments produced simple societies as humans had minimal impact on the environment while rich environments molded complex chiefdoms or stately societies because they imparted high impact on the environment) (Erickson 2008).

Cultural ecology held various issues, including the inability to provide models for explaining the origin and persistence of cultural features or determining the extent of environmental influence in the evolution of specific cultures (Orlove 1980). It viewed the center of human-environmental interactions as the exchanges of energy with other plants and animals in an ecosystem. Complex social phenomena were unexplainable due to the focus on the environmental determinism of societies with simple technologies that follow the linear relationship mode. Rather than exerting a lasting and impactful influence on the local environment, societies adapted to their constraints by nature (Richmond 2016).

Historical ecology attempts to amend the downfalls of cultural ecology by focusing on agency as the driving force behind human-environmental interactions. Historical ecologists focus on the intentional actions of people and the logic of indigenous knowledge, especially regarding resource creation and management. The disturbances caused by human activities are critical factors for shaping biodiversity and environmental health (Erickson 2008: 158). Erickson (2008) understands historical ecology as a theoretical perspective that offers an alternative to understanding human-environment interaction over the long term and the complex human histories of environments. Historical ecology emphasizes *landscape* as the medium created by humans freely acting within the environment. Landscapes can result from natural occurrences as much as human incidents; however, historical ecologists concentrate on human agency and indigenous knowledge of *landscape capital* (i.e., their understanding of resource management) to explain development and change (Erickson 2008). Landscapes are a place of interaction between humans and their environments with a temporal dimension that is as historical and cultural as it is evolutionary. Landscapes allow archaeologists to see the deep history of humankind inscribed on the land (Balée 2006). Rather than adapt to the constraints of an environment, humans practice resource management, working with nature, to construct and establish their environment (Erickson 2008: 160). Balée (1994) defines resource management as "the human manipulation of inorganic and organic components of the environment that brings about a net environmental diversity greater than that of so-called pristine conditions, with no human presence" (117). Historically, no environment containing humans can be classified as "pristine," as humans always affect their environment, sometimes positively or negatively, other times in big or small ways. Yet, there will always be indications of their presence.

A historical ecology perspective conveys simple forager-fisher or hunter-gatherers as agents of history, manifesting cultural pasts that reevaluate their placement on the so-called linear path of evolution (Balée 2006). Historical ecology challenged the notion of the "noble savage" or "pristine primitive" by exhibiting how indigenous people have not only altered their environment over time but at times enhanced their environment through intentional management practices. For example, numerous indigenous groups from North America, South America, and Australia engaged in the deliberate burning of forests to regulate species. The fires controlled by human agents enhanced the local landscape and amplified species diversity by removing invasive and overpopulated species from select parts of the environment, allowing more native species to flourish (Balée 2006; Erickson 2008).

Drawing from the deep historical understanding this theory provides, authors have suggested that linking historical ecology with conservation initiatives helps unify conservation paleobiology, conservation archaeobiology, and environmental history, creating a multi-disciplinary approach (Rick and Lockwood 2013). Historical ecology combined with other fields (i.e., paleobiology, conservation biology, ecology, history) offers insight into ecosystem change that can help inform contemporary environmental management and challenge long-held assumptions about the limited influence of humans in the distant past (Rick and Lockwood 2013). With influence from a historical ecology perspective, I analyzed eastern oysters from a coastal landscape along the York River in York County, Virginia, to provide data about Native American oyster harvesting practices. The intent was to establish reference conditions that assisted in framing management goals. My research initiatives reinforce the assertion made by Rick and Lockwood (2013) that the "perspectives from anthropology, ethnohistory, and archeology can provide insight into the ways traditional ecological knowledge, or the practices and beliefs of aboriginals, indigenous, or traditional peoples, may help improve the management of ecosystems" (Rick and Lockwood 2013: 47).

Sustainability and Resilience

Interactions between human society and the environment are best understood from a perspective that takes long-term dynamics into account and addresses questions from an interdisciplinary perspective on human societies and the physical environment (Redman 2005). My proposed view involves the concepts of sustainability and resilience. For contemporary archaeological theory to reflect and serve current society, archaeology must resonate with and be of interest to the local and global public. At this moment, discussions of climate change and ecosystem reconstruction sit at the forefront of the scientific community. Thus, topics such as sustainability and resilience permeate current archaeological research initiatives. As this study seeks answers to questions regarding the sustainability and resilience of the Chesapeake Bay oyster fishery, it is essential to define the place of both "sustainability" and "resilience" within the archaeological literature.

While many definitions for sustainability exist, all position sustainability as a positive, future-oriented goal with a fundamentally interdisciplinary intention. Sustainability originated from the fields of biology and economics to argue for the creation of systems of activity rather than the survival of discrete entities. Sustainability attempts to develop and maintain self-sustaining biological systems that will persist through time by working in harmony with, rather than against, the object of sustainability. Archaeology envisions "sustainability" in two ways: 1) to represent the material that is the focus of our inquiries (i.e., the sites, landscapes, and artifacts that we study), and 2) the practices of archaeologists in understanding the past through its material remains (i.e., archaeology as a process) (Carman 2016: 137). Sustainable archaeology as a material proposes a problem for the sustainability concept as artifacts do not breed, and therefore, cannot reproduce and add to a sustainable cycle. The archaeological record stands finitely and non-renewable, a deposit from one distinct moment in time. However, newer research looks beyond a singular terminus archaeological occupation to "archaeology as a process" that revives historical knowledge for modern and future usage, creating a continuous cyclical pattern. In this way, archaeology is sustainable so long as the "process" continues. "Sustainable archaeology" requires regular updates to remain relevant with current public interests if it is to be employed and incorporated into future human society (Carman 2016).

Sustainable archaeology should focus on understanding how past societies sustained long-term, resilient ecosystems, and in the process, avoided losing their socio-cultural complexity or falling into collpase. Locating sustainability within the dichotomy of collapse versus resilience allows archaeologists to better understand the past's value within the present. It resolves some of the growing need for deeper-time perspectives towards human-environmental relations. Much research reveals ancient and long-lived practices support sustainable lifeways. Sustainable archaeology presents the human experience in contexts that resonate with the most significant challenges of the present—a rapidly degrading environment and climate change resulting in the increased marginalization of certain groups. It centers on confronting such contexts to address emerging issues around humanity's uncertain future (Pikirayi 2019). This perspective allows questions such as: Did non-sustainable practices trigger the decline of particular cultures? For how long has human intervention in nature caused global environmental change? Can modern study of past environments contribute to the climate change debate? Sustainable archaeology informs on the ways people have changed the environment over time, both for the better and worse, and teaches us how not to repeat past mistakes (Carman 2016).

With evidence of historical sustainability comes the assumption of a resilient society or community practices. Resilience theory seeks to understand the source and role of change in adaptive systems, mainly transforming the systems (Redman 2005). In archaeology, changes are observed through a humancentric perspective. They are human-induced, shifting between periods of slow accumulation of "natural capital," intertwined by short sprints of practice restructuring resulting from external influences. Spatial and temporal attributes are discontinuous at all scales, meaning that change is not just the progression of a simple linear path; change is much more complex. The ecosystems in which change occurs do not have a single equilibrium with homeostatic control. Instead, ecosystems find balance through sets of destabilizing forces important for fostering diversity, flexibility, and opportunity and stabilizing forces important for productivity, fixed capital, and social memory.

Policies and management that apply fixed and overly structured rules for achieving constant yields lead to systems that increasingly lose resilience. This means ecosystems begin lacking the ability to absorb disturbances and ultimately end in collapse. Ecosystems are variable; therefore, management has to be flexible and allow space to change. The key to enhancing system resilience is for individuals, their institutions, and society to develop ways to learn from past experiences and accept that they will have to adapt to and compromise with inevitable uncertainties (Redman 2005). The long-term history of human-environment interactions found in the archaeological record reveals that many human responses and strategies to environmental pressure acted beneficially for a time. However, eventually, resilience decreases, and collapse comes for all ecological and social systems (i.e., the Chesapeake oyster fishery).

Resilience theory offers a framework for understanding that transformations, even the most socially and environmentally dislocating changes, are governed by particular dynamics and conditions. Understanding both the social and ecological systems in their own right is essential. However, it has become increasingly apparent that it is impossible to grasp one without realizing the recursive relationship social and ecological systems share (Redman 2005). Therefore, we must understand both the human and environmental processes that lead to the collapse of the Chesapeake Bay oyster fishery before substantial restoration can occur. Neither one cause can take the total blame for the collapse of the ecosystem as both the human and environmental factors acted contemporaneously. Thus, it will take historical knowledge of both the human and environmental effects on the oyster fishery to create sufficient baselines for restoration.

Methods

With the help of Professor Martin Gallivan, Department of Anthropology at William & Mary, I received access from the JRIA to the oyster shell recovered at 44YO0797. At first observance, apparent differences in shell size existed among the features. Following shell analysis methods of Lawrence (1988), Kent (1989), Jenkins and Gallivan (2019), and Thompson et al. 2020), I measured all whole, left oyster valves to infer the location of harvest—nearshore or offshore. Left valves were chosen for analysis because they are the cupped value to which the oyster meat attaches, while the right valves are the flat top of the oyster, often discarded after shucking (Jenkins 2017). To begin, I separated the oysters from each feature into left (cupped, “inny” hinge) and right (flat, “outtie” hinge) values, counted, and weighed both. Only left valves were considered further, and all partially broken valves were removed from the sampling.

I measured and assessed the following attributes for all the whole, left valves: mass, height (longest measurement from hinge to growth end), length, height-to-length ratio (HLR), left valve concavity (LVC) (i.e., “cuppyness”), presence, absence, and type of attachment scar, and presence, absence, and type of parasitism. Each shell was measured in the same way: height and length collected using a set of digital calipers in millimeters, HLR calculated by dividing measured height by measured length, mass via a metric scale in grams, and LVC measured across the length of the shell with a tire depth gauge. The presence/absence of parasitism and attachment scars was observed qualitatively by the researcher. All data, shell number, and feature context information were recorded electronically in an excel spreadsheet.

While all attributes are helpful in harvest habitat assessment, height and presence or absence of parasitism are most crucial. Rick et al. (2016) use height as a proxy for oyster size over time because oyster growth is strongly correlated with the environmental conditions in which they reside. Many factors influence oyster height changes throughout time (e.g., harvest rates, ecological habitat, settlement location, eutrophication of water, temperature, salinity, etc.). However, for this study, habitat demographics are key in explaining the oyster height decrease found from the Late Archaic to Middle Woodland period, followed by a height increase again in the Historic period. Oysters from offshore reefs are typically larger and longer than those from nearshore reefs due to their continuous presence underwater and exposure to food and nutrients. In other studies, height has been employed as a proxy of human predation on oyster fisheries, as oyster growth rates decrease simultaneously with ecosystem health (Harding et al. 2008; Jenkins 2013; Jenkins and Gallivan 2019).

The presence or absence of parasitism is also an instrumental measurement in establishing oyster habitats. The presence of parasitism is a strong indication an oyster came from offshore reefs. As offshore reefs are typically subtidal, they are submerged underwater and never face tidal shifts. Though this means they can grow longer and larger, they are subject to the continuous predation of parasites, such as the boring sponge, boring clam, and polychaete worm, who also live in these subtidal conditions. The parasites require specific environmental conditions—high salinity and a constant supply of water—to survive that prohibit their existence in intertidal regions where nearshore oyster reefs form (Kent 1989; Jenkins and Gallivan 2019).

Height-to-length ratio (HLR) is the product of oyster height (the longer measure of dorsal to ventral) divided by length (shorter measure) and expresses the “roundness” of the valve. HLR provides an essential proxy for paleoenvironment and human population pressures (Thompson et al. 2020). On average, oysters with a higher HRL are more elongated and narrower, while oysters with a lower height to length ratio are more rounded. Longer and narrower oysters indicate dense, offshore reef habitation or sedimentation because the oysters must grow in an upward manner to reach nutrients. Nearshore oysters display the opposite trend, extending in a more outward, rounded fashion (Lulewicz et al. 2017). Additionally, the tidal cycles affecting nearshore reefs often stunt growth by not allowing oysters to feed and accumulate nutrients as frequently as offshore oysters continuously submerged underwater (Kent 1989).

The two other morphological characteristics—presence/absence of attachment scars and LVC—suggest harvest location based on traits associated with particular habitat areas. Attachment scars indicate the type of substrate the oyster grew on; more prominent scars imply a more tightly packed reef, while no scar means the oyster grew solitarily. Nearshore oysters likely have more prevalent attachment scars because of their greater need to attach to oyster substrates than offshore oysters to withstand the turbulent nearshore conditions. Offshore oysters are generally more deeply cupped, with a higher LCV, because they reside in subtidal conditions where the water column provides them a constant flow of food (Jenkins and Gallivan 2019). Thus, they have a greater opportunity to absorb nutrients and grow.

Based on the findings of previous studies (Rick et al. 202016; Jenkins and Gallivan 2019; Thompson et al. 2020), I can confidently hypothesize that oysters displaying the following characteristics are from nearshore reefs: smaller and shorter, more rounded with a low HLR, lack sponge parasitism, not deeply cupped with a low LVC and have attachment scars. In opposition, I hypothesize oysters that are longer and larger, have high HLR, show an increased presence of parasitism, are deeply cupped with high LVC, and have no attachment scars are from offshore conditions (Table 1; Figure 8). These categories are only generalized assessments used in the context of this study. Many other factors affect oyster shape and size.

Any features with small sample sizes (n < 20) were omitted from the study due to possible data inconsistencies. Due to this, I did not include three of the fourteen precontact roasting pits in further assessment—features 1040, 1060, and 1061. One precontact roasting pit, feature 1039, produced very high standard deviation ranges, many outliers, and conflicting data with the remainder of the features (i.e., small mean height and an extremely high percentage of parasitism) conforming to neither the characteristics of nearshore or offshore habitat zones. Due to these inconsistencies, feature 1039 was also removed from further analysis. Only ten of the fourteen identified precontact roasting pits were included in the study's data analysis—features 1003, 1033, 1034, 1062, 1063, 1064, 1065, 1077, 1079, 1085. Both historic features—1001 and 1057—had ample sample sizes and easily included in further analysis.

Chronological interpretation of the precontact pit features stemmed from radiocarbon dates taken by directly dating shell from each of the ten features. I sent six shells to Direct AMS for processing. Calib 8.2 software was used to calibrate the dates, adjusting for marine lag using the reservoir correction (ΔR = -4 +/- 40) for Cobb Island, Potomac River, MD (Rick et al. 2012: 207). This correction was chosen because the Cobb Island correction best reflects the upriver location of Site 44YO0797 along the York River (Rich et al. 2012).

Results

Six of the precontact features produced overlapping dates within the Late Archaic period (2,500 - 1,200 B.C.), and three features delivered similar dates for the end of the Middle Woodland period (500 B.C - A.D. 900) (Table 2). The date for feature 1085 returned a Middle Woodland I Date, circa B.C. 317 - A.D. 83 (Egloff and Woodward 2006). However, the mean height and percentage of parasitism for this feature were significantly higher than the other features dating to the later part of the Middle Woodland period. The high mean height value and high percentage of parasitism very closely resembled those of the features dating to the Late Archaic period. The area surrounding feature 1085 was the location of vast amounts of historic and 20th-century plowing, meaning it can easily be assumed the shell randomly selected for dating was mixed into a primarily Late Archaic deposit. Due to the strong morphological similarities with the other Late Archaic features and the plethora of plowzone in the area, I assumed roasting pit feature 1085 was more closely related to the Late Archaic features than the Middle Woodland features. Thus, I grouped it with the other six Late Archaic features for further analysis (Table 2; Table 3).

The date ranges for the historic pits were assumed based on the terminus post quem (TPQ) dates of artifacts found within the assemblages. Both features 1001 and 1057 date to the plantation slave quarters in use from 1777 and 1845. The artifacts found within each feature record a median TPQ of 1820 (Romo et al. 2021).

Late Archaic Features

Seven of the total ten prehistoric features dated to the Late Archaic period— features 1003, 1062, 1063, 1064, 1065, 1079, 1085—via radiocarbon dates, all with the exception of feature 1085 (reasons for placement explain in methods). Features 1003, 1079, and 1085 sat in machine stripped areas 4 and 5 (Figure 3). Features 1062, 1063, 1064, and 1065 were all located extremely close together in the east section of machine stripped area 3 (Figure 4). All seven were in the southern portion of the site, closer to the east side of the site boundaries than the Middle Woodland features, within the densest concentration of oyster shells (Figure 6).

Overall, 15 bifacial preforms and/or projectile points were uncovered during excavations dated to the Late Archaic period: thirteen Savannah River variant points (eight biface preforms and five complete projectile points), one either Brewerton Side Notched or Normanskill Variant projectile point, and one Lamoka biface preform. If classified as a Brewerton point, the questionable point could date any time between B.C. 4300 - 1600, and if classified as a Normanskill point, it could date any time between 2350 - 1850 (VDHR 2018). Both possible types provide date ranges that coincide with my hypothesized Late Archaic occupation. The Lamoka biface preform was made of quartz and could be dated to 2500 - 1500 B.C., firmly placed with the Late Archaic period (VDHR 2018). The Savannah River Variant points also date to the Late Archaic period, B.C. 2500 - 1200, supporting my chronology (VDHR 2018). Some Late Archaic debitage scatter was found around the areas where archaeologists discovered the projectile points. According to maps from the site report, two of the Savannah River Variant points sat close to roasting pit features 1062, 1063, 1064, and 1065. These projectile points were likely related to these features due to their proximity. All four features date within the points' usage time (Table 2), a period when Savannah River points were highly dispersed, as seen by the vast number found at Site 44YO0797 (Romo et al. 2021).

Features 1003, 1079, and 1085 fall within two large concentrations of A Horizon Late Archaic debitage. These two debitage concentrations contained mainly type two and three flakes, indicative of tool sharpening rather than production, implying only tool maintenance occurred at Site 44YO0797. The placement of the roasting pits directly outside of the lithic activity area is explicable by a small-scale site occupation where food production and tool upkeep occurred in very close proximity. A projectile point associated with the Middle Archaic period (B.C. 6000 - 2500) was found a few meters away from feature 1085, which again supports the association of feature 1085 with Archaic settlements (Romo et al. 2021).

The JRIA previously dated feature 1085, using a piece of animal bone found in the pit, and received a calibrated date of B.C. 544 - 399 with an 86.4 percent confidence interval (Romo et al. 2021: 185). The radiocarbon date of shell from this feature generated a date range of cal B.C. 317 - cal AD 83 and a median date of BC 99 with a 95% confidence interval. Even though both dates fall within the early part of the Middle Woodland period, the morphological characteristics of the oysters from the roasting pit and artifact typologies suggest a closer association with Late Archaic occupation than Middle Woodland. The mean height for feature 1085 was one of the highest of all the features and was significantly higher than the features classified as Middle Woodland. The report indicated a substantial amount of historic plowing in the area, meaning it was very likely the bone and oyster were redeposited from another location, or they provided erroneous dating results.

Feature 1085 produced an MNI of 279 shells, with 279 left and 277 right and a mean left valve height of 72.43 mm and 74 percent presence of parasitism (Table 3). Romo et al. (2021) indicated feature 1085 was visited multiple times during the Native American occupation of Site 44YO0797. This leads to questions about whether the oysters in the pit were accumulated over the long term. The oysters could date anywhere from the Late Archaic to the Late Woodland period rather than in a single occupation. More radiocarbon dates from feature 1085 are needed to explore this idea further. For the sake of this study, feature 1085 will continue to be classified as a Late Archaic feature based on morphological similarities and data equivalences with other Late Archaic features. The JRIA designated Feature 1085 as a Type 1 roasting pit measuring 80.77 cm by 48.77 cm with a depth of 38.1 cm (Figure 7). No evidence revealed thermally-altered soil around the pit. However, the feature did contain a deposit of dark gray, carbon-filled sand indicative of a firing event. Feature 1085 had a total of 8 fragments of carbonized matter out of 12 liters of soil: a rate of 0.667 CR/L. The pit additionally had a limited number of clamshells and animal bones.

Feature 1003 produced an MNI of 96 oysters, with 96 left shells and 57 right shells. The mean height was 57.79, and 63 percent of the shells showed evidence of parasitism. A radiocarbon date taken with shells from this feature gave a calibrated Late Archaic date of B.C. 1925 - 1625, and a median date of B.C. 1670 with a 95% confidence interval (uncalibrated date of cal pb 3934 +/- 31) (Table 2; Table 3). As a Type 1 roasting pit, it displayed apparent evidence of fire or heating. Feature 1003 comprised a central core of soil and burned oyster shells, surrounded by a large patch of thermally-altered E Horizon. The core of the feature—represented by Layer B and containing the actual feature fill—measured about 67.06 cm long by 48.77 cm wide and 19.81 cm deep. The thermally-altered E Horizon deposit (Layer C) extended around and below the core and measured 131.06 cm by 103.63 cm and 30.48 cm deep. The roasting pits were surrounded by sandy E Horizon soils darkened from very pale brown (10YR 7/3) to yellowish-brown (10YR 5/6), almost certainly due to heat. This suggests that the E Horizon soil was exposed to temperatures around 450° C. The types of burned shells found in Feature 1003 were rare for prehistoric sites at 44YO0797; only Feature 1003 contained burned oyster shells in any significant quantity. Additionally, a small number of scallop shells were recovered from Feature 1003 (Romo et al. 2021).

Feature 1062 contained an MNI of 185 oysters, with 185 left shells and 135 right shells. The mean height was 65.05 mm, and 69 percent of the shells showed evidence of parasitism. A radiocarbon date taken for this feature using shell gave a Late Archaic calibrated date range of cal BC 1928 - cal BC 1541, and a median age of BC 1740 with a 95% confidence interval (uncalibrated date of bp 3888 +/- 29) (Table 2; Table 3). Feature 1063 produced an MNI of 249, with 249 left shells and 146 right shells. The mean left valve height was 68.56 mm, and 48 percent of the shells show evidence of parasitism. A radiocarbon date was taken for this feature, giving another Late Archaic calibrated date range of cal BC 1848 - cal BC 1462 and a median age of AD 1642 with a 95% confidence interval (uncalibrated date of bp 3812 +/- 30) (Table 2; Table 3). Feature 1064 produced an MNI of 59, with 59 left shells and 33 right shells. The mean height of the left valves was 64.33 mm, and 54 percent of the shells show evidence of parasitism. The radiocarbon date for this feature gave a Late Archaic calibrated date range of cal BC 1959 - cal BC 1576, and a median age of BC 1771 with a 95% confidence interval (uncalibrated date of bp 3912 +/- 24) (Table 2; Table 3). Features 1062, 1063, and 1064 strongly resembled one another in appearance. All three features were situated nearby, forming a line equally spaced out. Features 1062 and 1063 were 100.58 cm apart, center to center, and 39.62 cm apart at their nearest points. Features 1063 and 1064 were 115.82 cm apart, center to center, but also 39.62 apart at their nearest points (Romo et al. 2021). Their locations and close median dates led me to attribute all three features as contemporaneous.

Feature 1065 produced an MNI of 30, with 27 left shells and 30 right shells. The mean height of the left valves was 57.66 mm, and 65 percent of the shells show evidence of parasitism. Its radiocarbon date produced a Late Archaic calibrated date range of cal BC 2304 - cal BC 1529 and a median age of BC 1724 with a 95% confidence interval (calibrated date of bp 3876 +/- 26) (Table 2; Table 3).

Feature 1079 produced an MNI of 40, with 40 left shells and 17 right shells. The mean height of the left valves was 74.34 mm, and 75 percent of the shells show evidence of parasitism. A radiocarbon date taken from this feature generated a Late Archaic calibrated date range of cal BC 2304 - 1901, and a median date of BC 2103 with a 95% confidence interval (uncalibrated date of bp 4165 +/- 27). (Table 2; Table 3). Classified as a Type 1 or fired roasting pit, it measured 68.58 cm by 48.77 cm with a depth of 15.25 cm. Feature 1079 comprised a core of oyster shells surrounded by thermally altered E Horizon. However, it did not contain any burned shell similar to Feature 1003. Feature 1079 was also smaller than Feature 1003; its core measured 42.67 cm by 32.00 cm and was 9.14 cm deep, while the thermally-altered E Horizon patch was 68.58 cm by 48.78 cm and 15.24 cm deep. Additionally, Feature 1079 contained no carbonized plant remains, despite evidence of a thermally-altered E Horizon.

Overall, the Archaic features produced an MNI of 935 shells, with 935 left and 695 right valves. The mean height for all left values was 67.25, and 63 percent of all the shells indicated the presence of parasitism (Table 4). Based on these results, I can confidently hypothesize that the oysters deposited in pit features dating to the Archaic period were primarily from subtidal conditions based on the proven assumptions of high amounts of parasitism and large shell heights associated with completely submerged, subtidal reefs that are beyond tidal points (Rick et al. 2016; Jenkins and Gallivan 2019).

Middle Woodland Features

Three roasting pit features—1033, 1034, and 1077— dated to the Middle Woodland period via radiocarbon dates. All three pits are located in the western half of machine stripped area 3 (Figure 5) along the southern boundary, overlooking the marshes of Carter Creek (Figure 6). Site 44YO0797 produced six projectile points clearly associated with the Middle Woodland period; three were quartzite Rossville projectile points, dating between 500 B.C. and A.D. 400 (DHR 2018). Romo et al. (2021) attribute the Rossville points to be potentially contemporary with Accokeek, Popes Creek, and/or Mockley ceramic deposits at the site. The three Middle Woodland features were in the same general area as two of the Rossville projectile points and one Potts projectile point. Features 1033 and 1034 were incredibly close to the Rossville points, while feature 1077 was near the Potts point dating to A.D. 500 - 1000 (VDHR 2018). The

Rossville points were also located near a concentration of Popes Creek sherds. This, combined with the knowledge that Rossville projectile points (500 B.C. to 400 A.D.) and Mockley ceramics (A.D. 200-900) shared a very short temporal overlap, suggests the Rossville points most likely were associated with either the Popes Creek (500 B.C. to 200 A.D.) or Accokeek (800-300 B.C.) ceramics present at the site (Gallivan 2003). The features' (especially 1034 and 1033) proximity to concentrations of Popes Creek sand tempered, net and press ceramic fragments additionally support Middle Woodland temporal conclusion (Romo et al. 2021). All three features were definitively located within distributions of Mockley ceramics (Romo et al. 2021: 123). Records show Mockley ceramics became very prevalent in eastern Virginia during the Middle Woodland II phase (A.D. 200 to 900), meaning the site was likely re-occupied several times during the Middle Woodland period, again supporting the hypothesis of Site 44YO0797 being a resource procurement camp during the Native occupation (Gallivan 2003).

These artifact assemblages align with the radiocarbon dates of the features (Table 2), serving to increase their reliability. Additionally, the JRIA previously dated an animal bone recovered from roasting pit 1077, producing a date range of A.D. 545 - 645 with a 95.5 percent probability (Romo et al. 2021: 122). This date overlaps slightly with the shell date generated for feature 1077 (A.D. 621 - 860) and lines up very well with the date for feature 1033 (i.e., A.D. 447 - A.D. 750) and feature 1034 (i.e., AD 415 - AD 715) (Table 2).

Overall, feature 1033 produced an MNI of 260 oysters, with a ratio of 260 left to 239 right valves. The mean height was 50.88 mm, and 16 percent of the shells showed evidence of parasitism. The radiocarbon date from this feature gave a Middle Woodland calibrated date range of cal AD 447 - 750 and a median age of AD 611 with a 95% confidence interval (uncalibrated date of bp 1930 +/- 25) (Table 2; Table 3). Within the pit, archaeologists recovered six pieces of Mockley shell tempered, net, and press ceramics. Feature 1077 produced an MNI of 79 oysters, with 54 left and 79 right valves. The mean height of the left valves was 46.50 mm, and a mere two percent of the shells showed evidence of parasitism. The radiocarbon date outcome for this feature established a Middle Woodland date of range of cal AD 590 - cal AD 899, and a median date of AD 736 with a 95% confidence interval (uncalibrated date of cal bp 1815 +/- 32) (Table 2; Table 3). This pit contained 5 Mockley shell tempered, net-impressed sherds and a small number of clam shells (Romo et al. 2021).

Feature 1034 produced an MNI of 826 oysters, with a ratio of 826 left to 648 right valves. The mean height of the left valves was 51.41 mm, and only seven percent of the shells showed evidence of parasitism. The radiocarbon date for this feature returned with a Middle Woodland cal AD 415 - cal AD 715 and a median date of AD 574 with a 95% confidence interval (uncalibrated date of cal bp 1975 +/- 27) (Table 2; Table 3). This feature contained two sherds of Mockley shell tempered net and press ceramics. It had a significantly greater number of shells than any other features (over 500 more than the following closest context). The reasons for the high shell numbers are unclear. However, I estimate they relate to the increase in population size, resource demand, and sedentarism associated with the Middle Woodland period (Dent 1995). Another explanation would be that feature 1034 was the remains of some large feasting event at the site during the Middle Woodland period (Jenkins and Gallivan 2019). Further investigations on this pit need must be conducted to be assured.

Both radiocarbon dates and artifact assemblages confirmed all features assumed to be Middle Woodland. Together the features produced an MNI of 1,140 oysters, with 1,140 left valves and 966 right. The mean height of all left valves averaged to be 51.05 mm, and only eight percent of the shells displayed evidence of parasitism (Table 4). Based on these results of this analysis, I hypothesize that the oysters deposited in pit features dating to the Middle Woodland period were primarily from intertidal conditions based on the presumption of small left valve heights and low percentages of parasitism due to the effect of tidal shifts (Rick et al. 2016; Jenkins and Gallivan 2019).

Historic Features

Two distinct historic occupations were present at Site 44YO0797—the 20th century US military camp and the 18th-to-19th-century plantation. The following subfloor pit features are associated with the historic Capahosic Plantation, which stood from ca. 1751 to 1884, and are presumed to mark the location of historic enslaved quarters. Shells from two historic pits were analyzed for this study—features 1001 and 1057. Feature 1001 was located in the west half of machine stripped area 3, and feature 1057 was found in the east half of machine stripped area 3, in a high concentration of oyster shells (Figure 4; Figure 5; Figure 6).

Feature 1001 was a sub-floor pit associated with Building 2. Sub-floor pits were relatively common on 18th- and 19th-century sites in Virginia, especially in the context of enslaved quarters (Samford 2000). Sub-floor pits served several functions, including borrow pits for clay, hiding spaces for stolen or illegal goods, food storage pits, personal storage pits, or even religious shrines. One of the most common uses of sub-floor pits in the Chesapeake watershed was for food storage. Feature 1001, a particularly large and deep sub-floor pit, identified the location of Building 2, presumably an enslaved families' quarters. Feature 1001 and Building 2 sat in the southwestern part of area 3 (Figure 5). The feature had a broad, roughly circular trash pit measuring 176.78 x 167.64 x 64.01 cm, which sat atop a filled-in, oblong sub-floor pit measuring about 91 cm by 61 cm and oriented with its long axis running approximately north-south. It sat in an area of very high calcium concentrations, likely resulting from the burning and storing of a vast amount of oyster shells. The trash pit contained four layers: A, B, C, and F. The majority of the artifacts recovered from Feature 1001 came from Layers A, B, and C. Layers A and B contained animal bones, a conch/whelk shell, brick fragments, nails, utensils, buttons, tobacco pipes, and a few other items. The tobacco pipe stems from these layers were most common between 1710 and 1750 (McMillan 2010:15). The ceramics from both deposits were predominantly pearlwares and creamwares, with small concentrations of whiteware and porcelain sherds. The artifacts found in Layer C were similar.

Overall, the trash pit layers have a TPQ, date after which a stratum, feature, or artifact must have been deposited, of 1820. They appeared to be secondary depositions filling in an eroded-out space atop the original sub-floor pit. The TPQ dates and artifacts suggest that filling the sub-floor pit and the deposition of the overlying trash layers occurred relatively quickly. Food remains were prevalent in Feature 1001, especially in the upper trash pit layers, which contained many animal bones and oyster shells. Other botanical remains included charred persimmon seeds, wheat/oat kernels, and corn cupules. Feature 1001 was relatively deep compared to the other sub-floor pits found at the site. This may indicate that it sat near a hearth, as hearth-front pits typically were deeper than those found elsewhere in a structure (Samford 2000). These attributes suggest Feature 1001 was likely a hearth-front pit. Since the predominant use of hearth front pits was food storage (Samford 2000), feature 1001 probably functioned as a storage cellar for food products such as oysters (Romo et al. 2021: 230-233). The oysters at Feature 1001 produced an MNI of 403 oysters, with a ratio of 337 left valves to 403 right values. The mean height was 77.36 mm, and 57.5% of the shells showed evidence of parasitism (Table 3).

The other Historic feature analyzed in this study was Feature 1057. It sat outside of any structure along the southeastern edge of area 3 in the middle of the highest concentration of oysters present at the site (Figure 4; Figure 6). Excavation revealed that Feature 1057 contained several distinct deposits (i.e., Layers A, B, and C). The upper levels (Layers A and B) had large amounts of charcoal and numerous architectural items, including several brick fragments and eight brickbats, 127 hand-wrought nails, and a small amount of mortar along with a lath hammer. Domestic items included ceramics, tobacco pipes, animal bones, buttons, a case, and wine bottle glass, some pewter, and three bone dominoes. A total of 91 pieces of ceramic surfaced in the feature, the vast majority being creamware sherds, though pieces of pearlware and fragments of whiteware were also present. The TPQ date for the filling of this feature was 1820 (Romo et al. 2021: 250-251) based on recovered artifacts. Floral and faunal analysis recorded a plethora of oyster shell in each layer, as well as five field cultigens—three-bean cotyledon fragments and two wheat/oat kernels. Soil chemistry placed the borrowing pit in high calcium concentrations, likely due to the nearly 2000 oyster shells deposited in the pit. The shells recovered from Feature 1057 produced an MNI of 1632, with a ratio of 1448 left valves to 1632 right valves. The mean height of the left valves was 62.83 mm, and 46.0% of the shells showed evidence of parasitism (Table 3).

The Historic features produced an MNI of 2035 shells, with 1785 left and 2035 right shells. The mean height for all left values was 65.57, and 48.1 percent of all the shells indicated the presence of parasitism (Table 4). While the Historic oysters had a lower percentage of parasitism than the Late Archaic oysters, both were very similar in height and still had a significantly higher presence of parasitism than the Middle Woodland oysters (Table 4). With this reasoning, I hypothesize that the oysters deposited in pit features dating to the Historic period were primarily from subtidal conditions based on high amounts of parasitism and considerable shell heights similar to those of the Late Archaic period. Additionally, by this time, oyster harvesting technologies arguably would have progressed, making the collection of subtidal oysters far simpler than in the Late Archaic or Middle Woodland times.

Data Analysis

The mean and standard deviations were calculated for height, HLR, and LVC for each feature and period. Percent parasitism and percent attachment scars were also calculated on both a period and feature level (Table 3; Table 4). For this study, the primary grouping of analysis was period—Late Archaic, Middle Woodland, and Historic—rather than feature. However, future studies could be conducted at a feature level observing the different uses of roasting pits between and/or within periods.

Boxplots compared the height, height-to-length ratio, and left valve concavity between Late Archaic, Middle Woodland, and Historic oysters. They display the range of frequency and outliers of each attribute. Historic feature data showed the greatest range for both height and high-to-length ratio. Historic and Late Archaic data had almost identical ranges for left valves concavity amounts. The Late Archaic oysters concluded the highest mean for each attribute, defining oysters from the Late Archaic period as the largest. For all cases, the Middle Woodland shell data produced the smallest values and the shortest ranges, similarly define the Middle Woodland oysters as the smallest (Graph 1). The boxplots determined outliers before all parametric statistical testing to decrease the likelihood of erroneous results.

All statistical testing used SPSS Statistics 21.0. Independent sample t-tests ran between all samples. Testing concluded statistically significant differences for the height, HLR, and LVC of oysters from the Late Archaic and Middle Woodland periods (Table 5, t-test, $p < 0.01$) as well as oysters from the Historic and Middle Woodland periods (Table 7, t-test, $p < 0.01$). A statistical comparison of oysters from the Late Archaic and Historic period only reported a statistically significant difference for LVC (Table 6, t-test, $p < 0.01$). However, this was the only comparison that assumed equal variances between the means. The height and HLR results indicated no statistically significant difference between the oysters from the Late Archaic and Historic periods, requiring the rejection of the null hypothesis that there is a difference between the two means (Table 6, t-test, $p > 0.01$). This indicates a strong correlation between Historic and the Late Archaic oysters.

To compare the mean height, HLR, and LVC for all three periods, I attempted to run one-way ANOVA tests. However, all ANOVA tests violated the assumption of homogeneity of variances, meaning the data could not be tested parametrically. After an analysis of histograms for each attribute by period, the data revealed non-normal distributions. The non-normal distributions required using the non-parametric alternative to the ANOVA test, the Kruskal Wallis, to test the relationship between the three groups. Kruskal Wallis tests run for height, HLR and LVC concluded a statistically significant difference between the Late Archaic, Middle Woodland, and Historic oysters (Table 8, Kruskal Wallis, $p < 0.01$).

Chi-squared tests compared the percent parasitism and attachment scar values for the three periods. The tests concluded a statically significant difference between the percent of parasitism and percent attachment scars between the Late Archaic, Middle Woodland, and Historic periods (Table 8, x^2, $p < 0.01$). All statistical tests demonstrated significant differences between oysters harvested during the Late Archaic and Middle Woodland periods and those gathered during the Middle Woodland and Historic period. However, some results indicated similarities between oysters' attributes in the Late Archaic and Historic periods. With these results, I can confidently conclude my hypothesis is supported. Oysters dating to the Late Archaic period were typically larger, longer, thinner, more deeply cupped, and had a higher percentage of parasitism. These values indicate that the Late Archaic period oysters were harvested from offshore reefs. Oysters dating to the Middle Woodland period were typically smaller, more rounded, less cupped, and had a lower percentage of parasitism. These values indicate that Middle Woodland oysters were harvested from nearshore reefs. Oysters harvested in the Historic period displayed very similar, in many cases statistically similar, characteristics to those harvested in the Late Archaic period, indicating Historic oysters were also harvested from offshore reefs. However, offshore oysters during the Historic period had more variation than offshore oysters during the Late Archaic period due to the deteriorating state of the oyster fishery and increased harvest demand.

Discussion

This study sought to determine practices utilized by Native Americans to maintain a resilient oyster fishery in the Chesapeake region over millennia and place them in conversation with the methods of post-Colonial oystering ventures that managed to collapse the oyster fishery in a few hundred years. The evidence from the twelve features considered from Site 44YO0797 suggests shifts in harvest location as leading explanations for Native American oyster sustainability. I argue the change in the primary location of harvest moved from offshore reefs during the Late Archaic period to nearshore during the Middle Woodland period due to increased population sizes and sedentism at the onset of the Middle Woodland period. This claim contradicts earlier ideas that Archaic coastal fisher-foragers only had the technological capacity to collect oysters along the coast at an "artisanal level" (Schulte 2017). Thompson and Worth (2011) indicated that the understanding of Holocene coastal adaptations is essentially an unknown phenomenon due to the lack of site visibility and accessibility to coastal areas resulting from eustatic sea-level rise, rather than an inability of humans to exploit the coasts (Thompson and Worth 2011: 55). Coastal dwelling Native Americans were more than capable of utilizing various estuarian resources as primary aspects of their subsistence systems. However, they actively managed their common pool aquatic resources and allowed for shifts in practices if ecosystems showed evidence of overuse.

Historically, people have deeply underestimated the capabilities of early Native Americans. Archeological evidence confirms the human utilization of shellfish and other estuarine resources as early as B.C. 4200 along the Atlantic coast and possibly earlier in irregular patterns. The increases in coastal settlement around B.C. 4200 correlate with general trends in sea-level rise and their effects on the greater availability of shellfish. The sea conditions following BC 4200 coincided with the increased human occupation of the Atlantic seaboard and the Gulf of Mexico. Native people continued to occupy the area from B.C. 4200 until about B.C. 3800 when significant sea-level fluctuations began for both bodies of water. By approximately B.C. 2400, sea levels on the Atlantic coast began returning to the higher conditions seen before B.C. 3800. Resettlement occurred along the Atlantic coast with an increase in coastal dwellers around B.C. 2400, the onset of the Late Archaic period (Thompson and Worth 2011).

My chronological analyses suggest the beginning of a more intensive occupation and resource extraction at Site 44YO0797 began around or slightly after B.C. 2400, coinciding with increased estuarine resources resulting from sea-level rise (Thompson and Worth 2011). Radiocarbon dates from the site indicate oystering began at the latest around B.C. 2304 and possibly earlier into the Archaic period. Site 44YO0797 presumably had a strong seasonal Late Archaic habitation. Seasonal scheduling of settlement was an essential characteristic of the Late Archaic period. Nomadic groups of forager-fishers followed distinct resources through strategic settlement shifts, moving from the interior Coastal Plain into the Piedmont region. Reoccupation of the sites every year was a frequent occurrence, given the seasonal predictability of the resources (Dent 1995). Thus, groups would likely return to Site 44YO0797 each year during the late winter to early spring for oyster season. They would remain in the area, collecting and processing resources until the harvest season was over (Claassen 1986).

The Type 1 roasting pits (i.e., those with evidence of firing) may represent the remains of on-site oyster processing. Ethnographic evidence indicates that roasting oysters directly in a fire was the preferred cooking method of Algonquian-speaking groups in Virginia and Maryland. Roasting was a convenient method of oyster preparation, as it both opened the valve and cooked the meat (Waselkov 1987). The oyster valves found in the Type 1 pits were likely harvested and cooked on-site by Late Archaic people residing in the area while resources were rich. Feature 1003, a Type 1 roasting pit, even contained burned oyster valves (Romo et al. 2021). No Type 1 roasting pits dated to the Middle Woodland period indicating oyster processing may not have been as active at Site 44YO0797 during that period, as Natives were more focused on collecting oysters to bring back to larger base camps.

It is crucial to acknowledge that new lines of evidence and data have arisen, supporting a perspective that at least some portion of Late Archaic Native populations lived at shell ring and shell midden sites throughout the year (Thompson 2018). To fully address the site occupation at 44YO0797, additional analysis of the Late Archaic oyster shells using radiocarbon dates and stable isotope analyses would be needed to deliver the temporal nature of shell accumulation (Thompson and Andrus 2015). Analysis of shellfish growth rings can reveal the climatic condition in which the shellfish died and, by proxy, the season in which it was harvested. Considerable evidence has been collected to support claims of year-round occupation at coastal sites dating as far back as the Archaic period (Claassen 1986; Thompson and Andrus 2015; Thompson 2018). Based on evidence from the stable isotope analysis of the growth rings of clams and oysters from the Sapelo Shell Ring complex in Georgia, Thompson and Andrus (2015) argued at least some Late Archaic populations collected aquatic resources year-round. This data implies a portion of the Archaic shell ring complex was occupied throughout the year. Another study by Russo (1998) on Horr's Island in southwestern Florida suggests at least some of the populations occupied the site throughout the year. This new evidence of year-round site occupation is a departure from previously held notions that Archaic coastal shell sites were seasonally occupied. It suggests more contemporary, complex models of Archaic hunter-gatherer societies. For these models to be recognized at Site 44YO0797, further research needs to be conducted to determine the seasonality of site occupation and oyster collection through sclerochronology and stable isotope analysis. While the entire extent of site occupation during the Late Archaic period is challenging to define, it can be accepted that offshore oysters were actively being harvested from Site 44YO0797 for at least part of the year throughout the Late Archaic period.

In the Late Archaic period, large sites were less frequent; small seasonal microbands were the norm. These small bands followed an annual rotation of resources in the Coastal Plains area that was highly correlated to waterways and estuarine resources like oysters (Dent 1995). Site 44YO0797 was presumably one of the areas where bands would settle for part of the year to collect oysters for subsistence. It has previously been assumed that people harvesting oysters in the Archaic period primarily hand-collected them from nearshore reefs. However, Dent (1995) refers to the Late Archaic period as "The Intensification Effort." About this time, Dent (1995) stated, "If the earlier era of the Archaic period represented more of an accommodation of nature, the latter began what might be referred to as the social appropriation of nature" (Dent 1995: 200). The Late Archaic period resulted in the intensified production of resources rather than previous efforts to maintain them. This intensification effort was a lifestyle change founded on new adaptational systems that took advantage of the more stabilized ecosystem. The recent environmental shifts revealed rich wetlands and coastal areas for Native American utilization (Dent 1995).

With these adaptations came many advances related to the abundant fisheries of the Chesapeake Bay, including increases in oyster collection techniques that allowed for the harvest of offshore oysters. Offshore oysters were frequently collected by specialized task groups that traveled in deep water in canoes and used tongs or dove themselves to retrieve subtidal oysters. Thompson (2018) suggested that shell ring and shell midden occupants also practiced mass capture techniques using woven fine-grain nets, fish traps, and weirs (Thompson 2018). Offshore oysters were significantly larger and of better quality than nearshore oysters, making them the favored target. This study provides evidence Algonquian-speaking Native Americans harvested offshore oysters during the Late Archaic period based on the assessment of oysters from roasting pits dating to the Late Archaic period. Not only did the Native Americans have the appropriate technology to harvest offshore oysters at such an early time, but they also had a vital understanding of the oyster fishery, keeping it resilient through population growth and technological innovation (Jenkins and Gallivan 2019).

Much of this resilience resulted from common resource management guidelines surrounding the oyster fishery. Thompson (2018) suggested that oystering operations during the Late Archaic represented significant labor investments and upkeep, necessitating collaboration and cooperation among villagers. By working together for harvesting endeavors, the Native's mass captures during oyster season would finance collective rituals for the rest of the year. The communal labor involved in the production and technology of fishing and oystering downplayed and suppressed free riders and agents in pursuit of social prestige through the individual control and management of surplus production. All group members had equal access to resources, technologies, and processing methods, lessening the likelihood of resource domination and increasing the ability for community cooperation in resource management (Thompson 2018). One such example of community-supported active management of the fishery by Native people is evidenced by the Middle Woodland shift in harvest from offshore to nearshore oysters.

There was limited site use during the Early Woodland period, indicated by a lack of Early Woodland projectile points from the site, limited ceramics, and no oyster roasting pit dating to the period (Romo et al. 2021: 151). This decrease in site usage during the Early Woodland can be explained by the generally well agreed upon trend that Atlantic sea levels had a high stand during the Late Archaic period, lowered during the Early Woodland period, and then returned to a high stand in succeeding times (Thompson and Worth 2011). Thus, Site 44YO0797 was actively inhabited and utilized for aquatic resources by Native People during the Late Archaic and Middle Woodland periods at higher sea level, and occupation continued into the Late Woodland and Contact periods.

Moving into the Middle Woodland period, Site 44O0797 begins to resemble a "field camp" site within Binford's (1980) hunter-gatherer model of "collectors." The storage of food for at least part of the year and the development of logistically organized food-procurement parties for resource collection characterized the new "collector practices." The specially organized task groups would leave residential locations and establish short-term field camps in resource-rich areas for food procurement (Binford 1980: 10). Collectors did not go out "searching" for resources; instead, they traveled to specific contexts intent on collecting resources in large quantities to serve as subsistence stores over long periods (Binford 1980). I believe, as early as the Late Archaic period and especially into the Middle Woodland period, Site 44YO0797 represented a regularly utilized field camp geared towards the oyster collection by Algonquian resource procurement groups in the fall and spring months (i.e., oyster season).

Site 44YO0797's primary use was as an aquatic resource procurement camp for Native Americans during the Late Archaic and Middle Woodland periods. Robert Tyndall's 1608 *Draughte of Virginia* map (Figure 9), redrawn with north at the top, displays historic oyster reefs directly downstream from the site's location (modified from Jenkins and Gallivan 2019). In comparison, a VIMS's map—the "York River-Beaver Dam to Roosevelt Pond oyster reef restoration populations for April of 2009" (Figure 9)—displays Site 44YO0797 in relation to a large area of highly fertile potential oyster habitat (the red areas) (VIMS 2009). These maps place the site near oyster habitats that existed in both historical and modern-day times, meaning precontact reefs would have been abundant in the area.

The Middle Woodland period is known as an era of rapid population growth, political centralization, and increased sedentism (Jenkins and Gallivan 2019). Larger population sizes and the rise of sedentary lifestyles required a more abundant and reliable food source, causing Natives to begin harvesting oyster reefs more intensively. In their work, Jenkins and Gallivan (2019) show a decrease in mean oyster height from the Middle Woodland I to the Middle Woodland II, following long-term trends of oyster height increase moving out of the Late Archaic period (Jenkins and Gallivan 2019: 15). Chesapeake shell midden saw some of their most intensive use during the Middle Woodland II period (AD 200–900), coinciding with recorded oyster shell height decreases. The results of my study follow this trend, displaying a decrease in mean oyster height from the Late Archaic to the Middle Woodland II period. The hypothesized explanation for these changes was a shift in oyster harvesting initiatives from offshore reefs to nearshore reefs moving from the Late Archaic to Middle Woodland occupation. Native people recognized signs of depletion within offshore reefs as their harvest yield intensified with growing population sizes.

Long-held common-pool resource management systems allowed Native American communities residing in the Chesapeake Bay during the Middle Woodland period to actively switch mass harvesting initiatives for everyday consumption to nearshore oyster reefs. The change provided relief to overharvested offshore reefs and fostered resilience within the fishery as a whole. Nearshore reefs were easier to access and did not require special task forces to retrieve. Distribution of labor could be better utilized with oyster harvest centered on nearshore reefs as women and children could walk along the coast and hand collect them while men hunted in the interior regions. The new practices allowed offshore reefs to generally be left alone to grow and produce spat that would later resettle in nearshore reefs. They became "parent reefs" in a new system of resilience where the offshore reefs replenished nearshore reefs whenever they became overharvested (Thompson et al. 2020). It is significant to note that as indicated by other studies, the Native Americans coming to re-establish coastal sites during the Middle Woodland period would primarily harvest nearshore oysters but on occasion harvested offshore oysters for special events and ritual feasts as a return to their ancestral practices still visible in the remains of Archaic roasting pit (Jenkins and Gallivan 2019). These practice shifts display the ingenuity of the Native Americans to adapt to changes in their social, climate, political, cultural, and environmental settings.

Native Americans maintained a sustainable and resilient oyster fishery moving through the Late Woodland period and into the early contact period. Jenkins and Gallivan (2019) reveal oyster height increases at Kiskiak following the Middle Woodland II period until the onset of

Colonization (Jenkins and Gallivan 2019: 15). At the start of the seventeenth century, the eastern oyster flourished throughout the Chesapeake Bay. When John Smith arrived on the Virginia coast in 1607, he remarked the oysters “lay as thick as stones” along the Bay floor. Other European settlers reported navigational hazards to their ships caused by enormous oyster reefs that thrust up from the Bay’s bottom (Smith 1624). European settlers initially collected oysters by hand and/or simple tools (i.e., tongs) from shallow nearshore reefs, following the practices laid out by the Woodland period Native Americans (Schulte 2017). They harvested oysters opportunistically by hand at low tide from intertidal oyster populations within the Chesapeake Bay region. This meant only oysters that were easily accessible, removable, and suitably sized for food were initially targeted by colonial collections (Harding et al. 2008).

Impacts on oyster reefs by early settlers appeared limited and local during the seventeenth and eighteenth centuries. In the 200 year interim, from the reduction of Native American populations to the rise of the market economy in the 1800s and 1900s, there was considerable continuity in oyster productivity. Many suggest the Native American common-pool resource management systems likely had lasting effects on the sustainability and resilience of the oyster reef populations (Thompson et al. 2020). As the Colonial period progressed and European settlement economized, oysters became more extensively utilized. They not only served as food; once shucked of meat, oyster shells were used in Virginia for roadbeds, agricultural lime, chicken “grit” (a poultry feed supplement), mortar, a composite form of concrete made of lime, sand, and crushed oyster shells called “tabby,” and starting in the mid-1800s, railroad ballast (Schulte 2017).

Large-scale commercial fishing began in the Chesapeake Bay in the early 1800s when New England oyster fishers began sailing south and dredging subtidal reefs in the Bay after depleting their local oyster beds. In the early-to-mid-1800s, the Virginia oyster fishery expanded rapidly in conjunction with growing railroad lines that began to link centers of commerce throughout the US. As oyster demand out west escalated, harvests increased from 178,000 bushels in 1849 to 2.3 million bushels in 1859 (Schulte 2017). This increase appeared primarily due to growing regional demand, enabled by more effective means of shipping and preservation (i.e., canning).

During the 19th century, working as an oyster fisher became both a source of income and a supplemental food source for many poor colonists and African Americans living along the East coast. This became especially true following the Civil War, as many newly freed African Americans in the southern states sought ways to earn a living. McDonald et al. (1992) claimed oystering became "a supplementary, but vital occupation" for blacks living in tidewater Virginia. In the mid-1800s, many African Americans found themselves living on "reservations," attempting to make a living through farming. However, poor land and low crop yields meant many families could not survive on the produce of their farms alone. Many turned to oystering as a supplement for their diets and incomes (McDonald et al. 1992). In York County specifically, an 1860 United States Census reported that at least nine percent of African American males worked the water as oystermen. Most of these oystermen lived along small tributary creeks (i.e., King Creek, Felgate's Creek, Carter Creek, and Indian Field Creek) that feed into the York River. Using dugout canoes designed initially by Native Americans, with modifications of African and European origins, African Americans provided much of the labor for oystering on these waterways throughout the 18th and early 19th centuries (McDonald et al. 1992).

A resident of one of the York County "reservations," Mr. Alexander Lee, gave an ethnographic account of his time living along Felgate's Creek. He said his father, John, had 66 acres of land and 60 fruit trees, but his main occupation was oystering. Lee recounted, "My father was an oysterer, he dealt with oysters, you see. He worked at the James River in the wintertime, at oyster season, he planted oysters…he had his own boat; his and his brothers had their own business…the majority of the people in the areas were farmers and…work the river…oysters and fishing" (McDonald et al. 1992: Ch. 5, pg. 6). Another resident recounted: "My uncle also worked the river. He was an oysterman. He used to take oysters to Richmond…Leave over the weekend, take his produce to Richmond, and sell them there…he was self-employed, he has his own oyster-grounds, he worked the water, he made a pretty good living there" (McDonald et al. 1992: Ch. 5, pg. 76). The abundant aquatic resources along the York River offered free African Americans a way to carve out a living as free individuals.

African Americans, both freed and enslaved, in York Country, VA, contributed substantially to the 19th century oystering industry. Pre-and-post Civil War censuses from York Country reveal that most free American-Americans worked as oystermen or fishers. The vast number of freed African Americans involved in the oyster fishery combined with York County probate inventories displaying a pattern of white farmers owning one or more canoes before emancipation indicated enslaved people's strong involvement in the oyster fishery (Mamary 1994). Oystering in York County, which began as a way to supplement diets, quickly expanded throughout the 19th century from a private activity into a large-scale industry. Harvesting tools and techniques rapidly adjusted with the growing industry. The once simple log canoe evolved into the sophisticated, multi-log "Chesapeake Bay Log Canoe" to meet the demands of larger catches, longer voyages, and increasing competition. M.V. Brewington, an early 20th-century log canoe crafter, insisted that the canoe's development was so intimately connected to the oyster fishery the two were almost inseparable (Brewington 1937).

This more technologically advanced "Chesapeake Bay Log Canoe" became a crucial feature in the economization of the Chesapeake Bay oyster fishery. They were quickly adapted to the demands of the nineteenth-century Virginia oystering industry. The rapid expansion of the oystering sector in the Southern Chesapeake demanded larger, swifter, and more rugged boats. As oysters grow only in depths under 50 feet, frequently in shallower tidal waters, boats had to be relatively flat bottomed and stable. The canoes, outfitted with long sharp lines, produced minimal water displacement and offered the speed and maneuverability necessary for oystering. Oystering from a canoe was divided into two tasks: one tending the tiller and sails or oars, the other pulling oysters from shallow waters. A skilled pair could tong 60 bushels in a day in a 30-foot canoe (Mamary 1994).

Before the Civil War, York County inventories divulged two general categories of people who owned oystering canoes. The first type was the individual, freed African American, such as Alfred Briggs, whose property record shows him owning a single canoe, oyster tongs, and 120 oyster baskets (Mamary 1994: York County Wills and Inventories 1858). He was assumed to be a small-scale oysterer, collecting oysters for subsistence and/or local sales when he had a surplus. The other type of oysterer, and the much more common type, was the wealthy white man who had held several acres of farmland, substantial quantities of enslaved peoples, and a small fleet of canoes. For example, Seymore Powell, a plantation master, owned several enslaved people, livestock, oxen, plows, and at least six canoes (Mamary 1994: York County Wills and Inventories 1838). Owning large clusters of canoes indicated the presence of sizable quantities of labor, most likely enslaved people's labor (Mamary 1994).

The popularity of the "Chesapeake Bay Log Canoe" and the large enslaved and freed African American populations in York County suggests a strong correlation between African-Americans, the canoes, and their involvement in the oyster fishery (Mamary 1994). The owners of Capahosic plantation very likely owned a fleet of canoes that were crewed by the enslaved people residing at Site 44YO0797. The enslaved people would collect deep water, subtidal oysters from the canoes to be sold at markets as an additional source of income for their masters. The enslaved people likely kept some of the harvests as well to supplement their poor diets. They would have shucked and roasted the oyster outside of their dwellings due to the pungent order of raw oysters (Mamary 1994). That would explain the location of several sub-floor pits filled with oyster shells directly outside of building structures presumed to be dwellings at the site. I hypothesize the Historic oysters recovered from Site 44YO079 resulted from the combined efforts of enslaved people oystering as supplementation for their poor everyday diets as well as a more commercialized oyster venture enacted by both freed and enslaved African Americans who resided on the land from the mid-1800s until the land was sold to the Navy in the early 1940s (Mamary 1994).

Following the Civil War, the enslaved people living on and around Site 44YO0797 were freed. The newly freed African Americans and their descendants coalesced into a small society and formed the township of Magruder on the land. The people living in and around Magruder heavily relied on catching and selling oystering for their livelihood. Selling oysters was very lucrative, especially heading into the late 1800s to early 1900s. Two Magruder residents, Knox Ratcliffe and Harold Ratcliffe, shared that they could sell a bushel (approximately 100 oysters) of oysters for $1.50 in the early 1900s (Harris 2019: 113); today, that would be almost $40 a bushel. When the Navy absorbed the township of Magruder, the residents were displaced and lost the rights to all their oyster grounds. They lost valuable waterfront land on the York River and the abundant resources the aquatic environment provided (Romo et al. 2021).

With the emergence of the market-based exploitation of the oyster fishery in the mid-1800s and 1900s, millions of pounds of oysters were harvested from the Chesapeake Bay every year (Thompson 2020), resulting in drastic declines in oyster reef habitats as measured by an 1889 survey (Schultz 2017). Freed African Americans who already had an affinity toward oystering and intimate knowledge of the construction and navigation of oystering boats carved a place for themselves in the extensive oystering industry (Mamary 1994). America's rapid economic development exposed the Chesapeake's oyster fisheries to a new level of demand and more intensified harvest technologies such as the dredge. Norfolk became one of the Chesapeake's oyster industry premier urban settings (Chiarappa 2018).

African American oystermen were at the center of the "oyster crazy," as the prominent labor force on many oyster boats (only as crew, not yet as captains). The crews had a profound knowledge of the most efficient techniques for harvesting oysters in the Chesapeake. They knew that if a boat's dredge chain length was too long, it would allow the dredge to rake deeper than necessary and destroy the bay's surface crust, an alteration that would make it too soft to sustain oyster growth. Alternatively, a light dredge pulled too quickly might skip over oysters rather than dig under them, either injuring them by breaking their bills or, even worse, killing them, diminishing future yields. If the dredge bag was too deep or large, it would, when filled, have a similar effect, gliding over the top of oysters left in its wake, either pushing them into the mud to suffocate or breaking their brittle edges (Chiarappa 2018: 78).

With this intimate understanding of the fishery came the recognition of how an increasingly cultivated ecosystem negatively affected the health and commodification of oysters.

As the shellfish economy grew more competitive entering the early 20th century, the Chesapeake Bay fishery began to collapse. The testimony of oyster workers recognized the harmful effects dredging had on oyster habitats. Beryl Whittington, an African American oysterman, argued industrialized harvesting practices lead to the destruction of both the ecological and economic health of the industry:

> "That's what killed them [oysters], taking the sails [off the schooners] and put them motors on them great big dredges, that killed the oysters. Just broke them up, that carried them away . . . motorized dredging. As long as they had the sails they kept plenty of oysters. See, then they got greedy. They wouldn't clean the [planted] grounds in the springtime like they did when I first come up here. . . . They stopped raking the grounds around I'd say '65. . . . That's when the oysters started fading away . . . when they stopped cleaning them grounds, the oysters just wouldn't take and wouldn't grow and they'd open up" (Chiarappa 2018: 82).

However, these warnings went ignored as people favored the economic return of the intensive oyster ventures over the long-term health of the fishery.

The first official mention of public oyster ground depletion was by Paxton (1858); he offered interviews and testimonies of prominent members of the oyster industry. His accounts described the depletion of oyster grounds in the York River and the lower Chesapeake Bay, both of which had been severely exhausted and damaged by oyster dredging by the 1850s. Similar damage was noted in several other Virginia waterways, including the James and Elizabeth Rivers, along the Bayside of Virginia's Eastern Shore and the Tangier/Pocomoke Sound. These early cautions went unheeded, and intensive harvesting and seeding continued—seed oyster harvest peaked at over 3 million bushels per year from 1890 to 1892 (Schulte 2017).

Post-Colonial common-pool resources management lacked the group cooperation and ecological understanding found in Native American practices. The post-Colonial oyster fishery fell victim to the "tragedy of the commons," an economic dilemma in which every individual has an incentive to consume a resource, but all act at the expense of every other individual. In this situation, every person behaves in their apparent own best interest, which inevitably results in harmful over-consumption of the resource. In this case, public oyster ventures overharvested the reefs present in the Bay because there were limited management policies to protect the resource from depletion.

The first significant harvest declines occurred in the late 1880s as market oyster numbers dropped by several million bushels per year (i.e., from over 6 million bushels in 1879 to less than 4 million by 1889). The 1890s found harvest numbers declining even more to less than 2 million bushels per year from the public grounds, requiring the private oyster reefs to contribute more than ever to yields. These declines of over 50% in only 25 years, like others before, went all but unnoticed. Even after various attempts to re-establish oyster populations, by the early 1920s, harvests on both public and private grounds declined, with the total yield falling to 4 million bushels per year and never recovering. Oyster growth on the public reefs dropped below 1 million by 1929. Finally, declines were met with considerable alarm by fishing industry managers and fishers. A 1929 Report of the Commission of Fisheries of Virginia described reef conditions as follows:

> "A survey of the natural oyster rocks on the ocean side of Accomac and Northampton Counties shows that thousands of acres of oyster bottoms, as defined by the Baylor Survey, have become entirely barren…The natural rocks in Virginia tributaries of the Potomac…have become depleted to such an extent that, with a few exceptions, they may be said to be now practically exhausted. The same conditions prevail in the Great Wicomico and York Rivers, in Mobjack Bay and its tributaries, and to a modified extent in the James River below the seed line. Some of the rocks in the Rappahannock and Piankatank Rivers are still comparatively productive, but many of the rocks in these rivers have either become much smaller in area or are now totally barren" (Schultz 2017: 127).

These declines are most directly attributed to the intensification of post-Colonial oyster harvesting practices such as constant tonging and dredging without adequate regrowth periods or replenishment of the public oyster grounds. In short, 19th century oyster harvesting ventures in the Chesapeake drove the once-thriving Chesapeake oyster fishery to ruin.

The evidence derived here supports previous assumptions that Native Americans living in the Chesapeake Bay watershed activity managed a sustainable oyster fishery for millennia explicitly centered on maintaining the resilience (i.e., ecological perspective of episodes of stability and change in human-environment relations) (Middleton 2011: 266). In contrast to previous assumptions, I conclude oyster harvesters in both the Archaic and Middle Woodland periods could harvest offshore oysters. However, during the Middle Woodland period, Natives actively focused on harvesting nearshore instead of offshore reefs to compensate for growing population sizes. The shift in practices represents common resource management processes that allowed the pre-Colonial oyster fishery to remain resilient in the face of increasing demands on harvest numbers. As can be seen with the historic period, when demand picked up without proper management, resilience quickly plummeted, and the post-Colonial fishery found itself in a state of disrepair. With new oyster management policy and ecosystem reconstruction initiatives, we are beginning to see improvements to the modern oyster populations and a chance of revitalization for the once great fishery.

Conclusion

The sustainability of the precontact oyster fishery in the Chesapeake was highly correlated to lower human populations and more limited harvesting practices. Nevertheless, the Native Americans still had a noticeable effect on the environment; generalizing Native oystering efforts in the Chesapeake as simply "artisanal-level" (Schulte 2017) overlooks the deep history of sustainable harvesting and shifting practices used to develop a resilient fishery (Jenkins and Gallivan 2019). Native Americans living in tidewater Virginia during the Late Archaic period had the skills and ingenuity to harvest oysters from offshore reefs and actively did so until the Middle Woodland period. The Middle Woodland marked a time of increased population size and sedentism; ergo, oyster harvesting intensified. I suggest that the inhabitants of Site 44YO0797 and other similar oyster midden sites along the Chesapeake Bay sustainably managed the oyster fishery while fostering resilience by exploiting oysters from diverse habitats as not to overexploit anyone shell bend. This served as a form of "collective management" for the resources to prevent overexploitation. My results demonstrate a shift in the primary location of harvest between the Late Archaic and Middle Woodland periods, from offshore to nearshore, as a collective decision to preserve offshore reefs from further degradation. These practices allowed the Native Americans to maintain an abundant, sustainable, and resilient oyster fishery in the Chesapeake Bay for millennia that at times even saw increases in ecosystem health and shell height (Jenkins and Gallivan 2019; Thompson et al. 2020).

The Colonization of the Chesapeake Bay watershed eliminated the long-standing Native American traditions, including all resource management practices. Native harvesting practices differed significantly from the dredging and culling of the 19th and 20th-century oyster fishery. Colonial ventures harvested Chesapeake oysters—both offshore and nearshore—on an industrial scale, leaving little-to-no time for spat regrowth and reef replenishment between harvest seasons. As the market economy grew, harvest yields increased. Without any limitations or management practices to protect the natural resources, the yearly harvest rates came to outnumber the annual growth rates, initiating the collapse of the Chesapeake Bay oyster fishery (Schulte 2017). While the Historic oysters from Site 44YO0797 were not harvested at the height of Historic oyster collection, they represent the beginning of a very destructive time for the Chesapeake oyster fishery.

The information uncovered from the past offers lessons for how we can proceed with future restoration initiatives and possibly reestablish our oyster fishery to a more self-sustaining level (Rick et al. 2016). Here we have seen that when actively managed by Native Americans, the Chesapeake Bay oyster fishery flourished for thousands of years. However, when Colonization terminated the common resource management practices, the oyster fishery was unknowingly condemned to collapse through the tragedy of the commons. My work demonstrates how deep historical data can provide concrete metrics and references for future resource management procedures and reconstruction endeavors. The next step is working to incorporate these data into conversations surrounding modern oyster restoration.

Current management techniques focus on the reseeding and reestablishment of reefs. However, these efforts merely keep populations stable. They do not allow for increases in population size because oysters are either harvested or killed by disease before reaching reproductive age. Today, the older age classes of oysters found in precontact times have been predominantly removed from the populations (Rick and Lockwood 2013). People must realize that when studying conservation techniques and baseline reconstruction for the Chesapeake Bay, it is important to consider that natural environmental and human factors have affected the marine ecosystem for over 150,000 years (Jenkins 2013). Thus, archeological studies such as this deliver a humanistic lens through which to view the history of the oyster fishery and possibly learn techniques from the past that can be applied towards the future. Here, I have offered a historical perspective to the human perceptions of ecological conditions that do not traditionally account for long-term changes that span decades, centuries, millennia of environmental conditions. We see large-scale harvesting of oysters from the Chesapeake Bay region can be and was sustained with proper institutions in place to protect against overexploitation. Long-term histories buried in shell middens may hold the key to future restoration, provided we accept that social and environmental forces have affected oyster and human populations alike.

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Appendix

Figure 1. Boundaries of Site 44YO0797 excavation with Carter Creek along the southern edge (Romo et al. 2021: 6).

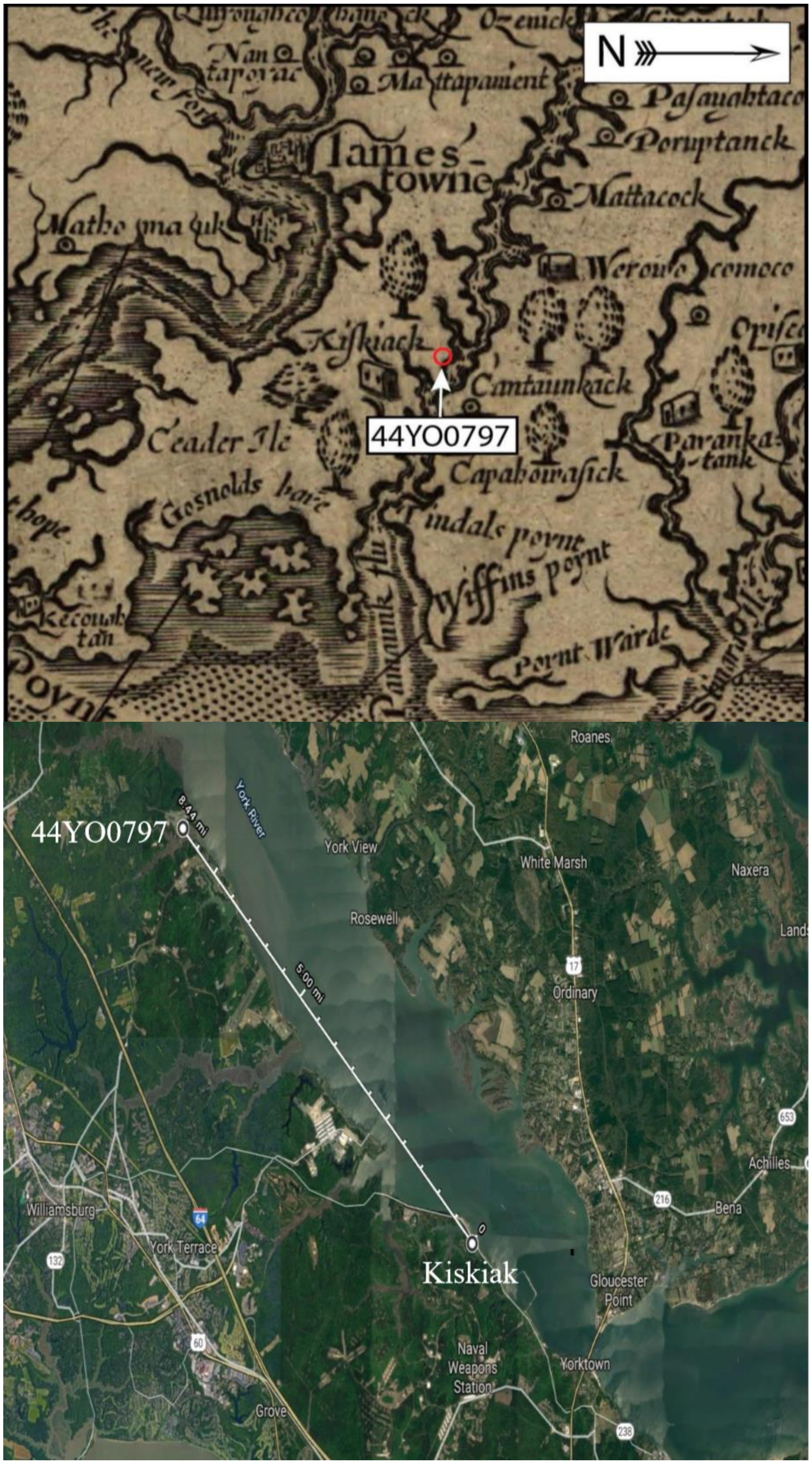


Figure 2. Top, location of Site 44YO0797 on John Smith's Map of Virginia (Smith 1624); bottom map, modern location of Site 44YO0797 approximately nine miles up the York River from Kiskiak (44YO02) (Photo copyright Google 2019).

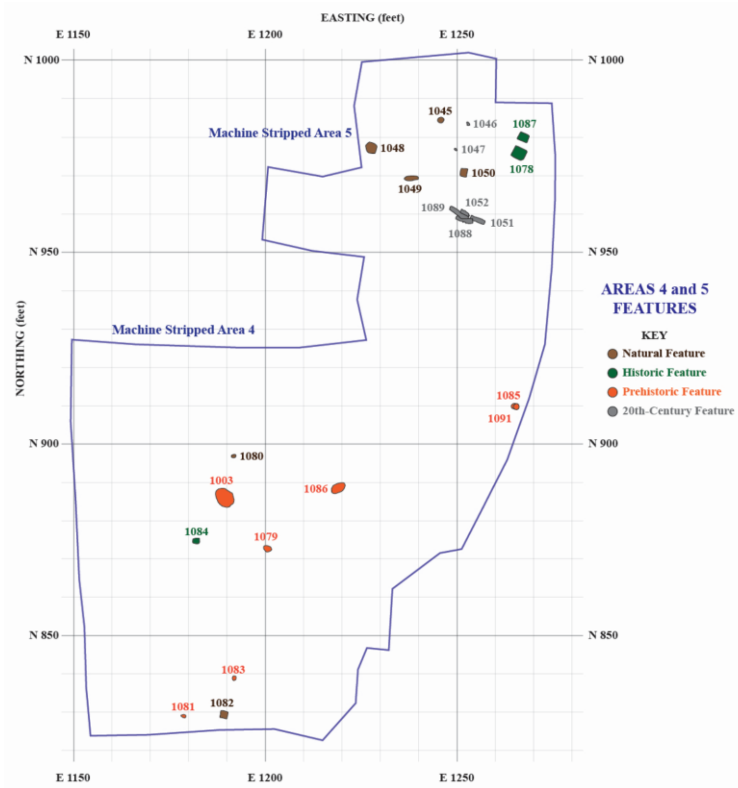


Figure 3. Machine stripped areas 4 and 5 containing features 1003, 1079, and 1085 (Romo et al. 2021: 110).

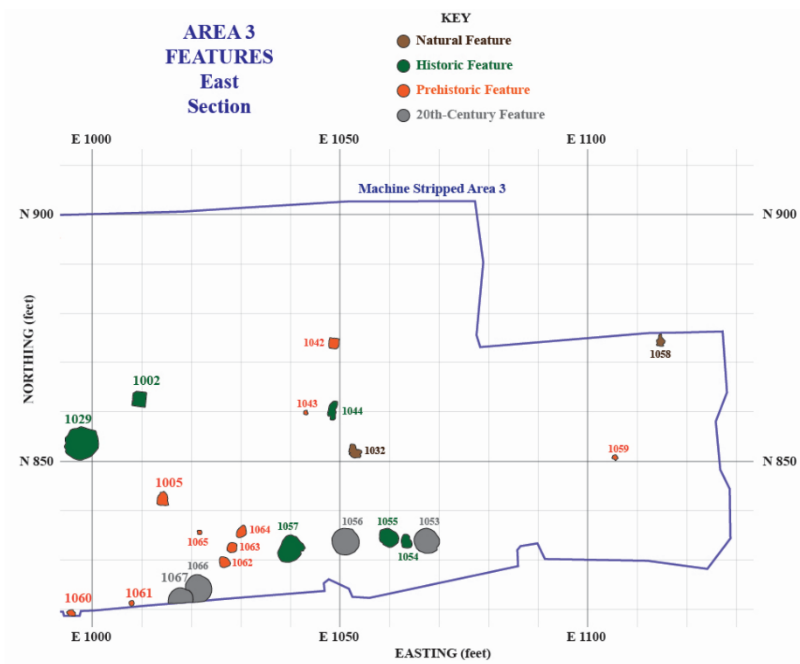


Figure 4. East half of machine stripped area 3 containing features 1057, 1062, 1063, 1064, and 1065 (Romo et al. 2021: 109).

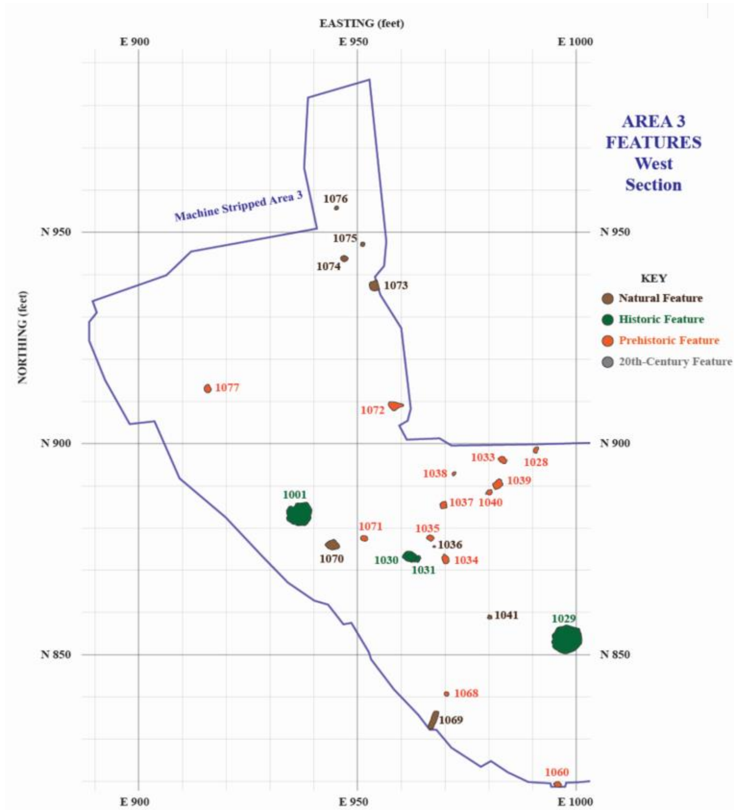


Figure 5. West half of machine stripped area 3 containing features 1001, 1033, 1034, and 1077 (Romo et al. 2021: 108).

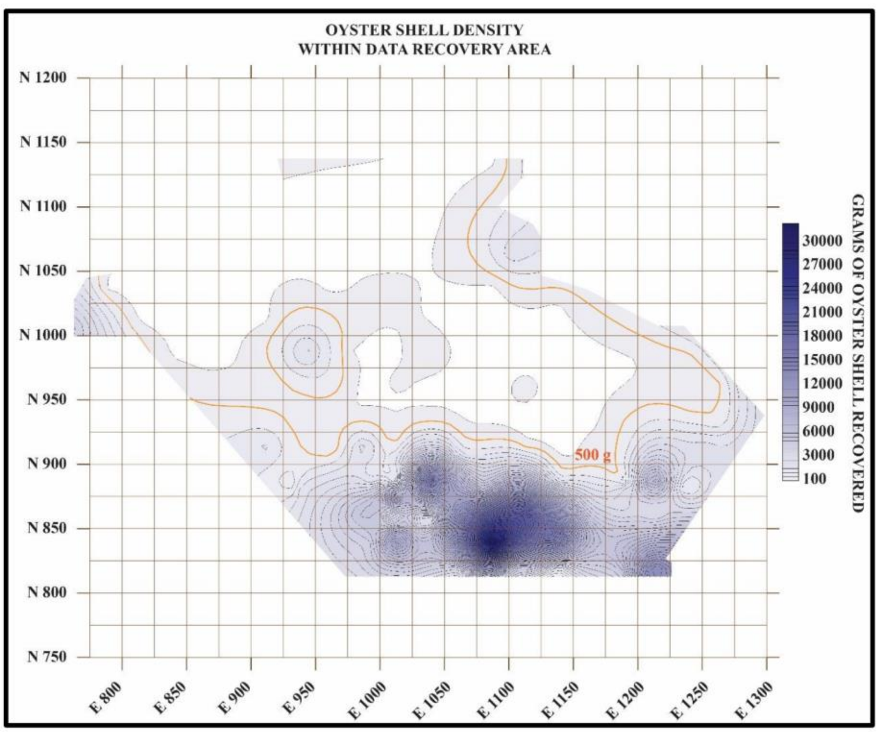


Figure 6. Oyster shell density (g) within boundaries of Site 44YO0797 (Romo et al. 2021: 178).

Figure 7. Photo of Feature 1085 (Type 1 roasting pit); dark gray layer where a fire once occurred (photo facing north) (Romo et al. 2021: 187).

Figure 8. Left offshore oyster from Late Archaic period, right nearshore oyster from Middle Woodland period (Jenkins and Gallivan 2019).

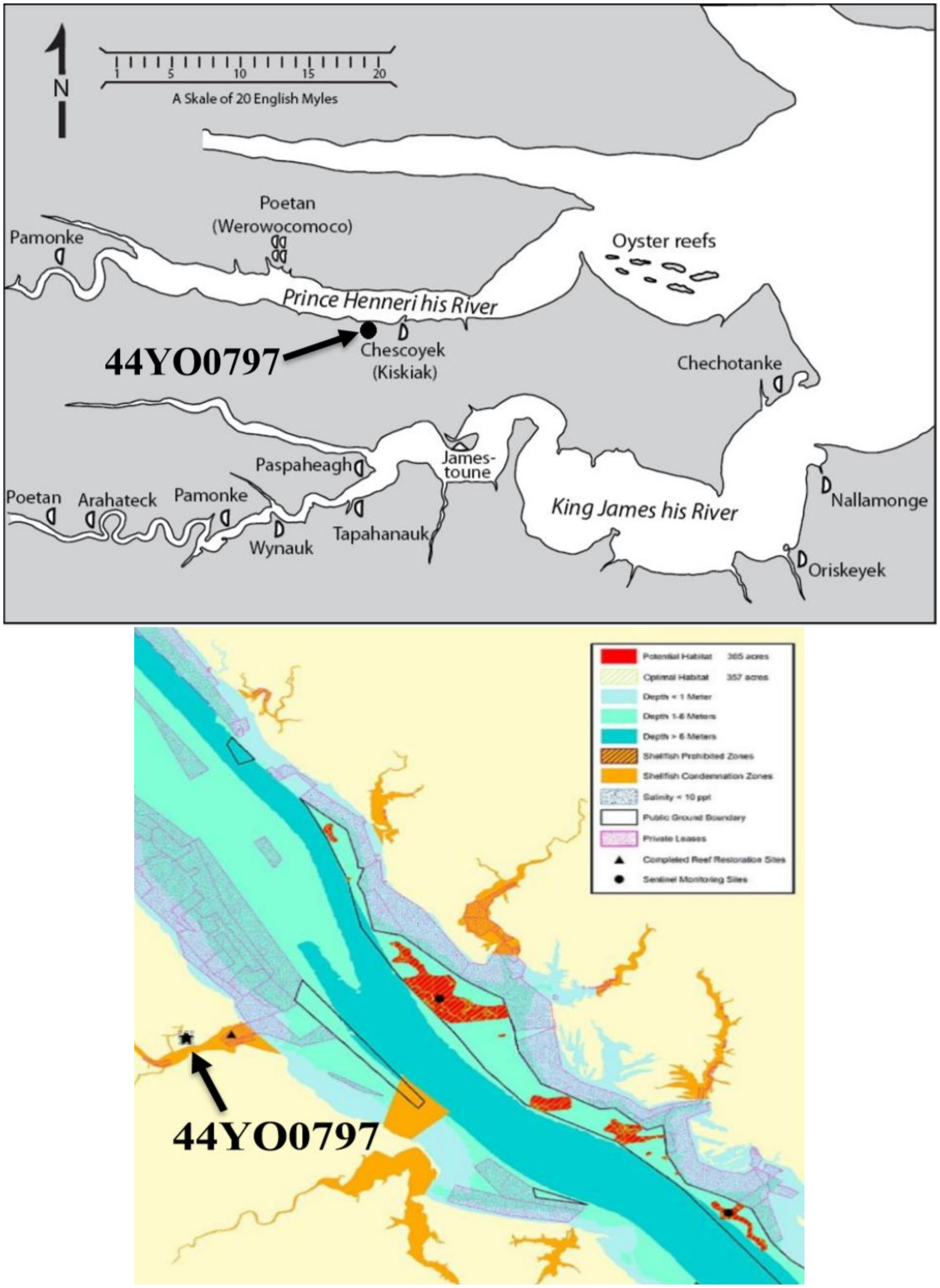


Figure 9. Top shows Robert Tyndall's 1608 Draughte of Virginia map redrawn with north at the top and oyster reefs downstream from Site 44YO0797 and Chescoyek (i.e., Kiskiak) (Jenkins and Gallivan 2019). Right shows VIMS York River-Beaver Dam to Roosevelt Pond oyster reef restoration populations for April of 2009 with Site 44YO0797 labeled across from area marked as potential habitat (VIMS 2009).

Harvest Location Indictor	Nearshore Oysters	Offshore Oysters
Height	Smaller	Larger
Height-to-Length Ratio	Short and round, low HLR	Long and rounded, high HLR
Left Valve Concavity	Shallow cupping, low LVC	Deeply cupped, high LVC
Parasitism	Absent	Present
Attachment Scar	Present, large	Absent or small

Table 1. Expected differences between nearshore, shallow water, oysters and offshore, deep water, oysters. Attributes used to hypothesize oyster harvest location (Modified from Jenkins and Gallivan 2019).

Sample ID	Feature	Sample Material	Calibration Curve	Conventional C14 Age (BP)	Median Age	Calibrated Dates		Period
						Range	%	
F1003_ 3703	1003	Shell	Marine 20	3834 +/- 31	BC 1670	BC 1871 - 1490	95.4	Late Archaic
F1062_ 16	1062	Shell	Marine 20	3888 +/- 29	BC 1740	BC 1928 - 1541	95.4	Late Archaic
F1063_ 1544	1063	Shell	Marine 20	3812 +/- 30	BC 1642	BC 1848 - 1462	95.4	Late Archaic
F1064_ 9	1064	Shell	Marine 20	3912 +/- 24	BC 1771	BC 1959 - 1576	95.4	Late Archaic
F1065_ 1	1065	Shell	Marine 20	3876 +/- 26	BC 1724	BC 1909 - 1529	95.4	Late Archaic
F1079_ 123	1079	Shell	Marine 20	4165 +/- 27	BC 2103	BC 2304 - 1901	95.4	Late Archaic
F1033_ 3	1033	Shell	Marine 20	1939 +/- 25	AD 611	AD 447 - 759	95.4	Middle WL
F1034_ 5706	1034	Shell	Marine 20	1975 +/- 27	AD 574	AD 415 - 715	95.4	Middle WL
F1077_ 0151	1077	Shell	Marine 20	1815 +/- 32	AD 736	AD 590 - 899	95.4	Middle WL
F1085_ 28	1085	Shell	Marine 20	2548 +/- 28	BC 99	BC 317 - AD 83	95.4	Late Archaic*

*F1085_28 dated to Middle Woodland I via C14 date, but morphological similarities associate it with Late Archaic typology.

Table 2. Calibrated dates for 44YO0797 displaying shells dating to the Late Archaic (B.C. 2500—1200) and Middle Woodland (500 B.C.—A.D. 900) periods. Radiocarbon dates calibrated with reservoir correction (ΔR) of -4 +/- 40 (Rick et al. 2012).

Feature	*n*	Height (mm) Mean	SD	Height-to-Length Ratio Mean	SD	Left Valve Concavity Mean	SD	Parasitism	Attachment Scar	Period
1003	96	57.79	14.19	1.44	0.25	9.42	3.07	63%	100%	L. Archaic
1062	185	65.05	16.72	1.42	0.21	10.92	3.75	69%	95.08%	L. Archaic
1063	249	68.56	20.33	1.5	0.34	11.69	4.16	48%	99.55%	L. Archaic
1064	59	64.33	20.31	1.45	0.23	11.32	3.32	54%	91.07%	L. Archaic
1065	27	57.66	16.16	1.44	0.20	9.05	3.23	65%	100%	L. Archaic
1079	40	74.34	14.85	1.51	0.21	12.17	3.97	75%	100%	L. Archaic
1085	279	72.43	19.04	1.7	0.32	10.15	3.20	74%	95.49%	L. Archaic
1033	260	50.88	11.45	1.33	0.19	7.52	2.83	16%	100%	M. WL
1034	826	51.41	12.59	1.39	0.24	8.4	2.94	7%	100%	M. WL
1077	54	46.5	11.47	1.33	0.20	7.3	2.29	2%	98.15%	M. WL
1001	337	77.36	24.64	1.63	0.39	10.36	3.94	57.5%	98.2%	Historic
1057	1448	62.83	23.09	1.51	0.33	8.99	3.73	46%	92.2%	Historic

Table 3. Means and standard deviations of height, HLR and LVC, and percentage of parasitism and attachment scars present for each feature.

Period	*n*	Height (mm) Mean	SD	Height-to-Length Ratio Mean	SD	Left Valve Concavity Mean	SD	Parasitism	Attachment Scar
Late Archaic	935	67.25	18.92	1.53	0.31	10.73	3.70	63.4%	96.95%
Middle Woodland	1140	51.05	12.33	1.38	0.24	8.15	2.91	8.4%	99.91%
Historic	1785	65.57	24.07	1.53	0.35	9.25	3.81	48.1%	93.3%

Table 4. Summarized means and standard deviations of height, HLR and LVC, and percentage of present attachment scars and parasitism on each shell for Late Archaic, Middle Woodland, and Historic periods.

	Test statistic	Result (t)	df	2-tailed signif.
Height	t-test	22.97	1320.5	<0.01
Height-to Length Ratio	t-test	12.15	1594.73	<0.01
Left Valve Concavity	t-test	17.49	1564.19	<0.01
Parasitism	Chi Squared (x^2)	673.57	1	<0.01
Attachment Scars	Chi Squared (x^2)	31.71	1	<0.01

Table 5. Statistical comparison for Late Archaic vs. Middle Woodland oysters.

	Test statistic	Result (t)	df	2-tailed signif.
Height	t-test	2.48	2037.95	p = 0.013 > 0.01
Height-to Length Ratio	t-test	-0.26	1905.72	p = 0.792 > 0.01
Left Valve Concavity	t-test	9.77	2590	< 0.01
Parasitism	Chi Squared (x^2)	103.84	2	<0.01
Attachment Scars	Chi Squared (x^2)	68.27	2	<0.01

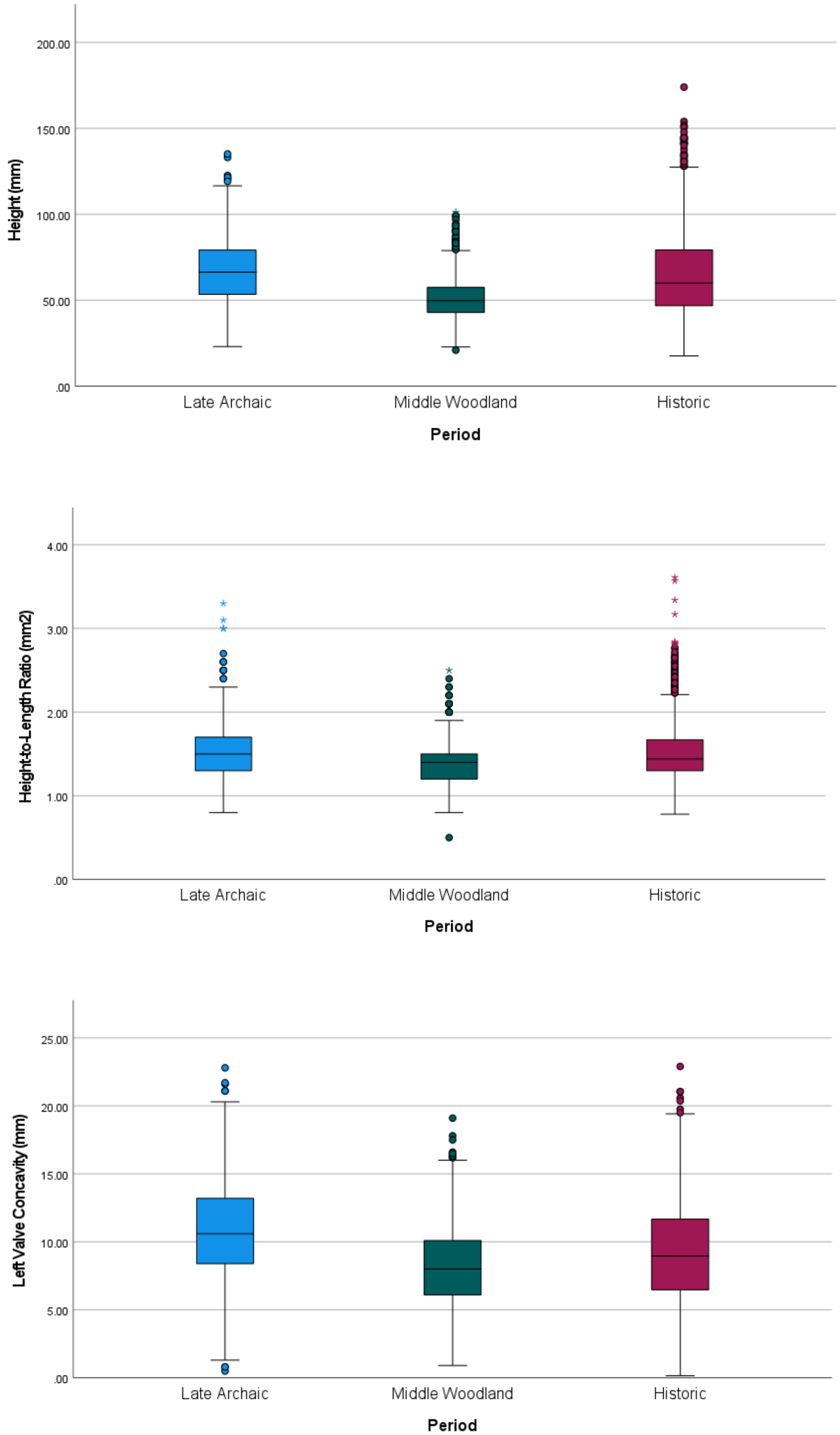
Table 6. Statistical comparison for Late Archaic vs. Historic oysters

	Test statistic	Result (t)	df	2-tailed signif.
Height	t-test	-22.99	2727.74	<0.01
Height-to Length Ratio	t-test	-14.194	2822.91	<0.01
Left Valve Concavity	t-test	-8.93	2791.02	<0.01
Parasitism	Chi Squared (x^2)	686.18	2	<0.01
Attachment Scars	Chi Squared (x^2)	76.09	2	<0.01

Table 7. Statistical comparison for Middle Woodland vs. Historic oysters.

	Test statistic	Result	df	2-tailed signif.
Height	Kruskal Wallis	425.70	2	<0.01
Height-to Length Ratio	Kruskal Wallis	171.35	2	<0.01
Left Valve Concavity	Kruskal Wallis	245.11	2	<0.01
Parasitism	Chi Squared (x^2)	959.41	4	<0.01
Attachment Scars	Chi Squared (x^2)	158.86	4	<0.01

Table 8. Statistical comparison of Late Archaic, Middle Woodland, and Historic oysters.



Graph 1. Boxplots of oyster height, height-to-length ratio, and left valve concavity displaying range of frequency and outliers of each attribute for Late Archaic, Middle Woodland, and Historic periods.