LIQUID LANDSCAPES: SUBMERGED ARCHAEOLOGICAL SITES IN FLORIDA AND THE TERMINAL PLEISTOCENE SETTLEMENT OF A NEW CONTINENT

A Dissertation

by

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ABSTRACT

This dissertation presents geological, chronological, archaeological, and geophysical datasets from two excavations of submerged precontact archaeological sites in the state of Florida, USA. Geoarchaeological excavations at the Ryan-Harley site (8Je1004) in north Florida demonstrate that the locality represents a discrete Suwannee occupation which occurred during the Younger Dryas (~12,900-11,500 years ago). At this time, the landscape of the Wacissa River basin was a coppice dune field, and overall conditions in the basin were windy and arid. Freshwater availability was seasonally variable, and the location of high-quality toolstone was difficult to predict. Fluctuating environmental conditions required hunter-gatherer groups to maintain a residentially mobile provisioning strategy dependent on lightweight, flexible, and standardized tool types due to uncertainty in resource availability. At the Guest Mammoth site (8Mr130) in central Florida, similar environmental conditions existed in the Silver River basin during the terminal Pleistocene. Geoarchaeological excavations at the site replicated results from earlier excavations in 1973, demonstrating that humans opportunistically scavenged carcasses of young Columbian mammoths that died at the edge of a small pond ~12,700 years ago. Both the Silver and Wacissa River basins remained arid and lacked reliable freshwater until ~8,000 years ago when fluvial sediments appear at both sites indicating perennial flowing water and a shift from arid, sandy basins toward lush, ecologically diverse, spring-fed rivers that attracted human groups.

DEDICATION

I dedicate this dissertation to my grandparents, Ellis and Sara Lou Smith. My grandfather taught me many important things in life that helped shape who I am today. His gentle nature and love of the natural world belied the fact that he was a veteran of three wars and spent the majority of his life serving in one capacity or another in the United States Armed Forces. His love of the land, woods, and water is something that remains in me to this day. From an early age, he impressed upon me the importance of loyalty to family, a hard work ethic, loving those around you, supporting your life partner, and planning for the future. I will never forget the lessons he taught me.

My grandmother is one of the most beautiful souls I know. She has instilled in me the value of treating others kindly and with fairness, staying positive, and the importance of laughing hard and often. My grandmother's demeanor strikes me as particularly important during a time when civility seems to be an uncommon trait in our world. She is the matriarch of my family and is the epitome of southern hospitality and graciousness. Her love of the simple things is reflected in her favorite pastimes; watching birds bathe on the porch, turkeys forage in the field, or the sun set over the trees on our little slice of paradise just east of Tallahassee. Her reminder to marvel in the everyday world has been a key lesson that I reflect upon when it seems that life simply won't slow down.

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CHAPTER I

INTRODUCTION

1.1. Overview

The Paleoindian record (before ~11,500 calendar years before present, hereafter cal yr BP) of the Southeastern United States (hereafter Southeast) is currently in a paradoxical situation. Contrasted with an extensive Paleoindian archaeological record is a lack of reliable radiocarbon ages on diagnostic point styles. Compounding this issue is a paucity of archaeological sites possessing the geologic context needed for accurate interpretations of the Southeast's earliest inhabitants. The lack of reliable data points for the Southeast Paleoindian record recently led to the exclusion of the entire geographic region from a prominent publication examining Paleoindian networks in North America (see Buchanan et al. 2016).

My dissertation comprises of geoarchaeological investigations at two submerged precontact archaeological sites in Florida that contribute reliable data to the Southeast Paleoindian period: Ryan-Harley (8Je1004) and Guest Mammoth (8Mr130). The research questions of each of my dissertation chapters are best summarized as:

- Is the Paleoindian (Suwannee) component at the Ryan-Harley site culturally discrete?
- What does the lithic assemblage at Ryan-Harley tell us about Paleoindian groups in the Southeast during the Younger Dryas?
- Does the Guest Mammoth site contain evidence of human-megafauna interaction in Florida and, if so, when did this interaction occur?

These questions fit into broader research paradigms concerning the study of the earliest people to enter the continent: the First Americans.

1.2. The Paleoindian Southeast

1.2.1. Geography and Environment

I follow David Anderson and colleagues in defining the Southeast as being bound by the Ohio and Potomac Rivers on the north, extending ~150 km beyond the Mississippi on the west, and the Gulf of Mexico and the Atlantic Ocean to the south and east, respectively (Anderson et al. 2015). This broad area includes the majority of the Atlantic and Gulf Coastal Plains in the east and south of the region, the Piedmont and Appalachian Highlands to the east and center, and the Interior Lowland Plateau and Interior Lowlands to the north and west (Anderson et al. 2015). These major physiographic boundaries appear to have ultimately delineated territories in which Middle and Late Paleoindian groups developed regional identities manifested by a variety of point styles (Anderson et al. 2013, 2015; Anderson 1990; Broster et al. 2013). The area's climate today is sub-tropical, warm, and humid. Modern vegetation is predominantly mixed hardwood and softwood forests. The late Pleistocene environment was much colder, windier, and drier, with temperate deciduous forests in the southern portions of the region and cool, mixed forests in the north (Halligan 2013). Fauna and flora were markedly different during this period, with a high degree of species diversity (Halligan 2013; Semken et al. 2010). Inland water sources were scarce, necessitating that groups mapped onto and moved along or between inland drainages where freshwater sources were more abundant (Anderson and Gillam 2000; Anderson et al. 2015; Dunbar 2016; Thulman 2009). Megafauna were plentiful in the region (Russell et al. 2009) but does not appear to have been as extensively exploited as in the American West (Grayson and Meltzer 2015). Marine and freshwater resources, in addition to abundant woodland flora and fauna in the Southeast, would have allowed for a lifestyle more adapted to foraging, with the taking of big game being largely opportunistic (Anderson et al. 2015; Dunbar and Vojnovski 2007).

Knappable stone was plentiful in the Southeast, with quality ranging from low to high. The prevalence of toolstone and abundant organic materials such as bone, ivory, and wood may partly explain the absence of caching behavior in the region during the Paleoindian period (Anderson et al. 2015). Sea level was dramatically lower during the late Pleistocene as well, with the coastline extending over a hundred kilometers farther than at present in some areas (Balsillie and Donoghue 2004; Harris et al. 2013). Marine transgression at the end of the Pleistocene was rapid and likely observable within lifetimes (Balsillie and Donoghue 2004).

1.2.2. Southeast Culture History

1.2.2.1. Pre-Clovis (> ~13,200 cal yr BP)

Most sites presented as Pre-Clovis in the Southeast fail to pass scientific muster (Anderson et al. 2015; Fiedel 2013). These sites, such as Topper, SC, Coats-Hines, TN, and Cactus Hill, VA, lack secure geologic contexts and absolute ages necessary to demonstrate that the artifacts at these sites truly predate Clovis. Currently, the Page-Ladson site, FL, stands as the only Pre-Clovis site in the Southeast from which controlled excavations produced unequivocal artifacts in a sealed geologic context associated with reliable radiocarbon ages. A date of ~14,550 cal yr BP was directly associated with a biface and several flakes found in a sinkhole on the bottom of the Aucilla River, securely placing people in the region well before Clovis times (defined below) (Halligan et al. 2016; Webb 2006). The Pre-Clovis period in the Southeast is proposed to represent an early exploration period by highly mobile groups that may have relied more heavily on osseous technology than stone tools (Waters and Stafford 2007, 2013; Waters et al. 2011). Proposed Pre-Clovis lithic artifacts in the Southeast region include Page-Ladson and Early Triangular points (Dunbar 2016; McAvoy and McAvoy 1997). However, excavations have yet to produce either style in a secure, dated Pre-Clovis context.

1.2.2.2. Early Paleoindian Period (~13,200-12,700 cal yr BP)

The Early Paleoindian period of the Southeast includes large Clovis sites (~13,100-12,700 cal yr BP) such as Thunderbird, Fifty, Cactus Hill, and Topper, which provide extensive information on Clovis biface production (Carr et al. 2013; Smallwood 2010; Waters and Stafford 2007). Blade production is also present at large Clovis quarry sites such as Topper and Williamson (McAvoy and McAvoy 2003; Smallwood et al. 2013). Bone and ivory implements from underwater contexts in Florida show an extensive osseous component of the Early Paleoindian toolkit (Dunbar and Webb 1996; Hemmings 2010). Artwork from this period includes incised patterns on an ivory shaft and dire wolf mandible, both which came from non-controlled surface contexts in the Aucilla River (Hemmings 2004). One of the few reliably dated Early Paleoindian sites in the Southeast comes from Florida's submerged contexts: an age of ~13,100 cal yr BP from an ivory point fragment excavated from in-situ at the Sloth Hole site in Florida (Hemmings 2010; Waters and Stafford 2007). Reliable ages from the Early Paleoindian period in the region also come from Cactus Hill (McAvoy and McAvoy, 1997). Derek Anderson and colleagues report Early Paleoindian dates from Topper, but replication of these ages has proved difficult (Anderson et al. 2016). Other Early Paleoindian sites in the Southeast lack either solid geologic context or the organic material necessary for reliable radiocarbon dates. The Early Paleoindian period in the Southeast characterized by Clovis toolkits. During this period, groups appear to have been adapting to and mapping onto the Southeast region's unique resources. Evidence for this behavior includes repeated visits to quarry sites like Topper and apparent base camps such as Thunderbird (Anderson and Sassaman 1996, 2012; Anderson et al. 2015).

1.2.2.3. Middle Paleoindian (~12,700-12,100 cal yr BP)

A series of fluted and unfluted lanceolate point styles begin to occur in the Middle Paleoindian period including Suwannee, Simpson, Barnes, Quad, Beaver Lake, Redstone, and Cumberland. Few of these styles come from secure contexts or are associated with absolute ages. The attribution of these point styles to the Middle Paleoindian period is based either on similarities to Clovis forms (Dunbar 2016), their stratigraphic position beneath Late Paleoindian and Early Archaic diagnostics (Dolan and Allen 1961; Goodyear 1999), their association with Pleistocene fauna (Dunbar and Vojnovski 2007), or in rare circumstances, radiocarbon ages on styles (Driskell 1996; Sherwood et al. 2004; Thulman 2017). The proliferation of point styles during this period supports the hypothesis that regional identities developed in certain geographical areas, such as the Coastal Plain or Interior Lowlands (Anderson et al. 2015). This regionalization coincides with the Younger Dryas climatic event, which began at ~12,900 cal yr BP and caused dramatic climate change that drove over 30 genera of utilized Pleistocene fauna extinct (Gill et al. 2009; Grayson 2006; Thulman 2009; Waguespack 2013). Evidence from multiple sites indicates unifacial industries were common in the Middle Paleoindian period, and small stone beads have also been recovered from Middle Paleoindian assemblages, indicating portable artwork was a part of camp life (Dunbar et al. 2006; Dunbar and Vojnovski 2007; Goodyear 1999).

1.2.2.4. Late Paleoindian (~12,100-11,500 cal yr BP)

The Late Paleoindian period in the Southeast is manifested primarily by Dalton points and their various, regional forms (Nuckolls, Greenbriar, Hardaway, etc.) (Anderson et al. 2015). Some experts have ascribed all unfluted lanceolate forms, including Quad, Beaver Lake, Suwannee, and Simpson, to the Late Paleoindian period (Anderson et al. 2015). This hypothesis is supported by relative sequences at sites such as Dust Cave and Hester (Goodyear 1999; Sherwood et al. 2004). However, these sites only contain Quad and Cumberland varieties and therefore do not provide information on other fluted and unfluted lanceolate forms. Dalton-point makers appear to have been the first to exploit the numerous rock shelters in the Southeast, indicating a different lifeway centered on central place foraging, broad-spectrum exploitation of fauna, and, clearly documented for the first time, flora (DeJarnette et al. 1962; Griffin 1974; Sherwood et al. 2004). Radiocarbon dates for the Dalton component at Dust Cave range from ~12,040 to 11,300 cal yr BP (Sherwood et al. 2004). Formal cemeteries such as Warm Mineral Springs and Sloan begin to appear during the Late Paleoindian period, further emphasizing both territoriality and cultural complexity (Cockrell 1990; Morse 1997). The appearance of side-notched points, such as Bolen, Big Sandy, and Union, mark the end of the Paleoindian period.

1.3. Florida Paleoindian Culture History

1.3.1. Pre-Clovis Period

Reliable data exists for the occupation of Florida prior to Clovis. Excavations at the Page-Ladson site in north Florida recovered lithic artifacts within an intact, stratified deposit dated to ~14,500 cal yr BP (Halligan et al. 2016). In addition, a butchered mastodon tusk was recovered from the same component, further reinforcing human presence at this early date. Apart from Page-Ladson, pre-Clovis evidence in Florida is tantalizing but largely unconfirmed. A common misconception concerning the pre-Clovis record at Page-Ladson involves the Page-Ladson type projectile point, several of which were found at the site for which the point is named. The Page-Ladson point style has been cited as a pre-Clovis diagnostic based on the recovery of a single specimen at the Wakulla Springs Lodge site. The deposit that produced this point was later dated to 15,600 ± 1,900 cal yr BP, but the age was not collected in association with the artifact and is instead an estimation of the recovered point's age based on comparable elevations of the artifact and the subsequent OSL age (Rink et al. 2012). Further studies at the site also showed extensive bioturbation of sand grains (Thulman 2012b), indicating that this date is an unreliable estimate for the deposits. Other proposed pre-Clovis localities in

Florida include Sloth Hole, Latvis Simpson, Little Salt Springs, the Alexon Bison site. At Sloth Hole, a stepped geologic trench was placed to expose a continuous stratigraphic column. The top of this stepped trench ended at sediments that yielded wood samples dated to ~14,200 cal yr BP (Hemmings 2004). Immediately above this layer were numerous flaked stone artifacts. However, this area saw no further excavation to confirm the possible pre-Clovis deposits and no formal publication exists of this data for evaluation. At the Latvis Simpson site, a single flake was found in bulk sediment samples collected from the profile at the site from a stratum containing a mastodon dated to older than 35,000 cal yr BP (Dunbar 2016). However, no published data or provenience information is recorded. At Wakulla Springs, OSL dates on sediment the bore a Simpson preform and Page-Ladson point were dated according to a “minimum age model” to 13,500cal yr BP. At Little Salt Springs, a wooden spear apparently skewering an extint giant tortoise was dated to ~14,100 cal yr BP (Clausen, et al. 1979). However, the remains of the tortoise dated far older, to ~16,400 cal yr BP. Additionally, little evidence has been presented that the spear is anthropogenic. The Alexon Bison, which contains the remains a chert projectile point embedded in the skull, yielded a date of 13,100 cal yr BP (Mihlbachler et al. 2000). However, the fragment dated did not articulate with the skull and may not have come from the same animal. Further, another date of ~11,500 cal yr BP was obtained from another fragment of bison crania. These dates have not been replicated and are also on impure fractions of bone collagen.

1.3.2. Early Paleoindian

A robust collection of Clovis points mostly recovered as isolated finds form a large part of the Early Paleoindian record in Florida. Florida contains classic, overshot/overface flaked, fluted forms typical of western sites as well as a possible variant with a more contracted waist (Dunbar 2016). Florida has produced a single age on an ivory foreshaft fragment found in Sloth Hole in a level that Clovis points have been displaced from. This age was obtained on XAD purified collagen and dates to ~13,000 cal yr BP; the second oldest reliably dated Clovis locality in North America (Waters and Stafford 2007). Apart from Sloth Hole, Clovis points have only been collected in-situ at the Paradise Park site on the Silver River (Neill 1958). No datable organic material was collected from the site, however, and return trips to the locality indicate the entirety of the Clovis component was excavated. In addition, many tools fashioned from ivory and modified bones of extinct Pleistocene species have also been found ex-situ in many Florida rivers. This material is likely attributable to Clovis, but none of these samples have been radiocarbon dated, and their manufacture could also pre-date or post-date Clovis. Overall, the most reliable evidence for pre-Clovis and Early Paleoindian occupation occurs in North Florida. This record fits a pattern of southward migration into the state. Ephemeral site signatures may be reflective of highly mobile groups that relied on curated tools they rarely disposed of or perishable tools, perhaps made of wood, which do not survive most post-depositional processes. Subsistence was likely broad spectrum, and a noticeable lack of megafauna exploitation sites, common elsewhere in the continent for Clovis, may be evidence of this (Grayson and Meltzer

2015). Additionally, caching behavior, typical of Clovis elsewhere in the continent as a means of providing high-quality toolstone insurance against the unknown, is absent in Paleoindian contexts of the Southeast (Anderson et al. 2015). Evidence of clothing and adornment is scarce, but a bead from possible Early Paleoindian context was recovered at Wakulla Spring (Rink et al. 2012). Ivory needles and an ivory bead preform have been collected from the Aucilla River, also inferring clothing (Hemmings 2010). Finally, artistic expression is minimal and relegated to incisions on tools or fossils, such as an incised lynx mandible from Sloth Hole, possible dire wolf jar ornaments from the Power Line site, and a zig-zag pattern on the side of an ivory foreshaft, also from Sloth Hole (Hemmings 2010). An extensive series of dates and Sporormiella evidence at Page-Ladson provides the most secure age on megafaunal extinctions in Florida at ~12,700 cal yr BP (Halligan et al. 2016).

1.3.3. Middle Paleoindian

The Middle Paleoindian period is poorly understood in Florida. Currently, no reported radiocarbon ages on diagnostic artifacts date to this period in Florida. A series of lanceolate points that exhibit high-quality craftsmanship, basal thinning, and (rarely) fluting are attributed to the Middle Paleoindian period in Florida including Suwannee, Simpson, Beaver Lake, Quad, and Redstone. The primary reasoning behind attributing these types to post-Clovis times is their overall morphological similarity to Middle Paleoindian points dated elsewhere in the continent such as Folsom (Surovell et al. 2016), Gainey (Hajic et al. 2007), Debert (MacDonald 1985), and Cumberland (Sherwood et al. 2004). Beaver Lake, Quad, and Redstone are infrequent in Florida, and are only represented by out of context finds in Florida's rivers (Dunbar 2016). However, PIDBA data shows that Suwannee and Simpson points have similarly constrained geographic areas, indicating mobility, but less so than in the preceding Early Paleoindian period. Both of these point styles are constricted to the Southeastern Coastal Plain and are rare in elevated regions such as the Piedmont, indicating regional geographic specialization. Suwannee points are most prevalent in north central Florida, dissipating south as far as the Tampa Bay region and as far northward at South Carolina. Simpson is less common in Florida and is most dense in central Georgia. Distributions drastically decrease southward to Florida and northward to South Carolina. Appreciable quantities of both styles fall along the Suwannee and Apalachicola Rivers in Georgia, indicating these drainage systems played a crucial role in the migration of these groups. Simpson points have yet to be found in stratigraphic context anywhere in the Southeast. Simpson mustache points often are assumed to be related, apparently based solely on the name, as there is no evidence for affiliation of these two types (Dunbar 2016). This is the Middle Paleoindian period; variety in point forms across broad regions, with very sparse concrete data. However, the pattern seems to indicate region specialization following the highly mobile Early Paleoindian groups. Short-term camps with specialized tools demonstrate some degree of settlement. Mobility in regional spheres is evident and interaction between neighboring groups at the fringes of these ranges is inferred. By looking at territorial ranges, Thulman (2009) demonstrated that Middle Paleoindian points in Florida are constrained around surface water. An apparently broad diet is evident at Ryan-Harley for the Middle Paleoindian period, which is discussed later. The discovery of more discrete Middle Paleoindian sites is needed and radiocarbon dates are critical to establish the chronology of this period in Florida.

1.3.4. Late Paleoindian

The Late Paleoindian period in Florida is highlighted by a shift in projectile point technology, culminating in the introduction of side-notched varieties with the dawn of the Early Archaic. The most common type of this period in Florida is the Dalton point, although Greenbriar is also present. The largest inventory of Paleoindian points in Florida has been compiled by David Thulman (2006). In this dataset, he only attributes 75 points to the Late Paleoindian phase, showing this is the sparsest period of Paleoindian habitation in Florida. No discrete Dalton components have been found in Florida. A Late Paleoindian component dating to ~11,900 cal yr BP is recorded at the Page-Ladson site, but only non-diagnostic artifacts were recovered from the stratum (Halligan et al. 2016). Dates on skeletal material, both on unpurified collagen, from Warm Mineral Springs (~12,000 cal yr BP) and Cutler Ridge (~12,000 cal yr BP), as well as an incised antler artifact from Little Salt Spring (~11,800 cal yr BP) represent the only other radiocarbon dates from this period in the state (Dunbar 2016). Taken at face value, these dates may indicate a Dalton burial tradition, corroborated with evidence from the Sloan cemetery in Arkansas (Morse 1997). Dalton is the first Paleoindian tradition in Florida to extend well beyond the Apalachicola River. This paucity of Late Paleoindian occupations in Florida has led some researchers to hypothesize that Suwannee may largely replace Dalton in Florida (Anderson et al. 2015). Much more research is needed in this period, as a total lack of sites in Florida has rendered informed interpretations of mobility, subsistence, and general lifeways during the Late Paleoindian period difficult.

1.4. Research Relevance and Broader Impacts

The above summary of the Southeast Paleoindian record demonstrates that few sites exist from which empirically derived assumptions about the Southeastern Paleoindian record can be made, particularly the Early and Middle Paleoindian periods. This is especially true for the lower Southeast, which includes the Coastal Plains of Alabama and Georgia as well as all of Florida. The paucity of intact, discrete, and reliably dated sites in this region means that before assumptions are made about Paleoindian lifeways in the lower Southeast, we need more reliable data points from which to draw conclusions. To this end, I initiated geoarchaeological studies at archaeological sites in Florida to address the following topics.

1.4.1. Human Adaptation to Climate Change

Following the Younger Dryas chronozone, the inhabitants of the Americas faced a changing landscape (Kennett et al. 2015; Waters and Stafford 2007). Fauna, flora, sea level, and climate were all in flux (Jacobson et al. 2012). The Younger Dryas is hypothesized to have forced broad ranging hunter-gatherer bands throughout the Americas to shift subsistence strategies and adapt to specific geographic regions (Anderson et al. 2011; Eren 2012; Miller and Gingerich 2013; Surovell et al. 2016). This gave rise to Clovis-like toolkits such as Folsom and Goshen in the American West (Frison 1990; Lassen 2016; Waters and Stafford 2014), Gainey and Debert in the Great Lakes region (Comstock 2011; Ellis 2004), and Barnes and Michaud-Neponset in the

Mid-Atlantic (Lothrop et al. 2016), among others. All of the aforementioned point types are widely thought to be post-Clovis in age, bear morphological similarities to Clovis points, indicate high popoluation mobility, and are constrained to specific geographic areas. Similar forms with similar distributions, such as Barnes and Redstone in the Cumberland Plateau and Appalachian Southeast (Goodyear 2006), and Suwannee and Simpson in the Southeast Coastal Plain (Daniel et al. 1986; Thulman 2012), remain undated, but are hypothesized to be Middle Paleoindian in age based on morphology and distribution (Dunbar 2016; Thulman 2009). Intense climate change occurred during the Younger Dryas period in the Southeast. Climate, sea level, and biodiversity all permanently shifted during the Early Paleoindian period toward cooler, drier conditions with less landmass and fewer available flora and fauna species during Middle Paleoindian times (Balsillie and Donoghue 2004; Halligan 2013; Russell et al. 2009). Archaeological sites inundated in the Gulf of Mexico like Fitch, J&J Hunt, and Ontolo Reef have yielded Suwannee points, indicating that Suwannee people adjusted to the loss of thousands of square kilometers of habitat within a few lifetimes (Faught 2004). Thus, further studies of Suwannee people will provide information on how the First Americans moved toward the settlement of the North American continent during the Younger Dryas.

1.4.2. Toward a Regional Geoarchaeological Understanding

Excepting rockshelters and submerged sites, Paleoindian components in the Lower Southeast are typically found in sandy substrates with little organic preservation, which is needed to secure samples for radiocarbon dating (Anderson et al. 2015; Dunbar and

Vojnovski 2007; Halligan et al. 2016). It is also typical that unfluted lanceolate point types are found comingled with later Early Archaic side-notched varieties (Anderson et al. 2015). The reason for this may be grounded in geology. Throughout the Late Quaternary, aeolian activity was the dominant geologic force shaping much of the landscape of the eastern United States (Markewich et al. 2015). Aeolian activity peaked during the Younger Dryas and remained constant until ~8,000 cal yr BP in the Lower Southeast (Markewich et al. 2015), resulting in inland dunefields on coastal plains over much of the eastern United States. Thus, the arid and windy climate of the region may have hindered sediment deposition from the Middle Paleoindian to Early Archaic periods. In river basins, these aeolian landscapes are now buried under Holocene fluvial sediments, indicating the cessation of aeolian activity. While more site investigations are needed to test this hypothesis, it may eventually provide a model for site location and land use by Paleoindian groups in the Lower Southeast during the late Pleistocene.

1.4.3. Paleoindian Subsistence

The Ryan-Harley and Guest Mammoth sites will both provide nuanced information on Paleoindian subsistence in the eastern United States. When compared to the American West, the eastern U.S. has much less evidence for the interaction of megafauna and humans (Grayson and Meltzer 2015), with some exceptions like Kimmswick, Alexon Bison, and Page-Ladson (Graham et al. 1981; Halligan et al. 2016; Mihlbachler et al. 2000). This trend indicates a different subsistence strategy for eastern Paleoindian groups (Anderson 2004; Gingerich 2013). Instead of focused megafauna hunting, the resource-rich Southeast may have been more conducive to foraging, with big game being taken opportunistically (Anderson et al. 2015; Hemmings 2004). If my excavations validate the Guest Mammoth as an archaeological site, the nature of the site (i.e., kill or scavenging site) will directly address this hypothesis. In addition, the Ryan-Harley Suwannee assemblage was recovered in direct association with extensive faunal remains (Dunbar et al. 2006). The null hypothesis is that these are food remains are naturally accumulated. Alternately, these remains may be Paleoindian-aged midden (Dunbar and Vojnovski 2007). If I fail to reject the null hypothesis, then further investigation of the faunal assemblage at Ryan-Harley will provide extensive data on Paleoindian subsistence in the eastern United States.

1.4.4. Defining Suwannee

The Ryan-Harley site is the only intact, stratigraphically discrete Suwannee point site (Dunbar et al. 2006). The majority of Suwannee points have been recovered out of secure geologic context on the bottom of Florida's rivers. When discovered in-situ, Suwannee points have not been found within discrete deposits or associated with organic material needed for radiocarbon dating (Daniel and Wisenbaker 1987; Dolan and Allen 1961; Dunbar and Vojnovski 2007; Neill 1958; Rink et al. 2012), leading to a debate over whether Suwannee pre-dates Clovis, is a Clovis contemporary, or post-dates Clovis. Thus, a radiocarbon date for the Suwannee type at Ryan-Harley would provide the first chronometric age for the Suwannee point style. However, regardless of the age, the fact that the Suwannee layer at Ryan-Harley is the only archaeological component at the site also allows for the definition of a Suwannee toolkit and for an in-depth analysis of Suwannee lithic technological organization (Dunbar et al. 2006). A detailed lithic technological study has been conducted on Suwannee from the large lithic assemblage recovered at Harney Flats (Daniel et al. 1986). However, at Harney Flats, the Suwannee material was found co-mingled with Early Archaic Bolen material (Daniel and Wisenbaker 1987), so that we cannot know which elements of the assemblage are Suwannee. Likewise, sites such as Dunnigan's Old Mill, Paradise Park, Bolen Bluff, Lake Helen Blazes, and Lake George all contain Suwannee components, but these components have either eroded away or are not discrete (Bullen 1958; Dunbar 2016; Rink 2012; Thulman 2011). Suwannee preforms may be present at site 8Le2105, and the Norden site may also bear a discrete Suwannee component, but more data are necessary from both sites (Dunbar and Vojnovski 2007; Hornum et al. 1996). Ryan-Harley represents the only confirmed discrete Suwannee deposit, allowing for a study of Suwannee technology to take place without concern of contamination by artifacts from earlier or later prehistoric groups.

1.5. Sites Investigated

1.5.1. Ryan-Harley, Florida (8Je1004)

The Ryan-Harley site was discovered in 1996. The underwater archaeological deposit is eroding into the stream channel but remains intact beneath a small island between the branches of the anastomosing lower Wacissa River in north Florida. The site underwent investigation in 1999 following the discovery of three out-of-context Suwannee points. During this investigation, 368 bone fragments and 193 lithic artifacts were recovered from a ~10 cm thick sandy layer over an area of about four square meters (Dunbar et al. 2006). In 2015, Dr. Michael Waters and I planned and directed renewed research at the site. We excavated twelve square meters, recovering 1,175 piece-plotted lithic artifacts. Among these are a Suwannee preform base and the distal portion of a projectile point (likely Suwannee). This combined 16m^2 of excavated area contains only Suwannee diagnostics. In addition, previous excavators hypothesize that the assemblage of bone fragments represents a midden from the encampment. This midden provides insight into prehistoric diet, as well as tool discard patterns which are not well represented in the Paleoindian record. The recovery of several stone beads from the site also makes Ryan-Harley one of the few recorded Paleoindian sites with examples of portable adornment (Glowacki 2012; Holliday and Killick 2013). Another intersting aspect of the site is the presence of extinct Pleistocene faunal remains, including muskrat, horse, camel, and tapir intermingled with the Suwannee lithic assemblage (Dunbar and Vojnovski 2007). Data suggest that these animals went extinct 12,700 cal yr BP around the end of the Clovis period (Halligan et al. 2016; Surovell and Waguespack 2009). While most archaeologists agree that Suwannee likely post-dates Clovis (Anderson et al. 2015; Dunbar et al. 2006; Thulman 2012), no absolute ages exist for Suwannee points. The association of Suwannee points with Pleistocene fauna leads to four mutually exclusive hypotheses regarding the age of the complex:

1) Suwannee post-dates Clovis, and therefore some Pleistocene animals survived longer in the Southeast than elsewhere;
2) Suwannee is contemporary with Clovis;
3) Suwannee pre-dates Clovis;
4) The extinct faunal material predates the Suwannee lithic material at Ryan-Harley.

Renewed geoarchaeological excavations at Ryan-Harley are necessary to determine the age of the site (and of Suwannee), the organization of Suwannee technology, and the association between Pleistocene fauna and the Suwannee cultural material at the site.

1.5.2. Guest Mammoth, Florida (8Mr130)

In 1971, George Guest discovered mammoth bones at a bend in the Silver River and relayed the discovery to Dr. Charles Hoffman, then an anthropology professor at the University of Florida. Preliminary investigations of the site revealed two Columbian mammoths buried under ~1.2 m of sediment and associated with archaeological materials in the form of a single "Clovis-like fluted point," six flakes, and "numerous" pressure flakes in direct association with the mammoths (Hoffman 1983, ca. 1985). In addition, two bones that bear what appear to be butcher marks were also recovered (Rayl 1974). Hoffman excavated for a single year, in 1973. Inaccurate radiocarbon ages of ca. 11,200 cal yr BP were obtained from impure samples of mammoth-bone collagen, and the site was largely rejected (Dunbar 2016). Only one formal publication resulted from this potentially significant excavation (Hoffman 1983).

Hoffman died in 2005, and a lack of interest since its excavation has led to the exact location of the Guest Mammoth and all associated archaeological material being lost. I summarize the significance of the Guest Mammoth into three key points, all of which likely inhibited its acceptance 40 years ago:

1) No confirmed mammoth kill site is reported east of the Mississippi River;

2) The radiocarbon age is on unpurified collagen and thus should be provisionally treated as a minimum age;

3) If the mammoth is Clovis in age, it will be one of only a dozen or so well dated Clovis sites in the Americas (Waters and Stafford 2007); however, if the age range falls outside of this, the mammoth is either pre- or post-Clovis, both of which are significant.

Evidence of megafauna exploitation is rare east of the Mississippi River, indicating eastern Paleoindian groups had a different subsistence strategy (Grayson and Meltzer 2015). Further work at the Guest site can directly address this idea. In the interim forty years since the site was first studied, significant archaeological advancements necessitate a return to the Guest Mammoth to find answers. Geoarchaeological analysis can evaluate the context of the site and demonstrate whether the deposits are intact. Reliable, absolute ages could be obtained from the mammoths or the surrounding sedimentary deposits, providing a key data point to the eastern Paleoindian record and the extinction of megafauna in the Southeast U.S. Considering this, I re-initiated archaeological investigations at the Guest Mammoth locality to ascertain its place in North American prehistory.

1.6. Conclusion

The Southeast U.S. Paleoindian record needs more reliable data points from which to draw interpretations of past human behavior. This is particularly true in the lower Southeast, which has recently become the focus of an active research agenda exploring the geoarchaeology of Paleoindian sites. This recent push stands on the shoulders or earlier, pioneering work by many scholars. The ensuing chapters of this dissertation represent my contribution to this agenda in the form of geoarchaeological studies of two additional Paleoindian localities and the first technological analysis of a discrete Suwannee lithic asemblage.

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CHAPTER II

GEOARCHAEOLOGICAL INVESTIGATIONS AT THE RYAN-HARLEY SITE, FLORIDA (8JE1004): IMPLICATIONS FOR HUMAN SETTLEMENT OF THE WACISSA RIVER BASIN DURING THE YOUNGER DRYAS

2.1 Introduction

Ryan-Harley (8JE1004) is a single component, submerged prehistoric site located 1.5 to 2 m underwater in a river channel adjacent to a small island within the spring-fed Wacissa River of North Florida (Figure 1). Ryan-Harley was discovered by avocational divers Ryan and Harley Means in 1994 and tested by the Florida Bureau of Archaeological Research (FBAR) in 1999. This testing revealed an extensive assemblage of extinct and extant faunal remains and lithic artifacts reported to occur in a discrete, 5-8 cm thick geologic stratum buried beneath ~1.5 m of sediment (Dunbar et al. 2006). Dunbar and colleagues (2006) excavated 193 lithic artifacts and 368 faunal specimens from ~5 m^2 of this stratum, not all of which was intact. Texture analyses determined that the sediments containing the artifacts likely derived from fluvial activity, but aeolian signatures are also noted (Balsillie et al. 2006). In 2015, the author excavated 12 m2 of the archaeological component, recovering 889 lithic artifacts and 1763 faunal elements in-situ. Further excavations in 2017 found 174 lithic artifacts and 241 faunal items in-situ from a 3 m^2 area. Previous excavators proposed that Ryan-Harley represents an ephemeral encampment along a riverbank or levee (Balsillie et al. 2006; Dunbar et al. 2006). The archaeological assemblage from Ryan-Harley contains debitage as well as unifacial and bifacial stone tools, including Suwannee points. Suwannee points have been recovered at other sites (Bullen 1958; Daniel and Wisenbaker 1987; Dunbar and Vojnovski 2007; Edwards 1954; Neill 1958; Rink et al. 2012; Thulman 2011), but Ryan-Harley is the only site to produce a Suwannee lithic assemblage from a discrete, buried context. No chronometric ages exist on the Suwannee point form. A single Suwannee point was found beneath an Early Archaic Bolen point at the Darby Spring site in central Florida (Dolan and Allen 1961). The age range for the Bolen type is ~11,900-10,900 cal yr BP (Thulman 2018) demonstrating that the Suwannee type at least pre-dates ~11,900 cal yr BP.

Extinct Pleistocene fauna found in association with the lithic material at Ryan-Harley led the original excavators to hypothesize that Pleistocene fauna survived later in the region than previously thought, based on the proposed Younger-Dryas age of Suwannee (Dunbar 2016; Dunbar and Vojnovski 2007; Dunbar et al. 2006). However, the contemporaneity of the Suwannee lithic material and the extinct Pleistocene fauna, as well as the discreteness of the Suwannee component, was inferred based on limited testing at Ryan-Harley. New excavations by the author were undertaken to understand the geologic context of the site, test the association of the Suwannee artifacts with Pleistocene fauna, and determine the age of the artifact-bearing component.

2.2 Materials and Methods

This analysis only considers materials found in-situ at Ryan-Harley in 2015 and 2017. In 2015 and 2017, an 8x2-m grid was excavated at Ryan-Harley in 1x1-m squares. Excavation proceeded by geologic units described above, with 10-cm levels in units 4-6 decreasing to 5-cm levels in Unit 3, which contained the Suwannee component. Excavation proceeded to the surface of Unit 2, the Suwannee paleosol. Units 1 and 2 were excavated in stratigraphic levels as a geologic test in square N1, E0. All artifacts were piece plotted in-situ, and an underwater laser was used to record depth below datum. Sediment was removed by water-induction dredge to the surface where it passed through 1/4 and 1/16th-inch screens with retained materials bagged accordingly. Plunge measurements were recorded through visual observation by dive team members and assigned to one of four categories: 0°, 1-30°, 31-60°, 61-90°. Trend measurements were collected on in-situ artifacts using underwater compasses. When an artifact exhibited plunge, the orientation of the plunge on the artifacts long axis was collected as its trend. When an artifact exhibited no plunge (0°), trend data were collected as an axis but not reported here due to uncertainty over the direction the artifact was trending. Stratigraphic profiles were drawn underwater, and lithology is reported following conventions laid out in the USDA Soil Survey Handbook (USDA, 1993). Radiocarbon and OSL sample locations were piece-plotted and collected from the exposed profile in 2015. The organic material used for dating was identified by Dr. Katherine Pouzman and assayed by the Keck Cycle Lab at the University of California, Irvine. Radiocarbon ages are calibrated with the IntCal13 calibration curve in OxCal 4.3. OSL samples were analyzed by Dr. Steve Forman at Baylor University, using 35 aliquots per sample. REE sampling involved collecting 10 milligrams of bone powder from each specimen using a Dremel tool. Samples of bone powder were analyzed by Dr. George Kamenov at the University of Florida via LA-ICMPS following methodologies outlined by MacFadden et al.

(2010). Particle-size analysis was conducted on sediment sub-sampled from a geologic core taken from Ryan-Harley in 2017 (17a). The core was sampled in 4-cm intervals yielding 31 samples, which were subsampled for particle size and sediment characterization. First, 10 g of sediment per sample was pretreated following LAC-Core SOP for particle-size analysis (2007). Following pretreatment, the 31 samples were analyzed with a CamSizer to obtain values for clast sizes > 2 millimeters (mm). The samples were then sieved to remove the larger clast sizes (> 2 mm), and the smaller fraction was analyzed with a MasterSizer 3000e. Next, 7 g of sediment per sample was analyzed for organic content via loss-on-ignition testing following protocols developed by the Texas A&M Agricultural Experiment Station (Morgan 2010). The paleo-DEM data were collected with spoon and bucket augers. The depth at which the transition between units 4 and 3 (peat to sand) occurred could be felt, and the auger hole depth was measured with a folding rule. The paleo-DEM was visualized in ArcMap 10.5. Geophysical data collection is described in DeSmet and Smith (2019).

2.3 Geographic and Environmental Context

The head of the Wacissa River is located at the base of the Cody Escarpment, an erosional feature related to prehistoric sea-level high stands ~30 km southeast of Tallahassee, Florida, USA. In Jefferson County, which encompasses the Wacissa River, the Cody Escarpment begins 60-45 masl and drops sharply to the Woodville Karst Plain, a 1200 km^2 area of shallowly confined to unconfined early Miocene to Oligocene-aged limestone within the broader Gulf Coastal Lowlands physiographic province (Upchurch et al. 2018). The Wacissa River is fed by 16 springs, most of which are located in the first 2 km of the river. These springs combine to produce an average discharge of 11 m^3 per second (Scott et al., 2004). The Wacissa flows south for 21 km until its confluence with the Aucilla River, losing 9 m of elevation along this course and breaking from a single meandering channel to an anabranching regime ~17 km downriver. The Ryan-Harley site is located near the beginning of this anabranching section.

While only 9.8 km from the coast and 4 masl at present, during the Younger Dryas Ryan-Harley was between ~170 km and ~120 km from the coast and between ~70 and ~60 masl (Joy 2019). The pollen record at Page-Ladson (~4 km south of Ryan-Harley) indicates a dry but relatively cool climate for the first 400 years of the Younger Dryas (~12,900-12,500 cal yr BP) (Hansen 2006; Perrotti 2017). Between ~12,500 and 11,500 cal yr BP, pollen data demonstrate warmer and wetter environmental conditions and suggest an overall savannah-like landscape interspersed with watering holes that were surrounded by hydrophilic plant communities (Hansen 2006; Perrotti 2017). Unit 5 at Page-Ladson, an organic and clay-rich pedogenic horizon that formed at the edge of a sinkhole between ~12,600 and 11,400 cal yr BP, demonstrates that groundwater levels were high enough to support intermittent freshwater in topographic low spots during this period of the Younger Dryas (Halligan et al. 2016). A sharp change in pollen profiles around 11,500 cal yr BP indicates the collapse of water-loving plant communities, indicating freshwater became scarce in the region (Perrotti 2017).

The faunal assemblage indicates a mixed environment, with aquatic, semi-aquatic, and upland species present (Dunbar et al. 2006; Dunbar and Vojnovski 2007). Possible reasons for this discrepancy with the palynological data are discussed later.

Overall, these data indicate that a brief period of available surface water in the Wacissa River Basin began during the Younger Dryas after 12,600 cal yr BP and ending around 11,500 cal yr BP.

2.4 Site Stratigraphy and Geologic Data

Ryan-Harley contains six stratigraphic units (Figure 2) (Balsillie et al. 2006). The stratigraphy described here is based on field observations from profiles exposed in 2015 and 2017, four ground penetrating transects, and six cores.

2.4.1 Unit Descriptions

2.4.1.1 Unit 1

Unit 1, a freshwater shell marl, is located about 2.2 mbs (meters below surface) at Ryan-Harley and is ~30 cm thick. Unit 1 is divided into two facies: Unit 1a, which contains small, crushed shells, and Unit 1b, which contains many unbroken gastropods. Unit 1 is primarily composed of fine and very fine sands. A fossilized juvenile bison vertebra and aquatic Testudines (turtle) carapace fragment were recovered in Unit 1. The age of this marl is unknown but likely dates to just before the last interglacial, MIS (Marine Isotope Stage) 5e (Sangamon, 129-116 thousand years ago, kya) when groundwater levels were last high enough to support freshwater pond environments before sea-level transgression over the Wacissa River basin, resulting in Ryan-Harley being submerged under 2 m of seawater (Figure 3) (Lambeck et al. 2002). Unit 1 abruptly overlies Oligocene-aged Suwannee Limestone bedrock.

2.4.1.2 Unit 2

Unit 2 is a ~20-45 cm thick layer of fine and very fine-grained quartz sands, typed as marine sands by the USDA soil survey of the region (Allen 1989). Unit 2 is separated from Unit 1 by a very abrupt boundary. The age of the initial deposition of Unit 2 is unknown, but an OSL sample at the top of Unit 2 yielded an age of 57,535 ± 4310 cal yr BP. The base of Unit 2 is loamy sand and contains a higher proportion of silts and clays, while the top of Unit 2 is predominantly fine sands. Unit 2 contains fossilized aquatic Pleistocene fauna including the remains of extinct testudines and a partially articulated American alligator, a freshwater species that can tolerate brackish water. Crossbedded structures are evident within Unit 2 in the ground penetrating radar (GPR) profiles (Figure 4). The upper portion of Unit 2 is pedogenically altered, and this soil formation period is defined here as the Suwannee paleosol. The Suwannee paleosol contains an elevated carbon content (~20%) and a relatively high concentration of silts (~40%) and clays (0.25%). The Suwannee paleosol slopes upward to the southwest and ranges from ~3 cm in thickness on the northeastern end of the excavated area to ~8 cm thick in the southwest. The Suwannee paleosol consists of clays to very fine-grained sands and is compact with strong subangular blocky structure. Lower portions of the Suwannee paleosol contain common redoximorphic concentrations and gleying throughout the layer (Figure 5). Given that this soil profile is now underwater, these redoximorphic features are relicts from a period when the groundwater table was lower, and the sediments were oxidized subaerially. These features must also have formed after pedogenesis, as soil formation would have destroyed such features. Likewise, the accumulation of organic matter indicates groundwater fluctuation. A portion of the Suwannee lithic and faunal assemblage is present on the surface of the Suwannee paleosol.

2.4.1.3 Unit 3

Unit 3 is a layer of structureless fine quartz sands ~2-9 cm thick, which clearly and abruptly overlie the Suwannee paleosol. Unit 3 is a thin horizon of aeolian sands that covered the Suwannee paleosol intermittently throughout the late Quaternary. An optically stimulated luminescence (OSL) sample at the bottom of Unit 3 yielded an age of 50,680 +/- 3805 cal yr BP. Suwannee lithic and faunal material occur throughout Unit 3, including at the contact of Units 3 and 4 (Figure 6).

2.4.1.4 Unit 4

Unit 4 is ~20 cm thick and is only present in the northeastern portion of the site, from 1.4 to 1.0 mbs, pinching out near the topographic high to the southwest. Unit 4 is separated into two facies. Unit 4a is peat with a weak subangular blocky structure which began accumulating by ~7,900 cal yr BP. This deposit accumulated slowly until ~5,000 cal yr BP. Unit 4b is a sandy lens which began accumulating after ~5,000 cal yr BP and contains a much higher concentration of silts and clays than Unit 4a. A wooden object ~7 cm long, 1 cm in diameter, with a tapered bevel on one end (similar to a foreshaft), and a modified piece of wood, were recovered on the surface of Unit 3, at the terminus of Unit 4. These artifacts yielded dates of ~6,150 cal yr BP and ~5,100 cal yr BP, respectively. A very abrupt, wavy contact with Unit 4 unconformably overlies Unit 3.

Faunal remains recovered in Unit 4 are predominantly disarticulated fish and aquatic testudine remains.

2.4.1.5 Unit 5

Unit 5a ranges from ~2-40 cm thick and is highly varied, containing both a concentration of coarse and very coarse sands along with a higher proportion of silts and clays. Unit 5a abruptly and irregularly overlies the wavy surface of Unit 4, which pinches out toward the middle of the 2015 profile. Unit 5a began forming after 5,000 cal yr BP and represents an increase in the competence of the Wacissa River. Unit 5b, a layer with a much higher concentration of sands and a weak subangular blocky structure, began forming by 4,900 cal yr BP. Unit 5b ranges from ~1-15 cm thick and extends across the entire profile with a relatively smooth surface and ceased forming shortly after ~4,130 cal yr BP. A single bone point was recovered in Unit 5, embedded at a ~60° angle. Faunal remains recovered in Unit 5 include disarticulated fish and turtle remains.

2.4.1.6 Unit 6

Unit 6 is ~50 cm thick, contains interbedded layers of sand and peat, and is still forming at the site. Unit 6 began forming shortly after 4,130 cal yr BP during a second, longer lasting fluvial pulse. A single Woodland-aged Deptford Check-Stamped ceramic body sherd (~3,000-1,000 cal yr BP) was recovered near the top of Unit 6, but it is possible that this item was deposited here by fluvial action. Faunal remains recovered in Unit 6 included disarticulated fish and turtle remains.

The lengthy unconformity demonstrated by this lithostratigraphic history indicates that further geoarchaeological analyses are necessary to test whether or not the archaeological assemblage at Ryan-Harley represents a palimpsest or a single-component site.

2.4.2 Particle and Sediment Characteristics

Granulometric analyses were conducted on sub-samples obtained from core RH-17a, collected in 2017, to better elucidate the depositional environment of the lithostratigraphic units at the site, particularly Units 2 and 3 (Figure 7).

Unit 1 sediments largely exhibit low skewness and kurtosis (~-0.08 for each), and predominantly consist of fine sands. The transition to Unit 2 is marked by jumps in skewness (~0.32), kurtosis (~1.8), and total carbon (~10%). Standard deviation and inclusive mean values also increase, demonstrating that particle sizes are becoming less homogenous.

Unit 2 sediments are largely fine-grained, moderately sorted, nearly symmetrical, and also leptokurtic. The transition between units 2 and 3 is marked by the Suwannee paleosol, which developed on the surface of Unit 2. Spikes in the clay, silt, and organic content on the surface of Unit 2 demonstrate an accumulation of fine-grained sediments indicative of pedogenesis. Unit 3 is marked by increased skewness, kurtosis, standard deviation, and inclusive mean values. These numbers indicate that Unit 3 sediments are largely fine-grained, moderately well sorted, highly symmetrical, and leptokurtic (sharply peaked). The inclusive mean of Unit 3 is ~3.9 phi units, which means the component is predominatly very fine sand. The skewness of Unit 3 is high (0.60) indicating the preponderance of fine-grained materials in this unit. The kurtosis of Unit 3 is ~1.6, indicating a leptokurtic tendency toward the average particle size (very fine sands). Unit 4a shows a decline in skewness values to (~-0.6), kurtosis (~0.9), and total carbon (~1%). Unit 4a primarily consists of fine sands (~70%). Unit 4b sediments vary between the top and bottom of the unit, with the bottom having low skewness (~-0.7) increasing to ~0.35 at the top. This trend is also true for kurtosis, which increases from ~0.8 at the base of 4b to ~2.0 at the top of the unit. Total carbon increases steadily throughout the unit, from 2% at the bottom toward 4% at the top. Unit 4b primarily consists of fine sands, with a minor intrusion of silt and clay fraction near the Unit4b/5a contact. Unit 5a exhibits a drop in skewness at the contact before rising back to ~0.32 at the Unit 5a/5b contact. Kurtosis also drops to before spiking to ~2.3 at the Unit 5a/5b contact. A drop in total carbon to zero at the base of Unit 5 is followed by a jump to ~10% carbon content at the 5a/5b contact. Unit 5a consists of primarily silt (~65%), and has the highest clay content of any unit at ~1%. Unit 5a is the only unit to contain very coarse sands (~0.1%) and also consists of ~2% coarse sands. After spikes at the 5a/5b contact, Unit 5b skewness and kurtosis values drop to ~-0.6 and 0.8 respectively, while total carbon content increases to ~13%. Unit 5b once again becomes dominated by fine sands (~78%). Unit 6 is also primarily fine sands (~80%), shows a drop in total carbon content to ~2% at the surface, and has roughly similar skewness and kurtosis values to Unit 5b at ~-0.4 and 0.9 respectively.

2.4.3 Paleolandscape Reconstruction

A total of 754 auger tests provided information on the surface geometry of Unit 3 buried beneath the island that contains Ryan-Harley. A digital elevation model (DEM) was created to visualize the surface of Unit 3 at the time of occupation (Figure 8). This model reveals that the overall terrain is dissimilar to that of typical karstic floodplains or river banks in the region (Mossa et al. 2017; Randall 2014) and has no obvious fluvially-derived features. Instead, the landscape bears hummocky microtopography and compares favorably with aeolian landscapes (Baas and Nield 2007; Claudino-Sales et al. 2010; Nagihara et al. 2004; Rango et al. 2000; Tripaldi et al. 2018; Woolard and Colby 2002). Several features on the DEM appear aeolian, including multiple irregular mounds interpreted as coppice dunes (Langford 2000; Rango et al. 2000), and deflation hollows between these mounds (Hesp 2002; Smyth et al. 2012). The deflation hollows are small and shallow and likely held small quantities of water. They are also disproportionate to the even smaller coppice dune features, which may be a factor of dune truncation following initial formation. All dune these features are oriented perpendicularly to the prevailing late Pleistocene northeasterly winds (Carver and Brook 1989; Markewich et al. 2015), reinforcing the idea that these features are the result of aeolian processes. The Ryan-Harley site is located between two dune-like features. Immediately northeast and southwest of the site are two prominent low spots, which may have held water intermittently during rainy seasons.

2.4.4 Geophysical Data

Prior to excavation, we bisected the 2015 excavation block with four ground-penetrating radar (GPR) transects to corroborate the results of the DEM and further examine the subsurface geologic deposits at Ryan-Harley (de Smet and Smith 2019). The GPR data demonstrate that Unit 3 and the Suwannee paleosol extend across the surface of the island and confirm the microtopography on the surface of Unit 3 seen in the paleo-DEM.

Given a lack of evidence for high-energy fluvial processes, these hummocky features are likewise interpreted as remnant coppice dunes. The GPR profile also shows that an anabranching channel of the Wacissa River has down cut through Unit 6, demonstrating that this fluvial feature intruded well after the deposition of Unit 3.

2.5 Archaeological Data

During the 2015 and 2017 excavations, fabric (trend and plunge) data were collected whenever possible on piece-plotted specimens. These data were used to further test the contemporaneity of the lithic and faunal material and the geologic integrity of the Suwannee component. The underlying assumption is that if the material was anthropogenically deposited and minimally disturbed, the lithic and faunal material would exhibit trend and plunge measurements that follow the surface contours of Unit 3 (Dibble et al. 1997; Eckerle et al. 2011). Conversely, the gradual accumulation of material, or a palimpsest, is expected to more exhibit homogenous fabric patterns derived from uniform depositional forces, such as trend patterns embricated in the direction of a flowing stream or prevailing winds (Eckerle et al. 2011). Further, if the lithic or faunal materials were deposited at different times, a similar discrepancy in fabric data would be expected among material types (Dibble et al. 1997). Last, trampling or rodent burrowing should result in a more randomized pattern of trend and plunge.

To this end, Rao scores on trend values indicate no significant difference between the directionality of the faunal and lithic material excavated ($n = 505$, $p = 0.1177$). Pearson's chi-square tests also show no significant difference between plunge measurements of lithic and faunal material ($n = 871$, $p = 0.2719$). While a significant portion of artifacts were recovered flat (0° plunge, n = 372, p = 0.0005), the majority of artifacts (499) have plunges varying from 1-90°. The flat artifacts exhibit no grouping among material type and are interpreted as the portion of the assemblage with the least post-depositional reworking. Redeposition is evident varying plunge values and in the vertical distribution of artifacts at Ryan-Harley, which are found from the top of and within Unit 3, to the surface of the Suwannee paleosol. A lithic refitting study identified three refits in the 2015 assemblage, further demonstrating that the Unit 3 lithic assemblage represents a discrete Suwannee component. As of writing, no faunal material analyzed from the 2015 or 2017 excavations exhibits obvious gnaw marks or evidence of trampling that would suggest extensive taphonomic reworking in Unit 3.

2.5.1 Chronometric Dating

Although obtaining a chronometric age on the Suwannee point type was a primary objective, the 2015 and 2017 excavations did not yield datable organic material from the Suwannee component. Three samples of bone were submitted for XAD collagen purification, but all failed to yield enough collagen to produce a reliable age. The eleven radiocarbon ages from the overlying strata all date to the Middle Holocene, including two ages collected immediately above the artifact bearing component (Unit 3) (Table 1). The earliest radiocarbon age collected above the artifact-bearing component is ~7,900 cal yr BP. Thus, the archaeological assemblage at Ryan-Harley lay exposed or was intermittently buried and exhumed by aeolian processes for several millenia prior to being capped by Unit 4. This length of exposure is likely the reason for the absence of organic preservation in Unit 3. An OSL age from the top of Unit 2 and another from the bottom of Unit 3 overlap at one standard deviation and average ~54,000 cal yr BP (Table 2). The presence of artifacts in these 54,000 year old sands, as well the origin of the Late Quaternary landform upon which the Ryan-Harley site is located, are discussed later.

2.6 Faunal Data

An interesting aspect of Ryan-Harley is the presence of extinct and extirpated Pleistocene fauna with the Suwannee lithic assemblage (Dunbar et al. 2006). This association was confirmed by the 2015 and 2017 excavations, which recovered remains of *Ondatra zibethicus* (muskrat), *Tapirus veroensis* (tapir), *Paleollama mirifica* (camel) and *Geochelone sp*. (giant land tortoise) in association with the Suwannee lithic assemblage. Rare-earth element (REE) analyses were conducted to test the association of the extinct and extant fauna quantitatively. REE's occur naturally in low concentrations (ppb or low ppm) of living vertebrate tissues. However, following the death of an organism, vertebrate skeletal material begins to acquire increased concentrations of REE's, which replace calcium, phosphorous, and other elements during diagenesis (MacFadden et al. 2010). The three variables governing REE uptake are element availability in local groundwater, time since deposition of a fossil, and diagenetic environment (Henderson et al. 1983). Given the similarity in context of the fauna, diagenetic environment and groundwater elemental make-up are assumed to be constants. This makes time since deposition the dominant variable affecting REE uptake for the Ryan-Harley faunal assemblage. As used elsewhere (MacFadden et al. 2010; Purdy et al. 2015), REE analysis is used here to determine whether or not the extinct and extant faunal materials at the site were deposited roughly contemporaneously. Among the twenty bone samples analyzed from Unit 3, two paleontological specimens from units 1 and 2 were submitted as controls. The control specimens contain similar elements but in different concentrations, confirming time since deposition is the governing factor on REE uptake at Ryan-Harley. The remaining eighteen samples from Unit 3 include extinct and extant fauna, fauna from multiple taxonomic classes, fauna from the high and low spots at the site, and samples from both the 1999 and 2015 excavations. The results of the REE analysis show a minimal difference in REE concentrations between Unit 3 specimens, indicating roughly contemporaneous deposition (Figure 9). However, error in REE analysis may be as much as 5% of the sample age (MacFadden et al. 2010), meaning roughly contemporaneous associationas could be within 400-600 years. Given this standard error and the commonly accepted, but undemonstrated, Younger Dryas age of Suwannee, the faunal material could have been deposited on this relict aeolian landscape several centuries before the Suwannee occupation at Ryan-Harley and still exhibit the same REE signature.

2.7 Discussion

These multiple, independent lines of evidence allow us to hypothesize a model for human occupation of the Wacissa River Basin during the late Pleistocene and early Holocene.

While these excavations did not achieve an age on the Suwannee type, geographic and morphologic data helps contrains the range of the time period. Suwannee projectile points are abundant and widespread only within the lower Southeast Coastal Plain. This restricted geographic range is a trend observed in other post-Clovis (~13,100-

12,700 cal yr BP) groups in the Southeast (Waters and Stafford 2007), such as Cumberland and Quad (Anderson et al. 2015). Unfluted lanceolates like Suwannee that are dated elsewhere fall into the Younger Dryas time frame (Anderson et al. 2015). Thus the distriubtion and morphology of Suwannee projectile points have led to the general consensus that Suwannee point makers lived during the Younger Dryas (~12,900-11,700 cal yr BP) (Anderson et al. 2015; Dunbar 2016; Thulman 2009), although this remains to be proven with a reliable age on the Suwannee type.

A primary consideration for understanding Suwannee use of the Wacissa River basin is the nature and volume of freshwater availability during the late Pleistocene. Today, the Ryan-Harley site is at the edge of an active channel of the Wacissa, measuring ~7 m in width and ~2.5 m in depth. The absence of a continuous confining layer in the Wacissa River basin means that water could have only been present at the Ryan-Harley site if one of two conditions were met. The first is that if hydrostatic head (water pressure at the Wacissa River headwaters) was high enough in the drainage area north of the Wacissa to maintain a base flow capable of reaching the Ryan-Harley site, 17.4 km downstream from the headwaters of the Wacissa. The second is that the potentiometric surface of the water table was elevated high enough to provide standing water in topographic low-spots.

During the hypothesized Suwannee time frame, sea level was far lower than at present, ranging from ~70 meters below sea level (mbsl) at 12,900 cal yr BP to ~60 mbsl at 11,700 cal yr BP (Joy 2019). Lower sea-level equates to a reduction in the potentiometric surface of the Upper Floridan Aquifer, and overall arid conditions indicate that hydrostatic head would have been insufficient to maintain year-round flow (Perrotti 2017; Thulman 2009). Thus, the Wacissa River may not have flowed on a consistent, annual basis during the late Pleistocene. However, Unit 5 at Page-Ladson demonstrates groundwater was intermittently accessible at the surface in the region during the Younger Dryas. The stratigraphic layer containing the archaeological component at Ryan-Harley is ~4 m above Unit 5 at Page-Ladson, and the lack of a confining layer for this region's aquifer allows for rapid infiltration of groundwater. Thus, only during periods of high water tables would surface water be available in the vicinity of Ryan-Harley. The relict redoximorphic concentrations on the surface of Unit 2 must have formed during this window of groundwater fluctuation and likewise demonstrate that intermittent surface water existed in the Wacissa River basin at the end of the Pleistocene. Thus, seasonal availability of surface water likely constrained human use of the Wacissa River basin during the late Pleistocene. The Unit 3 faunal assemblage at Ryan-Harley represents a mixed ecosystem, including upland and lowland species, in addition to taxa known to inhabit slow-moving rivers (Dunbar et al. 2006), further underscoring the likelihood of a seasonal river. However, other datasets point to an arid, open landscape indicating that while freshwater was sometimes available, it was scarce and when present, attracted a wide variety of taxa (Dunbar et al. 2006).

2.7.1 Geologic History of the Lower Wacissa River Basin

The freshwater marl of Unit 1 at Ryan-Harley likely dates to the beginning of the Sangamon Interglacial (126,000-122,000 thousand years ago, MIS 5e), when sea-levels peaked at roughly 6-8 m higher than present raising groundwater tables inland (Lambeck et al. 2002). Sea-level transgression and recession during the Sangamon deposited extensive sand sheets across the southeastern Gulf Coast that would later serve as parent material for sediments and soils now far inland and as source material for extensive aeolian activity during the late Quaternary (Markewich et al. 2015). Following the deposition of Unit 1, the fine marine sands of Unit 2 were deposited in the low-lying Wacissa River basin, which likely served as a sediment trap for entrained sand during periods when aeolian activity was high in the lower Southeast region. These peak activity periods include 70,000-50,000 years ago, when the aeolian features at Ryan-Harley first formed, and 16,000-11,000 years ago when the site was occupied (Ivester et al. 2001; Leigh 2008; Otvos 2004; Otvos and Price 2001). The very abrupt contact between units 1 and 2 suggests a geologic disconformity and may represent a truncation of Unit 1 during the Sangamon sea-level transgression.

On the surface of Unit 2, the Suwannee paleosol began forming ~57,000 years ago, during the Mid Wisconsin Glaciation (MIS 3) (Otvos 2004). At this time, extensive aeolian activity deposited widespread dunes on inland fluvial and marine terraces across the southeastern United States that correlate with the expansion of continental ice sheets, the shrinking of the Gulf of Mexico, and the onset of overall arid conditions (Ivester and Leigh 2003; Ivester et al. 2001; Leigh 1998; Leigh 2008; Markewich et al. 2015; Otvos 1991; Otvos and Price 2001). The preponderance of evidence indicates that aeolian activity shaped the relict interglacial deposits of marine sands in the Wacissa River basin prior to, during, and shortly after the late Pleistocene human occupation of Ryan-Harley, as seen elsewhere on the Gulf of Mexico and Atlantic Coastal Plain. This contradicts the previously published geologic results from Ryan-Harley, which proposed fluvial deposition as the main agent for units 2 and 3, although the authors do note that aeolian signatures are present in their data (Balsillie et al. 2006). However, the Gaussian analyses used during the previous study assume a roughly normal distribution of sediment sizes, a condition not met by aeolian sediments, which are inherently skewed toward fine clasts. These inland dunes at Ryan-Harley are the farthest east recorded in Florida but correspond to ages reported from dunes less than 150 kilometers to the west and north of the study area (Otvos 2004), suggesting the geographic range of aeolian activity during the late Quaternary is larger than currently recognized.

The fine to medium sands of Unit 3, the main artifact-bearing component, were deposited in the low-lying Wacissa River basin and consistently reworked by aeolian processes during the late Quaternary. Unit 3 remained exposed until ~8,000 years ago when it was buried by the formation of the Unit 4a peat. During this depositional hiatus, much activity took place. Throughout MIS 3 and MIS 2 (~57,000-14,000 years ago), aeolian activity was the dominant geologic force for most of the eastern United States (Markewich et al. 2015). A lack of landform stability due to constant aeolian processes led to consistent erosion and deposition at the site. At the onset of MIS 2 (~29,000-14,000 years ago), sea level fell to ~90 m lower than at present, exposing a landmass twice the size of present-day Florida (Joy 2019; Lambeck et al. 2002). Cold and dry conditions dominated the region, and the landscape overall lacked widespread freshwater (Grimm et al. 1993; Grimm et al. 2006; Perrotti 2017; Thulman 2009). Much of Florida instead resembled an open, sandy savannah with occasional vegetated sand sheets in low-lying basins and sporadic hardwood forests in upland areas (Grimm et al. 1993; Watts 1969, 1975, 1983; Watts et al. 1992). This interpretation is demonstrated by the Ryan-Harley paleo-DEM, which appears to reflect a sand sheet, most analogous to a coppice dunefield.

Hallmarks of coppice dunes include steep windward faces and tapered leeward faces (Langford 2000; Mountney and Russell 2006), overall small relief (Yue et al. 2005), and varying shapes (Du et al. 2010). The paleoenvironmental conditions in the Wacissa River basin during MIS 2 were suitable for inland vegetated dune formation, including prevalent shrubby vegetation, soil type (hydric Nutall-Tooles fine marine sands), known parameters of rainfall (22-330 mm/year), and windspeed (2.1-5.0 m/s) (Carver and Brook 1989; Du et al. 2010; Durán and Moore 2013; Perrotti 2017). Wind speed is the primary factor of sediment transport and thus governs vegetated dune height. Late Pleistocene paleowind speeds in the southeastern United States are estimated at 2.2 m/s (Carver and Brook 1989; Markewich et al. 2015), just over the threshold needed for coppice dune development. The final parameter is groundwater level which must be between 1.5 and 17 m below the surface for coppice dune formation. The redoximorphic features on the Suwannee paleosol demonstrate that this groundwater level parameter was met, at least on a seasonal basis.

The deposition of Unit 4a began at 7,900 years ago and marks the beginning of the modern Wacissa River regime. The high silt content of this layer indicates that the Wacissa River flow was minimal, however. Sea level was still ~25 m below present, and based on the depth profiles of karst features in the Wacissa River, few of the Wacissa's springs would have been contributing to the flow of the river at this time. By 4,900 years ago, the sandier peat of Unit 5a began forming due to swifter water conditions when sea-level reached near-modern levels, and all the Wacissa River's springs likely contributed to its flow. Unit 6 contains interbedded peat and sand layers reflecting the modern conditions of episodic flooding events, triggered by periods of increased rainfall and storm activity.

2.7.2 Paleontological, Geological, and Archaeological Significance

Given an inability to date faunal material from this layer, no unequivocal conclusion can be reached about the temporal association of the Suwannee lithic material with the Pleistocene fauna. However, fabric data suggest that the lithic and faunal material was deposited contemporaneously due to no significant difference in directionality between or among material type. The REE data likewise suggest approximate contemporaneity of the extinct and extant fauna due to similarities in rare-earth element signatures, but the REE error may be 5% of the sample age. A reliable age on Pleistocene extinctions less than 4 km away at Page-Ladson and ages from sites elsewhere in the continent demonstrate the disappearance of Pleistocene fauna by 12,600 cal yr BP (Gill et al. 2009; Grayson 2006, 2007; Perrotti 2017). While exceptions are published (Haile 2009; Woodman and Athfield 2009) and a "Pleistocene refugium" has been proposed in the southeastern United States (Russell et al. 2009), no reliable, post-Clovis radiocarbon ages have been obtained on megafauna in this region and the authors state that the evidence for a refugium is "meager" (Russell et al. 2009: 195).

Thus, given the likely post-Clovis age of Suwannee points, I propose an alternate hypothesis that the small assemblage of Pleistocene faunal remains in Unit 3 at Ryan-Harley represents an old-fossil problem. That is, Pleistocene faunal remains were ambient on the Suwannee paleosol or shallowly buried by the aeolian sands of Unit 3 when Suwannee point makers settled at Ryan-Harley. These fossils then became intermingled with the Suwannee artifacts and faunal material. The presence of faunal material just a few centimeters beneath Unit 3 in the Suwannee paleosol demonstrates that earlier faunal material was present on the landscape prior to the Suwannee occupation, supporting this alternate hypothesis. More data is needed to address test this hypothesis more rigorously.

Unfortunately, the mobility of artifacts through Unit 3 also means that no unassailable conclusion can be reached about the discreteness of the Suwannee lithic assemblage. The fabric data also demonstrate that while a portion of the assemblage may be minimally disturbed, the majority has been reworked by post-depositional process. However, three excavations at the site have only produced Suwannee projectile points within Unit 3. Data obtained on all piece-plotted artifacts recovered from the site demonstrate no patterns in trend or plunge within the assemblage or among material type that would indicate the presence of another archaeological component. Additionally, the presence of three refits further indicates that Unit 3 at Ryan-Harley contains a discrete Suwannee occupation. Last, nearly 96% of the lithic raw material within Unit 3 at Ryan-Harley is locally available chert. Significant concentrations of other raw material types are absent. Therefore, the preponderance of evidence indicates that the Ryan-Harley Suwannee lithic assemblage is culturally discrete.

Ryan-Harley, and the Suwannee type, still elude absolute geochronology, but an evaluation of the evidence discussed here narrows the range of the site considerably. While the artifacts are present in ~54,000 year old sands, experimental studies on the movement of lithics in dunes demonstrate that exposed items in loose substrate can migrate 15-17 cm downward from their original position (Wandsnider 1988). This downward movement is enhanced by warm, dry, and windy conditions, and Wandsnider also records lateral artifact movement as far as 0.45 m down slope within a single year (1988). Unit 3 slopes down to the northeast at an ~8% grade and arid, windy conditions persisted during and after the Younger Dryas in North Florida, creating an environment suitable for extensive artifact mobility. Thus, as conditions were conducive to artifact migration, these artifacts must have been originally deposited on the surface of Unit 3 before migrating downward into Unit 3. While a portion of artifacts was recovered on the Suwannee paleosol, the majority were recovered within Unit 3 and at the Unit 3/4 contact. This distribution of artifacts supports the hypothesis that the Ryan-Harley assemblage is intrusive to Unit 3, demonstrating that this material must post-date the Unit 3 sands. The portion of artifacts recovered with varying plunges is likely the result of this post-depositional reworking. Future analyses taking into account distribution patterns of trend and plunge within Unit 3 would further elucidate the role of post-depositional artifact movement in Unit 3. Further, considering the REE and fabric data, we know that the Ryan-Harley lithic material was deposited roughly contemporaneously (within 500 years) with the Pleistocene faunal material also present in Unit 3. If the extinct fauna were ambient on the surface when Suwannee point makers occupied Ryan-Harley, this provides a possible age range for the Suwannee component at Ryan-Harley of 12,700-12,200 cal yr BP, given the 500 year REE error.

2.8 Conclusion

During the late Quaternary, extensive aeolian activity transported and reworked marine sands to the Wacissa River Basin around 54,000 years ago. Persistent arid and windy conditions led to a long period of pedogenic alteration of these sands resulting in the Suwannee paleosol. During MIS 3 and 2, the Wacissa River Basin landscape was an active and expansive aeolian surface, dotted with wind-sculpted features analogous to coppice dunes. During the late Pleistocene, rising sea-levels coupled with a seasonally higher water table provided conditions conducive to surface water in topographic low spots or intermittently flowing streams. Residentially mobile Paleoindian groups mapped onto this predictable freshwater source as part of their seasonal rounds. Between 12,700 and 11,900 years ago, a small group of hunter-gatherers established a short-term campsite on the leeward side of a small dune near a seasonal watering hole. This group moved on, and the archaeological assemblage left behind was intermittently buried and exposed by aeolian activity and taphonomic agents that reworked a portion of the assemblage until water tables rose, inundating and sealing the site around 8,000 years ago. A series of sequential peats formed at the site, indicating the gradual development of the modern Wacissa River system, which reached roughly modern conditions by ~4,500 years ago.

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CHAPTER III

LITHIC TECHNOLOGICAL ORGANIZATION OF THE SUWANNEE TRADITION: THE VIEW FROM THE RYAN-HARLEY SITE (8JE1004), FLORIDA, USA

3.1 Introduction

Suwannee points are an unfluted lanceolate style which is most prevalent in the state of Florida, USA. Understanding the Suwannee point makers is confounded by a lack of discrete, in-situ Suwannee artifact assemblages (Table 1). While Suwannee points are believed to represent a post-Clovis, regionally-adapted group (Anderson et al. 2015; Thulman 2011), no absolute ages exist for the type. The Ryan-Harley site in north Florida is the only professionally-excavated site with a discrete Suwannee artifact horizon (Balsillie et al. 2006; Dunbar et al. 2006; Smith in press). Thus, the archaeological assemblage at Ryan-Harley provides the best sample available from which to study the Suwannee tradition. A lack of discrete Suwannee assemblages from the lower southeastern United States has led to the development of hypotheses about Paleoindian mobility and land-use in Florida from assemblages which contain multiple diagnostic artifact types or which include samples of ex-situ points and tools (Daniel and Wisenbaker 1987; Daniel et al. 1986; Dunbar and Vojnovski 2007; Goodyear et al. 1983). Archaeological excavations were undertaken at the Ryan-Harley site in 2015 to address this data limitation. Geoarchaeological analyses were conducted first and confirmed that the Suwannee component at Ryan-Harley is stratigraphically intact and culturally discrete (Smith in press). This paper presents an analysis of the Ryan-Harley lithic assemblage with the goal being to understand the technological, functional, and organizational strategies represented by the excavated Suwannee lithic assemblage. This paper presents macroscopic and microscopic analyses of the Suwannee assemblage at Ryan-Harley. The analyses specifically address whether the assemblage supports previous interpretations that Suwannee people were logistically organized (Daniel and Wisenbaker 1987), test the site's previous interpretation as a short-term camp site (Dunbar et al. 2006), and determine the activities important in daily life of Suwannee point makers.

3.2 Background

The Suwannee point type was identified in 1958 by Ripley Bullen. Suwannee points are unfluted lanceolate forms with concave bases, basal ears, end thinning, and moderate or slight waisting (Figure 11) (Bullen 1958; 1962; 1975b). The type is named for the Suwannee River in central Florida, where a dense concentration of the style occurs (Thulman 2009, 2011). Suwannee points are thought to be a post-Clovis Paleoindian complex and are largely confined to the Coastal Plain of the lower southeastern United States (Figure 12) (Anderson and Sassaman 2012; Anderson et al. 2015; Smith in press; Thulman 2011). However, no absolute ages exist for the Suwannee style, and some scholars have hypothesized that Suwannee pre-dates Clovis (Stanford 1991).

The presence of Suwannee points beneath an early Archaic Bolen point base (~11,900 – 11,000 cal yr BP) (Thulman 2018) at the Hornsby Spring site affirms the position of Suwannee as a Paleoindian type (Dolan and Allen 1961). Furthermore, Suwannee points exhibit a regional geographic distribution and are constrained to the lower southeastern Coastal Plain by the Chattahoochee/Apalachicola River to the west, the Appalachian Piedmont to the north, Pee Dee River to the northeast, and the northern edge of the Florida Lowlands/Everglades to the south (Anderson et al. 2010). Regional projectile-point manifestations such as Suwannee begin to occur throughout North America during the Middle Paleoindian period (Anderson et al. 2015; Lothrop et al. 2016; Surovell et al. 2016; Tune 2016).

Today, the Ryan-Harley site is located adjacent to a small branch of the Wacissa River. The Wacissa emerges from a group of 16 springs near the base of the Cody Escarpment, ~30 km southeast of Tallahassee, Florida, USA. The Cody Escarpment drops sharply to the Woodville Karst Plain, which contains many spring and sinkhole features (Yon 1966). The Wacissa flows south for ~21 km until its confluence with the Aucilla River, breaking from a single channel to an anastomosing regime ~17 km downriver. The Ryan-Harley site is ~18 km downriver at the beginning of the anastomosing section (Figure 13).

While the current water table in the Wacissa River basin is at or near the surface and much of the area is a hydric swamp (Prenger and Spencer 2005), conditions were far different in this basin during the Suwannee occupation (~12,700-11,500 cal yr BP) (Smith in press). Despite being only ~10 km from the coast and ~4 masl at present, Ryan-Harley was between ~170 and ~120 km from the coast and between ~70 and ~60 masl during the hypothesized site occupation period (Joy 2019). The pollen record at the Page-Ladson site, ~4 km south of Ryan-Harley, demonstrates that between 12,700 and 11,500 cal yr BP, the Wacissa and Aucilla River basins were savannah-like with intermittent watering-holes surrounded by hydrophilic plant communities (Hansen 2006;

Perrotti 2017). At Ryan-Harley, an arid, open, and windy environment persisted from ~54,000 until ~8,000 cal yr BP when the modern Wacissa River regime began. This is demonstrated by optically stimulate luminescence (OSL) ages on aeolian sands and features beneath Holocene fluvial sediments at the site (Smith in press). These data indicate that during Ryan-Harley's occupation, the Wacissa River basin was sandy, open, and windy, with terrain most similar to a coppice dunefield (Smith in press). Thus, fresh-water availability would have been the governing factor of hunter-gatherer groups traversing the landscape (Lee and DeVore, 1976; Thulman 2009). At Page-Ladson, an organic and clay-rich pedogenic horizon formed at the edge of a pond between ~12,600 and 11,500 cal yr BP, demonstrating that groundwater levels supported intermittent, likely seasonal, surface freshwater in topographic low spots during the occupation period at Ryan-Harley (Halligan et al. 2016). Indeed, auger data demonstrate that the Suwannee occupants at Ryan-Harley appear to have camped on the leeward side of a dune, adjacent to a small pond (Smith in press). Movement around freshwater sources is well recorded in the ethnographic record of hunter-gatherers in arid environments (Barnard 1992; Peterson 1973; Yellen 1977). Mobility around water has been proposed for Paleoindian and early Archaic hunter-gatherer groups in the lower Southeast (Anderson 1996, Daniel 1985; Dunbar 1991; Neill 1964), and previously demonstrated for Florida groups, including Suwannee (Thulman 2009). These fluctuations in freshwater availability would have mandated a high degree of residential mobility for Paleoindian groups in the Wacissa River basin.

The lithic landscape during the site occupation period is another important factor in the provisioning strategies of groups who settled the area (Andrefsky 1994b). Cherts in the region occur within the Suwannee Limestone Formation, an Oligocene-aged foraminiferal grainstone that spans much of North Florida and South Georgia (Austin et al. 2018). Suwannee chert, which occurs in this limestone, is a nodular replacement chert that fits into the broader category of cryptocrystalline quartz, although its precise classification is microspherulitic chalcedony (Upchurch et al. 2008). Suwannee chert varies in both color and grain size (Austin and Estabrook 2000; Upchurch et al. 2008). The Suwannee Limestone Formation has five distinct chert quarry clusters. The Wacissa Cluster intersects the Wacissa River, where Ryan-Harley is located, as well as the Aucilla River (Upchurch et al. 2008). The nodular, as opposed to bedded nature of the chert in this area, means that raw material availability is spread across the Wacissa River Basin as opposed to being focused at a few large outcroppings on the landscape. However, the average package size within the Wacissa Cluster is non-transportable boulder size nodules, and nodules are plentiful throughout the basin (Figure 3). It is likely that during the Younger Dryas, even more outcrops were evident given the open, exposed terrain of the Wacissa River Basin that is now buried beneath Holocene fluvial sediments. While Suwannee chert is durable due to tight interlocking grains, numerous fossil inclusions can render entire nodules unusable (Upchurch et al. 2008). Thus, while the material is plentiful, it is variable in quality.

3.3 Materials and Methods

This analysis includes all lithics collected in-situ at the Ryan-Harley site from excavations in 1999 (n=112) (Dunbar et al. 2006), 2015 (n=889) and 2017 (n=174). To most accurately examine the Suwannee toolkit, only piece-plotted artifacts recovered from buried portions of the Suwannee component are considered in this study. Artifacts found in the screen are not presented here. The only exception to this is the inclusion of two ex-situ artifacts, both biface fragments, which were refit to biface fragments found in-situ to form a complete point and a late-stage preform. Analyses of the Ryan-Harley assemblage included macro and microscopic methods.

3.3.1 Macroscopic Methods

Macroscopic analyses included visual observations and those made with a 10x loupe. All measurements were made with digital calipers or goniometers. Classification of debitage followed the typology laid out by Sullivan and Rosen (1985: 759). Data collected for all specimens include length, width, and thickness measurements (LWT), weight, and cortex percentages, which were collected following Andrefsky (2005: 115-117). Presence or absence of thermal and taphonomic alteration (polish/abrasion) was collected for all specimens. Raw-material type was also collected for all specimens, but due to the difficulty of typing Florida chert (Upchurch et al. 2008), the majority of artifacts could only be identified to geologic formation. In an effort to obtain more data about raw material, a qualitative raw-material-quality score was also used, where materials were scored as high, medium, or low quality. High quality was rated as raw material with no inclusions and a smooth texture. Medium quality material has few, small inclusions but a smooth texture. Low-quality material has a rough, grainy texture or large inclusions. Additional data collected for flake fragments included flake-fragment portion (proximal, medial, or distal) and termination type (feathered, stepped, hinge, plunging), whenever possible. In addition to the above attributes, data collected for proximal flake fragments included technological class (Andrefsky 2005: 120-127; Frison 1968; Raab et al. 1979), maximum thickness at bulb, eraillure scar presence and number, and platform width, thickness, and type (Andrefsky 2005: 94-98; Will 2000). Proximal flake fragments were only assigned to technological categories if diagnostic features were present that could be used to make a confident identification. For biface-thinning flakes, diagnostic features included more than three dorsal flake scars and feathered lateral margins. For edge-retouch flakes, flakes driven off an edge through pressure to sharpen an edge, diagnostic features included a small bulb of percussion, rounded lateral edges, and a stepped or feathered termination. Core-reduction flakes were typed based on the presence of cortex. Platform grinding was recorded as present or absent for all complete and proximal flake fragments. For complete flakes, in addition to variables previously listed, midpoint thickness was also collected, which was subtracted from maximum thickness at bulb to obtain a relative application load index for all complete flakes (Cotterell and Kamminga 1987). Data collected for bifaces included LWT and weight measurements as well as edge angle. Flaking indices for bifaces were calculated following Miller and Smallwood (2012). In lieu of traditional stage categories, bifacial artifacts were classified as having been edged, thinned, shaped into a formal preform, or shaped into a finished biface. Variables recorded during uniface analysis include LWT measurements, weight, morphological class (Daniel and Wisenbaker 1987), and number of edges worked. Tool blank, edge shape, and retouch face were also recorded. Unifaces were classified as either formal or informal. Formal unifaces show standardization in shape, effort in manufacture, evidence of maintenance, portability, and flexibility (Daniel and Wisenbaker 1987). Informal unifaces vary in size and shape and do not show extensive effort in production. Geometric index of reduction (GIR) was also calculated for all unifaces (Kuhn 1990).

3.3.2 Microscopic Methods

A sample of eighteen artifacts was analyzed for use wear to help elucidate the function of varying forms of artifacts at Ryan-Harley by Jim Weiderhold at Texas A&M University. Each artifact was first cleaned with a mild emulsifier in an ultrasonic cleaner to remove surface residues. The surface of the artifact was then cleaned with methyl alcohol and then macroscopically analyzed, photographed, and sketched prior to use-wear studies (Kay 1996). Each specimen was scanned using a Leica Z12.5 stereomicroscope with variable magnification from 10× to 100× to examine microflaking patterns and detect areas of interest, which are noted on sketches of each artifact (Odell 1980; Odell and Odell-Vereecken 1980). Next, areas of interest were viewed under a Leica DMLA compound microscope with Nomarski optics at 100×, 200×, and 500×. These magnifications are useful for revealing polish, rounding, and striations in detail (Keeley 1980). Images of observed wear were captured at each magnification level. Images were recorded with a CoolSnapPro camera integrated with Image-Pro Plus software (Wiederhold and Pevny 2013). Particular attention is paid to ridges near the working edge, which often retain the best evidence of polish and striations (Wiederhold and Pevny 2013). The number of wear spots for each artifact was counted by first scanning the artifact at 100x and documenting the number of spots where unequivocal changes in rock texture were present. Invasiveness of wear was recorded based on the location of the wear relative to the artifact's edge. Three patterns of wear were recorded including wear that appeared only on the edges of the artifact, use that appeared between the artifact's center and edge, and artifacts that exhibited wear in both locations. A similar system was used to record the location of wear on the three-dimensional surface of the rock. Location of wear was recorded as being present in low areas, on high spots, or both. Striae were recorded for each piece as presence/absence. After examination of each artifact, the wear patterns were described as having been used on soft materials, hard materials, or both. Wear on high spots is more likely to have developed from working rigid materials more resistant to deforming under pressure, such as rock, bone, and hardwoods (Wiederhold and Pevny 2013). Wear developed in low spots on an artifact indicates work of materials that deform enough to polish troughs and pits in the surface of the rock, such as hide, plants, and softwoods (Wiederhold and Pevny 2013). Artifact use was then determined based on overall morphology and use-wear patterns.

3.4 Results

3.4.1 Macroscopic Analyses

The assemblage examined for this paper includes 1175 lithic artifacts, including debitage, bifacial and unifacial tools, cores, and hammerstones. The majority of the

Ryan-Harley assemblage is made on local chert that compares favorably with the Suwannee type (n = 1143). Three other raw-materials types are also present, including chert from the adjacent St. Marks River basin to the west (n = 17), Coastal Plains chert that does not compare favorably with local Suwannee varieties (n = 14), and a single edge retouch flake made of quartzite. However, the attribution of raw material to types is made difficult by several factors, including the stain found on artifacts in Florida's rivers and inherent difficulties in sourcing Florida cherts (Austin et al. 2018). Due to these difficulties, it is possible that more raw material variability exists in the Ryan-Harley assemblage than can currently be determined.

3.4.1.1 Debitage

There are 1103 pieces of in-situ debitage in this assembalge (Table 5). This includes 284 complete flakes, 278 proximal flake fragments, 388 flake fragments, and 153 pieces of debris or shatter. Reduction types include bifacial thinning flakes (n = 301), followed by edge-retouch flakes (n = 171), core-reduction flakes (n = 147), platform-preparation flakes (n = 42), retouched-scraper flakes (n = 23), and bipolar flakes (n = 5) (Figures 14, 15). A further 261 proximal flake fragments and flake fragments could not be confidently assigned a technological class. The most common platform types were roughly evenly split between smooth (n = 259) and complex (n = 229) (Figure 16). Of pieces of debitage for which points of applied force can be observed, the majority of these are flakes of bifacial thinning (n = 252), followed by edge-retouch flakes (n = 126), core-reduction flakes (n = 88), platform-preparation flakes (n = 39), and retouched-scraper flakes (n = 22). The majority of biface thinning flakes have either complex platforms (n = 130) or smooth platforms (n = 101). Pressure and edge-retouch flakes (n = 126) most commonly exhibit complex (n = 57) or smooth (n = 52) platforms. Core-reduction flakes were overwhelmingly struck from smooth platforms (n = 54), a trend also true for platform preparation flakes (n = 25). A total of 45 flakes exhibit platform grinding, the most common of which were biface-thinning flakes (n = 30), followed by pressure or edge-retouch flakes (n = 8), and then core-reduction flakes (n = 7). The majority (~80%) of debitage (n = 872) bears no cortex, while 200 (~18%) pieces of debitage exhibit cortex covering less than half of the artifact's surface (Figure 17). Only 31 (~3%) pieces of debitage have cortex covering more than half of the artifact's surface. Cortex was absent on 96% of retouched-scraper flakes, 95% of edge-retouch flakes, 90% of bipolar flakes, 82% of bifacial thinning flakes, 82% of platform-preparation flakes, yet only 39% of core-reduction flakes (X^2 = 172.05, P = 0.00001). Nearly 98% of debitage was produced from medium- or high-quality material, with only 2% of debitage classified as low-quality, which were predominantly core-reduction flakes (X^2 = 105.70, P=0.00001). Low-quality materials were not observed among pressure and edge retouch flakes, retouched-scraper flakes, or bipolar flakes, and only five biface thinning flakes were produced from low-quality material (X^2 = 23.17, P = 0.003).

3.4.1.2 Bifaces

The Suwannee assemblage from Ryan-Harley includes fifteen bifaces, two of which were refit from two different fragments each (Table 6). The majority of the bifacial assemblage is on medium-quality chert (n = 13), with only two bifaces produced from high-quality raw material (Figure 9). Most of the bifaces produced on medium-quality chert are preforms or finished bifaces. No bifaces were produced from low-quality chert. Only three bifaces are complete, with an additional two estimated at greater than 75% completion. The remaining ten bifaces are less than 75% complete. The cross-sections of bifaces are either bi-convex (n = 9) or plano-convex (n = 6).

The majority of bifaces (80%) are either preforms or finished (n = 12), with the remainder being edged or thinned bifaces. Of the finished bifaces, two are bi-convex, and one is plano-convex. No edged bifaces exhibited a bi-convex cross section. Preforms and finished bifaces are mostly lanceolate in plan view, with one ovoid in shape. Edged and thinned bifaces are either ovoid or rectangular in plan view. Only six bifaces exhibit end-thinning, which begins to be present in thinned bifaces. Finished bifaces have width-to-thickness (w/t) ratios greater than 4.2 mm. While two preforms have w/t ratio of above 4.0 mm, the remainder are constrained between 2.6 and 4.0 mm. Excepting one preform, all bifaces with a w/t ratio less than 2.8 are either edged or thinned. All preforms and finished bifaces exhibit flaking indices of greater than 0.222, while all edged and thinned bifaces had flaking indices beneath 0.222. All finished bifaces had flaking indices of greater than 0.327. Preforms most commonly had flaking indices of between 0.222 and 0.32. The highest and third-highest flaking indices were recorded for the two bifaces made on high-quality material. Overall, biface stages correlated well with flaking indices (Figure 19), but these results were not statistically significant (X^2 = 11.46, P = 0.25) likely due to the small sample size.

3.4.1.3 Unifaces

Of the recovered lithic assemblage, 49 artifacts are unifacial (Table 7, Figure 22). Many of these artifacts are either complete (n = 18) or appear more than 50% complete (n = 15). The identified types include informal (n = 25) and formal unifaces (n = 24) (Figures 16 and 17). Formal unifaces include a diverse variety of scrapers (n = 19), four combination tools, and one adze. The majority of unifaces were produced from either bifacial-thinning flakes (n = 15) or core-reduction flakes (n = 17). Indeterminate flakes (n = 10), cortical spalls (n = 4), blade-like flakes (n = 2), and one reduced nodule account for the remaining tool blanks. Only four formal unifaces show evidence of hafting. The majority of unifaces are produced on high-quality raw material (n = 25), including twelve informal unifaces and thirteen formal unifaces. This trend, however, is not statistically significant (X^2 = 0.33, P = 0.83). Of the thirteen artifacts produced on medium-quality chert, seven are informal and six are formal. Of the four artifacts produced on low-quality material, all are informal tool types. With regard to tool blank, the majority of unifaces are produced from flakes (n = 42). Bifacial thinning flakes and core-reduction flakes are most prevalent, accounting for fifteen (31%) and seventeen (35%) of tool blanks, respectively (X^2 = 11.25, P = 0.02). The remaining blanks include cortical spalls, blade-like flakes, and a single reduced nodule. Informal unifaces are almost equally likely to have been produced on bifacial thinning flakes (n = 11) and core-reduction flakes (n = 10). No formal unifaces exhibit a geometric index of reduction (GIR) of less than 0.4444, and most have GIRs greater than 0.69023, indicating relatively intensive curation of unifaces overall (Kuhn 1990). As expected, a

Mann-Whitney test demonstrated that the GIR is greater for formal unifaces (mean rank 31.84) than informal unifaces (mean rank 17.88), (U = 129, P = 0.001).

3.4.1.4 Cores and Hammerstones

Only seven cores and a single hammerstone were recovered from the Suwannee component. The cores are split between unidirectional (n = 4) and multi-directional cores (n = 3) (Figure 18). The unidirectional cores are prepared and conical in shape, while the three multi-directional cores are unprepared, tested cobbles. With regard to size value, multi-directional cores exhibited greater variability than unidirectional cores, ranging from 6,056 to 221 (Andrefsky 2005: 145). Smaller, unidirectional cores exhibit less variability, with size values ranging from 168 to 48. A Mann-Whitney test demonstrated that multi-directional cores (mean rank 6.0) were always larger than unidirectional cores, but this difference is not significant (mean rank 3.6), (U = 3, P = 0.18).

The single hammerstone recovered is a rounded limestone cobble with a size value of 567. The limestone cobble is soft, easily scratched with a fingernail, and exhibits multiple impacts (Figure 18D).

3.4.2 Microscopic Analyses

Eighteen artifacts, including bifacial and unifacial stone tools, were analyzed for microwear patterns (Table 4). Use wear was hindered by staining that accumulates on artifacts submerged in Florida's rivers (Burke 2014). This stain masked many parts of the artifacts, but where the stain was not fully developed, use wear was common (Figure 24, insets). Of the artifacts analyzed, fifteen showed use, including six bifaces, seven formal unifaces, and two informal unifaces (see Figure 19). The objects showing no use wear include two informal and one formal uniface. The average number of wear spots observed was 4.8 for bifaces, 2.8 for formal unifaces, 0.6 for informal unifaces.

3.4.2.1 Bifaces

Wear was present as polish on all six bifacial specimens. In addition to polish, two of the six bifaces also bore striae. While wear was common on bifaces, location of the wear varied. Three bifaces have wear that does not occur on the tools' edges, while the other three have wear on both the edge of the piece and invasive from the edge. Wear on five of the bifaces occurs only on high spots. Wear patterns observed on five bifaces are consistent with use derived from hard materials. One biface, the only biface to no exhibit wear on high spots of the artifact's surface, has wear consistent with working soft material.

3.4.2.2 Unifaces

Use-wear polish is present on all but one formal uniface from Ryan-Harley, and two unifaces bear striae. Use wear on four formal unifaces is constrained to the edge. The remaining three formal unifaces exhibit wear on the edge of the piece and invasive from the edge. Use occurs on high ridges of five formal unifaces and is present in both high and low spots on two. Only one formal uniface exhibits wear indicative of use on soft material. The remaining six formal unifaces exhibit use indicative of hard materials. Wear on the informal unifacial tools includes one tool with edge wear and one with invasive wear. Both informal unifacial tools show wear only on high spots. Striae were observed on one of the tools, which has wear consistent with use on both hard and soft materials. The second tool bears wear indicative of working soft materials.

3.5 Discussion

The data from the Suwannee toolkit from Ryan-Harley serves as an important initial data point for understanding the function, technology, and organization of a discrete Suwannee lithic assemblage.

3.5.1 Lithic Technology Represented at Ryan-Harley

The lithic landscape at Ryan-Harley contains varying quality materials in high-abundance. Expectations for this landscape include formal and informal tool production. Opportunities to acquire toolstone would have been readily available, but high-quality materials are infrequent on the landscape. While a few blades and blade-like flakes are present in the assemblage, biface production appears to be the primary goal of reduction. This is likely a factor of ubiquitous raw material in the Wacissa River basin, which rendered the maximization of cutting edge unnecessary (Andrefsky 1994, 2009; Odell 1996). The most common technological classes are bifacial thinning flakes (~33%), pressure and edge-retouch flakes (~10%), and core reduction (~10%). Nearly 73% of core-reduction flakes exhibit 10% cortex or less, and only ~4% of flakes have cortical platforms, indicating that when core reduction was performed at Ryan-Harley, it was done on prepared unidirectional cores. Uncommon technological classes are flakes of platform preparation and bipolar reduction. The lack of platform preparation is also reflected in relatively few instances of platform grinding. The paucity of bipolar flakes, often seen as evidence of extreme raw-material conservation (Goodyear 1993), also may reflect the fact that raw-material conservation in the Wacissa River basin, and perhaps Florida in general, was not necessary.

The majority of debitage at the site is of bifacial reduction despite bifaces not being the most prevalent tool type recovered. This disparity indicates that the majority of reduction was from bifacial cores and that later-stage bifacial reduction was performed on bifaces which were finished on location and carried offsite. The majority of debitage (80%) exhibits no cortex, and a high proportion of edge-retouch flakes reinforces the idea that most reduction occurring at Ryan-Harley is on later-stage tools. Core-reduction flakes are present, however, and, given a lack of known chert outcrops in the immediate area, cores must have been transported by Suwannee people to Ryan-Harley. Further evidence for the emphasis on bifaces as cores is the statistically significant proportion of informal tools produced from bifacial thinning flakes, a low incidence of cortex overall, and few examples of unprepared cores (Kelly 1988). While it does appear that bifaces had long use-lives, the high proportion of informal unifacial tools produced from the by-products of bifacial reduction indicates that bifaces also served as cores (Kelly 1988).

I hypothesize that this bimodal dataset of platform preparation is the product of two separate reduction streams: mid-stage reduction and retooling of late-stage curated tool forms, both of which are present in the assemblage (Figure 20). The raw-material-quality score shows that low-quality materials are uncommon overall, and 64% of the time are associated with core reduction, although this result is not statistically significant (X^2 = 3.87, P = 0.14), which may be a factor of the small sample size of low-quality raw materials at the site. Bifacial thinning flakes are made on medium- or high-quality material 96% of the time, indicating a strong preference of material quality, despite the relative abundance of low-quality raw material (X^2 = 10.35, P = 0.005). Additionally, no edge or scraper retouch flakes are on low-quality material, indicating that the bifaces and unifaces being retouched are of high quality. This preference for material quality may be reflective of the provisioning of individuals against the unknown (Binford 1979; Binford 1980; Graf 2010; Kelly 2003; Kelly and Todd 1988; Kuhn 1994; Surovell 2009), demonstrating that despite familiarity with the region and ubiquitous toolstone, Suwannee people still provisioned themselves, possibly against environmental uncertainty. While most material appears local, a fraction on the assemblage is on non-local toolstone, demonstrating that the occupants at Ryan-Harley moved about the landscape frequently.

Bifaces at Ryan-Harley are mostly broken early-stage forms, with the exception of two broken tips that appear to be from finished bifaces and a reworked complete Suwannee point. Two bifaces were refit, including a biface preform and the previously mentioned reworked Suwannee point. In addition to further demonstrating that the Suwannee assemblage at Ryan-Harley is discrete and intact, the refits (Smith in press) and prevalence of early-stage bifaces indicate production, curation, and discard on site. Based on distinct plano-convex cross sections, five bifaces (preforms or earlier stages) appear to have been manufactured from flakes, while the remaining 12 were reduced from bifaces. Thus, data from Ryan-Harley show that bifaces were central to the Suwannee reduction strategy.

Unifaces are the most diverse portion of the toolkit. Despite their varied final forms in the Ryan-Harley assemblage, most unifaces started as either core- or bifacial-reduction flakes. As bifaces appear to be the final goal of most Suwannee reduction, it seems that suitable flakes were set aside for uniface production during bifacial reduction. Both formal and informal unifaces were most commonly produced on high- or medium-quality bifacial-thinning or core-reduction flakes, indicating conservation of high-quality debitage throughout the reduction sequence. The majority of informal unifaces are made of low- or medium-quality cortical spalls or core-reduction flakes, while the majority of formal unifaces are made on medium- to high-quality bifacial- or core-reduction flakes. Thus, informal unifaces were produced expediently in earlier stages of reduction, while formal unifaces at Ryan-Harley were planned and produced on suitable flakes made during later reduction stages. This meets expectations for hunter-gatherer groups in a lithic-rich landscape where quality varies (Andrefsky 1994a). Informal tools produced on bifacial thinning flakes are of variable quality, indicating that production of such tools was an opportunistic by-product of bifacial reduction. However, several informal tools exhibit cortex, indicating that informal tool production occurred throughout all stages of reduction. Relatively few scraper-retouch flakes were found, despite a large scraper assemblage. Thus, scrapers were more frequently discarded than retouched at the site. As many scrapers exhibit high degrees of curation, Ryan-Harley occupants appear to have been disposing of old tools, perhaps in favor of new unifaces produced from biface-thinning or core-reduction flakes.

3.5.2 The Functions of the Suwannee Toolkit

Microscopic studies on a sample of the Ryan-Harley Suwannee tool assemblage give high-resolution information on the use of these tools. The bifaces analyzed exhibit more varied use wear than either formal or informal unifacial tools. Use varied in its location on both the edge and invasively from the edges of tools. Use also varied by the relief marked by use, indicating varied use on both hard and soft materials. This variability is more consistent with bifaces serving as multi-use items. Wear on bifaces is consistent with use of these artifacts as knives, projectile points, and scrapers. Formal uniface use wear was more uniform, with the majority exhibiting wear on the edges and on high spots. Polish on formal unifaces indicates they were most commonly used on hard materials. The outlier among the unifaces is a lightly used formal uniface which exhibits polish from soft materials, possibly hide. Two of the four informal unifacial tools that were analyzed showed no wear while use on the other two informal unifacial tools is minimal and varied. Informal unifaces also had the least number of observed wear spots, indicating that informal unifaces were produced for expedient uses and did not have long-use lives.

On the basis of morphology alone, the diverse assemblage of formal and informal scrapers indicates a variety of specific camp tasks, including the working of bone and/or wood, and the scraping of hide. Many artifacts in the Suwannee toolkit fit into artifact categories reported from Harney Flats, an extensive base camp site where a large assemblage of Suwannee and Bolen artifacts were recovered but could not be separated due to large excavation levels and sandy sediments (Daniel and Wisenbaker 1987). The Ryan-Harley assemblage contains many types identified at Harney Flats, including Suwannee points and preforms, formal and informal unifacial tools, multi-directional cores, unidirectional cores, and blade-like flakes. Absent from the Ryan-Harley site but present at Harney Flats are Simpson points and preforms, Bolen points and preforms, lozenge-shaped bifaces, discoidal cores, bifacial adzes, hafted spokeshaves, flakes with projections, abraders, and exotics (Daniel and Wisenbaker 1987). A possible explanation for this disparity is that the presence of these latter types at Harney Flats is the result of comingling from Simpson or Bolen components. However, it is also possible that differences between these assemblages are a product of site type (residential base camp versus short-term camp) or sample size.

3.5.3 Technological Organization at Ryan-Harley

Harney Flats is currently the only site from which a technological-organization study has been conducted on the Suwannee complex (Daniel et al. 1986); however, Daniel et al. this assemblage contains Suwannee, Simpson, and Bolen tool forms to arrive at the conclusion that Suwannee people were logistically organized (Daniel et al. 1986: 54). A critical topic relating to how a group is organized are studies of land-use and provisioning strategies (Binford 1979, 1980; Kelly and Todd 1988; Shott 1986). Research has demonstrated that distribution of subsistence resources governs resource selection strategies (Binford 1980, 2001; Kelly 1995). As food procurement is prefaced by the acquisition of materials needed to hunt (Binford 1980), observable patterns in lithic industries often indicate the overall land-use strategy. Two strategies, provisioning individuals versus provisioning place, represent ends of a continuum of decision-making strategies, each of which results in observable archaeological patterns (Binford 1980; Graf 2010; Kuhn 1994; Odell 1996; Shott 1986). When groups provision individuals, the emphasis is on items that fit a mobile lifestyle with a high degree of resource uncertainty reflected in lightweight, standardized, and versatile toolkits. These qualities serve to minimize risk overall. When provisioning places, groups do not necessarily need to foreplan resources, as they return to familiar places repeatedly where resources may have been left behind during previous trips, or stockpiled (Binford 1978, 2001). This strategy permits less-formalized, expedient, often situational technologies. Assemblages from logistically-organized groups overwhelmingly use local toolstone and do not exhibit materials from long-range transport (Graf 2010). Alternatively, residentially-organized groups will have toolstone from local and non-local sources, including some that indicate long-distance transport (Graf 2010). Within logistically-organized groups, primary reduction is often expedient and unstandardized, bulky items are common, and there is little evidence for discretionary use of toolstone. Within residentially-organized groups, primary reduction is usually economical, standardized, and lightweight, with some degree of toolstone selection based on task (Graf 2010). Secondary reduction for both groups should follow the same general trends. When comparing sites across space, residential organization should manifest high variability among assemblages and low variability between assemblages. If groups are logistically organized, assemblages should have low variability within assemblages and high variability among them. Toolstone at Ryan-Harley is predominantly made of locally available Suwannee chert. However, non-local chert from the St. Marks formation is also present in the assemblage (~25 km west), as is an edge-retouch flake made of quartzite (Upchurch et al. 2008). As the nearest source for knappable quartz materials are alluvially deposited cobbles in the Suwannee River ~75 km to the east, minimal evidence of long-distance transport is present in the Suwannee component at Ryan-Harley (Upchuch et al. 2008). Thus, with regard to toolstone source, Ryan-Harley is somewhat in-between the expectations of residential and logistical mobility. Given that organization studies are also dependent on comparing assemblages from multiple sites, only the future discovery of intact, discrete Suwannee deposits will help define the true organization strategy of the group.

While evidence for primary reduction is lacking, secondary-reduction strategies at Ryan-Harley relied on economized, formal bifacial cores to produce bifaces and flakes suitable for unifacial tools. The emphasis on bifacial cores is evidence of raw-material economy and orientation toward transportable, reliable technology, typical of residentially mobile groups. Use of bifaces as cores also indicates a need to prepare for tasks that cannot be anticipated ahead of time (Keeley 1980; Kelly 1988). Furthermore, most completed formal tools are on high-quality material. Informal tool types are less common in the assemblage and are more likely to be on pieces with noticeable cortex or inclusions, or on bifacial-reduction flakes of high-quality.

Understanding inter-assemblage patterns is stymied by a lack of comparable Suwannee assemblages with discrete deposits. The similarity of many of the tool forms at Ryan-Harley to those found at Suwannee camps such as Harney Flats and Norden may be an indication of low variability among assemblages (Daniel and Wisenbaker 1987; Dunbar and Vojnovski 2007), but more discrete Suwannee assemblages are needed for informed comparisons. However, variability within the assemblage is high, as would be expected from a residentially organized group that prioritized versatility and conducted a variety of daily tasks at encampments.

The discard of unbroken, curated unifaces at Ryan-Harley and production of bifaces may be an example of a “retooling” event (Kelly and Todd 1988). While both bifaces and unifaces at Ryan-Harley are curated, they are not exhausted. These artifacts, which typically exhibit long use-lives elsewhere, may have been recycled and discarded at more frequent rates among Suwannee people due to more ubiquitous raw material overall (Goodyear et al. 1983; Goodyear 1979; Kelly and Todd 1988).

3.6 Conclusion

The in-situ lithic assemblage at Ryan-Harley provides the first discrete Suwannee toolkit for analysis. The artifacts present demonstrate that Ryan-Harley is a short-term campsite. The toolstone primarily originated from nodules in the Wacissa River basin and arrived at the in the form of large, prepared unidrectional cores. The overall pattern of discarding curated unifaces while producing and retooling bifaces indicates that the Ryan-Harley site represents a “retooling” event prior to a mobility episode. Given widespread aeolian acitivity in the Wacissa River basin during the Younger Dryas, it is likely that Suwannee people were traversing across a wide or along a relatively arid expanse during seasonal mobility rounds.

The organization of technology at Ryan-Harley indicates a high degree of residential mobility. The diverse tool assemblage, curation of unifaces and bifaces, and raw-material selection are all typical of societies that provision people as opposed to places. The exception to this is the fact that the overwhelming majority of the assemblage is of local toolstone. It may be that the plentiful nature of raw material of varying quality in the immediate area simply meant that less distance was needed to be traversed between outcrops. More data are needed to determine whether the reliance on local raw material is a factor of plentiful outcrops within an embedded procurement strategy or if direct procurement occured at specific outcrops with higher-quality material, which would be more typical of logistically organized groups. The best way forward in this regard is studies to source toolstone within the Wacissa River Basin to specific outcrops, which has proven difficult thus far (Upchruch et al. 2008). Alternatively, identification and excavation of another discrete Suwannee component would be informative, as residentially-organized societies should leav behind lithic assemblages with minimal differences between sites.

Technologically, the Ryan-Harley site indicates reliance on the reduction of large flake blanks into unifacial tools and the use of bifacial cores for both expedient tool production as well as the manufacture of bifacial knives and projectile points. The function of these artifacts is patterned, with unifacial tools set aside for specific tasks, bifacial tools serving as multi-purpose items, and informal flake tools showing no pattern indicating expedient production for unforeseen tasks. With wear spots observed as a proxy for intensity of use, bifaces were the most heavily used objects, followed by unifaces, and then expedient flake tools. As the first discrete Middle Paleoindian assemblage from the lower Gulf Coastal Plain, the lithic assembalge from Ryan-Harley will hopefully serve as an important data point in understanding Younger Dryas archaeological populations in North America.

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CHAPTER IV

GEOARCHAEOLOGICAL EXCAVATIONS AT THE GUEST MAMMOTH SITE (8MR130): EVALUATING THE EVIDENCE FOR MEGAFAUNA EXPLOITATION IN THE LOWER SOUTHEAST DURING THE LATE PLEISTOCENE

4.1 Introduction

The Guest Mammoth site was the first professionally-excavated submerged prehistoric site in the Americas. Charles Hoffman excavated the site in 1973 after the location was reported to the University of Florida by avocational divers (Figure 21). The original excavation was pioneering work and established techniques that were far ahead of the time, including many still used today. However, at the 1974 Society for American Archaeology meeting, the first and only time the Guest Mammoth site data were discussed, the presentation on the site was criticized and dismissed (Rochelle Marrinan, personal communication 2019). Hoffman's talk was given an 11:00 PM slot on Friday night in a general session. Since then, it is occasionally mentioned as a possible early site (Anderson et al. 2015; Grayson and Meltzer 2015; Surovell and Waguespack 2008) but has long been regarded as simply a curiosity due to the projectile point which does not appear Clovis-like, the site's underwater context, and questionable radiocarbon ages.

The scarcity of archaeological sites in the Southeast United States dating to the late Pleistocene with secure geologic context, unequivocal artifacts, and absolute ages is well recognized (Anderson et al. 2015; Buchanan et al. 2016; Waters and Stafford 2007). Published data demonstrate that the Guest Mammoth site may possess the qualities necessary to be included on the shortlist of late Pleistocene archaeological sites in North America. Hoffman excavated 30 m^2 of the site and found Pleistocene faunal remains and lithic artifacts buried beneath a stratigraphic sequence up to 2 m thick (Hoffman 1983; Rayl 1974). Hoffman uncovered the faunal remains and lithic artifacts laying directly on the surface of a dense marl interpreted as the bed of a late Pleistocene pond (Hoffman 1983). Six radiocarbon ages demonstrated organic preservation throughout the stratigraphic sequence. Hoffman proposed that the Guest mammoths were butchered or killed by a group of hunter-gatherers during the late Pleistocene. However, in the decades following the excavation, the location of the site, all the associated lithic material, and the majority of the faunal assemblage including the cut marked bones were lost (Smith 2019). In 2017, I relocated and excavated an additional 9 m^2 of the Guest Mammoth site to characterize its geologic context, determine the age of the mammoths, and evaluate the association of any new lithic material recovered with the mammoths. This article summarizes existing data and presents new findings relevant to the site's potential role in the peopling of the Americas.

4.2 Methods

Hoffman's methods are described at length by Rayl (1974) and Smith (2019). In 2017, Block C (3x1 m) and Block B (3x2 m) were excavated in 1x1m squares. Excavation proceeded by 10-cm levels within units 8-4, decreasing to 5-cm levels within Unit 3. Excavation halted just beneath the surface of Unit 2, the dense marl. Unit 1 was identified by an EdgeTech 3100, 4-24kHz sub-bottom profiler. All artifacts and faunal material observed were piece plotted in situ, and an underwater laser was used to record depth below datum. All sediment was removed by water-induction dredge to the surface where it passed through 1/4 inch screen with retained materials bagged accordingly. Sediment from units 2-4 also passed through 1/16 inch screen. Stratigraphic profiles were drawn underwater, and lithology is reported following conventions laid out in the USDA Soil Survey Handbook (USDA 1993). Radiocarbon and OSL sample locations were piece-plotted and collected from the exposed profile in 2017 and 2018. The organic material used for dating was identified by Dr. Katherine Pouzman and assayed by the Keck Cycle Lab at the University of California, Irvine. Radiocarbon ages are calibrated with the IntCal13 calibration curve in OxCal. OSL samples were analyzed by Dr. Steve Forman at Baylor University using 35 aliquots per sample with 0% K content, 0.63 Grays/1000 years, and a moisture content of 60%. XAD purification of the Guest Mammoth bone followed protocol outlined by Stafford et al. (1988).

4.3 Background

The Guest Mammoth site (8Mr130) is part of a prehistoric landscape submerged under ~4 m of water in the Silver River of Marion County, Florida, USA. The Silver River is in the Central Valley physiographic region of Florida (Figure 22) (Lane and Hoenstine 1991; White 1970). The Central Valley is a ~40 m deep karstic depression bounded to the east and west by uplands, and the region has been ecologically productive throughout its history (MacFadden 2017; Webb 1974). Underlying the Central Valley are highly drained, quartz aeolian sands, with silts and clays present within deeper deposits (Lane and Hoenstine 1991). The Silver River originates from the first magnitude Mammoth Spring, and 30 other springs contribute to its flow in the first river mile. Approximately

4 km below the headspring, the southerly flowing main channel of the Silver River takes several sharp turns. These turns have underwater cut banks that in some areas expose compact marls which were once subaerially exposed. These marls, now submerged under ~4-9 m of freshwater, are vestiges of intermittent late Pleistocene ponds that make up a landscape where Pleistocene faunal remains and Paleoindian cultural material are common (Martin 1966; Rayl 1974). The Guest mammoths and associated artifacts lie directly on one of these marls. The Silver River continues downstream of the site for ~9 km before its confluence with the Ocklawaha River, which flows north into the St. John's River, which then drains into the Atlantic Ocean.

Pollen data from Lake Tulane (~190 km south) demonstrate that during the late Pleistocene, the region was dry, windy, and open (Grimm et al. 1993; Watts and Hansen 1994). Conditions shifted at the beginning of the Younger Dryas (~12,900 cal yr BP) to more humid, wooded environments (Grimm et al. 1993; 2006). This trend continued until the end of the Younger Dryas (~11,500 cal yr BP), which was marked by a brief period of drought, followed by gradually ameliorating conditions into the Holocene (Watts and Hansen 1994). At present, the Guest Mammoth site is ~9 meters above sea level (masl), ~80 km from the Gulf of Mexico Coast, and ~90 km from the Atlantic Coast. However, at the beginning of the Younger Dryas (~12,900 cal yr BP), the Guest Mammoth site would have been ~75 masl, 150 km from the Gulf Coast, and 110 km from the Atlantic Ocean.

4.4 Summary of Previous Research

Initial investigations of the site left scattered documentation which was tracked down, reviewed, and summarized (Smith 2019). Three sources contain data from the 1973 Guest Mammoth excavations. A student of Hoffman's produced a 68-page unpublished master's thesis on the excavations (Rayl 1974), and Hoffman published a summary of work in 1983. Additionally, Hoffman's unpublished excavation notes, curated as the Charles A. Hoffman papers at the George A. Smathers Library (MS Group 292) at the University of Florida in Gainesville, are cited here as Hoffman ca. 1985.

4.4.1 Geologic Context

Hoffman (1983) and Rayl (1974) describe six lithologic units at the Guest Mammoth site based on an exposed profile from a 4x6-m excavation block (hereafter, Block A) and two sediment cores. No further data is provided on the two cores, but stratigraphic descriptions from the 1973 testing and excavations, as well as Hoffman's methods, are reported elsewhere (Rayl 1974: 20-22; Smith 2019). Hoffman used letters for his stratigraphic units, which I have converted to numbers (reported here) to account for additional units not observed by Hoffman. Table 1 compares Hoffman's geologic units and those described in 2017.

4.4.2 Chronology

Hoffman obtained six radiocarbon ages from the 1973 excavations. One is an age of ~11,300 cal yr BP (GAK-4512) on unpurified mammoth-bone collagen from rib fragments collected in situ at the Guest Mammoth site (Hoffman 1983). This age is considered a minimum age, given problems associated with the inclusion of humic acids in improperly treated bone collagen samples from tropical climates (Stafford et al. 1987; 1988). Hoffman also reported an age of ~11,800 cal yr BP from the "shelly marl directly overlying the bone bed" (Hoffman ca. 1985), which is suspected of having reservoir-effect contamination from the karst bedrock (Phillippsen 2013). However, the date was obtained above the mammoth remains and artifacts, and thus provided a limiting age for the exposure of the mammoth bones. Radiocarbon ages at the top of the profile collected by Hoffman all date to the late Holocene. Rayl (1974: 10) cites personal communication for "a layer of clay marl below… the [Guest Mammoth] bone bed [which] was radiocarbon dated at 14,000 B.P," but provides no supporting data for this age.

4.4.3 Faunal and Lithic Assemblage

The site produced a well-preserved assemblage of extinct and extant fauna. Hoffman (ca. 1985) uncovered 204 bone fragments from what he determined to be three Columbian mammoths (*Mammuthus columbi*): a young calf, a six-year-old juvenile, and a third mammoth that is not described (Hoffman 1983; Rayl 1974). Figure 23 is a reconstruction of the 1973 excavations within the Guest Mammoth bone bed. A metatarsal and vertebra from a *Bison sp*., an antler core and metatarsal of *Odocoileus virginianus,* miscellaneous fragments of Testudines (Rayl 1974: 25), and a single bone of a large felid are also reported, but not otherwise described (Hoffman 1983). A projectile point, six flakes, and a "large quantity" of microdebitage were associated with the mammoths (Hoffman 1983; Rayl 1974: 42). The mammoths and lithic material were lying on the surface of a compact marl, buried by unconsolidated sand and crushed shell. The "rib and pelvic area" of the mammoths had the densest concentration of lithics

(Hoffman 1983). A “pile” of mammoth bones in the southern portion of the site may represent stacking of elements (Hoffman 1983: 85). A long-bone epiphysis found in situ and belonging to the mammoth calf bears what appear to be cut marks (Rayl 1974: 41-50).

Hoffman also recovered an early Archaic Bolen point (~11,500-11,000 cal yr BP) and five bone pins above the bone bed, but exact provenience was not given. A middle Woodland-aged St. John’s Incised Bowl (~2,200-1,500 cal yr BP) came from “well above” the mammoth bone bed, stratigraphically above the Bolen point (Hoffman 1983). This relative cultural sequence at the site indicates general site integrity. Following Hoffman’s work, Paleoindian artifacts out of context have been recovered within ~100 m of the site, including a Clovis point and ivory shaft fragment (Pharmer, Personal Communication 2019).

4.5 2017 Excavations

Hoffman’s investigations were remarkable for the time but left behind several questions, most notably whether the site can be included in the list of Clovis-aged or older sites with associated mammoth remains (Grayson and Meltzer 2015; Surovell and Waguespack 2008; Waters and Stafford 2007). Amibiguities also remained regarding the stratigraphy and chronology of the site. The new excavations in 2017 focused on three objectives.

1) Re-evaluate the stratigraphy of the site to determine the integrity of the proposed human-megafauna interaction.

2) Determine whether more artifacts from the bone bed are present to determine the association of the lithics with the mammoths.

3) Obtain accurate ages of the mammoths and the overlying and underlying geologic units.

4.5.1 Stratigraphy

Our work revealed a more complex stratigraphic sequence than described by Hoffman and Rayl. Renewed excavations first focused on a 2x3-m area (Block B) ~8 m south of Hoffman's Block A (Figure 24). Block B was excavated from 1.3 mbd to a depth of 4.2 mbd and produced no strata analogous to the compact marl described by Hoffman or Rayl. An additional meter-long probe was inserted at the base of this unit and encountered no resistance indicating the presence of Unit 2. A single bone pin, refit from two fragments, was found within Unit 6 at 2.3 mbd in Block B. Excavations then moved to the 1x3-m Block C, 3 m north of Block B and ~1 m south of Block A. Block C revealed the compact marl, contained seven lithologic units, and was excavated from 1.6 to 3.5 mbd (Figure 25). The 60-cm-thick Unit 2 in Block C is a dense, light grey silty marl on top of which the mammoth remains and artifacts lie. The surface of Unit 2 is irregular and contains dips and channels that appear to be relict water-erosion features. Unit 3 is the matrix covering the artifacts and mammoth bones. Unit 3 is unconsolidated fine sands and crushed freshwater shell (Viviparidae, Pilidae, and Hyrobiidae). This layer is ~10 cm thick and tapers out on the western end of the profile. Unit 4 is a light grey silty sand with a maximum thickness of 20 cm that also tapers out on the western portion of the site. It does not match any stratigraphic description provided by Rayl

(1974) or Hoffman (1983). Unit 5 is a ~20-25-cm thick layer of brown silty loam. Unit 6 is a ~15–50-cm thick layer of grey silty sand. Unit 7 is a ~5-25-cm thick layer of light brown sandy silt with extensive broken and unbroken gastropod shells. Unit 8 is a ~10-50-cm thick layer of brown sandy loam and is still forming at the site.

In 2019, survey of the site and surrounding area was performed with an EdgeTech 3100 sub-bottom profiler, sweeping the 4–24 kHz range. This survey was conducted to examine whether relict pond or sinkhole features could be observed in the geophysical data. The sub-bottom profiler identified Unit 1, a package of siliciclastic and possibly organic-rich sediments that extends below Unit 2 to ~6-7 mbd (Plets et al. 2007). The sub-bottom profiler also delineated what is interpreted to be the surface of Unit 2, a shallow, wide basin that appears similar to a small pond (Figure 24, inset).

4.5.2 Archaeological and Faunal Material

The faunal and archaeological material recovered in situ during the 2017 excavations was examined to determine whether there was any evidence that the artifacts were introduced to the site by natural processes prior to the submergence of the site. We piece-plotted two lithics and a bone flake in situ in association with five bones identifiable as mammoth (*Mammuthus columbi*) (NISP 5, MNI 2), a single deer astragalus, a muskrat (*Ondatra zibethicus*) mandible, and three fragments of Testudines. All mammoth bones, two of the lithics (a piece of shatter and a core reduction flake), and the bone flake were found lying directly on the surface of Unit 2 (Figure 25). The third lithic (an edge-retouch flake) was found in Unit 3, 6 cm above the surface of Unit 2. Microscopic use-wear studies on the flakes found no evidence of use. Nine pieces of microdebitage were recovered in the screen during the excavation of Unit 2 within Block C, including four complete edge-retouch flakes with flat platforms, two proximal flake fragments with flat platforms, two distal flake fragments, and one piece of shatter. The lithics are on a blue or grey raw material that appears to be silicified coral. The bone flake bears a dorsal and ventral surface, as well as the remnant of a point of applied force. Two of the mammoth bones appear to be from a juvenile animal, including one with an unfused epiphyseal surface. However, teeth from the young animal, which Hoffman (1983) identified as a yearling, are within the range of size expected from a late-term fetal mammoth (Richard Hulpert, Personal Communication 2019). Therefore, it is possible that the two individuals reflect a pregnant mother with a late-stage fetus, although sex could not be conclusively determined for either mammoth.

4.5.3 Chronology

Redating the site was necessary to evaluate its age and the site's geologic history. Beyond the six ages reported by Hoffman and Rayl, an OSL sample and thirteen additional radiocarbon ages were collected from the exposed Block C south wall profile at the Guest Mammoth site in 2017 (Table 2). No datable organics were present in units 3 or 2, but an OSL date obtained 3 cm below the Unit 2/3 transition demonstrates that the upper portion of Unit 2 was deposited between 13,730 and 11,670 cal yr BP. Multiple attempts to date mammoth bone from the 2017 excavations failed to extract any collagen. An attempt to date the scapula of the juvenile mammoth from Hoffman's 1973 excavation (Smith 2019) via XAD purified bone collagen yielded an age of 8565 ± 35 radiocarbon years before present (rcybp) due to inorganic contamination from chemical preservatives applied to the bones (Stafford, Personal Communication 2018). All ages obtained from Unit 4 and above are in a proper stratigraphic sequence that span the Holocene.

4.6 Discussion

4.6.1 Depositional History

Neither coring nor geophysics identified bedrock at the site. As such, unit designations begin with the deepest stratigraphic unit observed, Unit 1. Unit 1 was observed through a sub-bottom profiler, meaning its exact composition and nature is unknown. It appears to contain siliciclastic sediments with possible organic preservation (Plets et al. 2007). The sub-bottom survey also revealed the surface topography of Unit 2, which reinforces the interpretation of the unit as an ephemeral freshwater pond. The OSL age from the top of Unit 2 suggests that the surface on which the mammoth bones were buried post-dates 12,700 ± 1035 cal yr BP (BG-4689). A marked decline in *Sporormiella* presence at the Page-Ladson site in north Florida suggests that megafauna became extinct in Florida by ~12,700 cal yr BP (Halligan et al. 2016), suggesting bounding ages for the Guest Mammoths of 13,730-12,700 cal yr BP. Following their death, the bones were covered by Unit 3, which is a fluvial deposit, demonstrated by freshwater shell throughout the unit and the erosional features on the surface of Unit 2. No radiocarbon ages were obtained from Unit 3. Following the deposition of Unit 3, Unit 4 began forming ~8,000 cal yr BP. Following this, Unit 5 began forming shortly after 7,800 cal yr BP. Unit 5 was capped by Unit 6 shortly before ~7,400 cal yr BP. Unit 7 contains crushed shell and fine sand and began forming ~3,200 cal yr BP, before being capped by Unit 8 around 2,700 cal yr BP, which is still forming at the site.

4.6.2 Site Formation Processes

An unanswered question from Hoffman's excavations was the impact of post-depositional processes on the Guest Mammoth site. The following section examines the evidence for fluvial action, bioturbation, scavenging, or other processes that could adversely affect the site and its interpretation.

4.6.2.1 Fluvial Action

Both the 1973 and 2017 excavations found the mammoths and artifacts lying directly on the surface of Unit 2 (Hoffman 1983). Unit 2 was buried by a fluvial pulse which deposited Unit 3, raising questions about the role of moving water as a site-formation process. However, if fluvial action affected the site, archaeological and faunal material would be size sorted or oriented in the direction of river flow (Byers et al. 2015). The pressure flakes are clustered around the juvenile mammoth's ribs and pelvis in the upstream portion of the site, and no trend based on either artifact size class or orientation is present in the data from either excavation. No material recovered in 2017 exhibits obvious rounding or polish indicative of extensive fluvial transport (see Boldurian and Agogino 1982) and microscopic analyses of artifacts found no evidence of stream abrasion (see Shackley 1974).

4.6.2.2 Post-Depositional Mobilization of Materials

Possibly, given a long period of exposure of the Unit 2 surface, later groups visited the site and left artifacts behind that became associated with the mammoths. While this possibility cannot be ruled out, if this were the case, diagnostic artifacts from later cultures may be expected on the surface of Unit 2. However, the projectile point found by Hoffman is most similar to Paleoindian, lanceolate types, as opposed to early Archiac side-notched forms. Further, artifacts are not frequent above the surface of Unit 2. Within Block C, the surface of Unit 2 produced all but one artifact recovered during the 2017 excavations. Block B produced only two fragments of a bone pin from Unit 6. The bone pin is slightly triangular in cross-section with a tapering body and an unmodified expanding base. Unit 6 spans much of the middle and late Archaic-periods in which this style of bone pin are most frequent (Byrd 2011). Excavations of Block A by Hoffman recovered bone pins (quantity not given), a partially complete middle Woodland St. Johns Incised bowl (~2,200-1,500 cal yr BP), and an early Archaic Bolen point (~11,500-11,000 cal yr BP) from above Unit 2, but precise proveniences are not provided. Based on the presence of a bone pin in Unit 6 within Block B, the bone pins from Block A are likely from the same component but may have come from anywhere above Unit 2 (Byrd 2011). The St. Johns Incised bowl, which Hoffman says came from "well-above the bone bed," probably came from the top of Unit 7, the only stratigraphic layer with ages spanning the St. Johns culture period (Milanich 1998). Bolen projectile points date between ~11,900-11,000 cal yr BP in Florida (Thulman 2018). Thus, the Bolen point probably was deposited during the formation of Unit 3. The presence of early Archaic material above Unit 2 demonstrates that material in Unit 3 predates ~11,900-11,000 cal yr BP. Further, the presence of a projectile point in the mammoth bone bed demonstrates that another archaeological component, more similar to

Paleoindian rather than early Archaic diagnostics, exists on the surface of Unit 2. The presence of cut-marked bone from Hoffman's excavations further demonstrates human interaction with the Guest mammoths, and the overall similarity of lithic material on the surface of Unit 2 indicates that the assemblage present is from a single butchering event. Further, in square N11 E0, units 3 and 4 pinch out and Unit 2 is in direct contact with Units 5 and 6, which began forming ~7,500 cal yr BP. If artifacts were migrating downward through overlying components, they would be expected to occur as a palimpsest on the surface of Unit 2 in this area of the site. Instead, it appears that material is eroding from the surface of Unit 2 at this point, given the concentration of material at this stratigraphic interface. Thus, the presence of the single flake in Unit 3 is most likely associated with a subsequent Bolen occupation, evident from the diagnostic Bolen point which may have been displaced from Unit 3.

4.6.2.3 Evaluating the Evidence for Scavenging

In addition to bison, Hoffman and Rayl report deer, large cat, alligator, and turtle from the surface of Unit 2 (Hoffman 1983; Rayl 1974). Mammoth, deer, turtle, and muskrat remains were recovered in situ on Unit 2 within Block C in 2017. Multiple species in bone beds are common at other Paleoindian sites (Bement and Carter 2010; Boldurian 2008; Graham and Kay 1988; Halligan et al. 2016) and are expected at a watering hole in a relatively arid landscape. The presence of large and small scavenger species raises the possibility of carnivore damage or scattering to the mammoth carcasses. Hoffman and Rayl make no mention of carnivore damage on the bones, and no gnawing or markings are present on the mammoth bones recovered in Block C. Further, the Guest

Mammoth bone bed is confined to a ~6x4-m area, smaller than the 10x10-m area or greater expected from extensive scavenging of a single deceased animal (Haynes 1991, 2006). This bone-bed area is also comparable to those reported at other mammoth-kill sites (Graham and Kay 1988; Haury et al. 1959; Hemmings and Haynes 1969). The cut marks on mammoth bones from Hoffman's excavations were present on elements or portions of elements not typically targeted by scavengers and do not have the morphology of carnivore markings (Burke 2016; Haynes 1980, 1983; personal communication 2016). Trowels or other tools were not used during the bone-bed excavations (Rayl 1974: 16), rendering human agency of the cut marks by prehistoric people the most likely possibility.

4.6.2.4 Further Taphonomic Studies

Sites that contain only younger or older animals may indicate either natural die-offs or selective hunting, as these demographics are more likely to succumb to environmental pressures and are easier prey choices (Haynes 2016). The presence of two young mammoths at the Guest site thus presents an equifinality issue, as this mortality profile could represent either an active kill or a butchering event following the natural death of the animals. Based on element distribution, Rayl (1974) concluded that the mammoths died on their bellies at the edge of a small pond. Elephants rarely get mired in deep sediments, and they do not sleep on their bellies (Haynes 1988), behavioral evidence that the Guest mammoths appear to have died naturally. Further, it is unlikely for this posture to result from an active hunt and elephants are known to collapse on their bellies and die, particularly near watering holes, due to stress (referred to as sudden-death posture)

(Haynes 1988). Excavations in 2017 revealed that the Guest Mammoth site could represent the natural death of a mammoth mother during childbirth. Studies of modern elephant populations demonstrate a high death rate during calf birthing, for both calves and mothers (Sukumar 2003), and the majority of the mammoth calf remains were recovered from the pelvic area of the juvenile mammoth (Rayl 1974: 30). While the scattering of remains may indicate carcass processing on site, human butchering does not always result in extensive scattering of remains (Graham and Kay 1988; Hemmings and Haynes 1969; Johnson 2006). Hoffman (1983) did state that a stack of elements is present south of the main bone concentration, but did not elaborate. The bone flake recovered in 2017 may be evidence of butchery, but the provenience of the flake is questionable given its presence at the termius of Units 3 and 4, and it cannot be determined whether the flake is of mammoth bone.

4.6.3 Archaeological and Anthropological Significance

The evidence here suggests that the Guest Mammoth site was exploited by Paleoindian people. However, the degree of human involvement in the death of the Guest mammoths is difficult to resolve, and a lack of detailed information has led to confusion regarding the site (Smith 2019). Overall, the Guest assemblage is similar to other mammoth-exploitation sites that contain few artifacts, which are often non-diagnostic (Boldurian 2008; Brunswig 2007; Grayson and Meltzer 2015; Haury et al. 1959; Holliday et al. 1994; Johnson 2006; Joyce 2006). The expedient lithic assemblage and cluster of pressure flakes indicate sharpening of tools on-site. Additionally, taphonomic data, the possible bone pile, cut marks, and similarities with existing megafauna exploitation sites all support the inference that the Guest mammoths died naturally and were then butchered opportunistically. The evidence from the Guest site supporting opportunistic scavenging of the animal and not deliberate hunting lends support to the hypothesis that specialized big-game hunting was less common, or at least less formalized, in eastern Paleoindian groups than in the American West, perhaps due to the higher biological diversity and larger diet breadth in Eastern North America (Cannon and Meltzer 2004).

4.6.3.1 Cultural Affiliation

The projectile point from Guest is not diagnostic of Clovis forms, or any other common Paleoindian projectile type in the eastern United States. Points similar in size to the point from Guest are present at both Early and Middle Paleoindian sites in the American West (Boldurian 1999; Buchanan 2006; Stanford 1978) and South America (Flegenheimer et al. 2015). New OSL ages suggest the Guest Mammoth's can date no earlier than 13,735 cal yr BP. Further evidence on the extinction of megafauna in the America's demonstrates that the Guest Mammoth site cannot post-date 12,700 cal yr BP (Halligan et al. 2016; Grayson and Metlzer 2015; Surovell and Waguespock 2008). Given that Unit 2 may have remained exposed for ~1,000 years prior to burial, it is possible that at least part of the assemblage is the result of later groups that arrived on site, raising the possibility that post-Clovis groups exploited the Guest Mammoth bone bed. However, lengthy exposure of the bone bed is refuted by the observation that the bones recovered in the 2017 excavations are in good condition, with no splintering or dessication that would indicate prolonged, subaerial exposure of the Guest Mammoth bone bed. This lack of physical degradation to the mammoth bones indicates a rapid burial of the bone bed, further decreasing the likelihood that later humans interacted with the Guest mammoths.

4.7 Conclusion

The fact that the 1973 and 2017 excavations of the Guest Mammoth site came to largely the same conclusions is but more evidence that the site deserves further attention. Multiple working hypotheses still exist for the site and it remains possible that the mammoths were butchered shortly after they died or scavenged at a much later time. Several things are clear, however. The Guest mammoths are buried within a stratified cultural and sediment sequence. The mammoth bones and associated artifacts are lying on the surface of a relict, subaerially exposed watering hole. Taphonomic data from the site and information on the behavior of elephants, in addition to a lack of supportable alternate hypotheses for the presence of modified bones and lithic material in the bone bed, indicate the Guest mammoths died naturallyand were not the victims of a hunt. An OSL age below the bone bed demonstrates the Guest Mammoths cannot predate ~13,735 cal yr BP. Extensive evidence on megafaunal extictions in the Americas demonstrate that mammoths died out by 12,700 cal yr BP, providing a terminus ante quem age for the Guest mammoths, but not necessarily the archaeological material which could have been deposited several millenia after the mammoths. The presence of an Early Archaic Bolen artifact above Unit 2 provides a useful constraint on the age of the Guest Mammoths and associated artifacts, indicating that the site is likely the result of Paleoindian scavenging of the mammoth carcasses. I estimate the age of the Guest mammoths between 13,730 cal yr BP and 12,700 cal yr BP, using the OSL standard dedviation and empirical extinction date of megafauna as brackets. The ultimate age of the artifacts is unclear and more testing of the site may resolve this, particularly if a deeper stratigraphic sequence is present toward the center of the pond. However, OSL dating of Unit 2 demonstrates that the mammoths died by ~12,700 cal yr BP, providing another age on the extiction of megafauna in the Southeast region. Following 12,700 cal yr BP, seasonal flow of the Silver River began, leaving erosional features on the surface of Unit 2 and contributing to the deposition of Unit 3. By ~8,000 cal yr BP, a series of organic-rich silty sediments signals the start of the perennial flow of the Silver River that continues to this day.

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CHAPTER V

CONCLUSIONS

Data presented in this dissertation provide additional data from two more sites for consideration by Paleoindian scholars when making hypotheses about the lifeways of the lower Southeast's first inhabitants.

5.1 Characterizing Suwannee Technological Strategies

Geoarchaeological testing and excavations of the Ryan-Harley site demonstrate that the site contains a discrete occupation of Suwannee point makers. Geologic data show that the Suwannee occupants of Ryan-Harley camped briefly at the site during a time when the Wacissa River basin was an inland dune field. The occupation at Ryan-Harley likely occurred after the beginning of the Younger Dryas (~12,900 cal yr BP). During this period, evidence gathered as part of this project suggests that Suwannee people were faced with uncertain environmental conditions, including changing fauna and flora, fluctuations in sea level, and a cooler, drier climate. Trends in the Suwannee artifact assemblage from Ryan-Harley reflect what might be adaptations to this uncertainty. The toolkit is versatile, standardized, and economized, with a diverse assemblage of unifacial tools and curated bifaces. The assemblage appears to represent retooling behavior, with Suwannee people preparing and using late stage bifaces, producing and re-sharpening unifacial tools, and discarding exhausted unifaces. Core-reduction strategies inferred from the debitage assemblage indicate that bifaces served as both cores for informal-tool production as well as the production of diagnostic Suwannee projectile points. The use of bifaces as cores and reliance on unifaces indicates an emphasis on a portable, adaptable toolkit.

5.2 The Relationship of Late Pleistocene Fauna and Humans in Florida

Both Ryan-Harley and Guest Mammoth provide insights into the exploitation of late Pleistocene fauna by prehistoric people. At Ryan-Harley, the presence of now extinct and extirpated fauna in direct association with the Suwannee toolkit resulted in confusion regarding the age of Suwannee and the timing of Pleistocene extinctions. These above data indicate that it is likely, given the exposed, relict nature of the Wacissa River basin throughout the late Pleistocene, that Pleistocene faunal elements were ambient on the landscape when Ryan-Harley was inhabited by Suwannee point makers. At the Guest Mammoth site, it appeards that prehistoric humans did, in fact, butcher the Guest mammoths following their natural death. This event occurred ~12,700 years ago, and the opportunistic butchering indicated by the site's lithic and faunal assemblage lend further support to the hypothesis that big-game hunting was not as specialized of an activity in the Eastern United States when compared with the American West. The OSL age of 12,700 cal yr BP also provides further support for the extinction of Late Pleistocene fauna at the onset of the Younger Dryas.

5.3 The of the Florida Paleoindian Site Geoarchaeology

The search for more discrete Paleoindian contexts in the lower Southeast has been confounded by a geological problem. Environmental conditions were simply not conducive to the rapid burial of sites in much of the eastern United States. Surficial exposure of the region to aeolian processes for much of the late Quaternary stymied organic preservation also. These data demonstrate that the most important factor in determining the location of a site is the presence of reliable, surficially available freshwater during the late Pleistocene. The search for the first people to inhabit the lower Southeast must consider the fact that the landscape was overall, not hospitable to long-term human occupation. This makes both the Ryan-Harley and Guest Mammoth sites unique in that they represent aspects of hunter-gatherer life that are often ephemeral; a short-term camp and opportunistic scavenging event, respectively. These sites demonstrate that Paleoindians in the lower Southeast were highly mobile, maintained diverse but curated toolkits, and maintained a subsistence strategy best characterized as opportunistic foraging. Future explorations into the earliest Southeasterners will rely heavily on submerged contexts. Geoarchaeological studies have unequivocably demonstrated that the best stratigraphic records in the Southeast are found in rockshelters or underwater. It is worth noting that while rockshelter data are reliably thorough and comprehensive, underwater contexts can vary in their utility. As underwater research is significantly more of a logistical and financial burden, it must be carried out with far more attention to the contribution potential sites can offer to the advancement of our archaeological knowledge. The results of my dissertation indicate that work is best targeted toward deep karst features within river basins. Shallow features may contain extensive archaeological evidence but are subject to the inherent geoarchaeological limitation of much of the region that is the arid, sediment starved landscape of the late Pleistocene Southeast. I feel that this dissertation should end on a positive note, reflecting my excitement about what the future holds for our field.

Fortunately for me, many new students of submerged prehistory have recently begun to take up the challenges of this work, and their efforts will no doubt push our discipline even further in directions that we cannot begin to imagine.

APPENDIX A

CHAPTER II FIGURES AND TABLES

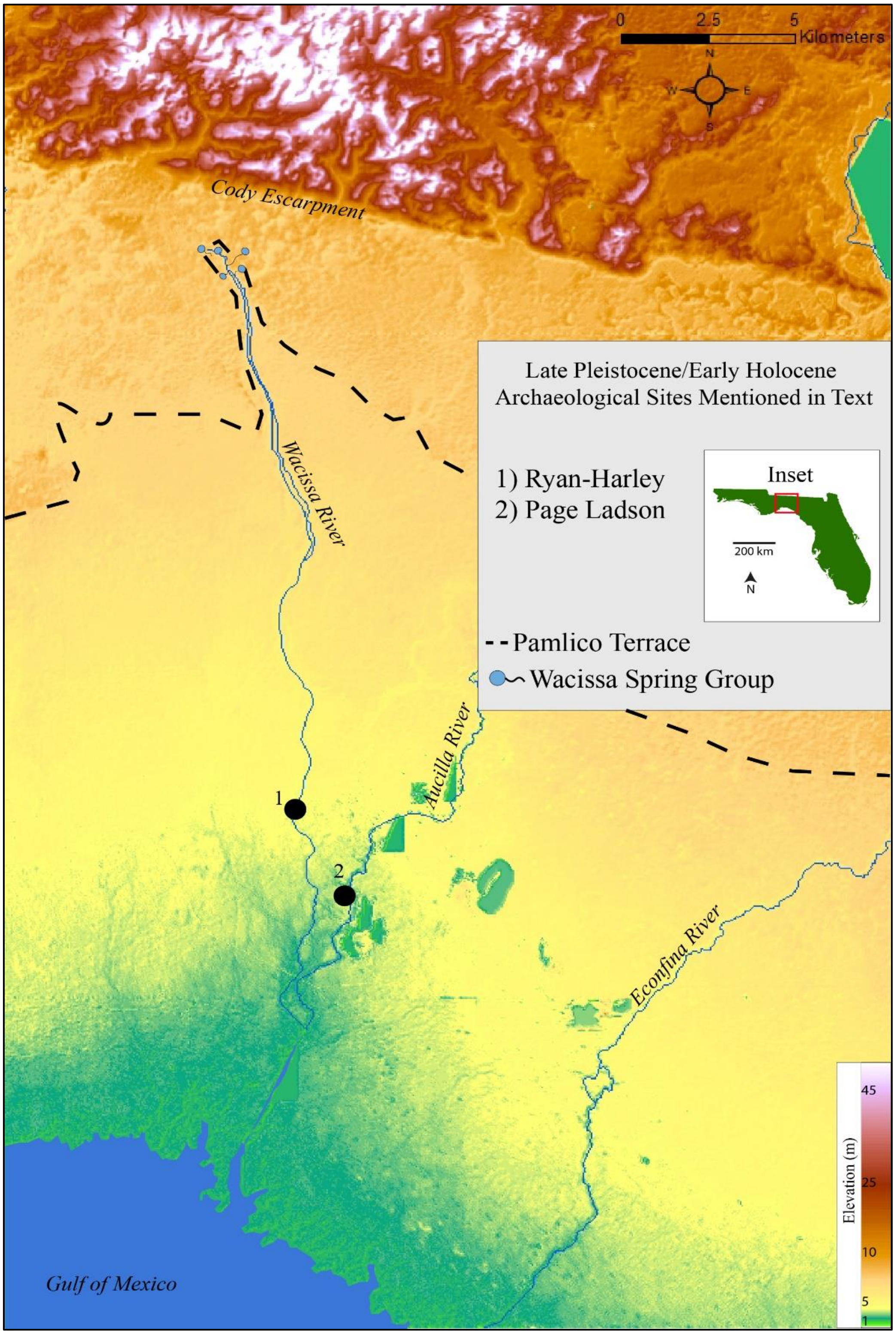

Figure 1: Location of geographic features and archaeological sites mentioned in the text

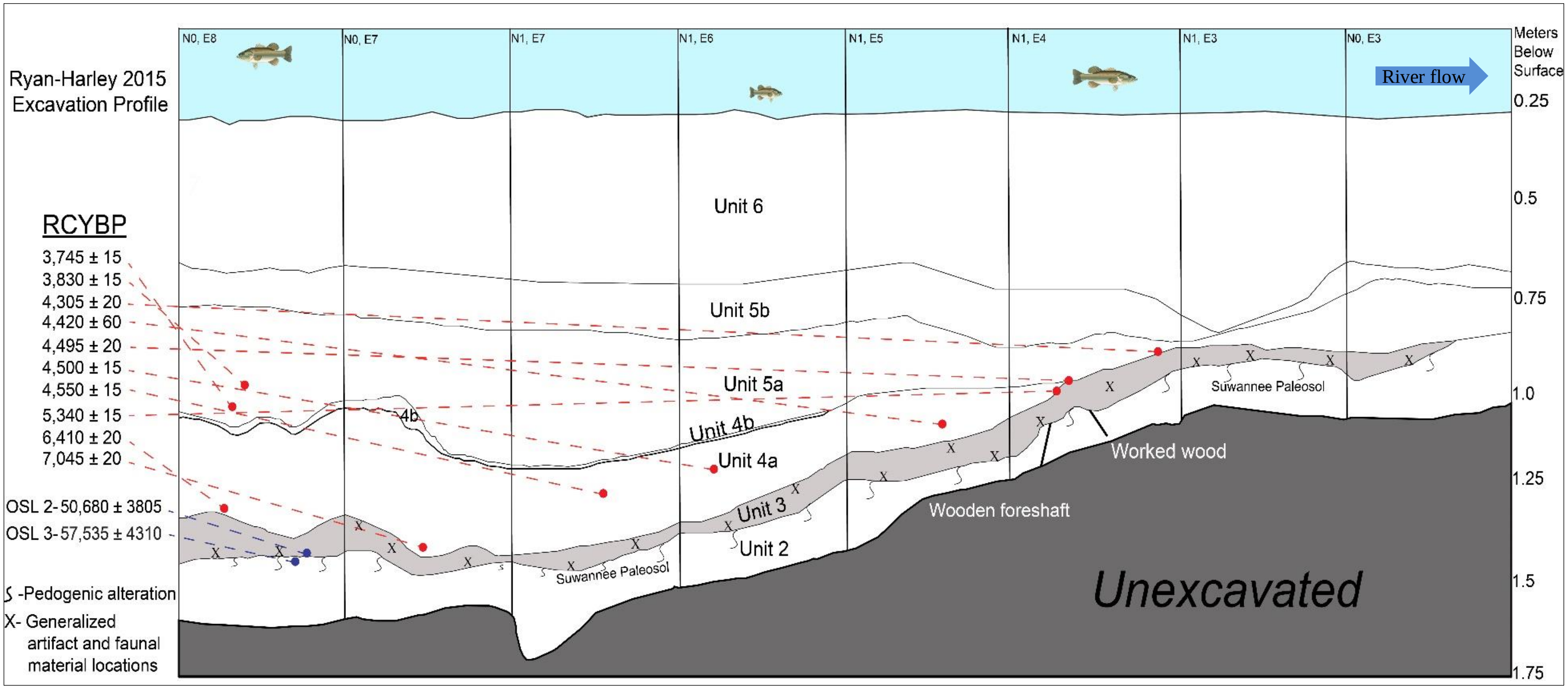

Figure 2: Lithologic units and location of absolute ages at the Ryan-Harley site. Profile from 2015 excavations. View is looking toward island (southeast), river flows to right of image.

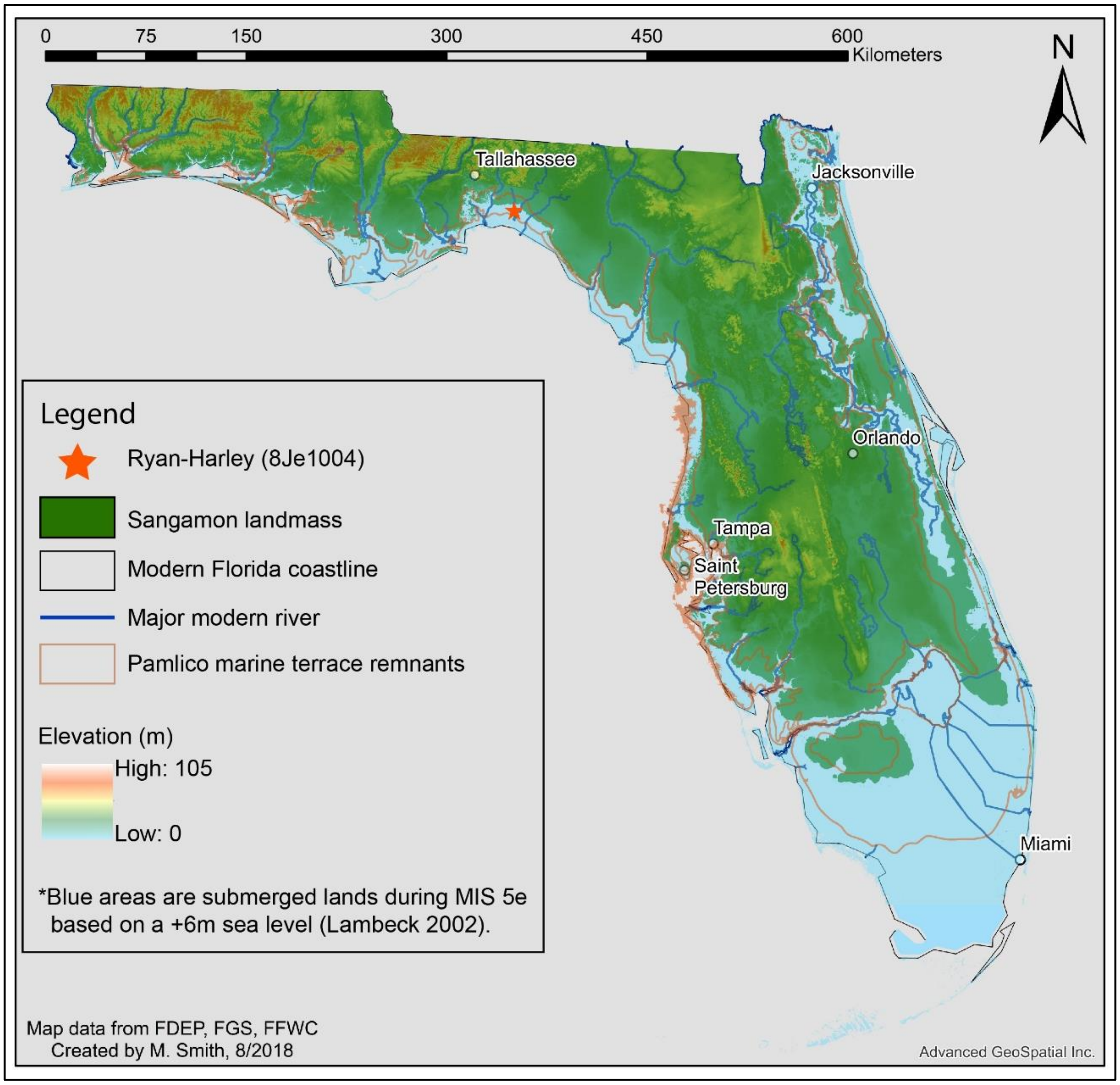

Figure 3: Florida landmass during Sangamon Interglacial (~130,000-115,000 years ago), MIS 5e. Ryan-Harley is ~5 km offshore, under ~2 m seawater.

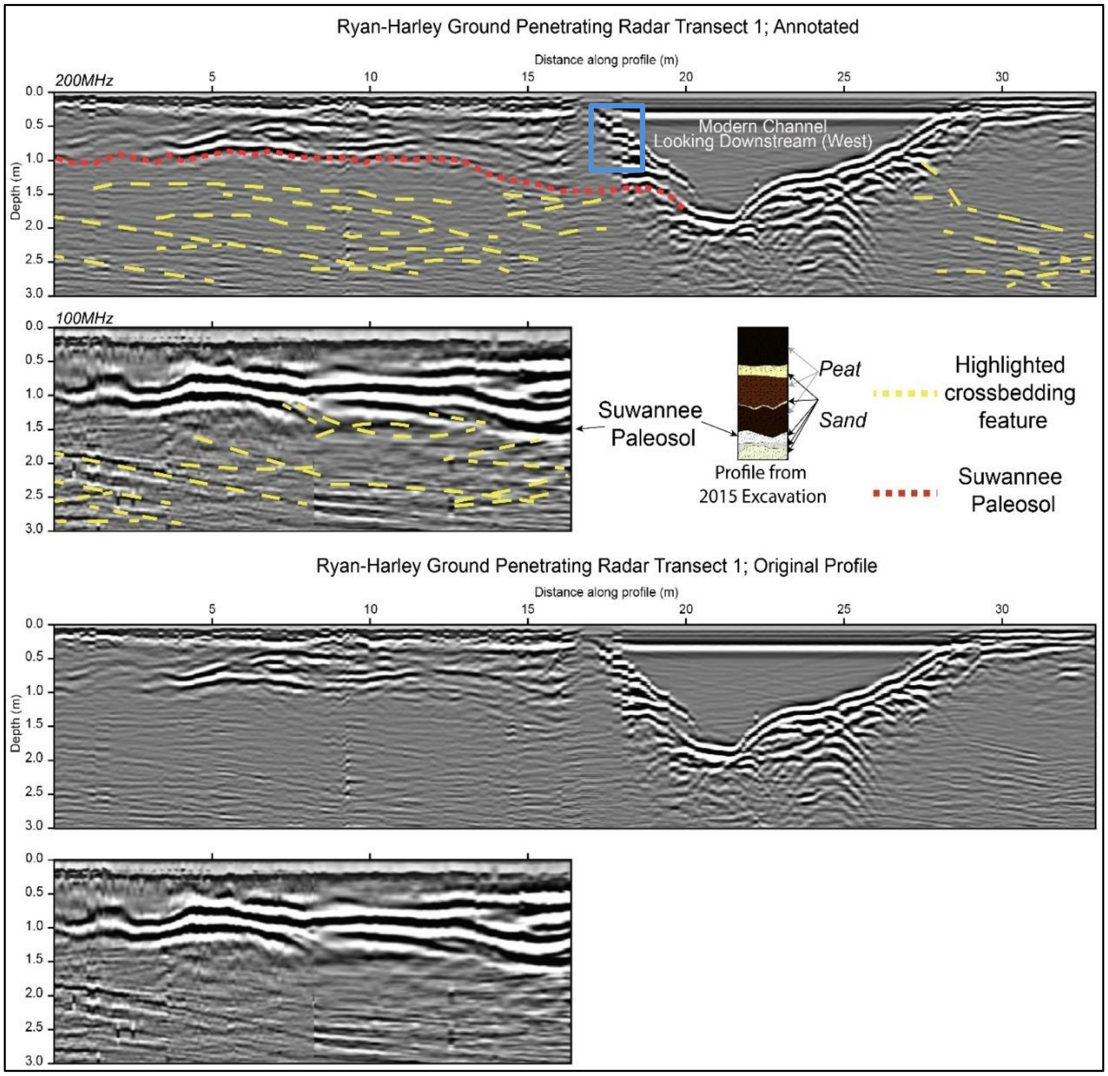

Figure 4: GPR transect 1 imagery. Above profile is annotated to show crossbedding and the Suwannee occupation surface. Bottom image is unaltered GPR profile. Blue box is 2015 excavation area. View is looking downstream (southwest).

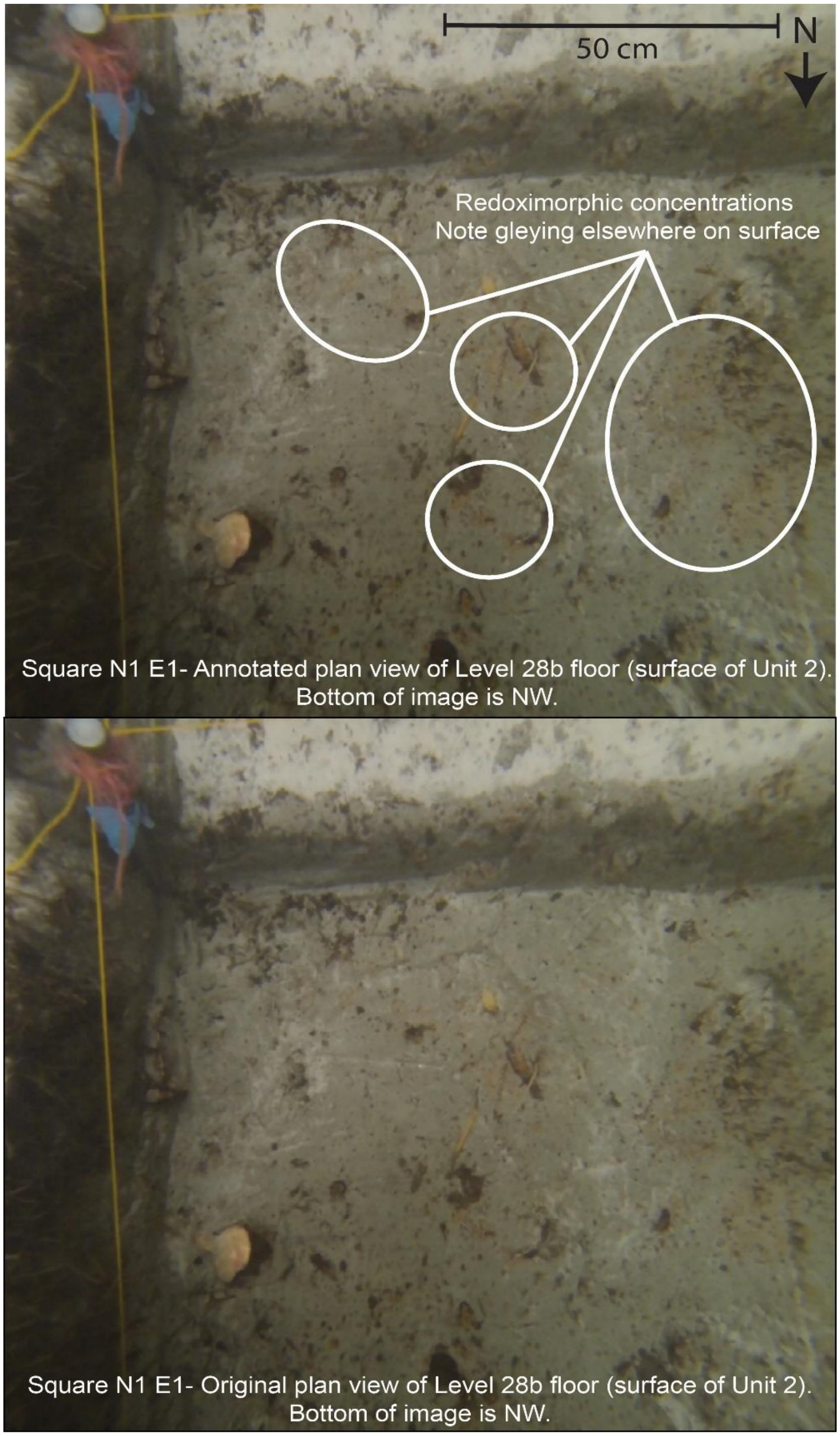

Figure 5: Redoximorphic features on the surface of Unit 2 (Suwannee Paleosol) indicating fluctuating groundwater tables. The white sand on the unit at the top of the screen is Unit 3. Top of each image is south, view is from channel looking toward island.

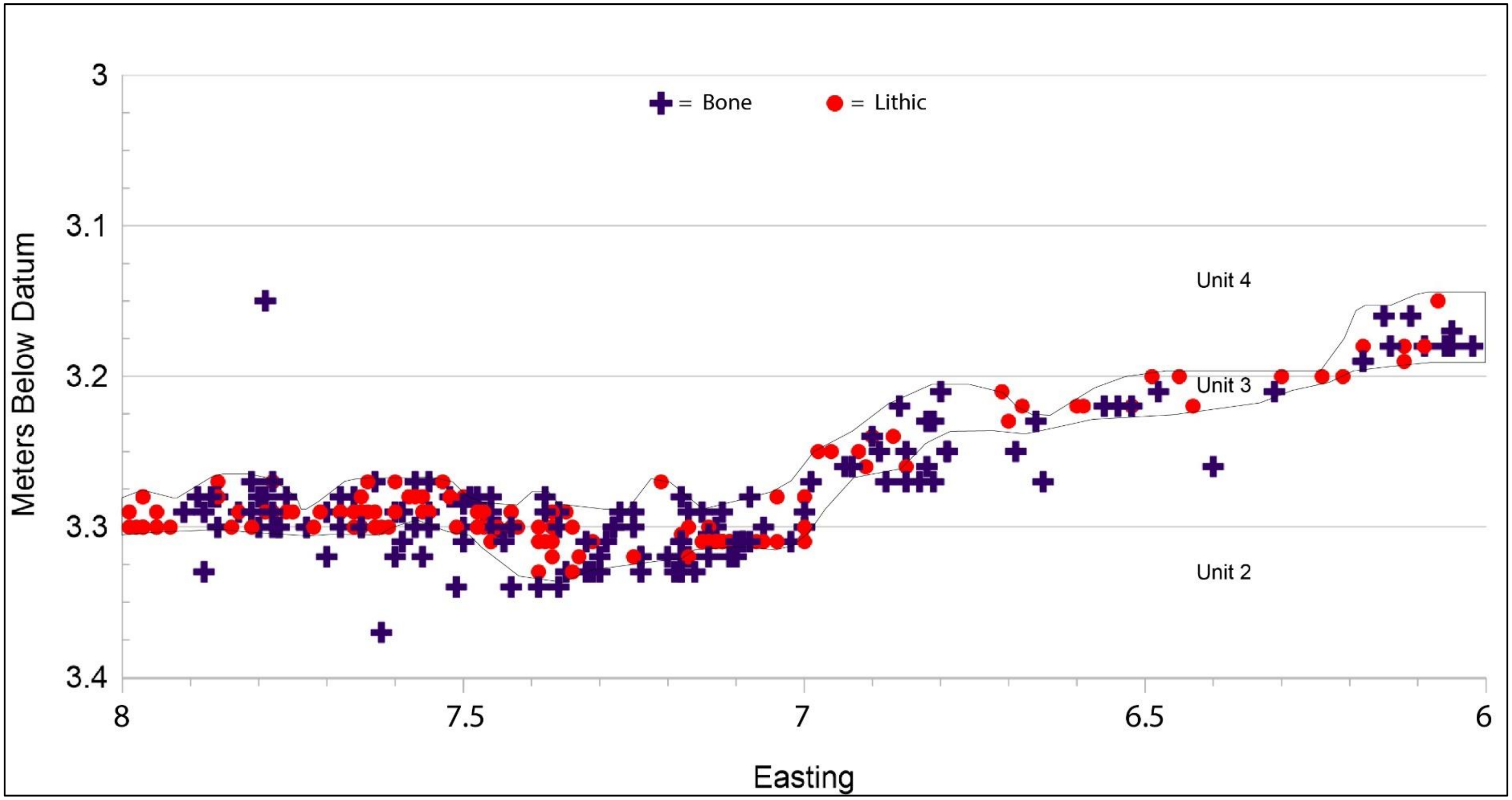

Figure 6: Vertical distribution of lithic and bone material in relation to geologic units N1 E7 and N1 E8 from 2015 excavation block at Ryan-Harley. View is looking toward island (southeast), river is flowing toward right of image.

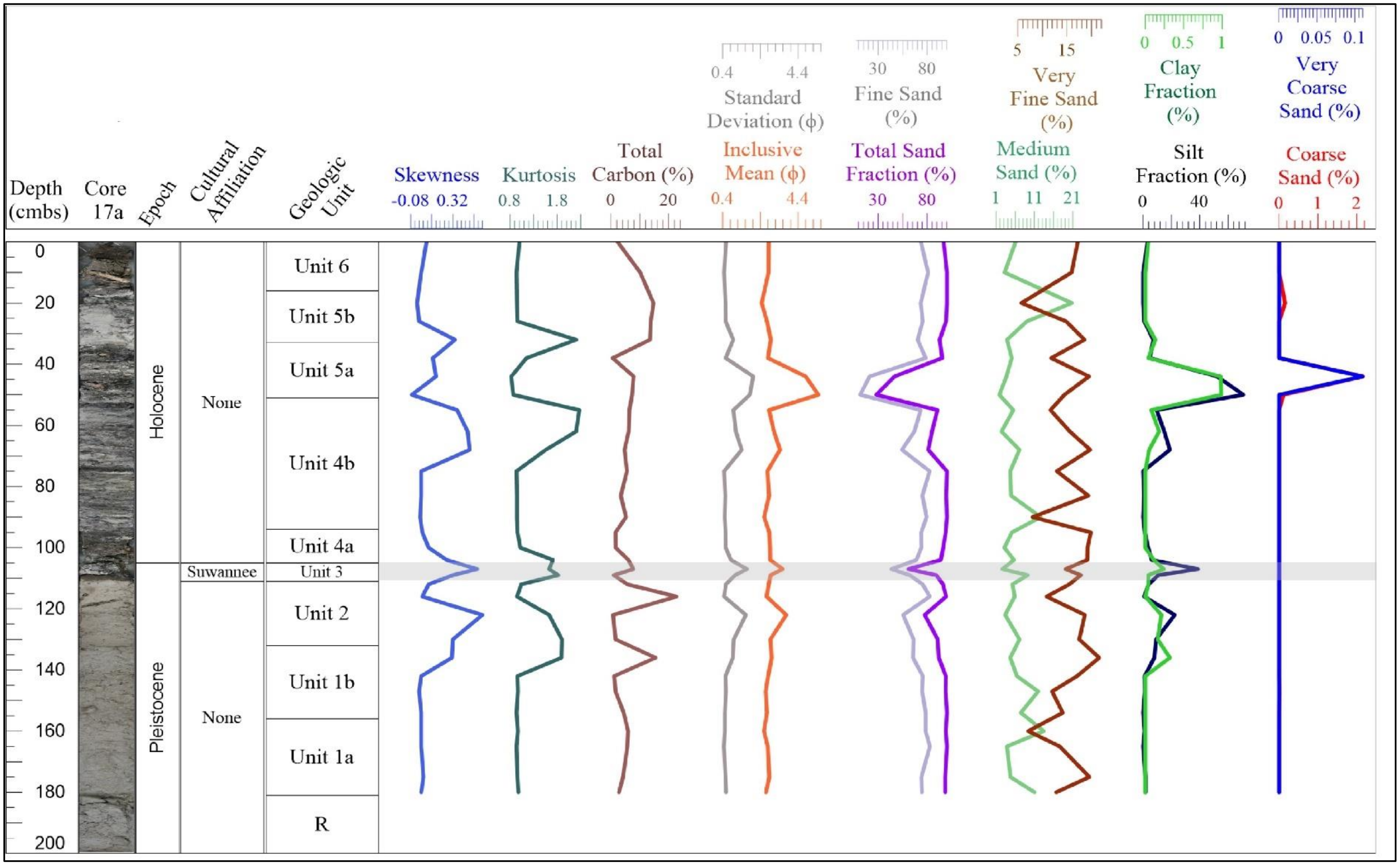

Figure 7: Sedimentological and soil characterization data obtained from Core 17a at Ryan-Harley.

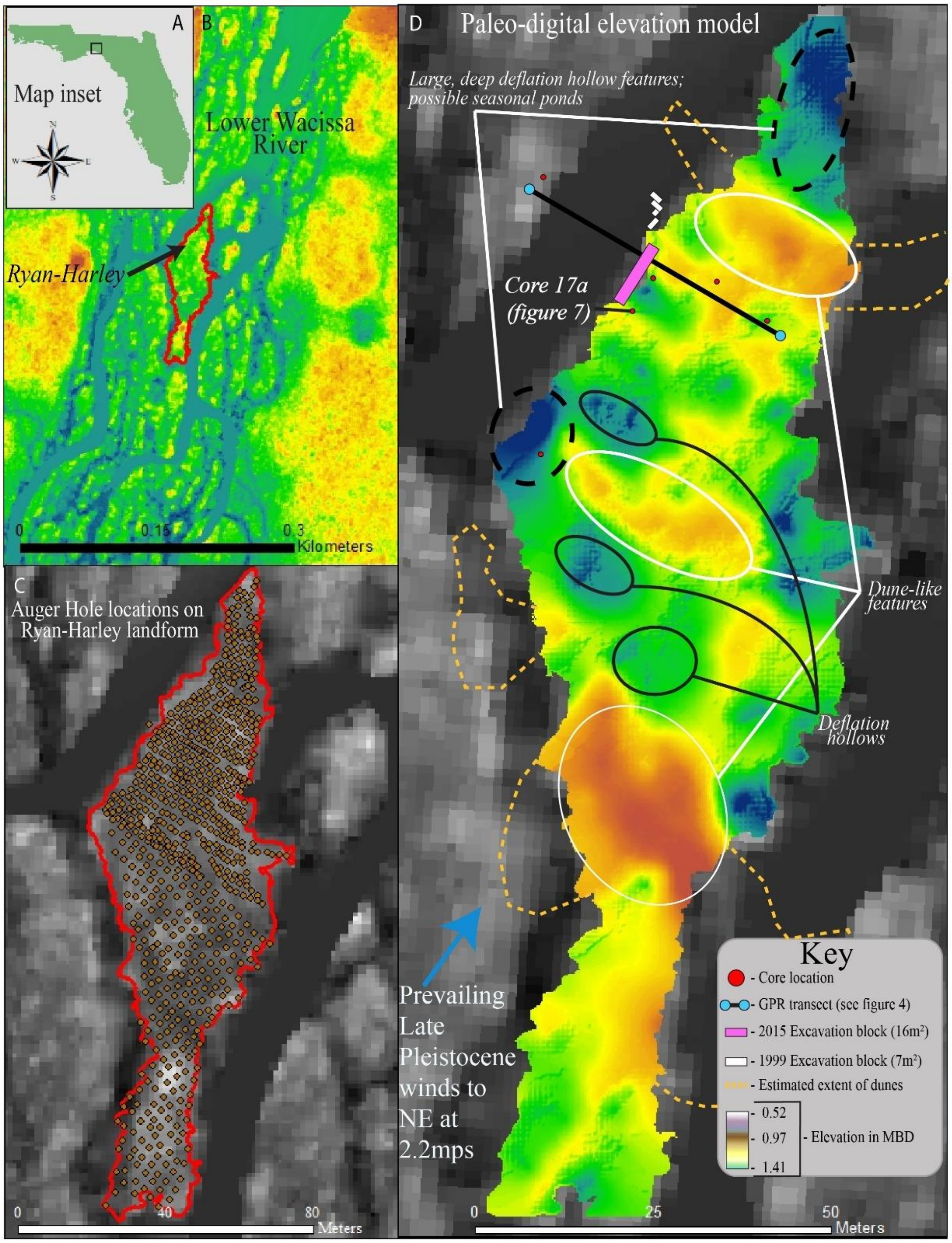

Figure 8: A, map inset; B, LiDAR-derived DEM showing Ryan-Harley site within the anastomosing section of the Wacissa River; C, locations of auger holes placed on Ryan-Harley landform to derive paleo-topography; D, paleo-topographic DEM of Suwannee surface at Ryan-Harley, including map of geologic and archaeological tests. North is at the top of all images.

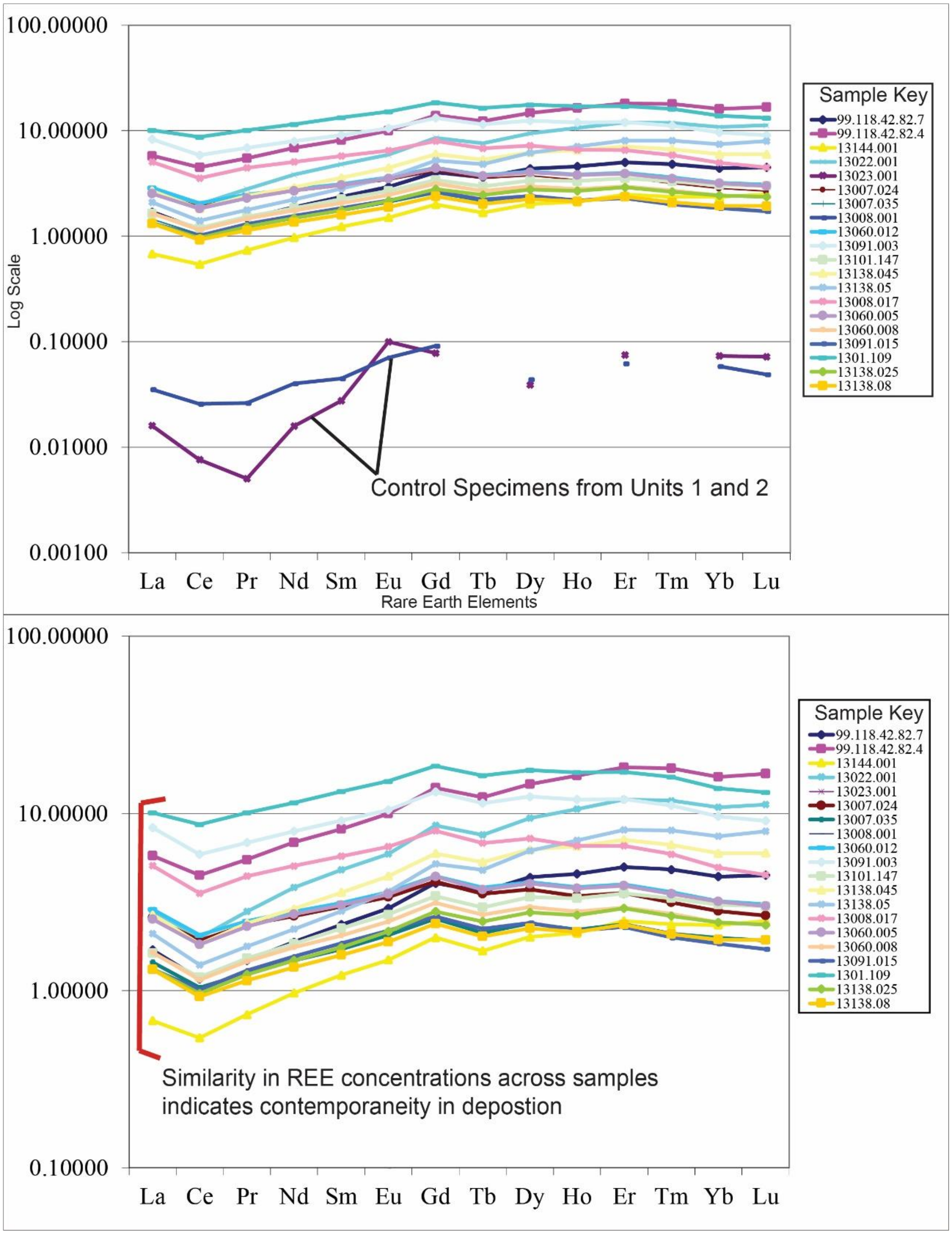

Figure 9: Results of Rare Earth Element analyses; A, all specimens submitted for analyses; B, specimens submitted from the Suwannee component (Unit 3).

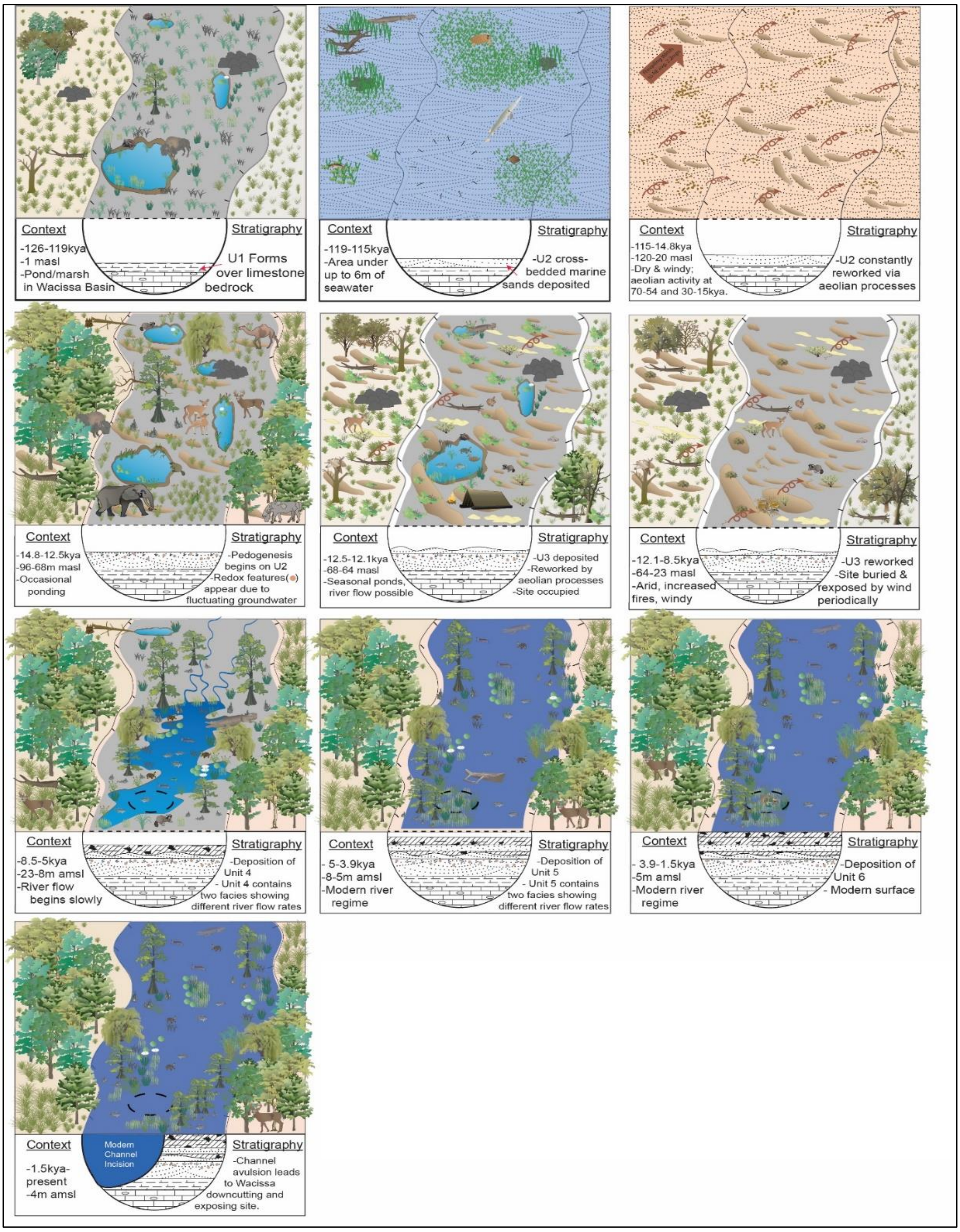

Figure 10: Illustrated geologic history of the Ryan-Harley site. Fauna shown are present in faunal assemblages reported in Dunbar et al. 2006 as well as in the 2015 excavations. Flora type and density are derived from paleoenvironmental records published in Perrotti 2018. Statigraphic cross section patterns follow USGS convention. Sea level based on Joy 2019.

Lab No	Sample No.	Idenitification	δC	Modern Fraction	δC	^{14}C age	**Calibrated Median Age (IntCal 13)**
UCI-153345	RH-C14-2015-4	*Taxodium distichum*	-25.6 ± 0.1	0.6275	-372.5 ± 1.0	3745 ± 15	4130 BP
UCI-153346	RH-C14-2015-8B	*Taxodium distichum*	-25.5 ± 0.1	0.6209	-379.1 ± 1.0	3830 ± 15	4204 BP
UCI-153348	RH-C14-2015-11	Monocot/herbaceous dicot	-	0.5852	-414.8 ± 1.3	4305 ± 20	4887 BP
Beta-132151*	-	-	-	-	-	4420 ± 60	4911 BP
Beta-123575*	-	-	-	-	-	4590 ± 70	5091 BP
UCI-190033	RH-07-1	Culturally modified wood	-27.8 ± 0.1	0.5716	-428.4 ± 1.1	4495 ± 20	5097 BP
UCI-163513	RH-C149-23-15-4B	Charcoal	-	0.5712	-428.8 ± 1.0	4500 ± 15	5101 BP
UCI-163514	RH-C149-23-15-4A	Charcoal	-	0.5677	-432.3 ± 1.0	4550 ± 15	5331 BP
UCI-198104	RH-C14-17b-1	Wooden foreshaft/point	-27.9 ± 0.1	0.5144	-485.6 ± 0.9	5340 ± 15	6151 BP
UCI-153344	RH-C14-2015-2	*Taxodium distichum*	-25.2 ± 0.1	0.4502	-549.8 ± 0.9	6410 ± 20	7330 BP
UCI-153347	RH-C14-2015-10	*Quercus sp.*	-29.3 ± 0.1	0.4160	-584.0 ± 0.9	7045 ± 20	7893 BP

Table 1: All radiocarbon ages obtained from the Ryan-Harley Site. Asterisk indicates 1999 excavation ages, see Dunbar et al. (2006); all others ages are from this study.

Lab No.	Sample No.	Aliquots (dose calculations/original aliquots measured)	Grain size (um)	Equivalent dose (Gray)	Over-dispersion %	H_20%	Cosmic dose rate	Dose rate	OSL Age (years BP)
BG-4363	RH OSL 2	35/35	150-100	22.93 ± 0.92	10 ± 2	40 ± 5	0.18 ± 0.018	0.45 ± 0.03	50,680 ± 3805
BG-4364	RH OSL 3	34/35	250-150	20.18 ± 0.72	17 ± 2	40 ± 5	0.18 ± 0.018	0.35 ± 0.02	57,535 ± 4310

Table 2: OSL ages obtained from Ryan-Harley site.

APPENDIX B

CHAPTER III FIGURES AND TABLES

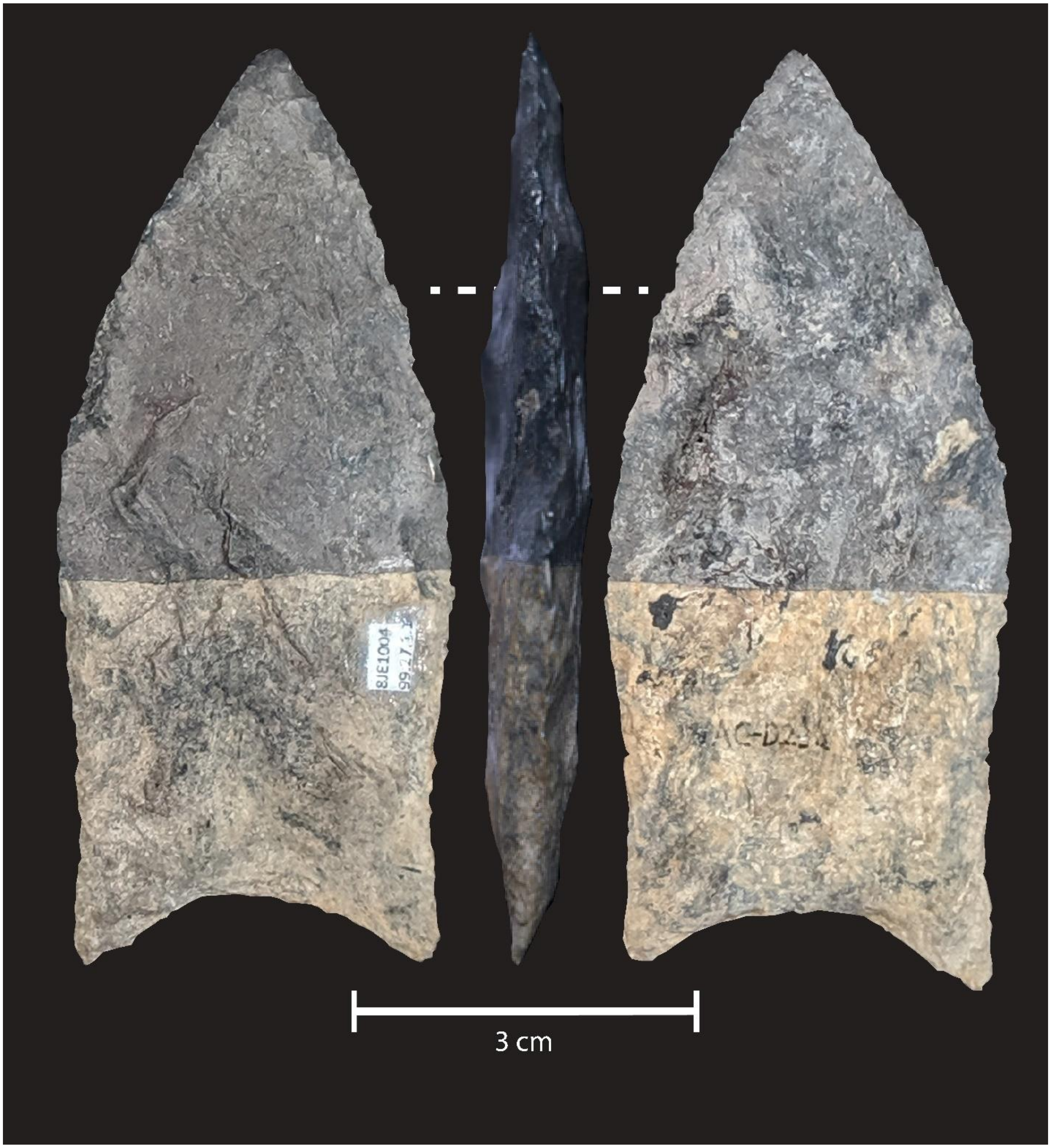

Figure 11: Suwannee point recovered from Ryan-Harley site. The tip was found out of context, and the base was found in-situ during the 1999 excavation.

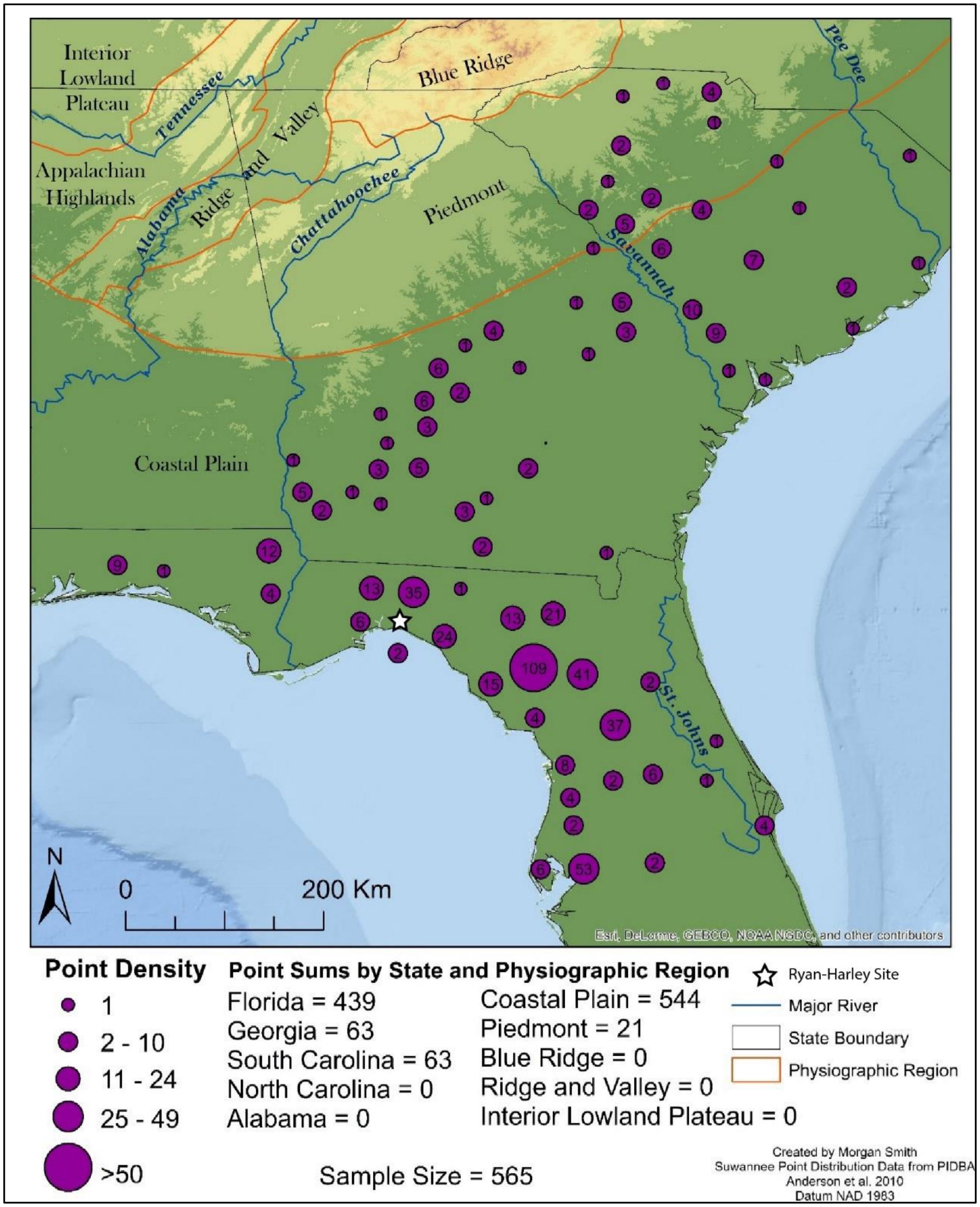

Figure 12: Distribution of Suwannee points in the lower Southeast United States.

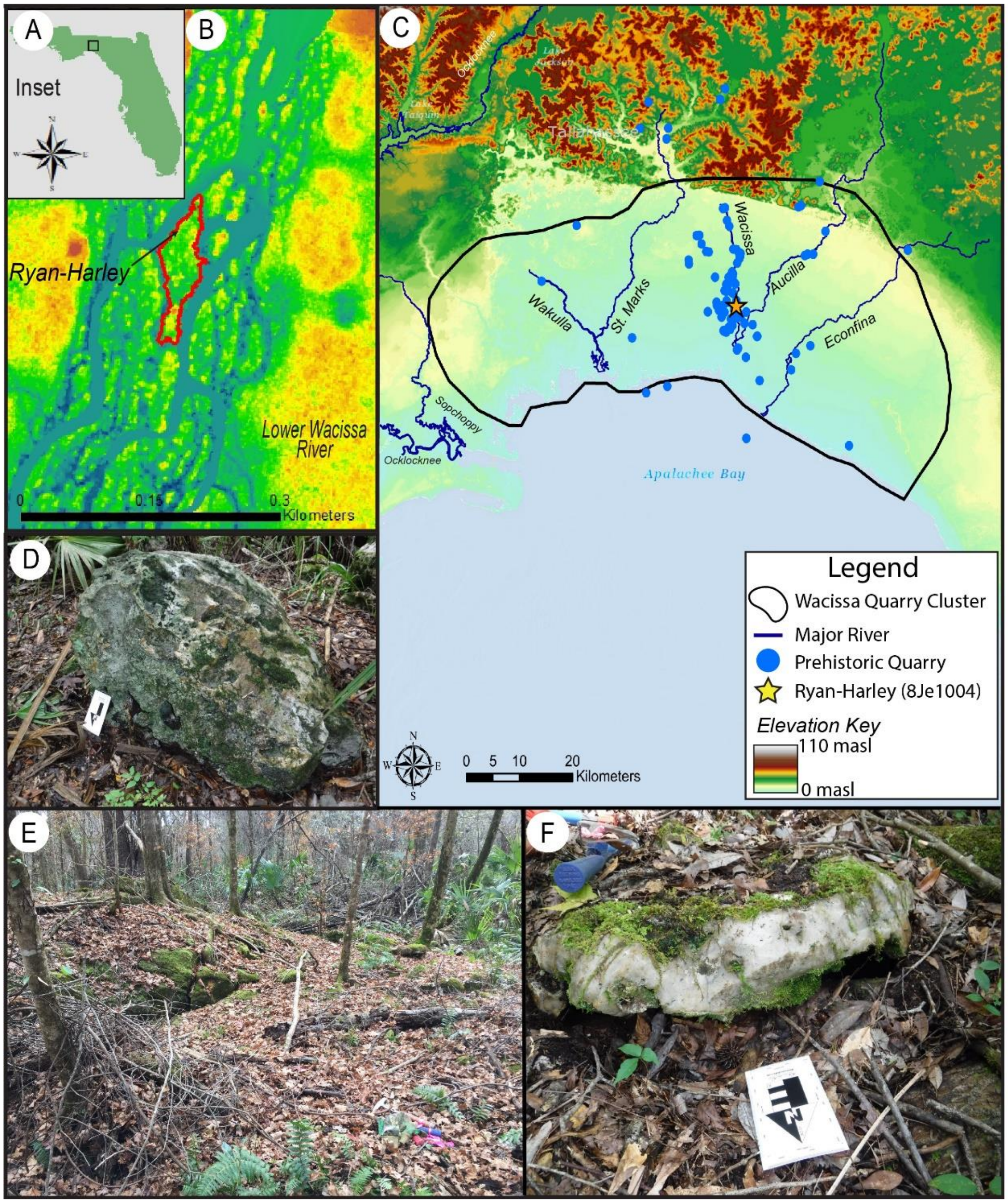

Figure 13: A, inset of map area. B, location of Ryan-Harley within the anastomosing section of the Lower Wacissa River. C, map of site region, including major rivers and confirmed prehistoric quarry sites. D, large boulder of chert ~8 km from the Ryan-Harley site. E, typical outcropping of Suwannee chert-bearing limestone formation in the Wacissa River Basin. F, outcrop of high-quality material ~6 km from Ryan-Harley.

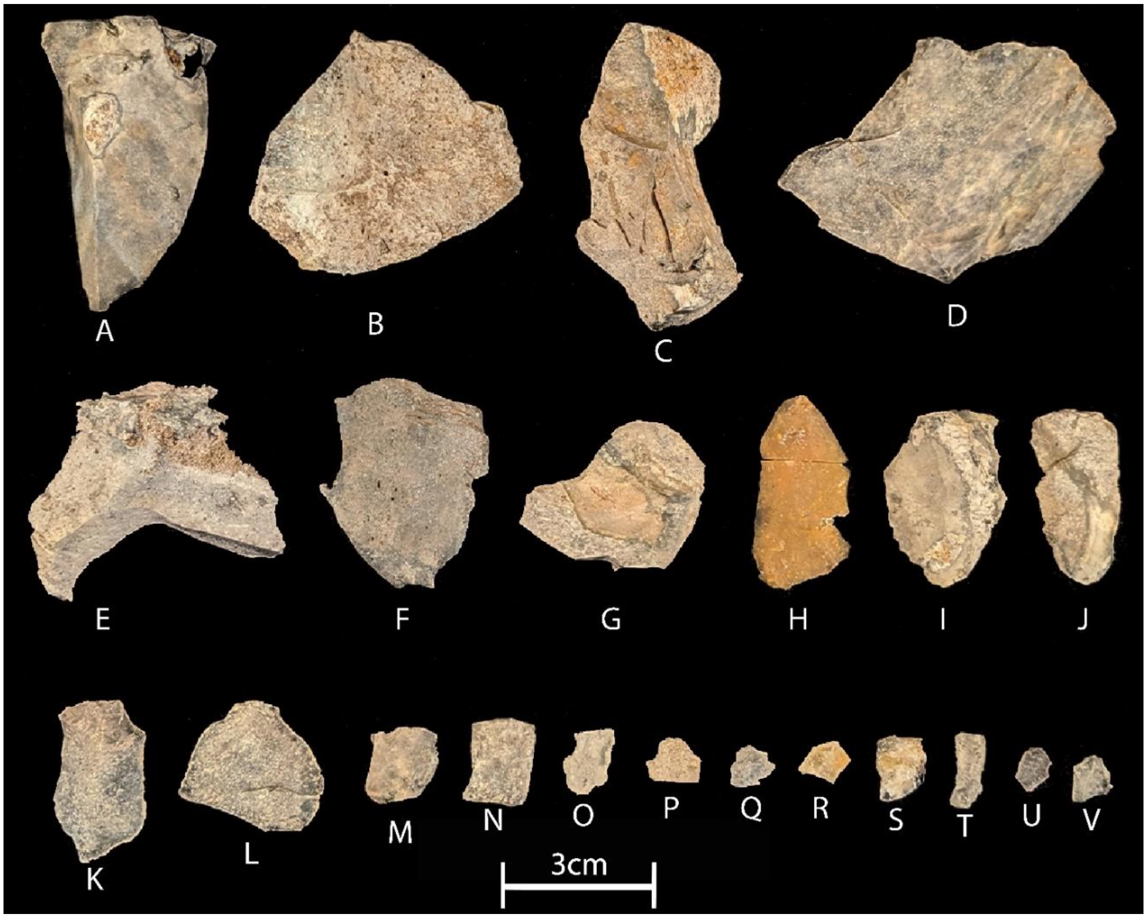

Figure 14: Representative debitage from Ryan-Harley site. A-F, core-reduction flakes; G- bipolar flake; H-L, bifacial-thinning flakes; M-0, platform-preparation flakes; P-T, edge-retouch flakes; U-V, scraper-retouch flakes. Specimens H and S are on non-local material, St. Marks Chert and Quartzite respectively. All others cf. with local Suwannee chert.

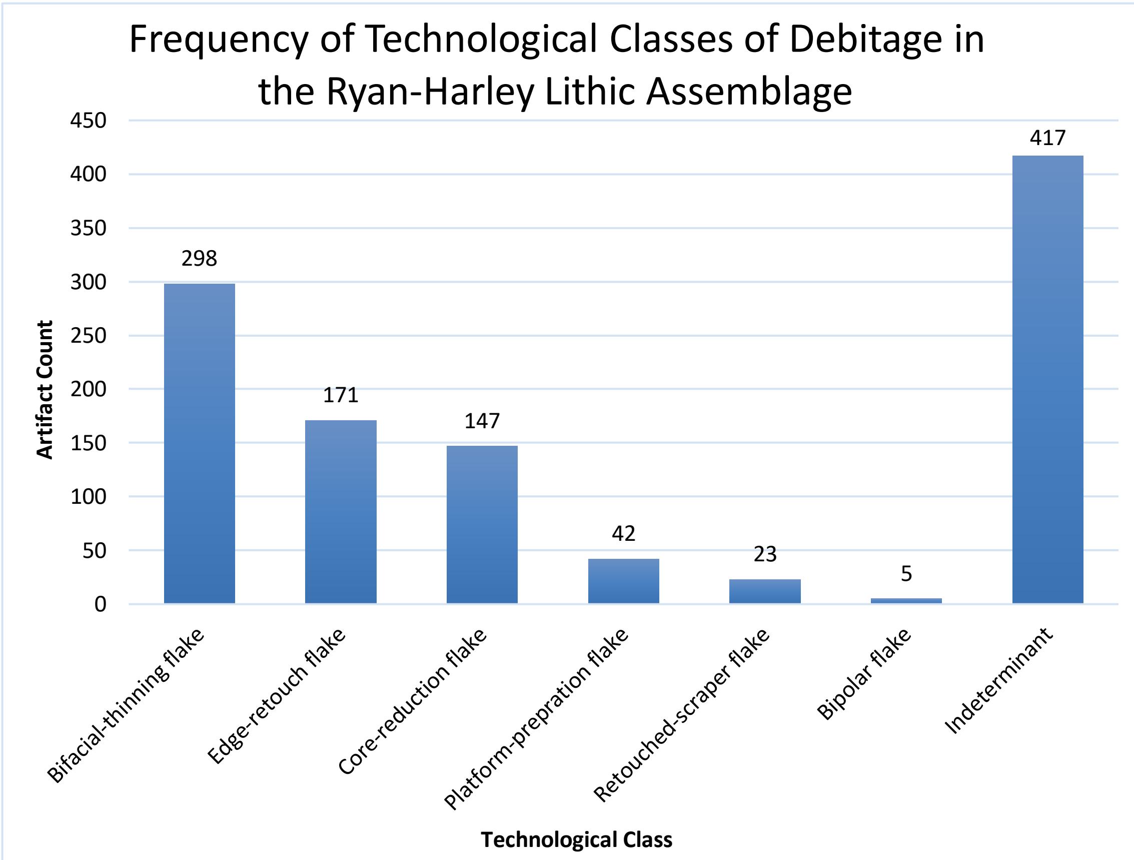

Figure 15: Bar chart of debitage technological classes present in the Ryan-Harley lithic assemblage.

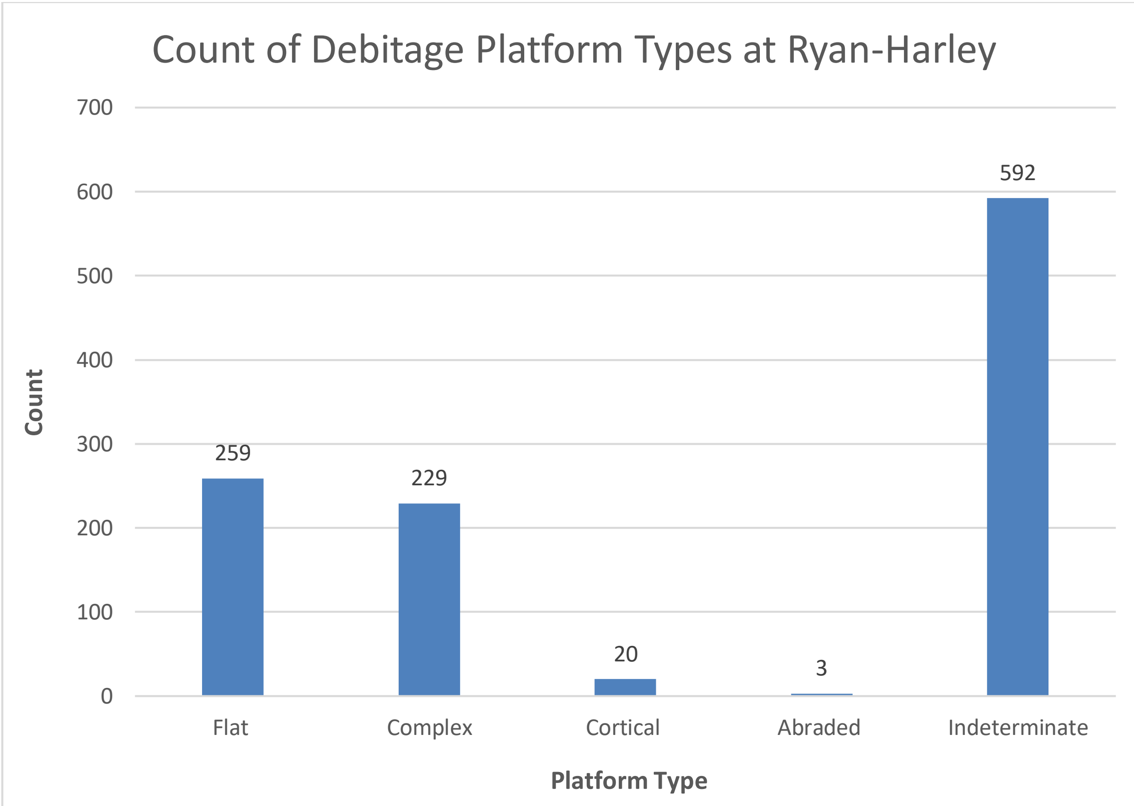

Figure 16: Bar chart of debitage platform types present in the Ryan-Harley lithic assemblage.

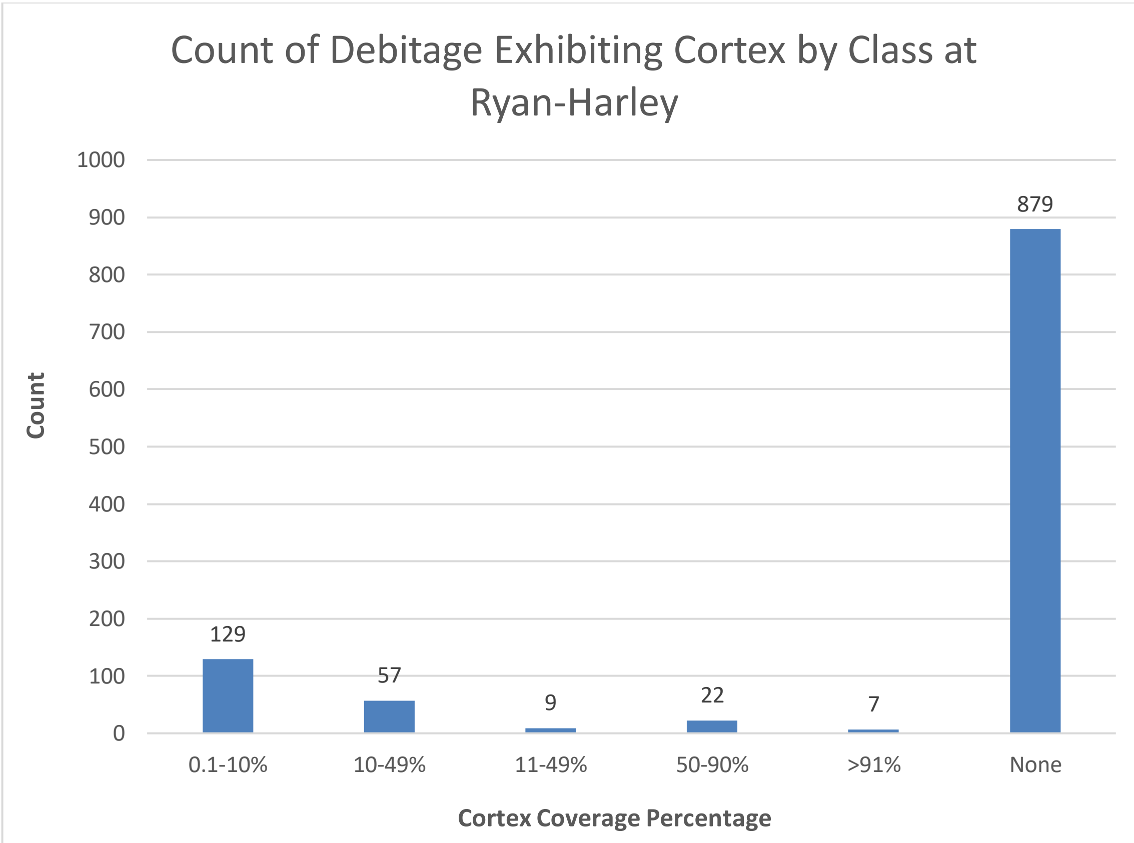

Figure 17: Bar chart of debitage cortex coverage present in the Ryan-Harley lithic assemblage.

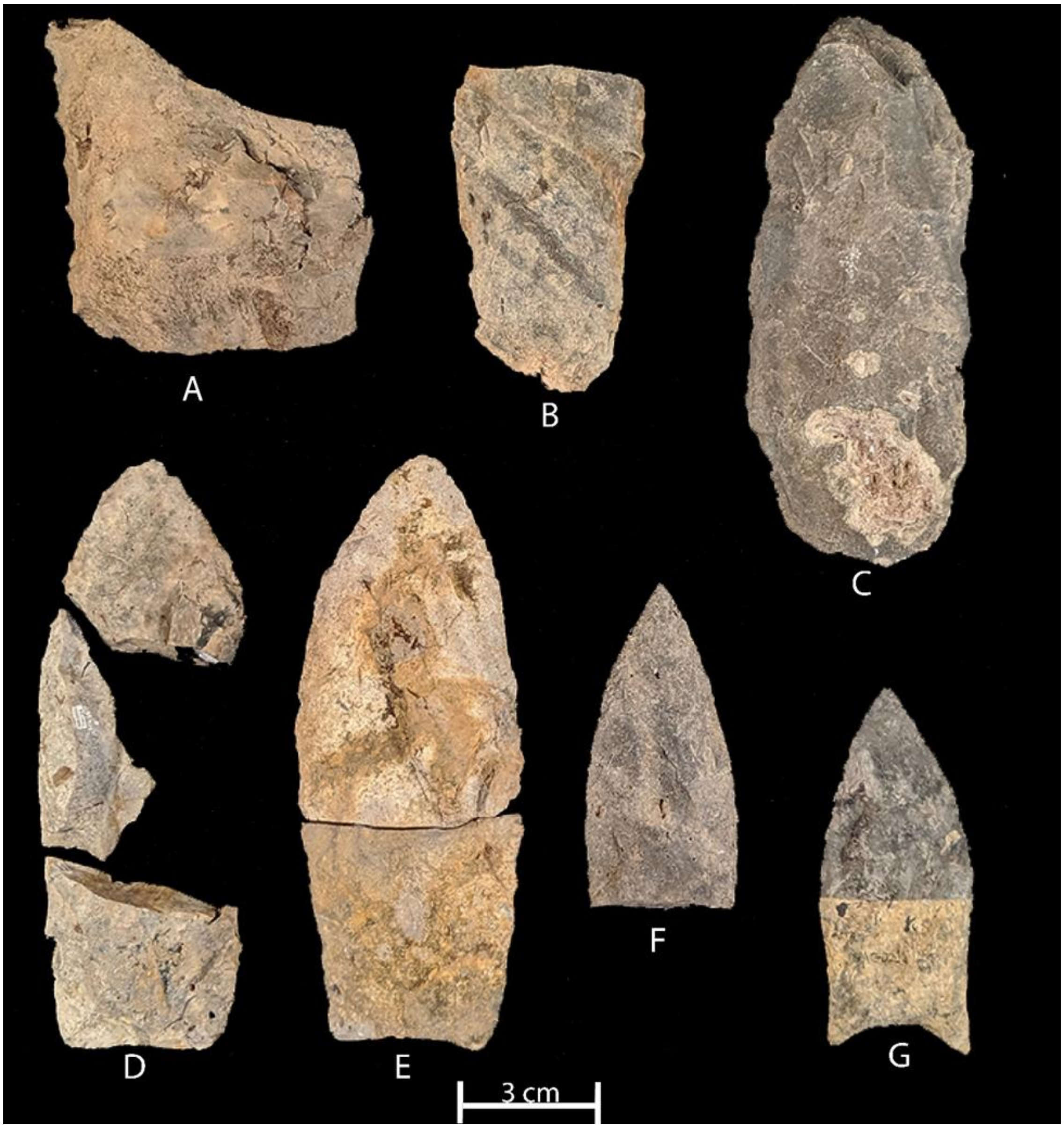

Figure 18: Representative bifaces from the Ryan-Harley site. A, stage 1 biface; B-C, stage 2 bifaces; D-E, stage 3 bifaces; F-G, stage 4 bifaces. Artifact E was refit from two in-situ fragments. Artifact D does not refit.

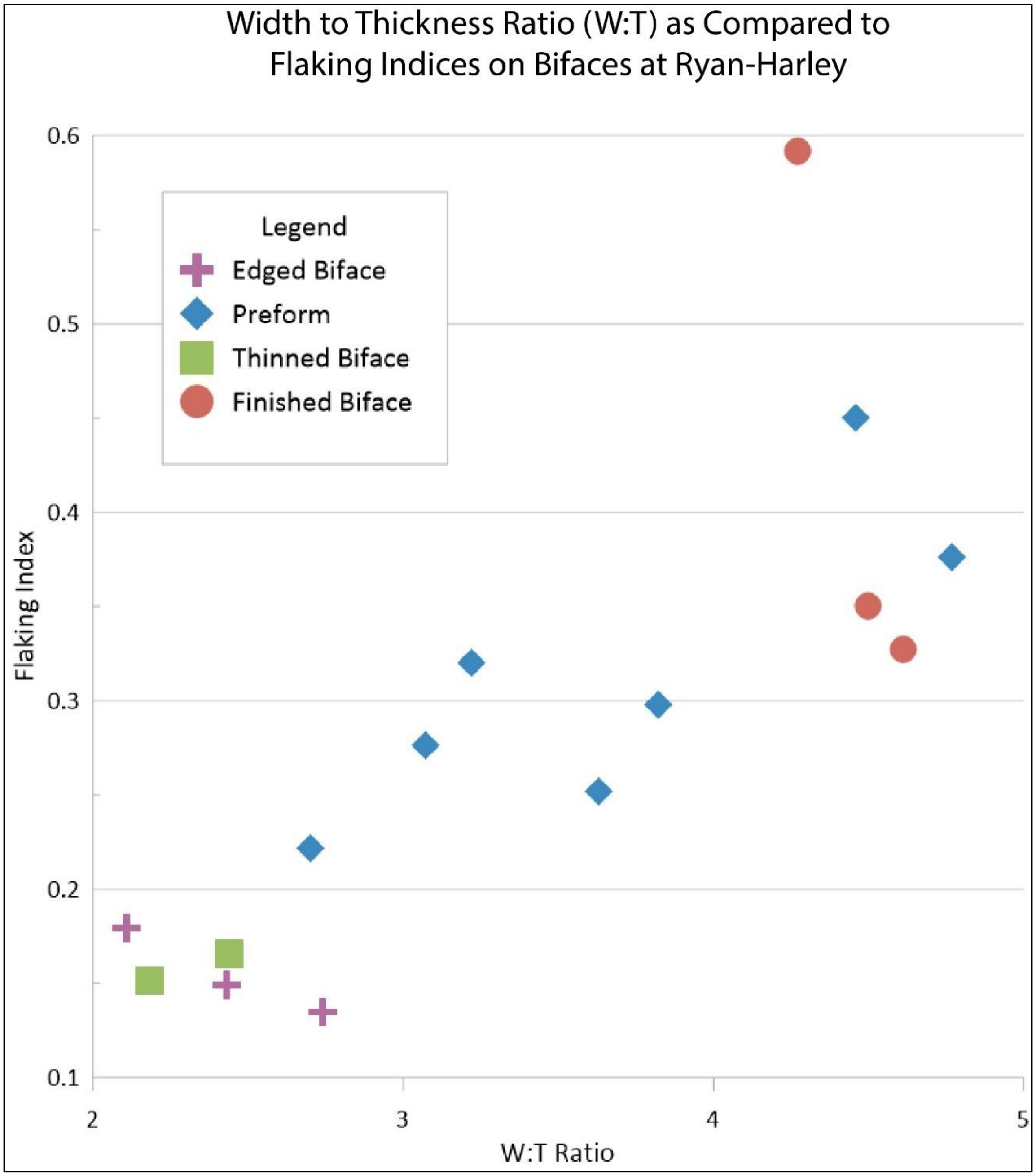

Figure 19: Flaking indices compared with width to thickness ratios of bifaces from the Ryan-Harley site.

Figure 20: Representative formal unifaces from the Ryan-Harley site. A-B, early stage unifaces broken during production; C-D, K, oval scrapers; E, adze; F, end scraper on blade; G-H, crescent scraper, I-J, end scrapers.

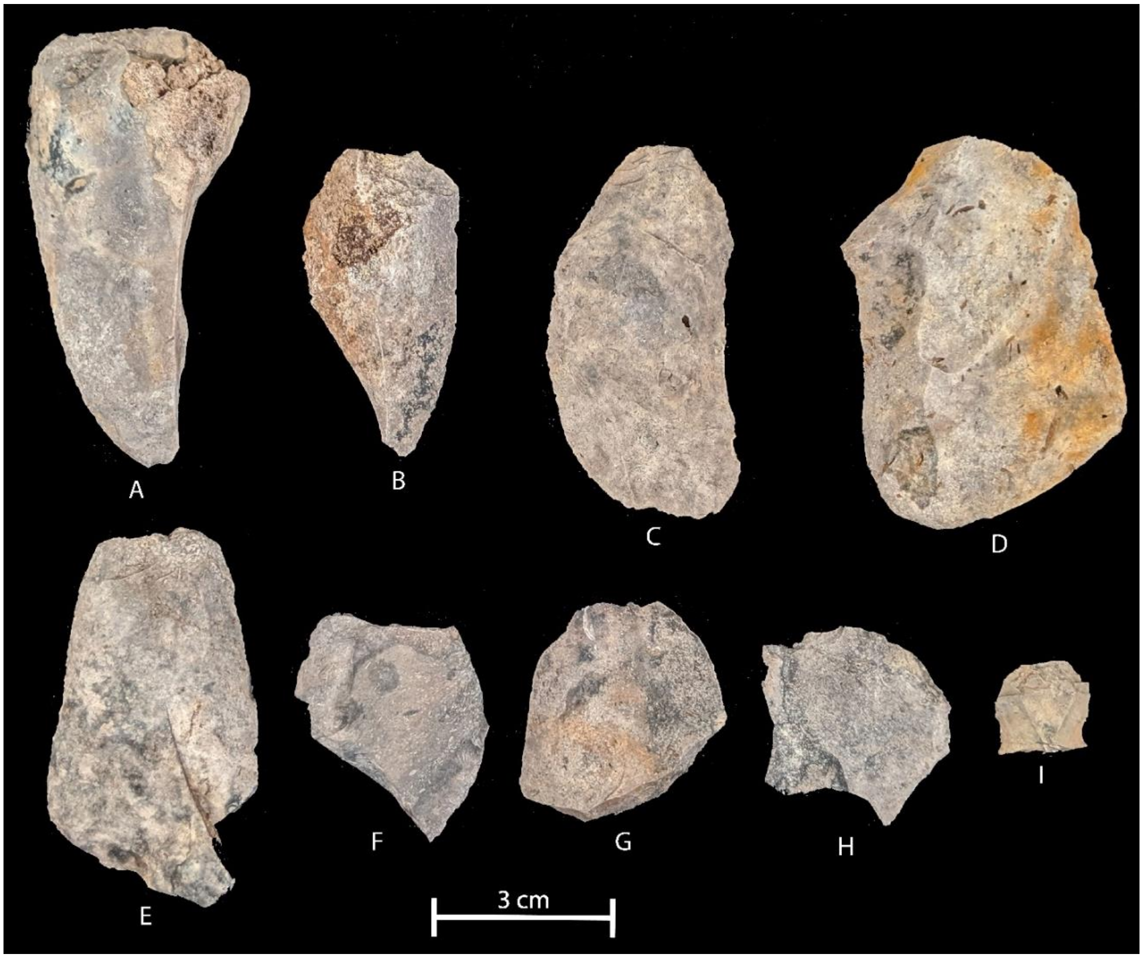

Figure 21: Representative informal unifaces from the Ryan-Harley site. A-B, cortical utilized flakes; C, E, utilized flake; D, H, combination tool; F-G, I, scrapers on flakes.

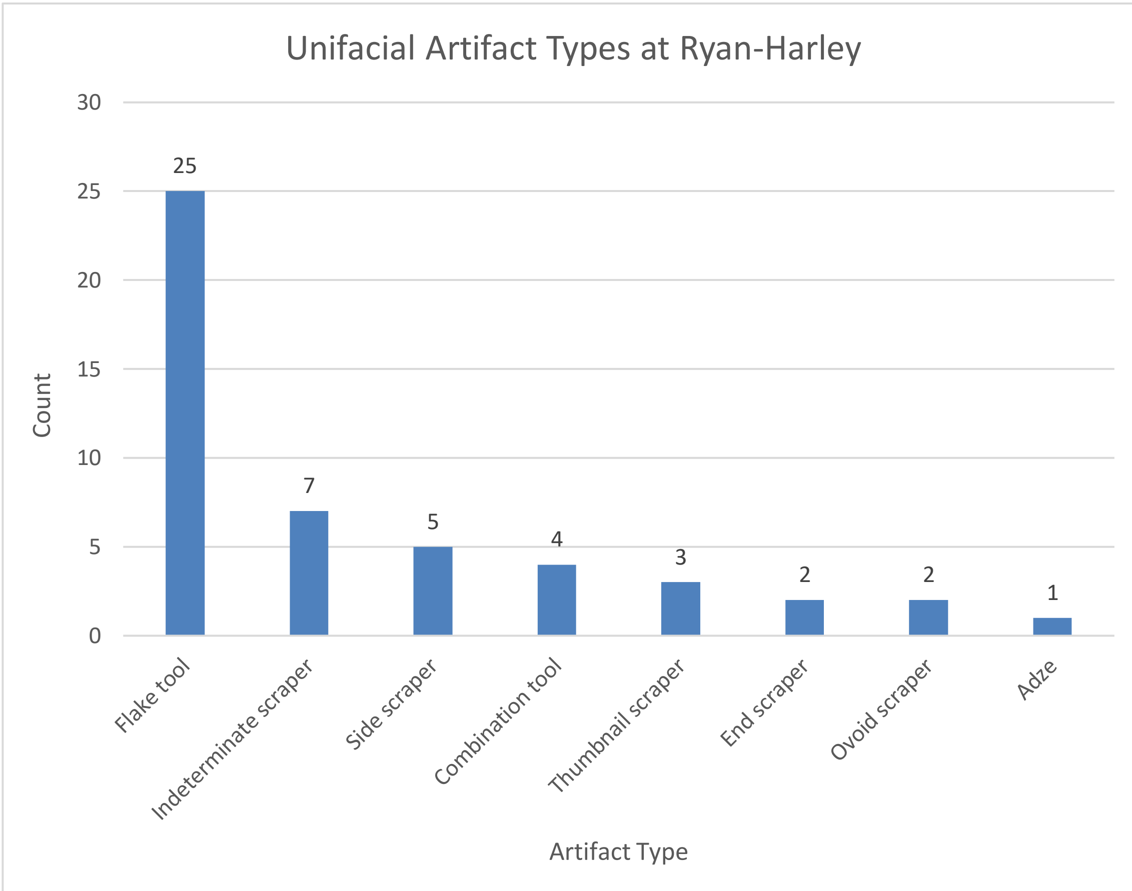

Figure 22: Counts of unifacial artifact types at Ryan-Harley.

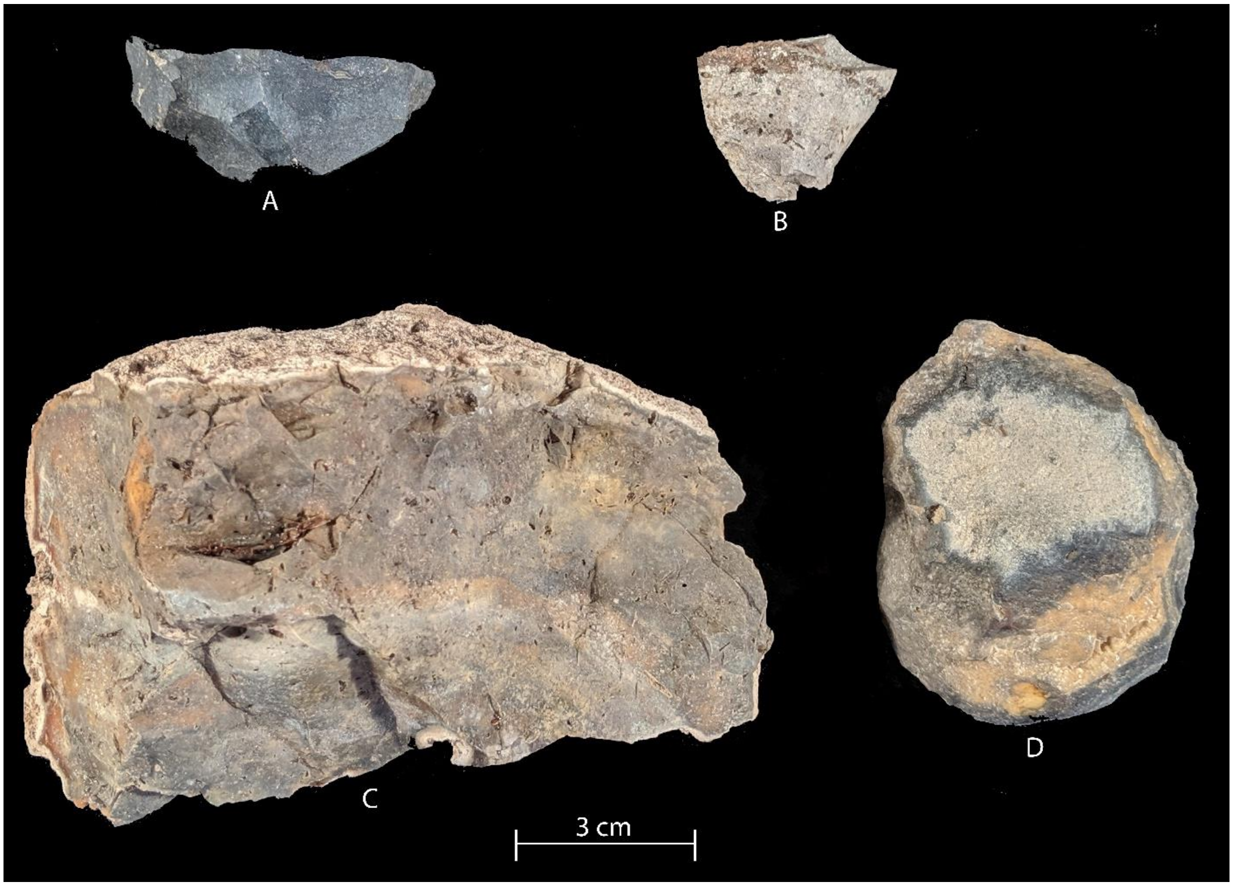

Figure 23: Representative cores and hammerstone from the Ryan-Harley site. A-B, unidirectional cores; C, tested cobble; D, hammerstone.

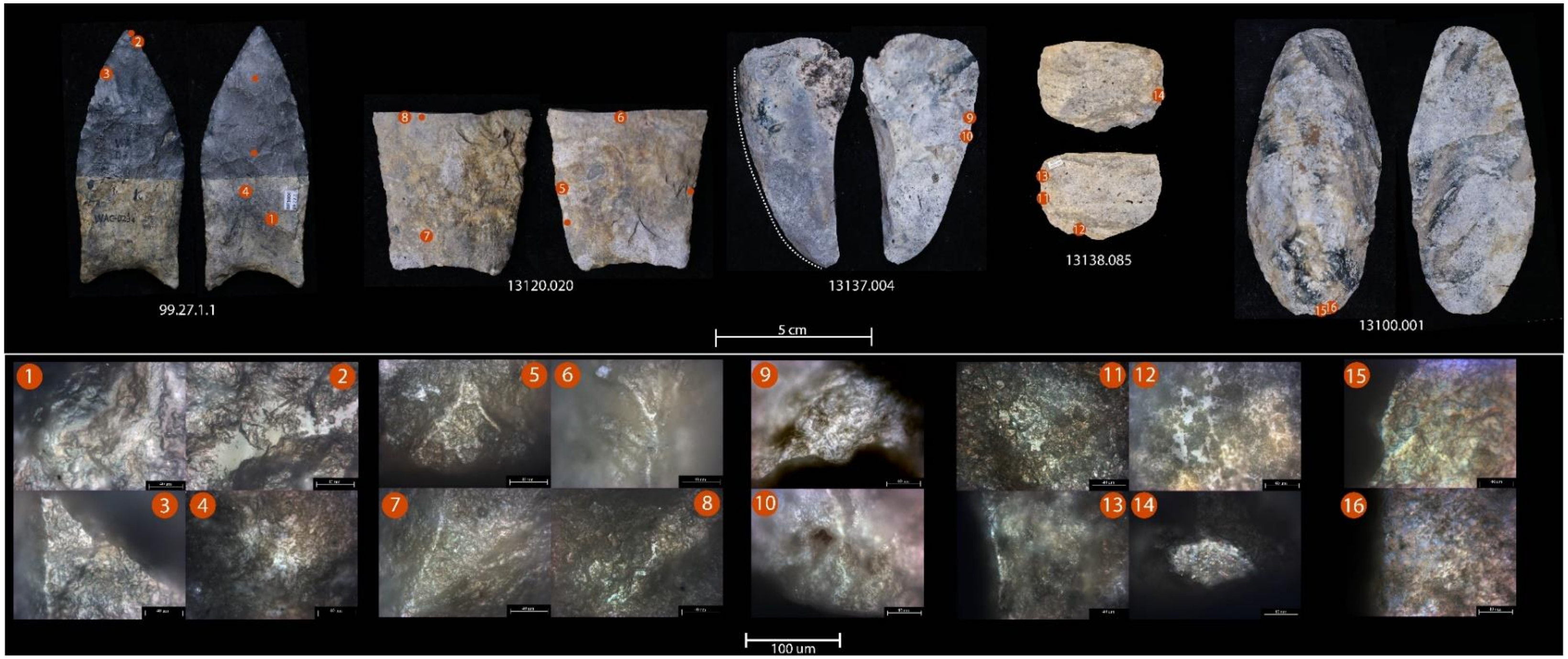

Figure 24: Representative use wear of varying artifact types recovered from Ryan-Harley.

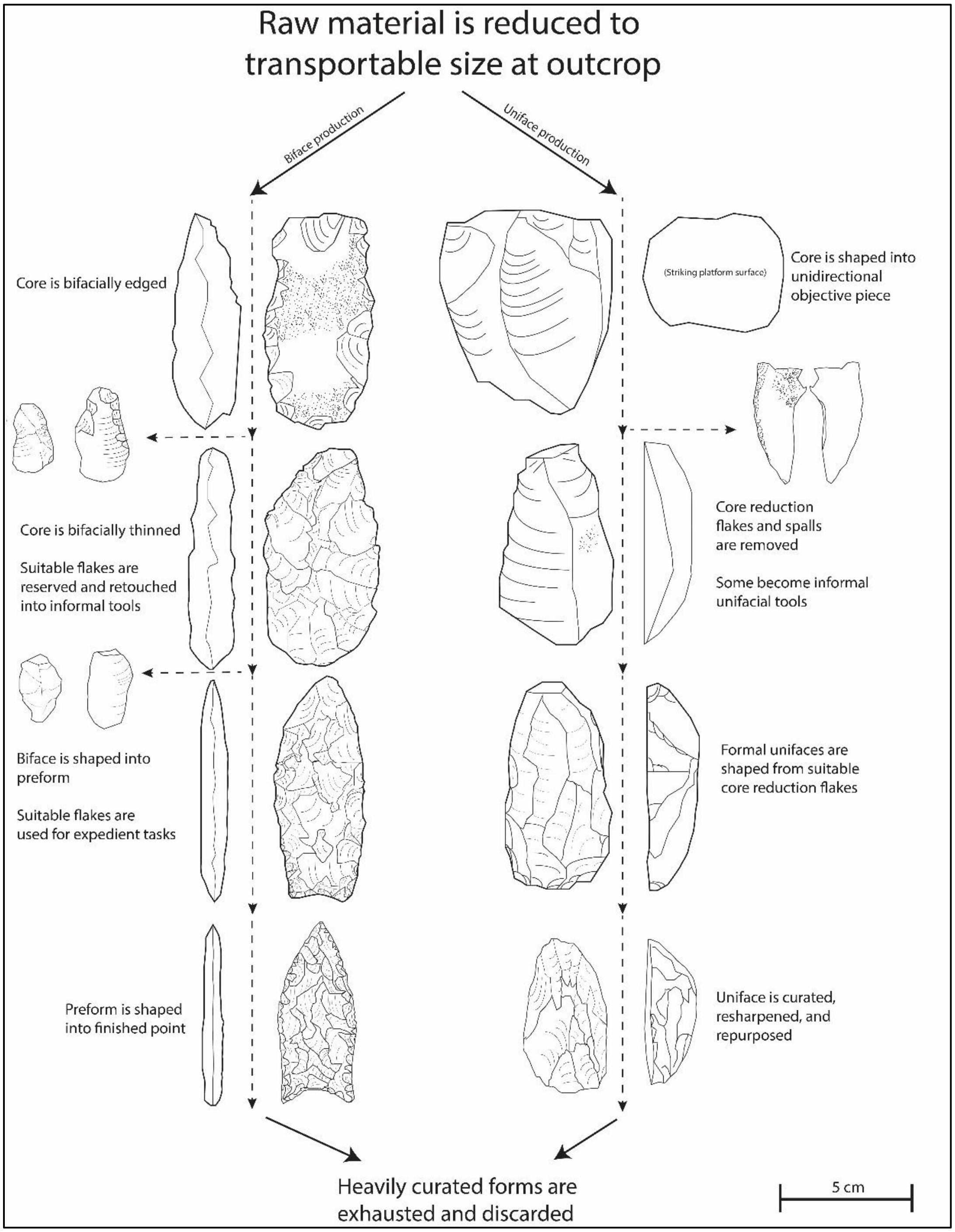

Figure 25: Hypothesized reduction sequence of Suwannee lithic technology based on analyses of the Ryan-Harley in-situ assemblage.

Site No.	Site Type (sensu Binford 1979)	Key Findings	Challenges	Discrete Suwannee Assemblage?	Relevant Citation
Ryan-Harley (8Je1004)	Short term camp	Diagnostic Suwannee artifacts and lithic assemblage from discrete, buried context;	No absolute ages on Suwannee artifacts; Poor organic preservation	Yes	Dunbar et al. (2006)
Harney Flats (8Hi507)	Base camp	Largest Florida Paleoindian site; extensive lithic assemblage; Suwannee points found in-situ in buried context	Inability to stratigraphically separate Suwannee artifacts from Early Archaic Bolen component or Simpson component of unknown age; No absolute ages obtained due to poor preservation	No	Daniel and Wisenbaker (1987)
Norden (8Gi40)	Seasonal camp	Large lithic assemblage ex-situ; Small in-situ assemblage shows potential for intact buried deposits	Largely surface scatter; no diagnostic artifacts in situ; No absolute ages obtained due to poor preservation	No	Dunbar and Vojnovski (2007)
Dunnigans Old Mill (8Gi24)	Animal processing?	Suwannee points ex-situ; non-diagnostic lithics and extinct fauna in-situ.	Poor organic preservation; no diagnostic artifacts in-situ; no absolute ages obtained due to poor preservation	No	Dunbar and Vojnovski (2007)
Helen Blazes (8BR27)	Short term camp?	Suwannee points and debitage recovered in-situ in buried context	Inability to stratigraphically separate Suwannee component from later, Archaic components; Poor organic preservation; Extensive bioturbation; no ages	No	Edwards (1952); Rink (2012)
Lake George Point (8PU1470)	Base camp?	Extensive site area; Large concentration of intact Suwannee points	Surface collection; little potential for intact deposits; no absolute ages on Suwannee	No	Thulman (2011, 2012)
Paradise Park (8MR92)	Short term camp	Potentially stratified Clovis, Suwannee, and Bolen sequence in a test unit	Geologic context uncertain; no organic preservation; Site re-evaluations cannot replicate initial findings; no absolute ages on Suwannee	Unknown	Neill (1958)
J & J Hunt (8JE740)	Unknown	Suwannee point found ex-situ; non-diagnostic artifacts recovered from stratified deposits	No diagnostic artifacts from in-situ; no absolute ages on Suwannee	No	Faught (2004)
Hornsby Spring (8AL124)	Unknown	Single Suwannee point found in-situ beneath an Early Archaic Bolen point base; Suwannee and Bolen components stratified	Insecure geologic context; No absolute ages	No	Dolan and Allen (1961)
Bolen Bluff (8Al439)	Base camp	Large, multi-component Suwannee and Bolen site	Inability to separate Bolen and Suwannee components; No absolute ages from the site; Poor organic preservation	No	Bullen (1958)

Table 3: Known archaeological sites with reported Suwannee artifact components.

Specimen No.	Artifact type	Number of wear spots observed	Invasive or edge focused wear	Wear location	Striae?	Hard or soft material	Possible use
99.27.1.1	Biface	7	Both	High spots	Yes	Hard	Projectile point
13124.009	Biface	4	Invasive	High spots	-	Hard	Hafted knife
13137.049	Biface	2	Invasive	-	-	Soft	Hafted biface
13120.020	Biface	7	Both	High spots	-	Hard	Hafted biface/planer
13138.054	Biface	3	Invasive	High spots		Hard	Scraper
13138.075	Biface	6	Both	High spots	Yes	Hard	Knife
13095.016	Informal uniface	0	No wear	-	-	-	-
13137.004	Informal uniface	2	Invasive	High spots		Soft	-
13137.030	Informal uniface	0	No wear	-	-	-	-
13145.001	Informal uniface	3	Edge	High spots	Yes	Both	Multi-tool
13073.001	Formal uniface	5	Both	High spots	-	Hard	Sidescraper
13073.019	Formal uniface	1	Edge	High spots	-	Hard	Endscraper
13101.004	Formal uniface	4	Edge	High spots	-	Hard	Planing/scraping
13112.020	Formal uniface	3	Invasive	High spots	-	Hard	Wood scraper
13112.050	Formal uniface	0	No wear			-	-
13113.001	Formal uniface	4	Invasive	High spots	Yes	Hard	Adze
13138.085	Formal uniface	4	Edge	Both	Yes	Hard	Grinding
13100.001	Formal uniface	2	Invasive	Both	-	Soft	Hide scraper

Table 4: Results of usewear analyses from Suwannee toolkit at Ryan-Harley.

Debitage class (n)	Technological class	n
Complete flake- 284		
	Bifacial-thinning flake	144
	Edge-retouch flake	64
	Core-reduction flake	50
	Platform-preparation flake	16
	Retouched-edge flake	8
	Bipolar flake	2
Proximal flake fragment- 278		
	Bifacial-thinning flake	111
	Edge-retouch flake	61
	Core-reduction flake	47
	Platform-preparation flake	22
	Retouched-edge flake	14
	Bipolar flake	1
	Indeterminant	22
Flake fragment- 388		
	Bifacial-thinning flake	46
	Edge-retouch flake	46
	Core-reduction flake	50
	Platform-preparation flake	4
	Retouched-edge flake	1
	Bipolar flake	2
	Indeterminant	239
Debris/shatter- 153		
		Grand Total- 1103

Table 5: Summary of debitage data from the Ryan-Harley site.

Specimen No.	Width to thickness ratio	Biface category	Flaking index
13351.096	2.432092	Edged biface	0.126
13093.009	2.738871	Edged biface	0.135
13138.054	2.181615	Thinned biface	0.151
13116.032	2.442641	Thinned biface	0.166
13095.003	2.109787	Edged biface	0.179
13102.004	2.693712	Preform	0.222
13101.094	3.632275	Preform	0.252
13137.049	3.070362	Preform	0.276
13349.037	3.824094	Preform	0.297
99.118.42.79	3.221194	Preform	0.32
13121.005	4.606762	Finished biface	0.327
13138.075	4.500655	Finished biface	0.35
13120.02	4.774929	Preform	0.376
99.118.3.2	4.464635	Preform	0.45
99.27.1.1	4.593484	Finished biface	0.62

Table 6: Ryan-Harley biface data.

Sample No.	Tool Type	Class	Geometric index of reduction
99.118.42.78	Flake tool	Informal	0.05223
99.118.44.70	Flake tool	Informal	0.0951
13137.030	Flake tool	Informal	0.103712
13092.001	Flake tool	Informal	0.1151
13073.020	Flake tool	Informal	0.11952
13349.003	Flake tool	Informal	0.13492
13351.141	Flake tool	Informal	0.1462
13124.001	Flake tool	Informal	0.18158
13038.024	Flake tool	Informal	0.19363
13120.019	Flake tool	Informal	0.195518
13073.033	Flake tool	Informal	0.19949
99.118.24.31	Combination tool	Formal	0.21681
07.193.1.1	Flake tool	Informal	0.21839
99.118.42.75	Combination tool	Formal	0.2757
13351.040	Flake tool	Informal	0.3179
13072.012	Flake tool	Informal	0.33464
13112.024	Flake tool	Informal	0.374789
13137.004	Flake tool	Informal	0.378453
13351.018	Combination tool	Formal	0.3792
13095.016	Flake tool	Informal	0.38277
07.193.2.1.21	Combination tool	Formal	0.409
13117.018	Flake tool	Informal	0.416423
13101.122	Scraper	Formal	0.4444
13101.093	Flake tool	Informal	0.4477
13024.028	Flake tool	Informal	0.46671
13371.132	Flake tool	Informal	0.4825
99.118.5.2.1	Scraper	Formal	0.50753
13138.098	Flake tool	Informal	0.515823
99.118.24.35.1	Scraper	Formal	0.574
99.118.44.73	Scraper	Formal	0.58932
13122.005	Flake tool	Informal	0.594747
13349.021	Scraper	Formal	0.615
13112.018	Scraper	Formal	0.639337
13001.006	Flake tool	Formal	0.64
13141.032	Flake tool	Informal	0.65473
13033.013	Scraper	Formal	0.69023
13112.030	Scraper	Formal	0.69613
13349.001	Scraper	Formal	0.77419
99.118.45.81	Scraper	Formal	0.793797
13002.005	Scraper	Formal	0.80559
13073.019	Scraper	Formal	0.81885
13138.062	Scraper	Formal	0.88377
13101.044	Scraper	Formal	0.894288
13100.001	Scraper	Formal	0.98669
99.118.11.36	Scraper	Formal	1.008
13138.085	Scraper	Formal	1.0651
13073.001	Scraper	Formal	1.1424
13113.001	Adze	Formal	1.25217
13112.020	Scraper	Formal	1.42018

Table 7: Summary of data from Ryan-Harley unifaces.

APPENDIX C

CHAPTER IV FIGURES AND TABLES

Figure 26: Historical photos from 1973 Guest Mammoth Excavation. Left: Dr. Charles Hoffman (center) showing a mammoth-bone fragment to Norther Arizona University field school students. Right, Hoffman and students examine the exposed Guest Mammoth bone bed from a glass bottom boat (Hoffman, ca. 1985).

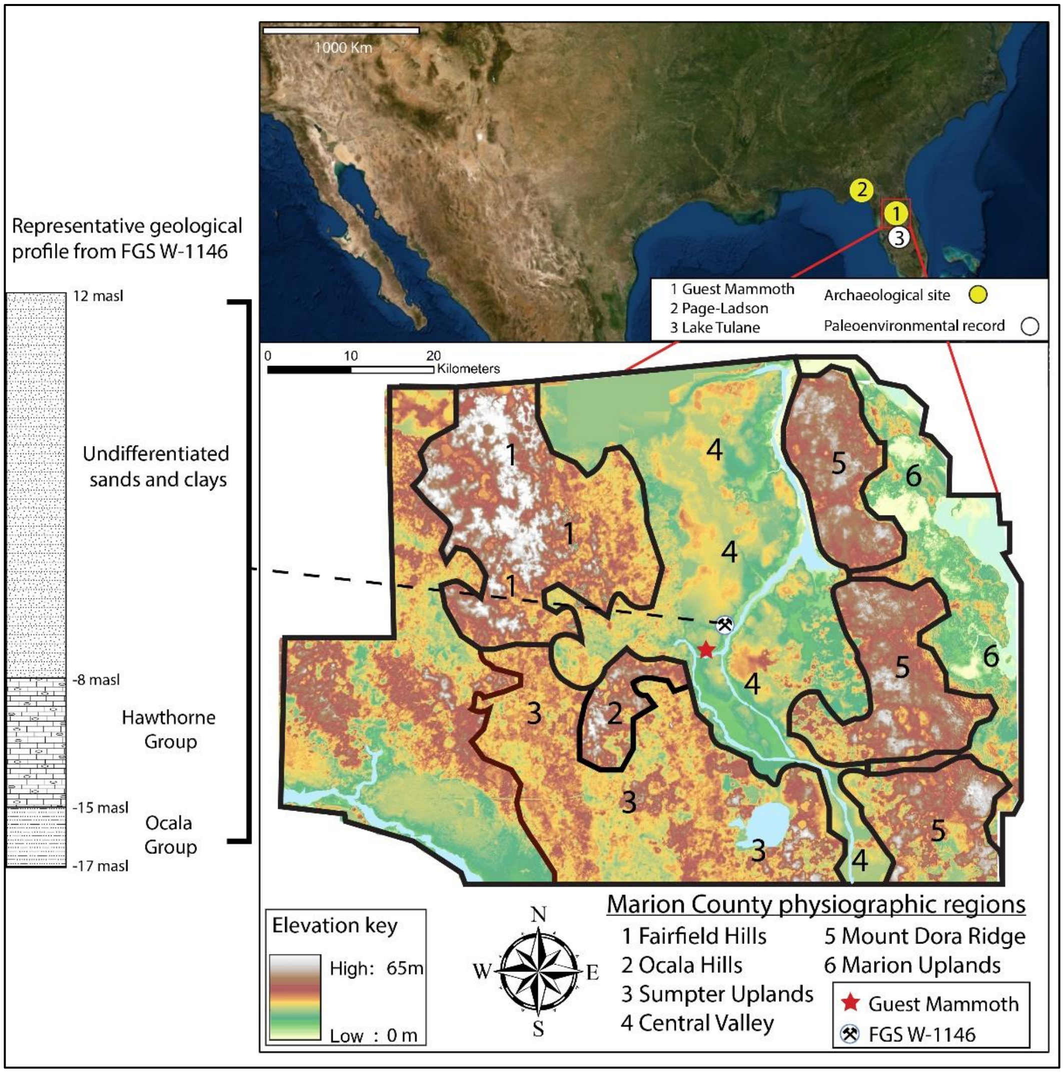

Figure 27: Top: Site location within North America and sites mentioned in the text. Bottom- Site location within Marion County, Florida, in relation to regional physiographic features. Left- Representative geologic profile from nearby FGS W-1146 (adapted from Lane and Hoenstine, 1991). Imagery from ESRI, NOAA, USGS, Garmin, NPS, and Marion County Engineers Office.

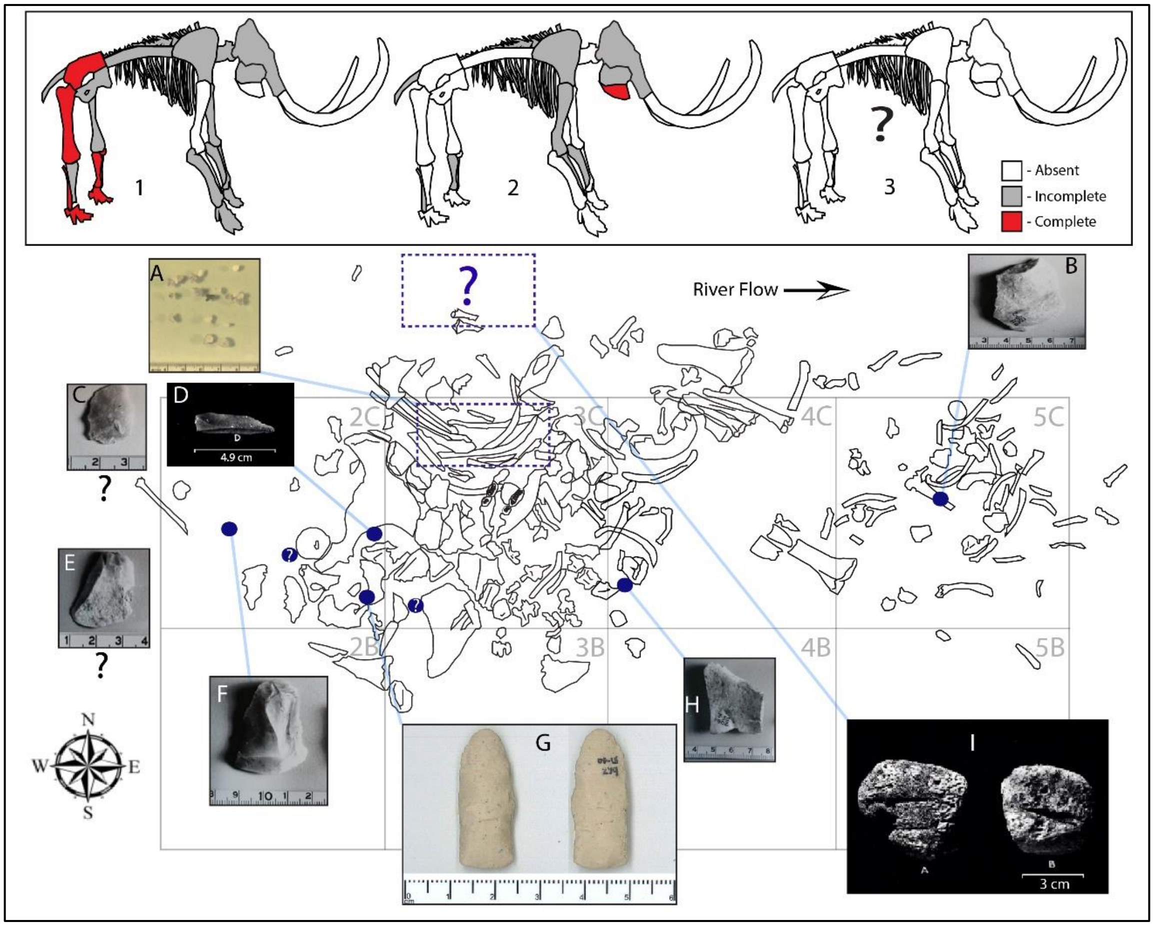

Figure 28: Top- Visual representation of mammoth elements recovered during 1973 excavations (data from Rayl 1974). 1, 6-year-old juvenile mammoth; 2, mammoth calf; 3, unidentified third mammoth, which is cited by Hoffman (1983) but from which no elements are described. Bottom- Recreation of Guest Mammoth 1973 findings. Provenience data from Hoffman ca. 1985, and Rayl 1974. Images from the author. A, microdebitage; B, flake; C, flake, provenience unknown; D, blade-like flake; E, flake, provenience unknown; F, flake; G, point; H, flake; I, approximate location of cut-marked bones as referenced in Hoffman ca. 1985.

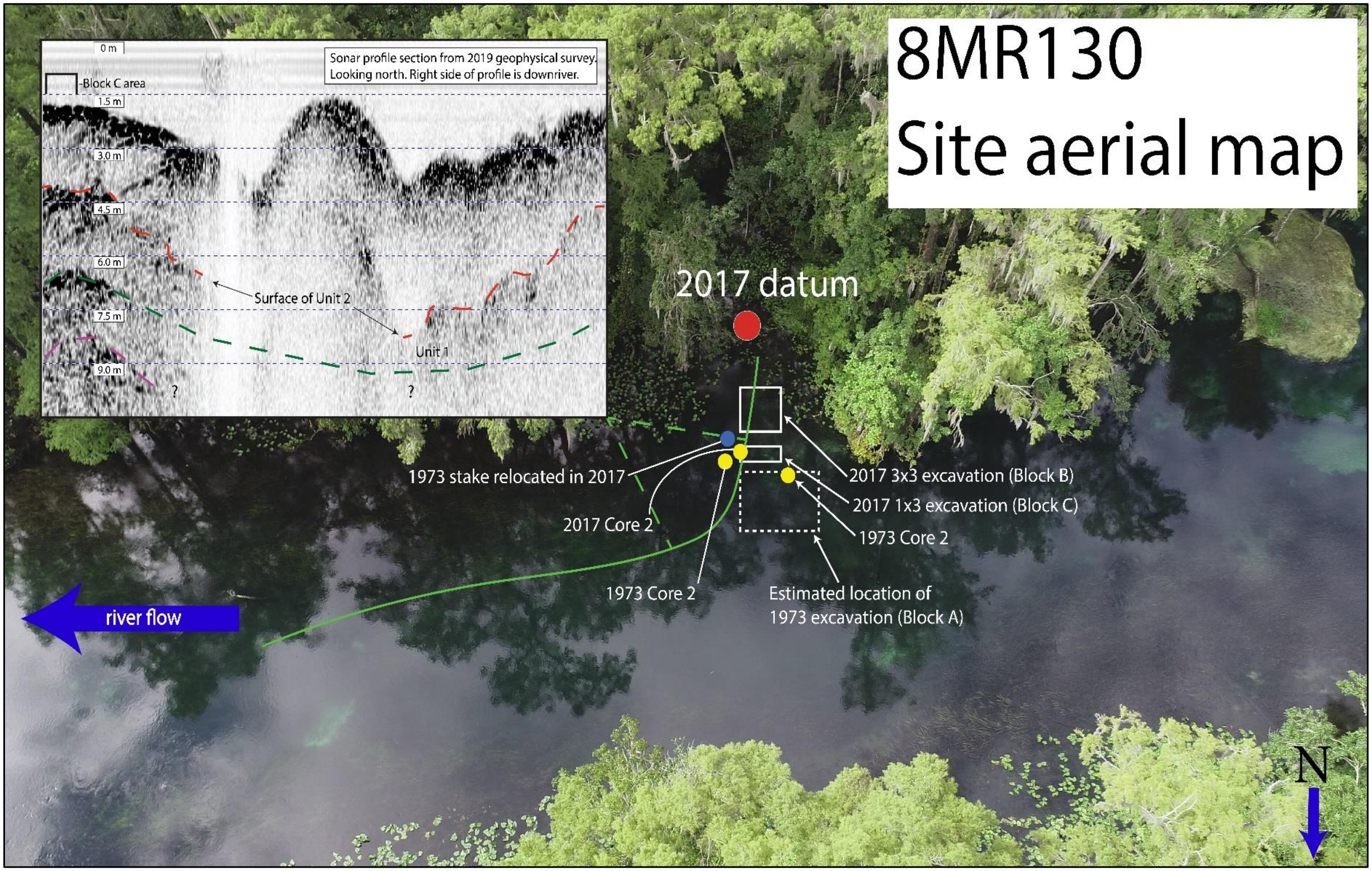

Figure 29: Site map identifying the location of excavation blocks, sediment cores, and other landmarks. Inset: Sub-bottom sonar profile of site area, showing surface of pond (Unit 2) and unknown, underlying strata.

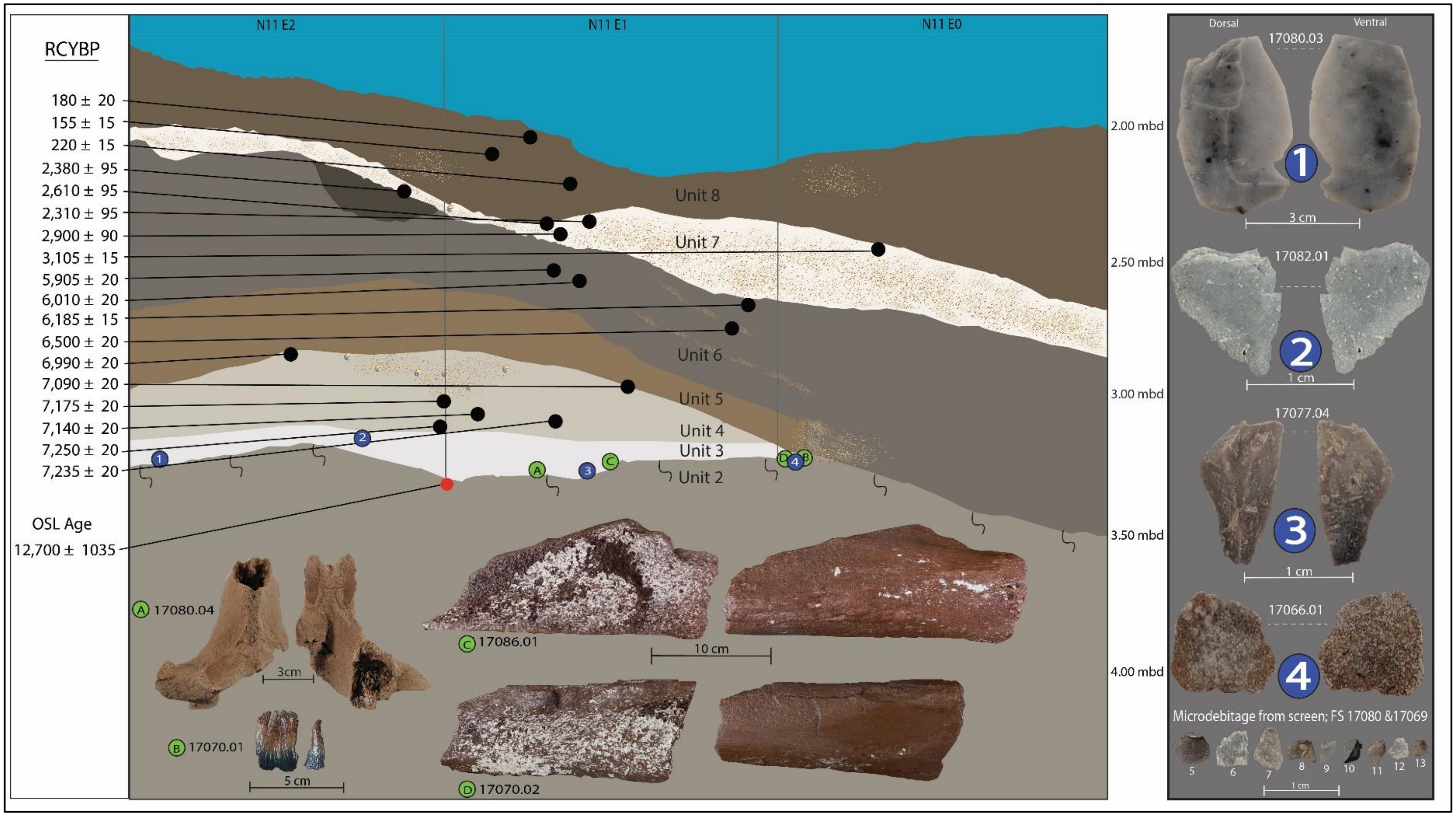

Figure 30: Stratigraphic profile of the south wall of 2017 excavation block C, including locations of radiocarbon and OSL samples as well as in-situ lithic material and mammoth bone. View is looking south, river flows to left of figure. Artifacts: 1, core-reduction flake, 2, edge-retouch flake, 3, shatter, 4, bone flake, 5-13 microdebitage.

2017 Stratum Designation	1973 Stratum Designation	Calibrated Age Range	Stratigraphic Unit Description
Unit 8	Layer A	224-142 cal yr BP	~10-50 cm thick brown sandy loam
Unit 7*	Layer B	3375-2118 cal yr BP	~5-25 cm thick light brown sandy silt
Unit 6*	Layer C	7464-6670 cal yr BP	~15-50 cm thick grey silty sand
Unit 5	Layer D	7870-7759 cal yr BP	~20-25 cm thick brown sandy silt
Unit 4	Not Described	8159-7922 cal yr BP	~20 cm thick light grey silty sand
Unit 3*	Layer E	No organic material preserved.	~10 cm thick layer of unconsolidated crushed shell and fine sands
Unit 2	Layer F	13735-12700 cal yr BP	~1 m thick compact, light grey silty marl
Unit 1	Not Described	Unexcavated.	Unidentified siliciclastic sediments, observed in geophysical data only

Table 8: Guest Mammoth stratigraphic unit designations and descriptions. The asterisk denotes an artifact-bearing components. Highlighing denotes the mammoth bone bed.

Radiocarbon							
Lab No.	**Sample ID**	**δ^{13}C**	**Modern Fraction**	**δ^{14}C**	**^{14}C age**	**Calibrated Age (IntCal 13)**	**Geologic Unit**
UCIAMS-180835	Wood	-24.8	0.9778	-22.2	180 ± 20	142-219	Unit 8
UCIAMS-180837	Wood	-25.8	0.9732	-26.8	220 ± 15	151-171	Unit 8
UCIAMS-180836	Wood	-25.7	0.9812	-18.8	155 ± 15	169-224	Unit 8
GAK-4509*	Charcoal	-	-	-	2310 ± 95	2118-2621	Unit 7
GAK-4511*	Wood	-	-	-	2380 ± 95	2301-2736	Unit 7
GAK-4510*	Wood	-	-	-	2610 ± 95	2379-2888	Unit 7
GAK-4508*	Wood	-	-	-	2900 ± 90	2842-3256	Unit 7
UCIAMS-198110	*Pinus* sp. (Pine)	-26.2	0.6793	-320.7	3105 ± 15	3323-3375	Unit 7
UCIAMS-198107	Unidentified stem	-29.1	0.4793	-520.7	5905 ± 20	6670-6757	Unit 6
UCIAMS-198105	cf. *Quercus* (possible Oak)	-29.5	0.4732	-526.8	6010 ± 20	6786-6913	Unit 6
UCIAMS-180834	Wood	-28.2	0.4632	-536.8	6185 ± 15	7010-7129	Unit 6
UCIAMS-198109	Unidentified hardw ood	-29.2	0.4452	-554.8	6500 ± 20	7413-7464	Unit 6
UCIAMS-211918	Grass blade	-	0.4189	-581.1	6990 ± 20	7759-7870	Unit 5
UCIAMS-198106	Unidentified organics	-15.4	0.4136	-586.4	7090 ± 20	7922-7965	Unit 4
UCIAMS-198111	Unidenitified organics	-15.9	0.4111	-588.9	7140 ± 20	7937-8004	Unit 4
UCIAMS-198108	Unidentified stem	-15.9	0.4095	-590.5	7175 ± 20	7956-8019	Unit 4
UCIAMS-211918	Grass blade	-	0.4063	-593.7	7235 ± 20	7982-8071	Unit 4
UCIAMS-211918	Grass blade	-	0.4055	-594.5	7250 ± 20	8006-8159	Unit 4
UCIAMS-201225	XAD purified collagen	-	-	-	8565 ± 35	9485-9560	Bone Bed; Unit 2 Surface
GAK-4512*	Unpurified bone collagen	-	-	-	9840 ± 190	10712-11992	Bone Bed; Unit 2 Surface
Beta-26060*	Shell marl	-	-	-	10220 ± 70	11617-12184	?
Optically Stimulated Luminescence (OSL)							
Lab No.	**Aliquots (Dose calculations/original aliquots measured)**	**Equivalent Dose (Gray)**	**Over-dispersion %**	**Cosmic Dose Rate**	**Dose Rate**	**OSL Age**	**Geologic Unit**
BG-4689	27/32	5.87 ± 0.18	9 ± 2	0.18 ± 0.018	0.63 ± 0.03	12700 ± 1035	Unit 2

Table 9: All chronometric ages obtained from 8Mr130, Guest Mammoth site.