Sea level rise and a Florida mortuary pond: how oysters (crassostrea virginica) reveal past climate change at the Manasota key offshore archaeologyical site

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CHAPTER 2. CONTEXTUALIZING THE MANASOTA KEY OFFSHORE (8SO7030) ARCHAEOLOGICAL SITE

2.1 Introduction

This chapter provides contextual background for the MKO archaeological site. First, relevant topics concerning Florida's changing landscape beginning 18,000 years ago are discussed. Particular attention is paid to the geological and coastal changes that took place in Florida during the transition from the late Pleistocene to the Holocene. These periods are important in the context of this study because the environmental changes that occurred during them affected MKO. It is important to consider how the landscape was different at the time the study site was utilized by Archaic period populations. Within this section is a targeted discussion of marine transgression in the Gulf of Mexico (section 2.2.1), as well as the geological and coastal processes in Sarasota County (section 2.2.2). This will be useful later as the process of marine transgression at MKO is analyzed in Chapter 6, Discussion. It is also important to consider modern coastal changes in the region of the study site, as these directly affected MKO in the more recent past.

This chapter then shifts to an archaeological focus, beginning with a brief history of the field of submerged precontact archaeology in Florida (section 2.3). It is important to understand why these types of sites were historically underrepresented in academia and how the field ultimately grew and is flourishing. This provides context for the discovery and subsequent investigation of MKO. Following this, an overview of the Archaic period of the Southeastern United States is presented (section 2.4.), followed by a more detailed discussion of the archaeology of Florida's Sarasota County (section 2.4.1). The final section (2.5) delves into the study site itself, with particular focus on the oyster assemblage (2.5.1).

2.2 Florida's Changing Landscape: Geology and the Paleoenvironment

Large-scale climatic changes during the late Pleistocene and throughout the Holocene are responsible for a landscape that was vastly different than modern day (Duggins 2012; Joy 2018). At the height of the LGM, massive ice sheets covered much of the Earth's northern surfaces (Anderson and Sassaman 2012:2; Balsillie and Donoghue 2004; Faught 2002; Upchurch et al. 2019:72; Waters 1992). With 5% of Earth's water within these ice sheets, sea levels fell around 120 meters (m) lower than the present day, exposing large swaths of the continental shelves (Anderson and Sassaman 2012:2; Balsillie and Donoghue 2004; Joy 2018). Reduced runoff from glaciers, a lower water table, and different rain patterns created an arid environment that supported more xerophytic plant species like scrub oak, pine, and grassy prairies (Milanich 1994:31, 40; Waters 1992:252). In Florida specifically, drier conditions and

depressed groundwater tables during the Pleistocene caused fewer, concentrated karstic freshwater resources (Duggins 2012; Dunbar 1987; Joy 2018; Milanich 1994:38; Thulman 2009; Wilson et al. 2019). This is because sinks, springs, and rivers are fed by aquifers, which in turn are affected by precipitation and sea level.

After the height of the LGM, temperatures began to increase, which funneled glacial meltwater into rivers and ocean basins (Dincauze 1996:421; Waters 1992:252; Wentz and Gifford 2007). Ultimately, this caused sea levels to rise during a process that continued for thousands of years. While the general trend after the LGM was one of climate warming, fluctuations in temperature continued to cause cooling spells (Dincauze 1996:421; Waters 1992:252; Wentz and Gifford 2007). The Younger Dryas (12,850 to 11,650 cal BP) was the last major cold spell and is characterized by a slowing or reversal in the rate of sea level rise, though meltwater discharge continued to generally increase (Anderson and Sassaman 2012:38; Balsillie and Donoghue 2004; Faught 2002; Faught and Donoghue 1997; Gregory et al. 2017). The transition from the Pleistocene to the Holocene is marked by the onset of the Younger Dryas, with the beginning of the Holocene at approximately 11,500 cal BP (Anderson 1996:51; Anderson and Sassaman 2012:40–41; Faught and Pevny 2019; Halligan et al. 2016; Hemmings 2004).

The Holocene is characterized by rapidly warming climatic conditions (Anderson and Sassaman 2012:38) with high plant and animal diversity, increased seasonality contrasts, drastic sea level fluctuations, and changes in ocean-atmosphere interactions and storm tracks (Anderson and Sassaman 2012:38; Dincauze 1996:422). As the water table rose, wetter conditions followed, marking a shift away from the arid environment characteristic of the late Pleistocene/early Holocene (Cook Hale and Sanger 2020). This facilitated establishment of freshwater sources and development of estuaries along the coasts of Florida (Anderson and Sassaman 2012:4; Cook Hale and Sanger 2020; Milanich 1994:67). Estuaries were able to support oysters from 9,000 to 8,000 cal BP and again after 7,000 cal BP (Cook Hale and Sanger 2020; Joy 2019). In southern portions of the state, wetter conditions during the middle and late Holocene (from approximately 8,900 cal BP to 3,200 cal BP) supported the spread of warm, temperate forests (Cook Hale and Sanger 2020). Increasing tropical conditions transformed uplands, and cypress swamps appeared along flooded river systems of the lower Southeast (Anderson and Sassaman 2012:73; Dincauze 1996:421; Koski-Karell 1995). On the Gulf coast, rising sea levels supported wetland development, peat formation, and an expansion of marine flora and fauna (Anderson and Sassaman 2012:75; Cook Hale and Sanger 2020). Research suggests wetlands and the Everglades formed after sea level stabilization and mass peatification in Florida around 6,000 BP (Doran 2002b; Duggins 2012; Upchurch et al. 2019).

2.2.1 Marine Transgression in the Gulf of Mexico

While the previous section presented general climate conditions after the LGM, this section more closely examines marine transgression in the Gulf of Mexico using sea level curves and other transgression markers. Early curves were reconstructed for the last 40,000 years using cores extracted from the continental shelf and radiocarbon dating of organics (Waters 1992:252). Geomorphological features, such as relict beach ridge formations and barrier islands, have also been used to model past sea levels (Ruppé 1980; Stapor et al. 1991; Surge et al. 2003; Tanner et al. 1989; Walker et al. 1995). Balsillie and Donoghue (2004) first attempted to create a comprehensive, high-resolution, composite regional sea level curve for the northern and eastern coasts of the Gulf of Mexico based on radiocarbon dating of a variety of materials and statistical modeling. The researchers created a numerical consensus for the most probable sea level elevation for a given date in the Gulf using data from research conducted in southern Florida (Balsillie and Donoghue 2004). Balsillie and Donoghue's (2004) curve was the standard model for marine transgression in the Gulf of Mexico until recently (Duggins 2012; Joy 2018, 2019).

Joy (2018, 2019) reviewed the Balsillie-Donoghue (2004) curve and addressed issues with sampling, dating, and analyzing sea level proxy data. The Balsillie-Donoghue curve differed from other Gulf of Mexico and eustatic sea level curves by as much as 25 m, justifying a reexamination of the data (Joy 2018). Joy (2018, 2019) edited these data, separated environmental sample types, and used Bayesian statistical models to create a time/depth curve with ± 5 m accuracy. The curve demonstrated transgression was a continuous process beginning circa 18,000 cal BP. While the general trend was one of sea level rise, meltwater pulses identified in the data showed there were three instances of rapidly rising seas, as well as shoreline retreat. This caused fluctuations above and below the current coastline. Sea level rise slowed around 7,000 cal BP and reached more modern conditions by 5,000 to 4,000 cal BP (Cook Hale and Sanger 2020; Joy 2018, 2019; Koski-Karell 1995). By 2,500 cal BP, coastlines were at their modern configurations (Joy 2018, 2019).

While sea level curves became more detailed over the years, they are still broad in their application to specific locations. Marine transgression affected shorelines differently due to local variations in tectonic, isostatic, and eustatic forces (Balsillie and Donoghue 2004; Cooper and Boothroyd 2011; Duggins 2012; Joy 2018, 2019; Rivera-Collazo 2015; Toscano and Macintyre 2003; Waters 1992:252). Therefore, broad sea level curves lack fine-grained resolution for specific locations. Submerged precontact sites offer an opportunity to add detail to current curves as they often contain dateable paleoenvironmental proxy material for past shorelines. They also allow archaeologists to

examine how sea level rise affects specific sites. In Florida, sites such as Ray Hole Spring (TA171; Taylor County; Anuskiewicz 1987), Venice Beach (8SO26; Sarasota County; Ruppé 1980), and J&J Hunt (8JE740; Jefferson County; Faught 2002) contributed information about sea level rise in specific regions in the Gulf of Mexico, providing insight into the process of transgression (Figure 2.1; see section 2.2.2). Studies of submerged sites are increasing, but there is a lack of data concerning how fluctuations above and below the modern coastline affected archaeological sites. The study of MKO provides an opportunity to examine inundation processes for one region in the Gulf of Mexico and how these changes affected the population using the area at the time.

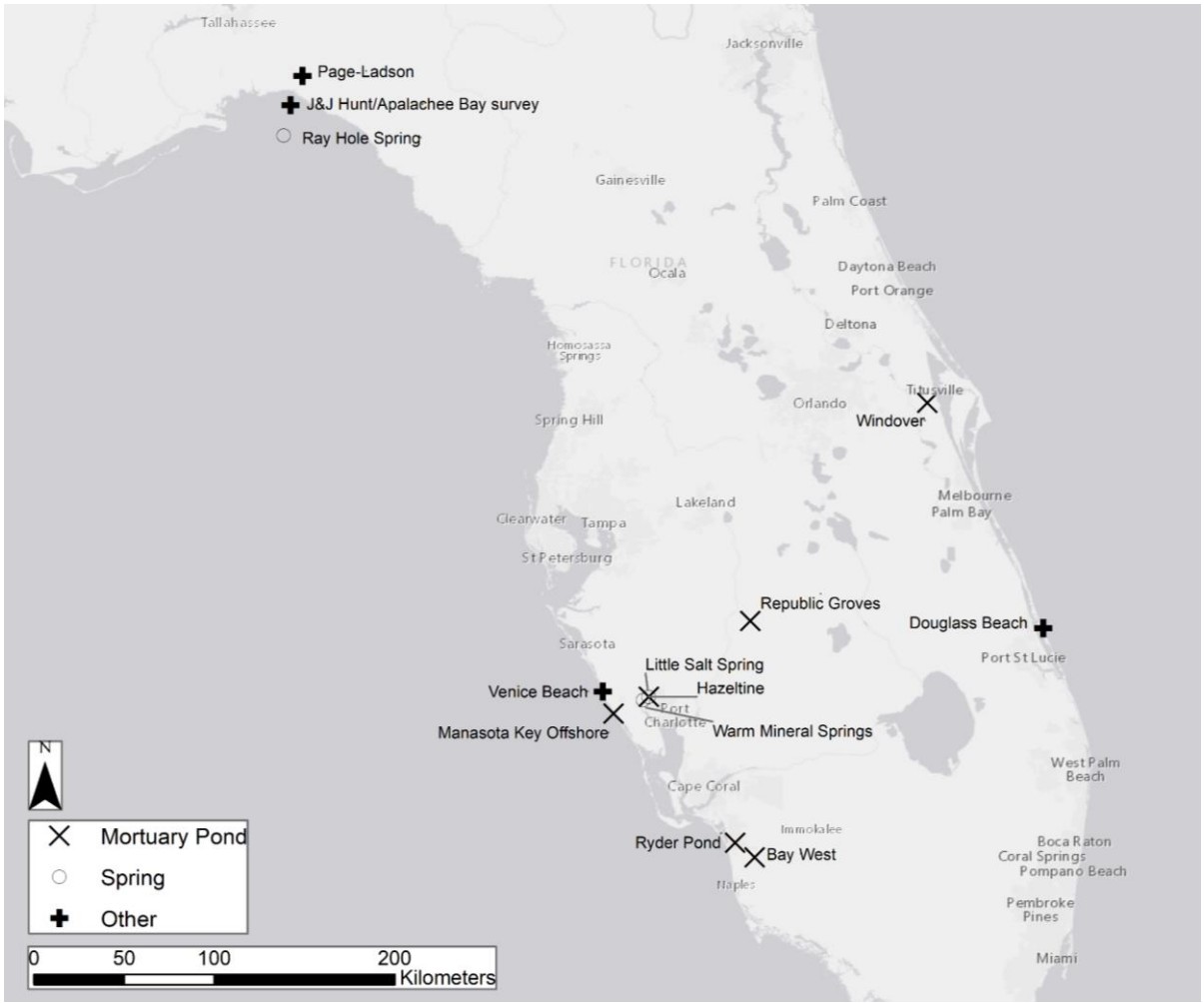

Figure 2.1. Specific Florida archaeological sites mentioned in this dissertation (Shapefiles courtesy FMSF; map compiled by author).

2.2.2 Geological and Coastal Processes of the Study Area

A discussion of marine transgression at MKO is not complete without a review of the geomorphological context of the larger landscape. This section focuses on Sarasota County, where MKO is located. When sea levels were lower during the late Pleistocene/early Holocene, the area west of Manasota Key was likely generally level subaerial terrain and part of mainland Florida, also known as the Florida Platform (Koski-Karell 1995). The Platform consists of all modern land currently above sea level, as well as the submerged continental shelf (Foster and Savage 1989:11; Upchurch et al. 2019:5). When sea levels were at their lowest, vast portions of the Florida Platform were exposed, especially to the west (Duggins 2012:23; Upchurch et al. 2019:72). Evidence that the Platform was once above water is visible in drowned paleoriver channels, sinkholes, caves, and archaeological sites (Duggins 2012; Faught and Donoghue 1997; Joy 2018; Ruppé 1980; Upchurch et al. 2019). Offshore of Sarasota County in particular, infilled sinks and springs were revealed by sub bottom profiling, and sediment cores revealed preserved terrestrial sediments below modern marine strata (Duggins 2018, 2019; Duggins and Price 2016; Wells et al. 2018).

Evidence of this once subaerial platform is also provided just offshore of barrier islands, which in this context refer to linear shoreline features consisting of bars of sand (Murphy 1990; Turck 2011). On the inland side of a barrier island, a tidal marsh or lagoon transitions to freshwater wetlands. These back barrier environments are waterlogged and considered low energy. Barrier islands are somewhat mobile features that likely formed beginning 6,000 to 5,000 years ago (Stapor et al. 1991). Mobility is attributed to multiple coastal processes, such as dominant currents and wind patterns, as well as marine transgression (Foster and Savage 1989:11; Wells et al. 2018; Wilson et al. 2019). Rising sea levels cause landward migration as waves wash over the islands, depositing sediments on the back or inland side of the barrier, sometimes referred to as back stepping. These overwashed sediments cap lagoonal, peaty deposits on the landward side of the island. Barrier islands migrate shoreward due to rising sea levels, leaving behind organic sediments on the shoreface (Koski-Karell 1995, Ruppé 1980). The strongest evidence of migration is peat strata underlying modern sand and eroding on the barrier island shoreface (Foster and Savage 1989:12). Venice Beach (13.26 km north of MKO) provides evidence of barrier island migration in this region: it was once up to 200 m further out in the Gulf as recently as the mid-1900s (Koski 1988; Ruppé 1980:38). Residents reported a swamp or marsh existed behind the dunes and extended the length of the public beach as recently as the 1970s. A further example is found in sediments offshore of Manasota Key. Wells and colleagues (2018) recorded sediments that included

pure muds, muddy sands, and organic-rich sands and muds containing faunal remains indicative of a back barrier environment.

Most of the modern day Manasota Key barrier island lies within Sarasota County, but the southernmost portion stretches into Charlotte County. The Manasota Key barrier island is parallel to shore and separated from the mainland by Lemon Bay (Figure 2.2). In its modern configuration, Lemon Bay is a shallow estuarine bay between Englewood and Manasota Key (Sarasota County Environmental Services Department 2020b). Tributaries include Alligator Creek, Forked Creek, Gottfried Creek, Ainger Creek, Oyster Creek, and Buck Creek. Freshwater also enters the bay via runoff, groundwater flow, and precipitation. Annual precipitation varied from 89.2 to 204.5 cm between 1980 and 2022; average annual precipitation is 133.8 cm. (Sarasota County Environmental Services Department 2023). Storms increase from June to October, introducing large amounts of freshwater to the bay. The bay reaches the Gulf via Venice Inlet, Stump Pass, Gasparilla Pass, and Charlotte Harbor. As a result, salinity fluctuates based on evaporation, precipitation, and tidal changes and has been recorded as low as 0.02 ppt and as high as 63.1 ppt from 1980 to 2022 (Sarasota County Environmental Services Department 2020b). Tides in this region are semidiurnal (Mendelssohn et al. 2017).

Manasota Key trends north-south and is part of the Gulf Barrier Chain, a series of 29 barrier islands founded on limestone and consisting of quartz sand and shell fragments formed over the last half of the Holocene epoch (Foster and Savage 1989:11; Wells et al. 2018; Wilson et al. 2019). Stapor and colleagues (1991) radiocarbon dated oyster shells on nearby barrier islands and hypothesized they developed after 5,000 BP, coinciding with a slowdown in sea level rise (Wells et al. 2018; Wilson et al. 2019). The youngest islands in this region emerged by 1,500 years ago (Stapor et al. 1991; Wells et al. 2018).

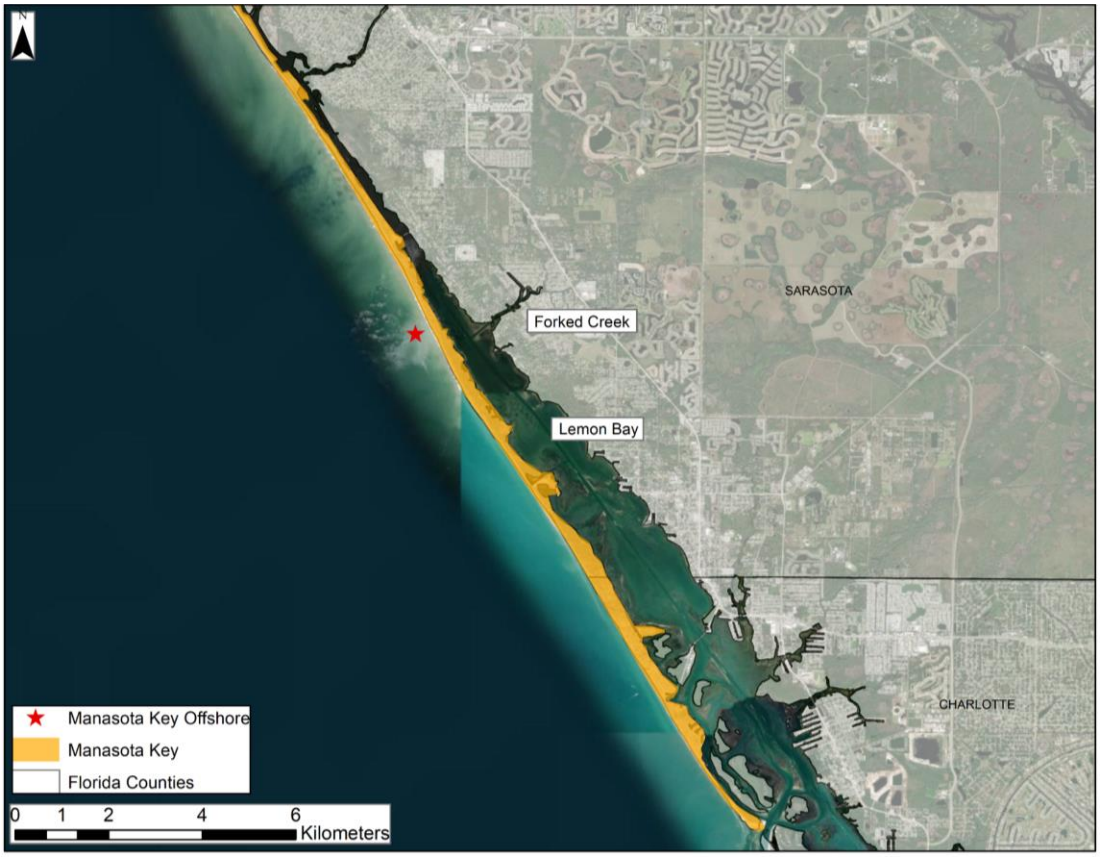

Figure 2.2. Manasota Key, Lemon Bay, and counties (Shapefiles courtesy BAR with Price addition).

Modern coastal processes actively affect MKO and the Sarasota County shoreline. The county lies within the Peace River Geomorphic District, which covers much of west-central peninsular Florida and is characterized by a flat landscape with limited relief (Upchurch et al. 2019:85). The gradually sloping inner continental shelf offshore of Manasota Key exhibits thin, patchy sediment cover consisting primarily of quartz sand, carbonate shell hash, and phosphatic sand with large expanses of limestone outcrops interrupting the landscape (Krivor 2016; Upchurch et al. 2019:53; Wells et al. 2018). Underlying the sand is an irregular limestone bedrock surface formed by karstic processes (Wells et al. 2018). Sediment coverage varies depending on waves, currents, winds, and storms. Wave energy in this region is low (mean significant wave height 80 cm) due to the wide and shallow coastal shelf (Foster and Savage 1989:10). Seasonal currents are parallel to shore, running southeastward in winter and northwestward in summer (Wilson et al. 2019). Prevailing winds are from the east, except during cold fronts when they are primarily northwesterly and impact the coast and inner shelf system by transporting large quantities of sediment from north to south (Wells et al. 2018). Low lying beaches, winter cold fronts, and summer storms contribute to a general trend of sand loss in the region (Foster and Savage 1989; Wells et al. 2018; Wilson et al. 2019). In the winter season, prevailing high energy

waves approaching from the northwest contribute to shoreline changes and long-term net southerly littoral transport of shoreline and sand (Foster and Savage 1989:9; Wells et al. 2018). Sand off this coast can move in large masses up to 3,000 m long in response to directional wave energy (Foster and Savage 1989:15). Wave refraction and manmade and natural barriers in the littoral zone further affect sand supply. Manmade barriers close to MKO include the Venice Inlet constructed in 1934, Venice Fishing Pier constructed in 1962, and sea walls along various beaches south towards Manasota Key. Foster and Savage (1989) reported that most buildings on the Key were constructed too close to the active beach, which hindered natural beach width fluctuations and affected natural shoreline evolution. Recent sea level rise also likely caused a net loss of sand as water migrated further ashore of the already scantly supplied beaches. Estimates of annual sand loss from the beach in some areas of Manasota Key are as great as 1.8 m (Wells et al. 2018).

2.3 Historical Context: Submerged Precontact Archaeology

This section provides a brief historical context of submerged precontact archaeology and the investigation of inundated sites in Florida. Inundated sites are defined as those that were initially deposited on dry land but subsequently filled with fresh or salt water as a result of rising water tables or sea level (Doran 1987). While the focus of this dissertation is on an offshore site, inland, freshwater sites are mentioned here because their discovery and investigation led to eventual developments in offshore research.

Initial submerged precontact site investigation began with avocational scuba divers who discovered preserved archaeological material and Pleistocene megafaunal remains in drowned karst environments (Dunbar and Waller 1983; Jenkins 1955; Milanich 1994:41; Waller and Dunbar 1977). In Florida, karst features include sinkholes, caves, springs, and sinking streams, many of which are filled with water that fluctuates in depth (Kaufmann 1993; Upchurch et al. 2019:5; Wells et al. 2018). The first realization that some of these features were once dry came from Warm Mineral Springs (SO19; Sarasota County; refer to Figure 2.1). This site was widely publicized and extensively studied because it contained the earliest submerged human remains ever located at the time (11,500 to 10,200 cal BP) (Almy 1975; Anderson and Sassaman 2012:63; Kaufmann 1993). Evidence that the feature was once dry existed in the form of extensive stalactites and stalagmites 24 m below the modern surface, as well as terrestrial plants and animals recovered from the spring ledges (Clausen et al. 1975; Cockrell 1990). The human remains also could not have been placed when the spring was fully watered. Warm Mineral Springs demonstrated that water levels at inland sites throughout the state fluctuated partly in response to sea

levels, which affected groundwater tables (Clausen et al. 1975; Cockrell 1990; Dunbar 1987; Upchurch et al. 2019:74). Nearby Little Salt Spring (SO18; Sarasota County) also provided evidence of Florida's changing landscape: the once-dry, 72 m deep sinkhole contained well-preserved human remains, as well as extinct megafauna (*Geochelone crassiscutata*) dating to 13,450 ± 190 BP and possibly associated with a modified wooden stake or spear dating to 12,030 ± 200 BP (Gregory et al. 2017). Both were recovered from a ledge 26 m below the present water surface (Dickel and Doran 2002:48; Dunbar 1987; Dunbar and Webb 1996:351; Gregory et al. 2017; Upchurch et al. 2019:294–295). An *in situ* hearth dated to 10,190 years ago further supported that the karstic feature was once dry (Milanich 1994:47). Warm Mineral Springs and Little Salt Spring provided examples of types of environments that could facilitate preservation of archaeological material following changes in water levels.

Many of Florida's currently large and flowing springs were likely sinkholes during the terminal Pleistocene/early Holocene, and today's lakes and small rivers were likely dry during that time period (Halligan et al. 2016; Joy 2018; Milanich 1994:31). Precontact archaeological sites are documented in relation to these water-filled karstic features, indicating these limited freshwater sources served important purposes to early populations and fauna (Doran 2002a; Duggins 2012; Dunbar and Waller 1983; Halligan et al. 2016; Kaufmann 1993; Milanich 1994:41; Wilson et al. 2019). This was supported by findings at the Page-Ladson archaeological site (JE591; Jefferson County), the earliest-dated submerged site in Florida that is widely known within the academic community for stratigraphic occurrence of human and megafaunal interactions [see Webb (2006) for a detailed discussion of the Aucilla River Prehistory Project]. These realizations were important in the context of offshore precontact archaeology, as inundated comparable landforms on the continental shelf could be targeted for study. Initial investigations at inundated inland sites such as Warm Mineral Springs, Little Salt Spring, and Page-Ladson furnished critical primary data for predictive modelling to locate sites on the outer continental shelf (Cockrell 1987:413).

Due to the climate and sea level changes described in sections 2.2 and 2.2.1, much of the evidence of early lifeways is likely now drowned on the continental shelves (Anderson and Sassaman 2012:2; Duggins 2012; Faught 1987, 2004; Hofman and Hoogland 2018; Krivor 2016; Milanich 1994:34; Wentz and Gifford 2007). Preservation potential of the remnants of these populations in an offshore context, however, was widely debated as sea level rise was viewed as a destructive process. This notion contributed to an underrepresentation of offshore precontact archaeology in academia. Challenges with locating and accessing inundated sites in an offshore context further stagnated the field at the time (Doran 1987; Faught 1987). Few offshore sites were the subject of research due to difficulty in locating

or identifying them (Dunbar 1987). Faught (1987) noted that the literature was virtually empty of reports concerning offshore archaeological sites, particularly from the late Pleistocene/early Holocene. Dunbar (1987) noted that surveys were cursory, and no meaningful work had taken place on Florida's Gulf continental shelves at the time of the publication.

Initial efforts to investigate submerged precontact sites were slow because submerged sites were less visible, funding was limited, methodologies were nascent, and the continental shelf is a vast landscape. Archaeologists had to reduce the potential area of survey for precontact sites. As a result, offshore research is founded on paleolandscape reconstruction, local coastal geomorphology, and terrestrial settlement patterns that are used to predict locations of offshore sites (Adovasio and Hemmings 2009; Benjamin 2010; Duggins 2012; Faught 2004; Joy 2018; Rivera-Collazo 2015; Ruppé 1980, 1988; Stright 1987). Ruppé (1980, 1988), for example, targeted drowned paleoriver channels and past sea level stillstands to locate archaeological sites in Venice, Florida. He conducted surveys off Venice Beach over several years, and his goals were to locate submerged sites via reconnaissance and ascertain what marine transgressed sites looked like. Ruppé (1980) utilized a fathometer to scan the seafloor for drowned riverbanks that were likely to contain archaeological sites, noting at the time that every river mouth in the county contained an abundance of archaeological material. He also surveyed the 9 m contour mark on nautical maps, hypothesizing it represented a past sea level stillstand or drowned beach. Ruppé (1980) noted the biggest challenge in locating inundated sites was the sheer amount of continental shelf to survey and the slow progress of diving high priority areas. Ruppé (1980) also realized the importance of targeting environments that could facilitate preservation of archaeological material and highlighted the protective aspect of barrier islands. He noted that archaeological deposits in back barrier locations become capped with overwashed sediments and thus remained protected. On the east coast of Florida, similar findings were documented [see for example (Bullen et al. 1968) concerning the CATO site and (Murphy 1990) concerning the Douglass Beach site].

In the Panhandle, Faught (1987, 2002, 2004) utilized findings from inland riverine research to guide offshore methodologies. Using knowledge of site distributions on adjacent coastlines, he followed paleoriver drainage systems from the coast into the Gulf to locate cultural material on the continental shelf in Apalachee Bay. Bathymetric data and digitized water depth and contour data were also used to reconstruct relict landforms and drainage systems and identify submerged landscapes likely to contain intact sites (Anderson et al. 2010; Duggins 2012; Faught 2002). During the Apalachee Bay survey, around 40 sites were identified up to 15 km out from the current shoreline (Faught 1987, 2002, 2004). This project represented one of the first targeted surveys of inundated archaeological sites on Florida's

continental shelf (Duggins 2012; Faught 1987; Stright 1987), and the methods of location and investigation are still used today, even at this dissertation's study site (Price 2019). The Apalachee Bay survey substantiated claims that targeted survey efforts based on knowledge of paleolandscapes, sea level changes, and human settlement patterns could result in discovery of archaeological sites on continental shelves (Faught 1987). The groundbreaking research in the Gulf also illustrated that there is potential for intact sites and stratigraphy to exist in an offshore context in Florida, countering the dominant theories at the time that were pessimistic and claimed limited preserved organics or context existed offshore due to the disturbing forces of sea level rise [see for example (Emery and Edwards 1966; Waters 1992; Wells et al. 2018); see Murphy (1990) for critique of theories]. In general, the study found that shallowly-filled, freshwater karst features may have formed into a protective and hypersaline lagoon that preserved archaeological deposits during inundation (Faught and Donoghue 1997:433; Joy 2018). The sloping and gradual grade of the Gulf of Mexico and low energy shore in the Florida Panhandle likely also provided additional protection from the impacts of transgression (Tanner et al. 1989:560; Waters 1992:263).

In summary, early efforts to investigate offshore precontact archaeology contributed to our knowledge of site survival on the continental shelves and revealed data concerning Florida's sea level history, as well as human use of the landscape prior to marine transgression. This section briefly reviewed the growing field of submerged precontact archaeology and touched on the types of environments that were conducive to preservation of archaeological material post transgression. While changes to Florida's coastal regions as a result of sea level and climate fluctuations during the late Pleistocene/early Holocene were dramatic, sites could be protected in sheltered springs and sinkholes, behind barrier islands, or in hypersaline, low energy lagoons. As our understanding of site preservation and coastal and sea level changes expands, the likelihood of locating more offshore precontact sites increases. This is especially so given technological advances of remote sensing equipment and developments in theoretical and methodological approaches. While there is a rise in offshore precontact archaeological research [see for example (Cook Hale et al. 2021; Davis et al. 2018; Duggins 2012; Faught 2014; Faught and Joy 2019; Grøn et al. 2021; Gusick and Faught 2011; Joy 2019; Mackie et al. 2013)], additional attention to this field is warranted. Further investigation of sites once they are located will contribute to a better understanding of how they survived sea level rise, thereby contributing to our knowledge of where archaeologists can expect to find additional sites.

2.4 Regional Culture History: The Archaic Period of the Southeastern United States

The Archaic period of the Southeastern United States is discussed here to provide cultural context for MKO. For the purposes of clarification, the Southeast describes both a culture area and geographic region, defined as those areas south of the Ohio River and east of the Mississippi River, including the modern states of Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Tennessee, Kentucky, Mississippi, Arkansas, and Louisiana (Anderson 1995; Anderson and Sassaman 1996, 2012:3).

In general, the Archaic period (from approximately 11,500 to 3,200 cal BP) of the Southeast is divided into three subperiods that are based on changes in subsistence technology, diagnostic lithic forms, and large scale environmental and demographic change (Anderson 1995; Anderson and Sassaman 2012:66; Milanich 1994:62). It begins with the end of the Paleoindian period around 11,500 cal BP, which also marks the Pleistocene/Holocene boundary (Anderson 1995; Anderson and Sassaman 2012:40; Halligan et al. 2016; Joy 2018; Krivor 2016; Milanich 1994:63). Climate change and prey animal extinction sparked cultural change and marked the beginning of the Early Archaic period (from approximately 11,500 to 8,900 cal BP) (Anderson and Sassaman 2012:2, 87). Though the climate was more arid than the modern day, changing climatic conditions and an increase in resources allowed Early Archaic period populations to expand and settle into hospitable areas (Anderson and Sassaman 2012:72; Doran et al. 2008:8–9; Milanich 1994:53). This is evidenced by more widely distributed lithics across the state. The Early Archaic period corresponds with the extinction of Pleistocene megafauna, increases in regional temperature, and shifts to humans' reliance upon modern species (Anderson 1995; Anderson and Sassaman 2012:66). It is distinguishable from the Paleoindian period in that dense human populations existed near wetlands and water sources across the Southeast region, evidenced by large numbers of sites and artifacts, though there was still a high degree of mobility (Anderson and Sassaman 2012:27, 71; Doran et al. 2008 8–9). This shift from logistical to residential mobility corresponds with the use of highly curated, expedient lithic technologies and specialized tools that suited foraging adaptations (Anderson and Sassaman 1996:27; Doran et al. 2008 8–9). The transition from lanceolate to stemmed forms and an increase in tool types suggested a greater variety of tasks and changes in subsistence practices to new plant, animal, and aquatic species (Krivor 2016; Milanich 1994:66). This is further indicated by the existence of awls, antler handles, fishhooks, and throwing stick weights (Milanich 1994:67). The Early Archaic period ended around 8,900 cal BP, which coincided with the Hypsithermal, a thermal maximum that resulted in visible culture changes in the archaeological record (Anderson 1995; Anderson and Sassaman 2012:66).

The Middle Archaic period (8,900 to 5,800 cal BP) corresponds with the middle Holocene (Anderson and Sassaman 2012:66; Cook Hale and Sanger 2020) and is characterized by an increase in population size as inferred by an increase in archaeological sites (Kratt 2005; Doran et al. 2008:8–9). Populations continued to expand across Florida in response to changing climatic conditions, and sites appear in settings in Florida not previously recorded, such as the St. Johns River and the Atlantic coastal strand, the southwestern portion of the state, and in the Hillsborough River drainage northeast of Tampa (Anderson and Sassaman 2012:66; Doran et al. 2008:8–9). Middle Archaic period populations also exploited a broader range of aquatic and terrestrial resources, made use of shell and faunal bone tools, and heat-treated their lithic materials (Austin et al. 2009; Krivor 2016; Milanich 1994:76; Wilson et al. 2019). An increase in tool variety suggested populations maintained a more sedentary way of life than their earlier counterparts (Austin et al. 2009; Milanich 1994:79). Sedentism was thought to have increased because of sea level rise and increases in the hydrological supply, which fostered wetland development and an increased reliance on freshwater and marine resources (Austin et al. 2009). This is supported in the archaeological record as an increase in the number and distribution of sites in coastal regions especially, some of which consisted of shell rings and middens and other evidence of terraforming activities. Mound building first appeared, providing additional evidence of population increase and suggesting groups were becoming more diverse (Cook Hale and Sanger 2020; Kratt 2005). Settlement near productive interior wetlands and inland freshwater springs, such as at Little Salt Spring, also occurred (Austin et al. 2009).

In the context of MKO, a particularly relevant cultural practice during this period was interment of the deceased into mortuary ponds (refer to Figure 2.1; sites are denoted with “X”). Mortuary ponds consist of shallow peat-bottomed ponds or other small water bodies and were the first formal cemeteries to appear in Florida (Doran 1987, 2002a, 2002b; Wentz and Gifford 2007). This cultural practice is unique to the state and is bound geographically to the central and southern peninsula (Anderson and Sassaman 2012:62; Wentz and Gifford 2007). Several ponds have been documented, and dates occur from around 10,000 to 7,000 cal BP, though no sites date more recently than the Middle Archaic period (Anderson and Sassaman 2012:63; Dickel and Doran 2002:57; Doran 2002b; Milanich 1994:70). Florida’s mortuary ponds include Windover (BR246; Brevard County), Ryder Pond (LL1850; Lee County), Bay West (CR200; Collier County), Republic Groves (HR04; Hardee County), and Hazeltine (SO79; Sarasota County), of which Windover is the best documented [see (Doran 2002a)]. These wet sites contributed to archaeologists’ understanding of the Archaic period due to survival of sensitive organic materials (Anderson 1995; Dickel and Doran 2002; Milanich 1994:70; Purdy 1991). Preserved

plant materials afforded insight into paleoenvironmental conditions, and fauna that were intentionally placed with burials or that perished in the pond provided examples of available resources (Doran 1987).

Preservation at these sites is the result of a complex interaction of peat chemistry and composition, water chemistry, and an anerobic, stable water environment (Doran 1987). Peat consists of decayed plant organic material that accumulates at a faster rate than microorganisms can recycle it (Stout and Spackman 2002:227). Peat forms in often stagnant environments lacking oxygen, such as in ponds, swamps, and marshes. Windover burials were exceptionally preserved due to the stable environment of the pond, as well as peat and water chemistry (Doran 2002a:8). The burials were placed below the active biological zone of the pond, where oxygenation, burrowing organisms, and roots could not penetrate. This anaerobic environment, coupled with a pH neutral peat (5.9 to 6.75) and no erosional processes affecting the site meant that delicate organics, such as woven fibers, survived thousands of years. One Windover peat stratum also contained a high concentration of freshwater snails, which likely contributed to preservation due to the calcium carbonate content of their shells (Dickel and Doran 2002:50).

It should be noted that besides Windover, much of what archaeologists learned about mortuary ponds was gleaned during rescue operations. These sites were also often not considered within the context of their larger landscapes. There are still unknowns concerning mortuary pond practices in Florida, particularly why exactly the practice developed and then fell into disuse. One hypothesis for the use of mortuary ponds is that post-Pleistocene dryer conditions made scarce water sources significant to Early and Middle Archaic period populations from a ritualistic standpoint (Doran 2002a; Milanich 1994:84). It is interesting that at a time when water was scarcer, communities chose to inter their deceased in freshwater sources. In terms of abandonment, archaeologists hypothesized that use of mortuary ponds ceased due to sea level rise and landscape change, which made interment in ponds impractical (Anderson and Sassaman 2012:100; Milanich 1994:84). Factors could also include changing views of water or increases in population size. Nevertheless, there was an interesting transition from mortuary ponds to shell mound burials (Anderson and Sassaman 2012:100; Klingle 2006). Tick Island (8VO24, Volusia County), for example, was a mound that consisted of burials within two platforms located on a shell ridge (Anderson and Sassaman 2012:100). At this site, which dated between 7,000 to 6,600 cal BP, earlier burials were covered with sand, and later burials were capped with a shell midden. Shell mound burials were then replaced with sand mound burials, the first of which appeared by 5,800 cal BP. This change in burial practice is attributed to sea level rise (see discussion in Chapter 6, section 6.7.3).

The Late Archaic period (from approximately 5,800 to 3,200 cal BP) corresponded with the onset of modern climatic conditions (Anderson 1995; Anderson and Sassaman 2012:66, 74; Krivor 2016) and the late Holocene (Cook Hale and Sanger 2020). Site frequency and distribution suggest populations lived in larger, more sedentary groups than their Middle Archaic period counterparts (Anderson and Sassaman 2012:74; Krivor 2016; Milanich 1994:102). These populations expanded across almost every part of Florida and exploited a wider variety of coastal and freshwater resources, as evidenced by extensive shell deposits, such as middens, mounds, and rings, which were more prolific than in the Middle Archaic period (Doran et al. 2008:8–9; Milanich 1994:85; Russo and Quitmyer 2008:239, 246). Many of these complexes demonstrate that populations lived year-round in permanently occupied villages with organized social systems (Anderson 1995; Anderson and Sassaman 2012:88; Krivor 2016; Milanich 1994:100; Russo and Quitmyer 2008:239, 246). Wetlands were also extensively settled, but smaller foraging camps were still present (Doran et al. 2008:8–9; Russo and Quitmyer 2008:239). Increase in cultural adaptability is evidenced by fiber and sand tempered pottery, which appeared between 4000 and 3000 BP (Anderson 1995; Anderson and Sassaman 2012:88; Kratt 2005; Krivor 2016; Milanich 1994:100; Wilson et al. 2019). The first ceramics consisted of fired clay pottery tempered with pant fibers (Almy 1976; Doran et al. 2008:8–9; Koski-Karell 1995). Interestingly, there is no evidence of agriculture in southwestern Florida during this period (Koski-Karell 1995). Populations relied instead on collecting, fishing, gathering, and hunting in the abundant estuaries and wetlands characteristic of this region.

The end of the Archaic period is marked by the widespread abandonment of coastal sites and changing use of the landscape, a result of long term trends in sea level fluctuations, floods, droughts, and storms that dramatically changed the distribution of these communities (Anderson and Sassaman 2010:66, 110; Saunders and Russo 2011). While Archaic period cultures were fairly uniform across the state, the post-Archaic period is characterized by diversification of regional cultures or traditions that developed more in isolation (Klingle 2006; Kratt 2005). Riverine settlements and large interior base camps provide evidence that these cultures expanded across much of Florida (Saunders and Russo 2011). Trade, ceremonialism, and horticulture intensified, along with the appearance of elaborate mortuary practices (Doran et al. 2008:8–9; Kratt 2005). Widespread use of pottery occurred, and the diversification of these forms, decorations, and manufacturing practices distinguished the culture groups in Florida at the time. Specific post-Archaic period cultures are not discussed in this dissertation and are instead referred to under the more general Woodland period designation.

2.4.1 Archaeological Context of the Study Area

The archaeological context of the study area focuses on west central Florida, in the vicinity of Sarasota and Charlotte Counties. In order to encompass relevant geographic features in the vicinity of MKO, a buffer of 50 km was used (Figure 2.3). Archaeological sites that fell within this buffer are discussed forthwith. This provides an adequate representation of the wider cultural landscape of which MKO is a part. This region has a rich archaeological history that spans over 14,000 years of human occupation, though the focus here is the Archaic period, with broader mentions of post-Archaic period cultures prior to contact with Europeans. According to the Florida Master Site File (FMSF), the state's central inventory of cultural resources, there are 625 recorded precontact sites (pre-1492) within 50 km of MKO. The generalizations made here are based solely off the data available in the FMSF, which has its limitations. Site descriptions can be broad, and some sites have few details associated with them. Nevertheless, the geodatabase illustrates that most of these sites congregate near the coast, on the shoreface of bays, or near rivers, sinks, and wetlands. Generally, there are fewer sites inland, though this may be attributed to their location in areas where development has not yet occurred. Those that are inland also concentrate around water sources, like the Myakka River. This river contains Pleistocene deposits eroding out of the banks (Cockrell 1977), indicating the potential for early sites to exist in this region of Florida. This study area's deep past is also evidenced by the aforementioned Warm Mineral Springs and Little Salt Spring. Of the 625 sites in the 50 km buffer zone, 375 are categorized as prehistoric, either with pottery or lacking pottery. Note that the term "precontact" is used throughout this dissertation in place of "prehistoric." Archaic period sites total 78. Unfortunately, 34 of the 625 sites are listed as destroyed, perhaps due to erosion, looting, or development.

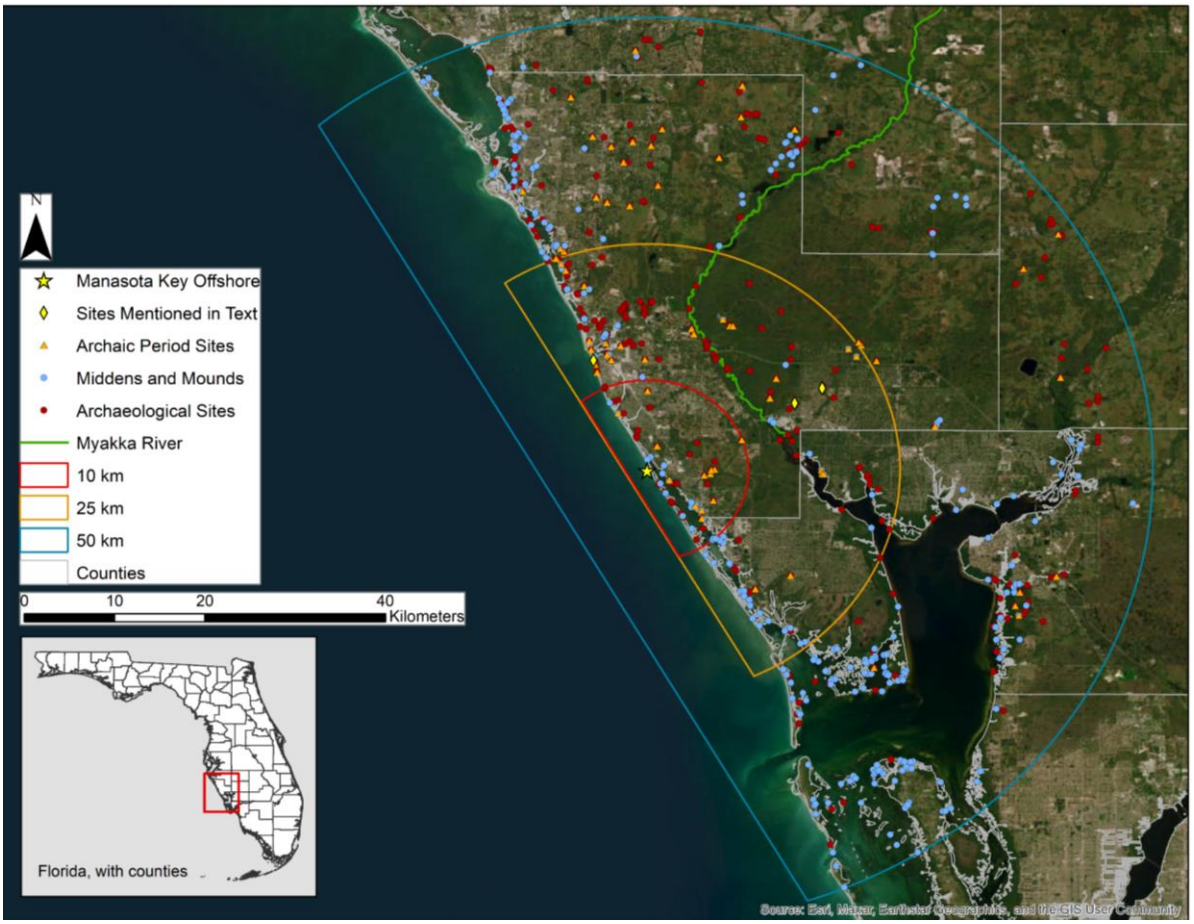

Figure 2.3. Archaeological context in the vicinity of MKO (Shapefiles courtesy of FMSF and BAR, with Price 2023 additions).

Long term occupation and repeated use of ancestral lands is evidenced by extensive middens and burial mounds. There were 204 middens (primarily shell) and 82 mounds, which included burial mounds.[2] These sites congregate near the coast and other water features, though development of these areas may be one reason for the number of recorded sites. Some of these features span from the Middle Archaic to the post Archaic period. These large-scale terraforming activities are indicative of larger population sizes and increase in sedentism characteristic of the Middle Archaic period. Widespread and long term use of the study area's coastal region is also evidenced by multicomponent sites. There are many examples of these, some of which contain elements that date from the Early Archaic period all the way through contact with Europeans.

In general, other precontact site classifications in the region include campsites, habitations, burials, low artifact scatters, and preceramic lithic scatters or specialized sites for the procurement of

[2] Within the FMSF, some sites are listed as both "midden" and "mound."

raw materials that may indicate more temporary occupations and smaller population sizes from the late Paleoindian and early Archaic periods. Sites in the interior that are not concentrated around water are generally smaller, suggesting they were not inhabited year round or are indicative of smaller populations. Coastal and wetland regions could certainly support larger populations due to more resources, something that is visible in the distribution of sites in this region.

Fifty-five sites are listed as submerged and included subdivisions such as saltwater submerged, freshwater submerged, wharf/dock/pier, cave/sink/subterranean-aquatic, inundated land site, wetland, tidal/estuarine, and river/creek/stream. The low number of submerged sites is a perceived absence and attributed to a lack of systematic underwater archaeological survey. Surveys are biased towards those on land, and there are likely many unrecorded submerged sites in the county. Populations certainly inhabited areas close to the coast and the now inundated portions of Sarasota County's bays, rivers, and continental shelf. Ruppé's (1988) work at the Venice Beach site revealed the potential for additional submerged sites to exist. Local scuba divers also reported locating worked shell while diving offshore of Venice and Manasota Key. One diver may have located a midden south of MKO (Steve Koski personal communication 2018), though archaeologists did not personally visit the site. Manasota Key beachgoers regularly report discovering lithic points in the surf zone of the beach along the Key. All of this evidence suggests Sarasota County's known archaeological record is sorely underrepresented in terms of inundated precontact sites.

2.5 The Manasota Key Offshore Archaeological Site

MKO, the subject site of this dissertation, is located 335 m offshore of Manasota Key in Sarasota County and sits at a water depth of 6.4 m (refer to Figure 1.1). The site was initially a freshwater pond located inland of the current coastline but was inundated by Holocene sea level rise and is now in an offshore context (Duggins 2018, 2019; Duggins and Price 2016; Duggins et al. 2018). The purpose of this section is not to present information about MKO in great detail, but to provide an overview of data pertinent to the research aims of this dissertation. Information about MKO comes from the efforts of the staff at BAR. At the time of this writing, there are no published peer-reviewed journals concerning MKO. Instead, the data and inferences in this dissertation are drawn from archived field notes, raw and processed remote sensing data (side scan sonar, magnetometer, sub bottom profiler, parametric sub bottom profiler, multibeam bathymetry), geodatabases created by various BAR staff, sediment core analysis, artifact list forms, unit level forms, artifact inventories, radiocarbon dating results, and internal reports. All of these data are stored at BAR in Tallahassee. Information is also drawn from multiple

conference presentations, most of which were led by the project's principal investigator, Dr. Ryan M. Duggins. While the author was present at all MKO field sessions with the exception of July 2016, credit is due to Dr. Duggins and the staff at BAR for their work. For clarification's sake, the portions of MKO research that concern mollusks and isotope analysis are the author's own contributions. The rest of what is known about MKO was wholly a group effort, though much of that work currently remains unpublished.

Fieldwork at MKO is ongoing since 2016 and is led by BAR's State Underwater Archaeologist, Dr. Duggins (Duggins 2018, 2019; Duggins and Price 2016; Duggins et al. 2018). Investigations were fundamentally part of an emergency archaeology effort, though it represents the most detailed study of a transgressed Archaic period site ever conducted. In the intervening years since 2016, extensive remote sensing conducted at MKO resulted in the most well-mapped Archaic period site located on the continental shelf. Knowledge of the extent and use of the site is informed by remote sensing, visual surveys and surface collection, sediment coring, and excavation of a 5 m^2 area.

MKO is the most recently documented Archaic period mortuary pond and the only one currently located in an offshore context (Duggins and Price 2016). It was reported to BAR in June 2016; the site consisted of an exposed, organic peat stratum protruding from marine sand at 6.4 m underwater. Embedded within the peat were cylindrical wooden stakes that were culturally modified and associated with skeletal material. Dislodged material was also mobile on the seafloor. Thorough side scan sonar and sub bottom profiler remote sensing revealed an extensive peat deposit. Evidence suggested MKO shares characteristics with other mortuary ponds across the state, and initial Accelerator Mass Spectrometry (AMS) radiocarbon dating of a modified wooden stake confirmed the site's Archaic period affiliation at around 7,214 ± 30 cal BP (Duggins and Price 2016).

The site as it is known today consists of a prominent and actively eroding peat ledge that reaches the surface of the seafloor to the west and southwest (BAR 2016a, 2016b; Duggins and Price 2016; Duggins et al.2018). According to currently accepted sea level curves, this preserved edge of the pond was likely circa 9 m above sea level around 7,200 cal BP (Joy 2018, 2019). The interior portion of the pond is buried beneath one or more marine strata (BAR 2016a, 2016b; Duggins and Price 2016; Duggins et al.2018). Exposed portions of the site (i.e., where the peat reached the surface of the seabed and was accessible to archaeologists) encompassed an area that was circa 1,295 m^2 and situated south and west of the hypothesized pond interior (Figure 2.4). A limestone outcropping is prominent to the west and north of the erosional peat ledge; it likely marked the edges of the pond prior to transgression (BAR 2018c). Cultural material included modified and charred wooden stakes, plant based cordage,

worked shell, potential textile remains, faunal material (some of which was burned), wood fragments, and human remains (BAR 2017d, 2018c; Duggins 2018, 2019; Price 2020). The initial preservation of this material is attributed to the peat environment and is comparable with assemblages from other mortuary ponds across Florida, particularly Windover.

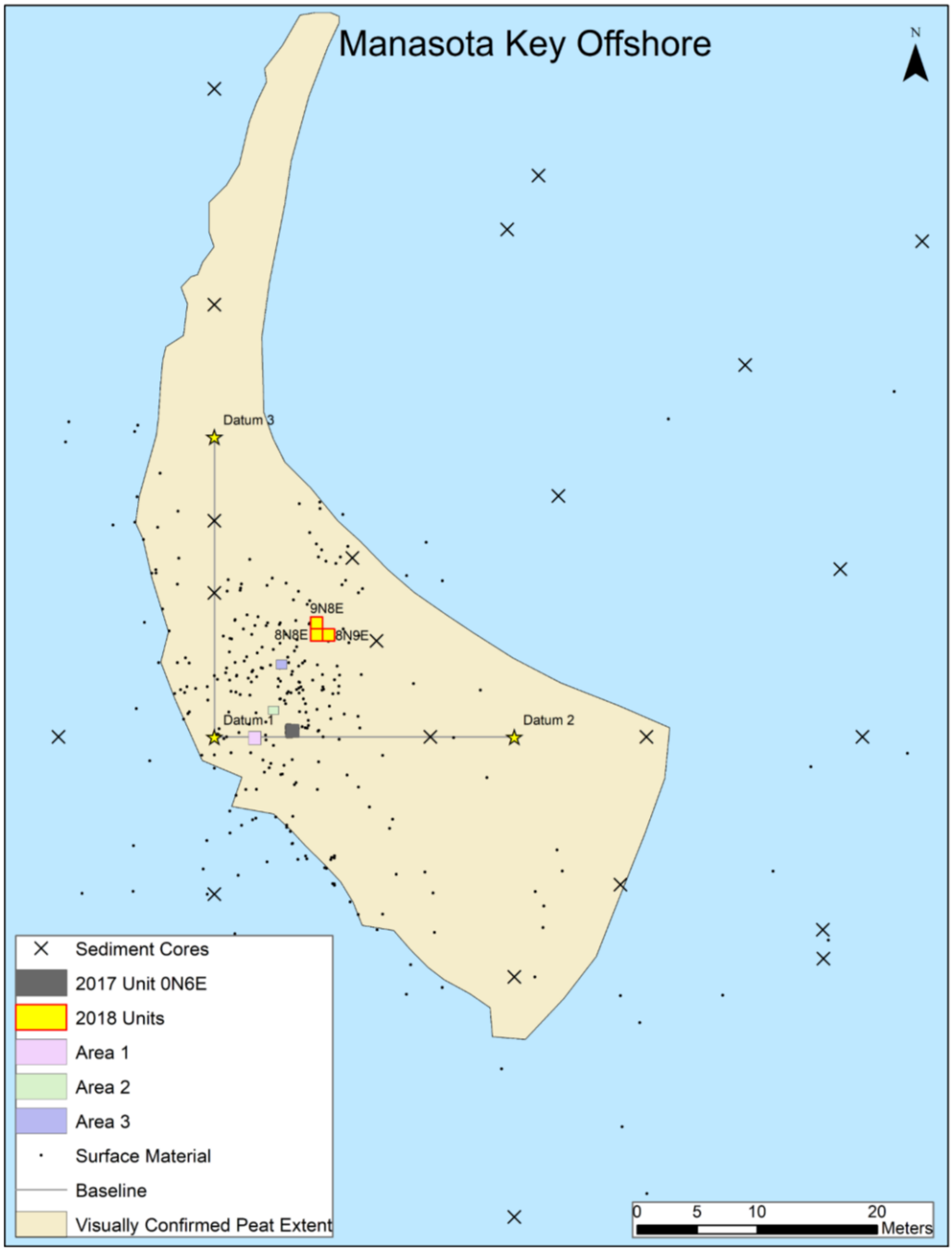

Figure 2.4. Cumulative site plan of MKO resulting from 2016 to 2019 fieldwork (Shapefiles courtesy BAR with Price additions).

Remote sensing revealed buried landscape features in the vicinity of archaeological material, including a distinct depression in the limestone measuring 2,900 m^2 and infilled with 2 m of sediment (Duggins 2018, 2019; Duggins and Price 2016; Duggins et al. 2018). South of the pond depression was a paleoriver channel, likely a remnant of nearby Forked Creek. Offshore (west) of the site, BAR located three infilled springs or sinkholes. These features are characteristic of Florida's karstic landscape and their existence on the continental shelf was previously hypothesized (Anuskiewicz 1987; Kaufmann 1993). Evidence of similar offshore features has been reported elsewhere (Krivor 2016; Lydecker et al. 2014; Upchurch et al. 2019; Wells et al. 2018; Wilson et al. 2019).

Sediment cores and unit excavation revealed intact deposits of freshwater peat capped with brackish, low energy shell and sands (BAR 2017c, 2017d, 2018b, 2018c; Duggins 2018, 2019). These deposits illustrate a preserved sequence of marine transgression at MKO. Units located near the periphery of the pond (Area 1, 2017 unit 0N6E) differed from those located in more interior portions (2018 units 8N8E, 8N9E, 9N8E). Those on the periphery contained a thin, 1 to 3 centimeter (cm) lens of modern loose shell hash with sand that transitioned to an organic peat (BAR 2017c; Duggins 2018; Duggins et al. 2018). The 2018 units contained a surface lens of modern loose shell hash with sand (BAR 2018b, 2018c; Duggins 2019). Below this modern stratum was a stratum indicating brackish conditions and not present in 2017 unit 0N6E, perhaps due to preferential erosion of more elevated pond portions. This loose sediment became more compact with denser shell as depth increased. Below this, wood and faunal fragments appeared in the stratum, with more substantial skeletal material, some of which exhibited barnacle and oyster shell growth, appearing as depth increased. Osseous remains rested directly atop or were embedded within an organic, rich, woody peat that appeared beneath the brackish sediments. The peat contained miniscule gastropods (genus *Tryonia*), abundant burned and unburned wood fragments, and faunal material. Evidence of marine transgression and changes in depositional environment were more obvious in the 2018 units via the brackish sediments that contained jumbled and displaced archaeological material (BAR 2018b, 2018c; Duggins 2019). Current sea level curves suggest this region of the coast was transgressed by 6,000 to 6,500 cal BP (Joy 2018, 2019), and it is hypothesized the stratigraphy in the 2018 units illustrates at least one transgressive event.

2.5.1 The Oyster Assemblage

Perhaps the most striking evidence of site preservation following transgression was marine fauna that were affixed to or growing directly around cultural and skeletal material. It was hypothesized that these oysters (*Crassostrea virginica*) and barnacles (including *Balanus eburneus*, *Balanus*

improvisus, *Balanus amphitrite*) represented evidence of exposure during the site's shift from a freshwater to brackish environment and provide a window into site formation processes present at this site, as well as an avenue for understanding how the site survived sea level rise.

Oysters (n=52) were recovered during surface surveys (n=1); from a June 2018 looter pit (n=2); and excavated from Area 1 (n=17), 2017 unit 0N6E (n=20), and 2018 units 8N9E (n=9) and 9N8E (n=3). Left valves (those that attach to substrate) totaled 33. Right valves totaled 19. There were three complete oysters in which both left and right valves were recovered as a set. In many cases, staff recorded oyster shells and barnacles *in situ* prior to recovery by hand. Some material was also transported to the surface via airlift during excavation and is stored in bulk sediment bags. Material from these bags is not included in this dissertation, as it is yet to be sorted or analyzed. While included in the total MKO inventory, highly fragmented valves were excluded from the research sample for this dissertation. The oyster valves are in variable conditions depending on their location across the site and depth below surface. Some valves from Area 1, for example, were fragmented and friable, likely due to their exposure at the surface. The valve shapes are also diverse, representing wide and flat or elongate and deeply cupped. Shell robusticity and frilliness also varies, and many valves contain colored striations on their outer surfaces.

Instances of barnacles associated with skeletal or cultural material totaled 14 field specimen (FS) numbers and were recovered during surface surveys (n=2) and from Area 1 (n=3); 2017 unit 0N6E (n=2); and 2018 units 8N8E (n=2), 8N9E (n=3), and 9N8E (n=2). FS numbers are unique identifiers linking recovered material to a specific provenience. It should be noted that each FS number contained multiple barnacles and fragments. A total individual barnacle count is not presented here, due to the highly fragmented nature of the material. Therefore, the map in Figure 2.5 illustrates barnacle FS number *instances* (not total barnacles) and total *individual* oysters. There are fewer studies of barnacles in an archaeological or paleoenvironmental context, and the purpose of their inclusion in this dissertation is to provide a comparative dataset for radiocarbon dating and isotopic analyses (see Chapter 6, Discussion).

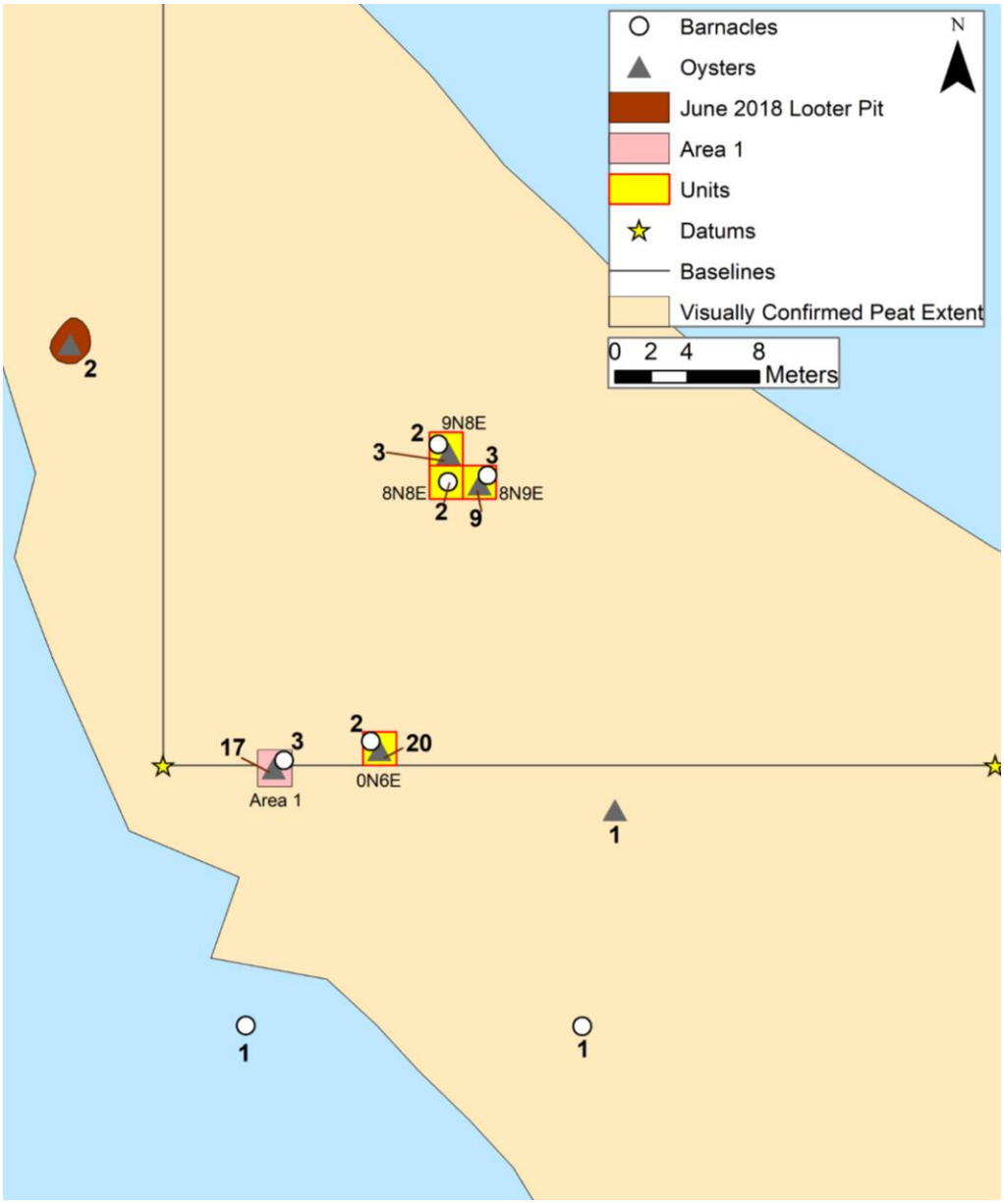

Figure 2.5. Distribution and frequency of individual oyster shells and reported instances of barnacles at MKO (Shapefiles courtesy BAR with Price additions).

Initially, it was hypothesized that oyster shells could have been deliberately placed funerary objects due to their direct association with crania and wooden stakes in Area 1 (BAR 2016a, 2016b; Ryan M. Duggins personal communication 2016; Duggins and Price 2016). Oyster valves were situated vertically around a cranium and interspersed with wooden stakes. Oysters are typically associated with brackish or saline environments, and it was surprising to see them associated with human remains. The bases of stakes and skeletal material were embedded in peat, but the oyster valves were within a silty marine shell hash layer situated above the heavily eroded peat stratum. Staff recovered all valves within

Area 1. When the objects were examined in the conservation lab, one of the valves contained embedded skeletal material (Figures 2.6 and 2.7). This was the first indication that oysters were not culturally associated with burials. Other valves contained concave impressions that indicated they were originally attached to cylindrical surfaces, potentially wooden stakes (Figure 2.8).

Figure 2.6. FS 8.02 group of oyster valves recovered from Area 1 in 2016; embedded skeletal material in center has been redacted (BAR 2017).

Figure 2.7. FS 8.02e post desalination and drying, during which skeletal material was detached. Note attachment scar which resulted from a human rib bone, scale in cm (Price 2020).

Figure 2.8. FS 8.02b oyster valve; note concave, cylindrical impression in attachment scar (Price 2020).

This finding guided future investigations at the site and encouraged BAR to recover oysters as they could reveal information about timing of sea level rise and exposure during transgressive events (Ryan M. Duggins personal communication 2017). During excavation of 2017 unit 0N6E, 20 oyster valves were recovered, though additional specimens are likely included in unsorted bulk sediment (BAR 2017a, 2017b, 2017c). While the author personally recovered valves during 2017 excavations, the author did not observe oysters attached to material in 2017 unit 0N6E. In 2018 unit 8N9E, the author personally observed a complete oyster attached to skeletal material. The author also observed multiple instances of barnacles attached to skeletal material in units 8N8E and 8N9E, as well as one wooden stake in 2018 unit 8N9E (BAR 2018b, 2018c). Given this, the hypothesis that oyster shell and barnacles represented an instance of marine transgression or shift to brackish environment at this site was bolstered. The 2018 units changed BAR's understanding of the site and revealed that preservation of organics occurred in this case regardless of marine transgression (BAR 2018c; Duggins 2019).

In 2018 unit 8N9E, the skeletal material and oyster valves (FS 2601.1 and 2606.1) were 25.5 cm below surface (cmbs) and within a marine transgressed stratum situated above peat (BAR 2018b, 2018c). The cmbs measurement refers to a specific date when excavations were performed (Price 2019). The material's existence below 25.5 cm of sediment likely preserved their integrity as they were still connected at the hinge in the life position. The right valve (FS 2601.1) was recovered first and stored at BAR's lab; the skeletal material and left valve (FS 2606.1) were recovered together and stored at Florida Gulf Coast University (FGCU) with the rest of the skeletal material. During the desalination and controlled drying process of the skeletal material, the shell became detached and was returned to BAR for further examination. Interestingly, the left oyster valve contained a barnacle on the surface where it

was originally attached to the skeletal material (Figures 2.9 and 2.10), indicating a barnacle formed first on the skeletal material and the oyster followed. Barnacles were attached to skeletal and cultural material in Area 1, 2017 unit 0N6E, and 2018 units 8N8E, 8N9E, and 9N8E. There was also evidence of barnacle attachment scars on skeletal material, artifacts, and oyster shells. A general increase in barnacles and barnacle fragments occurred from 11.5 to 28.5 cmbs in the 2018 units, corresponding with the fine-grained, grey marine shell hash layer and indicating prolific barnacle growth.

Figure 2.9. Left valve FS 2606.1 after desalination and drying; note embedded barnacle (2606.28) and skeletal material attachment scar (Price 2020).

Figure 2.10. Re-articulated left (bottom) and right (upper) oyster valves FS 2606.1 and 2601.1; note embedded barnacle (2606.28), scale in cm (Price 2020).

Given supplemental data from the 2018 units, evidence suggests oysters grew on skeletal material and wooden stakes that protruded above the seafloor in Area 1 and became displaced into the sediment below when that material collapsed. This explains the seemingly deliberate placement around crania. While the author personally observed oysters attached to skeletal material on two occasions in the field, the author did not personally observe oysters attached to wooden stakes. Large, cylindrical attachment scars on left valves (Figures 2.11 and 2.12), however, may indicate prior attachment to wooden stakes, but these could also correspond with larger skeletal material, such as femoral bones. Other oyster valves contained impressions indicative of attachment to skeletal material when compared to left valve FS 2606.1. These are important considerations in the context of choosing appropriate valves for analysis and radiometric dating (see Chapter 4 for methodology).

Figure 2.11. FS 2501.1 from unit 8N9E with large, cylindrical impression scar, scale in cm (Price 2020).

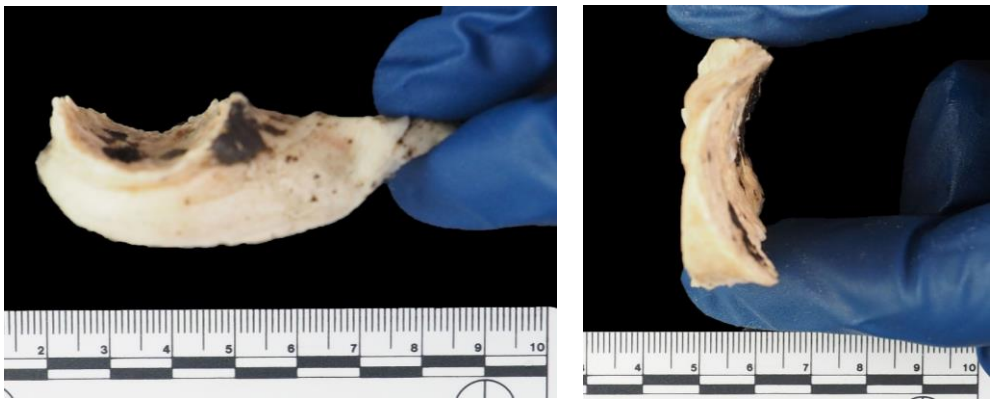

Figure 2.12. FS 2589.1 (left) and 2596.1 (right) from unit 8N9E with cylindrical impression scars, scale in cm (Price 2020).

While the focus of this dissertation is on the oyster assemblage, it should be noted that the total assemblage from MKO (n=6,323) includes a variety of datasets (Price 2020). Culturally modified material associated with an Archaic period mortuary pond is present in the form of modified wooden stakes, cordage, modified shell, and skeletal material. Organic material naturally present in an inland freshwater pond includes peat, wood and plant fragments, and faunal material. Organic material naturally present in a brackish environment includes oyster and barnacle, and material naturally present in a modern marine environment includes shell, shark teeth, and fossilized faunal material characteristic of Venice, Florida. These many-layered data can complicate archaeological interpretations, but they also offer a unique opportunity to study how a previously inland freshwater site became incorporated into the marine environment.

2.6 Summary

The detailed context provided in this chapter sets the stage for later interpretations of oyster data within the larger coastal and geomorphologic processes that affected MKO. The drastic effects of climate and sea level changes on coastal archaeological sites must be considered when making archaeological interpretations. To fully understand MKO's geomorphologic and archaeological context, this chapter examined Florida's changing landscape and climate beginning circa 18,000 years ago. A targeted discussion of sea level rise in the Gulf, as well as coastal processes off Sarasota County, further provided details concerning the processes affecting MKO thousands of years ago and in the more recent past. The second half of the chapter shifted to an archaeological focus and first presented a background of the field of submerged precontact archaeology. It is important to consider the developments and landmarks of this nascent subdiscipline and how the discovery and subsequent investigation of MKO both rely on and contribute to it. An overview of the Archaic period of the Southeastern United States, as well as a more targeted discussion of Sarasota County's archaeological record were then discussed. This information illustrated how widely populated this portion of the west-central Gulf coast was at a time when "climate and shorelines were still moving targets (Cook Hale and Sanger 2020:10)." This section also reveals that more investigations offshore of this region need to take place, as the potential for inundated precontact sites to exist is great.

The final section of this chapter discussed the ongoing research at MKO and provided a detailed discussion of the oysters excavated from the site. Detailed analysis of a precontact site in a post-transgressive context is unprecedented, and MKO's existence proves skeletal material and organic artifacts can survive sea level rise. There is also an abundance of paleoenvironmental data that can tell

the story of this site's shift from a freshwater to marine environment. The oyster assemblage excavated from MKO provides direct evidence of site formation processes and serves as proxy material for examining Florida's changing climate. MKO was originally a freshwater deposit, but oysters inhabit brackish or saline waters. Oyster growth on skeletal material must have occurred following the onset of brackish-inducing climatic events, and it is the purpose of Chapters 4, 5, and 6 to examine this via oyster shell data, much of which will supplement other paleoenvironmental data presented throughout this chapter. A description of the oyster assemblage presented here also serves as a foundation for Chapter 3, which delves into the biology of oysters and how their study can reveal pertinent information concerning past environmental parameters. These valuable data will add to our understanding of how this portion of the coast changed over time due to Holocene sea level rise and what conditions led to the site's remarkable preservation in an offshore context.