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Weathering the Storm: Effects of Storm Periods on Ancient Populations of Coastal Florida

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WEATHERING THE STORM: EFFECTS OF STORM PERIODS ON ANCIENT POPULATIONS OF COASTAL FLORIDA

by

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ABSTRACT

Understanding human response to natural disasters is a core problem for environmental archaeologists. Hurricanes are often devastating to coastal populations, and recognizing behavioral change in response to these major storm events provides context for the resilience and adaptability of ancient coastal people. This research project focuses on retrodicting periods of increased storm frequency and intensity for regions of the Florida coast and comparing those storm periods to the existing archaeological record in order to determine if there are correlations between increased storminess and periods of site abandonment and/or changes in subsistence strategy. These potential correlations may aid in our understanding of human cultural response to dramatic environmental change. Particle size analysis was performed on sediment cores collected from 5 coastal Florida lakes in order to determine periods of increased storm occurrence dating back as far as 9000 B.P. After comparing these storm chronologies to dated materials from the existing archaeological record of the regions surrounding each of the coastal lakes, preliminary analysis shows the potential for correlation between periods of increased storminess and site abandonment. At the regional level and in several intra-site comparisons, there are some noticeable staggering effects between the periods of storminess and the radiocarbon dates of archaeological materials. Further investigation is needed to more fully understand the relationship between these two datasets, which may further our understanding of cultural resilience to environmental stressors and the catalyzing forces of site abandonment and subsistence change in coastal Florida.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

Hurricanes have devastating effects on the lives of people caught in their wake, and the means through which people prepare for hurricane disasters and cope with their aftereffects vary broadly over space and time. Archaeology provides several methods for analyzing changes in cultural behaviors over broad spans of time, but often has difficulty identifying individual events, especially those as brief as hurricane disasters. As a result, archaeological investigations rarely speculate about the occurrences of major storms and the responses of ancient cultures to their effects. Particle size analysis provides a means of identifying storm periods in the archaeological record, therefore bolstering our ability to infer their effects on ancient cultures and the means through which ancient people responded to them.

This project seeks to identify these responses in archaeological cultures of coastal Florida. Utilizing decades of research on the cultures of coastal Florida, combined with paleostorm data gathered from coastal lakes, this project will attempt to aid in our understanding of the relationship between ancient people and storms. My thesis focuses on three main research questions: 1) During what periods were the northwest, Gulf coast, and central east coast regions of Florida affected by high levels of hurricane activity in the precolumbian era? 2) Is a human response to hurricane disasters observable in the archaeological record? 3) How did different populations in Florida respond to these periods of storminess? To answer these questions, I will use particle size analysis of coastal lake sediment cores to reconstruct a storm chronology for these regions and compare those to changes over time in archaeological settlement patterns.

Five sediment cores were collected from coastal lakes in Florida. The first two are from

Merritt Island on the central Florida east coast, followed by individual cores from Bald Point State Park and Grayton Beach State Park in the northwest Gulf coast. Lastly, a core was collected from Cedar Key in the peninsular Gulf coast region. These core locations and the buffer used to determine relevant archaeological sites are shown in **Figure 1** below. The sediment data from these cores allowed me to determine during what periods hurricane activity was at an increased level of frequency and intensity. This dataset is used to build a storm chronology for each of the designated regions of Florida and provides a background of storm activity to compare against the archaeological record.

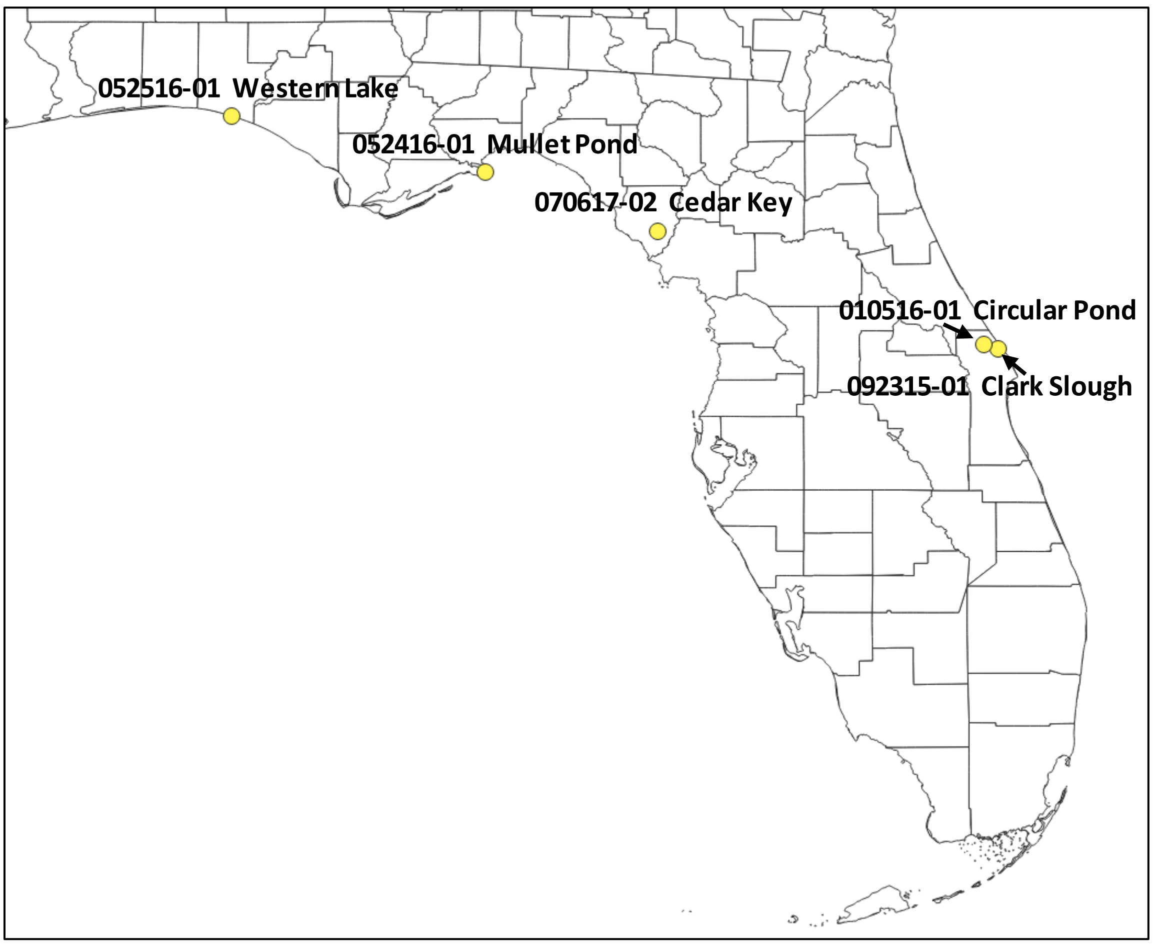

Figure 1. Location of the five sediment cores and geographic buffer of coastal archaeological sites

After creating a storm chronology for these regions, I turn to my second research question. Is a human response to hurricane disasters observable in the archaeological record? These 3 regions of Florida have been occupied by several unique archaeological cultures with distinct settlement and subsistence practices. After each of these distinct cultural groups were identified, I examined their archaeological record for changes in site occupation that are contemporary with detected periods of storminess. If correlations between periods of storminess and human behavioral change are identified (being cultural transitions, or changes in practice), my final research question can be addressed: How did different populations of Florida respond to these periods of storminess? Did their subsistence or settlement strategies affect the way in which they were able to respond to hurricane disasters? This project will address the potential for subsistence change, but is primarily focused on periods of settlement abandonment. By identifying periods of settlement abandonment within the archaeological record, they can be compared alongside the regional storm chronologies to determine any potential correlations.

This project was pursued with the understanding that this is a preliminary investigation. It is important to state here that this project will not settle the debate as to the causes of settlement abandonment and broad scale cultural change for archaeological cultures of Florida. To do so would be too environmentally deterministic. This would not address the variability in human behavior and agency and lead to an incomplete interpretation of past events. However, there is utility in considering research questions focusing on the ability of environmental changes to effect human cultural change, and I believe that any methodology which aids in furthering our understanding of this relationship in a practical and efficient way deserves attention.

In the following chapters I will present the results of this investigation and the theoretical framework that enables my research questions. Chapter 2 discusses the background of

archaeological and geological research that undergirds this investigation. It covers the known cultural history of the Florida coast and the current methodologies utilized by disaster archaeologists in relating events of disaster with changes in the behavior of human populations both in our recent history and ancient past. Chapter 3 details the methodology for collecting sediment cores and laboratory analysis, as well as the method for using various software for visualizing the sediment and archaeological data. Chapter 4 presents the results of both the coastal storm chronology for each of the archaeological regions of Florida and the aggregation of robustly dated materials of archaeological sites that fall within the storm impact radius of each of the sediment cores. Chapter 5 presents my analysis of each of the storm chronology investigations. This includes broad analyses of all archaeological sites within the storm impact radius of each sediment core and intra-site analyses that focus on the correlations between the storm chronologies and the occupation of singular archaeological sites based on the dated materials recorded from the site. The intra-site investigations are performed only when there is a large enough quantity of robust dates to compare with the archaeological record. Lastly, Chapter 6 will discuss the conclusions of my analysis and advocacy for future research.

2. LITERATURE REVIEW

Research for this project largely focuses on determining the locations and histories of coastal Florida archaeological cultures that may have been affected by periods of storminess. Additionally, research on the effects of major storms on ancient cultures is used to determine which material changes in the archaeological record may be indicative of a cultural response to periods of increased storminess. Any modification to the behavior of coastal Florida archaeological cultures that occurs subsequent to a period of increased storminess can be posited as a potential response to the effects of storms. Several authors have laid the groundwork for the methodological approach and understanding of cultural behaviors that this project builds upon to connect periods of increased storminess with potential cultural responses by ancient peoples, though at present there is a relative scarcity of information regarding this subject.

This chapter focuses on background information regarding two distinct research areas. First, I will discuss the relevant history of archaeological cultures that occupy the regions within the impact radius of storms that affected areas around each of the sediment core locations. In addition to the cultural chronology for each of these regions, this section identifies the relevant cultural practices of the ancient people that may have changed in response to the stressors related to major storm events. In particular, evidence of broad scale cultural change (i.e. regional change in subsistence practice and multi-site abandonment) is of interest when comparing these events alongside regional periods of increased storminess. The remainder of the chapter will address the current archaeological theory regarding the effects of major storm events and environmental/climatic changes that produce similar environmental stressors on the behavior of ancient human populations.

2.1 Coastal Archaeological Cultures and Regions of Florida

The coastal regions of Florida were inhabited by a variety of distinct archaeological cultures over the course of several archaeological time periods. An archaeological culture is a repeatedly occurring assemblage of artifacts and features within a specific spatiotemporal context that relates specifically to the material culture of a past human society (Johnson 2010: 237). Each of these cultures is characterized by individual subsistence strategies, social organization, ceremonialism, and technology, which can all be identified by the archaeological materials, features, and context of a site (Milanich 1994). A single archaeological site may have been utilized by several individual cultures and may span thousands of years or more.

For the purpose of this project, it is important to determine which archaeological sites are relevant to determining the effects of major storms. Paleoindian (12000-10000 B.P.) sites in Florida have been dated to over 12,000 calendar years before present (Milanich 1994: 33), with some, such as Page-Ladson, containing artifacts possibly dating back 2000 years further (Halligan et al. 2016). These dates far exceed the earliest dates that might be obtained from the storm chronology generated in this project, regardless of how the people of these Paleoindian sites may have been affected by major storms. Post-contact (after 500 B.P.), any number of behavioral changes or settlement abandonments that could previously have been attributed to the effects of major storms can be alternatively explained as a result of a myriad of additional causes related to European contact. Therefore, archaeological sites dating after European contact have also been excluded from this project.

It is important to note that particle size-derived storm chronology data become more compressed with age. Although the project data extend to about 6000 calendar years before present (yr BP), the resolution drops considerably with age. In order to utilize the highest

resolution possible for our storm chronology, the optimum data might be expected to come from the most recent precolumbian sites within our research area, as those have the highest likelihood of correlating with a higher resolution storm chronology. This range begins at around 2500 cal BP and extends to European contact at approximately 500 cal BP.

My thesis will focus on the distinctions between different archaeological cultures and how these differences in their practice and behavior affected the way in which they responded to hurricane disasters. Archaeological cultures can be identified within the bounds of a specific archaeological site, but are more commonly associated with a broader geographic region, so long as there is a recurring material culture present across all of the sites (Johnson 2010). This is different from a self-identifying cultural group, in which individual members identify with a specific culture based on shared ancestry, geographic location, language, religion, or other practices (Ennaji 2005: 19-23).

The earliest period of human occupation in Florida that can be compared against the storm chronology for the current project is the Late Archaic (5000-3000 B.P.). Regionalization of distinct archaeological cultures began during this time as human populations become better adapted to specific environmental zones (Milanich 1994:85). Small, nomadic human populations became significantly larger and more sedentary as people specialized in the utilization of localized resources, especially along the coasts and near inland waterways (Milanich 1994:85). Unfortunately, the Archaic period contains only sparse archaeological sites and a narrow breadth of data and pushes the outer bounds of the paleoclimate data that will be used. For this reason, the project employs Archaic-period sites only if they were continuously occupied after the Archaic period.

Research concerning the geographic regions of Florida archaeological cultures, their

technologies, and their behaviors stems largely from the seminal text *Archaeology of Precolumbian Florida* by Jerald Milanich (1994). This book divides the state of Florida into 9 distinct geographic regions and further describes the temporal, environmental, and cultural characteristics of each area (Milanich 1994). These regions, as depicted by Milanich (1994), can be seen in **Figure 1**. More recent research has focused on specific archaeological cultures and cultural regions within this broader geographic context. The regions that are the focus of this project are those that lie within the radius of hurricane-force winds centered on the five coastal ponds used to document the storm chronology. Sediment cores were taken from each of the ponds and the storm chronology generated from each of these five cores roughly defines the history of storm impacts on the surrounding area within a radius of 135 kilometers (Keim and Muller 2007). This radius is an average of the distance on either side of the eye of major storms (Category 3-5) within which sustained hurricane-force wind speeds occur. While less powerful storm events may have also impacted population behavior, these events cannot be reliably detected using this type of analysis. This follows the method utilized by Coor (2012) in a similar study. Based on these criteria, the relevant areas are the east and central, northwest, and north peninsular Gulf coast regions, as defined by Milanich (1994, xix), which are shown in **Figure 2** below. These regions contain several distinct archaeological cultures that are the core focus of research for this project.

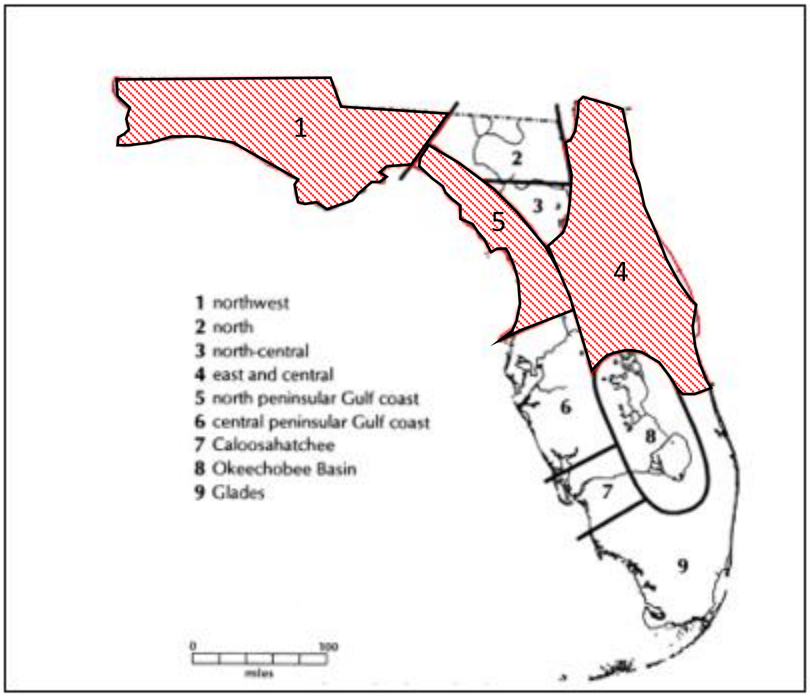

Figure 2. Map of Milanich's 9 archaeological regions of Florida (Milanich 1994). East and Central, Northwest, and North Peninsular Gulf Coast are highlighted.

2.1.1 East and Central Florida:

Settlement in the East and Central Florida region began in the Middle Archaic period around 7300 years before present (Randall et al. 2014:18). The Archaic populations of this time period were already engaged in shell midden construction, and so it is reasonable to assume that a large amount of their diet consisted of marine and estuarine resources. This premise is based on the observation that shell mounds consist of the discarded remains of subsistence practices and that the contents of the midden reflect the resource utilization of the archaeological culture associated with the midden (Randall et al. 2014:19). After approximately 3600 B.P., the St. Johns culture began to emerge along Florida's Atlantic coastline as well as at a large number of sites along the St. Johns River and Indian River Lagoon, both of which run parallel to the

coastline (Russo 1988:160). Rouse (1951) created a synthesis of many of these cultural sites along the Indian River Lagoon, which has remained a seminal work on the spatial and temporal characteristics of the St. Johns culture as well as the contemporaneous Malabar culture.

The St. Johns culture is recognized in 2 distinct phases, each containing sub-phases characterized by distinguishable ceramic typologies (Milanich 1994:247). The St. Johns II phase is differentiated from the St. Johns I phase through the appearance of check stamped pottery around 1200 years ago (Miller 1991:165). Combining the two phases, the people of the St. Johns culture were prevalent from 3600 B.P. until approximately 500 B.P. (Randall et al. 2014:18). The people of the St. Johns culture hunted and gathered a wide variety of food resources, especially shellfish and freshwater/estuarine species like catfish, turtle, and alligator (Milanich 1994:266).

Lying just south of the St. Johns river is the Indian River Lagoon which delineates the area of the St. Johns archaeological culture and the Malabar culture, a distinct cultural group that is often regarded as a transitional culture between the St. Johns culture to the north and the Glades culture to the south, which lies within the Glades region, comprising all of south Florida east and south of Lake Okeechobee (Klein 2012c:84). The Malabar culture is divided temporally in similar manner to the contemporary St. Johns culture. The Malabar I phase evolved out of the previous Orange ceramic culture and began around 2500 B.P. There are noted differences between the Malabar cultures and the earlier Orange period cultures, which were spread throughout the coastal southeastern United States. Primarily, the transition from Orange period to Malabar cultures show an increase in the diversity of subsistence strategies, incorporating more upland hunting and gathering to supplement the estuarine and marine shellfish gathering associated with the earlier Orange Period (Turck and Thompson 2016:52). The Malabar II phase transitions simultaneously with the St. Johns II phase around 1200 B.P. Subsistence practices for

this region generally consisted of marine resource exploitation in the form of shellfish gathering and intensive fishing (Klein 2012c:86). Settlements were in close proximity to the estuarine Indian River Lagoon, which allowed for a majority of fishing and shellfish collection to be performed locally within the marshes (Klein 2012c:86). Fishing was further supplemented by the hunting of birds, mammals, and reptiles in marsh and upland environments (Klein 2012c:86). These practices persisted throughout both Malabar I and Malabar II phases. A simplified breakdown of each of these archaeological cultures is shown below in **Table 1**.

Table 1. Archaeological cultures of East and Central Florida

Culture	**Geographic Region**	**Time Period (yr B.P.)**	**Reference**
Malabar II	Central Atlantic Coast/ Indian River Lagoon	1200-500 cal B.P.	Milanich 1994
St. Johns II	Central Atlantic Coast/ St. Johns River Basin	1200-500 cal B.P.	Milanich 1994
Malabar I	Central Atlantic Coast/ Indian River Lagoon	2500-1200 cal B.P.	Milanich 1994
St Johns I	Central Atlantic Coast/ St. Johns River Basin	3600-1200 cal B.P.	Milanich 1994
Orange	Central Atlantic Coast/ St. Johns River Basin	4000-2500 cal B.P.	Milanich 1994
Archaic	East Central Florida	7300-3600 cal B.P.	Randall et al. 2014

2.1.2 Northwest Florida:

The Northwest region of Florida is occupied by four distinct archaeological cultures. **Table 2** below provides a simplified list of these four cultures and their associated time periods. The earliest of these cultures is the Deptford culture, which first appeared at approximately 2500 B.P. Beginning in coastal sites along the Gulf coast of Florida and the Atlantic coast of South Carolina, the Deptford culture spread across the coasts of northwest Florida, but also proliferated inland near interior river valleys (Milanich 1994:111). Deptford culture was not exclusive to Florida, and occupied regions of the Atlantic coast of both South Carolina and Georgia (Milanich 1994:111). The people of the Deptford culture were adept in using fishing traps and enclosures to gather subsistence resources. Similar to the East and Central coastal archaeological cultures, an overwhelming amount of their diet consisted of marine fish and shellfish resources (Milanich 1994:112).

Following the Deptford culture was a relatively short-lived archaeological culture known as Swift Creek. Temporally spanning the period of 2000-1600 B.P. (Russo et al. 2014:121), the Swift Creek can be easily identified by its distinctive Complicated Stamped pottery and a unique lithic complex which includes a stemmed knife point designed for hafting known as a Swift Creek point (Milanich 1994:146). The subsistence strategies of Swift Creek were notably more mixed than the preceding Deptford culture, with some sites continuing with a largely marine resource gathering system, and some sites emphasizing riverine and forest resources (Milanich 1994:148). Swift Creek cultural sites are primarily found throughout the northwest and north peninsular Gulf coast regions of Florida (Milanich 1994; Sassaman et al. 2014).

The succeeding Weeden Island culture contains a large number of regional variants

within the Southeastern United States. The Northwest Weeden Island culture includes sites within the northwest Florida region (Florida Master Site File Archaeological Sites GIS Data Layer 2016). However, a much larger number of Weeden Island sites are located in the north peninsular Gulf coast region (Florida Master Site File Archaeological Sites GIS Data Layer 2016; Milanich 1994) and will be discussed below.

The Fort Walton culture lies within the northwest region of Florida (Milanich 1994:356). Though not exclusively a coastal culture, the Fort Walton people inhabited a large number of archaeological sites lining the northwest coast of the State. The earliest Fort Walton sites date to around 1000 B.P. and are presumed to have developed out of the late Weeden Island cultural group (Milanich 1994:358). Fort Walton subsistence involved a combination of maize and bean agriculture, as well as supplemental nutrition from wild plants, small game, fish, and shellfish (Milanich 1994:364-365). In coastal Fort Walton sites, the utilization and collection of aquatic species for subsistence continued after the practice was mostly phased out and subsequently replaced with agricultural practices in the interior riverine Fort Walton sites (White 2014:223). Evidence of maize agriculture is nearly nonexistent on coastal sites but appears contemporaneously at more inland sites (Klein 2012b:236). The ability to trade goods and resources over broad distances was apparent (Klein 2012a:204) and this, in combination with agricultural subsistence practices, would likely increase the resiliency of Fort Walton people to the effects of major storm events. Food shortages could be mitigated by agricultural surplus, and the domestication of plants would allow for populations to move further inland where the effects of hurricanes would be less severe.

Table 2. Archaeological Cultures of Northwest Florida

Culture	Geographic Region	Time Period (yr B.P.)	Reference
Fort Walton	Northwest	1000-500 B.P.	Milanich 1994; White 2014
Weeden Island	Northwest/ North Peninsular Gulf Coast	1600-1000 B.P.	Milanich 1994
Swift Creek	Northwest and Northeast Florida Coast/ North Peninsular Gulf Coast	2000-1600 B.P.	Russo et al. 2014
Deptford	Northwest Florida Coast/ Inland River Valleys	2500-2000 B.P.	Milanich 1994

2.1.3 North Peninsular Gulf Coast Florida:

The North Peninsular Gulf Coast contains cultures which overlap into the Northwest region and are shown below in **Table 3**. Swift Creek is the first cultural period associated with this region beginning around 2000 B.P.Transitioning from the Swift Creek culture around 1600 B.P. (Russo et al. 2014:121), the Weeden Island archaeological culture generally occupies the north peninsular Gulf coast of Florida, with some sites spreading into the northwest region (Milanich 1994:161; Russo et al. 2014:122). The majority of Weeden Island sites are coastal, with a smaller number of inland sites. The subsistence practices of the Weeden Island culture appear to be nearly identical to the preceding Swift Creek culture, though with an increased focus on horticulture (Russo et al. 2014:122). Evidence for the cultivation of maize, at least as a secondary resource, is present at inland sites (Russo et al. 2014). Their ceramic complex appears to have been a direct continuation from the Swift Creek pottery type, and the two practiced noticeably similar economic systems (Milanich 1994:166). These economic systems include a mix of sites that focus on riverine and forest resources, while others maintained a coastal

resource economic orientation (Milanich 1994:148). The Fort Walton culture, which evolved out of the Weeden Island culture in the Northwest region, does not propagate in the North Peninsular Gulf Coast region.

Table 3. Archaeological Cultures of North Peninsular Gulf Coast Florida

Culture	**Geographic Region**	**Time Period (yr B.P.)**	**Reference**
Weeden Island	Northwest/ North Peninsular Gulf Coast	1600-1000 B.P.	Milanich 1994; Russo et al. 2014
Swift Creek	Northwest and Northeast Florida Coast/ North Peninsular Gulf Coast	2000-1600 B.P.	Russo et al. 2014

A large number of sites are spread across the coastal regions of Florida. Each of these archaeological cultures is shown to have identifiable ceramic typologies, technologies, and subsistence strategies which allow recovered archaeological materials to be identified by researchers and grouped into regions based on the geographic extent of their associated archaeological materials. Coastal populations are particularly vulnerable to the impacts of major storm events. These archaeological sites may contain evidence for response to these storm events, but first it is important to clarify the impacts, both short and long-term, major storm events would have on the populations occupying the Florida coast over the last 7000 years.

2.2 Effects of Environmental Stressors On Ancient People

Understanding the relationship between human cultures and their environment is a fundamental goal of the field of environmental anthropology (Society for Applied Anthropology 2018). Several bodies of anthropological theory are born out of the need to understand the

human/environment interaction, and have built upon each other over time. This interaction has been a topic of philosophical discussion since the time of Thomas Malthus, who theorized that the complexity and success of all human societies was inherently linked to their environment (Malthus 1798). More specifically, Malthus argued that human populations were limited by their environment and that when human populations grew beyond the sustainable limits of their environment, human populations sharply began to decline in response to starvation and disease (Malthus 1798). Centuries later, this theory has continued to gain attention from academics like biologist Paul Ehrlich, who warned that this same basic principle applied not only to preindustrial societies, but also to present day, fully modern populations (Ehrlich 1968). Though inherently flawed due to its oversimplification of complex political and ecological systems, this argument allowed for the development of theories that modeled and explained human/environment interaction.

The relationship between the environment and human behavior became a central concept of the processual archaeology paradigm. During this period of anthropological thought, Julian Steward coined the term "cultural ecology," which refers to the anthropological idea that culture change is induced by adaptation to the environment (Steward 1972). The methodology for testing this relationship involved assessing and documenting the technology used by a culture to exploit their environment and identifying how patterns of behavior associated with the environment of a specific culture influences other aspects of their culture (Steward 1972). While providing a significantly more robust framework for identifying the human/environment relationship, this theoretical position is still insufficient to account for the abundance of variations in human behavior given the social, political, and individual variety that exists across archaeological cultures. These differences can be clearly observed, even in populations that occupy neighboring

or overlapping geographic areas and exist during the same time period.

Building from the foundation provided by cultural ecology, political economy is a body of theory which, from an anthropological perspective, examines the formation of complex political systems which develop in proportion to their access and control over resources (Sanders and Price 1968). In its simplest terms, a culture's political economy is the "distribution of wealth and power in a society" (Roseberry 1989:44). Focusing on access to resources and the production and distribution of resources, political economists debate the hierarchical relationship between the types of resources (luxury goods, food, crafts, etc.) and the magnitude of effect that the scarcity or surplus of one or more resources has on the behavior of populations as a whole (Hirth 1996). Given that site abandonment and broad scale subsistence shifts are relatively profound responses to environmental change, political economy enables a central research question of this research project. Specifically, were the immediate impacts and long-term environmental stressors brought on by occurrences of major storms significant enough to cause prolonged site abandonment or permanent shifts in subsistence practice?

Combining the study of cultural ecology with the analytical tools of political economy, political ecology studies how power relations shape human interaction with their environment (Morehart and Morell-Hart 2013:487). Political ecology provides much of the theoretical framework used by some current environmental archaeologists. Political ecology has had many definitions, but the version which most closely resembles its utilization for this project comes from Lamont C. Hempel (1996: 150) who described political ecology as "the study of interdependence among political units and of interrelationships between political units and their environment… concerned with the political consequences of environmental change." This theoretical lens reinforces the goal of this project, which is to further our understanding of the

response of human populations to the immediate and long-term impacts of major storm events at the level of individual settlements and at the regional scale. Understanding that interrelation between political systems and the inhabited environment, particularly as it relates to resource scarcity and population stability, is a primary objective of this investigation.

This project is primarily focused on understanding how ancient people in Florida responded to climatic periods of increased storminess. Though investigations in this area of research are not common, research that focuses on other substantial environmental changes, both short and long term, produces considerable insight into the effects of environmental change and the potential strategies utilized by people adapting to new environmental stressors. Below, I discuss the current anthropological research on human response to major storms. Additionally, I discuss how the effects of major storms parallel those of droughts, ENSO events, and sea level rise, present current anthropological research in those areas of study, and consider how these investigations steer the direction of this research project.

2.2.1 Major Storms

Without a doubt, major storms have serious impacts on any human settlement within their path. The focus of this project is to determine whether or not those effects, at least in regard to Florida archaeological cultures, can be observed in the archaeological record. Unfortunately, as far as Florida archaeological cultures are concerned, there has been a relative dearth of information regarding the potential effects storms have had on the behavior of coastal people. Research in the Caribbean has shown the responses and resilience of ancient people to major storms (Cooper and Sheets 2012:114), and this provides a useful analog in terms of similar environmental factors and technological capabilities. Additionally, research by Cooper and Peros (2010) provides a foundation for the methodology of determining what effects of major storms

can be detected through archaeological materials. Research into the effects of environmental change on paleodiet and paleomobility in the Andes has shown a wider range of dietary and mobility strategies during periods of environmental stability (Knudson et al. 2015).

Food procurement strategies, settlement patterns, and household architecture have been used as diagnostics for human adaptation to the potential effects of storms on coastal Caribbean people in northern Cuba (Cooper and Peros 2010:1226). The earliest evidence for subsistence in this area shows a focus on food resources within a specific environmental zone, namely shallow coastal waters (Cooper and Peros 2010:1230). Over time, this subsistence strategy broadened to include gathering of offshore reef and pelagic ocean resources. Access to caves as a form of shelter from powerful storms has been shown to correlate with the building of coastal settlements, all of which lie in close proximity to nearby cave systems (Cooper and Peros 2010:1229). Similar to that investigation, this thesis will attempt to refine the criteria for determining human response to ancient storm events and identify shifts from one form of behavior to another in order to determine if increases in storm frequency and intensity catalyzed these behavioral changes.

Lacking archaeological research pertaining to the response of ancient people to hurricane disasters, this project utilizes ethnographic data on preindustrial cultures as an analog to the potential cultural responses. In an ethnographic study by Charles Herron Fairbanks (1973), the Seminole were found to be wary of hurricane impacts and would flee toward higher ground in the event of an approaching storm. There are also historical analogs which show that major storm events can cause abandonment, even in highly industrialized societies. After a powerful hurricane hits the Cedar Keys in 1896, the Atsena Otie Key was irreparably damaged and the inhabitants of the area were all forced to abandon the area (Oickle 2009) There is little else

documenting the practices of North American cultures in response to storm events.

There is better documentation of storm events affecting cultures of similar subsistence strategy outside of the Americas. Raymond Firth (1939) documents the response of the people of Tikopia, a small island among the Solomon islands of Melanesia, to two separate hurricane events which occurred in 1952 and 1953. The storms are known by the Tikopian people to cause long term food shortages as the damage to vegetation from high winds dramatically reduces the available food supply. In response to hurricane damaged crops, the Tikopian people were observed to harvest and consume their available food supply almost immediately, and to ferment what other crops (banana and breadfruit) they had available (Firth 1959). In times of famine, the Tikopian people diminished their supply of higher quality food stores and resorted to harsher and harsher supplemental foods as the food stores continued to diminish (Firth 1959). After the storms of 1952 and 1953, the community leaders also apparently considered requesting permission and aid from the government in relocating to another island, but ultimately decided against it.

The ethnographic examples demonstrate the response to storm events at the community level. Activities necessary to bolster food supplies require an organization of labor beyond the capabilities of individual households. Drastic subsistence change and settlement abandonment can be observed as responses to the effects of major storms, but these responses are highly contingent upon severity of the storms impacts and the political systems of the affected population.

Hurricanes can have dramatic impacts on coastal habitats, which were a primary source of subsistence for coastal archaeological cultures (Milanich 1994). The consensus view of modern research has shown that human cultures have been exploiting aquatic resources on the

Florida coast beginning around 5000 B.P., with some authors further arguing for exploitation beginning over 7000 years ago (Saunders and Russo 2011:38). Oyster reefs can be irreparably damaged by hurricanes, which significantly decrease both oyster population sizes as well as the mean size of oysters from affected areas (Walters 2007). In 1985, a series of two hurricanes severely damaged the oyster reefs of the Apalachicola Bay, and many have still not recovered to their pre-impact levels (Livingston et al. 1999). Shifts in subsistence behaviors by coastal people may be attributed to these kinds of ecosystem changes. Higher frequencies of storms cause incremental damage to oyster reefs and interrupt the recovery period between events, which prolongs the effects of the reef destruction (Dollar and Tribble 1993:231).

Similarly, hurricane impacts have been shown to have the potential to damage the plant-based resources that were a mainstay in the diet of precolumbian people. Evidence of storm impacts have been difficult to identify, but severe food shortages as a result of natural disasters are often speculated on in the interpretations of archaeological research. In a study of the Holocene-era Wilton culture of South Africa, Walker (1995:254) suggests that a rapid fall-off in population numbers were a reaction to diminishing crop resources that may have been wiped out by a hurricane or frost. Flooding can reduce the yield of both crop and fish harvests. Crops would have been damaged by excessive water and insufficient drainage. Net fishing required shallow isolated ponds for maximum yield, and as ponds became deeper and interconnected due to floodwaters, the likelihood of a successful harvest would have diminished significantly (Milner 1998:77). Droughts, a more common cause of food shortages for many hunter-gatherer and horticultural communities, have been directly linked to settlement abandonment and societal collapse (Anderson 1994:281; Powers et al. 1983:345). Though longer lasting, droughts provide a baseline of cultural response to disaster induced food shortages that can be used to infer

potential response to storms.

2.2.2 Sea-Level Rise

Though the effects of sea-level rise develop over a longer period and last considerably longer than the effects of individual major storms, climatic periods of increased storm frequency and intensity are more analogous to long-term environmental change. Since the resolution of this project cannot detect distinct storm events and instead focuses on periods of increased storm activity, investigations into the responses of ancient populations to sea level rise would reveal the potential for response to a climatic shift with similar environmental impacts occurring during a similar span of time.

Rising sea levels are a long-term environmental change that can entirely inundate areas previously inhabited by ancient populations. A significant amount of research into the responses of human populations to rapidly changing sea levels has been performed in geographic regions around the world including throughout Europe, China, South Asia, Canada, North America, and the Philippines (Josenhans et al. 1997; Pawlik et al. 2014; Pope and Terrell 2008; Saunders et al. 2009; Turney and Brown 2007; Wang et al. 2012). In many of these investigations, sea level change resulted in substantial theorized response from ancient inhabitants using evidence found within the archaeological record. The investigation undertaken by Dr. Saunders and her colleagues analyzed a site that is in very close proximity to Western Lake and utilized a sea level chronology developed through methodologies similar to those used in this project to relate the rise of sea level to the occupational breaks at the Mitchell River 1 site (Balsillie and Donoghue 2004; Donoghue 2011; Saunders et al. 2009).

Periods of rapid sea level rise in the early-mid Holocene resulted in catastrophic flooding of Neolithic sites along the Mediterranean and Black Sea (Turney and Brown 2007). By mapping

archaeological site recordings along the coast of the Mediterranean and Black Sea and comparing calibrated radiocarbon dates taken from sites in the region, the authors conclude that significant flooding of coastal areas led to the displacement of potentially 145,000 individuals. These individuals migrated inland and eastward from the coast toward less flood-prone areas with access to coastal fresh water (Turney and Brown 2007:2040). In similar circumstances, investigations on the southern Yangtze delta plain, China, found that a period of rapid sea level rise and the subsequent formation of the freshwater-dominated Taihu Plain allowed for Neolithic settlement and the development of agriculture (Wang et al. 2012:61). Inundation of the costal floodplain by brackish water had previously made the area unsuitable for agricultural development. After sea levels began to recede, the progradation of the delta provided a wider ranging freshwater floodplain environment which allowed for the development of agricultural practices by the Neolithic people who migrated from coastal areas toward the upland floodplain in response to the rising sea level (Wang et al. 2012). In both cases, human response to the effects of rapid sea level change resulted in site abandonment, population migration, and changes in subsistence behavior.

Another instance of response to sea level rise can be seen on an archaeological site on St. Vincent Island in the North Peninsular Gulf Coast region of Florida (Donoghue and White 1995). The site was occupied for two distinct periods, which were separated by a period of inundation based on ceramics recovered from the site and the radiocarbon dating of shell materials (Donoghue and White 1995; 655). This shows that the site was abandoned as a result of sea level rise and a shift in the leading edge of the Apalachicola Delta, and then subsequently reoccupied once the high stand had subsided. This evidence is of particular importance within the context of this research project, because it occurs within the same geographic region and

timespan. This provides strong support for the assumption that archaeological cultures of Florida were capable of long term and periodic site abandonment as a result of environmental changes.

Flooding of coastal areas co-occurs as a result of both sea level rise and major storms. This flooding can modify the subsistence strategies of human populations who may lose access to low lying marshes and flats as a result of inundation. A prime example of this comes from an investigation on the islands of Ilin and Mindoro in the Philippines, which saw a shift in foraging strategies from primarily mangroves, rivers, and mudflats to environments of marine and brackish water (Pawlik et al. 2014:243). Materials from the earliest occupation of the site at 11,000 B.P. suggest that the initial subsistence of populations in the region relied on the foraging of mud crabs and bivalves from mangrove swamps and mudflats in addition to terrestrial snails (Pawlik et al. 2014:242). As sea levels rose over the next millennia, the ocean water inundation and flooding of the channels between the island lead to a development of marine and brackish water foraging strategy (Pawlik et al. 2014:242). The authors also suggest that this behavioral adaptation required only a modification of existing behaviors without the necessity for developing new technologies or techniques in response to changes in climate and environment (Pawlik et al. 2014:243).

2.2.3 El Niño

El Niño events are part of the El Niño-Southern Oscillation (ENSO), a recurring climatic pattern that occurs at irregular intervals of two to seven years, during which predictable disruptions of temperature, precipitation, and wind trigger a cascade of additional global side effects (NOAA, 2018). The intensity of these events varies considerably, as do their duration. Simultaneously, ENSO events cause increases in the air temperature and moisture content in some geographic regions and decrease it substantially in others.

In the Andes, warm phase ENSO events are typically associated with abundant precipitation, which can simultaneously lead to streambank erosion and the inundation of floodplains. Andean researchers demonstrate that the mitigation of floodplain inundation depends largely on the cultural behaviors, systems, and technologies of occupying human populations (Goldstein and Magilligan 2011). The Huaracane culture which occupied sites along the Moquegua Valley lived in close proximity to mid-valley floodplain and relied on a combination of agriculture fed by simple canals and a diverse secondary agrarian subsistence strategy of wild plants, land animal, and marine resources (Goldstein and Magilligan 2011:160). This strategy, though well adapted to typical decadal climatic trends, proved to be overly vulnerable to the intense flooding brought by an AD 700 "Mega-Niño," which had a less severe impact on both the Wari and Tiwanaku civilizations who utilized more complex up-valley terrace agricultural systems and whose sites were typically farther and more upland of the valley floodplain (Goldstein and Magilligan 2011). Additional Andean research revealed the convergence of two natural disasters: a severe drought from AD 1100-1500 and particularly severe ENSO event that immediately followed (Satterlee et al. 2000). The initial drought pressured human populations of the Osmore River region of southern Peru to favor high altitude reclamation as opposed to existing low altitude farming. Afterward, the consecutive flooding caused by the severe ENSO event washed out entire settlements in the lowland area and triggered significant pressure to shift away from the agrarian production favored as a result of the drought (Satterlee et al. 2000). Another example of the effects of convergent disaster events is discussed in regards to the Supe Valley of coastal Peru (Sandweiss et al. 2008). In this investigation, the authors posit that a series of earthquakes synergized with a subsequent ENSO event that caused the formation of the Medio Mundo beach ridge. The formation of this ridge

resulted in the inundation of agricultural fields and decreased availability of near shore fishing and gathering of marine resources (Sandweiss et al. 2008:1363).

In all of these investigations, the vulnerability to ENSO events is culturally specific, depending on the technologies, practices, and political complexities of ancient populations. Research into the Chumash hunter-gatherer societies of southern California emphasizes that diversified subsistence strategies are more flexible and adapt more easily to sudden environmental change brought about by droughts and ENSO events (Gamble 2005:98). Mobility, networks of exchange, and storage practices also aided in the resilience of the Chumash culture to drastic environmental change (Gamble 2005), all of which may additionally be factors in how populations are able to respond to individual major storm events, as well as periods of increased storm activity. Major storm events present similar environmental stressors to ENSO events in the form of excessive precipitation and flooding. For this reason, the adaptive strategies used to mitigate the impacts of ENSO events would also be useful in mitigating the same effects from major storms. Given the variability present in the adaptive strategies of ancient populations of the Florida coast, the response to periods of increased storminess will depend on the adaptive strategies utilized by the individual populations.

2.2.4 Risks of Environmental Determinism

Environmental anthropologists must always be wary of allowing their conclusions to be overly deterministic. However easy it may seem to attribute behavioral change in archaeological cultures to direct responses to environmental stimuli, it is important to remember the myriad of factors that influence human behavior outside the pressures of their environment. As stated by Mary Van Buren (2001:144), "The relationship between 'a society' and 'the environment' is not unitary but is characterized instead by a variety of interactions that involve different kinds of

people, motivations, resources, places, and outcomes." Not only are the responses to environmental changes variable due to cultural complexities and human decision making, but often deterministic approaches centered around paleo-environmental data lack knowledge of the complex interactions between individual environmental shifts and larger ecological systems (Jia 2013:77).

Deterministic approaches are not without their utility, and a resurgence of environmental determinism within recent years has continued to advocate for the impacts of environmental change on the prehistoric human behavioral change (Livingstone 2012). Especially in the area of research concerning human evolution, numerous hypotheses have proposed that climate-driven environmental changes were driving forces in the increases in human brain size and cultural complexity (Calvin 2002), as well as bipedality, behavioral adaptability, cultural innovations, and intercontinental immigration events (Livingstone 2012:566). While this project will not settle the issue of whether major storm events and/or periods of increasing storm frequency and intensity are solely responsible for the abandonment of Florida coastal archaeological sites or significant shifts in human subsistence and migratory behavior, it is hoped that the high-resolution storm chronology data may provide solid evidence for explaining human adaptive behavior in coastal environments.

2.3 Conclusions

The investigations described above underscore specific phenomena as key evidence for correlating environmental change with human response. There is a broad range in potential response, especially considering the vast differences in cultural behavior that exists within archaeological cultures of the coastal Florida region. The most common responses identified in these investigations fall into two categories. The first is settlement abandonment, which has been

argued above to be the result of environmental changes in response to major storms, ENSO events, and sea-level rise. In each case, when the pressures of environmental or climatic change became too insurmountable to be mitigated by less drastic cultural changes or existing technologies, settlements were ultimately abandoned, or relocated to more hospitable areas.

The second type of response is modification of subsistence strategies. Food procurement is a necessity to the survival of human populations, and the stressors brought by changing climate may incentivize the prioritization of specific food resources, and disadvantage others. This can be seen occurring within a distinct population, such was the case in Tikopia (Firth 1959), or at a broader regional level. Regional changes in subsistence practice that occur during the transitions from one cultural period to another may also be related to environmental stressors, which catalyze these changes by decreasing resource availability.

These two types of responses are prioritized in the analysis below. Periods of settlement abandonment are inferred from large gaps in time between dated materials within a region or within individual sites, so long as the sites have a robust set of radiometric dates. Subsistence change is more difficult to identify. The scope of this project focuses on the broader regional transitions of cultural periods and their associated changes in subsistence behavior.

3. MATERIALS AND METHODS

This research project was focused on analyzing sedimentological data and comparing it against the current regional archaeological record in order to assess any potential correlations between behavioral change in ancient human coastal populations and periods of increased storminess. Three distinct methods are used to produce and analyze the data necessary for this investigation. From a geological perspective, the sediment grains from 5 lake bed sediment cores were analyzed using a suite of diagnostics for the particle size and particle size distribution. Then, archaeological sites were scoured for robust radiometric dates in order to form a chronology of occupation at the intra-site and regional level for the geographic areas surrounding the sediment core locations. Lastly, GIS was used to map the locations of dated archaeological sites to determine which sites fell within the boundary of storm impact and to sort archaeological sites within these parameters by their nearest sediment core location.

In order to understand the effects that hurricanes may have had on ancient people, we have to be able to retrodict when and where major storms occurred. The primary components of this research project involved retrieving and analyzing sediment cores from coastal lakes in order to determine the particle-size distribution and age of each horizon of the core. After each layer of the core was run through the particle analyzer, the output was aggregated into a core profile and further studied for anomalies and distinct characteristics that allow a chronology of stormy periods to be created for the area surrounding each of the sampling locations. The chronology of stormy periods is then compared against occupational chronologies of archaeological sites in the surrounding area that would likely have been affected by the hurricanes that impacted the lakes. If there is any correlation between periods of storminess and behavioral changes in the

archaeological culture, including settlement abandonment and subsistence change, these environmental data may provide powerful explanations for cultural responses to changes in storm frequency by ancient coastal Floridians.

3.1 Field Methods

The selection of coastal lake sampling sites was based on a multitude of criteria to ensure that they provided accurate sedimentological data. Lakes needed to be naturally formed and generally be at least a few thousand years old. There needed to be a continuous record of deposition in their bottom sediments. Age information may not be readily available, and as such cores were sampled immediately after extraction to determine the age of the lake at the oldest interval of the core. A sample of bulk sediment was normally taken from the bottom few centimeters of the core and sent to be radiocarbon dated. The results provided an approximate maximum age for the core. Additionally, the lake salinity must be low enough to ensure that there is no direct connection between the lake and the ocean. If the salinity levels are found to be at marine levels, then a storm surge will not result in any change in the stable isotope ratios. A salinometer was used to test whether the salinity of the lake was less than marine, i.e., below 35 ppt. (parts per thousand). Lastly, lakes had to be accessible by boat and the bed of the lake needed to be reasonably clear of vegetation. If the lake could not be accessed by boat, then the only alternative was to wade to the center of the lake, provided that it was shallow enough to do so. The cores taken for this project are from two lakes on Merritt Island as well as Western Lake near the Choctawhatchee Bay, Mullet Pond in the northern Florida panhandle and another in Cedar Key on the central Florida Gulf coast. The locations of these ponds are shown in **Figure 1**.

The cores are extracted from the lake bed using a Livingstone/Bolivia-type drive rod piston corer as well as a pole-mounted valve corer. The cores are 2 ¾” (6.99 cm) inner diameter

and approximately 1 meter in length. The length is determined by the amount of sediment that the corer can be pushed through by hand, as well as the maximum length of the coring tube, which is approximately 125 centimeters. The 2 ¾” diameter ensures that there is a large enough volume of sediment for the several laboratory analyses. Lakes have varying sedimentation rates which may affect the length of the core.

After the cores are extracted, they are sealed within the coring tube, transported to the laboratory, and placed in a freezer for storage to await laboratory analyses. Freezing the cores prevents bacterial growth and ensures that the sediment will remain in place between sampling.

Each core is given an identification number that represents the day, month, and year it was extracted, as well as numbered chronologically in cases where multiple cores were extracted from the same location. The number, title, location, and length for the identification of the 5 sediment cores used for this project is in chronological order and are as follows:

Table 4. Information regarding the number, name, date, location, length, and archaeological region for each sediment core.

Core Number	**Core Title**	**Date Extracted**	**Core Location (DMS)**	**Core Length**	**Region**
092315-01	Merritt Island-Clark Slough	9/23/2015	28° 39' 27.72" N, 80° 40' 4.8" W	72.0 cm	East and Central
010516-01	Merritt Island-Circular Pond	1/5/2016	28° 41' 16.14" N, 80° 46' 2.34" W	90.0 cm	East and Central
052416-01	Mullet Pond	5/24/2016	29° 55' 31.08" N, 84° 20' 16.26" W	82.5 cm	Northwest
052516-01	Western Lake	5/25/2016	30° 19' 28.74" N, 86° 9' 0.78" W	110.0 cm	Northwest
070617-02	Cedar Key	7/6/2017	29° 29' 49.134" N, 83° 5' 53.532" W	54.6 cm	North Peninsular Gulf Coast

3.2 Laboratory Methods

In the lab, the cores are cut into two halves down the length of the core using a circular saw. A thin wire is used to separate the halves before pulling them apart, ensuring that the two halves will not stick together. The half-cores are photographed, measured, and then frozen so that they can be stored without further disturbing the sediment layers. One of the two halves was sent to the geochemistry lab of Dr. Yang Wang at Florida State University for stable isotope analysis. There, the cores are sampled at approximately 2-millimeter intervals and subjected to isotopic analyses in order characterize the geochemical signature of the core at each interval. Heavy isotopes of nitrogen and carbon are taken as indicators of incursion of marine water into the lake during storm events. The second half of the core is sampled at approximately 3-mm intervals for particle size analysis.

The core is separated into individual 3-mm layers, which is the finest interval that can be sampled from the core by hand. The top and bottom depth of each sample layer is recorded, as well as the total wet weight for each sample. The samples are then placed in an oven at 50 degrees C to dry. From there, the samples are cooled and reweighed in order to determine the percent moisture content of the core. The samples typically weigh between 2 and 10 grams depending on the types of sediment and the percentage of moisture. The dried samples are then disaggregated and suspended in a dispersant solution (5% sodium hexametaphosphate) before being run through a Cilas 1190L laser particle-size analyzer (PSA). Each sample is run through the analyzer a minimum of two times to ensure that the measurements are repeatable. The output of the PSA is stored in a template file that calculates a multitude of statistics, including the percentages of sand, silt, and clay, the mean, the standard deviation (sorting), the skewness, and the average particle diameter at distinct cumulative percentages of the sample particle size

distribution.

3.3 Sediment Profile Data

Analysis of each sample from the sediment cores is conducted to detect anomalies indicative of periods of storminess. Past research has shown that during major storm events, storm surge overwash deposits layers of coarse sediment into the beds of coastal lakes. These layers are preserved within the sedimentation of the coastal lakes in which they are deposited and can act as a proxy record of catastrophic hurricane strikes that occurred from the historical record back through the late Holocene (Liu and Fearn 1993; Liu and Fearn 2000; Donnelly et al. 2001; Donnely et al. 2004).

The output of the particle size analysis provides quantitative data on 27 different parameters for each sediment sample. These parameters are shown below in **Table 5.**

Table 5. 27 Statistics plotted for each sample of each sediment core

Measured Statistic	Observation	Units
Percentage of total sample volume containing particles greater than or equal to very fine sand	Percentage of Coarse Sample	µm
Percentage of total sample volume containing particles less than or equal to clay	Percentage of Coarse Sample	µm
Percentage of total sample volume containing particles within the range of silt grain size	Percentage of Coarse Sample	µm
Percentage of total sample volume containing particles greater than or equal to silt	Percentage of Coarse Sample	µm
Graphic mean grain size recorded in phi units	Coarseness of total sample volume	φ
Graphic standard deviation for mean grain size recorded in phi units	Width of Distribution	φ
Graphic Skewness	Width of Distribution	
Moment mean grain size recorded in phi units	Width of Distribution	φ
Moment standard deviation for mean grain size recorded in phi units	Width of Distribution	φ
Moment skewness	Width of Distribution	
Cumulative percentage of total sample volume less than or equal to 3.9 microns	Distribution of sample by maximum particle size	%
Cumulative percentage of total sample volume less than or equal to 63.0 microns	Distribution of sample by maximum particle size	%
Cumulative percentage of total sample volume less than or equal to 125.0 microns	Distribution of sample by maximum particle size	%
Cumulative percentage of total sample volume less than or equal to 250.0 microns	Distribution of sample by maximum particle size	%
Particle size diameter at 5 percent of the total sample volume in microns	Mean particle size by cumulative sample volume	µm
Particle size diameter at 10 percent of the total sample volume in microns	Mean particle size by cumulative sample volume	µm
Particle size diameter at 16 percent of the total sample volume in microns	Mean particle size by cumulative sample volume	µm
Particle size diameter at 50 percent of the total sample volume in microns	Mean particle size by cumulative sample volume	µm
Particle size diameter at 84 percent of the total sample volume in microns	Mean particle size by cumulative sample volume	µm
Particle size diameter at 90 percent of the total sample volume in microns	Mean particle size by cumulative sample volume	µm
Particle size diameter at 95 percent of the total sample volume in microns	Mean particle size by cumulative sample volume	µm
Particle size diameter at 98 percent of the total sample volume in microns	Mean particle size by cumulative sample volume	µm
Particle size diameter at 5 percent of the total sample volume in phi units	Mean particle size by cumulative sample volume	φ
Particle size diameter at 16 percent of the total sample volume in phi units	Mean particle size by cumulative sample volume	φ
Particle size diameter at 50 percent of the total sample volume in phi units	Mean particle size by cumulative sample volume	φ
Particle size diameter at 84 percent of the total sample volume in phi units	Mean particle size by cumulative sample volume	φ
Particle size diameter at 95 percent of the total sample volume in phi units	Mean particle size by cumulative sample volume	φ

These data are aggregated into depth plots, which display the depth of each sample along the y-axis in millimeters, and the measurement recorded for the specified parameter. The mean and standard deviations are generated for each of the plots, and then each plot is visually assessed in order to determine anomalies that can be interpreted as storm periods. The plots are also assessed side-by-side to determine if these anomalies co-occur across several of the 27 parameters. The depth for each of these anomalies is recorded and used in a linear age-depth model to determine the age of each sample and the corresponding anomaly. The depth and age of several radiocarbon samples from each core are plotted and the model generates a best fit line representing a calculation for determining the age of an anomaly given its depth.

Geosoft Oasis Montaj, a program for mapping and gridding geologic data, is used to

create a 3-dimensional representation of the particle distribution of the core. The depth of the sample in the core, the range of particle size intervals, and the total percentage of sample volume at each of the particle size intervals are displayed in a profile down the length of the core. The result is used to aid in visually identifying periods of storminess over the geologic history of the core. Periods of storminess are in general identified as having broader particle size distributions (larger sorting value) as well as having larger percentages of coarser sediments. These are easily observed in the 3-dimensional Geosoft images.

3.4 Geochronology

Two types of analyses were employed to date sections of the core at varying intervals of depth. Organic sediment samples from varying depths of the cores were sent to the National Ocean Sciences Accelerator Mass Spectrometry (NOSAMS) lab for Accelerator Mass Spectrometry (AMS) radiocarbon dating. When available, additional samples of wood and shell were extracted from the core by Dr. Wang at the Florida State University lab. These samples were also radiocarbon-dated and provide additional age control for some of the core intervals.

Gamma spectrometry is also utilized to date samples from the top approximately 30 centimeters of each core. After the core has been sampled and analyzed using the Cilas-1190L, the remaining sample material for the top 30 centimeters of the core were placed into 47-millimeter petri dishes and analyzed in a gamma spectrometer. Analysis time is typically two days. The results of the gamma spectrometry were used in developing lead-210 and cesium-137 chronologies, which cover the past 100-plus years.

The final aspect of this project was to compare the storm chronologies generated in the lab against occupational chronologies of archaeological sites near to the lakes where the cores were extracted. Closer sites were obviously more advantageous, but a maximum distance of 135

kilometers was used to infer that the archaeological sites would have been similarly impacted by paleostorms that have impacted the coastal lakes (Keim and Muller 2007). This impact radius is used based on investigations detailing that storms of category 3 and above will maintain hurricane level wind speeds 135 kilometers outward from their center on average (Keim and Muller 2007). Additional variables were considered when determining the potential effects of ancient hurricanes on the behaviors of ancient coastal people. Differences in the surrounding ecology for each site may determine how the site was impacted by major storms. Cultural practices may have also played a role in the response of site inhabitants. Their various participation in trade, migration, and their perception of space may all potentially contribute to how each group responded to hurricane disasters, and individuals within each population may have been differentially affected based on political and socioeconomic standing (Nix-Stevenson 2013).

3.5 Coastal Mapping Using GIS

The Florida Master Site File (2018) was used to georeference the locations of archaeological sites for this research project. The Florida Master Site File contains a large number of sites in GIS shape files. Contained within the shape files are data describing the location, name, and size of each archaeological site, as well as a description of the types of features and materials recovered from the site, and the corresponding archaeological cultures assumed to have occupied the site at different points in time.

QGIS 3.2.0 was used to plot the coordinates of the 5 sediment core locations used to generate the storm chronology for this project. After plotting the 5 points on a coastline base map, a polygon with a radius of 135-kilometers was used to map the impact radius of major storms centered on each of the 5 coordinate points. Each of these polygons represent the

maximum boundary for archaeological sites that would be affected by storms centered on the coordinates of the sediment core locations.

An elevation contour for the state of Florida (Florida Department of Environmental Protection 2018) was used to generate an elevation boundary representing areas of coastal Florida that were less than or equal to 25 feet above sea level and greater than 0. This area represents the coastal zone of Florida that is most vulnerable to the effects of major storms, given that the relative maximum for storm surge of recorded modern storms impacting the Southeast United States is approximately 25 feet, not accounting for tidal fluctuations (National Hurricane Center 2018). By intersecting polygons representing the 135-kilometer storm impact radius with the elevation model, I generated an area of interest for archaeological sites that would be most likely impacted by the effects of major storms. The resulting shape file was then used to trim the Master Site File to reveal only archaeological sites that simultaneously fall within the impact radius of one or more of the 5 sediment core locations and has an elevation equal to or below 25 feet above sea level. This site boundary is shown in **Figure 3** below.

Figure 3. The boundary of interest for coastal Florida archaeological sites based on their elevation and proximity to the 5 sediment core locations.

The final step in mapping the archaeological sites was to determine the distance between the locations of each individual archaeological site and its nearest sediment core location. This allowed me to correctly sort archaeological sites based on their nearest core location, as well as determine the distance for each site in order to ensure that each site recorded fell within the 135-kilometer storm impact radius for the sediment core locations. Using QGIS, I ran a vector analysis to create a singular vector connecting each archaeology site to the nearest coordinate

location of one of the sediment core extraction points. The length of this vector is measured in kilometers and represents the distance between the two points. The results can be observed in **Figure 4** below. These distances are also recorded in **Tables 21-24** for the recorded occupation dates for each core location.

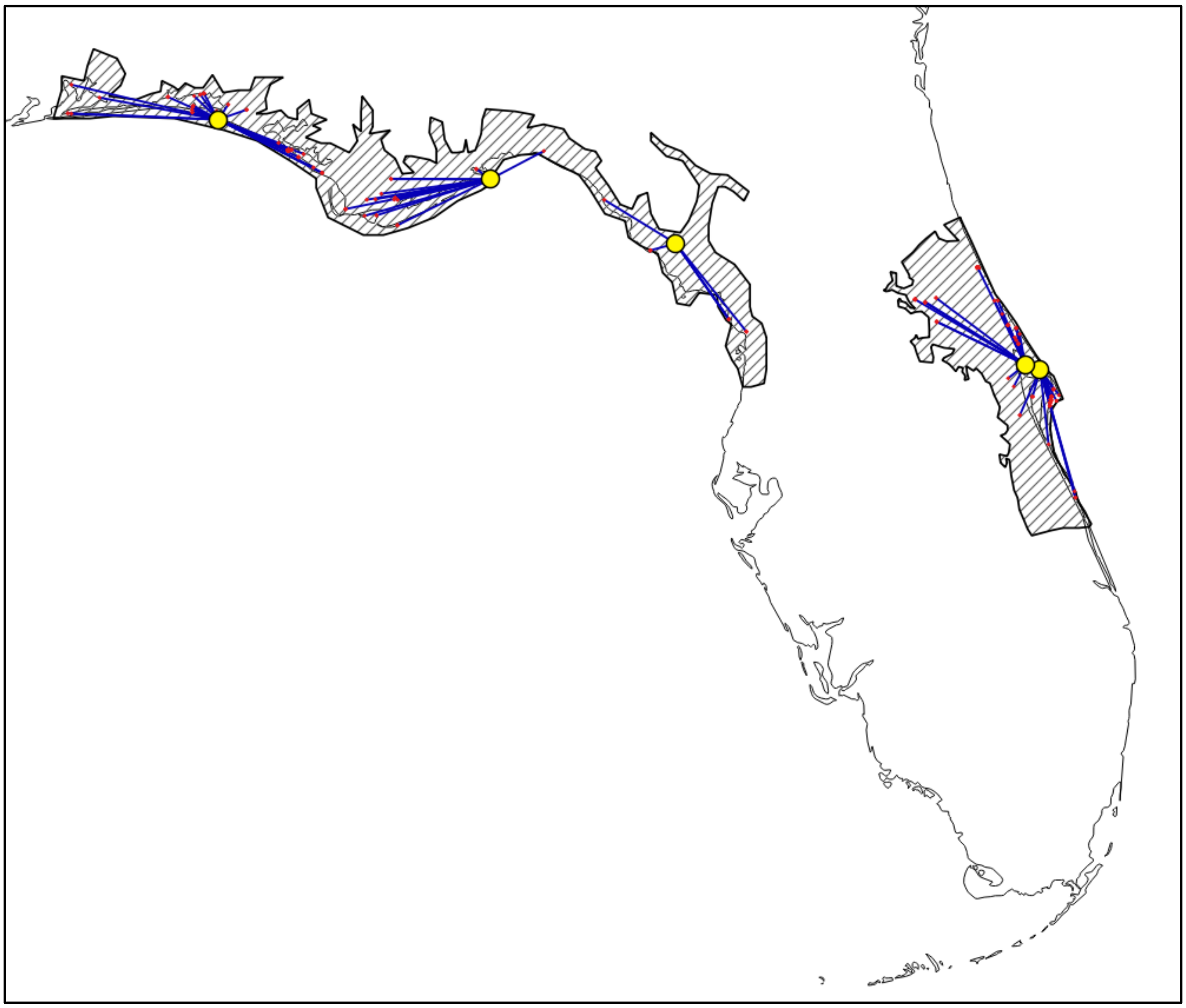

Figure 4. Distance vectors (blue) of archaeological sites (red) within the elevation and proximity boundary.

3.6 Historic Storm Compilation

The historic record was used to develop the methodology for determining the signatures of pre-historic storm periods. First, historic storms that impacted the coastal regions of Florida where the cores were collected were compiled from the NOAA Historic Storm Database. After determining the dates and locations of historic storms, sediment samples which are identified as being the same age as the storm events are analyzed for their particle size and particle size distribution signature.

Using the particle size signature generated by the historic storm periods, anomalous sediment samples which have similar particle size signatures can be identified as potential periods of storminess. This method allows us to determine the presence of storm periods for each of the coastal lakes, which may have different sediment compositions and environmental circumstances that affect the particle size and particle size distributions of their lake bed sediment.

3.7 Data Collection

In order to observe periods of abandonment within the archaeological record of coastal Florida, it was necessary to aggregate the largest possible sample of robust dates. This was achieved in several steps.

First, the Master Site File dataset was used to determine the total list of all archaeological sites within the elevation and proximity boundary. Each object contained within the shapefile provides a site name and site ID. Therefore, dates present in the archaeological literature that reference sites matching either of these parameters will have been predetermined to fall within the boundary of this research project.

The next step was to comb the archaeological literature for any published articles which

contain dated archaeological materials for coastal Florida archaeology sites. There is a large degree of variance in the coverage of archaeological sites along the Florida coast as well as a disparity in the focus of archaeological investigations. Using only the data found within the accessible published literature, it was impossible to build a reliable dataset of dated archaeological sites. Nonetheless, I aggregated as many robust dates from the published literature as I was able to find and identified which of the archaeological sites from the published literature matched either the site names or site IDs of the sites within the Master Site File.

For locations where published archaeological data were scarce, I was able to contact archaeologists who work within the region to acquire data outside of the accessible published literature. Specifically, for the region surrounding the 052416-01 Mullet Pond core, I was given archaeological data for sites near and around the Apalachee Bay by Dr. Nancy White. For the area surrounding Merritt Island, which represents cores 092315-01 and 010516-01, I was sent unpublished radiocarbon dates collected during the research projects of Tom Penders on the Cape Canaveral Air Force Station located on Merritt Island. Both of these datasets were parsed for sites contained within the boundary of interest.

The remaining archaeological dates were sourced from a dataset collected by Dr. Steve Dasovich for his M.A. thesis at Florida State University (Dasovich 1996). The data from this collection process was gathered primarily by contacting individual researchers and institutions in order to obtain their radiocarbon datasets or to grant permission for the data to be released by the laboratory responsible for running the dates (Dasovich 1996:10). The dataset contained hundreds of additional dates that fell within the site boundary and significantly improved the sample size for areas that were otherwise sparsely dated.

In all datasets collected for this investigation, the measurements recorded reflect the

uncalibrated and uncorrected radiocarbon results. This ensures that all calibrations and corrections performed after the fact are consistent and utilize the same method of calibration.

4. RESULTS

The methodology described in the previous chapter provides two distinct data sets which will be reported in this chapter. The first dataset listed addresses my initial research question: During what periods, if any, were the northwest, Gulf coast, and central east coast regions of Florida affected by hurricane activity in the precolumbian era? For each region, the relevant cores will be identified. Each core will have its depth converted to an age using a linear regression of radiocarbon samples taken from various sample depths. This will demonstrate how the dates of each detected storm anomaly will be dated. The parameters used to detect these anomalies, which are indicative of periods of increased storminess, will be displayed as sediment profile plots, representing the aggregate values of a single parameter for each sediment sample taken from the given core.

The second dataset describes the dated archaeological materials within each of the three archaeological regions of the Florida coast relevant to this project. Each set will be displayed as a frequency distribution that shows the age range of the dated materials for each region and the number of materials dated to a specific interval within that range. This reveals the gaps in the archaeological dates that are treated as periods of settlement abandonment for the purposes of this project.

The combination of these two datasets allows me to address my second research question: Is a human response to hurricane disasters observable in the archaeological record? If there are correlations between storm activity and settlement abandonment, then we will observe a staggering effect between dated archaeological materials and periods of increased storminess. Visually, we should see that storm periods occur during gaps in occupation, as opposed to

occurring during occupations. Additionally, if there were behavioral changes made by populations in response to the effects of major storms, then we should see evidence of these changes occurring during or following periods of increased storminess. As I will demonstrate, there are several noticeable patterns that emerge when comparing the chronology of storm periods against the occupational periods generated from the archaeological record.

4.1 Storm Histories of The Florida Coast

Observed anomalies in the 5 sediment cores were used to determine periods of storminess within the 135-kilometer radius of each of the coastal lakes. Anomalies within the sediment cores in which the parameters recorded for a sample show a distinct trend towards an increase in average particle size diameter and wider particle size distribution are correlated with increases in climatic energy and are therefore indicative of periods of storminess. In general, larger particle size diameter and wider particle size distributions should be evident within one or more of the sediment profile plots. The lake bed sediment from which the cores were taken vary in terms of the average size and distribution of sediment particles. For this reason, several plots are generally used in conjunction to determine where the anomalous layers lie. Depending on the contents of each lake bed, these anomalies will be more or less apparent when observing specific parameters. The sediment plots shown throughout this section are those which best visualize these anomalies. The plot representing the percentage of particles greater than or equal to the diameter of sand (shown as Sand%) is shown for all sediment cores. Additional supplementary plots are used, when appropriate, to demonstrate that the peaks occur across several parameters.

4.1.1 East and Central Florida

Two sediment cores are located within the East and Central region of Florida. The first of the cores to be extracted was core 092315-01 Merritt Island-Clark Slough from a coastal lake

just south of Clark Slough (see **Table 4**). Radiocarbon dates were taken from 3 depths of the core in order to model the age-depth formula for our sampling. The depths and ages of these samples are recorded in **Table 6.** A linear model with a y-intercept of 0 generated a best fit age-depth formula of $y = 0.0097x$, which was used to generate the ages of all periods of storminess recorded in **Table 7**. The plot of this linear regression is shown in **Figure 5**. A total of 16 periods of storminess were identified within core 092315-01 by recognition of increases in particle size using primarily the parameters of percentage of total sample volume of very fine sand grain size (62.5 microns) and larger (shown in **Figure 6**), as well as percentage of total sample volume of silt grain size (3.9 microns) and larger (shown in **Figure 7**). The profile in **Figure 7** was especially necessary for identifying particle size increases that deviated from the mean by at least 1 standard deviation.

The storm periods are identified by a comparison of their sediment profile plots. The 16 periods of storminess chosen for this core represent those which meet the criteria for being indicative of periods of storminess. Peaks in the sediment profiles which are visible in both percent sand (**Figure 6**) and combined percent sand and silt (**Figure 7**), especially those which are greater than one standard deviation from the mean, or significantly greater than their nearest neighbor measurements are used to infer the presence of these 16 storm periods

Table 6. Raw radiocarbon dates for samples taken from core 092315-01 Merritt Island-Clark Slough.

Radiocarbon Samples for Core 092315-01	
Depth (mm)	Age (yr BP)
68	0
270	1400
410	2770
545	4220
642	8130

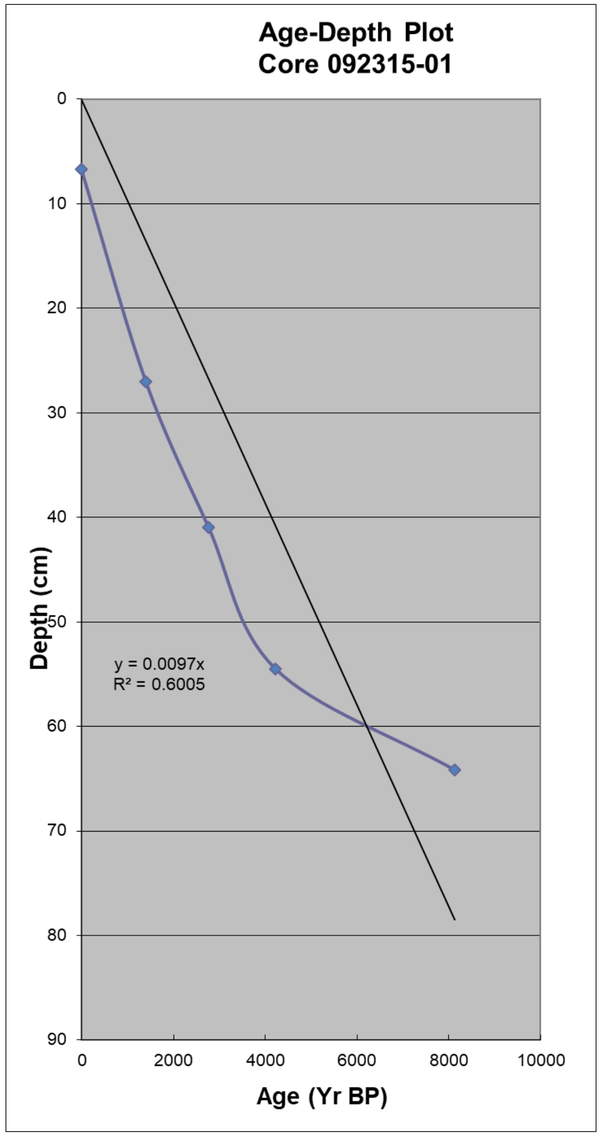

Figure 5. Linear regression for the 092315-01 core.

Table 7. Ages of storm periods recorded for core 092315-01 Merritt Island-Clark Slough. Calculation results are rounded to the nearest 10 years to generate the age estimate in yr BP.

092315-01 Merritt Island - Clark Slough	
Core Depth (mm)	**Age (yr BP)**
90.9	940
144.5	1490
179.2	1850
191.8	1980
226.5	2340
232.8	2400
276.4	2850
303.7	3130
330.5	3410
407.2	4200
451.4	4650
498.7	5140
539.7	5560
571.3	5890
602.8	6210
716.3	7380

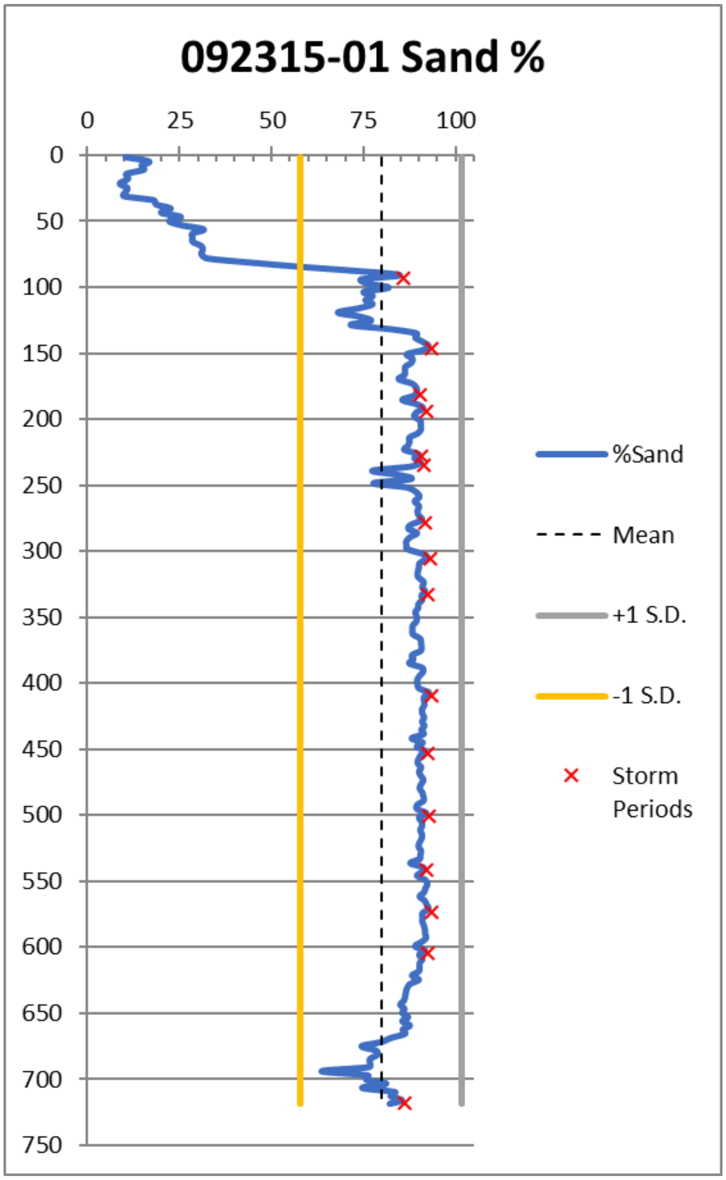

Figure 6. Sediment profile for core 092315-01 displaying the percentage (x-axis) of total sample volume containing particles of grain size greater than or equal to very fine sand (62.5 microns) along the depth of the core in millimeters (y-axis).

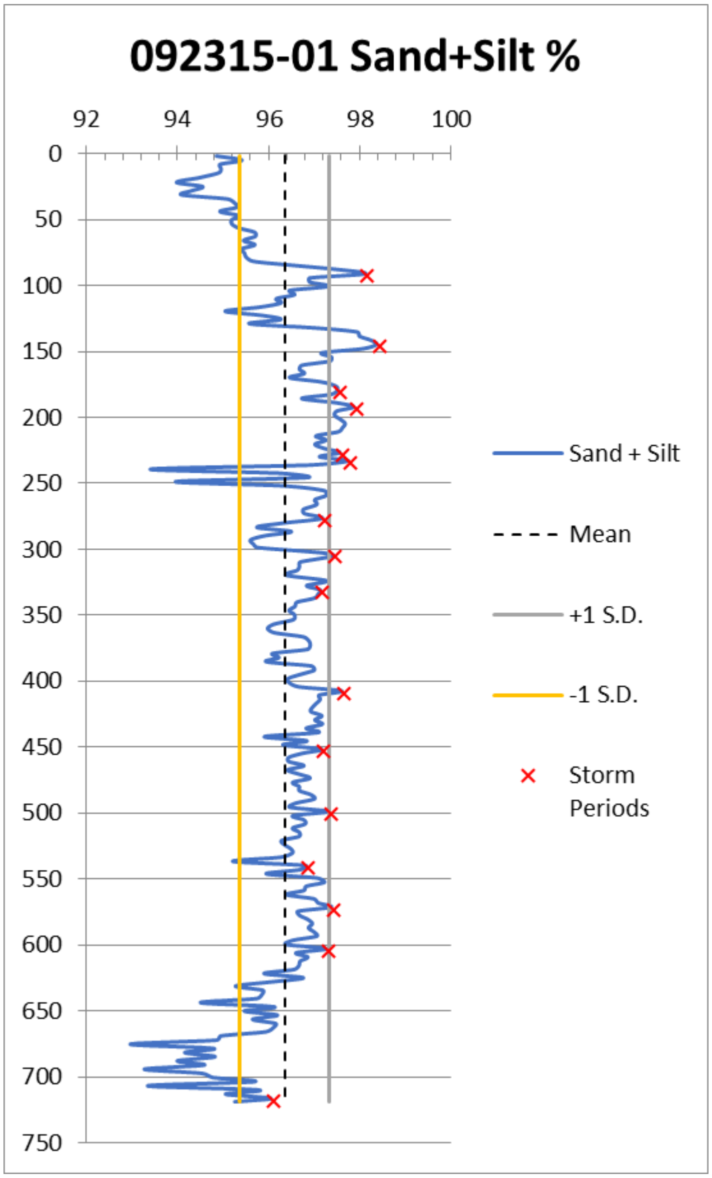

Figure 7. Sediment profile for core 092315-01 displaying the percentage (x-axis) of total sample volume containing particles of grain size greater than or equal to silt (3.9 microns) along the depth of the core in millimeters (y-axis).

The second core for the East and Central region of Florida was core 010516-01 Merritt Island-Circular Pond (see **Table 4**). Radiocarbon samples were taken from sediment organic carbon at 4 depths of the sediment core in order create an age-depth model. These depths and ages of these samples are recorded in **Table 8**. A linear model with a y-intercept of 0 generated a

best fit age-depth formula of y = 0.0114x which was used to generate the calibrated ages of all periods of storminess recorded in **Table 9**. The plot of this linear regression is shown in **Figure 8**. A total of 20 periods of storminess were identified within core 010516-01 by recognition of increases in particle size using primarily the parameter of percentage of total sample volume of very fine sand grain size and larger (shown in **Figure 9**).

The standard deviations for this parameter were exceptionally wide, and additional plots were used to compare and assess anomalies found within the primary parameter, including: percent clay, moment skewness, and graphic skewness. These additional plots are shown in **Figure 31**. Peaks which were maintained across these profile plots were used to determine the presence of the 20 periods of storminess.

Table 8. Raw radiocarbon dates after for samples taken from core 010516-01 Merritt Island-Circular Pond.

Radiocarbon Samples for Core 010516-01	
Depth (mm)	**Age (yr BP)**
65	470
260	3,550
384	4,300
760	5,030

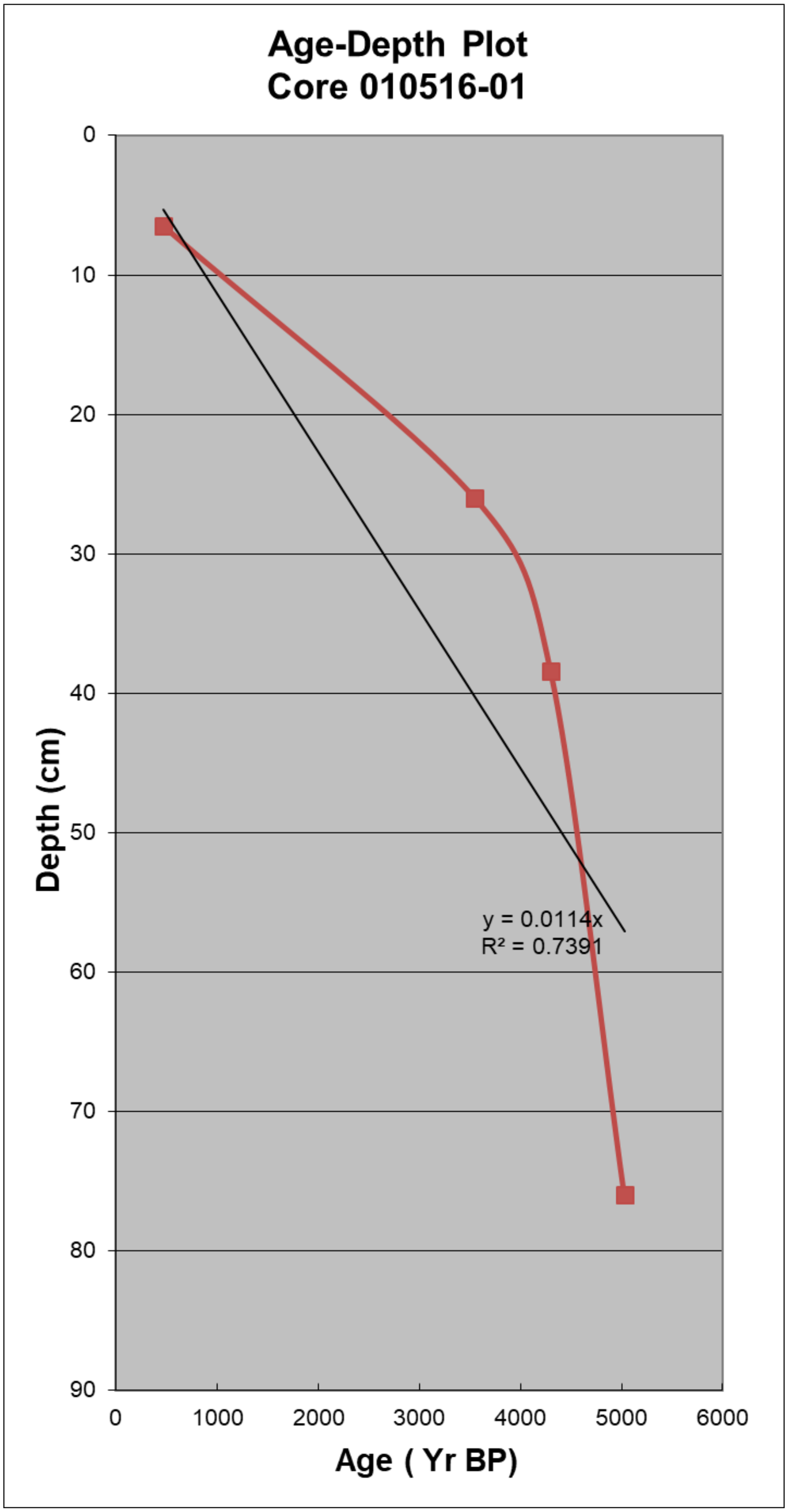

Figure 8. Linear regression for the 010516-01 core.

Table 9. Ages of storm periods recorded for core 010516-01 Merritt Island-Circular Pond. Calculation results are rounded to the nearest 10 years generate the age estimate in cal yr BP.

010516-01 Merritt Island - Circular Pond	
Core Depth (mm)	**Age (yr BP)**
85	740
95	830
190	1670
216	1890
248	2180
257	2250
450	3940
460	4030
478	4190
552	4840
606	5310
615	5390
624	5470
649	5690
764	6700
776	6810
795	6970
810	7190
820	7620
869	740

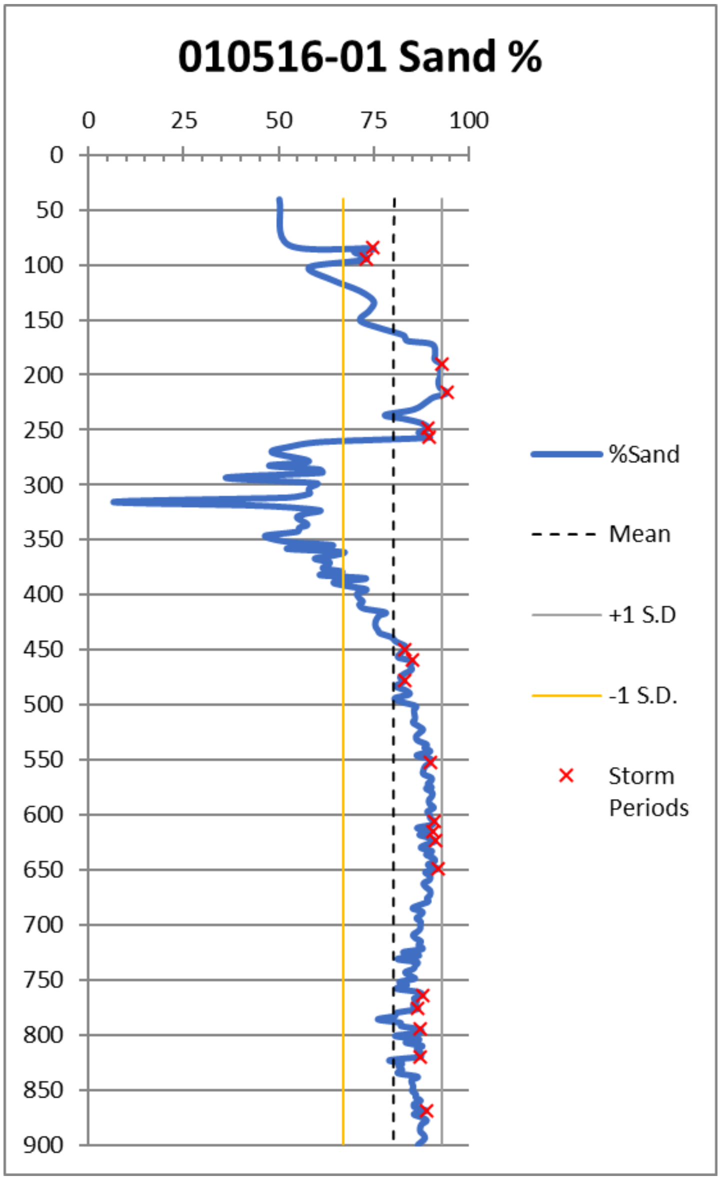

Figure 9. Sediment profile for core 010516-01 displaying the percentage (x-axis) of total sample volume containing particles of grain size greater than or equal to very fine sand (62.5 microns).

4.1.2 Northwest Florida

Two cores are located within the Northwest region of Florida. The first is core 052416-01 Mullet Pond (see **Table 4**). A total of 14 radiocarbon samples were taken. Of these 14, 6 were taken from organic sediment, 4 were taken from plant fragments, and 4 were taken from grass/twigs found within the sediment core. The ages and depths of these samples are recorded in **Table 10**. A linear model with a y-intercept of -80.324 generated a best fit age-depth formula of $y = 0.105x - 80.324$ which was used to generate the calibrated ages of all periods of storminess recorded in **Table 11**. A plot of this linear regression is shown in **Figure 10**.A total of 22 periods of storminess were identified within core 052416-01 by recognition of increases in particle size using primarily the parameters of percentage of total sample volume of very fine sand grain size and larger (shown in **Figure 11**) as well as Particle size diameter at 50 percent of the total sample volume in microns (shown in **Figure 12**).

Table 10. Raw radiocarbon dates for samples taken from core 052416-01 Mullet Pond.

Radiocarbon Samples for Core 052416-01	
Depth (mm)	**Age (yr BP)**
15	645
54	905
60	870
188	860
188	1100
274	1,230
308	1,075
440	1085
524	1,320
638	1330
784	1,520
833	1,440
945	1565
945	1665

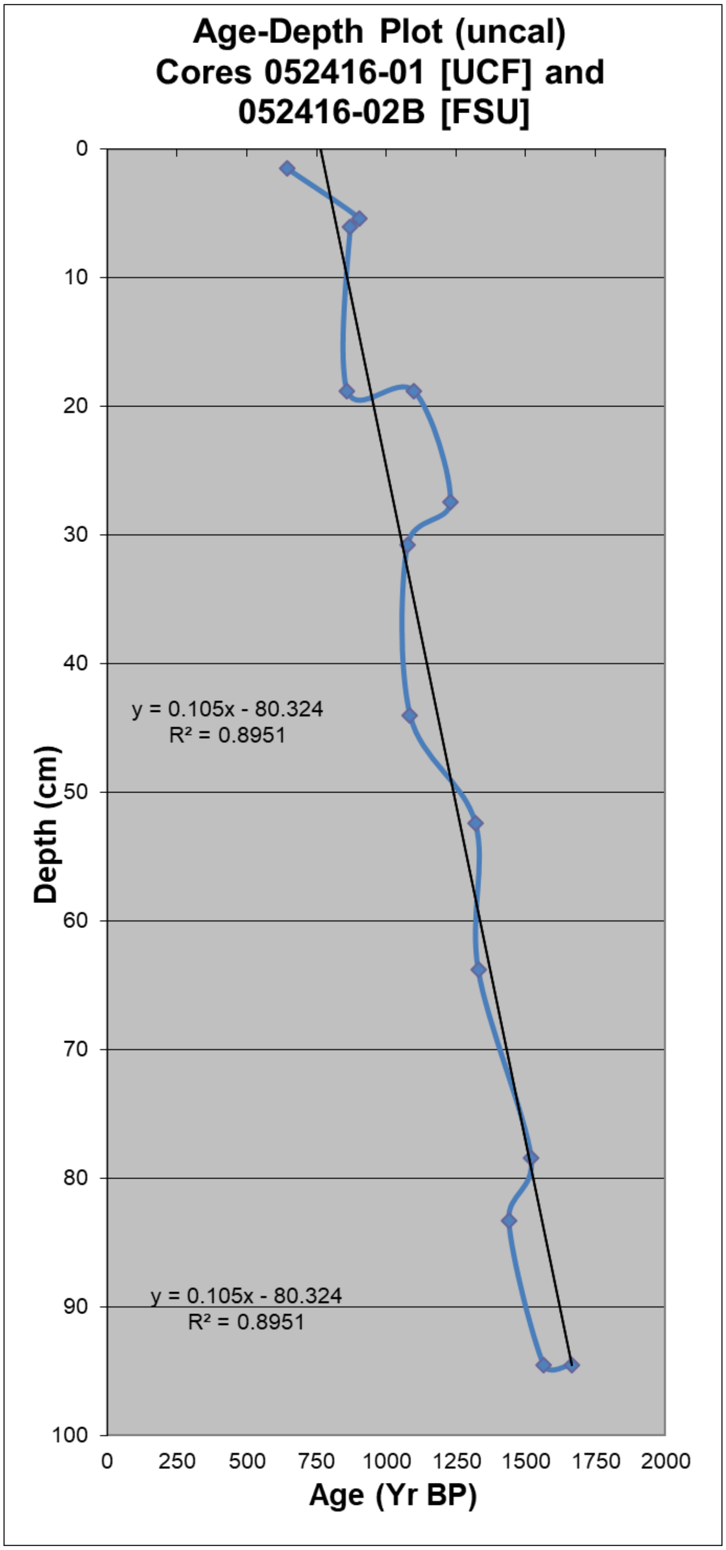

Figure 10. Linear regression of the 052416-01 core.

Table 11. Ages of storm periods recorded for core 052416-01 Mullet Pond. Calculation results are rounded to the nearest 10 years generate the age estimate in yr BP.

052416-01 Mullet Pond	
Core Depth (mm)	**Age (Cal yr BP)**
144	780
153	790
162	790
208	830
237	850
314	920
320	920
338	940
357	950
494	1070
502	1080
511	1090
520	1090
587	1150
677	1220
697	1240
718	1260
733	1270
739	1270
745	1280
786	1310
798	1320

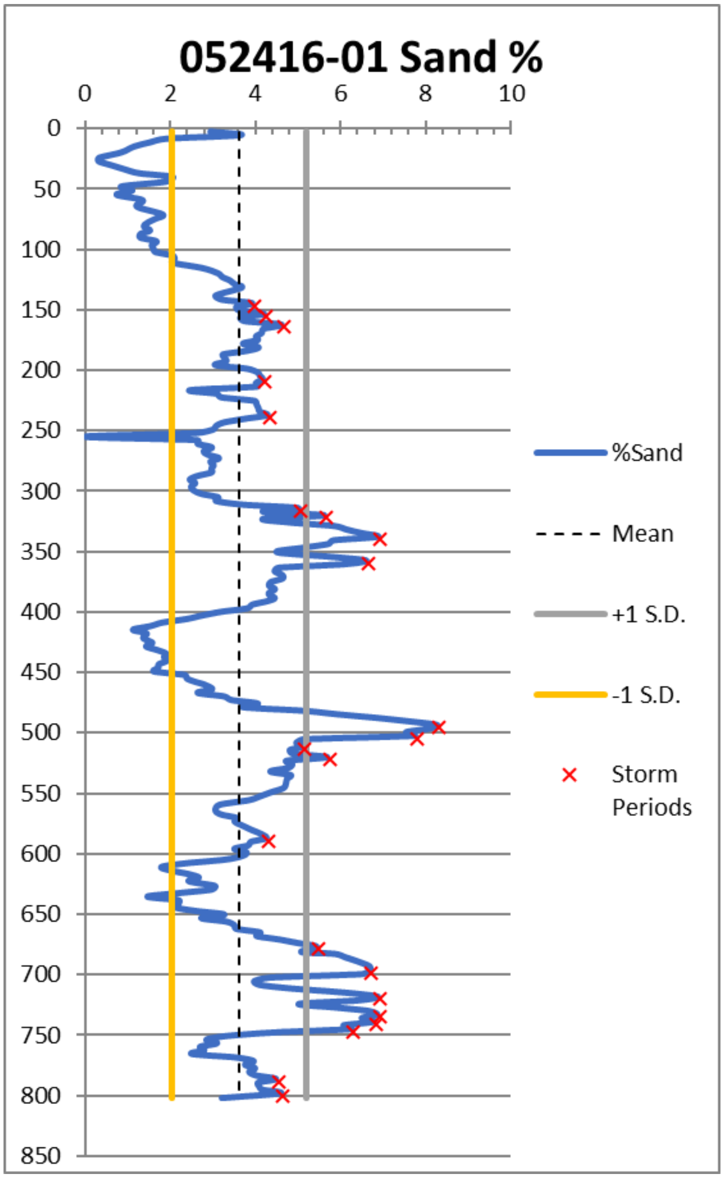

Figure 11. Sediment profile for core 052416-01 displaying the percentage (x-axis) of total sample volume containing particles of grain size greater than or equal to very fine sand (62.5 microns).

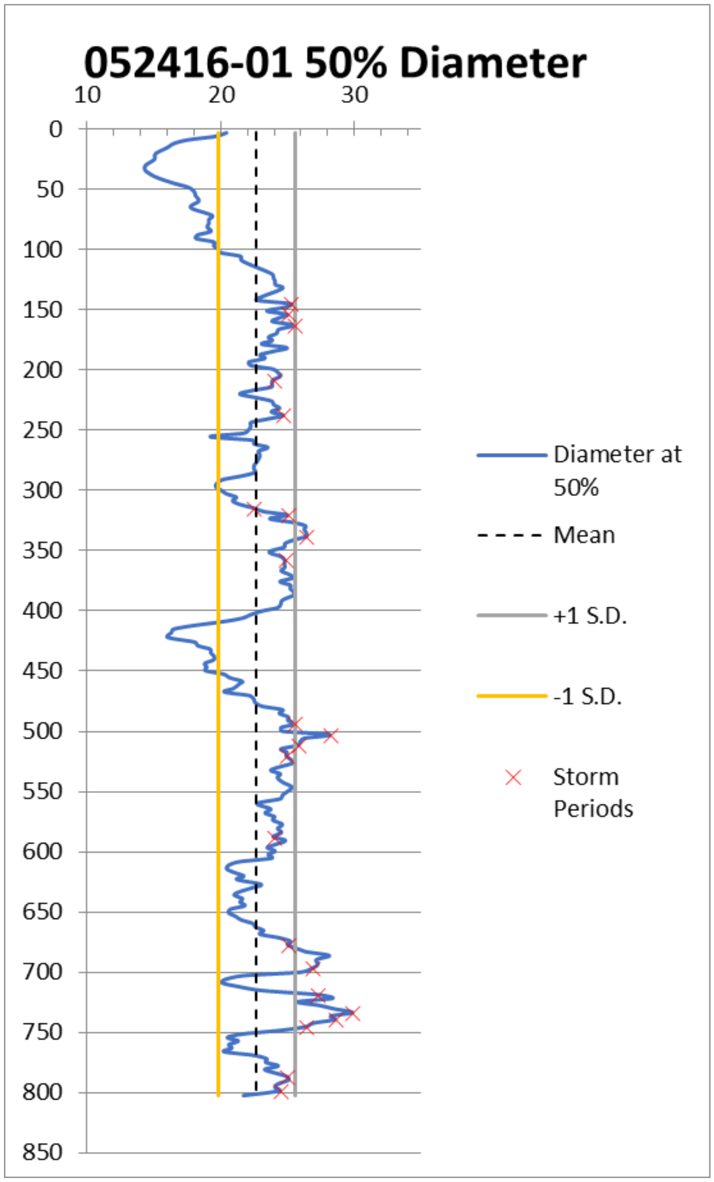

Figure 12. Sediment profile for core 052416-01 displaying the particle size diameter (x-axis) at 50% of the total sample volume in microns.

The second core in the Northwest region is core 052516-01 Western Lake (see **Table 4**). A total of 3 radiocarbon dates were taken from organic sediment. Radiocarbon dates were taken from 3 depths of the core in order to model the age-depth formula for our sampling. The depths and ages of these samples are recorded in **Table 12**. A linear model generated a best fit age-depth formula of y = 0.0266x which was used to generate the calibrated ages of all periods of storminess recorded in **Table 13**. A plot of this linear regression is shown in **Figure 13**. A total of 29 storm periods were identified within core 052516-01 by recognition of increases in particle size using primarily the parameters of percentage of total sample volume of very fine sand grain size and larger (shown in **Figure 14**) and comparisons of that plot with increases in particle size diameter at multiple cumulative percentiles as well as decreases in total percent clay and silt.

Table 12. Raw radiocarbon dates for samples taken from core 052516-01 Western Lake.

Radiocarbon Samples for Core 052416-01	
Depth (mm)	**Age (yr BP)**
280	1,690
550	2,230
950	3,120

Table 13. Ages of storm periods recorded for core 052516-01 Western Lake. Calculation results are rounded to the nearest 10 years generate the age estimate in yr BP.

052516-01 Western Lake	
Core Depth (mm)	**Age (Cal yr BP)**
12	40
31	120
46	170
63	240
79	300
88	330
97	370
118	440
128	480
136	510
148	560
191	720
225	850
235	880
269	1010
306	1150
318	1200
355	1340
454	1710
547	2060
795	2990
809	3040
830	3120
930	3500

052516-01 Western Lake	
977	3670
1026	3860
1048	3940
1076	4040
1088	4090

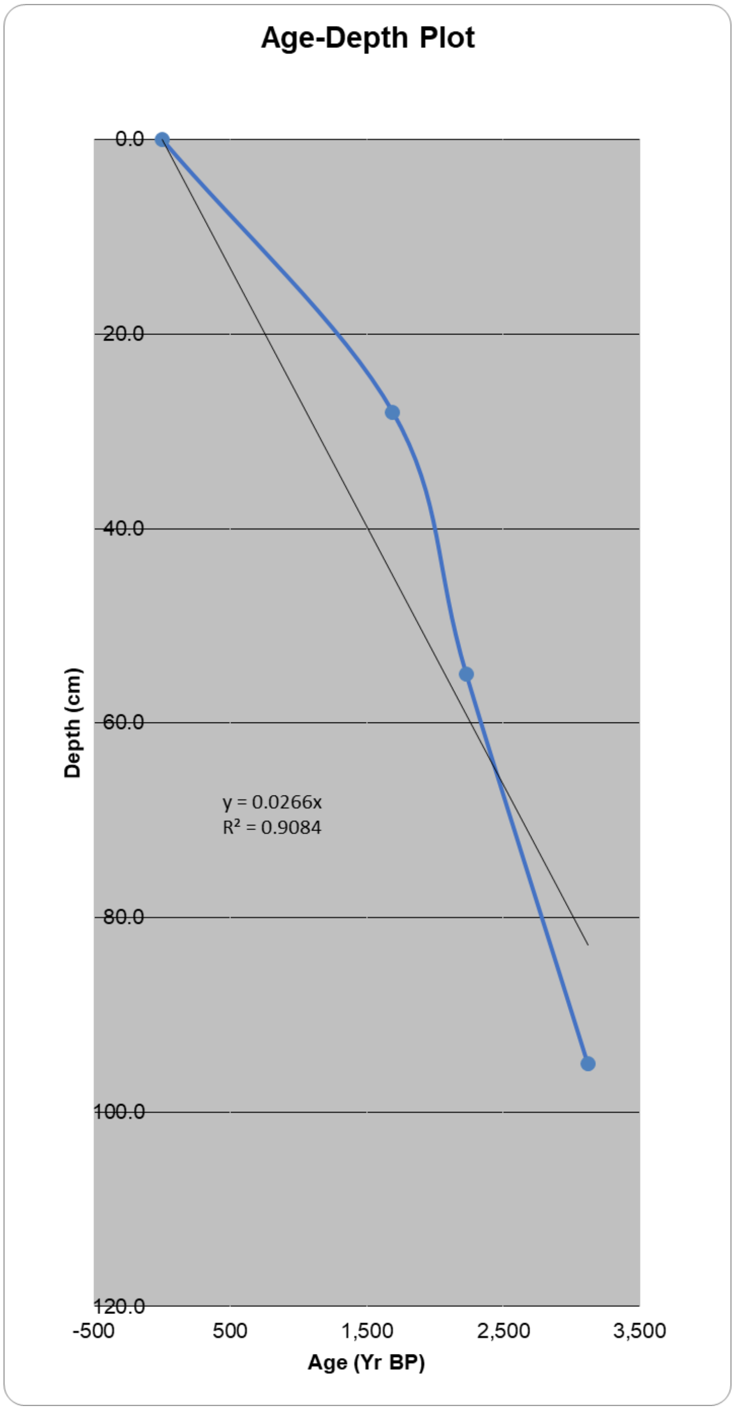

Figure 13. Linear regression of the 052516-01 core.

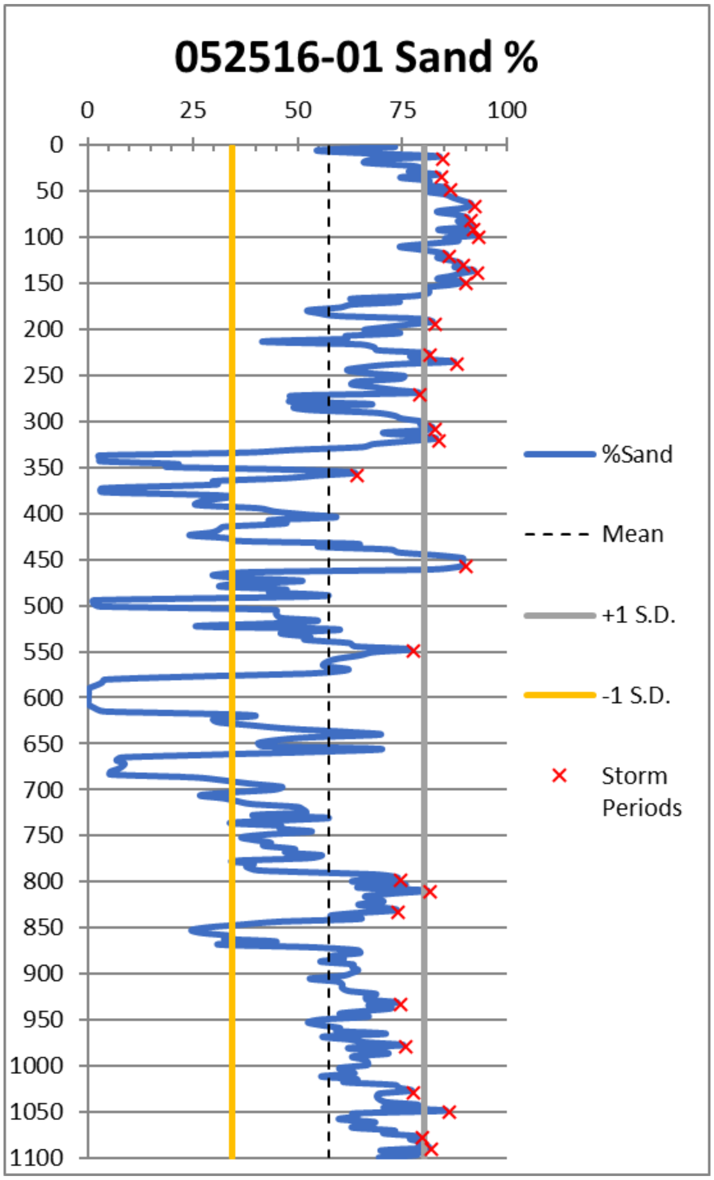

Figure 14. Sediment profile for core 052516-01 displaying the percentage (x-axis) of total sample volume containing particles of grain size greater than or equal to very fine sand (62.5 microns).

4.1.3 North Peninsular Gulf Coast Florida

One core is located within the North Peninsular Gulf Coast region. Core 070617-02 was extracted from a pond in Cedar Key (see **Table 4**). A total of 7 radiocarbon samples were dated from samples of plant fragments, shell and plant matter, and sediment organic carbon. The ages

and depths of these samples are recorded in **Table 14**. A linear model with a y-intercept of 0 generated a best fit age-depth formula of $y = 0.019x$ which was used to generate the ages of all periods of storminess recorded in **Table 15**. A plot of this linear regression is shown in **Figure 15**. A total of 19 periods of storminess were identified within core 070617-02 by recognition of increases in particle size using primarily the parameters of percentage of total sample volume of very fine sand grain size and larger (shown in **Figure 16**) and comparisons of that plot with increases in particle size diameter at multiple cumulative percentiles as well as decreases in total percent clay and silt.

Table 14. Depth and radiocarbon dates for samples taken from core 070617-02 Cedar Key

Radiocarbon Samples for Core 070617-02	
Depth (mm)	**Age (yr BP)**
30	0
50	0
125	200
275	840
300	990
398	1920
505	2285
505	3350

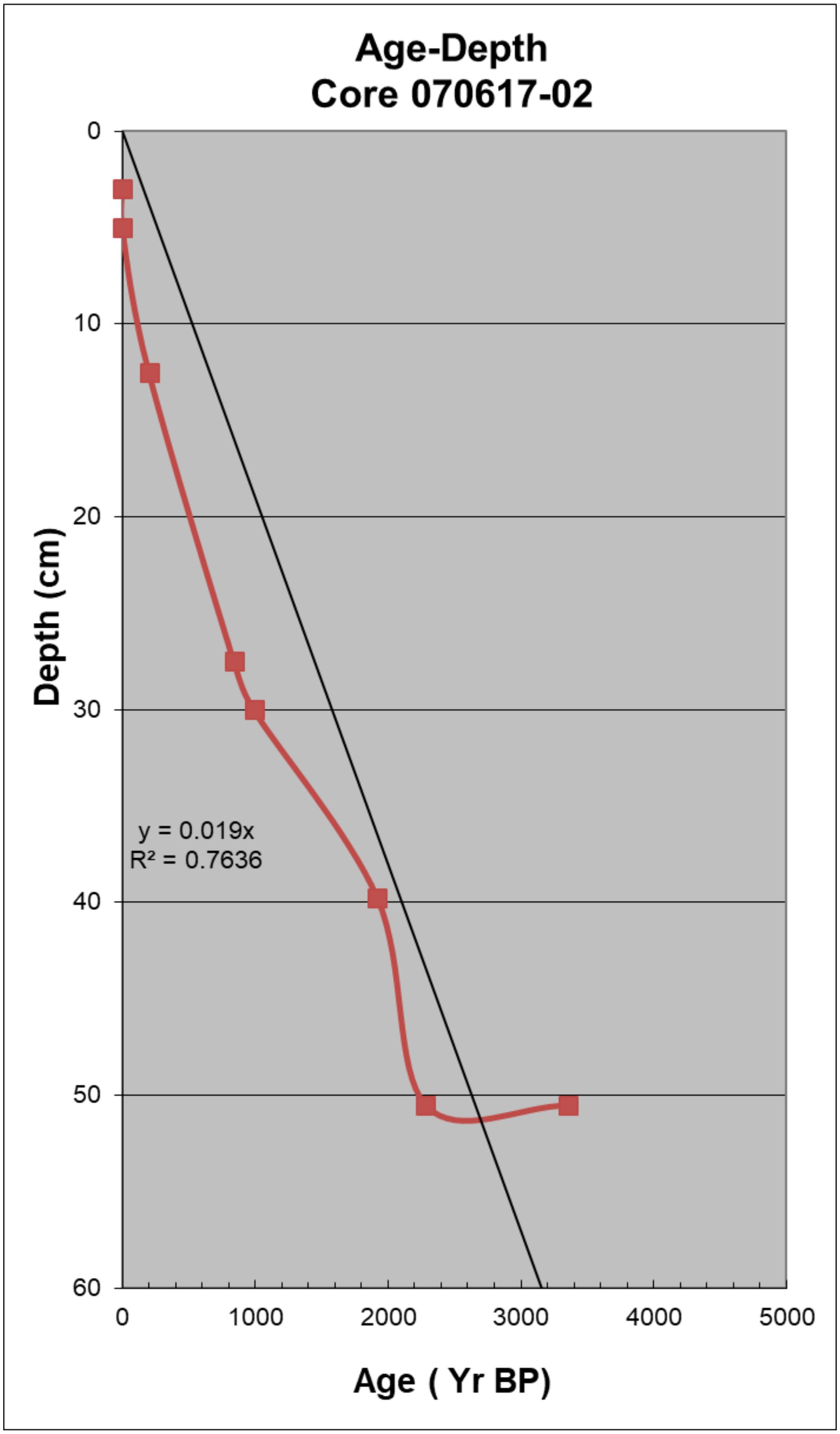

Figure 15. Linear regression of the 070617-02 core.

Table 15. Depth and ages of storm periods recorded for core 070617-02 Cedar Key. Calculation results are rounded to the nearest 10 years generate the age estimate in yr BP.

070617-02 Cedar Key	
Core Depth (mm)	**Age (yr BP)**
302	1590
308	1620
320	1680
329	1730
335	1760
350	1840
365	1920
374	1970
386	2030
392	2060
404	2120
443	2330
455	2390
464	2440
473	2490
479	2520
524	2760
533	2800
539	2830

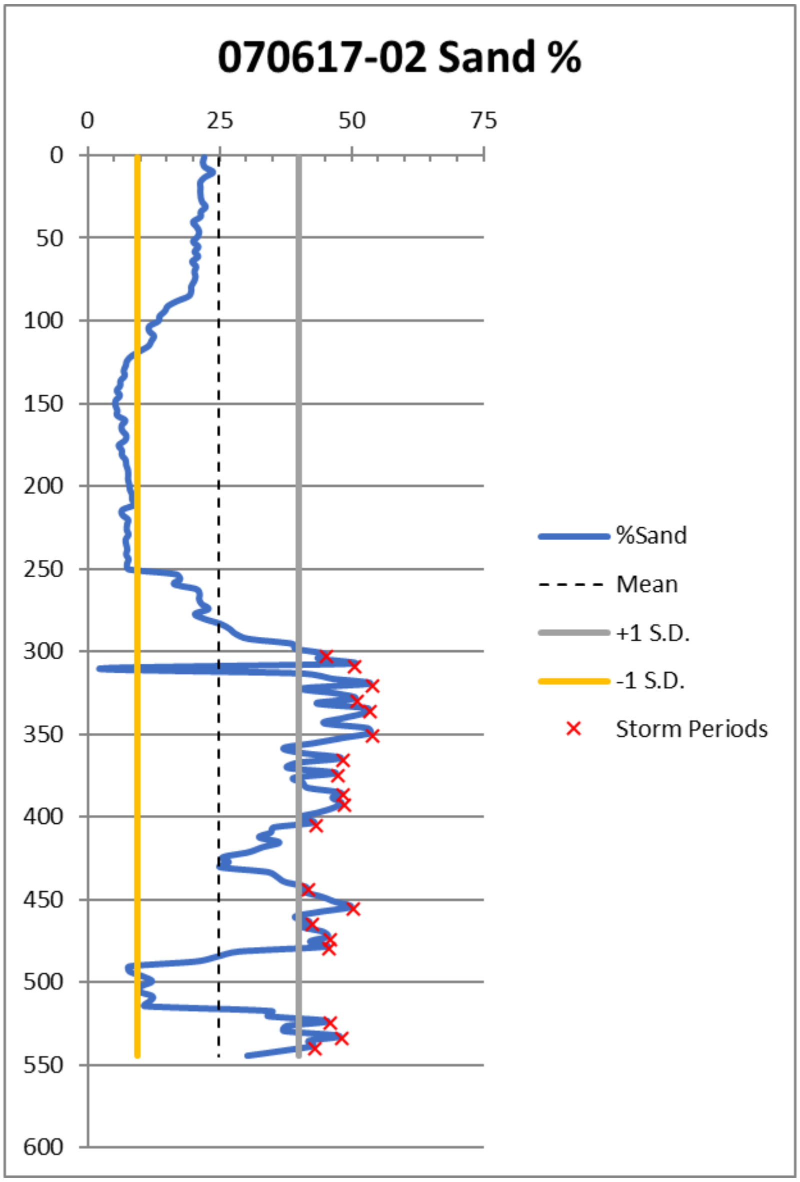

Figure 16. Sediment profile for core 052516-01 displaying the percentage (x-axis) of total sample volume containing particles of grain size greater than or equal to very fine sand (62.5 microns).

4.2 Occupational Histories of the Florida Coast

In order to properly examine the storm chronologies generated by the particle size analysis, it was necessary to collect and aggregate an occupation chronology for each of the geographic coastal regions falling within the storm effect radius of each of the sediment cores

that were compared alongside the storm chronologies to infer the potential response of coastal populations to the occurrences of major storms. The occupation chronologies for the regions were created primarily from radiocarbon dates, which were gathered from a number of different researchers and synthesized into individual occupation chronologies based on their proximity to the sediment core locations. These chronologies use the uncalibrated radiocarbon dates in order to ensure consistency across all recorded dates in the event that different types of calibrations were used. In addition to the date recorded for each sample, the site ID, site name, error, and laboratory ID will also be listed whenever possible.

These radiocarbon dates will be assessed in two ways. First, the intra-site occupation chronologies will be analyzed for all sites that contain several radiocarbon samples from which to identify periods of site occupation and abandonment. Significant gaps in the radiocarbon dates from a single site may be a sign of settlement abandonment, which will be cross-analyzed with the storm chronology generated for each of their relevant cores in order to determine if the periods of occupation are juxtaposed by periods of increased storminess. Second, all sites within the storm impact radius of the relevant cores will be analyzed together in order to observe larger geographic trends in settlement occupation and periods of abandonment. This could reveal human responses to periods of increased storminess on a broader geographic scale.

This section of the analysis would benefit greatly from a substantially improved database of radiocarbon samples for the coastal regions of Florida. As it stands, gaps existing within each of the regional occupation chronologies will be assumed to be potential periods of settlement abandonment. However, it is still very possible that gaps in the radiocarbon dates are a result of measurement error, sampling bias, or insufficient sample size. Primarily, it is the purpose of this project to demonstrate a method for analyzing storm chronology data in correlation with

archaeological data.

4.2.1 East and Central Florida

Cores for this region of the Florida coast were both extracted from costal lakes in Merritt Island, Florida. A single occupation chronology will be used for both cores, given their extremely close proximity to one another and the overall scale of our storm impact radius (135-km). Dates for this region of Florida are aggregated entirely from radiocarbon analysis. The dated materials include bone, shell, charcoal, sherd fibers, collagen, and bioapatite. A total of 149 samples were recorded from a combination of 38 individual archaeological sites. These dates and their respective site names, site IDs, and distance to nearest core location are displayed in alphabetical order based on their site ID in **Table 21** (appendix). The majority of the radiocarbon samples were measured by the Beta Analytic laboratory in Miami, Florida. Additional known laboratories where samples were measured were the University of Georgia's Center for Applied Isotope Studies (CAIS), Geochron Laboratories in Cambridge, Massachusetts, and the Radiocarbon lab of Florida State University.

A frequency distribution of all 149 recorded dates is shown in **Figure 17** below. Preliminary analysis of the data shows an earliest recorded date of 8120 B.P. and a latest date of 440 B.P. There is a large concentration of dates between 500-2200 B.P., and two smaller concentrations between 5000-5400 B.P. and 7100-7400 B.P. Gaps in the occupation chronology are shown in **Table 16** below. There are 10 gap periods in total. The most significant of these are the gaps at 3200-3600, 4400-5000, and 5500-6900, which all appear to be long periods without any recorded occupation dates bookended by continuous periods of recorded occupation dates. There also appears to be a distinct drop in occupation dates between 1800-2000 B.P.

Table 16. Gaps in the occupation chronology for sites near the 092315-01 and 010516-01 Merritt Island cores.

Gap Period (B.P.)	**Duration (yr)**
2200-2300	100
2500-2600	100
3200-3600	400
3800-4100	300
4100-4300	200
4400-5000	600
5500-6900	1400
7100-7200	100
7500-7800	300
8000-8100	100

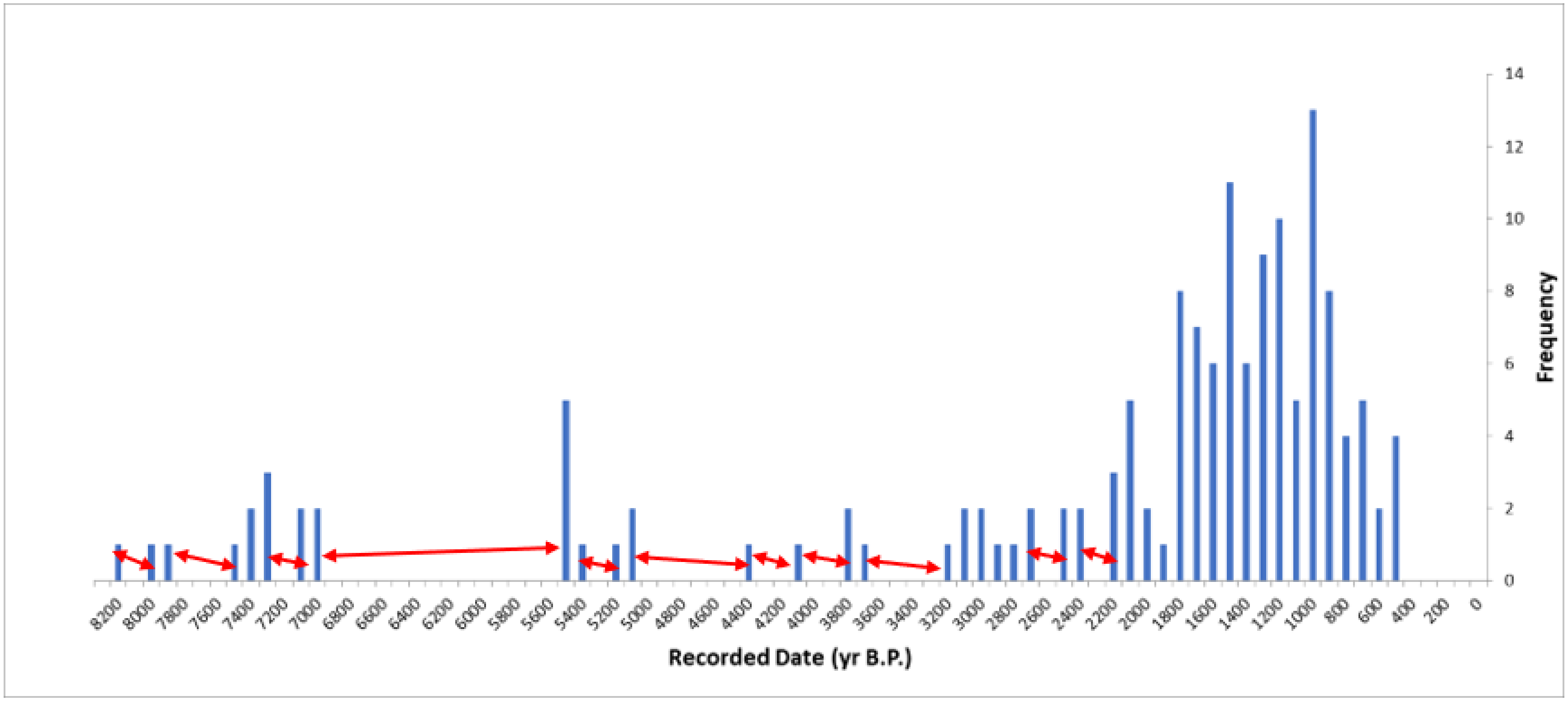

Figure 17. Frequency distribution of recorded dates for sites in proximity to cores 092315-01 and 010516-01.

4.2.2 Northwest Florida

Two sediment cores are located within the Northwest region of Florida. The first of these is the 052416-01 Mullet Pond core. Dates for sites near this core are entirely based on radiocarbon analysis. The dated materials include shell, bone, charcoal, soil organics, soot, and coprolite. A total of 36 radiocarbon samples were aggregated from 16 individual coastal archaeological sites within the 135-kilometer storm impact radius. Samples for which a known laboratory ID was recorded were collected from Beta Analytic, Teledyne Isotopes in Emerson, New Jersey, and the laboratories of Queens College, City University of New York, and Florida State University. These dates and their respective site names, site IDs, and distance to nearest core location are displayed in alphabetical order based on their site ID in **Table 22** (appendix).

A frequency distribution of all 36 samples is shown in **Figure 18** below. Preliminary analysis shows an earliest date of 5460 B.P. and a latest date of 680 B.P. There is a concentration of occupation dates from 1000-1800 B.P. and another less consistent concentration from 2400-3100 B.P. Gaps in the regional occupation chronology are shown in **Table 17** below. There are 10 gap periods in total. The gaps occurring at 2100-2400 B.P. and 3200-3600 B.P. are particularly interesting because they are each representative of periods of 300 or more years without occupation that are directly preceded by long periods of continuous occupation.

Table 17. Gaps in the occupation chronology for the 052416-01 Mullet Pond core.

Gap Period (B.P.)	**Duration (yr)**
1200-1300	100
1900-2000	100
2100-2400	300
2600-2700	100
3000-3100	100
3200-3600	400
3700-3900	200
4000-4400	400
4500-4600	100
4700-5400	700

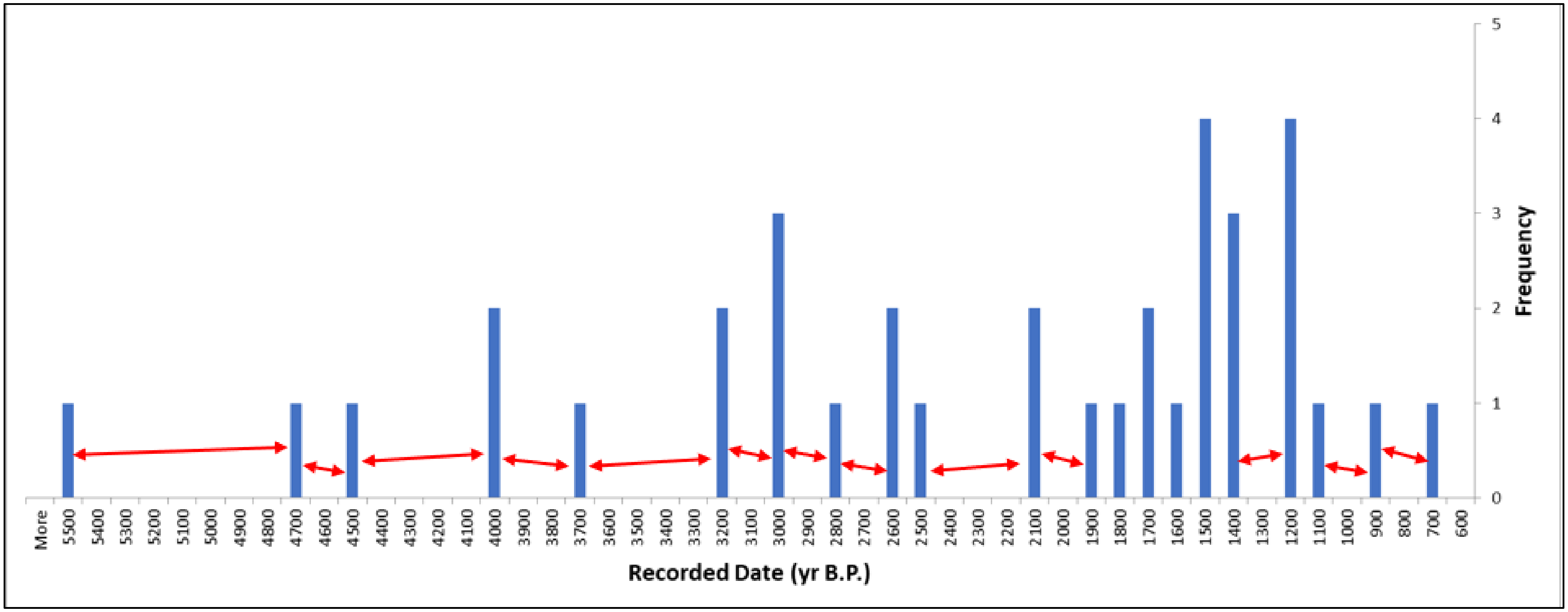

Figure 18. Frequency distribution of recorded dates for sites in proximity to core 052416-01.

The second core for the Northwest region of Florida is the 052516-01 Western Lake core. Western Lake is also the location of the sediment core used by Saunders et al. (2009) for their particle size analysis and occupation period correlations. Occupation periods for the archaeological sites within the storm impact radius were generated primarily through radiocarbon and OSL dates with additional settlement occupations generated from ceramic evidence. A total of 83 samples from 72 radiocarbon samples and 11 OSL samples were aggregated from 24 individual archaeological sites. These dates and their respective site names, site IDs, and distance to nearest core location are displayed in alphabetical order based on their site ID in **Table 23** (appendix).

A frequency distribution of all 83 samples is shown in **Figure 19** below. Preliminary analysis shows an earliest date of 6260 B.P. and a latest date of 340 B.P. Concentrations of occupation dates can be observed from 300-800 B.P., 900-1200 B.P., 1300-2000 B.P., and from 3300-4300 B.P. Gaps in the regional occupation chronology are shown below in **Table 18** below. There are 12 gaps in total. The gaps between 800-900, 1200-1300, 2000-2100, and 4300-5000 B.P. appear to be the most significant, as they are all either bookended or immediately preceded by large concentrations of occupation dates.

Table 18. Gaps in the occupation chronology for the 052516-01 Western Lake core.

Gap Period (B.P.)	**Duration (yr)**
800-900	100
1200-1300	100
2000-2100	100
2300-2600	300
2700-2800	100
2900-3000	100
3200-3300	100
4300-5000	700
5100-5200	100
5300-5400	100
5500-5900	400
6000-6200	200

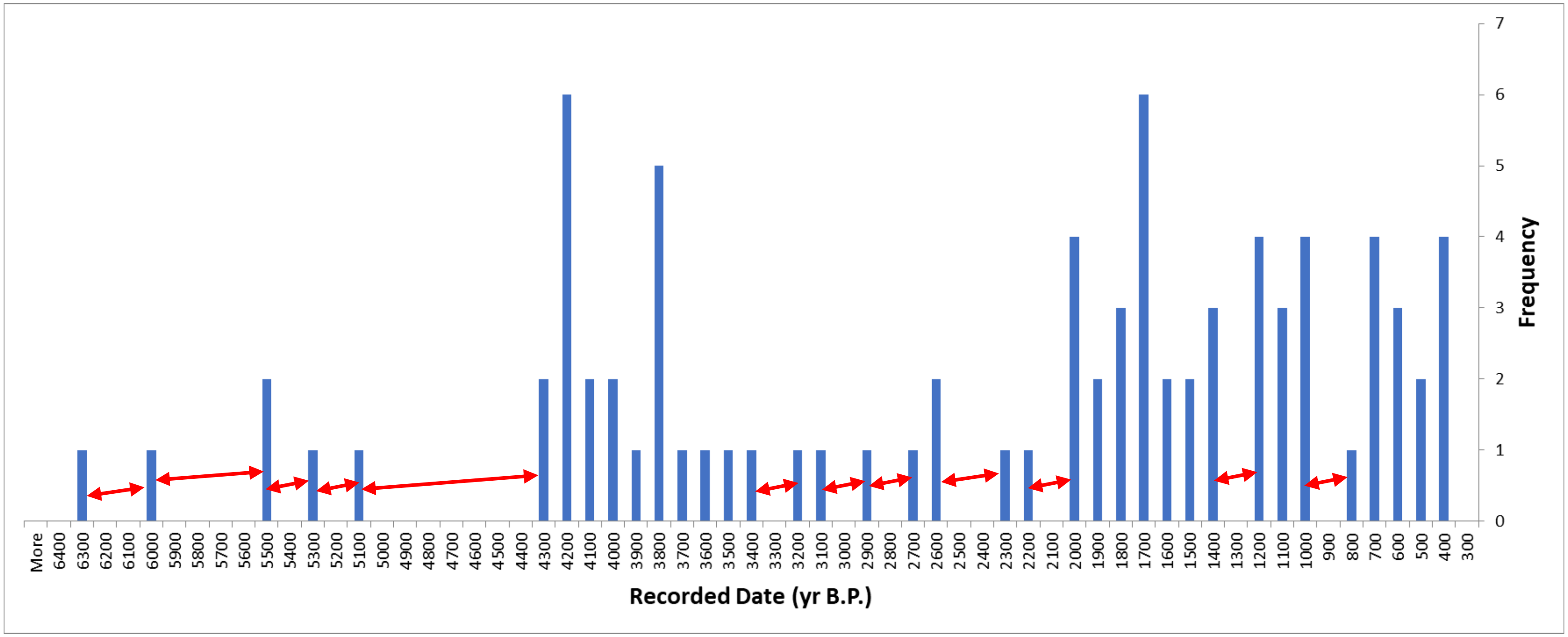

Figure 19. Frequency distribution of recorded dates for sites in proximity to core 052516-01.

4.2.3 North Peninsular Gulf Coast Florida

The sediment core for this region of Florida is the 070617-02 Cedar Key core. Occupation periods for archaeological sites within the storm impact radius were generated entirely from radiocarbon dates. A total of 58 radiocarbon dates were aggregated from 6 individual coastal archaeological sites. These dates and their respective site names, site IDs, and distance to nearest core location are displayed in alphabetical order based on their site ID in **Table 24** (appendix).

A frequency distribution for the 58 recorded dates are shown in **Figure 20** below. Preliminary analysis indicates an earliest recorded date of 3390 B.P. and a latest date of 1140 B.P. There is a singular large concentration of dates from 1100-2200 B.P. and a smaller concentration of dates from 2300-2700 B.P. Gaps in the regional occupation chronology are shown in **Table 19** below. There are 3 gap periods in total. The most interesting of these appears to be the gap between 2200-2300, which is immediately preceded by a large concentration of occupation dates.

Table 19. Gaps in the occupation chronology for the 070617-02 Cedar Key core.

Gap Period (B.P.)	**Duration (yr)**
2200-2300	100
2700-2800	100
2900-3300	400

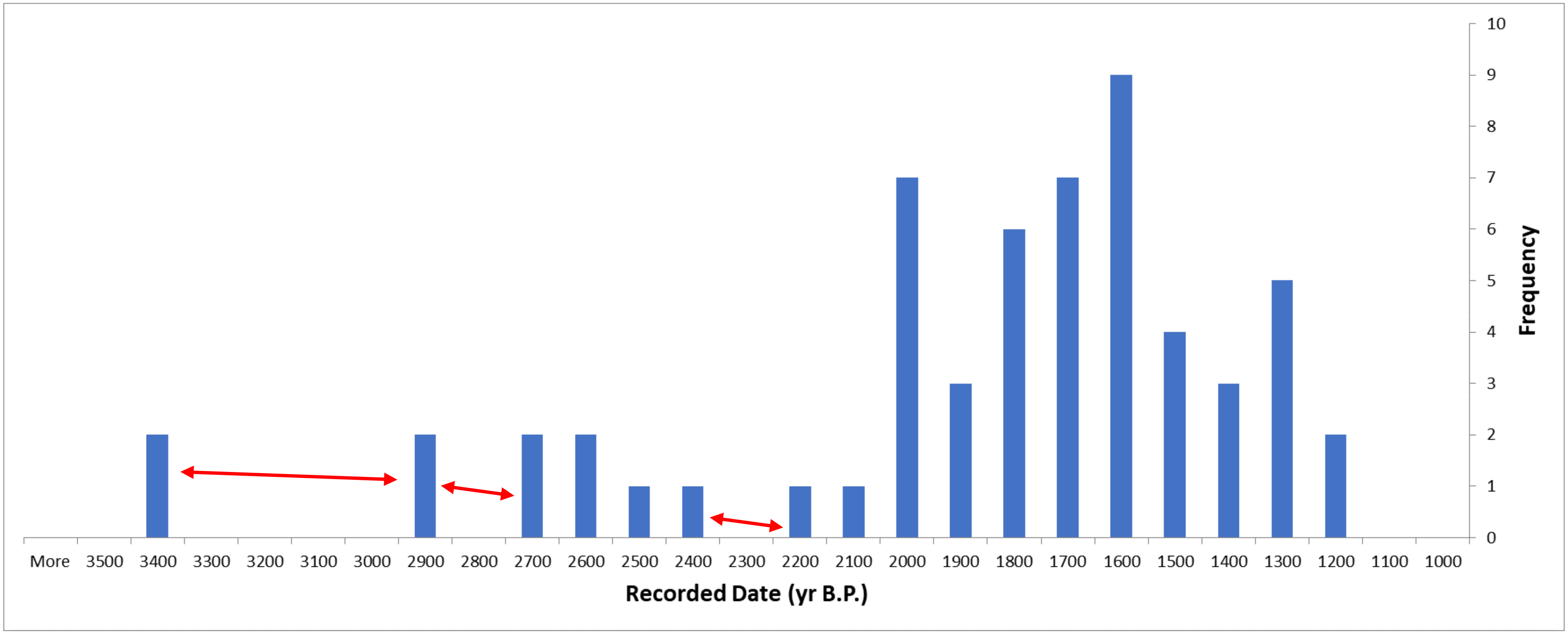

Figure 20. Frequency distribution of recorded dates for sites in proximity to core 070617-02.

In total, each of the archaeological regions that were analyzed contained more than one gap in the dates of archaeological materials that may be signatures of settlement abandonment. The majority of these gaps are only around 100 years, but some areas have vastly larger gaps in their dated materials which may reveal patterns of widespread abandonment for the regions. In the following chapter, I will compare these gaps to the periods of storminess generated for this project in order to assess the correlations between these large gaps in dated materials and the presence of storm events recorded in the sediment record. The gaps will be plotted alongside the retrodicted storm periods and history of these events and occupation dates will be described in relation to each other from the oldest to most recent dates.

5. ANALYSIS

In this chapter, I will analyze the occupation periods for each of the geographic regions of Florida in correlation with the storm chronology generated for each of the sediment cores. This may provide support for the idea that periods of increased storminess would have an adverse effect on ancient populations, and that their adaptive responses to periods of increased storm frequency and intensity can be observed within the archaeological record.

The focus of the analysis will be on gaps in the period of occupation that occur in tandem with periods of increased storminess as identified within the storm chronology. Additionally, dates for storms and site occupations will be assessed in correlation with the cultural periods of the geographic region. Transitions from one cultural period to another that occur during periods of increased storminess may support the hypothesis that environmental stressors caused by periods of increased storminess are in some part responsible for the adoption of new cultural behaviors and broad geographic changes in subsistence strategy.

The primary analysis will be at the broader regional geographic scale, looking for correlations across the occupation dates of each archaeological site to their most proximal sediment core location (e.g. storm chronology). Given that cores 092315-01 and 010516-01 lie in such close proximity to one another, archaeological sites for each of the core locations will be analyzed collectively as well as independently to assure that any results are appropriately identified. Independent analysis of each core will focus on the archaeological sites nearest to each of the two cores, based on the distance vectors generated for each site.

A secondary analysis will look for intra-site correlations between individual sites with the appropriate breadth of recorded dates and the storm chronologies generated for their nearest core

location. I have created an individual site chronology for five sites which contain 10 or more recorded dates and have compared each of them alongside the storm chronology for their nearest core location. Periods of storms for each of these correlations will be narrowed down to include only those events that occurred during or just before and after the occupation period of the individual archaeology site. Storm periods which occur outside of this threshold have little explanatory utility regarding the intra-site analysis of these specific archaeological sites. Intra-site correlations between periods of storminess and gaps in the occupation of sites appear to be prevalent among the sites investigated in this project. All potential correlations, and the reasoning behind their being labeled as correlations, will be discussed below.

5.1 Analysis of East and Central Florida Coastal Sites

This geographic region contains both Merritt Island cores 010516-01 and 092315-01. Additionally, 3 individual archaeological sites found within this region contain 10 or more recorded dates. These are the Windover site, which contains 13 unique radiocarbon dates, the Snyder's Mound/Scenic Lagoon site, which contains 26 unique radiocarbon dates, and the Hontoon Island/Hontoon Island Midden site, which contains 21 unique radiocarbon dates. Each of these sites will be analyzed for intra-site correlations with the nearest sediment core location. The 010516-01 core lies closest in proximity to all 3 sites, and the storm chronology generated for that core will be utilized for the intra-site occupation correlations.

Each of the two cores for this region show differing periods of storminess. While some events co-occur, the deposition of storm surge overwash into these two coastal lakes varies based on their unique environmental conditions. The 092315-01 core is located south of Clark Slough on the eastern coast of Merritt Island. The 010516-01 core is taken from a lake on the western side of Merritt Island near the Indian River. Do to differences in their surrounding environment,

these coastal lakes would likely have differences in their storm surge deposits.

5.1.1 010516-01 Merritt Island – Circular Pond

The 010516-01 core contains a storm chronology with 19 detected periods of storminess and surrounding archaeological sites incorporate a total of 107 distinct regional occupation dates. The correlation of these two sets of dates is shown in **Figure 21** below.

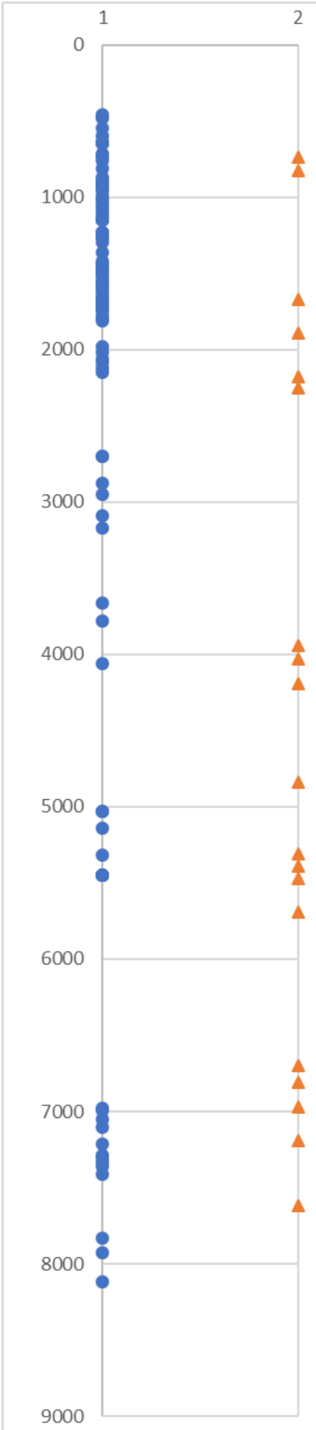

Figure 21. Correlation of two datasets for the 010516-01 core. The y-axis represents years B.P. Series 1 (in blue) represents the 107 occupation dates recorded for all archaeological sites nearest the core. Series 2 (in orange) represents the 19 individual periods of storminess detected via sedimentological analysis.

The data as depicted above reveals several potential correlations between the occupational periods of archaeological sites in this region and the storm chronology generated for the 010516-01 core. The earliest occupation date recorded at 8120 B.P. The first gap in the occupation chronology occurs from 7500-7800 B.P. with a single storm period occurring at 7620 B.P. After this there are several occupation dates from 7500-7000 B.P. with a small gap from 7210-7100 B.P. A storm period occurs during this small gap at a date of 7190 B.P. Occupation then resumes until a date of 6990 B.P. which begins another gap in occupation from 5400-6900 B.P. Five distinct storm periods occur during this gap in occupation, the last of which immediately proceeds the next continuous period of occupation with a date of 5470 B.P. There is a small gap from 5450-5320 B.P. with a storm period occurring at 5390 B.P. Another small gap is observed from 5320-5140 B.P. with a storm period occurring at 5310 B.P. The next gap in occupation occurs from approximately 5000-4000 B.P. During this gap in occupation there are two distinct storm periods. After a recorded occupation date of 4060 B.P. there is another gap until 3780 B.P. Two storm periods occur during this gap. Occupation continues until another gap between 3700-3200 B.P. There are no recorded storm periods that occur during this gap in time. The next gap in occupation occurs between 2700-2200 during which 2 additional storm periods are recorded. Finally, there is near continuous occupation dates from 2150 B.P. to the very latest occupation date recorded at 470 B.P. There is a single small gap in occupation from a date of 1980 B.P. to 1810 B.P. which co-occurs with a storm period at 1890 B.P. There are three more storm periods recorded at dates 1670, 830, and 740 B.P. These storm periods do not appear to correlate with any observable gaps in occupation.

There are some observable potential correlations between the occurrence of storm periods and cultural transitions within this region. The Malabar I phase transitioned from the earlier

Orange phase at around 2500 B.P. (Milanich 1994). Two distinct storm periods from the regional storm chronology occur very near that period and the transition to the Malabar I cultural period shows an increase in subsistence diversity with the utilization of shellfish gathering supplemented by upland hunting of birds, mammals, and reptiles (Milanich 1994; Turck and Thompson 2016:52), which would have likely been a more resilient subsistence strategy in regards to the environmental stressors brought about by increases in storm frequency and intensity. A more diverse subsistence strategy mitigates the effects that the degradation of one or more of those resources would have on a population. Moreover, this increase in resilience may address the near continuous occupation of the region starting at around 2150 B.P., which sees little, if any, periods of abandonment despite the occurrence of three additional storm periods.

5.1.2 092315-01 Merritt Island – Clark Slough

The 092315-01 core contains a storm chronology with 16 detected periods of storminess and surrounding archaeological sites, which incorporate a total of 40 distinct regional occupation dates. The correlation of these two sets of dates is shown in **Figure 22** below.

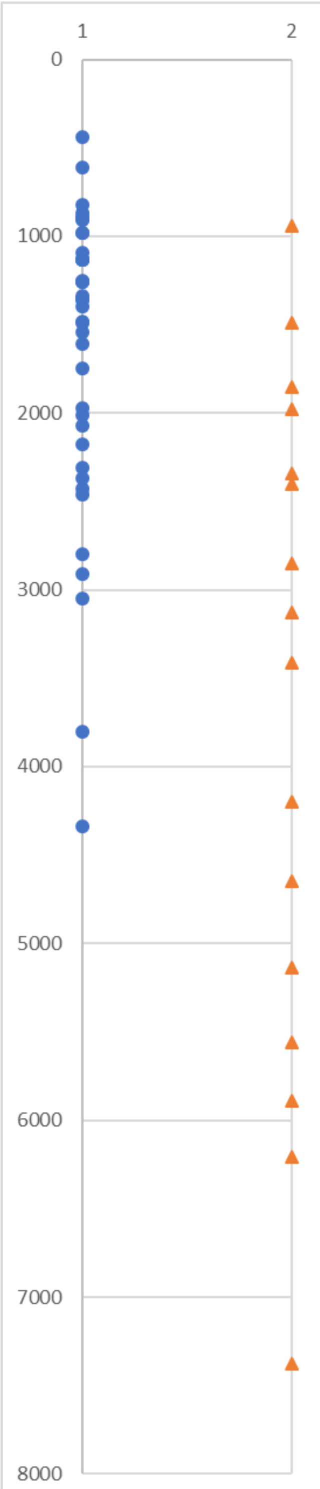

Figure 22. Correlation of two datasets for the 092315-01 core. The y-axis represents years B.P. Series 1 (in blue) represents the 40 occupation dates recorded for all archaeological sites nearest the core. Series 2 (in orange) represents the 16 individual periods of storminess detected via sedimentological analysis.

Although not as apparent as the previous core, I still believe that there are potential correlations that can be observed between the occupational periods of archaeological sites in this region and the storm chronology generated for the 092315-01 core. The first 6 storm periods within the storm chronology lie outside of the occupation chronology for sites nearest to the 092315-01 core. There is an initial occupation date at 4340 B.P. followed by a large gap in occupation until a second date of 3800 B.P. One storm period is recorded during this occupation gap at 4200 B.P. There is another occupation gap after the second date from 3800-3050 B.P. Two storm periods occur during this gap at 3410 and 3130 B.P. Site occupation continues after this until a gap beginning at 2795 B.P. A storm period occurs within the occupation 2850 B.P. and no storm periods are recorded during this gap in occupation. Occupation continues from 2460 B.P up until 2010 B.P. There are two storm periods recorded during this span of occupation. The next large occupation gap occurs from 1970-1750 B.P. There is a single storm period that occurs immediately before this gap at 1980 B.P. and another within the gap at a date of 1850 B.P. Finally, the occupation dates continue from 1750-820 B.P. with only small gaps from 1750-1610 B.P. and from 1250-1130 B.P. There are two storms which occur during this span of occupation and do not appear related to gaps in the occupation.

A cultural transition from the Orange period to the later St. Johns I period around 3600 B.P. and the transition from Orange to Malabar I occurs in this geographic region at around 2500 B.P. This transition includes the adoption of horticulture and agriculture into the subsistence practices of populations of the St. Johns I period. This change in subsistence strategy may explain the observable increase in resilience to the effects of storm periods beginning in this region after 3000 B.P. From this time until the latest occupation date recorded, gaps within the occupation period become smaller and are less frequently correlated with storm periods.

5.1.3 8BR246 Windover Site

The 8BR246 Windover site overlaps with a portion of the storm chronology containing 9 of the total 19 detected periods of storminess for the 010516-01 core and 13 site specific occupation dates. The correlation of these two sets of dates is shown in **Figure 23** below.

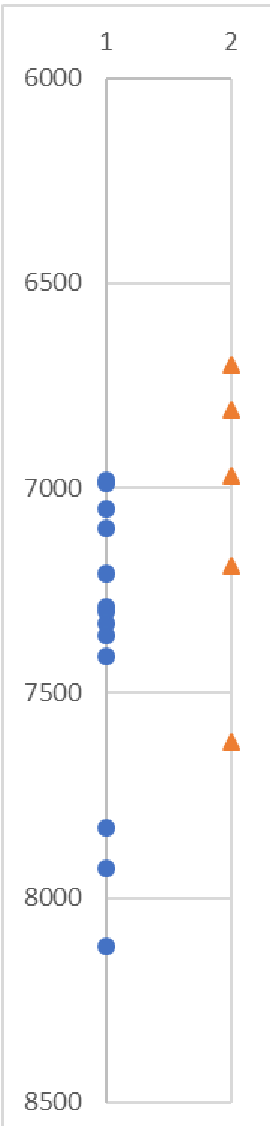

Figure 23. Correlation of two datasets for the 8BR246 Windover Site. The y-axis represents years B.P. Series 1 (in blue) represents the 13 occupation dates recorded from the site. Series 2 (in orange) represents 9 individual periods of storminess detected via sedimentological analysis from the 010516-01 core.

The 8BR246 Windover Site shows good support for the intra-site correlations between the occupation dates and the relevant storm periods for the nearest sediment core. The initial occupation of site occurs at a date of 8120 B.P., which is immediately followed by a gap in occupation until 7930 B.P. and another gap from 7930-7830 B.P. While there are no storm periods associated with these initial gaps, there is a storm period at 7620 B.P. which coincides with a gap in occupation dates from 7830-7410 B.P. Occupation begins again at a date of 7410 B.P., and continues through to 6980 B.P. with only one small gap between 7210 B.P. and 7100 B.P. There is a storm period recorded during this occupational gap at a date of 7190 B.P. The final span of occupation of the Windover site is recorded at a date of 6980 B.P., which is immediately followed by a series of three storm periods beginning at 6970 B.P. I believe that this site provides good evidence for intra-site vulnerability to periods of storm events and human response in the form of settlement abandonment.

5.1.4 8VO124 Snyder's Mound/Scenic Lagoon

The 8VO124 Snyder's Mound/Scenic Lagoon site overlaps with a portion of the storm chronology containing 6 of the total 19 detected periods of storminess for the 010516-01 core and 26 site specific occupation dates. The correlation of these two sets of dates is shown in **Figure 24** below.

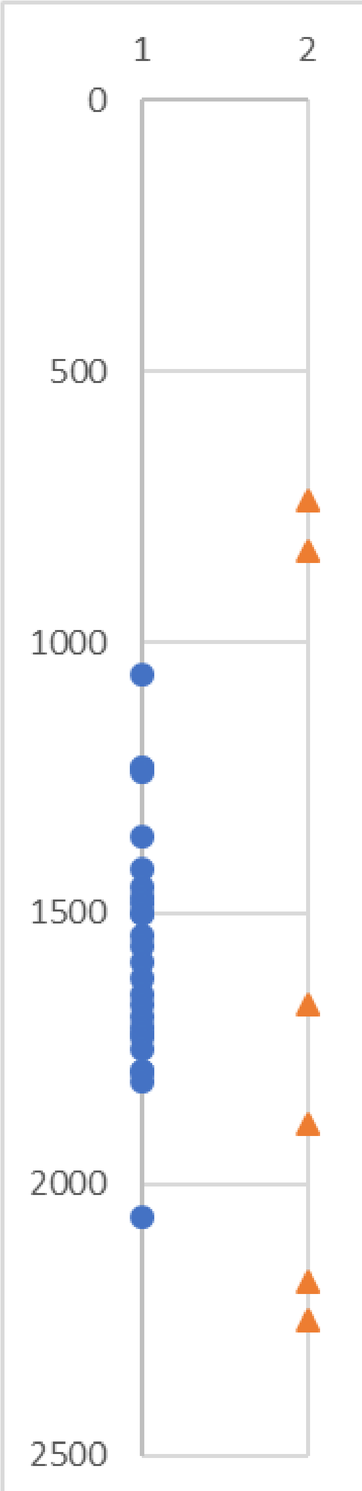

Figure 24. Correlation of two datasets for the 8VO124 Snyder's Mound/Scenic Lagoon site. The y-axis represents years B.P. Series 1 (in blue) represents the 26 occupation dates recorded from the site. Series 2 (in orange) represents 6 individual periods of storminess detected via sedimentological analysis from the 010516-01 core.

The 8VO124 Snyder's Mound/Scenic Lagoon site, again, shows good support for the intra-site correlations between the occupation dates and the relevant storm periods for the nearest sediment core. The initial occupation date for the site occurs at a date of 2060 B.P. and is immediately followed by a large gap in occupation dates until 1810 B.P. The initial occupation date and the following date after the occupation gap are both preceded by periods of storms at 2180 B.P. and 1890 B.P. respectively. After this point, there is a near continuous occupation from 1810-1360 B.P. during which one storm period is recorded at 1670 B.P. There is another small gap in occupation from 1360-1240 B.P. and another from 1230 B.P. to the most recent occupation date recorded for the site at 1060 B.P. There are no storm periods during any of these small gaps in occupation. However, the most recent occupation date recorded at the site is followed by 2 storm periods at 830 B.P. and 740 B.P.

This site appears to be another good example of intra-site correlation between occupation dates and periods of storminess. The first and last occupation dates for the site are each bookended by storm periods. This potentially describes a scenario in which the site was not initially inhabitable until after the end of a storm period and was ultimately abandoned due to another series of storm periods.

5.1.5 8VO202 Hontoon Island/Hontoon Island Midden

The 8VO202 Hontoon Island/Hontoon Island Midden site overlaps with a portion of the storm chronology containing 9 of the total 19 detected periods of storminess for the 010516-01 core and 21 site specific occupation dates. The correlation of these two sets of dates is shown in **Figure 25** below.

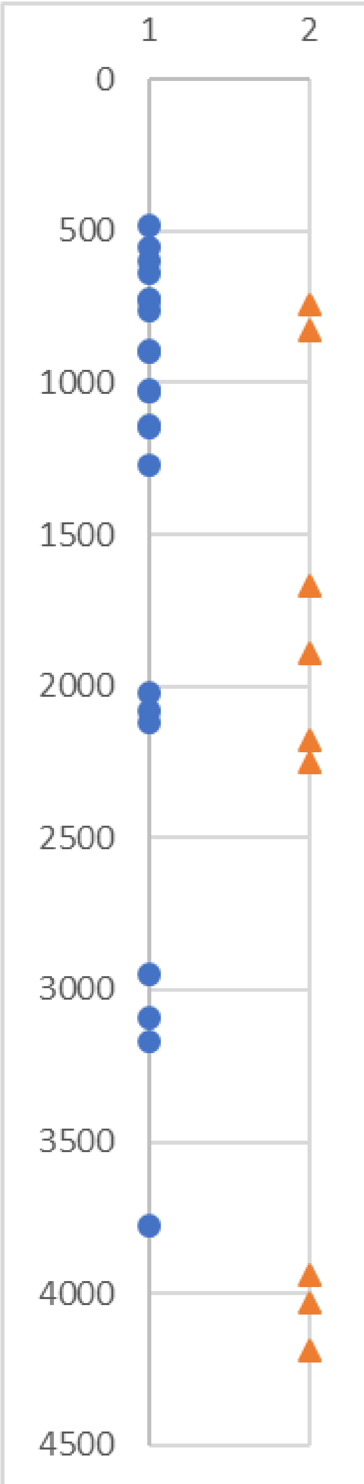

Figure 25. Correlation of two datasets for the 8VO202 Hontoon Island/Hontoon Island Midden site. The y-axis represents years B.P. Series 1 (in blue) represents the 21 occupation dates recorded from the site. Series 2 (in orange) represents 9 individual periods of storminess detected via sedimentological analysis from the 010516-01 core.

The last of the archaeological sites for the East and Central region of coastal Florida, the 8VO202 Hontoon Island/Hontoon Island Midden site appears to be another good example of intra-site correlation. The initial occupation date recorded for the site occurs at 3780 B.P. This is preceded by a storm period in that region at a date of 3940 B.P. There is a large gap after this occupation date until the next at 3170 B.P., but there are no storm periods recorded during that gap in occupation. Site occupation continues until another gap from 2950 B.P. to 2120 B.P. During this gap, 2 storm periods can be observed at 2250 B.P. and 2180 B.P. respectively. Site occupation continues from 2120-2020 B.P. after which there is another gap from 2020-1270 B.P. There are two storm periods that fall within this gap at 1890 and 1670 B.P. From here, the site occupation continues through to the last recorded occupation date of 480 B.P. with only two small gaps between 1020-900 B.P. and 890-760 B.P. The latter of these gaps contains a storm period at 830 B.P. There is another storm period at 740 B.P., but this does not correlate with a gap in the occupation dates.

Once again, the data shows support for the intra-site correlations between site occupation and periods of storminess. The majority of the occupation gaps contain periods of storms, including one brief gap later in the occupation. Although it does not appear that the site was ultimately abandoned as a result of a storm period, I believe there is evidence to support the idea that the site may have had periods of abandonment that were in some way impacted by periods of increased storm frequency and intensity.

5.2 Analysis of Northwest Florida Coastal Sites

This geographic region contains the 052416-01 Mullet Pond and 052516-01 Western Lake cores. Additionally, two individual archaeological sites found within this region contain 10 or more recorded dates. These are the Bayou Park site which contains 14 unique radiocarbon

dates and the Mitchell River #1 site which contains 13 unique radiocarbon dates. Both of these sites will be analyzed for intra-site correlations with the nearest sediment core location. The 052516-01 core lies closest in proximity to both sites, and the storm chronology generated for that core will be utilized for intra-site occupation correlations.

5.2.1 052416-01 Mullet Pond

The 052416-01 core contains a storm chronology with 22 detected periods of storminess and surrounding archaeological sites, which incorporate a total of 30 distinct regional occupation dates. The correlation of these two sets of dates is shown in **Figure 26** below. The storm chronology for this core is more difficult to work with, as the sedimentation rate for the lake was very high and had a noticeably narrower and finer distribution of particles throughout. The storm chronology encompasses a 640-year span of time from the first detected storm period to the last. This is a double-edged sword. While it presents a much shorter overall storm chronology with which to analyze alongside the archaeological data, it also provides a higher resolution for the detected storm periods, where several tightly grouped storm periods can be observed as distinct periods as opposed to one singular period. As such, **Figure 26** also contains a trimmed version of the occupation chronology for only those dates which are relevant for storm period/occupation correlations.

Figure 26. Correlation of two datasets for the 052416-01 Mullet Pond site. The y-axis represents years B.P. In both plots, Series 1 (in blue) represents the occupation dates recorded from the site. Series 2 (in orange) represents individual periods of storminess detected via sedimentological analysis from the 052416-01 core.

The regional dataset for the 052416-01 core is not as apparent as previous regions but may contain potential correlations between the occupational periods and the storm chronology. The earliest storm period recorded for the core is at a date of 1530 B.P. Although the occupation data contains several occupation dates prior to this point, it is impossible to assess correlations before this time as the storm chronology only allows us to see storm periods from this date forward. The storm periods recorded from 1530-1430 B.P. appear to be staggered with occupational gaps, but these gaps are all less than 100 years in length and are not large enough to be considered gaps in the occupational chronology. The first gap greater than 100 years occurs from 1320-1145 B.P., during which 5 storm periods are recorded. There are four detected storm periods between 1110-1020 B.P. occupation dates, but again this falls outside of what can be considered an occupational gap. There is another occupation gap from 1020-840 B.P. Five storm periods are observed during this gap, three of which are again grouped very closely together. Finally, there is a gap in occupation dates from 840-680 B.P., which is unassociated with any storm periods.

There is a broad scale cultural transition in this region around 1000 B.P. from the Weeden Island to the Fort Walton culture (Milanich 1994; White 2014). This transition involves a notable change in subsistence strategy from estuarine resources and horticulture to a more involved maize and bean agriculture with supplemental wild plants, small game, and shellfish (Milanich 1994:364-365). Primarily, this change in subsistence strategy was reflected in the interior riverine Fort Walton sites (White 2014:223) and may not have affected the subsistence strategies of coastal populations. This cultural transition does not appear to have caused any noticeable change in regards to the occupation/storm period correlations, but the dataset is lacking the sufficient breadth for analyzing these broad scale changes.

5.2.2 052516-01 Western Lake

The 052516-01 core contains a storm chronology with 29 detected periods of storminess and surrounding archaeological sites, which incorporate a total of 83 distinct regional occupation dates. Of these, 16 dates are omitted in the figure below. The maximum age of the core was around 3500 B.P. Archaeological dates from a period before this are unnecessary as they do not aid in explaining the relationship between the two datasets. The correlation of these two sets of dates is shown in **Figure 27** below. The far-left graph shows the entirety of the occupation, while the center plot shows dates from 2000 B.P. to the latest recorded date and the far right shows dates from the earliest recorded storm period to 2000 B.P. These additional graphs are included to make the data easier to visually assess.

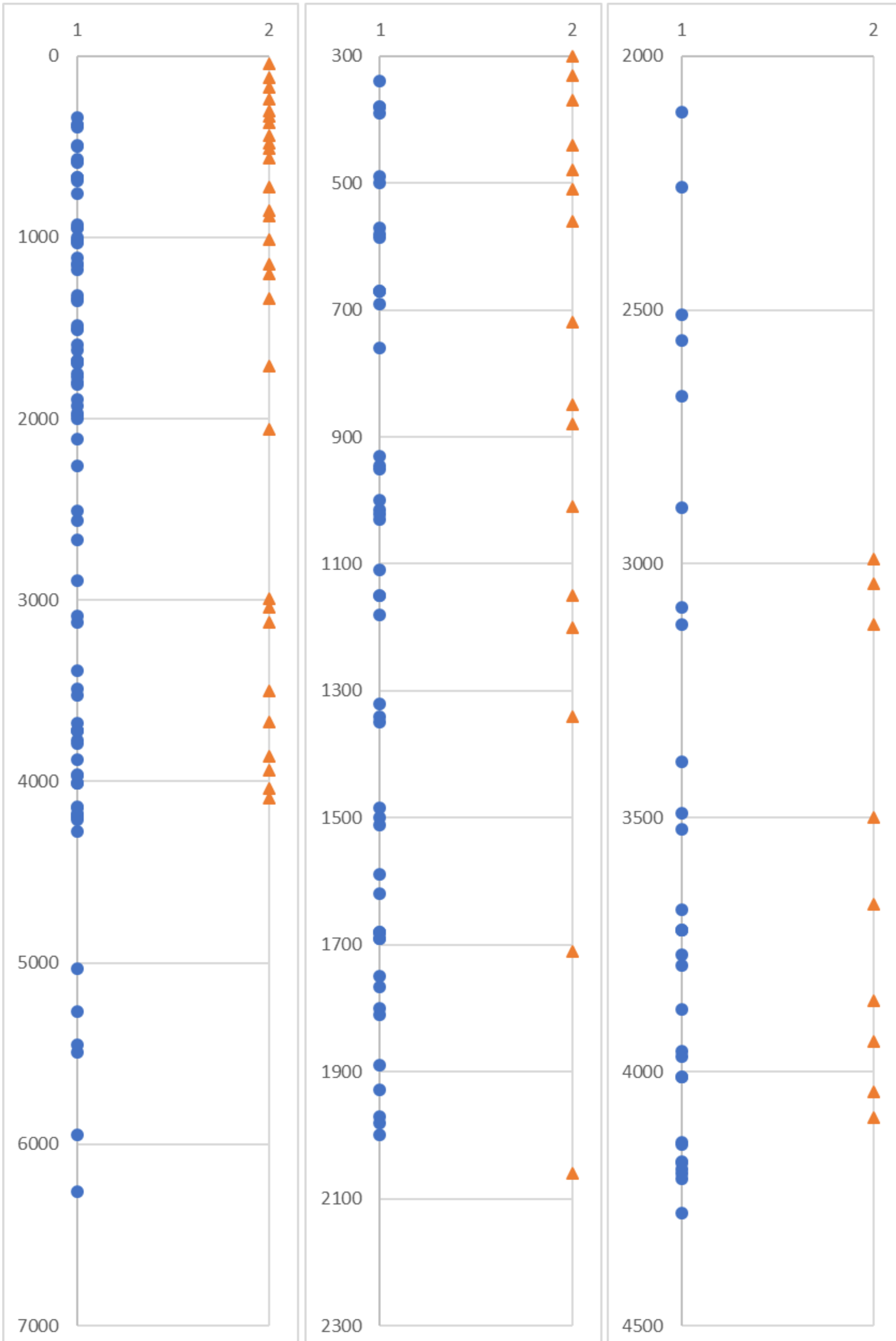

Figure 27. Correlation of two datasets for the 052516-01 core. The y-axis represents years B.P. Series 1 (in blue) represents 67 of the total 83 occupation dates recorded for all archaeological sites nearest the core. Series 2 (in orange) represents the 29 individual periods of storminess detected via sedimentological analysis.

The comparison of these two datasets reveals some interesting trends. The earliest date from the site is 6260 B.P. However, the storm chronology could only be generated back to 4090 B.P., so dates earlier than that period are irrelevant to the comparison. The first notable occupation date occurs at 4143 B.P. which is immediately followed by a gap until 4010 B.P. Two storm periods occur during this gap. There are gaps from 3960-3878 B.P. and 3878-3790 B.P. which each contain a single storm period. However, neither of these gaps is above 100 years, and are therefore to narrow to consider relevant. Site occupation continues until a gap from 3680-3523 B.P., which contains a period of storminess. After this point there are dates at 3120 and 3085 B.P. followed by a gap period until 2890 B.P. One period of storminess occurs during this occupational period and two storm periods occur during the gap from 3085-2890 B.P. After 2890 B.P., there is another gap in the occupation chronology until 2670 B.P., during which no storm periods are recorded. Additional gaps are shown from 2670-2560, 2510-2258, and 2258-2110 B.P. during which there are no periods of storminess recorded. The next gap in the occupation chronology occurs from 1485-1350 B.P. with a storm period co-occuring at 1350 B.P. A gap from 1320-1180 B.P. contains a storm period at 1200 B.P. The region contains dates from this point up until the historic period with only one gap occurring from 930-760 B.P. that contains two storm periods. Storm periods continue to occur after this pint, but no longer appear to have any correlation with gaps in the regional occupation chronology.

This core provides a good example of the potential for increased storm resilience as a result of behavioral change. The storm periods appear to have some correlation with occupational gaps until around 2000-1900 B.P. This point marks a notable transition from the Deptford to Swift Creek cultural periods. The Swift Creek had a notably more diverse subsistence strategy, with people at some sites continuing to utilize a majority of marine

resources and others switching to upland hunting and riverine gathering. Similarly, at 1600 B.P. we see a transition from the Swift Creek to Weeden Island cultural period, which brings about the adoption of horticulture and the beginnings of agriculture in the region. Both of these changes would assist in mitigating the effects of storms by decreasing reliance on vulnerable marine and estuarine resources.

The dating of the storm chronology for this core was unfortunate in regards to intra-site analyses. Dates from both the Bayou Park and Mitchell River 1 site were intended to be individually compared to the storm chronology for this region. However, the dates from both sites occur before the oldest date of the sediment core, and therefore provide no overlap with the storm chronology.

5.3 Analysis of North Peninsular Gulf Coast Florida Sites

This geographic region contains the 070617-02 Cedar Key core as well as 2 individual archaeological sites found within this region containing 10 or more recorded dates. These are the Crystal River site which contains 27 unique radiocarbon dates and the Garden Patch site which contains 24 unique radiocarbon dates. Both of these sites will be analyzed for intra-site correlations with the 070617-02 core, as this is both the nearest core location to both of the sites, as well as the only core location within the North Peninsular Gulf Coast region.

5.3.1 070617-02 Cedar Key

The 070617-02 core contains a storm chronology with 19 detected periods of storminess and surrounding archaeological sites which incorporate a total of 58 distinct regional occupation dates. The correlation of these two sets of dates is shown in **Figure 28** below.

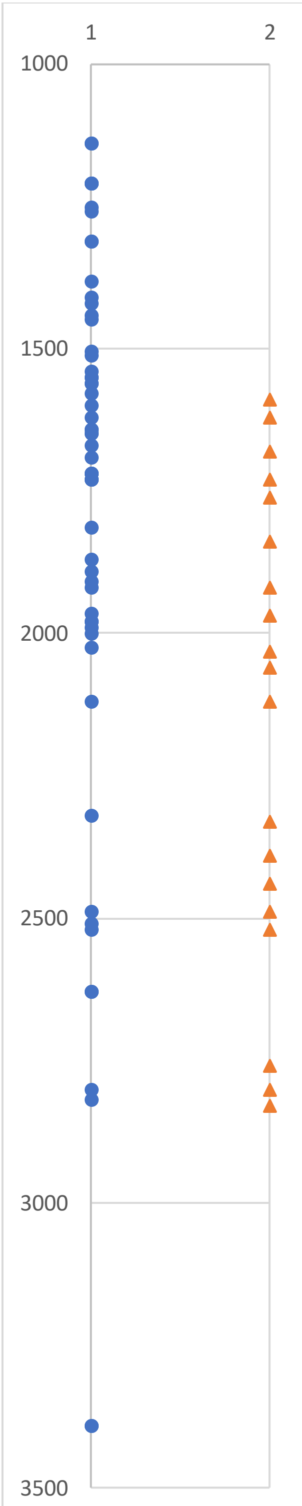

Figure 28. Correlation of two datasets for the 070617-02 core. The y-axis represents years B.P. Series 1 (in blue) represents the 58 occupation dates recorded for all archaeological sites nearest the core. Series 2 (in orange) represents the 19 individual periods of storminess detected via sedimentological analysis.

The dataset for the 070617-02 core is interesting to analyze as a whole. Although some evidence appears to suggest correlations between storm periods and occupation periods earlier in the occupation of the region, this begins to taper off as the data progresses through time. Toward the end of the regional occupation, there are several consecutive storm periods, but none seem to have had an adverse effect on site occupation at the regional scale. Still, there is an initial occupation date of 3390 B.P. which precedes a large gap in occupation until a date of 2820 B.P. One storm period is recorded at a date of 2830 B.P. during this gap. Occupation continues through 2820-2801 B.P., after which there is another occupation gap until 2630 B.P. Two storm periods occur during this gap at 2800 B.P. and 2760 B.P. There is another occupation gap from 2630-2520 B.P. which contains one storm period at 2520 B.P. Site occupation continues after this from 2520-2490 B.P. There is an occupation gap from 2490-2320 B.P., during which four storm periods are recorded. Another gap from 2320-2120 B.P. contains one storm period at 2120 B.P. There is a small gap from 2120-2025 B.P that contains two storm periods, but this gap is just shy of the 100-year mark that is used to determine relevant occupational gaps. After this point, site occupation continues relatively uninterrupted from 2025-1140 B.P., with only small gaps from 1870-1813 and 1813-1730 B.P., but are not sufficiently long enough to be assessed. Storm periods occur during these gaps and continue to occur for the rest of the site occupation, but no longer appear to correlate with gaps in the occupational chronology.

The inconsistency of correlations between the occupation dates and storm periods point towards a couple different interpretations. First, there is a transition in cultural periods within the region from the earlier Deptford culture to the Swift Creek cultural period at around 2000 B.P. This coincides with change in subsistence strategy to a more diversely mixed resource strategy emphasizing marine, riverine, and forest resources as opposed to a more simplistic marine

resource gathering strategy (Milanich 1994:148). The diversification of resource strategies may have increased the resilience of populations during this period, which may explain the uninterrupted period of occupation beginning at 2025 B.P. Another potential explanation lies in the fact that the dataset for this region relies heavily on dates from 2 archaeological sites, which together comprise 51 of the 58 total recorded dates for this region. It is difficult to analyze the entire regional occupation chronology from so few archaeological sites, and it will likely be more useful to see the intra-site analyses for these sites.

5.3.2 8CI1 Crystal River Indian Mounds

The 8CI1 Crystal River Indian Mounds site overlaps with a portion of the storm chronology containing all of the 19 detected periods of storminess for the 070617-02 core and 27 site specific occupation dates. The correlation of these two sets of dates is shown in **Figure 29** below.

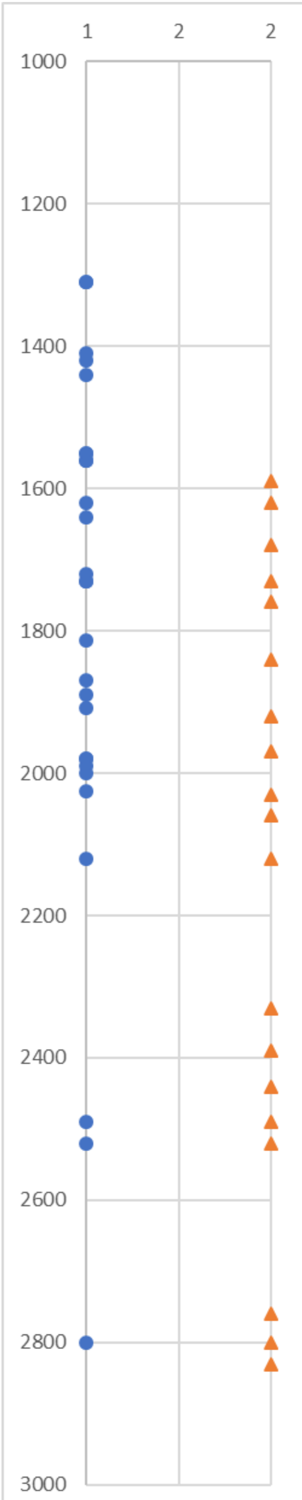

Figure 29. Correlation of two datasets for the 8CI1 Crystal River Indian Mounds site. The y-axis represents years B.P. Series 1 (in blue) represents the 27 occupation dates recorded from the site. Series 2 (in orange) represents 19 individual periods of storminess detected via sedimentological analysis from the 010516-01 core.

The intra-site analysis of the Crystal River Indian Mounds site reveals some interesting correlations that were difficult to observe in the regional dataset for the 070617-02 core. The gaps in occupation appear to be more noticeably staggered during the earliest occupation of the site, and this correlation appears to stop abruptly around 2025 B.P. 3 storm periods at 2830, 2800, and 2760 B.P. occur immediately before and after the initial occupation date of 2801 B.P. After this point, there is a gap in occupation from 2820-2520 B.P., during which one storm period occurs at 2520 B.P. There is another gap from 2490-2120 B.P. which contains 5 storm periods. There is another small gap from 2120-2025 B.P. However, this gap is below the 100-year minimum used for this investigation. After this point occupation remains fairly constant from 2025 B.P. to the last occupation date recorded for the site at 1310 B.P. Numerous storm periods occur during this time, but do not appear to have any direct correlation with occupational gaps.

Analysis of the intra-site dataset supports the idea that the cultural transition beginning around 2000 B.P. from the Deptford to the Swift Creek cultural traditions, and the associated changes in subsistence practice noted above, may have served to increase the resilience of ancient populations which inhabited the Crystal River Indian Mounds site. The lack of occupational gaps starting almost immediately after 2000 B.P. provides solid evidence of this effect. Additionally, it is possible that as population growth continued at the site, abandonment became a less viable reaction to storm events. A larger population would be more difficult to relocate, especially if there are established land use and subsistence practices, and thus people may have been forced to stay.

5.3.3 8DI4 Garden Patch

The 8DI4 Garden Patch site overlaps with a portion of the storm chronology containing

all of the 19 detected periods of storminess for the 070617-02 core and 24 site specific occupation dates. The correlation of these two sets of dates is shown in **Figure 30** below.

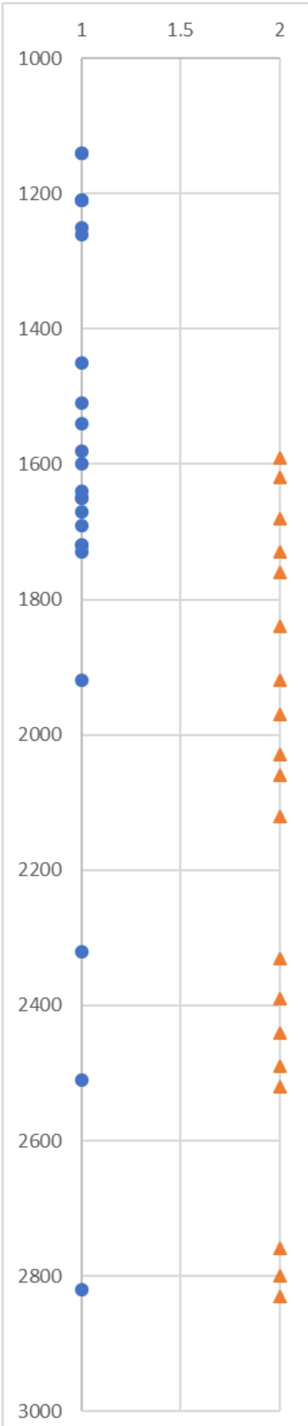

Figure 30. Correlation of two datasets for the 8DI4 Garden Patch site. The y-axis represents years B.P. Series 1 (in blue) represents the 24 occupation dates recorded from the site. Series 2 (in orange) represents 19 individual periods of storminess detected via sedimentological analysis from the 010516-01 core.

The intra-site analysis for the Garden Patch site reveals some interesting trends. Like the Crystal River Indian Mounds site, the occupation of the site does not begin until 2820 B.P., which is bookended by three separate storm periods. This is followed by a large gap in occupation from 2820-2510 B.P. during which there are three storm periods recorded. Another gap from 2510-2320 B.P. occurs immediately before a storm period at a date of 2490 B.P. After this there is an occupation gap from 2520-2320 B.P. during which four storm periods are recorded. There is a large gap following this date from 2320-1920 B.P. During this occupation gap five storm periods occur. There is another gap after 1920 B.P. until 1730 B.P. Three periods of storms are recorded during this gap in occupation. There is a period of continuous site occupation from 1730-1450 B.P. during which three storm periods occurred. These storm periods do not appear to have adversely effected the occupation of the site. There is an occupational gap from 1450-1260 B.P. This gap does not contain any periods of storms. Finally, the last continuous stretch of site occupation occurs from 1260 B.P. to the most recent recorded date for the Garden Patch site at 1140 B.P.

This site appears to have been more consistently affected to periods of storms in comparison to the Crystal River Indian Mounds site. There is only a single storm event recorded during a period of continuous site occupation and, like Crystal River, this occurs after what would presumably be the transition from the Deptford to Swift Creek cultural traditions.

6. CONCLUSIONS

6.1 Summary of Analysis

The analysis of the datasets revealed numerous potential correlations between storm period occurrence and settlement abandonment and/or subsistence change. Every core revealed some amount of staggering between periods of storm occurrence and periods of settlement occupation. Intra-site analyses, wherever possible, appeared to show even stronger correlations between the two datasets than the regional comparisons. Even in cases where this staggering effect was less present, it appeared to diminish over time, suggesting the potential for the archaeological cultures to have increased their resilience to major storm events through modifications of their behavior. This is observable in the Western Lake and Cedar Key cores, as well as in the intra-site analyses of Crystal River and Garden Patch. Alternatively, this effect could be the result of diminishing options as population growth made wholesale abandonment of settlements difficult. This phenomenon will need to be studied more closely, and more information regarding the behaviors and history of this site would be necessary before making any such claims for certain.

However, the data is not without its issues and remains statistically unverified. Given the relationship of the two types of data, it was difficult to utilize a statistical test that effectively tested the relationship between the two datasets while remaining unbiased. This statistical uncertainty hinders my ability to conclude unequivocally that there is a relationship between major storm occurrence and population behavior.

Instances in which storm periods immediately precede and/or occur during gaps in the dated materials are quantified in **Table 20** below for each regional and intra-site analysis. This table quantifies these in comparison to occupational gaps which are associated with the

individual storm periods as well as those occupational gaps that do not appear to correlate with the storm periods and periods of storminess that occur during periods of consistent occupation. The table excludes storm periods that significantly precede the earliest occupation date of a site in order to focus on those periods which may have led to behavioral shifts among ancient coastal populations.

Table 20. Quantifying periods of storminess which do and do not correlate with gaps in the occupations of regional and intra-site datasets.

Comparison of Occupational Gaps and Storm Periods by Region/Site	
010516-01 Merritt Island – Circular Pond	
Number of Storm Periods Followed by or Concurrent with Occupational Gaps	13
Number of Occupational Gaps Associated with Storm Periods	5
Number of Storm Periods Concurrent with Periods of Occupation	6
Number of Occupational Gaps Unassociated with Storm Periods	3
092315-01 Merritt Island – Clark Slough	
Number of Storm Periods Followed by or Concurrent with Occupational Gaps	6
Number of Occupational Gaps Associated with Storm Periods	4
Number of Storm Periods Concurrent with Periods of Occupation	3
Number of Occupational Gaps Unassociated with Storm Periods	0
8BR246 Windover Site	
Number of Storm Periods Followed by or Concurrent with Occupational Gaps	5
Number of Occupational Gaps Associated with Storm Periods	3
Number of Storm Periods Concurrent with Periods of Occupation	0
Number of Occupational Gaps Unassociated with Storm Periods	1
8VO124 Snyder's Mound/ Scenic Lagoon	
Number of Storm Periods Followed by or Concurrent with Occupational Gaps	5
Number of Occupational Gaps Associated with Storm Periods	3
Number of Storm Periods Concurrent with Periods of Occupation	1
Number of Occupational Gaps Unassociated with Storm Periods	2
8VO202 Hontoon Island/ Hontoon Island Midden	
Number of Storm Periods Followed by or Concurrent with Occupational Gaps	7
Number of Occupational Gaps Associated with Storm Periods	3
Number of Storm Periods Concurrent with Periods of Occupation	2
Number of Occupational Gaps Unassociated with Storm Periods	1
052416-01 Mullet Pond	
Number of Storm Periods Followed by or Concurrent with Occupational Gaps	12
Number of Occupational Gaps Associated with Storm Periods	3
Number of Storm Periods Concurrent with Periods of Occupation	10
Number of Occupational Gaps Unassociated with Storm Periods	0
052516-01 Western Lake	

Comparison of Occupational Gaps and Storm Periods by Region/Site	
Number of Storm Periods Followed by or Concurrent with Occupational Gaps	17
Number of Occupational Gaps Associated with Storm Periods	11
Number of Storm Periods Concurrent with Periods of Occupation	8
Number of Occupational Gaps Unassociated with Storm Periods	4
070617-02 Cedar Key	
Number of Storm Periods Followed by or Concurrent with Occupational Gaps	14
Number of Occupational Gaps Associated with Storm Periods	7
Number of Storm Periods Concurrent with Periods of Occupation	5
Number of Occupational Gaps Unassociated with Storm Periods	0
8CI1 Crystal River Indian Mounds	
Number of Storm Periods Followed by or Concurrent with Occupational Gaps	13
Number of Occupational Gaps Associated with Storm Periods	4
Number of Storm Periods Concurrent with Periods of Occupation	6
Number of Occupational Gaps Unassociated with Storm Periods	3
8DI4 Garden Patch	
Number of Storm Periods Followed by or Concurrent with Occupational Gaps	16
Number of Occupational Gaps Associated with Storm Periods	4
Number of Storm Periods Concurrent with Periods of Occupation	3
Number of Occupational Gaps Unassociated with Storm Periods	1

In every case noted in the table, there is a much larger quantity of storm periods which precede or occur during periods of occupation than there are storm periods that occur during periods of consistent occupation. Additionally, in every case there is a larger quantity of occupational gaps that correlate with periods of storminess than those that do not. Despite a lack of statistical rigor, which would undoubtedly bolster the explanatory power of these findings, it seems apparent that there is a measurable relationship between periods of storminess and gaps in occupation at coastal Florida archaeological sites.

This research project proved to be a fruitful investigation into the responses of ancient populations to sudden dramatic changes in their environment. This project suggests that there is some evidence of the impact of storm events and periods of increased storm frequency and intensity on several of the regional archaeological analyses. The Merritt Island, Mullet Pond, and

Cedar Key cores all contain site occupations that are consistently staggered with storm periods for some portion of the regional occupation chronology. In all cases, the appearance of more resilient site occupations occurs later in the occupation of the site and are relatively consistent with broad scale cultural shifts that would have brought about new adaptive strategies for mitigating the effects of major storms.

The intra-site investigations utilized a smaller sample of occupational data, but still proved to be a useful tool for observing site-specific reactions to periods of increased storm frequency and intensity. The chronologies of the Crystal River Indian Mounds and Garden Patch sites are less clear, but I believe that there is a high ceiling for future paleotempest research at these sites given their breadth of occupation data. In both cases, the staggering of storm periods and periods of occupation appear to end towards the last occupational period of the core, which gives further credence to the notion that changes in adaptive behavior may have increased resilience as it pertains to storm events.

6.2 Methodological Assessment

At the onset of this project, my primary goal was to develop a methodology for comparing storm chronologies generated from sedimentological data and the archaeological record. I believe that I appropriately demonstrated the utility of this methodology and the range of investigations that can be performed using this type of analysis. I fully recognize that there is substantial room for improving the methodology and refining the data used to test these comparisons. There are flaws in the methodology as it stands due to the high potential for sampling bias in the dated archaeological materials and the low sample size of robustly dated materials for the archaeological regions pertinent to this investigation. Gaps in the occupation chronology are not necessarily representative of actual periods of abandonment. Dates that may

show continuous occupation may have been omitted or seen as a low priority by the original investigators. Relative dating methods may have been used in place of absolute methods due to constraints in time, budget, or simply due to preference. Additionally, the locations of the cores used for this research project were not selected based on their utilization in this research. While the storm impact radius is likely to contain a number of similarly affected archaeological sites, it would be substantially more beneficial to have the cores placed in as close proximity as possible to the archaeological site being studied.

A larger number of radiocarbon dates used to calibrate the age-depth model would greatly improve the accuracy of the storm periods recorded for each of the sediment cores. Additionally, the incorporation of more recently published dated archaeological materials would improve the resolution and consistency of the site occupations and would provide the breadth of data necessary for additional statistical analyses beyond the observable correlations in the occupation/storm period plots. In general, the state of Florida contains a large quantity of robustly dated archaeological materials, but many remain unpublished or are otherwise inaccessible to student researchers without substantial effort.

6.3 Advocacy for Future Research

I strongly advocate for the continued development of the dated archaeological record for the state of Florida. Techniques for dating materials are becoming more accurate and less expensive, and I believe that this opens up several opportunities for new and more involved research. Providing opportunities for dating new archaeological materials and ensuring access to the currently available dated material record should be of the utmost priority for investigators working in Florida and throughout the field of archaeology. In addition to bolstering the number of radiocarbon dates collected from archaeological sites, there are improvements that can be

made to the Master Site File in terms of classifying and organizing the sites that would greatly benefit future investigations attempting to perform a similarly broad geographic investigation. Aggregating radiometric dates into an accessible digital document would make it far easier for researchers to utilize them. As it stands, finding dates inside of hand-written field reports is extremely difficult and tedious.

Expanding our ability as archaeologists to detect major storm occurrences within archaeological contexts would allow for this type of investigation to be pursued more regularly. There are methods of determining storm occurrence beyond the sediment record, though most of these remain unused in archaeological research. Disaster events are key variables in determining the causes of collapse or cultural change and I believe we should be leaving no stone unturned. As archaeologists, it is equally important to refine our methods for determining the impacts of major storm events on ancient people. Beyond site occupation and subsistence, there could be signatures of storm impacts hidden within household architecture, ritual practice, social hierarchies, or any number of cultural behaviors.

Additionally, I believe that this research project serves as a prime example of the utility of cross-disciplinary research. Too often the field of archaeology is criticized for its lack of statistical rigor and quantifiable data. However, I believe there to be some truth to this criticism, as it appears to me that a large amount of current archaeological research is averse to the notion of quantifiable data, as it could appear as too deterministic and does not provide for the variability of human behavior that we observe across time. While I agree that it is correct to be skeptical of research that purports direct cause and effect relationships between ancient populations and their environment, I also believe that there is utility to asking research questions that rely on statistical data. There is an abundance of methods and technologies for providing

new insights into the archaeological field of study that lie just outside of our general practice. Geology, biology, climatology, and chemistry have been used to great effect in archaeological investigations for decades, and there are still more techniques and theoretical frameworks that can be developed for cross-disciplinary research.

APPENDIX A: DATED ARCHAEOLOGICAL MATERIALS

Table A1. Radiocarbon Dates for Occupation Chronology of Geographic Region Surrounding Cores 092315-01 and 010516-01

092315-01 and 010516-01				
Site ID	**Distance (km)**	**Site Name**	**Radiocarbon Age (yr BP)**	**Reference**
8Br1641	27.8	NS BR 6	1360	Penders 2018
8Br1641	27.8	NS BR 6	1480	Penders 2018
8Br165	55.9	ZABSKI	2910	Dasovich and Doran 2002
8Br1872	21.0	Sam's Site	890	Penders 2018
8Br1872	21.0	Sam's Site	1090	Penders 2018
8Br1872	21.0	Sam's Site	1130	Penders 2018
8Br1872	21.0	Sam's Site	1250	Penders 2018
8Br1872	21.0	Sam's Site	1260	Penders 2018
8Br1872	21.0	Sam's Site	1260	Penders 2018
8Br1872	21.0	Sam's Site	1490	Penders 2018
8Br1872	21.0	Sam's Site	1610	Penders 2018
8Br193	36.5	GAUTHIER	440	Dasovich and Doran 2002
8Br193	36.5	GAUTHIER	870	Dasovich and Doran 2002
8Br193	36.5	GAUTHIER	1130	Dasovich and Doran 2002
8Br193	36.5	GAUTHIER	1130	Dasovich and Doran 2002
8Br193	36.5	GAUTHIER	4340	Dasovich and Doran 2002
8Br1933	25.7	Little Midden	2010	Penders 2018
8Br1933	25.7	Little Midden	2070	Penders 2018
8Br1933	25.7	Little Midden	2180	Penders 2018

092315-01 and 010516-01				
8Br1933	25.7	Little Midden	2460	Penders 2018
8Br223	21.6	QUARTERMAN	1400	Penders 2018
8Br223	21.6	QUARTERMAN	1540	Penders 2018
8Br246	17.8	WINDOVER	6980	Dasovich and Doran 2002
8Br246	17.8	WINDOVER	6990	Dasovich and Doran 2002
8Br246	17.8	WINDOVER	7050	Dasovich and Doran 2002
8Br246	17.8	WINDOVER	7100	Dasovich and Doran 2002
8Br246	17.8	WINDOVER	7210	Dasovich and Doran 2002
8Br246	17.8	WINDOVER	7290	Dasovich and Doran 2002
8Br246	17.8	WINDOVER	7300	Dasovich and Doran 2002
8Br246	17.8	WINDOVER	7330	Dasovich and Doran 2002
8Br246	17.8	WINDOVER	7360	Dasovich and Doran 2002
8Br246	17.8	WINDOVER	7410	Dasovich and Doran 2002
8Br246	17.8	WINDOVER	7830	Dasovich and Doran 2002
8Br246	17.8	WINDOVER	7930	Dasovich and Doran 2002
8Br246	17.8	WINDOVER	8120	Dasovich and Doran 2002
8Br2508	15.0	Hunters Camp	1000	Penders 2018
8Br2508	15.0	Hunters Camp	1150	Penders 2018

092315-01 and 010516-01				
8Br2508	15.0	Hunters Camp	1150	Penders 2018
8Br2508	15.0	Hunters Camp	1600	Penders 2018
8Br2508	15.0	Hunters Camp	1980	Penders 2018
8Br2508	15.0	Hunters Camp	2150	Penders 2018
8Br3178	22.8	Canaveral Rose's Garden	1350	Penders 2018
8Br82A	17.2	DE SOTO GROVE MIDDEN A	2310	Penders 2018
8Br82A	17.2	DE SOTO GROVE MIDDEN A	2370	Penders 2018
8Br82A	17.2	DE SOTO GROVE MIDDEN A	2430	Penders 2018
8Br85	23.9	BURNS	980	Penders 2018
8Br85	23.9	BURNS	1360	Penders 2018
8Br85	23.9	BURNS	1970	Penders 2018
8Br85	23.9	BURNS	3050	Penders 2018
8Br85	23.9	BURNS	3800	Penders 2018
8Br86	25.3	HOLMES MOUND	980	Penders 2018
8Br86	25.3	HOLMES MOUND	1340	Penders 2018
8Br88A	26.2	HAMMOCK MOUND A	910	Penders 2018
8Br88A	26.2	HAMMOCK MOUND A	1750	Penders 2018
8Ir25	93.2	CATO	2795	Dasovich and Doran 2002
8Ir49	97.7	PELICAN ISLAND NWR 1	820	Dasovich and Doran 2002
8Ir49	97.7	PELICAN ISLAND NWR 1	900	Dasovich and Doran 2002
8Ir49	97.7	PELICAN ISLAND	1130	Dasovich and

		NWR 1		Doran 2002
8Ir50	97.8	PELICAN ISLAND NWR 2	610	Dasovich and Doran 2002
8Vo109	27.5	TURTLE MOUND	810	Dasovich and Doran 2002
8Vo109	27.5	TURTLE MOUND	1260	Dasovich and Doran 2002
8Vo111	27.7	TURTLE MOUND BURIAL MOUND	940	Dasovich and Doran 2002
8Vo112	23.0	CASTLE WINDY MIDDEN	643	Bullen and Sleight 1959
8Vo112	23.0	CASTLE WINDY MIDDEN	650	Dasovich and Doran 2002
8Vo112	23.0	CASTLE WINDY MIDDEN	903	Bullen and Sleight 1959
8Vo112	23.0	CASTLE WINDY MIDDEN	910	Dasovich and Doran 2002
8Vo112	23.0	CASTLE WINDY MIDDEN	923	Bullen and Sleight 1959
8Vo112	23.0	CASTLE WINDY MIDDEN	930	Dasovich and Doran 2002
8Vo115	31.4	VAUT PLACE	1300	Dasovich and Doran 2002
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	1060	Dasovich and Doran 2002
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	1230	Dasovich and Doran 2002
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	1230	Dasovich and Doran 2002
8Vo124	21.3	SNYDERS	1240	Dasovich and

		MOUND/SCENIC LAGOON		Doran 2002
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	1360	Dasovich and Doran 2002
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	1420	Dasovich and Doran 2002
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	1450	Dasovich and Doran 2002
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	1470	Dasovich and Doran 2002
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	1480	Dasovich and Doran 2002
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	1500	Dasovich and Doran 2002
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	1500	Dasovich and Doran 2002
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	1540	Dasovich and Doran 2002
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	1560	Dasovich and Doran 2002
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	1590	Dasovich and Doran 2002
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	1620	Dasovich and Doran 2002

092315-01 and 010516-01				
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	1650	Dasovich and Doran 2002
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	1670	Dasovich and Doran 2002
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	1690	Dasovich and Doran 2002
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	1710	Dasovich and Doran 2002
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	1720	Dasovich and Doran 2002
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	1730	Dasovich and Doran 2002
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	1750	Dasovich and Doran 2002
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	1790	Dasovich and Doran 2002
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	1790	Dasovich and Doran 2002
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	1810	Dasovich and Doran 2002
8Vo124	21.3	SNYDERS MOUND/SCENIC LAGOON	2060	Dasovich and Doran 2002
8Vo129	19.1	SCOBEY PLACE	1500	Dasovich and Doran 2002

092315-01 and 010516-01				
8Vo129	19.1	SCOBEY PLACE	1570	Dasovich and Doran 2002
8Vo130	16.0	ROSS HAMMOCK-MIDDEN	1680	Dasovich and Doran 2002
8Vo131	16.1	ROSS HAMMOCK-MOUNDS	955	Dasovich and Doran 2002
8Vo131	16.1	ROSS HAMMOCK-MOUNDS	1680	Dasovich and Doran 2002
8Vo1700	28.0	VISITOR CENTER MIDDEN	930	Dasovich and Doran 2002
8Vo1705	31.3	EDGEWATER MIDDEN B	1440	Dasovich and Doran 2002
8Vo1705	31.3	EDGEWATER MIDDEN B	1490	Dasovich and Doran 2002
8Vo202	65.8	HONTOON ISLAND/HUNTOON ISLAND MIDDEN	480	Dasovich and Doran 2002
8Vo202	65.8	HONTOON ISLAND/HUNTOON ISLAND MIDDEN	550	Dasovich and Doran 2002
8Vo202	65.8	HONTOON ISLAND/HUNTOON ISLAND MIDDEN	600	Dasovich and Doran 2002
8Vo202	65.8	HONTOON ISLAND/HUNTOON ISLAND MIDDEN	640	Dasovich and Doran 2002
8Vo202	65.8	HONTOON ISLAND/HUNTOON ISLAND MIDDEN	720	Dasovich and Doran 2002
8Vo202	65.8	HONTOON ISLAND/HUNTOON ISLAND MIDDEN	730	Dasovich and Doran 2002
8Vo202	65.8	HONTOON ISLAND/HUNTOON	760	Dasovich and Doran 2002

092315-01 and 010516-01				
		ISLAND MIDDEN		
8Vo202	65.8	HONTOON ISLAND/HUNTOON ISLAND MIDDEN	890	Dasovich and Doran 2002
8Vo202	65.8	HONTOON ISLAND/HUNTOON ISLAND MIDDEN	900	Dasovich and Doran 2002
8Vo202	65.8	HONTOON ISLAND/HUNTOON ISLAND MIDDEN	1020	Dasovich and Doran 2002
8Vo202	65.8	HONTOON ISLAND/HUNTOON ISLAND MIDDEN	1030	Dasovich and Doran 2002
8Vo202	65.8	HONTOON ISLAND/HUNTOON ISLAND MIDDEN	1140	Dasovich and Doran 2002
8Vo202	65.8	HONTOON ISLAND/HUNTOON ISLAND MIDDEN	1150	Dasovich and Doran 2002
8Vo202	65.8	HONTOON ISLAND/HUNTOON ISLAND MIDDEN	1270	Dasovich and Doran 2002
8Vo202	65.8	HONTOON ISLAND/HUNTOON ISLAND MIDDEN	2020	Dasovich and Doran 2002
8Vo202	65.8	HONTOON ISLAND/HUNTOON ISLAND MIDDEN	2080	Dasovich and Doran 2002
8Vo202	65.8	HONTOON ISLAND/HUNTOON ISLAND MIDDEN	2120	Dasovich and Doran 2002
8Vo202	65.8	HONTOON ISLAND/HUNTOON ISLAND MIDDEN	2950	Dasovich and Doran 2002

092315-01 and 010516-01				
8Vo202	65.8	HONTOON ISLAND/HUNTOON ISLAND MIDDEN	3090	Dasovich and Doran 2002
8Vo202	65.8	HONTOON ISLAND/HUNTOON ISLAND MIDDEN	3170	Dasovich and Doran 2002
8Vo202	65.8	HONTOON ISLAND/HUNTOON ISLAND MIDDEN	3780	Dasovich and Doran 2002
8Vo22	86.4	BLUFFTON MIDDEN	2700	Dasovich and Doran 2002
8Vo22	86.4	BLUFFTON MIDDEN	2700	Dasovich and Doran 2002
8Vo22	86.4	BLUFFTON MIDDEN	3660	Dasovich and Doran 2002
8Vo2376	27.9	MIDDEN 1	1140	Dasovich and Doran 2002
8Vo2377	27.9	MIDDEN 2	870	Dasovich and Doran 2002
8Vo238	65.9	MARKER 55, HONTOON ISLAND	460	Dasovich and Doran 2002
8Vo24	79.7	TICK ISLAND	5030	Dasovich and Doran 2002
8Vo24	79.7	TICK ISLAND	5320	Dasovich and Doran 2002
8Vo24	79.7	TICK ISLAND	5450	Dasovich and Doran 2002
8Vo24	79.7	TICK ISLAND	5450	Dasovich and Doran 2002
8Vo25	80.0	TICK ISLAND BURIAL MOUND	5030	Dasovich and Doran 2002
8Vo25	80.0	TICK ISLAND BURIAL MOUND	5450	Dasovich and Doran 2002

092315-01 and 010516-01				
8Vo25	80.0	TICK ISLAND BURIAL MOUND	5450	Dasovich and Doran 2002
8Vo25	80.0	TICK ISLAND BURIAL MOUND	5450	Dasovich and Doran 2002
8Vo30	76.3	DE LEON SPRINGS	5140	Dasovich and Doran 2002
8Vo4365	40.4	CANAL STREET MIDDEN	1725	Dasovich and Doran 2002
8Vo81	77.9	TOMOKA STATE PARK MOUNDS AND MIDDEN	470	Dasovich and Doran 2002
8Vo81	77.9	TOMOKA STATE PARK MOUNDS AND MIDDEN	2880	Dasovich and Doran 2002
8Vo81	77.9	TOMOKA STATE PARK MOUNDS AND MIDDEN	4060	Dasovich and Doran 2002
8Vo90	50.7	GREEN MOUND	716	Dasovich and Doran 2002
8Vo90	50.7	GREEN MOUND	995	Dasovich and Doran 2002
8Vo90	50.7	GREEN MOUND	1110	Dasovich and Doran 2002
8Vo95	51.5	BILL ALLEN MOUND	1080	Dasovich and Doran 2002

Table A2. Radiocarbon Dates for Occupation Chronology of Geographic Region Surrounding Core 052416-01 Mullet Pond.

Recorded Dates for Core 052416-01				
Site ID	**Distance (km)**	**Site Name**	**Radiocarbon Age (yr BP)**	**Reference**
8Fr27	68.7	OYSTER BAY VILLAGE	680	Dasovich and Doran 2002
8Fr27	68.7	OYSTER BAY VILLAGE	840	Dasovich and Doran 2002
8Fr364	85.3	SAINT VINCENT 5	1110	White and Kimble 2017
8Fr364	85.3	SAINT VINCENT 5	1430	White and Kimble 2017
8Fr364	85.3	SAINT VINCENT 5	1890	White and Kimble 2017
8Fr4	3.1	TUCKER	1605	Dasovich and Doran 2002
8Fr4	3.1	TUCKER	2962	Dasovich and Doran 2002
8Fr4	3.1	TUCKER	4410	Dasovich and Doran 2002
8Fr4	3.1	TUCKER	4675	Dasovich and Doran 2002
8Fr71	77.9	PARADISE POINT	1320	Walker et al. 1995
8Fr71	77.9	PARADISE POINT	1430	Walker et al. 1995
8Fr71	77.9	PARADISE POINT	1500	Walker et al. 1995
8Fr71	77.9	PARADISE POINT	1780	Walker et al.

Recorded Dates for Core 052416-01				
				1995
8Fr744	63.6	VAN HORN CREEK SHELL MOUND	1120	White 1994
8Fr744	63.6	VAN HORN CREEK SHELL MOUND	3150	White 2003
8Fr744	63.6	VAN HORN CREEK SHELL MOUND	3170	White 2003
8Fr754	61.6	SAM'S CREEK CUTOFF SHELL MOUND	3630	White 2003
8Fr755	62.6	THANK YOU MA'AM CREEK	2760	White 2018
8Fr820A	63.6	Lost Dog Site # 2	2530	Parker and White 1992
8Gu2	95.7	GOTIER HAMMOCK	1380	White 2010
8Gu2	95.7	GOTIER HAMMOCK	1420	White 2010
8Gu38	70.9	OVERGROWN ROAD	1650	White 1994
8Gu56	80.9	DEPOT CREEK SHELL MOUND	2010	White 1994
8Gu56	80.9	DEPOT CREEK SHELL MOUND	2970	White 2010
8Gu56	80.9	DEPOT CREEK SHELL MOUND	2440	White 2010
8Gu60	75.4	CLARK CREEK SHELL MOUND	3970	White 1994
8Ta32	40.5	SOUTH OF WILLIAMS FISH CAMP	1020	Dasovich and Doran 2002
8Ta32	40.5	SOUTH OF WILLIAMS FISH CAMP	5460	Dasovich and Doran 2002
8Wa3	11.7	NICHOLS	1145	Dasovich and Doran 2002
8Wa3	11.7	NICHOLS	1550	Dasovich and Doran 2002

Table A3. Radiocarbon and OSL Dates gor Occupation Chronology of Geographic Region Surrounding Core 052516-01 Western Lake

Recorded Dates for Core 052516-01					
Site ID	**Distance (km)**	**Site Name**	**Radiocarbon Age (yr BP)**	**Type**	**Reference**
8By1347	77.4	Hare Hammock Ring	340	OSL	Hodson 2015
8By1347	77.4	Hare Hammock Ring	1015	OSL	Hodson 2015
8By1347	77.4	Hare Hammock Ring	1022	OSL	Hodson 2015
8By1347	77.4	Hare Hammock Ring	1110	OSL	Hodson 2015
8By1347	77.4	Hare Hammock Ring	1511	OSL	Hodson 2015
8By1347	77.4	Hare Hammock Ring	2000	OSL	Hodson 2015
8By136	60.4	SHOAL POINT SHELL RIDGE	950	Radiocarbon	Dasovich and Doran 2002
8By150	52.0	SHEEPHEAD BAYOU 2	570	Radiocarbon	Dasovich and Doran 2002
8By150	52.0	SHEEPHEAD BAYOU 2	670	Radiocarbon	Dasovich and Doran 2002
8By155	58.5	ST ANDREWS BAY 1	1680	Radiocarbon	Dasovich and Doran 2002
8By156	70.7	WILD GOOSE LAGOON 3	1690	Radiocarbon	Dasovich and Doran 2002
8By156	70.7	WILD GOOSE LAGOON 3	2110	Radiocarbon	Dasovich and Doran 2002
8By3	42.4	SOWELL	1340	Radiocarbon	Dasovich and Doran 2002
8By31	77.6	HARE HAMMOCK SMALLER MOUND	1589	OSL	Hodson 2015
8By31	77.6	HARE HAMMOCK SMALLER MOUND	1767	OSL	Hodson 2015

Recorded Dates for Core 052516-01					
8By31	77.6	HARE HAMMOCK SMALLER MOUND	1810	OSL	Hodson 2015
8By31	77.6	HARE HAMMOCK SMALLER MOUND	1928	OSL	Hodson 2015
8By31	77.6	HARE HAMMOCK SMALLER MOUND	2258	OSL	Hodson 2015
8By39	19.5	OTTER CREEK 2	585	Radiocarbon	Dasovich and Doran 2002
8By9	50.4	MIDDEN IN DAVIS POINT AREA	2890	Radiocarbon	Dasovich and Doran 2002
8Ok898	36.4	Bayou Park	3680	Radiocarbon	Mikell 2017
8Ok898	36.4	Bayou Park	3720	Radiocarbon	Mikell 2017
8Ok898	36.4	Bayou Park	3720	Radiocarbon	Mikell 2017
8Ok898	36.4	Bayou Park	3720	Radiocarbon	Mikell 2017
8Ok898	36.4	Bayou Park	3770	Radiocarbon	Mikell 2017
8Ok898	36.4	Bayou Park	3790	Radiocarbon	Mikell 2017
8Ok898	36.4	Bayou Park	3960	Radiocarbon	Mikell 2017
8Ok898	36.4	Bayou Park	3970	Radiocarbon	Mikell 2017
8Ok898	36.4	Bayou Park	4010	Radiocarbon	Mikell 2017
8Ok898	36.4	Bayou Park	4010	Radiocarbon	Mikell 2017
8Ok898	36.4	Bayou Park	4140	Radiocarbon	Mikell 2017
8Ok898	36.4	Bayou Park	4180	Radiocarbon	Mikell 2017
8Ok898	36.4	Bayou Park	4200	Radiocarbon	Mikell 2017
8Ok898	36.4	Bayou Park	4210	Radiocarbon	Mikell 2017
8Sr29	96.7	BUTCHERPEN MOUND	945	Radiocarbon	Dasovich and Doran 2002
8Sr393	97.6	MULATTO OAKS	1180	Radiocarbon	Dasovich and Doran 2002
8Sr393	97.6	MULATTO OAKS	1320	Radiocarbon	Dasovich and

Recorded Dates for Core 052516-01					
					Doran 2002
8Sr44	78.0	GRAVEYARD POINT MOUND	3490	Radiocarbon	Dasovich and Doran 2002
8Sr8	94.5	THIRD GULF BREEZE	1350	Radiocarbon	Dasovich and Doran 2002
8Sr8	94.5	THIRD GULF BREEZE	1485	Radiocarbon	Dasovich and Doran 2002
8Wl1278	12.8	MITCHELL RIVER #1	3390	Radiocarbon	Saunders et al. 2009
8Wl1278	12.8	MITCHELL RIVER #1	3523	Radiocarbon	Saunders et al. 2009
8Wl1278	12.8	MITCHELL RIVER #1	3878	Radiocarbon	Saunders et al. 2009
8Wl1278	12.8	MITCHELL RIVER #1	4143	Radiocarbon	Saunders et al. 2009
8Wl1278	12.8	MITCHELL RIVER #1	4178	Radiocarbon	Saunders et al. 2009
8Wl1278	12.8	MITCHELL RIVER #1	4192	Radiocarbon	Saunders et al. 2009
8Wl1278	12.8	MITCHELL RIVER #1	4278	Radiocarbon	Saunders et al. 2009
8Wl1278	12.8	MITCHELL RIVER #1	5032	Radiocarbon	Saunders et al. 2009
8Wl1278	12.8	MITCHELL RIVER #1	5271	Radiocarbon	Saunders et al. 2009
8Wl1278	12.8	MITCHELL RIVER #1	5454	Radiocarbon	Saunders et al. 2009
8Wl1278	12.8	MITCHELL RIVER #1	5495	Radiocarbon	Saunders et al. 2009
8Wl1278	12.8	MITCHELL RIVER #1	5950	Radiocarbon	Saunders et al. 2009
8Wl1278	12.8	MITCHELL RIVER	6260	Radiocarbon	Saunders et

Recorded Dates for Core 052516-01					
		#1			al. 2009
8Wl13	21.5	BASIN BAYOU WEST MOUND	1150	Radiocarbon	Dasovich and Doran 2002
8Wl13	21.5	BASIN BAYOU WEST MOUND	1150	Radiocarbon	Dasovich and Doran 2002
8Wl176	23.3	X 18313	1620	Radiocarbon	Dasovich and Doran 2002
8Wl191	21.9	X 88A	1680	Radiocarbon	Dasovich and Doran 2002
8Wl191	21.9	X 88A	1680	Radiocarbon	Dasovich and Doran 2002
8Wl191	21.9	X 88A	1690	Radiocarbon	Dasovich and Doran 2002
8Wl29	2.5	ALLIGATOR LAKE	2510	Radiocarbon	Dasovich and Doran 2002
8Wl29	2.5	ALLIGATOR LAKE	2560	Radiocarbon	Dasovich and Doran 2002
8Wl29	2.5	ALLIGATOR LAKE	3085	Radiocarbon	Dasovich and Doran 2002
8Wl29	2.5	ALLIGATOR LAKE	3120	Radiocarbon	Dasovich and Doran 2002
8Wl35	17.5	FOUR MILE VILLAGE	2670	Radiocarbon	Dasovich and Doran 2002
8Wl36	18.3	HORSESHOE BAYOU	1000	Radiocarbon	Dasovich and Doran 2002
8Wl36	18.3	HORSESHOE BAYOU	1500	Radiocarbon	Dasovich and Doran 2002
8Wl36	18.3	HORSESHOE BAYOU	1750	Radiocarbon	Dasovich and Doran 2002
8Wl36	18.3	HORSESHOE BAYOU	1800	Radiocarbon	Dasovich and Doran 2002
8Wl36	18.3	HORSESHOE	1890	Radiocarbon	Dasovich and

Recorded Dates for Core 052516-01					
		BAYOU			Doran 2002
8Wl36	18.3	HORSESHOE BAYOU	1970	Radiocarbon	Dasovich and Doran 2002
8Wl36	18.3	HORSESHOE BAYOU	1980	Radiocarbon	Dasovich and Doran 2002
8Wl38	19.1	FOUR MILE POINT #1	380	Radiocarbon	Dasovich and Doran 2002
8Wl38	19.1	FOUR MILE POINT #1	390	Radiocarbon	Dasovich and Doran 2002
8Wl38	19.1	FOUR MILE POINT #1	490	Radiocarbon	Dasovich and Doran 2002
8Wl38	19.1	FOUR MILE POINT #1	580	Radiocarbon	Dasovich and Doran 2002
8Wl38	19.1	FOUR MILE POINT #1	670	Radiocarbon	Dasovich and Doran 2002
8Wl38	19.1	FOUR MILE POINT #1	760	Radiocarbon	Dasovich and Doran 2002
8Wl543	6.4	LITTLE BAYOU WEST	930	Radiocarbon	Dasovich and Doran 2002
8Wl543	6.4	LITTLE BAYOU WEST	1030	Radiocarbon	Dasovich and Doran 2002
8Wl99	18.9	MONDAY MIDDEN	380	Radiocarbon	Dasovich and Doran 2002
8Wl99	18.9	MONDAY MIDDEN	500	Radiocarbon	Dasovich and Doran 2002
8Wl99	18.9	MONDAY MIDDEN	670	Radiocarbon	Dasovich and Doran 2002
8Wl99	18.9	MONDAY MIDDEN	690	Radiocarbon	Dasovich and Doran 2002

Table A4. Radiocarbon Dates for Occupation Chronology of Geographic Region Surrounding Core 070617-02 Cedar Key

Recorded Dates for Core 070617-02				
Site ID	**Distance (km)**	**Site Name**	**Radiocarbon Age (yr BP)**	**Reference**
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	1310	Dasovich and Doran 2002
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	1420	Dasovich and Doran 2002
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	1870	Dasovich and Doran 2002
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	1980	Dasovich and Doran 2002
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	1310	Pluckhahn and Thompson 2017
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	1410	Pluckhahn and Thompson 2017
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	1440	Pluckhahn and Thompson 2017
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	1550	Pluckhahn and Thompson 2017
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	1550	Pluckhahn and Thompson 2017
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	1560	Pluckhahn and Thompson 2017
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	1560	Pluckhahn and Thompson 2017
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	1620	Pluckhahn and Thompson 2017
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	1640	Pluckhahn and Thompson 2017
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	1720	Pluckhahn and Thompson 2017

Recorded Dates for Core 070617-02				
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	1730	Pluckhahn and Thompson 2017
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	1730	Pluckhahn and Thompson 2017
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	1813	Pluckhahn and Thompson 2017
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	1890	Pluckhahn and Thompson 2017
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	1909	Pluckhahn and Thompson 2017
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	1980	Pluckhahn and Thompson 2017
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	1990	Pluckhahn and Thompson 2017
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	2000	Pluckhahn and Thompson 2017
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	2025	Pluckhahn and Thompson 2017
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	2120	Pluckhahn and Thompson 2017
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	2490	Pluckhahn and Thompson 2017
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	2520	Pluckhahn and Thompson 2017
8Ci1	79.7	CRYSTAL RIVER INDIAN MOUNDS	2801	Pluckhahn and Thompson 2017
8Ci58	65.6	BURTINE ISLAND	2630	Dasovich and Doran 2002
8Ci58	65.6	BURTINE ISLAND	2630	Dasovich and Doran 2002
8Ci58	65.6	BURTINE ISLAND	3390	Dasovich and Doran 2002

Recorded Dates for Core 070617-02				
8Ci60	65.8	BURTINE ISLAND C	1505	Dasovich and Doran 2002
8Ci60	65.8	BURTINE ISLAND C	3390	Dasovich and Doran 2002
8Ci61	65.7	BURTINE ISLAND D	1965	Dasovich and Doran 2002
8Di4	17.2	GARDEN PATCH	2820	Wallis et al. 2015
8Di4	17.2	GARDEN PATCH	2510	Wallis et al. 2015
8Di4	17.2	GARDEN PATCH	2320	Wallis et al. 2015
8Di4	17.2	GARDEN PATCH	1920	Wallis et al. 2015
8Di4	17.2	GARDEN PATCH	1730	Wallis et al. 2015
8Di4	17.2	GARDEN PATCH	1720	Wallis et al. 2015
8Di4	17.2	GARDEN PATCH	1720	Wallis et al. 2015
8Di4	17.2	GARDEN PATCH	1690	Wallis et al. 2015
8Di4	17.2	GARDEN PATCH	1670	Wallis et al. 2015
8Di4	17.2	GARDEN PATCH	1650	Wallis et al. 2015
8Di4	17.2	GARDEN PATCH	1650	Wallis et al. 2015
8Di4	17.2	GARDEN PATCH	1640	Wallis et al. 2015
8Di4	17.2	GARDEN PATCH	1600	Wallis et al. 2015

Recorded Dates for Core 070617-02				
8Di4	17.2	GARDEN PATCH	1580	Wallis et al. 2015
8Di4	17.2	GARDEN PATCH	1540	Wallis et al. 2015
8Di4	17.2	GARDEN PATCH	1510	Wallis et al. 2015
8Di4	17.2	GARDEN PATCH	1450	Wallis et al. 2015
8Di4	17.2	GARDEN PATCH	1260	Wallis et al. 2015
8Di4	17.2	GARDEN PATCH	1250	Wallis et al. 2015
8Di4	17.2	GARDEN PATCH	1210	Wallis et al. 2015
8Di4	17.2	GARDEN PATCH	1210	Wallis et al. 2015
8Di4	17.2	GARDEN PATCH	1210	Wallis et al. 2015
8Di4	17.2	GARDEN PATCH	1140	Wallis et al. 2015
8Di4	17.2	GARDEN PATCH	1140	Wallis et al. 2015
8Ta35	56.4	FISH CREEK	1380	Dasovich and Doran 2002

APPENDIX B: ADDITIONAL SEDIMENT PROFILE PLOTS

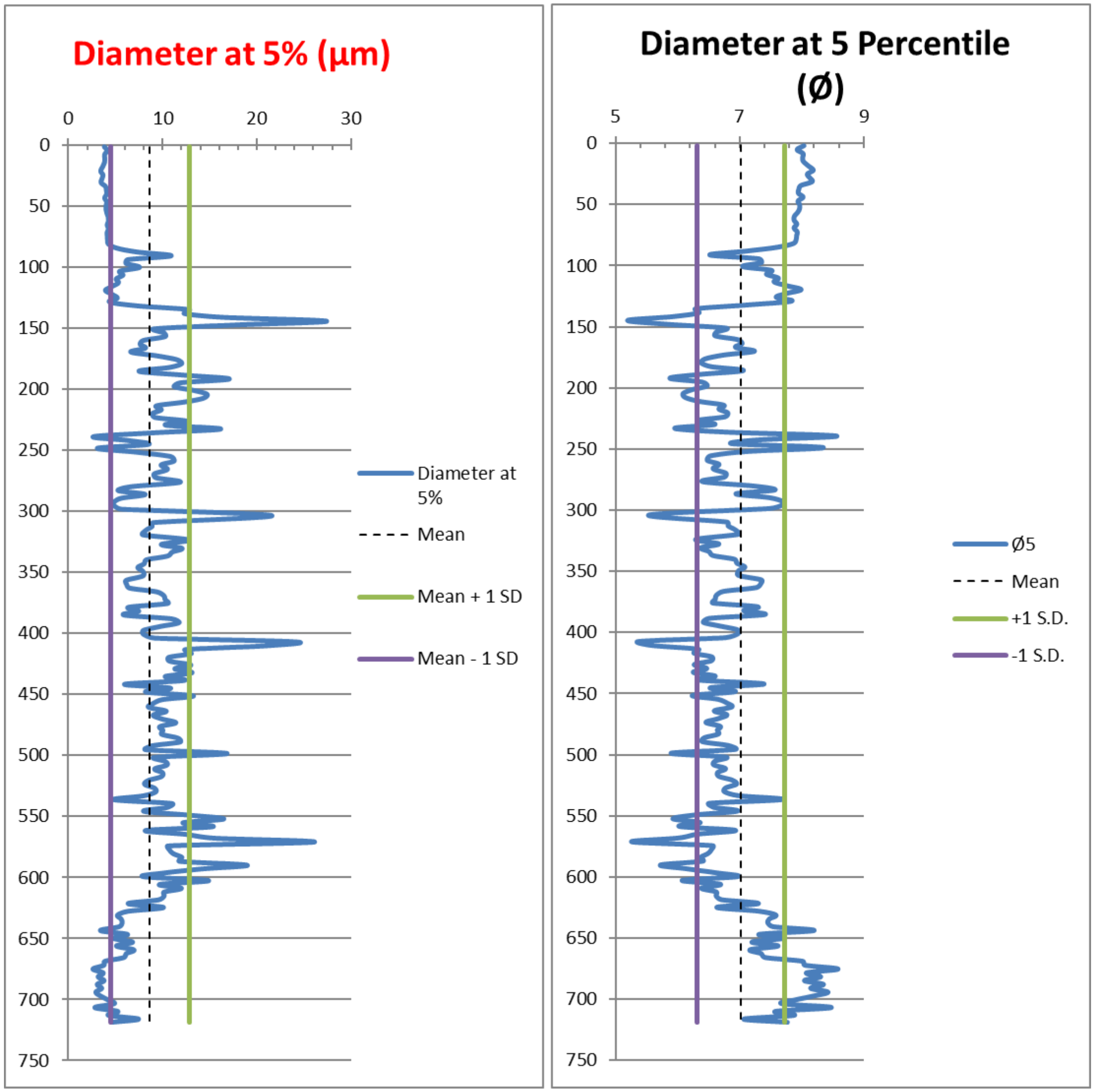

Figure B1. Particle size diameter at 5% of the cumulative particle size in microns and phi for the 092315-01 core. 142

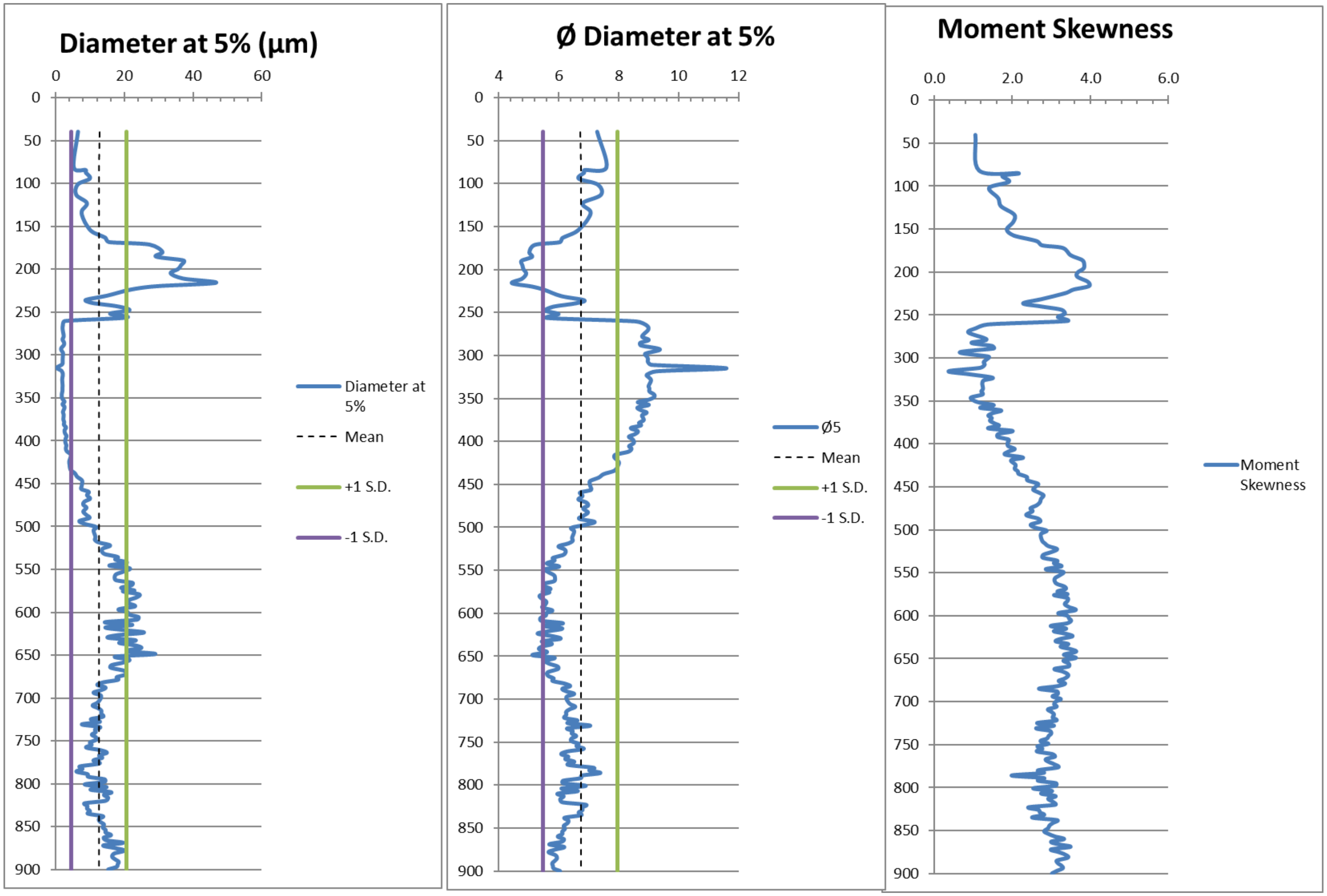

Figure B2. Particle size diameter at 5% of the cumulative particle size in microns and phi and moment skewness of the 010516-01 Merritt Island-Circular Pond core.

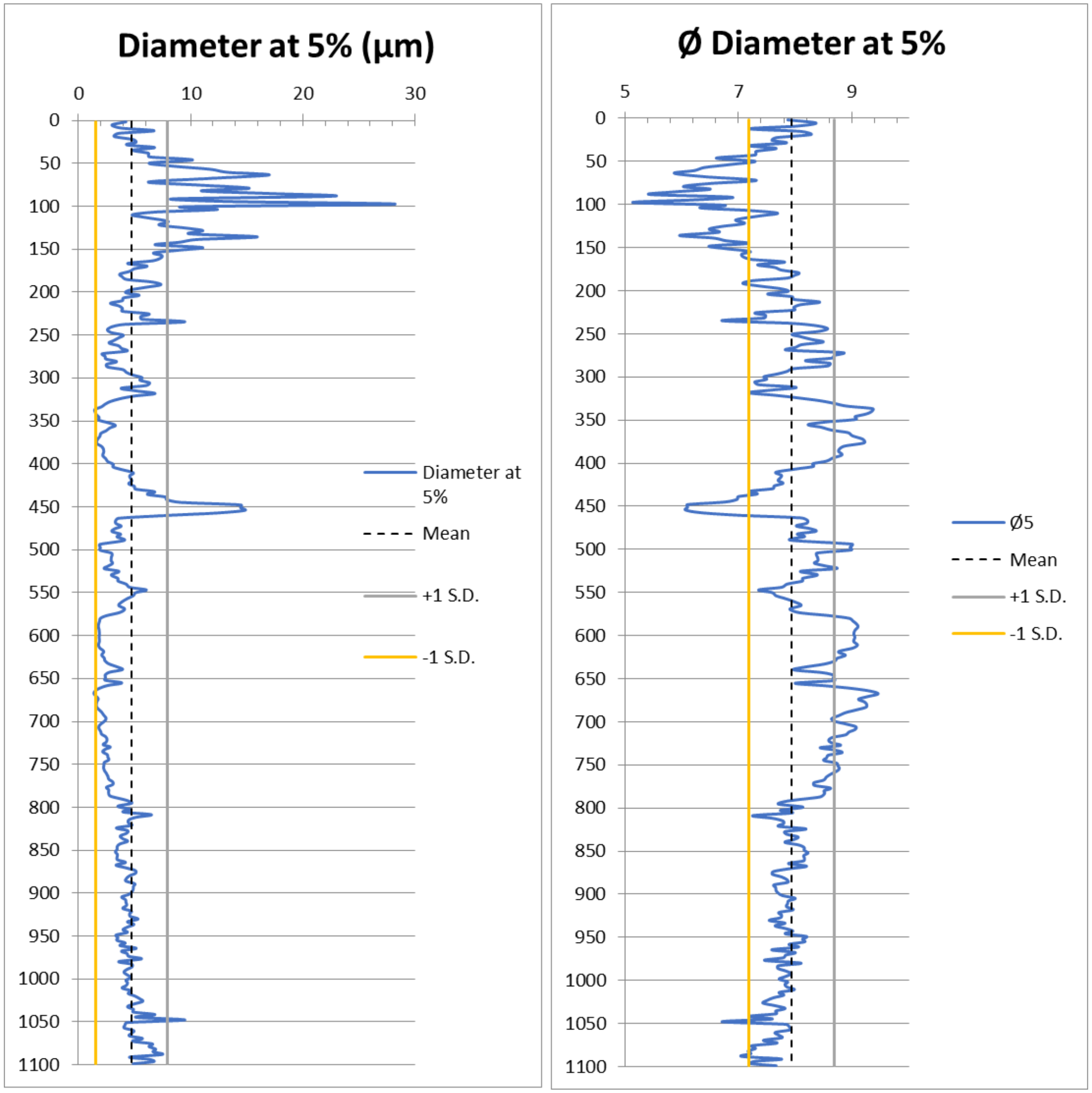

Figure B3. Particle size diameter at 5% of the cumulative particle size in microns and phi for the 052516-01 core.

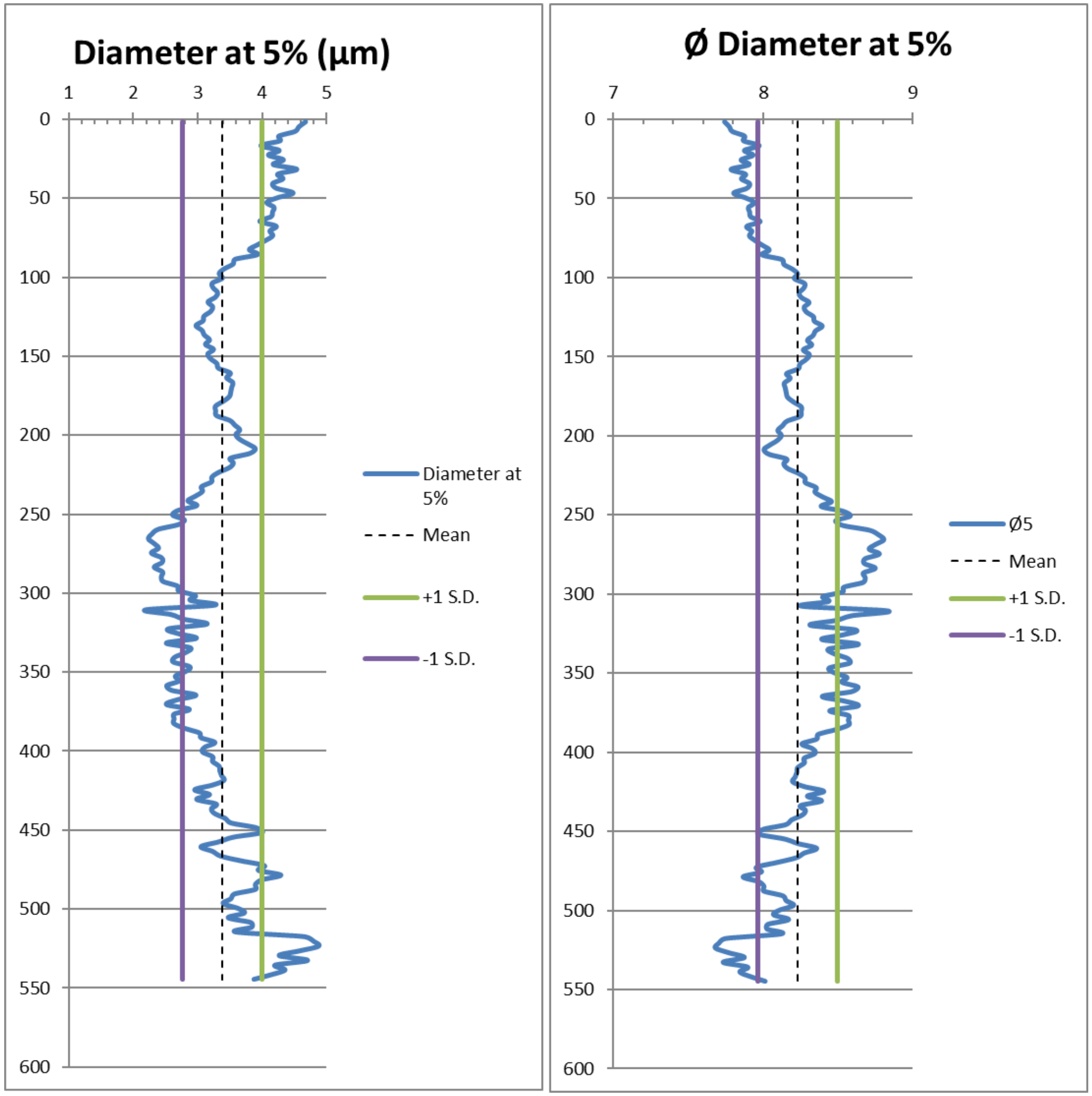

Figure B4. Particle size diameter at 5% of the cumulative particle size in microns and phi for the 070617-02 core. 145

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