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Diet Change Over Time in the Ais Community of Cape Canaveral, Florida

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DIET CHANGE OVER TIME IN THE AIS COMMUNITY OF CAPE CANAVERAL, FLORIDA

by

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ABSTRACT

Diet change over time is assessed for a Malabar II period (900 C.E. to 1565 C.E.) Ais indigenous community in Cape Canaveral, Florida, at the Penny Plot site (8BR158). To this end, 7,760 faunal fragments were examined, with 1,876 identified at the species, genus, or family level. Through identification and analysis of faunal remains, it can be concluded that, while the amounts of overall remains left behind as a whole increased, there were no significant changes in the types of fauna utilized or patterns of consumption. This suggests that the indigenous people who occupied this site managed their resources very effectively for a long period of time and likely passed on management strategies through generations to allow for plentiful food for years. This area of Florida has received little serious attention from scholars in the past, and through studying sites such as the Penny Plot site we are starting to paint a picture of precontact and colonial era Indigenous life in coastal Central Florida. Thus, we are better educating ourselves about the people who came first to Florida and their complex relationship with their surrounding environment, paralleling that of modern Floridians.'

ACKNOWLEDGEMENTS

I would like to thank all my friends and family for believing in me throughout this entire journey and my thesis committee for continuing to support and guide me even when I had doubts. If it weren’t for these people, I would not have gotten to where I am today.

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CHAPTER 1. INTRODUCTION & BACKGROUND

Coastal fisher-forager subsistence patterns have historically been an important topic of study for archaeologists working in the southeast United States (e.g., Andrus and Thompson 2012; Harke et al. 2015; Penders 2012; Reeder-Meyers et al. 2022; Reitz 2004, 2014; Russo 1986; Sigler-Eisenberg and Russo 1986; Thompson and Turck 2009; Thompson et al. 2020). Learning about and attempting to reconstruct these patterns can help archaeologists understand how and why people in the past made the subsistence choices they did and how these choices impacted their futures. This thesis focuses on uncovering the subsistence patterns of pre-contact fisher-foragers in the Central Florida area, specifically Cape Canaveral. Studies from the southern Atlantic coast of the United States reveal that precontact Indigenous peoples in this region were effective at managing food resources and keeping them sustainable over very long periods of time (Reeder-Myers et al. 2022; Reitz 2014; Russo 1986; Thompson et al. 2009; Thompson et al. 2020).

Coastal resources utilized by the indigenous fisher-foragers in this area can best be visualized via the idea of the common pool-resource (CPR) system, defined by Elinor Ostrom (2015:30) as "a natural or man-made resource system that is sufficiently large as to make it costly (but not impossible) to exclude potential beneficiaries from obtaining benefits from its use." Examples of these resource systems, Ostrom notes, include fisheries, irrigation canals, or grazing areas, anything that multiple people can take from for use and consumption (2015:30). In CPR systems, according to Ostrom (2015:30-31), "providers" are those who "arrange for the provision of a CPR," while "appropriators" are those who take resource units from those CPR systems (such as fish, clams, or berries). Ostrom notes that "when the CPR is a biological resource, such as a fishery or a forest, approaching the limit of resource units not only may produce short-run crowding effects but also may destroy the capability of the resource itself to continue producing resource units" (2015:32). Thus, management in any capacity is necessary to ensure the long-term stability of large resources such as fisheries, oyster/clam beds, local vegetation, etc. that are available within coastal areas and provide food for the inhabitants.

Additionally, discovering how and why these societies made the subsistence choices they did can tell researchers much about anthropogenic impacts on the surrounding environment and how they, in turn, affected the societies themselves (Andrus and Thompson 2012; Harke et al. 2015; Fradkin 2015; Lucas 2015; Reeder-Meyers et al. 2022; Reitz 2004, 2014; Russo 1986; Sigler-Eisenberg and Russo 1986; Thompson et al. 2009, 2020). Especially for coastal societies now and in the past, making the right choices when it comes to exploiting resources is vital.

Study Area

Cape Canaveral is a barrier island located within the vast Indian River Lagoon system. Osborn (2016:Chapter 1) describes this system in detail, noting the major bodies of water, including the Banana River, Indian River, Mosquito Inlet, and St. Lucie Estuary, that compose it. The Indian River Lagoon is named after its prominent Indian River, which extends from the Ponce de Leon Inlet in the north to the St. Lucie Inlet in the south (Penders 2012:81). As a whole, the entire lagoon system covers a span of 250 kilometers along the east coast of Florida (Penders 2012:82). Figure 1 below presents a map of the Cape Canaveral area within the state of Florida, with the region circled in red. Figure 2 presents a map of Cape Canaveral and the surrounding water bodies that make up the central Indian River Lagoon system.

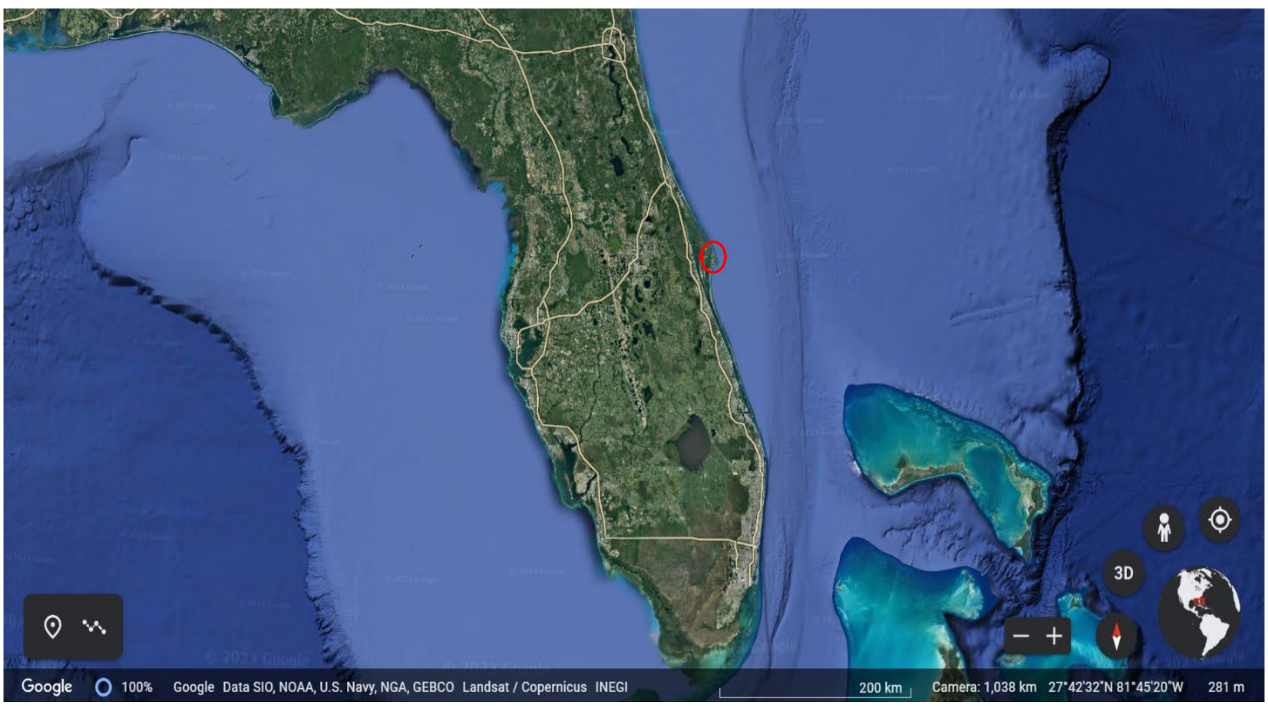


Figure 1. Cape Canaveral, Florida. Taken from Google Earth.

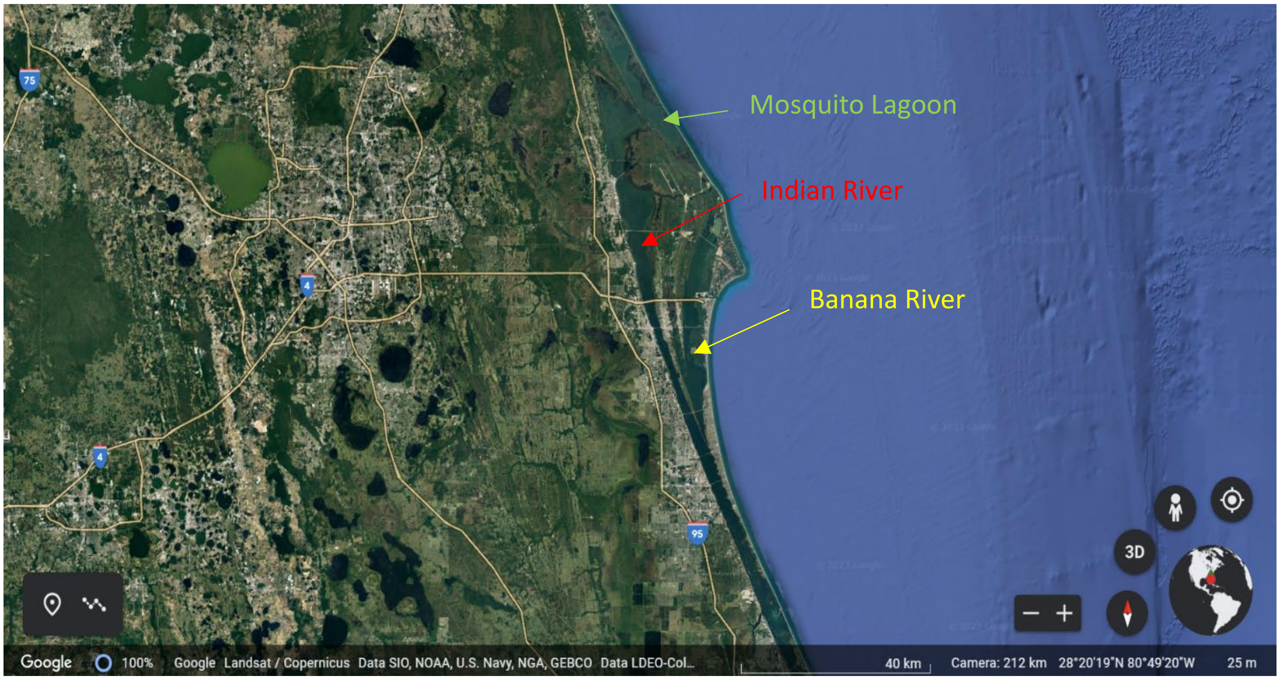


Figure 2. Central Indian River Lagoon Water Bodies. Taken from Google Earth.

The Indian River Lagoon system as a whole varies extraordinarily in ecology and biodiversity and is considered one of the most diverse estuary systems in North America (Florida State Parks 2023); for instance, Osborn (2016:Chapter 2) discusses the fact that the "foliage of many trees in the northern lagoon are deciduous, while the trees of the southern lagoon generally remain green year-round. Similarly, the southern lagoon region infrequently experiences "hard frosts," while the winters of the northern lagoon cannot sustain cold-intolerant tropical species." The Indian River Lagoon Species Inventory (2023a) describes a large variety of habitats that the lagoon houses, including beaches, salt marshes, tidal flats, seagrass beds, oyster reefs, and mangroves, all of which teem with aquatic and terrestrial life. The Indian River Lagoon system, as reported by Hall et al. (2014:66) in citing the Environmental Protection Agency's 2007 National Estuary Program Coastal Condition Report, is home to approximately 2,200 species of animals, with 700 of these being saltwater and freshwater fish. Additionally, the lagoon serves as a source of important economic revenue. The St. John's River Water Management District reports that, as of 2016, " the annual economic value of the [Indian River] lagoon was estimated to be $7.6 billion, which included nearly 72,000 jobs and recreational opportunities for more than 7.4 million visitors per year" (2023).

Aquatic animals have been a significant food source for many people living around the lagoon area since before European contact. For example, Thomas E. Penders (2012:86) has compiled extensive research on the CCSFS/CCAFS (Cape Canaveral Air/Space Force Station) base, where he reports in depth about the faunal remains found on indigenous archaeological sites on the base, citing Bellomo (1996) and Deming and Horvath (1999) in reporting that "...bony fish made up more than 80 percent of the vertebrate diet and included sea catfish, seatrout, Atlantic croaker, black drum, redfish, porcupine fish, and mullet..." As will be discussed later on in this paper, clams, oysters, and gastropods were also significant food sources for the past inhabitants of this area. The species described here are still economically important today. For instance, the Indian River Lagoon Species Inventory (2023b) writes that, "From 1987 - 2001, 1.04 million pounds of marine catfishes (including both the sea catfish, *Ariopsis felis*, and *Bagre marinus*, the gafftopsail catfish) were harvested commercially in the 5-county area (Volusia, Brevard, Indian River, St. Lucie, Martin) encompassing the Indian River Lagoon)." The Indian River Lagoon Species Inventory (2023c) also notes, for example, that the red drum fish (*Sciaenops ocellatus*) is still widely consumed throughout Florida and is also an important fish for recreational fishing. Lastly, the Indian River Lagoon Species Inventory (2023d, 2023e) notes that both the native southern quahog (*Mercenaria campechiensis*) and eastern oyster (*Crassostrea virginica*) species are significant food sources in Florida (2023). The Florida

Department of Agriculture and Consumer Services (FDACS) reported in 2020 that, in the year 2018, clams and oysters "...brought in $15.5 million in sales."

However, poor management and protection of the Indian River Lagoon has led to detrimental effects. Due to increasing population growth, agricultural pollution and wastewater drainage have become some of the main sources of harmful algal blooms in the lagoon, leading substantial "die-off" events of lagoon species (Barlie 2018:571). In addition to pollution, shellfish overharvesting has also become a significant issue in the lagoon system, though strong efforts such as constructing artificial reef lines are underway to mitigate the issue (Indian River Lagoon Species Inventory 2023f). Accumulated lagoon-bottom muck from anthropogenic activities, climate change and resulting sea level rise, and introduced invasive species have also contributed to the degradation of the lagoon and the many species who call it home (Indian River Lagoon Species Inventory 2023g).

We can learn much from investigating the past of the Indian River Lagoon. Anthropogenic activities have always had some kind of an impact on the environment, beneficial or harmful, and it will be revealing to see how these impacts have changed from the earliest human inhabitants of the Indian River Lagoon area to today. Thus, the overarching purpose of this project is to discuss how coastal peoples have interacted with their environments and impacted them and thus ultimately help us better understand why, as humans, we make the environmental choices we do. With a better understanding of this relationship between human and environment, we may be able to formulate plans for restoring the Indian River Lagoon and other affected water bodies like it so that they may continue to thrive for future centuries.

Site Background

The Penny Plot site, or Penny site (number 8BR158) is located on the barrier island that forms Cape Canaveral and was inhabited by members of the Indigenous Ais tribe from as early as 4,000 years ago to the approximate arrival of Europeans. The Penny Plot site is named so because it contains the graves of Euro-American homesteaders Nathan and Maria Penny, who died near the turn of the 20th century. Figure 3 below shows a map of the Penny Plot site's location within Cape Canaveral as well as nearby sites, some of which are mentioned in this paper. This site and the others shown on the map have been excavated in the last few years by student crews as part of the Cape Canaveral Archaeological Mitigation Project (CCAMP), which is a project designed to collect and analyze as much data as possible from sites on the CCSFS base before they become affected by sea level rise (Barber 2021). The data collected from the 2022 field season is analyzed in this paper.

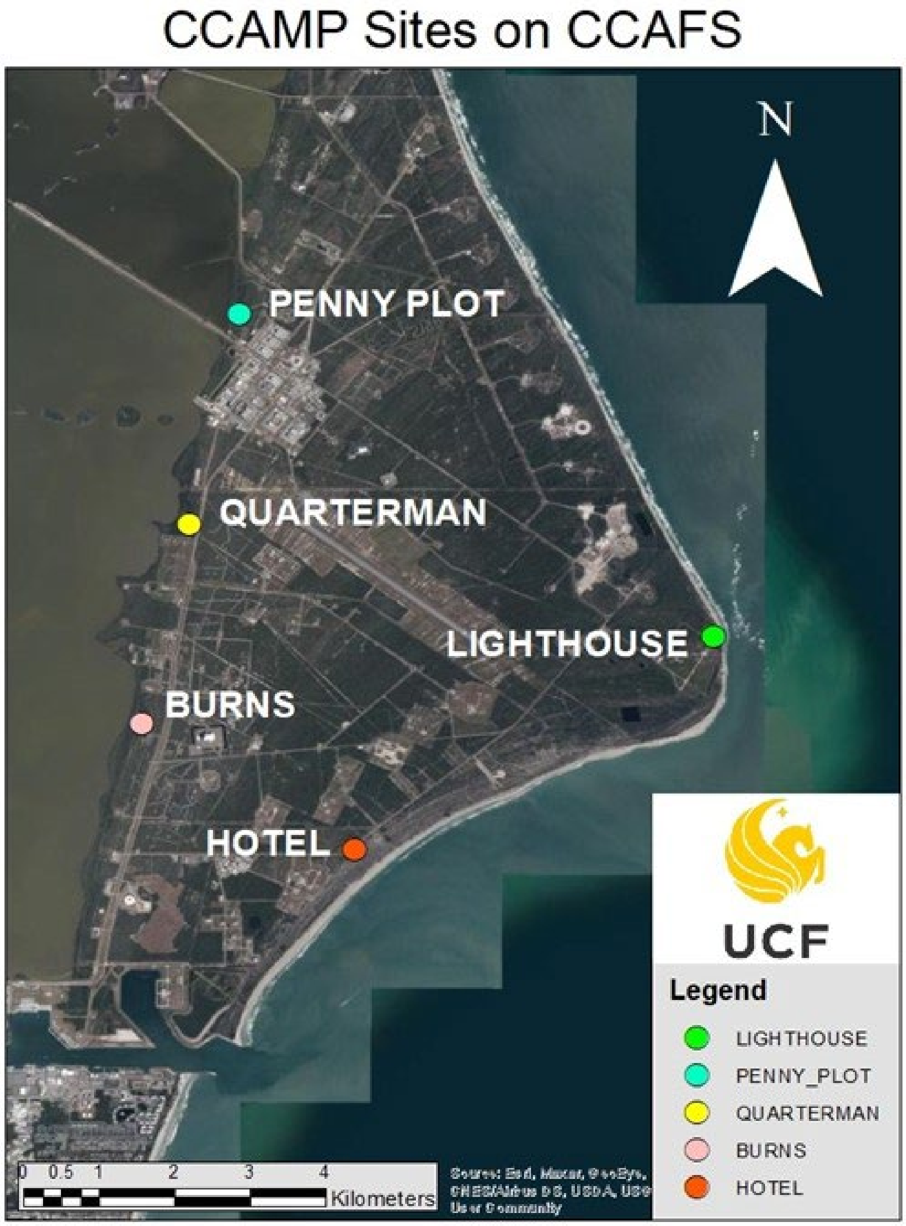


Figure 3. The Penny Plot Site and Other Sites Excavated by CCAMP Crews. Taken from Barber (2021: Figure 1) and Used with Permission by Barber.

At least since 4,000 years ago, Cape Canaveral as a whole was inhabited by the historic Ais and their ancestors (Davidsson 2001:27-28). This Indigenous group survived in the Cape Canaveral region by hunting and gathering a variety of aquatic and terrestrial resources, including marine and riverine fish, shellfish, sharks, turtles, and deer. Post-colonization, they controlled an expansive area from the Ponce de Leon Inlet down to Jupiter on the Southeast Florida coast, and they were the leaders of a tribal coalition consisting of themselves, the Surruque to the north, and Guacata and Jeaga tribes to the south (Davidsson 2001:28, 34-35).

The earliest comprehensive studies in the region were outlined by Rouse (1951:192-193) as a part of a larger survey of the entire Indian River area. Rouse is credited with determining the designations of cultural periods in this region (1951:259), including his Preceramic Period, Orange Period, Malabar I Period, Malabar I' Period and Malabar II Period. These initial designations have guided more accurately defined cultural periods supported by corresponding pottery typologies (Penders 2017:31, 35-36). For instance, see Table 1 below for the time periods that are now used in the Malabar area, as forwarded by Penders (2017:31-36). These are the main time periods that are seen at the Penny Plot site and thus will be used in this paper as cultural designations (but see also Penders (2017:19-38) for a more comprehensive overview of the archaeological cultural periods used for the entire Indian River Lagoon region).

Table 1

Time Period	Calendar Dates
Malabar II	900 C.E. – 1565 C.E.
Malabar I	500 B.C.E – 900 C.E.
Orange	2000 B.C.E – 500 B.C.E

The most recent scholarship surrounding the Penny Plot site is described in papers from students who worked at the site during CCAMP. For instance, much about what is currently known about the material uses of artifacts at the site are reported by student Kayley Haff (2022). Haff (2022:5) discusses the finds from the Spring 2022 excavations at the site, noting the abundance of cooked shellfish remains and modified giant whelk shells, which the author concludes were probably used for scooping or hammering. Haff also discusses the faunal remains found during the field season, which have led to my interest in pursuing the current project. Haff (2022:6) states that the "skeletal assortment consisted of drum fish teeth, small mammalian teeth, fish vertebral fragments, fish otoliths...deer long bone fragments, shark vertebral fragments, shark teeth, turtle carapace, and other small mammalian remains," with a few samples collected showing evidence of human modification. From her report, it is evident that the inhabitants of the Penny Plot site collected and consumed a very large and diverse assemblage of faunal resources, but that there seems to be a heavy reliance on aquatic species. This is in concordance with the previously discussed CCSFS site surveys mentioned by Penders (2012:86).

Review of Pertinent Literature

Here I review relevant literature from the southern Atlantic coast region of the United States, the state of Florida, and Florida's Indian River Lagoon, within which the Penny Plot site is located. The most common theme outlined by these studies is that pre-Hispanic indigenous peoples all along the southern Atlantic coast efficiently managed their aquatic resources and resourcefully adapted to challenges. It will be seen that, for most of the societies described below, their diets over millennia did not significantly change despite changes in climate and environment over the years.

Regional

The southern Atlantic coast of the United States has received much attention from scholars, and for good reason. As aforementioned, these scholars are helping to paint a much clearer picture of how pre-contact coastal indigenous societies managed their food resources in ways more complex than previously imagined. I aim to add to this already blossoming research with the results obtained from this current project.

Elizabeth J. Reitz (2014:726-727) has done extensive research on the coast of Georgia, discussing how pre-contact Indigenous groups in the Georgia Bight area managed their fisheries and were able to maintain a sustainable supply of fish that were important to the diet (namely, mullet and sea catfish) over a few millennia. Reitz (2014:727) also notes the resilience of the ecosystem itself, noting how well the fish primarily consumed were able to persevere in the face of anthropogenic, climate, and/or ecological impacts over the approximately three thousand year-long occupation of the region. For instance, the principle fishes exploited, sea catfishes and mullet, fluctuated in cycles over the period of occupation, with mullet abundance being high at one point and the catfish abundance being low at the same point and vice versa (Reitz 2014:Figure 4). According to Reitz (2014:724), "[these] cycles could be evidence that resource depression, trophic level shifts, prey substitutions, and recovery of these two popular fishes occurred within the region several times." Whatever the case, it would seem that the Indigenous population at any given time was able to rely on an abundance of sea catfish or mullet. Reitz (2014:727-728) goes on to explore possible strategies of anthropogenic resource management, such as territorial claims to different fishing areas, which could have led to the sustainability discussed above.

Along the same lines, Victor D. Thompson and John A. Turck (2009:256, 259) note that during the Late Archaic through the Late Woodland period (4,200-1,000 years BP [Before Present] of Georgia, indigenous societies throughout the coast were able to overcome challenges associated with decreasing sea level. Thompson and Turck (2009:256, 268-270) describe how during the Late Archaic (4,200-3,100 years BP), the society experienced significant population growth, but that this was disrupted during the sea level changes of the Early Woodland, which was detrimental to the coastal estuary system and thus to the coastal resources exploited by the indigenous people. As a result, it would seem that the inhabitants responded by hunting many more terrestrial mammals and reptiles than before and becoming more mobile in the process in order to access these resources (Thompson and Turck 2009:271-272). Finally, Thompson and Turck (2009:272) write that coastal resources once again became the main source of food for the indigenous people of the region after sea levels returned to Late Archaic levels following the end of the Early Woodland period, but that shell deposits did not reach the same size as before the Early Woodland. Burial mounds were also introduced, indicating significant cultural changes.

Thompson and Turck (2009:256-257, Figure 1) embrace Resilience Theory as a way to explain the changes described above, in which the indigenous society was following a larger adaptive cycle with four cycling phases known as growth, conservation, release, and reorganization. Thompson and Turck (2009:256-257) quote Nelson et al. (2006:409) when explaining these stages: "During the growth and conservation phases, long periods of growth and increasing connectivity take place. These are followed by the release and reorganization phases, which "involve an increase in the diversity of social and ecological units (households or plant resources) and of their functions, and increased opportunities for innovations."" One can see how the growth and conservation stages occurred as population grew during the Late Archaic and how the release stage came into play as sea levels dropped and the indigenous people started using new food consumption strategies (Thompson and Turck 2009:268-271). The reorganization stage began when coastal resources once again became the top exploited resources for food, but cultural changes such as burial mounds, which possibly indicated increased status and resource territoriality among certain families or groups, were introduced alongside this (Thompson and Turck 2009:272-273). This is a meaningful example of why studying pre-Hispanic coastal indigenous subsistence patterns is important in determining the ways that people and environment interact and the effects of this interaction.

In another example, Thompson and colleagues (2020:2) measured oyster sizes from numerous sites along the Georgia and South Carolina coasts and found that these oyster fisheries were relatively stable for a period of approximately 5,000 years. Contrary to the expected outcomes of oyster size decreasing due to increasing harvest intensification over time, the authors demonstrate that the size of harvested oysters at the selected sites *increased* (Thompson et al. 2020:3-5). This is important because, as outlined by Thompson and colleagues (2020:1) shellfish fluctuate in size as a result of overharvesting. Their evidence suggests that overharvesting was either prevented or mitigated significantly. The early forager societies of this region also seem to have exercised cautious and effective resource management, where the authors suggest “that fishing/shellfish harvesting territories and governing practices may have had considerable antiquity” (Thompson et al. 2020:5).

Similar results were obtained by Leslie Reeder-Meyers and colleagues (2022) from oyster fisheries from Australia, the Pacific Coast of North America, and the Atlantic Coast of North America. Reeder-Meyers and colleagues (2022:2) argue that “[today], oyster fisheries cannot be effectively restored and managed without considering the past, present, and future roles of Indigenous people.” This statement is especially apparent in their findings that, out of all of 30 sites surveyed, fishery declines or destruction “were rare and localized” for the study period of roughly 7,000 years before present (Reeder-Meyers et al. 2022:10, Figure 3). Contrary to the public belief that Indigenous fisheries were relatively small and “pristine,” Reeder-Meyers and colleagues (2022:10) note that Indigenous fisheries were immense and remarkably widespread, which actually allowed for the surplus that was later exploited (and eventually, heavily reduced) by European colonialists and capitalists. Reeder-Meyers and colleagues (2022:10) end with the powerful argument that ecosystem decline can be mitigated by consulting Indigenous groups on whose historic land modern fisheries are located. Importantly, however, one striking aspect of this work is that there is an evident gap in the oyster harvesting of the Southeast Atlantic coast from roughly 2,500 years before present to 1,000 years before present, where virtually no sites containing oyster remains were reported (Reeder-Meyers et al. 2022:2, Figure 1). In my thesis, I intend to address this gap and reconcile it with data collected from the Penny Plot site, which will hopefully inspire future research surrounding this gap in data.

Florida

Florida can be roughly divided into a series of culture areas based on pottery types, subsistence strategies, mound construction, and seasonal movement (Penders 2017:19), though arguments about where exactly these areas lie, and what separates them, abound (i.e., Loubser et al. 2005:26-28; Penders 2012; Russo 1986:1-4; Sigler-Eisenberg and Russo 1986:22-23). Generally, though, the cultural areas of Florida can be defined in Figure 4 below, taken from Penders (2017:Figure 10). Area 4 is where Malabar cultural periods are used and where the Penny Plot site lies in Cape Canaveral.

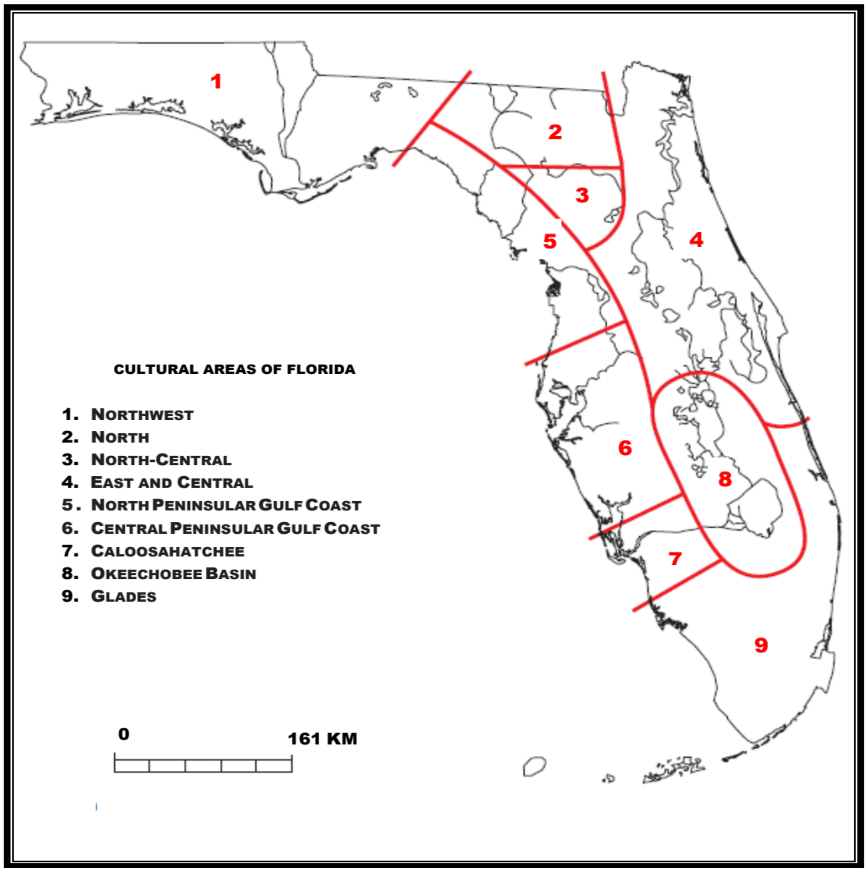


Figure 4. Cultural Areas of Florida, defined by Milanich (1994). Taken from Penders (2017:Figure 10) and Used with Permission by Penders.

Despite these debates, what is obvious from the studies reported below is precontact subsistence patterns differed all over the state, and that we still do not understand these patterns exactly. There is still much to be explored about precontact subsistence patterns in the state, but there is a solid foundation, as evidenced by the extensive body of research on the topic.

Russo conducted an extensive study of the Upper Basin of the St. John's River, an inland river located on the eastern side of the state that flows northward from Blue Cypress Lake near Vero Beach (Upper Basin) to the Atlantic Ocean east of Jacksonville (Lower Basin) (The Great Florida Riverway 2023). Rouse (1986:1-4) argues that, as opposed to the lower portion of the river in the north, which supports evidence of horticulture, the Upper Basin is located within the fisher-forager culture area of the Ais. Russo explores how the past inhabitants of the Gauthier site in the Upper St. John's River Basin consumed faunal resources through the Orange, Malabar I, and Malabar II periods. Russo's (1986) basic findings were that, over time, the inhabitants went from harvesting smaller, mainly shallow water fish in the river to harvesting larger, deeper water fish, with riverine fish dominating over marine fish in all periods. Russo (1986:40-41, 48-49) attributes these changes to rising sea levels affecting the St. John's River following the Orange Period as well as improvements in fishing strategies, indicating a "coevolution" of subsistence and environment, where both factors seem to have contributed in some way to the shifting of dietary choices.

Additional work on the St. John's River was completed by Randall (2013), who focused on Mount Taylor-period (7,400 to 4,600 years BP) shell sites in the Middle Basin. Unlike most of the work discussed in this paper, these sites consisted of freshwater shells, mainly Unionidae bivalves (river or freshwater mussels), the banded mystery snail (*Viviparus georgianus*), and the Florida apple snail (*Pomacea paludosa*) (Randall 2013:196). Randall (2013) condenses shellfish deposition events into three distinct episodes, which not only represent possible responses to climate change, but also intentional cultural actions. For instance, Randall (2013:205, 214) points out that, after Florida experienced a rise in sea level, small-scale deposits and shell ridges were formed linearly along the edge of the water in Episode I (7,600 to 7,260 years BP). In Episode II (6,350 to 5,700 years BP), new shell ridges were built in different areas (some were used as residential facilities) as were mortuary mounds (Randall 2013:207). Finally, in Episode III (5,700 to 4,600 years BP), Randall (2013:210-211) writes that" [i]ntensive shell deposition appears to have been concentrated at only a few locations, resulting in shell mounds twice the scale or more of previous efforts” and that these mounds were located near important ecological landscapes such as spring pools, places where channels joined together, or places where channels flowed into larger lakes. Randall (2013:211) also notes that, during Episode III, mortuary mounds were either constructed on top of previous settlements or constructed with fill from earlier shell deposits. What is evident here is that the indigenous people in this region clearly were not passively eating shellfish and discarding the shells at random. Quite the opposite, shell deposits seem to have had become a part of their history and suite of traditions, and this is shown by the constant reuse of earlier deposits for new purposes such as fill in burial mounds (Randall 2013:2014). In this case, then, subsistence is unable to be separated from the cultural sphere; in fact, it fuels it and allows for the creation of places of cultural importance.

Scholarship has also been published in St. Augustine on the east coast of Florida. One of the important cultural differences is that St. Augustine was inhabited by the historic Timucua tribe, who practiced agriculture, while the Ais, whose principal settlement in colonial times was located near Vero Beach, were fisher foragers. (Rouse 1951:24; Davidsson 2001:35, 37; Reitz 2004:68). Nonetheless, the data from St. Augustine can help inform the work of future research studying the anthropogenic impacts on the environment. In St. Augustine, Reitz (2004:64) examined data from several sites to determine the extent that “fishing down the food web,” or obtaining fish resources from lower and lower trophic levels over time, occurred in the distant and near past. What she finds overall is that significant variations in trophic level of fish caught occurred long before modern fishing in the area, and that the most significant drops occurred during the initial contact period with the Spanish and when Britain took over Florida, indicating how cultural changes could also affect fishing practices in addition to overfishing and climate variations (Reitz 2004:80). One of the most important contributions of this study is that it suggests that “the recent decline in the world's industrial fishery has its roots in changes that began several centuries ago” (Reitz 2004:81). This kind of knowledge can help foster a global attitude towards long-term sustainability in the world’s fisheries, and eventually, to other sources of food and resources.

Indian River Lagoon

Though much research has been done on the St. John’s River region to the west of Cape Canaveral (Bullen et al. 1967; Fradkin 2015; Penders 2017; Randall 2013; Rouse 1951; Russo 1986), the Indian River Lagoon area and Cape Canaveral itself suffer from a lack of research. This may be for a variety of reasons; sites located on Cape Canaveral generally have limited access due to the presence of the space force base, and construction has been continuing in the lagoon area for decades as Florida’s population grows, destroying both the lagoon and many sites within it (Indian River Lagoon Species Inventory 2023h; Milanich 1994:252).

Some of the first excavations in the area were conducted by George Woodbury at the Burns and Fuller burial mounds in 1933-1934 (Willey 1954). The findings reported by Willey (1954) show an overall trend in burial complexity from largely mass burials in the mounds to arc burials with the deceased heads’ pointing in towards a central point in the mounds over the course of the Malabar period. While excavation of Indigenous human remains is now illegal in the United States following the passing of the Native American Graves Protection and Repatriation Act (Public Law 101-601; 25 U.S.C. 3001-3013) in 1990 (United States House of Representatives 2022), these discoveries do show some sort of sociocultural change over time in Ais prehistoric and historic society, which is an important facet of determining if and why subsistence patterns changed over the years of occupation at the Penny Plot site. If something as complex and ritually important as burial patterns were significantly altered over time, then the possibility that diet may have changed (if at all) because of changing social, spiritual, or cultural factors should be considered.

As aforementioned, the first comprehensive survey in the lagoon area was completed by Rouse in 1951, who is credited with developing the concept of a distinct Indian River cultural area located along the length of the Indian River and approximately 50 kilometers inland (Sigler-Eisenberg and Russo 1986:21-22). Following this, archaeologist George Long surveyed and numbered a multitude of sites, including the Penny Plot site, in 1966-1967 for the National Aeronautics and Space Administration (NASA), who at this time was just beginning to start their space program in Cape Canaveral (Amanda Groff, personal communication; Long 1967). In the decades after, some reports describing the overall findings at different sites throughout the lagoon were created, but a majority of them are CRM (cultural resource management) reports written for the local authorities who wished to begin or modify construction projects at places where potential archaeological sites exist (i.e., Loubser et al. 2005; Penders 2017; Smith et al. 2007). However, these reports are vital for preserving important sites in the lagoon area and can provide a firm ground for further research to continue off of; for instance, a few studies have been conducted on sites in St. Lucie County, adjacent to the southern portion of the Indian River. A comprehensive report of excavations at site 8SL1181 at the Ten Mile Creek Water Preserve Area (WPA) in St. Lucie County revealed a very heavy reliance on aquatic resources; besides human remains, very little mammalian remains were found, including only four definitive White-tailed deer (*Odocoileus virginianus*) fragments (Loubser et al. 2005:201, 209). Additionally, while some remains of gar (*Lepisosteus spp.)* and sunfish (*Centrarchidae*) are assumed to have been captured from the freshwater Ten Mile Creek, the authors conclude that the lagoonal/brackish-water fishes found, including black drum (*Pogonias cromis*) and sheepshead (*Archosargus probatocephalus*) were caught in the Indian River, ten miles away from the site (Loubser et al. 2005:203-205). Great white shark (*Carcharodon carcharias*) teeth were also found at the site, which is significant because these sharks are usually found offshore in cooler waters, which may mean that boats were used to hunt and catch this food source (Loubser et al. 2005:205-206). This conclusion is supported by biological phenomena; Loubser et al. (2005:206) cite Kozuch (1993:1) in stating that loose, un-fossilized shark teeth rarely wash up on the shore due to the fact that shark carcasses tend to sink or become immobile after death.

Overall, the trend reported at site 8SL1181 is that there was “a shift from estuarine fish exploitation during the Late Archaic [approximately 3000 to 750 B.C.E.] to include some ocean fish during the East Okeechobee I period [approximately 750 B.C.E to 800 C.E.] to a focus on local animals during the East Okeechobee II period [approximately 800 C.E. to 1000 C.E.],” (Loubser et al. 2005:209). Though this site is not placed within the Malabar culture area in this paper, instead being placed within the East Okeechobee culture area (Loubser et al. 2005: 24-32), the use of the Indian River is important enough that I consider this report useful here. See Loubser et al. (2005:26-28) for a more thorough discussion of differing schools of thought surrounding cultural designations in East-Central Florida that is beyond the scope of the current project.

Site 8SL1181 can be compared with excavations at nearby site 8SL1646, which revealed that most of the food sources procured were from the local inland environment and not from the coast (Smith et al. 2007:61). Turtle made up nearly half or more than half of the assemblage for every level dug at the site, indicating not only a heavy reliance on this species over time (unspecified due to lack of radiocarbon dates) but also ways to manage this resource so it could last (Smith et al. 2007:Table 8). The second most frequent resource collected was local freshwater fish (Smith et al. 2007:73). Even just from these two site reports alone, it is easy to see that there may be significant differences between two sites located as close together as in the same county. Thus, studying pre-Hispanic indigenous subsistence patterns with close scrutiny is essential to identify even the smallest of variations between groups living in the same place.

Finally, there are a few reports on nearby sites from the Penny Plot site, including the Burns Mound (8BR85) site (Blessing et al. 2020; McAfoos et al. 2021) and the Quarterman (8BR223) site (Savateri and Barber 2023), which have been excavated by student crews as part of CCAMP. These reports are beginning to paint a picture of indigenous life on Cape Canaveral, whereby a mixture of aquatic and terrestrial resources were essential to survival.

For instance, the Burns Mound site has revealed that a large portion of the diet was comprised of invertebrates (namely, gastropods such as the Florida crown conch and the shark eye snail), followed by bony fish, where hardhead catfish, mullet, and seatrout were the most commonly consumed (Blessing et al. 2020). McAfoos et al. (2021) also reported that invertebrates were the dominant taxon found at the site. One of the most surprising finds at the Burns Mound site, and the most groundbreaking, includes the discovery of domesticated microbotanical remains, such as maize, beans, and squash, which are the first such domesticated plant remains to be found in pre-contact coastal East-Central Florida society (Duncan and Park 2023). However, according to Duncan and Park (2023:223), "the absence of processing tools, maize macroremains, and maize phytoliths, but the presence of maize starches in the pottery residue strongly suggests that pre-processed maize, likely flour, was being utilized." Thus, it is more likely that already ground maize flour, possibly along with squash and beans, were traded in from agricultural groups in the north of the state or that they were growing these crops further inland during the seasons when they were not occupying the coast (Duncan and Park 2023:224). Not only does this suggest seasonal movements among the pre-Hispanic Ais and their ancestors, but this also suggests, quite extraordinarily, that this society may not have been sole fisher-foragers after all and utilized agriculture to supplement their diets.

CHAPTER 2. MATERIALS & METHODS

Here I will describe the materials and methods employed in this study, separating excavation from laboratory work. Excavation occurred during January through May of 2022 and subsequent laboratory analysis during January through May of 2023. Materials excavated after the 2022 field season were not analyzed and were excluded in the data set.

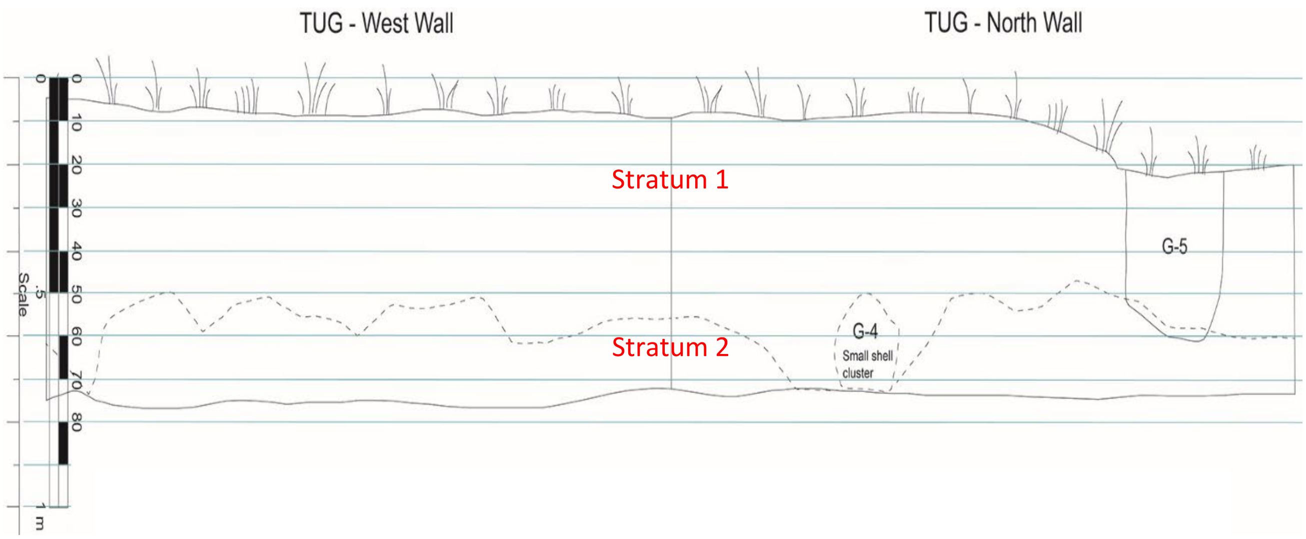
Excavation

Initial Phase I testing at the Penny Plot site was conducted by Research Analysts, Inc. (RAI), New South Associates, Janus Research, and Archaeological Consultants, Inc. (ACI) during the 1980s and 1990s (Thomas Penders, personal communication 2023). In 2020, a team of undergraduate student researchers under CCAMP conducted Phase I excavations of the site by digging 91 shovel test pits around the perimeter of the site, spaced 20 meters apart along 12 east-west transects (Barber 2021). These test pits helped to determine the boundaries of the site and mark where future excavation units would be eventually opened. Phase I testing also occurred in the 2021 and 2022 field seasons. Since 2020, Phase II excavations have been continuously conducted at the site. The student research team is split up into smaller groups who are then assigned to a specific test unit, and each unit is named in alphabetical order, starting with A, B, C, etc. in the order they are begun. Test Unit G was opened in January 2022, and it was fully excavated by May 2023. Excavation was conducted via arbitrary 10 centimeter levels and was deemed completed when the crew encountered two sterile levels in a row. Excavation methods included shoveling, troweling, and brushing, and soil was placed into buckets to be screened through a dry ¼” mesh screen. Whenever found, archaeological features (including possible hearths, postmolds, shell concentrations, complete faunal remains, etc.) were separated out from the rest of the soil matrix and pedestaled. Features were then excavated separately once the excavators reached a depth where the feature could not be distinguished from the soil matrix. One half of the feature was screened separately and the other half was taken for soil flotation analysis.

All artifacts and ecofacts were collected by level and placed into bags labeled with the level or feature information. Whenever encountered, especially large or whole artifacts and ecofacts were bagged separately and their position mapped using PTN (point North) and PTE (point East) coordinates relative to the unit. Not all shell remains were collected for every level due to space and time constraints, especially concerning *Donax variabilis* (coquina) because of its ubiquity at the site and small size (but it did make up a large portion of the Indigenous coastal diet in this region) (Thomas Penders and Sarah Barber, personal communication 2023). Thus, for instance, the coquina identified in this study represent only a portion of what was actually recovered from the site.

In the 2022 season, levels 1-8 were excavated, and data from this season is being analyzed here. Levels 1 and 2 were combined due to initial faulty readings on the datum position above modern ground surface. Figures 5 and 6 show maps of the northwest and southeast wall profiles, and figures 7, 8, and 9 show photographs of the North, South, and East walls and their marked features, respectively. In the profile illustrations, the spaces between the blue lines represent one ten centimeter level. I have also marked the cultural strata and the black earth midden that makes up Stratum 1, also shown in the photographs below. This midden accumulated over time due to repeated burning events and the repeated deposition of organic remains, creating a layer of rich black soil. Stratum 1 roughly covers levels 1-7 and stratum 2 level 8. Features G4, a shell cluster, and G5, G6, and G7, hearth features, were not excavated until the following field season, so these features are not a part of this paper’s data set, which covers only those faunal remains excavated in the 2022 field season, (levels 1-8 and features G1, G2, and G2-A), approximately 7,700 bone and shell fragments. Additionally, Feature G3, a small shell cluster, was only taken for soil flotation analysis, so that is also not presented here. Feature

G1 was a modified Knobbed Whelk (*Busycon carica*) shell with a coquina rock inside its opening surrounded by other shells and faunal bones, found at 23 centimeters below datum, feature G2 contained oyster and clam shell clusters found at 45 centimeters below datum, and feature G2-A was a hearth found within feature G2 at 51 centimeters below datum (Gerber et. al 2022). .



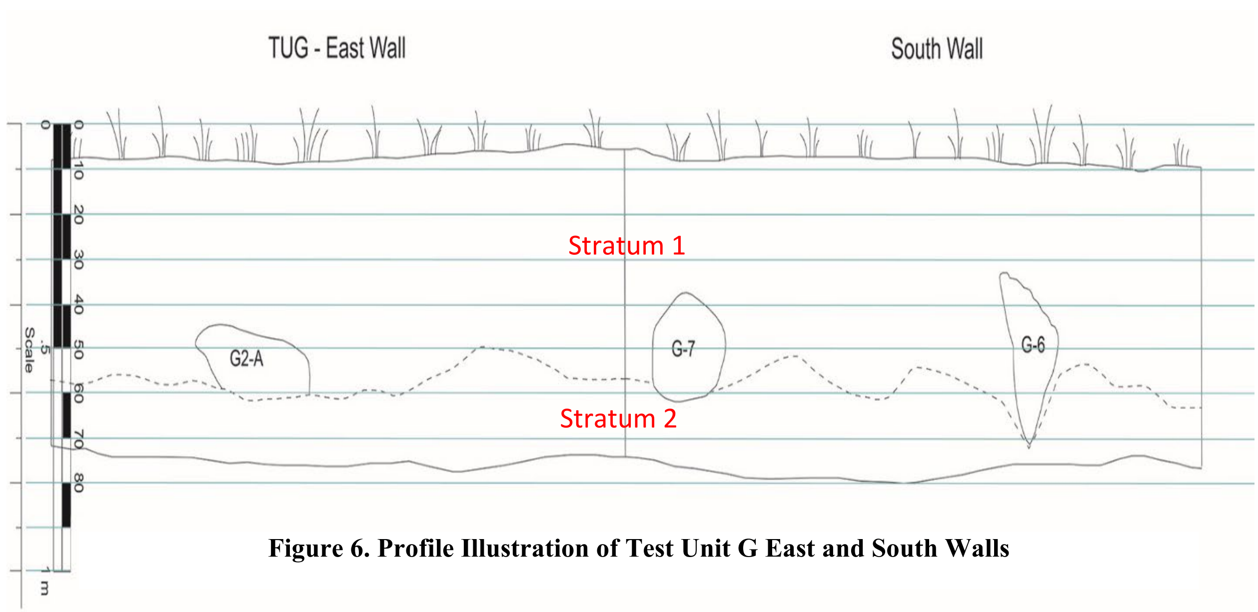


Figure 6. Profile Illustration of Test Unit G East and South Walls

Figure 7. Test Unit G North Wall with Features G4 and G5. Photograph by Lydia Kiernicki

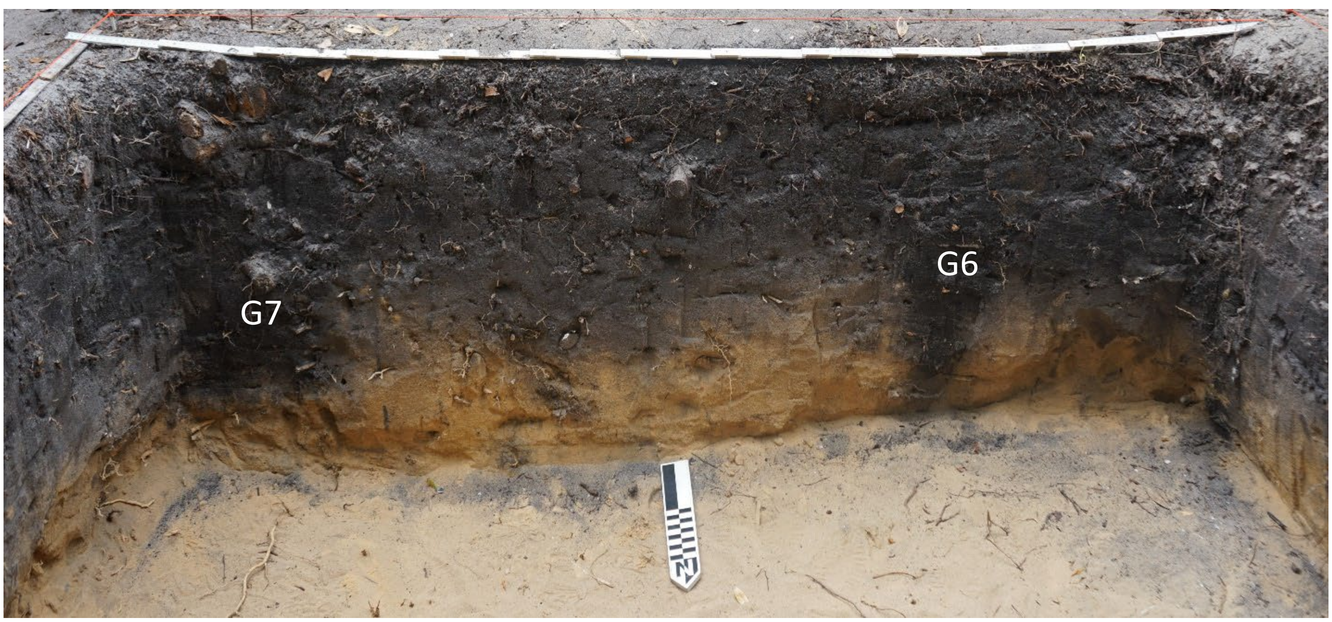


Figure 8. Test Unit G South Wall with Features G6 and G7. Photograph by Lydia Kiernicki

Figure 9. Test Unit G East Wall with Feature G2-A. Photograph by Lydia Kiernicki

Laboratory Analysis

All faunal remains from the 2022 field season were taken back to the laboratory to undergo proper identification. Resources used to aid in the identification process included the Environmental Archaeology Image Search database provided by the University of Florida's Florida Museum of Natural History (FMNH), the AFORO (Anàlisi de Formes d'Otòlits) Otolith Database, ichthyofauna skeletal collections provided by the FMNH, previously identified faunal remains from the nearby Burns Mound site, and relevant literature (Adams and Crabtree 2011; Murphy and Lane 2012).

Remains were separated using a pair of tweezers and placed into trays for weighing. A digital scale was used to weigh remains to the nearest tenth of a gram. Remains were separated and grouped together by same species, genus, or higher, identified, and weighed separately, for every field specimen bag collected at the site. For instance, bone or shell fragments from the same species, genus, family, etc. (depending on how far identification achieved) in the same bag would be counted and weighed together and placed into a separate container. This process would be repeated for every group of taxa in every bag. Figure 10 shows an example of this process, where otoliths (ear bones) of two different taxa of bony fish, *Ariidae* (marine catfishes), left, and *Micropogonias undulatu*s (Atlantic Croaker), right, are grouped together to be separately weighed and documented.

Figure 10. Separation of Ariidae Otoliths (Left) and Micropogonias undulatus Otoliths (Right).

Due to the extreme fragmentation of the remains and time constraints, it was impossible to identify all at the species level. An unidentified (UID) category was used when remains could not be identified beyond invertebrate versus vertebrate or at all. Data from the faunal fragments was put into a Microsoft Excel spreadsheet (see Supplemental File) and categorized by general taxon, including amphibian (Amphibia), Animalia, which were general unidentified remains, bird (Aves), bony fish (Actinopterygii) general sharks/rays/skates (Chondrichthyes) invertebrate, (Invertebrata), mammal (Mammalia), reptile (Reptilia), shark (Selachii), and vertebrates (Vertebrata). If possible, fragments were identified to the family, genus, or species level.

CHAPTER 3. RESULTS

Part I: Identifications & General Abundance

This chapter is split into two parts. First, I present the NISP (number of identified specimens) and weight of identified taxa (i.e., species, genera, or family) for invertebrates, bony fish, and chondrichthyes for every level and feature. This is followed by a discussion of the habitats of these identified taxa. Overall, 7,760 fragments in total were examined. 1,876 of these were identified at the species, genus, or family level, and 5,406 were identified as far as general taxon (i.e., bony fish, testudines, etc.). 478 fragments were not able to be identified at all. The cumulative weight of the entire assemblage was 5316.31 grams, about 5.3 kilograms. The cumulative weight of all of the NISP for the assemblage, totaling 7,282, was 5,045.03 grams.

Figure 11 below shows a comparison between unidentified and identified fragments for each level and feature analyzed for Test Unit G. As aforementioned, the small size of the fragments and time constraints did not allow for the identification of every fragment, even to the most general taxa.

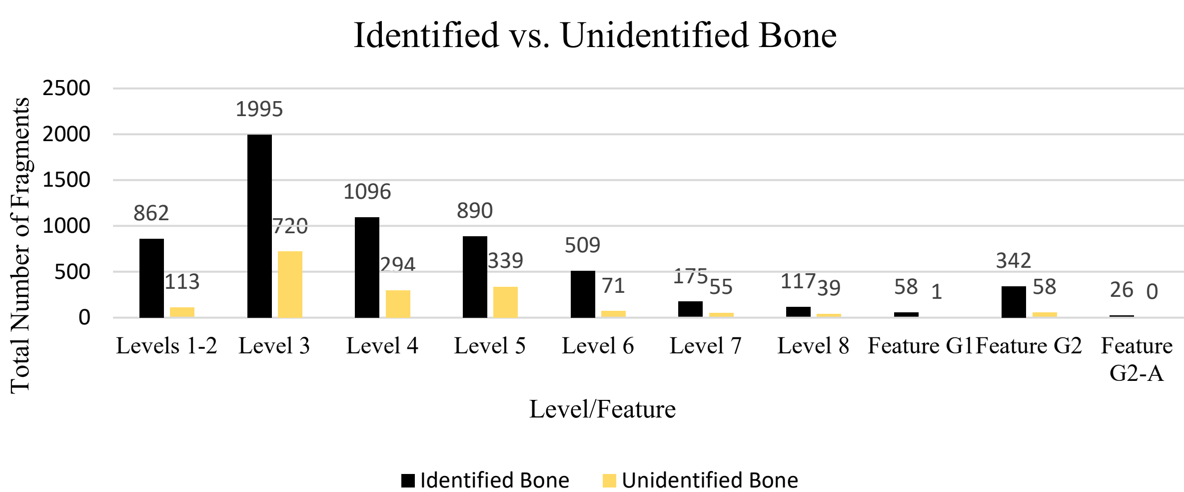


Figure 11: Identified vs. Unidentified Bone from Test Unit G

Levels 1-2

Due to possible surface disturbances and errors made in the field, levels 1 and 2 of TUG were combined for the purposes of this analysis. Levels 1 and 2 are fairly representative of the patterns seen in the following levels, whereby shellfish generally dominates both the actual NISP and the weight of the collected faunal remains, followed by either bony fish or testudines. I have chosen to include both the NISP and weight charts because, as seen in Figure 12 below, shellfish is much heavier than any other of the faunal remains recovered. For instance, shellfish makes up 39% of the identified remains in levels 1-2 but 71% of the total weight.

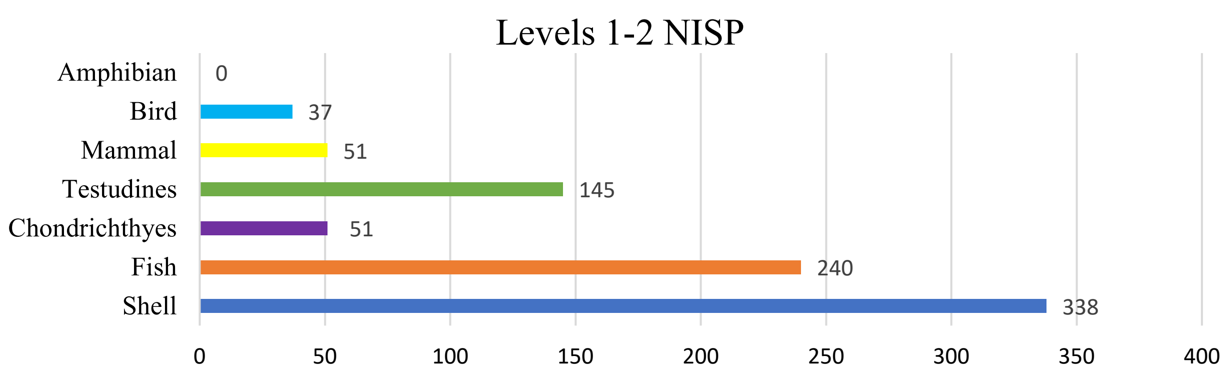


Figure 12: Levels 1-2 Number of Identified Specimens (NISP)

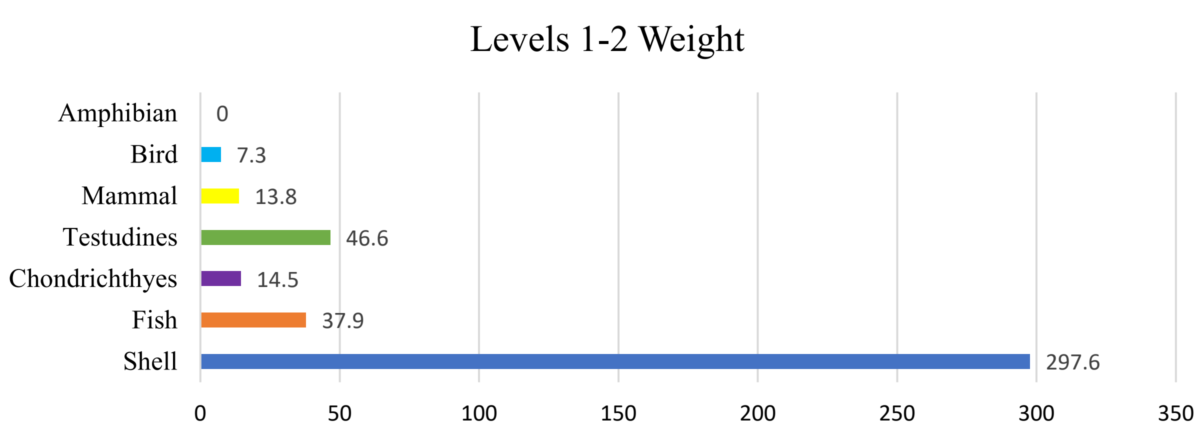


Figure 13: Levels 1-2 Weight of Each Taxa

Level 3

Level 3 contains the highest amount of faunal remains recovered, accounting for 35% of the 7,760 fragments collected and 30% of the weight. Level 3 also contains the highest amount of every general taxa identified as well as UID bone (not shown here).

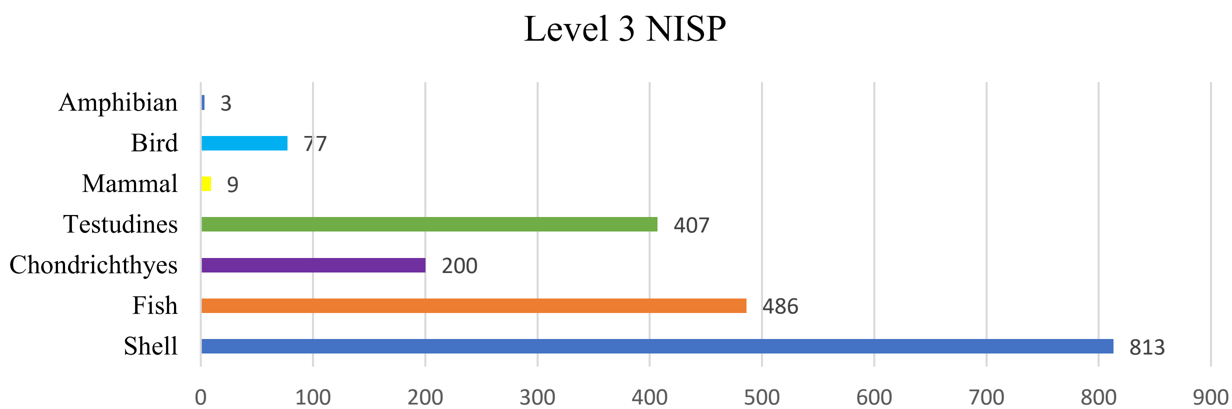


Figure 14: Level 3 Number of Identified Specimens (NISP)

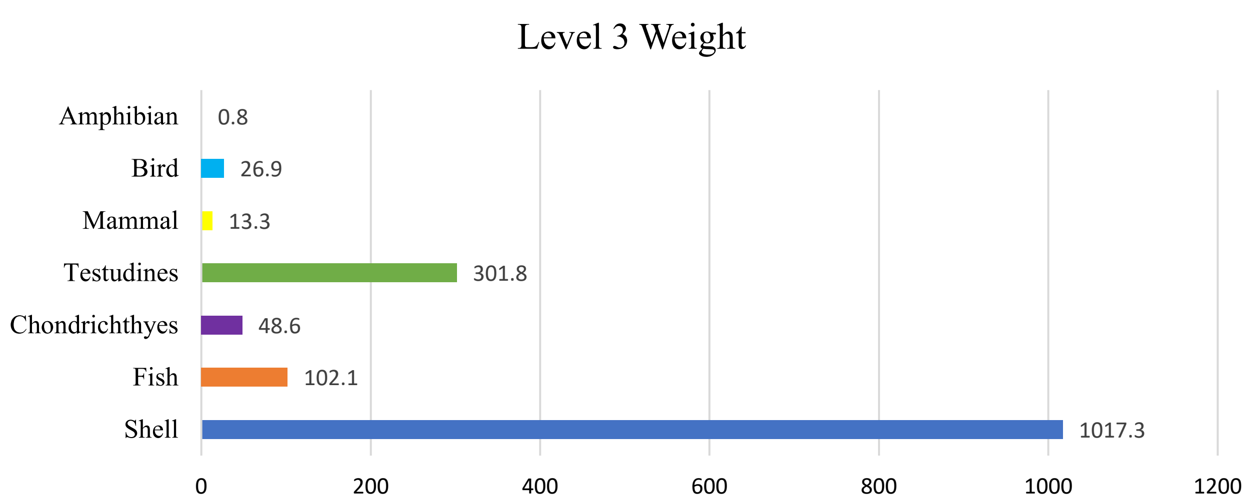


Figure 15: Level 3 Weight of Each Taxa

Level 4

There were no mammal remains found from level 4, yet this does not necessarily mean that mammal consumption had an absent or reduced presence in the diet during this occupation. The absence of mammal remains could be due to the location of the test unit, missed remains during excavation, or misidentification of other remains found.

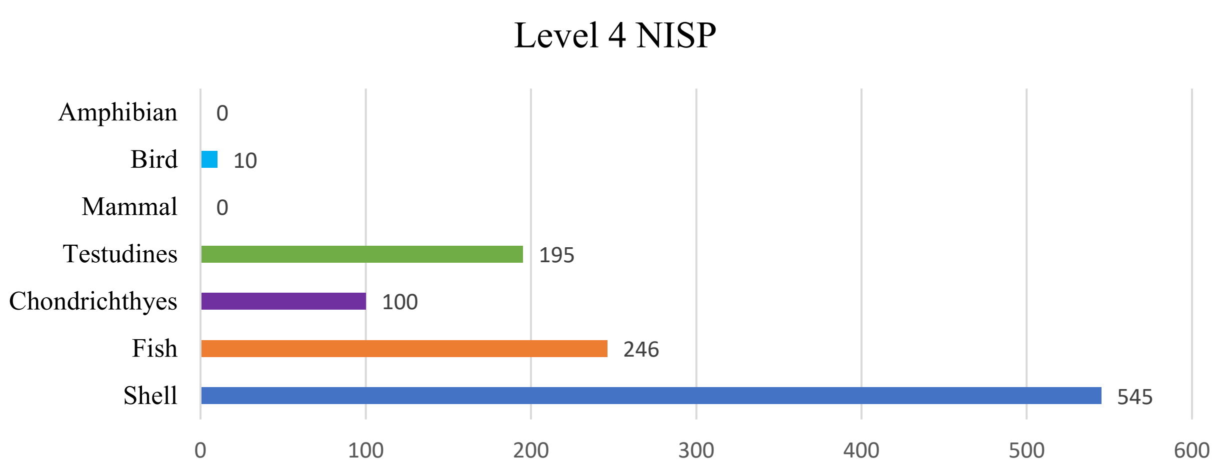


Figure 16: Level 4 Number of Identified Specimens (NISP)

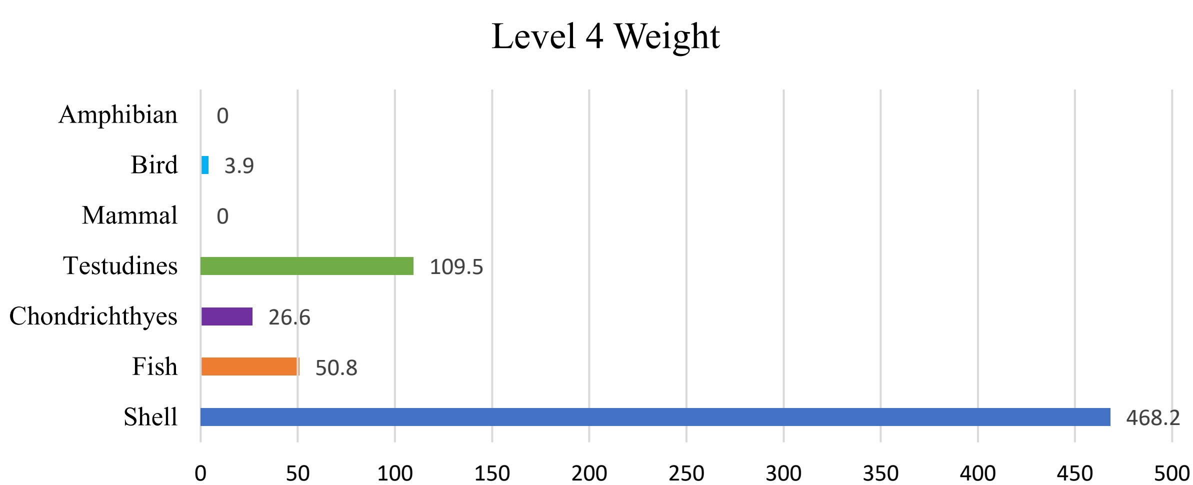


Figure 17: Level 4 Weight of Each Taxa

Level 5

Shellfish obtained from level 5 were preserved decently better than those of the other levels, allowing whole, nearly whole, or less fragmented specimens to be weighed, allowing for a higher weight recorded here than in any other level.

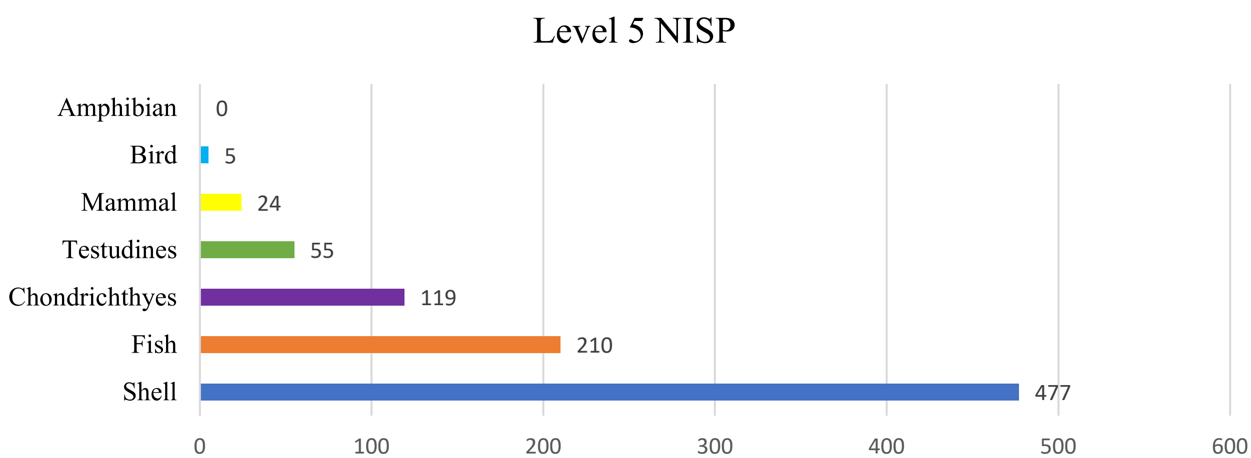


Figure 18: Level 5 Number of Identified Specimens (NISP)

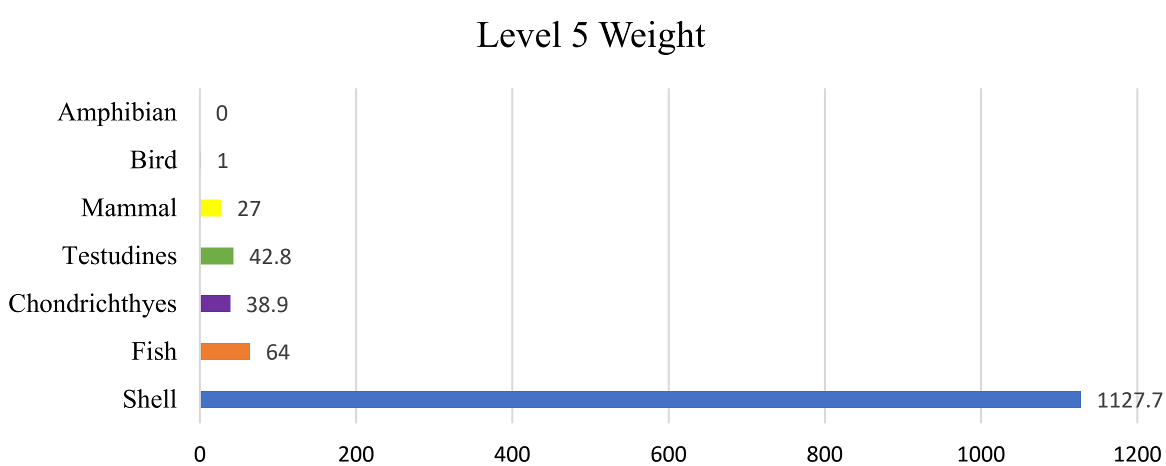


Figure 19: Level 5 Weight of Each Taxa

Level 6

In level 6, there were not as many remains collected as in the previous levels, and even fewer were collected in the following levels. Only 580 fragments in total were recovered from level 6, compared to a high of 2,701 fragments in level 3. Nonetheless, the same pattern remains whereby shellfish, fish, and testudines are the main remains being seen.

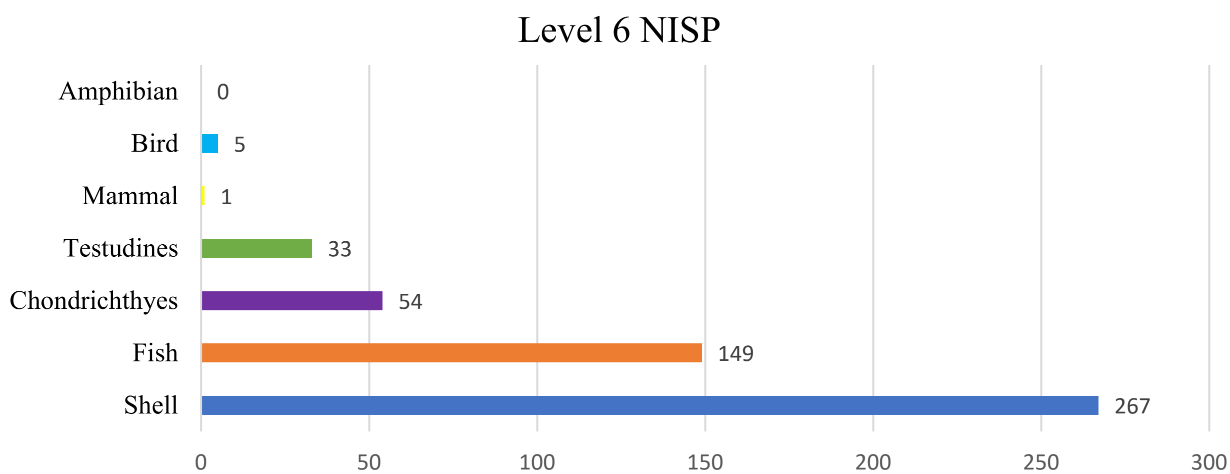


Figure 20: Level 6 Number of Identified Specimens (NISP)

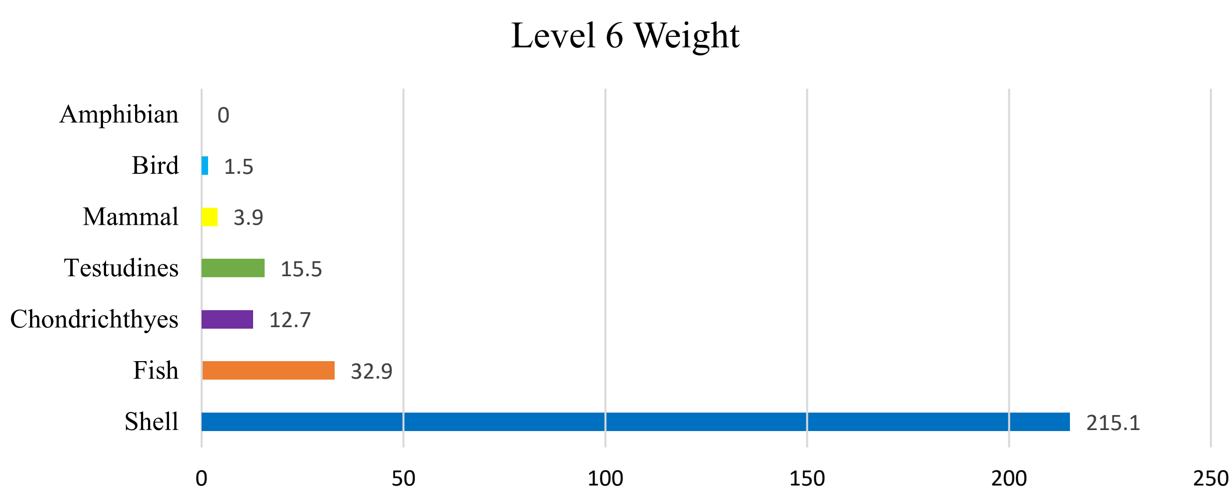


Figure 21: Level 6 Weight of Each Taxa

Level 7

Level 7 also did not contain any mammal remains, and neither testudines nor birds. Again, this may not be representative of the actual diet at this time and could be due to a number of outside factors such as errors made during excavation or identification or test unit location.

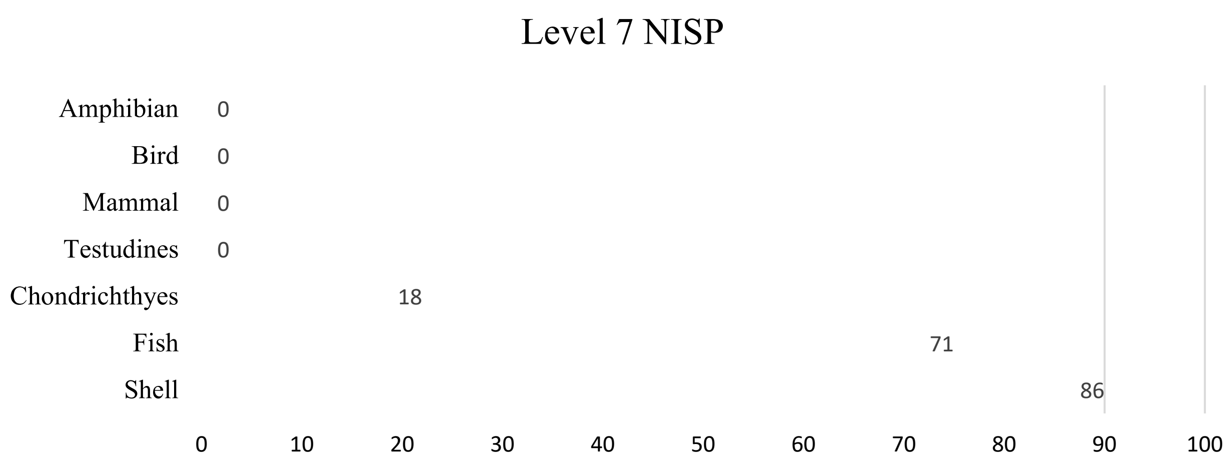


Figure 22: Level 7 Number of Identified Specimens (NISP)

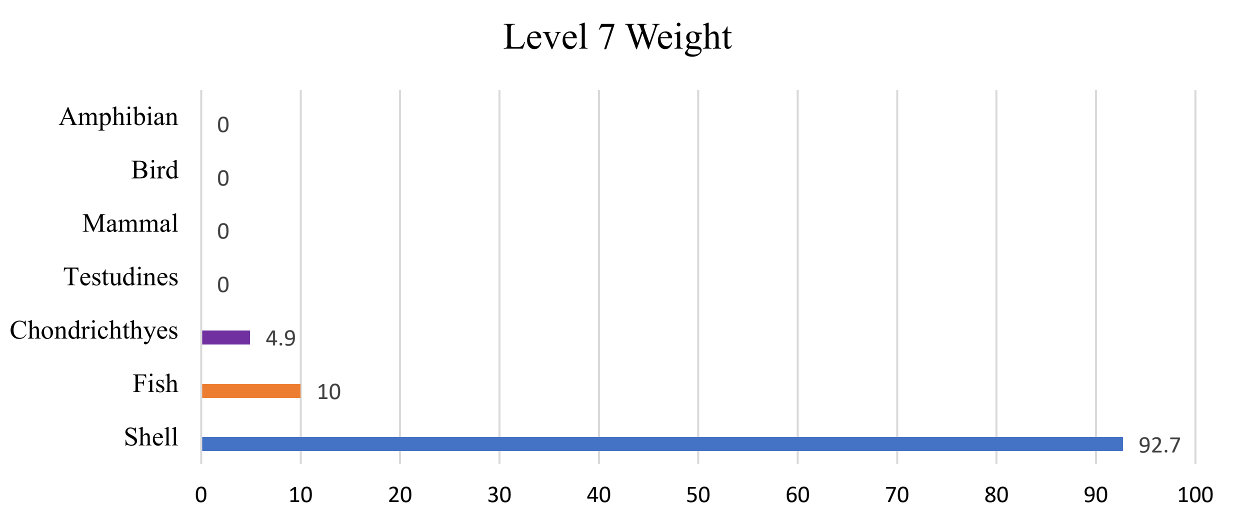


Figure 23: Level 7 Weight of Each Taxa

Level 8

Only 156 fragments in total were collected from level 8, only about 2% of the total assemblage. It is important to note that the materials recovered from level 8 are in a different stratum entirely and were deposited before the creation of the dense black earth midden of levels 1-7. Thus, it would seem that there was not an intense occupation at this site at this time.

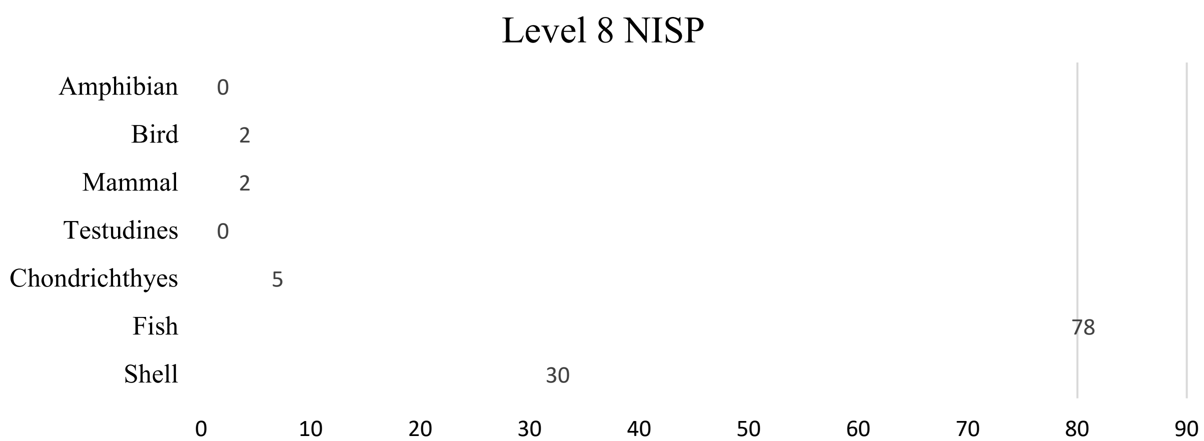


Figure 24: Level 8 Number of Identified Specimens (NISP)

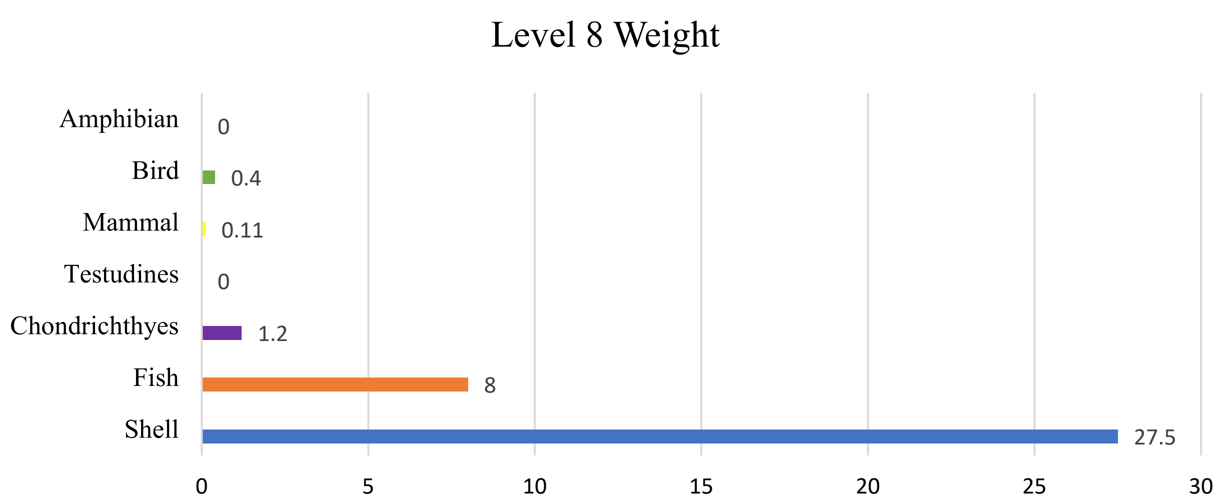


Figure 25: Level 8 Weight of Each Taxa

Feature G1

Feature G1 was particularly unusual because of the placement of the coquina rock inside the modified whelk, which was the largest and heaviest artifact of the feature, weighing in at 261.1 grams on its own. While the placement of the rock inside the shell may be intentional, it is unknown what exactly it means, though it was found in association with other shell and faunal remains that were collected in the same field specimen bag.

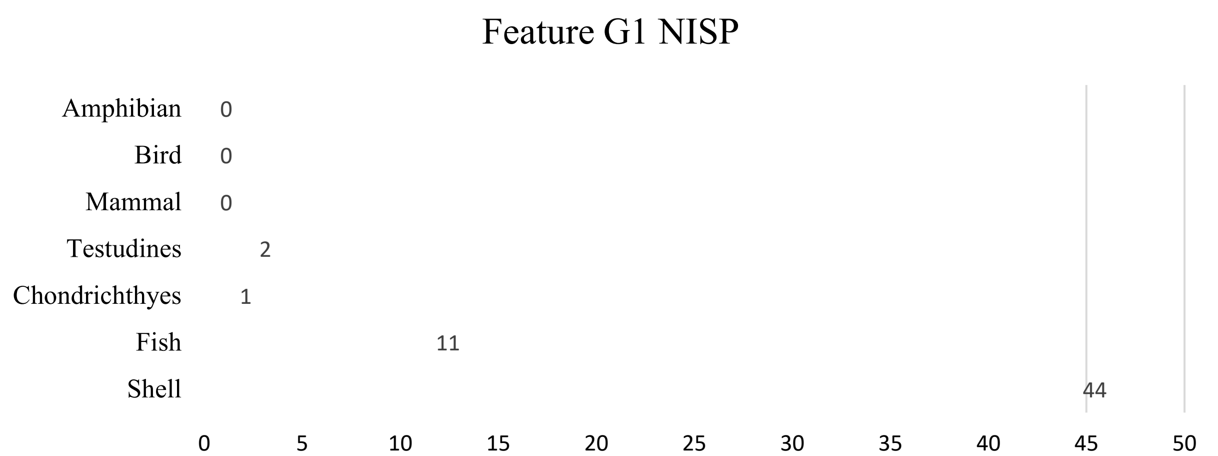


Figure 26: Feature G1 Number of Identified Specimens (NISP)

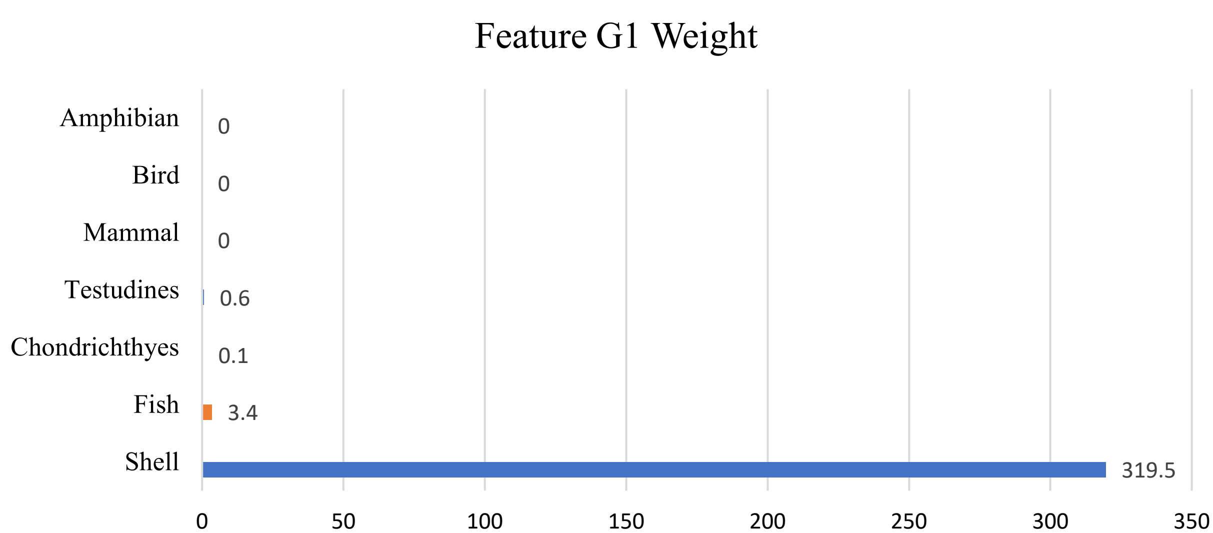


Figure 27: Feature G1 Weight of Each Taxa

Feature G2

Feature G2, a series of shell clusters, has by far the most fragments recovered all of three features excavated, where 80% of all feature remains come from this feature. In the field, feature G2 was found in association with the hearth feature G2-A, so it is likely that this is one of a few areas where food processing and cooking activities were repeatedly taking place at the Penny Plot site.

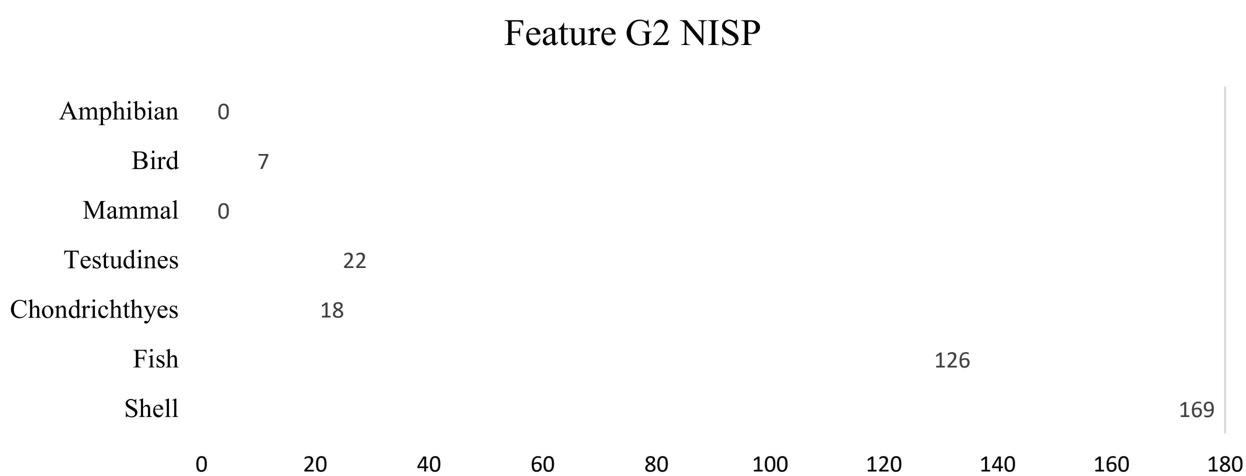


Figure 28: Feature G2 Number of Identified Specimens (NISP)

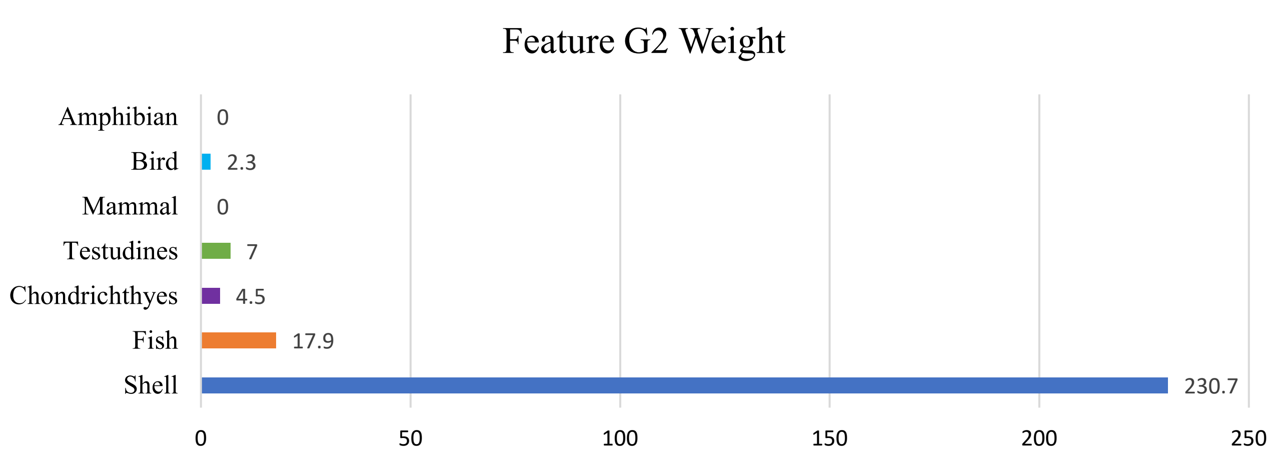


Figure 29: Feature G2 Weight of Each Taxa

Feature G2-A

Lastly, Feature G2-A is interesting because not only it is a standard hearth with dark and ashy soil, but it contains three fragments of shark remains, all belonging to the genus Carcharhinus, also known as Gray or Requiem sharks. The reason for this may be an external factor such as a disturbance or excavation error, but this feature is located quite deep. Therefore, this feature may have once been the site of the remains of one or a few entire shark meals that were cooked on the hearth.

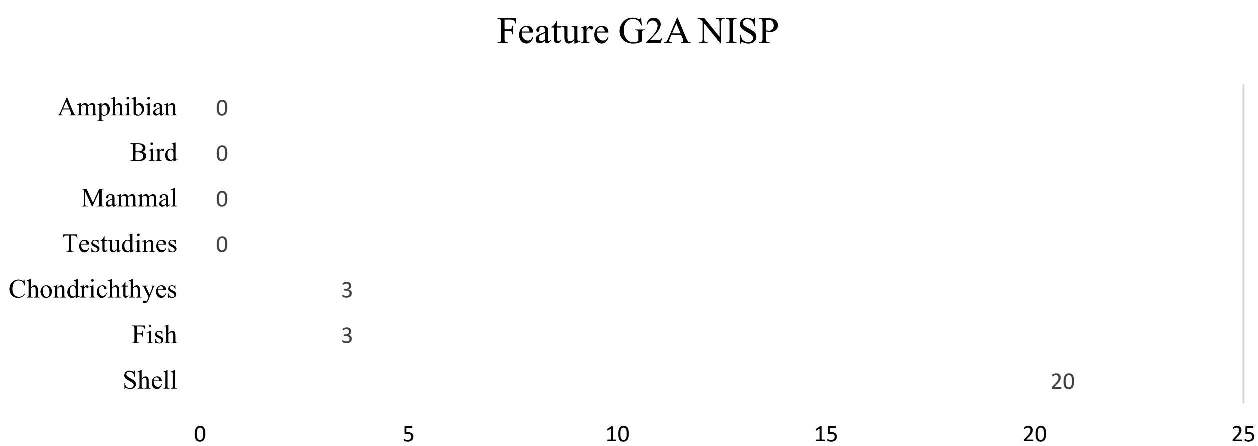


Figure 30: Feature G2-A Number of Identified Specimens (NISP)

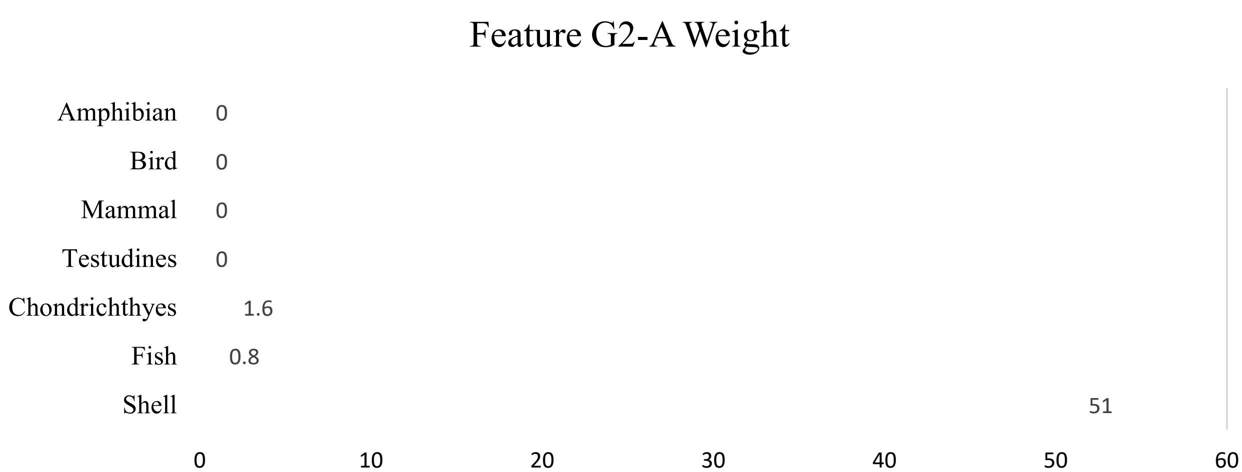


Figure 31: Feature G2-A Weight of Each Taxa

Part II: Species Abundance/Ecological Niche Exploitation

More details can be discovered when considering the individual species of each of the general taxa described above. For instance, it is evident that a majority of the aquatic species exploited are environmental generalists and live in a variety of aquatic habitats, most commonly in brackish lagoons and in the shallow littoral and neritic zones of the ocean (Froese and Pauly 2023; Gilmore et al. 1981; Indian River Lagoon Species Inventory 2023b-e, 2023i-l; Palomares and Pauly 2023). These species were generally exploited from the beginning to the end of indigenous occupation in this area, and it evidently worked well because there are not sudden drops in resources throughout the occupation. Thus, deep-water fishing was probably not common in this area, as opposed to what is reported by Russo (1986:40-41, 48-49) at Gauthier. This is not surprising, given the ecological and resulting biological diversity of the Indian River Lagoon system that the Penny Plot site is located in; even today, shore fishing is a common recreational activity practiced at places in the lagoon. Especially for shellfish, it would not be terribly difficult to procure this food item from the intertidal zone of the sea.

Invertebrates

Of the invertebrates, two species in particular dominate the entire assemblage, namely, *Melongena corona* (the Florida Crown Conch) and *Mercenaria campechiensis* (the Southern Quahog). *M. campechiensis* was the most abundant shell, representing more than half of the total identified invertebrate species (approximately 52%). In total, 599 fragments of *M. campechiensis* were recovered from Test Unit G, weighing 1,875.8 grams, approximately two kilograms. *M. corona* follows, representing approximately 28% of the total invertebrate NISP. These two invertebrates may have been collected separately and processed in the same area, but it is likely that they were collected together, both preferring to inhabit the shallow intertidal zone of the ocean and found throughout the Indian River Lagoon (Indian River Lagoon Species Inventory 2023d, 2023i). *M. corona* is also found in association with *Crassostrea virginica* (the Eastern Oyster) in oyster reefs and consumes this animal as a part of its diet (Indian River Lagoon Species Inventory 2023e; Rosenberg 2009). However, *C. virginica* does not make up a significant portion of the remains recovered, only representing 2% of the total invertebrate fragments identified.

Additionally, *M. corona* consumes also *Busycon* spp. (whelks), which can also be found in the Indian River Lagoon (Indian River Lagoon Species Inventory 2023j). As aforementioned, one whole specimen of *Busycon carica* (the Knobbed Whelk) was recovered from feature G1. This specific specimen was also modified into a hammer-like tool. While there were few specimens of *B. carica* recovered in total, this animal, in comparison to the other invertebrates found, was quite large and contained lots of meat to consume. In level 3, only three fragments together weighed 45.2 grams. While not exceptionally common in the Indian River Lagoon, *B. carica* can be found in shallow habitats, such as estuaries, intertidal flats, and creeks; it is also found near other bivalves such as oysters, scallops, and clams as these make up its carnivorous diet (Ferner and Weissberg 2005; Indian River Lagoon Species Inventory 2023k).

Other notable invertebrates collected include *Anadara brasiliana* (the Incongruous Ark Clam) and *Donax variabilis* (Coquina). *A. brasiliana* can be found in the deeper parts of the ocean, in the demersal zone near the ocean floor (Turgeon et al. 1998). Its location in deeper waters may be part of the reason that there are not as many recovered as those bivalves found in shallower waters, like *M. campechiensis*. Lastly, *D. variabilis* does make up a decent portion of the NISP of identified invertebrate species, about 8%, but it is a very small and light shell. Given its ubiquity at the site, many of these shells were not collected. *D. variabilis* is found in a variety of marine environments, occupying as shallow as the intertidal zone all the way down to 11 meters deep in the ocean (Rosenberg 2009). Jones et al. (2004:707) cite Ruppert and Fox (1988) in reporting "a seasonal cycle of migration across the beach zone, down into the shallow sub littoral in fall, and returning onto the beach as juveniles in the late winter." In either season, they would probably be fairly easy to catch using fishing nets, but the sheer amount of them present at the Penny Plot site as a whole may suggest that these species were caught on a seasonal basis (i.e., in late winter to fall), which in turn may indicate a seasonal occupation of the site.

A majority of the collected invertebrates are naturally found in shallow environments in marine and brackish habitats, allowing for the easy harvesting of more than one species at a time. Additionally, there are not any profound drops in any heavily relied on species. There is a reduction in the overall *M. campechiensis* fragments recovered from the site from levels 6 to 4 by 55%, though it may not be a result of purely human subsistence factors. Ecological impacts such as hurricanes or tornadoes (which destroy the coastline and induce flooding) may have impacted the availability of this species and other invertebrate species represented on the graph, as there is an overall small reduction in total invertebrates collected apparent in level 4. In level 3, there is an increase from level 4 of the amount of invertebrate species collected, which may indicate the recovery of these species following a devastating natural disaster as well as a resilience on behalf of the Indigenous people aiding this recovery via management strategies. The overall number of invertebrate species collected dramatically increases over time, where the mere 11 fragments combined found from levels 7 and 8 increases by a factor of a 40 to reach approximately 400 fragments found in level 3.

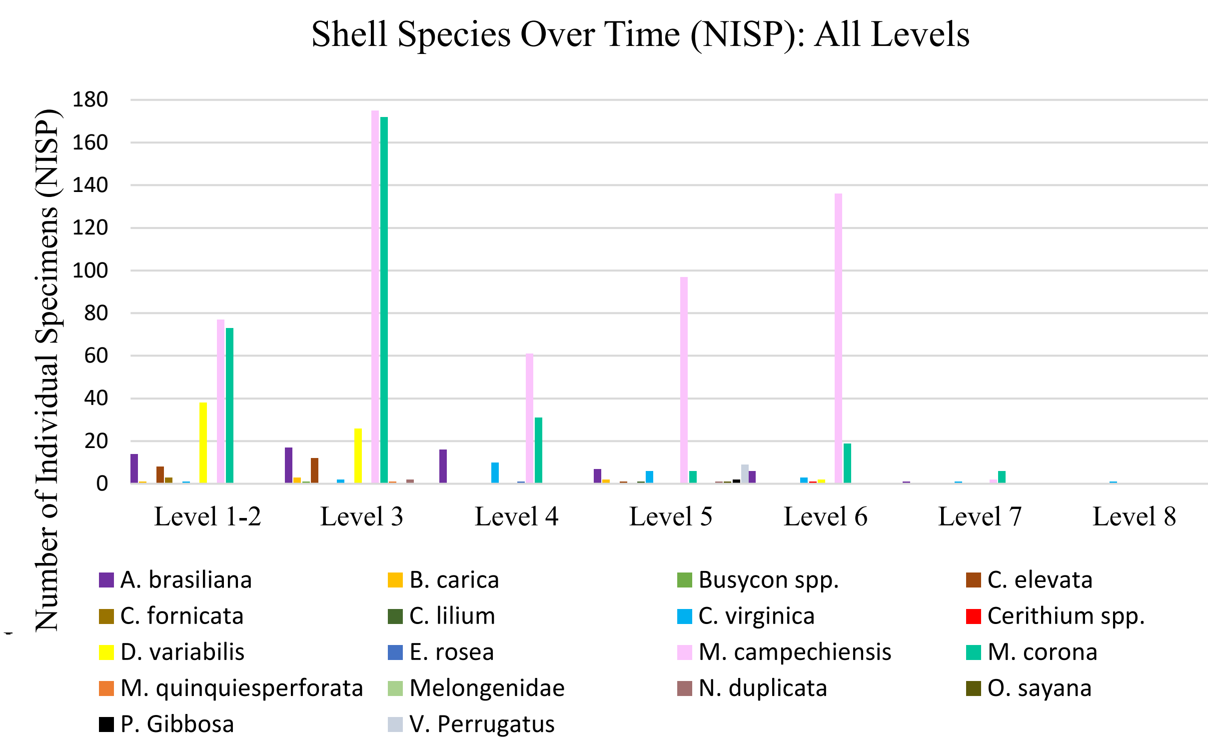


Figure 32: Number of Identified Specimens (NISP) of Invertebrate Species from Unit Levels

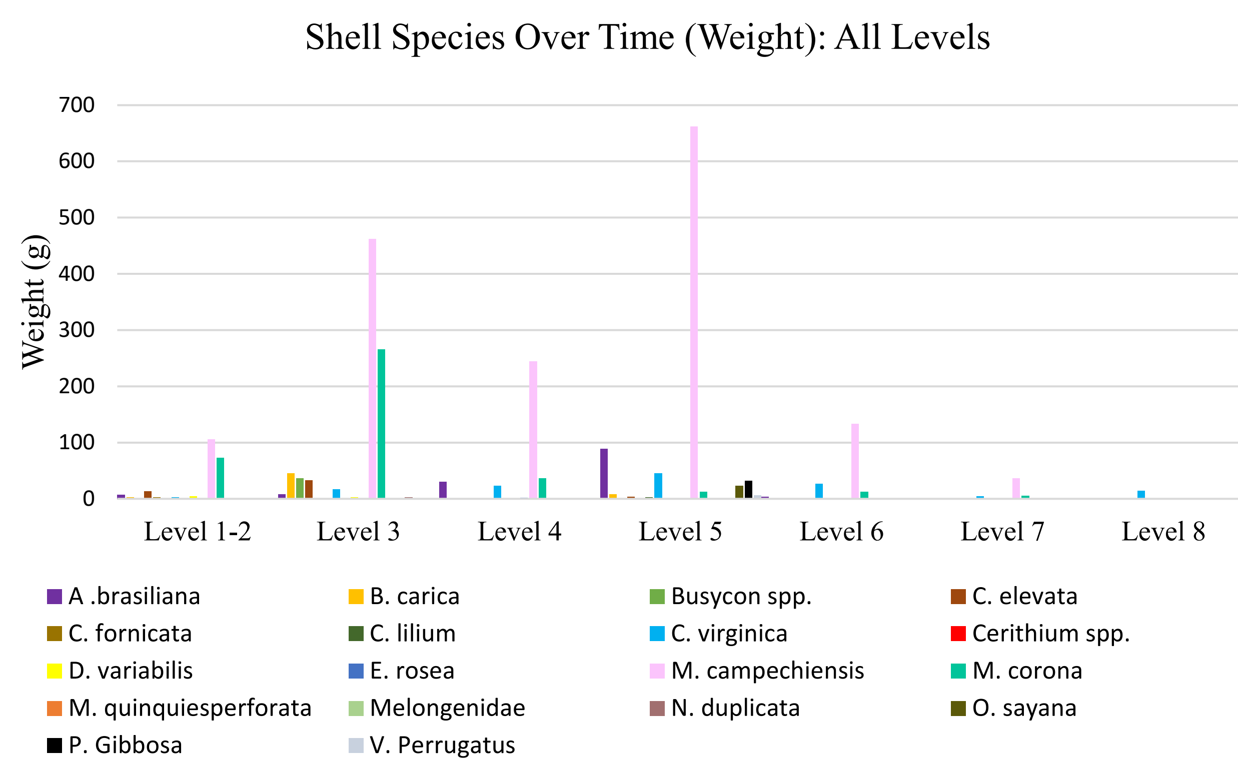


Figure 33: Weight of Each Invertebrate Species from Unit Levels

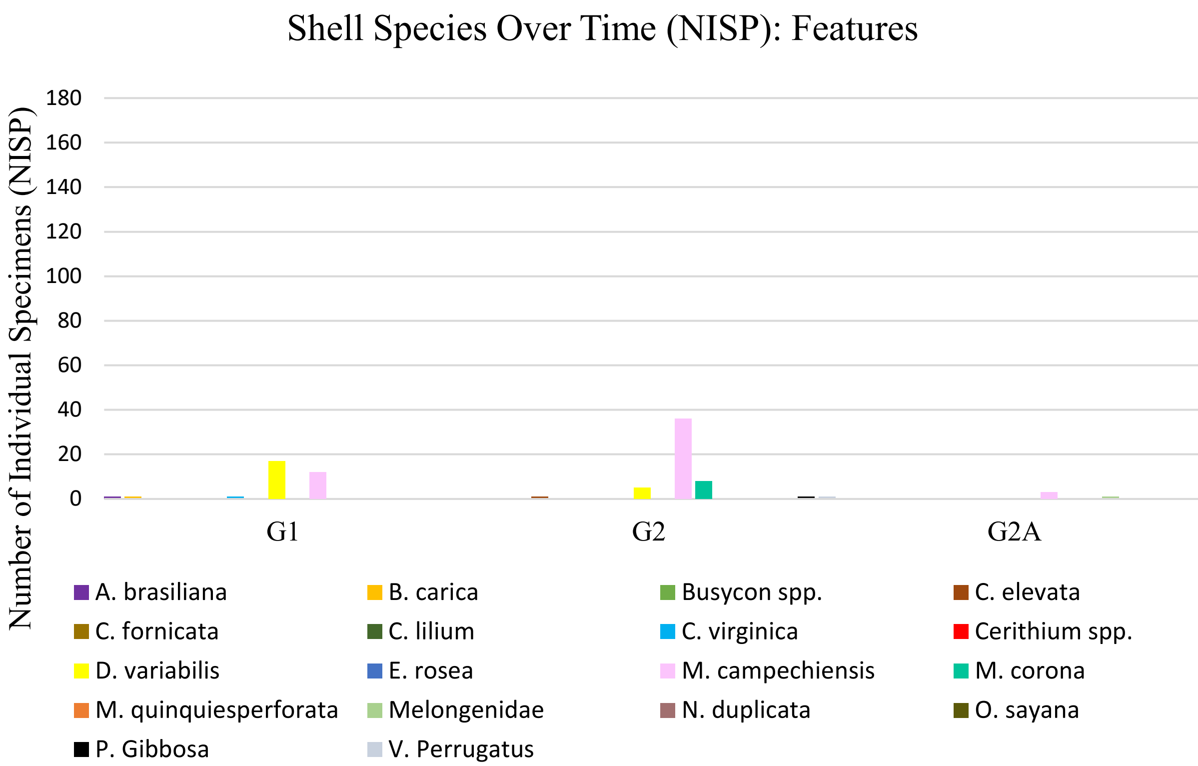


Figure 34: Number of Identified Specimens (NISP) of Invertebrate Species from Features

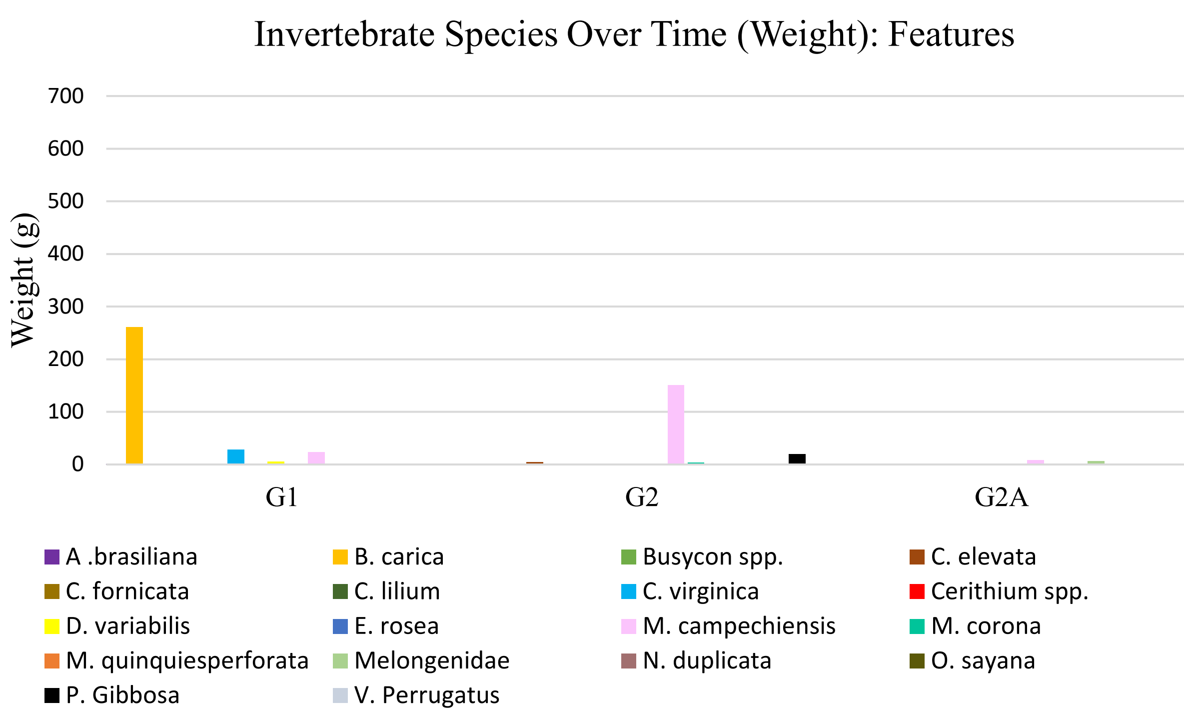


Figure 35: Weight of Each Invertebrate Species from Features

Bony Fish

Ariidae, fishes belonging to the marine catfish family, were the most heavily consumed of all the bony fish species. 145 out of 475, nearly a third, of the bony fish fragments recovered from Test Unit G belonged to this family, mainly represented by their otoliths. This family also represents 40% of the weight. Because of the fragmentary and dirt encrusted nature of the otoliths, it was impossible to further identify many of them past the family level. This number becomes even higher when adding the marine catfish species that could be identified beyond the family level (i.e., by distinct spinal bones and cranial bones) into either *Ariopsis felis* (Hardhead catfish) and *Bagre marinus* (Gafftopsail catfish). When all of the recovered remains of fishes belonging to the *Ariidae* family are combined, over half of the assemblage becomes represented by them. Approximately 53% of all fish fragments collected belong to this family.

Marine catfish are found in marine and brackish water environments on relatively shallow to deeper muddy bottoms; *A. felis* can also be found in reefs and in freshwater ponds and lakes (Gilmore et al. 1981:Table 1; Yáñez-Arancibia and Lara-Dominguez 1988). Both species are also found in mangroves, grass flats, and canal and river mouths (Gilmore et al. 1981:Table 1). These fish are common throughout the Indian River Lagoon system, but it is important to note that both species prefer warmer waters, migrating offshore into deeper waters during the winter months (Indian River Species Lagoon Inventory 2023b, 2023l). The fact that there is such an abundance of *Ariidae* fish fragments collected may indicate that the inhabitants at this site only came in the warmer months to harvest, but this does not exclude the possibility that they were in this area all year round and either did not catch these fish during the winter or fished in deeper waters to catch them during the winter.

Behind *Ariidae*, the most abundant fishes collected from the site belong to the *Sciaenidae* (Drum/Croaker family) and *Diodontidae* (Porcupinefish/Burrfish) families. Of the *Sciaenidae* family, most fragments were identified beyond the family level. Species identified include *Cynoscion spp*. (Seatrout/Weakfish), *Pogonias cromis* (Black Drumfish), *Micropogonias undulatus* (Atlantic Croaker), and *Sciaenops ocellatus* (Red Drumfish). The *Sciaenidae* family as a whole makes up roughly a fourth of the total bony fish NISP and 44% of the weight owing to their slightly heavier nature over *Ariidae* family fishes. Fishes from the *Sciaenidae* family are found in a large variety of aquatic environments, including shallow marine neritic and deeper marine benthic zones, estuaries, lagoons, mangroves, grass flats, canal and river mouths, and even salt marshes in the case of *S. ocellatus* (Gilmore et al. 1981:Table 1; Indian River Lagoon Species Inventory 2023c; Robins and Ray 1986). Their ability to tolerate a large range of environments probably accounts for the large amount of their remains recovered from the Penny Plot site, as the inhabitants probably utilized a number of different places to harvest these fish.

Fishes from the family *Diodontidae* were not able to be identified beyond the family level owing to the small and fragmentary nature of the remains, most of which being their preserved mouth plates. These fish are found throughout brackish and marine environments in the Indian River Lagoon system, including in inlets, grass flats, open sand bottoms, lagoon reefs, offshore reefs, and canal and river mouths (Gilmore et al. 1981:Table 1). Some fishes in this family are edible but are highly poisonous and difficult to properly prepare (FishBase 2023a, Seattle Aquarium 2023). Many fishes in the family *Tetraodontidae*, better known as Pufferfish, are also poisonous (FishBase 2023b). This family is represented in the assemblage collected from the Penny Plot site by the genus *Sphoeroides* and by the specific species *Sphoeroides maculatus* (the Northern Puffer). *Sphoeroides spp.* and *S. maculatus* are also found in a variety of marine and brackish habitats, including estuaries, lagoons, offshore reefs, inlets, and in the shallow neritic zone of the ocean (Gilmore et al. 1981:Table 1; Fish Base). However, *S. maculatus* is non-toxic and generally safe to eat (FishBase 2023c; North Carolina Department of Environmental Quality 2023). The presence of both *Diodontidae* and *Tetraodontidae* remains suggests that fishes in this family were certainly used by indigenous people in this area, but it is impossible to tell, disregarding *S. maculatus*, if they were species that could be safely consumed or were toxic. Some species in the *Diodontidae* family that are found in Florida, such as *Chilomycterus schoepfii* (the Striped Burrfish), are generally edible (but not very calorie dense), although most others are not (Fish Base 2023a, 2023d; Maryland Department of Natural Resources 2023). In the case that some or most of those used by the indigenous people were toxic, they were likely harvested for purposes other than consumption, perhaps for tipping arrows or other weapons with poison, or even for medicinal purposes like painkilling, as reported by Orsolini et al. (2018:5).

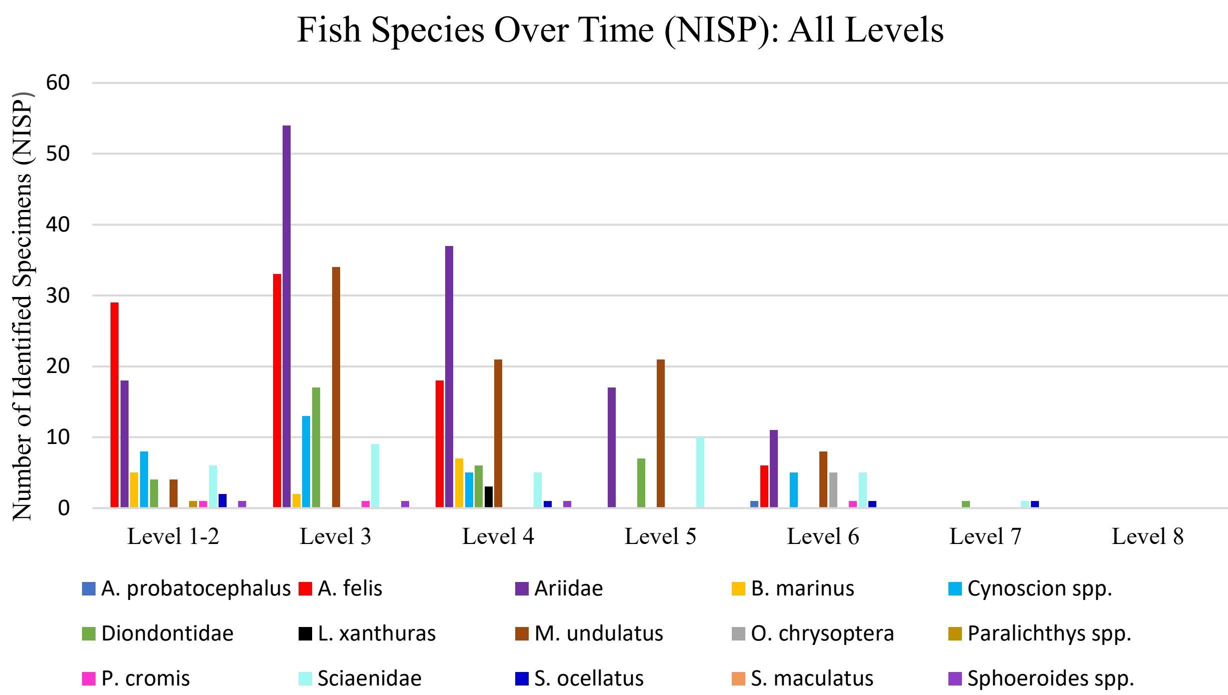


Figure 36: Number of Identified Specimens (NISP) of Fish Species from Unit Levels

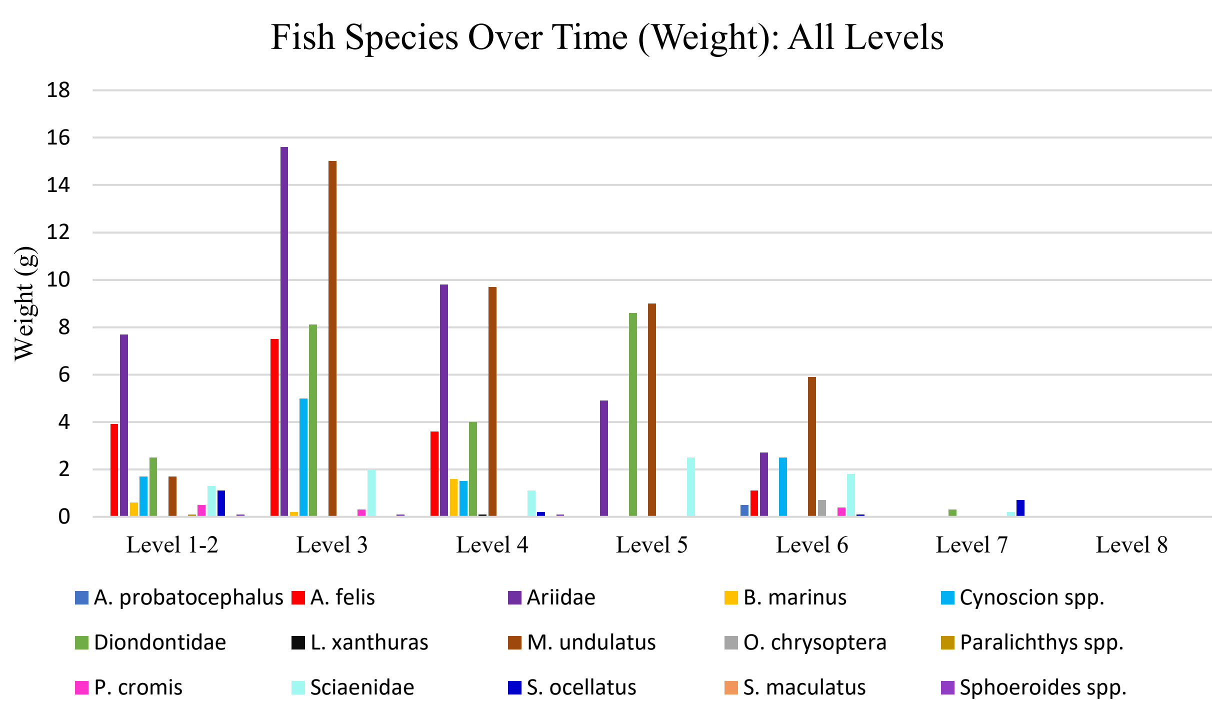


Figure 37: Weight of Each Fish Species from Unit Levels

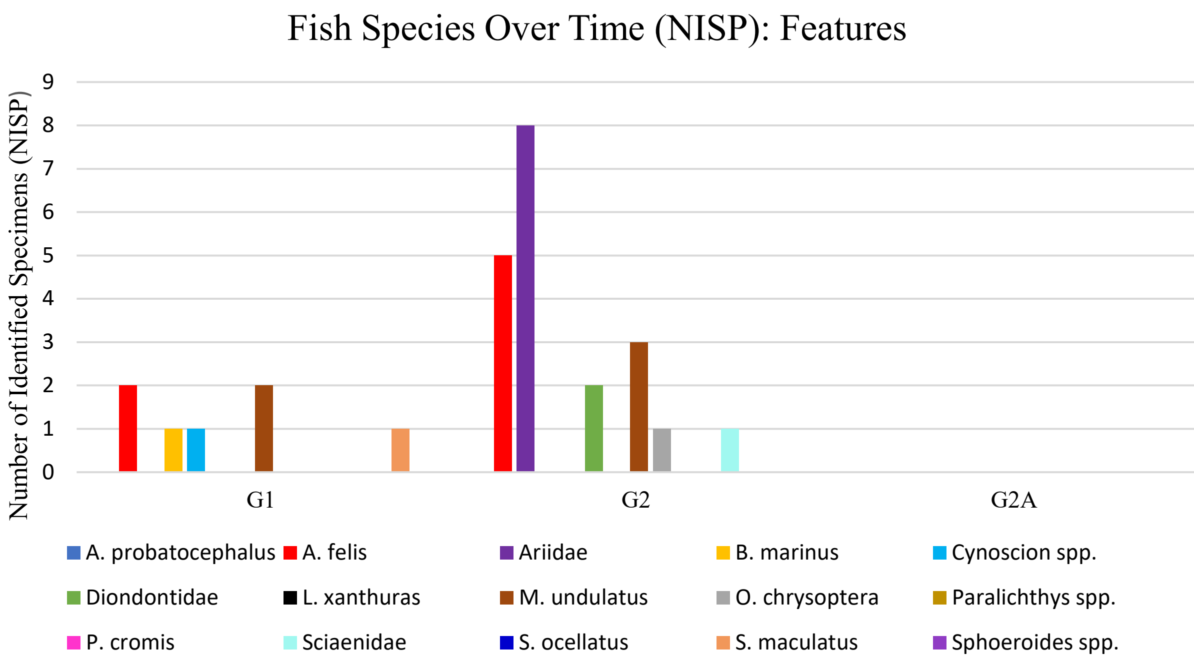


Figure 38: Number of Identified Specimens (NISP) of Fish Species from Features

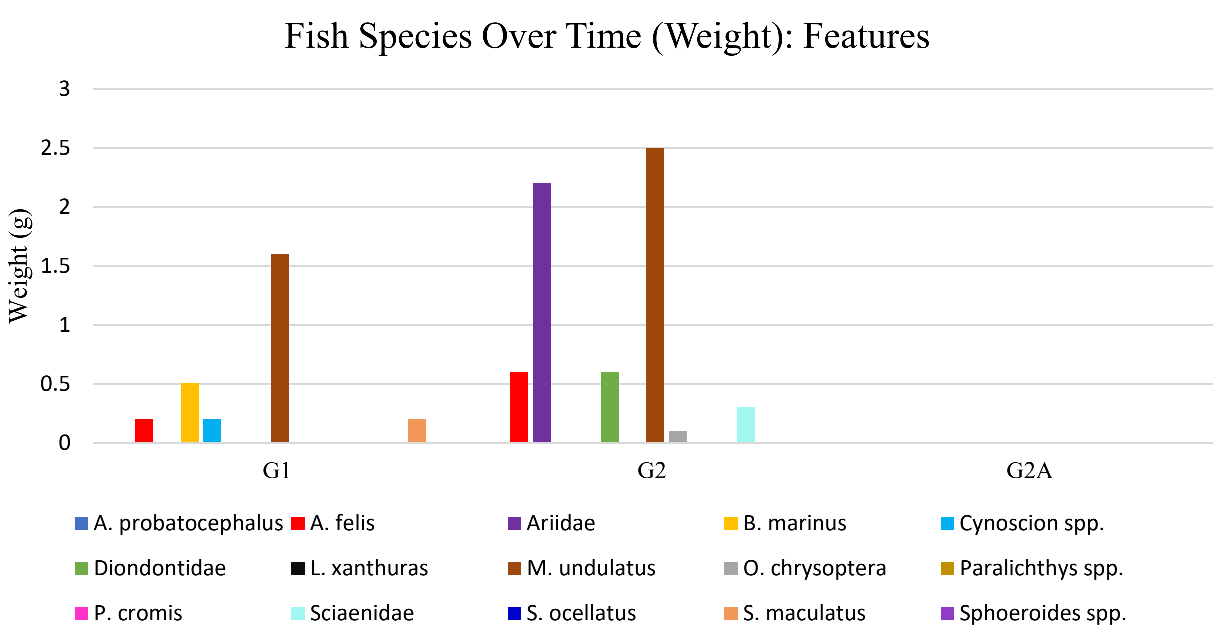


Figure 39: Weight of Each Fish Species from Features

Chondrichthyes

There were no chondrichthyes remains found in either levels 7 or 8, and only one *Carcharhinus spp.* vertebrae was found in any of the features (feature G2). The species *Rhizoprionodon terraenovae* (the Atlantic Sharpnose shark) clearly dominates the identified chondrichthyes, making up about 90% of the NISP for chondrichthyes 91% of the weight. It is most numerous in levels 3, 4 and 6. *R. terraenovae* can be found in the shallow neritic zone of the ocean down to the demersal zone, about 280 meters deep and frequently inhabitants lagoons, estuaries, and river mouths (Gilmore et al. 1981:Table 1; Smith 1997). Today, *R. terraenovae* is still consumed and is a healthy and sustainable seafood choice (National Oceanic and Atmospheric Administration Fisheries 2023).

All of the chondrichthyes species/genera found in the entire assemblage belong to the *Carcharhiniformes* (Ground Sharks) order. Besides *Galeocerdo cuvier* (the Tiger shark), who belongs to the *Galeocerdonidae* (Tiger sharks) family, sharks from the family *Carcharhinidae* (Requiem sharks) are the only other shark species observed in the assemblage. Species collected from this family include *Carcharhinus plumbeus* (the Sandbar shark), *Carcharhinus leucas* (the Bull shark), and *Negaprion brevirostris* (the Lemon shark). These sharks also frequently inhabit shallow waters and a number of brackish and fresh waters, including estuaries, lagoons, mangroves, reefs, canals, and rivers (Compagno 1984, Gilmore et al. 1981:Table 1; Lieske and Myers 1994). Requiem sharks are also a bit larger than *R. terraenovae* and thus pose a more significant threat of harm during the catching process, especially *C. leucas*, which has been reported multiple times to attack humans (Eccles 1992). *G. cuvier* is also quite large; one caught in 1991 weighed an astounding 808 kilograms, setting a world record, and it is also known to attack humans (Compagno 1984; International Game Fish Association 1991). *G. cuvier*, like the Requiem sharks, prefers to inhabit shallower waters in the ocean and is frequently found in estuaries, lagoons, and rivers (Gilmore et al. 1981: Table 1; Smith 1997).

Given the relatively small amount of *Chondrichthyes* fragments recovered from the total faunal remains assemblage (7% of the NISP and 3% of the weight), catching sharks was probably a dangerous yet incredibly rewarding endeavor. The smallest and most abundant shark species observed in the assemblage was *R. terraenovae*, which likely posed less of a significant threat of bodily harm than the larger Requiem sharks and Tiger shark. Requiem sharks may have been caught for ceremonial feasts, as one shark could feed many people. Shark catching may have also been an important cultural tradition, a tradition seen in many indigenous communities in the past and today, such as in the shark offering rituals and rites of passage of precontact indigenous people in Peru (Powell 2020) and the shark-calling rituals of people today in New Ireland, Papua New Guinea (Messner 1990).

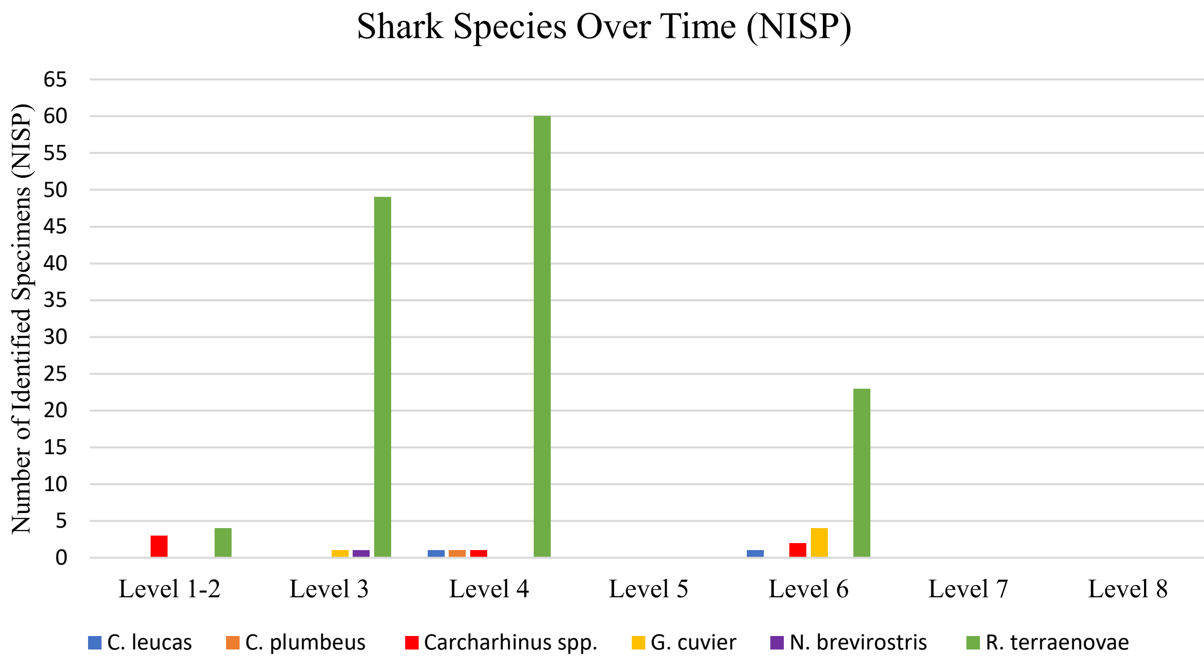


Figure 40: Number of Identified Specimens (NISP) of Shark Species from Unit Levels

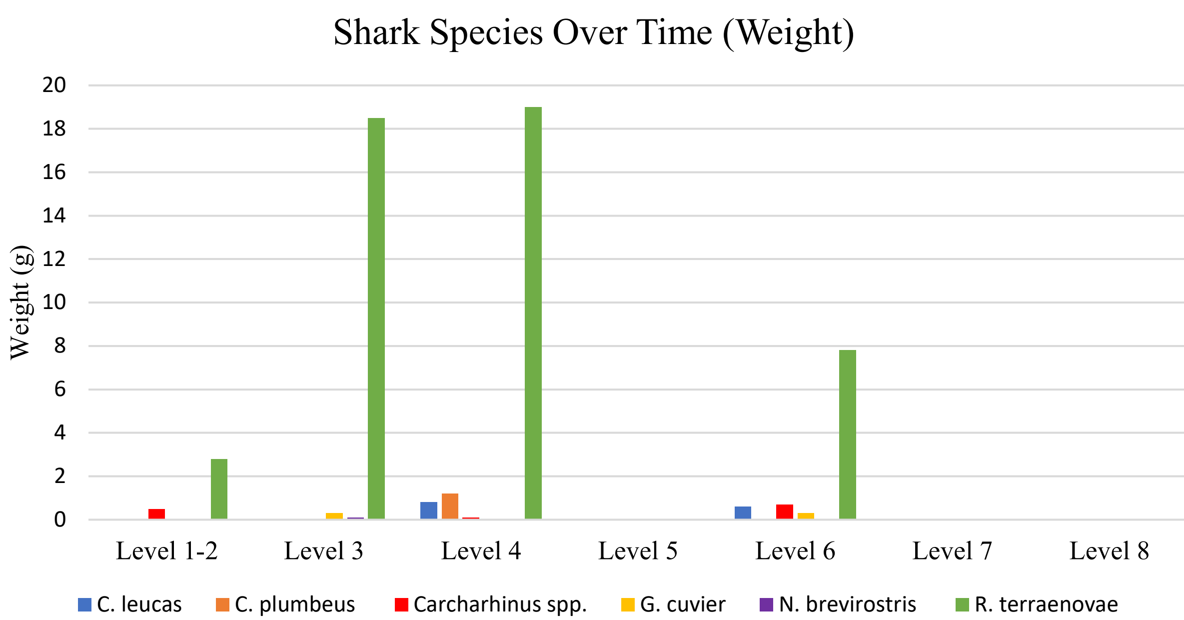


Figure 41: Weight of Each Shark Species from Unit Levels

CHAPTER 4. DISCUSSION

Species Exploited for Consumption

Table 2 below shows the species that were probably primarily used for consumption, and thus included in the discussion and figures below.

Table 2: Species Consumed at the Penny Plot Site

Species Name	**Common Name**
Anadara brasiliana	Incongruous Ark Clam
Anatidae	Ducks
Archosargus Probatocephalus	Sheepshead
Ariidae	Marine Catfishes
Ariopsis felis	Hardhead Catfish
Bagre marinus	Gafftopsail Catfish
Busycon carica.	Knobbed Whelk
Busycon spp.	Whelks
Carcharhinus leucas	Bull Shark
Carcharhinus plumbeus	Sandbar Shark
Carcharhinus spp.	Requiem Sharks
Chione elevata	Cross-Barred Venus Clam
Crassostrea virginica	Eastern Oyster
Cynoscion spp.	Weakfish, Seatrout
*Diodontidae**	Porcupinefish, Burrfish

Donax variabilis	Coquina, Variable Coquina
Galeocerdo cuvier	Tiger Shark
Leiostomus xanthurus	Spot Croaker
Mercenaria campechiensis	Southern Quahog
Melongena Corona	Florida Crown Conch
Melongenidae	Crown Conchs
Micropogonias undulatus	Atlantic Croaker
Negaprion brevirostris	Lemon Shark
Orthopristis chrysoptera	Pigfish
Paralichthys spp.	Flounder
Pogonias cromis	Black Drumfish
Rhizoprionodon terraenovae	Atlantic Sharpnose Shark
Sciaenidae	Drum & Croaker Family Fishes
Sciaenops ocellatus	Red Drumfish
Sphoeroides maculatus	Northern Puffer
*Sphoeroides spp.**	Pufferfish
Vokesinotus perrugatus	Gulf Oyster Drill

*Because further speciation was not attainable, it is impossible to tell if the species caught were safe to eat or toxic.

The graphs below show the ultimate diet change over time via the identified fragments of each taxa. Not included in these graphs are unidentified remains, 3 fragments of amphibian remains, a skull of a *Sorex longirostris* specimen (Southeastern Shrew), a partial femur from the family *Accipitridae* (Hawks, Eagles, Buzzards, and Kites), a partial tarsometatarsus from the order *Strigiformes* (Owls), and one tooth from *Didelphis virginiana* (Virginia Opossum). These fragments probably came from intrusive animals who may have dug into the test unit area before excavation or were otherwise present but not eaten. Other small invertebrate species, including *Cerithium spp*. (Cerith Snail), *Cinctura lilium* (Banded Tulip Snail), *Euglandina Rosea* (Rosy Wolfsnail) *Mellita quinquiesperforata* (Sand Dollar), and *Oliva sayana* (Olive snail), and *Plicatula Gibbosa* (Atlantic Kitten's Paw) that only represented a few fragments in the assemblage are also not included because they are likely intrusive or may have been accidentally caught during harvesting, used for jewelry, etc. This is not to say that the more common shells, such as *Mercenaria campechiensis*, were used for consumption exclusively; these also can be used in building construction and other miscellaneous tasks after the meat is removed and eaten, such as serving as tools.

As seen by the graphs below, there is a general trend of increasing faunal remains left behind as time goes on, which may be indicative of increasing population size as more people needed to be fed. What is also important to note is that, when viewed by strata instead of level, the majority of the identified remains, in total 98% of the NISP and 99% of the weight, falls within stratum 1, constituting levels 1-7, defined as the black earth midden shown in figures 5-9. This suggests that there may have been a break in occupation from level 8 to levels 1-7. However, there is a slight reduction in remains recovered at levels 1-2, where the total number of fragments found, excluding features, drops from 2,701 in level 3 to 975 to levels 1-2. As aforementioned, this could have been caused by surface disturbances, homesteader activities, etc., or this could really be indicative of a decrease in population and thus of food consumed and remains discarded.

Shellfish dominates here, accounting for about 35% of all the identified fragments and 75% of the entire weight of the total assemblage. At the other end of the spectrum, bird, mammal, and amphibian remains had the lowest abundance of the entire assemblage. Birds constitute approximately 2% of the total NISP and 0.8% of the weight (owing to the light, hollow nature of their bones). While a majority of the bird bones were too small to further identify, the most common positively identified was duck, representing approximately 47% of the identified bird NISP and 55% of the weight of the bird assemblage. Mammal remains primarily came from *Odocoileus virginianus* (White-Tailed Deer), with one fragment from *Delphinidae* (Oceanic dolphins). Deer bones represent only 1% of the NISP and weight of the entire assemblage, though other deer remains were found in other test units at the Penny Plot site. It is likely that the 18 fragments recovered represent parts of a few whole deer. Deer are large animals that could provide ample amounts of meat for multiple people; in this context, it was probably a relatively rare treat perhaps eaten on special occasions at ceremonial feasts. The small dolphin fragment recovered may have been misidentified or indicative of little amounts of dolphin being caught and brought back to the site. Reasons for this are unknown, though dolphin meat may have been taboo for the indigenous culture. Species in the *Delphinidae* family inhabit a variety of aquatic habitats (Smith 2023), and they can often be spotted directly in the Banana River near the site.

Lastly, testudines (turtles) make up approximately 11% of the total faunal assemblage NISP and 10% of the weight. The extremely fragmented state of the remains made it impossible to identify beyond just the order testudines. At the nearby Burns site, *Gopherus polyphemus* (the Gopher tortoise) is the most abundant species from the order testudines found in the assemblage from all test units, followed by *Terrapene carolina* (the Eastern Box turtle), both terrestrial species (McAfoos et al. 2021:6). Considering the data from the Burns site, it is likely that many of the turtle fragments recovered from the Penny Plot site were from terrestrial turtles instead of aquatic ones.

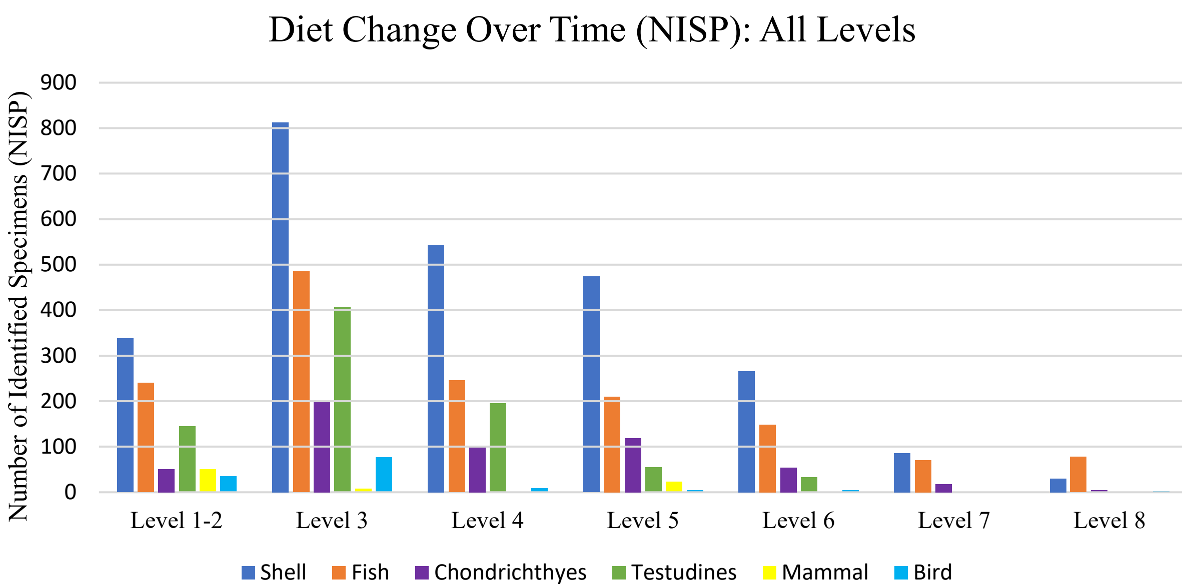


Figure 42: Number of Identified Specimens for All Unit Levels

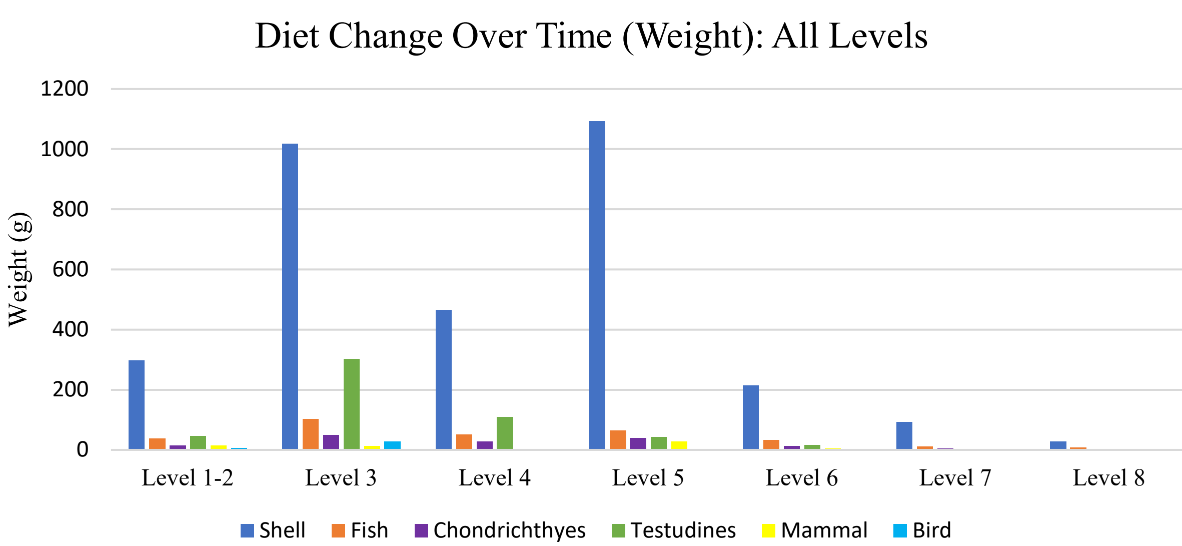


Figure 43: Weight of Each Taxa for All Unit Levels

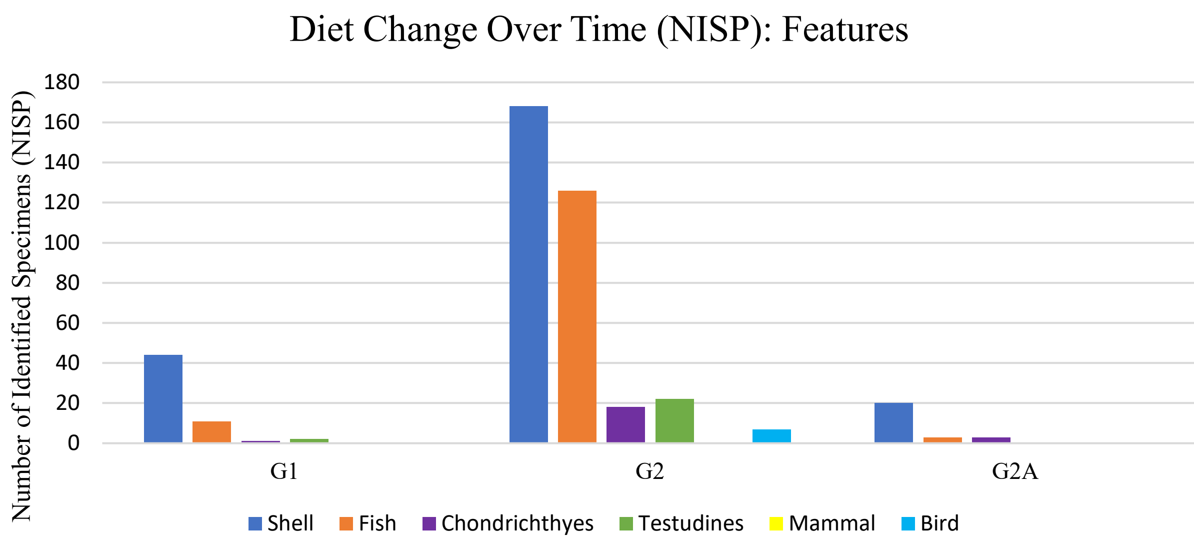


Figure 44: Number of Identified Specimens for All Unit Features

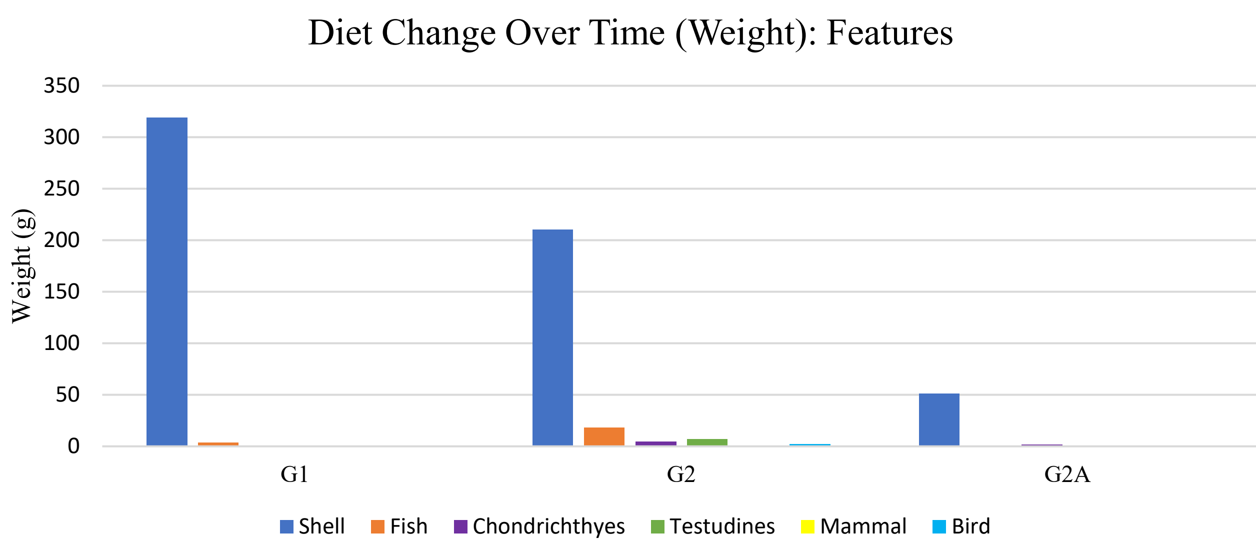


Figure 45: Weight of Each Taxa for All Unit Features

Change Over Time

Accelerator Mass Spectrometry (AMS) dating of charcoal found in test units A, B, and D at the Penny Plot site has revealed a Malabar II occupation of levels 4-8 at the Penny Plot site, beginning about 1,000 C.E. (Sarah Barber, personal communication). Most of the pottery finds from levels 1-8 of test unit G are of the St. John's check-stamped variety, which would indicate that the specific midden was constructed over the Malabar II period; however, it is possible that it may have been used later on into the colonial period (Penders 2017a:Table 5; Emily Tyler, personal communication 2023; Winklepleck et al. 2022). Thus, it is likely that the midden area of test unit G (Stratum 1) was constructed over a period of only a few hundred years.

In terms of actual change between levels, it would seem that there really is not a significant drop in any one resource as time went on. In fact, almost all of the major taxa described generally increase from one level to the next, culminating in level 3. Mammals are the only group that experience a decrease from levels 5 to 3, but they increase again in levels 1-2. As aforementioned, this may be the result of the deposition of a whole deer specimen after feasting into the midden, so it is unlikely that all of the fragments represent as many different individuals.

Given the information presented here and in the level-by-level breakdown, it is evident that the indigenous people who occupied the site were able to avoid significant resource depression, similar to the groups who occupied sites along the Southeastern Atlantic coast (e.g., Loubser at al. 2005; Reeder-Myers et al. 2022; Reitz 2014; Smith et al. 2007; Thompson and Turck 2009; Thomspon et al. 2020). It should also be noted, however, that the Penny Plot site's exact function or functions are unknown. There are quite a few tools found at the site, including *B. carica* hammers and adzes, stone tools, and bone points, but there are little remains of any structural foundations and no large shell mounds. Elsewhere, I have argued that the site was occupied on a seasonal basis, following analyses at other Floridian sites by Fradkin (2015), Harke (2015), and Sigler-Eisenberg and Russo (1986) at sites in the lower St. John's River, St. Joseph's Bay, and Wabasso Beach, respectively (Shenkman 2022). In test unit G, there is a phenomenon of hearths occurring on top of hearths in the stratigraphy, indicating that the inhabitants kept coming back time and again instead of using the same hearths for a long period of time. Concerning the relative lack of structural remains at the site, Seymour (2009:256) cites Binford (1990:121-122) as stating that, "all else being equal, there is a very general inverse relationship between mobility and investment in housing." Seymour (2009:257) also writes how multiple mobile hunter-gatherer groups in the American Southwest have "unobtrusive" housing and scant archaeological footprints, phenomenon similar to what is seen with the Ais. One post mold at the Penny Plot site retrieved a Malabar I date, but it is possible that this structure could have been temporary or an ad hoc structure created for food processing or protection from the weather, and thus not indicative of a residence. Therefore, the subsistence patterns seen here may be the result of the site's possible function as a special-use area.

Measuring the size of the remains and determining season of catch was beyond the scope of this project, so possible seasons of occupation could not be determined for the site. However, ethnographic accounts of 17th century European travelers Jonathan Dickinson and Alvaro Mexia show contrasting evidence that post-contact Ais Indigenous peoples traveled to the coast in late September through November, as reported by Dickinson, or winter and summer, as reported by Mexia (Sigler-Eisenberg and Russo 1986:28-29). Sigler-Eisenburg and Russo (1986) argue that the Zaremba site at Wabasso Beach (defined within the Ais settlement area) seemed to have been occupied solely during the spring and summer months and used as a processing site, evidenced by the measurement of coquina shells. They note that, though a traditionally "small site," the Zaremba site offers "unique glimpses of specialized production activities that contribute to an understanding of the ecological variables to which prehistoric peoples adjusted, the dynamics of group dispersal, and the social relations of production" (Sigler-Eisenberg and Russo 1986:21). Thus, even if the Penny Plot site was once the location of something as simple as food processing, one can see how the society changed over time just by examining the faunal remains left behind.

An additional study of seasonality from Indian River Lagoon sites was completed by Virginia Lucas (2015), who analyzed faunal remains from the Hunter's Camp and Palm Hammock sites within the Fox Lake Sanctuary in Titusville, Florida. Identification of bird species such as the pied belle grebe, the canvasback duck, the mallard duck, the blue-winged teal, the green-winged teal, and the redhead at the two sites, all of which species occupy Florida during the winter months, reveal that these sites were likely occupied during the winter (Lucas 2015:59-60). Further, an additional distinct summer occupation can be assumed through the identification of alligator and gopher tortoise remains at both sites, where both the alligator and gopher tortoise are known to escape the cold and become dormant in the winter by excavating holes, burrows, and caves to lie in (Lucas 2015:61). Lucas (2015:83-84) also noted that he Hunter's Camp site was identified to be a residential area, while the Palm Hammock site was identified to be a food processing area, and that these sites were likely related to each other and used by the same groups, based on chi-square calculations. The reasons why the inhabitants of this area migrated seasonally to these sites remain unknown. I speculate that the same reasons for coastal migrations away from inland areas during September to November, as observed by

Dickinson, were possibly at play farther back in time and can be seen at these sites, especially since these sites were occupied during the Malabar I and II periods.

Ultimately, the Penny Plot site may have been a processing site away from the main residential area further inland, or it may have been the site of a very small village near the coast that served as a seasonal camp. Whatever the case, it is evident that the people who came there enjoyed a diet rich in aquatic species that were located on or near the ocean coast or in nearby brackish waters, such as the Banana River.

CHAPTER 5: CONCLUSION

Through identification and analysis of faunal bone and shell fragments, I propose that the indigenous community at the Penny Plot site was successful at ensuring food stability for hundreds of years. This continues a trend of resource management practices being used down the Southeast Atlantic coast (e.g., Reeder-Myers et al. 2022; Reitz 2014; Russo 1986; Thompson and Turck 2009; Thompson et al. 2020). It is likely that harvesting techniques and management practices were passed from generation to generation to produce this stability across time. These possible management strategies were perhaps successful enough as to be able to accommodate a growing population in this area, as evidenced by the increasing amount of faunal remains left behind in the first few levels of test unit G. Indeed, Russo (1986:5) and Penders (2017:25-32) describe a growing population in the Indian River lagoon area from the Archaic period (c. 8,000 B.C.E. – 2,000 B.C.E) on due to rising sea levels (and thus increased aquatic bio-productivity), so the events reflected in test unit G may represent a microcosm of what was happening in the region on a larger scale. Test unit G and the area around it specifically was probably the site of multiple hearths and cooking events, as evidenced by the shell concentration and hearth features in the midden area (Figures 5-9).

What is still missing from research at the Penny Plot site is an investigation of site use and possible seasonality of the site. At this time, it is not known whether the site was definitively a processing area, a residential area, a hunting camp, etc., or if it was occupied on a seasonal basis from groups further inland. I suggest that the site is a processing area inhabited seasonally, but further research is needed to confirm or deny this, namely through measuring the size of faunal bones and shell to determine season of catch and through spatial analyses of the site itself (through aspects such as post mold locations or hearth placements).

Additionally, it should be noted that this paper presents data from one test unit at one site, and the results obtained here may be affected by processes such as approximate test unit location, determining sample size, or human error during excavation and identification. The conclusions cannot be definitively applied to the entire Malabar period Ais community, even just within Cape Canaveral, unless more research is done at neighboring sites and at areas within the expanse of Ais territory down Florida's east coast.

Of course, this story is not complete without data from other categories of finds from the site, such as plant food remains, ceramics, and lithics, and the analyses of these artifacts and ecofacts are currently undergoing investigation at CCAMP. However, the data presented here start to paint a colorful picture of life of an Ais community in Cape Canaveral, where harvesting fish and turtles, hunting deer and sharks, collecting shells, and preparing all these items for consumption were all important daily tasks.

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