# GEOARCHAEOLOGICAL INVESTIGATIONS INTO PALEOINDIAN ADAPTATIONS ON THE AUCILLA RIVER, NORTHWEST FLORIDA

A Dissertation

by

JESSI JEAN HALLIGAN

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

May 2012

Major Subject: Anthropology

Geoarchaeological Investigations into Paleoindian Adaptations on the Aucilla River, Northwest Florida

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Approved by:

Chair of Committee, Michael R. Waters
Committee Members, Ted Goebel
Cristine Morgan
C. Andrew Hemmings
Head of Department Cynthia Werner

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# ABSTRACT

Geoarchaeological Investigations into Paleoindian Adaptations on the Aucilla River, Northwest Florida. (May 2012)

Jessi Jean Halligan, A.B., Harvard University

Chair of Advisory Committee: Dr. Michael R. Waters

This dissertation addresses how Paleoindians used the karst drainage of the Aucilla River in northwestern Florida during the Pleistocene/Holocene transition (approximately 15-10,000 $^{14}C$ yr B.P.). I take a geoarchaeological approach to discuss Paleoindian land use by first defining the Late Pleistocene and Holocene geological record, and then by creating a model of site formation processes in the Aucilla River.

Both underwater and terrestrial fieldwork were performed. Underwater fieldwork consisted of hand-driven cores and surface survey, vibrocoring, underwater 1 x 1 m unit excavation, and controlled surface collection. Terrestrial fieldwork consisted of shovel and auger test pits. Seventeen cores were collected from five different submerged sinkhole sites, which were used to select two sites for further study: Sloth Hole (8JE121), which had been previously excavated, and Wayne's Sink (8JE1508/TA280), which was recorded but not formally investigated. Five vibrocores and two 1 x 1m units were used, with previous research, to define the geological and geoarchaeological context of Sloth Hole. Fifteen vibrocores, six 1 x 1 m excavation units, and ten 1 x 1 m surface collection units were used to define the geological, geoarchaeological, and archaeological context of Wayne's Sink. A combination of 130 shovel and auger test pits was used to define the geological, geoarchaeological, and archaeological potential of the terrestrial landscape. Five new Holocene-aged terrestrial sites were recorded.

All of these data were evaluated with archival data from previously-excavated sites to create models of site formation and Paleoindian land use in the lower Aucilla Basin. This research shows that there have been four major periods of sinkhole infill in the lower Aucilla basin. The first occurred prior to the Last Glacial Maximum, with each sinkhole containing peat deposits that date in excess of 21,000 calendar years ago (cal B.P.). These peats are overlain by sandy colluvium that dates to approximately 14,500 cal B.P. The colluvium is overlain by clays that contain evidence for soil formation. These soils vary in age, with radiocarbon dates of approximately 14,500-10,000 cal B.P. These clays are directly overlain by peats dating to 5,000-3,500 cal B.P., which are overlain by peats and clays that date to 2,500-0 cal B.P. Intact Paleoindian and Early Archaic deposits are possible in the late Pleistocene soils.

# DEDICATION

To my grandparents: Ken, Ruth, Stuart and Dorothy, for believing in me and for always trying to answer my endless questions.

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I sincerely thank the Florida Bureau of Archaeological Research for loaning me the equipment necessary to clean out the bottom of a river and gear for breathing while doing so. I also thank Roger Smith for allowing BAR personnel to assist me, and I thank Franklin H. Price and Dan McClarnon for their heroic efforts on my behalf. Thanks to Mary Glowacki, Louis Tesar, and Jim Dunbar for the assistance with permits and help and advice throughout my fieldwork. I thank Joe Donoghue for the loan of the vibrocorer. Thank you to the Florida Museum of Natural History, especially Donna Ruhl and Neil Wallis, for allowing me access to the collections.

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# CHAPTER I

# INTRODUCTION

## Peopling of the Americas, Paleoindians, and Pleistocene Florida

Despite more than a century of research, scholars still debate where and when the first people entered the New World and still have many questions about how these first Americans changed and adapted. The Clovis period, dating to circa 11,050-10,800 radiocarbon years before present ($^{14}$C yr B.P.) or 13,100-12,600 calendar years before present (cal B.P.)[1] spans the earliest unequivocal human occupation of North America (Waters and Stafford 2007), but an increasing number of potential pre-Clovis sites have been reported and debated (Adovasio et al. 1990; Adovasio et al. 1999; Fiedel 2000; Gilbert et al. 2008; Goodyear 2005; Haynes 2005; Keene 2009; Kelly 2003; Miotti 2003; Sandweiss 2005; Waters et al. 2011a; Waters et al. 2011c). Paleoindian settlement and subsistence strategies, especially those of Clovis, are also unresolved (Anderson 1996,

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This dissertation follows the style of *American Antiquity.*

[1] Throughout this dissertation, chronology is of the utmost importance. For the terminal Pleistocene (approximately 20,000-11,000 cal B.P.), radiocarbon ages and calendar years are significantly different. Most of the archaeological data used in this dissertation are radiocarbon dated if they are dated at all, but numerous proxy records are dated in calendar years B.P. only. Therefore, it is important to calibrate the radiocarbon ages for direct comparisons, and also so that it is possible to discuss when in real time archaeological events occurred. Thus, the first time a radiocarbon age is presented, it is followed by the calibrated age. Subsequently, I will only refer to the calendar age. All ages were calibrated to 1σ using OxCal version 4.1. (IntCal 09 curve) (Bronk Ramsey 2009, 2010). If the radiocarbon age is an estimate (such as an estimated span for a cultural period) and has been reported without standard deviation information, I calibrated it by using an arbitrary standard deviation of ±10. These ages should be considered approximate. Because calibration curves change frequently, all ages were recalibrated for this dissertation from the original source unless noted.

2005; Dunbar and Vojnovski 2007; Gillam and Anderson 2000; Hemmings 2004; Kelly and Todd 1988; Meltzer 2004).

Since stone tools were first discovered with extinct fauna at Folsom and Blackwater Draw, New Mexico, in the Late 1920s and Early 1930s (Antevs 1935; Cotter 1937, 1938, 1939; Howard 1933), Paleoindian archaeologists have been attempting to explain four major research questions: who were the first Americans, when did they arrive, where did they come from, and what route did they take? With the advent of radiocarbon dating in the mid-20th century, scholars thought they had their answers (Haynes 1964). For several decades, the prevailing paradigm was that big-game hunters from Siberia followed megafauna crossing the Bering Strait. These people arrived in Alaska approximately 14,000 calendar years ago, developed the distinctive bifacial and blade technologies that we call Clovis, and continued to follow the game animals through an ice-free corridor between the massive Cordilleran and Laurentide ice sheets. After arriving south of the ice sheets, they spread in all directions, covering the entire continent in a few hundred years, and possibly causing the end of the megafauna through overhunting (Martin 1984). With the death of the megafauna and the end of the Pleistocene, people developed regional subsistence strategies and eventually created thousands of Native American cultures.

In recent decades, this paradigm has been challenged on the basis of several chronological and technological complications. First, improvements in radiocarbon analysis have allowed us to more precisely date Clovis, showing us that Clovis has a relatively small age range, allowing very little time for continent-wide migration (Waters and Stafford 2007). Second, the dated Clovis sites are nearly simultaneous and do not show any clear trends of settlement direction, as one would hope to see with a founder population (Waters and Stafford 2007), although this lack of a directional trend may partially be due to a radiocarbon plateau around 10,500-11,000 $^{14}C$ B.P. causing individual radiocarbon ages to represent wide ranges of calendar years (Reimer et al. 2009). Third, an increasing number of sites in North American appear to be older than the established range of Clovis (Adovasio et al. 1999; Gilbert et al. 2008; Joyce 2006; Lowery et al. 2010; Overstreet and Kolb 2003; Waters et al. 2011a; Waters et al. 2011c). Fourth, none of these earlier sites contains the distinctive Clovis technology in these Early strata. Fifth, South American sites are contemporaneous in age with Clovis and older sites, but also do not contain Clovis diagnostics (Dillehay 1989; Faught 2008). If these data are correct, we must again attempt to explain where and when and how people arrived in the New World.

Scholars break into two main camps: those who think that the evidence for pre-Clovis is compelling (Bradley and Stanford 2004, 2006; Faught 2006, 2008; Goodyear 2005; Waters et al. 2011a; Waters and Stafford 2007; Waters et al. 2011c), and those who are not convinced (Fiedel 2000; Haynes 2007; Kelly 2003). Both of these groups, however, share the goal of explaining the colonization of the Americas and the appearance of Clovis in most of North America almost simultaneously and for a very short period of time (Waters and Stafford 2007). No matter when colonization occurred, there are three main hypothesized routes for colonization of the Americas: along the

Pacific Coast, overland through Beringia and through the ice-free corridor, and across the Atlantic.

Pacific coastal route supporters use ecological models to show that the ice-free corridor was untenable during the time hypothesized for initial colonization (ca. 18-14,000 cal B.P., depending on the researcher), and use genetic and linguistic links between modern Native Americans and Asian populations to support an Asian homeland (Dixon 2001; Erlandson and Braje 2011; Fedje and Christensen 1999; Mandryk et al. 2001). Ice-free corridor supporters use the same genetic and linguistic evidence, but also use technological comparisons to say that the First Americans were using bifacial tools and hunting terrestrial mammals. Supporters of this model point out that there is little evidence of maritime adaptation in the Clovis record, and northern sites near the coast are significantly younger than Clovis, meaning that Clovis ancestors were unlikely to have been coastal peoples (Goebel 1999; Haynes 2005; Straus et al. 2005). The Atlantic hypothesis is based solely on technology and the similarities between the Clovis toolkit and Solutrean toolkits from Upper Paleolithic assemblages in Europe (and the concordant lack of similarity between Clovis and Upper Paleolithic Asian sites) (Bradley and Stanford 2004, 2006; Lowery et al. 2010; Wagner and McAvoy 2004). The supporters point out that large lanceolate bifaces with overshot flaking and formal blade tools are present in both Clovis and Solutrean assemblages but are extremely rare in the most toolkits throughout the world (Stanford and Bradley 2012).

At this time, all three models have problems and fail to completely explain the early site distribution in North and South America, but the two Asian origins models seem to be most compelling. Gillam and Anderson (2000) used least-cost analysis in GIS modeling in order to predict interior colonization with either the Pacific coastal or Beringian routes, showing that either or both routes could result in the observed site distribution of Clovis, while Early sites on the California Channel Islands seem to strongly support at least some coastal migration (Erlandson and Braje 2011; Reeder et al. 2011). Further, the genetics evidence strongly supports a an Asian homeland for Native American ancestors, with mtDNA evidence suggesting a relatively long stay in Beringia followed by a rapid colonization of the Americas (Tamm et al. 2007). The Y-chromosome data of individuals carrying the Q haplogroup (one of the best-published and common Native American haplogroups) suggests a split between Asian and Native American populations at approximately 13,400 cal B.P. after a rapid expansion in Asia of the haplogroup around 20,000 cal B.P. (Dulik et al. 2012). The Solutrean hypothesis currently is more difficult to support because it either ignores differences between Solutrean and pre-Clovis toolkits or fails to explain a several thousand radiocarbon year gap between Solutrean sites and Clovis sites, and, further, espouses a route that may not have existed and does not account for the existing genetic evidence (Goebel and Buvit 2011; Straus et al. 2005; Westley and Dix 2008).

No matter how the Americas were colonized, most Paleoindian research in North America still focuses upon the Great Plains, where archaeologists first found Pleistocene animals in association with stone tools (Antevs 1935; Cotter 1937, 1938, 1939; Howard 1933); this custom has persisted even though the southeastern United States contains the most recorded Paleoindian artifacts in North America (Anderson et al. 2009; Hemmings

2004). More than half of the recorded fluted projectile points in the Americas have been found east of the Mississippi River (Figure 1.1) (Anderson et al. 2009), along with proposed kill sites, quarries, and residential sites (Anderson et al. 2011; Redmond and Tankersley 2005; Robinson et al. 2009; Smallwood 2010; Webb et al. 1984). Thus, Great Plains-centered discussions of Paleoindians are often disregarding a large portion of the known material culture from this period. On the other hand, nearly all of these fluted points and purported Paleoindian artifacts in the Southeast were recovered from surface contexts and are not associated with any known site; further, most are undated and many are untyped, (Anderson et al. 2009), which limits their research potential.

Hundreds of fluted points and other Paleoindian artifacts have been recovered from the Aucilla River in northwestern Florida, including directly-datable tools of bone, antler, and ivory that rarely preserve in other areas. Many of these artifacts were discovered as surface finds in and around sinkholes within the modern channel of the Aucilla River, but some cultural materials also have been found in organic-rich sediments deposited on the sink margins during the Late Pleistocene. At this time, there is little understanding of how sediments and artifacts accumulated in these sinks or how the artifacts and bones have been affected by geologic processes. The Aucilla River has been investigated by avocational archaeologists for decades, but only a few sites have been professionally excavated and reported (Dunbar et al. 2006; Dunbar and Vojnovski 2007; Hemmings 1999b; Webb 2006).

This dissertation presents the results of geoarchaeological analysis of the lower Aucilla River, which is used to address how Paleoindians used the karst drainage of the

Aucilla River during the late Pleistocene and early Holocene. This dissertation has three main goals. I first define the geological history of the karstic Aucilla River during the late Quaternary (ca. 45,000-0 cal B.P.) based on the study of five sinkhole sites along separate sections of the lower Aucilla and upon terrestrial investigations adjacent to two of the sites. I then examine the context of artifacts at these localities to develop a model for archaeological site formation processes in the lower Aucilla. Finally, I utilize the archaeological data from intact cultural contexts to discuss Paleoindian and Early Archaic use of these unique sites.

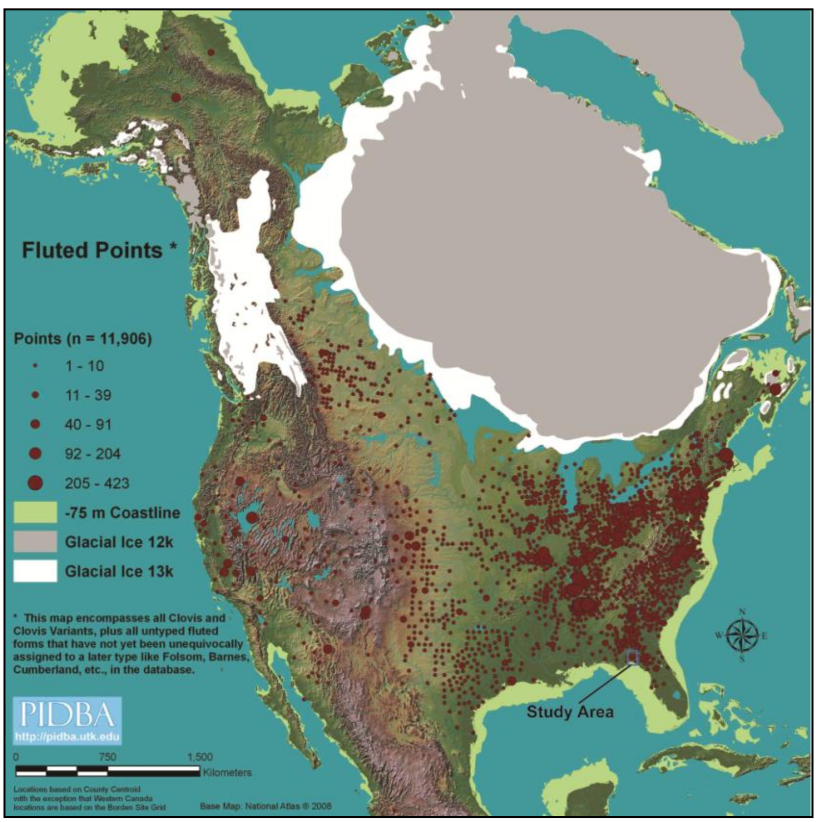



**Figure 1.1. Paleoindian point distribution from the Paleoindian Database of the Americas (Anderson et al. 2009) showing study area.**

To do this, I have combined fieldwork and archival research. The fieldwork consisted of vibrocoring at two submerged sinkhole sites, survey on land, and excavation underwater. The data (both geological and cultural) from these excavations were compared to published data from two sites and previously excavated but largely unpublished data from two other sites, all within the Aucilla River drainage. Geological comparisons helped determine if site formation processes were uniform within these sinkhole sites, as all five sites are in slightly different settings in the drainage basin. Analysis of the cultural material from intact Paleoindian deposits helped to explain how people were using each area in the past. Comparison of the sites to one another illustrates some larger cultural patterns and helps to show how those patterns changed over time.

Chapter II summarizes our current knowledge of Paleoindian archaeology in Florida and the Southeast. Chapter III presents the environmental setting of the study and summarizes what is known about the geology, geomorphology, and paleoenvironment of the lower Aucilla River. This chapter also introduces previous geoarchaeological research in the area. Field and lab methods are described in Chapters IV and V, respectively. Chapter VI discusses pilot study research at three submerged sinkholes that were not excavated further. Terrestrial research is discussed in Chapter VII. Chapter VIII presents the results of current and previous underwater research at the Sloth Hole site (8JE121). Chapter IX presents the results of terrestrial and underwater research at the Wayne's Sink site (8JE1508/TA280). Finally, Chapter X summarizes the regional geological and geoarchaeological interpretations for the lower Aucilla and interprets potential human activities in this area.

The Aucilla River is an ideal place for this study because these sinks have numerous directly datable artifacts, intact geological deposits dating to the Late Pleistocene, and potentially intact archaeological sites dating from Clovis to the Early Archaic and possibly earlier (Dunbar 2002; Milanich 1994; Purdy 2008; Webb 2006). These include beveled ivory rods, worked bone, and bone beads (Hemmings 2004) along with finely-worked high-quality stone projectile points. The Florida Bureau of Archaeological Research (2010) has records of 111 Paleoindian sites in Jefferson and Taylor counties, the two counties bordering the Aucilla, indicating the density of Early sites in this area. Therefore, Aucilla River sinkhole sites have the potential to help us understand some of the overarching issues of the peopling of the Americas, Paleoindian settlement and subsistence, and early Holocene cultural transitions.

# CHAPTER II

# PALEOINDIAN STUDIES IN THE SOUTHEAST

## Introduction

This chapter reviews the history of archaeological thought about the Paleoindian period in the southeastern United States from approximately 15,000 to 10,000 cal B.P. after briefly placing this discussion within the context of Paleoindian studies as a whole. I will focus upon northwestern Florida and provide comparisons with the extant Paleoindian dataset for the greater Southeast region. Most scholars divide the Paleoindian period into Early, Middle, and Late; I follow this convention in the following chapter, using the time spans generally accepted by researchers in Florida although these ages may differ from elsewhere in the Southeast. The theoretical concerns of each period differ, and the preponderance of the literature deals with single time periods. I will, therefore, discuss each time period in the following order: first, the dataset for the greater Southeast; second, the dataset for Florida, and, third, theoretical discussion and critiques related to these datasets. The theoretical discussion is organized around the major research questions addressed by the literature: site age, settlement and subsistence patterns, and technological organization.

### *Previous Florida Research*

Archaeologists have only recognized Florida's rich record of late Pleistocene artifacts during recent decades (Anderson 2005; Goodyear 2005; Hemmings 2004; Waters and Stafford 2007; Webb 2006). Some artifacts were found as early as 1875

(Wyman 1875), and there were other early discoveries in the "Melbourne bone bed" (Sellards et al. 1917), but either the age of the items was not recognized or artifact contexts were considered controversial. Beveled ivory rods reported by Jenks and Simpson (1941) were compared to rods from the Clovis locality at Blackwater Draw, but in the absence of absolute dating methods, their age could only be inferred. Not until Neill's (1958) discovery of the Silver Spring stratified Paleoindian site (8MR92) (Figure 2.1) did the Pleistocene occupation of Florida became accepted.

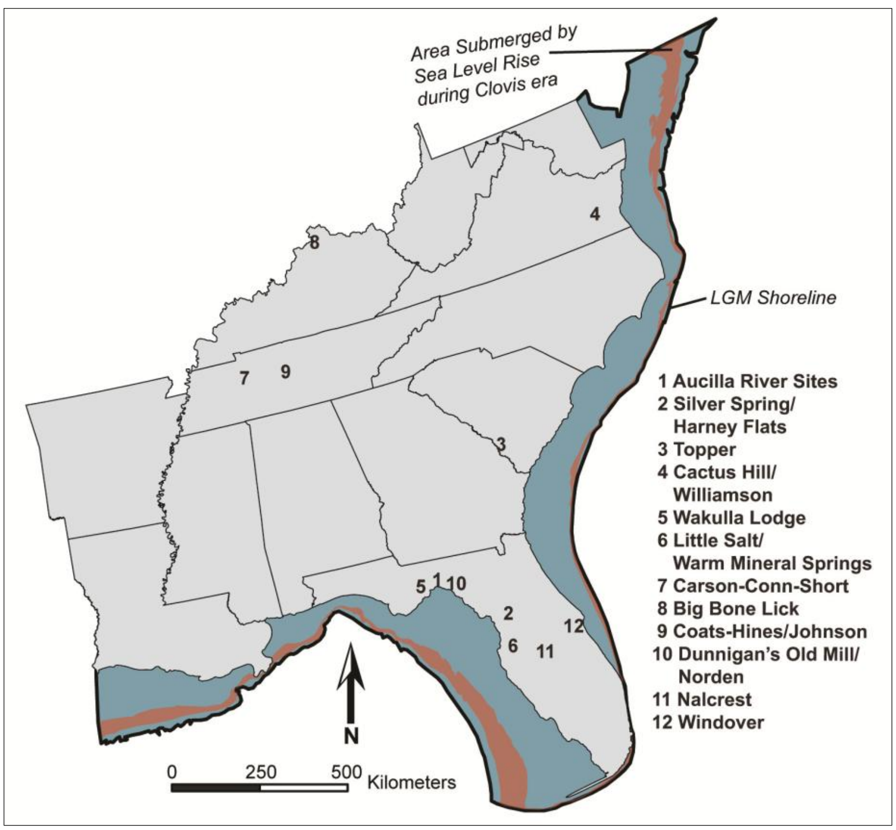



**Figure 2.1. Map of the southeastern United States with previously investigated sites mentioned in text, showing landmass during the Last Glacial Maximum (ca. 22,000-20,000 cal B.P.) and shoreline change during the Clovis period. See Figure 2.2 for more detail on Aucilla River sites.**

After this discovery and the concurrent increase in recreational SCUBA diving, underwater artifact collecting in Florida increased dramatically (Dunbar 2006a; Milanich 1994), eventually leading to scientific interest in the rivers. The Aucilla River Prehistory Project (ARPP) was the first systematic archeological survey of the Aucilla (Hemmings 1999a, 1999c; Muniz 1997; Webb 2006). Over 16 km of the river were surveyed by divers who recorded more than 50 sites, dated more than three dozen sinkholes, and excavated or tested portions of approximately fifteen submerged Paleoindian sites.

The ARPP discovered much of what is known about Paleoindians in northwestern Florida, but the nature of this survey also left unanswered questions. The ARPP was an underwater survey, so little testing took place on land, and it is unknown if terrestrial site density matches the underwater density. While the ARPP recorded at least 37 underwater Paleoindian localities in the lower Aucilla (Figure 2.2), there are no recorded terrestrial Paleoindian sites. Another problem has been that approximately a third of the sites recorded during the ARPP were tested or excavated, but many of the sites were never fully reported and the data analyses were never completed.

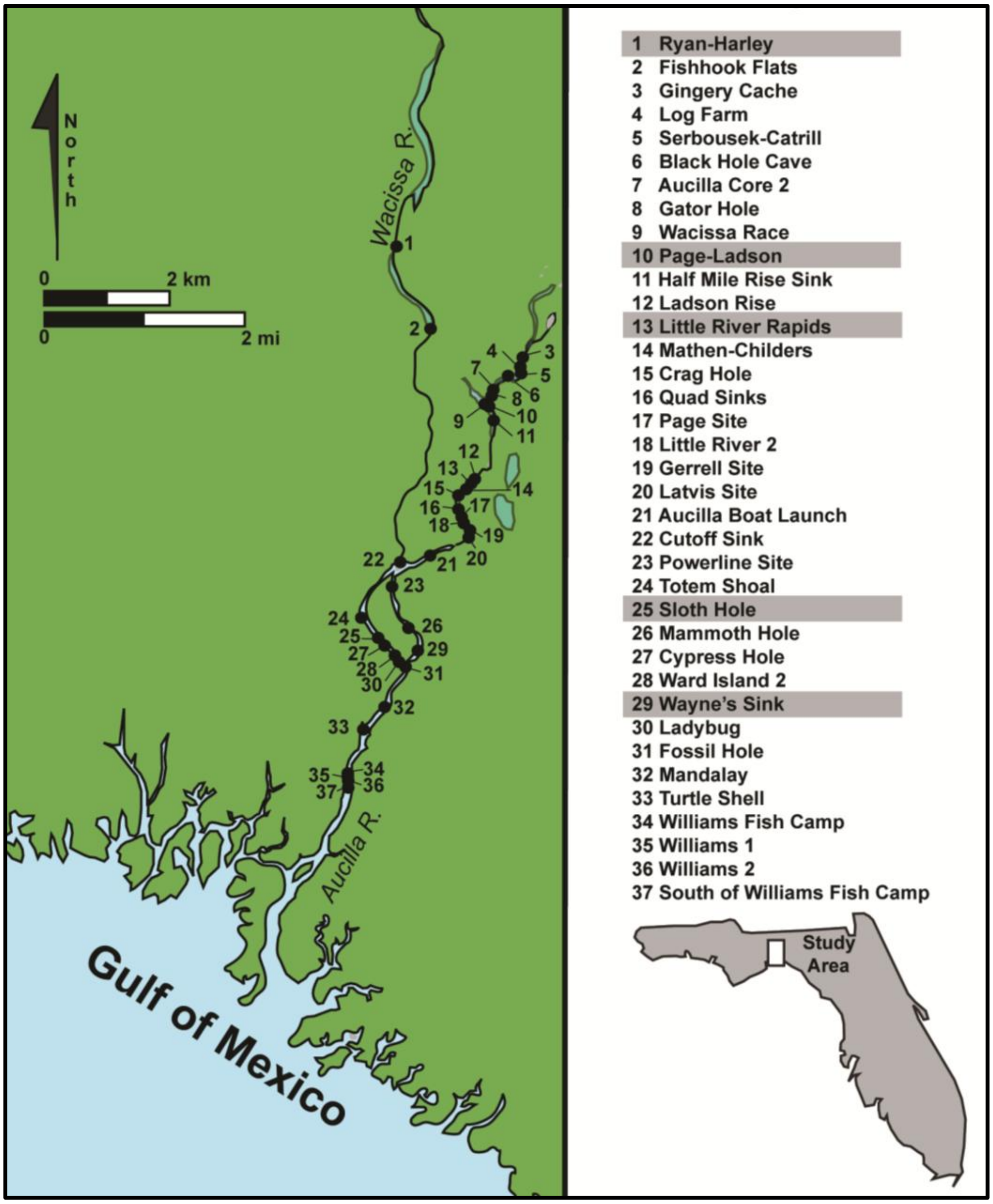
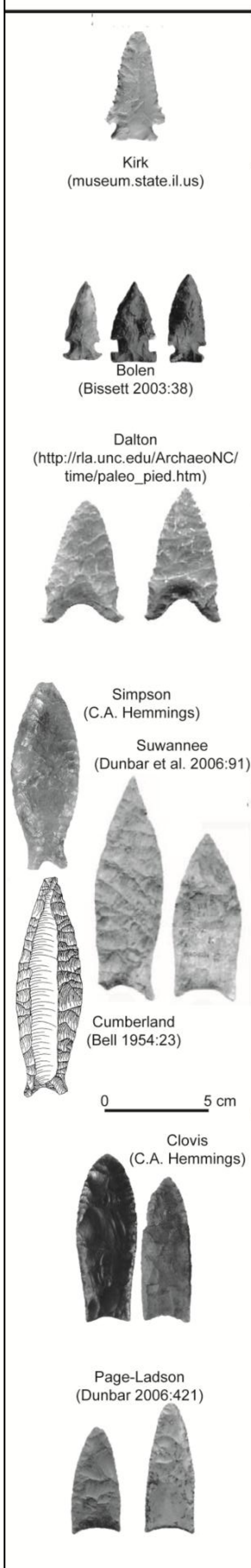



**Figure 2.2. Archaeological sites in the lower Aucilla River recorded during the ARPP. Sites examined in this study are highlighted.**




**The Cultural Historical Sequence for Florida Prior to 9,000 Radiocarbon Years B.P.**

| Diagnostic Point Types | Cultural Period | Group | Diagnostic Artifacts | Major Sites | Dates (14C unless noted) | Notes on ages |
|---|---|---|---|---|---|---|
| | Early Archaic | Kirk/ Wacissa/ Palmer | Kirk types and variants | Dust Cave (AL) | 8,800-7,010 | |
| | | | | Page-Ladson | no dates | |
| | | | | Harney Flats | 9,000 | |
| | | | | Ryan-Harley | no dates | |
| | | | | Tennesee Valley Sites (TN) | 9,500-9,000 | many dated sites |
| | Late Paleoindian/Early Archaic | Bolen | Bolen points, Aucilla Adzes, Bola stones, antler points | Deerstand | 9,730 | |
| | | | | Page-Ladson | 10,100-8,905 | on stake |
| | | | | Bolen Bluff | ~9,000-7,000 | old date |
| | | | | Sloth Hole | no dates | |
| | | | | Little River Rapids | no dates | |
| | | | | 8LE2105 | no dates | |
| | | | | Boca Ciega | no dates | |
| | | | | 8HI450 | no dates | |
| | | | | Norden | no dates | |
| | | | | J&J Hunt | no dates | |
| | | | | Ryan-Harley | no dates | |
| | Late Paleoindian | Dalton/ Hardaway | Dalton points, adzes | L'Anguille Sites (AR) | no good dates | |
| | | | | Dust Cave (AL) | 10,500-9,890 | mixed stratigraphy |
| | | | | Hardaway (NC) | 11,100 | old date |
| | | | | Hester (MS) | dates? | |
| | | | | Rodgers Shelter (AK) | 10,500-10,200 | |
| | | Dalton-like? | microliths | Nalcrest | see above | |
| | | Greenbriar | Greenbriar point | Boca Ciega | no dates | |
| | | | | Page-Ladson | no dates | |
| | | | | 8HI450 | no dates | |
| | Middle Paleoindian | Simpson/ Suwannee | Simpson points | Wakulla Springs | OSL age older than 12k | ages NOT associated |
| | | | Suwannee points, various forms | Ryan-Harley | no dates | |
| | | | | Norden | no dates | |
| | | | | Dunnigans Old Mill | no dates | no diagnostics |
| | | | | Harney Flats | no dates | |
| | | | | Page-Ladson | no dates | |
| | | | | Silver Springs | no dates | |
| | | | | Johson Sand Pit | no dates | |
| | | | | Ontolo | no dates | |
| | | | | Warm Mineral Spring??? | no dates | |
| | | other | Cumberland, Quad, Beaver | Dust Cave (AL) | 10,500-10,300 | |
| | Early Paleoindian | Clovis | Clovis, excurvate Clovis, ivory tools, blades (almost unknown in Florida) | Sloth Hole | 11,050 | |
| | | | | Lewis-McQuinn | no dates | |
| | | | | Silver Springs | no dates | |
| | | | | Helen Blazes | no dates | |
| | | | | Mathen-Childers | no dates | elephant/ Clovis |
| | | | | numerous surface finds in Aucilla River | no dates | |
| | | | | Cactus Hill (VA) | 10,920 | |
| | | | | Topper (SC) | OSL 13,500 | |
| | | pre-Clovis | Page-Ladson points? | Page-Ladson | 12,045 | ages NOT associated |
| | | | Simpson points? | Wakulla Springs | OSL age older than 12k | ages NOT associated |
| | | | none | Warm Mineral Spring | no dates | |
| | | | none | Little Salt Spring | 13,450-12,030 | stakes with tortoise |
| | | | none | Coates-Hines | 12,050 | |
| | | | "Miller point" | Cactus Hill (VA) | 15,070 | tentative |
| | | | "bend breaks" | Topper (SC) | OSL >15,000 | |

**Figure 2.3. Time periods (in radiocarbon years), major sites, and diagnostic point types discussed in text.**

Most of the Florida Paleoindian record comes from underwater sites, giving the false impression that there are no terrestrial Paleoindian sites in Florida. This is untrue, but terrestrial preservation is usually poor, so faunal remains and osseous artifacts are extremely rare. Much like the Paleoindian remains from elsewhere in the Southeast, artifacts consist primarily of lithics (Anderson and Sassaman 1996a). Terrestrial Paleoindian sites are also much less visible than underwater sites, as they generally are buried, and often can only be discovered by excavation or erosion (Balsillie et al. 2006; Daniel and Wisenbaker 1987; Dunbar and Vojnovski 2007). A handful of sites have been recorded, but very few have been chronometrically dated (Daniel and Wisenbaker 1987; Dunbar 2006b; Dunbar and Vojnovski 2007; Neill 1958). Diagnostic artifacts from all Paleoindian periods have been recovered from many of these undated sites. Figure 2.3 presents the major time periods, associated sites, and associated point types presented in this chapter.

## The Potential Pre-Clovis Period (pre-13,100 cal B.P.)

### *Pre-Clovis in the Greater Southeast*

Pre-Clovis strata have been reported from several sites in the Southeast, including three sites outside Florida and several within the state (Breitburg et al. 1996; Deter-Wolf et al. 2011; Dunbar 2002, 2006a, 2007; Goodyear 2005; Wagner and McAvoy 2004; Webb 2006). Cactus Hill in Virginia contains small bifacial points, flakes and flake tools, and small blade-like flakes/bladelets in strata below a defined

Clovis component. The site is located in an area with very fine sands, so issues of artifact mixing or potential deflation are hard to resolve (Wagner and McAvoy 2004). OSL ages on the stratigraphy seem to correspond well to ages on charcoal from the potential cultural stratum below Clovis (Wagner and McAvoy 2004), but these charcoal ages could be somewhat contaminated as they are based on loose charcoal fragments not associated with features (Haynes 2005). On the other hand, the artifacts from this stratum appear consistent with what might be expected for a technology that leads into Clovis, so the site remains a possible pre-Clovis locality. The Topper site contains an immense Clovis component in good stratigraphic context (Smallwood 2010), with a number of chert items in strata deeper than the Clovis component. As pointed out by Waters and colleagues (2009a), this site is much less likely  a pre-Clovis contender. The sediments containing these cherts are definitely older than Clovis; the cultural attribution of these materials is less certain, however. The Coats-Hines site contains the remains of at least three mastodons, at least one of which is associated with artifacts and contains cut-marked bone (Breitburg et al. 1996; Deter-Wolf et al. 2011). Two radiocarbon ages of 12,030 ± 40 and 12,050 ± 60 $^{14}$C B.P. (13,800-13,980 cal B.P.) have been obtained from sediments around the mastodon bones, along with a series of OCR ages that roughly coincide with these dates (Deter-Wolf et al. 2011). These new data have just recently been published, and this site provides tantalizing hints of mastodon butchery prior to the known age range of Clovis, but direct ages upon the mastodon or culturally-altered charcoal would better define the age of the human activities as the organic sediment ages could be somewhat inaccurate.

*Florida Pre-Clovis*

Artifacts from sediments predating Clovis have been reported for five different sites in Florida: Page-Ladson, Sloth Hole, Wakulla Springs, Little Salt Springs and Warm Mineral Springs. The early artifacts from Page-Ladson are the most fully published (Dunbar 2002; Webb 2006). These include an ivory tusk with possible cutmarks and nine lithic artifacts in a sediment layer dating to a pooled average of 12,045 $\pm$ 32 $^{14}$C yr B.P. (n=7) (13,951-13,826 cal B.P.) and several flakes from another, mixed, stratum (Dunbar 2002, 2006a:411). Two unfluted, basally ground lanceolate bifaces, named Page-Ladson points, were recovered from a nearby surface and may have come from the earlier strata (Dunbar 2006a). The possible pre-Clovis component of Sloth Hole is less well known. Flakes were discovered in the undated stratum above sediments dated to 12,300 ± 50 $^{14}$C B.P. (14,481-14,034 cal B.P.) (Hemmings 1999c); these have not been fully published, but the site has been cited as a pre-Clovis contender (Dunbar 2002).

The Wakulla Springs site, located approximately 35 km from the Aucilla River, is another potential pre-Clovis site. This is a terrestrial site on the shores of Wakulla Springs with an artifact-bearing stratum below a stratum from which a Suwannee or Simpson (proposed Middle Paleoindian period) preform was recovered (Dunbar 2006a; Dunbar and Vojnovski 2007; Tesar and Jones 2004), but the cultural materials were discovered in potentially bioturbated sands. Warm Mineral Springs and Little Salt Springs in central Florida also contain deposits dating to older than Clovis (Milanich 1994; Purdy 2008), but the context of these finds remains ambiguous. Thus, the potential pre-Clovis record in Florida could benefit from careful contextual excavation and increased exposure of sediments older than 13,100 cal B.P.

*Theoretical Concerns*

There are two main questions that remain unanswered about all the southeastern pre-Clovis sites: are the proposed materials cultural and are the stratigraphic contexts (and ages thereof) correctly interpreted? Therefore, pre-Clovis site discussion assumes archaeologists can recognize and agree upon cultural material, are correctly analyzing stratigraphy, have dating methods that work as proposed, and understand the age of and variation within Clovis, so can recognize a pre-Clovis assemblage. None of these above assumptions is as straightforward as we would like. All of the pre-Clovis contenders have been challenged on one or more of the above grounds (Anderson 2005; Fiedel 2000; Goodyear 2005; Haynes 2005; G. Haynes 2008; Kelly 2003; Waters et al. 2009a). Cactus Hill, Wakulla Lodge, Little Salt Springs, Warm Mineral Springs, and Page-Ladson may have stratigraphic problems (Dunbar and Vojnovski 2007; Purdy 2008; Tesar and Jones 2004; Wagner and McAvoy 2004; Webb 2006), while the cultural attribution of chert items at Topper is questioned (Fiedel 2000; Haynes 2005; Waters et al. 2009a). Sloth Hole and Coats-Hines have not been reported well enough to allow scrutiny (Breitburg et al. 1996; Deter-Wolf et al. 2011; Hemmings 1999b).

The evidence for pre-Clovis in the Southeast remains controversial, making it difficult to say much about human behavior. However, if these sites are real, it seems that pre-Clovis people in the Southeast were making bifaces and other kinds of stone tools and utilizing megafauna at sites like Coats-Hines and Page-Ladson, logical precursors to later Clovis activities. This fits well with the evidence from potential pre-Clovis sites in the rest of North America (Adovasio et al. 1999; Johnson 2007; Waters et al. 2011a; Waters et al. 2011c).

## Early Paleoindian (Clovis) (13,100-12,600 cal B.P.)

*Southeastern Clovis*

Clovis is the earliest generally-accepted technological complex in North America, with a widespread and distinctive fluted bifacial and blade technology (Antevs 1935; Bradley et al. 2010; Collins 1999; Hemmings 2004; Stanford 1991). Thousands of Clovis points have been found in surface collections throughout the Southeast (Anderson et al. 2009) (Figure 1.1), but very few Clovis points have been recovered from stratigraphic contexts. Even fewer are associated with radiocarbon-dated material. The Topper site in South Carolina is probably the best-known Clovis locality in the greater Southeast; this extensively-excavated site is a quarry with evidence for Clovis point and blade manufacture (Smallwood 2010, 2011; Waters et al. 2009a). Cactus Hill, mentioned above, contains a relatively substantial Clovis component (Wagner and McAvoy 2004). Carson Conn-Short is possibly the most complex Clovis site in the Southeast: it contains more than 40 features, many Clovis points, and numerous Clovis blades (Broster 1993; Smallwood 2011). The Williamson site in Virginia also contained numerous Clovis points and bifaces, and has evidence for separate quarry and residential areas (Smallwood 2011). Big Bone Lick, Kentucky (Hedeen 2008; Waters et al. 2009c) contains the remains of mastodons and Clovis points in a mixed stratigraphic context. The Johnson site in Tennessee has three Clovis points, more than 20 blades, and 25 fluted preforms that were collected along an eroded riverbank, but the site was never excavated (Barker and Broster 1996).

*Florida Clovis*

Hundreds of Clovis points have been found in Florida, but Clovis sites with stratigraphic information are not common (Purdy 2008; Thulman 2006). Not one Clovis point has been professionally recovered from an intact stratigraphic context in Florida, with the possible exception of the Helen Blazes site in eastern Florida, which was excavated in the 1940s (Edwards 1954). The only Clovis-aged archaeological date from Florida is on an ivory tool from Sloth Hole (8JE121) (11,050 $\pm$ 50 $^{14}C$ yr B.P. [SL-2850]) (Hemmings 2004; Waters and Stafford 2007) (13,081-12,865 cal B.P.). Sloth Hole is the best-excavated Clovis locality in Florida, although there are contextual problems even there. Recreational divers recovered five Clovis points from unknown contexts at the site, while professional excavation recovered five potentially Paleoindian broken bifaces and a mastodon fibula with evidence of butchery (Hemmings 1999b). Unfortunately, none of the Clovis points was discovered in an excavated context, and the mastodon fibula has not been dated.

Notes of the ARPP indicate that Clovis points are known to have come from at least eight other sites in the Aucilla, with tools made from extinct megafauna recovered from seven more. These underwater sites contain worked megafauna bone and ivory including atlatl hooks, pins, points, abraders, and daggers, showing a richer material-culture record in this area than can be seen elsewhere in North America and proving that humans were utilizing the large animals extinct by the end of the Pleistocene (Hemmings 1999b, 2004), although these artifacts were nearly all recovered from surface contexts and, thus, cannot be definitively attributed to manufacture by Clovis people.

*Theoretical Concerns*

Clovis is the earliest well-accepted technological complex in the Southeast (and North America), so most discussions of Clovis people historically have related to their status as a presumed founding population, and a significant amount of Clovis research is related to colonization models. The sparse but tantalizing data discussed in the pre-Clovis section above indicate that Clovis people may not have been the colonizers, but this is still controversial, so much of the literature reflects an ongoing debate about the way in which Clovis people adapted to new environments and discusses Clovis technology in this light (Anderson 2005; Fiedel 2000; Grayson and Meltzer 2002; Haynes 2005; Hemmings 2004; Waguespack and Surovell 2003). An implicit corollary of the Clovis-first theory is that Clovis is an unvarying phenomenon (Bradley et al. 2010; Hemmings 2004). Therefore, except for basic site reports, most discussions of Clovis (even by authors who support a pre-Clovis colonization of the Americas) tend to be written on a continent-wide scale, comparing datasets from thousands of kilometers apart (Bradley et al. 2010; Collins and Hemmings 2005; Grayson and Meltzer 2002; Hemmings 2004; Waguespack and Surovell 2003; Waters and Stafford 2007).

There are two major views of Clovis migration, heavily influenced by the Binfordian collector-forager subsistence spectrum and later evolutionary ecology theory

(Binford 1980, 1983; Kelly 2007; Stephens and Krebs 1986). There are those, primarily studying Clovis and Folsom adaptations upon the Great Plains, who see Clovis as being specialized, highly-mobile predators relying upon their advanced lithic technology to allow them to radiate rapidly throughout the continent (Kelly and Todd 1988; Surovell 2000; Surovell and Waguespack 2008; Surovell et al. 2005; Waguespack and Surovell 2003). Conversely, there are those who see these early people as more generalized foragers focused upon minimizing risk who continually adapted to new ecotones (Grayson 2001, 2007; Grayson and Meltzer 2002; Meltzer 2004).

Finds in Florida, such as worked megafaunal bone, ivory rods, and a *Bison antiquus* skull with an embedded projectile point fragment strongly indicate that Paleoindians were utilizing and attacking megafauna (Hemmings 1999b, 2004; Webb et al. 1984). These artifacts have been associated with Clovis because the megafauna seem to have been extinct by the end of the Clovis era and old bone and ivory may not be workable into tools (Bradley et al. 2010; Hemmings 2004), although Dunbar and Vojnovski propose a later extinction in Florida of some fauna based on the association of megafauna and artifacts at three undated sites attributed to the Middle Paleoindian period (Dunbar and Vojnovski 2007). Recent work by Waugespack and Surovell used optimal foraging theory and ethnographic analogy (Surovell and Waguespack 2008; Waguespack and Surovell 2003) to strongly suggest a Clovis focus on elephants. However, those in favor of the generalized forager interpretation point out that usage does not prove megafauna *reliance*, that these animals may only have been a small part of the entire resource spectrum, and that there is no way to absolutely link the osseous artifacts specifically to Clovis peoples (Grayson and Meltzer 2002; Meltzer and Holliday 2010), so the debate continues.

Archaeologists have proposed two settlement models for the observed distribution of Clovis in the Southeast, the staging-area model and the Oasis hypothesis. The staging area model proposed by David Anderson (Anderson 1996, 2005; Gillam and Anderson 2000) asserts that Paleoindians colonized the Southeast by following major drainages, which would have allowed them to encounter predictable resources. As people became more familiar with the territory, they radiated out into smaller drainages. This eventually led to individual bands occupying individual drainages, with macroband aggregations in areas between the drainages by the Early Archaic period. This hypothesis, however, explicitly denies any earlier colonizing groups, and predicts relatively sparse populations.

The second proposed model for Clovis settlement does not preclude Anderson's model, as this Florida-based model could apply equally well to a newly arrived or a well-established population. The "Oasis hypothesis" was proposed to explain the correlation between Clovis artifacts, megafauna, and sinkholes in Florida. This hypothesis (Webb 2006) states that Paleoindians focused upon the abundant sinks in northwest Florida during the Pleistocene-Holocene transition because lowered water tables limited the flow of surface water (Webb 2006). Because of the rarity of water, people and animals were attracted to these sinks, which still contained some water in the bottoms; this allowed Paleoindians to hunt with relative ease. Both of these models could be correct, with Anderson's describing the macro-level settlement system and the Oasis model describing the local distribution of artifacts.

Probably because most Clovis material in the Southeast lacks context, technological studies of artifacts dominate the published literature. These studies focus upon determining how similar or different the technological organization or reduction strategies are at various Clovis sites (Anderson et al. 2009; Bradley et al. 2010; Smallwood 2010, 2011), how Clovis material culture evolved from or evolved into different artifact types (including the whole Solutrean migration route hypothesis) (Bradley and Stanford 2004; Dunbar et al. 2006; Goodyear 2005; Hemmings 1999a, 1999b; Stanford 1991), and how Clovis technology was used (Frison 1989; Hemmings 2004; Redmond and Tankersley 2005; Titmus and Woods 1991; Waters et al. 2009b). The first two types of studies are based on seriation and statistics, although experimental archaeology (flintknapping) is also commonly used to recreate the technological process.

## Middle Paleoindian (12,800-12,400 cal B.P.)

### *Southeastern Middle Paleoindian*

The Middle Paleoindian period is problematic in the Southeast. On the Great Plains, Folsom sites are relatively well-defined and radiocarbon date to soon after Clovis, possibly overlapping the latest Clovis dates (Bement and Carter 2010; Collard et al. 2010; Holliday 2000). There are no archaeological sites in the Southeast, however, that date directly after Clovis. Several point types (Cumberland, Redstone, Suwannee, Beaver Lake, Quad, Coldwater, and Simpson) are proposed to belong in this gap (Anderson 1996; Anderson and Sassaman 1996a; Dunbar 2007), and these have been recovered from numerous sites, all undated. To further complicate matters, some researchers have suggested that any or all of these types could predate instead of postdate Clovis based on artifact seriation (Ellis et al. 1998; Goodyear 2005; Stanford 1991). Dust Cave, Alabama, contained one reworked Cumberland point in a component dating to 10,500-10,300 $^{14}$C yr B.P. (12,500-12,000 cal B.P.), (Sherwood et al. 2004), but there are no other directly associated ages with any of these types.

*Florida Middle Paleoindian*

Middle Paleoindian sites, defined by the presence of Suwannee and Simpson points, are equally problematic in Florida. Suwannees and Simpsons are large, waisted unfluted lanceolate points that are relatively common in the region (Thulman 2006 recorded 817 such points), but there are no dated Middle Paleoindian sites in Florida. No Simpson points have been excavated from a primary context, and no Suwannee points have been dated. Suwannee points have been found stratigraphically below or coeval with Early Archaic Bolen points at Harney Flats, Ryan-Harley, and Wakulla Lodge (Balsillie et al. 2006; Daniel and Wisenbaker 1987; Dunbar et al. 2006; Dunbar and Vojnovski 2007; Tesar and Jones 2004), but they have not been discovered in stratigraphic relationship with Clovis points. Further, the variable Suwannee type may consist of several types, possibly from different time periods (Dunbar and Hemmings 2004). Without radiometric ages, this cannot be resolved. Faunal remains are somewhat common at Middle Paleoindian sites, but they are usually leached of datable collagen

(Balsillie et al. 2006) (Dunbar and Vojnovski 2007; Webb and Dunbar 2006) so the age of these points remains controversial.

*Theoretical Concerns*

Because there are absolutely no dated Middle Paleoindian sites in Florida, and only a single age reported in association with a single point for the entire Southeast, one could say that this entire period is tentative. The chronological sequence of "Middle Paleoindian" is based on an association of extinct fauna with Suwannee diagnostics at Ryan-Harley, Dunnigan's Old Mill, and the Norden site (Dunbar and Vojnovski 2007), and upon artifact seriation. Dunbar and colleagues (Balsillie et al. 2006; Dunbar 2007; Dunbar and Hemmings 2004; Dunbar et al. 2006) believe Suwannee points are related to Clovis, especially excurvate Clovis. Several traits of lithic reduction seem to match Clovis rather well and the toolkits are also somewhat similar, including ovoid scrapers, end scrapers, and blade-like flake tools. Dunbar and colleagues consider these traits to be descendent of Clovis, but Stanford (1991) has pointed out that either or both Suwannee and Simpson points may be contemporaneous with or older than Clovis.

Because preserved faunal remains at Ryan-Harley, Dunnigan's Old Mill, and the Norden site (Dunbar and Vojnovski 2007) represent a number of different species ranging from muskrats to megafauna, Dunbar and Vojnovski have hypothesized that Suwannee people were pursuing an Archaic-like generalized foraging strategy very early. Of course, this implies that generalized foragers typified the Archaic and that taphonomic processes have not disturbed the site assemblages. This last assumption, especially, is problematic, as all three sites are in fluvial systems and site formation studies have only been performed at Ryan-Harley, (Balsillie et al. 2006) where a mid-Holocene sediment directly overlays the artifact level, indicating that the site was not buried very quickly or that is was buried quickly and was later re-exposed, both of which are problematic for archaeological context.

Thulman (2009) used isolated finds of Middle Paleoindian points as proxies for intensity of prehistoric land use and relative population densities. He used paleohydrology models to determine where surface water would have been available during the Middle Paleoindian period, as environmental reconstructions suggest that severe droughts occurred during this period in Florida. Comparing point distributions to these surface water maps, he inferred that Middle Paleoindian people were living in the areas with exposed surface water. This hypothesis is heavily reliant on several assumptions: paleohydrology models are correct; isolates actually correlate to intensity of use; these isolates actually date to the Middle Paleoindian period; and the Middle Paleoindian actually exists as a period. While a compelling idea, without chronometric dates, this cannot be resolved.

## Late Paleoindian/Early Archaic (12,600-10,700 cal B.P.)

### *Southeastern Late Paleoindian/Early Archaic*

This period, marked by numerous unfluted lanceolate point types and the first appearance of stemmed points, also suffers from problems with chronology and typology (Carter and Dunbar 2006; Dunbar 2007). Dalton, Kirk, Greenbriar, Union, and other point types are somewhat common but have not been extensively studied. Dalton points are probably the best known, with ages ranging from 10,700-8,000 $^{14}C$ yr B.P. (12,700-8,800 cal B.P.) depending on the publication (Anderson and Sassaman 1996a; Goodyear 1982; Morse and Morse 1996). The earlier age ranges place Dalton firmly within Middle Paleoindian contexts, while the later extends Dalton well into the Early Archaic, so the age and association of Dalton groups is somewhat complicated. The Sloan site in Arkansas is a large Dalton cremation cemetery (Morse 1997). The site contained numerous burials with projectile points and other stone tools. Several of the burials contained multiple remains and some showed potential evidence of revisit in antiquity. Greenbriar and Union points may or may not be local Dalton variants, but tend to have much more limited distributions (Anderson and Sassaman 1996a).

Kirk and Kirk variants are very common in the greater Southeast (Anderson and Hanson 1988; Daniel 2001), but are somewhat rare in Florida (Milanich 1994). Kirk points may be as old as 10,000 $^{14}C$ yr B.P. (11,500 cal B.P.) and may have continued in use until around 7,000 $^{14}C$ yr B.P. (7,850 cal B.P.) although most estimates would include the range of 9,500 (10,800 cal B.P.) and 8,500 $^{14}C$ yr B.P. (9,500 cal B.P.), (Anderson and Sassaman 1996b). According to researchers, Kirk points seem to be associated with semi-mobile foraging groups in the greater Southeast (Anderson 1996; Anderson and Hanson 1988; Barker and Broster 1996; Carter and Dunbar 2006; Daniel 2001; Monaghan et al. 2004; Sherwood et al. 2004). It appears that either Kirk was an extraordinarily long-lived type, that several sequential types are included within the classification, or that more radiocarbon dating is needed to determine the true age of these sites.

*Florida Late Paleoindian/Early Archaic*

Thulman (2006) only recorded 75 Late Paleoindian points, and included none of them in his statistical analyses. Ages for this time period are inferred by comparison with neighboring states, as there are few dates in association with diagnostics in Florida. These points are rarely found in original contexts and are poorly-reported in the literature. Page-Ladson has a component dating to the Late Paleoindian from which no diagnostics were recovered (Dunbar 2006), although a single terrestrial unit adjacent to the underwater portion of the site contained three Greenbriar points (Dunbar 2010, personal communication). Kirk points were definitely associated with burials at Windover, where they may date as young as 7,000 $^{14}C$ yr B.P. (7,850 cal B.P.) (Adovasio et al. 2001; Doran 2002). Several Kirks were also discovered above the Bolen level at Page Ladson, and a small number were discovered as isolated finds during the Aucilla River Prehistory Project. Dalton points have not been found *in situ* in northwest Florida, but isolates are known. The Nalcrest site contained Dalton points and microliths that Bullen and Beilman (1973) associated with Dalton, but the site was primarily a surface collection from a shallow submerged context.

All of the sites examined in this dissertation contain a known Bolen component. Bolen points are limited in distribution to Florida and southern Georgia, but they are extremely common in these areas. Bolens, large stemmed points and knives, are commonly considered to be Early Archaic (Carter and Dunbar 2006), but these diagnostics occur in both Late Pleistocene and Early Holocene strata, leading some to consider Bolen potentially a Late Paleoindian type (Dunbar and Vojnovski 2007; Milanich 1994). While radiometric ages of these sites are relatively rare, Bolen artifacts can be found nearly everywhere in northwest Florida. It is also very common for Bolen sites to contain earlier Paleoindian components, especially Suwannee diagnostics, which has led several (Carter and Dunbar 2006; Dunbar 2007; Faught 2006) to infer a genetic relationship with Suwannee. The Bolen component at Page-Ladson was dated to a pooled average of 9,959 ± 38 $^{14}$C B.P. (11,591-11,265 cal B.P.) (n=3), which is comparable to ages from Warm Mineral Springs (Carter and Dunbar 2006).

*Late Paleoindian Theoretical Concerns*

While some people have studied the Late Paleoindian period in the greater Southeast (Anderson 1996; Anderson and Sassaman 1996b; Ellis et al. 1998; Morse 1997), there is relatively little Late Paleoindian research in Florida. Overall, researchers think that this time period indicates a “settling in” period when humans adapted to local fauna and adjusted to megafauna extinction, but this is based on little data (Dunbar 2006a; Milanich 1994), and implies that this process had not already occurred. In other words, most of the research has focused on the transitions to Archaic lifeways as represented by the shift from lanceolate to stemmed points, even though there may or may not have been any other cultural changes. There is little research focused on Late Paleoindian lifeways in Florida, and the relationship between Paleoindian and Early Archaic in Florida is poorly-understood (Bissett 2003). While my research focuses upon Paleoindian adaptations in the Aucilla River of northwestern Florida, all of the

Paleoindian sites studied contain substantial amounts of Early Archaic material that may have important implications for understanding Paleoindian behavior. Specifically, both Kirk and Bolen points have been recovered from all of the sites.

If Paleoindian sites are also commonly Early Archaic sites, it is important to consider how the Paleoindian and Early Archaic actually differed. The toolkit of Bolen groups includes large bifacial points and knives, adzes (indicative of woodworking adaptations), and worked bone tools, all of which seem to display a generalized forager way of life (Bissett 2003; Carter and Dunbar 2006; Purdy 1991), while Paleoindian components contain large bifacial points and knives, worked bone tools, and large choppers that may have been used for woodworking (Bradley et al. 2010; Hemmings 2004). Thus, it is necessary to define how technologies and adaptations are different between Archaic and Paleoindian. Of course, research is needed to better define the Late Paleoindian period in Florida before we can determine how similar or different Late Paleoindian lifeways were from their precursors.

## Summary and Continuing Concerns

This has been a brief overview of the Paleoindian archaeological record in the Southeast, and of how researchers have approached this record. In general, studies are focused upon recreating chronologies, sequences of artifact manufacture, and reasons for site distributions. Scholars have been heavily influenced by processualism and Binfordian theory (Binford 1980, 1983), which has meant that experimental archaeology, ethnographic analogy, and statistical analyses have been very instrumental to our understanding of Southeastern Paleoindians. However, as can be seen above, some time periods and some research questions are considered much more important than others. A great deal of ink has been expended on how and when people got to the New World, what these first people ate, and how they moved across the landscape. Almost nothing is known about people after Clovis, especially in Florida, partially because of spotty datasets, but partially because of less research interest.

Absolute chronology is of the utmost concern in early Southeastern archaeology. Many diagnostic artifact styles lack direct dating of any kind, and very few of them have been found in stratigraphic relationships to aid in creation of relative chronologies. For instance, the culture history defined by Willey (1998[1949]), developed in the absence of absolute dating methods and revised by Bullen (1975) before the inclusion of underwater data, is still the most commonly used reference for Florida chronology and prehistory. There have been recent attempts to revise the Paleoindian chronology (Dunbar 2007; Dunbar et al. 2006; Dunbar and Vojnovski 2007), but these lack firm stratigraphic evidence or absolute ages and are still somewhat hypothetical.

Analysis of sites containing diagnostic artifact types has given us ideas about human activity during instants of the Pleistocene/Holocene transition, but without knowing when these actions happened, it is very difficult to interpret cultural choice, human adaptation to changing climates, group mobility, and subsistence strategies. Until the cultural historical framework is more firmly known, it is difficult to meaningfully discuss human behavior. Context and chronology need to be better clarified for Florida prior to 10,500 cal B.P. This has been recognized by many Paleoindian archaeologists: a brief survey of literature published in the past 20 years shows that nearly half of all southeastern Paleoindian articles in major journals specifically deal with site ages and geoarchaeological questions of site formation while many of the rest are general site reports (Anderson and Gillam 2001; Balsillie et al. 2006; Barker and Broster 1996; Breitburg et al. 1996; Broster 1993; Daniel 2001; Faught 2004; Gillam and Anderson 2000; Goodyear 1982; Hemmings 2000; Muniz 1998; Sherwood et al. 2004; Smallwood 2010; Waters et al. 2009a; Waters et al. 2009c).

Studies of Clovis and pre-Clovis are conducted on a continental scale, comparing datasets from far afield, but after Clovis, there is a perception (perhaps real, perhaps not) of increasing regionalization in the record, so post-Clovis studies are carried on at the level of single drainages, single counties, and single states. These differences may be real, but it is also possible that the regionalization is in the eye of the archaeologists (or, more accurately, that the apparent lack of regionalization in Clovis is only due to our way of studying Clovis), as indicated by Smallwood (2011).

This research has determined a few things: we know how the lithic artifacts were made and how many of them were used. We know how old Clovis sites are and something about where Clovis people were living and why. We have several theories about their subsistence. We still have many more questions than answers, however, about most of the research topics I have mentioned above. We have no idea how point types equate to cultural groups in the past or how old most of these types are. We, thus, do not know how different groups interacted and lived on the landscape. We do not know when people arrived in the Southeast, how they got there, or what they were doing when they did. We do not know how groups changed over time or how they adapted to the end of the Pleistocene, including megafaunal extinctions, rising water levels and major floral reorganizations. Thus, despite decades of study, much more research is needed if we are to understand Southeastern Paleoindians. This dissertation will strive to fill in some of the gaps in chronology and help to further our understanding of Paleoindian lifeways.

# CHAPTER III

# ENVIRONMENTAL BACKGROUND

The Aucilla River flows southward from its headwaters in southern Georgia, creating the boundary between Jefferson and Taylor counties, Florida, and emptying into the Gulf of Mexico. The entire length of the river runs over a carbonate substrate, from the heavily mantled Northern Highlands to the Gulf Coastal Plain, where the carbonates are covered with a thin layer of Quaternary sediments (Yon 1966:9) (Figure 3.1). Northwestern Florida currently has a warm and humid climate, and the area is covered with a warm mixed forest biome (Leduc 2003; Williams et al. 2000). This environment is a product of modern climates and sea levels; the Aucilla River would have been quite different as climates fluctuated during the terminal Pleistocene and Holocene. This chapter discusses the geology and environment of northwestern Florida and presents a review of past geoarchaeological research in the Aucilla.

## Geological Context

### *Modern Hydrology and Geography*

Northwest Florida is geographically unique in North America. The landscape is typified by shallow karst features eroded into Tertiary Limestone (Donoghue 2006) (Figure 3.1), and the Florida Aquifer keeps the numerous rivers and streams supplied with fresh water (Scott and FGS 2004). Because of their karst substrate, these rivers are not subject to processes typical of other streams. Portions of the rivers are spring- or seep-fed, and channels commonly follow the surface for short stretches, abruptly disappearing underground, sometimes for kilometers. Streambeds are shallow (often less than 2 m deep) and filled with heavily-eroded limestone bedrock and limestone boulder "shoals" (Figure 3.2). This bedrock limestone is pockmarked with sinkholes, some of which contain their own springs or seeps and continually recharge streamflow (Lane 1986; Scott and FGS 2004). The presence of flowing surface water in these systems is linked to Holocene sea-level highstands and high water tables. During periods of low sea levels and water tables, the only surface expression of the Aquifer may be in sinkholes and associated springs (Webb 2006).

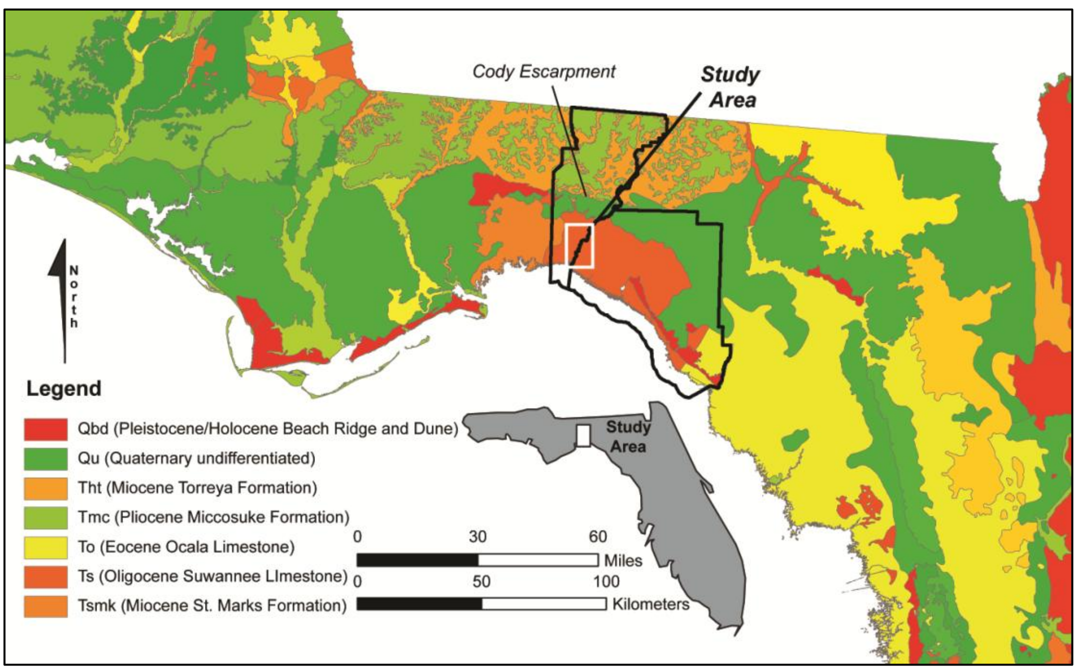



**Figure 3.1. Geologic map of Florida from Anderson (2006). Legend shows only formations in Jefferson and Taylor counties (black outline). Study area in white outline. Cody Escarpment marks edge of current coastal plain.**

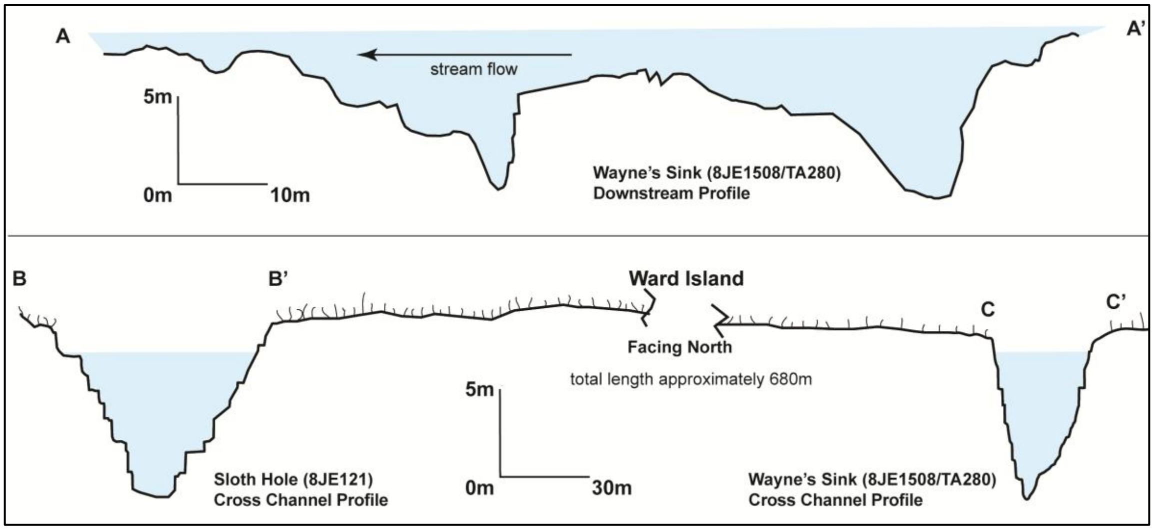



**Figure 3.2. Stream cross sections showing bathymetric change of sinkholes. See locations of cross sections on Figures 4-2 and 4-3.**

The Aucilla River, with a discharge of approximately 15,600 liters/second, is one of four rivers in the Ochlockonee basin that feeds into Apalachee Bay. The Aucilla drainage basin encompasses approximately 2200 $km^2$ in southern Georgia and Florida, with a total channel length of approximately 125 km. The lower Aucilla has some characteristics typical of coastal plain streams: the wide, shallow, tidally-influenced channel has a very low gradient (averaging 0.3 m/km over the last 25 km) meandering northeast to southwest into Apalachee Bay. This karstic stream also has some notable differences. The channel has eroded into the soft Oligocene-aged Suwannee Limestone, so it cannot easily change course (Donoghue 2006). In many places, the channel location has remained constant since at least the early Holocene (Webb 1998). Most notably, the Aucilla channel is not continuous. The lower Aucilla has numerous short surface "runs," interspersed with stretches of stream flow underground. Its main tributary, the Wacissa, flows into the Aucilla after a short surface run of approximately 23 km (Balsillie et al. 2006).

*Geologic Setting: The Karstic System*

The entire length of the Aucilla River runs over a limestone substrate. The northern section of the river runs over the Northern Highlands, a highly-dissected Miocene delta plain (Yon 1966:9) to the Cody Escarpment, a probable Sangamon-aged marine terrace with an elevation of 13-15 m above sea level (asl), which divides the Northern Highlands from the Woodville Karst Plain. This dissertation specifically deals with the lower Aucilla, located on the Woodville Karst Plain, part of the Gulf Coastal Lowlands (Yon 1966). Suwannee Limestone, a moldic pack-to-grainstone with little quartz sand, outcrops or is very near the surface on much of the karst plain. This limestone contains numerous dolomitic areas and common chert nodules (Balsillie et al. 2006). Karst features are very common as well. Karstic drainage systems, including the Aucilla, are commonly pockmarked with caves, springs, sinkholes of various types, disappearing stream channels, and underground stream flow, leading to very irregular topography (Jennings 1985; Lane 1986; White 1988).

Sinkholes are the most notable karst feature in the study area, as these contain most of the artifacts and potentially-intact archaeological deposits. Sinkholes, or dolines, as they are more properly known, have formed in the Tertiary-aged Suwannee limestone because mildly acidic rainwater and groundwater reacted with the limestones and dolomites, causing them to slowly dissolve, leading to the collapse or subsidence of surface sediments (Kindinger et al. 1999; Lane 1986; White 1988). Put simply, dolines form when underlying carbonates are differentially dissolved, usually at bedrock fractures or faults, and surficial mantles react to infill the depression (Jennings 1985:106-120). Dolines are generally oval or circular with three main shapes: conical, cylindrical, or bowl-shaped, with form usually genetically related to sinkhole type.

Although the literature varies in sinkhole classification, Jennings (1985) presents the most widely-used discussion of type (Figure 3.3). Solution dolines form when the surface mantle is relatively thin, allowing the underlying carbonates to be directly dissolved by surface and groundwater at a fracture point or intersection. This leads to translocation of carbonates down the widened fracture areas and increasing sinkhole size and complexity with time, although the relative rates of clastic fill to solution evacuation do much to determine eventual size and shape. Nearly all of the sinks within the current Aucilla channel are this type of doline (Donoghue 2006).

Collapse dolines form when carbonates farther under the surface are eroded, leaving voids that are infilled with water (Jennings 1985). When water tables drop, the voids empty, causing surface collapse. This type of sink often is cone- or cylinder-shaped, and commonly has a debris cone in the center. This kind of sink is quite common in Florida, but relatively rare in the Aucilla River (Lane 1986). Subsidence dolines form when thick soft (primarily sandy) sediments mantle carbonates. In this case, the mantling sediments slowly infill voids in the carbonates, leading to surface subsidence (Jennings 1985). These sinks are generally conical in shape, with mantling sediments draping the sides and no debris cone at the bottom. They occasionally occur in the upper Aucilla basin, but are not common in the study area (Donoghue 2006).

Subjacent karst dolines and alluvial streamsink dolines are also categorized by Jennings (1985:112-113), but are essentially sub-types of solution and subsidence sinks.

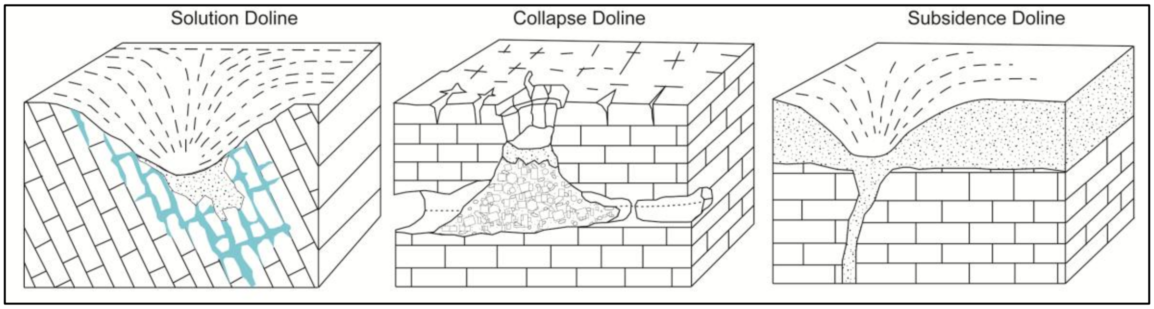



**Figure 3.3. Three major doline (sinkhole) types. Redrawn after Jennings (1985:107)**.

*Sea levels, Paleohydrology, and Sinkhole Response*

Sea level change is one of the most important environmental factors affecting this study area. During the Clovis period (12,600-13,100 cal B.P.), sea levels were approximately 50-70 meters lower than present (Balsillie and Donoghue 2004; Fiedel 1999; Peltier and Fairbanks 2006; Waters and Stafford 2007), meaning that the study area would have been more than 100 kilometers inland and would have been far upland. Throughout the Paleoindian period, the study area would have been an inland setting, possibly with a river, possibly with the only surface water available in sinkhole ponds. This change from a terrestrial system to a tidally-influenced fluvial system still needs to be chronicled. The low relief of the lower Aucilla means that minor fluctuations in sea level significantly alter the landscape. Thus, each sink potentially contains a complex mix of deposits accumulated in spring, pond, river, rockshelter, slope, and alluvial fan environments, each with its own archaeological preservation potential.

During the last glacial maximum (LGM) (ca. 22-20,000 cal B.P.), sea levels were as much as 110 meters lower (Peltier and Fairbanks 2006), but sea levels may have reached and exceeded modern heights by 4500 $^{14}$C B.P. (ca. 5100 cal B.P.) (Balsillie and Donoghue 2004; Blum et al. 2008) or may not have reached modern until approximately 1000 $^{14}$C B.P. (ca. 1000 cal B.P.) (Donnelly and Giosan 2008; Milliken et al. 2008). The presence of a mid-Holocene sea level highstand greater or equal to modern sea level is a topic still debated in the geology literature based upon the type of proxy data used (Bourrouilh-Le Jan 2007; Milliken et al. 2008; Simms et al. 2009; Törnqvist et al. 2004). Those who use nearshore dune features commonly report a mid-Holocene highstand, while those looking at inland features commonly see evidence of the same (Balsillie and Donoghue 2004; Blum et al. 2008; Bourrouilh-Le Jan 2007). Those who study deepwater corals have variable interpretations (Kievman 1998; Peltier and Fairbanks 2006), and those who study lagoonal features or barrier islands generally think there is no evidence for higher sea level in the mid-Holocene (Brooks et al. 2003; Milliken et al. 2008; Rittenour et al. 2007; Simms et al. 2009; Törnqvist et al. 2004). The presence or absence of a sea level highstand has important implications for this study.

This study area is currently in the tidally-influenced portion of the Aucilla River, with water levels observed to vary as much as 1.5 meters in the course of a single day due to tidal bore. A relative sea level of only 1 meter higher would have submerged much of the currently-terrestrial portion of this study area, which is currently only 0.3 to 2.5 meters asl, while a 3-meter rise would have submerged the entire area, which would have not only made the land unavailable for people, but would also potentially have destroyed any previous archaeological record in the area. Further, several of the submerged sinks, including one investigated in this study, contain outcrops of chert within the exposed bedrock of the sink margins. There is evidence for quarrying activities in these sinks several meters below current water level (Halligan 2009a; Hemmings 1999a). Thus, if modern water levels were reached during the Middle Holocene as proposed by Balsillie and Donoghue (2004), these cherts would have been available only to people willing to dive for them or to Paleoindians and Early Archaic cultures. On the other hand, if modern sea level was reached approximately 1,500 cal B.P, as stated by Milliken and colleagues (2008), these cherts would have been available throughout the Archaic and much of the Woodland periods. The sea level curve proposed by Balsillie and Donoghue (2004) is used in this dissertation because this curve incorporates more proxy data and is higher-resolution that most of the other published curves, thus it provides a more useful reference at the current time.

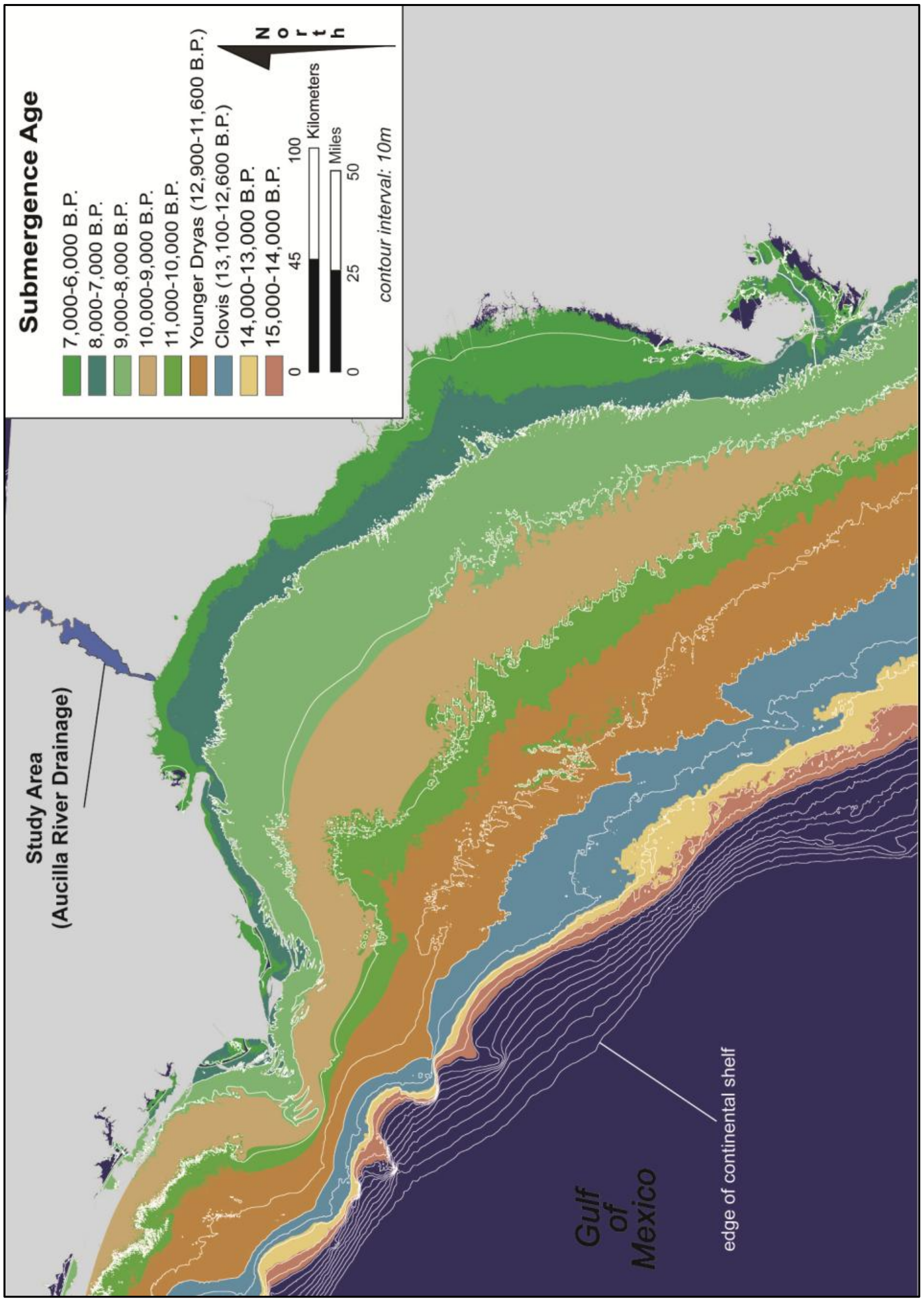



**Figure 3.4. Map showing submergence of the Big Bend area during the terminal Pleistocene and Holocene following curves proposed by Balsillie and Donoghue (2004). (See Figure 3.5, Table 3.1).**

Table 3.1. Sea Level Rise by 1000 Calendar Year Increments, using Balsillie and Donoghue (2004) Sea Level Curve.

| Age Begin | Age End | Level Min | Level Max | Total Years | Total Rise | Avg Rise/Year (m) | Notes |
|---|---|---|---|---|---|---|---|
| 15000 | 14000 | 97 | 79 | 1000 | 18 | 0.018 | |
| 14000 | 13000 | 79 | 64 | 1000 | 15 | 0.015 | |
| 13100 | 12600 | 67 | 51 | 500 | 16 | 0.032 | Clovis |
| 12900 | 11600 | 64 | 35 | 1300 | 29 | 0.022 | Younger Dryas |
| 11600 | 11000 | 35 | 45 | 600 | -10 | -0.017 | Sea level dropped |
| 11000 | 10000 | 45 | 23 | 1000 | 22 | 0.022 | |
| 10000 | 9000 | 29 | 22 | 1000 | 7 | 0.007 | |
| 9000 | 8000 | 26 | 10 | 1000 | 16 | 0.016 | |
| 8000 | 7000 | 10 | 5 | 1000 | 5 | 0.005 | |
| 7000 | 6000 | 5 | 0 | 1000 | 5 | 0.005 | |
| 6000 | 5000 | 0 | 4 | 1000 | -4 | -0.004 | Sea level dropped |
| 5000 | 4000 | 4 | 0 | 1000 | 4 | 0.004 | |

There is very good evidence that sea level rise after the LGM was episodic, with periods of very rapid change, followed by relatively stable shorelines, as can be seen in Table 3.1, Figures 3.4 and 3.5. Figure 3.4 was created using bathymetry data for the Gulf of Mexico obtained from NOAA (NOAA 2010) and high-resolution sea level curves from Balisillie and Donoghue (2004) to create a map of relative submergence of the Gulf of Mexico. This was done by taking the sea level maximum and minimum for each period represented in Table 3.1. The bathymetry data was then recoded for each time period by this maximum and minimum in order to display the extent of sea level change for each period. It should be noted that the sea level curve was created by Balsillie and Donoghue (2004) using multiple proxy records, including radiocarbon-dated specimens that were calibrated by the authors using IntCal04; this curve, thus, would vary slightly from one generated by IntCal09, but attempting to recalibrate their original data and then combine this with their data from sources that provide ages in calendar years would have introduced even greater inaccuracy. Also, Gulf of Mexico subsidence due to hydrocarbon removal and karst dissolution is well-documented, but the proposed rates of this subsidence vary by degrees of magnitude (Autin 2002; Blum et al. 2008; Törnqvist et al. 2004), so this figure did not take subsidence into account.

Sea level rise during the terminal Pleistocene also has important implications for human lifeways. Even at the relatively coarse resolution of the map in Figure 3.4, it is possible to see the dramatic effect of Late Pleistocene sea level rise in the Gulf of Mexico. For instance, the relatively rapid rise during the Clovis period (16 m in 500 years, or .032 m/year) combined with the shallow gradient in the Gulf means that shoreline change would have been visible on a yearly basis in some areas, with nearly 100 m of change/year. During the Younger Dryas, at approximately 12,900-11,600 cal B.P. (Straus and Goebel 2011), sea levels continued to rise dramatically: nearly 30 m in 1300 years (Table 3.1). This means that coastal environments would have been extremely unstable, and specifically coastal biomes probably would not have existed. From approximately 8,000 cal B.P. to the present, sea level rose comparatively slowly and steadily, so coastal environments probably could have adequately responded and moved shoreward. People also probably would not have seen noticeable change on an individual basis, which probably would have led to an impression of coastal stability.

## Environmental Context

### *Paleoclimate*

The Pleistocene is defined by the presence of glaciation; the beginning of the Holocene at approximately 10,000 $^{14}C$ B.P. (ca. 11,500 cal B.P.) is thus defined by the ending of continent-wide glaciers and general climate amelioration. Glacial retreat was not a linear process (Figure 3.5); from the LGM onward, there were several glacial advances that corresponded to lowered sea levels and generally cooler and moister climates in large portions of the Southeast (Clauzet et al. 2007; Peltier and Fairbanks 2006). The last late glacial climatic reversal, the Younger Dryas, is especially relevant to the study of southeastern Paleoindians because it may have been observable by people and may have caused the end of Clovis and/or the Pleistocene megafauna in North America (Dunbar 2006b; Firestone et al. 2007; Scott 2010; Semken et al. 2010). This period occurred roughly between 10,900-9,800 $^{14}C$ B.P. (12,900 and 11,600 cal B.P.) (C. V. Haynes 2008; Straus and Goebel 2011), and was marked by significant glacial advance and possible return to full glacial conditions in northern climes, but there has been much recent debate about its duration, intensity, causation, and impact on humans (Anderson et al. 2011; Firestone et al. 2007; Holliday and Meltzer 2010; Meltzer and Holliday 2010; Newby et al. 2005; Straus and Goebel 2011; Surovell et al. 2009)

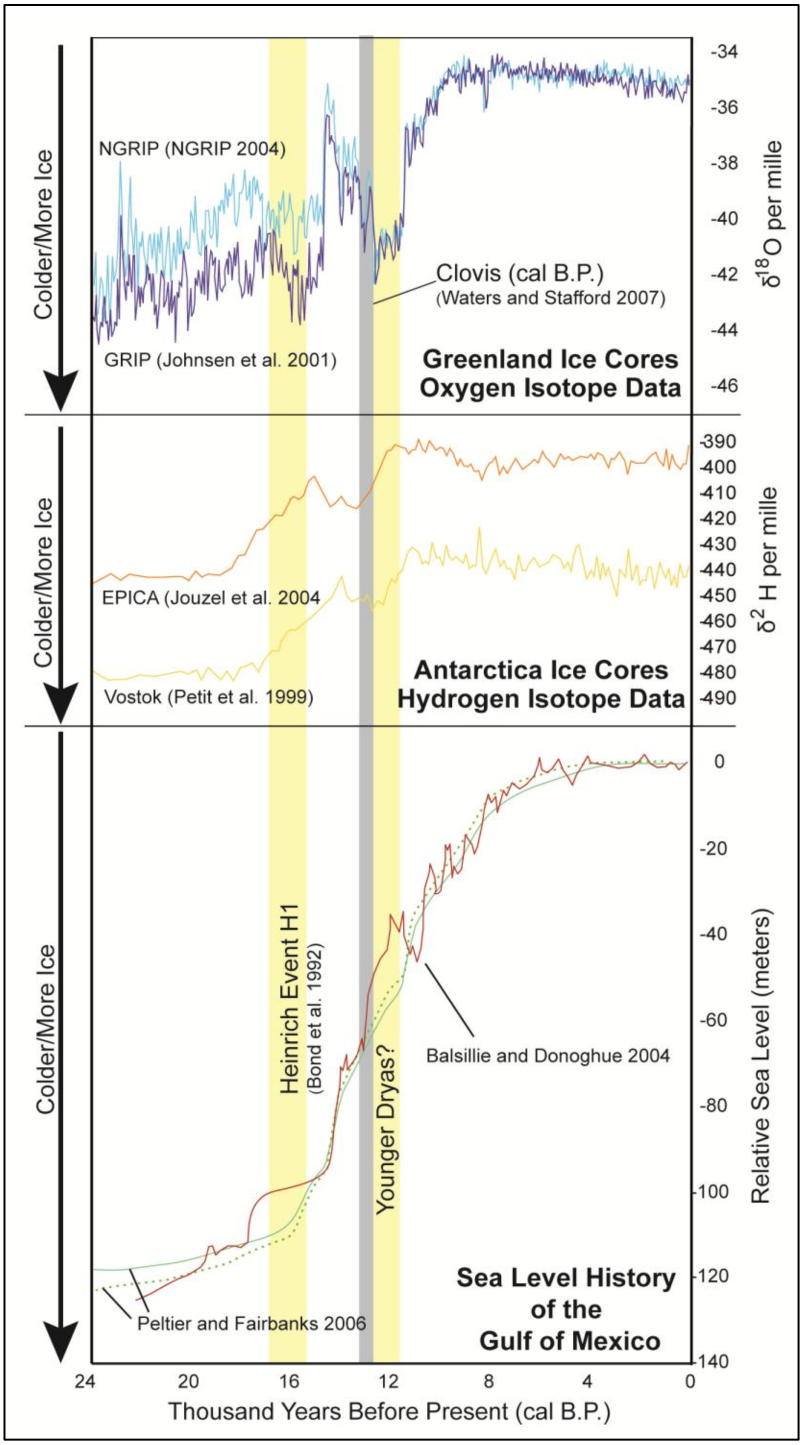



**Figure 3.5. Proxy records used to infer paleoclimate. References as noted in figure. Sea level curve includes IntCal04 calibrations as discussed in text.**

There is no direct way to measure the past glacial ice volume, but Figure 3.5 shows several proxy records that have been related to glacial advance and retreat. Isotopic data from extant Pleistocene ice can be used to infer environmental conditions when the ice was formed. Relative deuterium percentages (heavy hydrogen) collected from Antarctic ice cores and oxygen$^{18}$ percentages from Greenland ice cores have been correlated to glacial ice advance and retreat (Johnsen et al. 2001; Jouzel and community members 2004; NGRIP 2004; Petit et al. 1999). Relative sea level curves also can help give an approximate indication of the amount of ice contained in glaciers (Balsillie and Donoghue 2004; Peltier and Fairbanks 2006). By implication, more ice equals colder and drier, whereas less ice equals warmer, more modern conditions, although local areas may differ significantly from this trend (Dunbar 2006b).

Glaciations were highly cyclical, but within full-glacial times, there were cooler periods followed by abrupt warming, known as Dansgaard–Oeschger events (Dansgaard et al. 1984). This warming would lead to massive glacial calving in the North Atlantic, causing Heinrich events (Heinrich 1988), which were marked by increased percentages of ice-rafted glacial debris in ocean sediments occurring at approximate 10,000 year intervals. Because of this melting, large amounts of freshwater were discharged into sea currents, disturbing circulation patterns and possibly causing the next cold event (Bond et al. 1992), although see Bigg and colleagues (2011) for a summary of complications with interpreting this proxy record.

These proxy records only give information on total ice volume; it then becomes necessary to interpret how this applies to paleoclimate. Dunbar (2006b) discusses in detail how global circulation and ice volume models can be applied to climatic reconstructions of the Southeast during the terminal Pleistocene. Deep ocean currents, Gulf of Mexico currents, and terrestrial air currents created a complicated system leading to varying climate and biomes in the Aucilla basin during the past 15,000 years. For instance, lake core microbotanical research (Grimm et al. 2006) demonstrates warmer, wetter climate regimes in Florida during North Atlantic cold phases, possibly due to thermohaline circulation patterns. Further, periods of sinkhole infilling have been inferred to correspond to periods of lower water tables, drier climates, and less vegetation, allowing for sediment influx (Dunbar 2006b; Webb 1998).

*Flora*

This portion of northwestern Florida currently has a warm and humid climate covered with a warm mixed forest biome (Leduc 2003; Williams et al. 2000). The northern portion of the Aucilla River, upland of the Cody Escarpment, is known as the Northern Highlands and is covered with freshwater swamp flanked by mixed hardwood and pines, grading into longleaf pine and turkey oak along the Escarpment, turning into hardwood swamp in the study area and salt marsh along the coastline (Davis et al. 1996; NRCS 2011). During the terminal Pleistocene, the study area would have been far inland, so would have been covered by a somewhat different botanical assemblage. Figure 3.6 presents the modern biomes of Florida and the surrounding area and Figure 3.7 presents a simplified biome map of Florida and the surrounding area from the LGM until the end of the Pleistocene in calendar years after biome associations defined by Leduc (Leduc 2003) and Williams and colleagues (Williams et al. 2004) based on previously-published pollen and macrobotanical data for the area. As can be seen, there are no paleobotanical data available for the LGM, but soon after, the study area was covered by a warm mixed forest biome until 15,000 cal B.P., when cool mixed forest briefly made an appearance, followed by temperate deciduous forests from 14,000-12,000 cal B.P. By 11,000 years ago, warm mixed forests had reestablished themselves in the area. This has been the dominant biome until the modern day, which is shown in Figure 3.7.

These biome maps are highly generalized; individual species are grouped by type of plant, and replacement of any species by another within the same category does not change the overall biome. Thus, individual microbotanical records can provide much more information about the environment of a given locale. Florida probably never was covered with cold-clime biomes such as boreal forests or tundra in the Late Quaternary. Instead, specific pollen records indicate that the study area was covered by a mosaic of mixed deciduous forests and more open park and scrub lands throughout the late Pleistocene and early Holocene (Delcourt 2002; Delcourt and Delcourt 1998). The Page-Ladson site shows a well-established mesic hardwood forest between approximately 15,500-13,300 cal B.P. (Hansen 2006). The Lake Annie sequence in south-central Florida was dominated by rosemary, indicative of drier climate, prior to 13,000 cal B.P. (Watts 1975). Sequences from several other lakes in Florida show that floral biome changes are linked closely in time to northern Heinrich events, with peaks in pine pollen occurring during times of ice advance and moister climates, and a general trend towards oak and hickory during drier ice retreat events (Grimm et al. 2006; Watts and Hansen 1994).

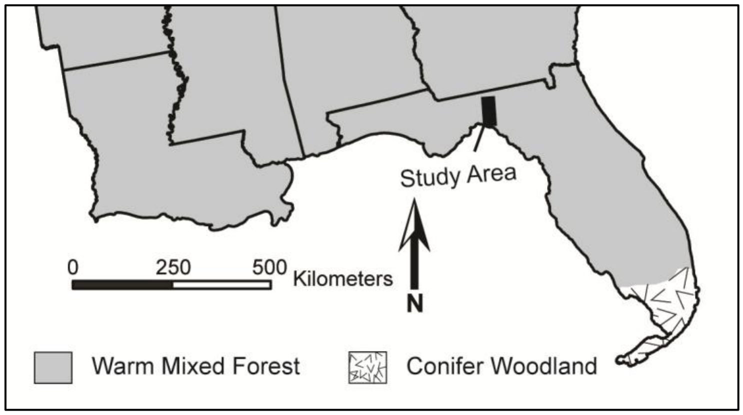



**Figure 3.6. Modern biomes for Florida and surrounding area. Simplified from Leduc (Leduc 2003) and Williams and colleagues (Williams et al. 2004).**

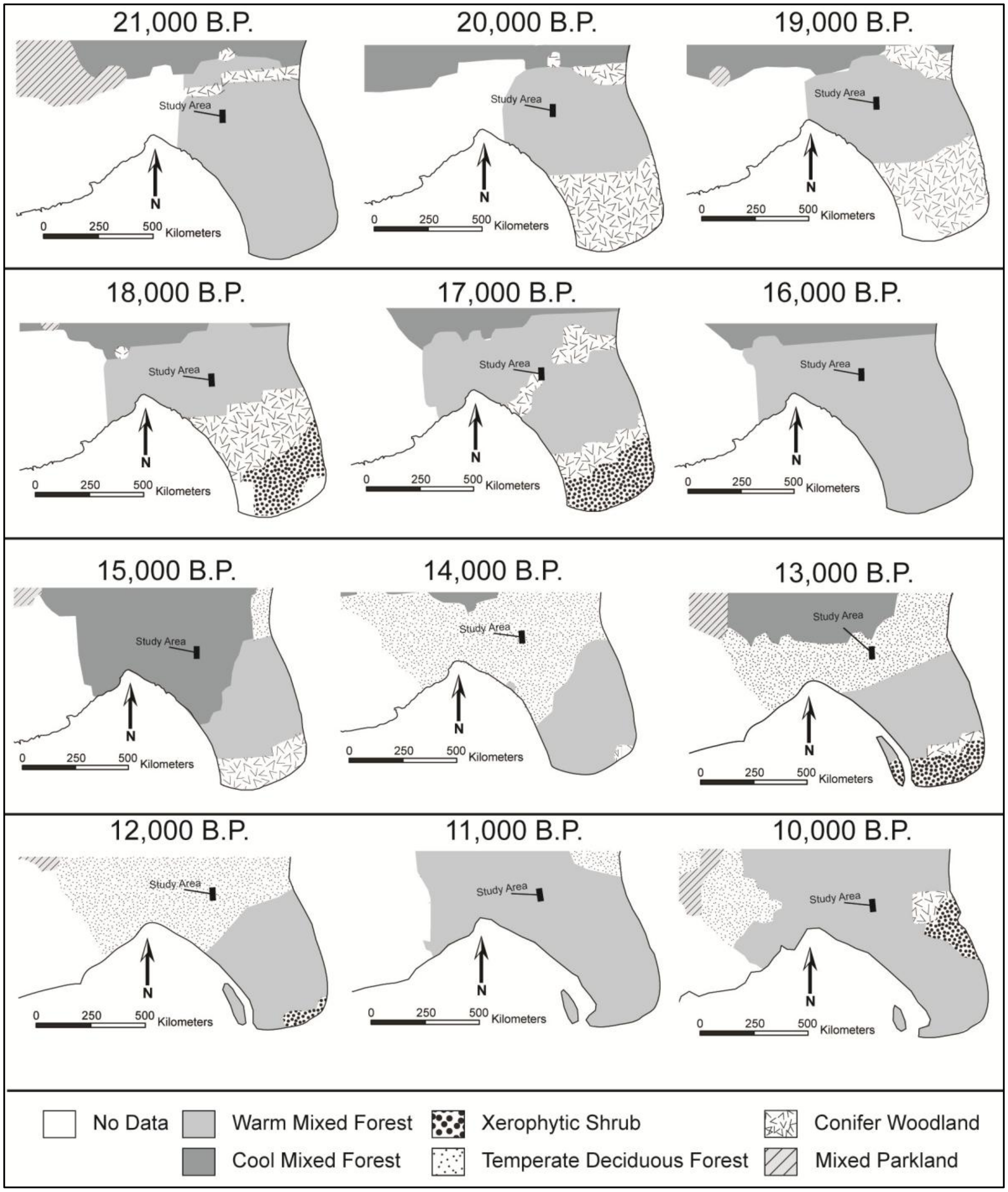



**Figure 3.7. Reconstructed biomes for Florida from 21,000 cal B.P. to 10,000 cal B.P. Simplified from Leduc (Leduc 2003) and Williams and colleagues (Williams et al. 2004).**

*Fauna*

Florida has one of the most intact Late Pleistocene (Rancholabrean) faunal records in the world, with the Aucilla River especially known for well-preserved specimens (Dunbar et al. 2006; Fisher and Fox 2006; Hemmings 2004; Webb et al. 1984; Webb and Simons 2006). While many of these remains were found in secondary contexts or are known from private collections, these bones sometimes can be dated or used in isotopic analyses that help explicate chronologies, animal behaviors, and local environments (Fisher and Fox 2006; Hoppe and Koch 2007; McDonald and Bryson 2010). Because the Rancholabrean faunal record is so extensive in the Southeast, it is occasionally possible to track environmental change by marking the local disappearance of certain small species (Mihlbachler et al. 2002). Unfortunately, the extinction dates of larger fauna in North America as a whole and specifically in the Southeast are still heavily debated (Faith and Surovell 2009; Fiedel 2008; Grayson 2007; C. V. Haynes 2008; Scott 2010).

In general, the Florida paleofaunal record indicates no-analog environments during the terminal Pleistocene. The faunal communities at the end of the Pleistocene were remarkably unlike modern assemblages, with greater species richness than can be found anywhere today (Morgan and Emslie 2010). For instance, at times, the Florida peninsula maintained populations of animals now extant only in western arid environments; these species were associated with animals now found only in tropical habitats and were also associated with species still found in Florida. Morgan and Emslie (2010) interpret these anomalous associations, which can be found as far back as the late

Pliocene, as coinciding with glacial intervals when Florida climates were drier with milder winters. Higher sea levels and cooler winters probably marked interglacials, restricting the presence of tropical and western fauna in the Florida record.

Several sinkholes in the lower Aucilla River, including Page-Ladson and Sloth Hole, contain numerous fauna dating to approximately 18,000-11,000 cal B.P. that include California condors (*Gymnogyps californianus*), a porcupine (*Erethizon dorsatum*) only found today in western and northern locales, margays (*Leopardus wiedii*), and several extinct species: giant land tortoises (*Geochelone crassiscutata*), pampatheres (*Holmesina floridanus)*, glyptodonts (*Glyptotherium floridanum)*, the bear *Tremarctos floridanus,* the capybara *Hydrochoeridae holmesi*, and the tapir *Tapiris veroensis* (Webb and Simons 2006). How these past faunal associations transitioned to the modern fauna, however, is still poorly-understood, as is the influence humans had upon these animals during this transition. Of course, climate and floral communities greatly influenced the available fauna, which probably had a great impact upon human activities.

## Geoarchaeological Context

Understanding sedimentation processes and past environments in the Aucilla drainage is important to understanding site formation processes. Artifacts with ages ranging from Paleoindian to historic are common in the river channel and can be found in numerous contexts: on surfaces as lag deposits, redeposited into younger sediments, or within undisturbed Late Quaternary deposits. The shallow limestone shoals typically contain a few centimeters of sand infilling vugs and cracks in the porous bedrock. These sands are either heavily deflated or redeposited and often contain artifacts in secondary context. Silts and clays can be found at the mouths of small intermittent feeder streams and occasionally on channel margins on the inside of stream meanders; these typically were deposited during series of flood events, so artifacts within these sediments are commonly redeposited (White 1988). More compact sediments are found on sinkhole margins. These sediments can be nearly any grain size, from small boulders to clays, and may be interbedded with intact organic layers. Sinks contain the most intact stratigraphy in the river channel and are most likely to contain intact archaeological deposits.

The sink margin sediments, though, result from a broad range of processes, so each deposit must be examined to determine if artifacts within the sediments could be in primary context (Balsillie et al. 2006; White 1988). More than 90 radiocarbon dates have been collected from geological sections in the Aucilla River that indicate at least three different cycles of sinkhole infilling dating to 42,000-36,000 $^{14}C$ yr B.P., 32,000-24,000 $^{14}C$ yr B.P., and 15,000-9,000$^{14}C$ yr B.P. (46,000-41,000 cal B.P., 37,000-29,000 cal B.P., and 18,500-10,200 cal B.P.) (Dunbar 2006b; Webb 1998), but the link between this infilling and larger climatic events has not yet been established.

Previous research at four different sites, Page-Ladson, Ryan-Harley, Sloth Hole, and Little River Rapids, (Figure 3.8) indicates that some deposits in the river channels can be relatively undisturbed while others are mixed and redeposited (Balsillie et al. 2006; Efverstrom 1999; Webb and Dunbar 2006). This may be significant because all four sites are in very different portions of the drainage (Figure 3.9). Further, all four sites contain areas where the archaeological record is heavily disturbed as well as areas that are mostly intact. Below is a brief summary of these four sites, which are used to provide comparative data in Chapter X.

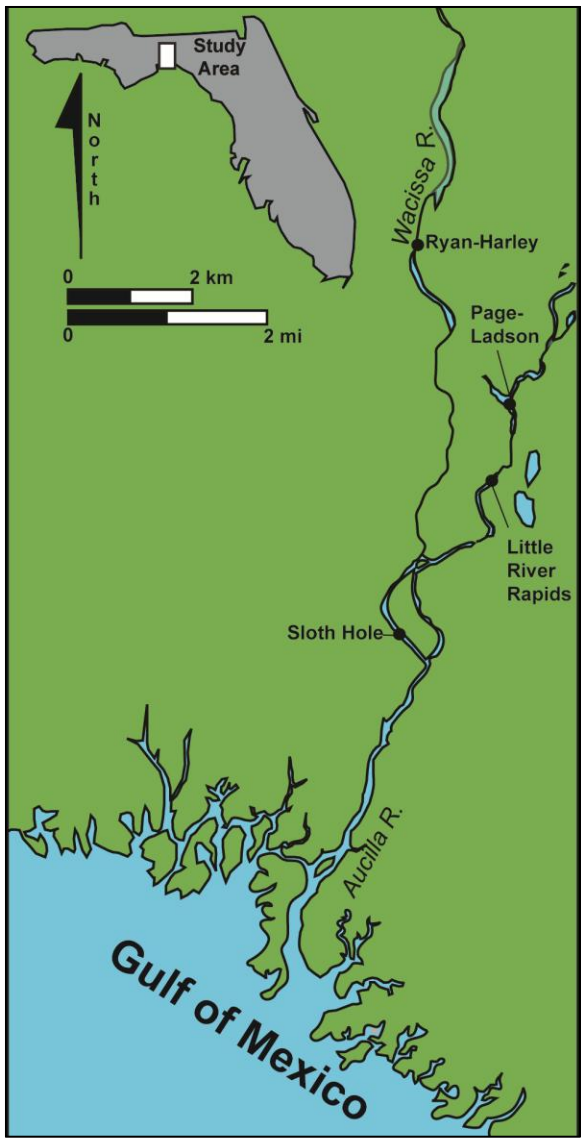



**Figure 3.8. Sites with previous geoarchaeological investigation.**

*Ryan-Harley (8JE1004)*

Ryan-Harley is located in the Wacissa River, the spring-fed main tributary of the Aucilla. This site appears to contain the nearly-intact remains of a Suwannee (inferred to be Middle Paleoindian) campsite with excellent faunal preservation (Balsillie et al. 2006; Dunbar 2006a; Dunbar et al. 2006; Dunbar and Vojnovski 2007). The shallowly-submerged site is located on the edge of the current river channel. Ryan-Harley was sampled for geoarchaeological analyses to provide paleoenvironmental site context data. Analyses indicate that sediments at the site were fluvially-deposited during periods of higher water, with some aeolian reworking during lower water levels (Balsillie et al. 2006). According to Balsillie and colleagues (2006), the site area was probably a low-energy point bar that people were using during brief periods of subaerial exposure based upon a slightly higher incidence of gravel in the artifact-bearing stratum along with evidence for aeolian sands within the artifact layers but not above them. They further conclude that the site has only been minimally-disturbed in the excavated areas, citing as evidence fragile fish scales that have preserved *in situ* on the artifact layer. This is the northernmost site I will discuss in the final chapter of this dissertation, and the only one located within the clear waters of the Wacissa River, providing a site within the same drainage basin but not in the same blackwater sinkhole setting as the other four sites discussed in this project.

*Little River Rapids (8JE1603)*

The Little River Rapids site (8JE1603) is a sinkhole and surrounding limestone shoal located in the Little River section of the Aucilla basin. The site was originally reported as part of a cultural resource project (Willis 1988), when a number of Early Archaic Bolen materials were recovered during an extensive controlled surface collection. No Paleoindian diagnostics were discovered during the CRM project, but avocational archaeologists had previously recovered numerous ivory points from the site. Researchers from the ARPP returned to the site and excavated approximately 8m$^2$, discovering sediments that bracketed the terminal Pleistocene and earliest Holocene. This included two paleosols along the sink margins, one dating to the terminal Pleistocene and one dating to before the last glacial maximum (Figure 3.9) with heavily-deflated areas in the rapids (Muniz 1997, 1998). Unfortunately, very little about this site has been published, and few notes are available to researchers, so this single stratigraphic column remains presents most of the known data about the site.

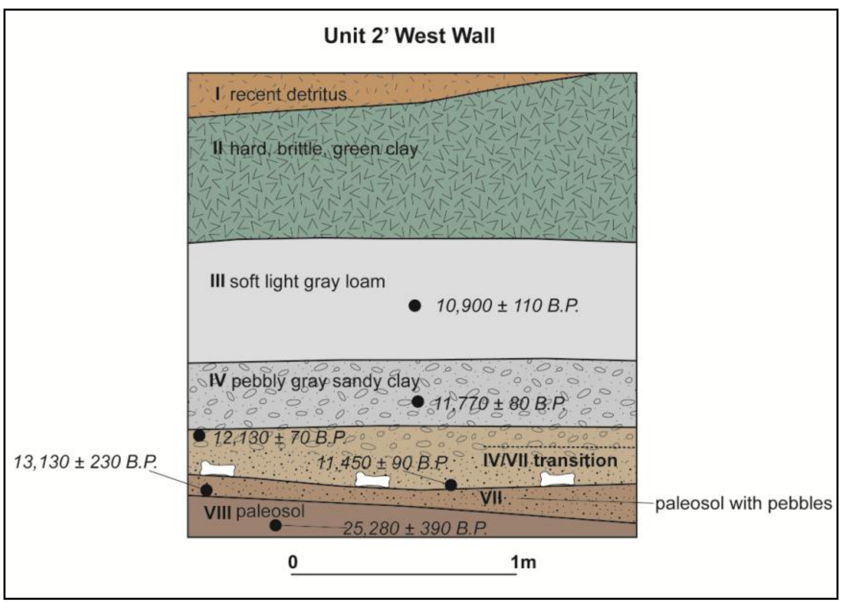



**Figure 3.9. Profile of unit wall from Little River Rapids, showing radiocarbon ages of deposits. Redrawn from Muniz (1997).**

*Page-Ladson (8JE591)*

Page-Ladson (8JE591) is arguably the most important Paleoindian locality in the southeastern United States. This site contains a nearly continuous sediment record from approximately 18,000 to 9,000 $^{14}$C B.P. (22,300-10,800 cal B.P.), spanning the entire Paleoindian period. The site was investigated from 1983-1997 by the Aucilla River Prehistory Project, when more than 50 $m^2$ were excavated into the late Pleistocene layers, uncovering well-preserved bone and ivory, and stone tools. These excavations recorded the geologic framework of the site, including extensive radiocarbon dating of archaeological, paleontological, and geological deposits (Figure 3.10). One of the late Pleistocene strata may contain evidence of the earliest Americans. Geologic Unit 3 contains a mastodon tusk with cutmarks and several lithic artifacts dating to 12,400 $^{14}$C B.P. (14,500 cal B.P.) based on a pooled average of seven radiocarbon dates (Webb and Dunbar 2006). Six of these dates were obtained on plant materials from within the excavation level containing the tusk (one was the organic material from within the tusk), while the seventh was upon bone collagen from a *Paleolama* jugal bone. Despite the extensive prior research, Page-Ladson has not been universally accepted as a pre-Clovis site because there are relatively few artifacts in this layer (eight flakes and two probable culturally-modified bones and the cut tusk), and because the underwater nature of the site has raised questions about the artifact context (Goebel et al. 2008).

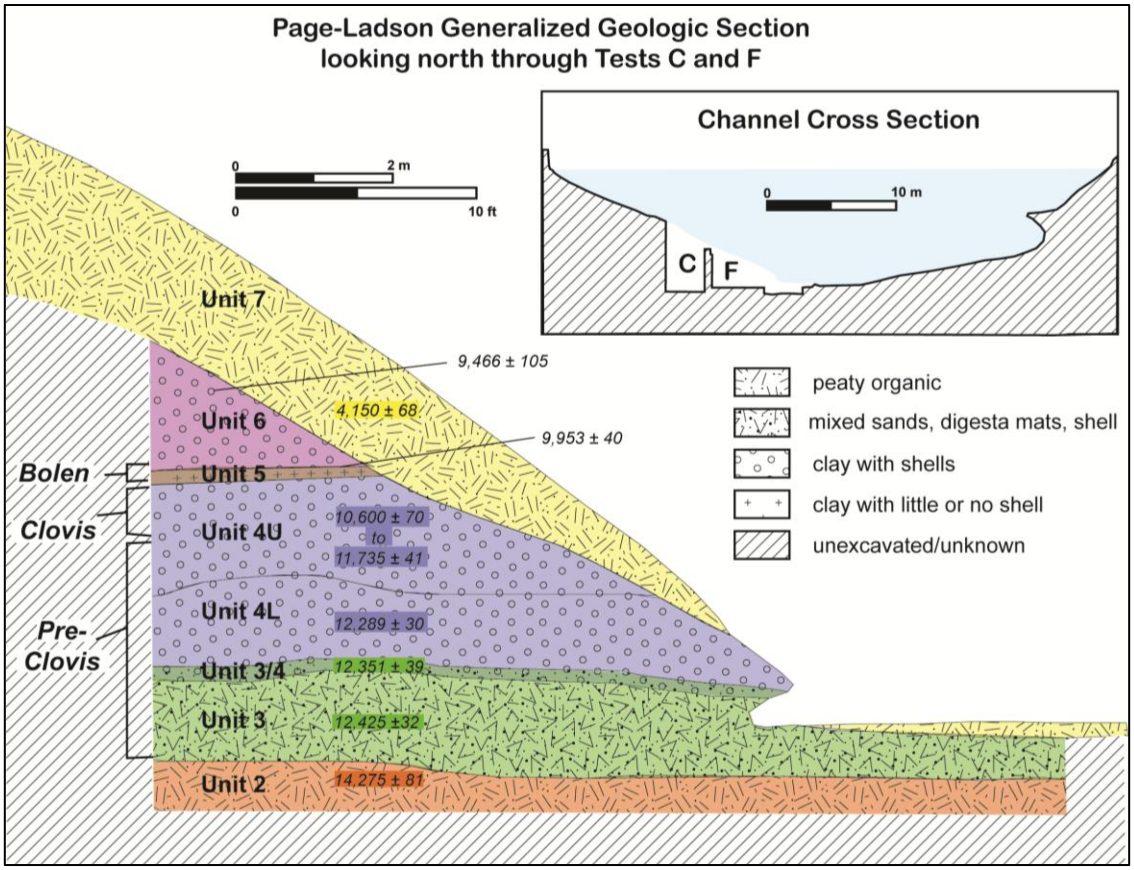



**Figure 3.10. Composite profile from Page-Ladson showing radiocarbon ages of units. Redrawn after Kendrick (2006:54).**

Portions of the stratigraphy are absent from different areas of the sink, including most of the middle Holocene, but analyses of the more intact portions have provided a wealth of geological and paleoenvironmental information. (Donoghue 2006; Dunbar 2006b; Hansen 2006; Kendrick 2006). For instance, much of the Unit 3 deposit consists of elephant digesta that was used to reconstruct paleodiet and paleoenvironment for these terminal Pleistocene animals. Micro- and macro-botanical analyses were performed (Hansen 2006; Newsom 2006) on these and other sediments to discuss climate change at the site through time. Sediment analyses showed that very slow-moving fluvial processes probably deposited many of the strata in the current sink margins, but colluvial input has been very important in the older deposits within the center of the sink (Kendrick 2006).

*Sloth Hole (8JE121)*

Sloth Hole (8JE121) was excavated by the Aucilla River Prehistory Project from 1994-1999. The site is a large sink located in the west run of the lower Aucilla (Figure 3.9) that contained numerous Clovis points and ivory tool fragments. More than 80 units were excavated at the site, which is discussed in more detail in Chapter VIII. Most notably, the excavators (Hemmings 1999b) have interpreted sediments on the eastern margin of the sink to represent an intact land surface that dates to 14,481-14,034 cal B.P. Stratified sediments were also noted above and below this surface. The western side of the sink is bounded by deflated and eroded limestones and the center contains pond sediments dating in excess of 40,000 cal B.P. (Hemmings 1999b, 2004).

Efverström (1999) discussed sediment properties in two excavation units at the site: Unit 57, located in the center of the sink, and Unit 22, near the eastern margin (Figure 3.11). Unit 22 contained wood dated to 12,300 ± 50 $^{14}$C yr B.P. (14,481-14,034 cal B.P.) in stratum 7 or 8 (Hemmings 1999b) (see discussion in Chapter VIII). Although this age is presented nowhere else, Efverström (1999:36) reports that stratum 14 in Unit 57 also dates to 12,300 $^{14}$C yr B.P.. Efverström sampled each stratum from these two units after excavation was complete, and performed several analyses on each: grain size, pollen content, magnetic susceptibility, bulk density, and water, organic, and carbonate contents. Grain-size analyses showed great variance by stratum (Table 3.2), and displayed that the central portion of the sink contained significantly more sand-sized grains than the margin, easily discernible from casual observation.

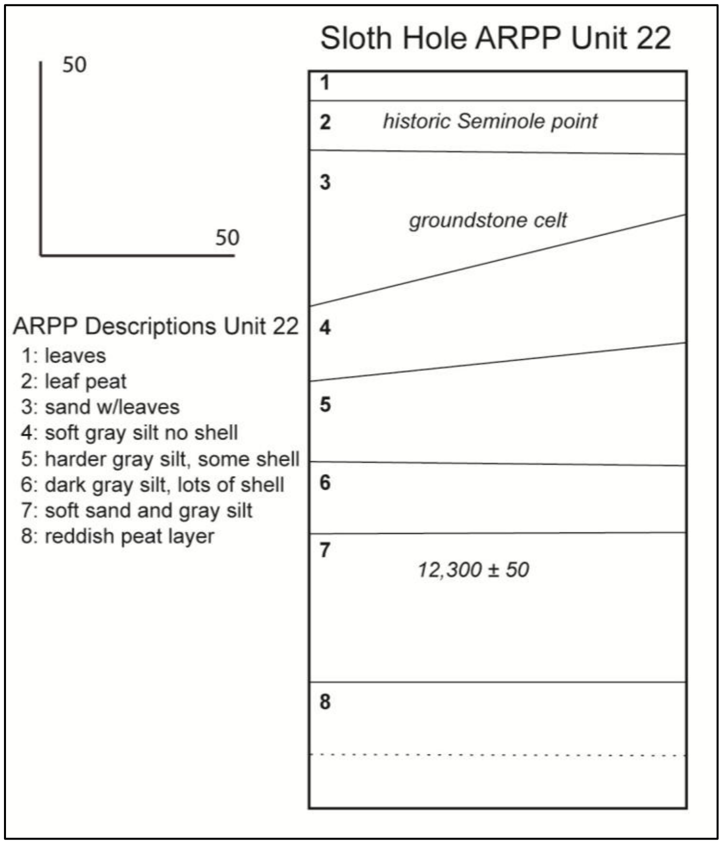



**Figure 3.11. Profiles of ARPP Unit 22. No profile is available for Unit 58.**

Pollen preservation in the sediments was quite good; analyses showed a regime with common *Chenopodiacea* throughout, more oak in the older layers, and pine increasing in the younger strata. Everström interprets this as representing seasonal drying in the area, with perhaps some prairie-like areas around the site in the earlier strata. He also recorded a disturbed zone in the pollen from samples 57-10 to 57-3 and thinks that 22-1 and 22-2 represent terrestrial deposition. Magnetic-susceptibility and loss-on-ignition both confirmed the disturbed zone. These records also suggest significant drying after 12,300 $^{14}C$ B.P. (Efverstrom 1999:45). These last analyses, however, were only performed on unit 57, and none of the analyses were able to be related to the radiocarbon chronology except in a preliminary way.

Table 3.2. Grain Sizes from Sloth Hole After Everström (1999:33-34).

| Sample | Depth (cm) | Percent | | | | Notes |
|---|---|---|---|---|---|---|
| | | >.3mm | >.2mm | >.063mm | >.025mm | |
| 22-1 | 15 | 12.8 | 7.2 | 73.6 | 6.4 | |
| 22-2 | 45 | 12.9 | 6.6 | 68.1 | 12.4 | |
| 22-3 | 75 | 25.4 | 10.6 | 47.9 | 16.1 | |
| 22-4 | 105 | 25.3 | 13.2 | 46 | 15.5 | |
| 22-5 | 135 | 9.6 | 6.9 | 54.8 | 28.7 | |
| 22-6 | 175 | 19.7 | 20.7 | 54.2 | 5.4 | 12,300 B.P. |
| 57-1 | 18 | 50.4 | 32 | 17.2 | 0.4 | |
| 57-2 | 20 | 24.3 | 25.3 | 47.6 | 2.8 | |
| 57-3 | 70 | 54.6 | 28.3 | 15.7 | 1.4 | |
| 57-4 | 76 | 24.8 | 26.2 | 44.6 | 4.4 | |
| 57-5* | 80 | 23.4 | 24.7 | 45.8 | 6.1 | |
| 57-7 | 91 | 21.3 | 25.8 | 46.3 | 6.6 | |
| 57-8 | 93 | 24 | 23.8 | 46.7 | 5.5 | |
| 57-9 | 103 | 21 | 12.6 | 50.1 | 16.3 | |
| 57-10 | 107 | 29.2 | 18.6 | 43.3 | 8.9 | |
| 57-11 | 130 | 33.8 | 21.4 | 42.2 | 2.6 | |
| 57-13 | 147 | 77.1 | 16.1 | 6.2 | 0.6 | |
| 57-14 | 167 | 16.6 | 17 | 61.6 | 4.8 | 12,300 B.P. |

*samples 6 and 12 were not analyzed

## Summary and Conclusions

Several researchers have proposed (Donoghue 2006; Dunbar 2002, 2006b; Thulman 2009; Webb 1998; Webb and Dunbar 2006) that during periods of lower sea levels and congruent lower water tables of the Pleistocene-Holocene transition, the Aucilla and Wacissa rivers did not flow, but many of the deeper sinks in the modern channel contained springs, making them convenient water sources that attracted people and animals. This theory, dubbed the "Oasis Hypothesis," implies that Paleoindian artifacts found within the sinks in margin sediments are in a primary context, which has not yet been clearly demonstrated. At this time, no studies have been done to see if sediments correlate between different sinks, different portions of the channels, or terrestrial areas; correlation would help show broad-scale system response to changing climates. All of these major geological issues must be addressed to understand archaeological preservation and context in the Aucilla. Although the sinkhole records from the Aucilla have provided a wealth of late Pleistocene paleoenvironmental data, these data still are somewhat spotty, and most of the intensive investigations have been based upon sites north of the current study area. Also, most research has focused upon paleoenvironment at an instance in time, with little focus on how past environments transitioned to modern. Further research is necessary to explicate this process. The link between climate change and geomorphic system response in a humid fluvial karst system is also still poorly-understood, so the processes of sinkhole erosion and infill need to be determined for archaeological context and site formation processes to be explained. As yet, there has been no published synthesis of processes at these important localities to determine regional karst history and analyze where intact deposits may be found at other sites. There has also been very little direct discussion of how artifacts and bones accumulated on sink margins (e.g., human agency, colluvial or alluvial transport, etc.). A geoarchaeological model of site formation is needed to explain how the record of human behavior has been preserved or modified by natural processes.

# CHAPTER IV

# FIELD METHODS

This chapter presents the methods used during the fieldwork for this project. Fieldwork for this dissertation progressed in four distinct stages to address my geological, geoarchaeological, and archaeological objectives. First, I performed a pilot study during which several sinks were investigated, leading to selection of fieldwork sites; second, I vibrocored at the two sinks selected for further investigation; third, underwater units were excavated at the two sinks; and fourth, terrestrial testing was conducted adjacent to the sinks. Methods for each built upon the last, so methods varied slightly between phases. Each step is presented separately below.

## Pilot Study, Fall 2008

In November, 2008, I conducted a reconnaissance survey of five sinkhole sites in the lower Aucilla basin to select localities for detailed study. These included Sloth Hole (8JE121), Wayne's Sink (8JE1508/8TA280), Cypress Hole (8JE1499), Totem Shoal (8JE1638), and Mandalay (8JE1539/TA147) (Figure 4.1), which were examined because recreational divers had collected Paleoindian artifacts from each site, and each had high potential for intact cultural deposits from the late Pleistocene based on notes from the ARPP. This was the first phase of the planned dissertation research and was conducted as a pilot study. Fieldwork consisted of two major activities: diver survey and extraction of short, small geological cores (2-inch diameter, no more than 1m long) for the purpose of sedimentological analyses. All work was performed from a 17-foot Dixon dive boat with a crew consisting of four people.

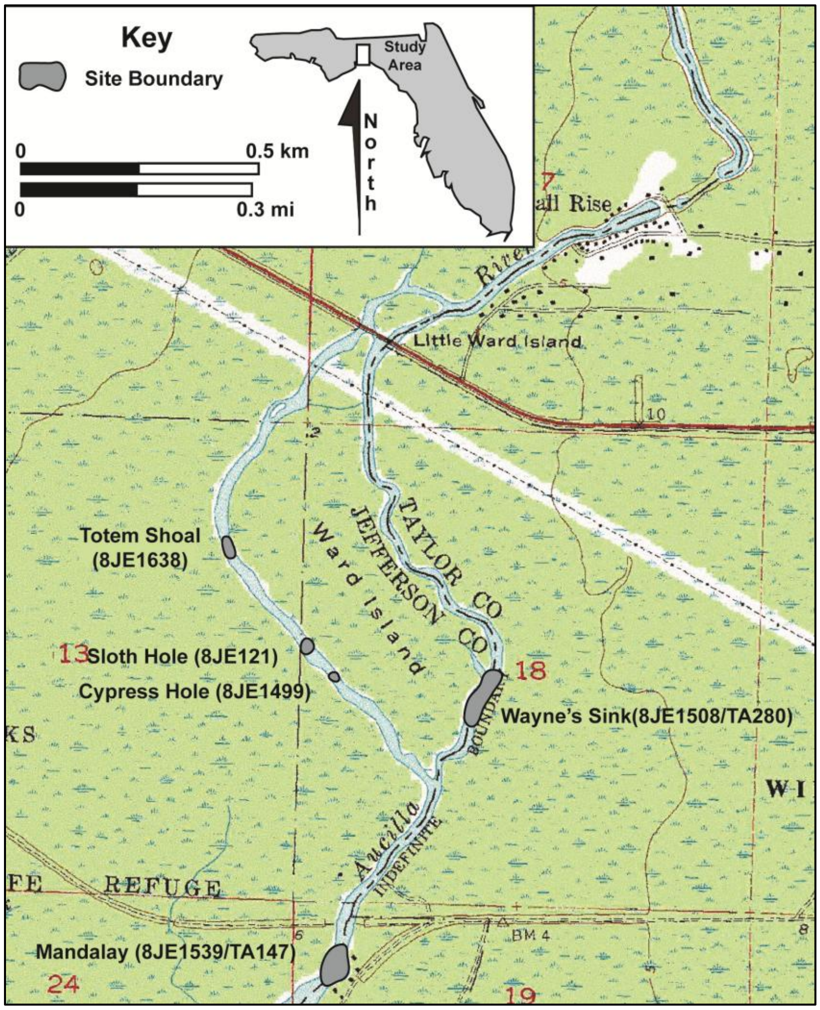



**Figure 4.1. Sites investigated during pilot study.**

The first activity was a visual inspection of each of the five sites. I dove in each sinkhole, accompanied by Dr. C. Andrew Hemmings, who has worked extensively in the Aucilla, including recording and excavating several of the sites visited during this project. The purpose of these initial dives was to look for areas that seemed to contain relatively intact sediment records and to look for any surface concentrations of cultural materials. Therefore, the diver survey followed no specific pattern; instead we roughly followed the contours of the stream bottom to view the deposits at different depths and on different terraces. This reconnaissance helped display the variation within and between the sinks. During the course of this initial dive, core locations were marked with nails attached to floats.

Each core was placed in an area that appeared to contain intact sediments, with preference given to potentially-intact sediment that possibly spanned the Pleistocene-Holocene transition. These judgments were based on several things: first, soft sediments on the current ground surface are indicative of slow flow in the modern era and possibly-intact older sediments below; second, potential age was based on depth and comparison of sediments to the dated record from Sloth Hole; finally, Hemmings's experience with Aucilla sediments was used to pick specific areas. When possible, we tried to place cores so they would overlap to get a longer potential record, as all core tubes were 60 cm or less to be manageable for hand pounding. Therefore, we placed one on an upper terrace and then one next to it on a lower terrace when possible. We entirely avoided areas with exposed limestone bedrock.

Table 4.1. Cores Removed During Pilot Study.

| Core # | Site Name | Site Number |
|---|---|---|
| 1 | Sloth Hole | 8JE121 |
| 2 | Sloth Hole | 8JE121 |
| 3 | Sloth Hole | 8JE121 |
| 4 | Cypress Hole | 8JE1499 |
| 5 | Cypress Hole | 8JE1499 |
| 6 | Cypress Hole | 8JE1499 |
| 7 | Cypress Hole | 8JE1499 |
| 8 | Wayne's Sink | 8JE1556/TA287 |
| 9 | Wayne's Sink | 8JE1556/TA287 |
| 10 | Wayne's Sink | 8JE1556/TA287 |
| 11 | Wayne's Sink | 8JE1556/TA287 |
| 12 | Wayne's Sink | 8JE1556/TA287 |
| 13 | Wayne's Sink | 8JE1556/TA287 |
| 14 | Mandalay | 8JE1539/TA147 |
| 15 | Totem Shoal | 8JE1638 |
| 16 | Totem Shoal | 8JE1638 |
| 17 | Totem Shoal | 8JE1638 |

Coring took place during a second dive. Two-inch PVC pipe was cut into approximately 60-cm sections with one section was used for each core. Cores were driven with a modified slide-hammer apparatus created for this project. It consisted of a 2¼-inch cup to place over the top of the PVC connected to a weighted slide hammer. It easily pounded through very resistant material including tree trunks and was usable by a single diver. This hammer worked so well, however, that core extraction was occasionally extremely difficult. Extraction required a strap wrench and the cooperation of two divers. Only one core was placed at Mandalay; three were extracted from Totem Shoal, Sloth Hole, and Cypress Hole, and six were removed from Wayne’s Sink. Core locations were defined by a Trimble GeoXT for later placement on project maps. See Table 4.1 for core numbers and site locations. After collection, cores were capped on both ends and kept in proper orientation. Upon arrival at the surface, all cores had a few drops of isopropyl alcohol added to them and they were kept in ice to retard growth of fungal bodies and prevent contamination of paleobotanical remains. They were kept refrigerated constantly after leaving the field until analysis. These cores were analyzed and housed in the Department of Anthropology at Texas A&M University. This research was reported to the Florida Bureau of Archaeological Research (Halligan 2009a).

## Selection of Fieldwork Locations

The examination of these five sites allowed for the selection of two localities for further research. It was determined that further examination of Sloth Hole was warranted in order to conduct investigations specifically focused upon geological context and geoarchaeological interpretations. Wayne's Sink was selected as the other underwater locality based upon its geology, artifact content, and geographic setting. Mandalay was also located in the main run of the Aucilla River, but very little potentially intact sediment was observed at the site during the pilot study investigation. Totem Shoal and Cypress Hole seemed to contain intact sediment sequences, but few artifacts were observed, and both sites are also within the west run of the Aucilla, the same geographic setting as Sloth Hole. The two sites selected, Sloth Hole and Wayne’s Sink, have dateable organics, early archaeological components, and potentially-intact sediment sequences. They are in two different sections of the river, so that potential regional geological patterns can be evaluated.

Finally, as mentioned in Chapter II, very little terrestrial research had previously been done on the lower Aucilla River drainage, so it was unknown if there are Paleoindian components on land. Therefore, I determined to study the two sinks and the swampland between them to develop a model for how cultural materials accumulated in the lower Aucilla and also to allow me to more fully discuss how Paleoindians used the karst drainage of the Aucilla River during the late Pleistocene and early Holocene. Sloth Hole has been extensively excavated, so the previous record from this site could be used to supplement this dissertation research.

*Sloth Hole (8JE121)*

Sloth Hole is a large sinkhole in the west run of the Aucilla that contains artifacts from the terminal Pleistocene, a partially intact stratigraphic record, and ample organic remains that can be radiocarbon dated. The ARPP excavated more than 80 1 x 1 m units in various portions of Sloth Hole between 1994-1999 (Figure 4.2), recovering evidence for ivory tool manufacture, megafauna processing, and lithic manufacture. As reported in Chapter II, this site yielded one of the earliest directly-dated artifacts in North America, and five Clovis points were recovered from the site by recreational divers (Hemmings 1999b, 2004). The site also contains an Early Archaic Bolen component (Hemmings 1999b) and a potential pre-Clovis component (Dunbar 2002). However, while individual artifacts from this site have been well-reported (Hemmings 2004), the site itself has not. No final report has ever been submitted and much of the analysis was never completed. Interim reports are available in newsletters of the ARPP (e.g., Hemmings 1999c), and tools from the site have been discussed (Hemmings 1999a), but this lack of synthesis and publication has made it difficult to analyze the site context and understand the cultural record. My research will help to address these issues.

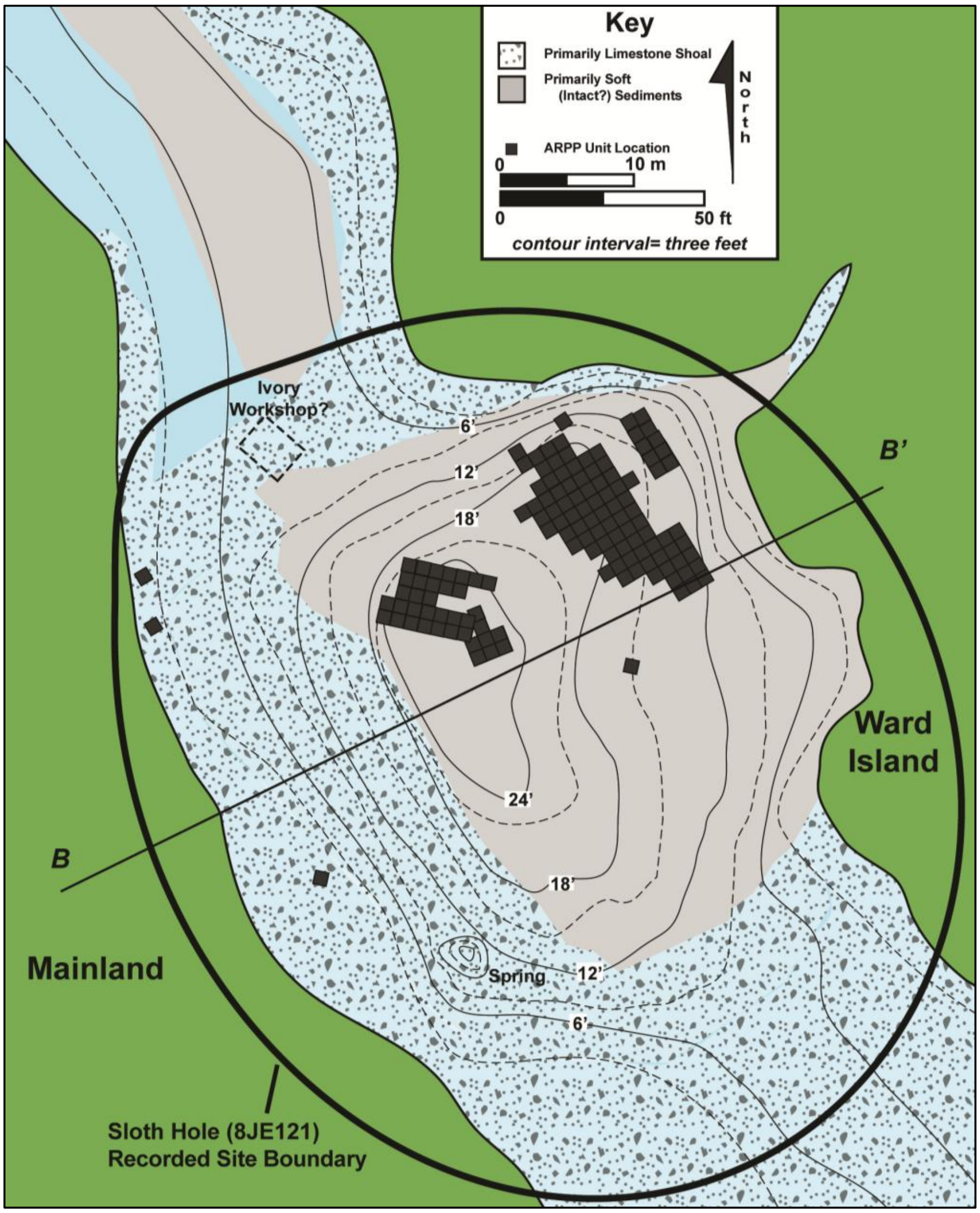



**Figure 4.2. Site map of Sloth Hole, showing previous underwater fieldwork. Cross-section line B-B' shown in Figure 3.2.**

*Wayne's Sink (8JE1508/TA280)*

Wayne's Sink is a large site on the boundary of Jefferson and Taylor counties actually consisting of three separate sinks (Figure 4.3). It is located in the main run of the Aucilla approximately 500 m from Sloth Hole (Figure 4.1). This site has never been excavated, but local collectors obtained hundreds of bone pins, numerous Bolen and antler points, and several atlatl hooks from the site (Grissett, personal communication 2009). The ARPP recorded the site in 2000 after visiting with Wayne Grissett and discovering another Bolen and a barbed ivory point (Hemmings 2004).

I selected this site for further excavation after a visit during the pilot study because it seemed an ideal locality for addressing the research goals of this project. The central sink at the site contained terraced layers of soft clayey sediments capped by peats that appeared to represent intact sediments. Unstained artifacts, probably exposed by recent storms, littered the sink walls and floor. The southern portion of the sink contains an outcrop of chert that shows evidence of prehistoric quarrying. These cherts have probably been submerged for at least the past 6,000 years based upon local rates of sea level rise (Balsillie and Donoghue 2004; Hemmings 1999a; Peltier and Fairbanks 2006). This site contains an early component, potentially has intact strata, and contains evidence for a prehistoric quarry, making it ideal to address my research objectives.

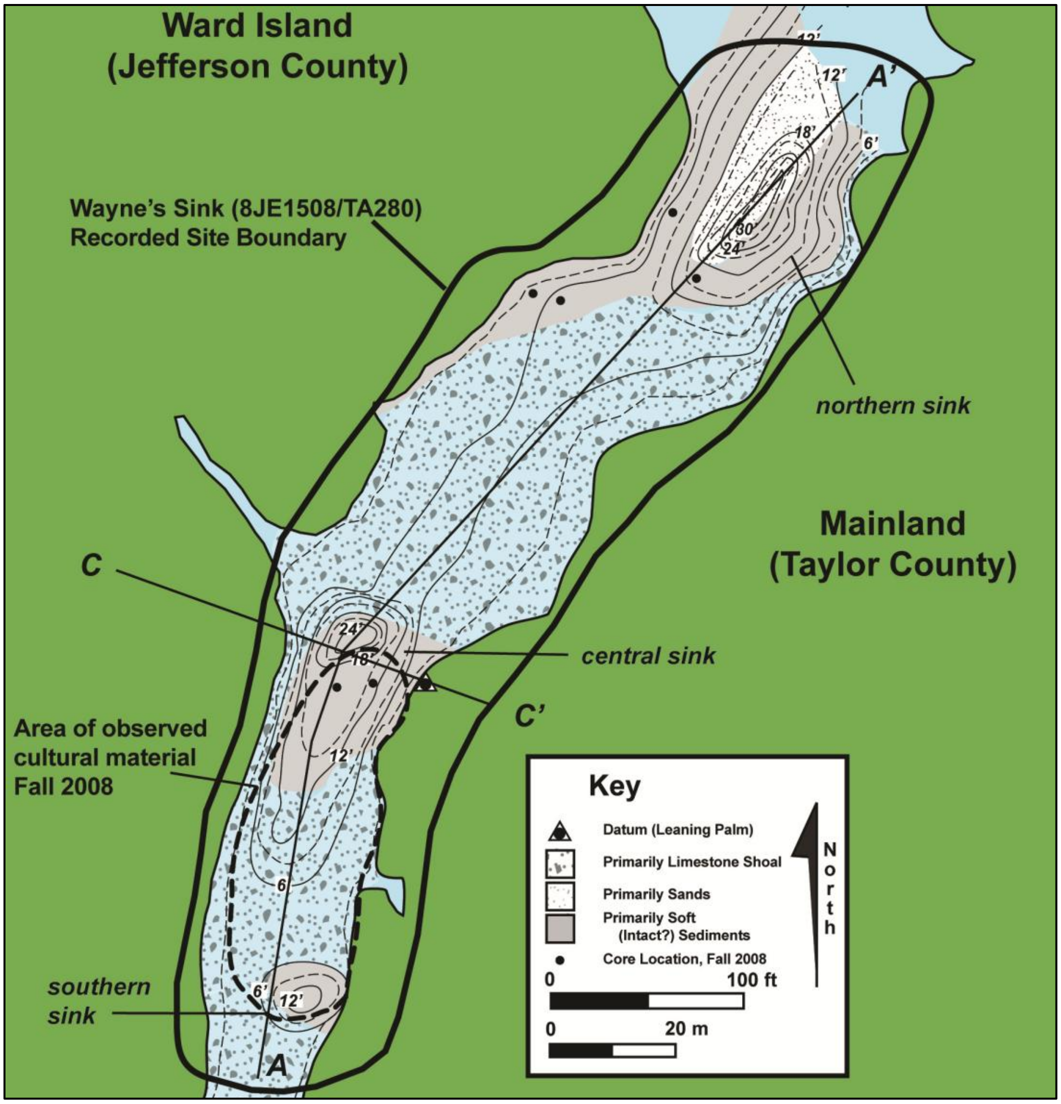



**Figure 4.3. Site map of Wayne's Sink showing results of reconnaissance survey. Cross section lines shown in Figure 3.2.**

*Terrestrial Areas*

Although there are numerous archaeological sites recorded in the lower Aucilla River, almost none of these sites are terrestrial and there are no recorded Paleoindian components on land. According to a BAR records search performed by the author on 12/25/2010, several mound sites have been recorded within a km of the river, but there are no recorded sites on Ward Island or within 800 m of either Sloth Hole or Wayne's Sink. However, there also are no recorded surveys on the island or in the immediate area except for one on the very northern edge of the island associated with the expansion of the Highway 98 bridge. Thus, it is unknown if there are terrestrial archaeological components associated with Sloth Hole or Wayne's Sink.

It is also unknown how the sediment sequences on land correlate to those underwater. According to the Natural Resource Conservation Service Soil Survey for Jefferson County (NRCS 2011), soils on Ward Island and the east bank of the Aucilla River are classified as Nuttall-Tooles fine sands, frequently flooded:

> This map unit consists of nearly level, poorly drained soils on flatwoods, hammocks, and other flat areas. They have sandy surface and subsurface layers over moderately to moderately rapidly permeable loamy subsoils below 40 inches. These soils have limestone bedrock within 20 to 40 inches of the surface. This map unit consists of nearly level, very poorly drained and poorly drained soils on flood plains. They are saturated or flooded with water much of the time (NRCS 2011).

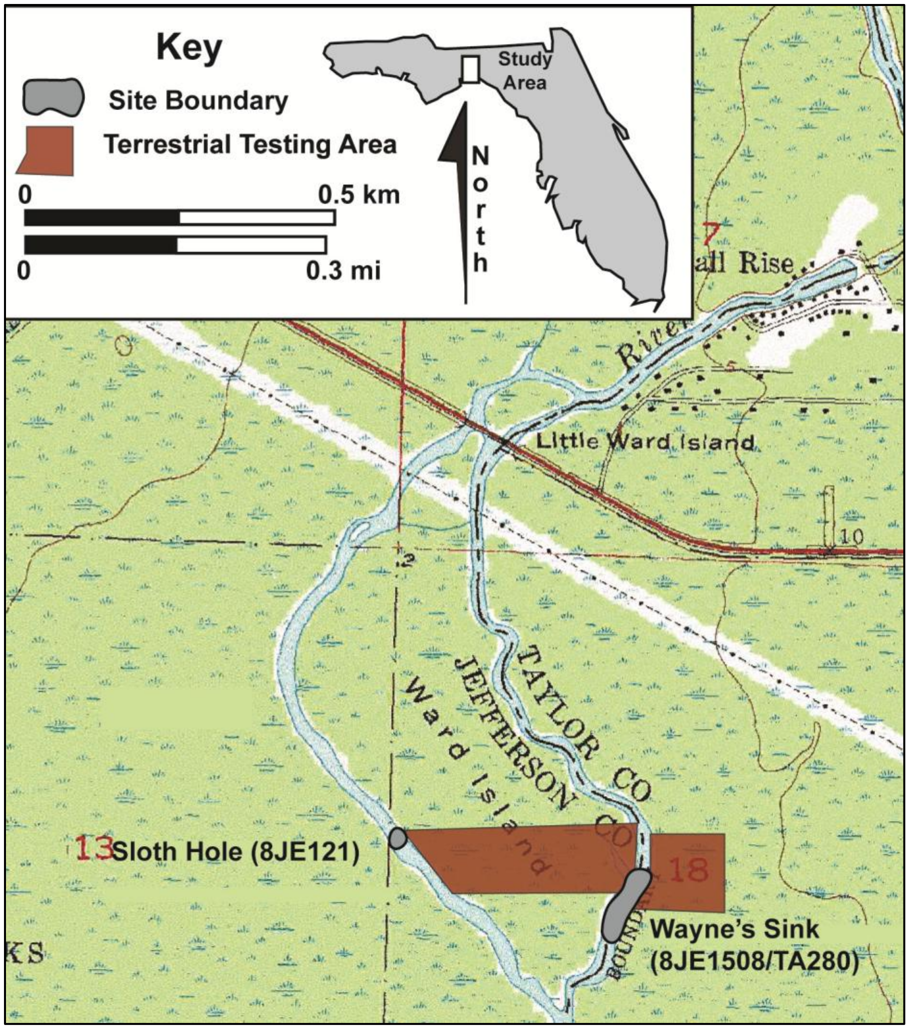



**Figure 4.4. Terrestrial testing area.**

These soils make it unlikely that there are deeply-buried archaeological deposits on most of the island, but the area was mapped very coarsely, so it is possible that isolated areas of different soils or places with deeper bedrock exist. Also, it is possible that these shallow soils are quite old and that they contain substantial archaeological deposits. Thus, terrestrial subsurface testing was necessary to the research objectives of my dissertation. It would have been incomplete to define the Late Quaternary history of the lower Aucilla using only underwater sequences and imprecise to discuss the site formation processes of this area without knowing if there are archaeological sequences on land and without examining their context. Finally, if terrestrial sites have preserved, it would have been inaccurate to discuss human use of the area without including these sites. Thus, I decided to excavate on Ward Island between Wayne's Sink and Sloth Hole and on the mainland adjacent to Wayne's Sink (Figure 4.4). The methods for investigating each of these areas are discussed in more detail below.

## Underwater Coring, Fall 2009

Twenty vibrocores were removed from Wayne’s Sink and Sloth Hole during November 2009 with the assistance of Ed Green and Andrew Hemmings (Table 4.2). These cores were removed using a vibrocorer (cement vibrator) borrowed from Dr. Donoghue at the Florida Geological Survey, which was deployed through the center of an 18’ pontoon boat (Figure 4.5). Three-inch (7.62 cm) diameter aluminum irrigation pipes in 30-40-foot (9.14-12.19 m) lengths were vibrated into the river bottom, marked at the deck line to record depth of penetration, capped on the top to create a vacuum, and removed using a handyman farm jack. After cores were raised, the bottoms were capped, and the tops were cut to remove extra length and water weight. Plastic caps were replaced on the core tops, and orientation, site name, and core number was recorded on each tube. All caps were duct taped for extra security. Locations were recorded with a Garmin handheld GPS. Some of the cores (cores 1-4) were inspected and capped on the bottom by divers, but experimentation showed this to be unnecessary for core integrity. Diver deployment also was inefficient for core removal and exhausting in the cold November water.

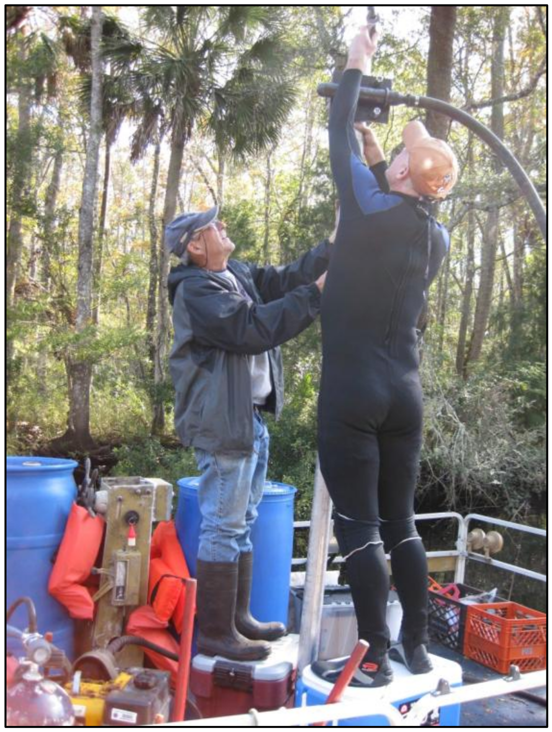


**Figure 4.5. Vibrocorer head being placed on aluminum core tube in center of pontoon boat.**

Fourteen cores were removed from the central sink of Wayne's Sink in two perpendicular transects to explicate cross-stream and downstream sediment profiles (Figure 4.6). These cores were each approximately 5 m apart, with the cross-stream cores placed to cross-cut the largest sink through the concentration of cultural material. The downstream transect was placed on the western bank of the river near the mouth of a tidal inlet and at the edge of the modern low-water terrace to facilitate study of stream processes in this area. One core (core 20) was removed from the northern sink through a shell-filled stratum (Halligan 2009b). Five cores were removed from Sloth Hole near the eastern bank of the site to determine downstream profiles near potentially-intact sediments (Figure 4.7).

Table 4.2. Cores Removed During Vibrocoring.

| FS # | Vibrocore # | Site Number | Water Depth (ft/m) | Sediment Length (cm) |
|---|---|---|---|---|
| 10050 | 1 | Wayne's Sink (8JE1508/TA280) | 12/3.66 | 70 |
| 10051 | 2 | Wayne's Sink (8JE1508/TA280) | 11/3.35 | 174 |
| 10052 | 3 | Wayne's Sink (8JE1508/TA280) | 15/4.57 | 115 |
| 10053 | 4 | Wayne's Sink (8JE1508/TA280) | 16/4.88 | 151 |
| 10054 | 5 | Wayne's Sink (8JE1508/TA280) | 20/6.1 | 45 |
| 10055 | 6 | Wayne's Sink (8JE1508/TA280) | 16/4.88 | 148 |
| 10056 | 7 | Wayne's Sink (8JE1508/TA280) | 17/5.18 | 194 |
| 10057 | 8 | Wayne's Sink (8JE1508/TA280) | 15/4.57 | 89 |
| 10058 | 9 | Wayne's Sink (8JE1508/TA280) | 3/0.91 | 118 |
| 10059 | 10 | Sloth Hole (8JE121) | 6/1.83 | 206 |
| 10060 | 11 | Sloth Hole (8JE121) | 7/2.13 | 213 |
| 10061 | 12 | Sloth Hole (8JE121) | 6/1.83 | 247 |
| 10062 | 13 | Sloth Hole (8JE121) | 113.35 | 181 |
| 10063 | 14 | Sloth Hole (8JE121) | 6/1.83 | 259 |
| 10064 | 15 | Wayne's Sink (8JE1508/TA280) | 13/3.96 | 160 |
| 10065 | 16 | Wayne's Sink (8JE1508/TA280) | 17/5.18 | 145 |
| 10066 | 17 | Wayne's Sink (8JE1508/TA280) | 19.5/5.94 | 210 |
| 10067 | 18 | Wayne's Sink (8JE1508/TA280) | 18/5.49 | 97 |
| 10068 | 19 | Wayne's Sink (8JE1508/TA280) | 17/5.18 | 31 |
| 10069 | 20 | Wayne's Sink (8JE1508/TA280) | 9/2.74 | 40 |

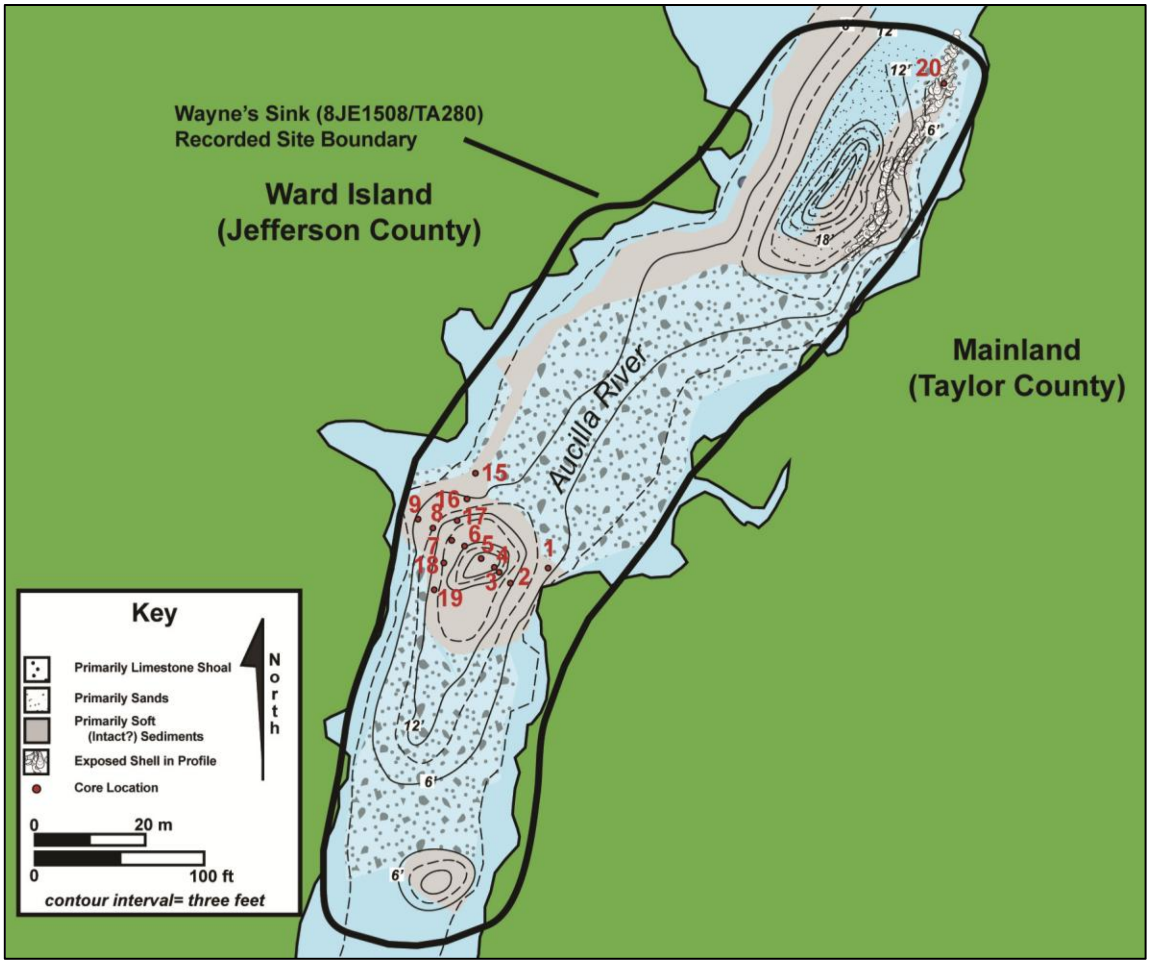



**Figure 4.6. Location of vibrocores removed from Wayne's Sink.**

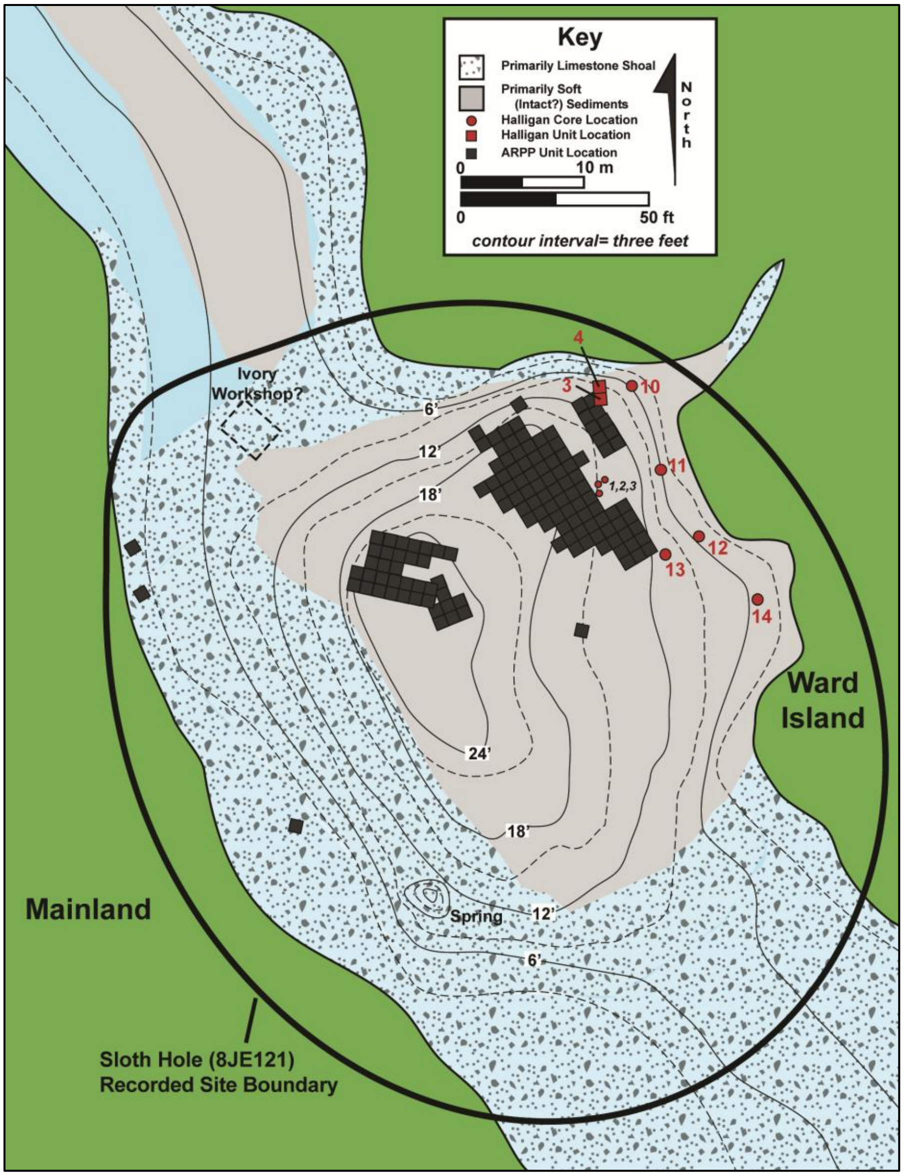



**Figure 4.7. Location of all fieldwork activities conducted during this research at Sloth Hole (core numbers 1-3 refer to pilot study cores).**

Removed cores were carefully placed at approximately a 30-degree angle in the bow of the support boat, an 18' aluminum johnboat, for transport back upriver, where they were stored vertically pending transport to Texas. These cores were stored outside (not climate controlled) because pollen analysis was not feasible, and these cores were collected for sedimentological research, which is not impacted by temperature changes. Cores were cut into 6-foot lengths and relabeled and recapped so they could fit in the bed of a pickup for transport back to Texas. They were padded with cotton batting and laid at an approximate 30-degree angle in the bed to minimize sediment deformation and jostling. Upon return to Texas, cores were stored upright until cut for sediment analysis, methods for which are described in Chapter IV. These cores were used to help define the sediment bodies at both sites, and coring data from Wayne's Sink was used to place the unit excavations.

## Underwater Unit Excavations, Summer 2010 and 2011

Using the coring data and information from the Fall 2008 study for placement, I excavated two (1 x 1 m) units at Sloth Hole and six (1 x 1 m) units at Wayne's Sink (Figures 4.7 and 4.8). The units at Sloth Hole were placed near the potential pre-Clovis stratum on the eastern side of the site. Wayne's Sink units were spread out. The first two (excavated in summer 2010) were excavated near the east bank of the river in an area of layered peat strata. Four were excavated during August 2011. Two of these were placed on the west side of the sink in an area of thick sediment deposits, one on the south side near outcropping chert and extensive evidence of quarrying activities, and the last one near the 2010 pits to address some complications in the stratigraphic profile.

During the 2011 excavations, underwater visibility was better than it has been in decades due to an historic drought. Therefore, an approximately 50-cm wide swath was cleaned from the water surface to the deepest portion of the sink on the western side of the site to investigate chronological issues raised by the 2009 and 2010 testing. Also 100% surface collection was done at several areas of the site to allow for analysis of post-depositional processes and possibly some analysis of flintknapping activities.

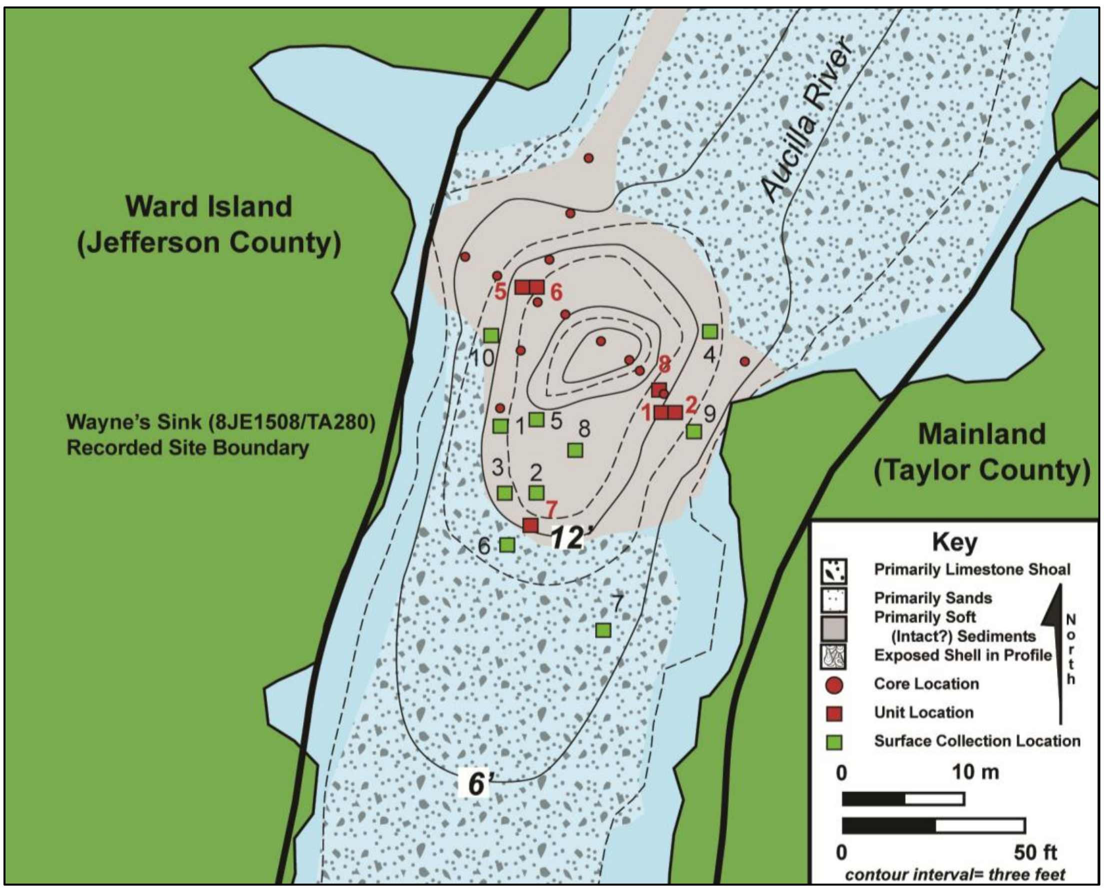



**Figure 4.8. Units excavated at Wayne's Sink, showing only central sink portion of site.**

All sediments except for surface sediments from all eight units were water-screened through nested 1/4-inch (.635cm) and 1/16-inch (.159 cm) (window screen) screens to recover very small cultural and paleoecological material. Surface levels were screened through 1/4-inch mesh only. Cultural material, bone, and a representative gastropod sample were saved from the 1/4-inch screen, but all material was collected and bagged from the finer screen to minimize processing time in the field. In organic strata, this meant that multiple 2-gallon sized bags filled with organic matter were collected per level, making artifact observation in these sediments nearly impossible in the field because of the large volume. To manage these data, a Field Specimen Log was created and maintained daily, with a specific F.S. number assigned to each level from each unit. At the end of every level, the number of bags associated with this F.S. number was updated and each bag was labeled according to its relative order.

A geological column sample was also saved from each unit and was collected as an oriented sample to allow observation of facies and sediment bedding features. This sample was collected as a 3-inch (7.62 cm) core that was later split so that sediments could be described and sampled in a laboratory setting. Excavations proceeded by trowel in natural stratigraphic layers, subdivided into 5 or 10-cm arbitrary levels. Large and diagnostic artifacts were plotted in place. Items suitable for dating and fragile items were recorded and stored separately to prevent damage. Profiles were drawn of all unit walls extant at the end of excavation to tie excavation data to sediment profiles. Dredges powered by 12 horsepower Honda "trash" pumps were used to remove sediment from the underwater units along with trowels. This sediment was brought to the surface and screened on a floating deck (Figure 4.9).

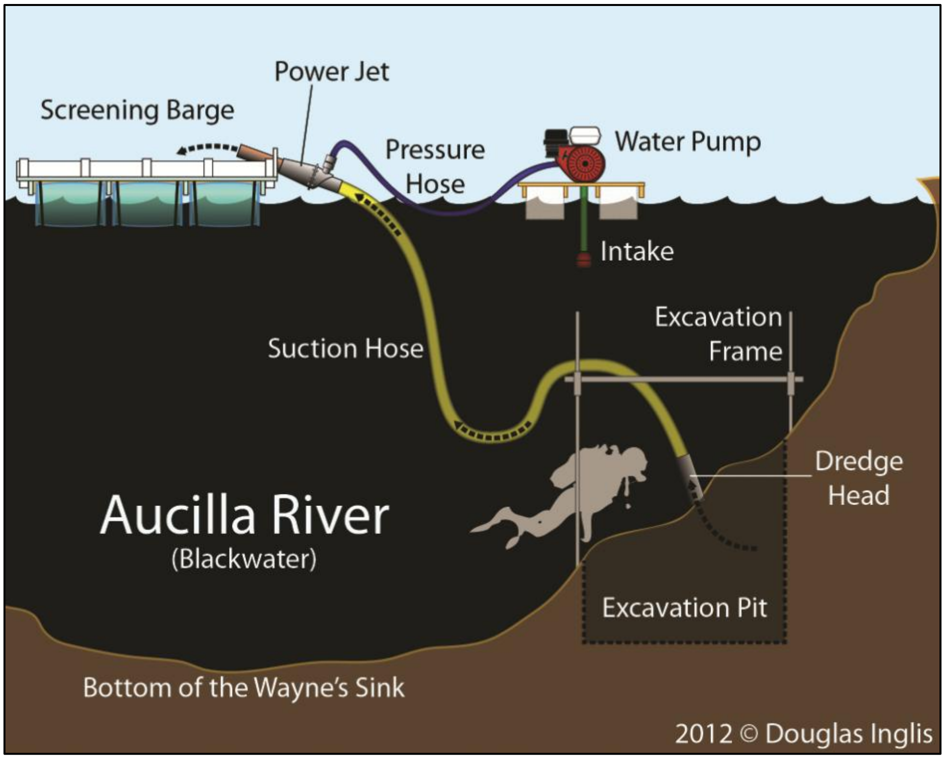



**Figure 4.9. Schematic showing underwater excavation process and screening setup. Used with permission of artist.**

## Terrestrial Testing, January 2011

The fourth field task was a survey of the land adjacent to the Aucilla River to discover if there are terrestrial Paleoindian sites and/or sediments dating to the Pleistocene/Holocene transition. This subsurface survey included 130 total shovel and auger test pits, 39 of which were located on lands owned and managed by the Suwannee Water Management District adjacent to Wayne's Sink. The other 91 pits cross-cut Ward Island between Sloth Hole and Wayne's Sink (Figure 4.10). The Ward Island test pits were all excavated on land that belongs to the Suwannee Water Management District but that is managed by the St. Marks National Wildlife Refuge, and so were under the purview of an ARPA permit.

The 39 mainland pits were located on one north-south transect (Transect A) and five east-west transects (named transects G-K, with one L pit) located approximately 50m apart with a pit spacing of between 10-20 m. The 10 m spacing was used for transect A, but the swampy conditions indicated that a larger pit spacing would be adequate and allow for more coverage. The 91 Ward Island pits were located on one north-south auger transect (transect F) and four east-west transects (named transects B-E from south to north) located approximately 50m apart with a pit spacing of between 20-40 m. The pit spacing was selected to maximize both survey efficiency and potential recovery as well as allowing for better understanding of terrestrial sediment bodies. Thirty-meter spacing is standard in Florida CRM research. The 20 m spacing was employed for Transects B-D except when I was forced to expand pit spacing to avoid large trees or extremely swampy areas. Because the sediments in these pits were extremely uniform and areas with archaeological potential became more obvious after this testing, pit spacing in transect E was 40 m unless an obvious change warranted a closer interval.

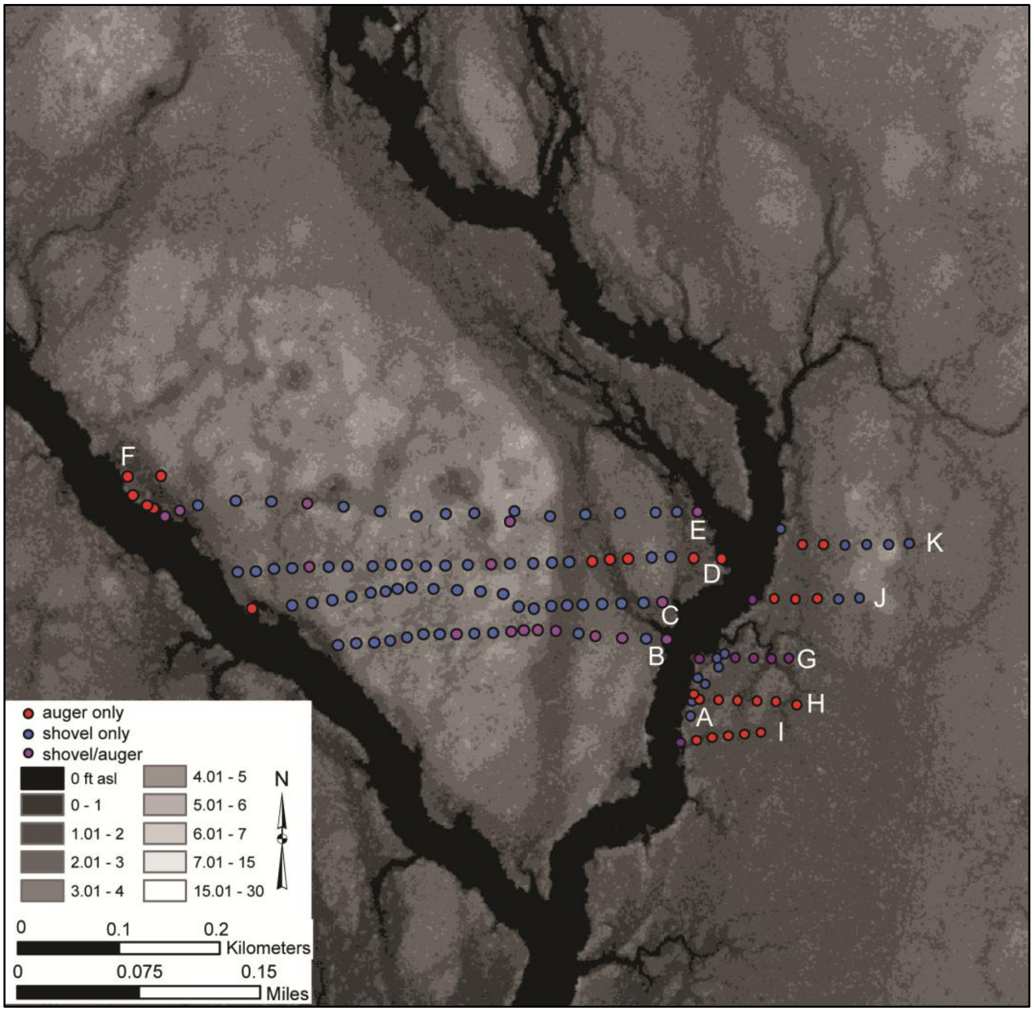



**Figure 4.10. Location of test pits on DEM generated from LiDAR, separated by pit type. Transect names are noted.**

A mixture of shovel tests and auger tests was used because this area is in the midst of a cypress swamp and the water table was often reached a very shallow depth (less that 50 cm below surface in many cases). Shovel tests were approximately 50 cm in diameter, and were excavated by shovel until water or heavy clay precluded removal of more sediment. Because mapping the entire sediment sequence was important to my research goals, excavation was continued to bedrock with a 4-inch (10.16cm) hand auger. In extremely swampy areas with standing surface water, the auger was used exclusively, which was very commonly the case on the mainland. Sediments were screened through 1/4-inch mesh, and all cultural materials and sediment samples from features were retained for laboratory analyses. Profiles and depth and association of artifacts were recorded for each pit (Appendix 3), and all test pits were back-filled after excavation. Photos were taken of sample pits as well as pits containing cultural features. Pit locations were recorded with a Trimble Geoexplorer XT.

Five new sites were discovered during this survey; these are discussed in Chapter VII. Several of the discovered sites had been looted extensively. In every case, there were large piles of rejected artifacts next to each looted area. When these were discovered, the pits were roughly mapped, and an example artifact pile was collected to help determine the types of activities that may have occurred at the site based on what was left behind. Photographs and GPS locations were taken of the looted areas.

## Fieldwork Summary

The four phases of fieldwork discussed above generated new data that will be discussed in subsequent chapters. Eight 1 x 1 m units have been excavated underwater. Forty-five total cores, counting vibrocores, hand cores from the pilot study, and column sample cores from excavated units, were also removed from underwater contexts. A total of 130 shovel and auger test pits were excavated on land. This resulted in more than 400 field specimens of various kinds used to provide the dataset for this research.

# CHAPTER V

# LABORATORY METHODS

This chapter presents the laboratory methods used in this dissertation. As with field methods, laboratory methods varied for each portion of the project because the project changed and evolved over time. Thus, here I discuss the processing related to each fieldwork phase below and follow this with discussion of the analytical methods applied to all materials.

## Pilot Study Core Processing

I originally proposed to split each core and perform pollen analysis on one half and sediment analysis on the other. Sediment analysis was to follow the methods recommended by Balsillie (Balsillie 1995; Balsillie, et al. 2002; Balsillie, et al. 2006; Balsillie and Tanner 1999). These methods required sampling laminae in a horizontal fashion. Initial samples (after shell and organics were removed by treatment with HCL and H2O2, respectively) needed to be approximately 45-60 g. Fine silts and clays were removed by screening through a 4-Φ (.0625 mm) mesh. These fine-grained sediments were then recorded by settling tube. The coarser fraction is then recorded by sieving for half an hour through ¼-Φ interval half-height geological screens. However, they also state that ½-Φ intervals may be used, although accuracy is sacrificed. These data should have been then entered into a statistical program, GRANPLOTS, which uses Gaussian distributions to predict environment of deposition.

I encountered several difficulties when attempting to use these methods. First of all, it was very difficult to sample accurately: it is important to obtain pristine samples when using this method, which meant that sediment along the core walls could not be used and sediment at the split portion of the core should be treated with suspicion. Therefore, the only way to obtain sufficiently-large samples was to use a thicker portion of the core. Thicker samples run the risk, however, of containing several laminae, which may represent very different depositional conditions. I also encountered the problem, sample size aside, that it was very difficult to collect thin laminae (~1 cm and less) without contamination, as any fluctuation in the surface led to sampling error. This was often easy to determine and relatively easy to rectify, as most of the very thin laminae had very high organic content, but this high organic content was a third problem. Sample sizes were extremely small for these laminae; after removing organics, they were nearly non-existent. Finally, I only had ½-Φ interval screen sizes available. All of these difficulties led to inconclusive results on a few samples processed following this method.

I revised my methods. Processing of cores followed the steps listed. First, all cores were constantly refrigerated to aid botanical preservation. Upon processing, each was removed only for as long as each stage required, after which it was returned to refrigeration. All cores were carefully split by cutting each side of the PVC pipe with a Dremel tool to avoid disturbing the internal sediments. The core was then sliced by cutting with a thin wire pulled straight through to avoid cross-contamination of strata.

After splitting, each stratum was carefully cleaned and one half of the core was chosen for photography based upon the clarity of the stratigraphy. After photographs, this half of the core was wrapped in plastic wrap along with a tag containing provenience information and was returned to refrigeration for future pollen analysis (which was not performed as part of the dissertation). The other half was used for sediment analyses. The measurements recorded for each stratum included depth and thickness, contact type, Munsell color, texture, and bone/artifact content. Texture was done by hand, using USDA standard descriptions. After examining each stratum, the sediment was screened through 1/16-inch mesh to recover any small faunal remains or artifacts. Several of the cores were judged to be too disturbed for pollen analysis; each of these was recorded and screened in its entirety.

A number of bones were encountered during processing of the cores (mostly fish). Each stratum containing faunal or cultural remains was issued a catalog number linked to the core number (i.e., 1010.003, meaning the third item recorded in catalog number 1010) and was listed individually on the log for this project. During fieldwork, we also collected fourteen osseous items and twelve lithic artifacts. Each of these items was washed, labeled, and entered into the catalog. Bones (none of which is unequivocally cultural in origin) were slowly and carefully dried without using chemicals before labeling, following the procedures used by the ARPP (Hemmings, personal communication, 2008). Lithics were washed and air-dried. All of these larger lithics and bones were photographed after drying and labeling.

## Vibrocore Processing

Twenty vibrocores were extracted from Wayne's Sink and Sloth Hole in November 2009 following the methods discussed in Chapter IV. After collection in the field, all cores were cut with an electric reciprocating saw into sections small enough to be transported in the back of a pickup truck. Each new section was labeled with site name, core number, core section number, and orientation. When placed in the rear of the vehicle, cores were padded with foam rubber to minimize disturbance of sediments due to road vibration. They were also placed at an approximate 30-degree angle upon consultation with geologists at the Florida Geological Survey. All cores were transported to the Department of Anthropology, Texas A&M University, for further processing. Upon arrival in Texas, all cores were stored upright until processing occurred.

Vibrocore processing started with core splitting. Cores were split in the author's garage to minimize wind-borne contamination of the sediments; because splitting was extremely messy, noisy, and hazardous, it could not be done inside a laboratory. Each core was placed into a handmade frame for stabilization during processing. Two sets of 2x4-inch boards were clamped together, with one set placed on each side of the core, which was laid flat on the garage floor. These four pieces of lumber were further clamped together on the sides of the core. I then clamped the core itself so it could not spin. I split the cores using a 7-1/4" circular saw with a 7" abrasive blade set to a depth that barely penetrated the aluminum core tube. The lumber frame provided a guide and support for the saw. The cutting process was extremely loud and fairly hazardous, as molten metal filings and dust filled the garage, so earplugs, safety glasses, dust masks and protective clothing were worn at all times.

After one side was cut, the core was rotated 180 degrees, usually releasing a flood of water from the top of the core, and the other side was cut. At this point, I used a length of fine-gauge wire placed lengthwise along the entire core to slice the internal sediments to avoid smearing the sediments down the profile. This worked very well unless large rocks, whole wood chunks or large shells were encountered. In these instances, the whole core except that area split, and the large item remained intact in one portion of the core. When the two halves were separated, I took a short video of each core, discussing my impressions of the stratigraphy as it was revealed. This turned out to be very important because many of the highly organic sediments oxidized almost instantly, dramatically changing colors. I also photographed each core at this time. I then wrapped each half of each core in plastic sheeting, which was duct-taped to seal it. Each side was then labeled with its site name, core number, and section. At this time, one half of each core was taken back to the laboratory for analysis, while the other half was stored in the garage as an archival reference if needed.

## Unit Excavation Processing

As mentioned in the fieldwork methods section, all underwater units were excavated in 5-10cm arbitrary levels giving way to natural stratigraphy. We also collected a 3-inch (7.6cm) diameter core from each unit to provide accurate texture, color, and structure data for each stratum. These were processed in the same way as the vibrocores above. All the rest of the sediments from each level were water-screened in the field. All eight units were screened through nested 1/4-inch (.635 cm) and 1/16-inch (.159 cm) screens to recover small material; 100% of the material collected in the 1/16-inch screen was retained for lab processing in Texas, while only artifacts, bone, and representative shell (primarily gastropod) samples were retained from the 1/4-inch mesh. Once in Texas, all materials from 1/4-inch bags were washed, gently brushed clean if necessary, slowly air-dried, and rebagged. This followed the methodology used during the ARPP. None of the bone artifacts or faunal bones were chemically treated, so they can be chemically analyzed in the future. In general, the slow drying process was successful, with all small bones preserving perfectly, and all natural larger bones made it through the process in very good shape. A few of the bone artifacts dried with minor desiccation cracks, but their overall integrity was also quite good.

The 1/16-inch bags were processed somewhat differently. In levels that had few organics, materials were washed until they were clean, dried, and rebagged. Very clay-rich levels occasionally required defloculation with Calgon in order to clean the materials. In this case, the sediment was placed in a large bowl, approximately 100mL of Calgon was added, and the mixture was stirred and left for twelve hours. At this point, the sediment was washed and the process repeated, if necessary. Heavily-organic samples were spread on trays, dried, and then washed. This caused the organics to float to the surface. They were skimmed off and discarded, since they were not collected for analysis and hampered recovery of cultural materials. This process was repeated two or three times until most of the organic matter was removed from the samples, at which time the remaining materials were rebagged to await sorting. Sorting of the window-screened materials was performed by several undergraduates. Each bag was separated into material category: bone, lithic, botanical, glass, ceramic, and shell, which were then further analyzed by the author.

## Terrestrial Testing Processing

All test pits were screened through 1/4-inch mesh, with only cultural materials collected in the field. Several of the sites had been extensively looted with numerous artifacts scattered on the surface. I collected samples of these surface assemblages. I also collected charcoal and sediment samples from within test pits in site areas. All of these materials were returned to Texas for processing. All lithic materials were washed, dried, and rebagged. Ceramics were dried, dry-brushed, and rebagged. Charcoal and soil samples were retained, with some being submitted for radiocarbon dating, but otherwise, these have not been processed.

## Analysis of Materials

*Conservation*

Although well-preserved underwater, the osseous remains from the Aucilla River needed careful treatment to ensure that they endure after being excavated. Bone was slowly air-dried following the drying methods determined by the ARPP (Hemmings 2008, personal communication). Chemical conservation was avoided to make bone available for future analyses. Ceramics were slowly dried. Lithic materials were washed and slowly dried. Bulk sediment samples were kept in dry, climate-controlled conditions.

*Faunal Analysis (Bone and Gastropod)*

Nearly all of the faunal remains discovered during this project were recovered from the fine-mesh screen samples, and so are extremely small. As mentioned above, they were sorted from the screen matrix by type. For each bag, these remains have been weighed by category (bone or shell). I then noted whether the bone is primarily whole or broken, and whether it consisted of terrestrial species, aquatic species, or both. Bone larger than 1/4" recovered from within the excavation units was further identified by element and species when possible. These identifications were made in consultation with the faunal reference collection at Texas A&M University. For shells, after weighing, condition (whether they were primarily broken or whole) and species were defined, tabulating species prevalence. A sample level analysis sheet can be found in Appendix I.

All faunal remains were examined for evidence of human modification. Modified remains and osseous tools were photographed and described following the methods of

Byrd (2011). One of the bone points was directly dated after photography and description. Nearly all of the large bone recovered during this project came from surface assemblages. These surface bones were separated by type when obvious (fish, mammal, turtle, for instance) and further subdivided when possible (teeth, ivory, longbone fragments, etc.) to aid in archiving and any future analysis. Each category was weighed and counted, but these surface bones were not further analyzed, as they had no potential to address the research goals of this dissertation.

*Lithic Analysis*

All debitage recovered from within excavation units was analyzed by macroscopic means. After washing and drying, all debitage was size-sorted, weighed, and scored for the following attributes, which were used to determine debitage type: size class, material type, weight, platform type, termination type, dorsal scars, portion, radial breaks, heat, and cortex percent and location (Andrefsky 1994, 2005; Dibble and Rezek 2009; Kelly 1988). Size classes were 1: <1 cm diameter; 2: 1-3 cm diameter; 3: 3-5 cm diameter; 4: >5 cm diameter. Material type was very general; I only separated cryptocrystalline silicates from other materials because the tannic waters of the Aucilla stained many of the flakes, making more specific designations impossible without breaking flakes to expose raw surfaces. Weight was measured to the nearest 0.1 gram. Platform types were cortical, flat, complex, and crushed/ground. Termination types were feather, hinge, step, and overshot. Number of dorsal scars was coded as 0, 1, 2, or 3+. Portion was whole, proximal, medial, distal, or shatter. Radial breaks were noted as 0, 1, or 2+. I classified evidence for heat into three categories: none, reddened or blackened (possible heat), and potlidded or crazed (definitely burnt). Cortex was scored as none, 1-99%, and 100%. See Appendix I for the debitage coding forms. Debitage of size class one was separated into material with platforms and material without, and each category was weighed as an aggregate and counted. This meant that size class 1 flake fragments and shatter were not differentiated; both were classified as fragments, artificially inflating this category, because the small size of these materials made differentiation between them unpredictable.

Flake type was assigned based on the scoring of the above categories. Fragments were debitage with no platforms but that still retained evidence of directionality of strike. Shatter was material that contained no directional indicators. Biface thinning flakes contained three or more dorsal scars and complex platforms. Overshots had overshot terminations. End thinning flakes had complex or crushed platforms and dorsal flake scars perpendicular to the flake direction. Blades had flat or cortical platforms, were twice as long as they were wide, at least two dorsal scars traveling in the flake direction (parallel arrises), and lateral margins. Bladelike flakes were the same but with complex or crushed platforms. Normal flake is the catch-all category for all material with a platform that does not fit into the more specialized categories. Tested cobbles were mostly cortical with one flake removal.

Cores were categorized by type, material type, flaking pattern, length, width, and thickness (Kelly 1988; Parry and Kelly 1987). Presence of cortex and invasiveness and edge angle for two flake scars were also noted. Tools were classified according to Southeastern and Paleoindian standard typologies (Bradley 1993; Bullen 1975; Collins

1999; Collins and Hemmings 2005; Waters et al. 2011b). Recorded attributes of non-bifacial tools were length, width, thickness, weight, material type, tool blank type, presence of hafting wear, number, shape, and length of worked edges, edge angle and invasiveness, total perimeter length, and dominant type of retouch (Andrefsky 2009; Eren and Sampson 2009; Kuhn 1990). Bifaces were scored for material type, length, width, thickness, weight, estimated completeness, missing portions, biface stage, edge angle and invasiveness on each side, flaking type, and cortex presence. Projectile points were further scored for point type, planview shape, base type, base indentation, notch depth, base width, and cross-section shape, and endthinning presence.

Attribute data were used to characterize the assemblages from each component and to compare components. These comparisons were used to make relative statements about site use, potential mobility, and planning (Collins 2008; Cowan 1999; Eren and Sampson 2009; Goodyear 1993; Kelly 1988, 1992; Parry and Kelly 1987); however, these statements are somewhat tentative, as nearly all of the lithics were recovered from surface contexts, artifact counts from within units are relatively low, and almost no diagnostic artifacts were recovered.

*Chronometric Analysis*

One of the major objectives of this research was to resolve chronological issues. Therefore, cultural deposits were directly radiocarbon dated whenever possible. Samples were selected from intact deposits within core tubes and column sample tubes when feasible. These samples ideally were short-lived botanical remains and bone to obtain the most accurate ages, after Waters (1992) and Waters and Stafford (2007).

Table 5.1. Submitted Radiocarbon Samples.

| Specimen No. | Site name | EU/ Vibro-core # | Level | Depth | Stratum | Material |
|---|---|---|---|---|---|---|
| 10053.001 | Wayne's Sink | VC 4 | | 55 cmbs* | Clay sapropel | Wood |
| 10054.001 | Wayne's Sink | VC 5 | | 30 cmbs | Basal peat | Twig |
| 10055.001 | Wayne's Sink | VC 6 | | 136 cmbs | Clay sapropel | Twig |
| 10057.001 | Wayne's Sink | VC 8 | | 89 cmbs | Peat | Peat |
| 10058.001 | Wayne's Sink | VC 9 | | 28 cmbs | Woody peat | Wood |
| 10058.002 | Wayne's Sink | VC 9 | | 83 cmbs | Clay (A horizon?) | Wood |
| 10059.001 | Sloth Hole | VC 10 | | 45 cmbs | Peat | Wood |
| 10061.001 | Sloth Hole | VC 12 | | 235 cmbs | Sapropel | Twig |
| 10061.002 | Sloth Hole | VC 12 | | 167 cmbs | Sandy colluvium | Charcoal |
| 10101.001 | Wayne's Sink | EU 1 | 9 | Level 9, 86 cmbd | Peat wedge | Peat |
| 10112.001 | Wayne's Sink | EU 2 | 23 | Level 23, 155 cmbd | Basal peat | Twig |
| 10116.001 | Wayne's Sink | EU 2 | 20 | Level 20, 141 cmbd | Peat | Bone |
| 10121.001 | Wayne's Sink | EU 1 | 24 | Level 24, 160-165 cmbd | Clay | Seed |
| 10122.001 | Wayne's Sink | EU 1 | 25 | Level 25, 169 cmbd | Peat/sand interface | Wood |
| 10127.001 | Wayne's Sink | EU 1 | 29 | Level 29, 185-190 cmbd | Clay | Seed |
| 10135.001 | Wayne's Sink | EU 2 | 40 | Level 40, 240-245 cmbd | Clay | Seed |
| 10136.001 | Wayne's Sink | EU 1 | 41 | Level 41, 245-250 cmbd | Gray-blue clay | Seed |
| 10160.001 | Sloth Hole | EU 3 | 42 | Level 42, 209 cmbd | A horizon? | Twig |
| 10163.002 | Sloth Hole | EU 3 | 45 | Level 45, 220-225 cmbd | Soft gray silt | Seed |
| 10189.002 | Waters Edge | B-19 | 4 | Level 4, 30-40 cmbd | Feature | Charcoal |
| 10219.003 | Wayne's Sink | L-1 | 2 | 50 cmbs | Peat | Peat |

*cmbs-centimeters below surface; cmbd-centimeters below datum

Unfortunately, however, this was not always possible. Several of the artifact-bearing strata were clay-rich sediments with very poor organic preservation. In these cases, the window-screen matrix was examined for potential radiocarbon samples even though the context of these samples was not known for sure. In every case, these samples returned an anomalously young age (in most cases, modern), almost certainly the result of collecting organics from the water column. Despite these difficulties, twenty-one radiocarbon samples were submitted and fifteen new radiocarbon ages were obtained for Sloth Hole and Wayne's Sink (four from Sloth Hole and eleven from Wayne's Sink). Table 5.1 presents the information about these samples.

*Sediment Analysis*

In the laboratory, each core was cleaned, photographed and described. Measurements of sediments were taken (in cm) from the top of the sediment column, with each new stratum described separately. I recorded each horizon depth, boundary distinctness and type, moist Munsell color (under fluorescent light), sediment texture, structure, and consistence according to U.S. Department of Agriculture categories, also noting any special features (USDA 1993). Shell and organic content and type were also noted. Appendix III contains the details of these cores. Organics for radiocarbon dating of sediments were also removed at this time, placed in aluminum foil, and placed in labeled bags. Each core was then rewrapped and stored for future reference. When recreating sediment cross sections, the cores were laid out in order so that correlations could be more easily detected.

Sediments from excavation units were analyzed using cores collected from within the units. These sediment descriptions were supplemented by the faunal analyses. While performing the analysis of the window-screened materials, I also noted the presence of heavy clays requiring defloculation, the presence and type of gravels, and the presence and type of any lithic materials in every level. Sediments from terrestrial test pits were described in the field.

While I had originally proposed to do formal grain-size analyses of these sediments following the methods mentioned in the pilot study section discussed earlier in this chapter, upon consultation with my advisor, we decided this was unnecessary because grain-size changes in the sediments were so dramatic that differing depositional environments were quite obvious. Most of the strata were so fine-grained that nearly all of the sediment passed through a 4-$\Phi$ (.0625mm) mesh, falling into the silts and clays category, best measured by the pipette method (Folk 1966; Galehouse 1971), with only trace amounts of sands. The other sediments were medium to coarse sands with only trace amounts of finer materials. Further, pedogenesis in the sediments was also readily apparent even though the depth of pedogenic activity was often quite shallow. Finally, many of the strata were such organic peats or so full of shell that processing them for grain-size analysis would have resulted in meaningless data because adequate sample sizes after this processing would have been unobtainable. Therefore, all sediment textures were obtained by hand-texturing moist sediments from cores and during field analysis of test pits and excavation units.

Correlations between sediments were made to recreate the cross-sections of the sinks and the terrestrial deposits between them. These correlations were made based upon radiocarbon dates, fossil content, stratigraphic position, type of deposit, and macroscopic appearance.

## Data Synthesis and Summary

Data recovered during this research were compared to information from Sloth Hole, Page-Ladson, Little River Rapids, and Ryan-Harley. I also analyzed artifacts from previous excavations at Sloth Hole at the Florida Museum of Natural History following the same methods as above during January 2012. Published profiles for Ryan-Harley, Page-Ladson, Little River Rapids and Sloth Hole were used to correlate strata based on radiocarbon ages, fossil contents, and sediment types. This allowed me to place the cultural materials from all sites within their respective contexts, in turn, permitting me to discuss human use of the lower Aucilla River during the terminal Pleistocene. The geological framework and previous paleoenvironmental research are applied to the archaeological dataset to discuss Paleoindian activities in the context of Late Pleistocene environments.

# CHAPTER VI

# UNDERWATER RESEARCH AT THREE SINKS

As discussed in Chapter IV, I visited five different sinkhole sites during the pilot study, eventually selecting Wayne's Sink for further excavation based on artifact content and sediment profiles and returning to Sloth Hole for further excavations. The three other sites, Cypress Hole, Totem Shoal, and Mandalay were visited because, according to local collectors, all three sinkhole sites contained either tools made from extinct faunal bone or diagnostic Clovis artifacts. My investigations of these three sites was limited to a single day of diving at each with the assistance of Tom Pertierra, C. Andrew Hemmings, and Micah Mones, collecting one to three short PVC sediment cores from each. No artifacts or bones were removed from these sites, but both were observed. The Paleoindian research potential of each site varies and is briefly discussed below.

## Cypress Hole (8JE1499)

Cypress Hole was originally recorded by the ARPP during a brief visit in 1994. This visit determined that the site contained at least a limited amount of megafaunal remains, some Weeden Island artifacts and a fluted biface. The 1994 activities also determined that Cypress Hole was separate from Sloth Hole, as there had been a bit of confusion regarding this site in collectors' reports of the area (Hemmings, personal communication 2009). During my visit in fall 2008, I placed four cores on and along terraces of the sink, which appeared on the surface to be very similar to Sloth Hole, but not as deep. We were unable to extract core 4, however, as it seemed to have been pounded through a log or a very resistant stratum.

Very soft fluffy organic sediments were located near the center of the sink, with harder sediments visible along the margins (Figures 6.1 and 6.2). Both cores 5 and 7, taken near one another, show a thick sapropel layer at the bottom (Figure 6.1 and Appendix II), which could be the same as the basal peats at Sloth Hole dating in excess of 20,000 cal B.P. Both also seem to represent slow infilling on a pond margin. Core 6 may represent a previous land surface, given the sedimentary structure found in the lower clays; this core was from approximately 3.3 m underwater, while core 5 was from 6 m and core 7 from 5 m underwater. Therefore, it is possible that core 6 was subaerially-exposed during the time that 5 and 7 were slowly infilling and sapropels were forming. The common presence of shell but small grain size (silts and clays) in core 6 indicates some sort of shallow-water, low-flow deposition before subaerial exposure.

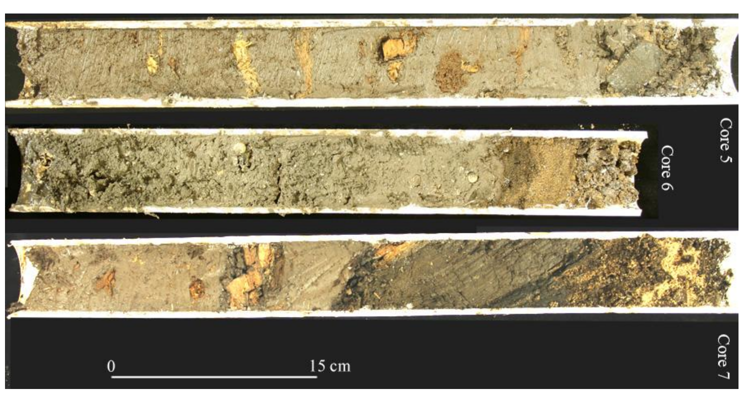



**Figure 6.1. Cores from Cypress Hole.**

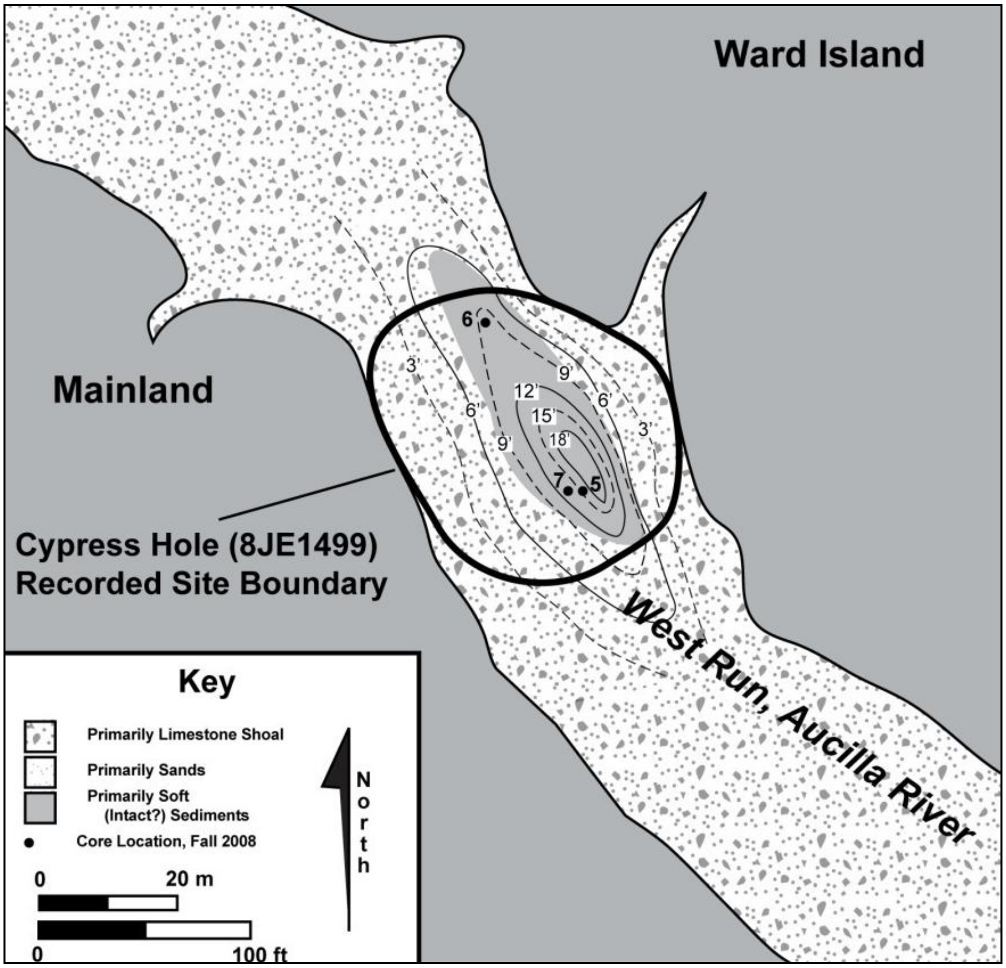



**Figure 6.2. Cypress Hole site sketch map. Bathymetry is approximate.**

## Mandalay (8JE1539/TA137)

Mandalay was originally recorded during the ARPP in 1989 through consultation with a local collector (Dr. Ohmes). He had discovered a Clovis point, copious bones of megafauna, and two *Equus* daggers from a sink at the site. During our visit in November of 1998, we discovered a very large sink approximately 100 m north of the Mandalay boathouse near the outlet of an ephemeral stream (Figure 6.3). This sink was approximately 10 m deep at the bottom, steep-sided, and filled with a lag deposit of coarse sands, bone, and modern trash at the bottom. It was surrounded to the west and south by very craggy limestone riddled by deep cracks. Because of the depth compared to other, previously dated, sinks in the Aucilla, sediments in the bottom of the sink were judged to be too old for the purposes of my research, so we scanned the side walls. The only terrace visible in the sink was at approximately 4.8 m deep, where silty muck overlaid harder silts and clays on the east side of the sink, but where bare or nearly bare limestone was exposed elsewhere.

The only core removed from the site (core 14) (Figure 6.4 and Appendix II) was from this terrace, on the east side of the sink near the stream outlet. The top of the core had alternating sands and leaf litter, overlying a sapropel. This sequence is probably the result of alternating periods of still water, during which organic matter settled on the terrace, followed by flood events exiting the ephemeral stream and dropping sand. The sapropel may actually be an intact ancient deposit, but its age is unknown. We collected a chunk of wood from the bottom of the core that has been reserved for future dating.

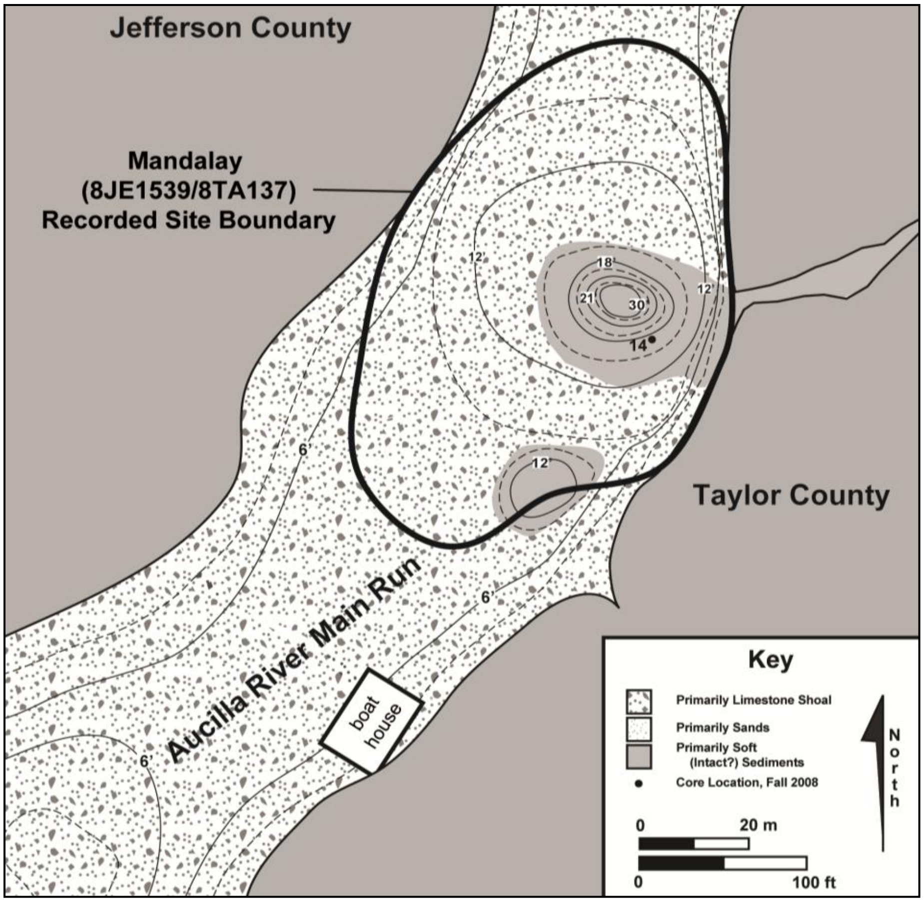



**Figure 6.3. Mandalay site sketch map. Bathymetry is approximate.**

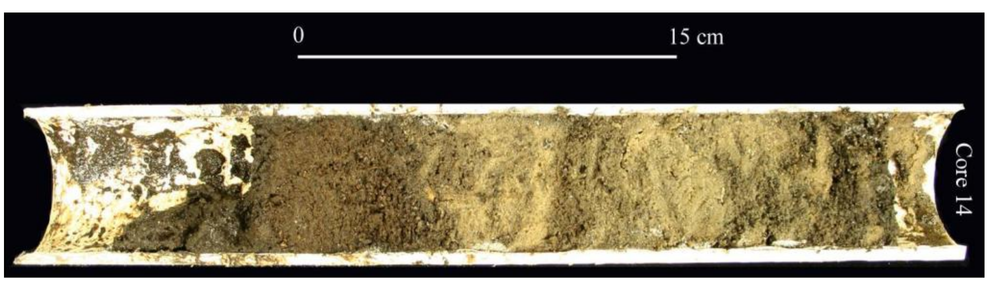



**Figure 6.4. Core from Mandalay.**

We did not collect any faunal remains or artifacts from this site. Photographs were not taken due to the extremely dark water and to a dramatic halocline during our dive at approximately 4.5 m below surface, which obscured visibility even farther. Although there may be intact deposits of Paleoindian age on the eastern side of this sink, Mandalay seems to have fewer potentially intact deposits than all of the others visited during this project. Thus, even though collectors had found several Paleoindian diagnostics at the site, Mandalay was judged to have less potential for future Paleoindian research.

### Totem Shoal (8JE1638)

Totem Shoal had not been documented prior to this project. It had been reported to the ARPP during fieldwork, but no site form was ever completed. A local collector had obtained a Clovis point and several ivory fragments from the site, and the shoals upstream and downstream of the site were well-known to local collectors. Our visit to the site revealed a sink filled with an organic muck very like that in Sloth Hole before excavation (Hemmings, personal communication 2008). Visibility in the bottom of the sink was negligible, although terraces along the side were readily apparent (Figure 6.5). No artifacts were observed during this site visit, although a mastodon bone was located very near core 15. We removed three cores from the site in various locations around the sink margin, where we judged deposits to possibly be of late Pleistocene age based on similarities with Sloth Hole (Figure 6.6 and Appendix II). Cores 16 and 17 both contained pond margin sediments and were too short to determine if intact Pleistocene sediments remained underneath. Core 15 appeared like cores from Sloth Hole, including a gray shell hash stratum (see Chapter VIII). At Sloth Hole, a similar stratum was underlain by a Clovis to Bolen-aged artifact layer. The Sloth Hole sequence could possibly be replicated at Totem Shoal, but the PVC core was too short to determine this.

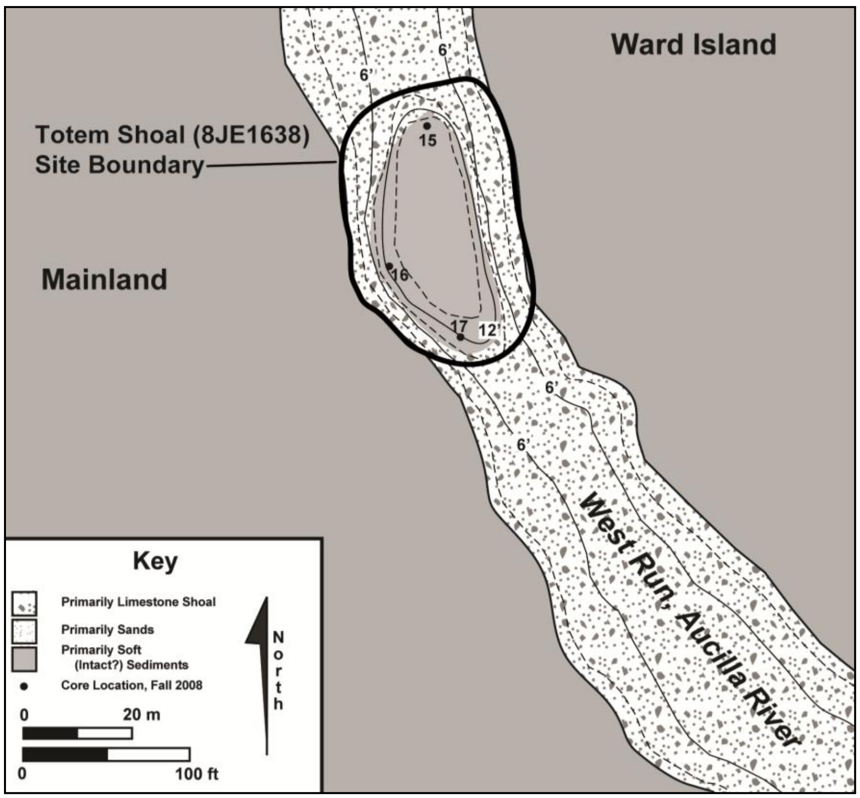



**Figure 6.5. Totem Shoal site sketch map. Bathymetry is approximate.**

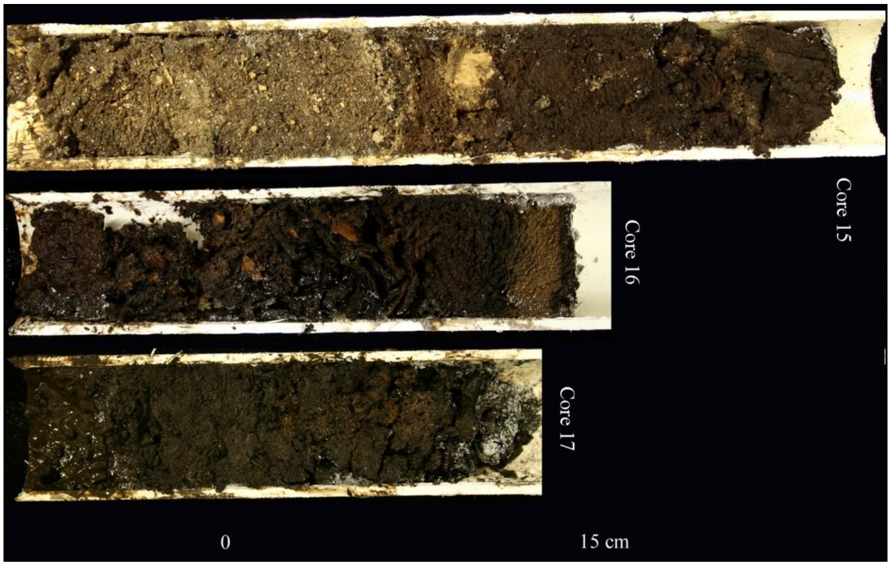



**Figure 6.6. Cores from Totem Shoal.**

No artifacts or faunal remains were collected from this site during fieldwork. No photographs were taken due to the dark water. We did locate a mastodon scapula near core 15 in very soft silty sediments but did not collect it. The profile in core 15 seems to be similar to the stratigraphic sequence in Sloth Hole, but the core was too short to confirm this. As with Cypress Hole, this site may prove fruitful for future research and should be investigated further.

## Summary and Conclusions

This brief chapter presents the data collected from three submerged sinkholes, Cypress Hole, Mandalay, and Totem Shoal, which were visited during the pilot study but were not studied further during this dissertation. The cursory investigation of these sinkhole sites indicated that deposits are similar for adjacent sinkholes, as the deposits in all three of these sites seem similar to those seen at Wayne's Sink and Sloth Hole. This may also indicate that the archaeological potential of adjacent sinks is somewhat similar. Further, portions of each site likely have future research potential. However, this research has shown that longer cores are absolutely crucial to properly explore the sinks; several of the cores collected during the pilot study failed to penetrate modern surface sands and peats and severely limited the interpretations I was able to make.

These three sites were rejected from further research after the pilot study for various reasons. One of the main goals of this research was to reconstruct the late Quaternary history of the lower Aucilla Basin using a manageable dataset. Therefore, upon consultation with my committee, we decided that two sites could provide an appropriate sample if they were from different portions of the river and could be compared to previously collected data. As discussed in Chapter IV, further excavation at Sloth Hole was deemed necessary to place the prior excavations into their geological and geoarchaeological frameworks. Thus, both Cypress Hole and Totem Shoal were excluded from further excavation because of their proximity to Sloth Hole and because they were located in the same portion of the river. Mandalay was excluded from further research because it seemed to have relatively little research potential, as most of the site area was bare limestone.

# CHAPTER VII

# TERRESTRIAL RESEARCH

This chapter presents the results of terrestrial testing, which discovered five unrecorded prehistoric sites. All of the terrestrial sites contained either heat-treated lithics or ceramics, so post-date the Paleoindian period (Dunbar 2007; Milanich 1994). Therefore, no further excavation was conducted at any of these sites as part of this dissertation because they could not address the primary research questions of this research. Materials from each site were analyzed following the methods used for Wayne's Sink and Sloth Hole, though, and potential interpretations of the sites based on these analyses are presented below. Four of the five sites have been at least minimally looted, and two of the sites contain subsurface features with datable organics, so further testing and monitoring of these sites is highly recommended.

## Terrestrial Research: Sedimentology

As discussed in Chapter III, I excavated a total of 130 tests pits using a combination of shovel and auger testing. Thirty-nine of these were on the mainland adjacent to Wayne's Sink, while 91 were located on Ward Island crossing the island in several transects between Wayne's Sink and Sloth Hole. These test pits were excavated for several reasons: to look for terrestrial archaeological components, especially Paleoindian sites, to examine sediment profiles on land so that they could be correlated with underwater sequences, and to use these data to further understand the late Quaternary history of the area.

The NRCS Soil Survey for Jefferson and Taylor Counties (NRCS 2011) describes the soils in the survey area, Nutall-Tooles fine sands, as shallow, poorly-drained, nearly level soils formed on floodplains. Nuttall soils are classified as fine-loamy siliceous thermic mollic albaqualfs, while Tooles soils are loamy siliceous thermic arenic albaqualfs. Albaqualfs are a great group of the soil order of Alfisols. Alfisols typically form under a hardwood forest cover and have argillic (clay-rich) horizons with ochric or umbric surface horizons (dark-colored, base-rich thick organic surface horizons). The suborder Aqualfs refers to soils that are commonly wet and display redoximorphic or iron-rich features due to this wetting. Albaqualfs are soils of this type with distinct textural differences between the upper horizon (epipedon) and the clay-rich argillic horizon (USDA 1993).

The shallow, wet nature of these soils was borne out by my testing; bedrock was reached between 15 and 165 cm below surface (cmbs) in 106 of the 130 pits, with bedrock less than 100 cmbs in 95 of those pits. In the other 24 pits, however, bedrock was deeper than 2 m below surface and was not reached by the auger test. Significantly, all of these deep pits were on the margins of the river channel or in a paleochannel (Figure 7.1). Throughout the survey area, it was extremely common to observe limestone bedrock on the ground surface, but, as can be expected with a karst landscape, this bedrock was uneven, with adjacent pits having extremely variable depths to bedrock (Figure 7.1). This means that it was possible to find deeper pockets of sediment or shallow bedrock nearly anywhere. Most of the survey area was filled with shallow paleochannels or tidal inlets; often these contained standing water for at least part of every day and were filled with wet mucky sediments.

Two main types of soil profiles were found in the survey area, named the wetland profile and the upland profile for ease of discussion. Wetland profiles were typified by a gray clayey marl, sometimes stratified. Occasionally this marl was covered by a thin, heavily organic A horizon, but often, this gray marl was immediately under the surface O horizon and continued to a B/R horizon of marl and weathering limestone until limestone bedrock was reached (Figure 7.2). O horizons varied from Oi horizons with intact leaf structure to Oa horizons that contained no structure. A horizons were typically black to very dark gray (10YR 2/1 to 7.5YR 3/1) clay loams with roots. The gray marly Bg horizons ranged from light gray to gray (2.5Y 7/2 to gley 1 5/N). Structure varied from none to weak angular blocky, and texture ranged from silty clay to clay loam. Prominent redoximorphic features were common. The water table in these pits was often reached at less than 30 cmbs, while bedrock depths varied greatly from less than 20 cm to greater than 100 cm. These were commonly found in the numerous tidal inlets.

Upland profiles (so named because the water table was not as shallow) had an O horizon overlaying an A horizon overlaying a sandy E horizon overlaying a sequence of B and C/R horizons (Figure 7.3). In pits with deeper bedrock, there are distinct $Btg_1$, $Btg_2$, B/C, and C/R horizons, while shallower pits had A-Bt-R horizon sequences. The A horizons varied from very dark brown (10YR 2/2) clay loam with granular structure to very dark gray brown (10YR 3/2) loamy fine sands with no structure. A horizons varied in thickness from 2 cm to nearly 20 cm in places. The underlying E horizon was present in all pits that contained artifacts, but was in only slightly more than half of the upland pits; if the pit was very shallow, sometimes it would only be 2-3 cm thick. E horizons were usually very dark gray brown to light brownish gray (10YR3/2 to 10YR 6/2) loamy fine sand to loamy very fine sand. These did not have structure. The clay or clay loam Btg1 horizons had prismatic to medium angular blocky structures, ranging from firm to friable consistence. Commonly, sand bridges from horizons above would coat the ped faces. Colors of these horizons generally ranged from very dark gray brown to olive brown (10YR 3/2 to 2.5Y 4/4). Redoximorphic features of brown (7.5YR 5/4) were common, especially in shallow pits. The Btg2 horizons were commonly clays or sandy clays with firm to friable angular blocky to subangular blocky structure. Colors generally ranged from yellow to dark grayish brown (10YR 7/8 to 2.5Y 4/2). Redoximorphic features were exceedingly common. If bedrock was shallow, the bottom of this stratum would commonly contain limestone pebbles from *in situ* weathering and was designated a B/R horizon. B/R horizons in deeper pits were commonly gray or light brownish gray (2.5Y 6/1 or 6/2) clay or sandy clay loam with common redoximorphic features and limestone gravels. Structure was weakly developed or not present. In all cases, archaeological deposits were associated with pits having sandy surface horizons (upland pits).

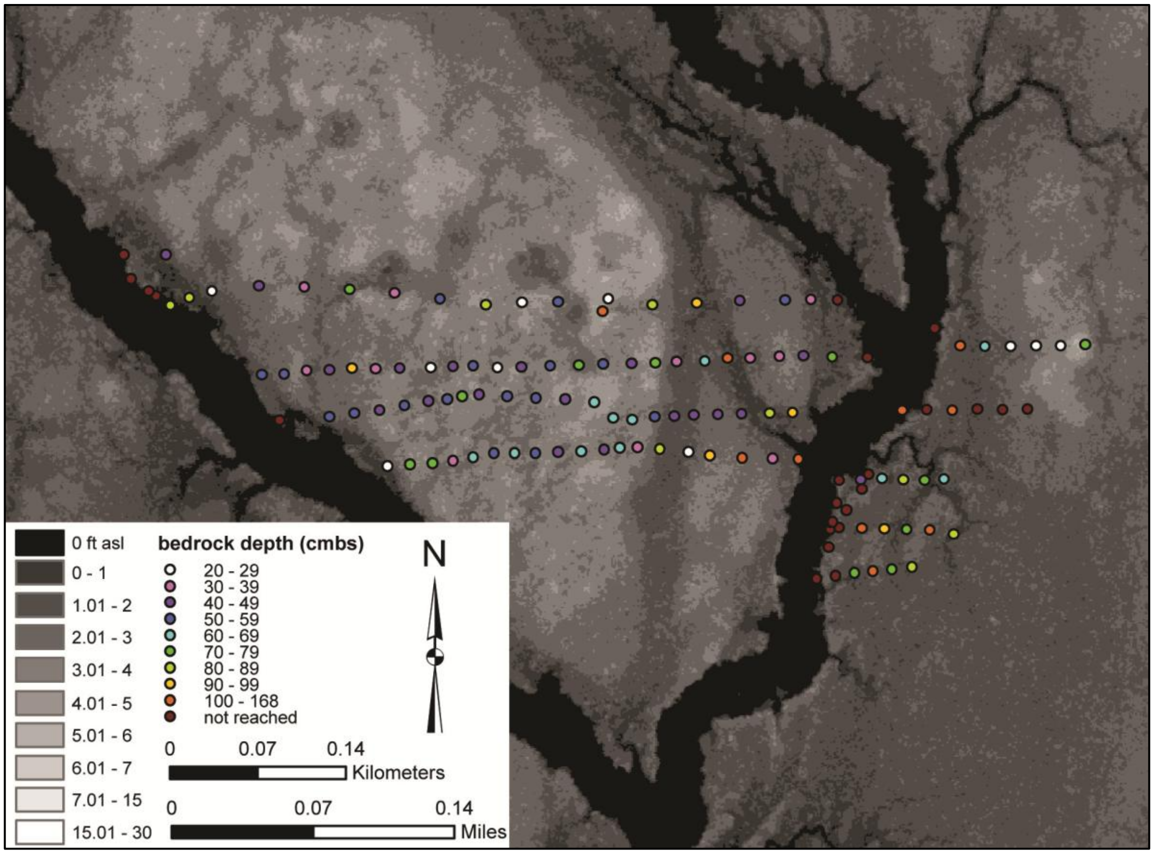



**Figure 7.1. Depth to bedrock of test pits placed on DEM generated from LiDAR.**

In general, pits with the "upland" soil profile were located on the western and very northeastern portions of the survey area (i.e., places with greater depth to bedrock). As can be seen on the LIDAR imagery (Figure 7.1), eastern Ward Island and the western portion of the mainland is cross-cut by many wide tidal channels that were filled with wetland mucks to bedrock (wetland pits) (Figure 7.4). The pits near the channel margins did not fit easily into either the wetland or the upland type. These pits had well-developed soils on top of marls overlaying peats, leading to the observed sediment profile in the river channel itself. The profiles of these pits were highly variable.

**Figure 7.2. Photo of "wetland pit," shovel and auger pit B-4.**

**Figure 7.3. Photos of two "upland pits," shovel pits B-18 and C-16.**

**Figure 7.4. Photo of tidal inlet in center of survey area.**

## Archaeological Results of Terrestrial Testing

Five sites were discovered during the terrestrial test excavations. All five sites are prehistoric in age. 8JE1751, The Water's Edge Camp, yielded diagnostic Deptford ceramics and at least one feature. 8JE1752, Sandy Knoll, contained nondiagnostic lithic debitage and grit-tempered ceramic fragments. Sites 8JE1753, Tiny Ridge, and 8JE1754, Downed Tree, both yielded nondiagnostic lithic debitage. 8TA48, the K-1 Mound site, is a small mound with much lithic debitage and diagnostic Deptford ceramics liberally littering the surface. All of the sites except the Tiny Ridge site had been extensively disturbed by previous looting activities, but four out of the five sites had sufficient intact deposits that they are still considered potentially-eligible for placement on the National Register of Historic Places. All five post-date the Paleoindian period, as they all contained ceramics, heat-treated lithics, or both.

Originally, I proposed to excavate a limited number of 1 x 1m test units on land as well as underwater, but the terrestrial testing project indicated that the terrestrial sediments have a low probability of containing intact Paleoindian deposits. Most of these test pits reached bedrock at less than 1 m below surface, and nearly all artifacts were found in a sandy horizon within the top 20 cm of the profile.

Sixteen of the 91 test pits excavated on Ward Island contained cultural material (Figure 7.5), while one contained a single faunal remain (a snake vertebra) that could not reliably be associated with human activity. These 16 positive pits were spaced in such a way that they were assigned to four different sites, issued the site numbers 8JE1751-8JE1754. In addition, three of these sites had previous looter disturbances, increasing surface exposure. Four of the 39 test pits excavated on the mainland contained cultural material (Figure 7.5). Three of these pits were associated with a single site, the K-1 mound site, while the fourth was within the site boundaries of the Wayne's Sink site, and is discussed in Chapter IX. In addition, the K-1 mound site had extensive previous looter disturbances, increasing surface exposure.

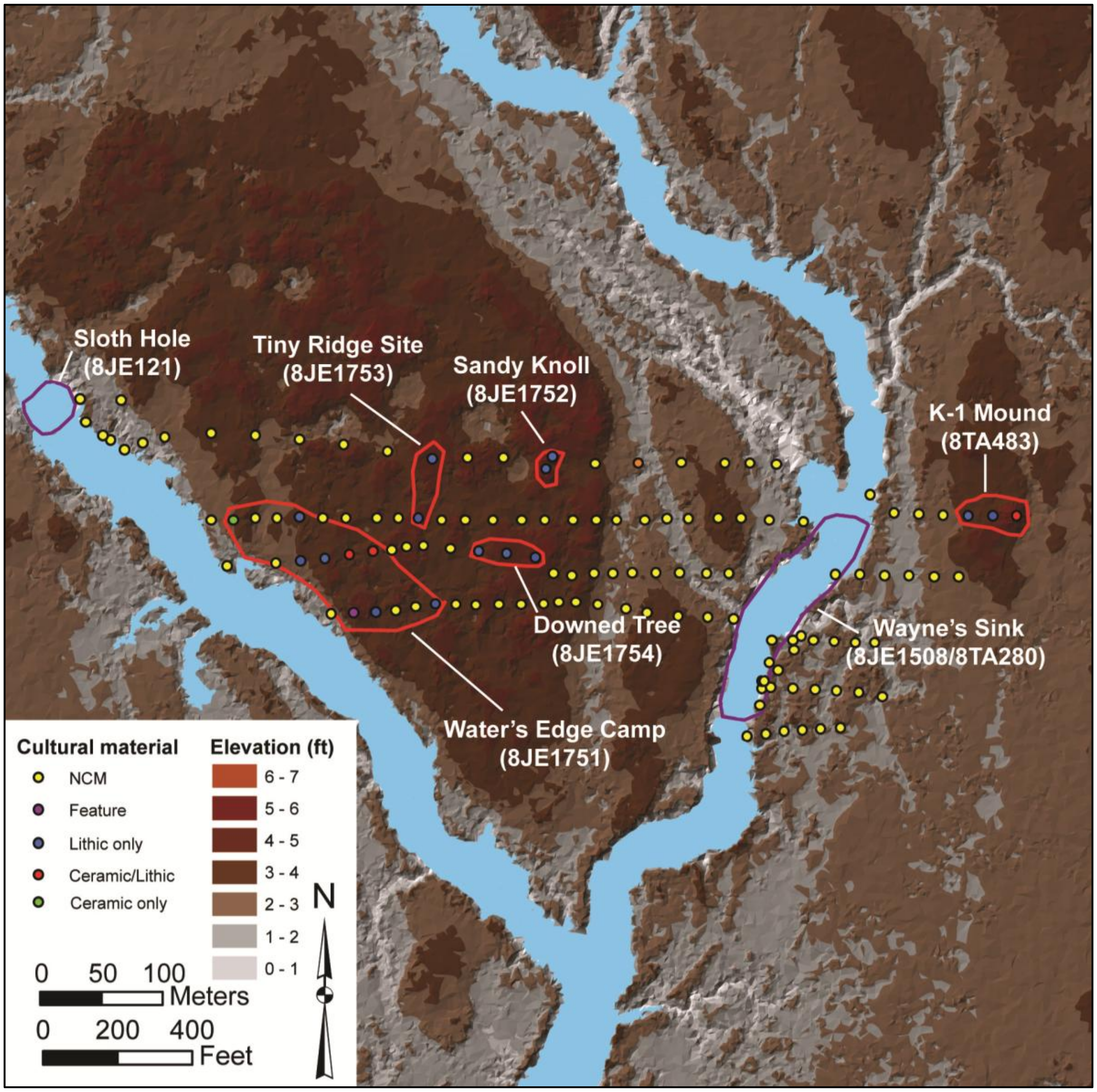



**Figure 7.5. Culturally-positive test pits from the terrestrial testing and assigned site boundaries.**

In addition to the test pits within site areas, surface collections were made from the looter's backdirt at the three most extensively disturbed sites and from the surface assemblage at Wayne's Sink in the hopes that this would help interpret site activities. A total of 1,300 pieces of lithic material, nearly 100 ceramic sherds, and less than 10g of bone and other organic materials were recovered from these investigations. This includes 31 bifacial tools and cores (Table 7.1) and 16 flake tools (Table 7.2). Each of the five new sites was registered with the Florida Bureau of Archaeological Research and was assigned a site number, but none of the sites was extensively mapped, and so each is only known from the contents of test pits and any surface exposures. Thus, these site maps should be considered preliminary. Further, analyses of the cultural material from each site are biased by these factors, so site interpretations should also be considered tentative. Each site is discussed in more detail below.

Table 7.1. Bifaces and Cores Recovered from Terrestrial Excavations.

| Site | AM # | Unit | Elevation cmbs | Length mm | Width mm | Thickness mm | Weight g | Estimated Completeness | Biface Type | Core Type | Core: flake scars | Planview Shape | Base type | base width mm | cross section shape | flaking type | end thinned | cortex present |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Downed Tree | 10194 | C-10 | 20-66 | 30.05 | 57.1 | 22.45 | 36.3 | ind | core | multi-directional | 5+ | ind | ind | | ind | edge | none | one side |
| K-1 Mound | 10222 | surface | 0 | 57.96 | 60.68 | 22.79 | 96.3 | 25%-50% | mid | | | lanceolate | round | 61.56 | plano-convex | edge | none | none |
| K-1 Mound | 10213 | K-1 | 0-20 | 16.55 | 35.8 | 10.34 | 3.9 | 1-25% | mid | | | ind | ind | | bi-plano | ind | none | none |
| K-1 Mound | 10221 | rodent spoil | 0 | 56.88 | 39.17 | 13.18 | 16.8 | 100% | late | | | ovoid | round | 32.07 | bi-convex | edge | none | none |
| K-1 Mound | 10214.03 | K-1 | 20-40 | 16.39 | 17.22 | 5.39 | 0.9 | 1-25% | point | | | ind | ind | | bi-plano | past midline | none | none |
| K-1 Mound | 10220 | near K-1 | 0 | 47.63 | 80.7 | 19.76 | 85.1 | 1-25% | core/ biface | bifacial | 5+ | ind | ind | | bi-plano | random | none | one side |
| K-1 Mound | 10222 | surface | 0 | 59 | 63.88 | 37.57 | 111.5 | 75-99% | core | bifacial | 5+ | ind | ind | | plano-convex | edge | none | one side |
| K-1 Mound | 10222 | surface | 0 | 111.54 | 85.27 | 70.12 | >600 | 100% | core | wedge-shape | 5+ | ind | ind | | ind | past midline | none | one side |
| K-1 Mound | 10222 | surface | 0 | 89.11 | 75.31 | 66.1 | 348.4 | 100% | core | conical | 4 | ind | ind | | ind | edge | none | none |
| K-1 Mound | 10222 | surface | 0 | 85.43 | 67.24 | 64.3 | 481.2 | 100% | core | multi-directional | 3 | ind | ind | | ind | random | none | both sides |
| K-1 Mound | 10222 | surface | 0 | 86.82 | 56.53 | 41.37 | 257.6 | 100% | core | uni-directional | 4 | ind | ind | | ind | past midline | none | one side |
| K-1 Mound | 10222 | surface | 0 | 126.5 | 84.38 | 54.56 | 539 | 100% | core | bifacial | 5+ | lanceolate | round | | plano-convex | edge | none | both sides |
| K-1 Mound | 10222 | surface | 0 | 116.88 | 90.93 | 69.78 | >600 | 100% | core | multi-directional | 5+ | ind | ind | | ind | past midline | none | both sides |
| K-1 Mound | 10217 | K-2 | 0-40 | 34.42 | 38.05 | 26.92 | 37.6 | 100% | core | multi-directional | 5+ | ind | ind | | ind | random | none | none |
| K-1 Mound | 10222 | near K-1 | 0 | 61.97 | 54.89 | 14.01 | 56.8 | 75-99% | adze | | | ind | ind | | plano-convex | edge | none | none |
| L-1 area | 10224.01 | surface | 0 | 52.36 | 42.75 | 24.91 | 44.3 | 75-99% | early | | | ovoid | round | | plano-convex | edge | none | both sides |
| Sandy Knoll | 10206 | E-7 | 0 | 181 | 70.68 | 26.45 | 283.2 | 75-99% | mid | | | lanceolate | ind | 42.01 | plano-convex | edge | none | one side |
| Sandy Knoll | 10212 | surface | 0 | 73.56 | 41.76 | 19.51 | 59.8 | 100% | mid | | | ovoid | ind | | plano-convex | edge | present | one side |
| Sandy Knoll | 10212.00 1 | near E-8 | 0 | 98.15 | 55.22 | 23.26 | 108.9 | 100% | mid | | | lanceolate | square | 47.18 | plano-convex | edge | present | one side |
| Sandy Knoll | 10207 | E-8 | 0-30 | 7.2 | 10.48 | 2.28 | 0.2 | 21-25%-49% | point | | | ind | ind | | bi-plano | past midline | none | none |

Table 7.1. (continued).

| Site | AM # | Unit | Elevation cmbs | Length mm | Width mm | Thickness mm | Weight g | Estimated Completeness | Biface Type | Core Type | Core: flake scars | Planview Shape | Base type | base width mm | cross section shape | flaking type | end thinned | cortex present |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sandy Knoll | 10207 | E-8 | 0-30 | 15.37 | 24.62 | 10.94 | 3.6 | 100% | frag | | | ind | ind | | plano-convex | edge | none | none |
| Sandy Knoll | 10207 | E-8 | 0-30 | 7.19 | 13.45 | 6.74 | 0.6 | 1-25% | frag | | | ind | ind | | bi-convex | edge | none | none |
| Sandy Knoll | 10207 | E-8 | 0-30 | 18.51 | 33.38 | 10.78 | 3.9 | 1-25% | frag | | | ind | ind | | diamond | edge | none | none |
| Sandy Knoll | 10212 | surface | 0 | 38.48 | 45.31 | 18.23 | 32.5 | 100% | core | multi-directional | 5+ | ind | ind | | plano-convex | edge | none | one side |
| Sandy Knoll | 10207 | E-8 | 0-30 | 24.23 | 24.99 | 14.99 | 7.8 | 1-25% | core | multi-directional | 5+ | ind | ind | | ind | random | none | none |
| Sandy Knoll | 10212 | surface | 0 | 100.09 | 64.5 | 48.43 | 352.6 | 100% | core | bifacial | 5+ | ovoid | round | | plano-convex | edge | none | none |
| Sandy Knoll | 10212 | surface | 0 | 60.9 | 46.28 | 42.22 | 110.7 | 100% | core | multi-directional | 5+ | ind | ind | | ind | random | none | both sides |
| Waters Edge | 10211.001 | end of B | 0 | 98.3 | 64.81 | 32.01 | 192.9 | 100% | adze | | | ind | ind | 37.62 | plano-convex | edge | none | one side |
| Waters Edge Camp | 10271 | surface | 0 | 24.41 | 42.43 | 16.72 | 9.4 | 1-25% | mid | | | ind | ind | | plano-convex | edge | none | none |
| Waters Edge Camp | 10271 | surface | 0 | 57.85 | 54.9 | 21.12 | 62.2 | 21-25%-49% | mid | | | lanceolate | round | 0 | bi-plano | edge | none | none |

Table 7.2. Flake Tools Recovered from Terrestrial Excavations.

| Site | Unit | Depth cmbs | Length mm | Width mm | Thick mm | Weight g | tool blank | tool type | hafting wear | worked edges | edge shape | edge angle | max invasive | worked edge/ perimeter |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| K-1 Mound | surf | 0 | 78.85 | 74.96 | 38.44 | 198.50 | core red. | retouched flake | none | 1 | straight | 45 | 6.68 | 0.24 |
| K-1 mound | K-1 | 20-40 | 6.75 | 14.17 | 4.47 | 0.40 | ind. flake | fragment | none | 1 | point | 70 | 3.43 | 0.18 |
| Sand Knoll | E-8 | 30-60 | 34.51 | 48.27 | 26.28 | 29.40 | cortical | retouched flake | none | 1 | straight | 80 | 8.06 | 0.31 |
| Sandy Knoll | surf | 0 | 51.95 | 43.44 | 22.60 | 38.30 | ind. flake | retouched flake | none | 1 | straight | 80 | 13.67 | 0.24 |
| Sandy Knoll | surf | 0 | 71.32 | 75.01 | 36.75 | 181.30 | core red. | side scraper | none | 2 | straight | 90 | 16.89 | 0.64 |
| Sandy Knoll | surf | 0 | 33.70 | 18.34 | 10.61 | 4.10 | ind. flake | fragment | none | 2 | point | 75 | 8.15 | 0.77 |
| Sandy Knoll | surf | 0 | 44.30 | 53.14 | 14.85 | 28.90 | core red. | side scraper | none | 1 | straight | 90 | 6.74 | 0.14 |
| Sandy Knoll | surf | 0 | 94.12 | 66.40 | 51.37 | 253.80 | core red. | retouched flake | none | 1 | straight | 55 | 14.07 | 0.11 |
| Sandy Knoll | surf | 0 | 60.80 | 42.37 | 29.43 | 62.20 | core red. | end scraper | none | 1 | convex | 75 | 32.47 | 0.14 |
| Sandy Knoll | surf | 0 | 43.40 | 38.25 | 18.82 | 30.20 | core red. | end scraper | none | 1 | convex | 85 | 20.50 | 0.16 |
| Sandy Knoll | surf | 0 | 69.32 | 66.35 | 29.08 | 99.80 | ind. flake | adze | present | 3 | straight | 45 | 18.45 | 1.00 |
| Sandy Knoll | E-8 | 0-20 | 20.55 | 31.51 | 9.00 | 5.30 | ind. flake | graver | none | 3 | ind | 80 | 5.78 | 0.41 |
| Sandy Knoll | E-8 | 0-20 | 11.45 | 15.72 | 4.10 | 0.40 | ind. flake | fragment | none | 3 | ind | 20 | 5.46 | 0.30 |
| Sandy Knoll | near E-8 | 0 | 59.12 | 31.92 | 19.69 | 36.90 | cortical | end scraper | present | 3 | convex | 85 | 17.24 | 1.00 |
| Waters Edge | B-19 | 30-40 | 16.27 | 20.12 | 5.98 | 1.30 | ind. flake | fragment | none | 1 | straight | 45 | 5.78 | 0.34 |
| Water's Edge | B-15 | 30+ | 20.03 | 20.75 | 4.23 | 1.30 | biface thin | retouched flake | none | 1 | convex | 90 | 1.89 | 0.22 |

*The Water's Edge Camp (8JE1751)*

The Water's Edge Camp (8JE1751) site is located on the western side of Ward Island on the east bank of the Aucilla River. This area is on a low rise adjacent to a tidal inlet. Current vegetation is oak, cypress, palmetto, and palm, with grass covering most open areas. This site is approximately $890m^2$ in area, and encompassed 15 test pits on three different transects. The site boundary was drawn as the river bank and as the edge of positive test pits, which were excavated at 20 m intervals, but test pits at closer intervals may change this boundary. In addition, the site may extend farther to the south, outside the survey area.

Nine of the 15 pits within the site boundary were positive for cultural material (Figure 7.6), containing lithic debitage, sand-tempered ceramics (including one Deptford check-stamped sherd), potentially datable organics, bone fragments, and a feature. In addition, portions of this site had been previously excavated by looters to an approximate depth of 30 cmbs. This looter activity occurred in approximately eight larger areas (varying from 1-4 m in diameter) and numerous small pits (approximately 5-10 cm in diameter). The looters' activity was largely concentrated on the southern edge of the site, near transect B. This disturbance was not precisely mapped, but Figure 7.6 shows a sketch map of the site area with rough outlines of looter activities and the distribution of cultural deposits.

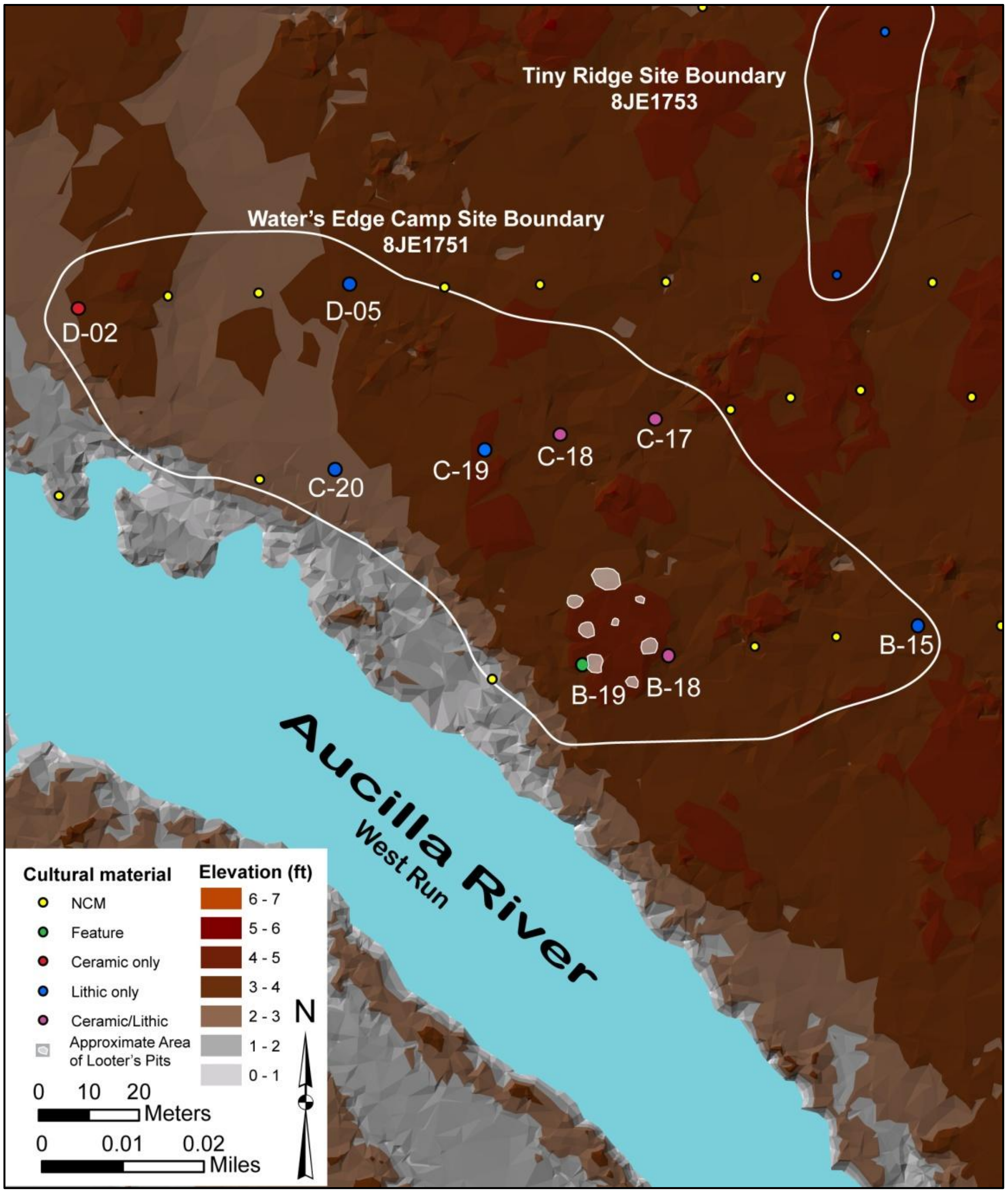



**Figure 7.6. Sketch map of the Water's Edge Camp (8JE1751).**

A feature was located in the west wall of test pit B-19, which was placed immediately west of a large looter's disturbance. This disturbance had many flakes located on the backdirt pile. The feature was first encountered at 30 cmbs, and it continued until bedrock was reached at the bottom of the test pit (73 cmbs). Because of the feature, this test pit was excavated in 10cm levels, and the feature materials were screened separately from the matrix to help determine depth and type of cultural materials. The matrix above the feature and the fill within the feature both contained very black sediment, ceramics, lithics, and charcoal. Several pieces of charcoal for radiocarbon dating and two small (4x6-inch) bags of sediment were retained from the feature. Figure 7.7 shows a photograph of this feature at 60 cmbs, with bedrock appearing in the bottom of the pit and confining the feature. A large piece of charcoal from within the feature (Level 4, 30-40 cmbs) was dated (SR-8065; UCIAMS 97619), but unfortunately returned a modern age, probably due to contamination from water movement within the sediment column. Because Deptford ceramics and lithics were found within the feature, the actual age is probably between 2500-1800 cal B.P. (Milanich 1994).

**Figure 7.7. Feature located in test pit B-19.**

Two-hundred-and-forty-nine pieces of lithic material weighing a total of approximately 760 g were recovered from the excavations at Water's Edge Camp. These consisted of 85 flake fragments, 107 normal flakes, 23 biface thinning flakes, 6 pieces of shatter, 3 flake tools or fragments, 2 biface fragments, 1 bifacial adze and 3 pieces of possible groundstone. Details of the tools are presented in Tables 7.1 and 7.2. Twenty-five lithics were size class one, less than 1 cm in diameter; these were not analyzed further. Most of the debitage (78%, n=195) was size class 2, with only 22 pieces from size class 3 and 7 from size class 4. When materials from the surface collection were excluded, this size sorting is even more dramatic. Of the 220 lithic artifacts from excavation units, 190 are size class 2, 17 are size class 3 and 4 are size class 4. All three of the bifacial tools were recovered from surface contexts at the site. Twelve flakes, or 5% of the entire assemblage larger than size class 1, are entirely cortical, while 32, or 14%, contain some cortex. Fifty-seven flakes, or 25%, have been reddened or blackened by heat, while an additional 21, or 9%, have been potlidded or heat-crazed. All of these materials indicate that this site probably was at least a short-term campsite, where tool reduction and refurbishing occurred. Because at least some ceramics are present at the site, it may have also been a longer-term residence. Most of the flakes are quite small, so perhaps relatively little primary reduction occurred, but a significant percent of cortical flakes indicates that some was taking place.

Ceramics recovered from the site consisted of 19 plain grit or sand tempered body sherds, two plain grit or sand tempered rim sherds, five Deptford check-stamped body sherds, and one punctate rim sherd totaling 184.3 g. This small amount of pottery does little to inform upon activities at the site, but more than two vessels are represented and Deptford ceramics are generally considered to date between 2500-1800 cal B.P. (Milanich 1994). Deptford represents the first Woodland culture recognized in Florida, marked with sand-tempered ceramics and reliance upon coastal resources.

**Figure 7.8. Looter's pit near pit B-18.**

Further mapping of the disturbed area and site boundaries (including testing with a closer interval) is recommended if any management practices will disturb the site area further. This site is considered potentially eligible for the NRHP under criterion D, based on the presence of intact subsurface features, which contain datable deposits. This site could contribute substantially to our knowledge of local prehistory; therefore, further evaluation to determine eligibility is recommended. Also, looter activities at this site are somewhat extensive, especially in the main artifact concentration (Figure 7.8 shows one of the larger looter's pits). If they continue unchecked, this site will be entirely destroyed, as all archaeological context will be lost. Therefore, site monitoring is recommended.

*The Sandy Knoll Site (8JE1752)*

8JE1752 is a lithic scatter located on the western bank of an ephemeral pond. Current ground cover is grass, scrubby pine, and oak. The site area is nearly flat and only approximately 440 $m^2$. Sediments at the site are the usual upland profile: a sandy A horizon topping a sandier eluviated horizon over a clay Bt horizon overlaying decomposing limestone bedrock. This site was heavily looted: nearly 80-90% of the apparent surface area was disturbed to an approximate depth of 30 cm below the surface. Site boundaries are inexact, but the amount of disturbance indicates that looting probably stopped where the looters stopped finding artifacts. Also, the pond to the west consists of marls overlaying shallow bedrock, while bedrock is readily visible on the surface to the north of the site. Given these three factors, the Sandy Knoll site probably is not much larger than the current defined boundary. Figure 7.9 shows a sketch map on the Ward Island LiDAR imagery.

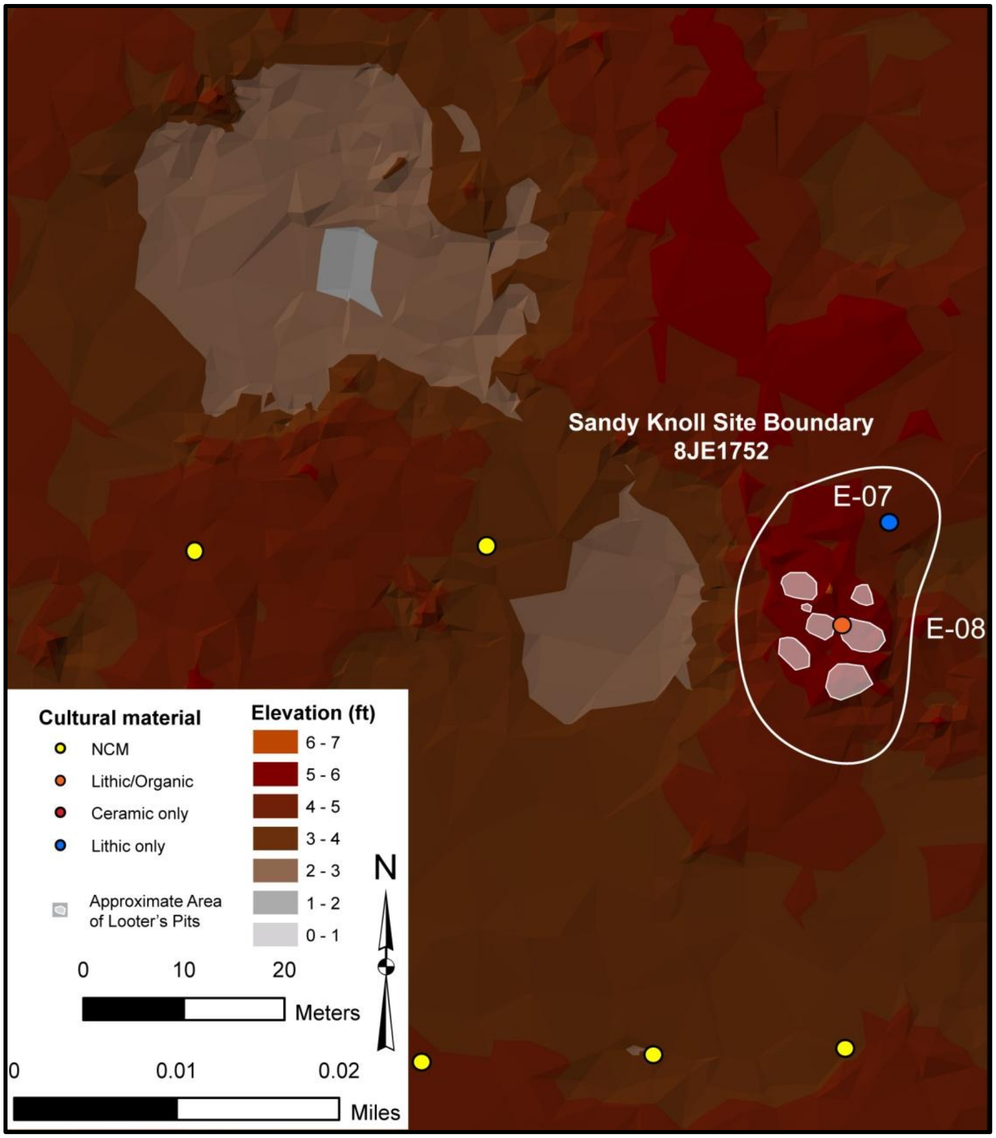



**Figure 7.9. Sketch map of the Sandy Knoll site (8JE1752).**

This site seems to represent a lithic reduction area. A large mid-stage chert biface was discovered on the ground surface near test pit E-07 (which was extremely shallow, with only 26 cm of sediment on top of bedrock) (Figure 7.10). Hundreds of flakes and cores lay in piles on the ground near the disturbed areas, but relatively few of these flakes were cortical, meaning that some initial reduction probably occurred elsewhere.

To help characterize site activities and possibly to help determine what was removed from the site, the materials from one of these entire piles (looter rejects) were collected. One test pit (E-08) was also placed between two major looter disturbances to see if any intact sediment remained under the disturbances. This showed that at least the top 30cm were redeposited spoil that contained hundreds of small and medium flakes. The bottom of this test pit seemed to have a few cm of relatively intact strata that contained more lithics and a piece of bone, indicating there may be fragmentary intact portions of the site under the looter’s spoil.

This site contained by far the most debitage and the most variety of artifacts recovered during terrestrial testing. The single test pit and one looter's reject pile contained a total of 647 lithics. This consisted of 180 flake fragments (32%), 278 normal flakes (49%), 33 biface-thinning flakes (6%), 50 pieces of shatter (9%), seven flake tool fragments (1%), nine biface fragments (2%), two pieces of groundstone (.4%), two core fragments (.4%), two side/end scrapers (.4%), and one each of the following: adze, blade, point tip, chopper, end scraper, and overshot flake (.2% each). Heat treating was relatively common in the assemblage: 179 artifacts (33%) were heated, while 60 (11%) were potlidded or crazed. Most artifacts contained no cortex (79%), but 24 flakes were completely cortical (4%), and 88 had some cortex (16%). Details of the bifacial tools and flake tools are available in Tables 7.1 and 7.2, respectively. Because of the density of cultural material in such a small tested area, I am tentatively calling this locality a lithic workshop. This assessment could be modified by future research. The bone from this site is potentially datable, but no diagnostic artifacts were recovered. The high percentage of heat-treating, however, precludes a Paleoindian occupation. While this site is heavily disturbed, it is still considered potentially eligible for inclusion on the National Register of Historic Places under criterion D until further testing can confirm the depth of looter disturbance and can help determine if there are any large areas of intact sediments. Further, occasional monitoring may be warranted in case looting activity continues.


**Figure 7.10. Biface found on surface near pit E-07.**

*The Tiny Ridge Site (8JE1753)*

This site is located near the center of Ward Island in a relatively open woodland setting. Mature pines and oaks dominate the overstory, with grasses covering the ground. While the site area is approximately 1177 m$^2$, this site consists of only two positive shovel test pits (D-10 and E-11). One of these pits, E-11, contained a single flake, while pit D-10 contained a relatively thick cultural stratum consisting of debitage and less than one gram of organic materials. The LiDAR imagery of Ward Island shows that this site is on a slightly-elevated but dissected landform on the western edge of a lower area, which was observed in the field to be an ephemeral wetland (Figure 7.11). This site is relatively near the Water's Edge Camp (8JE1751), so further testing at either site may eventually connect the site boundaries, but at this time, they are considered separate due to the spatial separation. Unlike most of the other sites on the island, no looting was observed at the Tiny Ridge Site, so this site is judged to be relatively intact, although the small amount of research at this location limits any interpretations.

Tiny Ridge could represent the remains of almost any prehistoric activity. The small amount of organic remains perhaps came from a dispersed feature not observable in the test pit. All of the debitage was non-diagnostic, although at least one flake was heat-treated, so the site is probably not Paleoindian in age. The site contained a total of 31 flakes, five of which (16%) were size one, 23 (74%) were size 2, and three (10%) were size 3. Cortical spalls made up 19% of the assemblage, with four (15%) bearing some cortex and one (4%) being fully cortical. The assemblage consisted of 17 flake fragments (59%), 10 flakes (34%), and two pieces of shatter (7%). Unlike most sites on Ward Island, several of these flakes (8) were found within the Bt horizon of the test pit, and not within the sandy A and E horizons. Unfortunately, sand from the upper horizons also liberally coated the ped faces within the Bt horizon. Until the site is further explored, little more can be said. The Tiny Ridge site is considered to be potentially eligible for the NRHP under criterion D pending further testing due to the presence of datable organics in a single test pit and based on the relative depth of the deposits. This site is not currently threatened, although the potential for looting seems endemic on Ward Island.

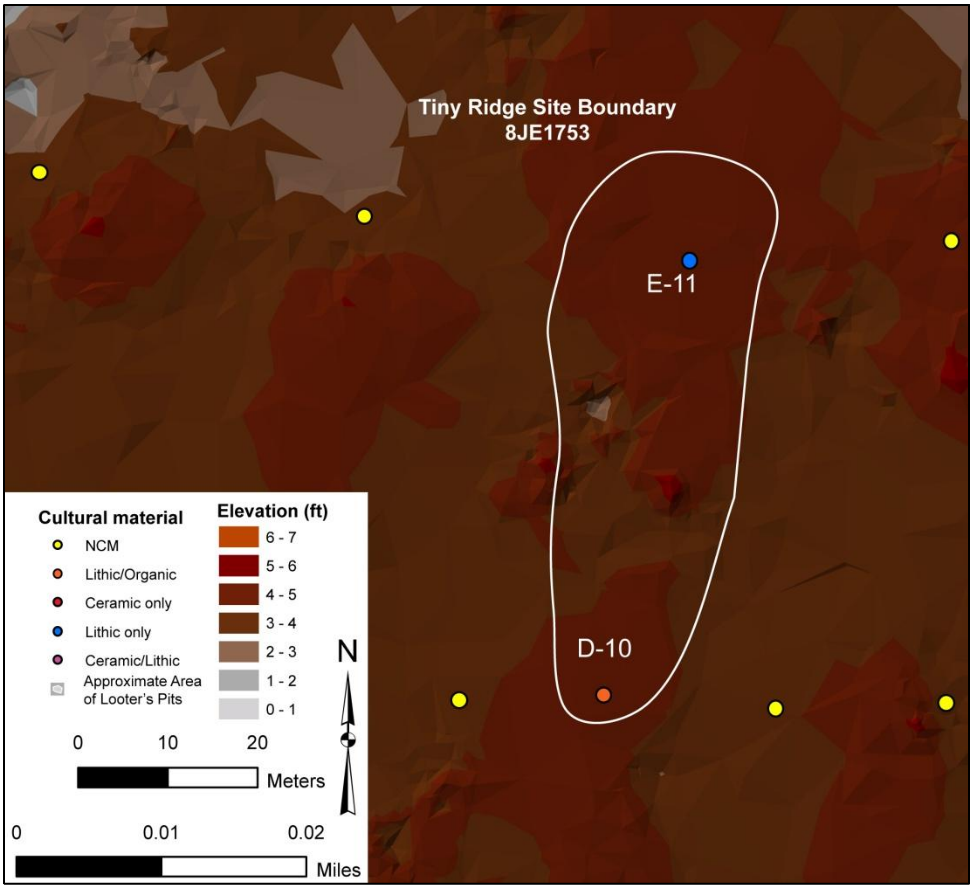



**Figure 7.11. Sketch map of the Tiny Ridge site (8JE1753).**

*The Downed Tree Site (8JE1754)*

The Downed Tree site is also located near the center of Ward Island on slightly higher ground (Figure 7.12). This site consists of three culturally-positive test pits in a row on transect C (C-10, C-11, and C-12), but no cultural material was recovered from either transect to the north or south. Therefore, the site area is estimated to be 993 m$^2$, but, as with all sites discovered during this survey, boundaries were not extensively delineated. This site is located in a relatively open area with mature oaks, pines, and grasses. It has been extensively pothunted on its eastern (and densest) side, as can be seen in Figure 7.12. As with the other two looted sites, disturbance seems to be limited to the A horizon only (approximately 20-30cmbs), but this depth is also where almost all of the artifacts have been seen and recovered. A large tree is down next to pit C-10, and seems to have constrained the looting activity slightly, as none was observed to the north of it.

The Downed Tree site seems to have been more ephemeral than either the Sandy Knoll site or Water's Edge Camp, as the looter spoil only contained a dozen or so artifacts and did not have any larger materials. Therefore, no surface collection was made at this site. The debitage in the test pits also was not very numerous and was all within the upper A and E horizons. No ceramics were recovered, but the high percentage of heat-treating indicates a post-Paleoindian age. Forty-four total flakes were recovered from the three positive test pits: eight size 1 (18%); 32 size 2 (73%); three size 3 (7%); and one size 4 (2%). Cortex was present on 28% of the flakes (11% primary, 17% secondary). Heat-treating was more prevalent here than at the other sites: 50% (18) was reddened or blackened by heat, while 3% (n=1) was potlidded or crazed. Twenty-two flakes or 61% were fragments, 10 (28%) were normal flakes, two (7%) were biface thinning flakes, and there was one core fragment and one piece of shatter (3% each).

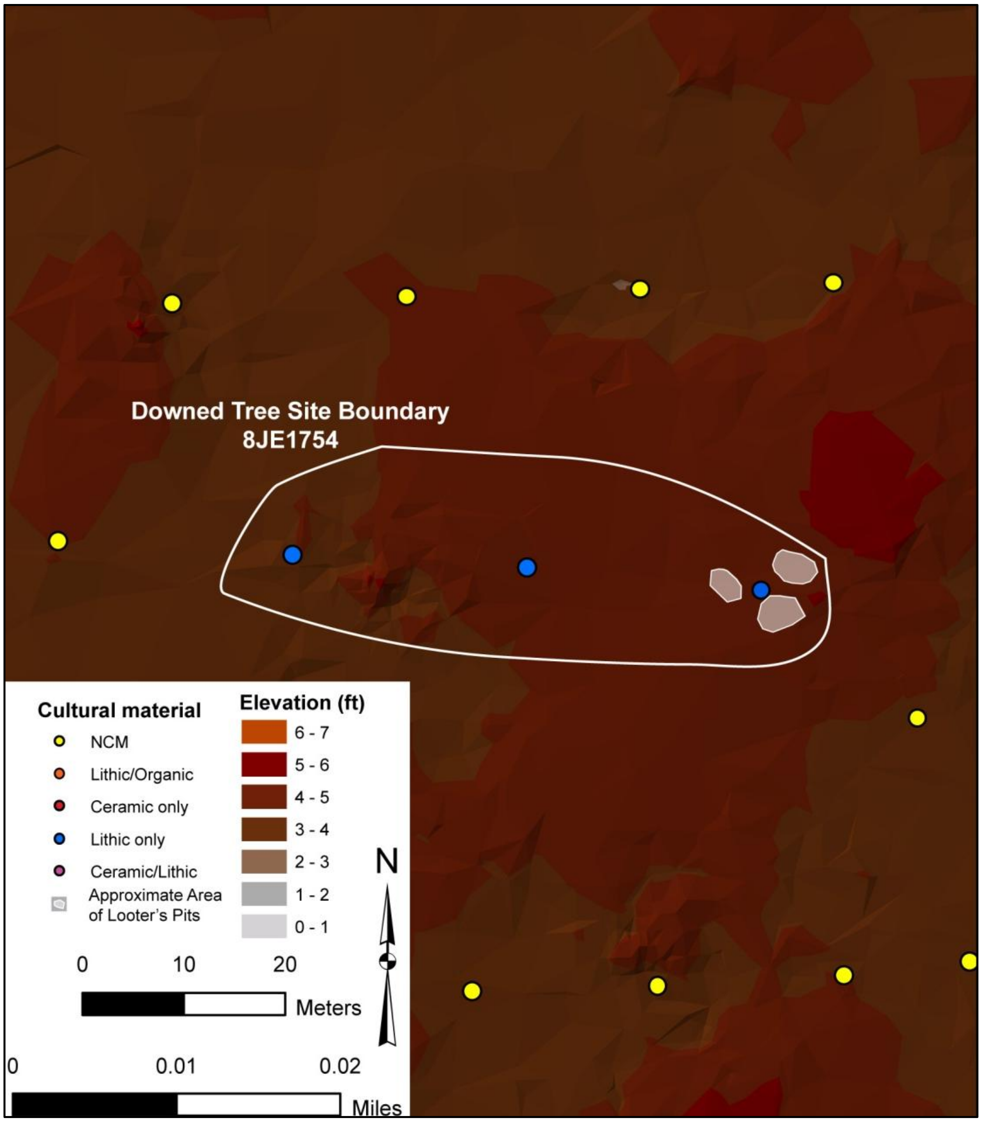



**Figure 7.12. Sketch map of the Downed Tree site (8JE1754).**

Because all stages and sizes of lithic material are present, this site is tentatively considered to be a locality where some tool manufacture occurred, from secondary core reduction to final product. This site has only been poorly defined and is considered potentially eligible for the NRHP under criterion D pending further testing. While looted, it definitely contains subsurface deposits, so potentially could contain features or other important information. All observed looter's activity at this site was at least more than a year old, so this site is probably not threatened by further looter activity, but occasional monitoring is recommended.

*The K-1 Mound Site (8TA483)*

The K-1 Mound site is located on a slight rise at the end of a tidal inlet approximately 100 m east of the current channel of the Aucilla River. The site is currently covered by oak, mature pine, palmetto, and palm, with grass covering most open areas. Exposed bedrock is very common in the site area, and bedrock is relatively shallow. This site is approximately 1380 $m^2$ in area, and encompassed three test pits on a single transect. Site boundaries were drawn as the edge of positive test pits, which were excavated at 20 m intervals, but test pits at closer intervals may change this boundary. In addition, the site may extend farther to the north, south, or east, outside this survey area.

The three test pits (Figure 7.5), contained lithic debitage, sand-tempered ceramics, potentially-datable organics, bone fragments, and a feature (a mound). Portions of this site had been previously excavated by looters to an approximate depth of 30 cm below surface. This looter activity occurred in approximately eight larger areas (varying from 1-4 m in diameter) and numerous small pits (approximately 5-10 cm in diameter). The looters’ activity was largely concentrated on the mound area, which is the eastern margin of the site, near pit K-1. This disturbance was not precisely mapped, but Figure 7.13 shows an overview map of the site area with rough outlines of looter activities and the distribution of cultural deposits, while Figure 7.14 shows a close-up of the site area.

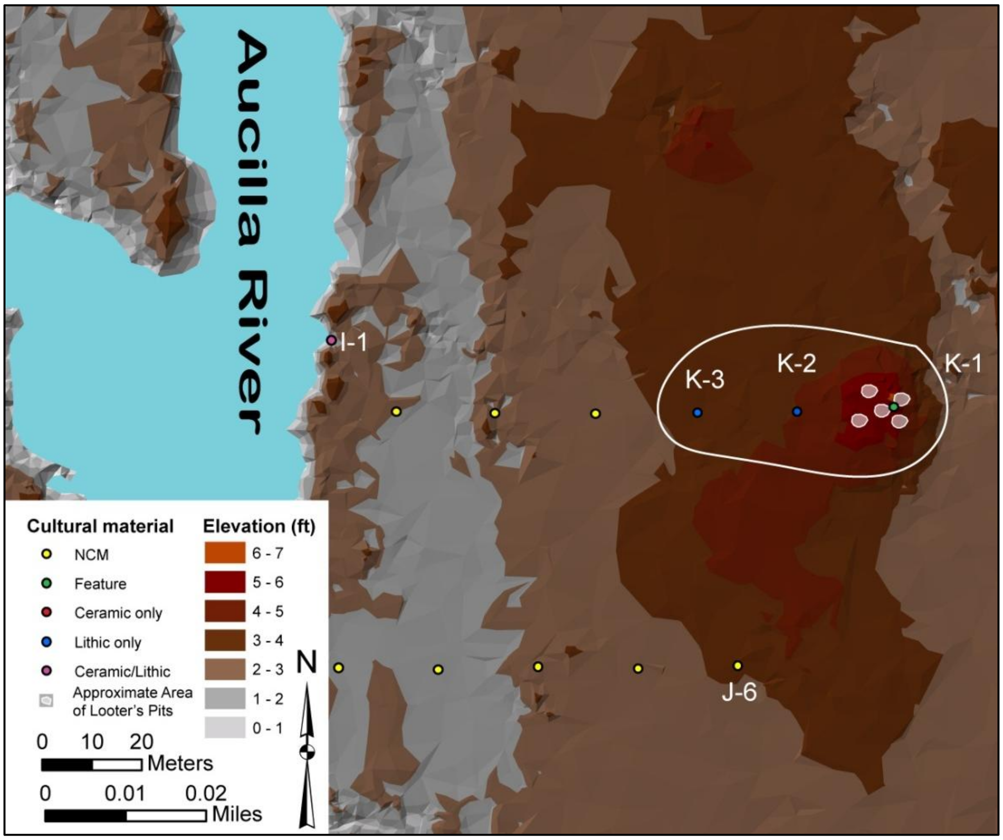



**Figure 7.13. Overview map of the K-1 Mound site (8TA483).**

The mound is quite small (approximately 15 m in diameter and approximately 50cm high). The surface was littered with cultural material exposed by the looters. There were approximately seven piles of debitage, mostly cores and rough bifaces, probably rejected by the looters, with a light scatter of debitage over the entire mound area. Also noted were at least 50 cores, core fragments, and early-stage bifaces on the site surface. To get some representation of the activities and range of materials used at the site, one of the reject piles was completely collected in the field (Figure 7.15). There were also numerous ceramic sherds scattered over the mound, but the density was much lower (only approximately 30-40 were observed on the surface). All observed sherds appeared to be either nondiagnostic or Deptford in age, indicating an age of between 2500-1800 cal B.P. for the site (Milanich 1994).

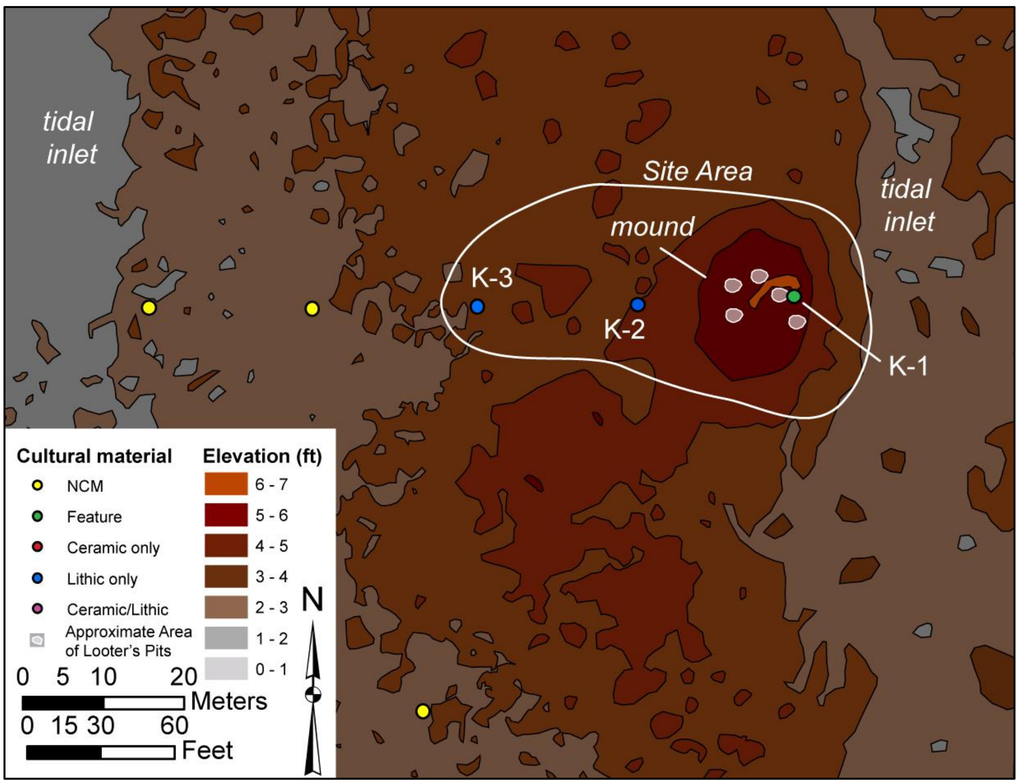



**Figure 7.14. Sketch map of the K-1 Mound site (8TA483).**

A total of 318 lithic artifacts were recovered: 65 (20%) were size 1, 203 (64%) were size 2, 32 (105) were size 3, and 18 (6%) were size 4. Eighty of these lithic items were cortical; 40 were partially cortical, and 40 were completely cortical (16% each). More than half of the artifacts showed evidence of heat-modification. Forty-four items

(18%) were potlidded or heat-crazed, while 106 (44%) showed color change. Nearly all of the lithics seemed to be part of the reduction sequence with very few formal tools: one flake tool, one nondiagnostic point fragment, and one late-stage biface are the only tools collected (0.4% each) (Tables 7.1 and 7.2). The rest of the assemblage consisted of 129 fragments (51%), 86 flakes (34%), 12 biface-thinning flakes (5%), 14 pieces of shatter (6%), four other biface fragments (1.6%), and six core fragments (2%). In addition, approximately 120 g of ceramics were recovered. These consisted of 73 plain grit- or sand-tempered sherds, seven Deptford check-stamped sherds, and one Deptford simple-stamped sherd from pit K-1, and one Deptford check-stamped sherd from the surface near K-1.

**Figure 7.15. One of the biface/core piles *in situ* on the K-1 Mound site.**

Pit K-1 was placed on the eastern margin of the mound immediately adjacent to a looters' pit to explore the nature and depth of deposits and also to try to preliminarily assess the damage caused by looters. Mound fill consisted of approximately 50 cm of black (10YR2/1) midden sediment containing dense lithic debris, bone, ceramics and charcoal over approximately 10 cm of a disturbed B horizon that contained few artifacts, followed by a Bt/R horizon filled with dense clay and decomposing limestone, with limestone bedrock reached at 73 cm below surface (Figure 7.16). Several pieces of charcoal for radiocarbon dating were retained from the midden fill.

**Figure 7.16. Profile of K-1 test pit showing mound fill in top portion.**

The two other test pits in the K transect (K-2 and K-3) were both positive for cultural material as well, but neither contained any mound fill, and both had very shallow sediment on top of bedrock (27 cm below surface in K-2, and 25 cm below surface in K-3). Site density may be lower off the mound; K-2 contained less than 10 pieces of debitage, while K-3 contained only one flake.

**Figure 7.17. Looter's pit near pit K-1. Beer bottle in center provides scale.**

A single transect through the mound site did not delineate the site boundaries or completely characterize site activities, but some preliminary interpretations can still be made. People (probably Deptford people, between 2500 and 1800 cal B.P.) considered the area important enough to build a small mound or to live in the location long enough to create a midden that resembles a small mound. The numerous cores and early stage bifaces on the surface indicate that quite a bit of early stage tool manufacture occurred here, while the density of smaller flakes in the mound fill indicate that tools were also refurbished or finished. No shell was observed in these test pits or the looters' exposures, but a few fragments of terrestrial mammal bone were recovered from pit K-1, indicating a terrestrial focus to subsistence activities. Because this is a mound (or moundlike midden), it is also possible that people were buried here, though the project failed to produce any direct evidence for this. Deptford people were known to bury people in specially-constructed mounds as well as within midden deposits (Milanich 1994), so the data collected so far cannot eliminate the possibility of human burial at this site.

Figure 7.17 is a photo of one of the larger looters' pits. These pits look as though they have been abandoned for several years. Further mapping of the disturbed area and site boundaries (including testing with a closer interval) is recommended if management practices potentially will disturb the site area further. The K-1 Mound is considered potentially eligible for the National Register of Historic Places under criterion D, based on the presence of intact subsurface features, which contain datable deposits. This site could contribute substantially to our knowledge of local prehistory; therefore, further evaluation to determine eligibility is recommended. Also, this site is a mound, so it could potentially contain human remains, even though it is very small and very shallow, so the site should be protected or further evaluated on these grounds. Looter activities at this site were somewhat extensive, especially in the main artifact concentration. If these illicit activities begin again, the site will be entirely destroyed, and any human remains would be disturbed. Although the looters' pits looked to be old and no longer active, occasional site monitoring is recommended.

## Discussion

This chapter has presented the site-specific results of investigations of the terrestrial areas surrounding Wayne's Sink and Sloth Hole. This included five newly-recorded sites and the recovery of recovered nearly 1300 lithic artifacts and 100 ceramic sherds, allowing a tentative discussion of some general trends in human behavior in this area. Further, only 20 of the 130 excavated pits contained cultural material, but these pits could be assigned to five distinct sites, meaning there is definite spatial patterning to the cultural materials. This geographical and archaeological information allow for some geoarchaeological generalizations about the area.

*Spatial Interpretations*

As previously mentioned, the terrestrial survey discovered two main sediment profiles in the test pits-upland and wetland profiles, with stream margin sediments being a third type of profile with elements of both. Wetland profiles are most common on the eastern side of the project area around a series of and tidal inlets (Figure 7.18). It is probably not coincidental that cultural material was recovered from the upland pits exclusively; no artifacts were found in any pits with wetland profiles, although site areas often were very near wetlands. This pattern could be indicative of two things: that site areas were originally much greater, but the erosion and infill of the wetland areas destroyed parts of the sites, or that these landforms have actually been relatively stable throughout the Holocene and that people avoided the more swampy areas. Of course, possibly both are true, and these two scenarios are difficult to distinguish. On the other hand, from a predictive standpoint, it is relatively easy to see where cultural material is most likely to be found in this area simply by examining LiDAR maps. When planning the testing strategy and excavating in the field, I did not have this imagery, so transects were planned on arbitrary locations and arbitrary bearings. The correlation between tidal inlets and pits with wetland profiles is almost exact, confirming the utility of these maps for planning purposes in the future.

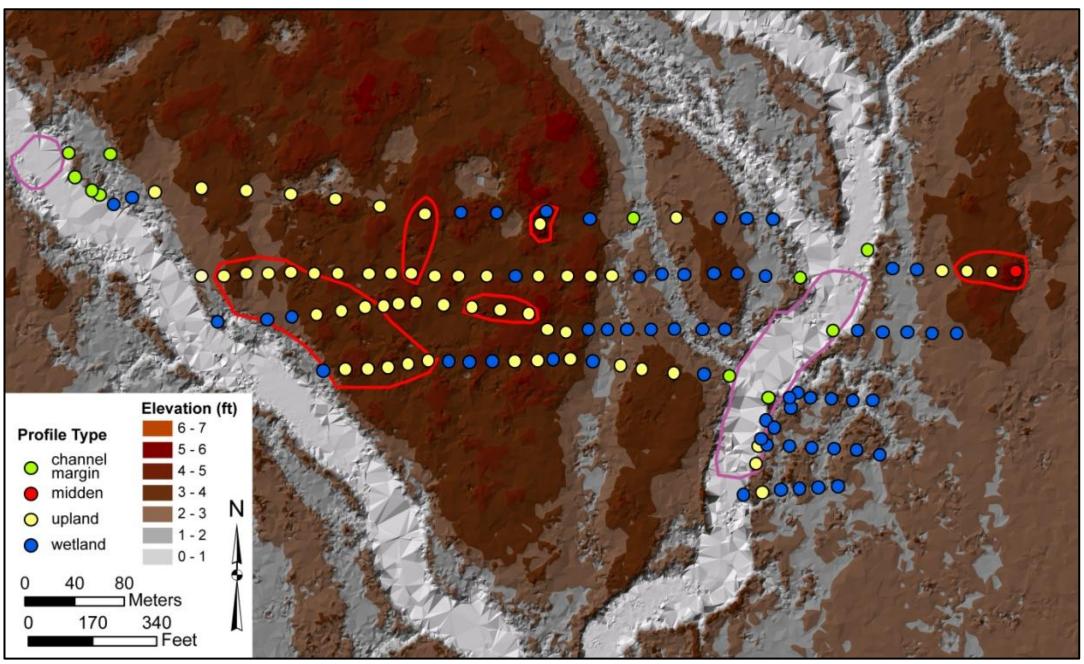



**Figure 7.18. Sediment profile types of each test pit on LiDAR map. Terrestrial site boundaries are marked in red; Sloth Hole and Wayne's Sink are outlined in purple.**

Perhaps even more interesting is that slightly less than half of the 130 test pits had upland profiles (56) and half had wetland profiles (74). Twenty pits, or 36% of the upland pits, were positive for cultural material, meaning that approximately one of every three upland pits contained artifacts. This very high density of material culture may be indicative of relatively heavy prehistoric occupation of the area, or perhaps is most indicative of how limited dry, relatively well-drained land is in this area. However, when planning future surveys, it seems as though it would be quite justified to minimally test tidal inlets and focus efforts on relatively high spots, as they seem most likely to contain material culture. This project has confirmed that wetland areas have almost no potential for containing cultural remains, while areas with sandy A horizons are extremely likely to contain artifacts. Future research that focuses upon these upland areas is most likely to be fruitful for finding cultural activity.

The horizontal clustering of artifacts is also informative. For this analysis, I excluded all artifacts from surface contexts, as their original depths are unknown. I also excluded artifacts from the two test pits that contained definite features (B-19 at Water's Edge Camp and K-1 at K-1 Mound) because in both cases the extent of material culture equaled the extent of feature fill and the top 30 cm of artifacts from test pit E-8 (Sandy Knoll), because the top 30cm of this pit were obviously disturbed, with looter's spoil piled on the top of the pit. The area between 28-35 cm below surface of this test pit looked like a disturbed A horizon; thus for the purposes of this analysis, elevations of artifacts from 30 cm below surface and deeper were corrected to reflect this (i.e., 30 cm was subtracted from depth values to arrive at an approximate depth below the original surface).

When surface artifacts were excluded, artifact counts were significantly lower (only 381 lithic artifacts out of 1300), but more accurate depth information remains.

Three-fourths of artifacts (287; 75%) were found in the upper 30 cm of the sediment profile, with 82% found in the upper 40 cm. This strongly indicates that most sites in this area are very shallow; given that bedrock is also usually less than a meter deep, this statement is not as meaningful as it might seem. Most cultural materials were recovered A horizons, with some coming from the mixed strata at the top of the B and bottom of the A or E horizons. A few flakes were also recovered in the screen with B horizon sediments, but in every case, these artifacts came from pits in which sand from the horizons above coated the B horizon ped faces, indicating downward movement of particles. None of the flakes was clearly recovered from a B horizon.

*Intersite Comparisons*

All five terrestrial sites are similar in more than location and setting. While the sample from each site is fairly limited, there are some consistent trends. Only two sites contained ceramics; K-1 mound and Water's Edge Camp. Ceramics at both sites consisted of small grit-tempered sherds. A small percentage of these had surface treatments that marked them as diagnostic of the Deptford period, congruent with the Early Woodland period in the greater Southeast. While these two sites may be multi-component, there is no indication of such at the current time. It is probably not coincidental that both of these sites are the larger, more complex sites with features and preserved organics as well as ceramics and lithics. Because these two sites date to roughly the same period, comparing them can inform upon different strategies. Figure 7.19 shows a comparison of all lithic materials sorted by reduction classes between these sites while Figure 7.20 shows a similar comparison of lithic materials by assigned category. Both figures display percentages by relative frequencies rather than absolute frequencies to account for varied artifact counts between sites. No diagnostic lithic artifacts were recovered in any of the terrestrial sites, so the three aceramic sites, Sandy Knoll, Tiny Ridge, and Downed Tree, remain undated. All three of these sites have at least some heat-treated materials, however, so they probably at least date to the Holocene, as Florida Paleoindians did not commonly heat-treat their lithic raw materials (Carter and Dunbar 2006; Dunbar 2006a; Milanich 1994). These three sites also appear on Figures 7.19 and 7.20 to aid comparison between all terrestrial sites.

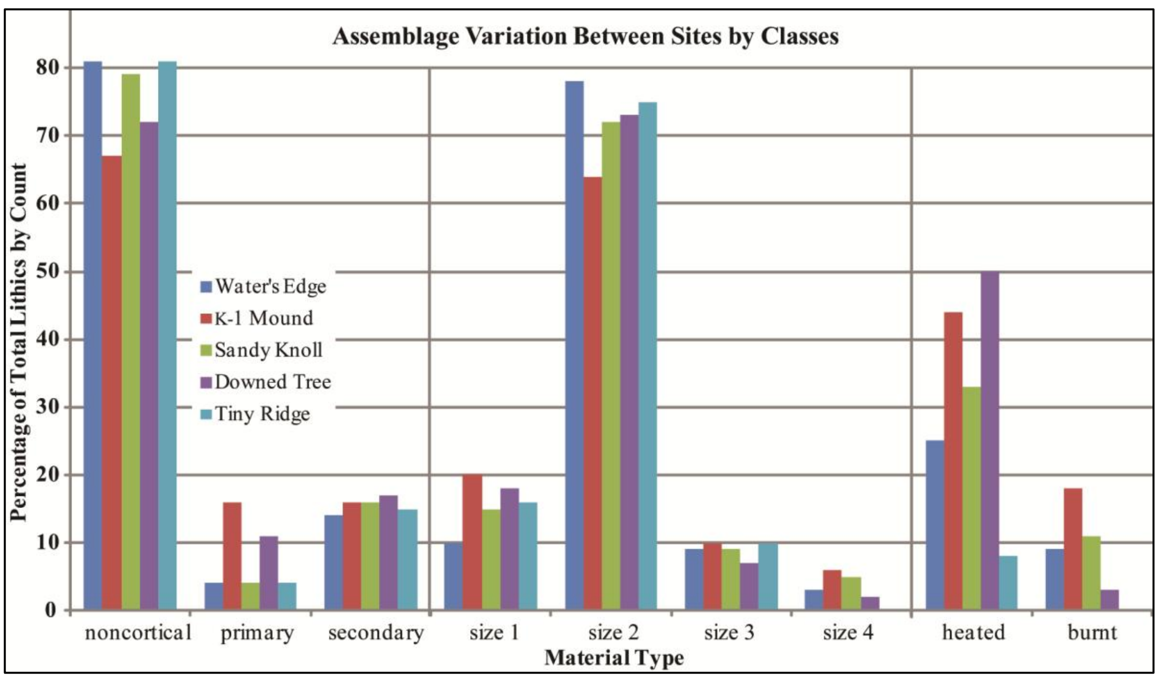



**Figure 7.19. Comparison of all terrestrial sites by reduction classes. Deptford sites: Water's Edge Camp and K-1 Mound; aceramic sites: Sandy Knoll, Downed Tree, and Tiny Ridge.**

Several patterns are immediately apparent. First, all five sites are fairly similar across these categories; for all sites, noncortical debitage, secondary debitage, and size class 2, represent roughly equal percentages of the assemblages, which are dominated by flake fragments and normal flakes. However, the K-1 mound site is a bit of an outlier when looking at these data. This site has a more equal distribution of reduction materials across all categories; it also has an anomalously high percentage of heated material, fully cortical material, flake fragments, and shatter. Because so many cores were observed on the surface of this site, I tentatively interpret this pattern to be the signature of the full range of flintknapping activity from initial to final core reduction. Therefore, I propose that the other sites display a signature of later stages of tool production: most initial reduction took place offsite, with final shaping and finishing occurring in these localities. This may be further supported because tool ratios are higher at both Sandy Knoll and Water's Edge Camp and because Water's Edge Camp has a relatively high percentage of biface thinning flakes.

The comparatively high percentage of tools at Sandy Knoll and Water's Edge Camp may also mean that people were performing more varied tasks at these two sites than the others. However, this seems less likely when considering that K-1 Mound is an entirely anthropogenic topographic feature containing copious charcoal, organically-blackened sediments, bone fragments, and ceramics. Thus, this high relative tool count may also be representative of sampling error and/or looters' activities at any or all three of the sites. The small amount of material recovered from both Downed Tree and Tiny Ridge make comparisons difficult, but they have fairly similar distributions except for percentage of heat treated materials, so they may represent the remains of similar activities. Of course sample size is an issue and potential biases arise from using surface collections to make interpretations of this kind, so further research may disprove these hypotheses.

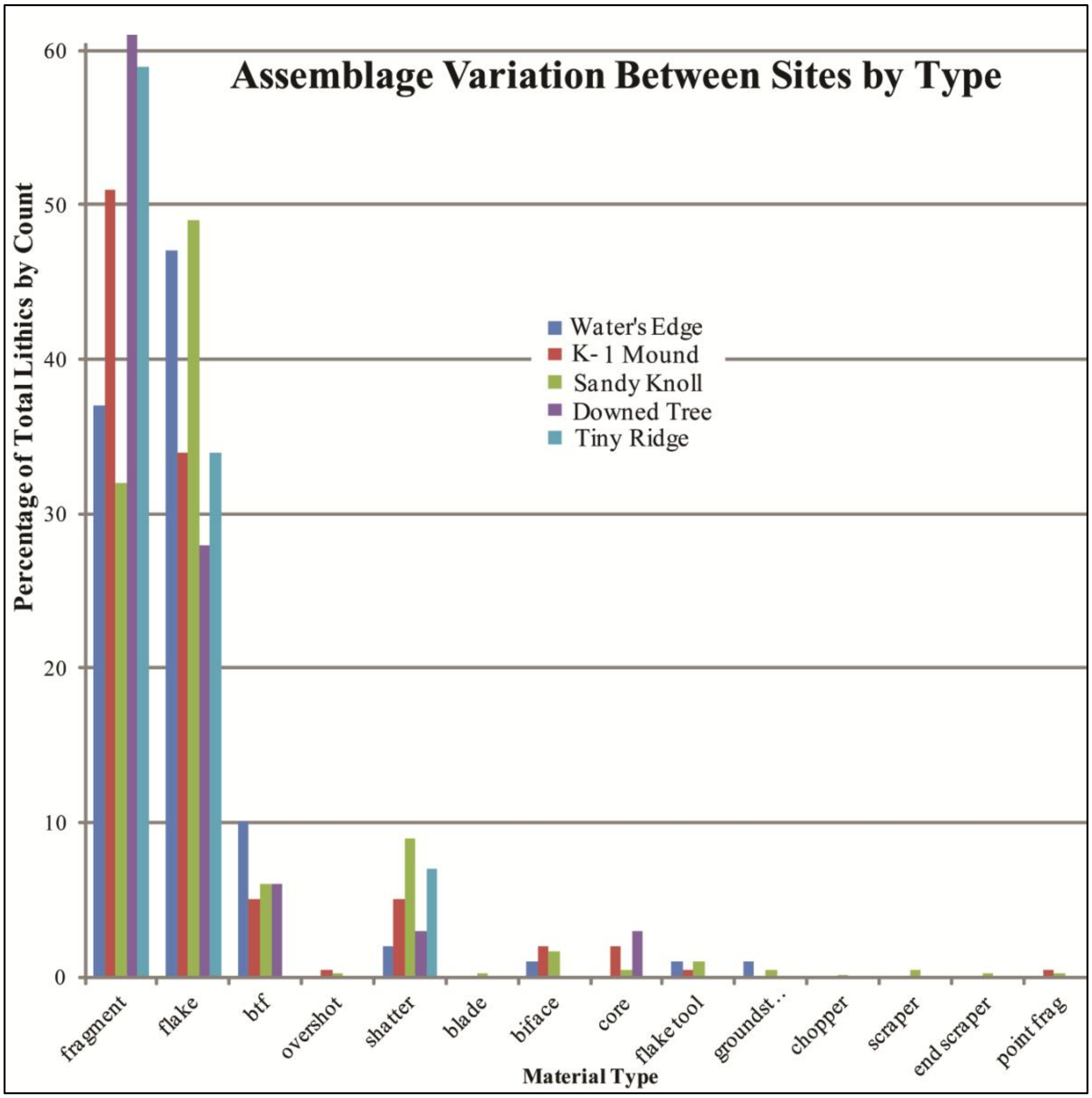



**Figure 7.20. Comparison of all terrestrial sites by classified lithic artifact type.**

## Summary and Conclusions: Implications for Paleoindian Studies

The terrestrial investigations in the lower Aucilla area have shown that archaeological materials are quite dense in this area even though sediments are poorly-drained and flooding is frequent and common. Site locations are predictable: they are entirely limited to the slightly higher ground where sandier, well-developed soil profiles occur. Deeply-buried sites are unlikely to be found anywhere except on current channel margins because bedrock depths are nearly always less than 1 m below surface. The extremely clayey Bt horizons with prismatic structure do not allow for good organic preservation, but no *in situ* artifacts were found in a Bt horizon. Therefore, the potential for stratified sites also seems to be quite low. Further, all sites discovered during the survey seem to postdate the Paleoindian period; in the case of the two Deptford sites, they postdate it by nearly 10,000 years. Thus, the potential for preserved terrestrial Paleoindian sites in this area and on this soil type seems low.

This brings up the next issue; namely, the source of the Paleoindian artifacts in the adjacent sinks. The terrestrial testing generates three hypothetical scenarios. First, the clay soils on land are very old and are intact. Paleoindian sites still remain undiscovered within them, but I did not happen to find any diagnostic Paleoindian remains during this project. Because these terrestrial sediments have not been disturbed, artifacts in the sinks were deposited within them by people who were also using the nearby land; thus, artifacts did not get into the sinks by erosion. Alternatively, it is irrelevant whether sediments on land are intact or not because Paleoindians were only focused on the sinks and did not leave any artifacts on land. Third, sometime after the Paleoindian period, all or most of the sediments on land were eroded away. This could have occurred in two ways. During a dry period with little vegetation, flooding could have removed much sediment; alternatively, if the mid-Holocene sea level spike (see Chapter III) (Balsillie and Donoghue 2004) did occur, this area would have been in the nearshore swash zone, so sediments would easily have eroded. This latter scenario would have destroyed terrestrial Paleoindian remains and very possibly could have relocated artifacts to within the sinks. In this latter case, artifacts within the sinks could represent both human and natural activity.

Because the terrestrial clays did not preserve datable organics within them, these three scenarios cannot be differentiated by the terrestrial record, although it seems very unlikely that people would not have used the land at all if they were using the sinks, so the second scenario is the least plausible. The sediment profiles indicate that terrestrial soils formed from weathering bedrock with possibly a minimal amount of deposition from fluvial processes. Because these soils are so shallow, it is difficult to determine if they began to form 5,000 or 15,000 years ago. These scenarios can only be addressed by examination of the underwater record with special attention to artifact context. This will be addressed in the following chapters.

# CHAPTER VIII

# SLOTH HOLE (8JE121) RESULTS

This chapter discusses the results of all fieldwork conducted at the Sloth Hole site, located in the West Run of the Aucilla River, the lowest outlet of the braided Wacissa River. This site was first excavated by members of the Aucilla River Prehistory Project (ARPP), who found several mastodon skeletons and numerous stone, bone, and ivory tools at the site. More ivory tools and tool fragments have been recovered from this site than any other in North America (Hemmings 2004). Sloth Hole also has one of the earliest directly-dated artifacts in North America, and portions of this site may contain the remains of an ivory tool manufacturing workshop. Five Clovis points were recovered from the site by recreational divers, and the site also contains an extensive Early Archaic Bolen component (Hemmings 1999b).

Unfortunately, much of the site information is not readily available to the scientific community. No final report was prepared and much of the analysis has not been published. Interim reports are available in newsletters of the ARPP (Hemmings 1999c), and tools from the site were discussed in an M.A. thesis (Hemmings 1999b), but this lack of synthesis and publication has made it difficult to analyze site context or understand what the artifacts may mean. My research was performed to provide geological and geoarchaeological context to these previous findings. To this end, I conducted a pilot study, underwater vibrocoring, underwater unit excavation, underwater surface collection, terrestrial excavation, and radiocarbon dating. I also examined the artifact collections from the previous excavations.

## Previous Research

Sloth Hole was first visited by scientists in the 1970s after a local collector reported the large number of extinct faunal bones and Paleoindian artifacts he had recovered from the site. According to notes archived with the Florida Museum of Natural history, S. David Webb and C. Vance Haynes removed two cores from an unknown location within the center of the sink that they called the "short core" and the "long core." They obtained three ages from the basal strata: 43,690 ± 3740 $^{14}$C B.P. (SMU-321) and 42,240 ± 2770 $^{14}$C B.P. (SMU-313) in the "long core" and 28,700 ± 1690 $^{14}$C B.P. (SMU-307) in the "short core." The loose material on top of the peat in the "short core" returned a modern date (SMU-249) and a loose peat on top of the 40,000 year old peats in the long core returned late Holocene ages of 2,780 ± 100 $^{14}$C B.P. (SMU-284-humates) and 1,920 ± 80 $^{14}$C B.P. (SMU-279-peat). Scientists returned to the site in 1994, when members of the Aucilla River Prehistory Project spent four days investigating the site under the direction of S. David Webb and C. Andrew Hemmings.

During the 1994 investigations, three concentrations of material culture, designated areas 1, 2, and 3, were roughly mapped (Hemmings 1999b). Area 1 was located on the limestone shoals on the southern end of the site (approximately the southern margin of the map in Figure 8.1); Area 2 was located in the center of the deepest part of the site (area of excavation units [EU] 0-5), and Area 3 was located on the northern shoals (approximate area of "Ivory Workshop" in Figure 8.1). These early investigations recovered a lanceolate point preform, numerous faunal bones of several extinct species, and several other lithic artifacts (Hemmings 1999b:6), but no official unit excavation occurred.

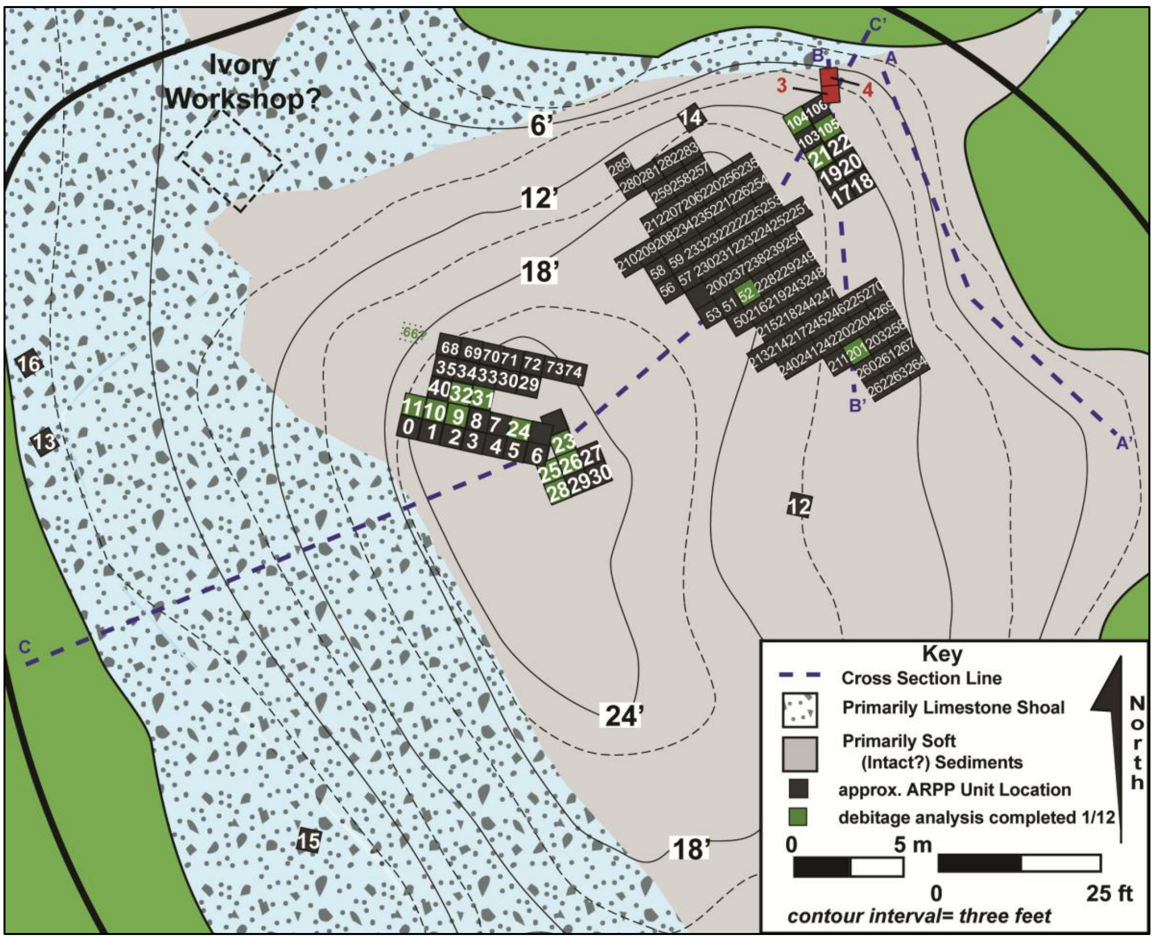



**Figure 8.1. Approximate location of units excavated at Sloth Hole during the ARPP based on ARPP notes. The location of unit 66 is unknown but hypothesized to be near excavation units 68-69. I analyzed debitage from the units marked in green. Cross section lines mark sections shown later in chapter.**

The ARPP returned to the site in 1995, choosing area 2 for formal excavation. Excavation unit (EU) 1 seemed to be disturbed, with several layers of unconsolidated sand and leaves (named levels 1-4) containing bone and artifacts lying in direct contact with a hard peat that dated in excess of 41,000 $^{14}$C B.P. (called level 5 in this area) (Hemmings 1999). This contrasted with most of the 12 other units excavated in this area, from which Hemmings (1999b:8) reported a sequence of peat (level 5) overlain by a mixed sand stratum (level 4) containing bones and artifacts overlain by mixed leaf and sand strata (levels 1-3). EU 6 appeared to have additional stratified deposits underneath the leaves and above the peats, and thus was considered to be relatively intact. Collections from this area contain large amounts of faunal bone from extinct species and many artifacts ranging from the Paleoindian to historic time periods. According to Hemmings (1999), Paleoindian/Early Archaic artifacts seemed to be concentrated in the layer designated as level 4 for this area, which is described as "banded silt/sand laminae" (Figure 8.2). Several EUs (12-16) were also placed on the margins of the site, all of which had shallow riverine deposits overlaying the limestone bedrock.

During ARPP fieldwork, strata were designated as levels (e.g., Level 1 = stratum 1) from top to bottom of excavation units during the ARPP fieldwork. In general, correlations were made for adjacent units, with most of an area designated with a consistent set of stratigraphic designations, but different areas had their own stratigraphic nomenclatures. This was almost certainly done because the dark water within the site made it incredibly difficult to see even the strata within a single unit; thus detailed local descriptions were needed to make later correlations. Unfortunately, I was unable to find many field notes explaining inter-unit correlations, so I recreated them in most cases based on my own experience with the site.

In 1996, several more units were placed in area 2 around EU 6, which had been found to contain more stratified deposits than the other area 1 excavation units. Radiocarbon samples were collected from EU 23, which contained artifacts in several strata, including the aforementioned stratum 4 (Figure 8.2). Stratum 4 in EU 23 also contained a juvenile mastodon fibula with cut-marks near a bifacial knife/preform and a large battered piece of chert. Stratum 4 was not dated; immediately above this in stratum 3c, however, a single grape seed was AMS dated to 4470 ± 60 $^{14}$C B.P. (Beta-93652). Hemmings (1999b:13) believed that stratum 4 dated to the terminal Pleistocene or earliest Holocene because extinct fauna were common in the assemblage and the only diagnostic artifacts recovered elsewhere from this stratum dated to the Paleoindian and Early Archaic periods.

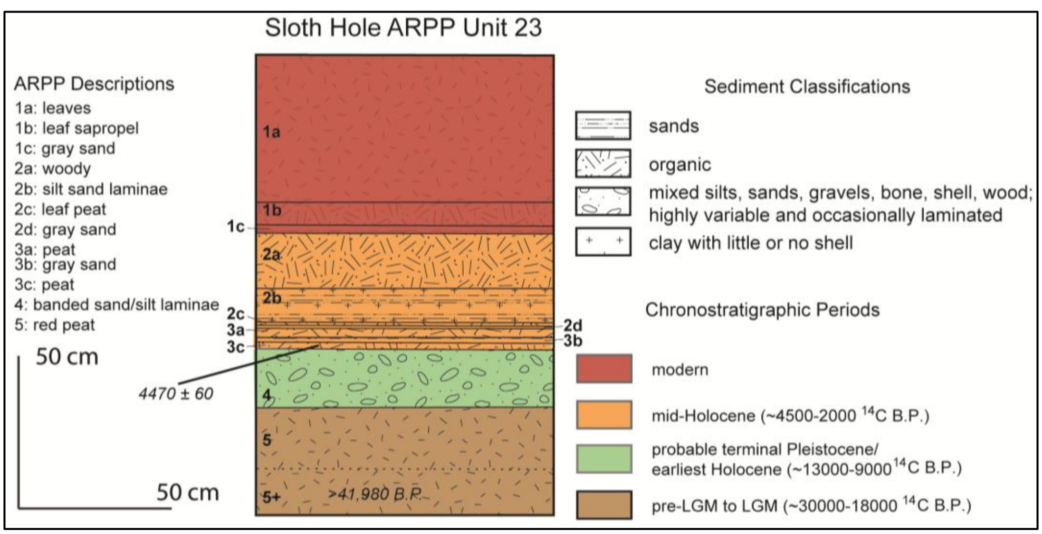



**Figure 8.2. Wall profile of ARPP EU 23 (modified from Hemmings 1999).**

Also in 1996, the excavation of six units also took place on the eastern side of the sink outside the bounds of areas 1, 2, and 3. This area was designated excavation block A (units 17-22). These six units yielded more than 200 pieces of debitage in the nearly two vertical meters excavated. A radiocarbon age of 12,300 ± 50 $^{14}$C B.P. (Beta-95341) (14,490-14,030 cal B.P.) was obtained in stratum 7 from EU 22 just below these flakes (Hemmings 1999b:16). Figure 8.3 shows the stratigraphy of EU 23 as designated in Hemmings's Figure 6 (Hemmings 1999b:14). However, there is some confusion on where the radiocarbon date was obtained, because stratigraphic unit 7 is the second stratum from the bottom, but the thesis text says that level 7 was the deepest reached in the excavation (Hemmings 1999b:16). There is no description in the text of the type of stratum the age came from. Therefore, either of the two deepest strata could potentially be the one from which the date was obtained. I followed the stratigraphic labels from the drawn profile rather than the text of the thesis, interpreting the provenience of the dated sample to be the second stratum up for two reasons. The base of EU 22 was described as a peat. In other dated excavation units and cores within the sink, a sandy/silty stratum overlaid the basal peat, which dates to greater than 30,000 $^{14}$C B.P. (see Figure 8.2). Further, archived radiocarbon submission sheets from the ARPP stated that the dated sample came from EU 22 "level 7 in *gray clays*" (my emphasis), not from peat.

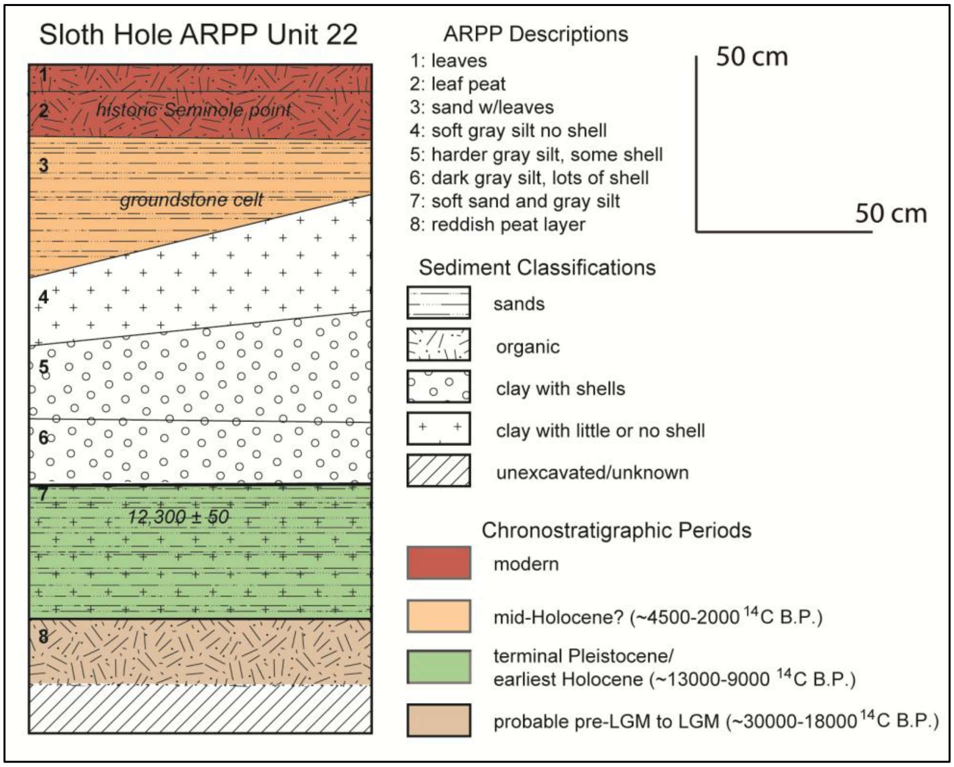



**Figure 8.3. North wall profile of ARPP EU 22 based on Hemmings (1999). See text above for discussion of radiocarbon age.**

No more excavation units were specifically discussed in Hemmings (1999), as his thesis focused on analysis of the Paleoindian and Early Archaic diagnostics recovered from the site during the early studies, but excavations at the site continued in 1997, 1998, and 1999. During those years, numerous units were excavated on the eastern margin of the site (Figure 8.1) and thousands of lithic, ceramic, and osseous artifacts were recovered, but no comprehensive report of these excavations is yet available. An area of many ivory fragments was found on the northern shoals (marked ivory workshop on Figure 8.1), and several more radiocarbon ages were obtained from sediments on the eastern side of the site.

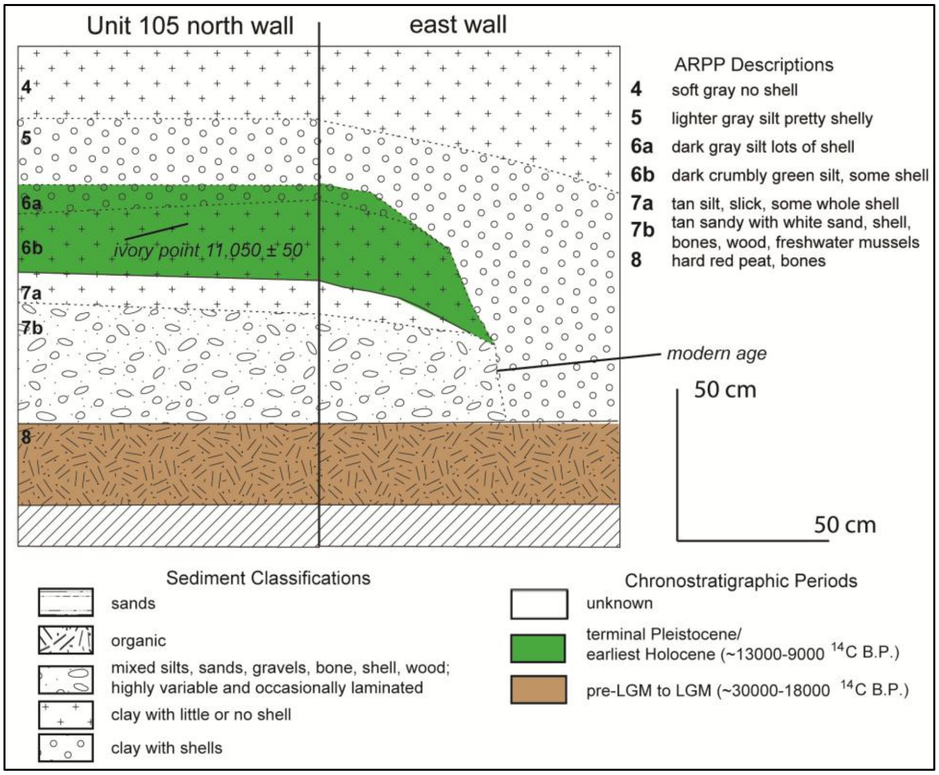



**Figure 8.4. Wall profile of ARPP EU 105 from ARPP notes.**

One of these units on the eastern side of the site, EU 105, contained an ivory point that was directly dated to the Clovis period (11,050 ± 50 $^{14}$C yr B.P. [SL-2850]) (13,100-12,860 cal B.P.). This is noted as coming from level 5 (Hemmings 2004:145), but the excavation notes clarify that it actually was discovered in stratum 6b, but was ascribed to stratum 5 based on sediment adhering to it. The profile of EU 105 in Figure 8.4 was recreated from ARPP notes. Flakes were found in this stratum below the ivory point and are thus potentially pre-Clovis in age (Dunbar 2002). However, a modern date was also obtained from below all of these materials on a log in level 7b of this same unit on the southern side of the unit where an area of slump had occurred. Therefore, this ivory point alone cannot reliably be used to date associated cultural remains, as some of the materials may be associated with this slump.

Field notes for the Sloth Hole excavations are available at the Florida Museum of Natural History, which I accessed in January 2012, using these notes to create the composite site sketch map in Figure 8.1. Some units for which profiles are available or from which artifacts were collected are not on this figure because location information about these units was not available in the ARPP notes. Figure 8.5 contains several sketches of profile drawings I could create or redraw from the archived notes; these are incorporated into the site cross sections presented later in the chapter. All ages on these profiles are as they were presented in the notes.

The 1999 edition of the *Aucilla River Times*, the newsletter for the ARPP, contained an important summary of the 1998 fieldwork at the site (Hemmings 1999c), and, in conjunction with ARPP notes, it roughly provides some further context for the Sloth Hole excavation. A large amount of Bolen-aged material, including several projectile points and Aucilla Adzes were recovered from the 1998 excavations. These seem to have been concentrated on the units numbered in the 200s, indicating that the eastern margin of the site was heavily utilized by an Early Archaic group. A large amount of surface collection was also performed during these years, recovering several more ivory point fragments.

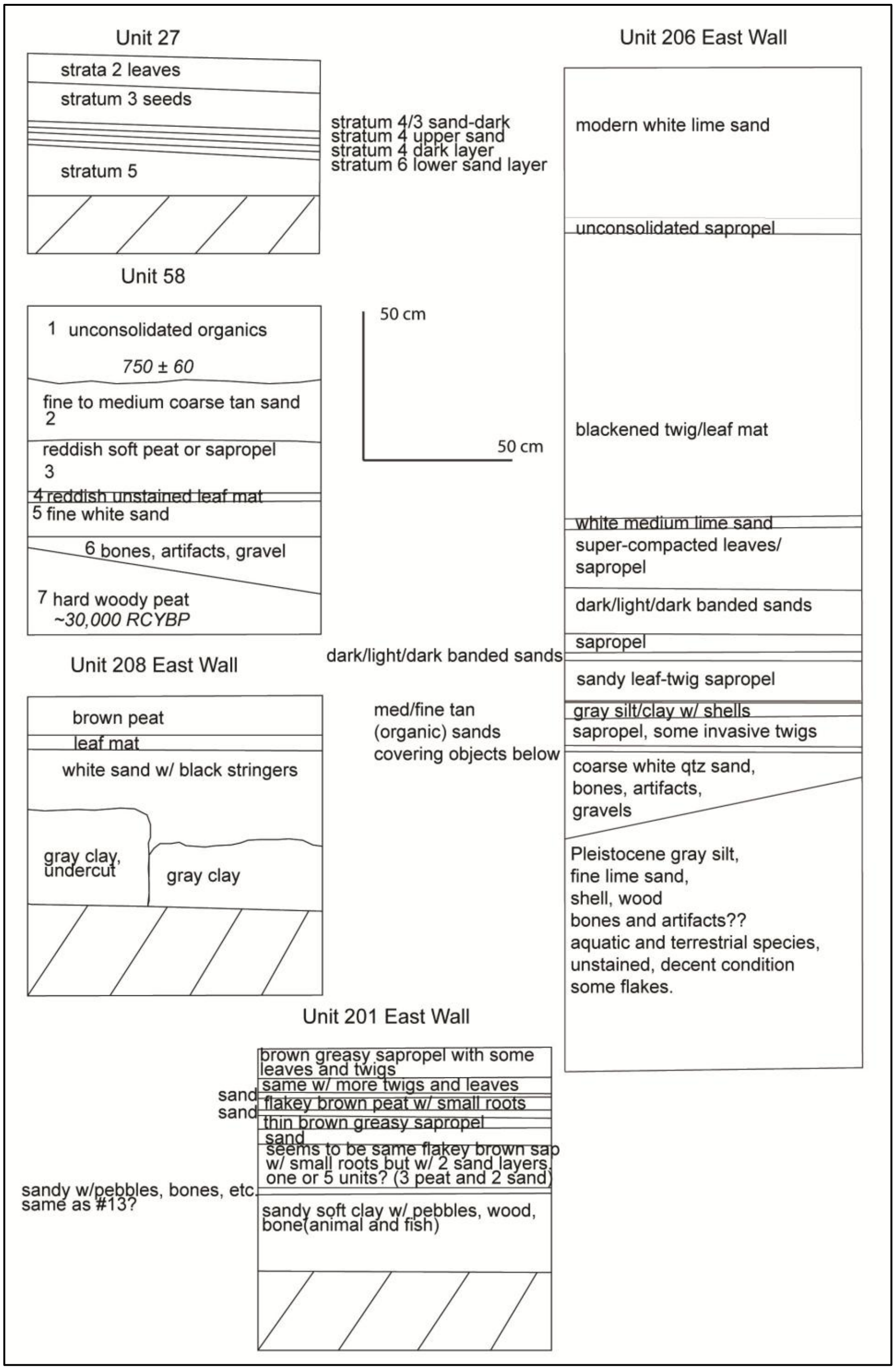



**Figure 8.5. Profile drawings for ARPP EUs with known locations from ARPP notes.**

The ARPP also obtained several radiocarbon ages on previously undated or poorly-dated strata. An *in situ* palm stump located adjacent to EU 53 (Figure 8.1) returned an age of 34,760 ± 1600 $^{14}$C B.P. (Beta-95342). EU 230, level 14, contained a mastodon tusk. Wood stuck to this tusk (60 vertical cm above the palm stump) returned a slightly younger age of 28,470 ± 170 $^{14}$C B.P. (Beta-119349). The alkali-extracted collagen from a mastodon calcaneus located in nearby EU 210 on the top of level 14 (which is described as being similar sediments) returned a much younger age of 12,180 ± 60 $^{14}$C B.P. (Beta-119350). These disparate ages probably represent some type of erosional unconformity, as descriptions of these sediments do not indicate soil formation and stability: "We were able to track the strata from 34,760 to 12,300 radiocarbon years ago. This period is contained in a homogeneous highly compacted layer of gray silt/clay, fine white sand, limestone pebbles, wood and animal bones nearly 160 cm thick" (Hemmings 1999c). This range of grain sizes provides strong evidence for occasional colluvial or alluvial pulses separating depositional episodes.

ARPP research at Sloth Hole yielded many important discoveries including the Clovis-aged ivory point, the potential ivory workshop area on the northern shoals, and potential pre-Clovis artifacts in excavation area A in the strata above the 14,490-14,030 cal B.P age and below the ivory point. The ARPP discovered a large amount of Paleoindian material in the center of the sinkhole and the remains of several mastodons, at least one of which may have been butchered. The investigators collected at least 15 radiocarbon ages from within their excavation units and defined a general geological framework for the site. Peat strata dating in excess of 30,000 cal B.P. were dated at the base of multiple units. Over these peats, they found variable strata of diverse thicknesses containing sands, bones, and artifacts; two dates from these cluster around 14,000 cal B.P. Above these layers are strata with mid-Holocene (5,000 cal B.P.) to modern ages. The ARPP did not recover artifacts from the basal peat strata, but artifacts and bones were reported with all other strata.

These data have been difficult to interpret because no detailed report of the excavations is yet available. Thus, the purpose of my reinvestigation of the site was threefold. First, I needed to refine the geological history of the sink, better defining the geological units and the depositional processes that caused them. Second, this geological history was necessary to provide a means for evaluating the context of the Paleoindian and potential pre-Clovis material at the site. Third, these evaluations would then allow for discussion of human activity.

To refine the geoarchaeological context for Sloth Hole, I conducted fieldwork exclusively on the eastern margin of the site to explore stratified sediments with terminal Pleistocene ages, rather than areas with no stratification or extremely old ages. Geological information was collected from eight cores, including three short PVC cores extracted during the pilot study and five longer vibrocores. This information was bolstered by several terrestrial test pits on the eastern shore of the site, and I excavated two underwater 1 x 1 m units to provide more precise stratigraphic data regarding artifact context. Figure 8.6 shows the location of all underwater fieldwork from this project. I also conducted debitage analysis of some of the lithic material from previous excavations following methods discussed in Chapter V to create a dataset comparable with the rest of my dissertation.

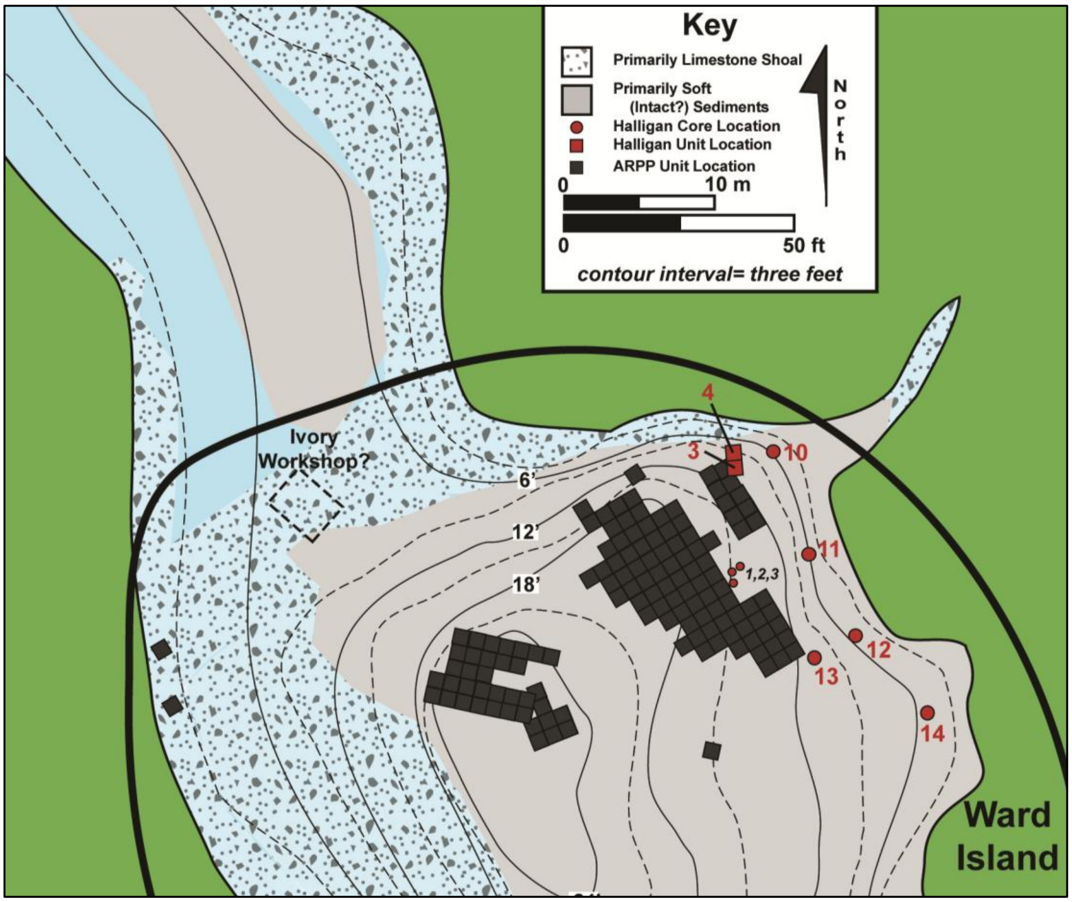



**Figure 8.6. Site map of Sloth Hole showing location of all fieldwork conducted during this dissertation. A larger version of this map appears in Chapter IV.**

## Defining the Geological Context

*Fieldwork Steps*

The first step in determining the geoarchaeological context at Sloth Hole was to define the geology. A total of eight cores were removed from Sloth Hole, and two 1 x 1 m units were excavated to record the sequence of sediments on the margins of the sink. The first three cores were short PVC cores collected during the pilot study from a shallow terrace on the eastern side of the site adjacent to excavation Area A (Figure 8.7). Each was placed approximately 1.5 m apart in an area where ARPP excavations had already removed the upper (probable Holocene) strata to sample the Clovis-aged sediments and potential pre-Clovis sediments that dated to 14,490-14,030 cal B.P. The data from these cores are presented in Appendix II and Figure 8.7. All of these cores were short (a maximum of 65 cm). No radiocarbon samples were extracted from these cores, but one half of each core has been refrigerated since collection and reserved for future analyses.

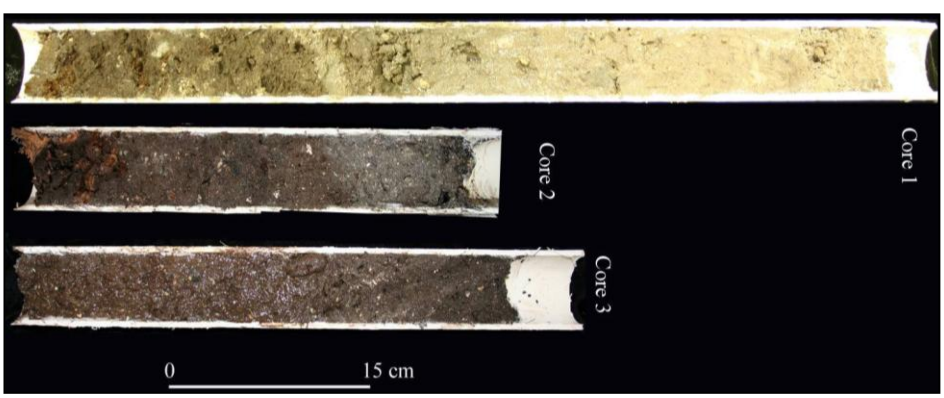



**Figure 8.7. Pilot study cores from Sloth Hole.**

The three short cores were helpful for acquainting me with sediments in the Aucilla, and for allowing me to gain insights into the range of processes within the river, but my analyses showed that they did not contain enough data to be truly informative. Thus, five longer cores (vibrocores 10-14) were removed with a vibrocorer from the eastern bank of the site nearer to the shoreline than any previous excavations (Figure 8.6). These cores ranged from 189-257 cm long, giving a much more inclusive view of sediments on the channel margin. Cores 10-14 all contained a similar sequence of sediments. The base of these cores was a sapropel that was overlain by one to four mixed sandy strata that were, in turn, overlain by a hard silty clay with soil structure. This clay was covered by shell-filled clay which was covered by an organic stratum. All vibrocore profiles are presented in Appendix III. No artifacts were recovered from any of these eight cores but some faunal remains (primarily fish bone and turtle shell) and extensive macrobotanical remains were discovered during core processing.

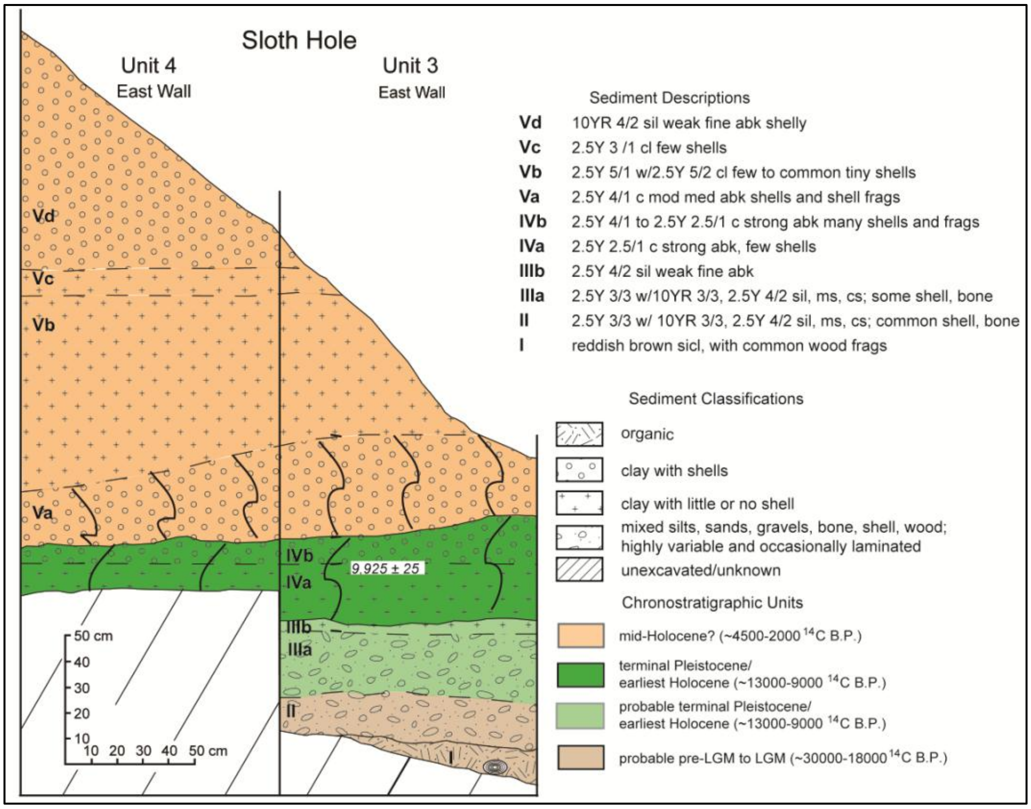



**Figure 8.8. East wall profile of EUs 3 and 4, showing defined stratigraphy and $^{14}C$ samples dated as part of the current project.**

I excavated two contiguous 1 x 1 m excavation units in August 2010. These units were placed adjacent to ARPP excavation block A, where the 14,500 cal B.P. age was obtained from EU 22 Level 7 and were placed north and east of ARPP EU 105 (Figure 8.6), which contained the radiocarbon-dated ivory point (Hemmings 2004; Waters and Stafford 2007). All materials from these excavations were screened through 1/16" mesh to aid in the recovery of small artifacts and faunal remains. Because of time constraints, we excavated in arbitrary 10-cm levels through the upper strata within natural stratigraphic layers, and switched to 5-cm levels giving way to natural stratigraphy as we approached the hard clayey horizon. EU 3 was excavated to 275 cm below datum (cmbd), but EU 4 was excavated only to 225 cmbd because of time constraints (Figure 8.7).

*Stratigraphy*

The stratigraphy of Sloth Hole was defined on the basis of the previous research at the site with the addition of the eight cores, two underwater units, and five terrestrial shovel and auger test pits excavated on the eastern margin of the site. I also obtained four new radiocarbon dates that helped refine the chronology of Sloth Hole when combined with the 15 previous ages. All of the ages obtained during this work are shown with ARPP ages recovered from both notes and publications in Table 8.1. These allowed me to define seven major geologic divisions encompassing four major periods of sinkhole infill. Each of these is described below, starting with the bottom of the profile.

Table 8.1. All Radiocarbon Ages from Sloth Hole. ARPP Ages are Shaded Gray. Unshaded Ages were Obtained During this Fieldwork.

| Stratum | Sample No | 14C Age | SD | Material | Cal Max | Cal Min | EU/Core |
|---|---|---|---|---|---|---|---|
| VII | Beta-119351 | 750 | 60 | organic detritus | 732 | 659 | 8JE121U58LX |
| VII | SMU-279 | 1,920 | 80 | peat | 1,950 | 1,776 | long core |
| VII | SMU-284 | 2,780 | 100 | humates | 2,995 | 2,772 | long core |
| VI | UCIAMS-96271 | 4,115 | 20 | wood | 4,799 | 4,571 | JH VC 10, 45cmbs |
| VI | Beta-93652 | 4,470 | 60 | grape seed | 5,282 | 4,978 | ARPP U23 L3a bottom |
| IVa | UCIAMS-96474 | 9,925 | 25 | twig | 11,330 | 11,258 | JH EU3, 209 cmbs |
| IVa | SL-2850 | 11,050 | 50 | ivory point | 13,081 | 12,865 | ARPP 105 L6a |
| IIIa/IIIb contact | Beta-119350 | 12,180 | 60 | bone | 14,120 | 13,934 | ARPP U210 L 14 |
| IIIa | Beta-95341 | 12,300 | 50 | wood | 14,481 | 14,034 | ARPP U22 L7 |
| II | UCIAMS-96473 | 25,950 | 110 | charcoal | 30,903 | 30,590 | JH VC 12, 167 cmbs |
| II | Beta-119349 | 28,470 | 170 | wood stuck to tusk | 33,204 | 32,571 | ARPP U230 L 14 |
| II? | SMU-307 | 28,700 | 1,690 | peat | 34,670 | 31,483 | short core |
| I? | Beta-108173 | 32,690 | 540 | wood | 37,987 | 36,620 | ARPP C2 S5 |
| I | Beta-95342 | 34,760 | 1,600 | wood | 41,399 | 38,059 | palm stump |
| I | Beta-108172 | 35,240 | 380 | wood | 41,023 | 39,956 | ARPP C1 S11 |
| I | UCIAMS-96472 | 37,730 | 440 | twig | 42,665 | 42,019 | JH VC 12, 235 cmbs |
| I | Beta-108174 | 38,350 | 440 | peat | 43,078 | 42,400 | ARPP C2 S6c |
| I | SMU-313 | 42,240 | 2,770 | peat | 48,231 | 43,678 | long core |
| I | SMU-321 | 43,690 | 3,740 | peat | 49,651 | 44,882 | long core |
| I | Beta-83379 | >41,980 | | wood | 45,592 | 45,098 | ARPP U1 22 |
| I | Beta-83380 | >43,670 | | wood | 47,000 | 46,000 | ARPP U1 69 |
| IV | SMU-249 | modern | | organic | | | short core |
| IVa | none | no collagen | | rodent bone | | | JH EU3, 205-210 cmbs |
| IIIb | none | no collagen | | turtle bone | | | JH EU3 237 cmbs |
| IVa | UCIAMS-96475 | -25 | 20 | seed | | | JH EU3, 220-225cmbs |

*Stratum I*. This unit is highly organic. It ranges from a hard, compacted sapropel to a peat in the center of the sink, while on the margins, it is quite common for the mineral fraction to dominate. In these sediments on the sink edge, preserved wood is surrounded by massive clays. This stratum is dark reddish brown to dark gray brown and fairly hard, with common preserved wood fragments. Stratum I fills the bottom and the entire eastern side of the sinkhole, as it was the basal stratum in most ARPP units. I encountered it at the base of most of the eight cores and excavation unit 3. The thickness of this unit is unknown because its depth was not penetrated in any of the cores or units. Stratum I was deposited in a shallow pond or slowly-flowing stream environment that was nearly always wet. Organics settled into the sink and preserved, becoming compressed over time. On the sink margins, clay filled in the spaces between trees and branches that had fallen into the river or sink. A twig with bark from the basal sediments of Core 12, a clay with many well-preserved wood fragments, returned an age of 37,730 ± 440 $^{14}$C B.P. (UCIAMS-96472) (42,665-42,019 cal B.P.). This fits well with the eight previously obtained ages from stratum I, which range from 49,650-38,060 cal B.P. (Table 8.1). No artifacts have been reported from this stratum.

*Stratum II*. This stratum is a heterogeneous mix of gravels, sands, silts, clays, and shells. Grain sizes range from gravel to silt. Color varied from black to yellow brown. Shells range from few to many, varying from commonly whole to commonly broken. Pond snails and freshwater mussels are both common. Tiny fish bones are common, and larger bones occur as well. This stratum was observed in all of the cores and in EU 3 as well as most ARPP units. Occasionally, weak subangular blocky structure was observed.

Stratum II varied from 40-100 cm in thickness. Stratum II is probably derived from colluvium for two reasons: the stratum is poorly-sorted and contains poorly-rounded nonspherical limestone gravels that were most likely derived from local bedrock. The stratum becomes thinner and finer-grained toward the center of the sink. This stratum could have been deposited either underwater or subaerially, but it is most likely that the colluvium originated subaerially based on the climate proxies discussed further in the depositional history section below.

An age of 25,950 ± 110 $^{14}$C B.P. (UCIAMS-96473) (30,590-30,903 cal B.P.) was obtained on a large piece of charcoal from this stratum in core 12. This stratum is fairly similar to the ARPP EU 22 level 7, dated to 12,300 ± 50 $^{14}$C B.P. (Figure 8.3); these disparate dates represent at least two separate colluvial pulses. The profile from Core 12 supports this; the two strata above the dated stratum are also sandy and extremely variable and may not be easily distinguished during excavation because of murky water. In Core 12, the two strata above were distinguishable in the lab because of changing amounts of shell and because of very slight evidence for pedogenesis in the two upper layers, indicating some period of stability. However, this core was placed just below the modern intertidal zone and would have been periodically subaerially exposed with even slightly lower sea levels. Thus, there is an excellent chance that deeper sediments would not contain this pedogenic evidence to aid in distinguishing the strata. Four ages ranging from 37,987-30,590 cal. B.P. have been obtained from this older colluvial layer (Table 8.1). Stratum II contains no artifacts but did contain some bone.

*Stratum III*. Stratum III is also very heterogeneous, with a wide variety of grain sizes and common shell and bone. Grain size varies from gravel to silt. Color varies from black to light yellow brown. Shell ranges from commonly whole to commonly broken; both freshwater mussels and pond snails are common. This stratum varies from 20-80 cm thick. This stratum has been subdivided because the top few (5-15cm) of the stratum, IIIb, is a more uniform fine silt loam with few shells (whole and broken apple snails) and common bone, while IIIa is poorly-sorted sands, silts, and clays with common shells. This stratum was found within all cores and in EU 3; it was also within most ARPP units. Stratum III probably was deposited by a colluvial event because it is very poorly-sorted with common angular gravels. As with stratum II, this deposit could have occurred subaerially, underwater, or a combination of both. Weak subangular blocky structure is visible in some portions of IIIb, indicating some subaerial exposure of the sediment after deposition. No ages were obtained on this stratum during this research; we attempted to date an unstained turtle bone from within stratum IIIb, but it lacked collagen. The ARPP dated two samples from stratum III. A mastodon skeleton was recovered from the contact between IIIa and IIIb. According to ARPP notes, the bones were pressed into IIIa, with IIIb overlaying them. The calcaneus from this mastodon returned an age of 12,180 ± 50 $^{14}$C B.P. (14,120-13,934 cal B.P.). The date from within IIIa was 12,300 ± 50 $^{14}$C B.P. (14,481-14,034 cal B.P.), which is just slightly older. These are the only ages from this stratum. In EU 3, Stratum IIIb contained five flakes in several levels, but as I discuss in the geoarchaeological section below, I am not confident about their context. It is unknown if the ARPP obtained artifacts from this stratum.

*Stratum IV.* Stratum IV is clay that ranges from black to a very dark gleyed gray in nearshore cores. This stratum is also subdivided. The upper 5 cm of this sediment commonly contained many tiny snails (stratum IVb), but there were no shells within the lower part of the stratum (IVa). Within excavation unit 3, stratum IVb (200-205 cmbd) contained no terrestrial snails, but quite a few tiny pond snails; structure was moderate angular blocky, and texture was clay. The next 20 cm (205 to 225 cmbd) also was clay with strong angular blocky structure, but stratum IVa contained essentially no shell although it did contain small mammal bone fragments and rodent teeth. Stratum IV displayed well-developed soil structure in all cores and units. Structure ranged from granular to angular blocky, and consistence was firm to friable; slickensides were present in one core. Stratum IV ranges from 10-25 cm thick. I interpret this stratum to be a shallow A horizon that formed in fluvially-deposited floodplain clays. These were subaerially exposed, allowing for soil formation. Two ages came from this stratum. A twig from near the top of stratum IVb in excavation unit 3 returned an age of 9,925 ± 25 $^{14}$C B.P. (11,330-11,258 cal B.P.), while the ARPP ivory point yielded a date of 11,050 ± 25 $^{14}$C B.P. (13,081-12,865 cal B.P.). This point was also recovered from near the top of stratum IVb (Table 8.1). The base of stratum IV remains undated. The heavy clays had very poor organic preservation overall, so we attempted to date material from the screened sample, which yielded modern ages. We also attempted to date an unstained rodent bone from within stratum IV, but it lacked collagen. Twenty lithic artifacts were recovered during this research from stratum IVa, but none were clearly present in stratum IVb. An unknown number of artifacts were recovered from this stratum by the ARPP.

*Stratum V.* Stratum V consists of three or four clayey substrata with varying amount of shells, depending on the core or unit. The following descriptions of these substrata were obtained from EUs 3 and 4 because all four substrata were well-expressed within them. In EU 4, stratum Va was a 5Y 4/1 clay with soft moderate medium angular blocky structure containing common pond snails, both whole and broken. This sub-stratum also has evidence for pedogenesis the cores with structure ranging from strong fine prismatic to angular blocky in all of the cores and with clay films present in at least one of the cores. Stratum Vb was a dark gray (2.5Y 5/1 to 5/2) clay loam with soft weak medium angular blocky structure and few to common snails, both whole and broken. This stratum was not present in all cores but was within the EUs 3 and 4. Stratum Vc was a very dark gray (2.5Y 3/1) clay loam with friable moderate medium angular blocky structure with few to common snail shells; it was expressed in all cores and both EUs. Vd is a dark grayish brown (10YR 4/2) silty loam with weak soft fine angular blocky structure and common whole snails. This substratum was not seen in the cores near the shoreline and cannot be reliably correlated to ARPP units.

Stratum Va was deposited in a shallow pond environment based on the fine grain size and the common presence of pond snails. It was then subaerially exposed to soil formation processes, much like the underlying stratum IV. These two strata probably do not represent an A horizon overlaying a B horizon as opposed to two separate A horizons, although it is entirely possible that some pedogenesis of stratum Va did penetrate to the dark clay stratum. There are two reasons for this: first, the tiny shells in stratum IVb suggest exposure and bioturbation of the dark clay. Second, the common presence of large pond snails in stratum Va and their absence from stratum below it indicates that stratum Va was deposited after a shift to a shallow water pond environment, which underwent pedogenesis during a period of subaerial exposure after deposition. In other words, this shelly stratum was deposited after a complete shift of depositional environments to a period with relatively high water tables but little water movement on this side of the sink. Stratum Va is not dated but there are numerous organic samples from the stratum that could be dated in the future. A number of flakes are associated with stratum Va.

Strata Vb-Vd also were deposited in shallow pond environments; the weak to moderate soil structure within these strata is suggestive of periods of deposition (wetter environments) followed by brief periods of subaerial exposure (drier with some soil formation). Shell quantity varied throughout these strata, but there were always at least some pond snails and varying amounts of terrestrial snails. For instance, in units 3 and 4, 0-70 cmbd contained no terrestrial snails, which corresponds to stratum IVd. Some terrestrial snails were in 70-140 cmbd (stratum IVc), and many were in 140-160 cmbd (stratum IVb). Artifacts are associated with Vb and are on the surface of Vd, but these strata also remain undated. Stratum IV varied from one to nearly three m thick. Dateable botanical remains were rare in stratum IV overall, but a few samples have been reserved for radiocarbon dating.

*Stratum VI.* This stratum consists of alternating bands of organic strata and medium to coarse sands. The organic strata ranged from black to very dark reddish brown; these were organic with botanical preservation varying from core to core. Sands were yellowish brown to light yellowish brown, and were commonly rounded quartz with some carbonate sands. Stratum VI is somewhat variable, with peat thickness and number and thickness of sand bands varying from core to core. In Core 10, this stratum continued to the top of the core. In several of the other cores, sand drapes periodically interrupted the peats and sapropels, probably representing individual storm surges. The peats were missing from the top of excavation units 3 and 4 due to prior ARPP excavations of adjacent units. In the terrestrial test pits, these peats were at the bottom of the pit, and were commonly overlain by gleyed gray mucky marls (Stratum VII). Structure was not observed in these sediments.

Stratum VI varied in thickness from 0-75 cm. It was probably deposited in a shallow pond or a fluvial system with low flow rates. The peats and sapropels formed as organic materials deposited within the sink were preserved in continually wet conditions. The sand lenses represent periodic input from the margins of the sink during storms. The base of this stratigraphic unit in Core 10, obtained from a piece of wood with bark on it within peat, was dated to 4115 ± 20 $^{14}$C B.P. (UCIAMS-96271) (4799-4571 cal B.P.), dating firmly to the mid-Holocene. The ARPP obtained an age of 4470 ± 60 $^{14}$C B.P. (5282-4978 cal B.P). on a similar deposit in excavation unit 23, in the deepest portion of the sink. Artifacts and bones were recovered from this unit during the ARPP excavations, but I did not observe any in the cores I collected.

*Stratum VII.* Modern sediments mantle some of the cores and at least one of the ARPP units. These sediments are generally medium-coarse quartz sands with intermixed organics. They were probably deposited within the sink during modern storm activity. They were dated to 732-659 cal B.P. by the ARPP in unit 58. These sands vary in thickness from 10-50 cm, and contain numerous artifacts and bones of all time periods. In the terrestrial test pits, the gleyed wetland marls overlaying the peats of Stratum VI also belong to this stratum. These marls were not dated and probably formed from floodplain deposition of fine-grained sediments onto the modern sink margin. They varied in thickness from 20-70 cm.

All of these data were combined to make two generalized cross sections of the stratigraphy; one near shore based on coring data and one in deeper water based on my unit excavations and upon ARPP data. Figures 8.9 & 8.10 show the generalized profile drawings with the generalized sediment descriptions, while Figures 8.11 and 8.12 show these profiles grouped by major chronostratigraphic unit.

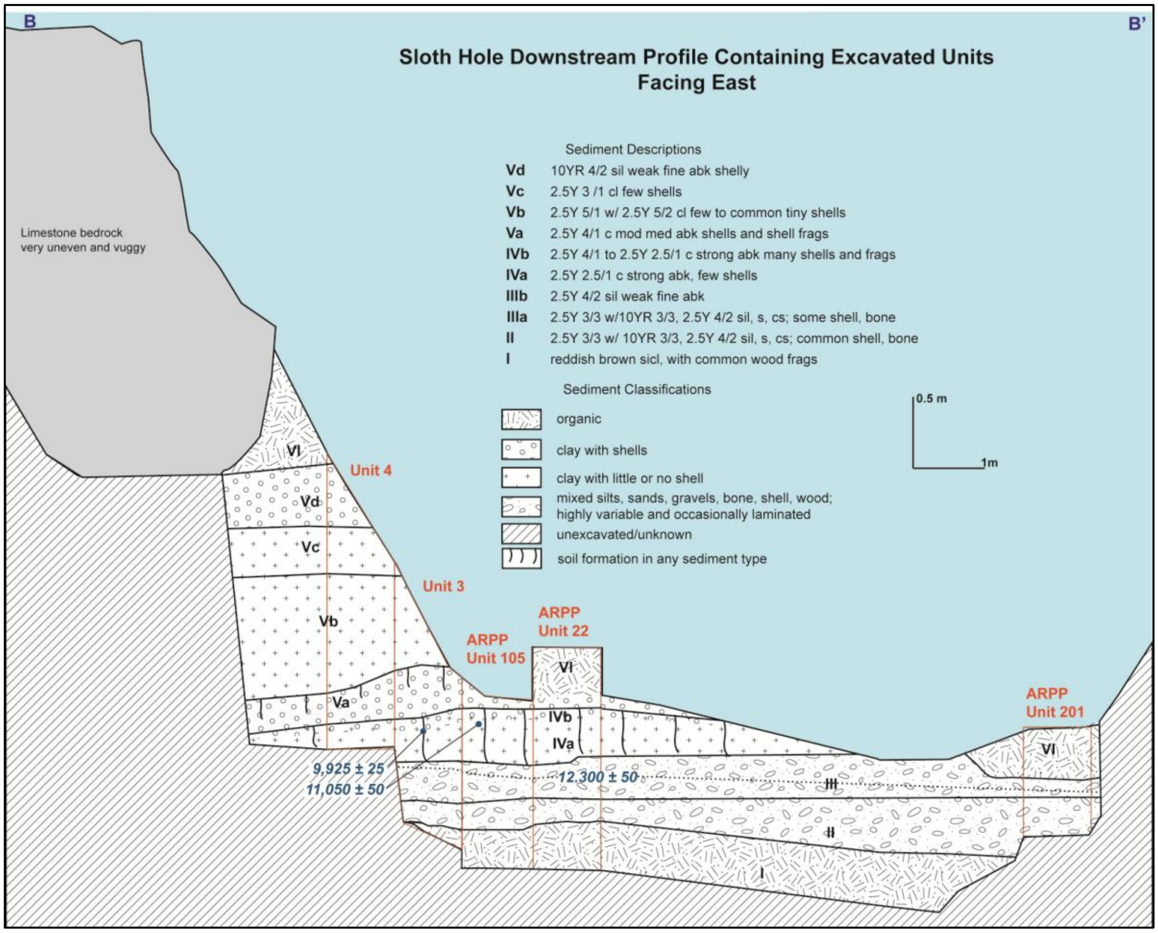



**Figure 8.9. Deep water cross section showing unit stratigraphy.**

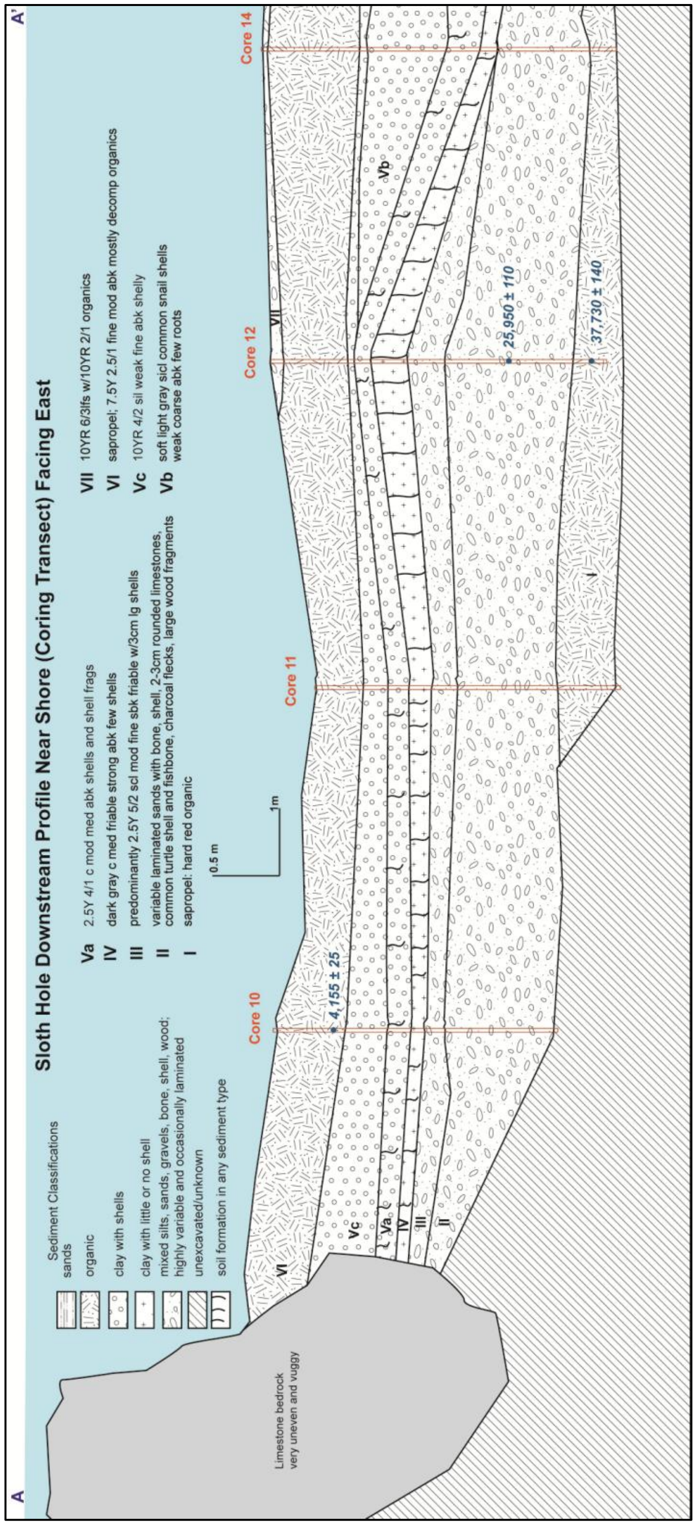



**Figure 8.10. Nearshore cross section showing core stratigraphy.**

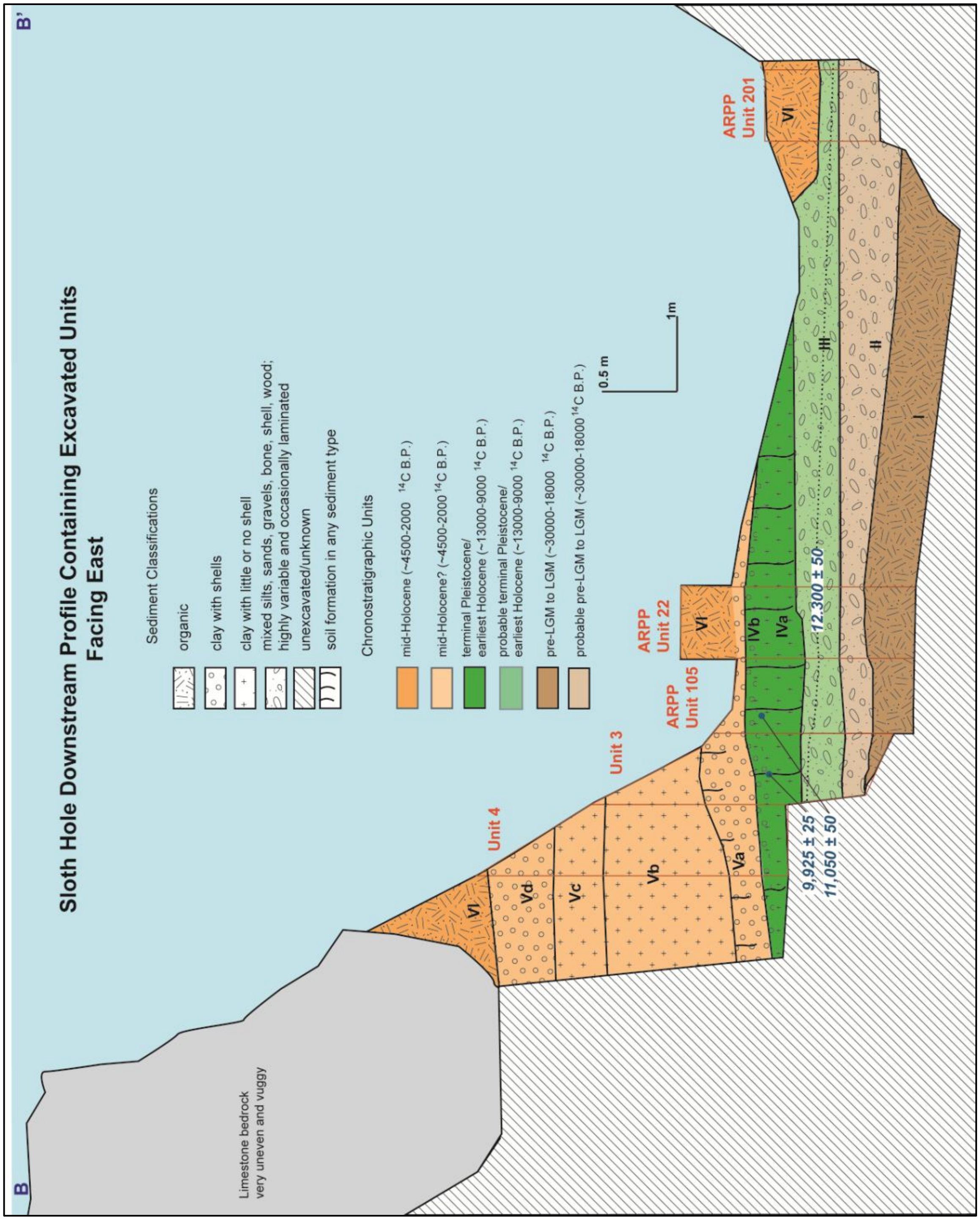



**Figure 8.11. Chronostratigraphic units in deeper water.**

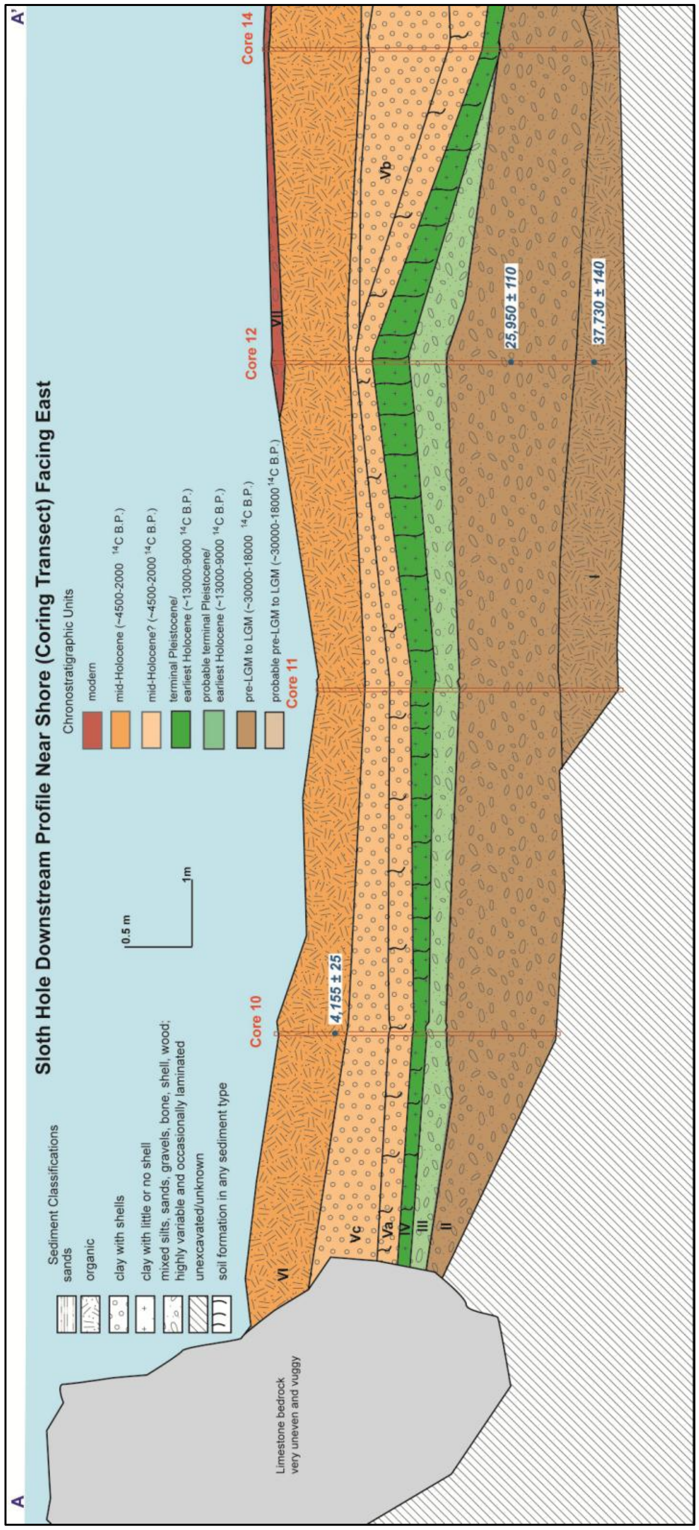



**Figure 8.12. Nearshore chronostratigraphy.**

*Summary and Depositional History*

The radiocarbon data for Sloth Hole represent a record of four major periods of sinkhole infilling, two of which significantly pre-date human activity in the area. ARPP researchers defined three major periods of sinkhole infilling for the Aucilla Basin as a whole: 46,000-41,000 cal B.P., 37,000-29,000 cal B.P., and 18,500-10,200 cal B.P. (Dunbar 2006b; Webb 1998). The three earliest periods of the Sloth Hole record correspond well to these, with an additional mid-Holocene period of infilling at Sloth Hole. Figure 8.13 presents a schematic cross section of the sink showing the geological strata discussed and the approximate distribution of cultural material. The sediments within the sink resulted from variety of depositional processes. The peat and sapropel layers were deposited in an anaerobic, consistently wet environment, probably with little to no water movement; the colluvial strata were probably deposited during relatively dry environments during which occasional catastrophic wasting occurred. The discussion below includes both previous and current ages from the site, all of which were calibrated to 1-$\sigma$ using the methods discussed in Chapter I. The entire range of ages is used rather than the midpoints for this discussion because some of these ages have very large standard deviations; these less precise ages are generally on such old sediments that this does not significantly change the discussion of sinkhole processes.

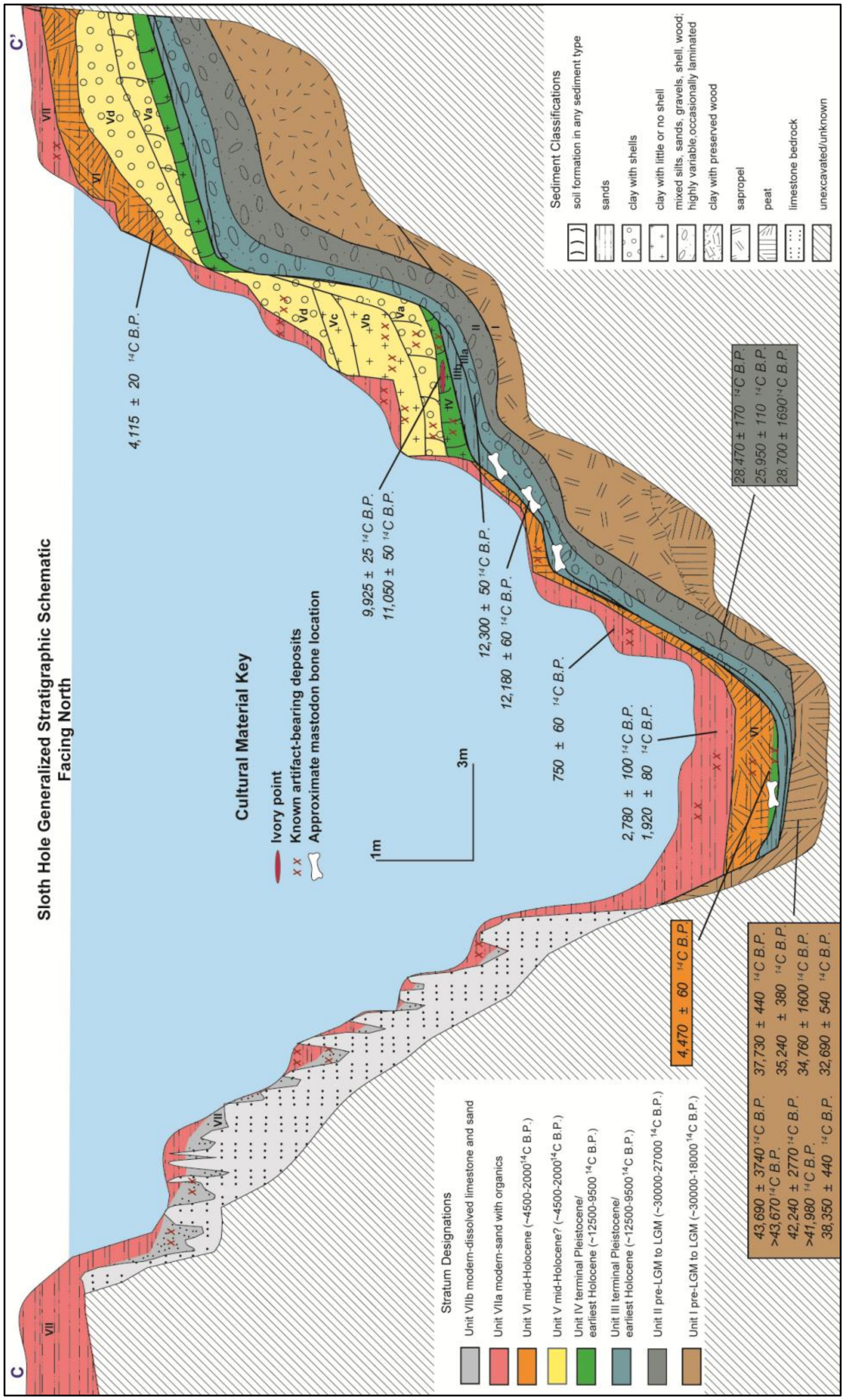



**Figure 8.13. Schematic cross section of Sloth Hole.**

Nine radiocarbon ages span the period from approximately 48,000 cal B.P. to approximately 36,000 cal B.P. The sink seems to have been a shallow pond environment with quiet waters allowing peat formation (Stratum I). At this time, proxy records indicate that sea levels were fluctuating relatively rapidly from 60-80 m lower than present with a general trend toward sea level lowering (Lea et al. 2002). This probably represents an overall cooling trend. Local climate, however, may have been relatively moist, as there was enough surface water to allow peat formation. The Aucilla River could not have been flowing at this time because sea levels were so low that flow could not have occurred over the limestone shoals to the north and south of the site, which are less than 2 m below the current water level in the sink. Thus the water in the sink probably came from the springs within the sink. Several pollen records from the Florida peninsula indicate that two separate peaks in pine pollen occurred around 47-45,000 cal B.P. and again around 40-36,000 cal B.P. (Grimm et al. 2006; Watts and Hansen 1994). Grimm and colleagues (2006) have noted that these peaks closely correlate to Heinrich events and interpret these pine peaks to correspond to cooler, moister climate. This matches the basal peat record at Sloth Hole well.

There are no radiocarbon ages for the period between approximately 36,000-33,000 cal B.P. This either indicates a period of no deposition and landscape stability, indicates an erosional unconformity, or indicates that we have not yet dated enough samples. The latter seems the least likely, given how well the other ages from the site cluster. An erosional unconformity may be the most likely because there is no evidence for landscape stability or soil formation in the peats of stratum I. Proxy records for the period indicate a rapid cooling trend and sea level drop (Lea et al. 2002; Peltier and Fairbanks 2006), which seems unlikely to lead to landscape stability.

Stratum II was deposited sometime between 33,000-30,000 cal B.P. This stratum is a colluvial deposit of mixed sands and gravels and may have been deposited subaerially, underwater, or both, although it probably began above the water. This colluvial deposit may have been caused by either mass wasting or sinkhole expansion. Mass wasting could be caused by storm activity or flooding, either of which would require the water level in the sink to be low. Alternatively, this colluvial deposit could have been caused by sinkhole expansion. Solution sinks can enlarge by increased dissolution of their limestone substrates (Jennings 1985). Often sinkholes expand during times of lowered water tables, because the system maintains a dynamic equilibrium during high water tables in which the water itself maintains the pressure on sediments above (Cooper et al. 2011; Jennings 1985; Kaufmann 2009). A local drought could have released the pressure on the sink margins, causing collapse of the sediments and the appearance of colluvium. Either explanation seems to require the local area to be relatively dry, which may be supported by the proxy records. Sea levels were still dropping dramatically at this time (Lea et al. 2002; Peltier and Fairbanks 2006), so it is likely that local water tables dropped in response. There are no local pollen records for this period, but regional records (Grimm et al. 2006; Watts and Hansen 1994) show that pine pollen levels declined from 33-30,000 cal B.P., suggesting increasingly warm and dry conditions through this period, but a pine pollen peak occurs at 33,000 cal B.P., so the beginning of this period was perhaps very cool and moist.

No radiocarbon ages are present for sink deposits from 30,000 cal B.P. until well after the LGM. This may indicate little sediment input or may indicate a lack of dating or a lack of preserved datable materials. There may also have been some erosion of finer sediments. Perhaps the water table had dropped so much that even the springs within the sink were unable to flow and there was minimal sediment input of any kind.

The next series of ages (represented by two radiocarbon dates obtained by the ARPP) cover the period from 14,481-13,934 cal B.P. (strata IIIa and IIIb). Stratum III is a colluvial deposit containing a mix of poorly-sorted sand, shells and gravels (IIIa), overlain by some very fine sands and silts in the upper portions of the stratum (IIIb) that were probably deposited in a shallow water environment with periodic drying, as indicated by the common presence of apple snails in IIIb, a species that is well-adapted to periodic wet-dry cycles (Thompson 1984). The colluvial episode or episodes that deposited stratum IIIa occurred before 13,934 cal B.P., because an articulated mastodon skeleton dating to 14,120-14,027 cal B.P. rests on the contact of IIIa/IIIb. Sea levels at this time were approximately 95 m lower than present at the beginning, but approximately 80 m lower by the end (see sea level discussion in Chapter III), so climate was rapidly warming and more water was becoming available as groundwater was rebounding in response. Thus, the water table may have rebounded enough that flow within the sink had resumed. This is supported by the presence of the mastodon, a wetland-adapted animal (Fisher and Fox 2006), which may have died on the side of the waterhole. The pollen records from the Page-Ladson site, only approximately 5 km northeast of Sloth Hole, show that there was a local expansion of mesic forests and floodplain hardwood forests at approximately 14,500 cal B.P., as climates continued to become warmer and precipitation increased (Hansen 2006).

Stratum IV is dated to 13,081-11,258 cal B.P. based on the range represented by the ivory point in stratum IVa in ARPP EU 105 and the age from the top of stratum IVa in Unit 3. As discussed above, Stratum IV seems to represent a land surface (A horizon) based upon its dark color and the well-developed soil structure. For this soil horizon to develop, it had to have been exposed at the surface for some length of time. Attempts to date the IIIb/IVa contact failed, so the exact length of this period of stability is unknown. However, the dramatic textural and structural changes between IIIb and IV and the different gastropod types make it seem likely that some time elapsed between the two strata.

This stratum spans the Younger Dryas, so it is unclear what the system response to the Younger Dryas within the sink was because pedogenesis homogenized the stratum. During the Younger Dryas, sea levels in the Gulf of Mexico had rapidly risen to only 35 m below present, followed by an equally rapid drop to 45 m below present from 11,600-11,000 cal B.P. (see Chapter III). Perhaps stratum IV reflects this. The clay-rich sediments may have been deposited by higher water levels in the sink which were then exposed by the subsequent sea level drop. The Bolen period is hypothesized to have been drier, with less available surface water (Carter and Dunbar 2006; Dunbar 2006b). This would have allowed for soil formation to occur within IV. Stratum IVb represents the flooding and bioturbation of this stratum, with pond snails disturbing the top 5 cm of the level. Pollen records from Page-Ladson show that mesic forests disappeared with an increase of chenopods (which prefer dry, disturbed areas), charcoals, and degraded pollen at approximately 11,500 cal B.P. (Hansen 2006), indicating a sudden drought; this was an abrupt change from the previous warming trend with increasing moisture.

Stratum V represents some portion of the Early to Middle Holocene period from approximately 11,200 to 4,800 cal B.P. These sediments indicate slow infilling of the sink, with clayey pond sediments and pond snails dominating the sequences. This may well represent a slow, steady increase in water level within the sink congruent with the steady rise in sea levels during the early Holocene. Stratum IVa has been pedogenically altered, indicating a temporary halt in water level rise during this period. Artifacts are associated with this, showing that humans were utilizing this area during its exposure. Stratum IVb also contained artifacts in an excavation level associated with a relatively high percentage of organics, which might represent a very brief surface exposure that was rapidly buried by more pond deposits.

These soft shell-filled clay pond deposits eventually became capped by organics (Unit VI). Approximately 4800 years ago, processes in the sink changed slightly, so that peat formation resumed in the sinkhole. These peats were also formed in shallow water with plenty of light for plant growth. Periodic storm surges are represented in the occasional sandy laminae within these peats. This peat formation ceased sometime in the late Holocene. All of the modern sediments topping the cores are sandy overburden and wetland clayey marls (which may be analogues in process to stratum V) topped by leaf litter. The switch from clayey pond deposition to organic peats and sapropel deposition during the mid-Holocene may be related to a reduction in sediment load for the river or may mean water tables were fluctuating less, so organics were not being periodically dried and clays were not being redeposited on floodplains, as peats form best when they are consistently wet (submerged at least 80% of the time) (Davis 1911).

## Geoarchaeological Context

Now that the general geological framework has been outlined, it is possible to discuss the geoarchaeological framework of the artifacts recovered from the excavations. I excavated two contiguous 1 x 1 m excavation units at Sloth Hole in August 2010 (Figure 8.14). These units were placed north and east of ARPP EU 22 where the 14,481-14,034 cal. B.P. age was obtained from stratum IIIa and adjacent to ARPP EU 105 (Figure 8.6), which contained the Clovis-aged ivory point. These units, excavation units 3 and 4, were placed in consultation with C.A. Hemmings to sample the most intact stratigraphic sequence at the site. Their purpose was to help determine the age and context of artifacts recovered from the previous excavations. All materials from these excavations were screened through 1/16" mesh to aid in the recovery of small artifacts and faunal remains. Because of time constraints, we excavated in arbitrary 10-cm levels within natural stratigraphy and switched to 5-cm levels within natural stratigraphy as we approached the clayey A horizon (Stratum IV). EU 4 was excavated to a total of 225 cmbd, while EU 3 was excavated to a total of 275 cmbd. Again because of time constraints, excavation of EU 4 ended within the black clay A horizon (stratum IVa), which was extremely difficult to excavate, while EU 3 was excavated through to the basal sapropel (stratum 1).

*Context of Current Excavations*

A total of 72 artifacts were found in numerous levels throughout these two units (Figure 8.14); all but two were nondiagnostic flakes and shatter, and several were tiny flakes found in the 1/16 inch screen. One modified bone tool fragment and one possible end-thinning flake were also recovered from within the units. No ceramics were found in the excavation units, but a number of flakes, bones, and ceramics were found during the surface cleaning of these units. Because these lack context, they were washed, dried, and sorted by material type, but I did not analyze them further, and they are not included in the artifact discussions below. Artifact frequencies by level are shown on Figure 8.14. Specifics of these materials are discussed in more detail in the material culture section that follows.

Artifacts counts were generally very low, with fewer than five in most levels (Figure 8.14), but there are several areas of higher density. The surface of unit 4 contained a relatively high flake concentration (13 flakes) in the top 40 cm, especially when considering how little of EU 4 was actually excavated due to the extreme slope of the unit. However, these flakes are almost certainly all from surface context, as the top of the excavation unit was somewhat bioturbated and very soft, and they have not been assigned to an archaeological component.

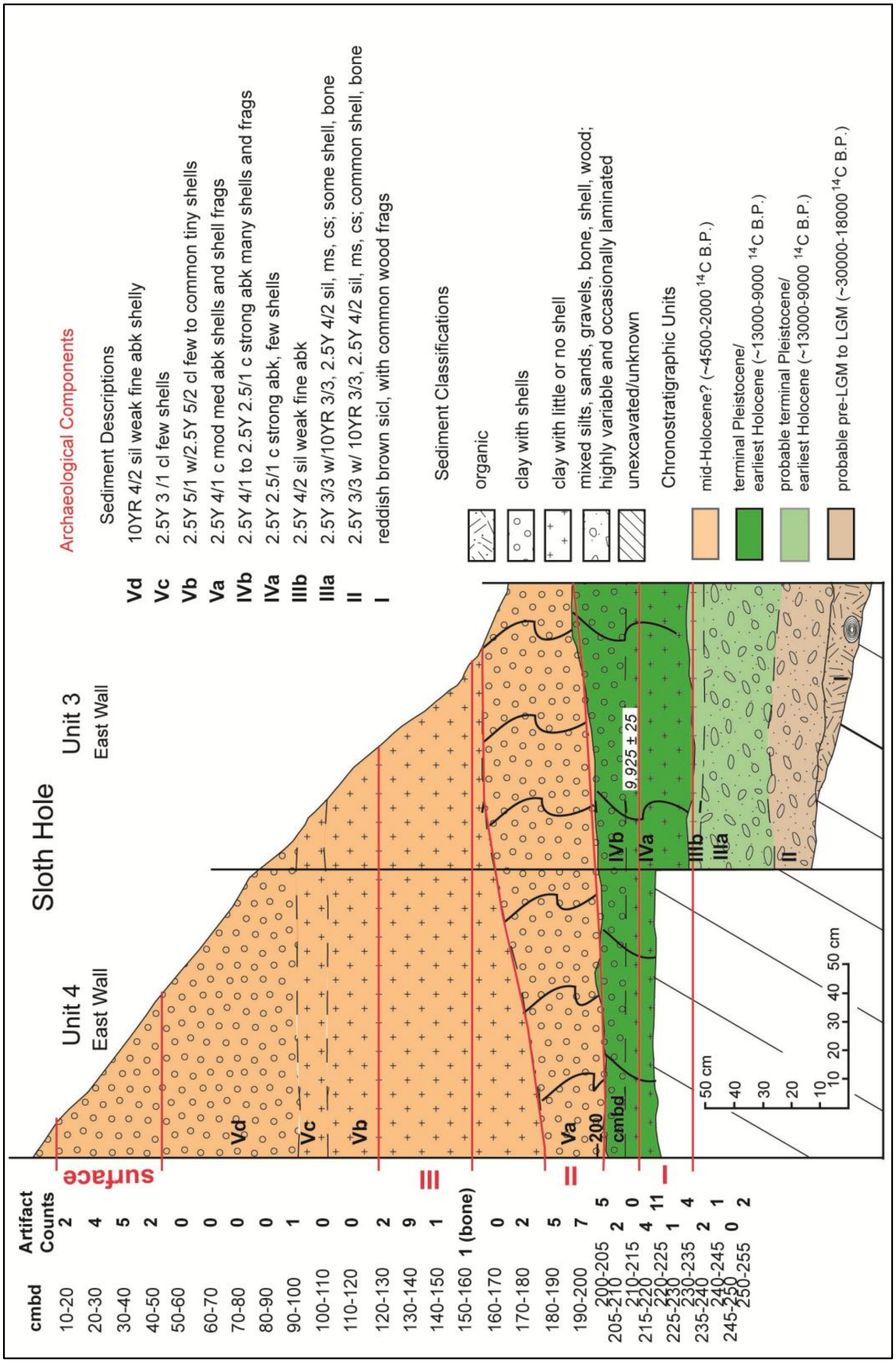



**Figure 8.14. East wall profiles of EU 3 and 4.**

The second artifact concentration from the surface has been designated as Component III. This component was most concentrated in stratum Vb at 130-140 cmbd with nine flakes in this level and several above and below it (including a bone tool). The sediment profile from the two cores was not different for this level, but when analyzing the 1/16 inch materials, many terrestrial snails and a relatively high amount of organic debris were observed, so a surface approximately equivalent to this excavation level may have been briefly subaerially exposed and used by people. The artifacts within this stratum likely represent a single component because this level seems to have been so briefly exposed. Bioturbation by snails and plants probably has erased the vertical and horizontal integrity of the materials a bit, but the fine-grained sediments were deposited by very low flow rates, so the artifacts are unlikely to have been washed in from elsewhere.

Strata Va and IVa have the densest concentrations of material culture that make up two archaeological components. Stratum Va has a few artifacts in every level for a total of 22 lithics that make up Component II. This stratum has been pedogenically altered, with well-defined angular blocky structure. Artifacts were probably deposited on the surface of this sediment while it was subaerially exposed, and were then bioturbated into it by the numerous snails in Stratum V. The pedogenic alteration of this sediment means that it was exposed for some length of time; artifacts may, thus, represent multiple occupations. Again, because the sediments are so fine-grained, these artifacts are unlikely to have gotten into the stratum by redeposition, although they have probably been moved by bioturbation.

Artifact densities increased in stratum IV. Stratum IVb contained only two flakes, but IVa contained 20 flakes in total, which were assigned to Component I. The well-defined structure of this stratum and the presence of terrestrial fauna indicate subaerial exposure. Although the time encompassed in this stratum is unknown, the Clovis-aged ivory point was recovered from near the top of stratum IVa in ARPP unit 105, and the radiocarbon age from the top of stratum IVa in unit 3 encompasses the Early Archaic Bolen period. Thus, the entire Paleoindian period seems to be represented by this stratum and Component I may actually represent several occupations of various late Pleistocene and early Holocene ages. Stratum IVb is filled with pond snails, showing that this surface was submerged in pond deposits as water levels rose to shallowly-cover the stratum. The few artifacts near the top of this stratum have probably been bioturbated somewhat by these pond snails, but, as can be seen on Figure 8.14, most of the artifacts were found within stratum IVa rather than within IVb.

The artifacts were probably not simply reworked into stratum IVa from the top of stratum IVb because it is highly unlikely more artifacts would be found in the lower stratum than the upper. The presence of the artifacts within rather than on top of Stratum IV indicates two things: first, deposition of this stratum was not instantaneous; it occurred over a period of time, possibly co-occurring with soil formation, and, second, there may be stratigraphic separation between the archaeological components that could be determined with further excavation. The artifacts were probably not redeposited into stratum IVa because the stratum was homogeneous clay; it contained a few rodent and turtle bones but did not contain gravels or sands that would indicate a depositional activity capable of entraining large artifacts like the ivory point or even larger flakes.

Stratum IIIb contained five flakes in 15 cm of sediment. Unfortunately, I have little confidence in the context of these flakes, because the surface of stratum IIIb was irregular, so the contact between IIIb and IVa was difficult to trace. However, IIIb is the fine-grained sediment on the top of the colluvial layer IIIa. Paleoindians could have been on this surface as it was deposited sometime after 14,000 cal B.P. Evidence for this activity would then have been covered by the clays of stratum IV. Artifacts from the surface of IIIa could thus be in original context, but more data are needed to determine this. If artifacts are within IIIa, they are almost certainly in secondary context, as they are part of the colluvial deposit or have been reworked into the sediments by bioturbation.

While at least two of the flakes from Stratum IVa were observed *in situ,* none of the flakes from stratum IIIb were, so they might have fallen in from the excavation side walls. Wall slump from stratum V was a constant battle while excavating strata IV and III. It is even possible that the high artifact count from IVa is partially an effect of slumping as well. While every effort was made to avoid contamination from levels above, by the time we were excavating these deeper strata, the soft silty sediments of Vb and Vc were sloughing into the units at least once a day. Every time this occurred, we would stop excavation, clean up and screen slumped material separately, and then resume, but it is unfortunately possible that a flake or two could have escaped notice in the very dark, sediment-filled waters. Given that artifact counts in above strata are not particularly high, however, it is relatively improbable that the small amount of slumped sediment from above would account for all or even most of the materials in our deeper levels. This is especially unlikely because a large number of Bolen diagnostics were recovered during earlier ARPP excavations, and stratum IV, dating to 11,400-11,250 cal B.P., is almost exactly Bolen-aged (ca. 11,500-11,200 cal B.P.) (Carter and Dunbar 2006), making it very possible that the Bolen component came from stratum IV.

In summary, three archaeological components are likely represented in excavation units 3 and 4 with the possibility of a fourth located on the top of stratum IIIb. No diagnostic artifacts were recovered from these two excavation units except a possible end-thinning flake segment recovered from the surface levels, and there is only one direct age on sediments in these EUs, so occupation dates are somewhat tentative. The earliest definite component in these EUs, Component I, is associated with stratum IV, and probably dates to the Paleoindian through Early Archaic periods, based on the stratum age. Component II is associated with stratum Va, and is somewhat younger than Bolen. Component III is associated with stratum Vb, and is possibly mid-Holocene in age. The final cluster of artifacts is the surface assemblage at the site, which consisted of artifacts and bones of all ages, and is probably mostly intermixed and redeposited. There could be some areas of artifacts in their primary contexts, but it would be nearly impossible to tease these out from the rest of the redeposited materials.

*Inferred Context of Former Excavations and Locations of Potentially-Intact Archaeology*

Based on the geoarchaeological framework I have established, I can make some general inferences about the context of previously-recovered artifacts from Sloth Hole. First, Paleoindian artifacts can only potentially be found in primary context in four stratigraphic locations: 1) within stratum IV; 2) possibly within IIIb, which is so far undated, but is younger than 14,000 cal B.P. 3) in the IIIa/IIIb interface if there are pre-Clovis artifacts; 4) within the center of the sink on top of older sediments if stratum III does not extend over these sediments. In this last case, the water in the sinkhole would have needed to be very low. Paleoindian remains from any strata above the Bolen soil are in secondary context. Paleoindian remains recovered from any portion of the limestone shoals are almost certainly intermixed with later materials. Any future Paleoindian research at the site, thus, should target stratum IVa and excavate through IIIb, paying careful attention to archaeological context.

Intact Early Archaic remains could found in or on top of stratum VI. Stratum Va remains undated so could be Early Archaic as well. Intact Middle Archaic remains could be found throughout stratum V in both primary and secondary contexts, as there is some evidence for subaerial exposure, but most of the stratum represents slow and continuous pond deposition. Late Archaic materials, dating from 5000-2500 cal B.P. (Milanich 1994:85-104), could be found within stratum V, but these materials are probably redeposited because there is no evidence for subaerial exposure within the peats. Artifacts in this stratum most likely would be redeposited during storms, when the sands were also deposited, or they are associated with fishing or other water-related activities. Woodland materials may also be within strata V or VI, with the same caveats.

ARPP excavations at Sloth Hole discovered four main artifact concentrations. Older materials seemed to be concentrated near the surface on the northern shoals and the center of the sink. A large amount of ivory and at least one of the Clovis points recovered by a collector was found on the northern shoals, while the sink center contained a mastodon fibula with cut-marks and numerous Paleoindian tool types (though no diagnostics). An ivory point, and many Bolen artifacts were found on the eastern side of the site; a potential pre-Clovis deposit also was described above the 14,000 cal B.P. sediments in excavation area A. A Clovis point was reportedly also recovered by a collector from the walls of one of these units on the southeastern margin of the site. Woodland ceramics, historic artifacts, and heat-treated lithic materials were found everywhere in the site in surface contexts.

I found no evidence for pre-Clovis deposits in my cores or excavation units. Based on my investigations, intact pre-Clovis materials likely could only be found in two stratigraphic contexts: at the IIIb/IIIa contact or possibly within stratum IIIa. Materials found upon the northern and southern shoals (including the ivory workshop) are from highly deflated and probably conflated contexts, and would need very careful analysis to determine specific context. Materials recovered from ARPP stratum 4 in the center of the sink (ARPP area 2) seem to be representative of Paleoindian tool types, with little evidence for more recent intrusive material, but materials from this area also should be carefully analyzed as they are overlain by mid-Holocene aged sediments, meaning these materials lay exposed on the sink floor for thousands of years, so are essentially also from a surface context. The Woodland and historic artifacts probably are redeposited into the sink and are associated with stratum VII. Below, I discuss the specifics of the material culture from previous and current excavations.

## Archaeological Context

### *Debitage Analysis of Previously-excavated Units*

The stone tool assemblage from Sloth Hole is discussed in Hemmings (1999). A total of 59 ivory tool and tool fragments and 64 lithic tools were classified and analyzed (including Clovis points from local avocational collections) (Figure 8.15), but the debitage was not analyzed as part of that research. Thus, as part of this dissertation, I examined the entire debitage assemblage housed in the Florida Archaeology collections of the Florida Museum of Natural History, which may or may not be the entire assemblage, as the site was excavated through the Vertebrate Paleontology division, and some materials may not have been accessioned with the Florida Archaeology branch. Although my sample from these units may not be complete, I subjected the materials from 16 units to the same lithic categorization used for the materials from my excavations (see Chapter V) to generate data that are directly comparable.


**Figure 8.15. Clovis points from Sloth Hole. Photo courtesy of C. A. Hemmings.**

These units were selected to sample each excavated area at the site, although area 2 was more heavily selected than other areas. EUs 22, 104, and 105 were analyzed because they were adjacent to my excavations, while the rest were selected at random. Analyzed units appear in green on Figure 8.1. I also analyzed some of the debitage from area 1, but did not finish this entirely because most of these materials were from the surface collection. I analyzed a total of 460 lithics, with 291 coming from formal excavation units. To determine if the site varied spatially, I examined these data both as a grouped assemblage and separated them by area as determined by the ARPP (area 1, area 2, excavation block A, and then the two units between area 2 and excavation block A proper). When separating by area, the sample sizes were widely variable, so the trends shown should be treated cautiously. This information appears in Tables 8.2 and 8.3 and in Figures 8.16 and 8.17. The tables show absolute count, while the figures show percentage by count to somewhat equalize sample size variation. These data should be directly comparable to the data from my excavations, discussed later in this chapter, with two single caveats: although material from the ARPP excavations was screened through 1/16 inch mesh, the materials from this fine screen were not accessioned with the rest of the cultural material associated with the site, so I did not have access to these materials. I do not have information about stratigraphic association for most artifacts, so multiple components could easily be conflated in each excavation unit.

Table 8.2. ARPP Lithic Debitage Attributes by Counts.

| **Site Name** | **Number of Units** | **count by debitage attributes** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **non-cortical** | **primary** | **secon-dary** | **size 1** | **size 2** | **size 3** | **size 4** | **heat** | **burnt** |
| All ARPP | 16 | 263 | 49 | 72 | 7 | 273 | 60 | 58 | 23 | 40 |
| Area 1 | N/A | 89 | 3 | 16 | 4 | 89 | 11 | 9 | 3 | 18 |
| Area 2 | 10 | 120 | 34 | 40 | 6 | 111 | 40 | 45 | 12 | 11 |
| Block A | 3 | 32 | 8 | 7 | 1 | 43 | 2 | 1 | 6 | 5 |
| A & 2 | 2 | 13 | 4 | 8 | 1 | 23 | 3 | 0 | 2 | 2 |

It should be immediately apparent in Figure 8.16 that a grouped analysis of the debitage is masking much of the variability in the assemblage. Area 1, on the southern shoals, for instance, has an unusually high percentage of non-cortical size class 2 materials, with a relatively high amount of burning. Area 2, which consists of 10 of the 16 analyzed units (one analyzed unit was not attributable to an area), contains an unusually high percentage of the two largest size classes. Excavation Block A and the two units between A and 2 are very similar to one another, with the area between being distinguished only by having an unusually high amount of secondary flakes, so these two could potentially be grouped to create more robust and comparable sample sizes.

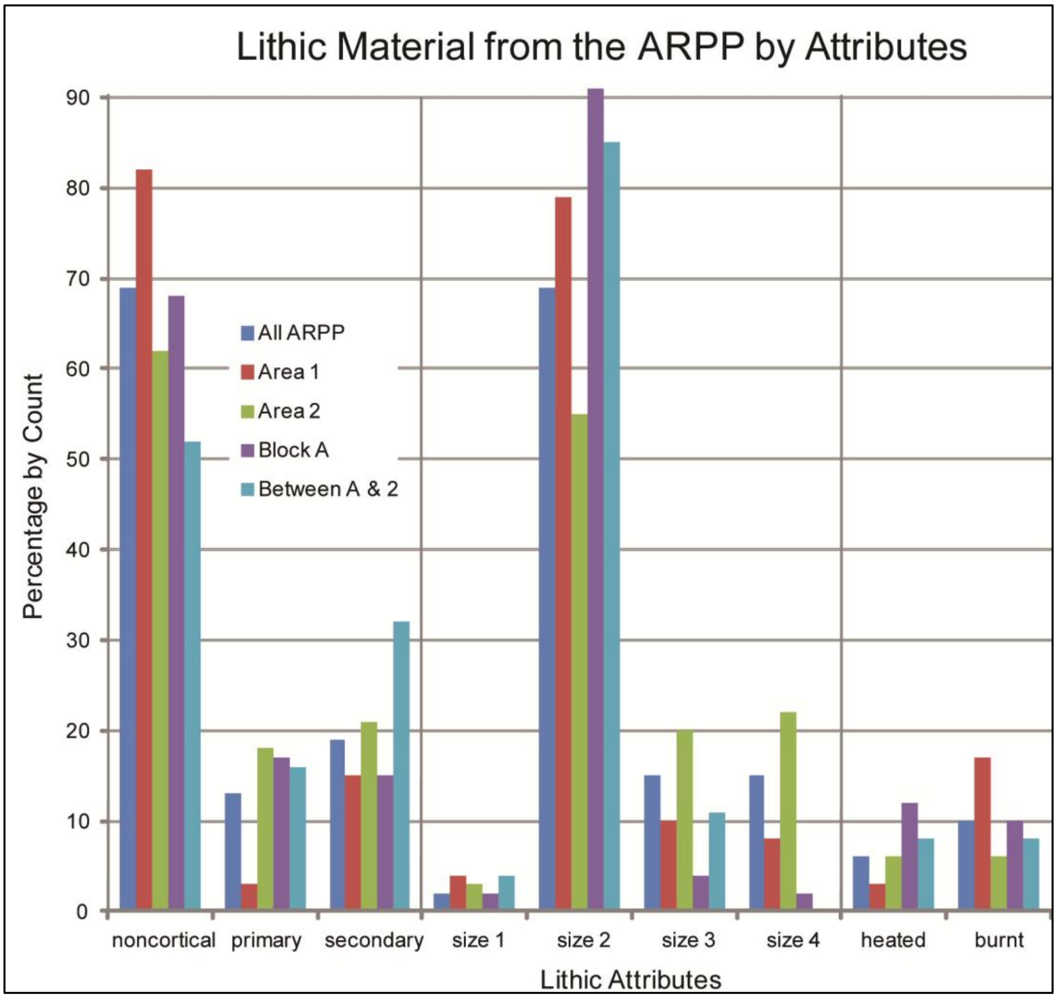



**Figure 8.16. ARPP lithics sorted by debitage attributes.**

When examining the materials by type instead of by debitage attribute, differences by area are also readily apparent (although relative sample size continues to be an issue). Both Areas 1 and 2 have greater type diversity than the other 2 areas, which is possibly because these areas contained 21% and 40%, respectively, of the total analyzed lithic material. However, there are still some notable trends: Area 1 has a relatively large percentage of flakes to flake fragments; biface thinning flakes are unusually common in the area between A and 2. Only area 2 contained a blade, a chopper, and overshot flakes, all of which are commonly associated with Clovis assemblages (Bradley et al. 2010; Waters et al. 2011b); this area also contains relatively more large debitage and relatively less heated debitage, which may indicate that this area represents the remnants of Clovis activities. If this is the case, the rest of the areas may not represent intact Paleoindian activities at the site.

Table 8.3. ARPP Lithics by Type.

| Site Name | # of Units | lithic assemblage by type | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **frag** | **flake** | **btf** | **over-shot** | **shatter** | **blade** | **biface** | **core** | **flake tool** | **ground stone** | **chop-per** |
| All ARPP | 16 | 252 | 165 | 29 | 2 | 33 | 2 | 1 | 3 | 6 | 1 | 1 |
| Area 1 | N/A | 28 | 58 | 3 | 0 | 12 | 1 | 1 | 0 | 1 | 0 | 0 |
| Area 2 | 10 | 84 | 77 | 15 | 2 | 12 | 1 | 1 | 3 | 0 | 0 | 1 |
| Block A | 3 | 24 | 17 | 2 | 0 | 3 | 0 | 0 | 0 | 0 | 1 | 0 |
| Between A & 2 | 2 | 10 | 9 | 5 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |

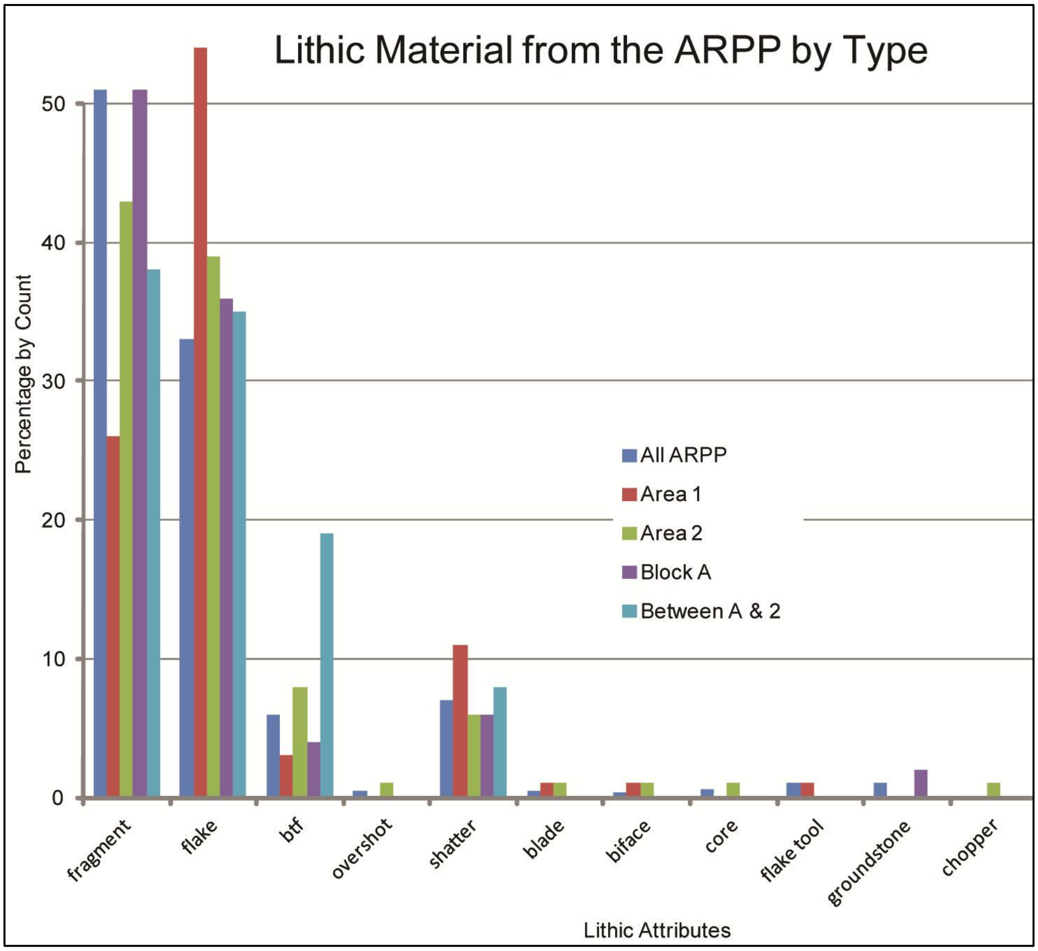



**Figure 8.17. ARPP assemblage percentages by type.**

*Artifact Analysis of Current Units*

As mentioned above, I recovered one bone tool and 71 lithic items from EUs 3 and 4. These were grouped into three main components and the surface assemblage, with the five flakes from stratum IIb considered a potential separate component (designated 1a in these analyses). Tables 8.4 and 8.5 below show the artifacts by debitage categories and by debitage class for each component, and Figure 8.18 shows the percentages graphically. The group statistics include the flakes from the surface, which are in the second row of Table 8.4 so their distribution can be observed. Figure 8.18 shows these same data as percentage of total for each component. The very limited quantity of material recovered from these units severely limits interpretations, and sample sizes for each component are not significant, but each component is quite different from the previous. This helps to confirm my tentative separation by stratum and indicates that all the flakes are not simply redeposited materials or materials that fell in while we were excavating.

Table 8.4. Debitage from EU 3 and 4 by Attributes.

| Component | count by debitage attributes | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | non-cortical | primary | secondary | size 1 | size 2 | size 3 | size 4 | heated | burnt |
| all | 39 | 8 | 8 | 17 | 50 | 5 | 0 | 11 | 5 |
| surface | 9 | 1 | 2 | 1 | 10 | 2 | 0 | 5 | 0 |
| 3 | 7 | 2 | 2 | 1 | 10 | 1 | 0 | 3 | 2 |
| 2 | 11 | 0 | 0 | 8 | 10 | 2 | 0 | 3 | 2 |
| 1 | 12 | 5 | 1 | 4 | 18 | 0 | 0 | 3 | 1 |
| 1a | 0 | 0 | 2 | 3 | 2 | 0 | 0 | 0 | 0 |

Table 8.5. Debitage from EU 3 and 4 by Type.

| Component | frag | flake | btf | shatter | end thin |
|---|---|---|---|---|---|
| all | 33 | 22 | 2 | 3 | 1 |
| surface | 3 | 4 | 2 | 3 | 1 |
| 3 | 4 | 3 | 1 | 4 | 0 |
| 2 | 12 | 5 | 1 | 1 | 0 |
| 1 | 8 | 10 | 1 | 3 | 0 |
| 1a | 5 | 0 | 0 | 0 | 0 |

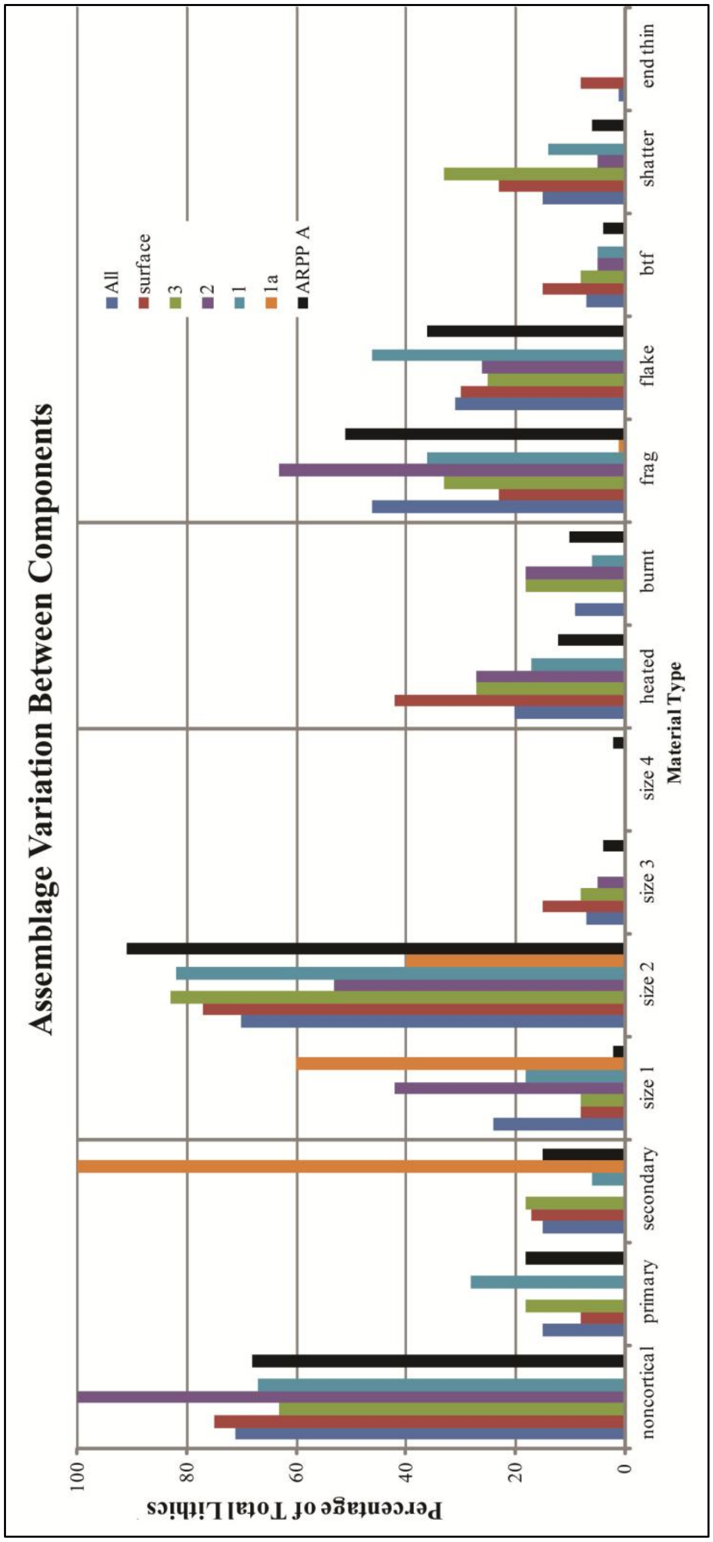



**Figure 8.18. Debitage from EU 3 and 4 by percentage.**

Figure 8.17 also contains the ARPP excavation area A materials for comparison. These data do not vary substantially from the grouped information from EUs 3 and 4. In fact, the only significant difference is in the higher percentage of size class 2 and lower percentage of size class 1 material in the ARPP units. This can easily be explained by the lack of 1/16-screen materials from the ARPP in the accessioned collection (see note in beginning of section). The only other difference is that flakes and flake fragment percentages were higher in the ARPP units as compared to shatter. This may be significant or be related to sample size.

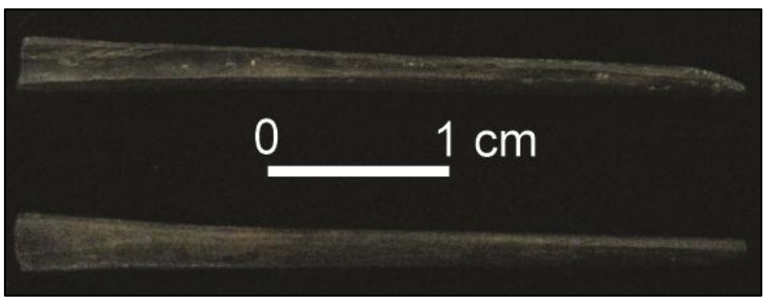



**Figure 8.19. Bone tool from Component III, EU 4.**

The small amount of cultural material recovered from these two units can be attributed to at least 3 different cultural components, but it is hard to make any interpretations of behavior based on the limited sample sizes. All of the components contain evidence for tool refurbishing. Component I might have some evidence for tool manufacture because cortical debitage amounts are comparatively high. Component III contained a bone tool fragment as well as a few flakes (Figure 8.19), indicating that more than lithic manufacture occurred, but the meaning of this is hard to determine.

## Sloth Hole Summary

This chapter briefly presents the previous research at Sloth Hole site, leading into a discussion of the geological framework of the site. I have defined seven major geological components spanning the period from 47,000 cal B.P. to the present. These strata show evidence for peat formation in a shallow pond prior to 30,000 cal B.P. At least one major colluvial episode occurred ca. 30,000 cal B.P. Sediments are then absent until the terminal Pleistocene and earliest Holocene, when there was another colluvial episode followed by soil formation. The early-middle Holocene sediments show that the sink was a shallow pond with periodic drying. Around 5000 years ago, peat formation began again. These three major periods of sinkhole infilling correspond exactly with those noticed by ARPP researchers (Dunbar 2006b; Webb 1998).

My excavations allowed me to define at least 3 distinct archaeological components in the sediments on the eastern margin of the sink. The oldest is associated with stratum IVa, and spans the entire Paleoindian period. Component I contains a Clovis-aged ivory point and numerous flakes in association with Early Archaic ages. Components 2 and 3 are undated but predate the 5,000 cal. B.P. peats, so are Early or Middle Archaic in age. Intact Paleoindian remains are only possible in four locations within the sink: in the stratum IVa soil, on the top of the Late Pleistocene colluvium (IIIb/IIIa contact), within undated unit IIIb, or on top of older sediments in the sink center in places where the colluvium did not cover prior deposits. I found no evidence for pre-Clovis deposits in my cores or excavation units. Materials found upon the northern and southern shoals are from highly deflated and conflated contexts and should be treated with suspicion. ARPP stratum 4 in the center of the sink (ARPP Area 2) seems to mostly contain tool types commonly found in Paleoindian assemblages, with little evidence for more recent intrusive material, but materials from this area also should be treated with some suspicion as they are overlain by sediments at least 6,000 years younger, meaning these materials may have lay exposed on the sink floor for thousands of years. In summary, the record from Sloth Hole indicates that artifacts within the sink accumulated as a result of both cultural and natural processes.

# CHAPTER IX

# WAYNE'S SINK (8JE1508/8TA280) RESULTS

This chapter discusses the results of all fieldwork conducted at the Wayne's Sink site, located in the main run of the Aucilla River approximately 4 km north of the current river mouth. This site had never been excavated prior to this fieldwork, but it was well-known to local avocational archaeologists who had collected numerous stone, bone, and ivory tools from the site. Because Wayne's Sink had never been professionally-excavated, the age and context of these materials was completely unknown. Further, the site's role in human activities in the area was also unknown. To define these, my work at Wayne's Sink consisted of a pilot study, underwater vibrocoring, underwater unit excavation, underwater surface collection, and terrestrial excavation. This site was the main focus of fieldwork for this dissertation.

## *Research Background and Pilot Study*

Wayne's Sink was originally recorded during the 1996 ARPP field season through contact with local collectors. Avocational archaeologist Wayne Grissett of Tallahassee had collected a number of artifacts from the site during the 1970s, including many stone tools, Early Archaic Bolen points, several atlatl hooks, and numerous antler points (Figure 9.1). ARRP members discovered a barbed ivory point and a large (approximately 20 cm) Early Archaic Bolen point during their 1996 visit in a sink just to the south of where Grissett had made most of his discoveries. Thus, two site forms were completed for the site. The area where the ivory and Bolen points were recovered was called Glory Hole, while the main part of the site was called Wayne's Sink.


**Figure 9.1. Artifacts collected from Wayne's Sink by Wayne Grissett.**

During our visit in November 2009, we discovered that the site is composed of a large area of limestone shoal interrupted by three moderately-large sinks (Figure 9.2). The centers of these three sinks contain layers of peats interspersed with clays; at least a few may represent submerged land surfaces as tree stumps and cypress knees are visible in the sink walls in some of these clays. The northern sink was infilled with sand and had a maximum depth of approximately 10 m below mean water level. Few artifacts were observed in this sink except for a large number of historic bottles. The southern side of the sink slopes gently upward to an area of limestone shoal that ranges from 0.75-2 m below mean water level. Numerous lithic artifacts, some ceramic artifacts, and common bones along with coarse sands were found within the vugs of these shoals. This shoal is approximately 40 m long, and leads into another, larger sink. This center sink is approximately 30 m wide, 35 m long, and 8 m deep. Its bottom is filled with bones and artifacts. Its southern side and the limestone shoals between it and the southern sink contain an outcrop of chert-bearing limestone that shows evidence of prehistoric quarrying, including numerous cores, large spalls, and at least one large hammerstone. This shoal is approximately 30 m long and is interrupted on the southeastern side by a third small sink. This small sink is only about 10 m wide and 4 m deep; several tree stumps were visible in the sides of this sink, and a few artifacts were observed in the bottom. A half-stained point midsection (possibly an Early Archaic Bolen) was recovered near the layered strata in the Middle sink during our reconnaissance (Figure 9.3). Numerous stained and unstained flakes were also noted in and around the Middle sink. This visit also confirmed that the artifact concentration was continuous between the southernmost sink with the ivory point and the rest of the site area, so the "Glory Hole" designation was dropped, grouping the entire area under the name Wayne's Sink.

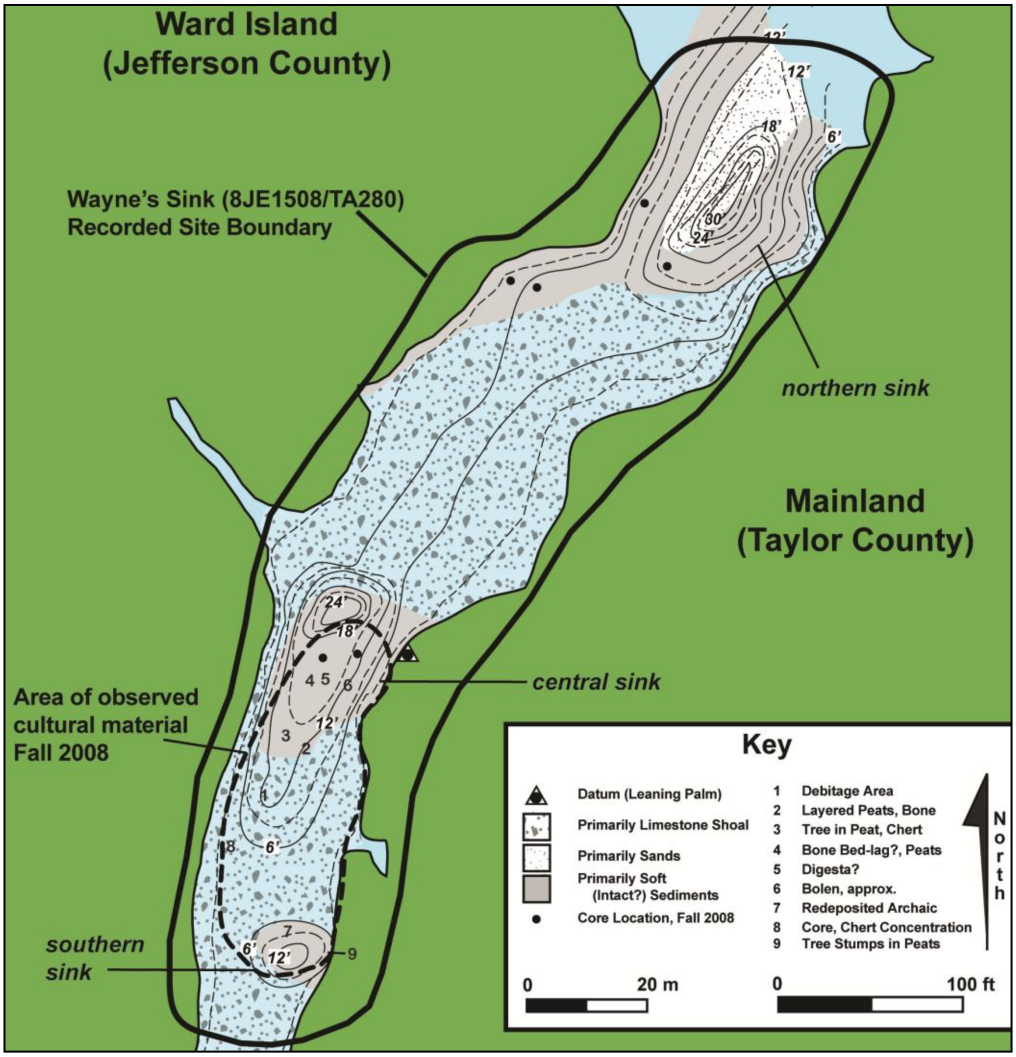



**Figure 9.2. Wayne's Sink Site sketch map as understood after pilot study.**

Six sediment cores were collected during the pilot study from various areas within the three sinks and in areas with soft sediments on the channel margin. These are shown in Figure 9.4 and discussed in Appendix II We also collected several bulk sediment samples from within the middle and northernmost sinks. These samples may be elephant digesta, based on similarities to digesta deposits from Page-Ladson

(Hemmings, personal communication, 2008), and they have been archived for future paleobotanical study.

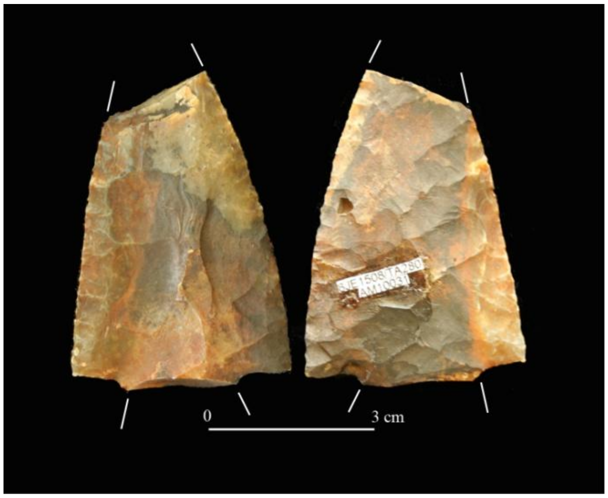



**Figure 9.3. Notched point midsection collected from surface context within Wayne's Sink.**

As mentioned in Chapter IV, Wayne's Sink was chosen as the focus for future fieldwork based on these pilot study findings. The site contained numerous Early Archaic and several Paleoindian artifacts, had evidence for prehistoric quarrying, and contained multiple areas with potentially-intact sediments. Thus, Wayne's Sink potentially had all the data necessary to address the major goals of my research. First, it seemed likely to have sediment records that spanned the terminal Pleistocene and Early Holocene, allowing me to reconstruct the geologic history of the area during this period. Second, it seemed to have cultural materials spanning the same period, allowing me to discuss site formation processes within this sink and human behavior in the area.

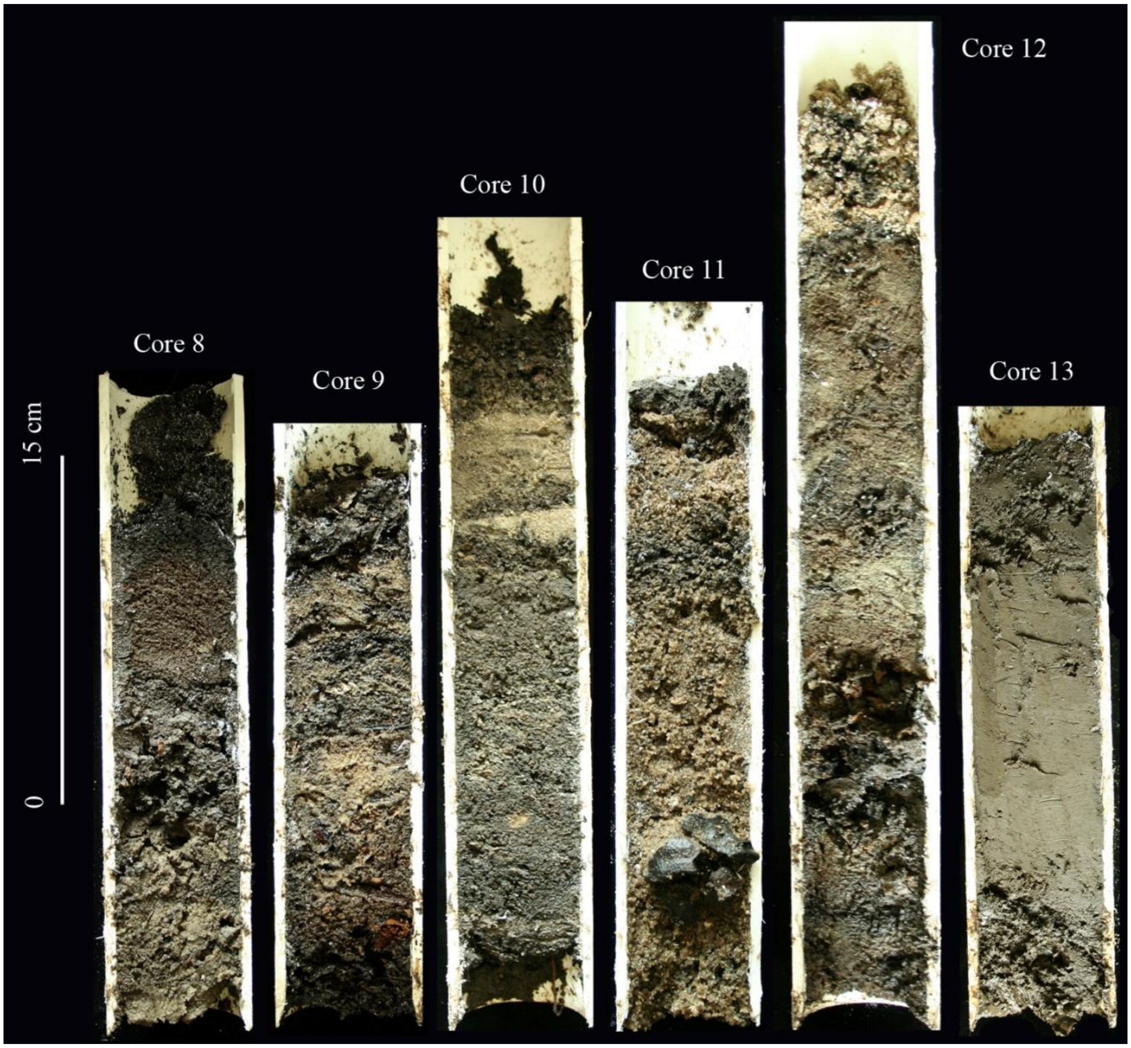



**Figure 9.4. Short PVC cores collected from Wayne's Sink during pilot study.**

## Defining the Geological Context

*Fieldwork*

The first step in defining site formation processes at Wayne's Sink was to define site geology. To this end, I conducted multiple phases of fieldwork, beginning with the pilot study, but also including vibrocoring, terrestrial testing, underwater excavation, and underwater surface collection. The six pilot study cores were placed to provide maximum coverage of the entire site. These cores helped me to define some of the variation within this portion of the river, but they were not long enough to be truly informative. No artifacts were recovered from the pilot study cores, but fish bones were common. I did not date any samples from the pilot study cores, but preserved organics were very common within them, and half of each core was retained and refrigerated for potential future study.

These short cores showed that the center sink contained the most intact sediments and visual inspection located the most artifacts in the same location, so the center sink became the focus of future studies. Thus, in Fall 2009, fourteen vibrocores were removed from two transects within the center sink to define the late Quaternary stratigraphy. Vibrocores 1-9 crossed the sink at its widest point, sampling sediments on both banks. Vibrocores 15-19 were placed on the western side of the sink, sampling the downstream sediment profile adjacent to Ward Island. These cores ranged from 45-194 cm long and contained evidence for a wide variety of depositional processes. Unlike the Sloth Hole vibrocores, these cores did not show a consistent series of sediments, so correlations were made on the basis of faunal content, sediment types, and radiocarbon ages. Several correlations were impossible until later unit excavations revealed some of the complicated facies within this sink. The details of these cores are presented in Appendix III. No artifacts were discovered, but fish bone was common, and some larger faunal remains (mostly turtle shell) were recovered from several cores. Organic preservation was very good in many of the cores, so a number of samples were used for radiocarbon dating.

I also placed six 1 x 1 m excavation units in three different areas on the margins of the sink. Excavation units (EU) 1 and 2 were excavated as a 1x2 m unit in July 2010 and were placed on the eastern side of the sink in the vicinity of vibrocore 4, which contained what looked like a paleosol in the bottom stratum. These units were excavated to a depth of 268 cm below datum (cmbd), and the units themselves were placed approximately 5 m and 5.2 m below mean water level. EU 5-8 were excavated in August 2011 (EU 3 and 4 were excavated at Sloth Hole in August 2010). EU 5 and 6 were placed on the western side of the sink to sample a thick sediment bank that contained potential soil development; these two units were excavated as a 1x2 m unit to a depth of 250 cmbd and were placed approximately 4 and 4.5 m below mean water level, respectively. EU 7 was placed on the southern margin of the sink at approximately 5.3 m below mean water level in an area of dense quarry debris to test for the possibility of stratified quarry deposits. This unit was only excavated to a depth of 50 cmbd because it contained just surface debitage lying directly on culturally-sterile peats. EU 8 was placed approximately 5 m north of EU 1 and 2 to explicate some complications of the stratigraphy at approximately 5.4 m below mean water level. This unit was excavated to a depth of 100 cmbd.

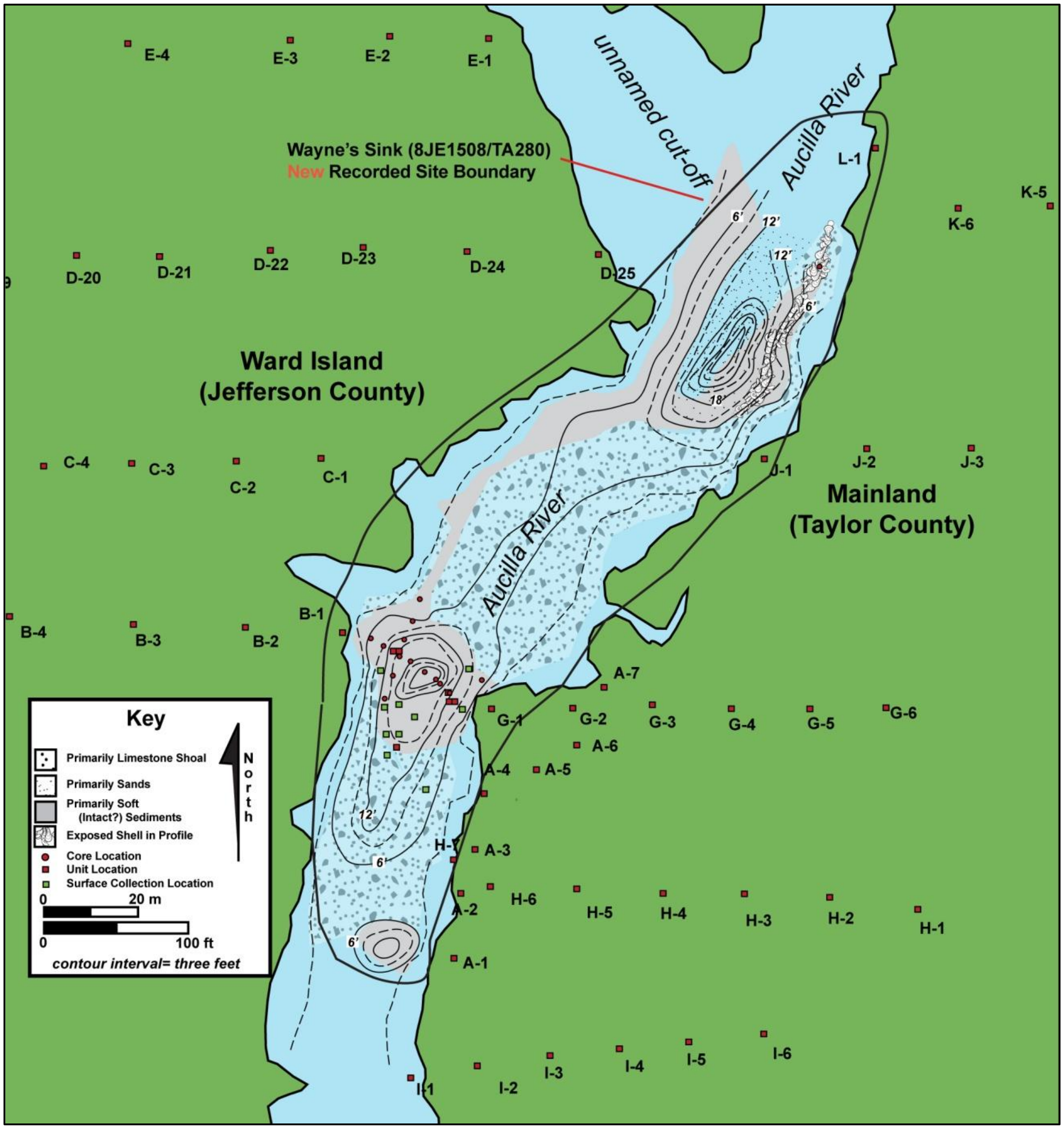



**Figure 9.5. Map showing locations of all fieldwork conducted at Wayne's Sink after the pilot study.**

In August 2011, 10 1 x 1 m areas were randomly selected for 100% surface collection to gather quantitative data about the distribution of bones and artifacts within and around the sink. Underwater visibility was exceptionally good during this fieldwork due to an historic drought in the area, so we were able to do an extensive visual survey of the underwater surface sediments. Finally, the terrestrial areas on both shores of the sink were sampled for cultural material by shovel and auger pits. Figure 9.5 shows an overview of the site with the placement of all testing conducted at the site after the pilot study, while Figure 9.6 shows a closeup of the central sink with all underwater testing labeled.

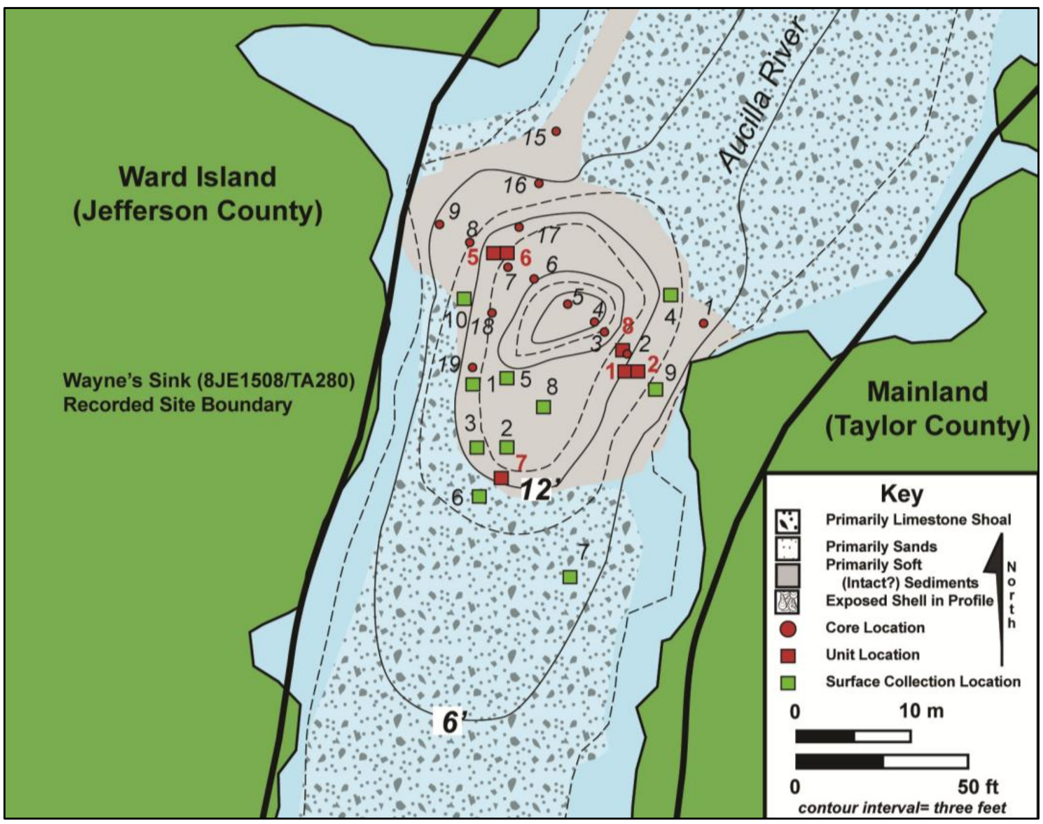



**Figure 9.6. Map showing closeup of underwater fieldwork at Wayne's Sink.**

*Stratigraphy*

The sediments observed in six excavation units, 20 cores, and approximately 50 terrestrial test pits, well as extensive visual inspection of the sink, were used to define the stratigraphic sequence of the Wayne's Sink site. I defined 11 different geological strata that could be correlated across the sink. Fifteen radiocarbon ages were obtained on the sediments; four of these ages were modern, but the remaining 11 were used to define the geological framework of the site. All four modern ages were obtained on botanical items extracted from the 1/16-inch screen fraction; the deeper sediments had poor organic preservation, and no suitable materials for dating were observed *in situ*. Unfortunately, all of the seeds separated from the fine screen fraction must have been intrusive or contaminated (Table 9.1). The 11 usable ages show that there were three or four major periods of sinkhole infilling encompassed by 11 different geological units. Table 9.1 presents the radiocarbon ages obtained from Wayne's Sink. All radiocarbon ages were obtained prior to the 2011 field season, so sediments within excavation units 5-8 were not dated. Numerous organic samples have been retained from all four EUs however, so further dating is possible.

Table 9.1. Radiocarbon Ages from Wayne's Sink. Rejected Ages Are Shaded.

| Stratum | Sample No. | 14C Age | SD | Material | Cal Max | Cal Min | EU/Core |
|---|---|---|---|---|---|---|---|
| IX | UCIAMS-97618 | 2,070 | 20 | peat | 2,109 | 1,993 | STP L-1, 50 cmbs |
| IX | UCIAMS-96275 | 2,220 | 15 | wood | 2,310 | 2,159 | VC 9, 28 cmbs |
| VIIIa | UCIAMS-96276 | 3,315 | 20 | wood | 3,570 | 3,484 | VC 9, 83 cmbs |
| VIIId | UCIAMS-97621 | 3,420 | 20 | peat | 3,693 | 3,640 | EU 1, 86 cmbd |
| VI | UCIAMS-96277 | 3,920 | 20 | twig | 4,419 | 4,299 | EU 2, 155 cmbd |
| VI | UCIAMS-97622 | 4,155 | 25 | bone-purified collagen | 4,817 | 4,626 | EU 2, 142 cmbd |
| VI | UCIAMS-96279 | 4,220 | 20 | wood | 4,841 | 4,728 | EU 1, 169 cmbd |
| IIIa | UCIAMS-96272 | 12,305 | 40 | wood | 14,481 | 14,042 | VC 4, 55 cmbs |
| Id | UCIAMS-96273 | 18,020 | 70 | twig | 21,571 | 21,351 | VC 5, 30 cmbs |
| Ic | UCIAMS-96274 | 21,650 | 100 | twig | 26,149 | 25,790 | VC 6, 136 cmbs |
| Ib | UCIAMS-97620 | 23,610 | 120 | humic acids | 28,540 | 28,165 | VC 8, 89 cmbs |
| from screen | UCIAMS-96278 | -405 | 20 | seed | | | EU 1, 160-165 cmbd |
| from screen | UCIAMS-96280 | -410 | 20 | seed | | | EU 1, 185-190 cmbd |
| from screen | UCIAMS-96282 | -2,945 | 20 | seed | | | EU 1, 245-250 cmbd |
| from screen | UCIAMS-96281 | 90 | 20 | seed | 253 | 34 | EU 2, 240-245 cmbd |

In the modern environment, limestone shoals upstream and downstream of the sink constrain stream flow in such a way that the eastern side of the sink experiences higher flow rates than the western side, resulting in a tidal and fluvial current removing fine-grained sediments on the eastern side, which are then swirled around the sink slowly to settle out on the western side. This may have been happening in the past, as significant clay banks are found on the western side of the site, which are absent on the eastern bank. In general, processes within this sink seem similar to those seen at Sloth Hole, where the western bank is more erosional, and the eastern side is a backwater with more deposition. Eleven major stratigraphic units have been described in the sediments at Wayne's Sink. Each stratum is discussed below in stratigraphic order from deepest to shallowest. All of these data were generalized to provide an outline of processes within the sink margins. Figure 9.7 shows the cross stream distribution of strata. Because the stratigraphy at this sink was so complicated, known correlations are marked with solid lines, while hypothesized stratum boundaries are designated with dashed lines and question marks.

*Stratum I.* Stratum I is an organic sediment ranging in texture from peat to sapropel and ranging in color from black to dark grayish brown. Occasionally, the mineral percentage dominates the organic and the stratum becomes a massive clay containing well-preserved wood fragments. Four sub-strata within this stratum probably represent different episodes of peat formation. Stratum Ia is a very hard peat with well-developed structure, while stratum Ib is a peat with more sandy inclusions and many more wood fragments. Stratum Ic is organic with traces of medium sand. It has very weak subangular blocky structure, and contains more clay and shell and some limestone gravels. Stratum Id is a massive organic stratum that contains no shell or limestone. No artifacts were observed in Stratum I, but fish bone and turtle shell were common. Stratum I was found at the base of all cores and units that were near the bottom of the sink; the thickness of this stratum is unknown because it was not penetrated in any of the cores or units. Stratum I probably formed in a shallow pond environment. I obtained three radiocarbon ages on stratum I (Table 9.1) that date the stratum to 28,500-21,300 cal B.P.

*Stratum II*. This stratum is a heterogeneous layer consisting of three sub-strata. Stratum IIa is approximately 30-50 cm thick and consists of a poorly sorted mixture of loamy sand with very common limestone gravels, cobbles, and boulders with common wood fragments. Stratum IIb is a silty clay with weakly defined structure, few limestone gravels, and common organics. It is approximately 50 cm thick. Stratum IIc contains coarse sands with some silt, but no gravels; pond snails are very common, and preserved organics are rare. This stratum is approximately 50-70 cm thick as well. Large turtle shell fragments are common throughout stratum II and gastropod shells, both whole and broken, abound. This stratum also extends throughout the sink as it is found in cores and units on opposite sides of the sink. This stratum was probably deposited by at least one, and possibly several, episodes of colluvial activity based on the mixture of grain sizes and the presence of limestone gravels and cobbles. It is undated but has tentatively been assigned a terminal Pleistocene age based on its relative place between stratum III and stratum I. Several pieces of debitage were recovered from stratum IIa in excavation units 7 and 8; see discussion of these materials in the geoarchaeological context section.

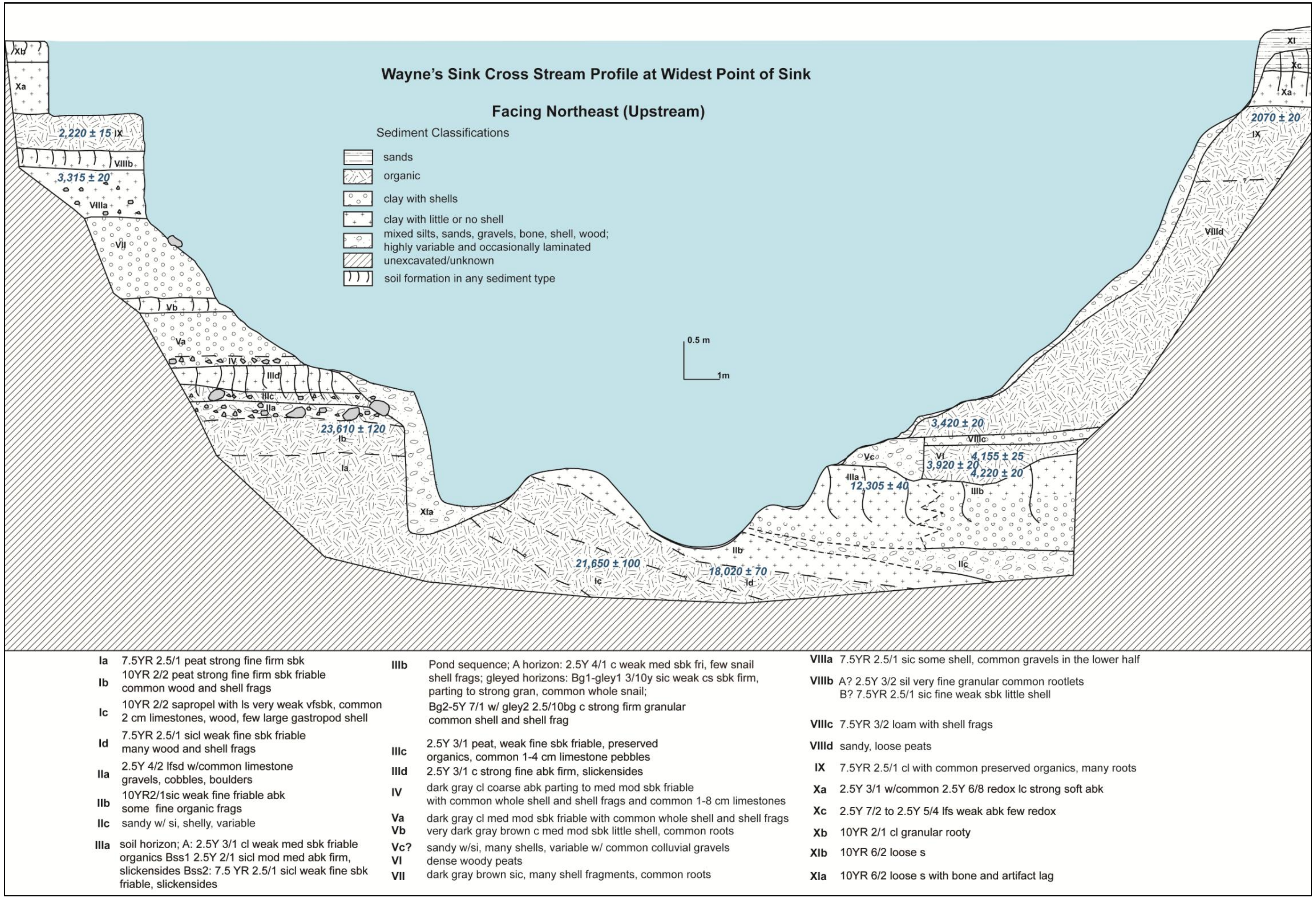



**Figure 9.7. Generalized cross section showing Wayne's Sink strata.**

*Stratum III*. This stratum is very clayey throughout with well-developed soil structure. Four substrata were assigned to this stratum-two on the western side of the sink and two on the eastern. On the eastern side of the sink, there is a facies within the stratum that caused stratum III to be split in two Stratum IIIa forms a paleosol that developed in a loamy parent material. The upper 30cm is an A horizon with preserved organics (very dark gray 2.5Y 3/1 clay loam, weak medium subangular blocky friable structure). This overlays a Bss1 that is 40 cm of black (2.5Y 2/1) silty clay loam with moderate medium angular blocky firm structure and slickensides. The bottom observed portions of this profile is a Bss2 (IIIa) horizon that was greater than 30 cm in thickness. This was a black (7.5YR 2.5/1) silty clay loam with weak fine subangular blocky friable structure with slickensides. This profile was observed in vibrocores 3 and 4 and excavation unit 8.

The facies between IIIa and IIIb was not observed, but IIIb is a shallow pond sequence that consists of an A horizon over two gleyed strata that overlay stratum IIc. The A horizon is 15 cm thick and is a dark gray (2.5Y 4/1) clay loam with medium weak subangular blocky friable structure and few gastropod fragments. This overlays 40 cm of gleyed (gley 1 3/10Y) silty clay with weak coarse subangular blocky parting to strong granular firm structure with common whole and fragmentary gastropod shells. This is followed by 15-20 cm of another gleyed clay (gley 2 2.5/10BG) with firm strong granular structure and common tiny gastropod and mussel shells; manganese balls were common, and the sediment oxidized almost immediately upon exposure to air.

Strata IIIc and IIId are located on the western side of the sink. They are correlated on the basis of the well-developed soil structure, although this correlation is tentative pending radiocarbon dating of the western sequence. IIIc is a peat with well-preserved organics, common limestone pebbles and cobbles, and weak soil structure. This stratum may actually belong with Stratum II, but was separated because the peat formed on top of the Stratum II colluvium. Stratum IIId is a clay with strong angular blocky structure and slickensides. It contains many roots and common open cracks from the slumping of underlying sediment.

Stratum III formed in a shallow pond environment with fluctuating water levels that led to some overbank deposition of sediments (IIIa) and some gleying of sediments (IIIb). The sequence on the western side is undated, but on the eastern side, stratum III returned a single age of 12, 305 ± 40 $^{14}$C B.P. (UCIAMS-96272) (14,481-14,042 cal B.P.) based on a twig collected from the A horizon (IIIa). Several radiocarbon samples were submitted from the fine screened portion of EU 1 and 2 from IIIb sediments, but no ages were obtainable: these materials obtained from the screen all returned modern ages. Artifacts were found within this stratum in EU 1, 2, and 5. Several larger artifacts, including two bone tools, were recovered from the top of IIIb (EU 1 and 2), but these items may be more properly associated with Stratum VI, as discussed in the geoarchaeological section.

*Stratum IV*. Stratum IV is a dark gray clay loam with friable coarse angular blocky structure, poorly sorted common fist-sized limestone, a few boulders, whole shell and shell fragments. It is approximately 25-50cm thick and was only observed on the western bank of the site. This deposit was probably caused by bedrock collapse leading to sinkhole expansion, with some clays infilling the gaps between the limestones; these clays were probably deposited in a shallow pond, based on the gastropod assemblage. The stratum is not dated, but a number of ivory fragments and a horse tooth were recovered from the stratum. These faunal remains are likely to be secondary context because they were recovered from within this poorly-sorted deposit. If they had been deposited in a primary context within the clays after the rockfall occurred, there should have been more extensive faunal remains (e.g., a whole horse jaw instead of a single tooth). This indicates that the original place of deposition for the Pleistocene faunal remains was probably the parent material for the colluvial deposit (i.e., higher up the sink banks or on a now-collapsed limestone overhang). Clearly, Pleistocene faunal remains were very available at the time this rockfall occurred. Because of this, I postulate a late Pleistocene or very early Holocene age for this deposition, but it is possible that the stratum is much younger. Four artifacts were recovered from this stratum in EU 5 and 6.

*Stratum V.* Stratum V consists of clay and clay loam and is made up of three substrata. Strata Va and Vb are both on the western bank and were observed in EU 5 and 6. Stratum Va is a dark gray clay loam filled with shells and shell fragments. It is approximately 50 cm thick. Stratum Vb is dark gray brown clay with little shell and common roots and is approximately 25 cm thick. This stratum has a drowned cypress knee that had grown through it and medium moderate subangular blocky structure. Because cypress knees need at least periodic exposure to air, this knee, in combination with the soil structure, is evidence of subaerial exposure. Stratum Va was probably deposited in a shallow pond environment, while Va accumulated as a series of overbank flood deposits. Stratum Vc, located on the eastern side of the sink, consists of coarse sands, poorly rounded gravels, whole and broken shell and preserved organics. This stratum is colluvial in origin. No radiocarbon ages are associated with stratum V, but it is hypothesized to be middle Holocene in age based on relative stratigraphic position. the occurrence of fiber-tempered pottery in Stratum Vc. Elsewhere, this pottery dates to 4,500-3,000 cal B.P. (Milanich 1994). Artifacts are associated with this stratum.

*Stratum VI*. Stratum VI consists of a series of woody peats located on the eastern side of the sink. No soil structure was observed in these peats, but there were several sand laminae that represent periodic storm deposits. This stratum ranges from 20-90 cm thick. These peats contain well-preserved organics with numerous cypress and palmetto seeds, and they probably formed in a shallow pond environment that was covered by a cypress swamp biome. Stratum VI, located on the eastern side of the sink, was recorded in vibrocore 2 and excavation units 1 and 2. Stratum V on the western side of the sink likely correlates to this stratum based on relative stratigraphic position. Three radiocarbon ages were obtained from the base of the stratum (Table 9.1) that range from 4,419 to 4,728 cal B.P., making stratum VI middle Holocene in age. Artifacts are associated with this stratum, and, in fact, one of the radiocarbon ages, 4,155 ± 25 $^{14}$C B.P. (UCIAMS-97622) (4,817-4,626 cal B.P.), was obtained on a bone point collected from this stratum from the side wall of EU 2. Numerous flakes and one other bone pin are also associated with this stratum.

*Stratum VII*. Stratum VII is a dark gray brown silty clay with many shells, both whole and broken, and many roots. This stratum was observed in the bank of the western side of the sink, but was not seen in any cores or excavation units. The clay was probably deposited in a shallow pond environment and is approximately 100 cm thick. No dates were obtained from this stratum, although the stratum capping it dates to 3,500 cal B.P., so stratum VII is probably also middle Holocene in age. No artifacts were observed in this stratum, but examination of the stratum was cursory.

*Stratum VIII*. Stratum VIII is composed of four substrata and is correlated by radiocarbon ages on both sides of the sink. On the western bank, stratum VIIIa is a black (7.5YR 2.5/1) silty clay with some shell and common poorly-sorted gravels in the lower half. This substratum is approximately 60 cm thick and was probably deposited by colluvial activity infilled by shallow pond clays. It is overlain by a 30-cm thick clay with soil structure (stratum VIIIb). Pedogenesis has formed a B horizon (black 7.5YR 2.5/1 clay with fine weak subangular blocky structure and little shell) overlain by a gleyed granular A horizon (very dark grayish brown 2.5Y 3/2 silty loam with very fine granular structure and common rootlets). This stratum was deposited in a shallow pond with common water table fluctuation through it to cause the gleying. This sediment may represent a former intertidal sediment. On the eastern side of the sink, this stratum is composed of a 15-cm thick loam (VIIIc) overlain by a 200-300-cm thick peat deposit composed of loose peats with common sand laminae (VIIId). The peats were deposited in a shallow pond environment, while the sand laminae represent storm deposits. Strata VIIIa and VIIIb were observed in the western bank but were only sampled in Vibrocore

9. Stratum VIIIc was only observed in EU 1 and 2, and Stratum VIIId was observed in multiple cores and all unites on the eastern side of the sink. A single radiocarbon date on stratum VIIIa returned an age of 3,315 ± 30 `$^{14}$C B.P. (UCIAMS-96276) (3,570-3,484 cal B.P.). Stratum VIIId was dated to 3,420 ± 20 $^{14}$C B.P. (UCIAMS-97621) (3,693-3,640 cal. B.P.). Artifacts were recovered from this stratum on the eastern side of the sink, but no artifacts were observed in the single core that sampled this stratum on the western side of the sink.

*Stratum IX*. Stratum IX is a 50-120 cm thick organic sediment present on both sides of the sink at approximately equal elevations. This sediment did not have obvious soil structure, but it contained many roots. On the eastern side of the sink, the organic content dominates, so it is a peat with few shells. On the western side, the mineral fraction dominates, making it an organic clay. This stratum is in the current intertidal zone of the river and is subaerially-exposed during low tides. Two radiocarbon ages were obtained on this stratum. On the western side of the sink, the stratum returned an age of 2,220 ± 15 $^{14}$C B.P. (UCIAMS-96275) (2,310-2,159 cal B.P.), while the eastern side at the very top of the stratum returned an age of 2,070 ± 20 $^{14}$C B.P. (UCIAMS-97618) (2,109-1,993 cal B.P.). No artifacts were observed in this stratum, but a flake was recovered from shovel test L-1 just above the peat.

*Strata X and XI*. Strata X and XI are both historic to modern. Stratum X makes up the current banks of the channel and the terrestrial sediments in the project area. These sediments consist of loams and clays with soil structure ranging from granular to prismatic with common redoximorphic features; these sediments are between 15-160 cm thick. This stratum was also found in the shovel test pits adjacent to the channel; see chapter VII for detailed discussion of sediments in shovel test pits. Artifacts were associated with stratum Xa in test pit L-1.

Stratum XI is a sandy stratum that ranges from 2-150 cm thick. On land and on channel side slopes, it consists of medium to coarse sand with some gravels. Within the channel bottom, this stratum is filled with a gravel, artifact, and bone lag deposit. The bottom of the sink is not infilled with modern leaves, which is common for some sinks. There is enough flow through the center of the sink, especially during ebb-tide, that fine-grained sediments and leaves are pulled through the sink.

*Summary and Depositional History*

Wayne's Sink contains a record of at least three major periods of sinkhole infilling. The first of these occurred just prior to and slightly overlapping the LGM from approximately 28,500-21,000 cal B.P. The second occurred during the terminal Pleistocene with a clay deposit that formed a soil that dates to approximately 14,000 cal B.P. and is probably time-transgressive. Third, this soil was overlain by mid to late Holocene-aged sediments spanning the period 4,800-3,400 cal B.P., which are overlain by late Holocene to modern sediments dating to 2,300 cal B.P. and younger. The gap between the mid and late Holocene sediments may be a factor of sampling rather than reflecting a true depositional hiatus. Figure 9.8 shows the strata within the sink grouped by these chronostratigraphic units. A number of depositional processes are represented within the sink sediments, ranging from colluvial pulses perhaps associated with sinkhole expansion and collapse to shallow water pond sediment deposition.

Stratum I seems to be time-transgressive, spanning the period from approximately 28,000 to approximately 21,500 cal B.P. In Wayne's Sink, this period was represented by shallow-water peat formation, meaning that a pond was in the sink during this time. During the LGM (approximately 21,000 cal B.P.), sea levels were as much as 130 m below present (Balsillie and Donoghue 2004; Peltier and Fairbanks 2006), so the Aucilla River would not have been running and the only water could have been from groundwater flow or rainfall. The Florida Aquifer would likely also would have been quite low (Donoghue 2006; Faure et al. 2002), so the springs may have not been flowing or were not flowing much, which leaves rainfall as the most likely source for the water. This period of peat formation coincided with a peak and decline in pine pollen records for Florida (Grimm et al. 2006), which Grimm and colleagues interpret as being a proxy for warm, wet climate conditions. Thus, there may have been enough rainfall to keep the sink wet enough to allow peats to form.

A peak in ragweed pollen at 21,000 cal B.P. indicates a return to drier, more open conditions. This may be represented in Wayne's Sink by the cessation of peat formation. This is further supported by the stratigraphic sequence in EU 7. This unit was excavated on the southern edge of the sink in approximately 5 m of water. The unit had surface sands filled with bones and artifacts lying directly on two different peat strata (strata Ia and Ib). In this excavation unit, these peats displayed very well-developed hard prismatic structure with common desiccation cracks that were infilled by the surface sands. This argues for some period of subaerial exposure and drying that allowed this structure to form. It should also be noted that stratum I is not continuous in the bottom of the sink;

large rotated peat blocks are common in the sink floor, which may have been caused by later sinkhole expansion, which could have been aided by periodic drying of the sediments.

There is a gap in the radiocarbon record from approximately 21,500 cal B.P. until 14,500 cal B.P. This latter age was obtained near the top of a well-developed soil sequence within stratum III (Table 9.1), so the actual deposition may have occurred earlier. The terminal Pleistocene period in this sink is somewhat complicated. Based on stratigraphic correlation, at least one colluvial mass wasting event started on the western side of the sink, possibly from sinkhole expansion, causing large limestone boulders to fall into the sides and fill the bottom of the sink with clays and small gravels (Strata IIa-IIb). Stratum IIb was covered by clays with some gravels (IIc). Although stratum II is undated, an ivory fragment was found in EU 1 Stratum IIc, which could indicate a Pleistocene age for this stratum.

After the deposition of stratum II, more clay was deposited (stratum III). On the eastern side of the sink, strata IIIa and IIIb represent a terrestrial/pond facies (Figure 9.9). Stratum IIIa was subaerially-exposed long enough to form a well-weathered terrestrial soil with defined A-$B_1$-$B_2$ horizons. Stratum IIIb was subjected to fluctuating water tables in a shallow pond that caused this sequence to become gleyed with manganese balls forming within the lower portion; these sediments were also highly bioturbated by pond snails. Spring seeps are (and probably were) very common in the bottom of these sinks (we reopened one during the excavation of unit 7, for instance), so localized damp spots are quite common and may have been equally common in the past.

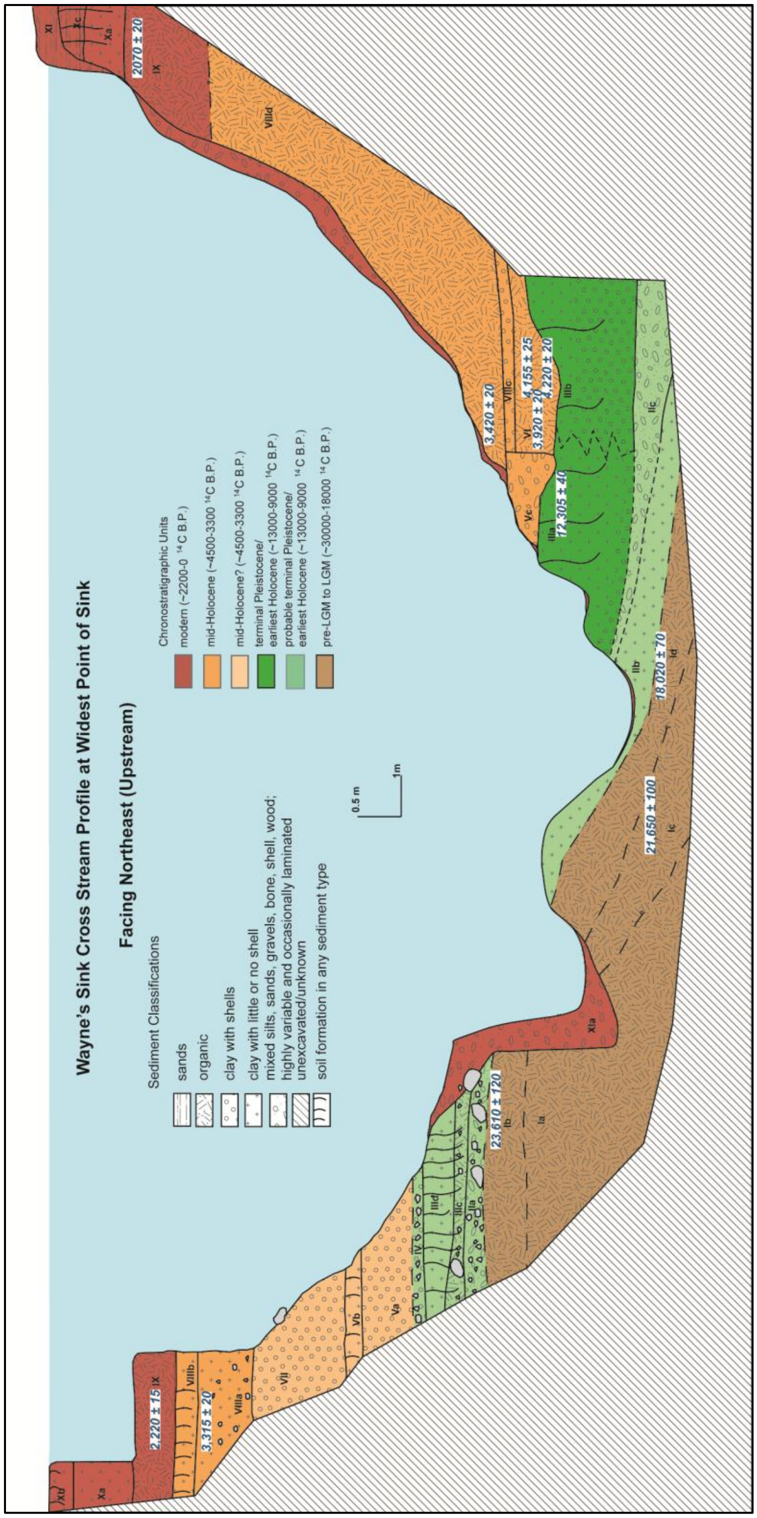



**Figure 9.8. Generalized cross section of Wayne's Sink showing chronostratigraphy.**

Strata IIIc and IIId, if they do correlate with this sequence, represent a switch from wet conditions to drier conditions with subaerial exposure on the slightly higher western side of the sink, as IIIc is a peat indicative of constant submergence while IIId has well-developed firm angular blocky structure with slickensides. Stratum III was then capped by another sink expansion event, depositing stratum IV, which contained Pleistocene faunal fragments; thus, it is likely that stratum IV was deposited within or just after the Pleistocene.

Because stratum III has only one radiocarbon date and stratum IV has none, their true chronological relationship is unknown, but some period of stability is represented by the soil formation. Water levels in the sink presumably had to rise sometime before or around 14,000 cal B.P. to deposit the sediments, followed by a water level drop that exposed the sediments to soil formation processes. Sea levels were rising steadily from 15,000 cal B.P. to 11,600 cal B.P. (see Table 3.1), with the only noticeable drop in water occurring during the Younger Dryas (12,900-11,600 cal B.P.). Although it is very possible that localized drying may have occurred during some other period, it is also possible that this soil formed during its exposure during the Younger Dryas. The Page-Ladson pollen data indicate that around 12,500 $^{14}$C B.P. (14,300 cal B.P.), cypress pollen percentages peaked and then declined as hardwood mesic species increased in frequency (Hansen 2006). Ragweed pollen increased greatly during this time until around 12,300 $^{14}$C B.P. (14,100 cal B.P.), which is usually indicative of local disturbance and dry environments (Hansen 2006).

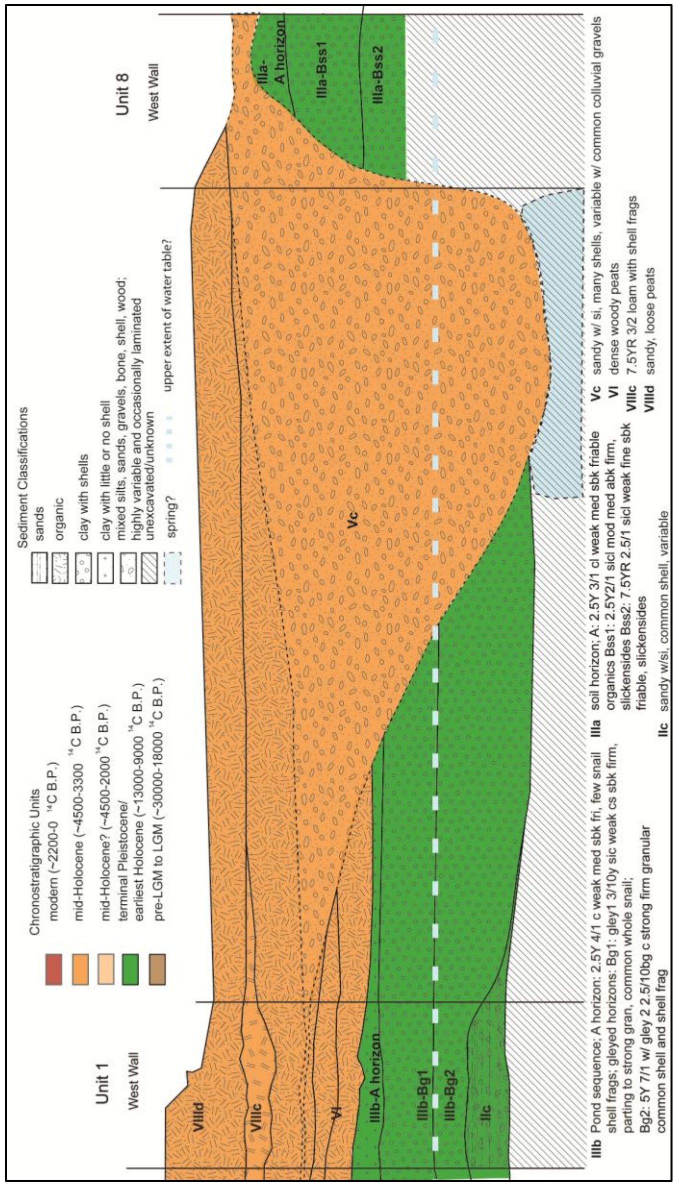



**Figure 9.9. Possible reconstruction of the relationship between strata IIIa and IIIb based on EU 1 and 8 profiles, facing west. Sediments between the EU profiles are interpolated.**

Based on the artifact data from EU 1 and 2, it is possible that the surface of stratum III was exposed until the mid-Holocene. Regardless, there is a gap in the radiocarbon dates within the sink from the terminal Pleistocene until the mid-Holocene.

Around 4,800 cal B.P., shallow pond deposition resumed in the eastern portion of the sink, with nearly a meter of peats (Stratum VI) deposited in this area over stratum III between 4,841-4,200 cal B.P. The tentative corollary of stratum VI on the western margin of the sink is stratum V. Stratum V consists of pond deposits that infilled the colluvium of stratum IV, capped by a brief period of subaerial exposure and soil formation. Figure 9.8 is a tentative reconstruction of these strata based on the profiles of EU 1 and 8.

At approximately 5,000 cal B.P., sea levels (Balsillie and Donoghue 2004; Milliken et al. 2008; Peltier and Fairbanks 2006) and environments (Grimm et al. 2006; Hansen 2006; Watts and Hansen 1994) were approaching modern, with near-modern climate conditions. It seems that the eastern portion of the sink stayed consistently, or near-consistently, wet during this period, allowing for peat formation. Sediments on the western side were not submerged as deeply, so were periodically exposed, and circulation patterns within the sink continually deposited silts and clays on this side of the sink, which were then occupied by pond snails. This sequence developed weak soil structure during periods of exposure. After this exposure, pond deposition resumed, presumably with higher water levels stratum VII), but prior to 3,500 cal B.P., another colluvial event happened, depositing more limestone on the western bank (stratum VIIIa), and depositing a sandier loam on the peats of stratum VI (stratum VIIIc). The sequence of peat formation on the eastern bank (VIIId) and clay deposition on the western bank (stratum VIIIb) then resumed until this sediment was again exposed to soil formation processes on the western bank sometime prior to 2,300 cal B.P. The peat preservation on the eastern side of the sink probably was related to increasing moisture during the Holocene; sediments on this deeper side of the sink were not regularly desiccated, so the organics preserved.

At some point prior to 2,300 cal B.P., peat formation resumed on the eastern bank, while clay filled with preserved organics was deposited on the western side (stratum IX). These strata were deposited at roughly equal elevations and are both currently in the intertidal zone. These were probably deposited in water levels and stream conditions somewhat similar to today. Modern sediments overlay these. On the banks are clayey soils formed in a combination of alluvium and decomposing limestone (X), with sandy sediments probably deposited during storm events covering the channel bottom and eastern slope (XI).

## Geoarchaeological Context

The general geological framework I have defined can now be used to help explicate the context of cultural material at Wayne's Sink. As noted above, no artifacts were recovered from any of the cores, but the six 1 x 1 m units excavated at the site all contained at least some cultural material. The 10 surface collection 1 x 1 m units contained significant amounts of both artifacts and bone. Finally, one terrestrial test pit was positive for cultural material. All of the excavation units were screened through 1/16 inch mesh, allowing for the recovery of very small items. In numerous levels, the only artifacts observed were items that would have been lost with any larger screen size.

These tiny artifacts are probably more informative of post-depositional processes than cultural ones. In total, I recovered more that 250 artifacts from within the four excavation units at Wayne's Sink. Each set of units is presented below.

*Excavation Units 1 and 2*

A total of 183 artifacts were recovered from EU 1 and 2. These two units were excavated as a 1x2 m unit during July 2010 on the east side of the channel. The upper 150 cm of these excavation units consisted of alternating peats and sand lenses, strata VI, VIIIc, and VIIId (Figure 9.10). These two excavation units contained a number of artifacts in these upper level peats, including a bone point that was radiocarbon dated to the mid-Holocene and a bone pin that was not dated. These two bone items and a large flake were recovered from a thin peat lens (stratum VI) overlaying the clay-rich A horizon of stratum IIIb and probably all came from the same archaeological component, which dates to approximately 4,800-4,600 cal B.P. based on overlapping ages of the peat and the bone point; this is labeled Component II on Figure 9.9.

There is no definitive evidence for Paleoindian or Early Archaic occupations in EU 1 and 2. Only nine flakes were recovered from the IIIb clay strata. These strata are hypothesized to date to the terminal Pleistocene based on correlation of the A horizon with the dated A horizon of stratum IIIa, but these clays are undated. Six of the nine recovered flakes were distributed widely throughout the nearly 100 cm of clay. The only potential evidence for Paleoindian activity is three flakes that were discovered in the southwest corner of EU 1, 240-245 cmbd. These were recovered from just above the contact of IIIb/IIc; they were not observed *in situ*, but were closely attributed to this location and elevation after they were discovered in the screen.

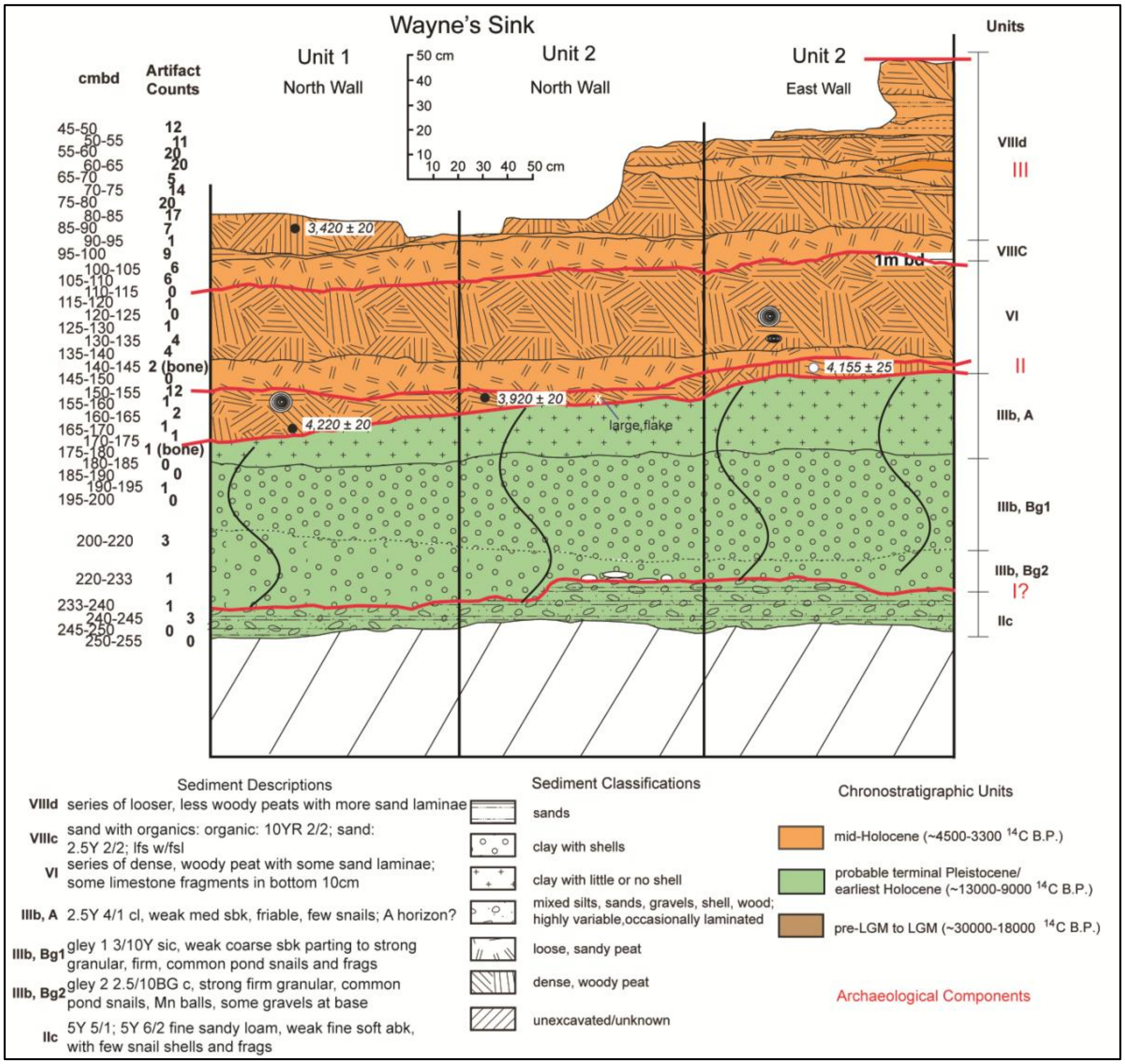



**Figure 9.10. North and east walls of EU 1 and 2.**

I have tentatively assigned the artifacts from these two excavation units to three possible archaeological components. Component I is the possible early component consisting of these three flakes recovered from the IIc/IIIa contact, although further excavation is necessary to confirm this association. Component II is in the bottom of Stratum VI, lying on or near the contact with Stratum IIIc. Component III, with the densest material remains, is associated with Stratum VIII at the top of the sequence.

Component I, if it is real, may be in secondary context. The surface upon which it rests is a lag surface with common gravels. However, alligator bone discovered on this contact was still nearly articulated, so this context is not completely disturbed. Further research would be necessary to determine if these three flakes are, in fact, the ephemeral remnants of Paleoindian or Early Archaic activities at the site.

Component II is associated with the top of stratum IIIb and the bottom sub-stratum of stratum VI. This component consists of 16 pieces of lithic debitage and two bone tools. One is the bone point that was radiocarbon dated (Figure 9.11); the other was a small bone pin. A large flake was also plotted at the contact between strata III and IV; this is shown in Figure 9.9. While both piece-plotted artifacts were found within the peat on top of stratum III and the bone point dates to the same time as the peat (4,817-3,640 cal B.P.), it is unclear if the artifacts were deposited on the A horizon, or if they were deposited within the peat and redistributed downward, as at least some of the smaller flakes were found within the top 5cm of the clay layer. It is also possible that more than one occupation is represented on this surface, especially if the A horizon was subaerially-exposed for a long period.

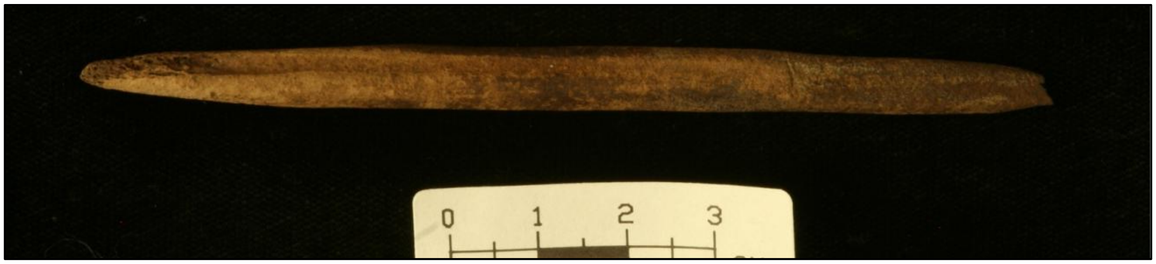



**Figure 9.11. Bone point from Component II before radiocarbon sample was removed.**

If the artifacts are associated with the surface of IIIb, they potentially represent multiple cultural periods, as this surface was exposed at least periodically for several thousand years. If the artifacts are found within the peats of VI rather than at the contact or within the surface of IIIb, they are much more likely to represent a single component that either was deposited by Late Archaic people (5,000-2,500 cal B.P. [Milanich 1994]) during a brief drop in water level or that was redeposited by fluvial processes into the peat. This latter scenario is possible; the large flake would have required a great deal of energy to transport, but one other larger limestone cobble was recovered from this stratum; a few oyster shell fragments (only available at the coast) were also recovered. However, it seems likely that a storm surge large enough to bring oysters several kilometers inland would have also left a significant sand deposit, which was not observed. Thus, it seems more likely that Component II was deposited as a result of cultural activities. Further excavation of a larger block could help determine if this is a single component, or if multiple occupations occurred on the A horizon.

The final component, Component III, is associated with the upper peat layers of the excavation units (stratum VIII). This component dates to less than 3,500 cal. B.P.

based upon a single radiocarbon date obtained from this layer. Most of the flakes were probably washed in from above or from upstream; they do not vary greatly in grain size from the coarse sands found within the peats. Most of the flakes within these strata are size class 1 (<1cm) (98 of 143). Further, this geological unit was probably deposited relatively rapidly as an age of 2,100 cal B.P. was obtained on the overlying stratum VIII. Thus, I have grouped nearly 50cm of depth into this single Late Archaic-aged component. There are two peaks in flake density in this component from 55-65 cmbd and 70-85 cmbd, and the only two large flakes (size 3+) were found in 60-65 cmbd and 80-85 cmbd, respectively, so Component III probably could be designated IIIa (lower) and IIIb (upper), but they are grouped here because they are approximately contemporaneous and are probably the result of the same processes. This component is likely the result of repeated redeposition of small debitage during storm events, possibly in combination with episodic use of the sink margin during brief periods of subaerial exposure. However, water levels would have had to have been quite low in the sink (4-5 m lower than present) for this exposure to have occurred.

*Excavation Unit 8*

This unit was placed approximately 5 m north of EU 1 and 2 near vibrocore 4 to try to relate the stratigraphy from EU 1 and 2 and the vibrocore. This core revealed the well-developed soil sequence of IIIa reported above, while EU 1 and 2 had the IIIb pond sequence. A radiocarbon age of 12,305 ± 40 $^{14}$C B.P. (UCIAMS-96272) (14,481-14,042 cal B.P.) was obtained on a piece of wood from the A horizon in IIIa within the vibrocore. Organic preservation was very poor in EU 1 and 2, so no ages were obtainable even though several samples were submitted. Thus, it was important to expose more of the sediment sequence to correlate these areas.

EU 8 was excavated to a depth of 100 cmbd, well into the Bss horizon under the 14,300 cal B.P. age in IIIa. All but the southern 20 cm of this unit had the same stratigraphy as VC 4. EU 8 was serendipitously placed exactly at the edge of an erosional channel that had been filled in by a major slumping event that occurred prior to peat formation in this area. Figure 9.12 shows all four wall profiles of this unit to display the edge of this channel. Figure 9.9 shows how I interpolated the stratigraphy between EU 8 and EU 12.

This unit contained only 17 total artifacts in deposits reaching a meter of depth. This included four ceramic sherds and 13 pieces of debitage. The four sherds were undecorated, thick-bodied, fiber-tempered pottery. This pottery dates to the Orange period, approximately 4,500-3,000 cal B.P. (Milanich 1994), which is the earliest pottery in Florida and spans the Archaic-Woodland transition. These are the only ceramic artifacts that were recovered from any underwater excavation units, although a few dozen sherds were retrieved from surface contexts. The largest sherd was found on the contact between Strata Vc and IIIa. Stratum Vc is a colluvial sandy stratum with very common whole and broken shell and limestone gravels, helping to confirm the age of this stratum. The other sherds were found in lower levels, and were probably associated with Stratum Vc on the southern margin of the excavation unit, as stratum III is Pleistocene in age.

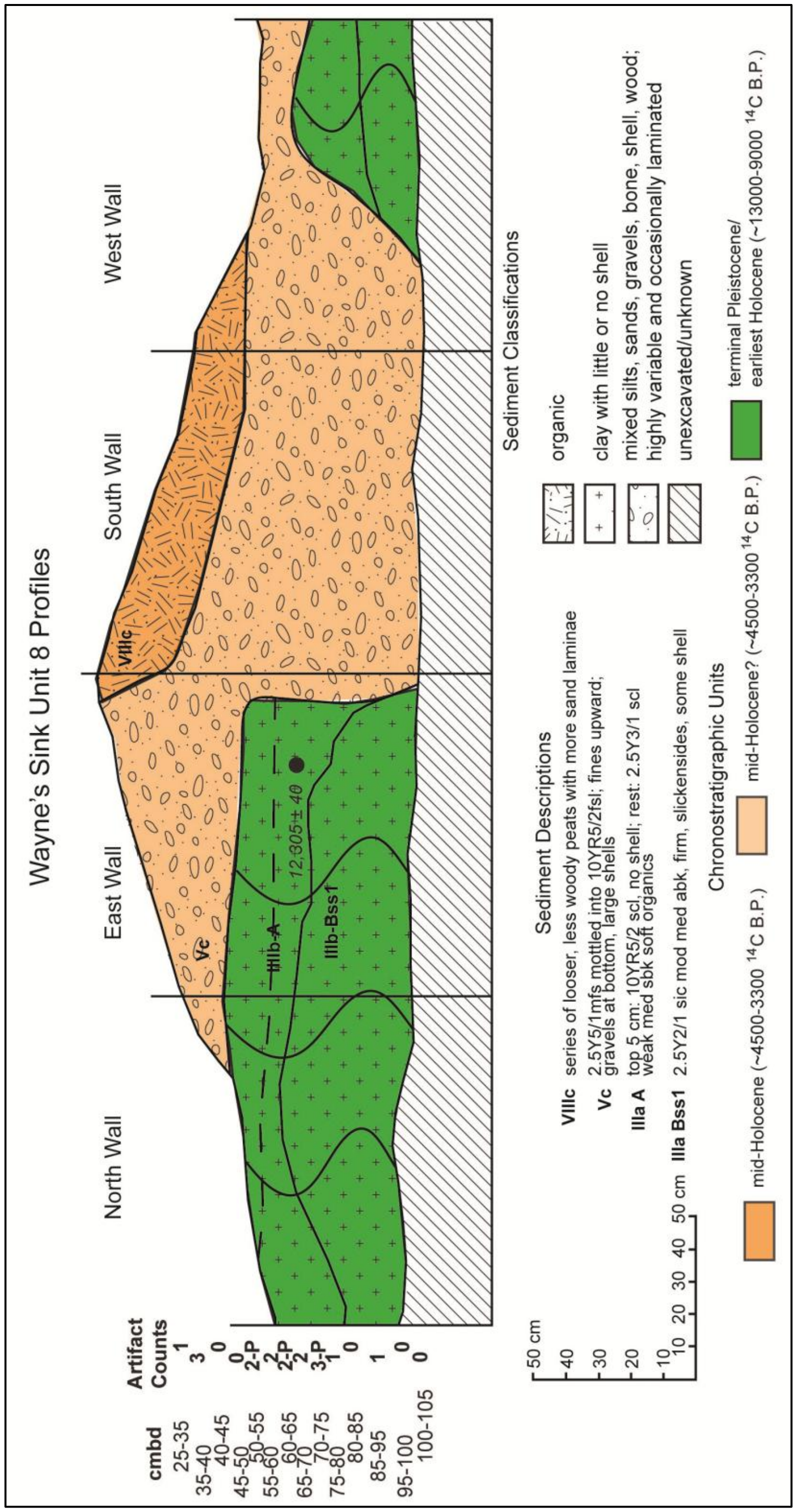



**Figure 9.12. Profiles of EU 8.**

The debitage from this unit shows no evidence of clustering by level (Figure 9.11); however, the size distribution of the artifacts from this unit is different than distributions from all other excavation units. In all other EUs, the majority of flakes were size class 1 (<1 cm). In this unit, only four of the 13 flakes recovered were size 1, and two flakes were relatively large (size 3; 3-5 cm). This is especially notable because there were numerous small gravels and coarse sand-sized particles in each level, with large cobbles in a few levels. Therefore, this low number of small flakes is probably not due to grain-size sorting. This is potentially related to cultural activity, even may possibly be related to Paleoindian activities that occurred in or on stratum III, but it is difficult to make any definitive statements because of the small sample size. No cultural components were assigned to this unit because of the small sample and because the colluvium disturbing the southern portion of the unit seems to have blurred the cultural signature of the deposits.

### *Excavation Units 5 and 6*

EU 5 and 6 were excavated in August 2011. These units were placed on the western margin of the sink and were excavated to a depth of 250 cmbd on the edge of a large clayey sediment bank that contained evidence of multiple depositional episodes and multiple periods of soil development (strata Ib-VII) (Figure 9.13). Numerous artifacts were also observed at the bottom of this sediment bank. EU 5 was excavated in 5 or 10 cm levels from top to bottom following the protocols used in all other units (see Chapter IV), but EU 6 was excavated largely to provide access to EU5. Therefore, level thickness varied. All materials were still screened, and large items were still mapped in place, but the vertical resolution of smaller items is not as precise in EU 6. In Figure 9.13, plotted artifact counts only refer to the counts from EU 5.

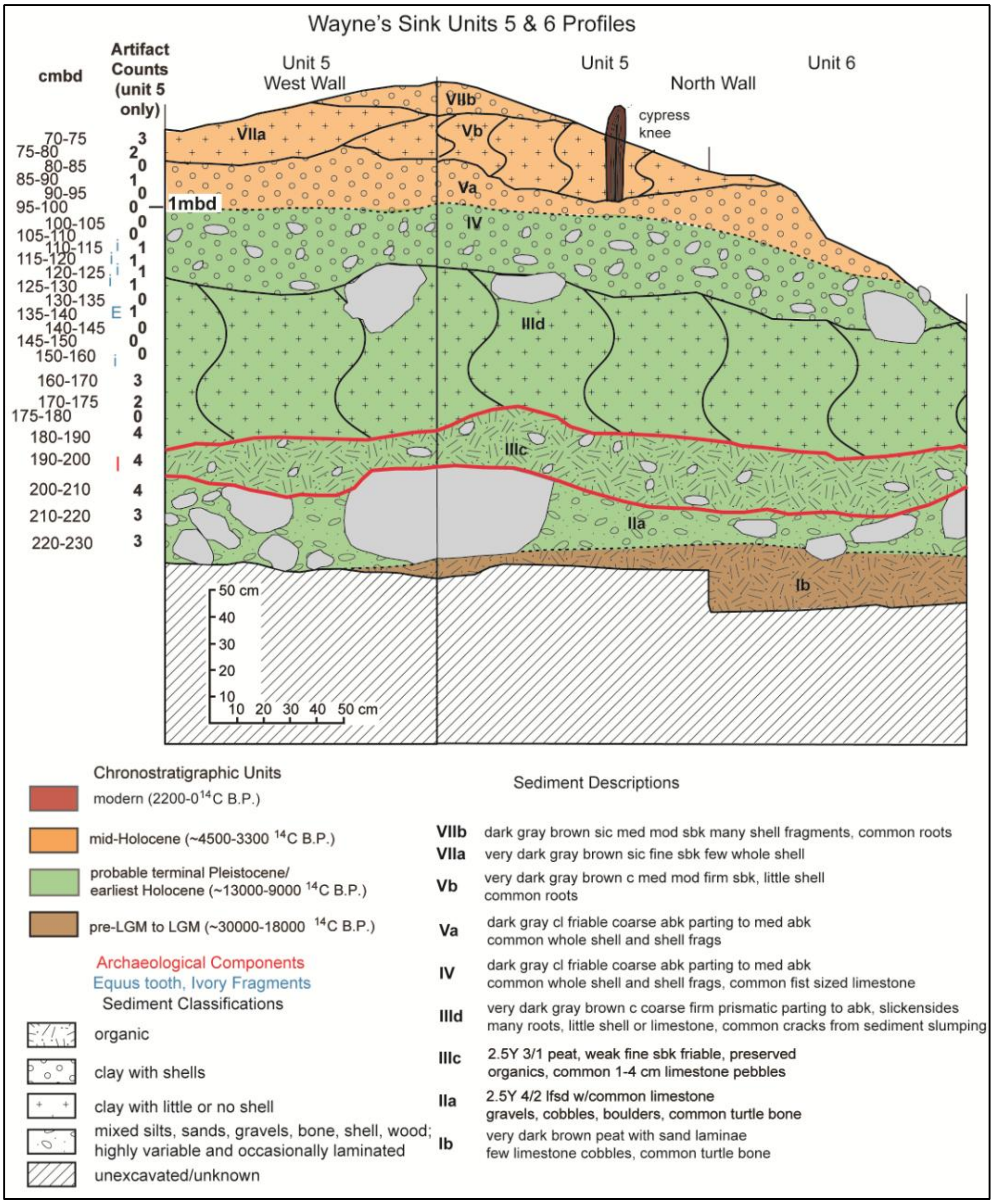



**Figure 9.13. Profiles of EU 5 and 6.**

A total of 34 lithic artifacts were recovered from EU 5; all but five were size class 1; an additional 30 came from EU 6; all except one of these was also size class 1. In other words, artifacts were rare and small within these units. Despite at least two periods of soil formation, subaerial exposure, and relative surface stability (see Figure 9.8), there was no compelling evidence of prehistoric occupation as opposed to artifact redistribution in these two excavation units. I have tentatively assigned the single archaeological component to stratum IIIc, as artifact counts for this stratum are relatively high compared to the rest of the levels from these units. As discussed above, this stratum probably dates to the terminal Pleistocene. There are no other real concentrations of cultural material in EU 5 & 6.

Ivory fragments and a horse tooth were found within stratum IV, potentially dating this stratum to the terminal Pleistocene. Because this stratum was deposited by a mass wasting event of some kind, however, it is possible that these Pleistocene faunal remains were within the original limestone gravels prior to their redeposition, in which case the unit could be significantly younger. Low amounts of debitage that can be found throughout the profile are probably the result of bioturbation when sediments were subaerially exposed. Numerous artifacts can be found on the sink surface, and several of the strata had significant open desiccation cracks. Given that almost all of the debitage from this unit was found only in the 1/16-inch screen, these artifacts could easily have washed onto the unit surface and worked their way down the profile. Based on these findings, the western bank contains much less archaeological material than the eastern bank of the sink. There seem to be relatively intact sediment sequences on the western bank, but they do not seem to have been occupied by humans in the area tested.

*Excavation Unit 7*

EU 7 was excavated in August 2010 to a depth of 50 cmbd. This unit was placed on the southern margin of the sink adjacent to the limestone bedrock in an area where large amounts of quarry debris mixed with sands and bones were visible on the sink surface. This unit was placed here to see if stratified quarry debris could be found. Unfortunately, this was not the case (Figure 9.14). Approximately 10-15 cm of sand (stratum XI) was removed from the unit, which yielded 11,603 g of bone, 155 g of unmodified ivory, another 114 g of teeth, 16,223 g of lithic artifacts, 69.8 g of pottery, and 66 g of bottle glass in the 1/4" screen. This included several biface fragments, including one mid-stage lanceolate base, and several possible bone tool fragments.

Once this sandy deposit was removed, however, stratum Ia and Ib sediments (in this case, sapropels) were revealed. Excavation of the unit continued for several levels to confirm that these were basal peats. During these excavations, an area of elephant digesta was mapped in the northeastern portion of the unit, and a spring was reopened in the southeastern portion of the unit. This spring ejected cold fresh water during the rest of the excavation, and eroded the floor of the unit. The sapropels that made up the unit floor were very compact with well-developed prismatic structure. Sand and artifact infilled desiccation cracks riddled the unit. While numerous flakes were found throughout the excavation unit, all observed cultural material came from these cracks, and none could be assigned to the peats. Given that the peats date in excess of 21,000 cal

B.P. elsewhere in the sink, this is not surprising. Excavation of this unit ceased after it was confirmed that it did not contain any stratified quarry deposits and only contained artifacts in secondary context.

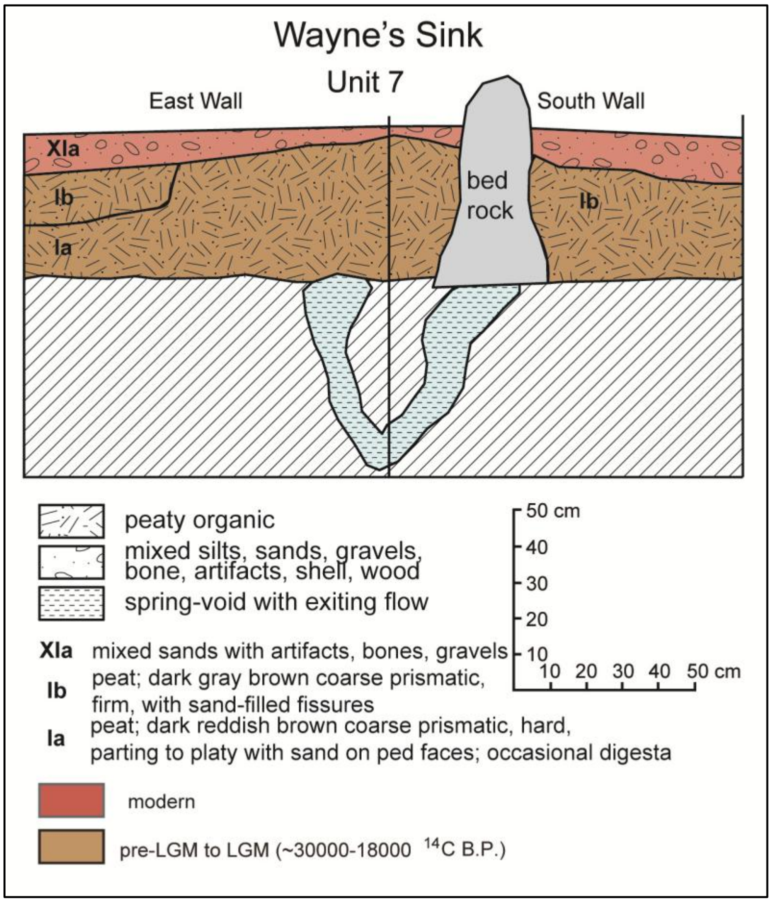



**Figure 9.14. Profiles of EU 7.**

*Terrestrial Investigations*

The terrestrial survey was designed to determine if there were terrestrial archaeological components corresponding to the artifact concentrations in Wayne's Sink. Only one of the pits along the sink margin contained cultural remains, L-1. This would seem to indicate that no artifacts came into the sinks from the river banks, but this is somewhat deceptive. Most of the test pits that did not reach bedrock were also located on the margins of the river channel. In fact, several of these deep test pits had peats on the bottom, the most common type of sediment in the sink proper. However, pits placed 20 m west or east of the shore generally reached limestone bedrock less than 70 cmbs (see Figure 7.1). The majority of the shovel test pits flanking Wayne's Sink had wetland soil profiles of gleyed marls overlaying bedrock that were generally less than 1 m in depth (see Chapter VII). No artifacts were recovered from these sediments. Therefore, it is unlikely that there are large intact preserved sites on the margins of Wayne's Sink that are currently eroding into the sink, but there may be remnant cultural deposits within the 10m or so of the channel margins, and it is possible that a site completely eroded into the sink in the past, leaving no traces on the land.

The only test pit that contained cultural material in the vicinity of Wayne's Sink, L-1, was at least 100 m north of the submerged artifact in the central sink (Figure 9.5). This test pit was placed because a number of artifacts were observed on the ground surface in an eroded bend of the Aucilla channel. These included several sherds of Deptford pottery, flakes, cores, and a piece of groundstone. These artifacts were all located on the clay (stratum Xa) that made up the base of this eroded area, which was extremely hard and gray (gley 15/N) with many organics and coarse angular blocky structure with slickensides. While excavating this profile, a heat-treated chert flake was found within the clay approximately 15 cm above a dense peat deposit (stratum IX) that was dated to 2,070 ± 20 $^{14}$C B.P. (UCIAMS-97618) (2,109-1,993 cal B.P.) (Figure 9.15). This clay deposit is the most likely origin for the other artifacts also.

**Figure 9.15. Flake in profile of L-1 above peat stratum just above trowel blade.**

Given that Deptford ceramics date to approximately 2,500-1,800 cal B.P. (Milanich 1994), almost contemporaneous with the peat, either the clays and artifacts were deposited nearly simultaneously after peat formation ceased or the artifacts were abandoned and then were washed into the clays at a later date. This clay probably represents a subtle floodplain levee; in other words, the clay would have slowly accumulated on the banks with seasonal flooding, so cultural materials abandoned within would probably have relatively good locational context, but may or may not have good organic preservation depending upon how long they had been left on the surface before being covered by the next flood episode.

*Context of Cultural Material*

Nearly all of the artifacts recovered from Wayne's Sink were from surface contexts on the sink bottom and on the top of the excavation units. Ten 1 x 1 m surface collection units were placed randomly on the bottom of the sink in order to help explicate how materials arrived in the sink. These surface materials were simply sorted by type and weighed to provide relative amounts, but they were still very informative. Table 9.2 presents these data. The location of these units is shown on Figure 9.5.

First, while bones can be found anywhere in the sink bottom, bone tools were found almost exclusively on the eastern margin of the site just below the peat deposits (strata VI, VIIIc, VIIId); thus they probably eroded from these peats, and are most likely to be Late Archaic or younger in age. Second, flakes can be recovered almost everywhere in the sink bottom with close inspection, but by far the densest amounts are recovered from the rocky chert-bearing shoals on the southern side of the sink, with the shoals on the northern side following closely behind. Third, surface artifact density on either the western or eastern margins of the sink are very low, and these artifacts are most commonly found at the eroded edges of sediment banks; thus it seems unlikely that many of these artifacts (at least the large ones observable without screening) are washing onto the sink margins from either upstream or downstream. Instead, it seems most likely that they are eroding from the immediately adjacent sediment banks.

Further, very few, if any, artifacts are currently eroding into Wayne's Sink from onshore. The terrestrial deposits adjacent to the sink were shallow and negative for cultural material except on the very margins of the channel. However, it is possible that the dense material culture on the shoals partially represents remnant terrestrial deposits that have been deflated and conflated. If water levels in the sink were lower, these shoals would have been exposed and potentially were covered with sediments. If people were utilizing these areas, as water levels in the sink rose and the fluvial system again flowed, these archaeological deposits would be winnowed along with the sediments. There is also evidence for bank slumping on the western sink margin (the numerous rockfall/colluvial events), so it is possible that portions of sites have also slumped into the river, to be slowly reworked into the surface contexts within the sink.

Table 9.2. Surface Collection Information.

| Surface Collection | Lithic count | Lithic weight (g) | Bone tool weight (g) | Pottery | Faunal count | Faunal Weight (g) | Historic Materials (g) | Notes |
|---|---|---|---|---|---|---|---|---|
| 1 | 12, 1 bifacial core | 291 | 1 midsection: 4.2 g | | 15- some large mammal | 356 | pocketknife, feather edge transferprint, shell casing: 31 | 1 whelk, 2 oyster shells |
| 2 | 13, 1 flake tool (spokeshave) | 913 | none | | 34- common large mammal | 1478 | 1 1970s beer bottle: 191 | |
| 3 | 5, 1 bifacial chopper; 1 bifacial adze? | 302 | none | | 29; mostly large mammal, large turtle | 1375 | 1 bottle lip (green); 1 1970s soda bottle: 504 | |
| 4 | 7; large uniface | 425 | none | | 5; mammal and turtle | 89 | etch a sketch, coke bottle: 857 | limestone; 175 g |
| 5 | 22; 4 bifacial core frag | 1181 | 1 distal? Hollow bone dagger: 10.3 | | 18; large mammal rib, turtle | 778 | soda bottle: 501 | ivory: 20 g; limestone: 95 g |
| 6 | 36; 1 biface frag, 1 large core frag, large secondary flakes | 2221 | none | 1 plain grit temper body; 34.1 | 31-gator scute, mammal, turtle | 702 | medicine bottle glass 12.5 g | |
| 7 | 70; 4 bifacial cores | 2714 | possible mid section of handle: 44.7 g | 2 Deptford check body: 76.6; 1 plain grit body: 15.3 | 22 | 672 | none | limestone: 23 g |
| 8 | 153; 5 bifacial cores; 2 bifaces, 1 adze, 3 unifaces | 10048 | 1 midsection: 4.1 g | 2 plain body-22; 1 linear 9.6 all grit | 226; mammal, deer? tooth, turtle fish | 2707 | | ivory-6, 56 g; limestone 646g; gator excreta: 6; 93.7g |
| 9 | 0 | 0 | 0 | 0 | 3 | 62 | pull tab Schlitz can; 27g | limestone: 444 g; quartz pebble 3.9 |
| 10 | 6 (flakes) | 44.8 | 1 ivory distal frag: 3.7; 5 distal frags:27.4 | 0 | 42; equus cannon?; geochelone shell | 1257 | canvas boat shoe: 511 g | ivory frag: 5.2 g; limestone: 3058, ~30 |

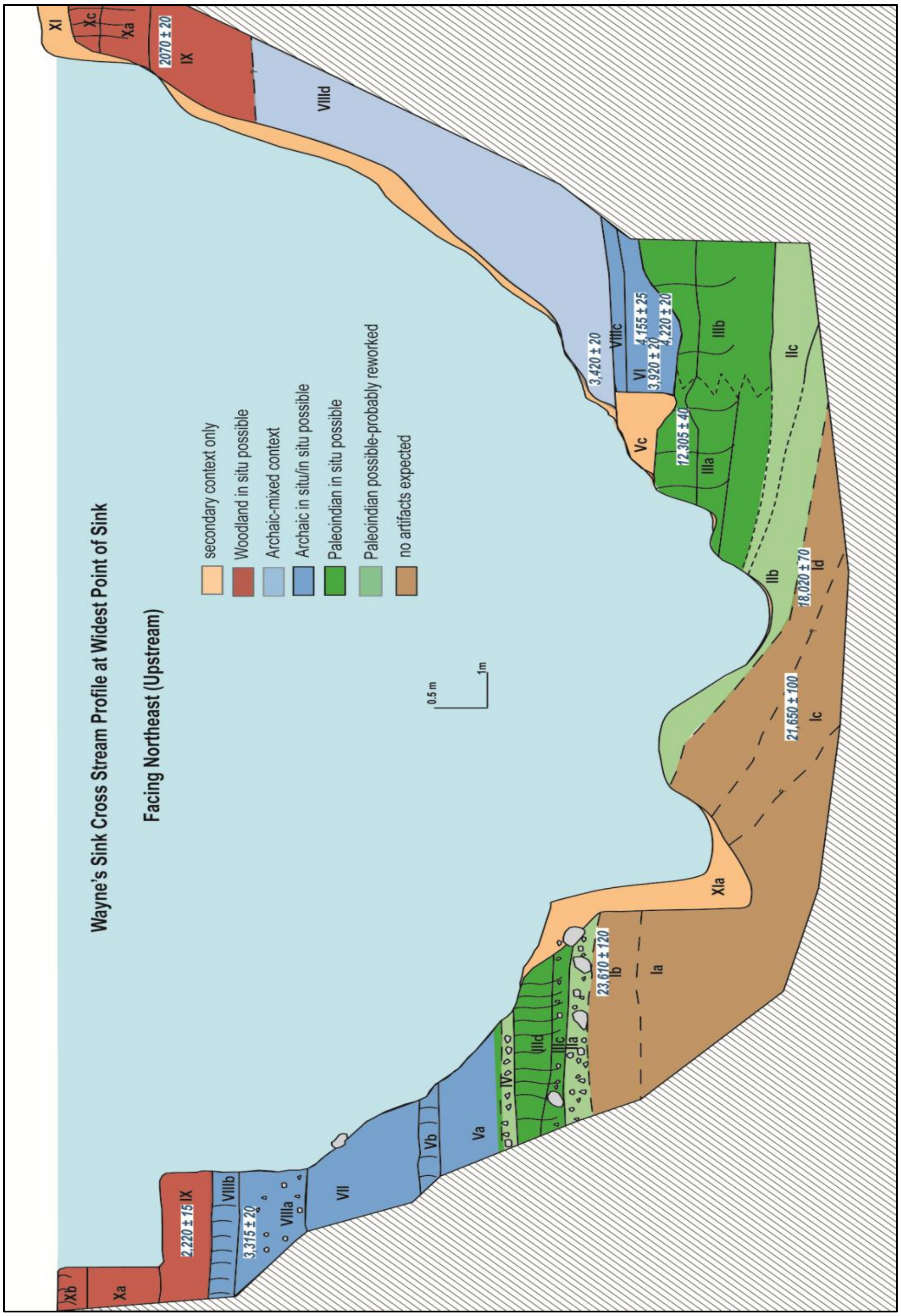



**Figure 9.16. Wayne's Sink generalized site potential map.**

Potentially-intact cultural deposits can be found in several places within the sink (Figure 9.16). Paleoindian artifacts could potentially be found *in situ* on the surface of stratum IV, depending upon its age, on the surface of stratum III and within all of stratum III, and, lastly, on the surface of stratum IIa, depending upon its age. However, it should be noted that even though it is possible that there are intact deposits within stratum III, these would likely be pre-Clovis in age since the top of the stratum is 14,000 years old. Therefore, Clovis and later Paleoindian deposits are *most* likely at the top of this stratum. Artifacts within stratum IV are likely to be redeposited. Early Archaic Bolen artifacts could be found on the top of stratum III, possibly at the top of stratum IV, and, potentially, within stratum V.

A potentially-intact Late Archaic component (Component II) seems to be within stratum VI; other Late Archaic components are within the peats of stratum VIII; these may be partially redeposited and partially intact. Stratum VIIIe contains redeposited Late Archaic Orange Period ceramics, but intact deposits are unlikely in this colluvium. Buried Archaic components are possible but were not observed within strata V and VII. Stratum IX could potentially contain Early Woodland artifacts in good context. Stratum X contains Deptford (early Woodland) period artifacts on the mainland; this unit is above the sink except during flood stage. Artifacts within this stratum are subject to some downward transport along ped faces, but otherwise are in relatively good context. Obviously, all strata could contain earlier artifacts in secondary context that were brought in by people, flood events, or other post-depositional processes. Finally, the quarry debris at the southern edge of the site could contain materials from nearly any time period. Figure 9.16 presents the cross section for Wayne's sink once more, coding the strata by their likelihood for intact archaeological deposits. This is an idealized map; see the unit profiles for observed artifact distributions.

## Archaeological Context

As discussed above, most of the cultural material recovered from Wayne's Sink was removed from surface contexts. This material was not analyzed beyond sorting by type and weighing. However, the surface sample from EU 7 alone provides a hefty record of extensive flintknapping on the southern margin of the sink (16,200 g of lithic materials from the 1/4" screen). No artifacts were recovered from any of the sediment cores, so the data presented below only include material removed from formal excavation units. Less than 300 total lithic artifacts were recovered from within the over nine cubic meters of sediment that were removed from the excavation units. By far the most artifacts were recovered from excavation units 1 and 2; these artifacts were assigned to three separate archaeological components associated with strata III, VI, and VIII (see Figure 9.9), although there were scattered flakes recovered from other levels. A single possible component was discovered in EU 5 and 6 within stratum III (Figure 9.12). No separate components were seen in EU 8. Only redeposited artifacts were found in EU 7, so no artifacts from this unit are included in these analyses. Table 9.4 presents the summarized debitage information using count data, while Figure 9.17 displays these data as percentages of total counts to facilitate comparison.

Table 9.3. Debitage Attributes for All Materials from within Wayne's Sink Excavation Units.

| **Component** | **Count by Debitage Attributes** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **noncortical** | **primary** | **secondary** | **size 1** | **size 2** | **size 3** | **size 4** | **no heat** | **heated** | **burnt** | **frag** | **flake** | **btf** | **shatter** |
| All Units | 57 | 4 | 12 | 186 | 67 | 5 | 1 | 41 | 19 | 13 | 194 | 51 | 3 | 11 |
| All Unit 1/2 | 46 | 2 | 9 | 129 | 54 | 1 | 2 | 31 | 17 | 9 | 136 | 41 | 2 | 7 |
| U1/2 C1 | 3 | 0 | 0 | 2 | 2 | 0 | 0 | 3 | 0 | 1 | 4 | 0 | 0 | 0 |
| U1/2 C2 | 0 | 0 | 1 | 17 | 2 | 0 | 1 | 20 | 0 | 0 | 16 | 4 | 0 | 0 |
| U1/2 C3 | 32 | 12 | 18 | 98 | 45 | 1 | 1 | 24 | 16 | 7 | 43 | 28 | 2 | 7 |
| All Unit 8 | 4 | 3 | 2 | 4 | 7 | 2 | 0 | 7 | 2 | 0 | 8 | 3 | 0 | 2 |
| All Unit 5/6 | 6 | 0 | 0 | 57 | 6 | 0 | 0 | 3 | 0 | 3 | 53 | 6 | 0 | 2 |
| U5 C1 | 1 | 0 | 0 | 14 | 1 | 0 | 0 | 0 | 0 | 1 | 14 | 1 | 0 | 0 |

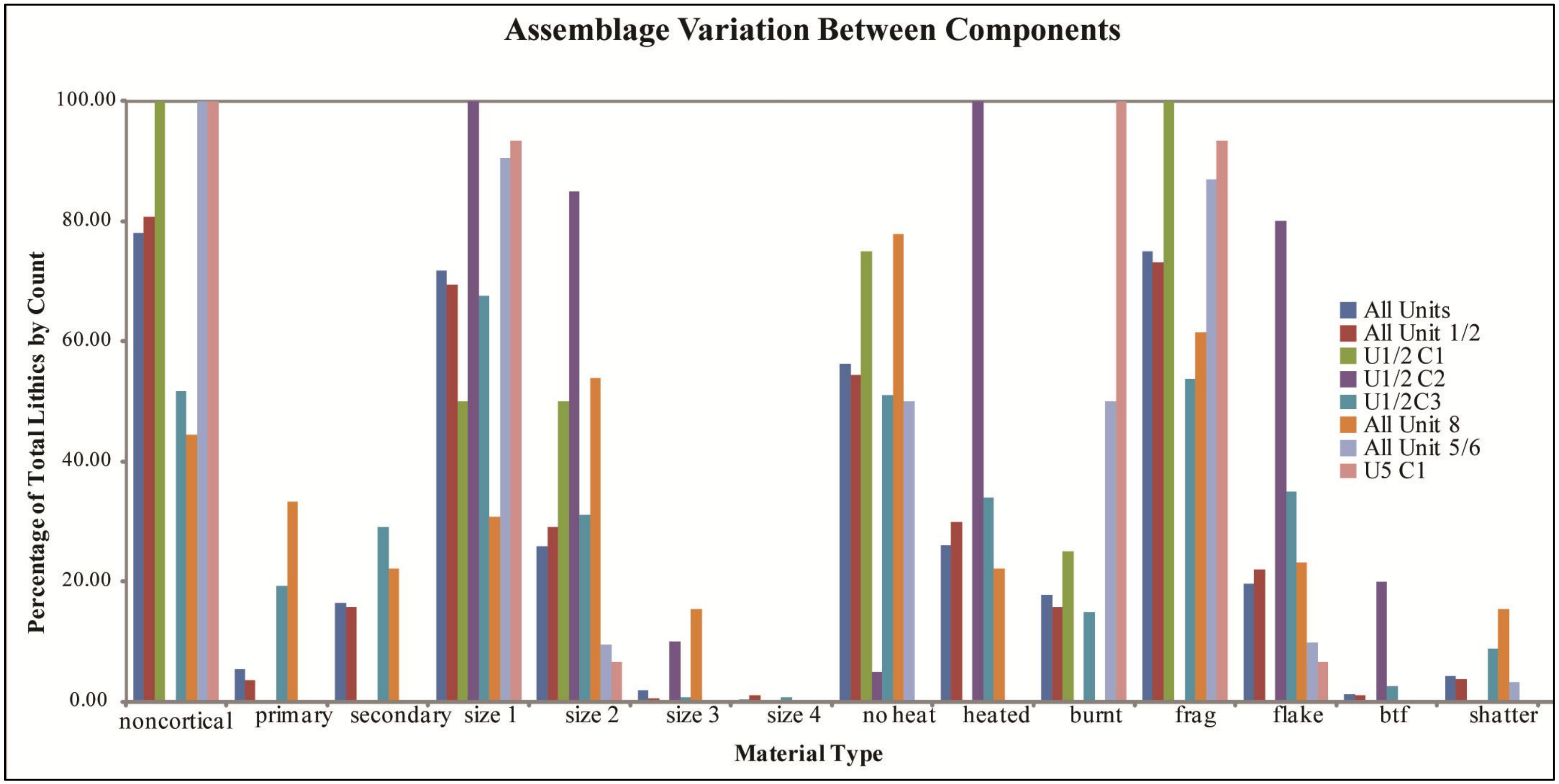



**Figure 9.17. Wayne's Sink debitage comparison by EU and component.**

No diagnostic lithic artifacts were recovered; in fact, the only lithics from excavated context were unmodified debitage. One bone point dated to 4,817-4,626 cal B.P. (the beginning of the Late Archaic) and one bone pin were recovered from the top of stratum IIIc and the bottom of VI in units 1 and 2, and 4 sherds of Late Archaic pottery were recovered from the base of stratum Vc. Because only a few pieces of debitage were removed from excavation units it is difficult to make any statements about human behavior based on flintknapping activities, but these bone and ceramic artifacts suggest that Late Archaic people were using the sink for more than just extraction of raw materials for later flintknapping. As noted before, EU 8 seems to be somewhat anomalous with a larger percentage of larger flakes and fewer flake fragments, but small sample sizes in most units severely limit interpretations of human behavior.

## Wayne's Sink Summary

This chapter summarized the geoarchaeological and archaeological research conducted at the Wayne's Sink site. Eleven geological strata spanning the period from 28,500 cal B.P. to the present were identified. These strata show evidence for peat formation in a shallow pond prior to 21,000 cal B.P. Sediments post-dating 21,000 cal B.P. and extending to the terminal Pleistocene and earliest Holocene are absent from the site. At approximately 15,000 cal B.P., there was a colluvial episode followed by soil formation within the sink, followed by another gap in the radiocarbon record until approximately 5,000 cal B.P. Around 5000 years ago, peat formation began again. The

Early-Middle Holocene sediments show that parts of the sink were a shallow pond with periodic drying. These last two major periods of sinkhole infilling correspond to those noted by Aucilla River Prehistory Project researchers (Dunbar 2006b; Webb 1998), but few sinks seem to contain peats from the LGM, making Wayne's Sink a relatively rare repository for this paleoenvironmental record.

My excavations defined at least three distinct archaeological components in the sediments on the eastern margin of the sink in EU 1 and 2. The oldest potential component is associated with the stratum IIc/IIIb interface on the eastern side of the site and to within stratum IIIc on the western bank. This component probably dates to the Paleoindian period. Component I contains only a few flakes, so further examination is necessary to determine the nature and extent of this component. At least part of Component II dates to the earliest part of the Late Archaic period, approximately 4,700 cal B.P., and consists of two bone tools and a handful of lithic debitage at the top of stratum IIIc (a soil) and the bottom of stratum VI (a peat). Component III also dates to the Late Archaic period, around 3,650 cal B.P. This component consists of numerous artifacts in peats with interbedded sands.

Paleoindian remains could occur in four stratigraphic positions within the sink: on the surface of stratum IIa, depending upon its age, on the surface and within all of stratum III, and, lastly, on the surface of stratum IV. Archaic materials could potentially be found in a primary context in many locations within the sink (see Figure 9. 16) Materials found upon the northern and southern shoals are from highly deflated and conflated contexts, as there is no stratigraphic separation within these materials.

# CHAPTER X

# SUMMARY AND CONCLUSIONS: GEOARCHAEOLOGICAL FRAMEWORK OF THE LOWER AUCILLA BASIN

This chapter presents the Late Quaternary geological history of the lower Aucilla River and a geoarchaeological site potential model. The geological histories of Page-Ladson, Sloth Hole, and the terrestrial research area are compared to previously published information from several other Aucilla River sites and to available paleoenvironmental records from the terminal Pleistocene and Early Holocene. This is followed by a discussion of geoarchaeological site context and of human activity in the Aucilla River basin. Finally, the chapter ends with a summary of the research and recommendations for future work.

## Defining the Geological Context

To reconstruct the geological history of this area, it is necessary to expand beyond the small segment of the river encompassed by Sloth Hole, Ward Island, and Wayne's Sink to determine how typical the study area was for the entire drainage. Wayne's Sink and Sloth Hole are situated in the modern intertidal zone in a continuously flowing section of the Aucilla River, so they potentially could have a different geological history and different archaeological potential than the region as a whole. As discussed in Chapter III, limited geoarchaeological research had previously been conducted by Aucilla River Prehistory Project (ARPP) researchers at three other sites in the Aucilla drainage: Ryan-Harley, Page-Ladson, and Little River Rapids. These three sites are located in different settings within the stream system (Figure 10.1) and are relatively far apart. Ryan-Harley is located in the Wacissa River on the edge of a paleochannel, Page-Ladson is located in a sink in the Half-Mile Rise section of the river, which is fed by one of the main outlets of the Wacissa River but is separated from the lower Aucilla by a series of stream swallows; Little River Rapids is located on rapids within the Little River section of the river, the last discontinuous section of the river prior to its final emergence and continuous surface run approximately 2 km north of the study area. These three sites provide a view of the range of processes that can be found in the Aucilla sinks.

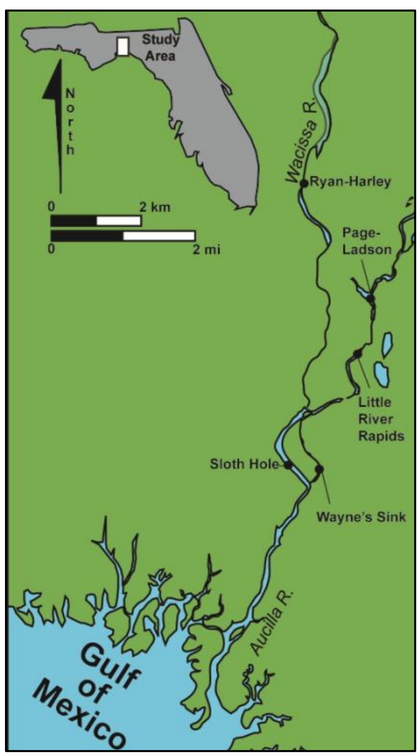



**Figure 10.1. Aucilla River sites used for recreating regional geological history.**

*Stratigraphic Correlations between Wayne's Sink and Sloth Hole*

The stratigraphies of Sloth Hole and Wayne's Sink are discussed in Chapters VIII and IX, respectively. There are many correlations that can be made between the strata at these sites. In each, there were four major periods of sinkhole infilling. In each, a sequence of peat is overlain by colluvium. In both, this colluvium is overlain by a clay deposit, which was subaerially exposed to soil formation processes. In both, these soils are then overlain by additional clay followed by peat deposition. Finally, previous researchers had found Paleoindian and Early Archaic Bolen artifacts at both. Figure 10.2 presents the generalized cross-section with strata and chronostratigraphic periods highlighted for Sloth Hole. Figure 10.3 shows the same data for Wayne's Sink.

There is one notable difference in the two sequences. The oldest dated stratum at Sloth Hole is much older than the basal stratum at Wayne's Sink. Nine radiocarbon ages from the basal peat in Sloth Hole (stratum I) span the period from 48,000-36,000 cal B.P. This is then followed by a colluvial layer that dates to 33,000-30,000 cal B.P., followed by a 15,500-year gap until approximately 14,500 cal B.P., when there is another colluvial pulse. In contrast, the oldest dated stratum at Wayne's Sink (also stratum 1), a sapropel, dates from 28,500 to 21,300 cal B.P., just prior to the LGM and a period with no recorded sediments from Sloth Hole. It is possible that there are older peats and colluvial strata at Wayne's Sink that correspond to the oldest strata at Sloth Hole because the vibrocorer could not penetrate the compact sapropel of stratum Ia at Wayne's Sink. The Sloth Hole stratigraphic sequence, however, seems very unlikely to contain a peat that dates from 28,000 to 21,000 cal B.P. because the upper peats at the site have been sampled and dated a number of times, and they are directly overlain by a series of colluvium. Therefore, there is some difference in the timing of depositional events between the two sites, even though they are less than a kilometer apart, during the millennia just prior to the LGM, even though geological processes at the two sites are similar.

After this difference, the sequences within the sinks correlate fairly well. Stratum III at Sloth Hole is colluvium dating to 14,500-13,900 overlain by a soil that dates to 13,000-11,250 cal. B.P. (stratum IV). Stratum II at Wayne's Sink is undated colluvium that is overlain by a well-developed soil sequence (stratum III) with a single age of 14,480-14,000 cal B.P. on the eastern side of the sink. On the western side, stratum II is also overlain by a clay sequence with well-developed soil structure (stratum III). At both sinks, these strata are the most likely situational context for Paleoindian materials.

On the eastern side of Wayne's Sink, stratum III is capped by another colluvial deposit (stratum IV) that is probably also Pleistocene in age because of the presence of ivory and a horse tooth in the stratum. There is no corresponding colluvium in the cores or units removed from Sloth Hole, so the colluvium in Wayne's Sink is probably related more to intrasite processes than to regional events.

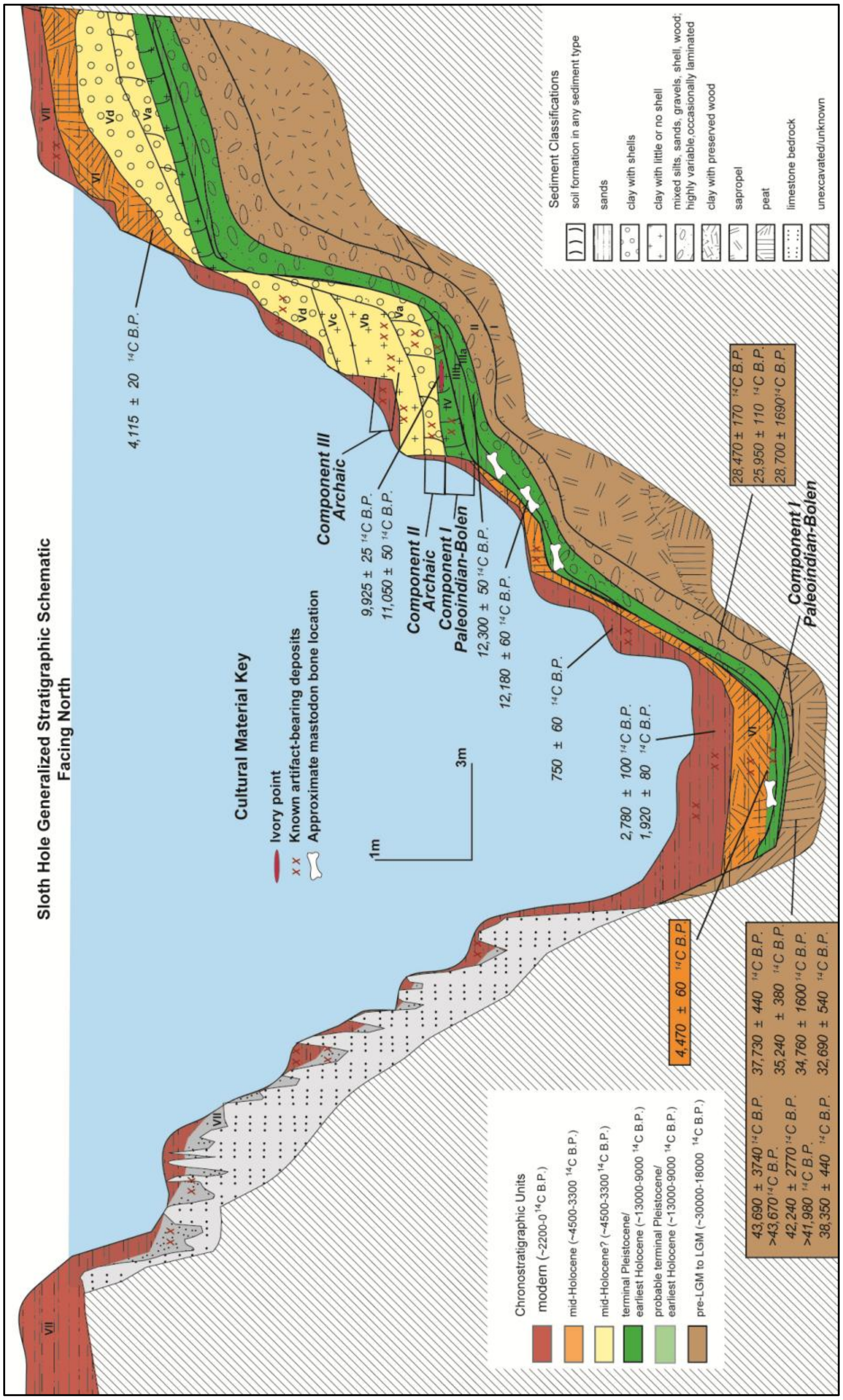



**Figure 10.2. Generalized section of Sloth Hole showing strata and ages.**

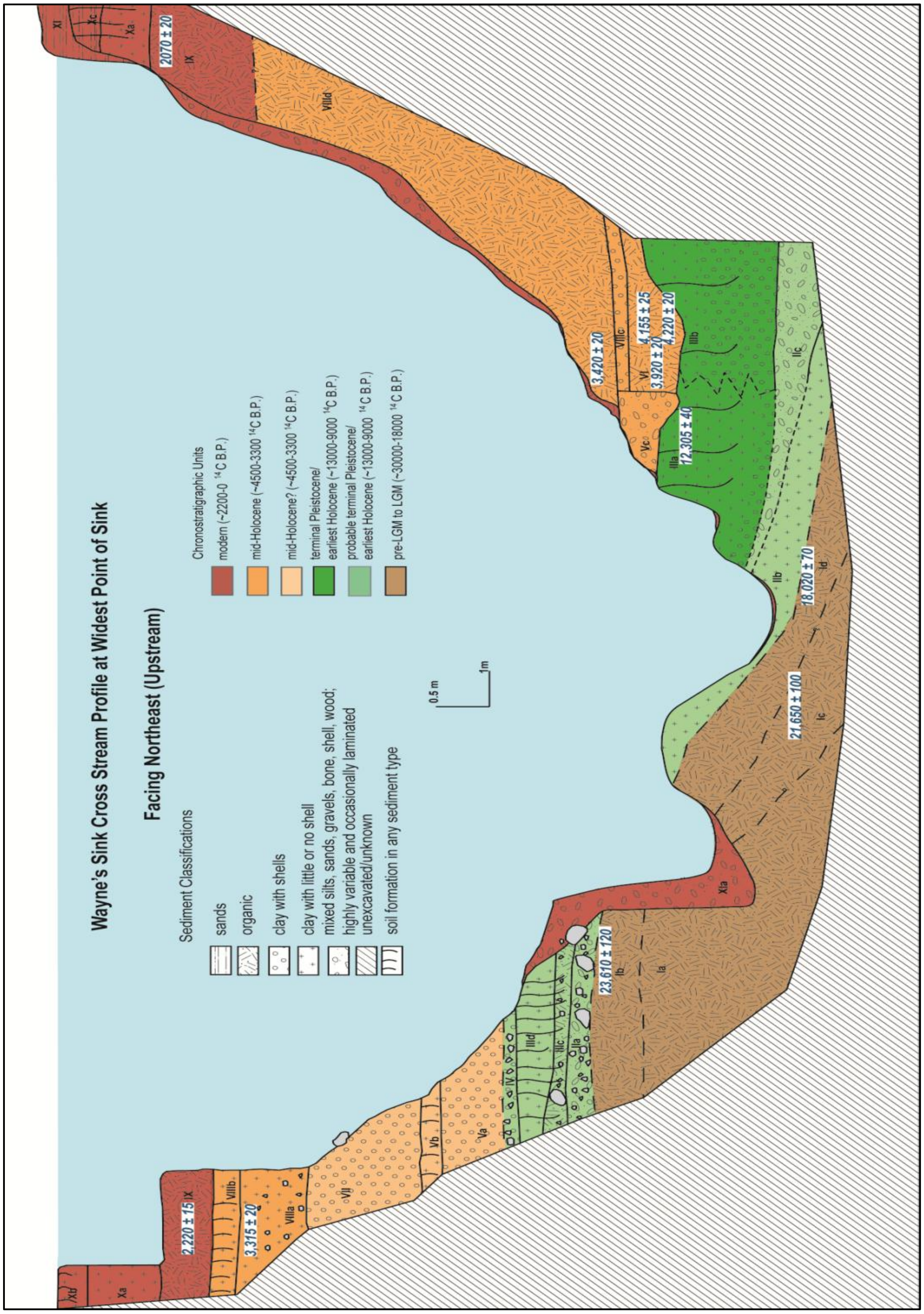



**Figure 10.3. Generalized section of Wayne's Sink showing strata and ages.**

The soil horizon on the eastern bank of Sloth Hole and the colluvium on the western bank of Wayne's Sink are both capped by more than 2 meters of clay filled with pond snails alternating with clay containing fewer to no pond snails. These clays were deposited on the backwater side of their respective sites, which accounts for the thickness of the deposits. The bottom shelly clay strata at both sites show significant evidence for pedogenesis (stratum Va at Sloth Hole, strata Va and Vb at Wayne's Sink). Neither of these sequences has been dated although both do contain datable organics. At Wayne's Sink there is another small and thin colluvial lens within these clays (VIIIa) and another clayey paleosol (stratum VIIIb) at the top of the clay sequence which dates to 3,570-3,480 cal. B.P. At Sloth Hole, there is evidence of brief subaerial exposure in the clay sequence but no other clear paleosol. The eastern side of Wayne's Sink does not contain this clay stratum; instead stratum III is directly overlain by peats.

In both sites, peat began forming again at a nearly identical time in the Middle Holocene. In Wayne's Sink, peats are found only on the eastern side of the sink, and the resumption of peat formation dates to 4,720-4,420 cal B.P., based on three ages obtained on the lowest peat stratum (stratum VI) overlaying the paleosol. A single date near the bottom of the peat sequence (Unit IX) at Sloth Hole returned a similar age of 4,680-4,570 cal B.P., indicating some similarity of process at this time.

In Wayne's Sink, the top paleosol (stratum VIIIa-c) on the western side of the site dates to 3,570-3,484 cal B.P. and is approximately the same age as a second peat stratum (VIIIe) on the eastern side of the site, which has a similar age of 3,670-3,640 cal B.P. There is no similarly-aged sediment correlation for Sloth Hole, but this is quite probably an effect of sampling, as very few of the upper strata at the site were dated. Above these peats at both sites, there appears to be a thousand-year gap in the sequence that may be due to sampling error. The next sequence of ages at Wayne's Sink is at 2,300-1,990 cal B.P. upon organic to clayey sediments in the current intertidal zone (stratum IX). There seems to be more than a thousand year gap between strata VIII and IX, which may be represented in the soil of stratum VIII. In Sloth Hole, modern intertidal sediments were observed but not dated or sampled; these were grouped with stratum VII, modern sediments. In both sites, these sediments are overlain by a clay stratum (stratum X at Wayne's Sink) that makes up the current terrestrial river bank. No radiocarbon ages were obtained from this stratum, but Deptford ceramics were recovered from this stratum at Wayne's Sink and upon Ward Island, which indicates that the sediments date to approximately 2,500-1,800 cal B.P. (Milanich 1994). Both sites are then capped with modern sandy deposits.

These two site sequences and the terrestrial sequence suggest that there were either six or seven periods of sinkhole infilling in this segment of the basin (four periods at each site), depending upon whether or not the gap between 3,500 and 2,300 cal B.P. is real. Almost all of these periods of infilling are followed by a period of stability represented by soil formation. The first three periods of infill occurred prior to 21,000 cal B.P. and have been grouped on Figures 10.2 and 10.3. The first period of infilling was caused by peat formation that occurred around 40-50,000 cal B.P. followed by colluvial fill around 30,000 cal B.P. The third period was peat formation that occurred from about 28-21,000 cal B.P. and was followed by a period of exposure that allowed soil structure to develop in the peat. These three strata are uncorrelated between the sites. The fourth period correlates almost exactly at around 14,500 cal B.P. in both sites; it also roughly correlates in depositional processes with colluvium overlain by clay deposition and soil formation that extends through the Paleoindian period into the early Holocene. This is followed by clay deposition with more soil formation. The next dated sequence, the fifth overall, marks the return to peat formation in both sites at around 4,600-4,700 cal B.P. In Wayne's Sink, this peat is matched by clay deposition on the western bank; this clay shows evidence for stability and soil formation sometime after 3,500 cal B.P., with deposition resuming sometime prior to 2,300 cal B.P., which leads into modern sediments within the sinks and terrestrial portions of the sites. These latter two sequences may be the sixth and seventh periods of infill or just the sixth. Sloth Hole is correlated based on observed sediment profiles to this later sequence; there are no dates for this upper part of the stratigraphy.

I have grouped these periods of infilling into four overall periods that relate to major changes in geographic processes and to potential cultural activities. First is the time of episodic infilling spanning 50-20,000 cal B.P. While this period represents a vast span of time, it also represents the period prior to any evidence for human use of the area and further represents periods of peat formation in each sink. The second period of infilling encompasses the terminal Pleistocene and earliest Holocene from approximately 15,000-11,000 cal B.P. This is followed by the third period that is mid-Holocene in age, approximately 5,000-3,500 cal B.P., followed by modern deposition in the sink (2,300-0 cal B.P.). This grouping is displayed in the color scheme used in all cross sections throughout Chapters VIII, IV, and X to help with visual correlation of deposits.

*Stratigraphy of the Three Other Sinks*

The stratigraphic sequences and geographic processes that operated throughout the late Quaternary at Sloth Hole and Wayne's Sink correlate very well. These sites are, however, less than a kilometer apart, so it is necessary to compare them to other sites in the Aucilla drainage in order to determine if these processes and periods of sinkhole infill are continuous.

Page-Ladson (8JE591) is located in a sink within the Half-Mile Rise portion of the river at a major confluence of the Aucilla and Wacissa Rivers. This site contains a nearly-continuous sediment record from 22,300-10,800 cal B.P. (18,000 to 9,000 $^{14}C$ B.P.), spanning the entire Paleoindian period (Webb 2006). The site was originally investigated from 1983-1997 by the ARPP, when more than 50 units were placed into the terminal Pleistocene strata. The investigators submitted more than 50 radiocarbon samples from the sink strata, gathering 48 ages that allowed them to define seven geological units (Kendrick 2006; Webb and Dunbar 2006). Unit 1 was a sandy stratum filled with shells, silts, and digesta mats (Kendrick 2006) (Figure 10.4). This stratum spanned the period from 22,300-18,100 cal B.P., based on eight radiocarbon ages. Unit 2 was a dense red woody peat that dated from 18,496-17,896 cal B.P. Unit 3 was another silty gravelly sandy stratum interbedded with proboscidean digesta mats. This stratum was probably derived from a combination of colluvium and elephant activities. It dates to 14,644-14,128 cal B.P. Unit 4 was a thick (greater than 2 m) sandy silt filled with gastropods and well-preserved organic fragments that dated from 14,460-12,579 cal B.P. Unit 5 was a sandy clayey silt that dated to 12,071-11,726 cal B.P. Unit 6 was a well-sorted sandy silt with gastropods and limestone pebbles. This deposit was pedogenically altered and the top was truncated by erosion. Unit 6 dates to 11,591-10,800 cal B.P. Unit 7 consists of nearly 2 m of alternating peat and quartz sand horizons. This unit dates to 4,821-4,584 cal B.P.

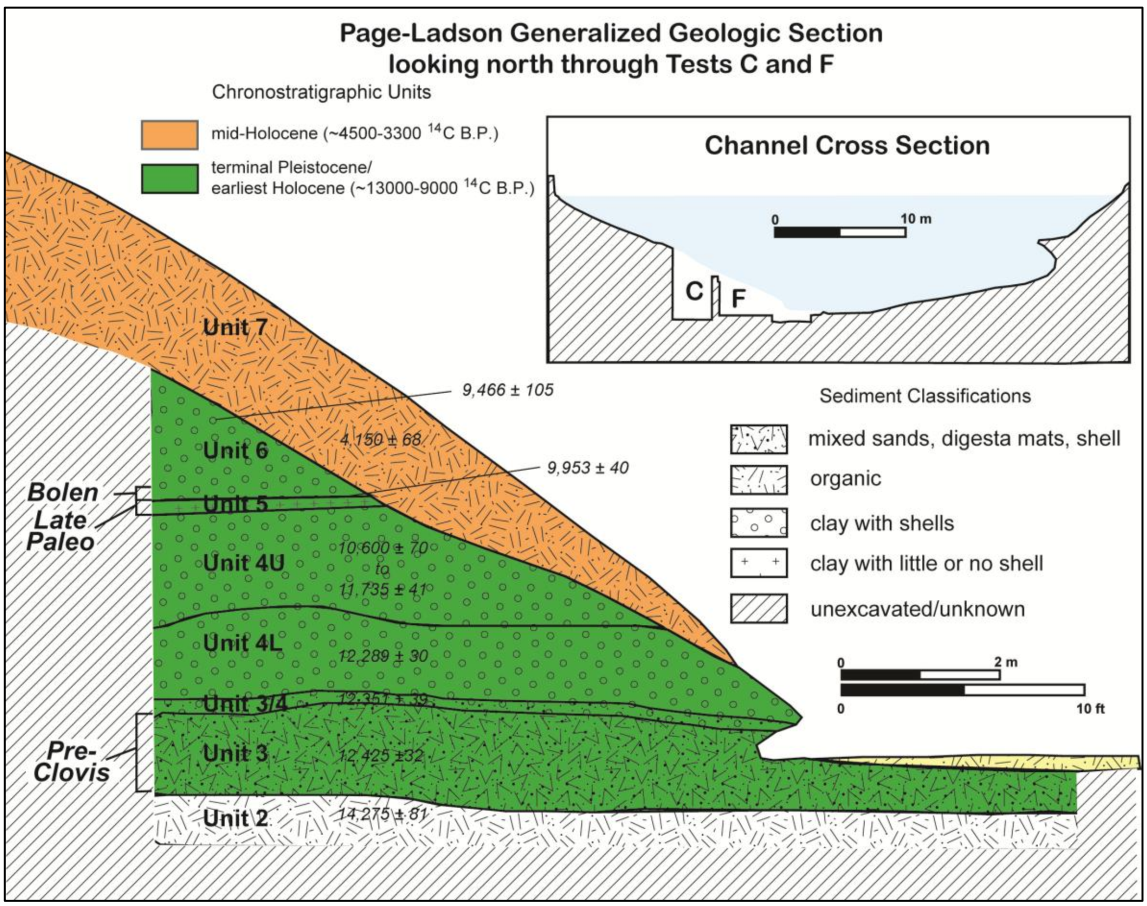



**Figure 10.4. Page-Ladson stratigraphic sequence. Adapted from Webb and Dunbar (2006) and Kendrick (2006).**

The Ryan-Harley site (8JE1004) is located on a shallowly-submerged terrace of the Wacissa River. The site contains the remains of a Paleoindian campsite with Suwannee diagnostic artifacts (Balsillie et al. 2006; Dunbar et al. 2006; Dunbar and Vojnovski 2007). The stratigraphy of the site has not been specifically presented in the published literature of the site, and no official strata designations have been presented, but the single published profile of the site (Dunbar and Vojnovski 2007:170) shows there to be seven strata overlaying limestone bedrock. The bottom stratum is a sandy peat layer, overlain by a sandy stratum. This sandy stratum is overlain by a sandier stratum with some gravels. This contains the remains of the Paleoindian campsite and some evidence for pedogenesis. This paleosol is immediately overlain by a sandy peat, which is, in turn, overlain by a woody peat and modern sand. Two radiocarbon ages from immediately above the artifact layer date the beginning of peat formation to 4,872-5,450 cal B.P. The rest of the sequence is undated, but the Suwannee point type is considered to be Paleoindian and may date to immediately after Clovis (ca. 13,000-12,400 cal B.P.) based on artifact typology (Balsillie et al. 2006; Daniel and Wisenbaker 1987; Dunbar et al. 2006; Dunbar and Vojnovski 2007; Tesar and Jones 2004).

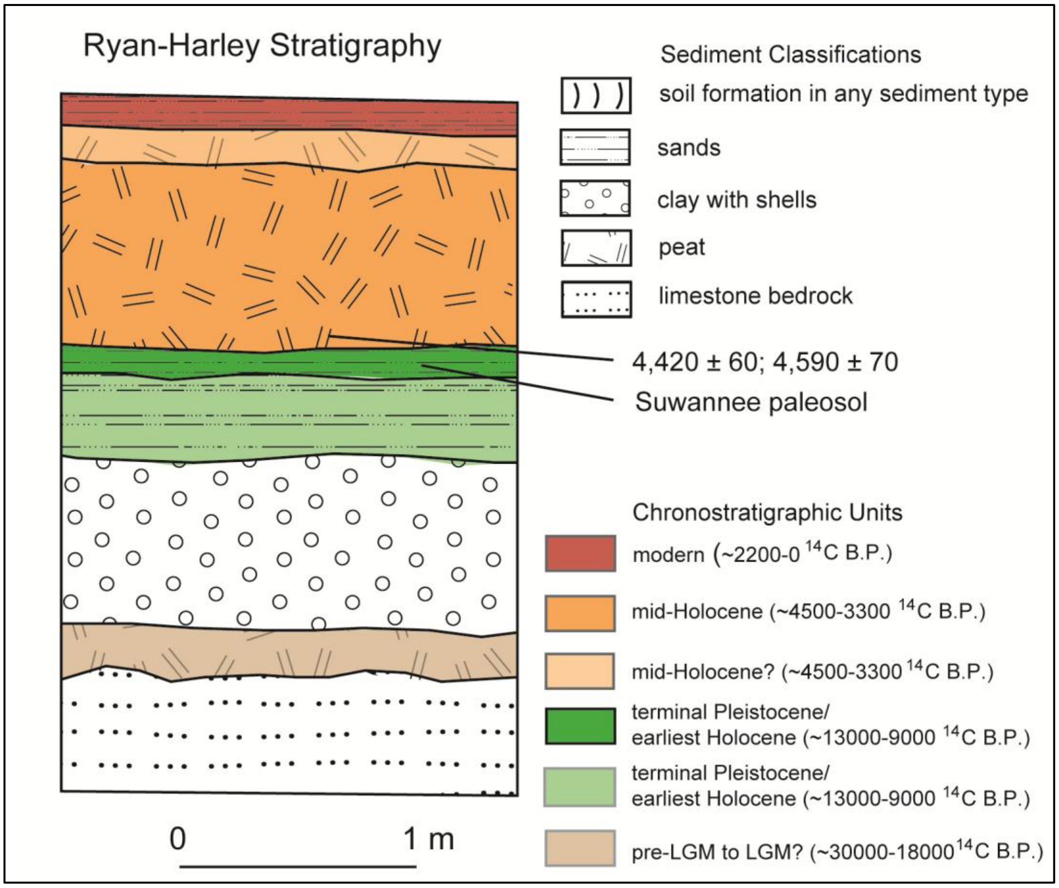



**Figure 10.5. Ryan-Harley site stratigraphy. After Dunbar and Vojnovski (2007:170).**

The Little River Rapids site (8JE1603) is located in the Little River section of the Aucilla; along with at least 19 other sites (see Figure 2.2). The site consists of a section of shallow limestone rapids filled with artifacts and a deeper area on the northern portion of the site with some preserved sediments. The site was subjected to controlled surface collection in 1987 as part of a mitigation project, at which time the investigators concluded that the site was completely deflated with no stratified deposits (Willis 1988), but that the site retained relatively good horizontal control based on the spatial patterning of artifacts. The site was re-investigated by members of the ARPP in 1996-1998. They excavated several units on the northern side of the sink and reported the single profile shown in Figure 10.6 (Muniz 1998). The base of the site is covered by Unit VIII, which is described as a paleosol and seems to be an organic sediment that has been pedogenically-altered. This dates to 30,407-29,621 cal B.P. Above that is Unit VII, described as a paleosol with pebbles, dating to 16,468-15,275 cal B.P. A transitional zone leads into Unit IV. Unit IV is described as a pebbly gray sandy clay and has a single age of 13,724-13,501 cal B.P. Above this is Unit III, a loam that dates to 12,896-12,652 cal B.P. This sequence is capped by two undated strata; Unit II is described as a hard brittle green clay, while Unit I consists of modern organic fill. There is no interpretation provided in the original report, but the green clay may be a shallow pond deposit such as seen in stratum IIIb in Wayne's Sink. Unfortunately, artifact contexts from this site have not been reported, so it is unknown which strata contained cultural material.

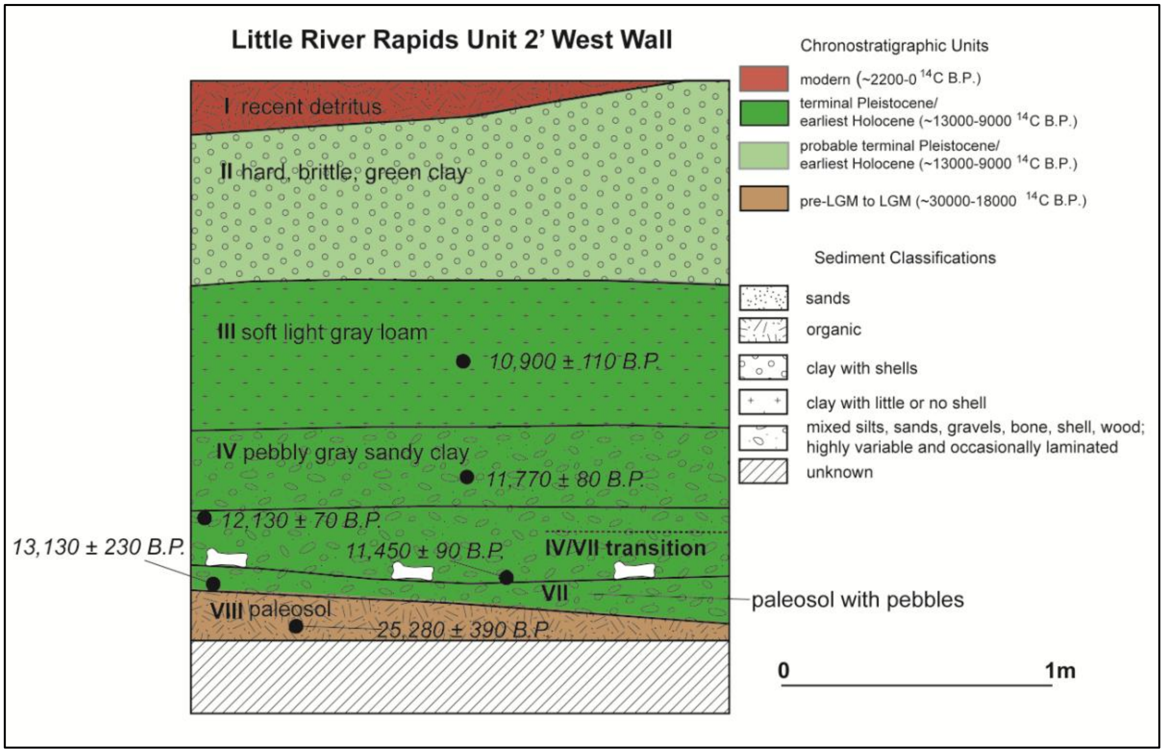



**Figure 10.6. Little River Rapids profile after Muniz (1998). Descriptions from Muniz.**

*Summary and Depositional History*

The stratigraphic sequences and geologic histories of Sloth Hole, Wayne's Sink, Page-Ladson, Ryan-Harley, and Little River Rapids are remarkably similar. Based on the data from these five sinks, there appear to have been four major periods of sinkhole infilling in this area during the past 50,000 years. The stratigraphic sequence of each site is plotted by thousand-year increments along with sea level and regional pollen records in Figure 10.7. The regional pollen record is from Grim and colleagues (Grimm et al. 2006) and is a high resolution pollen record from Lake Tulane in central Florida showing four of the major pollen groups the authors used for their environmental discussion: pine, oak, ragweed, and grass. The pollen curves were created by the authors.

Sea level curves were obtained from Peltier and Fairbanks (2006) and Balsillie and Donoghue (2004). It should be noted that both the pollen curves and the sea level curves were calibrated by the original authors using the IntCal04 calibration curve.

Figure 10.7 is color-coded using the chronostratigraphic framework determined at Wayne's Sink and Sloth Hole to aid in comparison between the sites. If there are sediments within the sink for a given time increment, a box appears in the column for that sink that is infilled with the pattern that correlates to the sediment type. If there are no data for a period, the column is left empty. If there are undated sediments that occur in the stratigraphy between two dated sequences, these sediments are noted with text in the empty space, but a sediment box is not placed on the chart. The sediment ages were obtained with the IntCal09 calibration curve (Bronk Ramsey 2010; Reimer et al. 2009) to correspond to all of the other research in this dissertation, so there are slight age differences between the proxy records and the sediment records, but these are not significant at the scale shown in Figure 10.7. The three most recent Heinrich events (see Chapter III) are also shown on this figure because they have been noted to strongly correlate with abrupt change in regional climate patterns (Dunbar 2006b; Grimm et al. 2006).

The first period of infilling occurred from approximately 48,000 cal B.P. to approximately the last glacial maximum (LGM) at roughly 22-21,000 cal B.P. The early sediments in Wayne's Sink, Little River Rapids, and Sloth Hole all consisted of peats. There are no dates reported from the bottom of Ryan-Harley, so it is unknown how old it is, but the basal deposit in the site is also a peat. The deepest sediments excavated at

Page-Ladson are colluvial in origin and date to just before the LGM at 22,000 cal B.P., with peat forming immediately after the LGM. During excavations, this colluvial layer was never penetrated completely, so it is unknown if it is underlain by a peat. Nevertheless, the oldest dated sediments in four of the five sites are indicative of shallow, continuously moist pond environments. Each of these early deposits formed at a different time (Figure 10.7). There is very poor chronological correlation, even though the basal deposits do correlate in process. I hypothesize that this may be due to each sink becoming essentially isolated during the period leading up to the LGM because lowered tables related to extremely low sea levels may have periodically disconnected sinks from the Florida Aquifer. Each sink thus had an individual history prior to the LGM. This could potentially be tested with more radiocarbon dating of the peats paired with paleobotanical and faunal studies to determine whether age discrepancies are real or only apparent and to see if differing local environments are indicated by the botanical and faunal remains. However, there is no evidence of human activity in the area during this period, so for the purposes of this study, these sediments are grouped under the chronostratigraphic category of "pre-LGM," and they are not discussed further.

After the LGM, sediments are absent until the terminal Pleistocene and earliest Holocene in all of the sites except Page-Ladson, which has a nearly continuous sediment record for the Late Pleistocene. This absence may be due to an erosional unconformity dating to the terminal Pleistocene, or may be related to a prolonged period in which the sinks were dry and deposition is minimal. However, there is a colluvial stratum in all five sites, including Page-Ladson, during the terminal Pleistocene. This colluvium is not dated at Wayne's Sink or Ryan-Harley, but in both cases it directly underlies a soil that dates to the terminal Pleistocene. At the three other sites, this stratum dates to approximately 14,500-15,000 cal B.P. This is closely related in time to a large spike in ragweed in the Lake Tulane pollen record that is interpreted to represent a drying period with increased evidence of disturbance (Grimm et al. 2006); pollen from Page-Ladson also indicates a warming trend (Hansen 2006) (Figure 10.8). The colluvial sediments themselves are indicative of low water levels in the sinks, relatively little local ground cover, and possibly a drop in the water levels within the sink causing catastrophic wasting along the sink margins, or, potentially, occasional flash flooding that caused sediments to slough into the sinks. All of these indicate increasingly dry and warm conditions during the terminal Pleistocene, possibly with less forest cover.

In all five cases, a pedogenically-altered sediment directly overlies the colluvium. At Ryan-Harley, this soil is undated but it contains a single Paleoindian (Suwannee) archaeological component. At Wayne's Sink, a date of 14,481-14,042 cal B.P. was obtained from within the A horizon of the paleosol. The soil at Sloth Hole spans the period from 13,081 to 11,258 cal B.P., while at Page-Ladson it dates to 11,591-11,265 cal B.P. According to field notes, Little River Rapids contains an older soil, dating in excess of 15,000 cal B.P. This site also has sediment dating to 12,896-12,652 cal B.P. described as a soft loam and overlain by hard granular clay. This may represent either a soil or a pond deposit, based on my experience in the river. These altered sediments are indicative of relatively long-term subaerial exposure of the sink margins on the scale of decades.

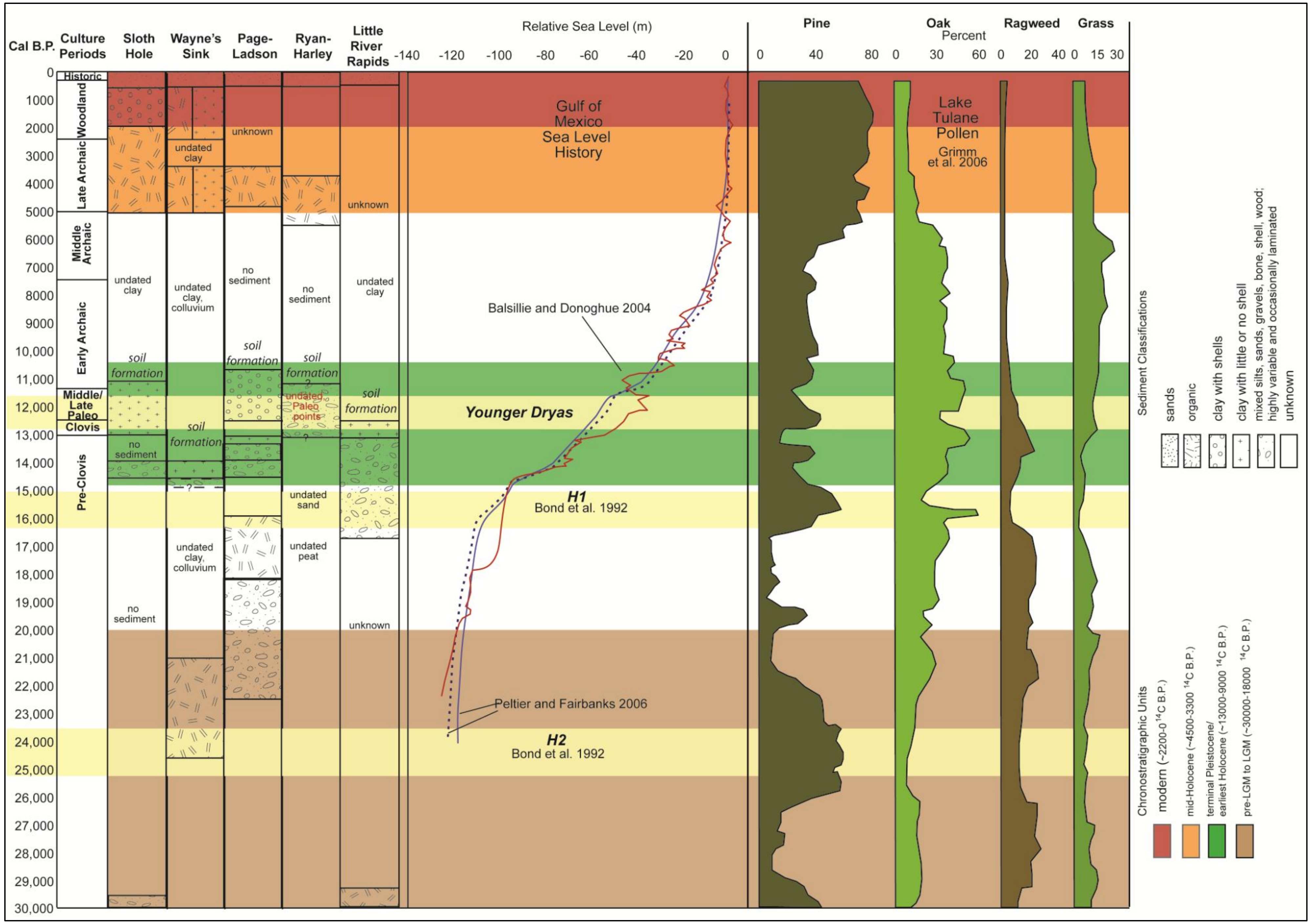



**Figure 10.7. Sediment records of the five sites with proxy records. Lake Tulane pollen from Grimm et al. (2006). Sea level from Balsillie and Donoghue (2004) and Peltier and Fairbanks (2006).**

The dates of these soils do not completely correlate, but they are close enough to hypothesize region-wide soil-forming processes during the period from approximately l4,000-11,000 cal B.P. The water table probably was quite low overall; the soils at all sites except Ryan-Harley were located on sediments that are at least 4 m below the current mean water level in the sinks. At best, the sinks would have been small, spring-fed ponds. Water could not have traveled over the limestone shoals on the upper and lower sides of the sites since these shoals in all cases are less than 2 m below the current water level. However, there are two main ways in which the soils could have formed. Except at Ryan-Harley, all the soils formed on very fine-grained sediments (silts and clays), so soil formation may have been a cumulic process related to cycles of slightly higher and slightly lower water levels, perhaps even at the seasonal level, causing short periods of minor deposition followed by short periods of soil formation.

Alternatively, the soils could have formed after an extended period of high water deposited a large amount of clays and silts, then water receded, allowing these sediments to be pedogenically altered. The regional paleobotanical records cannot help distinguish these two scenarios because this period encompassed a great deal of environmental variation (Figure 10.8), and it may be that each mode of soil formation was at work. This could be distinguished by more dating of the sediments or perhaps by micromorphological and paleomagnetic studies. If the dates from within the whole column are synchronous, it is likely the sediment was deposited at the same time, while micromorphology or paleomagnetism may be able to distinguish short periods of stability shown within the sediment record.

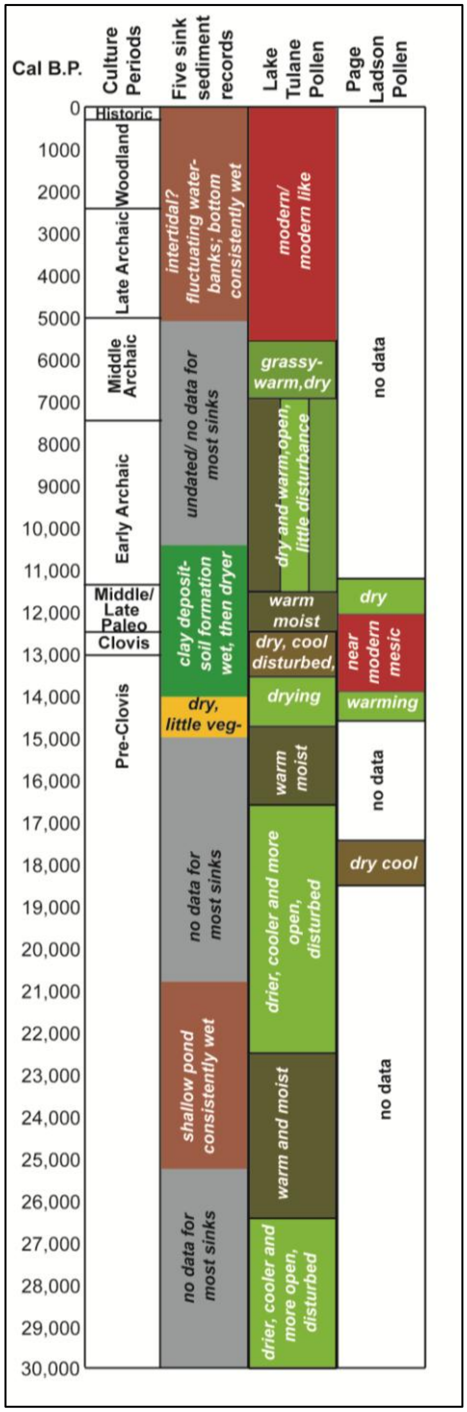



**Figure 10.8. Paleoenvironmental interpretations of the sediment and pollen records. Sediment interpretations are mine, Lake Tulane interpretations are from Grimm and colleagues (2006) and Page-Ladson interpretations are based on Hansen (2006).**

This period of soil formation overlaps with the Younger Dryas period (12,900-11,600 cal B.P.), when sea levels rose extremely rapidly, than dropped nearly 10 m in a few hundred years. Pine and grass pollens peaked, followed by a rapid drop in pine pollen at the end of the Younger Dryas, which has been interpreted as a dry, cool environment with an open, patchy overstory being replaced by a warmer, moister climate regime with increasing amounts of oak, but in which pine remained common (Grimm et al. 2006). This was then followed by a dry, warm, and open environment that was in place at Page-Ladson and Lake Tulane by approximately 11,800 cal B.P. at the very end of the Younger Dryas. In other words, climate and sea level were both changing rapidly, and plants, animals and humans probably had to adjust equally rapidly.

After about 10,000 cal B.P., sediments are either absent or undated in all five sinks until the peats resumed forming at almost exactly the same time in four of the five. This absence may be due to a number of factors, including erosional unconformities caused by sea level fluctuations, floods, or storms; explanation of this absence, however, needs more research. Peat formation resumed at approximately 4,700 cal B.P. at Wayne's Sink and Sloth Hole, at roughly 4,800 cal B.P. at Page-Ladson, and at approximately 5,000 cal B.P. at Ryan-Harley. There is no age reported on the "recent detritus" at Little River Rapids, and it is unclear if the site is topped by a peat. Overall, these peats indicate the resumption of continually or near-continually wet conditions within the sinks. Also at 5,000 cal B.P., sea level reached approximately modern and climate conditions approached modern (Figures 10.7-10.8). Thus I tentatively interpret this peat formation to coincide with reconnection of the sinks to the fluvial system and a continuous water supply. Pollen records are also indicative of modern or near-modern plant biomes, with the Lake Tulane records indicating steady proportions of pollen for the past 5,000 years. This is also the point at which climate probably became relatively stable. For people, approximately 5,000 cal B.P. probably marked when the environment, coastlines, and animal behavior became predictable on a broad scale as well.

The peats themselves are markers of shallow pond conditions, but even in the modern fluvial system, each sink acts as its own closed-system pond with its own circulation and sediment settling patterns, as was discussed in Chapter IX. Further, at Wayne's Sink, there are synchronous ages on peats on the eastern bank of the sink and upon shallow pond clays on the western margin. This pattern is indicative of some water movement within the sink. There are no ages on the clays at Sloth Hole, and I do not have data about whether there are matching clays at the other three sinks. It is interesting to note that peat formation starts slightly earlier upstream, which could indicate earlier resumption of shallow pond sequences, but this will have to be examined with more data from other sites.

In Wayne's Sink, there is a gap in the radiocarbon record between 3,500 cal B.P., which was obtained on a peat and matching soil, and 2,300 cal B.P., which was obtained within the current intertidal sediments on a peat on one side of the sink and an organic clay on the other side. This gap may be a real hiatus represented by soil formation, but the late Holocene sequences in other sinks were not dated to the same extent, so there are no corroborating data at this time. After 2,000 cal B.P., sediments have been deposited on the modern riverbanks, but sediments within the channels in all sinks are sands, probably brought in during storms, and accumulations of organic matter.

In general, the sediment sequences in all portions of the lower Aucilla correspond remarkably well. Prior to the LGM, each sink seems to have experienced its own depositional history, but by about 15,000 years ago, all five sinks were experiencing the same regional processes, with similar sediment types deposited at similar times. In all five sites, a colluvial layer is overlain by a terminal Pleistocene/early Holocene soil. This is then overlain by a mid-Holocene peat and clay sequence that continued to the modern day, or that ended at about 3,500 cal B.P. If the latter hiatus is real, sediments resumed deposition starting at approximately 2,500 cal B.P. and continued to the present day. These sediments chronicle change from shallow ponds to an intertidal fluvial system.

## Geoarchaeological Framework

The geological history of the sink provides the framework for discussing questions of site context and interpretations of human behavior in this portion of the Aucilla drainage. First of all, the excavations presented in this dissertation revealed potentially-intact and buried archaeological components within the sediment packages of both Sloth Hole and Wayne's Sink. No artifacts were associated with the earliest depositional period from 30,000 cal B.P. to the LGM. Artifacts were associated with all other depositional periods; however, the potential contextual integrity of these materials varied greatly.

*Geoarchaeological Context at Sloth Hole and Wayne's Sink*

There are three different cultural components in Wayne's Sink and three in Sloth Hole. These are discussed in detail in Chapters VII and IX and appear on Figures 10.2 and 10.3. In Sloth Hole, all three components were located on the east side of the sink. Component I was found within stratum IV, which is associated with an ARPP ivory point dated to the Clovis period and with an Early Archaic radiocarbon age. Component II is found within stratum Va, while Component III is within stratum Vb. Both components are undated but are probably associated with Archaic people. The two excavation units at Sloth Hole also contained a number of flakes throughout almost every excavation level that could not clearly be associated with any context. These almost certainly have been redeposited either from the terrestrial sediments adjacent to the sink by slopewash or from bioturbation of the components within the sink.

Three components were also discovered at Wayne's Sink. Component I is located at the interface of strata II and III on both sides of the sink. Component II is associated with the top of stratum IIIb and bottom of stratum VI on the eastern side of the sink. This component is definitely Late Archaic in age, based on a dated bone tool, but may also contain earlier materials. Component III is also Late Archaic in age, is located on the eastern side of the sink, and consists of a number of flakes associated with peat strata (stratum VIIIe).

The final archaeological component discovered during this project was terrestrial. There are a number of at least partially preserved sites on land. All of the sites recorded during the terrestrial fieldwork contained ceramics or heat-treated lithics, so they probably post-date the Paleoindian period, and at least two of them contained Early Woodland Deptford ceramics. The other three are undated, but provide a record of extensive prehistoric use of the island. The specific geoarchaeological context of each of these sites was discussed in Chapter VII.

*Geoarchaeological Context in the Lower Aucilla*

The archaeological deposits discovered at Sloth Hole and Wayne's Sink can be compared to those from Ryan-Harley, Page-Ladson, and Little River Rapids in order to discuss both archaeological potential and site formation processes in the lower Aucilla. Artifacts in primary context are not associated with any of the deposits from prior to the LGM.

The second depositional period (approximately 16,000-10,000 cal B.P.), however, is of the utmost interest for Paleoindian studies, as it spans the pre-Clovis, Clovis, Middle Paleoindian, Late Paleoindian, and Early Archaic periods. The earliest post-LGM deposit at all sites but Page-Ladson, where there is no depositional break, is a sandy colluvium dating to before 14,000 cal B.P. (Figure 10.9). Any artifacts within this stratum would be pre-Clovis in age. These artifacts would have to be carefully analyzed for context. If they are lying on top of the colluvium or on top of individual colluvial pulses, contextual integrity could be good, but if they are within a colluvial deposit, they are very likely to be redeposited. However, even redeposited, unambiguous artifacts within this colluvium would confirm pre-Clovis occupation of the area. Artifacts are associated with this stratum at Page-Ladson, consisting of several lithic artifacts and a mastodon tusk with cut-marks (Dunbar 2006a), but further research is needed to better understand the context and cultural attribution of these items. There are no reported artifacts associated with the colluvial layer at Little River Rapids, although there are a number of bones. There are no artifacts reported from this layer at Ryan-Harley or Sloth Hole.

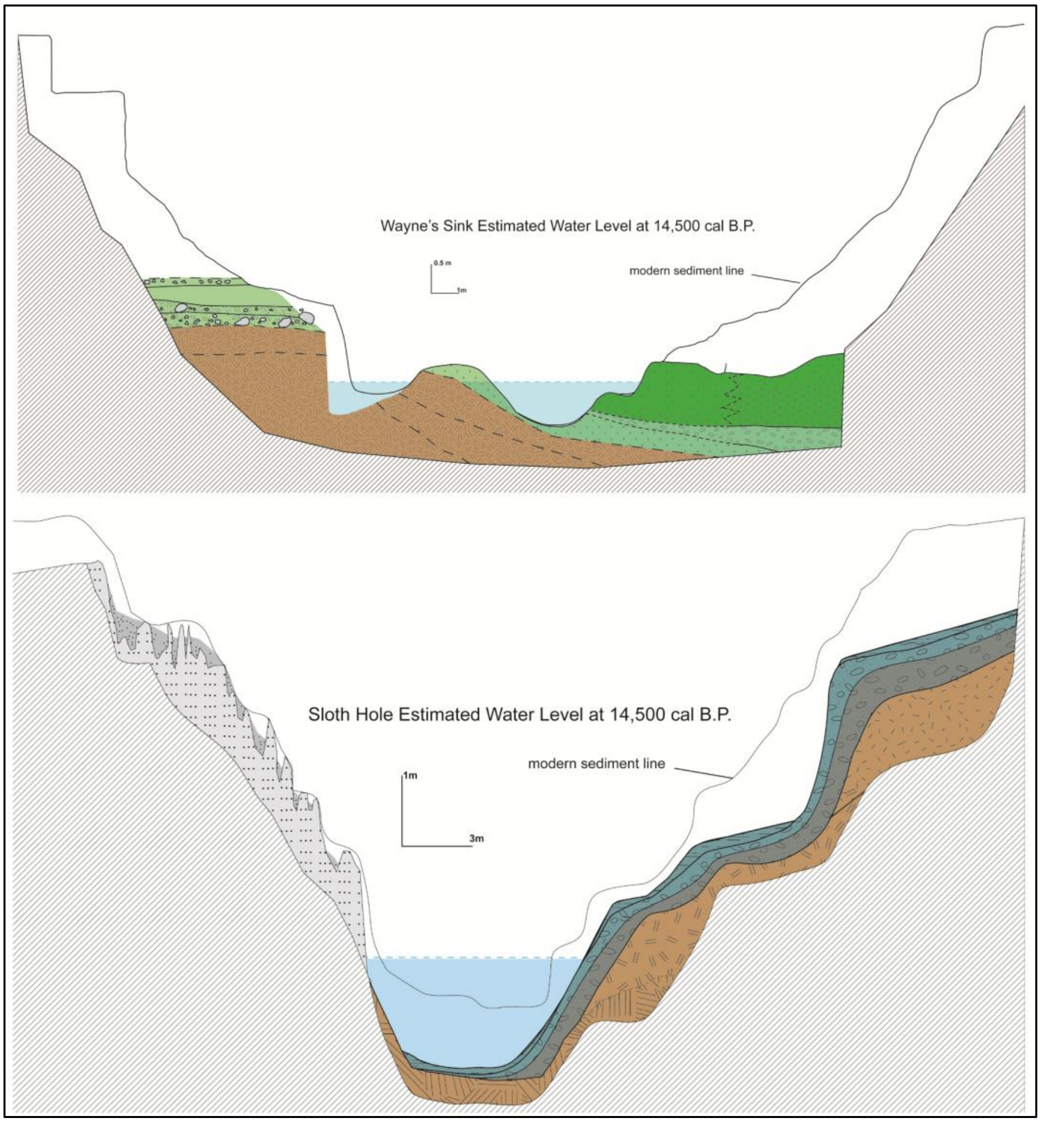



**Figure 10.9. Estimated water levels and sedimentation in Wayne's Sink and Sloth Hole approximately 14,500 cal B.P., after deposition of colluvial layer. Illustrations colored following Figures 9. 8 and 8.13.**

Component I at Wayne's Sink occurs either on the top of the colluvial layer or within 2 cm of the colluvial layer. Archaeological Component I is located on the interface between stratum IIc and III on the eastern side of the sink and within IIIc on the eastern side of the sink (Figure 10.2). Based on radiocarbon dates for the sediment, this component must be Paleoindian-aged. However, this component, in combination with the regional geological framework, calls into question the age of the soil at Wayne's Sink. The upper portion of stratum III was dated to approximately 14,400 cal B.P., well before Clovis. There are three possible explanations: there is evidence for pre-Clovis at Wayne's Sink within stratum III, the artifacts were reworked through this soil to rest on the more resistant colluvial layer of IIc and the peats of IIIc, or old wood was dated. The first could only be tested by more excavation. The second is possible; a krotovina of some kind could have gone unrecognized by the excavator in the dark water, but low counts of cultural material are present throughout stratum III on both sides of the sink, which leaves the old wood problem. I attempted to be careful with sample selection, but it is still possible. Given that the soil at Wayne's Sink is significantly older than the soils found at the four other sites, this latter hypothesis seems possible, and further dating of stratum III is recommended. Regardless, the artifacts of Component I on the east side of the sink were located on top of a colluvial deposit that was buried in a shallow pond setting. These materials may have contextual integrity, but more excavation of these sediments would be required to determine this.

Overlaying the colluvium, every site has a depositional package that dates to the terminal Pleistocene. Each site further contains evidence for pedogenic alteration of this depositional package during some part of the Paleoindian period (Figure 10.10). At all sites except Ryan-Harley, this sediment is clay that was deposited near the sink bottom and was altered post-depositionally. Ryan-Harley is at an elevation nearer to the modern water level, and the soil is sandy. In all sites except Little River Rapids (for which artifact locations are unknown), artifacts are associated with this stratum, but each soil varies. Unfortunately, this means that, while the presence of a terminal Pleistocene soil seems ubiquitous, the archaeological potential for each soil also varies, as does the potential for contextual integrity.

At Sloth Hole, Component I was associated with radiocarbon ages dating to the Early Archaic Bolen period. ARPP investigations also recovered an ivory point directly dated to the Clovis period from this stratum. Therefore, Component I probably represents at least two occupations of the sink margin during the Early Paleoindian and Early Archaic cultural periods. This terminal Pleistocene and early Holocene soil could either have formed as a cumulic soil horizon or it could have formed as a unit in a synchronously-deposited sediment package. If the former, there could be some spatial separation between Clovis and Early Archaic deposits that may be traceable to recreate original occupation surfaces and activity areas. If the latter, the two components would be conflated and mixed, limiting interpretation of cultural activity from either period. This may be determinable from notes of the ARPP excavations, and definitely would be resolvable by further excavation of stratum IV using very thin levels (<5 cm) and good elevation control within the stratum.

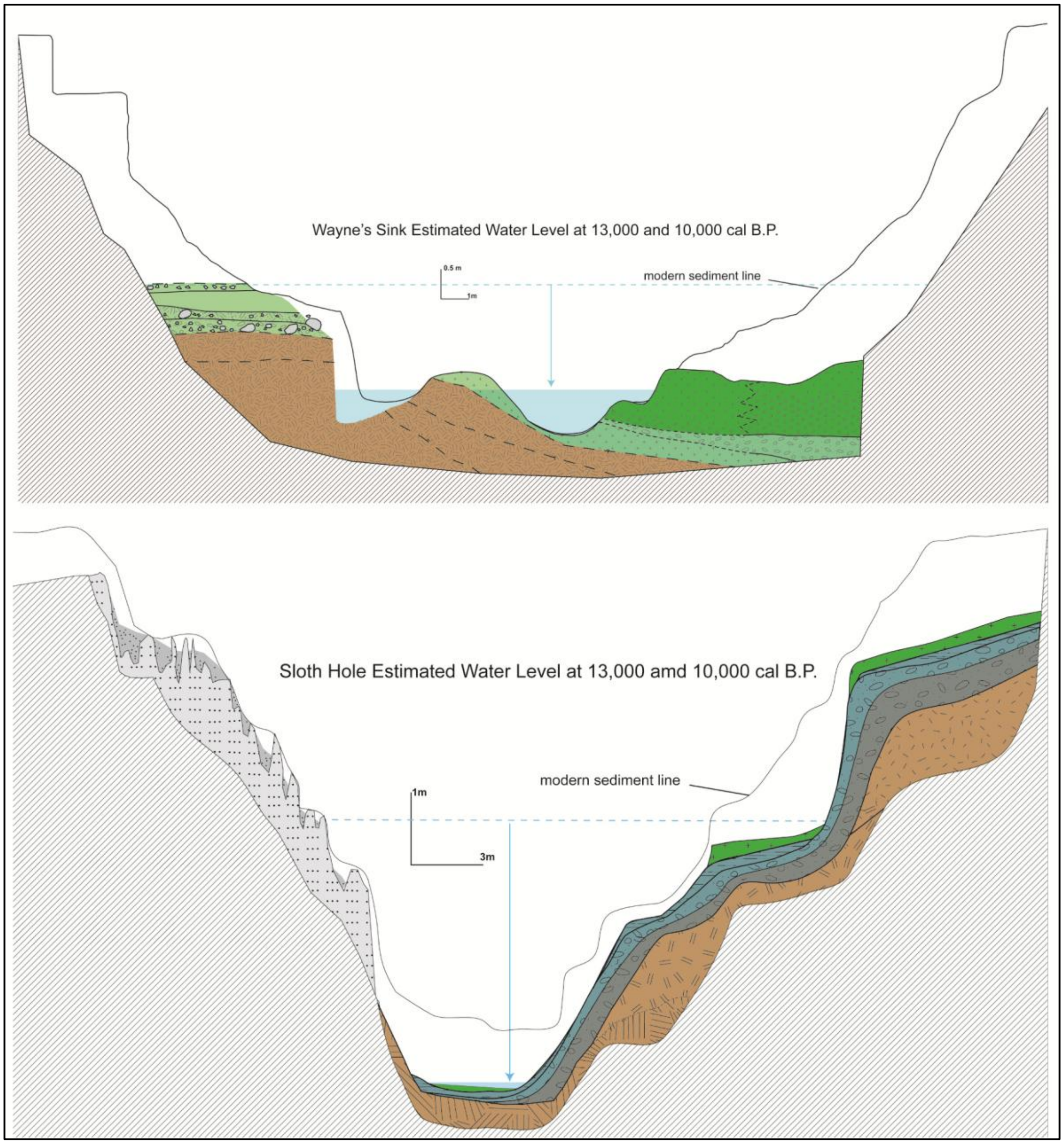



**Figure 10.10. Estimated water levels and sedimentation in Wayne's Sink and Sloth Hole at approximately 13,000 and 10,000 cal B.P. This is the approximate surface available for Clovis and Bolen people after deposition of clay and soil formation. Dashed blue line is approximate maximum extent of water, solid blue is minimum of water. Illustrations colored following Figures 9. 8 and 8.13.**

Further, Component I also may potentially be associated with a concentration of artifacts associated with a cut-marked mastodon bone in the deepest portion of the sink. These items were excavated and recorded by the ARPP, and while none of my units or cores explored this area, it appears that these items were all located in laminated sands below the stratum VI peats (Hemmings 1999b). These items are all very large, so they are unlikely to have been transported by anything less than a major colluvial event. They may represent an intact portion of Component I. If this is the case, water in the sink was extremely low during the terminal Pleistocene.

At Wayne's Sink, Component II rests on top of the soil. This soil surface seems to have been available at least periodically from approximately 13,000-5,000 cal B.P. Therefore, it may represent multiple episodes of cultural deposition spanning the entire Paleoindian and Early and Middle Archaic periods. However, the directly dated bone point dates to the earliest part of the Late Archaic period, contemporaneous with the base of the stratum VI peat. Any artifacts on this soil dating to earlier periods have been subjected to the post-depositional processes common to all surface sites: conflation with later artifacts, movement by people and animals, trampling, fire, etc. If, as discussed above, the soil is dated correctly, any artifacts found within it are pre-Clovis in age or have been translocated into the sediments along ped faces. The translocation along ped faces was observed in terrestrial test pits on Ward Island (see Chapter VII), so this is definitely possible. The Late Archaic portion of Component II seems to have been submerged almost immediately and to have been then preserved in peats. It could have also been deposited in the shallow pond by people, but it probably was not redeposited in the pond by natural processes as discussed in Chapter IX. Further exposure of the component would be necessary to determine this.

At Ryan-Harley, the Late Pleistocene soil contains what the investigators have interpreted as a Suwannee-period campsite (Balsillie et al. 2006; Dunbar et al. 2006; Dunbar and Vojnovski 2007); there are some Bolen remains at the site, but they are careful to note that these are not associated with the Suwannee campsite. At this site, sedimentary analyses have revealed that the site was probably exposed at the surface for a period of time after its occupation, due to the input of aeolian sands, but that very little reworking of sediments probably occurred as the site was buried in fine-grained sediments (Balsillie et al. 2006). The investigators interpret this to mean that artifacts were probably *in situ*. This is possibly true, but if the site was exposed for a long period of time at the surface, there could have been a significant amount of artifact movement.

At Little River Rapids, Early Archaic materials made up the majority of the artifacts recovered during the surface collection (42 Bolen points were recovered). While ivory points had been reported by local collectors, none were found by the researchers (Willis 1988). In the brief reports of the site (Muniz 1997, 1998), no reports are made of the stratigraphic position of any cultural materials, but based on radiocarbon ages, the Bolen materials were probably associated with the green clay, while the reported Paleoindian materials were mostly likely from the loamy stratum underlying this green clay. This site seems as though it is mostly redeposited or deflated, but any artifacts found within these fine-grained strata could have good contextual integrity.

At Page-Ladson, the terminal Pleistocene-Early Holocene stratum consists of more than two meters of fine-grained sediments that contain some evidence for fluvial deposition and some evidence for pond deposition (Kendrick 2006). This deep sequence contains a few flakes in Clovis-aged layers (Unit 4 upper), but no diagnostically Clovis material; these fine-grained sediments are interpreted to be fluvial in origin with little interruption in deposition (Kendrick 2006). A thin Late Paleoindian-aged stratum overlaid this (Unit 5); artifacts were recovered from this deposit, but no diagnostics. Artifacts in this stratum were submerged relatively quickly in a slow-moving fluvial deposit; thus, their archaeological integrity is likely to be very good (Dunbar 2006a). Above this was a pedogenically-altered soil associated with Bolen remains (Unit 6); Scudder (2006) interpreted this sediment to be a shallow pond deposit that was not subaerially exposed, with artifact distributions reflective of discard patterns. The artifact distributions within the stratum may otherwise (Carter and Dunbar 2006). Regardless, the artifacts showed little evidence of post-depositional reworking; their context seems to be very good, whether they represent living activities or deliberate disposal (Carter and Dunbar 2006). At Page-Ladson, then, there is separation between different Paleoindian and Early Archaic components, meaning these components are unlikely to be intermixed.

During the third period of infilling (approximately 5,000-3,500 cal B.P.), peat formation began almost synchronously at Sloth Hole, Wayne's Sink, Page-Ladson, and Ryan-Harley (no date was reported for Little River Rapids). These peats directly overlay the soils at Page-Ladson, Ryan-Harley, Little River Rapids, and the east bank of

Wayne's Sink. Therefore, in all of these locations, Early and Middle Archaic artifacts could only be found in the contact between the soils and peats (Figure 10.11). Peat formation happens in shallow pond environments where flow is gentle enough to not disturb organics, where mineral sediment load is light enough to keep the organics the predominant component, and moisture is constant or near-constant (Davis 1911). Within these sediments, Late Archaic artifacts could be found in undisturbed context if there were brief periods of subaerial exposure, which should be observable as fine-grained mineral layers within the peats. The common sand lenses in these peats, however, usually represent storm deposition, and artifacts within these sand lenses are most likely redeposited.

In Sloth Hole and the western bank of Wayne's Sink, the soil is overlain by clay strata (stratum V in Sloth Hole, and strata V, VII, and VIII at Wayne's Sink). In Sloth Hole, Archaeological Components II and III were associated with these sediments. Component II was deposited on a soil that was formed in shallow pond deposits. Thus, this component was deposited after water levels in the sink had risen then lowered again. These artifacts may also represent more than one period of cultural activity, but artifacts probably retain good horizontal stratigraphy as they were also submerged in shallow pond deposits. Component III probably represents only a single brief period of activity on the sink margin. These artifacts showed evidence of vertical bioturbation, as they spread across several levels, so contextual integrity was fairly low, but as a record of a single period of activity in the past, there may still be important archaeological information to be obtained from the component.

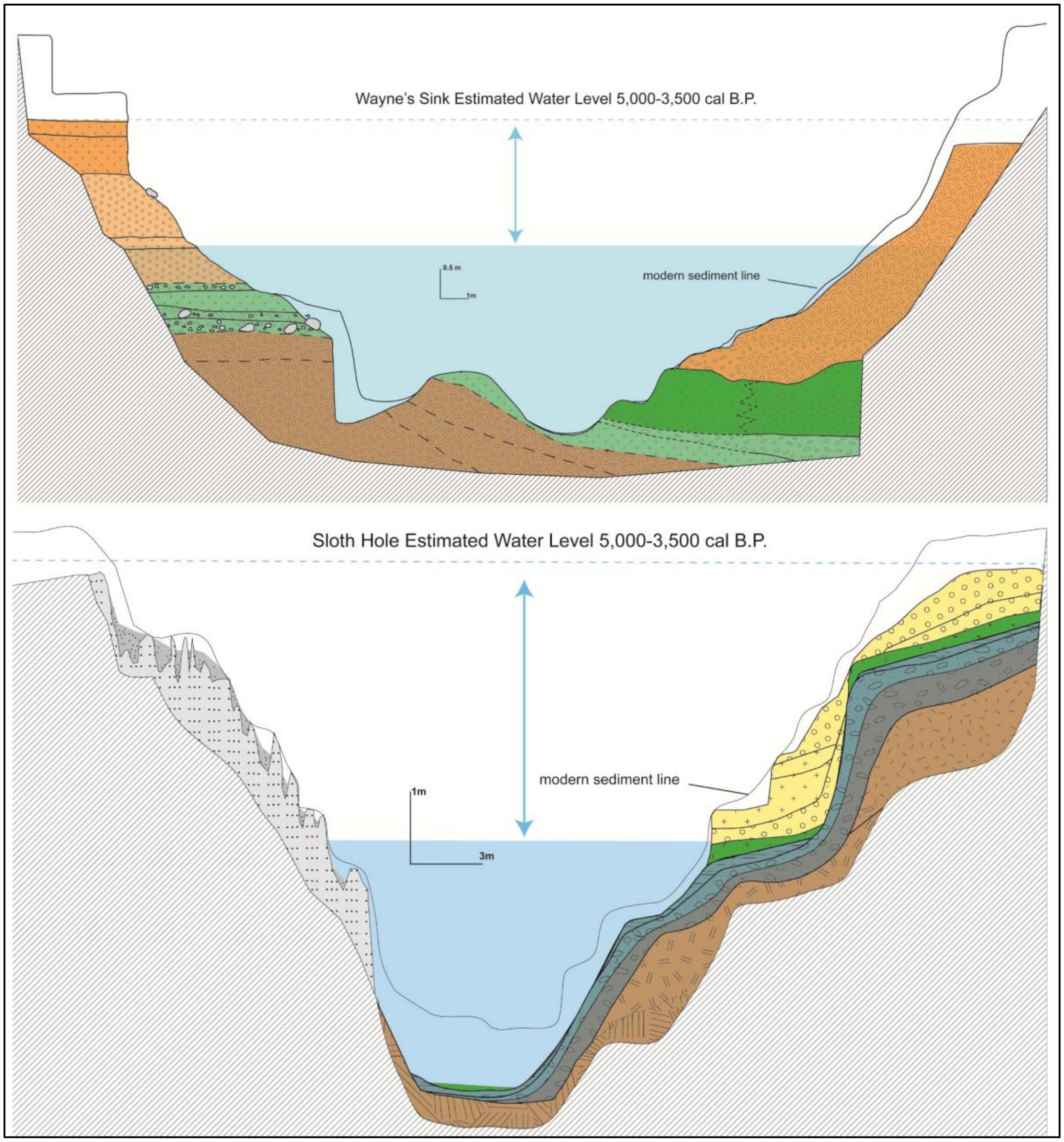



**Figure 10.11. Estimated water levels and sedimentation in Wayne's Sink and Sloth Hole at approximately 5,000-3,500 cal B.P. This is the approximate period of peat formation. Dashed blue line is approximate maximum extent of water; solid blue is minimum of water. Illustrations colored following Figures 9. 8 and 8.13.**

In Wayne's Sink, no distinct archaeological components were associated with strata V, VII, and VIII, although a few scattered flakes were associated with numerous excavation levels. The sediments are undated at this time, but all are mid-Holocene in age, based on their relative position between Pleistocene and dated Late Holocene strata. The sediments contained two separate paleosols and one colluvial episode. Because all of the artifacts were very small (<1 cm) and generally occurred in isolation, the few flakes were likely redeposited by slopewash and colluvial activity. Artifacts with good contextual integrity may occur within these sediments, especially within the paleosols, however.

Fluvial processes dominated the fourth period of sinkhole infilling (approximately 2500-0 cal B.P.). This period is only differentiated from the third period of infill in the sediments at Wayne's Sink, where it consisted of sediments in the current intertidal zone and the modern river banks (strata IX-XI). Deptford ceramics were associated with these sediments in stratum X, the current river banks. The current intertidal zone stratum (IX) is composed of a flat surface containing clays with common organics and some loose sand on the top. Artifacts on this surface are subjected to constant wetting and drying, and they are likely to be washed into the stream during flood events. Further, it appears that the river is slowly widening by slow, slight erosion of stratum X during both flood events and the daily ebb and flow of the tides. This is evidenced by areas along the bank with recently-slumped sediment. This means artifacts found on the top of stratum IX should be treated with suspicion, as they may have been recently deposited upon this surface, although they probably were eroded from sediments very nearby. Figure 10.12 shows the approximate water level fluctuation in Sloth Hole and Wayne's Sink during the most recent period of sinkhole infill.

All five sites contained surface sands (stratum XI in Wayne's Sink and stratum VII in Sloth Hole). These sands cover the modern banks and bottom of the sink. Within the sink bottom, these sands are full of bones and artifacts dating from the Paleoindian to the modern periods. While some of these artifacts and bones were probably washed into the sinks during flood events, many are too large to have been transported very far, and almost all of them are too large to be entrained once they fell into a sink as flow at the bottom of the deep, steep-sided sinks is negligible. Flow rate over the shoals bounding the sinks, however, is often quite rapid. This almost certainly explains the common concentration of cultural materials near the shoals in most sink bottoms. Therefore, although these items within the sink bottoms are still redeposited in most cases, they are probably relatively local in origin. In many cases, the artifacts found near the sediment banks probably originated within the sediment banks; the artifacts found near the shoals probably eroded from, or very near, the shoals.

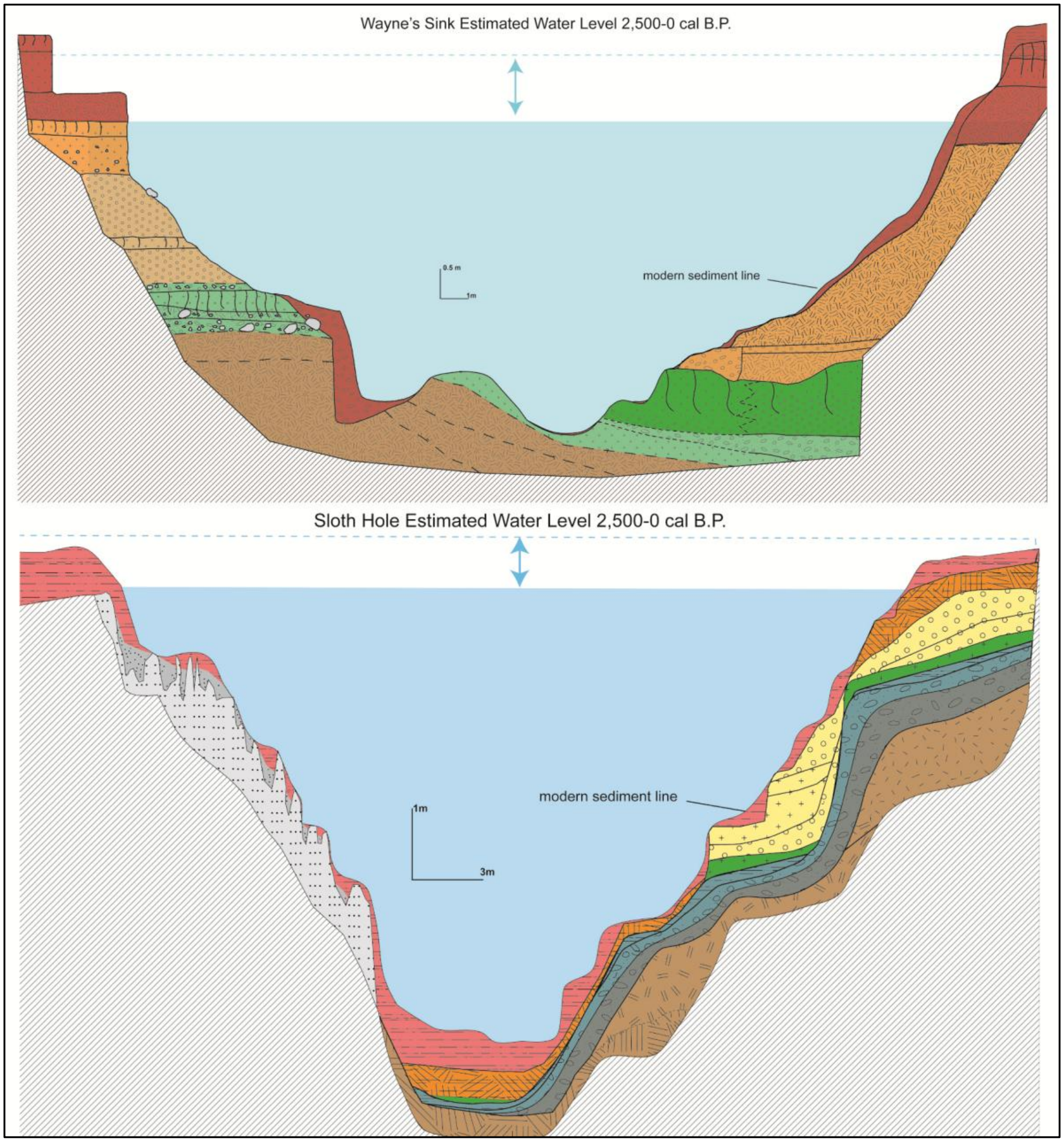



**Figure 10.12. Estimated water levels and sedimentation in Wayne's Sink and Sloth Hole at approximately 2,500-0 cal B.P. This is the approximate extent of the modern intertidal zone. Dashed blue line is approximate maximum extent of water; solid blue is minimum of water. Illustrations colored following Figures 9. 8 and 8.13.**

In summary, Paleoindian and Early Archaic artifacts can be found in undisturbed contexts within the terminal Pleistocene paleosols that are at least somewhat common in the sinks within the lower Aucilla, but each one of these paleosols needs to be investigated individually because each one is slightly different, representing a different time span and potentially containing different cultural components. Each also may have preserved these materials differently. These soils should be very recognizable; in both Wayne's Sink and Sloth Hole, the soil was very hard with well-developed angular blocky structure, for instance. Archaic period materials can be found within the peats and clays along the sink margins, but these items are typically redeposited. Woodland artifacts may be found in the sediment represented by the current intertidal zone, and Woodland period sites are extremely common within the terrestrial areas, but all Woodland period items found within the sink proper, unless they were associated with fishing activities, were redeposited into the sink. Figure 10.13 presents this information graphically, discussing the archaeological site potential for each sink.

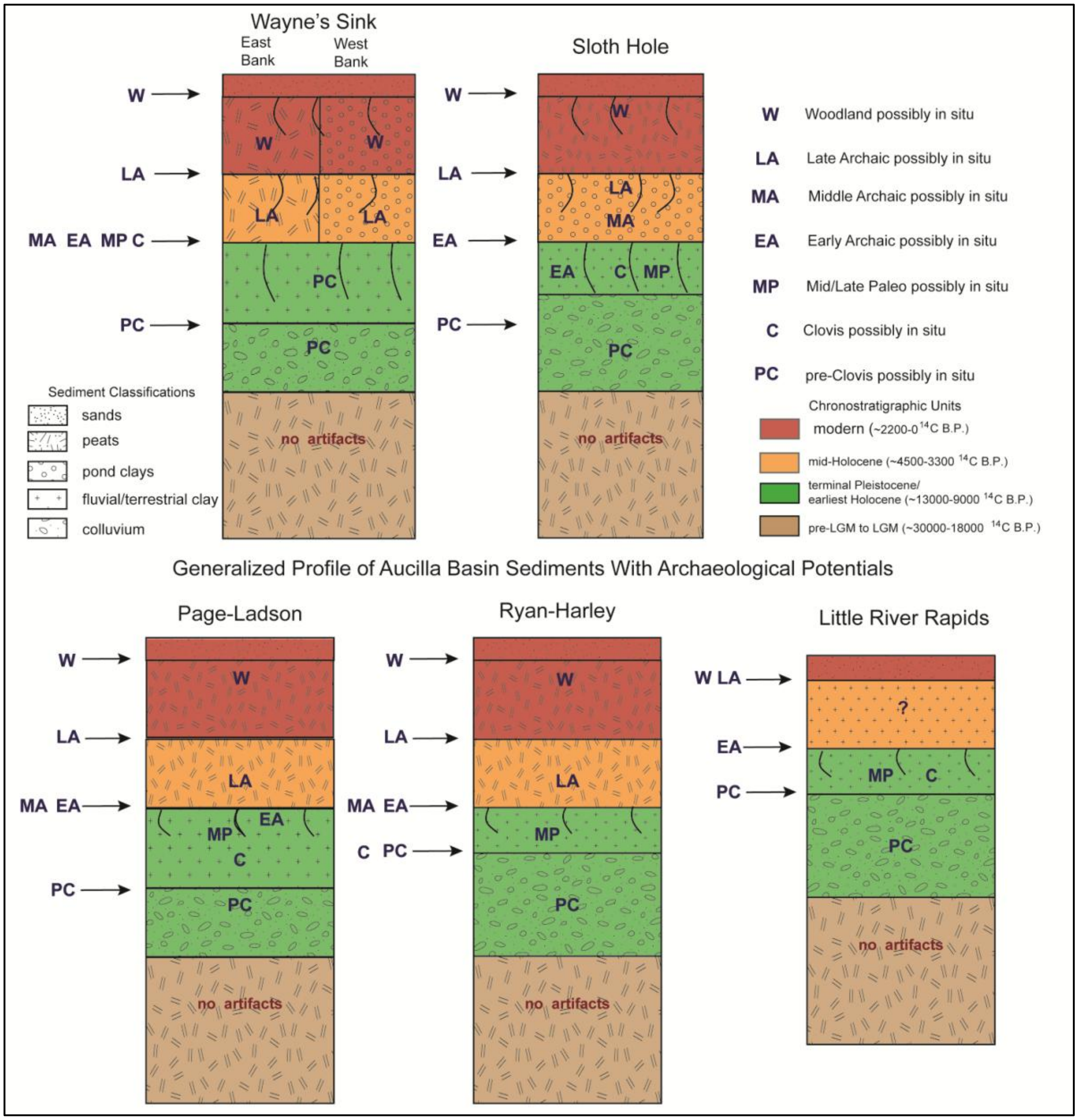



**Figure 10.13. Generalized section of Aucilla Basin sediments coded by time period, with generalized archaeological preservation potential.**

## Archaeological Framework

The final goal of this dissertation is to discuss human behavior in the lower Aucilla basin during the terminal Pleistocene and early Holocene based upon the materials recovered from undisturbed archaeological components. Thus far, this research has defined the geological and geoarchaeological frameworks of the lower Aucilla River basin by comparing the data from vibrocores, shovel test pits, and excavation units in Sloth Hole and Wayne's Sink to three other, previously excavated sinks. The archaeological components recovered during the underwater excavations consisted of nondiagnostic lithic flakes, shatter, and three bone tools, one from Sloth Hole and two from Wayne's Sink. Of the six archaeological components defined (three at each site), three definitely post-date the Paleoindian period, one is associated with a sediment that spans the Paleoindian period (Sloth Hole Component I), one may be entirely redeposited (Wayne's Sink Component I), and one may date to any time from the Late Paleoindian to the Late Archaic (Wayne's Sink Component II). Further, as stated above, the Paleoindian-aged paleosols are extremely variable, so Paleoindian artifact context is also variable.

My research serves to confirm earlier hypotheses about human activities in the basin. First, these investigations have confirmed that pre-Clovis deposits in all five sinks discussed would be associated with a sandy colluvial layer. This layer would have been deposited during a dryer climate with more open vegetation during a time when sea level was more than 80 m lower than present and the mouth of the Aucilla would have been more than 100 km seaward. These data seem to support the Oasis Hypothesis, which states that low water levels limited available water to within sinkholes. Therefore, sinkholes became attractive areas for people and animals (Dunbar 2002, 2006a, 2006b; Thulman 2009; Webb 2006). A corollary of this is that these sinks would then have become increasingly disturbed around the margins from animal trampling, which could have contribute to or even triggered the sandy colluvial deposits and could have reworked any artifacts left on the sink margins.

If people were in Florida at this time, they probably would have been using the same waterholes as the other animals, and there should be some evidence of human use in these sediments. At the same time, if the waterholes were the only water source, it seems likely that people were not living too near them because large predators also would have been attracted to the waterhole for both hunting and water. Scavengers (possibly including people) would have been attracted to the carcasses, causing further danger for people. Therefore, human evidence around the waterholes is expected to be ephemeral and limited largely to hunting and/or scavenging activities, based upon ethnographic analogy to forager behavior around oases in places with large carnivores and rare surface water (Kelly 2007; Lee and DeVore 1976). This is precisely what the potential pre-Clovis record in Page-Ladson seems to display, although further research is necessary to confirm the presence of pre-Clovis at this site.

Clovis, later Paleoindian, and Early Archaic people also experienced relatively dry climates. The terminal Pleistocene paleosols reported at all of the sites except Ryan-Harley formed at least 4-5 m below the current water level of the river. The river could not have been running aboveground at that time; thus, people would still have had to utilize the water holes dotting the landscape. The mastodon fibula with cut-marks and stone tools in the deepest part of Sloth Hole suggest that Clovis people were butchering and possibly hunting large game around the sink; they may also have been extracting ivory for tools from elephants that they killed or that died around the waterholes. The presence of five complete Clovis points within the sink suggests the former. None of these theories about Clovis people is new (Dunbar 2006a; Grayson and Meltzer 2002; Hemmings 2004; Surovell and Waguespack 2008), but my research confirms that the spatial patterning of some of the materials within the sink is due to cultural rather than natural processes.

Congruently, the debitage analysis completed during this dissertation revealed very little debitage considered diagnostic of Clovis reduction strategies: there were almost no overshot flakes, few blades (one), no blade cores, a very low percentage of isolated platforms, and large flakes were not common (Bradley et al. 2010; Waters et al. 2011b); thus, it seems that at least initial lithic reduction was not an important Clovis activity at the site. None of the other sites discussed in this investigation contained a clear Clovis signature, even though Clovis points have been recovered from at least nine of the sites in the Aucilla River, according to notes of the ARPP.

The Suwannee campsite at Ryan-Harley is undated, but is hypothesized to occur shortly after Clovis and to contain evidence for late survival of megafauna, as extinct animal bones are associated with the cultural component(Balsillie et al. 2006; Dunbar 2007; Dunbar et al. 2006; Dunbar and Vojnovski 2007). This site was the only site not located in a sinkhole, and appears to have been a campsite with much more extensive use. Ryan-Harley was located on a point bar located alongside a paleochannel, and the researchers are unsure if freshwater was locally available at the time of site occupation (Balsillie et al. 2006; Dunbar et al. 2006). People may, thus, have been living away from the waterholes, as proposed above, using logistical forays to obtain this and other resources. Although it is difficult to use this undated site to make definitive cultural statements, if the megafauna survived past Clovis in Florida, one would expect people who descended from Clovis, if they were following similar adaptive strategies, to make similar logistical decisions.

This research did not discover any Late Paleoindian cultural components, but sediments spanning the Late Paleoindian period were present at Page-Ladson and may be contained in the undated sediments at Wayne's Sink; this provides the possibility that archaeological materials could have been culturally deposited within the sinks. I did find data relevant to Early Archaic Bolen cultures. Extensive Bolen remains were recovered from Sloth Hole, Page-Ladson, and Little River Rapids; Wayne's Sink contains some Bolen deposits, and the investigators of Ryan-Harley noted the presence of Bolen materials (Carter and Dunbar 2006; Dunbar et al. 2006; Halligan 2009a; Hemmings 1999b; Muniz 1998; Willis 1988). The Bolen evidence at Sloth Hole is most likely associated with the paleosol (stratum IV) that has ages overlapping the Bolen period. This soil is the same one associated with Clovis; either very little had changed in the local environment in several thousand years, or, as suggested by the pollen records (Figures 10.7 and 10.8), a period of moister conditions was interrupted by a drought that caused local drying, causing people to return to reliance upon the sinks. The large number of adzes recovered from Sloth Hole (Hemmings 1999b) suggest that woodworking was an important activity conducted at the site by these Early Archaic people. Further, the increase in the amount of materials, the variety of tool types found in the Bolen components at Sloth Hole, Little River Rapids, and Page-Ladson, and the evidence for hearths at Page-Ladson (Muniz and Hemmings 2006), all indicate that Bolen people were living on the sink margins, possibly because the large mammals that made the sinks dangerous were no longer around, and it was more convenient to live near their freshwater sources.

The lower Aucilla also contains an extensive record of more recent cultural activities. Most of the sites discovered during this fieldwork could be ascribed to Late Archaic and Woodland people who occupied this area after sea levels and climate conditions were essentially modern. Based upon data from Ward Island and the K-1 mound site (Chapter VII), these people were living in the drainage basin on a regular basis, and they were conducting a great deal of primary and secondary stage lithic reduction; this was possibly to create less bulky items for transport, but it is also possible that this debitage represents the accumulation low-intensity lithic reduction over the course of many years. This flintknapping may be associated with Wayne's Sink; the chert-bearing limestones on the south side of Wayne's Sink were used as toolstone sources where extensive quarrying and primary reduction occurred, as shown by the many kilograms of debitage that were recovered from the single 1 x 1 m unit excavated near this toolstone outcrop (excavation unit 7, see Chapter IX). This toolstone outcrop was probably under water, at least most of the time, after the Early Archaic period, but the same chert seam may have been terrestrially available nearby.

## Recommendations for Future Work

This dissertation has defined the geological sequence of the lower Aucilla basin during the Late Quaternary, discovering that there were three major periods of sinkhole infilling post-dating the LGM. Cultural materials are associated with all three periods. More radiocarbon dating of the clay sequences at Wayne's Sink and Sloth Hole to determine exactly where these sediments fit within the geological framework would help to flesh out the geological model presented here. This would also directly date Components II and III at Sloth Hole, defining the entire cultural chronology on the eastern bank of the site. Further examination of the paleosols discovered during investigations at both sites would reveal new information about Paleoindian and Archaic people in the Aucilla River drainage.

This research has proposed the archaeological potential of each period of sinkhole infill. Based upon this research, intact pre-Clovis deposits are possible, but they would only be associated with colluvium, so careful analyses would be needed to demonstrate their association with radiocarbon dated materials and to determine their contextual integrity. Further examination of the proboscidian remains from Sloth Hole that date to 14,100 cal B.P. may thus be warranted, as the animal seems to have perished on top of the colluvium and to have been buried in fine-grained sediments which could have allowed any archaeological materials associated with the elephant to maintain contextual integrity

Later Paleoindian remains can only be found associated with the terminal Pleistocene soils within the sinks in the lower Aucilla Basin. Terrestrial research indicates that intact Paleoindian sites are unlikely to be found on land, at least in the study area. Thus, in future examinations of submerged Paleoindian sites, effort should be make to locate the terminal Pleistocene paleosol and to target this sediment. Because these paleosols are heterogeneous in their time spans, care should also be taken to select a paleosol that spans the period of interest, as most of these sediments are deeply-buried and a great deal of effort is necessary to expose the soils. However, further exposure and excavation of these soils is likely to yield a wealth of information about Paleoindian behavior around the sinks as some of the fine-grained soil sequences are likely to have excellent contextual integrity.

Early Archaic materials are also correlated with these paleosols; they may be separated in deposition from earlier components (Page-Ladson) or they may occur conflated with them (Sloth Hole), so future analyses should attempt to separate these component using thin excavation levels. Many questions about Early Archaic lifeways could be answered by further examining the extensive Early Archaic remains, however. In all five examined sites, the upper portion of the sediment column consisted of peats; the base of these peats dated to almost exactly to the same time; roughly 5,000 years ago, or to the beginning of the Late Archaic period. Thus, in the underwater portions of this research area, Middle Archaic sites are likely to be rare or conflated with earlier deposits, and most of the Middle Archaic-Woodland artifacts are likely to be redeposited within the peat sequences. If looking for submerged sites of these periods, fine-grained mineral sequences within the peats should be targeted and the Holocene clay sequences found on the backwater side of the sinks may contain rapidly-buried Archaic sites with good organic preservation.

Ever since the first ivory rods were reported from the Florida rivers (Jenks and Simpson 1941), these streams have been known to be repositories of Paleoindian artifacts and extinct faunal remains. The Aucilla River contains one of the densest concentrations of recorded Paleoindian sites in North America (37 localities with known Paleoindian remains in the lower 10 km of the stream; almost certainly there are many more located in the currently-submerged reaches of the river). The archaeological potential of this stream was recognized and explored by the Aucilla River Prehistory Project during the late twentieth century. This research provided an excellent framework for Paleoindian activities within the area, but left some questions about artifact context and age. My research has attempted to address these issues, thereby providing a basis for future explorations in the basin. Human behavior was not the main focus of this dissertation. Now that the geoarchaeological framework of these sinkhole sites has been provided, there are clear areas to search for intact or relatively intact archaeological sites. Future researchers can use this framework to target these locations so that the data recovered from their excavations can directly address questions of human choice in the past.

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# APPENDIX I: ARTIFACT AND UNIT CODING SHEETS

# Debitage Coding Sheet

## All Debitage

**Site Name**
**Accession Number**
**Unit**
**Level**
**Elevation**

**Size**
1: <1cm diameter
2: 1-3cm diameter
3: 3-5cm diameter
4: >5cm diameter

**Material**
1: Cryptocrystalline silicate
2: Limestone
3:conglomerate
4: sandstone

## Codes for sizes 2-4

**Weight** grams

**Platform**
0: missing
1: cortical
2: flat
3: complex
4: crushed

**Termination**
1: feather
2: hinge
3: step
4: overshot
5: shatter

**Dorsal Scar**
0: 0
1: 1
2: 2
3: 3+

**Portion**
1: complete
2: proximal
3: medial
4: distal
5: shatter

**Radial break**
0: none
1: 1
2: 2+

**Heat**
0: none
1: reddened or blackened
2: potlidded/ heat crazed

**Cortex amount**
1: Primary (100% cortex on dorsal side)
2: Secondary (1-99% cortex on dorsal side)
3: Tertiary (no cortex)

**Cortex location**
0: none
1: whole dorsal
2: proximal
3: distal
4: margin

**Flake type**
1: fragment (medial or distal only)
2: normal (platform present, not one of other kinds)
3: biface thinning flake (complex platform, 3+ flake scars)
4: overshot (overshot term
5: shatter
6. tool resharpenning (platform is tool edge)
7. end thinning
8. blade
9. bladelike
10. tested cobble

**Comments**

## Codes for size 1

**Flake Type**
1: fragment (no platform)
2: complete (platform)

**Count** total number by type
**Combined weight** weight by type

# Biface Coding Sheet

**Site Name**
**Accession Number**
**Unit**
**Level**
**Elevation**

**Material**
1: Cryptocrystalline silicate
2: Limestone
3:

**Length (mm)**

**width (mm)**

**thickness (mm)**

**weight (g)**

**estimated completeness**
0: indeterminate
1: 100%
2: 75-99%
3: 50-74%
4: 25-49%
5: 1-25%

**missing portions**
0: none
1: base
2: tip
3: base/mid
4: tip/mid
5. indeterminate

**biface stage**
1: early
2: middle
3: late
4: point
5: fragment
6: core
7: chopper
8: adze

**point type**

**planview shape**
1: circular
2: lanceolate
3: ovoid
4: straight
5: triangular
6: corner-notched
7: side-notched
8. random

**base type**
1: concave
2: ovoid
3: rounded
4: square
5: corner-notched
6: side-notched

**base indentation (mm)**

**notch depth (mm)**

**base width (mm)**

**cross section shape**
1: bi-convex
2: bi-plano
3: plano-convex
4: diamond

**edge angle side 1 (degrees)**

**max invasiveness side 1 (mm)**

**edge angle side 2 (degrees)**

**max invasiveness side 2 (mm)**

**dominate flaking type**
0: indeterminate
1. edge only
2. to midline
3. past midline
4. some overshots
5. random

**end thinned**
0. none
1. present

**cortex present**
0: none
1: one face
2: both faces

**core type**
1: multidirectional random
2. bifacial
3. unidirectional
4. conical
5. wedge-shaped

**core flake scars**
1: 1
2: 2
3: 3
4: 4
5: 5+

# Flake Tool Coding Sheet

**Site Name**
**Accession Number**
**Unit**
**Level**
**Elevation**

**Material**
1: Cryptocrystalline silicate
2: Limestone
3:

**tool blank**
1. indeterminate flake
2. core reduction flake
3. blade
4. biface thinning flake
5. cortical spall

**hafting wear**
0: none
1: present

**worked edges**
1: 1
2: 2
3: 3

**worked edge shape**
1: indeterminate
2: pointed
3: straight
4: concave
5: convex

**edge angle (degrees)**

**max invasiveness (mm)**

**retouched face**
1: indeterminate
2: unimarginal
3: bimarginal,
4: edge
5: alternating

**dominant retouch type**
1. indeterminate
2. nibbling
3. scaly
4. stepped

**worked edge length (mm)**

**perimeter length (mm)**

**max thickness (mm)**

**max width (mm)**

**max length (mm)**

**weight (g)**

**tool type**
1: fragment
2: retouched flake
3: retouched blade
4: end scraper
5: side scraper
6: burin
7: graver
8: spokeshave
9: adze

**Level Analysis Form**

| Unit | Level | Depth | AM: | Site Name |
|---|---|---|---|---|
| Shell Types: | | | | |
| Shell Amount: | Shell Broken/Whole? | | | |
| Bone Types: | | | | |
| Bone Amount: | Bone Stained/Unstained? | | | |
| Lithic Types: | | | | |
| Lithic Amount: | Lithics Stained/Unstained? | | | |
| Other Artifacts? | Type? | | Amount | |
| Gravel Types: | | | | |
| Gravel Amount: | | | | |
| Heavy Clay? | Heavy Organics? | | | |
| Notes: | | | | |

# APPENDIX II: PILOT STUDY CORE PROFILES

**Core 1: Sloth Hole (8JE121)**

| Stratum | Munsell | Texture | Description | Contact with above | Comments | Artifacts/Fauna |
|---|---|---|---|---|---|---|
| 0-65 cmbs | 10YR 4/2, 10YR 5/2 fading to 2.5Y 4/3, 2.5Y 4/1 | loamy fine sand | gray sands with lighter sands | n/a | few limestone fragments; common botanical material | common whole snail shells and some mussel shell fragments |
| 35-42 cmbs | 10YR 4/1 | silt loam | fine gray sediments | gradual | large rock at top of stratum | some whole snail shells |
| 40-44 cmbs | 2.5Y 4/1 to 2.5Y 6/1 | loamy fine sand | gray shell hash | abrupt | fine (<.5cm) organic drape on top of this stratum | abundant snail shell fragments |
| 44-55 cmbs | 10YR 3/1, 2.5Y3/2, 10YR 5/2 | organic w/ fine sand | peat w/ fine sand laminae | abrupt | contains 4-5 fine sand drapes | |
| 55-65 cmbs | 10YR 3/1 | organic | sapropel | abrupt | no shell in stratum | |

**Core 2: Sloth Hole (8JE121)**

| Stratum | Munsell | Texture | Description | Contact with above | Comments | Artifacts/Fauna |
|---|---|---|---|---|---|---|
| 0-11 cmbs | 5Y 5/1 to 5Y 4/1 | loamy sand | gray shell hash | n/a | snail shell on top of column | common crushed shells |
| 8-25 cmbs | 2.5Y 3/1 to 2.5Y 3/2 | organic with loamy fine sand | brown peaty sediment | abrupt | Mg balls and many wood frags | with common snail shell frags (larger than above) |
| 24-25 cmbs | 10YR5/2 | fine sand | sand drape? | abrupt | | |
| 25-31.5 cmbs | 2.5Y 3/1 | wood with silts and clays in gaps | woody peat | abrupt | | |

**Core 3: Sloth Hole (8JE121)**

| Stratum | Munsell | Texture | Description | Contact with above | Comments | Artifacts/Fauna |
|---|---|---|---|---|---|---|
| 0-35 cmbs | 2.5Y 3/1 grading to 10YR 3/2 | compacted loamy fine sands | shell hash | n/a | scattered wood fragments | small shells common throughout |

**Core 4: Cypress Hole (8JE1499) not able to be extracted**

**Core 5: Cypress Hole (8JE1499)**

| Stratum | Munsell | Texture | Description | Contact with above | Comments | Artifacts/Fauna |
|---|---|---|---|---|---|---|
| 0-1 cmbs | 10YR 2/1 | organic | organic stratum | N/A | | |
| 1-5 cmbs | 10YR 5/4 | coarse sand with some silt | | clear | few organics | |
| 5-10 cmbs | 10YR 5/4 | coarse sand | sandy fill? | abrupt | wood fragments pushed into contact with above | turtle shell 6-10 cmbs |
| 10-50 cmbs | 10YR 2/1 fading to 10YR 3/1 | silty clay | massive sapropel with wood fragments | abrupt | common wood fragments | 2 fishbone frags. 10-20 cmbs |

**Core 6: Cypress Hole (8JE1499)**

| Stratum | Munsell | Texture | Description | Contact with above | Comments | Artifacts/Fauna |
|---|---|---|---|---|---|---|
| 0-8 cmbs | 10YR 5/4 w/ 10YR 5/4 | medium sand with trace silt | sands with some leaves | N/A | | |
| 8-9 cmbs | 10YR 2/1 w/ some 10YR 5/4 | clay | clays with leaves | clear | | |
| 9-15 cmbs | 10YR 3/1 | silty clay loam | weak angular blocky structure w/sand on ped faces | abrupt | | shell common |
| 15-20 cmbs | 10YR 4/1 | clay | weak angular blocky structure, no sand on ped faces | gradual | | shell common, 1 fish bone |
| 20-30 cmbs | 10YR 4/1 | clay | weak angular blocky structure, no sand on ped faces | gradual | | shell common |
| 30-39 cmbs | 10YR 4/1 | clay | weak angular blocky structure, no sand on ped faces | gradual | some limestone fragments | shell common |
| 39-43 cmbs | 2.5Y 2.5/1 | clay loam to clay | gray shell hash | clear | | shell common |

**Core 7: Cypress Hole (8JE1499)**

| Stratum | Munsell | Texture | Description | Contact with above | Comments | Artifacts/Fauna |
|---|---|---|---|---|---|---|
| 0-2 cmbs | 2.5Y 3/1 | organic with clay | organic mat | N/A | clay in interstices | |
| 2-8 cmbs | 10YR 7/3 | medium to coarse sand | sand drape | clear | | |
| 8-12 cmbs | 10YR 2/3 w/ trace 10YR 7/3 | organic w/trace sand | organic layer | abrupt | well-preserved wood | |
| 10-29 cmbs | 10YR 2/1 | tree branch | | abrupt | sample for ID collected | |
| 27-33 cmbs | 2.5Y 3/1 | clay to silty clay | massive clay with organics | abrupt | | |
| 33-37 cmbs | 10YR 2/1 | tree branch | | | sample for ID collected | |
| 37-52 cmbs | 2.5Y 3/1 | clay | weak subangular blocky structure | | many preserved wood fragments | |

**Core 8: Wayne's Sink (8JE1508/TA280)**

| Stratum | Munsell | Texture | Description | Contact with above | Comments | Artifacts/Fauna |
|---|---|---|---|---|---|---|
| 0-2 cmbs | 10YR 2/1 | silty organic | compact decaying leaf litter | n/a | | |
| 2-7 cmbs | 10YR 3/2 | organic | sapropelic muds-high organic matter | abrupt | | |
| 7-12 cmbs | 10YR 2/1 & 10YR 2/2 | organic | mucky decaying organics, some leaf structure | clear | | |
| 12-19 cmbs | 10YR 2/1 & 10YR 5/3 | loamy fine sand with organic laminae | sand | abrupt | organics are branches | |
| 19-21 cmbs | 10YR 7/2 | loamy sand | sand | gradual | branch fragments | fish bone |

**Core 9: Wayne's Sink (8JE1508/TA280)**

| Stratum | Munsell | Texture | Description | Contact with above | Comments | Artifacts/Fauna |
|---|---|---|---|---|---|---|
| 0-3 cmbs | 10YR 2/1 | organic | decomposing leaves with silts | n/a | | |
| 3-5 cmbs | 10YR 5/4 | loamy sand | a few fine layers of leaves | abrupt | | fish bone, at least one scale |
| 5-7 cmbs | 10YR 2/1 with 10YR 5/3 | organics with sand | peat with sand drapes | abrupt | | fish bone |
| 7-9 cmbs | 10 YR 5/4 | loamy fine sand | sands with few organics | clear | | |
| 9-10 cmbs | 10YR 2/1 with 10YR 5/3 | organics with loamy sand | peat with sand drapes | clear | | |
| 10-13 cmbs | 10YR 5/3 with 10 YR 2/1 | loamy sands with some organics | sand with organic laminae | clear | | |
| 13-18 cmbs | 10YR 4/3 | loamy fine sand | mottled sands and organic fragments (mostly sticks | abrupt | | |
| 18-21 cmbs | 10YR 21\/1 | organic | decomposing organics with a trace of sand | abrupt | | |

**Core 10: Wayne's Sink (8JE1508/TA280)**

| Stratum | Munsell | Texture | Description | Contact with above | Comments | Artifacts/Fauna |
|---|---|---|---|---|---|---|
| 0-4 cmbs | 10YR 2/1 | organic | decaying leaf layers with silts | n/a | | 1 fish bone |
| 4-8 cmbs | 10YR 6/3 with 10YR 2/1 | loamy very fine sand | sand with some organic traces | abrupt | | |
| 8-9 cmbs | 10YR 2/1 | organic with loamy fine sand | leaf layer | abrupt | | |
| 9-10 cmbs | 10YR 6/3 | loamy fine sand | sand drape | abrupt | | |
| 10-11 cmbs | 10YR 2/1 | organic with loamy fine sand | leaf layer | abrupt | | |
| 11-11.2 cmbs | 10 YR 7/3 | loamy fine sand | sand drape | abrupt | | |
| 11.2-15 cmbs | 10YR 3/2 | organic with trace of fine sand | massive sapropel | abrupt | | |
| 15-20 cmbs | 10YR 6/3 with 10YR 2/1 | loamy fine sand with organics | sand with organic laminae | abrupt | | |
| 20-25 cmbs | 10YR 2/1 | organic with loamy fine sand | leaf layer | abrupt | | |
| 25-26 cmbs | 10YR 5/3 | loamy fine sand | sand drape | abrupt | | |
| 26-28 cmbs | 10YR 2/1 | organic | decaying leaves and stick fragments | abrupt | | |

**Core 11: Wayne's Sink (8JE1508/TA280)**

| Stratum | Munsell | Texture | Description | Contact with above | Comments | Artifacts/Fauna |
|---|---|---|---|---|---|---|
| 0-1 cmbs | 10YR 3/1 | organic with trace of fine sand | highly organic | n/a | | |
| 1-7 cmbs | 10YR 4/1 | coarse sand | sand | abrupt | | few shell |
| 7-9 cmbs | 10YR 2/1 with 10YR 4/3 | loamy sand | sand | abrupt | some organics | few shell |
| 9-28 cmbs | 10YR 4/3 | medium to coarse sand | massive sand | abrupt | | common shell and fishbone, one mammal vertebra |

**Core 12: Wayne's Sink (8JE1508/TA280)**

| Stratum | Munsell | Texture | Description | Contact with above | Comments | Artifacts/Fauna |
|---|---|---|---|---|---|---|
| 0-6 cmbs | 10YR 5/3 | loamy sand | sand drape | n/a | very loose sand | |
| 6-7 cmbs | 2.5Y 2.5/1 | organic | sapropel | abrupt | organics all dissolved | |
| 7-17 cmbs | 2.5Y 3/2; 10YR 3/2; 10YR 2/1 | organic | mottled sapropel | abrupt | charcoal flecks, mostly decomp wood | fish bone, few shell fragments |
| 17-19 cmbs | 10YR 2/1; 10YR 3/2 | organic with loamy fine sand | sapropel | clear | blacker layer from above | fish bone |
| 19-20 cmbs | 10YR 3/2 | loamy fine sand | buried A horizon? | abrupt | | fish bone |
| 20-23 cmbs | 2.5Y 5/2 | loamy fine sand | gray sands | clear | B horizon? | fish bone |
| 23-29 cmbs | 10YR 2/2 | wood | large fragment of log | abrupt | | |
| 29-32 cmbs | 10YR 2/2; 2.5Y 5/2 | loamy fine sand | mottled sands | abrupt | tiny wood frags | fish bone |
| 32-34 cmbs | 10YR 2/1 | organic | dark organic layer | clear | | fish bone |
| 34-38 cmbs | 10YR 2/1; 10YR 2/2; 2.5Y 5/2 | loamy fine sand | mottled sands | clear | | fish bone |

**Core 13: Wayne's Sink (8JE1508/TA280)**

| Stratum | Munsell | Texture | Description | Contact with above | Comments | Artifacts/Fauna |
|---|---|---|---|---|---|---|
| 0-5 cmbs | 10YR 2/1 | clay | weak friable subangular blocky structure | n/a | a few wood fragments | |
| 5-10 cmbs | 2.5Y 2.5/1 | clay | weak very friable subangular blocky | abrupt | | |
| 10-15 cmbs | 2.5Y 2.5/1 | clay | weak very friable angular blocky | gradual | | |
| 15-20 cmbs | 2.5Y 3/1 | clay | weak friable angular blocky | gradual | | |
| 20-25 cmbs | 10YR 2/1 | silty clay | no structure, very wet | abrupt | top centimeter slightly darker | |

**Core 14: Mandalay (8JE1539/TA137)**

| Stratum | Munsell | Texture | Description | Contact with above | Comments | Artifacts/Fauna |
|---|---|---|---|---|---|---|
| 0-1 cmbs | 2.5Y 2.5/1 | organic | sapropel | n/a | all organics dissolved | |
| 1-12 cmbs | 2.5Y 2.5/1; 2.5Y 5.2; 10YR 3/1 | loamy sand | mixed sands with leaves | abrupt | very weak angular blocky structure | |
| 12-14 cmbs | 10YR 2/1 | organic with trace sand | peat | clear | | |
| 14-18 cmbs | 10YR 4/3; 10YR 2.5/1 | loamy sand | mixed sands | abrupt | storm surge? | |
| 18-24 cmbs | 10YR 2/1 | organic | sapropel | abrupt | wood mostly decomposed | |
| 24-29 cmbs | 10YR 2/1 | organic | peat | abrupt | wood less decomposed | |

**Core 15: Totem Shoal (8JE1638)**

| Stratum | Munsell | Texture | Description | Contact with above | Comments | Artifacts/Fauna |
|---|---|---|---|---|---|---|
| 0-14 cmbs | 10YR 2/1 | clay with many preserved organics | sapropel with weak subangular blocky structure | n/a | sand drape @4 cmbs-10YR 5/3 fine sand | |
| 14-17cmbs | 10YR 2/2 | organic loam | sapropel | abrupt | limestone pebble at top | turtle shell and fishbone |
| 17-32 cmbs | 10YR 7/1; 10YR 3/1; 10YR 6/3 | loamy sand | mottled shell hash with weak angular blocky structure | abrupt | small broken snail shells | fishbone |

**Core 16: Totem Shoal (8JE1638)**

| Stratum | Munsell | Texture | Description | Contact with above | Comments | Artifacts/Fauna |
|---|---|---|---|---|---|---|
| 0-1 cmbs | 10YR 2/1 | organic | sapropel | n/a | | |
| 1-3 cmbs | 10YR 5/1 | fine sand | sand | abrupt | storm surge? | |
| 3-8 cmbs | 10YR 2/2 | organic | condensed leaf layers | abrupt | pond margin? | |
| 8-22 cmbs | 10YR 2/2 | organic | peat | clear | heavily disturbed sand (storm surge?) deposit near center | |

**Core 17: Totem Shoal (8JE1638)**

| Stratum | Munsell | Texture | Description | Contact with above | Comments | Artifacts/Fauna |
|---|---|---|---|---|---|---|
| 0-10 cmbs | 10YR 2/1; 10YR 4/3 | organic with trace sand | peat with sand laminae sands | n/a | wood fragments semi mineralized | |
| 10-17 cmbs | 10YR 2/1 | organic | peat | gradual | wood fragments semi mineralized | 1 turtle shell frag |
| 17-20 cmbs | 10YR 2/1 | organic | peat with less wood | gradual | wood fragments semi mineralized | |

# APPENDIX III: VIBROCORE PROFILES

**Waynes Sink Vibrocore 1**

| Horizon Description | Depth (cm) | Boundary Distinctness | Munsell | Texture | Structure | Moist Consistence | Special Features | Shell? | Sampled? | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| mottled sands w/organic laminae | 0-18 | abrupt | sand: 10YR 5/3; organic: 10YR 2/1 | loamy fine sand | | | | | | |
| organic mat | 18-30 | abrupt | 7.5YR 2/1 | decomposing organics with silts | weak sbk at bottom | very friable | | | | plant structure still intact |
| sands w/organic laminae | 30-56 | abrupt | sand: 10YR 5/3; organic: 7.5YR 2/1 | sand | | | | one snail shell | | some plant structure |
| peat | 56-59 | abrupt | 7.5YR 2/1 | organic silts | | | | | | some plant structure |
| colluvium | 59-67 | abrupt | 10YR 2/1 & 10YR 5/3 | silty med-coarse sand | | | common 3 cm gravels | | | |
| clay | 67-70 | | 2.5Y 3/1 | silty clay | massive? | | | | | |

**Waynes Sink Vibrocore 2**

| Horizon Description | Depth (cm) | Boundary Distinctness | Munsell | Texture | Structure | Moist Consistence | Special Features | Shell? | Sampled? | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| brown sand | 0-9 | abrupt | 10YR 6/2 | med sand | | | | | | |
| unconsolidated gravels | 9-20 | abrupt | 7.5YR 2.5/1 | loose organics | | | | | | plants intact |
| sands w/organic laminae | 20-32 | abrupt | sand: 10YR 6/4; organics: 7.5YR 2.5/1 | fine sand | | | | | | 3 organic laminae |
| sapropel | 32-35 | abrupt, wavy | 7.5YR 2.5/1 | organic silty loam | | | | | | no plant structure |
| gray sand w/organic mottles | 35-39 | abrupt, wavy | 10YR 6/2 | loamy fine sand | | | | | | thin laminae of organics |

**Waynes Sink Vibrocore 2**

| Horizon Description | Horizon Depth (cm) | Boundary Distinctness | Munsell | Texture | Structure | Moist Consistence | Special Features | Shell? | Sampled? | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| sapropel | 39-41 | abrupt | 7.5YR 2.5/1 | organic silty loam | | | | | | no plant structure |
| sand drape | 41-42 | abrupt, wavy | 10YR 6/3 | loamy fine sand | | | | | | |
| sapropel | 42-65 | abrupt | 7.5YR 3/2 | organic loam | weak sbk | friable | | | | some fine sand laminae |
| sand | 65-75 | abrupt | 10YR 6/2 | sand | | | large shell filled with clay | | | |
| peat | 72-75 | abrupt | 7.5YR 3/2 | organic | | | | | | some plant structure |
| sand | 75-77 | abrupt | 10YR 6/2 | loamy sand | | | | | | |
| peat | 77-81 | abrupt | 7.5YR 2.5/1 | organic w/some sand | | | | | | leaves still intact |
| sand | 81-88 | abrupt | 10YR 6/2 | loamy sand | | | | | | some wood |
| peat | 88-91 | abrupt | 7.5YR 2.5/1 | organic | | | | | | |
| sand w/ organic laminae | 91-96 | abrupt | 10YR 6/2 | loamy sand | | | | | | 1 clay ball |
| peat w/ sand laminae | 96-115 | abrupt | 7.5YR 3/2 w/10YR 6.2 sands | organics w/ some sands | | | | | | large wood pieces |
| brown loam | 115-130 | abrupt | 7.5YR 3/2 | loam | | | | few | | |
| peat | 130-150 | abrupt | 7.5YR 3/2 | organic | | | | | | many wood frags |
| gray clay | 150-174 | | 10YR 5/1 | clay loam | weak sbk | friable | | | | |

| Waynes Sink Vibrocore 3 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Horizon | | | | | | | | | | |
| Description | Depth (cm) | Boundary Distinctness | Munsell | Texture | Structure | Moist Consistence | Special Features | Shell? | Sampled? | Notes |
| peat | 0-40 | abrupt | 7.5YR 2.5/1 to 2.5Y 2.5/1 | silty organics | | | some sand | | | plant structure still visible |
| brown shelly | 40-61 | abrupt | 2.5Y 5/2 w/ 2.5Y 5/1 | loamy fine sand | | | | common shell frags | | |
| shelly has | 61-65 | abrupt | 10YR 5/2 | loamy fine sand | | | | many shell frags | | |
| colluvial? | 65-85 | abrupt | 10YR 4/2 | sandy clay loam | | | few rounded gravels | common whole shell | | fish bone |
| A horizon? | 85-89 | abrupt | 2.5Y 3/1 | clay loam | med mod abk | friable | | | | |
| Bss? | 89-115 | | 2.5Y 2/1 | silty clay | fine mod abk | firm | slickensides | | | |

| Waynes Sink Vibrocore 4 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Horizon | | | | | | | | | | |
| Description | Depth (cm) | Boundary Distinctness | Munsell | Texture | Structure | Moist Consistence | Special Features | Shell? | Sampled? | Notes |
| coarse sand | 0-5 | abrupt | 10YR 4/3 | coarse sand | | | few 2 cm gravels | | | some organics |
| shelly organic | 5-11 | abrupt | 2.5Y 2.5/1 | organic with some fine sand | | | | common shell | | |
| gray shelly | 11-22 | abrupt | 2.5Y 5/1 | very fine sandy loam | med weak sbk | very friable | | many shell frags | | |
| shelly brown | 22-39 | abrupt | 10YR 5/2 | fine sandy loam | | | | common whole shell | | |
| gray w/shell | 39-42 | abrupt | 2.5Y 5/1 | med to fine sand | | | | common whole shell | | fining upward |
| brown shelly | 42-49 | abrupt | 10YR 5/2 | med to fine sand | | | | common whole shell | | |
| A? | 49-81 | clear | 2.5Y 3/1 | clay loam | weak med sbk | friable | | | 55cm- organic wedge | some organics |
| Bss1? | 81-121 | clear | 2.5Y 2/1 | silty clay loam | mod med abk | firm | slickensides | | | |
| Bss2? | 121-151 | | 7.5YR 2.5/1 | silty clay loam | weak fine sbk | friable | slickensides | | | |

**Waynes Sink Vibrocore 5**

| Horizon Description | Horizon Depth (cm) | Boundary Distinctness | Munsell | Texture | Structure | Moist Consistence | Special Features | Shell? | Sampled? | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| sand/clay mixed | 0-3 | abrupt | clay 10YR 2/1; sand 10YR6/3 | clay w/sand inclusions | weak fine abk | friable | | | | |
| heavy clay | 3-28 | abrupt | 10YR 2/1 | clay | weak fine abk | friable | | | | some organic frags |
| sapropel | 28-45 | | 7.5YR 2.5/1 | organic loam | weak fine sbk | friable | | few frags | 30 cmbs- wood | |

**Waynes Sink Vibrocore 6**

| Horizon Description | Horizon Depth (cm) | Boundary Distinctness | Munsell | Texture | Structure | Moist Consistence | Special Features | Shell? | Sampled? | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| black loam | 0-29 | clear | 10YR 2/1 | fine sandy loam | fine mod sbk | friable | | | | common wood frags |
| red peaty | 29-102 | clear | 10YR 2/2 | organic | fine weak sbk | friable | | | | common wood frags |
| sandier | 102-148 | | 10YR 2/2 w/10YR 6/2 | loamy med sand | weak very fine sbk | very friable | few 2 cm limestones | few large shells | 136cm twig | common wood frags |

| Waynes Sink Vibrocore 7 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Horizon | | Boundary Distinctness | Munsell | Texture | Structure | Moist Consistence | Special Features | Shell? | Sampled? | Notes |
| Description | Depth (cm) | | | | | | | | | |
| peat w/ sand laminae | 0-62 | abrupt | organic: 7.5YR 2.5/1; sand: 10YR 6/2 | organic w/ fine sand | | | | few 2cm whole shells | | shell and wood throughout core |
| sand w/organic laminae | 62-91 | abrupt, wavy | 10YR 6/2; 10YR 4/2; 10YR 2.5/1 | sand w/ organics | | | | few 2cm whole shells | | |
| peat w/ sand laminae | 91-115 | abrupt, wavy | 7.5YR 2.5/1; 10YR 6/2 | organic w/ loamy fine sand | | | | | | large wood chunk @ 112 |
| peat | 115-128 | abrupt | 7.5YR 2.5/1; 10YR 6/2 | organic | | | | | | |
| sand w/ shell | 129-139 | abrupt | 10YR 6/2; w/ common mottles of 7.5YR 2.5/1 | loamy sand | | | common 1 cm gravels | common shells and shell frags | | |
| sand w/ organic laminae | 139-160 | abrupt | 10YR 6/2 w/7.5YR 2.5/1 | loamy sand | | | | | | many wood chunks |
| peat w/ sand laminae | 160-176 | abrupt | 10YR 4/2 w 10YR 6/2; 10YR 2.5/1 | loamy fine sand to fine sandy loam | | | | few small shell frags | | |
| peat | 176-192 | abrupt, wavy | 7.5YR 2.5/1; 10YR 2/2 | organic w/some fine sand | | | | | | |
| sapropel | 192-194 | | 10YR2/2 | clay w/ organics | fine weak sbk | very friable | | | | |

| Waynes Sink Vibrocore 8 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Horizon | | Boundary Distinctness | Munsell | Texture | Structure | Moist Consistence | Special Features | Shell? | Sampled? | Notes |
| Description | Depth (cm) | | | | | | | | | |
| sandy lag | 0-4 | abrupt | 10YR 4/2 | sand | | | | | | turtle shell and wood |
| A? | 4-34 | abrupt | 2.5Y 3/1 | clay | strong fine abk | firm | slickensides | | | |
| colluvial? | 34-52 | abrupt | 2.5Y 3/1 | fine sandy loam | weak fine sbk | very friable | common 1-4 cm gravels | | | preserved organics |
| colluvial | 52-70 | abrupt | 2.5Y 4/2 | loamy fine sand | | | common 4 cm gravels | | | fish bone |
| sapropel | 70-89 | | 7.5YR 2.5/1 | silty clay loam | strong fine sbk | | firm | | 89-peat wedge | very organic |

| Waynes Sink Vibrocore 9 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Horizon | | Boundary Distinctness | Munsell | Texture | Structure | Moist Consistence | Special Features | Shell? | Sampled? | Notes |
| Description | Depth (cm) | | | | | | | | | |
| peat | 0-47 | clear | 7.5YR 2.5/1 | organic | | | | | 33-wood | much undecomposed wood |
| yellow gleyed | 47-60 | clear | 2.5Y 3/2 | silty loam | granular | | | | | many rootlets |
| clay | 60-76 | clear | 7.5Y 2.5/1 | clay | fine weak sbk | very friable | | | | |
| clay | 76-118 | | 7.5YR 2.5/1 | clay | | | | few | 83 twig w/bark; wood chunk @ 90 | many wood chunks |

**Sloth Hole Vibrocore 10**

| Horizon | | Boundary Distinctness | Munsell | Texture | Structure | Moist Consistence | Special Features | Shell? | Sampled? | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| Description | Depth (cm) | | | | | | | | | |
| organic | 3-54 | 0 cm, wavy | 7.5Y 2.5/1 | silty loam | fine mod abk | very friable | | no | C-14 45 cmbs | mostly decomp organics |
| brown clay | 54-86 | 2 cm | 5Y 5/5, oxidizes to 2.5Y 5/2 | silty clay loam | | | | few frags | | charcoal flecks |
| brown clay | 86-102 | 3 cm | 5Y 5/5, oxidizes to 2.5Y 5/2 | silty clay loam | | | | common small shells and fragments | | charcoal flecks |
| gray (A?) | 102-112 | 0 cm, wavy | 2.5Y 3/1 | silty clay | strong fine abk | | | no | | charcoal flecks |
| brown | 112-127 | 1 cm | 2.5Y 3/2 | fine sandy clay loam | strong coarse abk | | | few frags | | charcoal flecks |
| mixed sands | 127-142 | 1 cm | 2.5Y 3/4 w/ 2.5Y 6/1 | fine sandy clay loam w/ med sand | | | | little shell | | charcoal flecks |
| brown | 142-145 | 1cm | 2.5Y 3/1 | silty loam | | | | common fragments | | charcoal flecks |
| mixed sands | 145-190 | 2cm | 2.5Y 7/1 w/ 2.5Y 3/1 | medium sands w/ silty clay loam | | | | common fragments | | some sediment deformation charcoal flecks |
| gray brown sands | 190-209 | | 2.5Y 2.5/1, 3/1, and 7/1 | fine sandy loam with medium sand | | | | some whole shell, common fragments | | charcoal flecks |

**Sloth Hole Vibrocore 11**

| Horizon Description | Horizon Depth (cm) | Boundary Distinctness | Munsell | Texture | Structure | Moist Consistence | Special Features | Shell? | Sampled? | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| surface sand | 3-4 | 0 cm | 10YR 5/4 | silty fine sand | none | | | | | |
| sapropel | 4-37 | 0 cm, wavy | 7.5YR 2.5/1 | mostly decomposed organics, silty loam | none | | | | | some whole wood |
| brown clay | 37-56 | 2 cm | 2.5Y 4/1 | silty clay | medium mod abk | very friable | | <1 cm shell frags | | charcoal |
| gray shelly | 56-66 | 4 cm | 2.5Y 5/1 | fine sandy clay | medium mod prismatic | friable | clay films | very few | | charcoal |
| black clay | 66-89 | 0 cm, wavy | 5Y 2.5/1 | clay | strong granular | very friable | slickensides | common 2 mm shells in top 5 cm | | |
| brown clay | 89-107 | 0 cm | 10YR 4/1 | fine sandy clay loam | strong fine abk | | | common whole 2cm shells | | charcoal |
| sandy | 107-142 | 3 cm | 2.5Y 5/2 | loamy med sand | none | | 2-3 cm rounded limestone | common whole 2cm shells | | |
| sand/silt | 142-161 | 1 cm | 2.5Y 5/2 & 2.5Y 3/1 | compacted sandy silt | | | | | | |
| black clay | 161-166 | 1 cm | 7.5YR 2.5/1 | compacted clay loam | | | | | | turtle shell @ 163 |
| mottled sand | 166-180 | 2 cm | 2.5Y 5/1 & 2.5Y 3/1 | compacted mixed loamy med sand | | | common <1cm limestone frags | few shell frags | | wood frags |
| brown sapropel | 180-217 | | 10YR 3/2 oxidizes to 7.5YR 2.5/1 | fine sandy loam very compacted | med mod abk | friable | few <1cm limestones | few whole | | some wood |

| Sloth Hole Vibrocore 12 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Horizon | | Boundary Distinctness | Munsell | Texture | Structure | Moist Consistence | Special Features | Shell? | Sampled? | Notes |
| Description | Depth (cm) | | | | | | | | | |
| sand | 0-8 | 0 cm | 10YR 6/3 w/ 10YR 2/1 | loamy fine sand | | | | none | | charcoal flecks |
| sapropel | 8-57 | 0 cm | 7.5YR 2.5/1 | silty loam | fine weak abk | very friable | several 2-3 mm sand drapes | | | charcoal flecks |
| brown clay | 57-58 | 0 cm | 10YR 5/2 | clay loam | weak abk | very friable | | none | | charcoal flecks |
| crushed shells | 58-73 | 2 cm | 2.5Y 4/3 w/5% gley 1 2.5/5GY silt mottle | sandy clay loam | strong fine abk | friable | | many 2mm shells and crushed shells | | charcoal flecks, fishbones |
| gleyed | 73-99 | 0 cm | Gley 1 3/5GY w/ 2.5Y 3/1 | clay | strong fine granular | hard | | none | | charcoal flecks |
| brown sandy | 99-128 | 2 cm | 2.5Y 5/2 | sandy clay loam | mod fine sbk | friable | | common 3 cm large shells | | charcoal flecks |
| shelly sand | 128-164 | 3 cm | 2.5Y 6/2 w/10YR 3/2 | loamy med sand w/ clay loam | med weak sbk | very friable | | common 3 cm large shells, crushed shells | | charcoal flecks |
| banded sands | 164-223 | 0 cm | 10YR 2/1 w/ 2.5Y 6/1 | loamy med sand w/med sand | laminated | | | 4cm shell, oyster frag | C-14 | charcoal flecks, fishbones, wood |
| clay and wood | 223-247 | | 7.5YR 2.5/1 | silty clay | massive | | | none | C-14 | large wood plug at bottom |

| Sloth Hole Vibrocore 13 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Horizon | | Boundary Distinctness | Munsell | Texture | Structure | Moist Consistence | Special Features | Shell? | Sampled? | Notes |
| Description | Depth (cm) | | | | | | | | | |
| leaf litter | 3-16 | 2 cm | 2.5Y 2.5/1 | | | | | | | charcoal flecks |
| sand | 16-24 | 1 cm | 10YR 3/2 w/ 7.5YR 2.5/1 | loamy med sand | | | | | | charcoal flecks, some organics |
| organics w/sand | 24-43 | 0 cm | 7.5YR 2.5/1 w/ 10YR 3/2 | med sand | | | barely decomp organics | | | charcoal flecks |
| gray shelly | 43-52 | 2 cm | 2.5Y 4/1 | silty clay loam | med mod abk | friable | | common whole shell | | charcoal flecks |
| gray more shell | 52-62 | 3-4 cm | 2.5Y 4/1 w/20% mottles of Gley 1 2.5/5gy | silty clay loam | weak granular | very friable | | tiny snails and crushed | | charcoal flecks |
| granular | 62-71 | 2 cm | Gley 1 2.5/10y | silty clay loan | weak granular | very friable | | few shells and shell frags | | charcoal flecks |
| brown clay | 71-81 | 0 cm wavy | 2.5Y 3/1 | clay | med strong abk | very friable | | none | | charcoal flecks |
| sandy | 81-100 | 3 cm | 2.5Y 4/2 | sandy clay loam | weak fine abk | very friable | | few broken shell | | charcoal flecks |
| med sands | 100-123 | 1 cm | 2.5Y 5/2 | loamy med sand | | | | common broken shell | | charcoal flecks |
| brown sands | 123-125 | 1 cm | 2.5Y 3/1 | fine sandy loam | | | | few shell frags | | charcoal flecks |
| mottled strat | 125-135 | 2 cm | 2.5Y 6/2 w/ 2.5Y 3/1 | med sand w/ fine sandy loam | weak fine abk | friable | | common broken shell | | charcoal flecks |
| laminated sands | 135-163 | 1 cm | 10YR 2/1 w/10YR 3/1 | fines sandy loam | weak fine sbk | very friable | | common broken shell | | charcoal flecks |
| organic silts | 163-185 | | 10YR 3/2 | clay loam | weak mod abk | firm | | 1 cm shell and frags | | wood plug at bottom |

| Sloth Hole Vibrocore 14 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Horizon | | | | | | | | | | |
| Description | Depth (cm) | Boundary Distinctness | Munsell | Texture | Structure | Moist Consistence | Special Features | Shell? | Sampled? | Notes |
| organic | 0-2 | 1 cm | 7.5YR 2.5/1 | unconsolidated organics | | | | | | |
| sand | 2-7 | 2 cm | 10YR 5/3 | loamy med sand | | | | | | |
| sapropel | 7-34 | 2 cm | 7.5YR 2.5/2 | silty loam | | | | | | mostly decomp organics |
| sand | 34-44 | 1 cm | 10YR 5/4 w/ 10YR 2/1 | loamy fine sand | weak fine abk | very friable | | | | |
| peat | 44-52 | 1 cm | 7.5YR 2.5/2 | silty loam | weak fine abk | very friable | | | | barely decomp organics |
| sand | 52-54 | 1 cm | 7.5YR 3/2 | fine sandy loam to sandy loam | weak fine abk | very friable | | | | many organics |
| organic | 54-71 | 1 cm | 7.5YR 3/2 | organics with silt | | | | | | whole twigs and sticks |
| gray dense shell | 71-74 | 3 cm | 2.5Y 4/1 | clay loam | | | | many tiny shells | | common fish bone |
| gray less shell | 75-136 | 4 cm | 10YR 5/1 | clay loam | med strong abk | very friable | | few 3 cm shells @90 | | |
| gray more shell | 136-161 | 4 cm | 5Y 5/1 | sandy clay loam | med strong abk | very friable | | common shell | | |
| black granular | 161-172 | 1 cm wavy | Gley 1 2.5/10y | clay | fine strong granular | firm | | none | | |
| sand w/silts | 172-219 | 3 cm | 2.5Y 5/2 w/2.5Y 3/1 | loamy fine sand w/clay | massive? | | | large snail shell frags | | large wood frag @234 |
| laminated sands | 219-239 | 1 cm | 10YR 3/2 w/ bands of 10YR 6/2 | loamy fine sand | weak fine abk | very friable | | | | |
| sapropel | 239-259 | | 7.5YR 3/2 | silty loam | coarse abk | friable | | | | |

**Waynes Sink Vibrocore 15**

| Horizon | | Boundary Distinctness | Munsell | Texture | Structure | Moist Consistence | Special Features | Shell? | Sampled? | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| Description | Depth (cm) | | | | | | | | | |
| organic | 0-16 | clear | 7.5YR 2.5/1 | clay loam | massive | | few .5cm limestones | | | charcoal flecks |
| clay w/ l.s. | 16-53 | clear | 10YR 4/2 | sandy clay loam | fine weak abk | friable | common .5cm limestones | | | |
| sand w/ l.s. | 53-74 | clear | 10YR 3/3 w/ 10YR 7.3 | loamy sand | fine weak abk | very friable | common .5-3 cm limestones | | | |
| sand w/wood | 74-80 | abrupt | 7.5YR 5/1 | loamy fine sand w/organics | med weak sbk | very friable | | | | common wood frags |
| peat | 80-96 | abrupt | 7.5YR 2.5/1 | organic | med strong abk | firm | | | | common wood frags |
| sand | 96-100 | abrupt | 10YR 7/1 | fine sand | | | | | | |
| sapropel | 100-106 | abrupt | 10YR 2/1 | loam | strong med sbk | friable | sand bridges | | | few wood frags |
| sand | 106-112 | abrupt | 10YR 6/2 | fine sand | | | common redox 10YR 5.6 | | | |
| peat | 112-120 | abrupt | 10YR 2/1 | organic | stron med abk | firm | | | | common wood frags |
| sand w/ organics | 120-125 | abrupt | 10YR 6/1 w/ 10YR 2/1 | fine sand | | | | | | |
| sapropel | 125-137 | | 10YR 2/1 | loam | mod med abk | friable | sand bridges | | | wood dissolved |

**Waynes Sink Vibrocore 16**

| Horizon | | Boundary Distinctness | Munsell | Texture | Structure | Moist Consistence | Special Features | Shell? | Sampled? | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| Description | Depth (cm) | | | | | | | | | |
| sapropel | 0-20 | abrupt | 10YR 2/1 | clay loam | mod med abk | friable | | few vivipara frags | | organics dissolved |
| gravel lens | 20-22 | abrupt | 10YR 7/1 | no sediment | | | common 2 cm limestone gravels | | | |
| sapropel | 22-65 | clear | 7.5YR 2.5/1 | clay loam | mod med abk | firm | | | | |
| sapropel | 65-130 | clear | 10YR 3/1 | loam | strong coarse abk | friable | | few mussel and vivipara frags | | common wood frags |
| sandy sapropel | 130-153 | | 10YR 2/1 | fine sandy loam | mod coarse abk | firm | | common shell frags | | |

| Waynes Sink Vibrocore 17 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Horizon | | | | | | | | | | |
| Description | Depth (cm) | Boundary Distinctness | Munsell | Texture | Structure | Moist Consistence | Special Features | Shell? | Sampled? | Notes |
| sands w/ organics | 0-23 | clear | 7.5YR 2.5/1 w/ 7.5YR 6/1 | loamy sand | fine weak sbk | very friable | | few gastropod frags | | common organics |
| sandy | 23-35 | clear | 7.5YR 7/1 | loamy sand | fine weak sbk | very friable | | few gastropod frags | | |
| sapropel | 35-113 | abrupt | 7.5YR 2.5/1 | clay loam | med mod sbk | friable | | few gastropod frags | | |
| sandy | 111-113 | clear | 10YR 6/2 | loamy sand | | | few 2cm limestones | few gastropod frags | | |
| log | 113-127 | abrupt | 7.5YR 2.5/1 | wood | | | | | | |
| sandy | 127-143 | clear | 10YR 7/3 | fine sand | | | few redox 10YR 5/6 | | | |
| sapropel | 143-156 | clear | 10YR2/1 | fine sandy loam | med strong abk | firm | sand bridges | | | |
| sandy | 156-166 | clear | 10YR 7/3 | fine sand | | | | | | |
| sapropel | 166-230 | abrupt | 10YR 2/1 | loam | med mod abk | friable | sand bridges | | | common wood frags |
| sandy | 230-252 | | 10YR 6/2 | loamy fine sand | | | common 2-4 cm limestones | | | common wood frags |

**Waynes Sink Vibrocore 18**

| Horizon Description | Horizon Depth (cm) | Boundary Distinctness | Munsell | Texture | Structure | Moist Consistence | Special Features | Shell? | Sampled? | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| colluvial | 0-18 | abrupt | 10YR 4/2 | coarse sand | none | common 8cm limestones | | | | common fishbone |
| mottled | 18-28 | abrupt | clay: 10YR 3/2; sand: 10YR 6/3 | silty clay w/ loamy fine sand | weak med sbk | friable | | | | |
| sapropel | 28-78 | abrupt | 7.5YR 3/2 w/ 7.5YR 2.5/1 | clayey organic | mod coarse abk | firm | | | | small wood frags |
| sapropel | 78-97 | | 7.5YR 3/2 | clayey organic | weak fine abk | friable | | few frags in 1mm laminae | | |

**Waynes Sink Vibrocore 19**

| Horizon Description | Horizon Depth (cm) | Boundary Distinctness | Munsell | Texture | Structure | Moist Consistence | Special Features | Shell? | Sampled? | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| A? | 0-21 | abrupt | 7.5Y 2.5/1 | silty clay loam | mod med abk | firm | clay films | | | |
| B? | 21-31 | | 7.5YR 2.5/2 | clay loam | mod fine abk | firm | clay films | | | |

Waynes Sink Vibrocore 20

| Horizon | | Boundary Distinctness | Munsell | Texture | Structure | Moist Consistence | Special Features | Shell? | Sampled? | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| Description | Depth (cm) | | | | | | | | | |
| shelly sand | 0-9 | abrupt | 10YR 8/1 | loamy fine sand | | | | many oyster and mussel shell frags | | |
| shelly loam | 9-20 | abrupt | 10YR 6/2 | loamy fine sand | | | | many oyster and mussel shell frags | | |
| clay | 20-34 | | 10YR 5/1 | clay loam | strong med sbk | | | few shell frags | | few wood frags |

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