ARCHAEOMALACOLOGICAL DATA AND PALEOENVIRONMENTAL RECONSTRUCTION AT THE JUPITER INLET I SITE (8PB34A), SOUTHEAST FLORIDA

by

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This thesis was prepared under the direction of the candidate's thesis advisor, Dr. Arlene Fradkin, Department of Anthropology, and has been approved by the members of her supervisory committee. It was submitted to the faculty of the Dorothy F. Schmidt College of Arts and Letters and was accepted in partial fulfillment of the requirements of the degree of Master of Arts.

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ABSTRACT

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The Jupiter Inlet I site is situated between the Atlantic coast and the Loxahatchee River in southeast Florida. Although excavations were previously conducted, faunal remains were not systematically collected until recently. Molluscan remains recovered in 2010 are examined to reconstruct past ecological habitats, identify which water bodies were used for extracting resources, and document changes in molluscan species over time. Based upon identifications, only brackish and marine species are represented, indicating that the Loxahatchee River was brackish rather than freshwater during the time of occupation and that the site inhabitants were collecting mollusks from both the lagoon and coastal waters.

ARCHAEOMALACOLOGICAL DATA AND PALEOENVIRONMENTAL RECONSTRUCTION AT THE JUPITER INLET I SITE (8PB34A), SOUTHEAST FLORIDA

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CHAPTER ONE: INTRODUCTION

The Jupiter Inlet I site (8PB34a) is a complex pre-Columbian site, consisting of a large village, midden, monumental shell mound, and burial mound. This study focuses on excavations conducted in what is thought to be a transitional area portion between the monumental mound and village area. This investigation focuses on the molluscan, or shellfish, remains recovered from one of the test units excavated within an arm-like extension of the monumental mound. Test Unit 8 contained the remnants of a deep pit feature and was dug to a depth of 195 cm below surface before the water table was reached. As the molluscan samples were quite extensive, so a sampling strategy was employed, only the remains from three levels within this test unit were analyzed. These levels were chosen since it is hypothesized that each represents a different cultural occupation.

The majority of Jupiter Inlet I is located within the confines of DuBois Park in Jupiter, southeast Florida. The park is located along the south side of Jupiter Inlet, which links the Loxahatchee River to the Atlantic Ocean. This site is part of a much larger group of culturally related sites in the area, collectively identified as the Jupiter Inlet Complex, which includes Jupiter Inlet II and Lighthouse sites (8PB35), Scheurich Midden (8PB9261), Suni Sands (8PB7718), and Meghen's Mound/DuBois West (8PB11550). These sites are grouped together not only due to their proximity but for their similarities in cultural attributes including ceramic, faunal, and tool assemblages (Davenport et al. 2016 in press; Kennedy et al. 1993, Wheeler 2002).

Objectives of Study

For this thesis research, the molluscan remains recovered during excavations conducted at the Jupiter Inlet I site in 2010 were analyzed. The research seeks to accomplish the following objectives:

- Reconstruct the environmental habitat zones present at the site at the time of human occupation based upon the molluscan species identified.
- Identify the environmental zones (freshwater, brackish, and/or marine) used by the Jupiter Inlet I inhabitants and to what extent.
- Determine whether there are changes in the kinds and quantities of molluscan species represented through time.

Environmental Setting

The Jupiter Inlet I site is situated within Palm Beach County in southeastern Florida. The eastern boundary of Palm Beach County is the Atlantic Ocean and the western includes Lake Okeechobee and the northern Everglades. The county is divided into three physiographic categories (Schroeder et al. 1954:5-6). The Atlantic coastal ridge is the easternmost zone and it extends three to eight km inland. The western zone includes the northern Everglades. In between these two physiographic zones lie the sandy flatlands in which intermittent pine flat woods, hardwood hammocks and grassland systems comprise the vegetative habitats (Richardson 1977). The coastal region of Palm Beach County is littered by aquatic habitats. Said aquatic features include the Atlantic Ocean, Lake Worth, other small lakes and marshes, inlets, relic dunes, and maritime hammocks (Schroeder et al. 1954:5-6). The natural inlets of Palm Beach County include Boca Raton Inlet to the south and Jupiter Inlet to the north.

Jupiter Inlet is considered the southernmost part of the Indian River Lagoon. Specifically, Hobe Sound is the portion of the lagoon that stretches from St. Lucie Inlet in the north, to the south at Jupiter Inlet. According to the St. Johns River Water Management District (SJWMD), the Indian River Lagoon is North America's most diverse estuary with more than 4,300 species of plants and animals that call it home (Hazen and Sawyer Environmental Engineers and Scientists 2008). This water body is vital as it facilitates the growth of fish and shellfish as a spawning and nursery ground. Without a doubt, this habitat was a nutrient-rich resource for the pre-Columbians who took up residence at and around Jupiter Inlet. Figure 1 presents a map of the Indian River Lagoon and Jupiter Inlet.

Figure 1. Map of the Indian River Lagoon and Surrounding Habitats (arrow indicates approximate location of Jupiter Inlet site) (St. Johns River Water Management District)

The Jupiter Inlet I site is located on the southern bank of Jupiter Inlet near the confluence of the Atlantic Ocean with the Loxahatchee River and associated tributaries. The site is less than 0.5 km west of the Atlantic Ocean. It has been suggested that the Loxahatchee River probably existed for over 5,000 years since modern-day climactic conditions were reached in Florida (Brooks 1974; Watts and Stuiver 1980). The salinity of the Loxahatchee River would fluctuate from mostly freshwater to brackish estuarine water due to the opening and closing of the Jupiter Inlet.

Jupiter Inlet is a natural inlet. Nevertheless, like other inlets, it has been opened and closed as a result of both natural and cultural processes: the former includes tidal variation, storm surges, and droughts; the latter, human intervention. The earliest recorded information pertaining to Jupiter Inlet dates to 1627 when the inlet was naturally opened. According to historical records, the Governor of Florida at that time, Luis de Rojas y Borja, ordered "fortified sentinel stations" to be constructed along the coasts in response to hostile Dutch ships entering coastal waters. Some of these ships were recorded to enter the inlet due to structural damage from accidents and consequently taking on water (Davenport et al. 2016 in press; Davidson 2001:84).

The year 1845 marked the earliest written record of this inlet shoaling up and closing due to hurricane forces (Davenport et al. 2016 in press). Major Benjamin Putnam's 1849 map illustrated that the inlet was closed and that the Loxahatchee River sloughs connected all the way to the Everglades (Davenport et al. 2016 in press). Another important insight comes from Captain Capron. In 1855, Capron and his men were stationed at the inlet during a time when it was naturally closed, and the Loxahatchee River had turned completely freshwater. When the inlet was closed, the air became so stagnant that the men suffered from adverse health conditions and fevers known as "Jupiter Fever" that was transmitted by mosquitos. Consequently, Major Haskin, Capron's superior officer, ordered Capron and his men to reopen the inlet. Capron reported that it took 120 men a total of 18 days to manually open the inlet (Davenport et al. 2016 in press; DuBois 1968).

During the years 1913 to 1922, the inlet was moved 304.8 m north to its present-day location. The inlet was open throughout the Prohibition years (1920-1933) and there are a number of accounts of bootlegging boats coming through the inlet. Jupiter Inlet was closed in 1942 during World War II in order to protect from possible invasion from German U-boats. It was reopened in 1945 at the end of the war.

The U.S. Coast and Geodetic Survey began the construction of the Atlantic Intracoastal Waterway in 1912, more than a century ago. Its purpose was to connect the almost continuous tracks of creeks, lakes, and rivers into one solid waterway along the east coast of Florida. By doing this, boaters, both commercial and recreational, could navigate without the rough seas of the Atlantic Ocean. Many inlets connect the Atlantic Ocean and the Intracoastal Waterway, including Jupiter Inlet. Once the freshwater rivers and lakes along the coast were connected, the U.S. Army Corps of Engineers permanently opened the natural inlets and constructed new artificial ones along the coast (Hazen and Sawyer Environmental Engineers and Scientists 2008). This action made most of the waters, including the Loxahatchee River, brackish up to the present day.

CHAPTER TWO: REGIONAL CULTURE HISTORY AND ARCHAEOLOGICAL CULTURE AREAS OF SOUTH FLORIDA

Regional Culture History

The prehistory of southeast Florida is divided into three major periods: Paleoindian, Archaic, and Belle Glade. The following description of each period is derived from the synthesis provided by Milanich (1994, 1998).

Paleoindian Period

The Paleoindian period (10,000 – 7,500 B.C.) is indicative of the earliest known inhabitants in the state of Florida. During this time, climactic conditions were much different than today as Florida was significantly cooler and drier. As this period was towards the end of the Pleistocene, or Ice Age, much of the water was frozen in glaciers farther north. Thus, sea levels were much lower than present day and the state of Florida was twice its present size. Modern-day rivers, lakes, and other surface waters did not exist. Therefore the Paleoindian peoples camped near waterholes and deep freshwater springs and relied on a nomadic hunting and gathering subsistence strategy. They hunted megafauna, such as mammoth and mastodon, now extinct, as well as smaller game and also collected wild plant resources. Toward the end of this period, warmer and wetter conditions began to prevail, and many of the megafauna became extinct, thus leading to changes in the cultural traditions and adaptations of Florida’s inhabitants.

Archaic Period

The Archaic period (7,500 – 500 B.C.) is separated into three temporal divisions based upon environmental and climactic conditions, artifact assemblages, and settlement patterns. This period is generally marked by the onset of a warmer and wetter climate as well as a significant rise in sea level.

The Early Archaic (7,500 – 5,000 B.C.) is characterized by cultural changes associated with climactic fluctuations at the end of the Pleistocene. The warm and wetter conditions during the beginning of the Holocene Epoch resulted in the extinction of the Pleistocene megafauna and changes in plant communities. Consequently, Early Archaic people had to develop new tools and strategies for hunting smaller game and subsisting on different plant resources.

During the Middle Archaic (5,000 – 3,000 B.C.), the warming and wetter trend continued and as such, more surface waters became available. During this time period, Lake Okeechobee and the Everglades were beginning to be formed (Milanich 1994:75-85). The Loxahatchee River and associated estuaries are also assumed to have begun forming around this period as well. Pre-Columbian populations in south Florida occupied a variety of locations, though there was a preference for higher elevated areas.

The Late Archaic (3,000 – 500 B.C.) marks the time when modern environmental and climactic conditions had been reached, and Florida stabilized to its present size. Most of Florida was inhabitable because freshwater was accessible on the coasts and the interior of the state. By 3,000 B.C., the sea had reached its current level, barrier islands had formed on both coasts, beach ridges were initiated, estuaries were fully formed, precipitation further increased, and the native vegetation and fauna were modern.

Abundant fish and shellfish resources were available so that populations increased in size and were able to become more sedentary. By the end of the Late Archaic, 500 B.C., Florida's indigenous populations were practicing a number of distinctive lifeways adapted to specific regions within Florida (Kennedy et al. 1991:5; Milanich 1994:85-86; Miller 1998:39-40).

Belle Glade Period

The Belle Glade period is characterized by local inhabitants of southeast Florida becoming increasing sedentary as well as adapting to local environments. These people occupied lands throughout the interior of the state including the Everglades and Lake Okeechobee, southern Lake Kissimmee, as well as along the Atlantic coast. In the Everglades, they would travel by dug-out canoe and seasonally camp on tree islands to procure resources such as freshwater fish, turtle, snake, deer, alligator and wading birds. They would also travel to the coast to obtain marine resources, including fish, shellfish, sharks, and sea turtles.

Archaeological Culture Areas

Okeechobee Basin

The Okeechobee Basin cultural area extends from Lake Kissimmee and the Kissimmee River drainage to the southern reaches of Lake Okeechobee and was populated by the Belle Glade peoples. This area is distinctive because of its unique assemblage of earthworks which includes mounds, ditches, linear and angular embankments, canals, and ponds (Davenport et al. 2016 in press; Milanich 1994:279-280;

Sears 1982; Sears et al. 1994). In addition to these earthworks, Belle Glade Plain pottery is also a distinct marker for this cultural region.

The archaeological work of Dr. William Sears at Fort Center provides the most complete information about the Belle Glade culture. Based upon ceramic seriation, settlement patterns, and C-14 dating, Sears divided the Belle Glade cultural sequence into four temporal periods, Belle Glade I-IV (Sears et al. 1994).

Belle Glade I (450 B.C. – A.D. 200) is the earliest occupational period for Fort Center and the period when construction of the Great Circle Ditch began. The inhabitants of the site subsisted on freshwater resources such as turtles and fish, which provided the bulk of the diet. Semi-fiber tempered pottery is the distinct ceramic type encountered at the single family dwellings (Sears et al. 1994:192-194).

During the Belle Glade II Period (A.D. 200 – 600/800), Fort Center was primarily a ceremonial site and mortuary specialists used a charnel pond as well as preparation platforms to inter the deceased. A hunting, gathering, and fishing subsistence pattern continued during this period.

Belle Glade III Period (A.D. 600/800 – 1200/1400) is marked by the collapse of the charnel pond and ceremonial activities as well as the introduction of St. Johns Check Stamped ceramics to the Lake Okeechobee Basin. There were no new settlement patterns during this time and there appeared to be an increase of Belle Glade Plain ceramics (Sears et al. 1994:199-200).

Belle Glade IV Period (A.D. 1200/1400 – 1700) marks a transition in earthwork construction and settlement patterns at Fort Center. House mounds were built to attach to a new type of earthwork, linear raised earthen embankments. During this period, some of the first European artifacts begin to appear at south Florida archaeological sites from either trade or wrecked ships. Many historic artifact types were excavated from the top of the mounds denoting a distinguished status of the individuals buried in association with such exotic goods.

East Okeechobee

The boundary of the East Okeechobee cultural area is delineated by Carr and Beriault (1984) as the coastal regions of Martin, Palm Beach, and the most northern portions of Broward County (Figure 2). More specifically, this area extends from the St. Lucie Inlet as its northernmost boundary south to the Palm Beach/Broward County line near the Boca Raton Inlet. The western boundary is ambiguous but excludes the large earthwork complexes associated with the Belle Glade culture. The East Okeechobee cultural area chronology is based on radiocarbon dates and ceramic sequences from the Jupiter Inlet I site (8PB34a) and is divided into four periods, Okeechobee I-IV (Wheeler 2002).

Okeechobee I Period (750 B.C. – A.D. 800) is indicative of a movement of interior Archaic Glades populations to the coastal areas of Palm Beach County. Wheeler (2002) suggests this was due to the onset of Glades Plain ceramics to the coastal region.

Continuing into the Okeechobee II Period (A.D. 800 – 1000) ceramic analysis has shown an introduction of St. Johns Plain ceramics from the north as well as Miami Incised and Opa Locka Incised from the south. Belle Glade Plain is abundant at some sites within the East Okeechobee cultural area including within the Boca Raton Complex.

During this period, settlements were concentrated along the coast and were probably occupied on a permanent basis (Wheeler 2002).

Okeechobee III Period (A.D. 1000 – 1513) is marked by further contact and influence of the northern pre-Columbian cultures of the St. Johns River Valley, thus an increase in St. Johns series wares throughout the area (Wheeler 2002)

Okeechobee IV Period (A.D. 1513 – 1763) marks the onset of European contact. St. Johns series wares tend to dominate some sites and native groups such as the Jeaga were situated along the coast (Wheeler 2002).

The association of the East Okeechobee cultural area to that of the Okeechobee Basin cultural area (see Figure 2) has been discussed in the works of Furey (1972), McGregor (1974), Sears (Sears et al. 1994), and Wheeler (Wheeler et al. 2002). Furey (1972) notes that the coastal area was heavily influenced by the Belle Glade people who lived around Lake Okeechobee. The majority of the populations lived along the coast, especially around the body of water known as Lake Worth, and the numerous small rivers flowing east from the Everglades (Kennedy et al. 1991). Obvious as it may be, these people lived tactically in order to take advantage of freshwater, brackish, and marine food resources as well as transportation passageways.

Belle Glade pottery, typically associated with the Okeechobee Basin region, is found in relatively large quantities in East Okeechobee sites such as the Spanish River Complex and Boynton Mound (Carr et al. 1998:35-36). Many of the sites in this cultural area consist of coastal shell mounds, shell middens, burial mounds, sand earthworks, and small resource procurement sites (Wheeler et al. 2002:123). Many have been destroyed, however, by development over the past two centuries. Both Belle Glade ceramics and the occurrence of earthworks led to the correlation of these two cultural areas (Carr and Beriault 1984; Furey 1972; Griffin et al. 1979; Sears 1974, 1982).

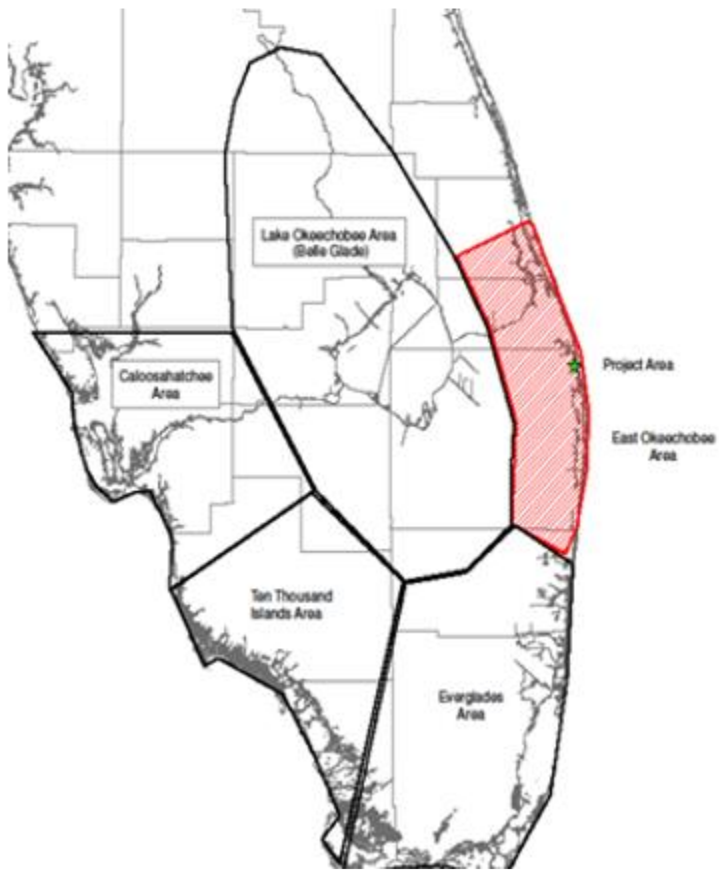

Figure 2. Map of South Florida’s Archaeological Culture Areas with the Jupiter Inlet I Site Location (marked by asterisk) (Davenport et al. 2016 in press; based off Carr and Beriault 1984)

CHAPTER THREE: HISTORICAL BACKGROUND AND PREVIOUS ARCHAEOLOGICAL RESEARCH

Historical Background

It is documented that Juan Ponce de Leon visited the Jupiter Inlet area in 1513. According to his writings, he mentions a river called Rio de la Cruz (River of the Cross) where he placed a stone crucifix at the river's mouth (Davis 1935; Kennedy et al. 1993; True 1944). Further reaches to expand Spanish thresholds were made by Pedro Menendez de Aviles from 1565-1568 in St. Augustine, and by his soldiers in Santa Lucia, a fort somewhere near Jupiter Inlet, in 1566. The relationship between the native people and the Spanish was hostile at Fort Santa Lucia, which eventually led to the Spanish abandoning the settlement shortly thereafter (Kennedy et al. 1993; Lyon 1974). Later, in 1605, the Spanish created a map of the region. They called the people inhabiting the Loxahatchee area the "Xega," or Jeaga. The main village was called Jobe which later was modified to the modern name Hobe Sound in Martin County, which is just north of Jupiter (Connor 1925:35).

Jonathan Dickinson, the famed Quaker, was shipwrecked in 1696 just north of the Jupiter Inlet. He was captured by the local Native Americans and believed to be taken to Jupiter Inlet I. The years that circulate around the Dickinson shipwreck were times of great turbulence. The Ais, Jeaga, Mayaimi, and Tequesta were fighting among themselves for land and resources. As a result, many of them sought safe passage to other geographical locations such as St. Augustine and Cuba. During the 1800s, the Seminoles were thought to have arrived in the area (Davis 1935; Lyon 1974). It is at this time that they named the river Loxahatchee, meaning River of Turtles. During this time, early pioneers also came to the Jupiter area (DuBois 1968).

In 1883, A.E. Douglass created the first and only known sketch map of the Jupiter Inlet I site (Figure 3). The map included the location of what would later become known as Jupiter Inlet I, Jupiter Inlet II, and the Lighthouse Mound. Further details of Jupiter Inlet I included in the map are the monumental mound with its radiating ridges, a serpentine-like ridge, and a sand burial mound (Meghen's Mound/DuBois West) to the southwest (Davenport et al. 2016 in press; Kennedy et al. 1993; Wheeler et al. 2002:159). Douglass's map is so important because it revealed the massive size of the site prior to shell-mining activities in the 1900s.

Figure 3. Sketch Map of the Jupiter Inlet Area in 1883 by A. E. Douglass including the Jupiter Inlet I Site

In 1884, Francis Le Baron, a surveyor and avocational archaeologist, visited the Jupiter Inlet I site and made several collections which included a coquina limestone plummet and sherds of St. Johns Check Stamped, St. Johns Plain, Belle Glade Plain, and Sand-Tempered ceramics (Davenport et al. 2016 in press; Goggin 1949; Wheeler et al. 2002:159). Clarence B. Moore supposedly visited the site in 1896 but no accounts of his trip or findings have been published (DuBois 1957; Kersey 1981:11).

The DuBois family heritage had its beginnings when young Harry DuBois first visited Jupiter Inlet in the 1880s. He commented on the land including its charm, the monumental shell mound, and the "wild rivers" of the area (Kersey 1981:1). He moved to the Jupiter Inlet area in 1892 and purchased Stone's Point, an area encompassing 18 acres on the Loxahatchee River. He began a business, growing oranges, pineapples, and bananas (Kersey 1981:7). Although the orange crop failed, the pineapples and bananas took off and made him a quick profit (Kersey 1981:8-9). He built a pineapple packing house, which, according to local history, was brought to the DuBois property by barge, where it was placed on the west side of the monumental mound. It still stands today in its original location at the site. Around this time, Harry DuBois began to build his home on top of the monumental mound (Kersey 1981:8-9). This structure still stands today on top of the mound and would later be named 8PB34b in the Florida Master Site File (FMSF) database.

Harry DuBois used the Celestial Railroad for the transportation of his agricultural goods. This railroad connected the cities of Jupiter and Juno (Kersey 1981:6). The railroad transported passengers, but, most significantly, it picked up goods from the steamboats on the Indian River in the north, and transferred them south, to sailboats on

Lake Worth (Kersey 1981:6). When pineapple and banana sales declined, Harry began an apiary, or bee-keeping business.

Harry DuBois married Susan Sanders in 1898 and they had their first child, John, in 1899 (Kersey 1981:10). For the remainder of the DuBois family history to date, John DuBois would carry out most of the undertakings associated with the family name, including the current DuBois Park (Kersey 1981:11-12). Harry and Susan eventually had three other children: Henry, Anna, and Neil. In 1917, John took on the task from his father to monitor the removal of two-thirds of the Jupiter Inlet I mound in order for the shell to be transported to Lake Park where it would be used for road fill and construction (Figure 4). He sent the artifacts exposed from this process to the Florida Museum of Natural History (FLMNH) to be analyzed by Ripley Bullen. This shell mining gave the mound its present-day appearance.

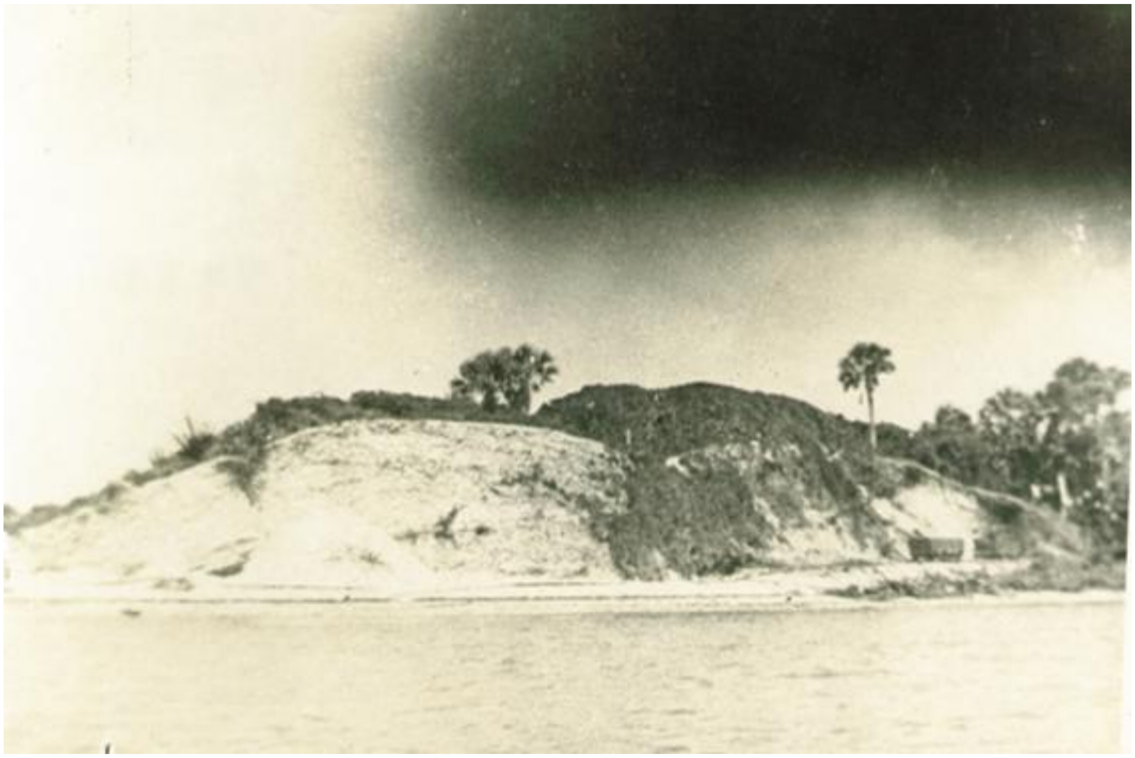

Figure 4. Southern end of Jupiter Inlet I Shell Mound Prior to Major Shell-Mining (Florida History Project archives)

In 1924, John DuBois married Bessie Wilson and they lived in the family's house for some years thereafter. John's father, Henry, passed away in 1925. John and Bessie established a fish camp next to the family marina on their property in 1926 in order to accommodate the needs of the local fishermen. Also they opened a restaurant specialized in local fare such as oysters and pompano, which John would personally procure (Kersey 1981:13).

In order to offset the bills from the restaurant and fish camp, John and Bessie would rent out their home on top of the Jupiter Inlet I shell mound during the winter months. The most notable of tenants were Dr. Charles M. Andrews, Professor Emeritus from Yale University and his wife Evangeline (Kersey 1981:16-17). The couple became enthralled when they discovered that the location in which they resided season after season was the very spot where Johnathan Dickinson was rumored to have been captive by the Jeaga tribe (Kersey 1981:16). The couple researched and prepared the *Dickinson Journal*, which was published by Yale University Press in 1945 (DuBois 1968:24; Kersey 1981). The Andrews family was responsible for the major alterations of the DuBois home throughout the years. They built additions which included a second floor, fireplaces, and a chauffer's home.

In 1946, Susan DuBois, the eldest child of John and Bessie, married Charles Kindt. Charles Kindt was a Marine stationed at the Jupiter Lighthouse during World War II. They operated the fish camp in the years following the war (Kersey 1981). John expanded his family operation into a recreational park and beach facility after World War II which included public restroom access and a children's play area. Finally, in 1946, the DuBois family homestead was sold to Palm Beach County and the family moved to West Palm Beach (Kersey 1981:18-20).

Previous Archaeological and Zooarchaeological Research at Jupiter Inlet I

Multiple archaeological excavations were carried out at the Jupiter Inlet I site over several decades, and the site was finally placed on the National Register of Historic Places in 1981. John Goggin (1949) made two visits to the site, once in 1942 and again in 1944. He noted that the site was once much larger before the shell-mining in 1917 and commented on the artifacts found by Francis Le Baron (Wheeler et al. 2002:159).

The first controlled excavation at the site occurred in 1965 and was led by Dr. William Sears of Florida Atlantic University (FAU). He hoped to find evidence of

European contact in order to confirm the accounts that Juan Ponce de Leon, or the famed shipwreck survivor, Jonathan Dickenson, had been present at the site. These excavations were carried out on the southern slope of the remaining portion of the mound. The results are described as “yielded no additional significant material” (Kersey 1981:11).

In spring 1990, Ryan Wheeler, then a student at FAU, visited the site during the construction of a new parking lot which revealed extensive shell deposits to the south of the monumental mound. Wheeler received permission to excavate a test unit to better understand the impact of construction and determine the stratigraphic integrity of the area. Cultural material remains recovered included shell tools, pottery, and a single fine-grained limestone plummet (Wheeler et al. 2002:159). In 1991, he opened three additional test units to the west of the 1990 excavation. Due to the nature of the deposits and the increased development of the area as a park by Palm Beach County Parks and Recreation Department, a more comprehensive study was recommended. During these excavations, Wheeler provided a taxonomic list of the faunal remains recovered, but no substantive analysis.

Of all the previous reports, Kennedy’s (1993) study provides the most complete understanding of the Jupiter Inlet I site. The other reports, although informative, either built upon Kennedy’s report or provide specific information regarding individual finds from the site. An example of a specific find would be Bessie DuBois’s (1957) article on a celt and pendant from the site. In 1992, Dr. Kennedy and students from FAU undertook a systematic excavation of the park in order to establish a baseline for future research and provide Palm Beach County Parks and Recreation Department with a management plan. Kennedy stated any future research within the park must be tempered with the assurance that the cultural resources with the park would be protected. He also stated that the site is of paramount regional significance, as it is one of the last coastal shell mound complexes in southeast Florida (Kennedy et al. 1993:2).

The molluscan analysis from the 1992 excavations focused on nutritional reconstruction, seasonality, and habitat utilization. The results showed that the majority of the site was intentionally constructed and much of the shell strata were attributed to mound building and not primary midden refuse (Kennedy et al. 1993). Seasonality studies were highlighted by analyzing incremental growth patterns of quahog clams (*Mercenaria* spp.). Cross-sections on 43 left valves using a lapidary saw revealed that these clams were harvested in the fall season (Kennedy et al. 1993).

Most of the zooarchaeological remains were recovered within the black earthen deposits rather than within the shell deposits; the inhabitants may have redeposited midden materials on top of the mound features for use as building material (Kennedy et al. 1993). From the preliminary examination of the faunal assemblage conducted at that time, it appears that terrestrial vertebrates were low in frequency in comparison to aquatic vertebrates and invertebrates, and that the diet of the site inhabitants consisted primarily of fish and shellfish.

In 2008, Christian Davenport, Palm Beach County Archaeologist/Preservation Officer, and Gregory Mount conducted the first preliminary investigations of the Kindt Parcel. The Kindt Parcel is a plot of land approximately 181.7 m (596 feet) long by 22.6 m (74 feet) wide, located on the western periphery of DuBois Park. Multiple buildings are located on the property, including three residences, a commercial building, a shed, and the ruinous remains of a barn (Davenport and Mount 2008; Davenport et al. 2016 in press). This area was purchased in 2007 by Palm Beach County to expand DuBois Park. Then a small scale investigation consisting of shovel tests and a single test unit was conducted to assess the property, and it revealed prehistoric cultural deposits extending across the property with the densest concentrations in the northern third of the property (Davenport and Mount 2008).

In 2009, the Archaeological and Historical Conservancy, Inc. investigated and developed a management plan for DuBois Park (Carr et al. 2009). Excavations were conducted by the wood wrap-around porch as it was beginning to deteriorate and sink into the monumental mound. They uncovered black earth midden deposits along the northeastern portion of the monumental mound. This suggests at least some people were living on top of the mound during the prehistoric period.

In 2010, excavations were conducted by the Palm Beach County Archaeologist and a team of volunteers on the western periphery of the site within the Kindt Parcel. Seventy-four shovel test pits and nine test units were carried out in compliance with the installation of a sidewalk and fence within the confines of DuBois Park. The test units were within the village area of the site and included transitional areas such as the "causeways/arms" discussed in the work of Kennedy et al. 1993. It is believed that distinct building episodes were evidence of quick accumulation and "basket loads" could be seen (Carr et al. 2009; Davenport et al. 2016 in press; Kennedy et al. 1993; Wheeler et al. 2002:184). This was supported by radiocarbon dates from two test units: A.D. 780-790 and A.D. 790-900 (Davenport et al. 2016 in press).

In 2011, Palm Beach County's Park's and Recreation Department moved forward with plans to turn the DuBois family pioneering home (8PB34b), located on top of the monumental mound, into a historic house museum. Part of the renovation process involved was to update the electric utilities on top of the mound. A total of 13 test units were investigated during this excavation, all from on top of the mound. Similar ceramic types were encountered from the top of the mound as those from the village area, likely meaning that these components were constructed contemporaneously.

Although some preliminary work was done on the faunal remains recovered during the several excavations at the Jupiter Inlet I site over the past several decades, no substantive zooarchaeological analysis has been conducted. More specifically, questions regarding the environmental setting of the site at the time of occupation have not been addressed. The focus of this thesis, therefore, is to examine the molluscan assemblage in order to reconstruct the marine ecological zones that were present at the site in the pre-Columbian period and document any changes in the molluscan species, and thus habitat zones, over time.

CHAPTER FOUR: THE INVERTEBRATE FAUNAL ASSEMBLAGE AT JUPITER INLET I

Materials and Methods

Materials

The molluscan faunal remains analyzed in this thesis were recovered during the excavations conducted in 2010 by the Palm Beach County Archaeologist and volunteers (Davenport et al. 2016 in press). A total of nine test units were excavated within a transitional area between the monumental mound and the village. According to A.E. Douglass' sketch map drafted in 1883, this transitional area contained three causeways, or arms that extended between these two areas (see Figure 4).

The test units measured 1 m X 1 m and were dug in 10 cm arbitrary levels within natural strata. The archaeologists took a column sample from Test Unit 8, a test unit excavated at the southwestern tip of the second causeway/arm, in close proximity to the village (see Figure 4). This column sample measured 50 cm X 50 cm for each 10 cm arbitrary level, and was sieved through three different sized nested screens: 6.4 mm (1/4 inch), 3.2 mm (1/8 inch), and 1.6 mm (1/16 inch).

The molluscan assemblage examined here came from the Test Unit 8 column sample. Because of the enormous amount of materials recovered in this sample, the molluscan remains from three levels were selected for analysis: Levels 6, 8, and 10. Each of these levels are hypothesized to be from a different cultural stratum and therefore represents a different cultural occupation. Furthermore, only the 6.4 mm (1/4 inch) sample from the three levels were studied.

Methods

Analysis of the invertebrate faunal materials followed standard zooarchaeological procedures (Reitz and Wing 2008). Specimens were identified to the lowest taxon possible using the comparative reference collection from the Department of Anthropology, Florida Atlantic University, and the Malacology Range, Florida Museum of Natural History (FLMNH). Shell element represented, portion of element recovered, side (right or left), and any evidence of modification (burning or hafting) was recorded.

Quantification of the faunal materials included a count of the total Number of Identified Specimens Present of each taxon (NISP) and calculated estimates of the Minimum Number of Individual animals represented (MNI). Each level of the column sample was treated as a discrete sample and quantified separately.

The MNI determinations were calculated for every lower level taxon (genus, species) identified and were based on paired elements and individual size. Specimens from higher taxon identifications such as class, order, or family were not used in determining MNI unless it was certain that such specimens represented additional individuals not included in the lower level taxon identifications. In this study, estimation of the relative abundance of each taxon was based upon MNI.

Taxa Representation

A total of 96,676 invertebrate fragments representing 9,905 molluscan individuals were identified in the Jupiter Inlet I faunal assemblage. All taxa identified in the assemblage are listed in Table 1. Quantification of the assemblage, calculated separately for each of the three levels, is presented in Appendices A, B, and C.

Table 1. Taxonomic List

SCIENTIFIC NAME	**COMMON NAME**
INVERTEBRATES	
BIVALVES	
Brachidontes exustus	scorched mussel
Geukensia demissa	ribbed-mussel
Geukensia granosissima	southern ribbed-mussel
Ischadium recurvum	hooked mussel
Mytilidae	mussels
Anadara notabilis	eared ark
Anadara spp.	ark
Lunarca ovalis	blood ark
Arcidae	arks
Noetia ponderosa	ponderous ark
Glycymeris spp.	bittersweet clam
Tucetona pectinata	comb bittersweet
Pinctada imbricata	Atlantic pearl-oyster
Isognomon spp.	tree-oyster
Anomia simplex	common jingle
Crassostrea virginica	eastern oyster
Ostrea equestris	crested oyster
Ostreidae	oysters
Codakia orbicularis	tiger lucine
Lucina pectinata	thick lucine
Parvilucina crenella	many-lined lucine
Chama sp.	jewelbox
Carditidae	carditids
Trachycardium egmontianum	Florida pricklycockle
Mulinia lateralis	dwarf surfclam
Donax sp.	coquina
Iphigenia brasiliana	giant coquina
Cumingia vanhningi	Van Hyning's cumingia

Table 1. Continued

Cumingia spp.	semele
Tagelus plebeius	stout tagelus
Mytilopsis leucophaeata	dark falsemussel
Anomalcocardia cuneimeris	pointed venus
Chione elevata	Florida cross-barred venus
Mercenaria spp.	quahog
Timoclea pygmaea	white pygmy-venus
Timoclea spp.	pygmy-venus
Veneridae	venus clams
Choristodon robustum	Atlantic petricolid
Bivalvia	bivalves
GASTROPODS	
Lithopoma tuber	green starsnail
Lithopoma sp.	starsnail
Helicinidae	drops
Cerithium litteratum	stocky cerith
Cerithium muscarum	flyspeck cerith
Cerithium spp.	cerith
Crepidula fornicata	common Atlantic slippersnail
Crepidula maculosa	spotted slippersnail
Crepidula plana	eastern white slippersnail
Crepidula spp.	slippersnail
Nassarius polygonatus	
Nassarius vibex	bruised nassa
Prunum sp.	marginella
Acteocina sp.	barrel-bubble
Subulinidae	awlsnails
Euglandina rosea	rosy wolfsnail
Microceramus pontificus	pontiff urocoptid
Gastropoda	gastropods
Gastropoda (land snails)	gastropods (land snails)
Mollusca	mollusks
MISCELLANEOUS INVERTEBRATES	
Polychaeta	polychaetes
Balanidae	acorn barnacles
Decapoda	crabs

A total of 62 molluscan taxa were represented, of which 39 were bivalves and 19 were gastropods. The other invertebrate taxa identified were polychaetes, acorn barnacles, and crabs. In each level of the column sample analyzed for this study, bivalves outnumbered aquatic gastropods significantly in terms of MNI (Table 2). By far, oysters from the family Ostreidae dominated all levels of the column sample. Habitats of all aquatic mollusks identified are presented in Table 3. All the aquatic molluscan taxa represented occur in shallow marine and/or brackish waters.

Table 2. Totals of Aquatic Molluscan Class – All Levels

Molluscan Class	**Level 6**	**Level 8**	**Level 10**
	MNI (%)	**MNI (%)**	**MNI (%)**
Bivalves	3753 (99.58%)	1861 (98.21%)	2338 (98.69%)
Gastropods	16 (0.42%)	34 (1.79%)	31 (1.31%)
Totals	**3769 (100.00%)**	**1895 (100.00%)**	**2369 (100.00%)**

Table 3. Habitats of Aquatic Mollusks Identified

TAXON	Type of Water Body			Substrate		
	shallow brackish	**shallow marine**	**intertidal**	**sand or mud**	**seagrass beds**	**rocky**
Bivalves						
Brachidontes exustus	X		X			X
Geukensia demissa	X		X	X		
Geukensia granosissima	X			X	X	
Ischadium recurvum	X		X			X
Anadara notabilis		X		X	X	
Lunarca ovalis		X	X	X		
Noetia ponderosa		X	X	X		
Glycymeris sp.		X		X		
Tucetona pectinata		X			X	
Pinctada imbricata	X					X
Isognomon sp.	X		X			X
Anomia simplex		X				X
Crassostrea virginica	X		X			
Ostrea equestris		X	X			
Codakia orbicularis		X		X	X	
Lucina pectinata		X		X		
Parvilucina crenella		X		X	X	
Chama sp.		X				X
Carditidae		X		X		X
Trachycardium egmontianum		X		X		
Mulinia lateralis	X			X		
Donax sp.		X		X		
Iphigenia brasiliana		X		X		
Cumingia vanhyningi		X	X	X	X	
Tagelus plebeius	X		X	X		
Mytilopsis leucophaeata	X					X
Anomalcocardia cuneimeris	X	X	X	X		
Chione elevata		X	X	X	X	
Mercenaria spp.		X	X	X		
Timoclea pygmaea		X			X	
Choristodon rombustum		X	X			X
Gastropods						
Lithopoma tuber		X	X			X
Cerithium litteratum		X	X		X	
Cerithium muscarum	X		X	X	X	
Crepidula fornicata		X	X			X
Crepidula maculosa		X	X			X
Crepidula plana		X	X			X
Nassarius polygonatus		X	X	X		
Nassarius vibex		X	X	X		
Prunum sp.		X		X	X	

Description of Taxa

The faunal evidence indicates that the site inhabitants obtained animal resources from both the brackish waters of the Indian River Lagoon and the more saline coastal inshore waters of the nearby Atlantic Ocean (see Table 3). Most of these species are typically found in the shallow substrates of the Indian River Lagoon and still occur along the coastal areas of the region today.

Bivalves

Bivalves were far more numerous than gastropods in the faunal samples. The most common bivalves represented in terms of MNI were crested oysters and eastern oysters. The crested oyster (*Ostrea equestris*) typically occurs in shallow intertidal waters on hard substrates such as rocks and other shells, including oyster beds (Abbott 1968; Carnegie et al. 2006; Lee 2009; Mikkelsen and Bieler 2007). This species can tolerate a minimum salinity range of 20-25 parts per thousand (ppt) but exhibits stronger life expectancy in higher salinity areas with low turbidity (Britton and Morton 1989; Galtsoff and Merrill 1962; Menzel 1955). The eastern oyster (*Crassostrea virginica*) occurs in shallow brackish waters on hard substrates. Unlike the crested oyster, this species prefers a more estuarine habitat much lower in salinity. The salinity needed for optimal growth of the eastern oyster is 10-28 ppt (Berquist et al. 2006; Buroker 1983; Wilson et al. 2005). Table 4 compares the MNI and percentages of crested versus eastern oyster in each level.

Table 4. Comparing Oyster Species

Taxa	MNI (%)		
	Level 6	Level 8	Level 10
Crassostrea virginica	521 (25.11%)	347 (36.72%)	403 (38.86%)
Ostrea equestris	1554 (74.89%)	598 (63.28%)	634 (61.14%)
TOTALS	**2075 (100.00%)**	**945 (100.00%)**	**1037 (100.00%)**

Other common bivalves represented in terms of MNI were giant coquina, scorched mussel, dark falsemussel, stout tagelus, and common jingle. Giant coquina (*Iphigenia brasiliana*) is a fully marine bivalve which prefers shallow sandy substrates. In some cases, this species also inhabits estuarine areas (Mikkelsen and Bieler 2007). Scorched mussel (*Brachidontes exustus*) was the most commonly encountered mussel (Mytilidae) species identified. This mussel is a common intertidal species associated with oyster reefs within the Indian River Lagoon. It has a high tolerance for changes in salinity; spawning occurs in the spring when sea water temperatures increase and in the fall when sea water temperatures decrease (Barber et al. 2005; Berquist et al. 2006). The dark falsemussel (*Mytilopsis leucophaeta*) is known for being a fouling estuarine species which is most notably found attached in clumps along with barnacles, shipworms, and the hooked mussel (*Ischadium recurvum*) (Lee 2009; Rehder 1981). Conversely, stout tagelus (*Tagelus plebeius*) prefers sandy mud substrates especially mudflats from near the low-tide line to about 2 m (Abbott 1968; Lee 2009; Rehder 1981). Common jingle (*Anomia simplex*) is a common shallow marine bivalve. This animal attaches itself to rocks and other shells, thus leaving an imprint upon its host shell when it detaches (Abbott 1968). A typical range for the common jingle is from low-tide line to 9 m (Abbott 1968; Rehder 1981).

Other bivalves represented included Atlantic pearl-oyster, ribbed-mussel, and southern ribbed-mussel. Atlantic pearl-oyster (*Pinctada imbricata*) is an epibyssate species, which means it lives directly on the surface of the sediment. In this case, it is most commonly found attached to rocks and sea fans (Abbott 1968; Lee 2009; Mikkelsen and Bieler 2007; Rehder 1981). Ribbed-mussel (*Geukensia demissa*) is another epibyssate species found among intertidal rock commonly associated to the oyster reefs within the Indian River Lagoon (Jost and Helmuth 2007; Lee 2009). This mussel species demonstrates a highly varied salinity tolerance from 6-70 ppt (Jost and Helmuth 2007). This salinity range is quite robust; however, ribbed-mussels seem to prefer the lower salinities near black mangroves. Southern ribbed-mussel (*Geukensia granossisima*), closely related to *Geukensia demissa*, is also an epibyssate species which forms dense beds in shallow waters including peat/mud salt marshes and bays (Abbott 1968; Jost and Helmuth 2007; Rehder 1981).

Quahog clam (*Mercenaria* spp.) was also minimally represented by a few individuals. One of the most widely studied bivalves In North America, it is an important commercial species today (Barile et al. 1986). Several other species were less represented. Hooked mussel (*Ischadium recurvum*) takes up residence on intertidal oyster beds near, or just below the low-tide line (Abbott 1968; Lee 2009; Rehder 1981). Tree oyster (*Isognomon* spp.) is most commonly encountered in subtidal and intertidal surfaces of the Indian River Lagoon particularly near red mangrove (Abbott 1968; Hall 1985; Mikkelsen and Bieler 2007; Rehder 1981; Siung 1980). Tree oyster species are more abundant in waters with higher salinity; however, spawning will occur after high levels of rain when the salinities are lower (McPherson et al. 1984; Siung 1980). Pointed venus (*Anomalocardia cuneimeris*) prefers sand and mud substrates within intertidal lagoons (Abbott 1968; Mikkelsen and Bieler 2007; Rehder 1981). Conversely, eared ark

(*Anadara notabilis*) thrives in shallow grassy environments cross cut by muddy substrates (Abbott 1968; Mikkelsen and Bieler 2007; Redfern 2013; Rehder 1981). White pygmy-venus (*Timoclea pygmaea*) is also found in shallow marine grasses, typically in waters less than 2 m (Lee 2013; Mikkelsen and Bieler 2007).

Several bivalve taxa were minimally represented. Dwarf surfclam (*Mulinia lateralis*) resides in estuaries within soft strata such as sand and mud (Mikkelsen and Bieler 2007; Rehder 1981). Florida cross-barred venus (*Chione elevata*) can be found burrowed into shallow sand marked by intermittent marine seagrasses (Abbott 1968; Mikkelsen and Bieler 2007; Rehder 1981). This species thrives in warmer waters and may tolerate salinities as low as 18 ppt (Rothchild 2004). Finally, blood ark (*Lunarca ovalis*) is an intertidal species which resides in sand and mud substrates in shallow waters up to 3 m (Lee 2009; Mikkelsen and Bieler 2007; Rehder 1981).

Aquatic Gastropods

Aquatic gastropods were represented by 14 taxa. The most common gastropods represented in terms of MNI were slippersnails, especially the common Atlantic slippersnail (*Crepidula fornicata*). This species is intertidal, commonly attached to hard substrates including rocks, other slippersnails, and horseshoe crabs (Abbott 1968; Lee 2009; Rehder 1981). Spotted slippersnail (*Crepidula maculosa*) occupies the same environment as the Atlantic slippersnail; it is commonly found on dead pen shells (Abbott 1968; Rehder 1981).

Other gastropods represented were bruised nassa and two kinds of ceriths, stocky cerith and flyspeck cerith. Bruised nassa (*Nassarius vibex*) is a common intertidal species that occupies muddy sand substrates near the low-tide line (Abbott 1968; Lee 2009; Rehder 1981). As a scavenging feeder, this snail is known to live among oyster beds and emerge from the substrate in order to feed (Lee 2009). Conversely, stocky cerith (*Cerithium litteratum*) occupies algae-covered rocks amongst marine grasses or other plants in shallow waters from intertidal depths to 12 m (Abbott 1968; Redfern 2013; Rehder 1981). Flyspeck cerith (*Cerithium muscarum*) is more similar to stocky cerith as this species also inhabits shallow grassy areas in bays and estuaries (Abbott 1968; Rehder 1981). Flyspeck cerith occurs throughout the Indian River Lagoon's seagrass habitats while tolerating a moderate degree of thermal tolerance upwards to 34°C. In addition, this species tolerates salinities ranging from 18.3 ppt to over 41 ppt (Murray and Wingard 2006).

Several aquatic gastropods were represented by only one shell. Eastern white slippersnail (*Crepidula plana*) inhabits rocky substrates such as oyster beds as well as on top of other shells in intertidal environments near mangroves; however, they prefer slow moving waters with low wave exposure (Redfern 2013; Rehder 1981). It is distributed throughout the Indian River Lagoon as a eurythermic species, one that tolerates a wide range of temperatures (5-35°C) and is considered an oligohaline to euryhaline species tolerating salinities between 15-38 ppt (Collin 2001). Green starsnail (*Lithopoma tuber*) is a marine gastropod that is situated along hard substrates such as reefs and rocks near low-tide line to shallow waters (Abbott 1968; Collin 2001; Rehder 1981).

Miscellaneous Aquatic Invertebrates

Nonmolluscan invertebrates represented consisted of acorn barnacles (Balanidae), bristle and feather duster worms (Polychaeta), and a few crab (Decapoda) claw fragments. Acorn barnacles are marine crustaceans that remain permanently attached to a hard substrate, such as oysters (Kent 1998). Their frequent occurrence on oysters may explain their abundant presence in the site faunal assemblage. Bristle and feather duster worms inhabit muddy and soft sediments of estuarine habitats including mud flats, seagrass beds, and marshes (Larsen and Doggett 1991).

CHAPTER FIVE: THE MOLLUSCAN FAUNAL ASSEMBLAGE AND PALEOENVIRONMENTAL RECONSTRUCTION

Mollusks are one of the most important groups of invertebrates in a marine or estuarine ecosystem since they inhabit almost every habitat and niche. As such, they are sessile organisms that indicate subtle environmental changes. Based upon the theoretical underpinnings by Dincauze (1987), change in the number of fauna from an archaeological site allow the researcher to infer information about paleoenvironmental change. Accordingly, this thesis discusses the molluscan remains as a proxy for changes which may include salinity variation, opening or closures of inlets, and climatic events such as sea level fluctuation.

Contributing Factors to Environmental Change

Effects of Salinity on Molluscan Communities

Estuaries such as the Indian River Lagoon are characterized by constant and variable changes which include rainfall and tides. As such, daily water depth, salinity, and the presence or absence of water in shallow areas are all affected by tidal changes (Harris et al. 1983). Heavy rainfall may create short-term periods which include large amounts of freshwater, and dry spells can skyrocket salinity levels in a given area due to higher rates on evaporation (Harris et al. 1983). Even seasonal changes in temperature and rainfall affect salinity (Boyer et al. 1999). But generally speaking, high salinities indicate a dry season (Florida winter), whereas low salinities represent wet seasons (Florida summer) following late winter or spring floods (Harris et al.1983:5).

The most frequently encountered invertebrates in this analysis were the eastern oyster (*Crassostrea virginica*) and the crested oyster (*Ostrea equestris*). Oysters from the Ostreidae family thrive within a wide salinity gradient. Nevertheless, each species has a distinct optimal salinity preference (Britton and Morton 1989). The crested oyster is best adapted for higher salinities of outer shores or open seas. It occurs in tidal inlets and settles on rocks; it is usually absent in the reduced salinities of inner bays (Britton and Morton 1989). During drought years, however, when salinities increase significantly above normal levels, crested oysters may enter bays and displace the eastern oyster (Gillard 1969; Hofstetter 1977; Parker 1955).

The crested oyster will cohabitate with the eastern oyster but this normally indicates salinities over 28 ppt (Wells 1961:249). The eastern oyster is an exceptional euryhaline species, meaning it thrives in an environment with widely varied salinities; it can survive in salinities from 5-30 ppt (Castagna and Chanley 1973; Galtsoff 1964) but optimal salinity for adult eastern oysters is usually cited from 12-28 ppt. Research has noted that eastern oysters will be more frequently invaded by boring organisms such as sponges, barnacles, bryozoans, and algae as water salinity surpasses 15 ppt (Britton and Morton 1989).

Inlet Closures and Openings

The closure and opening of inlets also have a significant effect on salinity and consequently, molluscan fauna. There are two types of inlets, natural and artificial. Jupiter Inlet is a natural inlet that has been altered multiple times throughout the previous millennia. Natural inlets migrate, moving north and south along the coastline. These reasons are often attributed to natural causes such as tidal variation, storm surges, or drought, and the changes may alter salinity at different scales. For example, a medium scale change equates to several decades, whereas a long-term scale associates to anywhere between 100 and several hundred years (Walker 1992:95). Products of long term scale inlet change may be climatic variability, change of inlet dynamics, or even sea level fluctuations (Walker 1992:96).

Geophysical research offers assistance to archaeologists when studying the dynamics of an inlet. During the early 1980s, a graduate student at the University of Miami conducted research on Holocene sediments within the Indian River from St. Lucie north to Melbourne. Almasi's findings (1983) revealed three distinguishable oyster beds that related to the opening and closing of an inlet about 8 km north of Vero Beach (approximately 96 km north of the Jupiter Inlet). The three distinguishable oyster beds along the Indian River revealed the inlet was closed at ca. 2,065 +/- 195 years before present (80 B.C. and A.D. 310) (Almasi 1983:102-103). Based on South Florida paleo-sea level curves derived from Scholl et al. and Neuman (1969; 1969) from Bermuda, Almasi was able to correlate the sea level as within 60 cm of the present sea level. The findings were that this area within the Indian River Lagoon was hyposaline, or having very high salinity content, which is similar to present-day conditions (Almasi 1983:102-

103). The research revealed that as sea levels continued to rise, the barrier of the coastal dune and ridge was breached by the inlet and the area became saturated by sea water. (Almasi 1983:103-104).

As such, when inlets open, sedimentation rates increase. This is in many times detrimental to oyster communities and other benthic life. The communities thrive if there is some exchange with sea water, but require a stable substrate (Britton and Morton 1989). As such, large inlets are not productive for oysters because of a higher exchange of sea water and substrate instability (Almasi 1983; Britton and Morton 1989).

Climatic Data

The long-term research carried out by Marquardt and Walker on the Gulf coast of Florida has aimed to address climatic fluctuations throughout the Woodland Period (500 B.C. – A.D. 1000) and to document the subsequent actions and implications for human and non-human populations. Therefore, the following discussion intends to draw correlations from their research on the Gulf coast to that of the Atlantic coast near the Jupiter Inlet I site derived from this thesis research.

During the Late Woodland Period (A.D. 500 – 1000), European records reveal a cold and dry climate with increased frequency of severe weather. In addition, sea levels were anywhere from 30-100 cm lower than present-day conditions. This period is known in European historical records as the Vandal Minimum (A.D. 500 – 850), and identified as the Buck Key Low sea level stand on the Gulf coast of Florida. Persistent warm and dry summers were detected in the early and late Buck Key Low (A.D. 500-600 and A.D.

700-750, respectively), punctuated by cooler winters during the Middle Buck Key Low (A.D. 600 – 700). According to Wang's thesis research (2009), a prolonged period of drought and cooling may have been responsible for the abandonment of coastal southwest Florida archaeological sites by the Calusa people around A.D. 750.

The following climatic period identified on the Gulf coast is known as the La Costa High (ca. A.D. 850 – 1200). This period falls between the transition from the Late Woodland Period into the Early Mississippian Period and correlates to the Medieval Warm Period in the European historical records. Again, this period is exemplified by warm temperatures, periods of drought, frequent storm events, and periods of ample rainfall (Marquardt and Walker 2012:34). A higher than present sea level, however, was revealed toward the end of this period and Calusa settlements underwent abandonment again. The estimated sea level rise was 30-100 cm above current sea level. This explanation of abandonment has been thought to link with dendrochronological data from the Georgia Bight at A.D. 1176-1220. The tree-ring data demonstrated a major period of drought during this time (Blanton and Thomas 2008:801-805).

Subsequently, during the transition from the Late Woodland to Early Mississippian Period, there was an overall rise in sea level. At the Jupiter Inlet I site, the three levels examined in this thesis can be correlated to these aforementioned sea level episodes. Level 10 coincides with the end of the Buck Key Low. During this period, sea levels were approximately 30 cm lower than present-day conditions. Level 8 represents the transitional period between the Buck Key Low and the La Costa High as seas continued to rise. Level 6, the youngest level, is associated with the beginning of the La Costa High. According to this climatic data, and the specific levels studied in this thesis, the inhabitants of the Jupiter Inlet I site would have experienced an overall rise in sea level during these occupations.

Archaeomolluscan Data and Paleosalinity Conditions

Paleosalinity conditions were assessed for the three cultural occupations studied in this thesis from the Jupiter Inlet I site by comparing the two most represented species, eastern oyster and crested oyster in terms of their estimated MNIs. As previously indicated, these species have differing salinity tolerances. It is clear that the hypersaline crested oyster outnumbers the euryhaline eastern oyster in all three levels analyzed. Nevertheless, there appears to be more pronounced differences between Levels 6 and 8 than between Levels 8 and 10. In order to validate these claims, a Chi-Square test was performed. Accordingly, the results of these tests confirm that some of these differences were indeed statistically significant.

The transition from Level 10 to 8 represents the culmination of the Buck Key Low and the gradual movement into the La Costa High sea level stand. Higher p-values from the Chi-Square test indicated that there was minimal significance of the change between eastern and crested oysters from Levels 10 and 8. However, the differences between Levels 8 and 6 were statistically significant according to the low p-values. Accordingly, it appears that there was an overall increase in salinity within the southern extent of the Indian River Lagoon during these several periods of occupation. This coincides with the demonstrated general rise in sea level from the Buck Key Low into the La Costa High.

CHAPTER SIX: SUMMARY AND CONCLUSIONS

The molluscan faunal assemblage analyzed here indicates that the Jupiter Inlet I inhabitants were collecting shellfish from both local brackish and marine waters. No freshwater mollusks were identified thus, the Indian River Lagoon near the Jupiter Inlet was apparently brackish during the several periods of occupation, though the degree of salinity changed over time. Moreover, local populations procured molluscan resources from the marine waters of the nearby Atlantic Ocean. It is likely that the Jupiter Inlet was open during these occupations. As such, the salinity of the southern Indian River Lagoon near the Jupiter Inlet was much higher, and likely supported a larger population of hypersaline crested oysters, opposed to the euryhaline eastern oyster.

APPENDICES

APPENDIX A: JUPITER INLET I (8PB34A) TEST UNIT 8 LEVEL 6

¼" COLUMN SAMPLE

TAXON	NISP	Percent	MNI	Percent
MOLLUSKS				
Bivalves				
Brachidontes exustus	485	2.97%	248	6.61%
Geukensia demissa	72	0.44%	37	0.99%
Ischadium recurvum	5	0.03%	5	0.13%
Mytilidae	431	2.64%	0	0.00%
Anadara notabilis	3	0.02%	2	0.05%
Anadara sp.	2	0.01%	1	0.03%
Lunarca ovalis	3	0.02%	2	0.05%
Glycymeris spp.	2	0.01%	1	0.03%
Tucetona pectinata	5	0.03%	2	0.05%
Isognomon spp.	21	0.13%	11	0.29%
Anomia simplex	102	0.62%	34	0.91%
Crassostrea virginica	1120	6.85%	521	13.88%
Ostrea equestris	3058	18.71%	1554	41.41%
Ostreidae	7416	45.37%	1200	31.97%
Parvilucina crenella	1	0.01%	1	0.03%
Chama sp.	1	0.01%	1	0.03%
Mulinia lateralis	2	0.01%	2	0.05%
Iphigenia brasiliana	365	2.23%	76	2.03%
Cumingia vanhyningi	2	0.01%	1	0.03%
Cumingia sp.	1	0.01%	1	0.03%
Tagelus plebeius	29	0.18%	19	0.51%
Mytilopsis leucophaeata	39	0.24%	21	0.56%
Anomalcocardia cuneimeris	4	0.02%	2	0.05%
Chione elevata	5	0.03%	3	0.08%
Mercenaria spp.	2	0.01%	1	0.03%
TImoclea cf. *pygmaea*	4	0.02%	2	0.05%
Timoclea spp.	5	0.03%	3	0.08%
Veneridae	1	0.01%	1	0.03%
Bivalvia	3160	19.33%	1	0.03%
TOTAL BIVALVES	**16346**	**100.00%**	**3753**	**100.00%**
Aquatic Gastropods				
Cerithium litteratum	2	8.70%	2	12.50%
Cerithium muscarum	2	8.70%	2	12.50%
Crepidula fornicata	3	13.04%	3	18.75%

Crepidula maculosa	2	8.70%	2	12.50%
Crepidula spp.	7	30.43%	7	43.75%
Gastropoda	7	30.43%	0	0.00%
TOTAL AQUATIC GASTROPODS	**23**	**100.00%**	**16**	**100.00%**
Land Gastropods				
Helicinidae	43	3.56%	43	3.56%
Euglandina rosea	1	0.08%	1	0.08%
Microceramus pontificus	10	0.83%	10	0.83%
Gastropoda (land snails)	1153	95.53%	1153	95.53%
TOTAL LAND GASTROPODS	**1207**	**100.00%**	**1207**	**100.00%**
Miscellaneous Mollusks				
Bivalvia	1634	22.76%	3753	75.42%
Gastropoda (aquatic snails)	23	0.32%	16	0.32%
Gastropoda (land snails)	1207	16.81%	1207	24.26%
Mollusca	4316	60.11%	0	0.00%
TOTAL MOLLUSKS	**7180**	**100.00%**	**4976**	**100.00%**
Arthropods				
Balanidae	11090	99.99%		
Decapoda	1	0.01%		
TOTAL ARTHROPODS	**11091**	**100.00%**		
TOTAL INVERTEBRATES	**32985**	**100.00%**	**4979**	**100.00%**

APPENDIX B JUPITER INLET I (8PB34A) TEST UNIT 8 LEVEL 8

¼" COLUMN SAMPLE

TAXON	NISP	Percent	MNI	Percent
MOLLUSKS				
Bivalves				
Brachidontes exustus	43	0.30%	27	1.45%
Geukensia granosissima	19	0.13%	19	1.02%
Ischadium recurvum	3	0.02%	3	0.16%
Mytilidae	124	0.86%	0	0.00%
Anadara notabilis	4	0.03%	3	0.16%
Anadara spp.	2	0.01%	2	0.11%
Lunarca ovalis	1	0.01%	1	0.05%
Pinctada imbricata	125	0.87%	30	1.61%
Isognomon spp.	8	0.06%	2	0.11%
Anomia simplex	90	0.62%	23	1.24%
Crassostrea virginica	791	5.49%	347	18.65%
Ostrea equestris	1190	8.26%	598	32.13%
Ostreidae	6020	41.78%	532	28.59%
Lucina pectinata	1	0.01%	1	0.05%
Trachycardium egmontianum	2	0.01%	2	0.11%
Mulinia lateralis	4	0.03%	3	0.16%
Iphigenia brasiliana	240	1.67%	125	6.72%
Cumingia vanhyningi	2	0.01%	1	0.05%
Tagelus plebeius	129	0.90%	56	3.01%
Mytilopsis leucophaeata	106	0.74%	64	3.44%
Anomalcocardia cuneimeris	4	0.03%	4	0.21%
Chione elevata	9	0.06%	4	0.21%
Mercenaria spp.	34	0.24%	8	0.43%
Timoclea spp.	3	0.02%	2	0.11%
Bivalvia	5455	37.86%	4	0.21%
TOTAL BIVALVES	**14409**	**100.00%**	**1861**	**100.00%**
Aquatic Gastropods				
Lithopoma tuber	1	2.17%	1	2.94%
Lithopoma sp.	1	2.17%	1	2.94%
Cerithium litteratum	1	2.17%	1	2.94%
Crepidula fornicata	4	8.70%	4	11.76%
Crepidula maculosa	4	8.70%	4	11.76%
Crepidula spp.	6	13.04%	6	17.65%
Nassarius polygonatus	2	4.35%	2	5.88%

Nassarius vibex	8	17.39%	8	23.53%
Euglandina rosea	9	19.57%	5	14.71%
Gastropoda	10	21.74%	2	5.88%
TOTAL AQUATIC GASTROPODS	**46**	**100.00%**	**34**	**100.00%**
Land Gastropods				
Helicinidae	4	1.18%	4	1.18%
Gastropoda (land snails)	334	98.82%	334	98.82%
TOTAL LAND GASTROPODS	**338**	**100.00%**	**338**	**100.00%**
Miscellaneous Mollusks				
Bivalvia	14409	72.67%	1861	83.34%
Gastropoda (aquatic snails)	46	0.23%	34	1.52%
Gastropoda (land snails)	338	1.70%	338	15.14%
Mollusca	5034	25.39%	0	0.00%
TOTAL MOLLUSKS	**19827**	**100.00%**	**2233**	**100.00%**
Arthropods				
Balanidae	3136	99.97%		
Decapoda	1	0.03%		
TOTAL ARTHROPODS	**3137**	**100.00%**		
TOTAL INVERTEBRATES	**22964**	**100.00%**	**2233**	**100.00%**

APPENDIX C JUPITER INLET I (8PB34A) TEST UNIT 8 LEVEL 10

¼" COLUMN SAMPLE

TAXON	NISP	Percent	MNI	Percent
MOLLUSKS				
Bivalves				
Brachidontes exustus	71	0.30%	36	1.54%
Geukensia demissa	18	0.08%	17	0.73%
Geukensia granosissima	21	0.09%	21	0.90%
Ischadium recurvum	14	0.06%	8	0.34%
Mytilidae	424	1.80%	0	0.00%
Anadara notabilis	7	0.03%	12	0.51%
Lunarca ovalis	4	0.02%	3	0.13%
Arcidae	1	0.00%	1	0.04%
Glycymeris sp.	1	0.00%	1	0.04%
Tucetona pectinata	168	0.72%	33	1.41%
Isognomon spp.	2	0.01%	1	0.04%
Anomia simplex	172	0.73%	36	1.54%
Crassostrea virginica	762	3.24%	403	17.24%
Ostrea equestris	1437	6.12%	634	27.12%
Ostreidae	5470	23.28%	805	34.43%
Codakia orbicularis	1	0.00%	1	0.04%
Lucina pectinata	2	0.01%	2	0.09%
Carditidae	1	0.00%	1	0.04%
Donax sp.	1	0.00%	1	0.04%
Iphigenia brasiliana	599	2.55%	177	7.57%
Cumingia spp.	3	0.01%	2	0.09%
Tagelus plebeius	143	0.61%	62	2.65%
Mytilopsis leucophaeata	122	0.52%	57	2.44%
Anomalcocardia cuneimeris	6	0.03%	6	0.26%
Chione elevata	3	0.01%	1	0.04%
Mercenaria spp.	19	0.08%	8	0.34%
Timoclea spp.	3	0.01%	2	0.09%
Choristodon robustum	1	0.00%	1	0.04%
Veneridae	7	0.03%	5	0.21%
Bivalvia	14009	59.63%	1	0.04%
TOTAL BIVALVES	**23493**	**100.00%**	**2338**	**100.00%**
Aquatic Gastropods				
Cerithium muscarum	1	2.17%	1	3.23%
Cerithium spp.	2	4.35%	2	6.45%

Crepidula fornicata	15	32.61%	15	48.39%
Crepidula maculosa	3	6.52%	3	9.68%
Crepidula plana	2	4.35%	2	6.45%
Crepidula spp.	3	6.52%	3	9.68%
Nassarius polygonatus	2	4.35%	2	6.45%
Nassarius vibex	1	2.17%	1	3.23%
Prunum sp.	1	2.17%	1	3.23%
Acteocina sp.	1	2.17%	1	3.23%
Gastropoda	15	32.61%	0	0.00%
TOTAL AQUATIC GASTROPODS	**46**	**100.00%**	**31**	**100.00%**
Land Gastropods				
Helicinidae	2	0.61%	2	0.61%
Microceramus pontificus	1	0.31%	1	0.31%
Gastropoda (land snails)	324	99.08%	324	99.08%
TOTAL LAND GASTROPODS	**327**	**100.00%**	**327**	**100.00%**
Miscellaneous Mollusks				
Bivalvia	23493	75.57%	2338	86.72%
Gastropoda (aquatic snails)	46	0.15%	31	1.15%
Gastropoda (land snails)	327	1.05%	327	12.13%
Mollusca	7223	23.23%	0	0.00%
TOTAL MOLLUSKS	**31089**	**100.00%**	**2696**	**100.00%**
Arthropods				
Balanidae	3198	100.00%		
TOTAL ARTHROPODS	**3198**	**100.00%**		
TOTAL INVERTEBRATES	**34290**	**100.00%**	**9923**	**100.00%**

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