What’s in Your Toolbox? Examining Tool Choices at Two Middle and Late Woodland-Period Sites on Florida’s Central Gulf Coast

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What's in Your Toolbox?
Examining Tool Choices at Two Middle and Late Woodland-Period Sites on Florida’s Central Gulf Coast

by

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A thesis submitted in partial fulfillment of the requirements for the degree of Master of Arts
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ABSTRACT

The examination of the tools that prehistoric people crafted for subsistence and related practices offers distinctive insights into how they lived their lives. Most often, researchers study these practices in isolation, by tool type or by material. However, by using a relational perspective, my research explores the tool assemblage as a whole including bone, stone and shell. This allows me to study the changes in tool industries in relation to one another, something that I could not accomplish by studying only one material or tool type. I use this broader approach to tool manufacture and use for the artifact assemblage from Crystal River (8CI1) and Roberts Island (8CI41), two sequential Middle and Late Woodland Period (A.D. 1-1050) archaeological sites on the central Gulf coast of Florida. The results of my research show that people made different choices, both in the type of material they used and the kind of tools they manufactured during the time they lived at these sites as subsistence practices shifted. Evidence of these trends aligns with discrete changes in strata within our excavations. The timing of depositional events and the artifacts found within each suggest people also used the sites differently through time. These trends exemplify the role of crafting tools in the way people maintain connections with their mutable social and physical world.
CHAPTER 1
INTRODUCTION

Without question, the study of subsistence tools offers distinctive insights into the lives of the people who crafted and used them. Indeed, the list of accomplished research focusing on specific materials, tool types, manufacturing processes is long. However, researchers rarely study the entire tool assemblage at a site; instead, bone, stone, shell and other tool assemblages are usually studied and reported in isolation. As a result, changes in one tool industry are rarely understood in relation to changes in another. I take a broader approach to tool manufacture and use at Crystal River (8CI1) and Roberts Island (8CI41) archaeological sites. By examining bone, stone, and shell tools from both sites holistically, I reveal clear trends in material selection and tool manufacturing over 950 years of occupation.

Crystal River and Roberts Island sites are Woodland Period (ca. 1000 B.C. to A.D. 1050) shell mound centers characterized by platform mounds, plazas and burial complexes. The sites are located between 3 and 4 km northwest of the town of Crystal River in Citrus County on Florida’s west-central Gulf Coast (Figure 1.1). Crystal River is the best known of the two sites and is widely recognized for its participation in the Hopewell Interaction Sphere, a multi-regional system of exchange in exotic goods and ceremony during the Middle Woodland Period (A.D. 1 to 400) (Caldwell 1964; Struever 1964). Extending from Florida northward to the Great Lakes region, the Hopewell interaction encompasses sites throughout much of the eastern U.S. Crystal River’s
large and diverse assemblage of exotic materials and artifacts including silver and copper ornaments, and crystal quartz (e.g. Greenman 1938:331; Goad 1978; Moore 1903, 1907, Pluckhahn et al 2010a,b; Pluckhahn et al. 2015). A National Historic Landmark and a Florida State Park, the site sits on the northern bank overlooking the Crystal River about midway along its path from the headsprings out to Crystal Bay and the Gulf of Mexico. Less than a kilometer west of Crystal River, at the confluence of the Crystal and Salt Rivers, sits the Roberts Island Shell Mound Complex (Pluckhahn et al. 2015:3). Roberts Island is actually a cluster of sites, first recorded by Ripley Bullen (reports on file at the Florida Master Site file, Tallahassee) (Pluckhahn 2015; Weisman 1995b).

These two sites are located within a rich ecosystem. Tidal forces from the bay produce a mixing of marine saltwater and inland fresh waters, creating rich estuarine and marine environments with abundant natural resources available to the people who lived there. This setting provided a mosaic of terrestrial and marine resources exploited for subsistence, including food, building materials, trade goods, and for crafting of a variety of tools.
Research Design

Weisman (1987, 1995a) has summarized previous archaeological investigations at Crystal River. The most intensive and widely known investigations of Crystal River are those of C.B. Moore (1903, 1907, and 1917) and Ripley Bullen (1951, 1953). Both Moore and Bullen intensively excavated burials, a method not practiced today, and created detailed maps of the mounds and features at the site. They recovered abundant artifacts including exotic goods that would later secure Crystal River’s place within the Hopewell Interaction Sphere (Goad 1978). While findings from these excavations
contributed to the site’s recognition and eventual preservation, these early works lacked a refined research design and the excavation techniques lacked precision (Pluckhahn et al. 2010b:165, 2015:22). This resulted in inadequate provenience control and recovery methods biased toward idealized artifacts including complete tools and exotic goods.

Although limited, further investigations by Willey (1948, 1949a,b), Smith (1951) Bullen (1951, 1953, 1966), and Weisman (1985, 1995a:35-36) attempted to resolve conflicts about where Crystal River fit within the known cultural chronological order through examination of pottery and mound construction (Pluckhahn et al. 2010a:166; Weisman 1995a:28-29). By the 1990s, archaeology at the site took place primarily in response to storm damage (e.g. Ellis 1999, 2004; Ellis and Martin 2003; Estabrook 2009, 2011; Weisman and Newman 1993), as part of the park’s management plan (e.g. Ellis 1999; Ellis et al. 2003), or as student research papers (e.g. Green 1993; Judd 1997; Katzmarzyk 1998; Mabulla n.d.) (Pluckhahn et al. 2010a:167). Conversely, current investigations incorporating a theoretically-based research design and using controlled methods have endeavored to answer broader behavioral questions about the people who lived at these two sites and their connections with others, both regionally and interregionally.

With a grant from the National Science Foundation, Drs. Pluckhahn and Weisman from the University of South Florida, and Dr. Thompson from the University of Georgia, conducted fieldwork for three seasons (2011-2013) with graduate and undergraduate students. My own research began with my participation in the final two field seasons. The Crystal River Early Village Project (CREVAP) seeks to develop a better understanding of site development within a broader research design designed to
investigate the roles of competition and cooperation at the sites (Pluckhahn et al. 2010b). Detailed mapping of the anthropogenic landscapes was accomplished using LiDAR (Light Detection and Ranging) and total station survey, providing a better understanding of the sites and revealing features previously unseen by earlier researchers (Pluckhahn et al. 2015:23). Geophysical survey clarified mound and midden composition. Small-diameter coring and shovel testing further clarified mound and midden content and spatial extent. Finally, small test trenches provided larger windows on mound and midden stratigraphy and produced larger artifact assemblages for study.

Bayesian statistical modeling of radiometric dates on materials from these excavations clarified discrete occupational episodes, which revealed four general phases of occupation for Crystal River between about cal AD 150 to 1050 (Blankenship 2013; Norman 2014; Pluckhahn et al. 2015) (here and throughout, I use italics to indicate the Bayesian-modeled calibrated dates). The timing of Roberts Island falls within the latter two phases, between about cal AD 500 to 1050. Table 1.1 specifies the range of dates for the four phases for both sites.

Working in concert with the CREVAP, I investigate subsistence tool choices using the data from four trenches at Crystal River and both shovel tests and trench excavations at Roberts Island. However, because my theoretical perspective centers on a relational perspective, I consider the developments and changes through time within a broader landscape in which tools are only a part. This means that I include both subsistence and non-subsistence activities as these speak to the relatedness of tasks in going about social living. I discuss this perspective in further detail in the next section. I
synthesize the work of others who have completed important research on individual materials, human-environmental interactions, and food procurement activities from both sites (Blankenship 2013; Duke 2015; Estabrook 2011; Menz 2012; Norman 2014). Tool assemblages as a whole have the potential to provide data on the breadth of tasks occupying daily life, ranging from acquisition and preparation of food to the crafting of ornaments. Their provenience provides information about the location, timing, and range of specific tasks that make up people’s technological identity and social organization.

As laboratory technicians and I sorted and processed the material from the excavations, we quickly became aware of shifting characteristics in subsistence remains and tool choices at both sites, even before quantifying the data. Pluckhahn et al. (2015) use Bayesian-modeled radiocarbon dates, providing a phase-based chronology that characterizes the timing and diversity of depositional episodes and the activities at these sites. The established four phases provide the basis for quantifying the tool assemblages both temporally and spatially. I suggest people made different choices, both in the type of material they used and the kind of tools they manufactured during the time they lived at these sites as subsistence practices shifted. Evidence of these trends aligns with discrete changes in strata within each test unit. The timing of depositional events and the artifacts found within each suggest people also used the sites differently through time. These trends exemplify the role of crafting tools in the way people maintain connections with their mutable social and physical world. Phases (Table 1.1) and corresponding radiocarbon dates assigned to these events allow me to frame artifacts securely within time.
Table 1.1. Phases based on radiocarbon dates (from Pluckhahn et al. 2015)

<table>
<thead>
<tr>
<th>Phases</th>
<th>Phase modeled 95% probability ranges (cal AD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Beginning</td>
</tr>
<tr>
<td>Phase 1</td>
<td>69–225</td>
</tr>
<tr>
<td>Phase 2</td>
<td>221–321</td>
</tr>
<tr>
<td>Phase 3</td>
<td>478–634</td>
</tr>
<tr>
<td>Phase 4</td>
<td>723–881</td>
</tr>
</tbody>
</table>

While dated burials at Crystal River suggest an earlier presence, Phase 1 marks the earliest known midden construction and dates from around cal AD 150 with a median modeled length of 37 years at 95 percent probability. Phase 2 is the longest of the phases (median modeled length 190 years) characterized by an increased rate and extent of midden deposition, perhaps associated with an increase in activities of larger population or more permanent settlements (Pluckhahn et al. 2015). Phase 3 (median modeled length 94 years) is represented at both sites, although, in a lesser areal extent than in Phase 2 at Crystal River. Early midden deposition appears to have taken place at Roberts Island during this time. In the final phase (median modeled length 100 years), activities at Crystal River artifacts are limited to Trench 3, suggesting a concentration of activities in the vicinity of Mound A, accompanied by a waning in other areas of the site. Conversely, at Roberts Island, oyster (Crassostrea virginica) shell deposition suggests rapid platform mound construction in this phase (Pluckhahn et al. 2015).

In the remainder of this chapter, I introduce the reader to the theoretical approach known as relational archaeology. Chapter 2 begins with the archaeological
history of Crystal River, discussing the research and recovered artifacts followed by a
discussion of the past and present environment. Undoubtedly, prehistoric inhabitants
experienced climate fluctuations during the site’s long occupation that played a part in
the diversity of their activities and how they lived life as a whole. Therefore, I also
discuss environmental setting in this chapter. Chapter 3 describes some of methods
developed by researchers for each of the three raw material types used in the
manufacture of artifacts in my study. I draw from these methods to address my research
questions. In Chapter 4, I provide the results of my examination of the materials, with
particular attention to the contextual significance. Finally, Chapter 5 discusses the
implications of these results and synthesizes my research in the context of that of
others.

Theoretical Context

Although I focus on implements used in subsistence pursuits, I take an holistic
approach that appreciates the versatility of these implements to function in multiple
ways, and for purposes that we cannot always determine. This involves considering the
temporality and historicity of interrelationships and patterns of activities by people going
about their daily life (Ingold 2000:154). Indeed, I argue that a fully informed study must
take into account the relationships between toolmaker, raw materials, and tool types, as
well as how these relate to subsistence and other activities. Therefore, I also consider
other artifacts such as ornaments and ceremonial items because knowledge and
expertise in crafting certain materials cross boundaries between utilitarian and symbolic
realms. As an observer of the material remains, I need theoretical tools to guide my
analysis of the data and explore these relationships. I admit, however, that this is not an easy task since the archaeological record reflects only bits and pieces of daily life.

My approach draws from recent interest in what researchers describe as “relational archaeology” (Fowler 2013; Hutson 2010; Ingold 1993, 2010). Relational archaeology presents a non-linear and dynamic way of thinking about people in interrelationships with the world in which they dwell, a world that embodies social relationships, landscapes, things and activities. Therefore, activities like shellfish harvesting, mound building, tool making, or cooking are embedded practices, situated within a framework of dwelling.

Hutson (2010) emphasizes the benefit of a dwelling approach to connect the material remains with people’s identities as he investigates the lives of people, past and present, living at a Classic Period site in the Yucatan, Mexico. For example, he explores how changes in the location of an ordinary task like meal preparation are linked to household relationships and norms. Further, he examines evidence of these and other interactions as they change or carry forward to new households over time. Through the everyday engagement with other people, with things created and places built, the Maya developed their identity (Hutson 2010).

Fowler (2013) applies a relational approach in his examination of mortuary practices of Early Bronze Age and Chalcolithic people in Northern England. He investigated 355 mortuary deposits at 150 regional sites. His assertion is that relationships develop from interactions between people, places and things and are key to understanding the people and their practices. Relationships, both changing and enduring, reveal the specific ways in which people’s histories unfold.
Tim Ingold (1993, 2010) introduces the concepts of taskscape and textility within a relational perspective as a way to visualize patterns of dwelling activities and the processes of creating form from raw materials. The two concepts are particularly useful in a relational approach to tool kits and subsistence practices at Crystal River and Roberts Island. I briefly describe these concepts and their application to my research.

Taskscape, although derived from and related to the concept of landscape, is different in Ingold’s formulation. Viewed through diverse perspectives, the idea of landscapes warrants clarification as a key term in association with taskscape, and as it applies to this research. The idea of a landscape is a construct by modern theorists who attempt to divine a meaningful representation of its role in the lives of past people (Knapp and Ashmore 1999:6). Earlier archaeological approaches to landscapes sometimes characterized them as being akin to the natural environment or settlement patterns (e.g., Anschuetz et al. 2001:158; Ingold 2000:191; Whittlesey 1997:19), or simply as settings upon which to plot archaeological data (Knapp and Ashmore 1999:1). Currently, however, many theorists focus on a holistic view of landscapes, exploring the human/landscape interrelationship. For example, Bender (2002:1) writes, “Landscapes are created out of people’s understanding and engagement with the world around them.” Landscapes may come to exist because of the way people perceive, experience, and conceptualize them (Knapp and Ashmore 1999:1). These authors focus on the landscape as a complex element in relation to human lives.

Tim Ingold (2000:191) proposes, “the landscape becomes a part of us, just as we are a part of it” through simply living in it. If we embrace the idea of the landscape in present tense, then it follows that the landscapes existed in the same manner for the
people living at Crystal River and Roberts Island in the past. Their landscapes included not only the mound complex we know today, but the waters they fished and places they traveled; all those places, fluid and evolving, impacting and impacted by the day-to-day activities of living.

Ingold (2000:154) introduces taskscape as “an array of dwelling activities.” Tasks are those activities carried out within a social framework while going about life (Ingold 2000:195). Through this perspective, landscape temporality and the living activities weave and reweave histories. This connection intrinsically links landscapes and taskscape. Taskscape comprises a range of related individual and group activities, forming patterns of community activity, including tool and ornament manufacture, mound building, and subsistence activities, to name just a few. These tasks embody socially-embedded activities within a community and among individuals, symbolizing their personal and social identity (Ingold 2000:202).

The people living at Crystal River left an enduring record of their activities in the form of monumental architecture and other material remains deposited across past landscapes. For example, activities related to the construction of shell mounds at Crystal River define a taskscape. Yet, no taskscape stands alone, nor is it static. Instead, together, they form connections, made and remade in the mutable webs of relationships (Ingold 2000:195). Individuals or groups engage in planning and directing mound construction and related activities; artisans fashion tools with which to carve out canoes that carry oysters back to the site; others manufacture baskets and shell hammers, facilitating oyster harvesting. The above activities demonstrate some examples that make up a taskscape of mound construction. Yet, those embedded
activities and others organize and reorganize to make up other taskscapes such as those related to food procurement, preparation, and cooking, ceremony, mortuary practices, etc. Therefore, the activities invested in building mounds interconnect through other taskscapes. In fact, all manner of living activities may define related taskscapes, in both locally and perhaps far-reaching locals within and outside of Florida.

Take, for example, Crystal River’s direct role in the Hopewell Interaction Sphere as evidenced by burial practices and the diverse assortment of exotic artifacts (including mica, copper and quartz) similar to those seen in Hopewellian sites in the Ohio River Valley and at Middle Woodland sites throughout much of the eastern U.S. (Pluckhahn et al. 2010:278; Pluckhahn and Thompson 2014:63). The features and artifacts found at the site suggest complex systems of social and political organization and exchange operating across multiple scales. Perhaps, as Sharon Goad (1978) proposed, the people of Crystal River crafted items such as cups and ornaments from regionally available marine gastropods, exchanging them for exotic goods from elsewhere.

However, recent research suggests a more complicated relationship. In her thesis, Beth Blankenship (2013) examined marine shell and shell artifacts recovered from surface and subsurface collections at Crystal River. Her results indicated that certain mollusk species occurred in different contexts and frequencies, suggesting spatial, temporal, social, and environmental boundaries. Quahog clam (*Mercenaria mercenaria*) and crown conch (*Melongena corona*) occurred in the southern part of the site, but not in the northern part, and appeared important in the making of utilitarian tools, but not as ornaments and mortuary goods. In contrast, lightning whelk (*Busycon contrarium*) occurred commonly in burial contexts as gorgets, cups, dippers, spoons,
and more, but appears infrequently in domestic contexts. A recent study of contemporary mollusk distributions, conducted at 760 stations along Florida’s Gulf Coast between years 2009 and 2012, showed a low occurrence of lightning whelks near Crystal River (Stephenson et al. 2013:305-313). If these low occurrences were true of the Woodland period, we might assume that the limited access to lightning whelk during the occupation of Crystal River increased their value in the materialization of complex networks, locally, regionally, and beyond. Residents may have imported lightning whelk from areas to the north or south, where they are more abundant, before trading them farther afield to people in areas where they would have been rarer still, in exchange for materials such as copper and quartz that were exotic to people at Crystal River.

Although limited in the local area, the people may have harvested Lightning whelks for food, or obtained them as raw materials or in finished forms as cups and ornaments. However, there is good evidence that they were familiar with the use of related species of gastropods. Crown conchs appear abundantly in domestic contexts in the form of utilitarian tools such as hammers, perhaps reflecting their use in subsistence-related tasks, construction, and manufacturing. While the above mentioned mollusk study did not include the crown conch, they appear to be plentiful in the area; I have observed living crown conch by the dozens in the shallow tidal waters near Crystal River. Thus, the taskscape of crafting ornaments reveals broader connections to the acquisition of raw materials, subsistence production, and other activities involved in multi-scalar social organization and exchange. The previous example highlights not only the advantages, but also one of the principal challenges in a relational approach to archaeological research. The challenge is that associations and relationships seemingly
extended in all directions, encompassing multiple activities, materials, and places that altered and were altered by the people as they went about living. The material fragments of these past taskscapes offer myriad potential avenues for investigation. Recognizing this challenge, I focus on those involving making tool assemblages associated with subsistence practices and their temporal, spatial and social arrangements, while keeping in mind the relatedness of many taskscapes. If I consider that the temporality of the taskscape is fundamentally social and that tasks such as material procurement and tool manufacture are socially embedded activities (Ingold 2000:195), then I can examine the material remains of these activities not simply as functioning for a specific subsistence activity, but as integral parts of a larger social environment.

The concept of taskscape highlights the fact that toolmaking is embedded in larger contexts. However, it is also important to understand toolmaking in the more immediate context of the toolmaker and material. The concept of textility of making (Ingold 2010:92) emphasizes these human/material interactions as a negotiation between the material properties and the craftsperson in the process of making a thing such as a shell hammer or a bead. Ingold advances several foundational arguments for making and materials that influence the way I perceive creativity in the tool assemblages. First, the process of giving form to things is a flexible, forward-moving interrelationship based on improvisation (Ingold 2010:97). Attempting to recover a lineal connecting chain from finished tool to raw material neglects the creative process inherent in most toolmaking. Second, while things do not have agency in and of themselves, they are connected in relational networks (Latour 1993:89) with the actions
of the craftsperson. Finally, form is guided by the “fields of force and flows of the material” as well as the practitioner’s knowledge of line and surface (Ingold 2010:91). Past adjustments influence future steps and no two paths are identical.

By challenging us to think about the role of materials and relationships in the creative process, Ingold and others move us away from interpreting tool making as a lineal, causal relationship, one of the toolmaker imposing form onto raw material. Instead, we conceptualize tool making as an ever-evolving relationship between people, place, and things. However, this is not is not trouble-free. In the past, archaeologists have generally favored form over process (Ingold 2000:193; Oyama 1995:13). Indeed, what we see when we examine an artifact is its form ascribed with specific attributes that permit investigation of temporal and spatial variations, access to and selection of raw materials, possible uses, and more, in the pursuit of understanding past human practices. For example, the chaînes opératoire approach, which has been particularly popular among lithic analysts, deconstructs behavioral patterns or chains, looking for meaningful relationships in the lifecycles of objects from recovered artifact back to raw material. This is a lineal process rather than one that is interrelational (Jones and Alberti 2013:15). This approach, even in its wording, fails to take into account the improvisation required by the toolmaker working with heterogeneous materials.

Instead, I employ a mobile, non-lineal practice of examining artifacts through the actions or movements that created them, not from the present looking back, but as their making unfolds, adding significance to the role of the materials themselves. Rather than viewing the character of materials as meaningful because of human agentive actions, as in a materiality approach (Ingold 2007; Jones and Alberti 2013; Olsen 2012), this
perspective presents materials as active participants, vital and vibrant in their own right (Bennett 2010), in the material/human interaction (Ingold 2007). The toolmaker does not take control of the material, forcing it into a shape. Rather, experience and creativity direct the toolmaker’s hand while the material responds to and influences that experience and creativity. A knapped stone tool, for example, takes form through many reductive steps. Each flake removal is calculated and accomplished with the toolmaker’s understanding of the way in which the stone acted previously or the way it may react to the strike of a hammer stone. Due to inclusions and other characteristics within, the stone does not always react positively to give the toolmaker the desired result. For example, a step fracture results from a flake that breaks short during removal, causing a sharp rise or step. This may occur due to flaws in the stone, a mistake by the toolmaker, or both. The toolmaker must reevaluate his or her future sequence of flake removals to eliminate the undesirable fracture. This is a good example of how the stone’s individuality fosters active participation in the tool making process.

Guided by the toolmaker’s knowledge of line and surface, things take form “within fields of force and flows of material” (Ingold 2010:92). Materials of bone, stone, and shell store a record of growth and formation expressed in the lines and surface of the material. Forces applied by the toolmaker, combined with those within the material, tend to follow lines. Ingold (2010:92) illustrates this by examining the woodcutter splitting wood with an axe. As the axe enters the wood, the wood gives way, following the lines of the grain. We can make the same case for creating a bone point. The toolmaker may perform cuts, scoring the bone before snapping off the proximal and distal ends and
splitting it longitudinally. Each task requires knowledge of where and how deep to score before attempting to snap or split the bone. Bones may react to force and flows, following different lines depending on freshness, thermal alteration, or age of the animal and skill of the toolmaker.

These approaches influence how I examine and report on the tool assemblages from Crystal River. Taskscapes represent the day-to-day activities in the social lives of people, which include tool making. Taskscapes interconnect with many activities across the landscape, as the people live and know it, perhaps sharing connections with faraway places and people. This allows my research to consider the relatedness of many activities connected to subsistence, such as ornament making. Textility brings the toolmaker and the material together in a negotiative relationship rather than one unbalanced by the imposition of form onto material. Indeed, it considers that the materials play a role in their own making because of properties formed in their own development. I employ these concepts in my research to illustrate how various tool industries, especially stone, bone, and shell, developed and changed through time in relation to each other and to the broader landscape of which they were a part.
CHAPTER 2
THE CRYSTAL RIVER AND ROBERTS ISLAND SITES

Crystal River is perhaps one of the most important Woodland-period archaeological sites not only in Florida, but also in eastern North America (Greenman 1938; Griffin 1946; Phillips et al. 1951:173-74; Willey and Phillips 1958:160). It is famous for the number, size, and shape of its mounds, and as the southernmost large-scale expression of the Hopewell Interaction Sphere (Blankenship 2013; Thompson and Pluckhahn 2010:44; Weisman 1995a) (Figure 2.1.). Part of the Florida State Parks, the site achieved status as a National Historic Landmark in 1990. Despite its standing and widespread recognition, however, Crystal River has been the subject of only sporadic archaeological investigation. Much of the early research at the site focused on collecting exotic artifacts and classifying cultural periods. Until recently, modern archaeological work has been limited to small-scale investigations in response to park management needs and to mitigate damage by natural causes.

Far less known than Crystal River, Roberts Island Shell Mound Complex includes five recorded sites (8CI36, 8CI37, 8CI39, 8CI40, 8CI41), originally recorded by Bullen in 1972 (report on file at the Florida Master Site File, Tallahassee), and defined by Weisman (1995a). In addition, 8CI576, recorded by Ellis in 1993 (FDEP 2000), and three previously unrecorded sites (FS1, FS2 and FS3) (Figure 2.2), recently identified by CREVAP, may also be considered part of the complex.
Figure 2.1. The Crystal River Site
Map courtesy of Thomas Pluckhahn
Figure 2.2. The Roberts Island Sites
Map courtesy of Thomas J. Pluckhahn.
Archaeological History

By the time C.B. Moore conducted investigations at the Crystal River in 1903, he had traveled extensively throughout the southeastern United States, excavating and recording hundreds of archaeological sites. Motivated by the work of his contemporaries Jeffries Wyman, Andrew E. Douglass, and others (Mitchem 1999), Moore investigated sites on the both the eastern and western coasts and along much of the St. Johns and other major rivers, nearly circumnavigating Florida.

Moore’s work near Crystal River appears to have been motivated by the work of others in the region. Upon viewing the finely crafted and well-preserved artifacts recovered by Frank Hamilton Cushing from the Key Marco Site, near Naples, Florida, Moore decided to expand his endeavors to Florida’s western coast (Mitchem 1999; Moore 1900). Between the winter of 1900 and the fall of 1902, Moore visited and reported on sites from Clearwater harbor near Tampa to Ten Thousand Islands, the Chatham River near the North-West Cape, from Perdido Bay near the Florida and Alabama border to Cedar Keys just south of the mouth of the Suwannee River. In 1903, continuing south along the coast from the Suwannee River, Moore came upon Crystal River.

With permission granted by the landowner, Mr. R.J. Knight, Moore and his crew began excavating and mapping the Crystal River site. He created letter designations (A-H) for the mounds still used today. Although Mound A was visible from the river and known by the area residents, the burial mound and other features of the site were not, and the site appeared to Moore to be undisturbed by previous digging (Mitchem 1999; Moore 1903). In total, he mapped seven mounds, excavated parts of the whole complex, and rigorously excavated the central burial Mound F, much of E (the slope),
and parts of C (the circular embankment) (Moore 1903; Pluckhahn et al. 2010a; Weisman 1995a:12). Within seven days, his crew had destroyed the entire mound, documenting over 225 burials and recovering numerous local and exotic artifacts.

As he excavated, Moore focused mainly on burials and burial goods such as ceramic vessels and ornamental items. He took reasonably good notes, and during the summer months of no fieldwork, he photographed, researched, and described the artifacts, preparing for publication. He was the first to recognize that some of the ornaments made of exotic materials such as native copper and meteoric iron resembled those from the Ohio Valley region, suggesting Crystal River's connection to that area (Moore 1901:240; Pluckhahn et al. 2010a). Moore also described common artifacts of local shell, bone and stone, although with less detail than the items of more interest to him.

In his 1903 publication, Moore reports discovering large quantities of shell, bone, and stone implements and ornaments from the burial mounds at Crystal River. Unfortunately, for the most part, he does not include many illustrations of these in the report. The shell implements that he does note were primarily made from the columellae of large marine gastropods. Some he describes as “ground squarely across one end to serve as chisels and sometimes given a circular edge for use as gouges” (Moore 1903:394). Ten triangular sections of body whorls from a lightning whelk and one rectangular section were termed chisels. A large number of cups were made from various types of shell including lightning whelk, horse conch (*Triplofusus giganteus*), and Crown conch (*Melongena corona*). Some of these appeared to have been ceremonially broken before placed in the graves, similar to the treatment of some
ceramic vessels (Moore 1903). Three whelk shell tools had perforations for handles, with evidence of use wear at the beak. He noted three cockle (*Cardium*) shells and a number of clamshells and sections of shells that appeared to have wear. Other shell artifacts included small shell beads, 11 whelk gorgets, celts, and other ornaments. Over 100 shell ornaments and 17 celts showed severe deterioration. He does not mention whether any of these were collected.

Moore (1903) also discussed finding numerous hammerstones, pebble hammers, ground stones, flaked stone tools, and lithic debris. He identified a variety of stone material including chert and limestone, a conglomerate he called “pudding-stone,” sandstone, slate, and quartz (Moore 1903:397). Implements made from these materials included hammerstones made from chert and quartz, pebble hammers of sandstone and “pudding-stone,” and hones, or abrading stones made from sandstone and ferruginous sandstone. Ferruginous sandstone is cemented together mainly by iron oxides (El Hariri 2008). Thirty-one bifacial points, blades, and knives make up the flaked tool assemblage recovered. Moore (1903:397) noted that some of these stone tools exhibited fine workmanship, while others were said to be of “rude” quality. He believed that nine of these tools, all found in context with burials, exhibited breakage for ceremonial purposes. He also recovered stone celts including 14 complete and several broken specimens ranging in size from 2.5 to 12.5 inches (6.4-32.8 cm).

Returning to Crystal River in 1906, Moore (1907:408) excavated the part of Mound E not previously dug in 1903, along with six “trial holes” in the southern part of Mound C, the circular embankment. He located two burials in C and excavated 186 burials from E. Of these, he discussed recovering none of the “superior quality” artifacts
that he had recovered from Mound F in 1903 (Moore 1907:408). He did note 78 bone implements, typically made from the cannon bone of deer. The bone was split, then fashioned into pointed implements, exhibiting round or flattened cross-sections. He also reported five stingray spine lancets along with numerous marine shell columellae, chisels, gorgets, gouges of various species, and 53 drinking cups made from lightning whelk. He recovered an additional 15 bifacial stone tools including small points, lance-heads, and knives (Estabrook 2011; Moore 1907). Five of these were recovered in one burial. Moore commented on the quality and artisanship of some of the blades, the largest measuring 6.5 inches (16.5 cm). Chert comprised most of this assemblage, with one point of quartzite and one of chalcedony.

Moore (1918) made a final investigation of Crystal River in the spring of 1917. Intrigued by the disparity in the wealth of grave goods he witnessed between Mounds (F), (E), and (C), Moore excavated another 24 burials. He observed that the construction of the embankment differed considerably from that of the slope and mound, in that it appeared constructed of midden debris (Moore 1918). He previously noted the layering of gray and white sand with lenses of stained sand with a ledge of shell at the margin in Mound F. Constructed of white sand and shell, the slope (E) contained burials found mostly in the shell layer (Weisman 1995a). Moore recovered few artifacts from the burials within the embankment, remarking on artifacts attributed to only six burials (5, 6, 8, 11, 15, and 21). He briefly describes these as a limited number of bone, stone, and shell implements, charmstones, and a shell gorget (Moore 1918). Moore attributed the disparity in grave gifts to a chronological difference in the burials.
Moore seemed little interested in the shell tools recovered at Crystal River, few meriting an illustration or more than a brief description in his publications (1903, 1907, 1918). Of those he describes, large gastropod hammers and cutting-edge tools received much of his attention, particularly the horse conch and lightning whelk. Moore’s work at Crystal River, indeed his descriptive publications, encouraged further interest in the archaeology of Florida’s western coast (Weisman 1995a).

Greenman (1938) used Moore’s descriptions and illustrations to examine Crystal River and 17 other Florida mound sites for the presence of Hopewellian traits. Of 321 available traits he identified, the Florida mound sites demonstrated 133 of them. Crystal River comprised the largest number of traits of any Florida site, including a variety of copper specimens, mica, awls of deer bone, ceremonially destroyed stone celts, and more (Greenman 1938). Misinterpreting the ceramic sequences, Greenman failed to recognize fully their connection to Hopewell ceramics. Nevertheless, the connection to Hopewellian traits coupled with a diverse artifact assemblage spurred further interest in the site and led to national recognition for Crystal River (Weisman 1995a).

Beginning in the 1940s, the impetus for archaeological research at Crystal River shifted to the development of a cultural chronology using ceramic sequences and to the integration of the site within a greater regional culture history framework. Gordon Willey, in a series of investigations of the ceramics recovered during Moore’s 1903 excavation, and his own later visit to the site, rigorously deliberated the ages [or time periods] of the ceramic assemblages. First suggesting the negative-painted ceramics belonged to Santa Rosa Swift Creek, he suggested a possible Mississippian component (Willey and Phillips 1944; Pluckhahn et al. 2010). Later, Willey (1949a) placed this ceramic type
within the Hopewellian context, suggesting a Woodland-period burial complex. Contesting Willey’s temporal interpretations, Ripley Bullen (1951, 1953) and Hale Smith (1951) excavated parts of the burial mound complex arguing that at least some portions of the main burial complex were constructed during the Mississippian period (Pluckhahn et al. 2010).

Ripley Bullen continued to work at Crystal River through the 1950s and 1960s, making significant contributions to the site’s interpretation and preservation. Between 1960 and 1964, he was influential in the acquisition, planning, and development of the site as a historical memorial, making Crystal River the first archaeological state park in Florida (Estabrook 2011). Perhaps 1960 marked Bullen’s most extensive, yet least reported, investigation at the site. He identified and mapped two previously undocumented mounds (J and K) and the midden area B (Pluckhahn et al. 2010; Weisman 1995a). He excavated 35 burials in Mound G, as well as several burials overlooked by Moore in a portion of Mound F and in the embankment C (Pluckhahn et al. 2010). Moore and Bullen demolished the central burial mound complex (C, D, E and F); all that remained was a series of spoil piles. Bullen reconstructed the complex in 1964 and 1965 (Weisman 1995a).

Bullen took photographs of his work at Crystal River, but he kept few notes and never completely published the results from his 1960, 1964, and 1965 investigations of the site (Weisman 1995a). Most of the artifacts Bullen recovered from the site are located at the Florida Museum of Natural History (FMNH) in Gainesville (Weisman 1995a).
Fieldwork at Crystal River nearly stopped after Bullen’s excavations, although interpretations did not. While many archaeologists noted connections between the Florida and the rest of the Southeast (e.g. Brose 1979; Sears 1962; Seeman 1979), some also explored connections farther afield. Bullen (1966), Kellar and colleagues (1962), and McMichael (1960, 1964) all suggested connections to Mesoamerica. Ford (1966, 1969) compared formative cultures of the southeastern United States and Mesoamerica by examining how closely they shared certain traits, suggesting a diffusion of ideas, traits, and perhaps people from the Mexican Gulf Coast to the Southeast (Weisman 1995a).

A seemingly popular idea in the 1960s and 1970s, and one which continues to hold intrigue today, is that the features at Crystal River serve as important components for marking astronomical events. Hardman (1971) highlighted the importance of the two stelae for as astronomical sighting and aligning tools (Weisman 1995a). He also recorded the discovery of Stela 3, which he suggested originally stood at the top of Mound J (Estabrook 2011; Hardman 1971).

Brent Weisman and Jeffrey Mitchem conducted an investigation at Crystal River in 1985. At the time, the University of Florida was conducting an archaeological field school at the Tatham Mound, a Safety Harbor Culture (A.D 1000-1650) burial mound dating to the Mississippian Period, located 25 miles east of Crystal River (Weisman 1985; 1995a). Interested in the possibility of a Mississippian component at Crystal River, Weisman and Mitchem worked in concert with the Florida Museum of Natural History, then called the Florida State Museum, and with volunteers from the Withlacoochee River Archaeology Council (WRAC) to conduct a one-day excavation in
Midden B near Mound J (Weisman 1995a). This was perhaps the first public archaeology day at Crystal River (Figure 2.3.). The objective was to perform controlled stratigraphic excavations in order to obtain a ceramic chronology and identify cultural components of the site. Using auger or posthole probes, they located two potential areas for excavation, placing two 2-x-2-m test units in the midden. Excavating in 20 cm levels, participants screened artifacts through .25-inch (.635-cm), hardware cloth, completing one 2-x-2-m unit and one 1-x-1-m square each to a depth of 20 cm. Artifacts included projectile points, shell, faunal material, and pottery sherds (Weisman 1985, 1995a). As of 1995, the artifacts from this excavation had not been analyzed completely, although preliminary examination revealed no Safety Harbor-Period ceramics. Instead, the upper level of both excavations contained ceramics of the Weeden Island period (Weisman 1995a). The Florida Museum of Natural History currently houses the artifacts and other material from this excavation.

Subsequent archaeological work at Crystal River focused mainly on mitigating the effects of natural disasters or proposed park improvements and maintenance. Much of this work came after a severe storm in 1993, which uprooted many trees. Weisman and Newman (1993) investigated and recovered data from five of the tree falls. Flooding damaged the mobile home park located east of Mound A, which resulted in its removal and subsequent acquisition of the park property by the state. This included a seawall, installed to facilitate the mobile home park, which sustained significant damage. In 1998, an archaeological investigation took place as part of the restoration plan (Ellis 1999; Ellis et al. 2003)
The most current research conducted at Crystal River has utilized non-destructive techniques to conduct strategic investigations with minimal excavation. In 2007, Lori Collins and Travis Doering (2009) used High-Definition Digital Documentation (H3D) to record the Crystal River site and associated features. This project produced the first recorded technical mapping survey of the site since C.B. Moore’s survey, providing a fully georeferenced baseline for further archaeological investigation.
In 2008, with the help of field school students from the University of South Florida (USF) and the University of West Florida (UWF), Pluckhahn and Thompson (2009) conducted additional mapping using ground penetrating radar, GPR, electrical resistivity, and total stations. They produced appreciably more detailed topographic maps with a referenced grid system that precisely located past excavations and guided future testing (Pluckhahn and Thompson 2009).

More recently, with funding from the National Science Foundation, Drs. Thomas Pluckhahn, Victor Thompson, and Brent Weisman began the Crystal River Early Village Project (CREVAP), which seeks to examine the role of cooperation and competition in the growth of early village societies, using Crystal River as a case study (Pluckhahn et al. 2010). Field investigations include geophysical survey and coring, as well as small-scale excavations at Crystal River and the closely related sites on Roberts Island. Between 2011 and 2013, graduate and undergraduate students from USF and Ohio State University participated in these tasks, including excavation of four trenches at Crystal River and two trenches on Roberts Island. The three field seasons and the subsequent laboratory work have produced several student theses (e.g. Blankenship 2013; Delgado 2013; Duke 2015; Gilleland 2013; Menz 2012; Norman 2014), and a number of conference papers and publications (e.g. Perry-Sampson 2015; Pluckhahn and Thompson 2014; Pluckhahn et al. 2015; Thompson et al. 2015). I completed my own study in association with CREVAP, focusing on artifacts retrieved from these excavations.
Environmental Background

The Crystal River site, situated on the north bank of the river of the same name, overlooks the Crystal and Salt Rivers. From atop Mound A, the view comprises a rich diversity of both wetland and upland plant and animal communities. Probably constructed within hydric or prairie hammock communities (FDEP 2000; Pluckhahn 2009), the current anthropogenic landscape of the site is composed primarily of mollusk shell and aboriginal detritus which encouraged a hardwood closed canopy forest after abandonment. To the north, near the Main Burial Complex, is an estuarine tidal marsh area. Looking west-southwest from the summit of Mound A, one can view the Crystal River and an expansive estuarine tidal marsh. Deciduous and mixed evergreen forests, swamp forests, mesic-hydric Live Oak/Sable Palm communities occur within the state park and surrounding areas.

Located in a transitional zone between temperate and semi-tropical zones, the Crystal River area comprises a diverse ecosystem. The Crystal River is a spring-fed, tidally influenced river connecting the Kings Bay with Crystal Bay and the Gulf of Mexico. Today, 70 known springs contribute to Kings Bay and Crystal River (Chen 2014:70). The combined flows make this system a first magnitude spring flow, the fourth largest in Florida (Rosenau et al. 1977). Kings Bay is topographically low, located near the freshwater-saltwater interface of the upper Floridan Aquifer. Consequently, some of the springs discharge brackish water. These are mainly located in the western or central parts of the bay, while freshwater springs cluster on the eastern side (Champion and Starks 2001).

Situated in the Gulf coastal lowlands of Citrus County, also known as the Springs Coast Region, the Crystal River watershed encompasses 54 km² and is part of the of
the Chassahowitzka coastal strip of the Big Bend Karst Division of the Ocala Uplift District (Brooks 1981). The Ocala Uplift or Ocala platform represents an area of uplift and accelerated erosion, exposing underlying chert-bearing limestone (Upchurch et al. 1981). Exposed limestone outcroppings occur on the surface and in the eroded riverbanks near the Crystal River Site, providing material for ground stone tools. Chert outcroppings of Ocala Limestone from the Crystal River Formation occur to the north and east of the site, while Suwannee Limestone occurs to the south. These and other chert sources provided raw material for flaked stone tools.

The coastal lowlands contain salt marshes, lagoons, fresh water swamps, and hammocks. Crystal Bay is a shallow low-energy estuarine environment without sandy beaches. Vegetation on and near the shoreline include Black Mangroves, Sawgrass, Cordgrass, and Black Needle Rush Marshes (FDEP 2000). These salt marshes act as nurseries for fish and other aquatic animals, contributing to a productive environment for oysters (*Crassostrea virginica*), fish, turtles and other marine life, and providing abundant harvests for the occupants. Gastropods including crown conch and lightning whelk, and bivalves including oyster, quahog clam and other species, not only provided food sources, but also occur at the archaeological site as raw materials for making tools. Chopping, cutting, scraping, and grinding describe some of their proposed uses. Artifact assemblages also include net gauges and weights, cups, gorgets, beads and other ornaments of shell.

Wetland and upland communities provided habitats for white-tail deer (*Odocoileus virginianus*). Deer bone and antler fashioned into points, fishhooks, pins and other implements contributed largely to the bone tool assemblage at the site. Other
animals including bear, panther, alligator, turtles, sharks, stingrays and other fish, have contributed to the tool assemblage at the site.
CHAPTER 3

METHODS

Common tools of everyday life have much to tell us about how past people carried out their daily lives. But tools do not offer simply a view of the mundane; they represent an integral part of a complete way of life. As tools were indispensable to the people who made and relied upon them, so they are essential to us in our attempt to answer questions about the living activities of past people. Researchers continue to develop methods that enhance our knowledge of toolmakers and their tools, and thus shape our understanding of the lives of past people. Those researchers who developed and revised methodological techniques for the study of bone, stone, and shell tools inform my research methods (e.g. Adams 2002; Austin 1997, 2013; Eyles 2004; Luer et al. 1986; Marquardt 1992; Upchurch et al. 1981; Walker 1992, 2013). Before explaining my own research, I briefly describe some of the important research accomplished by archaeologists in the southeastern United States, focusing foremost on work done in Florida.

Previous Stone Tool Research

Of the three material types in my study, flaked-stone tools and debitage studies dominate the literature, in part due to the good preservation of stone artifacts and the long history of their analysis. While earlier lithic studies focused more on formal tools and bifacial typology within a cultural historical paradigm, later researchers have
expanded their methods to examine raw material sources, lithic debitage, micro-wear, experimental replication, and more. Conversely, ground stone tool studies lag behind those of flaked stone, perhaps because these artifacts are rarely temporally diagnostic. They often fall into a miscellaneous category in reports and papers, particularly in the Southeast. Bone tools have rarely been the subject of intensive analysis. Given my methodological approach focusing on the interrelatedness of activities within taskscapes that develop community activity patterns, well-designed tool research is integral to formulating and evaluating hypotheses about past behavior.

**Flaked Stone**

Lithic studies focusing on identifying temporal typologies of flaked stone dominated the research interests of archaeologists from the 1950s through at least the 1970s (e.g., Bullen 1968, 1975; Cambron and Hulse 1975). Ripley Bullen (1968) developed the first Florida projectile point typology in 1968. He revised this typology in 1975, adding eleven more point types to the original 39 (Bullen 1975). His work stands as a foundation for methods of identifying bifaces in Florida. Revisions to his typology have been offered by studies focusing on specific temporal periods, tool types, and distribution patterns (e.g., Dunbar and Hemmings 2004; Farr 2006; Schroeder 2002; Thulman 2006, 2012). Methodological techniques such as digital scans and geometric morphometrics (Thulman 2006, 2012) have moved typological studies toward a greater understanding of variations within distribution patterns and typological groupings.

Often overlooked in the past in favor of formal tools (particularly bifaces), debitage is an integral part of flaked stone assemblages, and key for understanding lithic technological organization. A large body of more recent lithic studies is dedicated
to debitage analysis. Common methods include mass analysis (Ahler 1989); Minimum Analytical Nodule Analysis (MANA); Primary, Secondary, Tertiary method (PST); Interpretation Free Method (IFM) (Sullivan and Rozen 1985); Individual Flake Analysis (IFA) (Magne 1985); and various experimental methods. Although many researchers note flaws in these methods when one is relied upon as a singular means of evaluating an assemblage (e.g., Andrefsky 2007:392-402; Bradbury and Carr 1995; Carr et al. 2012; Ingbar et al. 1989; Sullivan and Rozen 1985), in combination two or more of these methods provide effective analytical tools.

Austin (2013) used multiple lines of evidence in his flake debitage analysis at the Pineland Site, Florida, including Sullivan and Rozen’s (1985) methods for debitage analysis, attribute analysis, experimental reduction data, and flake size-class. Using these methods, he established core reduction as the predominant reduction activity, linked to expedient and microlith tool manufacture, while complete or nearly complete bifacial tools were imported. Similarly, Estabrook (2011) recorded flake size using the Sullivan and Rozen typology and platform attributes for the small number of waste flakes from early excavations at Crystal River. He suggested neither core reduction nor bifacial tool production dominated the assemblage. These two examples are only small parts of far more comprehensive analyses by these two authors.

Raw material research in the Southeast, such as sourcing or provenance studies, are of increasing interest for their potential to understand lithic acquisition strategies and use (e.g. Austin 1997, 2013; Austin and Estabrook 2000:200-16; Carr et al. 2012; Endonino 2007; Estabrook 2011). They may reveal local, regional and interregional interactions that can help unravel the movement of people, their exchange practices, as
well as how they structure technology (Endonino 2007). Researchers use visual and geochemical analysis techniques that enable them to determine with better accuracy the source of lithic material.

Upchurch et al. (1981) conducted a comprehensive analysis to determine if Florida’s chert exhibited characteristics distinguishable between formations, between quarry clusters, and between individual outcroppings, with varied success. Building on his landmark work, Austin (1997) and Endonino (2007) refined Upchurch’s quarry cluster analysis, redefining geological distribution. Endonino reevaluated select quarry clusters by looking at the size and abundance of the benthic foraminifera Lepidocyclina, a key index fossil in Ocala Limestone chert. He and others noted the importance of continuing raw material analysis and incorporating it into archaeological research. While researchers continue to fine-focus raw material research, sourcing raw materials accurately and consistently to the level of a specific quarry clusters remains elusive.

Nevertheless, further developing these methods continue to prove crucial to understanding patterns of human activities. Utilizing raw-material provenance analysis, Austin and Estabrook (2000:200-16) examined patterns of chert procurement and distribution over time. Their work is important in complex considerations of differential access and control of resources, exchange systems, and territoriality.

Richard Estabrook conducted the first comprehensive analysis of the flaked stone tools at Crystal River. By completing a holistic study of the procurement, life history, and final deposition of stone artifacts, he attempted to answer specific questions about social inequalities at Crystal River (Estabrook 2011). Artifacts for Estabrook’s study included material from excavations by Ripley Bullen and from other work
completed during park improvement and maintenance, storm and tree fall clean up, and other investigations. He examined photographs of artifacts from early excavations by C.B. Moore. He used a number of combined methods to test his hypotheses. Based on quarry cluster methods developed by Upchurch, and revised by Austin and Endonino, Estabrook identified the sources of the raw materials in the assemblage. Utilizing Geographical Information Systems (GIS), Cost Path and Weights of Evidence allowed him to predict the quarry locations and their availability to the inhabitants of the site. He measured the metric attributes of the chipped stone specimens and stone debitage and conducted use-wear analysis.

A bias exists in the type of lithic artifacts from early excavations due to the recovery practices and interests of early archaeologists. Because he completed his dissertation before the work by CREVAP, Estabrook did not have the advantage of analyzing controlled samples. Newly recovered, well-provenienced lithic material will potentially provide further answers.

**Ground Stone**

Ground stone technology includes diverse tool types for a wide range of manufacturing and processing tasks. Much of the research on ground stone comes from the southwestern U.S. and in other areas where households relied heavily on ground stone tools in subsistence practices (e.g.; Adams 1999:475-98; Diehl 1996:102-15; Mauldin 1993:317-30; Wills 1988). Manos, metates, mortars, and pestles for processing vegetal foods, meats, pigments, and tempers are abundant in many of these areas. In contrast, archaeologists in the Southeast typically devote far less effort to the analysis of ground stone implements. Ground stone artifacts often garner mention only in a
miscellaneous category of lithic studies, and even then only as they pertain to flake stone production. Some notable exceptions include the studies of bannerstones from the Savannah River Valley by Sassaman and Randall (2007:196-211), the analysis of greenstone artifacts from Moundville by Gall and Steponaitis (2001:99-117) and Wilson (2001:118-28), and the study of plummets from Poverty Point by Lipo et al. (2011). Even here, these exceptions focus mainly on the unusual categories of ground stone, undervaluing hammerstones, adzes, abraders, polishers, and other more utilitarian ground stone that often appear in small quantities and can be amorphous in shape, making morphological classification difficult. With the possible exception of plummets, ground stone implements make up a tiny part of the lithic artifact assemblage at Crystal River. However, classifications can still be made, as several examples illustrate.

Adams (2002) developed a classificatory system structured around the life history of ground stone implements. Her technological approach builds upon the foundational of classifications by Woodbury (1954), Martin et al. (1956, 1961, 1964) and Rinaldo (1959), to create qualitative and quantitative systems for ground stone analysis. Adams focuses on ground stone technology in the Southwest. Nevertheless, it is a valuable aid to research in all areas of the world. As I discuss later in the methods section, I have drawn from her methods, and adjusted her recording forms based on the form and attributes in the Crystal River and Roberts Island assemblages.

**Previous Bone Tool Research**

Acidic soils and predation accelerate the decomposition or destruction of bone after deposition, influencing our ability to identify and recover these artifacts. Bone does preserve well when burned partly and/or deposited in shell mounds and in wet sites.
Recovery of well-preserved bone implements from these types of sites has produced an abundant record of modified bone in Florida, yet they have received only a small amount of research and publication. There may be several reasons. The quantity of bone tools and bone tool debitage typically recovered from a site is relatively small in number, compared with lithics for example, and is functionally ambiguous. Furthermore, functional interpretations vary by researcher.

Karen Walker (1992) notes that reasonably large comparative collections of bone tools exist for some regions in Florida (e.g., Goggin 1950:46-49; Goggin and Sommer 1949; Griffin 1988; Richardson and Pohl 1985; Steinen 1982; Willey 1949a), and for specific sites (Gilliland 1975). Newer research is expanding on these earlier works, adding material from other sites (Patton 2013; Penders 1997, 2005; Walker 1992, 2000) and on more focused analysis such as production strategies and microwear (Byrd 2011). Walker presents a synthesis of the bone tool technology from three sites in southwest Florida (Josslyn Island, Buck Key Shell Midden and Cash Mound). Focusing on the use of bone tools for fishing technology as a basis for testing hypotheses, she attempts to solve some of the problems associated with existing typologies. Building off Walker’s Caloosahatchee typologies, Patton (2013) supplements the collection with a number of modified bones from the Pineland Site. Although Walker’s and Patton’s work is on material from southwest Florida, they offer the most complete typological data available that I can apply to the bone tool assemblage at Crystal River, and I thus draw heavily on their categories.

Unlike lithics and ceramics, Woodland and Mississippian bone tool forms present a somewhat homogenous assemblage that shows little variation over time (LeMoine
According to Jerald Milanich (1994:154), from the Orange Period through the historic times, the similarities in the form and manufacturing process of bone tools make temporal diagnostics difficult. The tool making sequence for these tools remained remarkably constant (Gilliland 1975:205-209; Wheeler 2004:149). On the other hand, Penders (2005:247) points out that engraved designs on bone sometimes correspond to incised pottery designs of the same period. Few bone tools from Crystal River show indication of designs, but do show possible use wear and hafting markings, which suggest possible functions. Systematic recovery and radiometric dating suggest chronological placement.

Byrd (2011) examined microwear and manufacturing patterns in an assemblage of bone tools from Archaic-period sites in the St. Johns Basin. The research suggested that consistent production strategies produced morphological tool types relevant to functionality. Byrd found that shape influenced use including cross-section, tip, base and shaft forms. However, the identifications of form and function are complicated when one tool functions for multiple tasks, or when several tools perform the same task, a problem identified by Gifford (1940). I pointed out earlier that using multiple lines of evidence in lithic analysis produce substantiated results; the same idea applies with bone.

Another difficulty is with the way in which researchers record the types and presumed function of modified bone, such as points vs. pins. For example, some researchers describe thin, round, elongated, pointed tools as pins for leatherwork or adornment, while others lump them together with other elongated pointed objects (Byrd 2011). This makes comparisons across assemblages difficult. Walker (1992), however,
presents a clear distinction between bone points and pins. Given the number of points recovered at Crystal River, compared to other bone implements (pins, awls, scrapers, etc.) this is an important distinction. To date, there are no in-depth analyses of bone tools at Crystal River and Roberts Island, presenting an opportunity to evaluate tool making sequences and typology for this assemblage.

Previous Shell Tool Research

Shell tools began to appear in the Late Archaic period, and possibly earlier (Henefield 1987; White 2003:30; White and Estabrook 1994). During the Woodland period, shell tools and ornaments became more important, in part as ceremonial items and as goods for exchange. Shell artifacts common to the central Gulf Coast include beads, drinking cups, hammers, picks, gouges, pendants, and plummets (see Bullen 1949:6,1966:861; Bullen and Bullen 1950:23-26,39,41; Goggin and Sommer 1949:54-55; Weisman 1995a:67-80). However, further detailed analysis of shell artifacts, particularly utilitarian tools from the region, remains underrepresented.

While shell and shell implements are common to sites in the central and northern Gulf coast, they are even more so to sites in south Florida. The copious numbers of shells, coupled with the lack of knappable stone, intensified their usefulness for tool manufacture. Consequently, work on shell implements at sites in this region dominates the research. In the 1940s, based on the work of Gordon Willey, John Goggin produced a widely cited yet unpublished manuscript establishing a functional typology for shell artifacts (Marquardt 1994). Goggin interpreted tool function and similarity of formal attributes, categorizing and naming shell artifacts based on perceived use (Patton 2013). These and revised names have remained a common way to refer to shell tools,
not suggesting a particular use, but as a way of recognizing a shape or size category. By the 1980s, shell tool research in southern Florida moved toward more holistic integrated studies.


Marquardt’s typology is widely used as a basis for classifying shell implements from sites around Florida and beyond. His research distinguishes 56 categories of shell tools. By synthesizing multiple shell species with the characteristics of their modifications, his system is useful beyond south Florida where some species are more
or less prevalent than others are. I use his typology as a foundation for my own evaluation of shell implements at Crystal River.

Martin Menz (2012) completed the only analysis on shell tools at Crystal River. He focused on the function and use-life of Type-G shell hammers from the Roberts Island site (8CI41) for his undergraduate thesis. Partly based on Marquardt’s typology, Menz recorded various measurements on whole, unmodified shell to come up with a length to width ratio of about 1.50:1, which he compared with modified hammer artifacts to establish the percentage of use wear. He then created functional replicas, testing them on various materials such as oysters, wood, bone and pecan nuts to establish wear pattern that he compared with the archaeological specimens. His results suggest that Type G hammers experienced extended use-lives with modification and retouch common. This suggests that, counter to Marquardt’s (1992:201) submission, they did not trend toward expedient tools (Menz 2012). The artifacts in Menz’s study consisted of shell tools gathered from the surface, without context. His work is an invitation for additional investigation using well provenienced hammers excavated from shovel tests and test units at Crystal River and Roberts Island.

Focusing on shell ornaments, Blankenship (2013) tested the hypothesis that the people of Crystal River assured their position in the Hopewell Interaction Sphere through controlling production and exchange of marine shell cups and ornaments, as suggested by Goad (1978). Working with surface finds and shell materials from coring during the 2011 field school season and with previously excavated shell, Blankenship examined the abundance and spatial placement of certain shell species, ornaments and related shell materials. She concluded that although complete ornaments occurred
plentifully in burials, the site lacked evidence for the manufacture of ornaments in enough abundance to suggest that they were regularly produced for trade, offering several alternate hypotheses. Small numbers of completed beads, plummets, and other ornamental goods excavated from the four trenches at Crystal River add credence to Blankenship's findings. To date, none of the newly excavated material suggests large-scale ornament manufacture.

**Methods Employed for This Study**

This section describes the methods employed in my study. These comprise the field collection methods and procedures, laboratory sorting and documentation, and finally artifact data collection and statistical methods. During the summers between 2011 and 2013, field school students recovered material from the two sites, sorting materials from certain proveniences while on-site. After the field school, sorting continued in the laboratory at USF with the help of graduate and undergraduate students. In order to address my thesis question, I collected the pertinent data from the separated artifacts for my study and applied statistical methods.

Based on a 2011 mapping, geophysical survey and strategic core sampling, Pluckhahn et al. (2015) chose locations for limited excavations within the Crystal River (Figure 3.1) and Roberts Island Mound Complexes (Figure 3.2). They positioned trenches across the midden at Crystal River and placed both shovel tests and trenches at Roberts Island, targeting areas with the potential to the reveal the form and timing of mound construction and midden accumulation (Pluckhahn et al. 2015).

Material recovered from four trenches at Crystal River provided a majority of the artifacts for this study. Trenches measured 1-x-2-m and 1-x-4-m in size, comprising 1-x-
1-m test units. Trench 1, located just northeast of Mound K on the higher and better-preserved ridge of midden, included Test Units 1 through 4. Trench 2, placed in the area of midden that was impacted by the 1970s mobile home park, northeast of Mound A, included Test Units 5 and 6. Trench 3, placed on the midden immediately north of Mound A, included Test Units 7 and 8. Finally, Trench 4, placed on the easternmost part of the midden ridge, behind the current park ranger residence, included Test Units 9 and 10. The long dimensions of Trenches 1 through 3 were oriented on an east-west axis, while Trench 4 was oriented north-south. Attendees of the summer field schools completed excavations of Trenches 1 and 2 in 2012, and Trenches 3 and 4 in 2013.

The method of excavating each test unit involved arbitrary 10-cm levels. The field crew screened material through .125-inch (3.2-mm) mesh, removing and bagging identifiable artifacts on site. Where soils made identification of artifacts difficult, we used water screening to clean the material. With the exception of oyster shells, which the crew counted, weighed, and left onsite to refill the trenches, we bagged and brought all of the artifacts and material remaining in the screen back to the laboratory for fine sorting. At the end of every day, the bagged artifacts received a distinct Field Specimen (FS) number, by provenience, which we recorded in a FS log.

We excavated each test unit to culturally sterile soil or until we reached the water level at low tide. This meant that we had to work effectively during low tide periods to reach the deeper extent of midden material and complete plan and profile drawings before the trenches became inundated. Finally, we took column samples from Trenches 1 and 4. These measured 25 x 25 cm and each level measured 4-cm in depth. The column samples provided material for pollen analysis and radiocarbon dating.
Figure 3.1. Locations of excavations at the Crystal River
(Figure complements of Thomas J. Pluckhahn)
Figure 3.2. Locations of excavations at the Roberts Island Site
(Figure complements of Thomas J. Pluckhahn)
Crews undertook surface collection, shovel test sampling, and trench excavations at Roberts Island. Shovel tests, placed on a 20-m grid, measured 50 by 50 centimeters. Methods for shovel testing incorporated arbitrary 10-cm levels excavated to a depth of 1 meter where possible. In areas where midden deposits continued below 1 meter, posthole tests extended the depth of the shovel tests by 30-50 cm (Pluckhahn et al. 2015). Using the same protocol for the shovel tests as with the test units, crews screened material using .125-inch (3.2-mm) mesh, counted and weighed whole oyster shells, and then removed the remaining screened material for further laboratory sorting.

A small number of artifacts recovered in 2011 during surface collection and limited coring are also included in my sample. Researchers collected 95 shell artifacts during a surface survey across the Crystal River site. In addition, they took 58 core samples at 20 m intervals across certain areas of the site (Blankenship 2013).

A little over three years of laboratory sorting produced the artifacts for this study. Graduate and undergraduate students sorted materials under the supervision of laboratory graduate assistants. Each provenience with a FS number constituting a level, feature, or locus revealed a variety of different materials, meticulously separated, weighed, counted and each documented on a tally form with an ending catalog number (e.g. FS 65.01). Students cataloged specimens, bagged them separately, then boxed and curated them in the Southeastern Archaeological Laboratory at USF. They are available for future analysis or await final curation at the Florida Bureau of Archaeological Research in Tallahassee.

Because I applied a relational perspective to my study, it was important to examine all forms of modified bone, stone, and shell material. This not only included
recognizable tools and tool debitage, but also other items such as pendants, gorgets, beads, and cups that required tools to craft. During sorting, students and I separated these materials for examination and characterization based on chosen methods for each material type. Laboratory equipment utilized for each material type include a digital caliper set to the nearest tenth of a millimeter to measure the physical attributes and a digital scale set to the nearest tenth of a gram to weigh the materials. To examine certain attributes, I employed microscopic examination using a LW Scientific binocular microscope with fluorescent lighting at 20x and 40x power and a Meiji EMZ-5D Stereo Zoom binocular microscope with variable LED lighting at between 7x and 45x power.

**Bone**

Our excavations recovered N=75 bone artifacts from Crystal River and N=7 from Roberts Island. These included bone tools from both sites (N=30, N=4), modified bone (N=20, N=1), waste material from tool manufacture (N=4) and antler fragments (N=16) from Crystal River and ornaments (N=5, N=2) from both sites. Prior to final examination and measurement, I attempted to locate and reassemble broken artifacts. Some specimens showed evidence of past breakage, while others succumbed to breakage during recovery or processing. In both cases, I was able to mend several of the fragmented specimens I examined each artifact and documented attributes on a Bone Tool Observation Form. Each artifact received a FS Catalog Number specific to the provenience (if not already assigned) and a tool number specific to the individual specimen. I noted the genus and species where identifiable. A preliminary tool type assigned to each tool loosely follows Walker’s (1992) typology. However, the bone artifact assemblage from Crystal River is small, with fewer types represented. Awls,
single-pointed and bi-pointed points implements constituted the largest number of complete identifiable bone artifacts, although the numbers are still small (N=15). Bi-pointed points are often represented as asymmetrical and symmetrical types. Asymmetrical points exhibit dissimilar bilateral proportions between proximal and distal ends, while symmetrical points exhibit proportional or nearly proportional characteristics. I make the distinction here to discuss differential measurements between the two types.

Material identification often proved difficult due to the fragmentation, degree of modification or degraded quality of the bone. However, Karen Walker (2000:28) noted that white-tailed deer metapodial bone represented the most common material used to make bone points in southwestern Florida, with some use of ray spines. In this assemblage, white-tailed deer metapodial appeared most common. Yet, unless positive, I listed specimens as unidentified mammal or unidentified vertebrate.

I measured each artifact, documenting the weight, maximum length, width, and thickness. Maximum length represented the longest linear measurement, while width represented the longest linear measurement perpendicular to the length, and thickness perpendicular to both length and width. Width and thickness measurements on the large number of rounded single-points and bi-points proved difficult to discern from one another. In this case, I recorded the width as the larger measurement.

Stone

As I note earlier, stone tool analysts have developed an array of methods that, when combined selectively, address particular questions. My relational perspective explores chipped stone and ground stone implements and debitage, and therefore I drew upon multiple techniques most pertinent to explore my thesis question.
In total, we recovered 1,439 lithic artifacts from the two sites, N=1251 from Crystal River and N=188 from Roberts Island. The primary material represented included locally acquired flaked stone debitage (flakes N=299, N=42, flake fragments N=496, N=29 and flake shatter N=391, N=68). Formal tools, bifacial and unifacial tools, and modified and utilized flakes represented a smaller number of the overall assemblage (N=22, N=5) along with cores and performs (N=6, N=5). Non-local crystal quartzs recovered from Crystal River, but not Roberts Island included 11 debitage specimens. In addition, we recovered a ground and pecked stone implements (N=5, N=3) and potential ground and pecked stone (N=18, N=36). We recovered almost 2500 pieces of limestone. I examined each for evidence of modification and/or usewear. Those showing indications of use or modification are included in the representative category above. Most, however, did not show signs of either and I simply recorded them as unmodified.

I began by separating the flaked stone morphological types using a modified flow chart developed by Andrefsky and Bender (1988, figure V1) and revised by Andrefsky et al. (1994:101) (see Figure 3.3). With the exception of flake fragments and non-flake shatter, each type received individual tool numbers and underwent individual examination. I first recorded nominal scale attributes for each type, such as source and type of raw material, color, presence or absence of thermal alteration on observation forms. Bifaces received additional attribute descriptions, largely adapted from Cambron and Hulse (1964). For flakes, I included type of termination (feathered, stepped, hinged) and platform attributes (flat, faceted, crushed, cortical) and type of preparation (trimmed, ground, or none) adapted from Andrefsky (2005, figure 4.7).
All of the stone underwent metric measurements. I recorded metric measurements specific to bifaces, both hafted and unhafted, which when combined with nominal attributes aided in identifying point types. Flake fragments and shatter simply received the classification of chert, quartz, silicified coral, or other, with a weight and quantity documented for each material type. I added notes to the fragments and shatter document when I encountered attributes worth mentioning. Most often, I noted evidence...
of heat alteration or damage in the form of crazing, potlids, and changes in color and texture.

One might say that the term ground stone is any stone artifact that does not fit into the flaked stone category. Ground stone is manufactured by and/or utilized for grinding, abrading, polishing, impacting, or a combination of these actions (Adams 2002). However, things rarely fit nicely into categories as well as we would like. Cores may undergo intermittent pecking during platform preparation and reconditioning processes for effective flake removal, while axes may undergo flaking as part of the shaping or re-sharpening processes. Adams identified five categories for ground stone: (1) tools for processing (manos, matates, mortars, and pestles) grains and seeds, pigments, clays and tempers; (2) tools for manufacturing (hammerstones, abraders, choppers, polishers); (3) items shaped by grinding, abrading, polishing, impacting such as plummets and other ornaments; (4) pigments and minerals; (5) hammerstones and pecking stones, which are used for working with both flaked and ground stone (Adams 2002).

Limited in number and diversity, the ground stone assemblage in this study included 62 implements of limestone, chert, and sandstone. Using Adams’s suggestions, I separated the assemblage, placing each artifact into one of the five categories listed above. Then, I took metric measurements of each, as recommended by Adams. However, because ground stone plummets were not well represented in her book, I modified the methods based on the ongoing work of Victor Thompson and Thomas Pluckhahn (personal communication).
Shell tools and tool fragments numbered 353 specimens. Hammer/pounder type tools fashioned from crown conch shell contributed the greatest number of specimens (N=310). I looked initially to Marquardt’s (1992) typology for shell tools as a guide. However, Marquardt’s work in southwestern Florida dealt with a much larger sample and a broader assortment tool types, represented by different species, lightning whelk and horse conch, which are not found in large numbers in west-central Florida. Marquardt’s typology incorporated 52 tool types including 10 sub-categories for gastropod cutting-edged tools and 11 gastropod hammers/pounders. He grouped hammers pounders and cutting-edge tools by identifying very specific measurements and arrangement of the hafting holes and notches and of the working edge. Although shell tool research at Crystal River and Roberts Island would benefit from this level of specificity, I chose to streamline the typology for my research similar to the one adapted by Eyles (2004) for his northern Florida work. Specifically, I grouped individual hammer and cutting-edged tool types into more inclusive categories and simplify others as shown in Table 3.1. I do recognize, however, that the most abundant shell tool at both sites is the hammer pounder that fits the Type G typology.

I documented nominal attributes and metric measurements on the CREVAP Shell Tool Observation form. The various kinds of modified shell required adjustments to the form to represent adequately their measurements and attributes. Instead of creating a new form for each of these, or cluttering the one form to accommodate all, I simply added attribute and measurement responses to each form as needed. I felt this adequately covered the needed information collected from the small number of assorted artifacts such as beads, perforated oyster, net gauges, and other modified shell.
Table 3.1. Revised shell tool typology

<table>
<thead>
<tr>
<th>Typology for This Study</th>
<th>Marquardt's Typology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hafted Gastropod Hammer/Pounder</td>
<td>Gastropod Hammer A, B, C, D, E, F, G.</td>
</tr>
<tr>
<td>Unhafted Gastropod Hammer/Pounder</td>
<td>Gastropod Hammer, Unhafted</td>
</tr>
<tr>
<td>Gastropod Hammer/Pounder Indeterminate Hafting</td>
<td></td>
</tr>
<tr>
<td>Gastropod Cutting Edge Tool</td>
<td>Gastropod Cutting-edged Tool A, B, C, D, E, H, I, J, Unhafted and Indeterminate.</td>
</tr>
<tr>
<td>Gastropod Tool Indeterminate Function/Hafting</td>
<td></td>
</tr>
<tr>
<td>Gastropod Dipper/Cup/Spoon</td>
<td></td>
</tr>
<tr>
<td>Columella Hammer</td>
<td>Columella Hammer</td>
</tr>
<tr>
<td>Columella Perforator</td>
<td>Columella Perforator</td>
</tr>
<tr>
<td>Columella Cutting Edge Tool</td>
<td>Columella Cutting-edged Tool</td>
</tr>
<tr>
<td>Columella Indeterminate</td>
<td></td>
</tr>
<tr>
<td>Bivalve Cutting/Scraping Tool</td>
<td>Bivalve Knife/Scraper</td>
</tr>
<tr>
<td>Perforated Bivalve</td>
<td></td>
</tr>
<tr>
<td>Unidentified/Modified Shell</td>
<td></td>
</tr>
</tbody>
</table>

Gastropod hammers/pounders represented the greatest quantity of modified shell. For these, I recorded the maximum length as the distance from the posterior end (apex) to the anterior end (base) and the maximum width as the distance from the aperture where it meets the shoulder to the opposite side of the shoulder. I recorded the body whorl thickness closest to where it meets the collumella at the base off the shell. Finally, I recorded the working-face width as the maximum distance across the collumella that showed obvious use such as blunting, beveling and spalling. I documented descriptions of the tool types (gastropod and columella hammer/pounders, cutting edge tools or indeterminate, columella perforators, hafted, unhafted or
indeterminate), wear type (blunt, spalling, blunt and spalling, beveled, little or no wear, unidentified), and the number of notches and or holes present.

**Measure of Density**

I used density measures to illustrate the distribution of artifact density across temporal phases and across the sites within each phase. Correlating tool and faunal density distributions allowed me to explore the relationship between tool choices and subsistence practices. I began by calculating the volume of each phase excavated in cubic meters. The volume for Phase 1 is .50 m³, Phase 2 is 3.10 m³, Phase 3 is .37 m³, and Phase 4 is 1.15 m³ for Crystal River and Roberts Island combined (Table 3.2). While reviewing the results, two problems arose. First, the volume for Phases 1 and 3 is small, making conclusions for these phases somewhat suggestive, relative to the other two phases. Second, at Roberts Island many of the artifacts fall outside dated contexts, yet fall within Phases 3 or 4. I remedied this by discussing the artifacts by early occupation (Phases 1 and 2) and later occupation (Phases 3 and 4) when applicable.
Table 3.2. Phase volumes

<table>
<thead>
<tr>
<th>Phases</th>
<th>Provenience</th>
<th>Volume (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Site</td>
<td>Unit</td>
</tr>
<tr>
<td>Phase 1</td>
<td>8CI1</td>
<td>Unit 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unit 5</td>
</tr>
<tr>
<td>Phase 2</td>
<td>8CI1</td>
<td>Unit 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unit 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unit 7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unit 9</td>
</tr>
<tr>
<td>Phase 3</td>
<td>8CI1</td>
<td>Unit 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unit 7</td>
</tr>
<tr>
<td></td>
<td>8CI41</td>
<td>STP 6</td>
</tr>
<tr>
<td>Phase 4</td>
<td>8CI1</td>
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<td>8CI41</td>
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<td>STP 7</td>
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<tr>
<td></td>
<td></td>
<td>STP 11</td>
</tr>
</tbody>
</table>
CHAPTER 4
RESULTS

As I noted briefly in Chapter 1, material recovered during the Crystal River Early Village Project provided refined radiometric dates that align well with stratigraphic breaks in test units. Based on these lines of evidence, Pluckhahn et al. (2015:32) established four phases of midden formation at the two sites (see Table 1.1). These results focused on those artifacts recovered from these well-dated phase contexts as they securely demonstrate that choices in material and morphology of subsistence tools are reflected in changing subsistence activities and social life. I included those artifacts that fall in the levels above and below the identified phases, as they are also important in forming a continuum of taskscapes that shape patterns of community activities over time.

Since my concern is with how tool assemblages change through time and in association with broader social contexts, it is worth reviewing the temporal trends noted by Pluckhahn et al (2015). Phases 1 and 2 occur only at Crystal River. In Phase 1, the midden was relatively small and the occupation may have been seasonal. In Phase 2, the community expanded dramatically and the occupation appears to have been year round. Settlement at Roberts Island began later, in Phase 3, and intensified during Phase 4. Conversely, activity at Crystal River declined during these latter two phases. When I examined the changes in the density and assortment of tools by phase at each site, the results aligned with these temporal trends.
However, is important to keep in mind that an imbalanced sampling occurs between the volumes of the phases. Phases 2 and 4 are better represented than Phases 1 and 3. Therefore, it is informative at times to characterize occupation by early (Phase 1 and 2) and late (Phase 3 and 4) to substantiate phase by phase results (see Table 3.2).

At Crystal River, Phases 1 and 4 exhibited a lower density and fewer tool types than Phase 2. This is consistent with the suggestion by Pluckhahn et al. (2015) that these phases represented less intensive occupation of the site. Phase 2 exhibited a much larger variety and density of tools, consistent with the expansion of the midden and greater permanent population. Overall, tool numbers declined during Phase 3, yet not to the extent that they did in Phase 4. This, coupled with the beginning settlement of Roberts Island, suggests a transition by the population away from Crystal River to the neighboring site. The tool assemblage in Phase 3 at Roberts Island included fewer implements and less variety, which is expected if people are beginning to settle there, or the settlement was less permanent. Tool variety and density increased during Phase 4 at Roberts, but never again reached the levels of the earlier Phase 2 at Crystal River. Yet, this increase may suggest a trend toward a more permanent settlement at Roberts Island.

The Crystal River (Table 4.1) and Roberts Island (Table 4.2) tool assemblages number 1445 and 377 specimens, respectively. I describe the assemblage by tool industry, beginning with bone tools, followed by stone, and finally shell. As I discuss each of these, I keep in mind the relational qualities of the different materials, artifacts, and activities.
Table 4.1. Artifact density by phase for Crystal River 8CI1

<table>
<thead>
<tr>
<th>Artifacts</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
<th>Total</th>
<th>Non-dated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>N/m³</td>
<td>N</td>
<td>N/m³</td>
<td>N</td>
<td>N/m³</td>
</tr>
<tr>
<td>Bone Tools</td>
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<td>4.00</td>
<td>48</td>
<td>15.49</td>
<td>1</td>
<td>2.70</td>
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<tr>
<td>Bone Tool Debitage</td>
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<td>1.29</td>
<td>4</td>
<td>1.29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antler</td>
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<td>5.16</td>
<td></td>
<td></td>
<td>16</td>
<td>5.16</td>
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<tr>
<td>Shell Tools</td>
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<td>2.00</td>
<td>36</td>
<td>11.61</td>
<td>9</td>
<td>24.32</td>
</tr>
<tr>
<td>Flaked Stone Tools</td>
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<td>5.80</td>
<td></td>
<td></td>
<td>18</td>
<td>5.80</td>
</tr>
<tr>
<td>Whole Flakes</td>
<td>8</td>
<td>16.00</td>
<td>201</td>
<td>64.84</td>
<td>33</td>
<td>89.19</td>
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<tr>
<td>Flake Fragments</td>
<td>2</td>
<td>4.00</td>
<td>371</td>
<td>119.68</td>
<td>12</td>
<td>32.43</td>
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<tr>
<td>Shatter/Non-orientable</td>
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<td>12.00</td>
<td>296</td>
<td>95.48</td>
<td>16</td>
<td>43.24</td>
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<tr>
<td>Quartz Debitage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11</td>
<td>3.55</td>
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<tr>
<td>Stone Cores and Preforms</td>
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<td>.97</td>
<td></td>
<td></td>
<td>3</td>
<td>.97</td>
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<tr>
<td>Ground and Pecked Stone</td>
<td>3</td>
<td>.97</td>
<td></td>
<td></td>
<td>3</td>
<td>.97</td>
</tr>
<tr>
<td>Potential Ground and Pecked Stone</td>
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<td>8.00</td>
<td>5</td>
<td>1.61</td>
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<td></td>
</tr>
<tr>
<td>Stone Non-tool</td>
<td>2</td>
<td>.65</td>
<td></td>
<td></td>
<td>2</td>
<td>.65</td>
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<tr>
<td>Shell Ornaments</td>
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<td>7.10</td>
<td></td>
<td></td>
<td>22</td>
<td>7.10</td>
</tr>
<tr>
<td>Bone Ornaments</td>
<td>2</td>
<td>4.00</td>
<td>2</td>
<td>.65</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>25</td>
<td>50.00</td>
<td>1038</td>
<td>334.85</td>
<td>71</td>
<td>191.89</td>
</tr>
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</table>
Table 4.2. Artifact density by phase for Roberts Island Sites 8Cl41 and FS1

<table>
<thead>
<tr>
<th>Artifacts</th>
<th>Phase 3</th>
<th>Phase 4</th>
<th>Total</th>
<th>Non-dated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N  N/m³</td>
<td>N  N/m³</td>
<td>N  N/m³</td>
<td>N</td>
</tr>
<tr>
<td>Bone Tools</td>
<td>2 1.74</td>
<td>2 1.74</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Shell Tools</td>
<td>4 10.81</td>
<td>45 39.13</td>
<td>105</td>
<td></td>
</tr>
<tr>
<td>Flaked Stone Tools</td>
<td>2 1.74</td>
<td>2 1.74</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Whole Flakes</td>
<td>11 9.57</td>
<td>11 9.57</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Flake Fragments</td>
<td>8 6.96</td>
<td>8 6.96</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Shatter/Non-orientable</td>
<td>8 6.96</td>
<td>8 6.96</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Quartz Debitage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stone Cores and Preforms</td>
<td>3 2.61</td>
<td>3 2.61</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Ground and Pecked Stone</td>
<td>1 .87</td>
<td>1 .87</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Potential Ground and Pecked Stone</td>
<td>2 5.41</td>
<td>9 7.83</td>
<td>11 9.57</td>
<td>25</td>
</tr>
<tr>
<td>Stone Non-tool</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shell Ornaments</td>
<td>1 .87</td>
<td>1 .87</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>Bone Ornaments</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>6 16.22</td>
<td>90 78.28</td>
<td>96 83.50</td>
<td>281</td>
</tr>
</tbody>
</table>
Bone

Bone is often poorly preserved on archaeological sites; not surprisingly, it represents the fewest number of artifacts studied for this project. This lack of preservation makes positive morphological and species identification difficult for the fragmented and degraded specimens. With that in mind, I chose a conservative approach to identification. The metapodial bones of white-tail deer were the material of choice in the Southeast for awls (Kidder 1932:202), for single and bi-pointed points (Walker 2000:28), for most bone implements (Marquardt 1992:240), and for other implements (Richardson and Pohl 1985:149; Wheeler 2004:154). Consequently, I suggest my results are skewed toward unidentified mammal, while under representing white-tail deer. Even though the total number of bone tools is low, we find interesting trends in artifact density and location.

As shown in Table 4.3, the density and variety of bone tools are particularly high in Phase 2. Recent radiometric dates suggest a rapid expansion of the midden to the southeast during this phase, concurrent with the construction of Mounds H and K and perhaps in preparation for subsequent mound construction (Norman 2014; Pluckhahn et al. 2015:32). Pluckhahn and colleagues (2015) suggest the development of a larger, more permanent population. It follows that the density of bone tools used to sustain a larger population is higher during this phase (15.49/m³) relative to the other three phases (8.44/m³) combined. Likewise, examining tool density for early occupation (Phases 1 and 2) vs. late (Phases 3 and 4), including the un-dated Roberts Island tools in the latter, the outcome is similar (14.17/m³, 3.95/m³).

There is evidence for localized concentrations of bone tools at various points in time, but also across the site at Crystal River. Test Unit 5 (37-127 cmbd) and Test Unit
9 (45-135 cmbd) are located on Midden B. The former is located east of Mound K and, north of Mound A, while the latter is located on the easternmost end of the midden (see Figure 3.1). Both date primarily to Phase 2. Yet bone tool density between the two is quite dissimilar, with a lower density for Test Unit 5 (2.90/m³), versus Test Unit 9 (11.61/m³). Pluckhahn et al. (2015) suggests people may have extended the midden, where Test Unit 5 is located, to frame the lagoon and create a formal entry. Even though this location offered direct access to the river and its resources, I would not expect the day-to-day activities, particularly those dealing with provisioning and processing food, to take place at the entry to the site. It is more likely these activities took place away from the “front door.” This might account for the lower density in Test Unit 5. Test Unit 9, on the other hand, located about 100 meters east, is also in an area of the midden with direct access to the river. The greater density of bone tools in this test unit, particularly bone points used for fishing (I discuss these in depth later in the chapter) suggest that this area of the midden was important in harvesting fish.

Unfortunately, at the time of this writing, we do not have the faunal results for Test Unit 9 to inform a comparison between the two test units. Also, the Phase 2 contexts of Test Units 1 and 7 (near Mounds A and K) also contain few bone tools. Unfortunately, we recovered too few tools from Roberts Island to make spatial assumptions.

Contrasting with Phase 2, the overall density of bone tools drops sharply in Phases 3 and 4 at both sites, even though there is a shift in activities to Roberts Island during that time. We recovered no bone tools from Roberts Island in contexts directly dated to Phase 3. Only two bone tools in one test unit, Unit 8 (1.74/m³), can be securely associated to Phase 4. We recovered only one tool from Phase 3 contexts at Crystal
River, from Test Unit 7 (2.70/m³). The timing of this decline corresponds to a shift in subsistence foods, away from terrestrial and marine vertebrates, toward invertebrates. Duke’s (2015) research revealed a decline in some marine vertebrates after Phase 2 and an overall decline in vertebrates after Phase 3, with a corresponding increase in invertebrates, specifically bivalves. At the same time we see a shift in resource exploitation and decline in bone tool use, we also see an increase in the use of shell tools, which I discuss later.

Table 4.3. Bone Tool density by phase for Crystal River and Roberts Island

<table>
<thead>
<tr>
<th>Bone Artifacts</th>
<th>Phase</th>
<th>Total</th>
<th>Non-dated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Bone Awl</td>
<td>2</td>
<td>.65</td>
<td>1</td>
</tr>
<tr>
<td>Single Point</td>
<td>1</td>
<td>2.00</td>
<td>2</td>
</tr>
<tr>
<td>Bi-pointed</td>
<td>1</td>
<td>2.00</td>
<td>7</td>
</tr>
<tr>
<td>Fish Hook</td>
<td>1</td>
<td>.32</td>
<td></td>
</tr>
<tr>
<td>Needle</td>
<td>1</td>
<td>.32</td>
<td></td>
</tr>
<tr>
<td>Beamer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broken Point/Tip</td>
<td>9</td>
<td>2.90</td>
<td></td>
</tr>
<tr>
<td>Unfinished Point</td>
<td>2</td>
<td>.65</td>
<td>1</td>
</tr>
<tr>
<td>Debitage</td>
<td>4</td>
<td>1.29</td>
<td></td>
</tr>
<tr>
<td>Modified Bone</td>
<td>20</td>
<td>6.45</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
<td>4.00</td>
<td>48</td>
</tr>
</tbody>
</table>

It is prudent to take some of these results with caution due to sampling bias, as illustrated by the results from Test Unit 1. Here, the density of bone points (the only tool type recovered) is high in Phase 1 (4.00/m³), with only two specimens. There is an apparent decrease in bone point density in Phase 2 (2.90/m³) with nine specimens, yet
overall number is much higher. However, in Phases 1 and 3, just a few artifacts affect density considerably because the volume is low (.50 m³ and .37 m³ respectively), compared with Phase 2 (3.10 m³) and Phase 4 (1.15 m³). The disparity in overall volume coupled with the limited number of artifacts recovered within some of the phases and across test units and shovel tests limit strong conclusions. Therefore, I examine bone, stone and shell relative to one another because sampling bias should affect them equally.

Bone points, including single and bipoint as well as broken point tips, show greater overall density (9.81/m³) than any other bone tool type, followed by unidentified modified bone (7.32/m³). As I noted in Chapter 3, the use of bone points related to fishing is well documented. In fact, Walker (2000) proposes fishing as the primary use for bone points as composite fishhooks, throat gorges, and leisters. A high density of points and broken point tips are found in Phase 2, Test Unit 9 (5.81/m³). Although we do not have the results of the faunal analysis for this test unit, it is clear from an earlier report from Test Unit 5 that a balance between terrestrial and marine (particularly estuarine) resources occurs during this time, with a strong focus on mullet (Little and Reitz 2015:4). However, other fishes in the family of Siluriformes such as catfishes, and of Sparidae, including porgies, redfish, and bream are also common. People targeting these species would have employed multiple fishing strategies, including netting, spearing and line fishing. One can also argue that these point types may have had several applications for both hunting (projectile points) and crafting (weaving). However, Walker infers a specific use for bi-points as throat gorges.
We recovered six symmetrical bi-points, three asymmetrical bi-points, and three single-pointed points, ranging in length from 61.1 to 110.7 mm, mean 81.1. Generally, bi-pointed points showing symmetry are shorter in length (61.1-76.6 mm: mean 67.8) than those that are asymmetrical (81.1-110.7 mm: mean 96.9). Single points range from 74.0 to 108.3 mm with mean of 87.4 mm, better represented by the median of 79.9. The range in size of the symmetrical points is small, compared with the range of the other two point types, though the samples for both types are small and may not reflect the true range of sizes. This is still interesting and prompts me to speculate whether these have a specific function, requiring standardization. Perhaps bone points were manufactured in consistent sizes as throat gorges for a particular size range of fish, or as replaceable parts to a composite fishing implement such as a leister or hook. The size may even indicate a preference by a single individual, as four of the six complete bi-points came from levels 8 and 9 of Test Unit 9.

By comparison, bi-points from the Pineland Site Complex (500B.C.- A.D. 1500) in Lee County, southwestern Florida, also exhibit differential lengths among 8 symmetrical points (range 42.6-78.9), four asymmetrical points (range 43.9-142.0 mm), and 12 complete single-pointed points range from 48.7 to 176.0 (Patton 2013:733-738). We might expect to see similar results from other sites if each of these has a use or range of uses specific to each type, but unfortunately, comparative data are limited. If we hope to make better assumptions about the role of these two types of tools, we need more detailed morphometric analyses, experimental replication and use, and comparative use wear analyses on a greater number of samples across sites.
A macroscopic examination of the bone point assemblage reveals that some exhibit scars from manufacturing and from hafting or attachment (Figure 4.1). Table 4.4 shows the location of the possible hafting marks or grooves, measured from the tip of the point nearest the markings. I refer later to proximal and distal ends for some of the points. As with hafted bifaces, the proximal end is the hafted end and the distal end is the point furthest from the hafted end. With bone points, the distinction between the two ends is sometimes difficult to determine, particularly with symmetrical bipoints having no attachment markings. However, for asymmetrical and single points, I refer to the blunted end as the proximal end.

Table 4.4. Location of possible hafting/attachment marks on bone points

<table>
<thead>
<tr>
<th>FS #</th>
<th>Type</th>
<th>Hafting Location (mm) distance from tip</th>
<th>Overall Length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>660.23</td>
<td>Asymmetrical</td>
<td>15.54-18.76</td>
<td>99.07</td>
</tr>
<tr>
<td>660.24</td>
<td>Asymmetrical</td>
<td>19.24</td>
<td>110.66</td>
</tr>
<tr>
<td>1145.23</td>
<td>Symmetrical</td>
<td>7.67-12.10</td>
<td>61.06</td>
</tr>
<tr>
<td>1150.11</td>
<td>Symmetrical</td>
<td>18.00-24.42</td>
<td>76.55</td>
</tr>
<tr>
<td>247.29</td>
<td>Tip only</td>
<td>16.00-19.00</td>
<td>26.43</td>
</tr>
<tr>
<td>640*</td>
<td>Tip only</td>
<td>14.78-16.63</td>
<td>34.07</td>
</tr>
<tr>
<td>1150.15</td>
<td>Tip only</td>
<td>9.80-12.80</td>
<td>16.67</td>
</tr>
</tbody>
</table>

640* Point fragment from Test Unit 2, Level 4
Figure 4.1 illustrates some of the points (a-h), with an enlargement of particularly clear hafting marks on one point (c). Symmetrical bi-points (d-h) typically exhibit damage and spalling on one or both ends with little or no evidence for hafting, although two of the six (d and e) have a slight transverse depression near one end, possibly from hafting. The sixth point is fragmented and is not illustrated in the figure. Two of the three asymmetrical bi-points (a and c) display definitive transverse grooved markings near the larger blunt end (proximal) and all three exhibit a slightly stepped attenuation near (~ 6-8 mm) the proximal end also. I note that this characteristic on the other point types, whether or not hafting marks are present. It is possible this damage occurred from socketing or other type of attachment that caused the step. I suggest that these warrant further investigation. Single points did not exhibit hafting scars. One experienced sharpening on the distal end and beveling/flattening at the rounded base.

We recovered 12 broken point tips ranging from 9.0 to 51.1 mm in length. Eight of the 12 tip fragments occur in Test Unit 9 and are associated with Phase 2. Perhaps, back at the site, the toolmaker replaced the broken part, discarding it in the work area. This idea further supports the suggestion for the crafting, use, and repair of tools in the midden area near Test Unit 9. Three others occur in Phase 2, Test Units 1 and 5, and in an undated context of Test Unit 7. The last occurs in the later phases at Roberts Island. They are likely the remains of one of the three point types, as we did not recover pins at either of the sites. Even so, they lack the elements necessary for confident identification. What are interesting about these points are the break length and the position of possible hafting or attachment markings.
Figure 4.1. Bone points
Enlarged section of point C showing hafting marks
a) FS 660.24; b) FS 1160.23; c) FS 660.23; d) FS 1150.11; e) FS 693.18; f) FS 1160.24; g) FS 1145.23; h) FS 1145.32
The best example for this is specimen FS # 640 from Test Unit 2, Level 4 at Crystal River (Figure 4.2). Although this point fragment did not come from one of the test units included in my investigation, I include it in the statistical analysis. It is the only example I have with such well-preserved markings. Roughly associated with Phase 3, this partly burned point fragment exhibits not only deep transverse scaring, but also slightly oblique wrapping marks from the tip to near the break. The fire seems to have acted to enhance and preserve these markings. The deep transverse scarring exhibits distant from tip measurements consistent with those present on six other points (Figure 4.2). The end of the observable wrapping at 26.3 mm is near the mean breaking point for the twelve broken point fragments.

Figure 4.2. Bone point fragment with evidence of wrapping
The results of statistical testing for these point fragments indicate a weak similarity in mean break length between these two assemblages as a whole (\(M = 43.2\) mm, \(SD = 21.5\)) and those from Crystal River and Roberts Island (\(M = 32.5\) mm, \(SD = 15.0\)) conditions; \(t (61) = 1.7, p = .096\), with equal variances assumed. However, if we look at the distributions of broken points less than 70 mm in length, there is no significant difference between the mean break lengths for Pineland assemblage (\(M = 37.62\) mm, \(SD = 13.4\)) and those from Crystal River and Roberts Island (\(M = 32.5\) mm, \(SD = 15.0\)) conditions; \(t (56) = 1.2, p = .238\). The consistency in breakage between these two assemblages suggests that people used bone tools in similar ways.

I compared the lengths of the broken points discussed above with 50 pointed fragments from the Pineland Complex previously examined by Patton (2013) (Figure 4.3). Although the Pineland sample exhibited a much greater range from between 11.3 and 117.6 mm, they displayed striking similarities in mean break length. I suspect that the Pineland assemblage represents a wider range of point types including broken pins, which Patton does suggest for some specimens. This much larger sample may also represent a wider range of uses or simply a better representation of typical breaks. In total, 38 out of the 50 specimens fall within the length range found at Crystal River and Roberts Island, with a mean of 33.0 mm.

While I suggest the similarity in the break length of these point fragments reflects a pattern of use, I also have some concerns. The quantity of my sample is quite small. Not all of the point fragments have hafting/attachment scars and may have separated from an entirely different implement. I have not examined the Pineland sample for similar markings. The Pineland sample may include broken pins.
Figure 4.3. Break lengths (mm) for bone points
Crystal River (top), Pineland (bottom)
We need a more thorough examination of these and other points from coastal sites in the Southeast in order to make confident inferences about hafting and breakage patterns, and perhaps come closer to understanding the range of uses for each point type.

Three bone points ranging in length from 98.7 to 104.3 with a mean of 102.3 appear unfinished. However, two points display tip damage, suggesting intentional design, perhaps for expediency, or manufacturing failures appropriated for expedient use. The three points come from Phase 2, Test Units 1 and 9, and from Phase 4, Test Unit 8, Roberts Island. I might expect to see a number of manufacturing failures and unfinished tools in Test Unit 9, if tool production and maintenance is associated with this area of the midden. Although I do not, nearly 70 percent of the bone tools and debitage in Phase 2 do occur here.

The bone tool assemblage contains a few unique specimens. Of particular interest, is a well-preserved, flattened needle-like implement, measuring 113.1 mm in length, 8.5 mm in width, and 2.3 mm in thickness with a hole (eye) in the proximal end (Figure 4.4). Recovered in three pieces from Phase 2 contexts in Test Unit 5, it exhibits minor macroscopic wear and slight spalling at the tip. It retains its polish with some minor weathering and patination. We see eyed needles at Paleoindian sites in North America as early as about 13,000 calendar years before present (Lyman 2015:147). They have a long history of association with fiber technologies in the production and repair of clothing, netting, matting, basketry, bags, and various sewn and woven materials, and in integrating these activities with social and class identity. The Crystal
River needle may indeed have functioned in one or more of these capacities including adornment.

A single-piece fishhook from Phase 2, Test Unit 1, Level 10, weighs in at .01 g, is 19 mm long with a maximum thickness of 2.6 mm (Figure 4.5). Unfortunately, this fragile hook broke after recovery. Moore (2010) and Webb (1950) report similar fishhooks fashioned from deer ulna and toe-bones by reducing them to blanks, then finishing and removing the shaped hook. The Crystal River hook’s degraded condition limits this level of identification of material type and manufacturing detail. Another limiting factor is that single-piece hooks are rare at sites in Florida (Walker 2000), providing few samples to analyze. Perhaps, as Walker suggests, Florida’s prehistoric fishers favor composite hooks.

![Figure 4.4. Bone needle](image-url)
A split bone implement measuring 118.9 mm in length, 17.6 mm in width, 14.9 mm in thickness, resembles a beamer or scraper with a hollow interior. Recovered from Roberts Island, Shovel Test 13, near 85 cmbd, this tool dates to the later Phases (3 and 4). The specimen exhibits minor wear/smoothing on the edges.

Twenty-one unidentified modified bones represent specimens lacking enough identifiable attributes to place into a recognized tool type. Fifteen of these specimens come from Test Unit 9 (4.84/m³), five from Test Unit 5 (1.61/m³), and one from Test Unit
8 (.87/m³) at Roberts Island. Some show signs of only minor modification as to exhibit no identifiable elements of a finished form, while for others post-depositional damage from breakage, dislocation, and acid pitting make identification a tricky prospect. Still, some assumptions about their former morphology can be made. A split bone fragment (FS 247.29) having possible hafting or lashing grooves may represent the proximal end of bone point (FS 247.28) found in the same level. However, they do not fit together. Several of the modified bone fragments are medial, medial proximal and medial distal segments of split mammal bone. These may be examples of scraping, gouging, or weaving type tools. On the other hand, some of the more degraded specimens may simply be food remains.

Debitage

Bone tool debitage is rare at the two sites, given the number of modified bone implements. Four fragments retain evidence of scoring and snapping and come from Phase 2, Test Unit 9, Levels 9 (FS 1160.22) and 10 (FS 1167.27), in the area where we believe tool manufacture and repair took place (Figure 4.6). The method of scoring and snapping is prevalent in the manufacture of tools and non-tools alike (Byrd 2011), and is the most common first step in the process (Clark and Thompson 1953). One possible reason for the lack of specimens is that bone debitage is subject to misidentification during laboratory sorting, biasing the overall sample toward fewer samples. In this case, some specimens may be included with the faunal material for zooarchaeological analysis. In Level 10 of the same test unit, 16 badly degraded antler fragments show no evidence of manufacturing or utilization remains. The level of decay prevents certain
inclusion as debitage, although they may represent bits of a pressure flaker for knapping stone tools or other tool or debitage.

Figure 4.6. Bone debitage

Far left: FS 1167.27

Three remaining fragments: FS 1160.22

Ornaments

Five specimens from Crystal River and two from Roberts Island represent the bone ornament assemblage (Table 4.5). Two shark tooth pendants come from Test Unit 9, Phase 2 (Figure 4.7), and one comes from Roberts Island, Shovel Test 14,
associated with a later phase (3 or 4). All three are Bull shark (*Carcharhinus leucas*) teeth and exhibit suspension holes drilled in the center of the basal root end. Two exhibit breaks vertically through the suspension hole, one from each of the two proveniences. Cartilaginous fish vertebrae, with the neural and haemal arches removed and the centrum hollowed out comprise two of the four beads. One comes from Shovel Test 6, later phase of Roberts Island, and the other from Phase 2 of Test Unit 5 (Figure 4.7). Each shows evidence of smoothing on the outer centrum. The final bead is made from the tooth of a Sciaenidae fish family, perhaps a black drum and comes from Phase 1 of Test Unit 1.

Table 4.5. Bone ornament density by phase, Crystal River and Roberts Island

<table>
<thead>
<tr>
<th>Bone Ornaments</th>
<th>Type</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Total</th>
<th>Non-dated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>N/m³</td>
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<td>N/m³</td>
<td>N</td>
<td>N/m³</td>
<td>N</td>
</tr>
<tr>
<td>Beads</td>
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<td>4.00</td>
<td>1</td>
<td>.32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pendants</td>
<td>2</td>
<td>.65</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
<td>4.00</td>
<td>3</td>
<td>.97</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

⁴8CI41
Figure 4.7. Bone bead and shark tooth pendants. From left to right: FS 678.12, FS 1160.27, FS 1050.10

Flaked Stone

I report on 39 flaked stone implements (Table 4.6) and 1372 pieces of flake stone debitage (Table 4.7), including those securely dated to a phase (N =27 tools, N=1024 debitage) and those that fall outside dated contexts (N =12 tools, N=348 debitage), from Crystal River and Roberts island. As expected, flaked stone debitage contributes the greatest number of artifacts in this study. In terms of density, flaked stone is more prevalent in Phase 2 (306.12/m³); Phase 1 (32.00/m³), Phase 3 (83.79/m³), and Phase 4 (25.23/m³) exhibit lesser densities of debitage.
### Table 4.6. Stone tool density by phase for Crystal River and Roberts Island

<table>
<thead>
<tr>
<th>Tool Type</th>
<th>Phase</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>4</td>
<td>Total</td>
<td>Non-dated</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>N</td>
<td>N/m³</td>
<td>N</td>
<td>N/m³</td>
<td>N</td>
<td>N/m³</td>
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<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Bifaces</td>
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<td>.87</td>
<td>5</td>
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</tr>
<tr>
<td>Biface Fragments</td>
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<td>1.61</td>
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<td></td>
<td>5</td>
<td>1.59</td>
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<tr>
<td>Biface Preform</td>
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<td></td>
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</tr>
<tr>
<td>Unifacial Tools</td>
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<td></td>
<td>4</td>
<td>1.27</td>
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<td></td>
</tr>
<tr>
<td>Flake Tools</td>
<td>3</td>
<td>.97</td>
<td>1¹</td>
<td>.87</td>
<td>4</td>
<td>.95</td>
<td>1¹</td>
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<tr>
<td>Drill</td>
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<td>.87</td>
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<td>Cores</td>
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<td>Utilized Core</td>
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<td></td>
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</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>6.77</td>
<td>6</td>
<td>5.22</td>
<td>27</td>
<td>11.02</td>
<td>12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹8CI41, ²FS1

### Table 4.7. Stone debitage density by phase for Crystal River and Roberts Island

<table>
<thead>
<tr>
<th>Tool Type</th>
<th>Phase</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Total</th>
<th>Non-dated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>N/m³</td>
<td>N</td>
<td>N/m³</td>
<td>N</td>
<td>N/m³</td>
</tr>
<tr>
<td>Chert Flakes</td>
<td>8</td>
<td>16.00</td>
<td>227</td>
<td>73.23</td>
<td>1</td>
<td>5.41</td>
<td>1¹</td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>57</td>
<td>31¹</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fragments/Shatter</td>
<td>8</td>
<td>16.00</td>
<td>667</td>
<td>215.48</td>
<td>28</td>
<td>75.68</td>
<td>3,15¹</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
<td></td>
<td>180</td>
<td>80¹</td>
<td></td>
<td></td>
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<tr>
<td>Quartz Flakes</td>
<td>5</td>
<td>1.61</td>
<td>1</td>
<td>2.70</td>
<td></td>
<td>6</td>
<td>4.31</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Fragments/Shatter</td>
<td>49</td>
<td>15.81</td>
<td></td>
<td></td>
<td></td>
<td>49</td>
<td>15.81</td>
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<tr>
<td>Total</td>
<td>16</td>
<td>32.00</td>
<td>948</td>
<td>306.13</td>
<td>30</td>
<td>83.79</td>
<td>29</td>
</tr>
<tr>
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</tr>
</tbody>
</table>

¹8CI41
Implements include bifacially and unifacially-flaked tools as well as utilized and modified flakes, cores and preforms. While flaked stone occurs in all phases, flaked stone tools date exclusively in Phases 2 and 4. Similar to the division of bone implements, I also note a greater variety and slightly greater density of flaked stone tools in Phase 2 (6.77/m³) than I do in Phase 4 (5.22/m³). Again, several specimens fall outside of the dated phases: six from Roberts Island and six from Crystal River. Since Roberts Island dates to Phases 3 and 4, the temporal placement of the six stone tools in one or both of these phases is reasonably secure. However, those from Crystal River are distributed across test units and in cores, potentially in any of four phases, making any temporal assignment speculative. With this in mind, I consider an early (Phase 1 and 2) for Crystal River and late (Phase 3 and 4) for Roberts Island. This does not change the density for the early occupation because I cannot include the stone from undated contexts, but for the later occupation the density increases to 7.89/m³. This is interesting that the density of implements at Robert Island increases, yet the density ofdebitage decreases especially given that the density of stone cores increases as well (early .83/m³, late 3.95/m³).

Distribution of flaked stone implements across the site (Figure 4.8) at Crystal River is unlike what we see with bone and shell, in that the implements are distributed nearly equally between Test Unit 5 (N=11) and Test Unit 9 (N=12). Distribution by type, however, favors Test Unit 5 for bifacially flaked tools (N=7). All seven are within Phase 2. The remaining flaked stone includes two unifacially flaked tools, one flake tool, and a core. Test Unit 9 contains a larger variety of types including bifacially flaked tools (N=5), a preform, a flake tool, drills (N=2) and cores (N=3). Only two bifacially flaked tools are
within Phase 2. The remaining three bifacially flaked tools and one preform occur in Levels 2 and 3, directly above, but possibly associated with the phase. Other tools include a biface from Test Unit 1, and a multidirectional core from a coring sample (N=1).

![Flaked stone tool distribution, Phase 2, Crystal River.](image)

I expect to see a greater quantity and wider variety of stone tools from Test Unit 9, as I do with bone tools, if this part of the midden area supported some level of tool and/or craft production and maintenance. Indeed, there is a greater variety of finished tools. Yet, there are fewer bifaces and fewer waste flakes from flake tool manufacture. These occur in greater quantities in Test Unit 5, where far fewer bone tools occur. Cores and hammerstones occur in both test units. The small number of implements, coupled with no significant difference in the density of flake debitage between the two test unit areas, precludes making solid assumptions about the distribution of stone tool
manufacturing and use across the site. However, there are interesting possibilities for further research focusing on distribution when the remainder of the artifacts from the even-numbered test units at Crystal River is recorded.

**Sourcing**

I examine raw material sources for 372 flaked stone tools, whole and broken flakes, identifying 251 as belonging to one of three formations (Table 4.8). The flaked stone assemblage consists primarily of locally acquired chert from the Suwannee Limestone Formation (79.7 percent), which includes the Brooksville and Upper Withlacoochee clusters. Minor contributions come from the Crystal River Formation (11.1 percent) and may include the Ocala, Lake Panasofkee East and West, Gainesville and Lower Suwannee clusters. The Hawthorn Group contributes 9.2 percent, probably including Tampa Member and Coosawhatchie Formation cherts. I exclude from sourcing non-local flakes and the non-local quartz specimens, which occur in small numbers. I also exclude from sourcing all together nearly one thousand flake fragments and shatter. Although I did not source to the level of quarry cluster, my results indicate a strong selection for, or access to, raw materials from specific formations. These findings align well with the results achieved by Estabrook (2011) in his analysis of raw material sources for flaked stone recovered from the Crystal River Site in earlier excavations.

Using predictive models, Estabrook (2011:231) examined chert sources within a 50 km radius of the sites, suggesting the most accessible sources lie to the southwest and include the part of the Brooksville quarry cluster and the New Coastal Quarry Cluster. Although Crystal River Formation chert occurs in outcroppings closer to the site, his analysis suggests they require more effort to access and are therefore less
practical (Estabrook 2011:232). In his debitage analysis of 259 identifiable flakes, Estabrook (2011:241) finds that Suwannee Formation chert from the Brooksville Quarry Cluster accounts for about 85 percent of the material. The Crystal River Formation (including Ocala, and East and West Lake Panasoffkee) accounts for about 10 percent, while the Hawthorn Group accounts for less than five percent. These figures exclude 20 unidentifiable and 2 silicified coral flakes.

I could not identify with certainty the source of 121 whole flakes. Several potential factors affected my sourcing confidence, including the size of the specimen, number of identifiable attributes it retained, and my own experience and subjectivity. My inability to identify the source these flakes prompted me to compare them with the ones I could source. I suspected that the flake size was a major contributing factor. Therefore, I simply chose to examine the differences between the weights of individual flakes within the two groups. The mean and median weight for the whole flakes I could not source (UID flakes) were generally less (mean=1.98 g; median=.16 g) than the flakes I could identify (mean= 2.87 g; median .32 g). As I expected, the smaller specimens with fewer defining attributes generally proved more difficult to source. However, I do not believe the exclusion of the UID flakes influenced the results measurably.
Table 4.8. Flaked stone material source for Crystal River and Roberts Island

<table>
<thead>
<tr>
<th>Source</th>
<th>Suwannee</th>
<th>Crystal River</th>
<th>Hawthorn Group</th>
<th>Total</th>
<th>Silicified Coral</th>
<th>Non-Local</th>
<th>Quartz</th>
<th>Unidentified (UID)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Bifaces</td>
<td>9</td>
<td>1</td>
<td></td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biface Fragments</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td></td>
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<td></td>
<td>1</td>
</tr>
<tr>
<td>Biface Preform</td>
<td>1</td>
<td>1</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unifacial Tools</td>
<td>3</td>
<td></td>
<td>3</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
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<tr>
<td>Flake Tools</td>
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<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
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<tr>
<td>Drill</td>
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<td>1</td>
<td>2</td>
<td></td>
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<td></td>
<td>1</td>
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<tr>
<td>Cores</td>
<td>3</td>
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<td>3</td>
<td>6</td>
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<td></td>
<td></td>
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<tr>
<td>Utilized Core</td>
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<tr>
<td>Whole Flakes</td>
<td>179</td>
<td>25</td>
<td>21</td>
<td>225</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>108</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>200</td>
<td>28</td>
<td>23</td>
<td>251</td>
<td>2</td>
<td>1</td>
<td>6</td>
<td>113</td>
</tr>
<tr>
<td><strong>%</strong></td>
<td>79.7</td>
<td>11.1</td>
<td>9.2</td>
<td>100</td>
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</table>
Bifacially Flaked Stone

Biface and biface fragments (N=16) include nine diagnostic hafted types and one non-diagnostic type. Though limited in number, the biface assemblage includes a range of point types from Archaic to late Woodland/Mississippian types (Table 4.9). A selection of the whole and fractured bifaces is shown in Figure 4.9.

Table 4.9. Biface attribute data

<table>
<thead>
<tr>
<th>Catalog Number</th>
<th>Point Type</th>
<th>Material</th>
<th>Length (mm)</th>
<th>Width (mm)</th>
<th>Weight (grams)</th>
<th>Thermal Alteration</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>40.14</td>
<td>Pinellas</td>
<td>Suwannee</td>
<td>30.90</td>
<td>17.10</td>
<td>1.20</td>
<td>Ind.</td>
<td>3, 4</td>
</tr>
<tr>
<td>165.25</td>
<td>Duval</td>
<td>Suwannee</td>
<td>37.26</td>
<td>14.70</td>
<td>3.40</td>
<td>No</td>
<td>3, 4</td>
</tr>
<tr>
<td>247.33</td>
<td>Tampa-like</td>
<td>Suwannee</td>
<td>57.25</td>
<td>29.12</td>
<td>11.90</td>
<td>No</td>
<td>3, 4</td>
</tr>
<tr>
<td>649.19</td>
<td>Florida Copena</td>
<td>Suwannee</td>
<td>57.44</td>
<td>22.48</td>
<td>11.42</td>
<td>Yes</td>
<td>2</td>
</tr>
<tr>
<td>657.50</td>
<td>Columbia</td>
<td>Suwannee</td>
<td>61.90</td>
<td>22.96</td>
<td>17.74</td>
<td>Ind.</td>
<td>2</td>
</tr>
<tr>
<td>657.51</td>
<td>Triangular/ O'Leno</td>
<td>Suwannee</td>
<td>45.81</td>
<td>31.94</td>
<td>14.20</td>
<td>Yes</td>
<td>2</td>
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<tr>
<td>674.15</td>
<td>Florida Copena</td>
<td>Suwannee</td>
<td>58.71</td>
<td>26.16</td>
<td>17.84</td>
<td>No</td>
<td>2</td>
</tr>
<tr>
<td>1085.44</td>
<td>Possible Columbia</td>
<td>Suwannee</td>
<td>29.76</td>
<td>32.20</td>
<td>8.74</td>
<td>Yes</td>
<td>Probable 2 or later</td>
</tr>
<tr>
<td>1093.40</td>
<td>Tampa</td>
<td>Ocala</td>
<td>39.38</td>
<td>19.25</td>
<td>5.84</td>
<td>No</td>
<td>Probable 2 or Later</td>
</tr>
<tr>
<td>1093.41</td>
<td>Santa Fe</td>
<td>Suwannee</td>
<td>41.69</td>
<td>29.00</td>
<td>6.81</td>
<td>No</td>
<td>Probable 2 or later</td>
</tr>
</tbody>
</table>
We recovered two Columbia type points, one from Test Unit 9, Level 2, roughly associated with Phase 2, and the other from Test Unit 5, Level 5, Phase 2. The former, a finely made point is thinner and flattened in cross section (FS 1085.44). The later, less well made, chunkier point has a distinct median ridge (657.50). Both of the points exhibit use-wear and breaks. The former, thinner point displays a bend-break (hinged) fracture near the basal end. The latter displays moderate retouch and has a broken distal tip. It is possible both succumbed to an impact related failure. Both points are crafted from Suwannee Chert. Weisman (1995:37) reports that a Ripley Bullen picked up a Columbia point on a shell road near Mound G. The point is without provenience, but these points date to the Middle to Late Woodland, around A.D 200 to 1250 (Powell 1990). Bullen (1968:21) proposes that these points may serve as hafted knives or daggers. Although the point suffered a transverse break, wear on the remaining margins allow Estabrook (2011:262) supports Bullen’s conclusions for this point.

We recovered two Florida Copena–like points from Phase 2 contexts in Test Unit 5. These points date to the Woodland period and often occur with Deptford ceramics (Bullen 1969; Estabrook 2011:265; Milanich 1973:60). Both points are crafted from Suwannee Limestone chert and exhibit a triangular shape, thick and plano-convex in cross section, with a pronounced dorsal ridge. Specimen 649.19 from Level 3 displays a round base and encurvate/excurvate blade. Plentiful pressure flaking scars occur along the lateral margins of the medial distal section between 32.6 and 57.4 millimeters from the base. Evident use-wear also occurs in this area. The remainder of the basal medial section exhibits only percussion flaking, with no evidence of use-wear. Specimen 674.15 from Test Unit 5, Level 8 also displays the encurvate/excurvate blade shape, but
the base is straight. This specimen use-wear and retouch along all of the margins, though minor. Estabrook (2011:264,265) reports on a roughly made Copena crafted of Coosawhatchie Formation chert from Hawthorn Group that exhibits extensive resharpening, but no evident use-wear. This point was recovered during a seawall restoration project at Crystal River (Ellis 1999).

We recovered a point similar morphologically to a Duval (FS 165.25). These may function as projectile points and or as cutting, drilling and perforating tools. Duval points occur in Middle to Late Woodland contexts in Florida (A.D. 100-1000) (Bullen 1968:17). They are morphologically similar to the Mountain Fork type, which occurs during the same time in other parts of the Southeast, especially Alabama and surrounding areas (see Bense 1994:140; Cambron and Hulse 1975:93; Powell 1990; Webb and DeJarnette, 1948). The Duval tends to be slightly larger.

Crafted from Suwannee Limestone Chert, the point from Roberts Island Phase 3 and 4 resembles Bullen’s Duval subtype 3 (1968:17). It exhibits an encurvate-excurvate blade shape. It is plano-convex in cross-section with a single median ridge with deep flaking, giving the point a thick triangular shape, exaggerated near the distal tip. It retains less than 10 percent dorsal cortex. The shoulders are weak and tapered with shallow notches. The base is rounded and expanded slightly, but is unfinished, exhibiting only a few flake scars. Unfinished basal edges are typical for Mountain Fork types (Cambron and Hulse 1975:94). Wear on the tip suggests it may have also functioned as a drill or perforator.
Figure 4.9. Bifaces and fractured bifaces
First row: Columbia, FS 1085.44, FS 657.5; Florida Copena, FS 649.19, FS 674.15
Second row: Duval, FS 165.25; O'leno, FS 657.51; Santa Fe, FS 1093.41; Tampa, FS 1093.40
Third row: Fractured bifaces, FS 644.32, FS 657.52
Estabrook’s report on seven Duval types from earlier recovery at Crystal River include specimens representing Bullen’s (1968:17) subtype 1 (n=2), subtype 2 (n=1) and subtype 3 (n=3) as well as one unassigned Duval-like point. Six of the seven points are crafted from Suwannee Formation chert and one is crafted from Ocala Limestone chert from the Ocala quarry cluster (Estabrook 2011). Three of the seven points exhibit distal fractures (48%). A high occurrence of distal fractures suggests use as projectiles (Ahler 1971; Flenniken 1985; Odell and Cowan 1986). However, the actual cause of fractures is often difficult to differentiate between hunting and other processes (Dockall 1997; Fisher et al. 1984; Odell and Cowan 1986). Similar fractures may occur while using downward perforating or drilling actions (Austin 2013). In fact, Estabrook (2011) identifies one of the fractures as the result of drilling into a hard material like bone or antler based on the multiple small fractures and the polish on the remaining distal segment.

A triangular O’Leno-type point (FS 657.51) from Test Unit 5, Level 5 exhibits a convex cross section with an excurvate blade form and base. The base displays evidence of thinning and wear. Use wear and retouch are more evident nearer the distal tip than toward the basal medial section. The point, crafted from Suwannee Limestone Chert is the only known O’Leno-like point from Crystal River, but others do occur at Woodland sites. Weisman (1993: 34) reports one associated with St. Johns I (500B.C.-A.D. 750) from a site in the Wekiva River Basin. Bullen (1968:15) attributes the O’Leno to the Weeden Island period, A.D. 200-1200.

We recovered a Pinellas point (FS 40.14) from Roberts Island Shovel Test 5, Level 4, associated with Phase 3 or 4. Knapped from a flake, this small triangular point
is plano-convex in cross section with a slightly incurvate base and straight margins ending in a sharp distal tip. The ventral side exhibits few flake scars, primarily from retouch and the right ventral edge is beveled. Made from Suwannee Limestone Chert, the point closely resembles Bullen’s Subtype 2, with retouch creating an attenuated tip. This creates a thick sharp point, median ridged in cross section. The absence of identifiable wear precludes functional assumptions, although use as an arrow point or perforator is possible. Small triangular points occur at sites dating from Middle Woodland through historic times and are associated with the use of bow and arrow (Milanich 1994:232; Milanich and Fairbanks 1980:251). Estabrook (2011) reports on six Pinellas points from earlier work at Crystal River, the first by Bullen in Feature C, and the remaining five from Bidden B in the area of the trailer park after the 1993 storm. He suggests one of these as a candidate for a drill or perforator (Estabrook 2011:269).

We recovered a basal medial section of a Santa Fe type point (FS 1093.41) from Test Unit 9, Level 3. Not directly dated, it is likely associated with Phase 2. It exhibits a fatal transverse break, exposing a fossil inclusion, which likely weakened the point, perhaps facilitating an impact fracture. It is biconvex with one slight median ridge. Flaking appears random with abundant step fractures. The auriculated base displays thinning but no grinding and the auricles are intact. Slight use-wear is evident on the margins with possible retouch. The material is Suwannee Chert. Two Santa Fe points, recovered in earlier work during storm cleanup at Crystal River also exhibit similar transverse fractures (Estabrook 2011:270). Due to the morphological features, some consider the Santa Fe a Late Paleoindian or Early Archaic point type (e.g. Bullen 1975:46; Ferguson and Neill 1977; Justice 1987:44). Others suggest association with
the Late Archaic/Woodland periods because of their recovery from contexts that include ceramics. Ashley (2005:163) reports these Points from St. Johns II ceramic contexts at Shields site in northeastern Florida, and Mikell reports them in Late Archaic fiber-tempered ceramic contexts at the Riddick Bluff site in northwest Florida (1997:83), and in the Gulf Hammock region (1996:89). The recovery of three Santa Fe points in Woodland contexts at Crystal River, coupled with their appearance with ceramics at other sites, supports the assertions for a Late Archaic/Woodland assignment for this point type. Mikell also explores the idea of an early and late variant or type, based on dissimilar characteristics seen in some samples. Characteristics of the Paleoindian-Late Archaic types exhibit basal grinding and transverse parallel or collateral flaking, while a potential later type does not display these characteristics (Mikell 1996:89). Based on his examination of a cache of Santa Fe points from Bird Creek Fishing station, Mikell (1996:91) suggests they may serve as fishing spears or harpoons.

We recovered two Tampa-like points, one from Roberts Island Phase 3 and 4 contexts, Test Unit 8, Level 4 (FS 247.33), and the other from Crystal River, Test Unit 9, Level 3 in contexts above Phase 2 (FS 1093.40). These are generally associated with the Late Woodland to Mississippian occupations and perhaps into the Mission period (Bullen 1968:14; Powell 1990:49-50). The point from Crystal River, made from Ocala Limestone Chert, is teardrop-shaped with a thinned, rounded base and deeply retouched medial distal segments, which create a thick diamond-shaped working area. The distal end exhibits a fresh break, perhaps occurring during recovery or sorting. The remaining working area displays wear and polish that suggests drilling or perforating activity (Figure 4.9). Crafted from Suwannee Formation chert, the point from Roberts
Island resembles the Tampa point, but is large and falls outside the general length and width size ranges (length 23-47 mm, width 12-21 mm) recorded by Bullen (1968:14). It is triangular rather than ovoid or teardrop in shape, biconvex in cross-section with an excursive blade shape. The larger size and triangular shape may suggest a preform, yet retouch and minor usewear suggest it also experienced some use. The basal area is thin, a characteristic achieved early in the reduction process, with few finish flakes to create a round base. The distal tip is acute and sharp.

Estabrook (2011) reports on a Tampa-like point recovered from Test Unit 510N/498E, Level 1 (0-20 cmbs), by Weisman in his 1985 excavation at Crystal River. The point, made from Ocala Limestone chert, exhibits extensive polish and flake scars suggestive of cutting and slicing activities, with a potential basal hafting area.

We recovered six biface fragments, five from Phase 2 contexts at Crystal River and one from Roberts Island (Phase 3 and 4). Two broken medial distal segments from Test Unit 5 exhibit transverse fractures, likely occurring during manufacture. The first (FS 644.32), is made of Bay Bottom chert. It exhibits a hinged transverse fracture with no immediately noticeable cause. Because the fragment has evidence of platform trimming along the thicker margin and finish flaking on the thinner margin, it is likely a manufacturing failure. The second (FS 657.52), exhibits a similar transverse fracture. However, this fracture is clearly a manufacturing failure caused by a fossil inclusion. The point, made from Ocala Limestone chert is unfinished on one margin and nearly finished on the other. Neither has evidence of use after the fracture. A broken tip of a complete or nearly complete biface (FS 654.28) from Phase 2 contexts in Test Unit 1 exhibits a thermal break. The point exhibits a waxy appearance and has additional heat
damage including crazing and internal but incomplete fractures. The smallest specimen is the broken tip of a biface from Phase 2 of Test Unit 5 (FS 663.35). It is made of an unidentified chert that exhibits heat alteration.

We recovered four unifacially flaked tools from Phase 2 contexts in Test Units 5 and 9. The first, made from Suwannee Formation chert, resembles a rounded, hump-backed scraper made from an expended core (FS 644.31) (Figure 4.10). Remnant flake scars appear on the dorsal dome with later steep flaking along the lateral and distal margins. The proximal end is broken or simply not shaped. Minor polish is present on the dorsal side and minor wear evident only on a small segment of the left margin, partly obscured by additional retouch. It appears to have experienced little or no use after the final flaking. The second, a large flake, made of fossiliferous Suwannee Formation chert retains most of its bulb of percussion and dorsal cortex (FS 1160.31) (Figure 4.10). The knapper successfully removed the platform and attempted minimize the bulb, leaving a few flake scars on the ventral side. The left and right lateral margins exhibit unifacial flaking along the entire length. Wear suggests use as cutting tool. The third, a large irregular, slightly circular shaped flake with a cortical platform area, exhibits no further shaping with only light flaking along the margins (FS 1135.29). Breaks interrupt the flaking at two points. It is unclear whether these are due to usage or are post depositional in nature. The fourth, a small unifacially modified flake, possibly broken and discarded, contains only a few flake scars on the ventral surface, but appears to have heavy use near the distal tip, based on smoothing and polish (FS 644.36).

In addition to the Tampa-like point noted above as a possible drill, we recovered two other potential drills. The first, a heat-altered Suwannee-Formation chert flake from
Phase 2 contexts in Test Unit 9, with a pronounced dorsal ridge exhibits flaking along the margins that intensifies the triangular shape (FS 1113.31). Use wear is not evident, although the tip is slightly damaged, which may suggest some use or simply post-depositional damage. The second specimen, and the only silicified coral artifact, is from Roberts Island and is associated with Phase 4 contexts. It is triangular and morphologically resembles a drill or perforator (FS 132.27). It shows signs of thermal damage and is partly shattered, but retains a flaked edges and triangular shape. A thermally damaged Suwannee limestone triangular flake from Phase 2 contexts in Test Unit 9 exhibits shaping to a point. Estabrook (2011) also reports three potential drills/gravers from earlier recovery at Crystal River.

Figure 4.10. Unifacially-flaked scrapers
Left: FS 1160.31, Right: FS 644.31
Only two (2) specimens are identified as preforms. The first, a late stage preform section with a lateral break due to a fossil inclusion, comes from Phase 3 and 4 contexts at Roberts Island (FS 13.19). Crafted from Suwannee Formation chert, this production failure is probably the basal section of a well-crafted, thin biface preform. It does not exhibit evidence of use or of heat alteration. The second specimen (FS 1093.42), recovered from Test Unit 9 at Crystal River, is from the level directly above Phase 2 contexts. This preform, crafted from Ocala Limestone chert, exhibits intensive thermal damage, with deep crazing marks and a transverse fracture with a crenated edge. The dorsal side retains some cortex. The knapper attempted unsuccessfully to remove this and a hump. It is unclear whether the heating was the result of a discarded failure or an attempt to enhance the stone’s flaking properties.

In general, flakable stone cobbles, spalls and larger flakes may serve as parent material (cores) for flake tools. They can exhibit varying intensities of reduction; can function as tools themselves, showing signs of cutting, hammering and other activities. As a result, they express mobile functional qualities throughout their lifespan. This is the case with some specimens in the assemblage from Crystal River and Roberts Island.

We recovered four cores and seven possible cores. The assemblage consists of largely amorphous multidirectional specimens, with one possible unidirectional core. The first of the four definitive cores, crafted from Suwannee Formation chert comes from Phase 4 contexts at Roberts Island (FS 132.28). The well-formed ovate core exhibits bifacial flaking with one battered and blunted end. The knapper failed to remove stacked step fractures on one margin, creating a large thick edge. It is possible, given the attempt at shaping, that this is a failed preform repurposed to produce usable flakes.
and/or for use as a hammerstone or battering implement. The second, a possible unidirectional broken core from Phase 2 contexts in Test Unit 5 at Crystal River (FS 649.20) exhibits long unidirectional flake removal with remnants of trimmed and battered platforms. However, it suffered a fatal break and shows only minor flaking afterward that ended in severe step fractures. The third, a large, thick flake crafted from Suwannee Formation chert from Phase 2 Test Unit 9 (FS1099.44) displays random bifacial flaking with finish flaking on one marginal section. This heavily used flake core terminates in a hinge fracture. From the same location, a potential core exhibits a few random flake removal scars with evidence of battering on one end. The remaining four (4) core-like specimens exhibit varying intensities of random flaking with no further evidence of use.

Estabrook (2011) reports on ten identified cores recovered previously from several areas across the Crystal River Site, including Midden B, Feature C, the burial mound complex E and F, and from the area of the 1998 seawall replacement project. These, he notes, are mostly amorphous with the exception of one bipolar core recovered by Wheeler (2001) in preparation for a fence replacement project. Estabrook describes two expended cores, one of which exhibits pecking and attrition representative of hammering activities, while the remaining cores show evidence of random flake removal.

Debitage

The debitage assemblage consists of 1,372 whole flakes, fragments and shatter that occur through all phases and across both sites. Material is primarily chert from the Suwannee Formation, although a small number of crystal quartz is also present. The
largest concentration occurs in Phase 2 (306.1/m³) (Table 4.10) within Test Units 5 and 9 (Figure 4.11) at Crystal River. We see a similar tendency with flaked stone and bone tools in both density and variety. To a lesser extent, the same holds for ground and pecked stone. As mentioned earlier, this is a time of increasing and more permanent occupation and of midden expansion toward the southeastern part of the site. Few pieces of debitage come from Phases 1 (32.0/m³) and 3 (83.8/m³), and only 3 pieces of debitage (2.6/m³) from Phase 4. The remaining pieces of debitage from this last phase come from Roberts Island (22.6/m³).

I recorded the metric dimensions on all of the whole, broken and utilized flakes, placing them in size categories based on the longest dimension. Whole flakes are those with the platform and termination, either feather or hinged, intact. Broken flakes are those with platform intact and having a stepped termination. Utilized/modified flakes are either, and also include utilized fragments or shatter. Typically, the longest measure was the length, and occasionally the width. I placed each artifact in a size category from one to 12 centimeters (Figure 4.12).

Nearly all of the flakes (98%) measure less than six centimeters. A number of flakes fall in the category of less than one centimeter, 96 (29%) in total. Most (28%) are broken flakes. There may be several reasons for this. First, the broken flakes could be from flake removal resulting in step fractures. These types of fractures are more common with poorer quality chert. Additional breaks can occur during and after discard. Given the location of the most of the debitage is in the midden area (Test Units 5 and 9), where people conducted day-to-day activities, I expect some damage by trampling.
Our collection method using .125-inch (3.2-mm) screen allowed us to capture these smaller waste flakes.

A greater number of whole flakes are larger than one and less than five centimeters. Few flakes are greater than five centimeters. Perhaps activities producing large flakes, such as the reduction of large bifacial blanks or cores did not occur frequently, or people removed larger flakes, or utilized them. However, both Crystal River and Roberts Island sites have few utilized and modified flakes, and all are larger than two centimeters. Typically, larger flakes are more likely to be used as cutting tools and more easily identified, whereas smaller flakes may be utilized less and harder to identify as tools (Estabrook 2011).

Researchers have used relative proportions of four categories of debitage, whole flakes, broken proximal flakes, flake fragments, and shatter to characterize reduction activities (e.g. Austin 2013; Estabrook 2011; Prentiss and Kuijt 1988; Sullivan and Rozen 1985). Combined with debitage attribute analysis, the results strengthen inferences about types of activities, such as core reduction and tool manufacture. Sullivan and Rozen (1985) suggest that intensive core reduction produces a high percentage of complete flakes and non-orientable fragments, while patterned tool production produces high percentages of proximal and medial-distal fragments and low percentages of non-orientable fragments. A more balanced assemblage should represent both technologies (Austin 2013).
Table 4.10. Stone debitage density by phase for Crystal River and Roberts Island

<table>
<thead>
<tr>
<th>Tool Type</th>
<th>Phase</th>
<th>Debitage</th>
<th></th>
<th></th>
<th></th>
<th>Total</th>
<th>Non-dated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>N/m³</td>
<td>N</td>
<td>N/m³</td>
<td>N</td>
<td>N/m³</td>
<td>N</td>
</tr>
<tr>
<td>Chert Flakes</td>
<td>8</td>
<td>16</td>
<td>227</td>
<td>73.23</td>
<td>1</td>
<td>5.41</td>
<td>11¹</td>
</tr>
<tr>
<td>Fragments/</td>
<td>8</td>
<td>16</td>
<td>667</td>
<td>215.48</td>
<td>28</td>
<td>75.68</td>
<td>3,15¹</td>
</tr>
<tr>
<td>Shatter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quartz Flakes</td>
<td>5</td>
<td>1.61</td>
<td>1</td>
<td>2.70</td>
<td>6</td>
<td>4.31</td>
<td></td>
</tr>
<tr>
<td>Fragments/</td>
<td>49</td>
<td>15.81</td>
<td></td>
<td></td>
<td>49</td>
<td>15.81</td>
<td></td>
</tr>
<tr>
<td>Shatter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
<td>32.00</td>
<td>948</td>
<td>306.13</td>
<td>30</td>
<td>83.79</td>
<td>29</td>
</tr>
</tbody>
</table>

¹8Cl41
Other factors can complicate this model, such as non-technological causes that create greater numbers of broken flakes and fragments (Prentiss and Romanski 1988). If so, then a greater percentage of non-orientable fragments (Magne and Pokotylo 1981), combined with greater numbers of complete flakes and lower proximal flakes (Prentiss and Kuijt 1988) become better markers for core reduction.

An examination of the Phase 2 debitage assemblage at Crystal River reveals a higher percentage of medial distal flake fragments and non-orientable debris with lower percentages of whole and proximal flakes. These results, however, do not point to intensive core reduction or patterned tool production, nor are they particularly well balanced. They do suggest that the inhabitants manufactured bifaces and made flake tools from cores. The assemblage contains both cores and broken preforms. However, people also reworked and retouched tools and produced other tools including scrapers and drills. The debitage assemblage represents the remains of a variety of flaking activities and does not point to a specific intensive activity.
Figure 4.12. Distribution of debitage by size
Crystal River (top) and Roberts Island (bottom)
I consider only Phase 2 because Phases 1, 3, and 4 have so few artifacts (only 49 in all three phases combined). Similarly, the Roberts Island assemblage is small, consisting of 137 total for Phases 3 and 4 combined. However, it does exhibit higher percentages of non-orientable shatter, 49 percent, and fewer broken flakes, five percent. Twenty six percent of the assemblage is whole flakes. Again, these numbers do not suggest specific intensive reduction or production, but rather a variety of activities.

By test unit (Table 4.11), only Test Unit 5 exhibits the distribution of key indicators for core reduction. We also found one unidirectional core in this test unit. Further analysis of debitage including platform angle and number of platform facets would strengthen this inference. Flat platforms with angles between 45˚ and 90˚ are often associated with core reduction (Austin 2013). I recorded the platform facets during my examination, although not the platform angle. Test Unit 5 contained 20 of the 30 flakes with flat (or single faceted) platforms. Combined, these indicators suggest that core reduction took place to a greater extent in the area of Test Unit 5 than in other areas. However, the evidence supports a greater variety of activities at both sites rather than intensification of a particular strategy.

The elevated numbers of non-orientable debris, particularly at Crystal River may be due to non-technological factors, particularly thermal damage. During my examination, I noticed abundant crazing, cracking and potlid fractures on many of the debris. While I did not evaluate each piece of debris, it was obvious that many succumbed to overheating. This can caused the stone to shatter, producing non-
orientable debris. I suggest that the higher levels of debris are due, at least in part, to fire damage.

Table 4.11. Sullivan-Rozen debitage analysis by test unit

<table>
<thead>
<tr>
<th>Category</th>
<th>Whole Flakes</th>
<th>Proximal Flakes</th>
<th>Medial-distal Fragments</th>
<th>Non-orientable Shatter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Test Unit 1</td>
<td>6</td>
<td>4.0</td>
<td>4</td>
<td>2.6</td>
</tr>
<tr>
<td>Test Unit 5</td>
<td>105</td>
<td>22.2</td>
<td>43</td>
<td>9.1</td>
</tr>
<tr>
<td>Test Unit 9</td>
<td>33</td>
<td>12.8</td>
<td>25</td>
<td>9.7</td>
</tr>
</tbody>
</table>

Crystal quartz material includes six whole flakes, 24 flake fragments, and 25 pieces of non-orientable shatter. With the exception of one whole flake from Phase 3, Test Unit 1, the remaining whole flakes come from Phase 2, Test Unit 5. The flake fragments and shatter all occur in Phase 2. They concentrate in Test Units 5, numbering 20 and 15 respectively. Test Unit 1 includes three fragments and 10 pieces of shatter. Only one flake fragment comes from another area of the site, Test Unit 9.

Although very small individual crystal quartz does occur within certain Florida cherts, individual crystals large enough to craft tools and ornaments must have come from non-local sources. Sources for these crystals are probably no closer than the Georgia piedmont (Marquardt and Walker 2012). Considered an exotic material associated with Hopewellian interaction at Crystal River, specimens recovered from burial contexts by Moore (1907), include a three individual crystals with suspension grooves, two ground and polished plummet-shaped pendants of crystal and an
unworked double crystal. It is possible that the quartz debitage is the result of early stage manufacture of pendants, or from biface manufacture. However, we have found no quartz crystal bifaces.

**Ground and Pecked Stone**

The ground and pecked stone assemblage includes eight specimens that exhibit identifiable morphology and 54 others that exhibit possible modification and use, without positive identification. They occur at both sites and across all phases (Table 4.12). However, relative to the volume of midden, those positively identified occur frequently in Phase 2. Those with fewer identifiable features occur frequently in Phases 3 and 4 at Roberts Island. With the exception of one broken hematite specimen, all are limestone or silicified limestone.

Five specimens display evidence of use as a percussion implement, such as a hammer stone or chopper. Of these, four are silicified limestone and the other is limestone. All exhibit evidence of intensive use and are heavily battered and broken. Two of the implements, both from Test Unit 7, and both made from silicified limestone, are shaped purposefully into a wedge by flaking (FS 1088.19, 1110.2). They cross the lines between flaked stone and ground/pecked stone categories. Flake scars from the initial shaping are eroded by abrading and smoothing, either purposefully or the result of use. The distinctive shape and intensive use may suggest a particular task took place in this area of the site.

Two limestone implements display signs of use for abrading, perhaps for the platform preparation of flaked stone implements, or as sharpening instruments. One of these two implements has a hole at one end. It is difficult to tell whether it is an
intentional perforation or simply an opportunistic use of a natural feature of the limestone. The shape of the perforation suggests suspension, possibly as a net weight. The final implement, recovered from Roberts Island, is a tabular piece of limestone, resembling a paint pot. The remnants of a reddish residue remain in the small dimpled pot. Earlier investigations by Moore produced artifacts of hematite (Blankenship 2013; Estabrook 2011), a reddish iron oxide that produces the red ochre pigment. We recovered small quantities of this reddish pigment from both sites.

Fifty-four other specimens exhibit possible modification and use, without positive identification. In fact, some of these appear to have experienced only casual use and discard, leaving little evidence of wear behind. During examination, I grappled with the possibility that some of the observations of wear were simply expressions of natural features of the stone. However, their context suggests purposeful deposition at the site. I expect that microscopic examination may clarify and strengthen my interpretations.

Table 4.12. Ground and pecked stone artifacts.

<table>
<thead>
<tr>
<th>Tool Type</th>
<th>Phase</th>
<th>Non-dated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Ground/Pecked Stone</td>
<td>N</td>
<td>N/m³</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>.97</td>
</tr>
<tr>
<td>Potential Ground/Pecked</td>
<td>4</td>
<td>8.0</td>
</tr>
<tr>
<td>Stone</td>
<td>Total</td>
<td>4</td>
</tr>
</tbody>
</table>

¹8CI41
Stone Plummets and Ornaments

The stone ornament assemblage includes four ornaments, including three plummet-shaped objects and a cylindrical-shaped object. I include plummet-shaped objects in the ornamental category, although their form evokes many possible uses. While that form varies, most take the general form of a plumb bob, although there is no research to suggest they functioned as such in prehistoric North America. Thus, we refer to them as plummets due to their morphology and not their function.

Most often, plummets have a perforation, groove or set of grooves, presumably for suspension or attachment. Researchers continue to speculate about their uses. They may well have served purposes specific to people’s needs in different social and technological contexts, such as loom weights (Lipo et al. 2011), net-weights or sinkers (Goldstein 2004; Rau 1884), charmstones (Hector et al. 2005; Heizer 1949; Kroeber 1936; Yates 1889, 1890), or pendants or ornaments (Gilliland 1975:224,229; Pennypacker 1938).

Gilliland (1975:229) also suggests that the crudely crafted stone plummets may have functioned as weights or sinkers, while the finer examples were pendants. We might consider, however, usewear and post-depositional processes that act upon the condition of a particular material. Hard stone is likely to hold up far better than limestone and shell under the same conditions. Some of what we see as crudely made examples may simply have degraded through use and the action of water or acidic soils. Likewise, we should question the idea that only well-crafted items served decorative purposes or were special to people. Creating something special does not necessarily require exotic desirable materials. Further, limestone is easier and quicker to shape than quartz or chert. A mistake is less disastrous since the material is abundant on site. It would have
been a good material to learn and experiment on and perhaps function as a template before attempting a harder material. One of the artifacts is an unfinished piece of limestone, clearly taking the shape of a plummet.

C.B. Moore (1907) records 73 pendants, most made from stone including chert, limestone and quartz, as well as other hard stones, both in burial and domestic contexts at Crystal River. He reports on stone pendants associated with ones of copper and shell, some in situ with skeletons, in burials (Moore 1907). His description of the location and orientation of the pendants found in association with the remains lead Moore to believe the individuals wore the pendants suspended from the grooved attachment point. Further sketches of Florida’s Native Americans, attributed to Jacques le Moyne de Morgues, illustrate plummet-like pendants suspended from around the waist of men and women (see Lorant 1946).

We recovered two of the plummets and a cylindrical object, possibly an earplug, from Phase 2 level in Test Unit 9. One plummet, made of chert, exhibits a single groove on one end. The second end has a transverse break and the end is missing, though it retains an elongated shape with a bulbous middle. The smaller limestone plummet exhibits a slightly flattened globular asymmetrical shape, a grooved proximal end and rounded distal end. The cylindrical object, tapered at one end, resembles an earplug. However, it is worn badly. Perhaps the most interesting is an incomplete plummet, recovered from Test Unit 8, above Phase 2 contexts. It exhibits early stage shaping, and is ground thinner at one end. The large number of plummets from burial and domestic contexts, many made from local stone, and the incomplete one from our excavations, suggest people made plummets on site.
Shell

I report on 297 shell artifacts, 114 from Crystal River and 183 from Roberts Island (Table 4.13). There are 241 shell tools, 86 from Crystal River and 155 from Roberts Island. Ornaments number 56, with equal numbers from each site. We can securely date 116 of these to one of the four phases as shown in Table 4.14. Many of the implements (N=125) fall outside of the dated contexts. Of those, 105 come from Roberts Island. Therefore, I can safely expect them to represent tools from one of the later phases, Phases 3 or 4. Crown conch is the most abundant tool material present at each site, numbering 57 at Crystal River and 144 at Roberts Island. Lightning whelk provide abundant tool material at sites along the northern and southern Gulf coasts, but are not found in large quantities near Crystal River. Whelk tools number ten from Crystal River and five from Roberts Island.

Table 4.13. Shell Artifact count for Crystal River and Roberts Island

<table>
<thead>
<tr>
<th></th>
<th>8CI1</th>
<th>8CI41</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crown conch</td>
<td>57</td>
<td>141</td>
</tr>
<tr>
<td>Lightning whelk</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Quahog clam</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>Carolina marsh clam</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Atlantic oyster</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Unidentified large gastropod</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Ornaments and non-tools</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>114</td>
<td>183</td>
</tr>
</tbody>
</table>
Table 4.14. Shell tools by phase, Crystal River and Roberts Island

<table>
<thead>
<tr>
<th>Tool Type</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Total</th>
<th>Non-dated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>N/m³</td>
<td>N/m³</td>
<td>N/m³</td>
<td>N/m³</td>
<td>N</td>
</tr>
<tr>
<td>Hafted gastropod hammer/pounder</td>
<td>8</td>
<td>2.58</td>
<td>9</td>
<td>24.32</td>
<td>47</td>
<td>64</td>
</tr>
<tr>
<td>Unhafted gastropod hammer/pounder</td>
<td>3</td>
<td>2.61</td>
<td>3</td>
<td>2.61</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Gastropod hammer pounder indeterminate hafting</td>
<td>4</td>
<td>1.29</td>
<td>2</td>
<td>5.40</td>
<td>11</td>
<td>17</td>
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<tr>
<td>Gastropod cutting edge tool</td>
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<td>.87</td>
<td>1</td>
<td>.87</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Gastropod tool indeterminate function/hafting</td>
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<td>.32</td>
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<td>2.70</td>
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<td>3</td>
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<tr>
<td>Gastropod dipper/cup/spoon</td>
<td>2</td>
<td>.65</td>
<td>2</td>
<td>.65</td>
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<td></td>
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<tr>
<td>Columella hammer</td>
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<td>1.61</td>
<td>1</td>
<td>2.70</td>
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<td>.87</td>
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<td>Columella indeterminate</td>
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<td>3.61</td>
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<tr>
<td>Perforated bivalve</td>
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<td>.87</td>
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</tbody>
</table>
Similar to the distribution by phase of bone and stone tools, shell tools express greater morphological variability during Phase 2. Then, during the later phases of occupation, shell tool manufacture increases greatly, while variability declines. In fact, the density of shell implements in Phases 3 and 4 dwarfs that of bone and stone combined, and the variety of shell tools declines at both sites in favor of a single tool type, the gastropod hammer/pounder. At Roberts Island, these hammers litter the surface of the site; we had to step cautiously as we walked about the area.

At Crystal River, the distribution of shell tools across the site is unlike that of bone and stone tools, principally because the former are concentrated in later contexts. Shell implements, found in greater numbers and densities in Test Units 1 and 7, which include Phase 3 and 4 components, and are fewer in Test Units 5 and 9, which include primarily a Phase 2 component. However, variability in Test Unit 9 is greater than in the other test units, signifying diverse activities in this location, and during Phase 2.

At Roberts Island, patterns of shell tool distribution across the site are less clear. However, they are most abundant in Test Units 7 and 8 (N=64), in the area of the Phase 4 midden, west of Mound A. As expected, Test Units 1 through 6, located on the slope of Mound A, contain fewer shell tools (N=16). Yet, shell tools, primarily hammers, are found in shovel tests throughout the site, both near Mound A and in the midden. Additional research at Roberts Island is needed to make further assumptions about site use.

Common at both sites, gastropod hammers exhibit hafting holes and or notches, no hafting, or indeterminate hafting. They occur in increasingly higher densities through Phases 2 (3.87/m³), Phase 3 (29.72/m³), and Phase 4 (53.95/m³). Although, they are
absent in Phase 1. The dramatic increase in shell hammers, particularly in Phase 4, suggests a change in people’s everyday lives, one in which the hammer fulfilled an important role. Figure 4.13 displays a selection of crown conch hammers from Roberts Island.

Menz (2012) collected comparative samples of Type G shell hammers from the surface for his study of their use-life and function. His results suggested that the hammers experienced heavy use and curation rather than expedient use and discard. Based on his experimental replication and use on both bone and shell, Menz found that the use of shell hammers on bone produced heavy deep spalling, while use on shell produced blunting and light spalling. The wear results led him to suggest that the primary use included the processing of shellfish, predominately oysters (Menz 2012).

The hafted gastropod hammer assemblage in my study consists of 144 specimens; only four are made of Lightning Whelk. Crown conchs make up the remainder of the assemblage. Most show blunting (N=59), or blunting and spalling (n=62). The remaining hammers show spalling only (N=5), beveling (NN1), little or no wear (N=12) and no determination (N=2). Although my examination of this assemblage does not replicate that of Menz’s, my results do approximate his results, suggesting these hammers experienced the same or similar uses as he describes. The remaining gastropod tools include 15 columella tools, six of which are Lightning whelk while the remainder is unidentified large gastropods. Both of the cups or dippers are made from the outer whorl of the whelk.

Implements made from bivalves include six perforated shells of Carolina marsh clam and three of oyster. Bivalves with perforations are often considered net weights
(e.g. Hudson 1976:282; Marquardt 1992; Vojnovski 1998:259). These were found at Key Marco with the netting still attached (Gilliland 1975:184,187). Alternatively, these may have served as decorative wear. Figure 4.14 illustrates an example of a perforated oyster from Phase 2, Test Unit 9. Quahog clam provided the material for seven scraper-type tools and one possible net gauge. Quahog clams seem to occur early, during Phases 1 and 2. None were recovered at either site after this.

Figure 4.13. A selection of crown conch hammers
From left to right: FS 265.13, FS 235.19, FS 236.17, FS 276.16
Ornaments

We recovered equal numbers of shell ornaments (Table 4.15) from each of the two sites. Figure 4.15 represents a selection of shell ornaments. While not found in large quantities, beads are the predominate type of ornament at both sites. Their recovery in burial contests throughout eastern North America, suggests they were in high demand as trade goods (Ottesen 1979). Blankenship (2013) notes at least some evidence of bead production at Crystal River. To date, there is no research into bead production at Roberts Island. Gastropod columella or outer whorl likely represents the material used to craft the beads in this assemblage. However, many of the beads are small and degraded to the point that positive identification is difficult.
Table 4.15. Number and type of ornaments

<table>
<thead>
<tr>
<th>Ornament Type</th>
<th>Crystal River</th>
<th>Roberts Island</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrel Bead</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Disk Bead</td>
<td>19</td>
<td>27</td>
</tr>
<tr>
<td>Gorget</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Gorget Blank</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Disk Bead Blank</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Plummet</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Pendant</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Pin</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

The Crystal River Phase 2 contexts include 21 of the 28 shell ornaments. These are concentrated in Test Units 5 and 9 and include 10 shell disk-shaped beads and three barrel-shaped beads from Test Unit 5 and three disk-shaped beads, a tabbed circle artifact (TCA), a pendant and a pin from Test Unit 9. Test Units 1 and 6 include a gorget blank and a plummet-pendant respectively. The seven remaining shell ornaments include six beads and a gorget from undated contexts. The Roberts Island Phase 3 and 4 assemblages include 27 disk-shaped beads and a bead blank.

Three of the most intriguing shell artifacts are an unusually small TCA and the pendant from Test Unit 9, and another broken TCA or circular gorget from undated contexts in the same test unit (Figure 4.15). Crafted from the outer body whorl of a large gastropod, they are probably Lightning Whelk. Moore (1903, 1907, 1918) recovered the first of these artifacts that Luer (2013) would later call tabbed circle artifacts from burials.
at Crystal River. Since then, 15 more TCAs from coastal regions around peninsular Florida and along the St. Johns River have been added to a growing database (see Luer 2015:72). They are crafted primarily from the outer whorl of large gastropods, but may also be made of bone and other material. The tab and neck form is probably created for the attachment of a cord to suspend from the wearer's neck, chest, head or arm (Luer 2013:105).

The TCA shown in the center of Figure 4.15 is smaller than any recovered previously from Crystal River (width = 18 mm, height= 22 mm). It is comparable in size to TCA #13 recovered from Golden Glade (see Goggin n.d.:544; Luer 2013:108,109; Willey 1949a:109). Similarly, it lacks the incised concentric circles common to seven of the others at Crystal River. Also unlike all of the others from this site, it lacks a central perforation. In fact, most (21 of the 26) of the recorded TCAs, regardless of size have a central hole. This raises the question whether this example is a blank, discarded or lost before completion, or whether it is the desired form.

A broken circular segment pictured in the middle of the same figure resembles the bottom part of a circular TCA or gorget, similar to those recovered by Moore (1907, figure 14,15), and discussed by Luer (2013, figure 3), Luer et al. (2015). Although much of the artifact is missing, it seems to conform to the size and shape of a majority of the others. Given its degraded condition, the possibility that it exhibited incising is equivocal.

A trapezoidal shell artifact with a central perforation may also be a pendant. It is unlike any examples I have been able to find in the literature. Like the TCA’s and other gorgets, it might attach to the wearer by a cord. However, the suspension might appear awkward, as it would not lie flat. Other possibilities include hair clip or decoration or
perhaps to hold clothing together with the use of a shell or bone pin. Although purely speculative, this could have functioned as a size-grading tool to achieve consistency in bead dimensions, given the small-scale bead production activities at the sites. This could be tested by evaluating the outer bead dimensions. At this time, we can only guess at its use or uses.

Also pictured in the figure is a small sample of beads and a shell plummet. The plummet is one of four recovered from our excavations at the site and the only one crafted from shell. It exhibits a shallow incised line and elongated, with a bulbous middle and rounded end.

Figure 4.15. Shell ornament examples from Crystal River.
CHAPTER 5
DISCUSSION AND CONCLUSIONS

I have attempted to bring a relational perspective to my research by exploring shifts in the selection of raw materials, the types of tools people crafted from them, and how these choices reflect the changes we see in subsistence practices and artifact deposition across the Crystal River and Roberts Island sites. By examining the tool assemblages as a whole, patterns emerge that would remain unseen if I had examined only one type of material. The results of this research reveal that the tool assemblages changed over time in both the materials selected and the types of tools produced. Further, during the nearly 900 years of occupation, differences and similarities in the tools suggest that area specific activities took place in some parts of the sites and not others. During this time, people experienced climate events, which affected the ecosystem and influenced the way in which they practiced subsistence and constructed landscapes. These events associate with the four phases of occupation.

Data Synthesis

Beginning around AD 150, Phase 1 characterizes rapid midden (B) deposition in the western part of the site (Pluckhahn et al. 2015). The artifacts recovered from these contexts in Test Units 1 and 5 include 25 tools and ornaments, a comparatively small sample (50/m³) when compared with Phases 2 and 4. The phase volume is also low, .50 m³, which might be expected, since it represents an early occupation at Crystal
River. Pluckhahn and colleagues suggest a small seasonal population during this time, perhaps coming together for mortuary or ceremonial occasions. Low density of the tool and ornament assemblage is consistent with our understanding of the site at this time.

In contrast, Phase 2, with a volume of 3.10 m³, contributed the largest number (1038 specimens), the highest density (334.85/m³) and the widest variety of artifacts. Test Units 1, 5, 7, and 9 comprise components of this phase. Their placement across the midden provides a broader aerial view of activities at Crystal River. There is no evidence of occupation at Roberts Island at this time. This phase marks the height of human occupation at Crystal River, with larger populations, increased permanent settlement or both (Pluckhahn et al. 2015). Artifacts from the four test units suggest people utilized discrete areas of this midden differently.

Test Units 5 and 9 contributed the majority of the Phase 2 artifacts, although they occurred in lower densities in the remaining test units. There is evidence for area-specific activities supported by a greater density of bone tools from Test Unit 9 than in any other test unit, particularly bone points, which were likely used as leisters, throat gouges, or composite fishhooks. Shell tools also occurred in greater variety in Test Unit 9, including a net gauge, a perforated bivalve and bivalve cutting/scraping tools. The location of Test Unit 9 near the eastern extent of the midden with ready access to the river, coupled with the numerous bone and shell tools, supports the assumption that this area served an important role in the fishing economy at the site.

All four test units contained flaked stone tools and debitage. However, Test Unit 9 contained a larger variety of stone tool forms and Test Unit 5 contained more bifaces and debitage than any other test unit. Debitage analysis suggested that some core
reduction took place in this area of the midden, but also patterned tool production. Crystal quartz debitage came primarily from Test Unit 5. Plummet pendants, crafted from crystal quartz, have been recovered from burials at Crystal River (Moore 1903, 1907). The recovery of small amounts suggests some small-scale manufacture of these or other items.

Phase 3 marks a time of transition with a reduction in population and areal occupation at Crystal River, and the beginning occupation of the Roberts Island (Pluckhahn et al. 2015). Represented in levels within Test Units 1 and 7 at Crystal River and in STP 6 at Roberts Island, its volume (.37 m³) is lower than the other phases. Only 77 artifacts in this study came from Phase 3 contexts, 71 from Crystal River (191.9/m³), and six from Roberts Island (16.22/m³). Of those, 61 are waste flakes from flaked stone tool manufacture. Bone tools are nearly absent and we recovered no stone tools. In contrast, seven shell hammers from Test Unit 7 are represented in higher density (18.9/m³) than in Phase 2 (2.6/m³) at Crystal River, even given the reduced population. This is the first indication of what would become a pronounced intensification in the use of this tool type in Phase 4 at Roberts Island.

While tool variety and density wane during Phase 4 with fewer people living at Crystal River, tool variety and density increase during Phase 4 at Roberts Island. Although populations would never again reach the levels of the earlier Phase 2 at Crystal River, this increase may suggest a trend toward a more permanent settlement at Roberts Island (Pluckhahn et al. 2015). Gastropod hammers represent 141 of the 155 shell tools at the site. These numbers likely represent artifacts recovered from Phase 4. However, since 105 come from undated contexts, it is wise to consider the possibility
that at least some come for Phase 3. In any case, these represent an extreme intensification of the manufacture and use of one tool type.

Ornamental or non-tool type artifacts characterize similar temporal trends. As with tools, non-tool artifacts occur in lower densities in Phases 1 and 3. They occur in higher densities and express variety in materials (bone, stone, and shell) and form in Phase 2. Shell beads represent the entire ornament assemblage at Roberts Island. Although only one bead dates securely to Phase 4, the rest also likely occur during the height of occupation at the site, as do the shell hammers. Perhaps bead production increased with the number of gastropods harvested. However, this does not explain the restriction to beads, as gastropods provided the material for many of the ornaments previously. It is more likely that beads become more fashionable or more valuable as trade goods. Interestingly, 12 of the 28 beads come from Shovel Test 5, Level 10 and in the post hole extension between 100 and 150 centimeters below the surface, while the others are distributed in small numbers across the site. While, these may simply have been lost in bulk in this spot, we might also consider increased bead production specific to certain areas of the site. This would require additional testing since the related debris from manufacture is absent.

Pluckhahn et al. (2015) suggest that small-scale craft production occurred in domestic contexts. A relational view assumes that the crafting of utilitarian items such as bone, stone and shell tools shares techniques with crafting ornaments and each benefits mutually from the knowledge gained in the accomplishment of these tasks, particularly in domestic settings. I would expect this to be less so if people practiced intensive production of ornaments in specific areas. However, we do not see indicators
of intensive craft production in the form of production failures, blanks, and debris from manufacture at either site.

Several climate events influenced, at least in part, the way in which people conducted daily activities, collected food, and modified their landscapes. Impacts to the local ecosystem caused by sea level and temperature fluctuations would have changed the availability of, and access to, certain species. The temporal and spatial variability and density in the tool assemblage, reflects fluctuations in the population and in the species people targeted.

The early settlement of Crystal River corresponding to Phase 1 began near the latter half of the Roman Warm period (Norman 2014; Pluckhahn et al. 2015). In southwestern Florida, Walker (2013) describes warmer temperatures and higher sea levels during this time, though not as high as current sea levels. Norman (2014) points out that, due to regional variation, sea level rise at Crystal River may have been less than in regions further south. The results of faunal analysis suggest that people targeted aquatic resources above terrestrial ones, with mullet, sheepshead, sea turtle, and deer being the primary resources during this time (Little and Reitz 2015). Again, the small sample size limits the ability to make conclusions.

Phase 2 aligns with the last quarter of the Roman Warm period (Pluckhahn et al. 2015). Results of the faunal analysis support subsistence targeting more terrestrial animals, primarily deer, while aquatic resources, especially mullet and sea turtles, remain important food sources as well (Little and Reitz 2015). The authors also note evidence of lower diversity, but greater numbers of animals targeted and for socially significant access to high-value deer meat, particularly the hindquarters. Bone tools
crafted from deer metapodial bone are most plentiful in this phase. As discussed earlier, bone points are synonymous with maritime fishing industries. Duke’s (2015) research suggests a decline in marine vertebrate species and an uptake in invertebrates, particularly oysters, between early Phases 1 and 2 and later Phases 3 and 4. This corresponds with the decline in bone tools after Phase 2 and the sharp rise in the gastropod hammer, which Menz (2012) suggests supported harvesting oysters.

Phase 3 aligns with the first half of the Vandal Minimum (Pluckhahn et al 2015), and marks a time of cooler temperatures and lower sea level (Walker 2013). During this time, the population and the areal extent was reduced to the western part of the midden at Crystal River. Construction of Mound A began, and at the same time occupation and midden construction began at and Roberts Island (Pluckhahn et al 2015). There is a slight increase in bivalve biomass during this time (Duke 2015). There is also a slight increase in shell tools at Crystal River. This appears to be a time of transition, both socially and occupationally that matures in Phase 4.

Norman (2014) suggests that toward the end of the Vandal Minimum climate episode, corresponding with the beginning of Phase 4, lower sea levels may have made Roberts Island a more desirable location. In Southwest Florida, the lower temperatures and lower sea levels supported an increased population of gastropods (Walker 2000). If the Crystal River area experienced similar conditions, then the shallow waters around the marsh islands would have supported a variety of fishes and shellfish, including oysters and crown conch. Duke’s (2015) research suggests that shifts in dietary practices included targeting shellfish, particularly oysters during Phase 4. While crown conch provided an important food source, Menz (2012) suggest that they also provided
material for crafting hammers, an important tool for harvesting oysters. Using a relational view, I might also expect that hammers served multiple purposes, either over time or concurrently by different people performing different tasks. This does not oppose Menz's findings, but considers other uses in the performance of tasks, perhaps boat building or other construction activities, or household chores. Consider how often you picked up a flat tipped screwdriver and used it as a pry bar, scraper, or other task it was not designed for.

**Limitations**

Several sources of potential biases may have influenced the results. As I have mentioned, the disparity between the phase volumes and artifact densities creates a sampling bias that limits conclusions, particularly with individual Phases 1 and 3. I expect this since Phase 1 represents a smaller, less permanent occupation and fewer activities at Crystal River. Phase 3 is a time of transition as the occupation dwindles at this site and begins on Roberts Island. This is in contrast to Phases 2 and 4, which represent larger, permanent occupations and expansion. In part, examining assemblages based on early phases (1 and 2) vs. late phases (3 and 4) benefits interpretation.

A few distinctions occur between the recent work at Crystal River and Roberts Island that limit interpretation. There are fewer radiocarbon dates from Roberts Island, which limit the assignment of artifacts to a specific phase. In addition, more artifacts come from shovel tests at this site, most of which are not well dated. Consequently, many of the artifacts date either from Phases 3 or 4. Additional dating of these materials will aid in refining interpretations at Roberts Island.
The artifacts for my research are those recovered from the odd number test units in each trench excavation at Crystal River. Essentially, this is only one-half of the material available for study. Students are still sorting and cataloging material from the remaining even number test units. This will increase the volumes for each phase, produce many more artifacts for study and bolster interpretation of artifact density.

My work focuses on recent well provenienced artifacts. However, many artifacts from earlier excavations, some of questionable provenience, are still valuable resources for study. I refer to some of them in earlier chapters, when relevant, though I did not include them in my results. Many are from burial contexts, are complete, well preserved and represent both ordinary and ritual items. In the spirit of a relational perspective, including them would have benefited the overall interpretation of connections between the everyday and ritual lives of the people.

The faunal analysis from material in the eastern extent of the midden is not complete. I have made suggestions about tool use and activities in specific areas based on the types of implements and debitage recovered, but without the benefit of all of the data. The results of faunal analysis and other areas of study, I mention below, are integral to forming solid interpretations.
CHAPTER 6
FUTURE RESEARCH AND APPLICATIONS

As I mention above, research is ongoing. In progress, and newly completed theses include pollen analysis, micro artifact analysis, and ceramic analysis. Kendal Jackson (personal communication) is examining fossil pollen, sponge spicules and other microscopic indicators to reconstruct the site-specific environment during the Middle Woodland at Crystal River. Alex Delgado (personal communication) is using geophysical techniques combined with micro artifact and chemical sediment analysis to reconstruct potential activities in the Plaza at Crystal River. Rachel Thompson (2016) is examining pottery-making practices at Roberts Island and Crystal River, suggesting that changes in social identity can be viewed through changing pottery-making practices.

Laboratory sorting and cataloging of materials from the even numbered test units at Crystal River is ongoing. When complete these data will provide new opportunities for research for years to come. I expect that others will continue examining bone, stone, and shell tools, using new methods and additional data. I hope they will expand on, and enrich my own results.

Benefits

My research on bone, stone and shell tools and related implements is the first of its kind at these two sites. Indeed, rarely do researchers examine the tool assemblage as a whole. Instead, they examine one type of material or tool type. Both avenues of
study are relevant. In fact, each complements the other. The benefit of my approach is that it affords me comprehensive view of related activities and site use. This, in turn, reveals specific characteristics that appear only when viewed as a whole. The best example is that variety in tool forms across all material types is common during the height of occupation at Crystal River, a stark contrast to the intensive use of one tool type one material during the later occupation there and at Roberts Island.

My thesis will contribute to the ongoing research by Pluckhahn and colleagues (2010b) as they study competition and cooperation at the two sites. It strengthens the association of craft production with domestic life as opposed to intensive manufacturing activities. On a larger scale, it adds to our understanding of the people who constructed lived at and finally left Crystal River and Roberts Island. As my results show, this extends to people in regions near and far.

Anyone visiting the Crystal River Archaeological State Park might agree that the museum and interpretive program has great potential to grow and better engage the public. The displays do not represent accurately what we know about the lives of the people, their tools and crafts. Both the museum and self-guided interpretive tour are aged. My results can be included as part of a program of revision that focuses what we know about the people of both Crystal River and Roberts Island using well-designed, theoretically-based research. An updated and engaging interpretive program will appeal to more people and expand the public’s interest in archaeology.
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