What Fishing Tackle Should I Bring Today?: Safety Harbor Resource Collection Tools as Adaptations to Aquatic Environments

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WHAT FISHING TACKLE SHOULD I BRING TODAY?: SAFETY HARBOR RESOURCE COLLECTION TOOLS AS ADAPTATIONS TO AQUATIC ENVIRONMENTS

By

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ABSTRACT

This thesis reports on the results of research conducted to determine whether technological adaptations to local environmental conditions can be observed through geospatial and artifact analysis of Safety Harbor collections from the Tampa Bay region of Florida. Past artifact and spatial analysis did not take advantage of modern technological advancements when studying how human-environmental interactions can influence certain adaptations to local conditions. In this project, GIS was used to reconstruct local aquatic environmental conditions of waterways adjacent to Safety Harbor sites. New statistical software programs have also proven themselves useful to archaeologists seeking to conduct hypothesis testing of artifact data.

The Safety Harbor artifacts used in this analysis were accessed through the Alliance for Weedon Island Archaeological Research and Education (AWIARE) lab on Weedon Island. Fishing artifacts from these sites underwent hypothesis testing to identify any statistically significant morphological differences. Geospatial analysis was also conducted to determine if these differences correlate with differing aquatic environmental conditions. Technological adaptations to local conditions at these three sites were then compared to those previously identified in research on the Calusa. Ultimately, it was found through this research that Safety Harbor peoples did adapt their fishing technology differently depending on the aquatic environment adjacent to their occupation site. Additionally, the adaptations observed in Safety Harbor fishing technology were similar to those identified in research on the Calusa.
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CHAPTER 1: INTRODUCTION

The research presented throughout this thesis discusses an investigation of technological adaptations to local environmental conditions. Specifically, this thesis reports the results of geospatial and artifact analysis conducted on aquatic resource collection tool technology implemented at Safety Harbor sites to identify potential localized adaptations between said sites.

In the past, archaeological investigations of environmental adaptations to aquatic resource collection tools did not take advantage of the many modern technological advancements that archaeologists now implement to study how human-environmental interactions influence localized adaptations to material culture. In this project, ArcGIS and QGIS were implemented to reconstruct the local aquatic environmental conditions adjacent to the Safety Harbor sites being examined. R, a new statistical coding software program, is also being utilized in this study. R has proven itself useful to archaeologists planning to conduct various statistical analyses on their datasets, including more complex statistical methods such as hypothesis testing. Through implementing these modern technologies, I was able to investigate the environmental factors that can lead to observable localized adaptations in aquatic resource tool technology.

1.1 Historical Background of Western Florida

The western coast of Florida is a region with an extensive archaeological history. Precontact occupation in this region of the modern state of Florida is hypothesized to have begun as early as 12,000 years ago (Milanich 1994). Freshwater from the limestone catchments in the northern Tampa Bay region provided some of the only sources of potable water to the region's human and non-human inhabitants (Milanich 1994). Following this initial period of occupation
came many thousands of years of prehispanic cultures thriving and adapting to the ever-changing environment of western Florida.

The advent of the Early Archaic Period (10000 - 5000 BCE) brought with it the first of many cultural developments in this region of Florida (Milanich 1994). Some of the first adaptations undertaken by these early inhabitants were to their projectile and blade points, but over time they also began to adapt to their environment at a societal level (Milanich 1994, 2004). Northeastern Tampa Bay and modern day Sarasota County held some of the most significant Archaic Period populations in western Florida during this time (Milanich 1994). The end of the Archaic Period (10000 - 2000 BCE) saw the rise of numerous influential cultural groups on the western coast of Florida. In particular, the Weeden Island (CE 350 - 900) archaeological culture, which developed out of the Deptford (500 BCE - CE 100) and Swift Creek (CE 150 - 350) cultures, existed over a vast geographical area spanning from Mobile Bay, Alabama, to modern Manatee and Sarasota Counties (Milanich 1994, 2004). Weeden Island’s existence as an archaeologically distinct culture largely comes from the ceramic complex, as well as the identifiable environmental adaptations present at occupation sites (Milanich 1994). The Weeden Island Period is divided into an Early and Late period, and this shift is hypothesized to have occurred around CE 750 (Milanich 2004). The period is split at this date due to changes in settlement patterns (a transition from nucleated villages with mound centers to homesteads or small groups of homesteads) amongst Weeden Island sites, and the introduction of maize agriculture (Milanich 2004). The Weedon Island period is considered to be incredibly influential by Southeastern and Florida archaeologists due to the vast quantity of Weeden Island sites found throughout Florida, and as a result has been highly studied. Research on Weeden Island culture was especially prominent throughout the 20th century as archaeologists Gordon Willey and
Richard Woodbury (1942) began extensively surveying Weeden Island mound sites within the Greater Tampa Bay region (Willey 1945). Willey excavated numerous mounds, and published chronologies based on his Weeden Island excavations (Willey 1945, 1948). Subsequent studies on peninsular Weeden Island culture even began to identify regional variations of Weeden Island culture, such as the Manasota culture (CE 300 - 700) (Luer and Almy 1979, 1982). Around the year 900 AD, the Weeden Island culture had fractured into several distinct regional archaeological cultures (Milanich 1994). One of these regional culture groups is the subject of this research, the Safety Harbor culture group that included some historically documented independent polities such as the Ucita, Tocobago, Mocoso, and Pohoy amongst others (CE 900-1725) (Figure 1) (Milanich 1994, 2004).
Figure 1: Map of the regions occupied by Safety Harbor and Caloosahatchee Cultures, as well as important geographic features of these regions.
In the Southwestern region of Florida, the cultural landscape was dominated by one primary culture from 500 BCE until contact with the Spanish in the early 16th century (Milanich 2004). Specifically, the Caloosahatchee (shortened to Calusa) inhabited the region from Charlotte Harbor to Fort Myers (Figure 1). During the period this region was occupied by the Caloosahatchee, it was one of the most productive estuarine environments in the entirety of Florida (Milanich 2004). Several different rivers feed into the estuarine environment inhabited by the Calusa, allowing numerous fish and shellfish species to occupy the region in large numbers (Walker 2000). The surplus of marine food resources allowed the population to grow quite large, which subsequently resulted in a de-centralized complex society emerging around CE 300 (Milanich 2004; Sampson 2019). Over the next several hundred years, the population increased so much that the Calusa began to exert their influence over south Florida through the political annexations of surrounding Indigenous groups (Milanich 2004). The Calusa also developed intriguing material culture, as they utilized many coastal resources for subsistence and travel. One specific example of this was the way the Caloosahatchee utilized very advanced tools for fishing (aquatic resource collection tools), and for the process of manufacturing fishing tools (Marquadt 1992; Walker 1989, 1991, 2000). This unique society ultimately became a highly researched one in the 1970s and 80s as many archaeologists using processual theoretical approaches began studying the Calusa (Milanich 1994).

The Safety Harbor culture group existed contemporaneously with the Calusa and inhabited the Greater Tampa Bay region, with their influence extending as far south as Charlotte Harbor (Figure 1) (Milanich 1994, 2004). These two groups would have been in very close contact, and most certainly engaged with each other in trade and conflict (Worth 2014). The region inhabited by Safety Harbor settlements, the Greater Tampa Bay area, possesses many
similarities to the estuarine environment inhabited by the Calusa. While not quite as productive as the Pineland Sound or Charolette Harbor, the Tampa Bay area contains a vast amount of marine resources, which led to Safety Harbor settlements primarily relying on these marine resources for subsistence and the manufacture of tools (Figure 1) (Milanich 2004). Safety Harbor society also differed quite a bit from their southern neighbors. The Calusa are theorized to have functioned as a single political entity. Calusa archaeologists characterize this society as being a heterarchical, cooperative, and decentralized form of complex society (Marquadt 2014; Marquadt and Walker 2013; Sampson 2019). Conversely, Safety Harbor society was fractured into several different small independent polities (Milanich 2004; Mitchem 1989; Sampson 2019). Both regional western Florida cultures offer unique insight into the characteristics of complex hunter-fisher-forager society in extremely productive marine environments.

1.2 Advocating for More Research on Safety Harbor Practices

Despite these cultures both containing a vast wealth of information regarding complex societies that are heavily reliant on marine resources for survival, Safety Harbor culture has not been studied with the same intensity by archaeologists. This is not to say that archaeologists have not touched Safety Harbor sites. Jeffrey Mitchem (1989) wrote a comprehensive book which reviewed archaeological studies conducted on Safety Harbor sites, the types of artifacts identified at these sites, as well as a case study of the Tatham mound site, and an overview describing many aspects of Safety Harbor society. While this overview is informative and contains useful information regarding Safety Harbor culture, it has an extremely heavy focus on ceramic artifacts and colonial interactions between Safety Harbor settlements and the Spanish (Mitchem 1989). The importance placed on these two aspects of material culture resulted in
many different artifact types significant to Safety Harbor culture being overshadowed, specifically shell artifacts (i.e., Mitchem 1989).

These same issues are not present in comprehensive Calusa studies. Marquadt (1994), for example, authored a comprehensive book describing several aspects of Calusa society, many of which overlap with those described by Mitchem (1989). However, Marquadt’s (1994) publication brought some new interpretations of shell artifacts to the forefront of precontact archaeology in western Florida. Many of the “new” interpretations (new for the time) of shell artifacts were promoted by Walker (1989, 1991), who hypothesized that specific shell artifacts were utilized as fishing tools rather than pendants or various other non-subsistence artifacts (Marquadt 1994). The introduction of these interpretations sparked an extensive amount of research on shell tools at Calusa sites and how these tools differed based on conditions present in the ecosystems adjacent to these sites (Walker 2000). However, these interpretations have only just now begun to be applied in Safety Harbor literature. Specifically, Sampson (2019) conducted a case-study of a Safety Harbor site at Weedon Island and was one of the first archaeologists to apply these modern interpretations to shell tools excavated during her study. In order to better understand Safety Harbor culture and everyday life, it is necessary to apply these functional interpretations of shell artifacts found at Calusa sites to Safety Harbor artifact collections.

1.3 Research Question and Hypotheses

By applying these more recent interpretations to shell artifacts in Safety Harbor artifact collections, I hope to answer the following questions: 1) Did Safety Harbor people adapt their fishing tools differently in response to aquatic environmental conditions adjacent to each site, and 2) were these environmental adaptations similar to those made by the Calusa to their
localized environmental conditions? I hypothesize that there will be evidence of fishing tool adaptation to local ecosystemic conditions. Fishing artifacts will generally be larger and heavier at sites adjacent to deeper, fast-moving water where larger fish are present; these same artifacts will be smaller and lighter at sites adjacent to shallow and slower moving waterways where smaller fish are present. These types of environmental adaptations have been identified at Calusa sites, so I hypothesize that Safety Harbor fishing tools will possess similar adaptations (Walker 2000). To test my hypotheses, I examined the archaeological record of three Safety Harbor sites. Geographic Information Systems (GIS) analysis was also conducted to determine precise environmental differences between the Safety Harbor occupation sites. Finally, analogical analysis will occur between past findings at Calusa sites and the findings from Safety Harbor sites in this study to determine if these two groups adapted to their marine environments in similar ways.

1.4 Overview of Thesis

This thesis is split into several different chapters which each examine evidence and theoretical approaches critical to the study. Chapter 2 delves into a diverse series of topics that are crucial to understanding the context of this research. This chapter begins with a discussion on cultural ecology theory, the driving theoretical perspective of this study. Additionally, analogy as a methodological approach to understanding cultural practices between culture groups is also discussed. Information is then provided that develops the environmental and historical contexts of both Safety Harbor and Caloosahatchee cultures, which existed contemporaneously. This chapter is capped with the contextualization of the typology being used to identify Safety Harbor fishing artifacts in this study.
Chapter 3 discusses the materials and methods used to conduct the research of this thesis. The materials section of this chapter discusses the artifact collection used to gather data on Safety Harbor fishing artifacts, as well as some tools used to measure artifact attribute data. Methods including what types of statistical analyses were run on the different artifact types examined during the course of this research. Geospatial analysis is also discussed during this chapter, as I elaborate on the methods used to create the elevation maps for examining the depth of aquatic environments surrounding Safety Harbor sites. Limitations encountered during the course of this research project are also covered within this section of the thesis.

Chapter 4 examines the results of both the geospatial and statistical analysis conducted in this study. Results for statistical analysis of artifact attribute data are presented for each artifact analyzed in this study. Geospatial analysis results are also presented, with major findings being examined for the two different environmental reconstructions made for this research.

Chapter 5 discusses the results of the research conducted in this study, while also explaining the broader implications of each finding. This chapter first examines and discusses the findings for each individual artifact type and aquatic environment examined in this project. After a discussion of the individual results, the implications of the findings of this research are discussed in relation to the broader practices of fishing at Safety Harbor sites. Safety Harbor practices identified in this study were then compared to those present within Caloosahatchee society.

Chapter 6 concludes the research presented in this paper with some additional discussion of the results. Additionally, future research directions are proposed that may help further our understanding of Safety Harbor cultural practices.
1.5 Summary

This chapter discussed the context of this study. A brief overview of western Florida’s history provided a general understanding of the broader historical context of Safety Harbor and Caloosahatchee society. I then explained why more research should be conducted on Safety Harbor culture, as it is a significant culture on the western coast of Florida that demonstrates a society with unique subsistence strategies. Finally, I discussed the research questions and hypotheses guiding the present research. In the next chapter, I will discuss the theoretical and methodological paradigms that were implemented in this research design. Furthermore, context regarding the environment, and history of Safety Harbor and Calusa societies will be examined, as well as an overview of the typology of fishing tools used by these two archaeological culture groups.
CHAPTER 2: BACKGROUND

This chapter establishes context to valuable information used when conducting this research. The central archaeological theory which informs the research being conducted, cultural ecology, is explained. Background information pertaining to environmental determinism, one thread of cultural ecology, will also be scrutinized. I will go over the environmental context of the Tampa Bay area, which was occupied by the people who inhabited Safety Harbor settlements. Historical context will also be provided for both Safety Harbor and Calusa cultures, as this will better contextualize how these two societies were organized and interacted with one another. Finally, the typology being used to conduct this research will be presented. This typology section will explain how the interpretations of fishing artifacts at Calusa sites started and how these interpretations derived from Calusa fishing technology can also be applied to Safety Harbor contexts.

2.1 Cultural Ecology: How Humans Use Culture to Adapt to Their Environments

The research conducted here seeks to understand two different questions pertaining to Safety Harbor fishing technology. Question one, which seeks to understand how Safety Harbor fishing technology was adapted to localized environmental conditions, is heavily involved with a theory in archaeology known as cultural ecology. This theory focuses on how humans solve problems posed by the environment through the mechanism of culture (Steward 1972; Sutton and Anderson 2010). Throughout this section I will discuss several different aspects of this theory, including one controversial method of studying cultural adaptations to the environment. Specifically, I want to look at what cultural ecology and environmental-functionalist approaches mean when applied to archaeology, how these approaches have been used by archaeologists over
the past two centuries, the criticisms of environmental-functionalist approaches that led to the introduction of cultural ecology during the post-processual era, and how this theory is applied to archaeological research today. By understanding the nuances of this theoretical paradigm, we can become more informed as to why the inhabitants of Safety Harbor and Calusa sites adapted or did not adapt their fishing technology to their marine environments (Walker 2000).

Cultural ecology is the main theory that informs the research question being examined through this study. This theory holds that the primary mechanism that humans utilize to adapt to their environments is culture (Steward 1972; Sutton and Anderson 2010). Cultural responses to the environment one inhabits include aspects like technology, religious patterns and social organization, additionally these forms of cultural adaptations, unlike biological ones, can occur within the lifespan of an individual (Steward 1972; Sutton and Anderson 2010). According to cultural ecology, all people belong to a specific culture that has its own distinct ecological adaptations (Sutton and Anderson 2010). People must adapt their technology, and culture as a whole, to fulfill the biological needs of their group (supply of water, food, and reproduction) (Steward 1972; Sutton and Anderson 2010). The biological needs of each group, and how those needs are fulfilled, largely depends on the environment those people inhabit, which results in cultural and technological adaptation to the environment (Steward 1972; Sutton and Anderson 2010). While cultural ecology is interested in how the environment influences material culture, it is not primarily concerned with the origin and subsequent diffusion of this technology, rather it is interested in how this technology may differ depending on the environment it is implemented in and how this implementation impacts the larger society being examined (Steward 1972). As stated by Steward, “The environment is not only permissive or prohibitive with respect to these
technologies, but special local features may require social adaptations which have far-reaching consequences” (Steward 1972: 38).

As mentioned previously, cultural ecology theory has been used in the field of archaeology since the 19th century, though the term “cultural ecology” had yet to be introduced, and the theory has held continued popularity well into the 21st century (O’Brien 2001). The early versions of this theory stated that human interactions, including complex aspects of human culture such as technology, religious patterns and social organization, are directly influenced by the environment (Kushner 1970; O’Brien 2001; Steward 1972; Sutton and Anderson 2010). Saying “influenced” may even be too soft of a descriptor given how large of an impact it was believed the environment played in determining many aspects of human life. Generally, it was thought that culture functioned as an adaptive mechanism for humans acclimating to an environment (Sutton and Anderson 2010). However, some described the interaction between humans and their environment as automatic or mechanical in nature, implying that predictable responses to environmental conditions could be observed in humans (Kushner 1970; O’Brien 2001). At a very basic level this line of thought has value. For instance, you will not be catching tuna or manufacturing tools to catch tuna if you inhabit the Appalachian Mountains. Eventually this early view of cultural ecology would be adapted to the ideals of processual or “new” archaeology.

The usage of cultural ecology, and other general environmental-functionalist approaches, under the processual archaeological paradigm was similar to older interpretations of the theory mentioned above, but with an added level of complexity. Positivism, the goal of proving something as true or false through rigorous scientific testing, became a central piece of processual theory (Harris and Cipolla 2017). Positivist thinking quickly integrated theories such
as cultural ecology, as archaeologists began to test how people in the past adapted their technology, and subsequently their culture, to the environment they inhabited (Harris and Cipolla 2017). Processualist scholars believed that material culture was “man’s extrasomatic means of adaptation” (White 1959:8). Up front, this idea of culture having an adaptive function is not all that different from what we see in modern studies that utilize cultural ecology, including the study being conducted in this paper. However, the way environmental-functionalist theories were used by processual archaeologists extended much further than simply seeking to understand how people adapted their culture to their environmental conditions.

Culture as a whole was considered to be an adaptive mechanism used by humans that could be determined by their environment (Kushner 1970; White 1959). This form of cultural ecology, largely shaped by positivist thinking, is referred to as “environmental determinism.” Arponen and others (2019:3) describe environmental determinism as used by processualists as, “the contrast between understanding, explaining and describing prehistoric human action as a response or reaction to, and thus as if it were determined by, environmental factors as opposed to studying the various cultural and social factors affecting the course of human (pre)history.” Hodder and Hutson (2003:7) explain that in processual environmental determinism, “.....there are systems so basic in nature that culture and individuals are powerless to divert them.” As stated previously, there is some value in looking at the environment for answers as to why people behave in a certain way. However, overstating the importance of the environment, and subsequently downplaying the role that history and culture have in determining behavior, has led to heavy criticism of this aspect of cultural ecology theory by post-processual archaeologists.

Processualists' general lack of concern with the cultural and historical contexts associated with how past peoples adapted their artifacts to better suit the environment they inhabited is a
primary critique by post-processual archaeologists of environmental determinism’s application. Archaeologists such as Ian Hodder (1985) and Dobres and Robb (2000) began to advocate that the environment was not the most significant factor in the development of technology, or culture for that matter, by past human societies. Influential factors such as the contingency of historical events, and the idea that human agency can cause non-deterministic behavior to emerge in societies were used to argue against environmental determinism (Arponen et al. 2019; Dobres and Robb 2000; Hodder 1985). These scholars describe this trend towards determinism in processual archaeology as theory building grounded in the search for causal relationships, and that this search resulted in archaeologists discarding notions of cultural belief and agency (Hodder and Hutson 2003:7). The harsh critiques of this theory by post-processual scholars ultimately resulted in the idea of environmental determinism becoming a hotly debated and controversial subject (Bicho and Cascalheira 2018; Contreras 2016; Meggers 1954, 2001; Middleton 2017; Wheatley 1993).

Predating the heavy criticism of deterministic theories of human-environmental relationships, Julien Steward (1972) sought to introduce a new theoretical perspective to understanding the interactions between human culture and the environment in the 1950s. Steward’s (1972:36) theory differentiates itself from the criticized deterministic theories of human and social ecology by seeking to understand unique cultural features and patterns which characterize different geographic regions rather than trying to derive general principles applicable to any cultural-environmental situation. With the introduction of this theory, cultural ecology as we know it today was established. The goal of cultural ecology, or “...problem presented by...” as Steward (1972:36) phrases it, is to learn whether the adaptations of a human society to their environment require specific types of behavior or whether they permit a spectrum
of possible behavioral patterns. In this same sense, Steward’s (1972) version of cultural ecology uses a holistic interpretation of culture in which all aspects of culture are inter-connected and impacted by the environment. Bringing this interpretation to the present study, the resource rich estuarine environments inhabited by both Safety Harbor and Caloosahatchee peoples would influence the political, social, and religious patterns as well as the material culture of these groups. Steward’s (1972:36) cultural ecology also preempts the later criticisms of post-processual archaeologists but argues that the local environment functions as the extra-cultural factor that influences culture, rather than the “...fruitless assumption that culture comes from culture.” While Steward (1972) paved the way for the modern cultural ecology theory used today, it was not until later that the theory once again saw widespread use.

With the introduction of new technological advances into the field of archaeology, the theory of cultural ecology started to once again be advocated by archaeologists (Arponen et al. 2019). However, due to the criticisms of environmental determinism which were brought forth by post-processual archaeologists, cultural ecology as a theory has had to adapt to the modern archaeological landscape. In a sense, the theory has changed completely from what it once was. One modern functionalist theory that I find particularly appealing is advocated by Travis Stanton (2004). Stanton (2004) argues that environmental determinism, and functionalist approaches to cultural ecology as a whole, can only ever provide an incomplete picture, derived from one or more factors, of reality in the past. Instead of arguing that factors such as agency disrupt the idea of functionalist adaptations to one’s environment, Stanton (2004) doubles down on the influence of determinism. Essentially, he describes a version of deterministic reality where every aspect of human existence is determined by so many factors that it is impossible to comprehend all of them (Arponen et al. 2019; Stanton 2004). In this deterministic view, factors such as
environmental determinism, and less deterministic views of functional adaptations to one’s environment, do offer a window into why past people behaved a certain way, but this single- or multi-factored view will always be incomplete as there are simply too many influencing factors to ever fully understand the past (Stanton 2004). When working under this type of theoretical perspective on determinism, you must come to accept that you may never fully understand what drove the population being studied to adapt to their circumstances. However, by examining the archaeological, geographical, environmental, and cultural lines of evidence surrounding a particular behavior, it may become possible to increase our understanding of that particular practice. In the study being conducted here, I hope to examine as many lines of evidence as possible to determine how, and why, Safety Harbor peoples adapted their fishing technology to their environment. While conducting this study I also understand that the functionalist aspects of this study may be inherently incomplete due to the multitude of factors which ultimately influenced the individuals from Safety Harbor sites to make the adaptations they did.

2.2 Analogy as a Method for Understanding Environmental Adaptations

Human-environmental interactions have been a subject of interest within the realm of archaeology for many decades now, and throughout this time certain methods of rationalizing these interactions have risen and fallen (Dobres and Robb 2000; Harris and Cipolla 2017; Hodder 1985; Kushner 1970; Stanton 2004). The previous section discussed the importance of cultural ecological theory for understanding functionalist-environmental adaptations, but this theoretical perspective does not help me answer my second research question. This second question, whether the adaptations found at Safety Harbor sites similar to those made by the Caloosahatchee, can be better answered by using analogy. It is important to look at the origins of
analogical study, and how these studies have been used to better understand behaviors that are visible in the archaeological record.

One of the first instances of analogy being used as a method in a comparative study can be linked Cyrus Thomas in the 19th century to compare earthen mounds to historical accounts of mound building and use (Smith 2011). Despite its early beginnings in the discipline, analogical analysis achieved immense popularity in the field alongside the rise of processual archaeology (Harris and Cipolla 2017). While processual archaeology is widely known for transitioning archaeology towards becoming a more scientifically based field, it was also one of the first frameworks which began to seriously examine the place of theory in the discipline. This theoretical revolution drastically changed how archaeologists studied the archaeological record, as they strove to incorporate new methods that allowed them to explain phenomena that occurred in the past, rather than simply describing it (Harris and Cipolla 2017). To accomplish this goal of explaining phenomena in the past, it was necessary, in the eyes of processual archaeologists, to make the field of study more “scientific”. At the helm of this push to make the discipline more “scientific” were famous processual scholars such as Lewis Binford (1962) and James Deetz (1968) who sought to understand behaviors in terms of systems and functionality which could be supported through archaeological evidence (Gamble 2016). Environmental determinism, as discussed in the previous section, was the central driving force of this processual theoretical approach. According to this theoretical perspective, material culture was not derived from human creativity and innovation, but rather from the material conditions of the local environment they were situated in (Harris and Cipolla 2017). This interpretation dictates that an object was made because it needed to fulfill a specific role, or an adaptive function. For instance, a large heavy sinker weight is created to reach fish inhabiting deep and fast-moving waters. These functionalist
theories are what ultimately gave rise to the importance of analogical studies for understanding material adaptations, as modern populations and their adaptations would be used to interpret the archaeological record (Harris and Cipolla 2017).

As discussed above, explaining past phenomena was necessary to make the field more scientific. This sentiment resulted in numerous new lines of evidence being applied to archaeological research, such as analogy. Due to the increased desire of processual archaeologists to add legitimacy to the “archaeology as science” idea, many scholars began taking a positivist approach to their research (Harris and Cipolla 2017). As described in the last section, this positivist paradigm led archaeologists to research subjects with the goal of determining a true or false conclusion about the nature of human adaptations. Analogy was popularly used by processual scholars during this time to test such hypotheses, with some infamous cases using an analogy from modern populations to better understand past populations in completely different geographic locations (Binford 1983). Some processual archaeologists also used this positivist theoretical perspective to justify the creation of law-like principles, which could function as the “real success stories of the discipline” (Gamble 2016; Harris and Cipolla 2017:19).

One of the most well-known analogy-based theories created during processualism’s peak was Binford’s (1983) middle-range theory. This theory involved looking at ethnographic data, usually individuals living in similar environmental conditions to those being studied from the past and drawing analogies between modern behavioral patterns to behavior patterns identifiable in the archaeological record. The most famous example of this comes from Binford (1983), where he spent time with the Nunamiut, a foraging population, in Alaska. Binford (1983) drew connections between the behaviors of these Alaskan foragers and paleolithic foragers in France,
who inhabited a similar environment. Middle-range theory was implemented in Binford’s (1983) study to compare practices of material culture between these two groups who inhabited a similar environment during drastically different times. Analogies such as these only really work when you are operating under the presumption that people adapt their material culture solely to their environment, environmental determinism, which could result in vastly distinct groups of people adapting similarly because they inhabit similar environmental conditions. This particular example, and the theoretical approach accompanied with it, are quite infamous in north American archaeology, and have been critiqued thoroughly by subsequent theoretical schools (Arponen et al. 2019; Raab and Goodyear 1984; Kushner 1970).

One of the major critiques surrounding these early methods of analogical study is that an overarching generalization must be created between some sort of behavior observed in modern times, and the archaeological record (Raab and Goodyear 1984). There is an assumption that the behaviors of Binford’s (1983) two subject groups would have been similar due to external influences, such as the environment the peoples inhabited, despite these groups inhabiting areas a great distance from one another with millennia of time between them. The generalizing assumptions made while using this method of analogical research were considered questionable by many critics of this approach (Pierce 1989; Raab and Goodyear 1984). The criticism surrounding processual archaeology and middle-range theory, as used by Binford (1983), ultimately led to this deterministic analogical approach becoming less popular among archaeologists who entered the field in the 1980s (Gould 1980).

While there are serious issues with creating generalizations about the uses of tools and the behavior of groups based on analogies using modern ethnographic research, there were still certain instances where analogical study could be useful in the field. Allison Wylie (1982, 1985,
1988) has written extensively about analogical research (Watson 2014). Wylie (1985, 1988) reviewed many different arguments against analogy proposed by processual archaeologists, and ultimately concluded that analogy is not inherently flawed as a method in archaeology, however she acknowledged that analogy can be misused (Watson 2014). Wylie (1985, 1988) suggests that the key to working with analogical data in archaeology is to study and become knowledgeable with both the source side and subject side of the analogy being constructed (Watson 2014).

Being informed about both sides of an archaeological analogy allows archaeologists to become more aware of any potential cultural differences between the people being examined in the study (Watson 2014; Wylie 1985, 1988). Insights from scholars like Wylie (1985, 1988) have caused modern archaeological studies to utilize analogy to operate on smaller or subject-specific issues to minimize misuse of the theory. These approaches take some aspects of the popularized methods of analogy brought forth by Binford (1983); largely the acknowledgement that environmental conditions are one type of deterministic factor that influences behavioral changes. However, modern scholars modify the scope of their research to create generalizations based on the practices of specific groups (Walker 1991).

An example of one such modern analogical study was produced by Karen Walker (1991, 2000). This analogical study examines the usage of fishing technology by members of a subsistence fishing society, the Calusa, and any adaptations made by this group when inhabiting different environmental conditions. Walker (2000) utilizes many of the insights of scholars such as Wylie (1985; 1988) to avoid the misuse of analogy in her research design. Early geospatial analysis was also utilized in this research to better contextualize the aquatic environments surrounding the archaeological sites being examined in her study. Historical and archaeological data are also employed by Walker (2000) to further strengthen the arguments supported through
her research. Walker (1991) initially used analogy-driven archaeological research from precontact groups in Chile and Peru, who also relied heavily on marine resources for subsistence, to support her claim that certain artifacts are associated with fishing rather than non-utilitarian purposes like jewelry. This analogy between south American indigenous groups and the Calusa allowed Walker (1991) to create a new interpretation of shell tools found at Calusa sites. These new interpretations were then applied to a comparative study of two separate Calusa sites, which occupy different aquatic environments (Walker 2000).

Walker (2000) was able to identify morphological differences in fishing artifacts (aquatic resource collection tools) that were influenced by the unique human-environmental interactions at each site. The fishing artifacts examined by Walker (2000) were primarily: deer bone points that she hypothesized functioned as fishhooks; grooved-shell columella that she hypothesized and demonstrated to have functioned as sinker-weights; and polished rectangles that she hypothesized had functioned as net mesh gauges (Walker 2000). These tools were observed to have morphological differences based on the environment adjacent to the site they were excavated from. Specifically, Walker (2000) observed that fishing tools extracted from sites adjacent to deeper, fast-moving water were larger in size than fishing artifacts excavated from sites adjacent to shallow, slow-moving water. Walker (2000) tested her hypotheses by utilizing t-tests and measures of central tendency to find that statistically significant morphological differences did not exist between the examined fishing artifacts. However, the distribution of fishing artifact sizes within that dataset indicated that aquatic resource collection tool sizes were different depending on the marine environment adjacent to the site the artifacts were excavated from (Walker 2000). While the hypothesized identification of these fishing artifacts was controversial for its time, it has now become largely accepted that these tools would have
functioned as Walker (2000) described. Modern typologies, some of which were utilized to collect data for this project, acknowledge Walker’s methods as the proper way to interpret these artifact types (Marquadt 1992; Sampson 2019).

This type of influential modern analogical study allows archaeologists to make important determinations about the material cultures and behaviors of past societies. Smaller scale, regional analogies about how certain societies adapt to local environmental conditions have much more legitimacy than some of the more egregious analogies used to support “laws,” proposed during the height of processual thought. Modern comparative studies such as the one conducted by Walker (2000) have demonstrated that there is still a place for analogy when studying environmental adaptations in archaeology. However, these determinations identifying how and why certain groups adapt to specific conditions focus primarily on a smaller regional scale, compared to the global analogies proposed by Binford (1983) in his study of Arctic peoples.

2.3 Environmental Context

The environmental contexts surrounding this research project are the local waterways adjacent to the three Safety Harbor sites affiliated with the collections at the AWIARE (Alliance for Weedon Island Archaeological Research and Education) lab on Weedon Island, as well as the sites themselves. Both the Yat Kitischee site (Austin and Pochurek 2002) and the Weedon Island site (Sampson 2019) are located directly along the eastern coastline of the Pinellas Peninsula, though the Yat Kitischee site is located roughly 6.5 miles north of Weedon Island. The Weedon Island site is located within a recreation area, the Weedon Island Preserve, while the Yat Kitischee site is less than a mile away from the St. Pete-Clearwater International Airport. These archaeological sites are found within mangrove forests which naturally inhabit the coastline of Tampa Bay and its surrounding waters. The Bayshore Homes site (Austin 2011; Austin et al.
2007, 2008a, 2008b) is located roughly 10 miles Southwest of Weedon Island on the Gulf Coast of the Pinellas peninsula. This site is found within a highly developed residential district at the mouth of the Long Bayou, and its access to the Gulf is protected by strings of barrier islands (Figure 2) (Austin et al. 2007).

![Map of Tampa Bay subdivisions](image)

Figure 2: Seven subdivisions of the Tampa Bay established by Lewis and Whitman (1985).
The waterways associated with each of the aforementioned sites are part of the seven subdivisions of Tampa Bay (Lewis and Whitman 1985). These subdivisions are known as Old Tampa Bay, Hillsborough Bay, Middle Tampa Bay, Lower Tampa Bay, Boca Ciega Bay, Terra Ceia Bay, and the Manatee River (Figure 2) (Dix 2001; Lewis and Whitman 1985). Each of these subdivisions is home to slightly differing environmental conditions, with some being located directly next to major river systems which feed the Bay and others accommodating the more open waters of the Bay (Dix 2001). The most important of these subdivisions for the project at hand are the Old Tampa Bay, Middle Tampa Bay, and Boca Ciega Bay as these zones surround the Pinellas Peninsula (Figure 2).

Both the Old Tampa Bay and Middle Tampa Bay subdivisions are characterized by mangrove swamps, and tidal marshes directly along the coasts (Pinellas County Water Atlas 2020). Mangrove swamps and tidal marshes both exhibit similar environmental conditions to one another. They are characterized as low-energy environments with some exposure, and high fluctuations in temperature and salinity (Dix 2001). Further off the coast of these lands are vast and plentiful seagrass beds. These seagrass beds account for roughly 14,202 square acres of Tampa Bay and are a vital resource for marine life in the region (Fish and Wildlife Service 1982; Pinellas County Water Atlas 2020). Seagrass beds provide sediment stabilization, habitat diversity, nursery habitats for finfish and shellfish, and serve as indirect and direct food sources for many marine species in the region (Fish and Wildlife Service 1982:15). This shallow water ecosystem benefits tremendously from the nutrient rich estuarine environment of Tampa Bay, and helps the region remain an extremely productive marine environment.

The Boca Ciega Bay contains a much different environment compared to that of the other subdivisions which have been examined so far. There are many seagrass beds and mangrove
swamps throughout the Boca Ciega Bay, but there are also deep fast-moving channels which connect the Gulf of Mexico to this subdivision (Pinellas County Water Atlas 2020). The coastline of the Pinellas Peninsula once inhabited by Safety Harbor peoples is separated from the Gulf by Treasure Island, which is a small barrier island through which many of the aforementioned channels run (Austin et al. 2007; Pinellas County Water Atlas 2020). In-between these two landmasses there is shallow open water, which possesses a sandy sea floor with patches of seagrass vegetation throughout (Fish and Wildlife Service 1982; Pinellas County Water Atlas 2020).

Each of the seven subdivisions identified to exist in Tampa Bay are classified as an estuary by modern environmental research (Pinellas Water Atlas 2020; Lewis and Whitman 1985). Several major river systems such as the Hillsborough, Alafia, Manatee, and Little Manatee rivers feed into the Tampa Bay subdivisions, which enables them to have extremely high productivity levels (Dix 2001). The naturally boosted productivity levels of an estuarine environment are further enhanced by the excellent environmental conditions of Southwestern Florida. Specifically, this region of the state is considered to be in a subtropical environment where winter freezes are rare (Oliver and Hidore 1984). As a result of these ideal climatic and environmental conditions, which support an extremely productive seagrass and mangrove swamp environment, there are always abundant populations of fish and mollusk species in Tampa Bay (Estevez et al 1984; Taylor 1974; Walker 2000; Wang and Raney 1971).

Recent research has revealed that the vast majority of sea-level rise in the anthropocene, which has a heavily debated start date, has taken place from the late-1800s to the mid-1900s (Gonzalez-Tennant 2016; Lewis and Maslin 2015). This sea-level rise, in conjunction with other human factors such as construction and dredging, has already transformed the local environment.
surrounding each of the Tampa Bay subdivisions (Pinellas Water Atlas 2020). Each of these aquatic regions shows signs of direct human manipulation in many forms, including construction projects like channels that are one of the primary ways the local environments of these waters have been altered by modern humans in the region (Pinellas Water Atlas 2020). Artificially constructed neighborhoods and docks have also been erected along the coastline of Pinellas Peninsula and Treasure Island (Pinellas Water Atlas 2020). These constructions disrupt naturally occurring grass flats, an environmental feature essential to the survival of many species in this region and can change how water flows through various parts of the Tampa Bay estuary (Pinellas Water Atlas 2020; Fish and Wildlife Service 1982; Walker 2000). Many of these human-caused environmental changes have influenced the modern appearance of these Tampa Bay subdivisions formerly inhabited by Safety Harbor settlements, but through the use of historic maps an understanding of these ecosystems before disturbance by modern populations can be recreated (Pinellas Water Atlas 2020).

2.4 History of the Safety Harbor and Caloosahatchee Peoples

The two primary populations that will be examined in this paper have a rich history of habitation on the western coast of Florida (Milanich 1994; 2004). Both groups lived in areas that are characterized by very productive coastal ecosystems (Milanich 2004). These ecosystems allowed the Caloosahatchee and Safety Harbor peoples to develop complex subsistence fishing societies (Sampson 2019; Marquadt and Walker 2013). However, the type of governing apparatuses each of these cultures developed was vastly different from the other.

The Safety Harbor culture group that is the subject of this study primarily inhabited the greater Tampa Bay region (Milanich 1994; 2004). Many coastal Safety Harbor sites are characterized by shell middens and mounds; shell mounds can also be identified at inland Safety
Harbor sites (Milanich 1994; 2004). Unlike the Caloosahatchee, who existed contemporaneously with the Safety Harbor peoples, the Safety Harbor culture group is divided into several different regional varieties based on archaeological evidence (Milanich 2004). These regional variances in culture, as well as historical accounts from 16th century Spanish conquistadores, have been used to determine that Safety Harbor peoples inhabited towns that were likely the centers of individual small polities (Milanich 2004; Sampson 2019). Some of the most prominent of these small chiefdoms identified by the Spanish Conquistadors were the Ucita, Tocobago, Mocoso, and Pohoy alongside a few other tribes in the region (Milanich 2004; Gentleman of Elvas 1557).

Subsistence was an extremely important issue for the Safety Harbor peoples inhabiting the Greater Tampa Bay region (Milanich 2004; 1994). While a forager, or fisher-forager, subsistence strategy was primarily adopted throughout the region, some evidence of farming exists (Milanich 2004; 1994; Sampson 2019). However, the evidence of farming is generally limited to the northernmost reaches of Safety Harbor culture area (Milanich 2004). Their subsistence strategy relied heavily on both fresh and salt-water environments, as they harvested shellfish, fish, and a variety of other aquatic resources (Milanich 2004; Austin and Pochurek 2002). The Tampa Bay region is home to numerous different types of wildlife that would have been used for subsistence by Safety Harbor individuals. Both terrestrial and aquatic resources were plentiful for those inhabiting the Pinellas Peninsula. Of the aquatic resources, large numbers of both vertebrate and invertebrate species have been found at sites associated with Safety Harbor contexts (Sampson 2019; Austin and Pochurek 2002). Invertebrate species were especially useful for Safety Harbor peoples, as they would utilize this resource for both subsistence and the manufacture of shell tools (Austin and Pochurek 2002). Some of the more significant species of invertebrates that have been identified at Safety Harbor sites include
Callinectes sp (blue crab), Crassostrea Virginica (eastern oyster), Mercenaria sp. (quahog clam), Ostrea equestris (crested oyster), Neverita duplicata (shark eye), Melongena corona (crown conch), Busycon contrarium (lightning whelk), and Busycotypus spiratus (pearl whelk) (Sampson 2019). Aquatic vertebrates, primarily fish, were an extremely important subsistence resource for Safety Harbor peoples. These groups targeted several of the many fish species inhabiting the Tampa Bay estuary (Austin and Pochurek 2002). Remains from the Sampson Safety Harbor site on Weedon Island show that Ariopsis felis (Hardhead catfish), Mugil sp (mullet), Centropomus sp (snook), Carangidae (jack, pompano, jack mackerel), Archosargus probatocephalus (sheepshead), Cynoscion sp (seatrout), Sciaenops ocellatus (red drum), Paralichthys sp (flounder), and Diodontidae (burrfish or pufferfish) were the primary targets of fishing in the Old and Middle Tampa Bay regions by Safety Harbor inhabitants (Sampson 2019). Terrestrial vertebrates were another vital resource depended on by Safety Harbor peoples. Species such as Odocoileus virginianus (white tailed deer), Canis lupus (wolf), Procyon lotor (Raccoon), Sylvilagus sp. (rabbit), Alligator mississippiensis (Alligator), were some of the more commonly hunted species of terrestrial animal in the region (Sampson 2019).

The Southwestern region of Florida, immediately south of the lands attributed to the Safety Harbor culture, was once home to influential Caloosahatchee peoples (Milanich 2004; 1994; Sampson 2019). In the post-500 BCE period this region, ranging from modern Port Charlotte to Estero Bay (Figure 2), was potentially the most productive marine ecosystem in the entirety of Florida due to the nutrients brought forth by the Peace, Myakka, and Caloosahatchee rivers (Milanich 1994; 2004). The Caloosahatchee were able to systematically harvest the resources from the estuary systems of Charlotte Harbor, the Pine Island Sound, and the Estero Bay regions, which allowed them to thrive as a non-agrarian culture who relied primarily on
marine resources for survival (Milanich 2004; Sampson 2019). Research by Marquadt and Walker (2013) has suggested that the Caloosahatchee peoples adopted a unique form of governance as a result of the environment which they inhabited. Essentially, the unique environment inhabited by the Caloosahatchee was heterogeneous and ever changing (Marquadt and Walker 2013; Sampson 2019). The fluctuating nature of this environment ultimately raised numerous challenges and opportunities for the individuals inhabiting the region, and deeply affected the nature of their hierarchical societal organization. Marquadt and Walker (2013) propose that the Caloosahatchee adopted a heterarchical societal structure, and that this specific type of decentralized society would be beneficial to non-agrarian groups who rely on resources such as fish or shellfish for subsistence. This heterarchical societal structure would involve several powerful chiefdoms existing within a single political entity, giving each chief a certain degree of independent authority over their own polity (Sampson 2019; Marquadt and Walker 2013). By having a single politically powerful chief controlling each individual Calusa settlement, the chiefs would better be able to respond to localized shortages in aquatic resources that were essential for survival (Sampson 2019).

Caloosahatchee sites can generally be found adjacent to the resource rich estuarine environments they utilized for subsistence (Milanich 2004). Many of these sites are characterized by large shell middens, and at times feature multiple extensive sites within the same area. Despite the decentralized nature of Caloosahatchee society, they were able to create some staggering mounds at their occupation sites. These included middens which extend for hundreds of feet along the Gulf coastline. It has even been hypothesized that some of the mounds were interconnected to form massive causeways through the larger Caloosahatchee settlements (Milanich 2004). At several large Caloosahatchee sites, like Pineland, there were even canals
built between some of the larger mounds (Milanich 2004). These earthworks represent the complexity and coordination of the individual chiefdoms found in Calusa society. As discussed previously in this chapter, research conducted by Walker (2000) on the Calusa also identifies some important environmental adaptations found in their material culture. Fishing artifacts used by the Calusa were typically larger when the aquatic environment surrounding their sites were characterized by deep and fast-moving waters; similarly, the artifacts would also be smaller when the environment surrounding the site was characterized by shallow and slow-moving waters (Walker 2000). Similar tests have yet to be conducted on Safety Harbor sites, which inspired this project.

2.5 History and Typology of Precontact Gulf Coast Fishing Technology

Some of the artifacts being examined in the research of this paper have only been hypothesized to function as fishing tools for a relatively short amount of time. Specifically, bone points, smoothed shell columella, and polished rectangles were not always thought to have functioned as fishhooks and net mesh gauges (Marquadt 1992; Walker 1991). Early Florida archaeologists suspected that polished rectangles likely functioned as a variety of different types of artifacts. Some of these hypothesized purposes were bars, cut shell sections, spatulas, tablets, and narrow oblong strips (Marquadt 1992). Bone points, on the other hand, have long been interpreted as a variety of different tool types. Some scholars believed these artifacts to be representative of bone pins, and bone projectile points (Marquadt 1992). Bone points are common at quite a few Caloosahatchee sites, and as a result have been studied for over a century by scholars interested in coastal Florida archaeology. During much of this time, archaeologists who specialized in precontact Florida archaeology accepted the notion that these bone points were used primarily as projectile points for hunting or warfare (Marquadt 1992). It was
suggested by Goggin (n.d.) and Willey (1949:102) that these points were hafted to arrows in their use, while few scholars at the time suggested that they could have been utilized as composite fishhooks (Marquadt 1992). Similarly, smoothed shell columella were suspected to have functioned as jewelry or pendants (Marquadt 1992). These early interpretations of artifacts now considered to be related to fishing came from many prominent archaeologists who specialized in Floridian precontact archaeology. Specifically, Goggin (n.d. 549-552) and Moore (1907) suspected that the many artifact types like polished rectangles and smoothed shell columella couldn’t have a utilitarian use (Marquadt 1992). This view is largely predicated on a woodland-terrestrial bias in early scholars of precontact Florida. This bias limited early interpretations of potential fishing artifacts in the region and in turn has limited research on human-environmental interactions along Florida’s coast.

This old way of interpreting artifacts such as polished rectangles and bone points began to lose favor among precontact Florida scholars after Karen Walker (1991) began publishing much of her influential work on Florida fishing technology. The bulk of her work in the field has been dedicated to identifying the fishing technology of the Calusa and, in doing so, dismantling old interpretations of controversial artifacts such as bone points (Walker 1991; 2000). Several artifacts began to be interpreted in a new light, and some of them are of vital importance to this proposed research. Bone points (hypothesized to have functioned as fishhooks), polished shell rectangles (hypothesized to have functioned as net mesh gauges), and grooved shell columella (hypothesized to have functioned as sinker weights for fishing) are all tools which began to be interpreted differently with the research of Karen Walker (1989) (Figure 3, Figure 4, Figure 5, Figure 6, Figure 7, Figure 8). Walker (1989, 1991) first suggested that these artifacts be interpreted as related to fishing technology during a presentation at the 1989 Southeastern
Archaeological Conference (SEAC). After this initial presentation at the 1989 SEAC meeting, Marquadt (1992) began to include Walker’s (1989, 1991) interpretations into an extensive typology of shell and bone tools present at Calusa sites. These two scholars would go on to study numerous aspects of Caloosahatchee life using these new typologies (Marquadt and Walker 2013; Walker 2000). While the hypothesized uses of these artifacts originated out of Calusa research, the interpretations spread to a wider western Floridian context.

Figure 3: Fragmented bone point, hypothesized to be a fishhook.
Figure 4: Single-grooved shell columella, hypothesized to be a sinker weight.
Figure 5: Single-grooved shell columella, hypothesized to be a sinker weight.
Figure 6: Double-grooved shell columella, hypothesized to be a sinker weight.
Figure 7: Polished rectangle, hypothesized to be a net mesh gauge.
Each of these artifact identifications were initially created using archaeological samples from Caloosahatchee sites, but their presence has also been documented amongst Safety Harbor sites in the Pinellas peninsula. Christina Sampson (2019) identified these artifact types during her excavation of a Safety Harbor site on Weedon Island using the Caloosahatchee shell tool.
typology created by Marquadt (1992). This typology utilizes many of Karen Walker's (1989, 1991) interpretations of fishing tools and was one of the first precontact Florida typologies to include these artifact interpretations (Marquadt 1992). The overlap of fishing technology amongst Caloosahatchee and Safety Harbor culture groups is one of the driving factors of the analogical aspect to this research design. Marquadt’s (1992) typology will be used in the research conducted here to identify potential fishing tools from the artifact collections held by AWIARE. The interpretations proposed by Walker, and their implementation in extensive precontact tool typologies has ultimately changed much of the ways archaeologists view certain tools present at Floridian sites.

2.6 Summary

This chapter discussed much of the background knowledge used while conducting this research. The theoretical paradigm of cultural ecology was discussed, as the research conducted here uses many of the assumptions this theory proposes to explain why people adapted one way or another. Analogy was also contextualized, as this methodology is useful for interpreting cultural practices that are found between numerous diverse groups. The environmental context of the Tampa Bay area was also introduced, as this region is the primary environment being examined to answer this project's research questions. Historical context was also given for both Safety Harbor and Caloosahatchee peoples. This was done to show how these two contemporary societies were different in their political organization, but similar in their subsistence strategies. Aquatic resource collection tool typologies from Florida were presented to contextualize the knowledge used to conduct the artifact analysis necessary for the research of this thesis. In the following chapter I will discuss the materials and methods used to conduct statistical analysis of
artifact attribute data and geospatial analysis of the environments inhabited by Safety Harbor and Calusa societies.
CHAPTER 3: MATERIALS AND METHODS

This chapter describes the research sample and methods employed to answer the research questions. Both artifact analysis and geospatial methods are explained. To answer the first question being investigated in this study, did Safety Harbor people adapt their fishing tools differently in response to aquatic environmental conditions adjacent to each site, shell artifact classification was undertaken. To answer the second research question mentioned in this proposal, I will utilize analogy to compare any morphological differences in fishing technology caused by environmental adaptation to localized conditions to those observed in Caloosahatchee society.

3.1 Research Design

Several methodologies were utilized to answer my research questions. Artifact analysis is a method of examining and classifying artifacts from the past and has been utilized by archaeologists for centuries (Rouse 1960). In the proposed research, artifact analysis took place by utilizing the typology created by Marquadt (1992) for precontact Floridian shell and bone tools. Data collected during the artifact analysis portion of this study then underwent hypothesis testing. Specifically, I tested to determine if any significant differences in size can be found between artifacts of the same type which were excavated from different sites. Significant differences in size, or the lack thereof, between fishing artifact types from different Safety Harbor sites were then examined using a recreation of environmental conditions from historic depth-sounding maps. Depth-sounding measurements were used as they identify deep or shallow aquatic environments adjacent to each Safety Harbor site, which could result in aquatic environmental conditions differing to a point where it becomes necessary for fishing technology
to adapt uniquely (Walker 2000). One of the most important methods for recreating past environments is geographic information systems (GIS) analysis, which can allow a researcher to visualize certain aspects of what an inhabited environment looked like in the past, and how that environment was lived in. Through utilization of artifact, geospatial, and statistical analysis I sought to determine whether Safety Harbor peoples adapted their fishing technology to their environmental conditions. Many of the localized morphological differences to fishing technology observed in Calusa society have been published by Walker (2000). Based on Walker’s (2000) study, Calusa society adapted to use larger and heavier fishing tools when they settled near deep and fast-moving water. Conversely, the Calusa also would use smaller and lighter fishing tools when they settled near shallow and slow-moving waterways (Walker 2000). Using analogy, I sought to determine if Safety Harbor peoples incorporated technological environmental adaptations in similar ways to the adaptations implemented by Caloosahatchee peoples. I also sought to identify possible connections in fishing technology between two contemporary cultures who subsisted primarily on aquatic resources.

3.2 Methods

3.2.1 Coded System for Artifact Analysis

Artifact analysis is both a written and digital method of documenting the physical characteristics of a variety of different tools used by peoples of the past. This methodology has been of utmost importance for archaeologists since the inception of the research discipline and has been used to better understand practices of material culture within past societies. Particularly, this method has been used to develop many of the artifact typologies used to identify fishing technology within Florida (Marquadt 1992; Walker 1991).
The first step in conducting the artifact analysis side of this research was creating a coded system that would allow me to classify the different fishing artifacts I encountered during my research. Using a few different fishing artifact typologies focusing on Florida fishing technology, I was able to create a coded system that could effectively categorize the artifacts identified during data collection (Marquadt 1992; Walker 1989, 1991). The typologies identified in the literature were initially established by grouping up known types of Caloosahatchee fishing artifacts (Marquadt 1992). While there was some general crossover between the tools utilized by the Calusa and Safety Harbor culture groups, some of the more specific materials used to create the tools were not identified in the Safety Harbor collections. This coded system has its backbone on three parent codes which are: 1) Bone Points, 2) Grooved Shell Columella, and 3) Polished rectangle (Table 1). Each of these artifacts are hypothesized to have functioned as different types of fishing technology by Walker (1989, 1991). Specifically, bone points are thought to have been a type of fish hook; grooved shell columella are hypothesized to have worked as sinker weights, and this is usually evident by the grooves on one or both ends of the tool which could have been tied to a line; the third and final artifact type, polished rectangles, are generally interpreted as net mesh gauges (Marquardt 1992; Walker 1989, 1991, 2000). Once the parent coded system was established using the literature on Florida fishing technology, subcodes were created. These subcodes were identified using both the observed artifacts from the Alliance for Weedon Island Archaeological Research and Education (AWIARE) collection, as well as the Calusa fishing artifact typologies. Subcodes were established for two different variables which were observed during artifact collection: the material used to create the tool; and any observable differences in how the tool was manufactured. While the literature identified different possible sub-codes for nearly every parent code, the results of data collection found that only two parent codes had
subcodes which would be relevant to this study (Table 1) (Marquadt 1994; Walker 2000). Once these codes were established, the fishing technology samples from the AWIARE collection were organized within it.

Table 1: Coded system for Safety Harbor fishing artifacts

<table>
<thead>
<tr>
<th>Parent Codes: Parent Codes:</th>
<th>Bone Points (Fish Hooks)</th>
<th>Grooved Shell Columella (Sinker Weights)</th>
<th>Polished Rectangle (Net Mesh Gauge)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subcodes:</td>
<td>1a) Deer Bone</td>
<td>2a) Single Grooved Shell Columella</td>
<td>3a) Polished Shell Rectangle</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2b) Double Grooved Shell Columella</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1b) Stingray Barb</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2c) Perforated Bivalve</td>
<td></td>
</tr>
</tbody>
</table>

3.2.2 Materials for Artifact Data Collection

The artifact data organized into a coded system for this study comes from the Alliance for Weedon Island Archaeological Research and Education (AWIARE) collections at their lab on Weedon Island. Three specific collections from the Weedon Island lab were examined for this project, as their occupation periods have been dated to the Safety Harbor Period (CE 900-1725)
(Milanich 2004). The sites these collections come from are the Bayshore Homes site, the Yat Kitishee site, and the Weedon Island site (Austin and Pochurek 2002; Austin et al. 2007; Sampson 2019). As I organized and coded the data on fishing artifacts from the collections of these three sites, I documented three specific attributes from each fishing artifact: weight, length, and width. These specific measurements were used by Walker (2000) to conduct hypothesis testing to determine whether morphological differences existed between the fishing artifacts from Calusa sites with differing aquatic environmental conditions. In Walker’s (2000) study on Caloosahatchee fishing technology and localized environmental adaptations, she emphasized the importance of length for both columella and bone point measurements. However, many of the bone points found in the AWIARE artifact collection are fragmented with many being incomplete. Due to this inconsistency in length and weight, width was also measured as these tools were typically manufactured in a consistent manner from the metapodials of white-tailed deer (Odocoileus virginianus) (Figure 9). To measure the different attributes I utilized analog calipers, and a US-TNT-PRO scale which can measure to 0.1 gram. To take pictures of the artifacts I used a smartphone. To record the individual measurements of each artifact I first documented the data on paper in a notebook, then subsequently transferred this data into an excel spreadsheet on my laptop.
3.2.3 Map Data Materials and Map Generation

Geospatial analysis of the aquatic environments surrounding the Bayshore Homes, Yat Kitischee, and Sampson Weedon Island sites used both modern and historic nautical maps containing depth sounding measurements. Data pertaining to the geospatial analysis of the aquatic environments adjacent to the Safety Harbor sites was acquired through the United States government; specifically, the National Oceanic and Nautical Administration (NOAA) public databases which contain raster navigational charts formatted for use in GIS programs.
Unfortunately, at the end of 2023 these raster navigational charts will no longer be accessible as NOAA is moving on to a new system of digital mapping. These navigational charts contain depth soundings measurements for the aquatic environments immediately adjacent to each of the Safety Harbor sites the collections were excavated from. Historical depth sounding charts were also utilized in this project to attempt to recreate the aquatic environments inhabited by Safety Harbor peoples. These maps are primarily privately owned, and digital copies were purchased wherever possible. Certain historical maps are also held within collections at libraries, which were contacted for use when available.

Collected geospatial data was then uploaded into both QGIS and ArcGIS to recreate the environmental conditions present during the Safety Harbor Period (Milanich 2004). QGIS is an open-source Geographic Information System (GIS) which is licensed under the GNU General Public License (QGIS.org 2023). GNU is a recursive acronym which stands for “GNU’s Not Unix” and is pronounced like “g’nooo”. This software is the official project of the Open-Source Geospatial Foundation (OSGeo) (QGIS.org 2023). It has been made accessible on a variety of different operating systems including Windows, Mac, Linux, BSD, and mobile. This software supports numerous vector, raster, and database formats and functions (QGIS.org 2023). The other GIS software used in this project is ArcGIS. ArcGIS is a useful software for managing and extracting answers from imagery and remotely sensed data (E.S.R.I 2011). It includes imagery tools and workflows for visualization and analysis, and access to the world’s largest imagery collection (E.S.R.I 2011). This software program is privately owned, and access to UCF’s product license was required to operate this software.

Modern and historic depth-sounding nautical charts dating to the mid-1800s have been collected for this study from the sources mentioned above. The historic charts that were collected
for the Tampa Bay region were used to reconstruct the local environments of the three sites prior to the sea-level rise and human development experienced in the region as a result of the anthropocene, which has a heavily debated start date ranging between CE 1600 to CE 1960 (Lewis and Maslin 2015). Work by scholars, including Gonzalez-Tennant (2016), has revealed that a majority of the sea-level rise that has taken place on the Gulf Coast of Florida occurred from the late-1800s to the mid-1900s. Utilizing a geospatial reconstruction of the historic environmental conditions surrounding these sites provided me with further insight into the human-environmental interactions that took place at these sites. Observing these human-environmental interactions will subsequently further our understanding of why certain Safety Harbor and Calusa sites adopted similar or different adaptations to their local environments.

3.2.4 Materials and Methods for Statistical Analysis

Artifact attribute measurements taken during the data collection phase of this research project were documented in an Excel spreadsheet and used to conduct statistical analyses. Hypothesis testing was conducted on the artifact attribute data using the statistical coding software R. R is a language and environment for statistical computing and graphics (R Core Team 2011). It is also a GNU project, which is similar to the S language and environment which was developed at Bell Laboratories. R provides an extremely wide variety of statistical and graphics capabilities and is highly extensible (R Core Team 2011). R also delivers an open-source route to engaging in the S statistical coding language (R Core Team 2011).

Before the hypothesis testing was initiated, the data underwent certain tests to determine whether the data is homoscedastic or heteroscedastic, and to determine if the data has a normal or non-normal distribution. Given the small sample size of the fishing artifacts from each site, I
believe it will be beneficial to combine the fishing artifact data from the Sampson Weedon Island site and the Yat Kitischee site. Each site is surrounded by the shallow water of Tampa Bay, with limited access to the deeper waters of these regions. The Bayshore homes site is located on the opposite side of the Pinellas Peninsula and has more direct access to the open waters of the Gulf of Mexico. Additionally, specific attributes from two artifact types were selected for hypothesis testing. As previously discussed, width is the primary attribute of importance for bone points and as a result was the only bone point attribute to undergo hypothesis testing. Polished rectangles received similar treatment, as length and width were the only attributes to undergo hypothesis testing for this artifact type. The weight of a polished rectangle will not provide evidence of fishing adaptations while the other two attributes will. Polished rectangles are hypothesized to have functioned as a distance measuring device; the rectangle is used to gauge the size of holes in mesh nets, making the weight of these objects irrelevant to the study. Prior to the statistical testing being finalized from these two site groups, I hypothesized that differences representative of environmental adaptations would be noticeable in polished rectangles and grooved shell columella. However, the potential evidence for environmental adaptations, or lack thereof, should be accepted cautiously, as some limitations within the samples could skew the results. Specifically, I am referring to the grooved shell columella as there were only three samples of this artifact type documented throughout the data collection process.

3.3 Limitations

Typically, when conducting archaeological research there will be some limitations and obstacles encountered during the research process. This project is no different and based on the research that has been conducted, I have already observed some significant problems which could affect the results of this research. The largest possible limitation found within the research
is the sample size. Simply put, the artifact collection of fishing tools at the AWIARE collections is not very big. As stated in the methods section, a total of 76 fishing tools were documented from all three Safety Harbor sites. While I have decided to combine the sites into deep-water adjacent and shallow-water adjacent groups to make up for this disparity, it will be difficult to justify potential findings as indicative of any adaptation or lack there-of.

The small amount of fishing artifacts will also impact the types of statistics that can be run for this project. For example, there were only 3 grooved-shell columella sinkers within the entire collection of the three Safety Harbor sites. Additionally, perforated bivalves were primarily found at the Bayshore Homes site with only one other of this artifact type being identified from the Weedon Island collection. A sample size this small or a sample that is incredibly skewed to one site is inappropriate for statistical testing as it will cause errors with hypothesis testing statistics.

3.4 Summary

This chapter discussed the research design guiding this project, as well as the materials and methods utilized to conduct the study. Discussion in the research design subheading of this chapter demonstrates how I plan to use artifact analysis and geospatial analysis to answer the research question of this study. The methods section of this chapter examines how I plan to conduct artifact analysis and geospatial analysis, as well as the materials being used to conduct both of these analyses. Lastly, the limitations section of this chapter discusses the data shortcomings, and the potential implications that these shortcomings may have on the results. The following chapter will discuss the results of the artifact and geospatial analysis, which can subsequently be used to answer the research question of this study.
CHAPTER 4: RESULTS

To answer the research questions examined in this project, it was necessary to conduct statistical analysis on artifact data and geospatial analysis using both modern and historic nautical depth sounding measurements. By examining the results of these two analytical processes, I will be able to draw conclusions about how Safety Harbor people made localized environmental adaptations to their aquatic environments and how any potential adaptation identified may be similar, or different, to the neighboring Caloosahatchee. In this chapter, I examine both the results of the statistical and geospatial analysis which took place in this study.

In total, 77 Safety Harbor fishing artifacts were identified from the Alliance for Weedon Island Research and Education (AWIARE) collection (Table 2). The statistical analysis section of this chapter will be split into four sections pertaining to the different artifact types, and single subtype, examined during this research. Those artifact types being bone points (fishhooks), polished rectangles (net mesh gauges), grooved shell columella (sinker weights), and perforated bivalves (net weights) which are a subtype of sinker weight. Bone points and polished rectangles underwent hypothesis testing on specific attributes recorded from these artifacts. Grooved shell columella and perforated bivalves were unable to undergo hypothesis testing as their samples were either too small or were significantly skewed towards one site.
Table 2: Artifact type and percentage by site

<table>
<thead>
<tr>
<th>Artifact Type</th>
<th>Total # of Artifact Type</th>
<th>% of Sample Yat Kitischee</th>
<th>% of Sample Bayshore Homes</th>
<th>% of Sample Weedon Island</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grooved Shell Columella</td>
<td>3</td>
<td>0%</td>
<td>33%</td>
<td>67%</td>
</tr>
<tr>
<td>Perforated Bivalve</td>
<td>39</td>
<td>0%</td>
<td>97%</td>
<td>3%</td>
</tr>
<tr>
<td>Polished Rectangle</td>
<td>15</td>
<td>13%</td>
<td>60%</td>
<td>27%</td>
</tr>
<tr>
<td>Bone Point</td>
<td>20</td>
<td>40%</td>
<td>45%</td>
<td>15%</td>
</tr>
</tbody>
</table>

The geospatial analysis which took place during this project will be examined in two separate sections examining both the modern and historic depth sounding measurements. Modern depth sounding data, which was examined using QGIS and ArcGIS, was extensive and provided a full overview of the entire Tampa Bay region including Boca Ciega Bay and the adjacent waters of the Gulf of Mexico. Historic depth sounding data was less abundant than I had originally hoped, with the earliest Federal measurement of the Tampa Bay taking place in 1855. While this chart contained depth sounding measurements that were used to reconstruct the environment of four Tampa Bay regions (Old Tampa Bay, Middle Tampa Bay, Hillsborough Bay, and Lower Tampa Bay), crucial information was missing regarding the Boca Ciega Bay region resulting in an incomplete reconstruction of environmental conditions adjacent to the Bayshore Homes site using this map alone. Another nautical map from 1877 was utilized to
complete the historic depth sounding map using a county museum collection. While examining both the modern and historic environmental reconstructions the group of “hypothesized shallow water sites”, Yat Kitischee and Weedon Island, were analyzed first. The sole “hypothesized deep water site” of Bayshore Homes was then examined after this.

4.1 Artifact Analysis Data

4.1.1 Bone Points (Fishhooks)

From the AWIARE collections, 20 artifacts classified as bone points were identified (Table 3). Of these bone points, the vast majority were fragmented. The fragmentation of these bone points made statistical analysis of artifact attributes such as weight (g) and length (mm) unavailable for answering the research question of this project. Width (mm) was the primary attribute examined from this artifact type, and underwent analysis of central tendency measures, and hypothesis testing.

The mean width (mm) for bone points from each of the three Safety Harbor sites differed (Table 3). Bone points identified in Yat Kitischee Safety Harbor contexts were larger on average than both Weedon Island and Bayshore Homes bone points, while Bayshore Homes had the smallest bone points on average with some outliers recorded being extremely thin (Figure 10).
Table 3: Bone point width (mm) means

<table>
<thead>
<tr>
<th>Safety Harbor Site</th>
<th># of Bone Points</th>
<th>Mean Width (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yat Kitischee</td>
<td>8</td>
<td>7.2</td>
</tr>
<tr>
<td>Bayshore Homes</td>
<td>9</td>
<td>5.7</td>
</tr>
<tr>
<td>Weedon Island</td>
<td>3</td>
<td>6.7</td>
</tr>
</tbody>
</table>

Figure 10: Box plot displaying bone point width (mm) ranges from Safety Harbor sites.

To conduct hypothesis testing on these Safety Harbor artifacts, normality and homoscedasticity testing was done. To determine the normality of the bone point width (mm) artifact data, three different normality tests were run. Shapiro-Wilks, D'Agostino, and Anderson-Darling tests were conducted to determine whether the data had a normal distribution and p-values of .03128, .003189, and .08334 were generated for each test, respectively. These p-values indicate that the data are non-normal, so a Bartlett test of homogeneity of variances was run to
determine if the data was homoscedastic. This test generated a p-value of .8977, meaning that the data are homoscedastic. As a result of these tests, it was decided that a Kruskal-Wallis one-way ANOVA should be run to conduct the hypothesis testing. As stated in the methods section, both the Yat Kitischee and Weedon Island artifact collections were combined for this test to create a more robust “hypothesized shallow water” site sample. The Kruskal-Wallis one-way ANOVA generated a p-value of 0.8309, meaning that I accept the null hypothesis and that no significant differences were observed between the bone point widths (mm) of the two site groups (“hypothesized shallow water” site group and Bayshore Homes site group).

4.1.2 Polished Rectangles (Net Mesh Gauges)

Through examination and collection of data from the AWIARE collection, 15 artifacts classified as polished rectangles were identified (Table 4). Two attributes from these artifacts were considered to be of primary importance for answering the research questions being investigated in this study. Specifically, the length (mm) and width (mm) artifact attributes were selected for artifact analysis as these attributes would directly impact the size of holes in net mesh, and in turn indicate that Safety Harbor peoples were targeting larger fish in deeper waters.

Polished rectangle length means varied from one site to the next (Table 4). Unlike the bone points that were previously examined, polished rectangle means were highest at the deep water Bayshore Homes site, and lower for the Weedon Island and Yat Kitischee sites (Figure 11).
Table 4: Polished rectangle width (mm) and length (mm) means

<table>
<thead>
<tr>
<th>Safety Harbor Sites</th>
<th># of Polished Rectangles</th>
<th>Mean Length (mm)</th>
<th>Mean Width (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yat Kitischee</td>
<td>2</td>
<td>50.75</td>
<td>33.5</td>
</tr>
<tr>
<td>Bayshore Homes</td>
<td>9</td>
<td>53.4</td>
<td>26.9</td>
</tr>
<tr>
<td>Weedon Island</td>
<td>4</td>
<td>40</td>
<td>29.75</td>
</tr>
</tbody>
</table>

To conduct hypothesis testing on the length (mm) of these polished rectangles, normality and homoscedasticity testing was done. To determine the normality of the polished rectangle length (mm) artifact data, two different normality tests were run. Shapiro-Wilks and Anderson-Darling tests were conducted to determine whether the data had a normal distribution, these tests generated p-values of .1948, and .1644, respectively. D’Agostino normality tests were not
conducted on this artifact data because that test requires a minimum of 20 samples to run in R. These tests determined that the dataset has a normal distribution, which led to Levene’s tests being run to determine if the data is homoscedastic. The Levene’s test for homogeneity of variance was run on the polished rectangle length (mm) data and a p-value of .9094 was generated. Once I knew that this data had a normal distribution and was homoscedastic, I conducted hypothesis testing. A One-Tailed Student’s T-test was chosen and conducted on the Polished Rectangle Length (mm) data, with the alternative set to greater, and this test generated a p-value of .1368. This test suggests that I must accept the Null Hypothesis that there are no significant differences in the lengths of polished rectangles between the two site groups.

Polished rectangle width (mm) means were also different between the sites (Table 4). Bayshore Homes Polished rectangles had the smallest mean width (mm), while Yat Kitischee and Weedon Island polished rectangles had larger mean widths (mm) (Figure 12).

![Polished Rectangle Width by Safety Harbor Site](image)

Figure 12: Box Plot displaying polished rectangle width (mm) ranges from Safety Harbor sites.
To conduct hypothesis testing on the width (mm) of these polished rectangles, normality and homoscedasticity testing were conducted. Normality of the polished rectangle width (mm) measurements was tested using two different normality tests. Shapiro-Wilks and Anderson-Darling tests were conducted to determine whether the data had a normal distribution, these tests generated p-values of .5511, and .6087, respectively. D’Agostino normality tests were also not conducted on the polished rectangle width (mm) data because that test requires a minimum of 20 samples to run in R. These tests calculated that the dataset has a normal distribution, which led to Levene’s tests being conducted to calculate whether the data is homo- or heteroscedastic. The Levene’s test for homogeneity of variance was run on the polished rectangle width (mm) data and a p-value of .2947 was generated. Once I knew that this data had a normal distribution and was homoscedastic, I conducted hypothesis testing. One-Tailed Student’s T-test were chosen and run on the Polished Rectangle width (mm) data, with the alternative set to greater, and this calculation generated a p-value of .7786. The results of this hypothesis test indicate that I must accept the Null Hypothesis that there are no significant differences in the widths of polished rectangles between the two site groups.

4.1.3 Grooved Shell Columella (Sinker Weights)

Unlike every other artifact type analyzed in this research, grooved shell columella has only three total samples from all three Safety Harbor sites (Table 5). One of these samples comes from the Bayshore Homes site, while the other two grooved shell columella were associated with the Weedon Island site collection. The Bayshore Homes site grooved shell columella is a double grooved columella sinker, meaning it has been worked on both ends so that a rope may be tied to it on both sides. Each of the different grooved shell columella has differing artifact attribute measurements, with the double-grooved being considerably smaller and the single-grooved being
larger (Table 5). The differences in these values are visualized (Figure 13, Figure 14, and Figure 15).

Table 5: Grooved shell columella data

<table>
<thead>
<tr>
<th>Safety Harbor Sites</th>
<th>Type of Grooved Shell Columella</th>
<th>Length (mm)</th>
<th>Width (mm)</th>
<th>Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yat Kitischee (No Artifacts)</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Bayshore Homes (12bB265)</td>
<td>Double-Grooved</td>
<td>44</td>
<td>28.5</td>
<td>7</td>
</tr>
<tr>
<td>Weedon Island (592aW131)</td>
<td>Single-Grooved</td>
<td>79</td>
<td>17</td>
<td>25.4</td>
</tr>
<tr>
<td>Weedon Island (622aW264)</td>
<td>Single-Grooved</td>
<td>92</td>
<td>13</td>
<td>19.6</td>
</tr>
</tbody>
</table>
Figure 13: Box Plot displaying identified Safety Harbor grooved shell columella length (mm).

Figure 14: Box Plot displaying identified Safety Harbor grooved shell columella width (mm).
4.1.4 Perforated Bivalves (Net Weights)

The perforated bivalve sample that was collected from the AWIARE artifact collection is also imperfect, as almost all the perforated bivalves identified in these collections are associated with the Bayshore Homes site. Measures of central tendency were calculated for the large sample of Bayshore Homes perforated bivalves and were compared to the lone other sample identified from the Weedon Island site. Before delving into the calculations of means for length (mm), width (mm), and weight (g) for Bayshore Homes perforated bivalves, table 6 describes the attributes of the perforated bivalve sample (Table 6) (Figure 16, Figure 17, Figure 18).
Table 6: Perforated bivalve length (mm), width (mm) and weight (g) means

<table>
<thead>
<tr>
<th>Safety Harbor Sites</th>
<th># of Perforated Bivalves</th>
<th>Mean Length (mm)</th>
<th>Mean Width (mm)</th>
<th>Mean Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yat Kitischee</td>
<td>0</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Bayshore Homes</td>
<td>39</td>
<td>58</td>
<td>42.2</td>
<td>43.6</td>
</tr>
<tr>
<td>Weedon Island</td>
<td>1</td>
<td>52</td>
<td>38.5</td>
<td>17</td>
</tr>
</tbody>
</table>

Figure 16: Box Plot displaying identified Safety Harbor perforated bivalve length (mm) ranges.
Figure 17: Box Plot displaying identified Safety Harbor perforated bivalve width (mm) ranges.

Figure 18: Box Plot displaying identified Safety Harbor perforated bivalve weight (g) ranges.

4.2 Geospatial Analysis
4.2.1 Historic Map Data

Geospatial analysis of historic nautical maps containing depth sounding measurements and the subsequent reconstruction of Safety Harbor aquatic environments took place on the ArcGIS software. The results of this analysis will be analyzed in two separate groups, using the same designations as the hypothesis testing: the “hypothesized shallow water sites” group, and the Bayshore Homes site group. This analysis utilized historical nautical charts containing depth soundings measurements dating from 1855 and 1877. Charts were acquired through private sellers online, and through online museum collections (specifically, the Touchton Map Library). The depth sounding measurements of these charts were used in collaboration with the fauna information acquired through the Pinellas Water Atlas (2023).

The “hypothesized shallow water sites” group, containing both the Yat Kitischee and Weedon Island sites was examined first. Due to the proximity of these sites (6.5 miles apart), it was reasoned that their inhabitants would have similar access to the same waterways for fishing. Analysis of the 1855 depth sounding measurements shows that these sites had coastal depths ranging from 1-7ft. The deepest water that residents of the Yat Kitischee site would have been able to access within a 2-mile radius is 7ft (Figure 19). Extending this radius to 4-miles increases that maximum accessible depth to 14ft (Figure 19). Based on the depth sounding measurements identified by the historical maps and the Pinellas Water Atlas (2023), the environmental conditions of Old Tampa Bay can be reconstructed. These waterways were slow-moving and shallow, allowing for a highly productive seagrass environment to flourish due to the freshwater flowing in from the rivers of Lake Tarpon. Aquatic animal species such as mollusks are plentiful in this region, and fish species use these areas as spawning grounds. The deepest water depth Weedon Island residents would have had access to within a 2-mile radius, according to the
historical maps, is 18ft (Figure 19). Doubling this radius to 4-miles increases the maximum accessible depth to 41ft (Figure 19). Utilizing the Pinellas Water Atlas, and the historical depth sounding measurements, the environmental conditions of this region can be reconstructed. In the shallows of the Middle Tampa Bay area are productive sea-grass environments which allow for healthy mollusk populations and sheltered breeding grounds for many fish species, like those of the Old Tampa Bay. Additionally, these shallows have slower waters. However, there are also naturally occurring deep channels present that are close to the Weedon Island site. These channels host deep, fast-moving currents favored by pelagic fish species with depths ranging from 20-41ft. ArcGIS illustration of these channels show that they follow the flow of water out from the Bay into the Gulf of Mexico (Figure 19).
Figure 19: Reconstruction of Tampa Bay seafloor using historic depth sounding measurements taken from 1855/1877.
The Bayshore Homes site is located right at the junction between the freshwater flow of Seminole Lake and the Long Bayou and the saltwater of Boca Ciega Bay. Estuarine environments such as these are highly productive and have many of the benefits mentioned in the last paragraph. Boca Ciega Bay is also home to many sea-grass patches, which are an important symbol of aquatic environmental health (Pinellas Water Atlas 2023). The area of Boca Ciega Bay where the Bayshore Homes site is located is characterized by many small barrier islands, and John’s Pass, which is a naturally occurring channel between two islands with a maximum depth of 24ft (according to the historic charts). Analysis of the 1877 historic nautical chart shows that the shallows surrounding the Bayshore Homes site have a depth ranging from 1-13ft (Figure 19). Within a 2-mile radius of the Bayshore Homes site, Safety Harbor residents could have accessed waters as deep as 13ft. Expanding this radius to 4-miles shows that Safety Harbor residents of Bayshore Homes could have accessed waterways as deep as 24ft.

4.2.2 Modern Map Data

Geospatial analysis of modern nautical charts, acquired through NOAA, with depth soundings measurements also took place on ArcGIS, where it was observed that the modern environment has changed significantly compared to that of the 19th century and even more so compared to the environment inhabited by Safety Harbor peoples. The results of the modern geospatial analysis will be broken up into two groups (as was done with the hypothesis testing and historic geospatial analysis): “hypothesized shallow water site” environments, and Bayshore homes. This analysis examined the modern depth of the local aquatic environment surrounding each Safety Harbor site, while using fauna information provided by Pinellas Water Atlas (2023) to reconstruct the environments inhabited by Safety Harbor peoples.
The “hypothesized shallow water site” group consists of both the Yat Kitischee site and the Weedon Island site. These Safety Harbor settlements are close to each other geographically and have access to similar waterways, the Old Tampa Bay, and the Middle Tampa Bay. Based on modern depth sounding measurements acquired from NOAA (National Oceanic and Nautical Administration), shallow waters ranging from 1-8ft in depth surround the coastlines of the Old and Middle Tampa Bay areas (Figure 20). The deepest water accessible to Safety Harbor residents from the Yat Kitischee site within a 2-mile radius is 9ft, doubling the radius to 4-miles only increases the maximum accessible depth to 12ft (Figure 20). In a similar vein to the reconstruction made using historical data, the waters surrounding the Yat Kitischee site are still slow moving due to the shallow water and highly productive, as they are fed by the Lake Tarpon Canal. The deepest water accessible to Weedon Island Safety Harbor site residents within a 2-mile radius is much higher at 20ft and expanding this radius to 4-miles shows that Weedon Island residents had access to 30ft waterways (Figure 20). Through analysis of historic maps, we know that these channels are naturally occurring, though they have been expanded by modern human populations, and would have provided deep fast-moving waterways for Weedon Island fisherfolk.
Figure 20: Reconstruction of Tampa Bay seafloor using modern depth sounding measurements taken from NOAA.
The Bayshore Homes site is on the western shore of the Pinellas Peninsula, and the inhabitants of this site would have access to the Boca Ciega Bay. This waterway is impacted directly by fresh flowing water from Lake Seminole, which creates a productive estuarine habitat for fish and mollusk species. This region has suffered the most drastic changes since its habitation by Safety Harbor people, as numerous modern human structures now exist in the bay. Specifically, man-made islands that house suburban neighborhoods have been constructed all throughout the bay, breaking up much of the natural habitat that once existed in the region. Alongside these manufactured islands are several boat channels which have been constructed since the 1855 and 1877 surveys. Ignoring these modern human constructs, it can be observed that the local waterways surrounding the Bayshore Homes site range from 1-7ft (Figure 20). This is slightly shallower than those measured during the 19th century. Safety Harbor residents of the Bayshore Homes site would have had access to waters as deep as 8ft within a 2-mile radius of the site and would have had access to waters as deep as 18ft within a 4-mile radius. The waters within the two-mile radius are typically shallow and slow-moving, while those found within the 4-mile radius are deeper fast-moving waters heavily affected by the ocean's currents as they are unprotected by any landmasses.

4.3 Summary

This chapter examined the many results that were produced after geospatial and statistical analyses were run on the artifact attribute data, and the modern and historic depth sounding data. The results of statistical analysis were demonstrated for each of the four artifact types examined in this study. All the artifact attribute data examined had central tendency measures calculated, while bone points and polished rectangles also had hypothesis testing conducted on them. For both the bone points and polished rectangles hypothesis tests, none of the null hypotheses were
rejected. The results of geospatial analysis were also discussed in two different sections. Modern depth sounding measurements obtained from NOAA were used to recreate the modern aquatic environment surrounding the Safety Harbor sites examined in this study. Historic depth sounding measurements were obtained from two different historic maps from 1855 and 1877. This data was used to reconstruct the aquatic environment surrounding these Safety Harbor sites from a time before major sea-level rise began from modern industrial developments. In the next chapter, I will discuss the implications of these results and how they are relevant to this thesis's research questions.
CHAPTER 5: DISCUSSION

To fully understand if Safety Harbor people adapted their fishing technology to localized aquatic environments, the results of this project will be examined and discussed. In this chapter, I interpret the results from both the artifact and geospatial analyses which took place over the course of this study. Each of these analyses provided key insights into how Safety Harbor peoples shaped their material culture based on the localized aquatic conditions they inhabited. The results of the artifact analysis conducted in this study will first be discussed. This section will be separated into four sub-sections, based on the artifact types identified previously in this paper, which discuss the results of each test and the broader implications of these results for understanding Safety Harbor material culture on the Pinellas Peninsula. Results of the geospatial analysis and their implications will be discussed in the subsequent section. Discussion of these results will start with the historic reconstruction of the waterways surrounding the Pinellas Peninsula. The historic reconstruction will then be used to identify features that are still present in modern times, and features which have changed significantly. Through a discussion of this information, I will be able to visualize an aquatic environment similar to that inhabited by Pinellas Safety Harbor peoples. This visualization will further provide reasoning for adaptations to aquatic resource collection tools, or the lack thereof, identified through the data. Finally, the last section of this chapter will involve a synthesis of the interpretations to identify the behavior of Safety Harbor peoples that inhabited the Pinellas peninsula. These behaviors, which are specifically how they adapted to localized aquatic environmental conditions, will then be compared to those of the Caloosahatchee. Examining these two subjects will answer both research questions and conclude the study taking place in this paper.
5.1 Implications of Artifact Analysis

5.1.1 Bone Points (Fishhooks)

The results of the statistical analysis of bone points revealed some interesting trends between the examined Safety Harbor site collections, some of which are also present for other artifact types examined in this study. Width (mm) was the only artifact attribute that was examined for bone points, as the majority of these tools were fragmented. To learn more about potential localized environmental adaptations between the sites, bone point width (mm) attribute data underwent hypothesis testing. The results of this hypothesis testing showed that there were no significant differences between the means of bone point width (mm) between the site groups. This test showed that there are no apparent technological adaptations to localized aquatic environments, based purely on bone point width (mm), between the differing Safety Harbor sites. Interestingly, the largest bone point width (mm) recorded is associated with the Yat Kitischee site, which has the shallowest adjacent local waterways of any Safety Harbor site examined in this study. The smallest bone point width (mm) measured came from the Bayshore Homes site, which was hypothesized to have the easiest access to the deeper waterways typically inhabited by larger pelagic fish species. Inconsistencies present in this analysis of bone point width (mm) may be a result of sample limitations. Having access to a larger collection of complete Safety Harbor bone points may lead to more observable differences in other artifact attributes such as length being recorded and analyzed. Ultimately, the evidence deriving from this specific artifact attribute points to the conclusion that between the sites that were examined in this study, there were no differences in the localized adaptations to fishhook (bone point) tools.
5.1.2 Polished Rectangles (Net Mesh Gauges)

Two different artifact attributes were used for the statistical analysis of polished rectangles. Specifically, measurements of length (mm) and width (mm) were examined from each aquatic resource collection tool that was classified as a polished rectangle, as this artifact type is hypothesized to have functioned as a unit of measurement for Safety Harbor peoples who were manufacturing mesh nets. Each of these artifact attributes underwent hypothesis testing and the generated p-value for both tests indicated that there were no significant differences in the means of polished rectangle length (mm) or width (mm) between the Safety Harbor sites. The results of this study indicate that each of the Safety Harbor sites examined in this study have very similar net mesh sizes. While this is the result, the small sample size of this artifact type (n = 15) might not show the whole story.

However, this is the data produced in this study, and important conclusions can be drawn from this. While discussed in greater depth in Chapter 6, each Safety Harbor site examined in this study is adjacent to some form of shallow water environment. While certain sites have easier access to deeper water sites, the usage of nets would have primarily been limited to these shallow water zones. Polished rectangle data collected and analyzed during this study supports this idea, as each site has similarly sized nets. Localized environmental adaptations to these net mesh gauges were likely not necessary between the sites examined in this study as they were all adjacent to aquatic environments characterized by a large shallow-water zone. So perhaps this adaptation to fishing technology was something adopted throughout the Pinellas Peninsula region of Safety Harbor peoples.
5.1.3 Grooved Shell Columella (Sinker Weights)

Grooved Shell Columella, which are hypothesized to have functioned as sinker weights, had a very limited sample within the AWIARE artifact collection. In total, three grooved shell columella were recorded with two coming from the Weedon Island site and one being excavated at the Bayshore Homes site. Length (mm), width (mm), and weight (g) were examined in the study of these three artifacts. Through the examination of these artifacts, it was found that the sinker weights attributed to the Weedon Island site were longer and heavier than the sinker weight found at the Bayshore Homes site. However, the width of the Bayshore Homes grooved shell columella was larger than the other two. No hypothesis testing took place on these artifacts, as the sample size is too small.

Based on the limited attribute data examined from these artifacts, there is a noticeable difference between the length (mm) and weight (g) of the Weedon Island site weights, and that of the Bayshore Homes site. While the Bayshore Homes site was hypothesized to be the “deeper water site,” thus having easier access to pelagic fish species, the results of geospatial analysis altered this assumption. This revelation will be discussed further in the geospatial analysis section, but the Weedon Island site is also very close to a natural deep channel in the Middle Tamp Bay region that would have given residents easy access to deep waters and the fish species that reside within them. While this artifact data may point to Weedon Island residents adapting their technology, specifically the sinker weights, to this localized environmental condition, there are only three samples of this type from all Safety Harbor sites within the AWIARE collection used in this study. Something else of significance is the complete lack of this artifact type from the Yat Kitischee collection, potentially signifying that there was little need of sinker weights for
the fishing conducted by this site's residents. This lack of samples weakens any conclusion drawn from grooved shell columella.

5.1.4 Perforated Bivalve (Net Weights)

Perforated bivalve artifact data unfortunately are not useful for answering either of the research questions examined in this project. There are far too many data points for one site, and only one other perforated bivalve sample recorded from any other Safety Harbor site. The abundance of perforated bivalve samples at the Bayshore Homes site, and near-complete lack of these artifact types at any other site is confusing. For now, I must assume that this discrepancy is a result of differing priorities between the individuals who excavated the Bayshore homes site and the other two.

5.2 Implications of Geospatial Analysis

5.2.1 Historic Reconstruction

Using historic maps from 1855 and 1877, I was able to reconstruct the aquatic environment of the Tampa Bay area to something close to what would have been inhabited by Safety Harbor people. The evidence that was generated through this reconstruction drastically changed many of the assumptions that were made at the beginning of this study.

It was thought that the Weedon Island site and the Yat Kitischee site would have both been “shallow water sites” as they are positioned on the eastern shore of the Pinellas Peninsula. While this assumption held true for the Yat Kitischee site, it was an incorrect identification for the Weedon Island site. One of the primary reasons it was thought that this site could be interpreted as a “shallow water site” was due to the presence of numerous artificial channels
present throughout the modern Tampa Bay. While it is true that numerous channels have been constructed throughout the contemporary occupation of this region, historic nautical charts revealed that some of the deepest channels in the Bay occurred naturally. These channels are incredibly deep, with some areas reaching as far as 41 feet below sea level. Interestingly, these channels are within 4 miles of travel for Safety Harbor residents of the Weedon Island site, making access to this resource easy with canoes. Having such a deep channel within close proximity of the Weedon Island site changes how this site is interpreted. The waters adjacent to this site are characterized by shallow seagrass flats with slow-moving waters and a deep channel with fast-moving waters, allowing fisherfolk inhabiting this site to gather a diverse quantity of aquatic resources. The hybridized nature of this site’s aquatic environment could explain why there are no significant differences in mean sizes of fish tools between the sites.

While the historic nautical charts did change how the Weedon Island site should be interpreted, the Bayshore Homes site continued to have a similar interpretation. The shallow waters adjacent to the Bayshore Homes site between Pinellas Peninsula and its barrier islands range between 1-7ft and were characterized by seagrass flats, but the water depth drastically increases to 21ft in John’s Pass, a natural channel between the barrier island and the Gulf of Mexico, and beyond into the Gulf. While the waters of John’s Pass and the coastal Gulf of Mexico may not get as deep as those accessed by Weedon Island Safety Harbor peoples, the environment is much more suitable to large pelagic fish that require larger, heavier tackle. These coastal beach environments are characterized by relatively deep waters (ranging from 15-30ft) with little to no vegetation or structure (e.g., reefs, rock beds, ledges, etc.) on the sea floor. Open waters such as these are well-suited for pelagic fish species (e.g., sharks, tarpon, kingfish), with many of these species traveling east into John’s Pass. The Safety Harbor peoples inhabiting the
Bayshore Homes site would have had easy access to both shallow and deep-water regions, enabling inhabitants of this site to harvest resources specific to each of these environments. In similar fashion to the Weedon Island site, Bayshore Homes residents would have seemingly adopted a material culture suitable for the hybridized aquatic environment they inhabited.

As stated earlier in this section, the Yat Kitischee site was confirmed to be a shallow water site through GIS analysis of historic nautical charts. Unlike the other two sites which have easily accessible deep-water features, the Yat Kitischee site is purely shallow water. This would result in inhabitants of the site primarily fishing in the seagrass flat areas along the coast and slightly deeper regions of 13-14ft below sea level being easily accessible. This site is certainly the most different from the other two, as there is no deep-water environment adjacent to the site that could promote the development of hybridized fishing technology.

5.2.2 Modern Environmental Changes

An examination of historic depth soundings measurements obtained from modern NOAA nautical charts shows that many of the environments once inhabited by Safety Harbor peoples in this region have changed significantly since their earlier inhabitation. Generally, much of the depth measurement data are like those uncovered in the historic nautical charts. However, many areas have been manipulated by modern human inhabitants of Tampa Bay and by ecological activity such as storms and sea-level rise. Such change leads me to question the usefulness of modern depth soundings measurements in the reconstruction of aquatic environments in past studies such as Walker’s (2000) report of Caloosahatchee fishing technology.

Both the Yat Kitischee site and the Weedon Island site had their local aquatic environmental conditions impacted in similar ways by modern human habitation of the region.
Three man-made bridges, the Howard Franklin, Gandy, and Courtney Cambell bridges, have made large impacts to the coastline of this region. Additionally, the waterways surrounding these bridges have been dredged to unnatural depths when compared to the historic environmental reconstruction. Modern shipping channels have also been constructed throughout the middle Tampa Bay region, which changed historically shallow waters of 1-8ft to consistent depths of 20ft. Constructs such as these could drastically change the interpretation of environmental data if an environmental reconstruction was taking place using primarily modern data. While a researcher may be able to observe these human-caused changes to the aquatic environment of the Old and Middle Tampa Bay areas, it would be much more difficult to observe changes which have occurred naturally. Specifically, the seafloor has changed significantly in the 169 years that have taken place since 1855. Certain regions that were shallower in the past are now deeper, and vice versa. This factor would also lead to inaccurate reconstructions of the aquatic environment once inhabited by Safety Harbor peoples.

The previous issues present in modern depth sounding nautical charts are further exemplified in the waterways surrounding the Bayshore Homes site. Numerous man-made islands have been erected in the once open waterways of the Boca Ciega Bay. These islands have been used to construct suburban neighborhoods throughout the Bay for modern populations who want property adjacent to the beaches of St. Petersburg. Unfortunately, the construction of these islands has made it impossible to accurately recreate any semblance of the environment that once existed in the Bay. Alongside these islands are several channels which allow for private boat passage throughout the bay, and into private docks. Changes such as these make the usage of historic maps for these projects essential in areas where modern humans have drastically changed the environment.
5.3 Safety Harbor Adaptations to Fishing Tech and Connections to the Calusa

5.3.1 Pinellas Peninsula Safety Harbor Sites

After discussing the results of both the artifact and geospatial analysis, a view of Safety Harbor fishing technology and the adaptations to localized environmental conditions present in that technology can be constructed. Through this construction of Safety Harbor fishing culture at the three Pinellas Peninsula sites, I will be able to answer the first research question of this paper: did Safety Harbor people adapt their fishing tools differently in response to aquatic environmental conditions adjacent to each site?

Based on the artifact and geospatial analysis, it could be determined that two different types of aquatic environmental conditions were present in this research: 1) a hybridized aquatic environment characterized by both shallow sea-grass flats and easily accessible deep-water regions and 2) a shallow water aquatic environment with access to shallow sea-grass flats exclusively. These two groups are different than what was assumed when this study first began, which was more of a deep-shallow water dichotomy. While it was initially suspected that the Weedon Island Safety Harbor site would fall into the latter of these two aquatic environmental conditions, historic depth sounding measurements revealed that this site possesses the environmental characteristics of the hybrid category. Bayshore Homes, which was initially suspected to fall within the strictly deep-water category of the dichotomy, also was found to be adjacent to more of a hybrid aquatic environment than initially thought. The existence of this hybrid shallow and deep-water aquatic environment resulted in a lack of significant differences between artifact attribute means that were observed in the artifact analysis portion of this research.
While these two sites were re-categorized as hybrid Safety Harbor sites, the Yat Kitischee site remained a strictly shallow water site due to a lack of any outstanding deep-water feature in close proximity to the site. Having the Yat Kitischee site exist as a separate entity from the remaining two is valuable to the research being conducted in this study. However, if more aquatic resource collection tools (fishing technology) were present within the AWIARE collection for this site, resulting in a more robust sample, it’s possible that different conclusions may have been drawn. This hypothetical increase in sample size still may not have resulted in a significant difference in means being observed through hypothesis testing between the three sites due to the hybridized nature of the Bayshore Homes and Weedon Island Safety Harbor sites. Specifically, the Safety Harbor residents of both the Bayshore Homes and Weedon Island sites also manufactured tools that were well-suited for shallow water fishing, as they also had easy access to shallow water environments adjacent to their coasts. Fishing technology that was specialized for shallow water environments from these sites would still possess similar characteristics to those identified at the Yat Kitischee site, making it difficult to identify specific adaptations between the inhabitants of strictly shallow and hybrid aquatic environments.

So, if the means of artifact attributes can’t be used to identify significant differences between the aquatic resource collection tools identified at each site, even when geospatial data suggests that there are differences between the sites, how can localized adaptations be identified? In this case, I believe that localized adaptations can be identified through the presence, or absence, of specific artifact types that indicate the practice of deep-water hook-and-line fishing. Specifically, I am referring to the presence of grooved shell columella, which are hypothesized by Walker (2000) to have functioned as sinker weights for hook-and-line fishing. While the collection present at the AWIARE lab only possessed three grooved shell columella samples,
written reports from the archaeologists who excavated the Bayshore Homes site confirm that more of these artifacts were excavated there (Austin et al. 2008). Additionally, sinker weights were identified, recorded, and present within the AWIARE collection from the Weedon Island Safety Harbor site. Conversely, articles written discussing the presence of fishing technology artifacts at the Yat Kitiscee site explicitly state that these individuals relied heavily on net fishing, and bone point fishhooks (Austin and Pochurek 2002). However, these reports do not mention the use or presence of grooved shell columella sinkers for this hook-and-line fishing, which is supported by the lack of this tool in the Yat Kitiscee AWIARE collection (Austin and Pochurek 2002). Using the presence and absence of grooved shell columella sinker weights, we can identify a crucial adaptation from the hybrid sites: these individuals were crafting certain aquatic resource collection tools specifically to target fish species inhabiting deep water regions.

Examining faunal evidence from past studies at these three Safety Harbor sites further supports the idea that people at the hybridized sites were targeting deep and shallow water fish species, while the residents of the shallow water Yat Kitiscee site were almost exclusively fishing for shallow water species. One such example of this faunal evidence can be found in Sampson’s (2019) study of the Weedon Island Safety Harbor site (Table 7). Her examination of faunal remains excavated at this site shows that Safety Harbor peoples from Weedon Island were fishing for a variety of shallow and deep-water species (Table 7). Pelagic species that inhabit the top-water areas of deep-water environments were also observed within the faunal collection, suggesting that Safety Harbor residents of the Weedon Island site would have been fishing for both top-water and ocean-floor species inhabiting the deep-water environments. Similar evidence was also found at the other hybrid shallow-deep water environment site. Bayshore homes faunal remains convey that residents also targeted a diverse array of fish species inhabiting both shallow
and deep-water environments (Table 7). The faunal remains identified at the Bayshore Homes site also indicates that pelagic species inhabiting deep-water environments were targeted (Austin et al. 2008). Each of the hybrid shallow-deep water sites examined show faunal evidence of targeted fishing for both deep and shallow water fish species.

Table 7: Shallow and deep-water species identified at each site

<table>
<thead>
<tr>
<th>Site</th>
<th>Shallow-Water Species Present</th>
<th>Deep-Water Species Present</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weedon Island</td>
<td>Catfish, mullet, snook, seatrout, red and black drum, and flounder.</td>
<td>sheephead, mangrove snapper, porgies, mackerel, pompano, jack crevalle, ladyfish, and shark.</td>
</tr>
<tr>
<td>Bayshore Homes</td>
<td>Catfish, mullet, red and black drum, seatrout, pinfish, Atlantic croaker and flounder.</td>
<td>grouper, sheepshead, sea bass, porgies, grunts, sharks, jack crevalle, and lady fish.</td>
</tr>
<tr>
<td>Yat Kitischee</td>
<td>catfish, mullet, red and black drum, and seatrout.</td>
<td>Grouper and Sheepshead.</td>
</tr>
</tbody>
</table>

Faunal Evidence from the Yat Kitischee site, in conjunction with the fishing technology excavated from this site, indicates that shallow water fish species were primarily targeted. Species such as catfish, mullet, red and black drum, and seatrout were identified within the collections of these sites (Table 7) (Austin 2002). However, some species typically associated with deep water environments were also identified within the collection. Species such as grouper and sheepshead were observed within the faunal assemblage from Yat Kitischee (Austin 2002).
While these species may indicate deep-water fishing, it is known that juvenile grouper and sheepshead typically live in shallow waters before moving into deeper water environments during maturity (Brulé et al. 1998). These young groupers inhabited the grass flats that were fished by residents of the Yat Kitischee site using nets, and unweighted bone points. The absence of faunal remains from other deep-water species such as grunts and porgies also support this assumption (Austin 2002). Combining the faunal evidence from this site with the artifactual and geospatial data generated during the research of this paper shows that Safety Harbor residents of the Yat Kitischee site would have specifically been targeting shallow water fish species, while occasionally catching juvenile deep-water species using the same shallow water fishing methods.

Based on the information discussed above and the data presented throughout this research, it can be concluded that Safety Harbor people did adapt their fishing technology differently in response to localized aquatic environmental conditions adjacent to each site. Based on the three sites examined in this study, Safety Harbor peoples inhabiting the Pinellas Peninsula either lived adjacent to a shallow-deep water hybridized, or a shallow water aquatic environment. Based on the type of aquatic environment adjacent to each site, the Safety Harbor residents would manufacture tools that allowed them to exploit their aquatic resources to the fullest. In the case of shallow water sites, Safety Harbor residents would primarily rely on net-fishing. While hook-and-line fishing would still be implemented at shallow water sites, there was no need to attach heavy weights to their hooks as the bait being used would likely weigh down the hook enough to be effective. Safety Harbor sites adjacent to hybridized aquatic environments would have implemented many of the same strategies as those used within purely shallow-water sites. However, residents of these sites would have adapted their material culture to manufacture and use grooved shell columella sinker weights for the deep-water features adjacent to their sites.
Sinker weights are necessary to reach the deep-water zones as water moves significantly faster in these environments and would prevent your hook from ever reaching the desired location (Walker 2000).

Due to this conclusion being primarily derived from the presence and absence of grooved shell columella sinkers, there are some problems with this proposed explanation. Notably, the identification of grooved-shell columella sinkers from the Yat Kitischee site would undermine this explanation. However, based on published information about the site, and research conducted within the collection there seems to be a complete absence of these artifacts from the Yat Kitischee site.

5.3.2 Observed Safety Harbor Adaptations Compared to Calusa Adaptations

To answer the second research question being examined in this study, it is necessary to compare the adaptations to localized aquatic environmental conditions present in Safety Harbor fishing technology to those that have been previously identified in Caloosahatchee fishing technology. Information about Caloosahatchee fishing technology adaptations will come from Walker’s (2000) study on this subject. In this study, Walker (2000) examined three Caloosahatchee sites (the Pine Island, Estero Bay and Marco Island sites) adjacent to differing aquatic environments. The Pine Island and Estero Bay Caloosahatchee site is largely characterized by shallow sea-grass flats with slow moving waterways like those found in the Pine Island Sound. Shallow water aquatic environments such as these are very similar to those of Old Tampa Bay. Conversely, the Marco Island site is located adjacent to the Big Marco Pass and River, which is a deep-water channel with depths of up to 32 ft below sea-level. This deep-water site is also adjacent to several shallow water back bays to the east, resulting in a hybrid aquatic
environment around the Marco Island site (Walker 2000). Big Marco pass is home to pelagic fish species like tarpon, as well as sharks and shares many characteristics with John’s Pass adjacent to the Bayshore Homes site.

Artifact analysis was conducted on bone points (fishhooks), polished rectangles (net mesh gauges), and grooved shell columella (sinker weights) from the three sites. Walker (2000) found through this analysis that two out of three artifact types (grooved shell columella and polished rectangles) were larger at the shallow-deep hybrid aquatic environment site of Marco Island than those present at the strictly shallow water Pine Island and Estero Bay site. Bone points were unable to undergo analysis in Walker’s study as the sample only included one specimen from the Marco Island site. While grooved shell columella and polished rectangles data suggested that the hybrid Marco Island site generally had larger fishing technology artifacts than the shallow Pine Island and Estero Bay sites, there was considerable overlap between the artifacts from these sites. Ultimately, Walker (2000) concludes that fishing artifacts from the Pine Island and Estero Bay sites emphasize a greater reliance on catching smaller fish species that inhabit shallow water, while the Marco Island site artifact data suggests that Calusa residents of this site placed a greater emphasis on fishing for larger pelagic fish in the deep-water environment of the Big Marco Pass.

Comparing the adaptations to fishing technology based on localized environmental conditions identified by Walker (2000) to those identified in my own research reveals a lot of similarities between the two Florida culture groups. Both groups exhibit a lot of overlap in the size of fishing technology utilized at their sites regardless of the aquatic environment adjacent to each site (Figure 21, Figure 22). This demonstrates that even if a site is adjacent to a deep-water feature, the inhabitants will still produce significant amounts of tools to collect resources from
adjacent shallow water areas. If the sample of fishing technology artifacts from the Yat Kitischee site was more robust, it may have been possible to observe the slight differences in artifact size identifiable in Caloosahatchee aquatic resource collection tools. However, in both studies the key characteristics of the artifacts ultimately led to the conclusion that the hybrid sites placed more of an emphasis on deep-water fishing than the shallow-water adjacent sites did. In the Caloosahatchee research, fishing technology artifact attributes revealed that the hybrid site possessed larger quantities of larger artifacts than the shallow water site, despite their means being relatively similar (Walker 2000). Safety Harbor artifact data resulted in a similar phenomenon, as polished rectangles were longer on average and present in higher quantity at the hybrid sites. Additionally, the hybrid Safety Harbor sites were the only sites to have confirmed presence of grooved shell columella sinkers.
Figure 21: Distribution of Polished Rectangle Width (mm) measurements from Safety Harbor Sites. Polished rectangles are from Yat Kitischee (YK), Weedon Island (WI), and Bayshore Homes (BH).
Figure 22: Distribution of Polished Rectangle Width (mm) measurements from Calusa Sites examined in Walker’s (2000; 33) research. Pine Island (PI) and Estero Bay (EB) sites are shallow water, while the Marco Island site (MI) site is deep water.

By comparing the results of these two archaeological studies, it can be concluded that Safety Harbor residents did adapt their fishing technology to localized environmental conditions in a similar fashion to the Caloosahatchee. Both groups place greater emphasis on producing aquatic resource collection tools that are better suited for deep water environments when they are adjacent to a deep-water feature. These groups also use similar fishing technology to one another, which indicates communication and diffusion of ideas between these two groups who are geographically adjacent to one another.

5.4 Summary
Throughout this chapter, a lot of information is discussed which ultimately leads to the research questions of this study being answered. This chapter begins with a discussion on the implications of the artifact analysis conducted in this project. The results of geospatial analysis are then discussed, with some major findings from this analysis changing how sites are interpreted in this study. It was concluded that a hybridized shallow-deep water environment was adjacent to the Bayshore Homes and Weedon Island sites, while the aquatic environment adjacent to the Yat Kitischee site could still be classified as a shallow water environment. The implications of both these types of analyses were then used, in conjunction with faunal evidence from past studies from these sites, to answer the research questions of this study. This study’s results showed that Safety Harbor peoples inhabiting the Pinellas peninsula did adapt their material culture in response to their localized aquatic environments. Safety Harbor sites adjacent to hybridized shallow-deep water aquatic environments manufactured specific tools, grooved shell columella, to fish the deep water features adjacent to their occupation site. Residents from these hybridized sites would also still invest significant resources towards manufacturing tools for use in shallow waters. Conversely, Safety Harbor people inhabiting exclusively shallow water sites would not implement technology used to collect aquatic resources in deep water environments. Instead, residents of shallow water adjacent Safety Harbor sites, such as Yat Kitischee, would manufacture fishing tools that targeted shallow water fish species.

The second research question was then answered using the conclusions drawn from Safety Harbor adaptations to their localized aquatic environments in this study, and adaptations to localized aquatic environments observed in Caloosahatchee collections. Specifically, the Calusa also inhabited sites adjacent to both shallow-deep water hybridized, and strictly shallow water aquatic environments. The inhabitants of Calusa sites adjacent to strictly shallow water
environments would specifically manufacture tools to more effectively fish for shallow water species, while residents of shallow-deep water hybridized sites would manufacture tools effective in both shallow and deep-water environments. These adaptations to localized aquatic environments are similar to those observed in Safety Harbor collections, leading to the conclusion that these two contemporary societies adapted their fishing technology in similar ways.

In the next chapter of this thesis, I will give my concluding thoughts on this study and its results. Additionally, I suggest some future directions that can be taken based on the knowledge generated from this study.
CHAPTER 6: CONCLUSION

The aim of this project was to assess how Safety Harbor residents from three different sites on the Pinellas Peninsula adapted their fishing technology to their local aquatic environmental conditions and to compare any observed adaptations to those identified in Calusa society. As discussed in Chapter 2, the theory of cultural ecology speculates that humans adapt to their local environment through their culture. Safety Harbor people are no different and would have implemented the use of different aquatic resource collection tools and modified certain types of fishing tools to better suit the characteristics of their local aquatic environment. Through the examination of three different types of fishing artifacts, and one subtype, this study provides clarity on how certain aquatic environments may influence the types of tools used for fishing at Safety Harbor sites. Specifically, if sites have access to shallow water resources, they will generally use similar fishing tools, but if a deep-water feature is also within the accessible range of a population tools better suited to exploit those features will be manufactured and utilized. As summarized here, this study has provided new insights into how Safety Harbor people inhabiting the Pinellas Peninsula adapt their fishing technology to different localized aquatic environments.

In Chapter 4 and 5, I examined and discussed the results of the artifact and geospatial analysis at the different Safety Harbor sites examined in this study. While some of the artifacts that were examined in this study had a plentiful sample size, several groups suffered from limitations which could have impacted the answer to the first research question examined in this paper. Specifically, bone points, grooved shell columella, and perforated bivalve samples suffered from low sample sizes or uneven distribution among sites which impacted how the results of the statistical analysis was interpreted in relation to my research question. Despite these issues, the results of these analyses showed that some sites were misclassified based on
their adjacent aquatic environmental conditions at the beginning of the paper. Even with this misclassification, the results revealed important information about the fishing tools being implemented at each site. All three Safety Harbor sites examined in this study had fishing tool assemblages that had similar attributes (length, width, weight). This was interpreted to mean that each site had a heavy reliance on shallow water resources, and thus would have implemented numerous fishing tools suited for this environment. While the sites generally had similar fishing tools, the presence and absence of grooved shell columella, sinker weights, indicated that people occupying the sites that were closer to deep-water features had adapted the arsenal of fishing tools to better exploit those features.

Based on the discussion of results in Chapter 5, it was interpreted that Safety Harbor residents of the Pinellas Peninsula did adapt their fishing technology to localized aquatic environmental conditions. Inhabitants of hybridized shallow and deep-water sites implemented specific tools that are specialized for deep water fishing that are absent from strictly shallow water sites. Once the Safety Harbor adaptations to fishing technology were synthesized, they were compared to those made by Caloosahatchee people. Previous studies on the Calusa identified key adaptations to localized environmental conditions found by two specific sites, Pine Island and Marco Island. The shallow-deep hybrid site (Marco Island) was found to have larger tools than those of the strictly shallow water site (Pine Island). However, the calculated means of the artifact attributes were similar between the two sites, as the deep-water adjacent site was also adapted to shallow water fishing. These results are indistinguishable from those found at Safety Harbor sites over the course of this study. One major difference, however, is that the Calusa shallow water site assemblage did possess grooved shell columella artifacts whereas the Safety
Harbor shallow water site did not. Despite this difference, I believe that these cultures showcase similar adaptations to localized aquatic environmental conditions.

6.1 Future Directions

The findings and limitations of this study lead to several promising directions for future research on Safety Harbor culture throughout the Tampa Bay area.

One of the first future projects that comes to mind are further excavations of Safety Harbor sites to create a collection of complete bone point artifacts. One of the major limitations of my research was that nearly every bone-point was fragmented, making it impossible to distinguish bone points from being single- or bi-pointed. It is common for bi-pointed bone points to be associated with shallow water fishing in many different areas of the world, but none were visible in the AWIARE collections due to the severe fragmentation of these artifacts (Walker 2000). By establishing a more robust collection of bone points, it will be possible to identify deep and shallow water fishing adaptations through the type of bone point that was manufactured (e.g. bi-pointed for shallow water fishing, single-pointed for deep water fishing).

Similarly, I believe further excavation should be done to identify if grooved shell columella are present at shallow water sites. While this project concludes that adaptations exist because of a lack of grooved shell columella from shallow water sites, it would be best to confirm that this assumption holds true for more shallow water sites than just Yat Kitischee.

Additionally, I think that more shallow water Safety Harbor sites should be excavated to create a more robust data set of fishing artifacts used from these sites. I think it would be especially interesting to look at Safety Harbor shallow water sites from areas outside of the Pinellas Peninsula as well. Excavation of sites located directly on the barrier islands surrounding
the Tampa Bay region could also yield more interesting fishing technology data, as these sites would have had easy access to the Gulf of Mexico and the inland waterways between the mainland and the islands. Conducting further research on the topics discussed above will help strengthen our body of knowledge on Safety Harbor, and Floridian, material culture and more specifically fishing technology.
APPENDIX – SAFETY HARBOR ARTIFACT DATA
Table 8: Displays all Safety Harbor fishing artifact data collected during this study

<table>
<thead>
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