7592

Page 1

Ent D (FMSF only) __/__/__ **Survey Log Sheet**

Survey # (FMSF only) ________

Florida Master Site File
Version 2.0 9/97

Consult *Guide to the Survey Log Sheet* for detailed instructions.

Identification and Bibliographic Information

Survey Project (Name and project phase) Hontoon Island Reconnaissance Survey

Report Title (exactly as on title page) St. Johns Archaeological Field School 2000-2001: Blue Spring and Hontoon Island State Parks

Report Author(s) (as on title page— individual or corporate; last names first) Sassaman, Kenneth E.

Publication Date (year) 2003 Total Number of Pages in Report (Count text, figures, tables, not site forms) 216

Publication Information (If relevant, series and no. in series, publisher, and city. For article or chapter, cite page numbers. Use the style of *American Antiquity*: see *Guide to the Survey Log Sheet*.)

Technical Report 4, Laboratory of Southeastern Archaeology, Department of Anthropology, University of Florida

Supervisor(s) of Fieldwork (whether or not the same as author[s]; last name first) Jon C. Endonino

Affiliation of Fieldworkers (organization, city) Department of Anthropology, University of Florida

Key Words/Phrases (Don't use the county, or common words like *archaeology*, *structure*, *survey*, *architecture*. Put the most important first. Limit each word or phrase to 25 characters.) shell mounds, full-coverage survey

Survey Sponsors (corporation, government unit, or person who is directly paying for fieldwork)

Name Florida State Parks; Mr. Danny Paul, Manager, Blue Spring State Park

Address/Phone 2100 West French Avenue, Orange City, FL 32763

Recorder of *Log Sheet* Kenneth E. Sassaman Date *Log Sheet* Completed 04/16/03

Is this survey or project a continuation of a previous project? X No ❑ Yes: Previous survey #(s) [FMSF only] ________

Mapping

Counties (List each one in which field survey was done - do not abbreviate; use supplement sheet if necessary)
Volusia

USGS 1:24,000 Map(s) : Map Name/Date of Latest Revision (use supplement sheet if necessary): Orange City 1964

Description of Survey Area

Dates for Fieldwork: Start 05/15/00 End 06/15/01 Total Area Surveyed (fill in one) ca. 20 hectares ________ acres

Number of Distinct Tracts or Areas Surveyed 20 transects

If Corridor (fill in one for each): Width 30 meters _____ feet Length ca. 5.5 kilometers ___________miles

Survey Log Sheet of the Florida Master Site File

Research and Field Methods

Types of Survey (check all that apply): X archaeological ❑ architectural ❑ historical/archival ❑ underwater ❑ other:

Preliminary Methods (✓Check as many as apply to the project as a whole. If needed write others at bottom).

❑ Florida Archives (Gray Building) ❑ library research- *local public* ❑ local property or tax records ____________ ❑ win

❑ Florida Photo Archives (Gray Building) ❑ library-special collection - *nonlocal* ____________ ❑ new

X FMSF site property search ❑ Public Lands Survey (maps at DEP) X literature search

❑ FMSF survey search X local informant(s) ❑ Sanborn Insurance maps

❑ other (describe) ____________

Archaeological Methods (Describe the proportion of properties at which method was used by **writing in** the corresponding letter. Blanks are interpreted as "None.")

F(-ew: 0-20%), **S**(-ome: 20-50%); **M**(-ost: 50-90%); or **A**(-ll, Nearly all: 90-100%). If needed write others at bottom.

❑ Check here if **NO** archaeological methods were used.

___ surface collection, controlled
___ surface collection, uncontrolled
A shovel test-1/4"screen
___ shovel test-1/8" screen
___ shovel test 1/16"screen
___ shovel test-unscreened
___ posthole tests
___ auger (size:____)
___ coring
___ test excavation (at least 1x2 M)
___ other screen shovel test (size: ____) _____ ___ bl
___ water screen (finest size: ____) _______ ___ s
___ magnetometer
___ side scan sonar
___ unknown
___ other (describe): ____________

Historical/Architectural Methods (Describe the proportion of properties at which method was used by **writing in** the corresponding letter. Blanks are interpreted as "None.")

F(-ew: 0-20%), **S**(-ome: 20-50%); **M**(-ost: 50-90%); or **A**(-ll, Nearly all: 90-100%). If needed write others at bottom.

❑ Check here if **NO** historical/architectural methods were used.

___ building permits
___ commercial permits
___ interior documentation
___ demolition permits
___ exposed ground inspected
___ local property records
___ neighbor interview
___ occupant interview
___ occupation permits
___ subdivision maps
___ tax records
___ unknown
___ other (describe): ____________

Scope/Intensity/Procedures Survey designed as experiment in full-coverage survey, with shovel tests placed at 30-m interval along transects designed to be 30-m apart and traversing entire breath of Hontoon Island. As this was field school operation, pace was slow and deliberate, resulting in minimal coverage over two 5-week field seasons (ca. 8.5% of entire area). Cruciform shovel tests at 10-m interval used at locations of positive shovel tests to determine site boundaries.

Survey Results (cultural resources recorded)

Site Significance Evaluated? X Yes ❑No If *Yes*, circle NR-eligible/significant site numbers below. (UNDERSCORED)

Site Counts: Previously Recorded Sites 3 Newly Recorded Sites 2

Previously Recorded Site #'s (List site #'s without "8." Attach supplementary pages if necessary) 8VO214, 8VO215, 8VO202

Newly Recorded Site #'s (Are you sure all are originals and not updates? Identify methods used to check for updates, ie, researched the FMSF records. List site #'s without "8." Attach supplementary pages if necessary.)
8VO7493, 8VO7494

Site Form Used: X SmartForm ❑ FMSF Paper Form ❑ Approved Custom Form: Attach copies of written approval from FMSF Supervisor.

DO NOT USE SITE FILE USE ONLY DO NOT USE

BAR Related **BHP Related**
❑ 872 ❑ 1A32 ❑ State Historic Preservation Grant
❑ CARL ❑ UW ❑ Compliance Review: CRAT
#______

ATTACH PLOT OF SURVEY AREA ON PHOTOCOPIES OF USGS 1:24,000 MAP(S)

7592

ST. JOHNS ARCHAEOLOGICAL FIELD SCHOOL 2000-2001: BLUE SPRING AND HONTOON ISLAND STATE PARKS

Kenneth E. Sassaman

with contributions by:

Meggan E. Blessing
Sean P. Connaughton
Jon C. Endonino
Aidith Flores
Patrick O'Day
Sharyn Jones O'Day
John Schultz
Ashley B. Weser

Technical Report 4
Laboratory of Southeastern Archaeology
Department of Anthropology
University of Florida

Feb. 2003

1A-32 permit No. 9900.34

Cover photo of Blue Springs Park courtesy of West Volusia Historical Society, Inc.

Management Summary

The St. Johns Archaeological Field School of the Department of Anthropology, University of Florida, conducted two seasons of archaeological investigations at Blue Spring and Hontoon Island State Parks in the summers of 2000 and 2001 under a 1A-32 Permit, 9900.34. Testing beneath the Thursby House at Blue Spring, in advance of foundation repairs, revealed a 1.2-m stratified shell midden dating from roughly 4300 to 3500 rcybp. Both primary and secondary midden deposits were uncovered, the former indicative of habitation space (i.e., domestic structures). Ground penetrating radar was used to predict the locations of a stratigraphic facies between primary and secondary deposits. Additional testing in 2001 led to the application of a site-wide GPR survey to locate other such features. An arcuate arrangement of feature clusters spanning the northern and western elevations of the Thursby House represents the first Orange-period "village" ever detected along the middle St. Johns River.

In advance of construction of a new sewage treatment facility at Blue Spring, the 2000 field school tested a location some 200 m southwest of the Thursby House. Observed beneath one meter of recent alluvial deposition was a well-preserved shell midden of apparent preceramic age (i.e., >4000 rcybp). Groundwater levels prevented full characterization of this deposit, but the following summer a second text unit was excavated 100 m upslope, where bucker augering revealed the same buried midden. This unit penetrated over 80 cm of shell midden over another 20 cm of shell-free midden, all preceramic in age. These results confirmed the presence of an extensive early component beneath Orange-age shell midden beneath the Thursby House. Columns of midden deposits from five locations of testing provide abundant subsistence data for exploring possible changes in diet and paleoecology over a long period of more-or-less continuous occupation.

A large mound 1 km north of Blue Spring was investigated by Jeffries Wyman in the 1870s and looted 100 years later, allegedly for human burials. The mound is recorded in the Florida Master Site Files as 8VO41, and is herein dubbed Live Oak Mound. Work at this site was limited to topographic mapping, including the mapping of 135 looters' pits, along with limited testing at two such looters' pits. The results of testing suggest that the entire mound was initiated as an extensive preceramic midden dating from ca. 6300 rcybp. One probable episode of mounded shell overlying the preceramic midden is estimated to date to the Orange period (ca. 4000-3500 rcybp), and attests to the deliberate construction of this monument. The particular configuration of Live Oak Mound—a tall conical mound with a curving, trailing "ramp"—is a form that recurs at 8VO215 on Hontoon Island and is perhaps consistent with the now-destroyed shell mounds Wyman observed at the north end of Hontoon Island. The burials Wyman described from the upper portion of the Live Oak Mound most likely date to the St. Johns II period, although earlier interments are certainly possible. The field school effort encountered no human remains.

Reconnaissance survey of Hontoon Island was designed as a "full-coverage" effort to examine areas heretofore overlooked by archaeologists, namely the interior of

the island. No interior sites were located in several transects across the island, but two of the transects intercepted two small, buried shell-bearing sites (8VO7493, 8VO7494), heretofore unrecorded. Survey on the island also sought to refine site boundaries for four sites: 8VO202, 8VO214, 8VO215, and 8VO216. Definitive boundaries were established for two of these sites (8VO214, 8VO215), a third was not relocated (8VO216), and the fourth (8VO202) will require more shovel testing. On balance, the survey effort showed that sites long ago impacted by shell mining (e.g., 8VO202) have extensive subsurface middens still intact, and that many small shell-bearing sites along the margins of the island remain to be found.

Recommendations for continued archaeological investigations at Blue Spring and Hontoon Island State Parks include additional GPR survey of 8VO43; transit mapping and limited testing at 8VO214 on Hontoon Island and an unrecorded mound at Blue Spring; further subsurface characterization of 8VO202; reconnaissance survey to locate Palmetto Shell Mound (8VO40); and limited testing of small, shell-bearing sites along the east terrace of the St. Johns River and the margins of Hontoon Island.

Acknowledgments

The idea to conduct an archaeological field school at Blue Spring State Park was suggested by Steve Martin of Florida State Parks in a chance meeting with the senior author at a grant hearing in Tallahassee in 1999. A visit to the parks later that year sealed the deal. There I met with Steve and his colleague Norm Edwards, as well as Park Manager Danny Paul, Wildlife Biologist Richard Harris, and several other members of the Blue Spring staff. They took me to the Thursby House and explained that pending repairs to the foundation would potentially disturb the shell-midden deposits beneath. Virtually nothing was known about the age, depth, or content of these deposits, so testing was required before an assessment of potential impact could be made. Their need provided an ideal opportunity to conduct a field school at a site consistent with my long-term research, but also under circumstances akin to the cultural resource management archaeology many of the students would likely pursue as professionals. We also visited other sites on the parks and discussed their broader needs for resource management.

A research design was submitted to the Division of Historical Resources for a 1A-32 Permit (9900.34) and work began in May of 2000. By all measures, the field schools that summer and the following summer were a great success. We not only helped state parks fulfill their need to protect archaeological resources, but we tapped into a variety of research questions and found relevant data for addressing them, thus building on the work of Wyman, Moore, Purdy, and others. Our success in this effort was due in no small measure to the generosity and encouragement of Florida State Parks personnel. Danny Paul and his staff deserves our deepest thanks for making all of this possible. Special thanks go to Richard Harris for his interest, unwavering support, intimate knowledge of the parks' many resources, and friendship. The students were especially pleased with Richard's efforts with the front-end loader on backfilling day. Sherry Cody and her staff (Keith, Dick, J.R., and John) were gracious hosts on Hontoon Island, sharing their resources generously and putting up with the chaos that only 18 college students could create. From their positions in Tallahassee, Steve Martin and Norm Edwards were staunch supporters of our efforts and for that I am very grateful. Norm's visits to the Blue Spring site were always a pleasure, and we enjoyed taking a field trip with him to other sites in the region that first summer.

The field school teaching assistants were superb. Hats off to Pat O'Day, Sharyn O'Day, and Jon Endonino for a job well done. Of course, the students did most of the work and for that I am grateful. The 2000 field crew consisted of Meggan Blessing, Korinn Braden, John Brevard, Ben Burkley, Leslie Campbell, Brett Casteel, Sean Connaughton, Shelley Dittman, Mark Donop, Jeremy Fuller, Heather Hardester, Audrey Hull, Scott Hussey, Devon McAuliffe, Jim Mallard, Lesley Martin, Maile Miller, Amanda Nadeau, Sean (Odie) Odenwald, Michael (Whitey) White, and Rachel Zebell. The 2001 field crew consisted of Beth Auten, Kimberly Emery, Aidith Flores, Tiffany Forgays, Jeff Fowler, Anya Frashuer, Josh Kalb, Keith Kircher, Samara Mendel, Curtis Moden, Phil Roy, Morgan Schmidt, Katherine Sullivan, Danielle Thomas, Rena Tinsley, Renee Tousignant, Ben Walters, Ashley Weser, and Davide Zori. Innumerable other students poured hundred of hours sorting matrix in the lab and cataloging artifacts. My thanks to Ashley Weser for supervising much of that work.

Jon Endonino contributing to this report with his record of reconnaissance survey on Hontoon Island. Vertebrate faunal analysis reported here was conducted ably by Meggan Blessing. Portions of Sean Connaughton's senior thesis on resource depression appears in modified form in Chapter 7. Ashley Weser collected most of the data on pottery reported in Chapter 6. John Schultz of the C.A. Pound Forensics Lab at UF spent considerable time with us in the field collecting GPR readings, and he contributed to the authorship of Chapter 3. Aidith Flores pursued archival research after field school as part of an honors thesis. We are grateful to folk historian Bill Dreggors for assisting Aidith in this effort.

Institutional support for this project was provided by the University of Florida's Department of Anthropology under the leadership of Allan Burns. Office Manager Karen Jones cheerfully took care of all the administrative details to make this happen. My deepest thanks to both Allan and Karen for their support of this work.

Archaeological Supervisor Ryan Wheeler of Division of Historical Resources, and his successor Brenda Swann, deserve our thanks for administering our applications for permit. Our thanks to goes to State Archaeologist Jim Miller for his support of this work.

Contents

CHAPTER 1
INTRODUCTION AND RESEARCH ORIENTATION

The St. Johns Archaeological Field School of the Department of Anthropology, University of Florida, conducted two seasons of archaeological investigations at Blue Spring and Hontoon Island State Parks in the summers of 2000 and 2001. Located on the St. Johns River in Volusia County, Florida (Figure 1-1), these parks are home to several significant prehistoric archaeological sites, including shell mounds and middens investigated in the late 19th century by C. B. Moore (1892-94, 1998) and Jeffries Wyman (1875), and, most recently, by Barbara Purdy and colleagues (1987). The St. Johns Archaeological Field School divided its efforts among three tasks: (1) mapping and subsurface testing of Blue Spring Midden B (8VO43), located beneath the historic Thursby House; (2) mapping and subsurface testing of a shell mound (8VO41) herein dubbed Live Oak Mound (8VO41), one mile north of the Thursby House; and (3) reconnaissance survey of Hontoon Island.

The first of these tasks was undertaken at the request of Florida State Parks and with the consent of Florida Bureau of Archaeological Research. The late 19th-century Thursby House, closed to park visitors since 1989, was slated for repairs to its dilapidated pier foundation. Holes dug to install new piers would penetrate and potentially damage the prehistoric shell midden (8VO43) beneath the house. In the absence of prior knowledge about this site, State Parks sought information on the depth, age, and integrity of the shell deposits in order to assess potential impacts. The 2000 field school was designed expressly to provide this information. In the course of testing the shell deposit, State Parks officials requested assistance in assessing the archaeological potential of an area 180 m southwest of the Thursby House that was earmarked for construction of a wastewater treatment facility. The discovery in this location of a buried shell midden beneath a thick mantle of alluvial sand precipitated additional archaeological testing in the summer of 2001 to determine the relationship of these buried deposits to those beneath the Thursby House. Augering, ground-penetrating radar (GPR), and additional subsurface tests were used to establish continuity between the two shell deposits, and to refine knowledge about the stratigraphic composition of subsurface deposits site wide. The site contains components dating to the early Orange period (ca. 4000-3500 radiocarbon years before present [rcybp]), and the immediate preceramic era (ca. 4300-4000 rcybp). A significant finding of the GPR survey was recognition of a semi-circular pattern of feature clusters that arguably reflects an Orange-period community of four to five households. Also noteworthy is the recovery of several columns of stratified midden whose well-preserved faunal remains provide a fine-grained record of subsistence activities over several centuries.

The 2001 field school also expanded operations to include work at Live Oak Mound (8VO41). Jeffries Wyman (1875) conducted test excavations at the mound in the early 1870s, noting the presence of numerous human burials. Extensive looting activity in the 1970s apparently removed most, perhaps all, of the interments, leaving no surface occurrences of human bone in the scores of open pits inspected. Fieldwork centered on complete mapping of the mound with a laser transit, including all surface evidence for

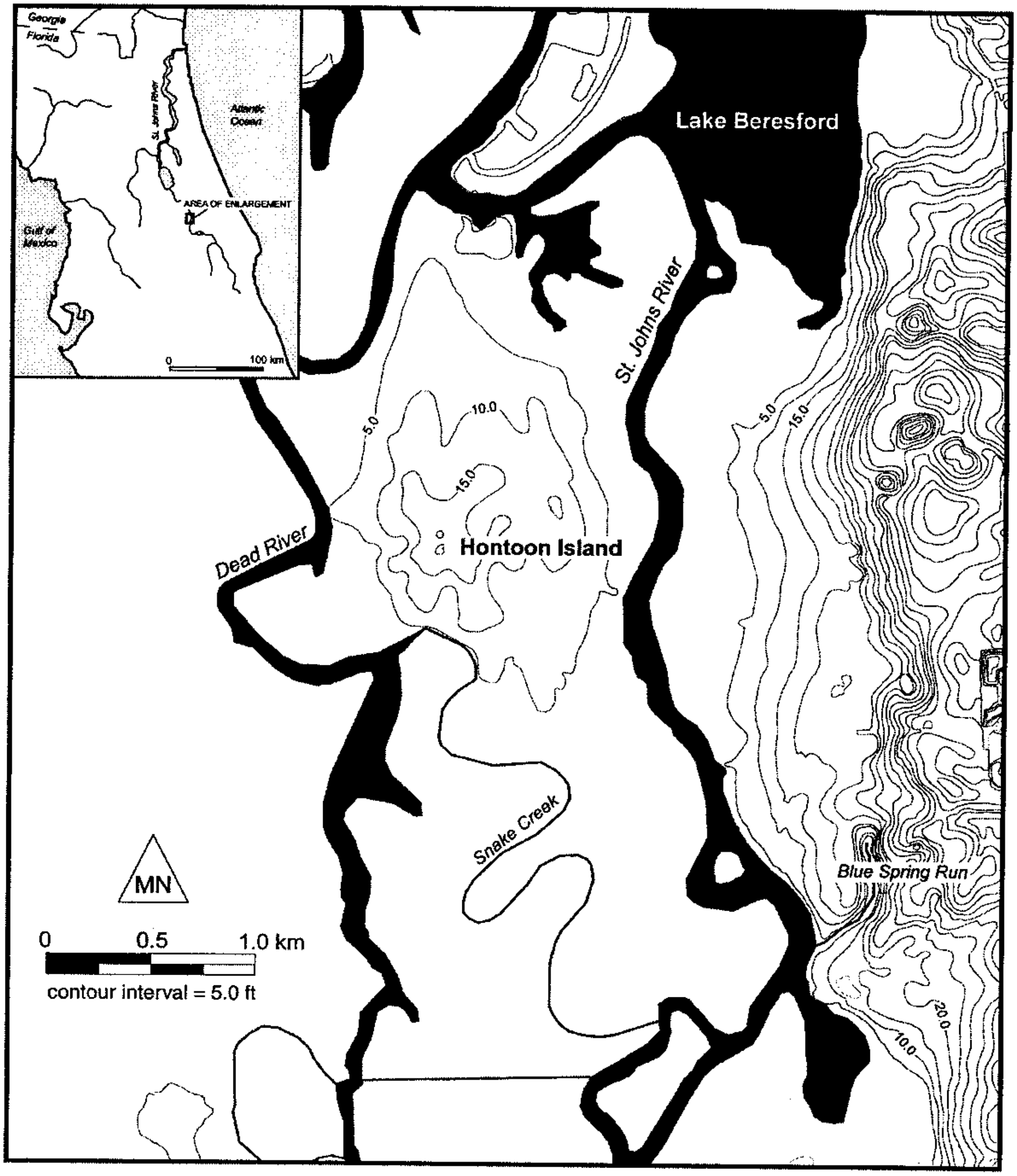

Figure 1-1. Area of Hontoon Island and Blue Spring State Parks in Middle St. Johns River Valley, Volusia County, Florida.

looting activity. Two test units at either end of the mound exposed intact strata, although differentiating between looter backfill and undisturbed deposits proved difficult. The only diagnostic artifacts recovered were St. Johns sherds and a few examples of Orange Incised, none from definitively undisturbed contexts. Despite the uncertainty of the stratigraphic sequence, the topographic map produced by field school students is a valuable contribution to a growing record of monument configuration. A radiocarbon assay on charcoal extracted from concreted shell midden at the base of the deposits places the onset of midden/mound formation at ca. 6300 rcybp.

Reconnaissance survey of Hontoon Island was conducted during both field school sessions to expose students to typical Phase I contract work. This effort was conceived as full-coverage survey of the island, with transects of shovel tests traversing the entire island at 30-m intervals. All prior work at Hontoon Island focused on the several shell mounds and middens along its perimeter. Shovel-test transects across the intervening pine flatwoods intercepted no archaeological deposits in the interior of the island. However, shovel tests were effectively used to refine the boundaries of three existing sites and to locate two new sites along the margin of the island. All transects were mapped with global positioning systems (GPS) technology.

Reported here are the full details of all aspects of field research conducted by the 2000 and 2001 St. Johns Archaeological Field Schools. All recovered remains were cataloged by type, count, and weight (Appendix A) and all material culture were analyzed for a variety of technological and functional attributes. Only about three-fourths of the large faunal assemblage has been analyzed to date, and none of the 67 flotation samples collected from features and columns have been processed. All records, assemblages, and bulk samples from the 2000 and 2001 field schools are currently housed at the Laboratory of Southeastern Archaeology at the University of Florida, and will be submitted in the near future to the repository of the Division of Historical Resources in Tallahassee for permanent storage.

EDUCATIONAL OBJECTIVES

The emphasis of the St. Johns Archaeological Field Schools in 2000 and 2001 was stratigraphic excavation. All students were trained and given experience with grid layout, level excavation, feature excavation, plan and profile mapping, and stratigraphic interpretation. All students also spent considerable time processing midden matrix through waterscreens, picking vertebrate faunal remains, artifacts, and other materials from snail-shell-rich matrix. UF Graduate Students Pat O'Day and Sharyn O'Day supervised most of the stratigraphic excavation at Blue Spring.

Intensive training in the use of a laser transit complemented experience with stratigraphic excavation. Field school students, all of whom spent at least one week working on a three-person mapping team, collected all of the transit readings that went into the production of site maps. Some of the students also had the opportunity to use the GPS and GPR equipment, the latter provided and deployed by John Schultz of the C.A. Pound Forensics Laboratory, University of Florida.

As mentioned above, reconnaissance survey of Hontoon Island enabled all students to gain experience with typical Phase I survey. Each student spent one week with a reconnaissance team under the leadership of UF Graduate Student Jon Endonino. The work involved not only site-discovery techniques, but also methods for determining subsurface site boundaries.

Both field schools were conducted for six weeks each from mid-May to late June, with the first five weeks in the field and the last in the lab back in Gainesville. Students and staff resided during the week at cabins on Hontoon Island provided by State Parks. Crews of six to seven students were deployed each morning to one of three assignments (reconnaissance survey, mapping, or excavation), each supervised by a staff member.

Work at Blue Spring took place among daily visitors to the park, many of whom stopped to ask questions about the excavations and mapping. Students were given plenty of opportunity to discuss the work with passers-by, and most seemed to enjoy it. Although interactions with the public sometimes impinged on the pace of work, these experiences seemed to help students think about the relationship between technical aspects of the work and the research questions that guided our work. They likewise helped to fulfill the obligation that all public-funded archaeologists have to share their findings with citizens.

RESEARCH ORIENTATION

The St. Johns Archaeological Field School is part of a long-term effort on the part of the senior author to reconstruct the details of prehistoric life in the middle St. Johns region from ca. 6000 to 3000 years ago. It is over this 3000-year period that hunter-gatherer populations in the region made increasingly intensive use of locations along the river for settlement, food collecting, and monument construction. One expression of this process is the Orange Culture of ca. 4000-3000 rcybp, the makers and users of the area's first pottery. A parallel development is found in the middle Savannah River valley, where the early pottery Stallings Culture existed from ca. 4500-3500 rcybp. These two venues of culture change, along with developments along the intervening Atlantic coast, signal the rise of "sedentism" and "complexity" in the greater region. A major goal of work in the middle St. Johns is to compare its historical developments with those of the middle Savannah River in order to reveal the regional-scale processes underlying these local cultural changes.

A key factor in the development of sedentary, "complex" hunter-gatherers worldwide is the exploitation of aquatic food resources. Global warming after the Pleistocene caused sea levels to rise as glaciers melted, returning moisture to the atmosphere and ultimately the oceans. Coastlines were submerged and groundwater levels in low-lying terrain rose to create increasingly extensive wetland habitat. Coupled with increased precipitation over the late Pleistocene, Holocene-aged land was generally well watered. A diminished rate of sea-level rise after 6000 rcybp led to increasingly stable and productive coastal and near-coastal habitat for species on which humans had to come depend. The St. Johns River at this time assumed its more-or-less modern configuration, with its lower third becoming a drowned estuary, and its middle third a series of lakes and wetlands connected through a broad, low-gradient channel. By 5500 rcybp, locations along the St. Johns, as well as the coast, were visited regularly, if not occupied permanently, by groups who collected and ate large quantities of fish and shellfish and built monuments out of shell and sand.

While the ecological conditions enabling intensive coastal and riverine settlement after 6000 rcybp are fairly well understood, the specific circumstances surrounding ensuing culture change in the middle St. Johns remain sketchy. Few data are available on fundamental issues, such as (1) the degree of settlement permanence; (2) the sustainability of intensive aquatic resource use; (3) the role of food storage; (4) the consequences of pottery technology on household economics; and (5) the significance of monument construction. All such issues are plagued by vague chronology and sampling limitations.

Although initiated by the need to assess potential impacts to 8VO43 from repairs to the Thursby House, the 2000 and 2001 field schools have contributed much new information on the larger issue of emergent sedentism and complexity among regional hunter-gatherer populations. Refined chronology, details of community and household organization, and fine-grained subsistence data are among the substantive contributions of this work. More broadly, the field school results have added to a growing body of evidence for continuity in intensive riverine settlement and monument construction since at least the sixth millennium B.P. Both Blue Spring Midden B and Live Oak Mound have basal preceramic components in locations of mound construction, and we suspect that the mounds on Hontoon Island were likewise initiated in the late Middle Archaic period. More work is required to substantiate that these nascent developments involved intentional mound construction, and not simply the accumulation of household refuse. Data on mound configuration is critical in this regard, as geometric regularities and cryptic patterning in the size and shapes of mounds has the potential to inform on aspects of social organization and community structure (e.g. Russo 1999). Curiously, mounds such as Live Oak and 8VO214 on Hontoon Island are bereft of material culture and direct evidence for domestic structures. Small, less conspicuous middens across the area most likely housed communities that contributed to mound formation and participated in the ritual activities enabled by their construction. The evidence for an arcuate village pattern of Orange age at Blue Spring Midden B provides our first model for the size and configuration of these early communities. In fleshing out the relationships between small, dispersed sites and mound complexes, we must strive for more refined chronology, through both radiometric means, as well as comparative analyses of material culture.

Florida archaeologists in recent decades have tended to focus on subsistence issues in their studies of shell middens and wet sites (e.g., Russo et al. 1992; Wheeler and McGee 1994c; Newsom 1987, 1994), and rightfully so. Now issues of monumentality have moved to the forefront (e.g., Aten 1999; Russo 1996a, 1999; Russo and Heide 2002). Subsistence data will continue to play a major role in this burgeoning area of research, because food processing and consumption patterns at mound sites may be expected to differ from that at domestic sites, and such data will be essential to infer season of use and paleoecological circumstances of mound activities. Beneath the veneer of sameness that is the subsistence record of 6000 years of life along the middle St. Johns are potentially meaningful differences in the scale and timing of subsistence activities. Attention to microstratigraphy and other fine-grained contexts, along with multiple scales of comparison, are required to expose this hidden variation.

Above all, our interest in understanding the causes and consequences of emergent village life and monumentality in the middle St. Johns will not be satisfied with a few short field projects or short-term engagements with museum collections. Genuine advances in this regard require long-term research that is intensively trained on small-scale problems set within a regional, even continental scale of comparative inquiry. The contributions of the 2000-2001 field school are a small step in that direction.

ORGANIZATION OF THE REPORT

An overview of the archaeological and historical contexts of this research follows in Chapter 2 as a prelude to the site-specific chapters on Blue Spring Midden B, Live Oak Mound, and Hontoon Island in chapters 3-5. A description of artifact assemblages recovered from all aspects of the field school efforts is given in Chapter 6, with special emphasis on the assemblage of Orange Plain pottery from Blue Spring Midden B. Chapter 7 reports preliminary results of the analysis of vertebrate and invertebrate faunal remains from Blue Spring. A concluding chapter summarizes the results reported herein and offers recommendations for two more seasons of fieldwork.

A complete catalog of all artifacts and faunal remains from the 2000-2001 field seasons is provided in Appendix A and was assembled by Ashley Weser. Tables of zooarchaeological data from each of the Blue Spring strata, compiled by Meggan Blessing, given in Appendix B. Both of these datasets are available from the senior author in digital format for interested researchers. A table reporting the radiocarbon assays for this project can be found in Appendix C.

CHAPTER 2
HISTORIC AND ARCHAEOLOGICAL CONTEXTS

The middle St. Johns region of northeast Florida has an archaeological record of intensive habitation at sites along the river and associated wetlands reaching back at least to 6000 years ago. Humans entered the region some 4000-5000 years earlier, but evidence of them is sparse, or at least inconspicuous. By 6000 B.P., their descendants began to occupy sites for lengthy episodes, and returned to the same locations repeatedly, leaving behind the inedible remains of shellfish, fish, and other food resources, along with artifacts made from bone, shell, and occasionally stone. They also began to inter their dead in locations that would eventually receive massive piles of shell and earth, huge monuments that perhaps not only marked the resting place of the dead, but also served as focal points of ritual and ceremony. By 4000 B.P. certain groups began to make and use the first pottery in the region. The regional population grew in size, and most likely became divided into several distinct ethnic groups, although they continued to share in a tradition of fishing, shell fishing, and mound building. The eventual dawn of agriculture some 1000 years ago had little impact on local communities. By the time Europeans arrived in the 16th century, the accumulated effects of some 6000 years of intensive land use and mound construction was a landscape so rich in archaeological sites that naturalists and antiquarians through the early 20th century would return regularly to the St. Johns to explore its seemingly unlimited riches. A few decades later, many of the region's shell mounds would be mined for road fill.

The area now occupied by Hontoon Island and Blue Spring State Parks is one of several in the middle St. Johns investigated by Jeffries Wyman (1875) and C. B. Moore (1892-94). Accounts of their field explorations constitute some of the only evidence we have for shell mounds destroyed for road fill. Modern archaeologists, most notably Barbara Purdy (1987, 1991), have demonstrated that some of the victims of shell mining have deposits preserved beneath the standing water and marshes of their terrestrial margins. Other work in the region has shown that deposits beneath and adjacent to shell and earthen mounds often yield components dating to the Middle and Late Archaic periods, when intensive riverine settlement was initiated (e.g., Aten 1999; Wheeler et al. 2000). Thus, despite the widespread destruction of mounds in the region, a vast archaeological record is preserved in adjacent wetlands and subsurface terrestrial contexts, and it is a record that holds clues to the rudiments of settled village life, mound building, and a fishing economy that would persist for upwards of six millennia.

Several reviews of the archaeology of the greater St. Johns region and its broader context in Florida have been issued since the 1950s (Goggin 1952; Milanich and Fairbanks 1980; Milanich 1994; Miller 1991, 1998; Purdy 1991), and a recent review of the Mount Taylor culture (Wheeler et al. 2000) synthesizes extant knowledge of the beginnings of intensive settlement in the region. We do not attempt to duplicate those efforts in this chapter, but rather provide a context for the specific field efforts reported herein. Much of the summary that follows was adapted from a recent study of archaeological site distributions in northeast Florida (Sassaman et al. 2000). Also reported here are the results of archival research by one of the 2000 field school students, Aidith Flores, on changes in land use at Blue Spring in the modern era.

ST. JOHNS CULTURE HISTORY

Paleoindian Period

First to colonize the western hemisphere, Paleoindian populations had no apparent antecedents in the "New World." When members of these founding populations reached Florida some 11,500 years ago, the environment was significantly different than it is today. Sea levels were 60-100 m lower (Gagliano 1977) and the Gulf shoreline extended 40-70 miles farther west. Climate was significantly drier and cooler than at present. Potable water in the interior of the state was found primarily in "water holes, lakes, and prairies fed by rainfall and very deep sinkholes that were fed at least occasionally by ground water from springs" (Milanich 1994:39). With limits to the amount of available moisture and cooler climate, vegetative communities were patchy. Xeric scrub covered the southern part of the peninsula, while the northern portion was covered with pine forest mixed with oak and hickory stands. Coastal areas are thought to have been dry and supported savannah and dune communities (Borremans 1990).

Due to the generally poor preservation of organic materials outside of aquatic contexts, stone tools and lithic debris from their manufacture and use are the defining elements of Paleoindian material culture. In addition, items of bone and ivory attributable to the Paleoindian period have been recovered in the rivers and springs of north and central Florida (e.g., Dunbar and Webb 1996; Dunbar et al. 1989). Many of these items may prove to be highly diagnostic of late Pleistocene technological traditions.

Paleoindian lithic technology placed an emphasis on high quality lithic resources and is characterized by "fine workmanship" (Borremans 1990:4). Projectile points such as the Clovis, Suwannee, and Simpson types are diagnostic of this period, as are a variety of other formal unifacial tools such as the endscraper. Informal, expedient tools, such as utilized flakes, are also common in Paleoindian assemblages. In general, these materials reflect a technology designed to be flexible and multipurpose (Daniel and Wisenbaker 1987). Other Paleoindian artifacts include abraders and hones of sandstone, groundstone tools, and egg-shaped bola weights (Milanich and Fairbanks 1980:39). Other items of Paleoindian material culture not made from stone include a host of organic tools such as bi-pointed bone tools, beveled ivory points/foreshafts, socketed antler projectile points, worked shell, and bone beamers, awls, and anvils (Dunbar and Webb 1996).

By and large, Paleoindian sites are most numerous in areas where water and lithic resources coincided in the Late Pleistocene (Dunbar and Waller 1983). Often referred to as the "oasis hypothesis," this model predicts that Paleoindians were more or less tethered to areas where these resources were available. Inasmuch as the distribution of Paleoindian artifacts shows a strong association with karst topography in about one-third of the Florida peninsula (north-central and gulf coast) (Dunbar and Webb 1983), this model appears valid. In the St. Johns Basin Paleoindian sites are much fewer, suggesting that occupation of the region was sporadic, possibly reflecting an environment not suitable for prolonged habitation (Miller 1998:51-53). The few Paleoindian sites known from the region are generally associated with "spring fed rivers of the Tertiary karst region" (Miller 1998:51).

Paleoindian sites in the St. Johns Basin ought to occur in areas where surface water would have been available, such as places where sinkholes penetrated the Floridan Aquifer. Possible spring sources of water in the St. Johns Basin include Salt Springs, Silver Glen Springs, Juniper Springs, Fern Hammock Springs, Green Cove Springs, Beecher Springs, and Blue Springs (Miller 1998:54). Neill (1964) reports the presence of Suwannee points at Silver Glen Springs, a first-magnitude spring in eastern Marion County that flows into Lake George. Another possible location for Paleoindian sites in the St. Johns Basin would be ridges containing uplands environments and sinkholes adjacent to the river. An example of this situation would be the Crescent City Ridge with its many sinkholes possibly providing "reliable water sources during the Late Pleistocene Epoch" (Miller 1998:55). Systematic searches of these potential site locations have yet to be conducted.

Archaic Period

The Archaic Period of Florida can be divided into three subperiods, Early (10,000-7000 B.P.), Middle (7000-5000 B.P.), and Late (5000-2500 B.P.), based largely on changes in projectile point styles. The appearance of fiber-tempered pottery signals the beginning of the Late Archaic Orange Tradition at about 4200 B.P. In general, a fishing-hunting-gathering lifestyle was followed by all Archaic Period peoples. Social formations are thought to be essentially egalitarian (although this is the subject of intesnse debate), and regional population levels appear to have increased from early to late periods.

Early Archaic. The Early Archaic immediately followed the Paleoindian period and is distinguished from it by the appearance of notched and then stemmed hafted biface forms after ca. 10,000 B.P. In general, the Early Archaic was characterized by wetter conditions than the preceding Paleoindian period and as a result of more surface water there are more Early Archaic sites in more locales. A change in subsistence practices also accompanied the environmental changes that contributed to the extinction of many Pleistocene animals. Despite the changes, many Early Archaic sites are found at the same locations as earlier Paleoindian sites (Milanich 1994:63).

With the exception of projectile point types, Early Archaic material culture is very similar to that discussed for Paleoindians. Numerous formal unifacial tools and expedient flake tools are present in Early Archaic lithic assemblages. Projectile point types diagnostic of this period include the side- and corner-notched Bolen, with stemmed types such as the Kirk Serrated, Hamilton, and Arredondo appearing later. Some investigators (Bullen 1975; Milanich 1994; Milanich and Fairbanks 1980; Purdy 1981) consider the Bolen type to be Late Paleoindian in age despite pan-southeastern similarities among well-established Early Archaic projectile point types. Big Sandy, Taylor, and Kirk Corner Notched points from Georgia and South Carolina, as well as the Autaga type from Alabama, bear many similarities with Florida Bolens.

As was the case for the Paleoindian period, few Early Archaic sites are recorded in the study area, although among them is arguably one of the more spectacular in the Southeast, namely the Windover Pond cemetery in Brevard County (Doren and Dickel 1988; Doren 2002). In general, Early Archaic sites are found at springs and high ground overlooking wetlands such as site 8SJ3135 in St. Johns County, located on a sand ridge overlooking a swamp (Miller 1998:61). Land use patterns for the Early Archaic, as they relate to the St. Johns Basin, are poorly documented, and we have little insight regarding the movement of populations between the Central Highlands, the St. Johns, and the Atlantic Coast. Presumably, the St. Johns Basin and Atlantic Coast were still not extensively utilized by Early Archaic populations for the same reason they were underutilized by Paleoindian groups. Yet, given an increase of surface water, especially perched sources rather than deep sources associated with the Floridan Aquifer, greater utilization during the Early Archaic period is expected. Perhaps the limited number of Early Archaic sites in the St. Johns Basin is more a result of poor sampling in the region, ineffective models for settlement and site location, and the inability to detect sites that may be buried or inundated beyond the reach of standard archaeological site-detection methods. In fact, a recent survey of Crescent Lake in Flagler and Putnam counties involved private collections research that was initiated by Barbara Purdy and her students in the early 1980s (Sassaman n.d.). Two individuals who have collected the shallow waters of the western margin of the lake have many examples of Early Archaic points, as well as earlier and later materials. Apparently, the record of Paleoindian and Early Archaic settlement in northeast Florida lies largely beneath freshwater lakes, ponds, and wetlands.

Middle Archaic. A general environmental trend toward wetter conditions and more and larger surface water sources characterized the Middle Archaic period. These environmental changes are thought to be responsible for changes in Archaic lifeways, resulting in different settlement, subsistence, and technological systems from previous periods. The beginning of the Middle Archaic is generally placed at about 7000 B.P. and its terminus around 5000 B.P. (Milanich 1994). As with all other prehistoric periods without ceramics, changes in projectile point styles signal the beginning of the Middle Archaic and are used as temporal indicators in assigning sites to particular traditions. Within the St. Johns Basin, the late Middle and preceramic Late Archaic is defined by the Mount Taylor culture, an archaeological construct derived from the Mt. Taylor site of Volusia County (Goggin 1952; Wheeler et al. 2000).

Compared to sites of previous periods, Middle Archaic sites are widely distributed throughout Florida, and it is during this period that shell middens began to accumulate along the St. Johns River and the Atlantic and Gulf coasts. Numerous sites are found in upland, riverine, coastal, and wetland locations and are suggestive of growing populations. The shell middens of the late Middle Archaic (Mount Taylor) period may indeed represent base camp functions, although independent evidence to verify this (e.g., traces of habitation structures) has yet to be found. Special use sites on the other hand contrast sharply with base camps with regard to their size and material content. Such sites often contain a modest assemblage of lithic debitage and a few tools or tool fragments. The small size and limited assemblages of these sites suggest short-term occupation and limited or specialized activities. Special use sites are interpreted often as temporary campsites or extractive locations.

Several Middle Archaic cemeteries have been investigated, most of which are subaqueous pond burials (e.g., Beriault et al. 1981; Clausen et al. 1979; Wharton et al. 1981). Although such sites are located to the west of the study area, the precedent of subaqueous burials at Windover suggests that this mortuary tradition was both widespread and long-lived in Florida. Other Middle Archaic cemeteries involve midden burials, such as those from the base of the Harris Creek shell mound at Tick Island (Aten 1999; Jahn and Bullen 1978).

Middle Archaic hunter-gatherers utilized a diversity of resources, and here again the importance of wetlands and other aquatic environments becomes apparent. Clearly, the presence of numerous shell middens along the St. Johns, Atlantic, and Gulf coasts attests to the use of shellfish by Middle Archaic hunter-gatherers after about 6000 B.P. Numerous fish bones, as well as reptile and amphibian remains, likewise speak to the importance of aquatic resources in the subsistence regime. Terrestrial faunal resources were also consumed by Middle Archaic peoples as is evidenced by the presence of deer, raccoon, opossum, and gopher tortoise, among other vertebrate remains (Russo 1990a). Important plant foods likely included hickory nuts, acorns, saw palmetto, persimmon, and a variety of other plant resources.

Middle Archaic material culture is represented in a number of media: stone, bone, shell, and wood (Wheeler and McGee 1994a, 1994b; Wheeler et al. 2000). Perhaps the best known and most studied are the stone artifacts, specifically projectile point types. In general Middle Archaic points are stemmed, broad bladed, and triangular. The most distinctive is the Newnan point, but Marion, Putnam, and Hillsborough points are also typical of the period. One technological trait of great importance in the Middle Archaic is thermal alteration. The effects of intentional, controlled heating on chert are well documented (Purdy 1981). This procedure reaches its zenith during the Middle Archaic, and is thought to be an adaptation to reduced band ranges and a means of improving the flaking quality of mediocre and poor lithic resources (Ste. Claire 1987).

Other than the point types just mentioned, Middle Archaic lithic assemblages are lacking in formal tool types. Rather, expedient and informal types are the norm. Common tools found in Middle Archaic lithic assemblages are utilized flakes, bifacial scrapers, hammerstones, perforators, drills, and a number of tool forms made from the reworked basal portion of broken points. Bone tools from the Middle Archaic have been recovered from midden sites along the St. Johns River and its tributaries as well as the subaqueous cemeteries mentioned earlier. Bone artifact types include decorative pins, points, awls, perforators, atlatl triggers, socketed antler points, and fish hooks (Russo 1990a; Wheeler and McGee 1994a). Also found in middens along the St. Johns are shell tools. Common Archaic types include adzes, celts, columnella chisels and planes, and hafted *Busycon* tools (Goggin 1952; Wheeler and McGee 1994a). Wooden artifacts are quite rare, as are other artifacts made of perishable materials. The Groves' Orange Midden, a wet site on lake Monroe in Volusia County, has provided a glimpse into the organic components of Mount Taylor assemblages that are generally absent or poorly preserved form terrestrial sites (Purdy 1994; Wheeler and McGee 1994b). Another recent project at the Lake Monroe Outlet Midden (8VO53) has added an enormous amount of new insight on Middle Archaic diet, ecology, and material culture (Archaeological Consultants 2000).

Late Archaic. The Late Archaic period begins at about 5000 B.P. and ends by about 2500 B.P., although the criteria for this time period are variable and hard to define at the regional scale. The Late Archaic is sometimes divided into preceramic and ceramic subperiods. The preceramic subperiod ends when fiber-tempered pottery of the Orange tradition began to be produced after about 4200 B.P. The production of this pottery marks the beginning of the Orange period which itself has been subdivided into five subperiods based on primarily ceramic attributes (Bullen 1972). Recent radiocarbon dating of the pottery types used to define the Orange sequence give reason to suggest that the Orange chronology and typology for the middle St. Johns needs to be completely rethought (Sassaman 2003).

Environmental trends that began during the Middle Archaic reached essentially modern conditions in the Late Archaic. Increasing surface water and productive coastal environments led to the occupation of almost every habitable locale in the state, particularly in east Florida (Milanich 1994:89). One possible exception is the interior uplands which, according to Milanich (1994), appear to have fewer Late Archaic sites than in the preceding Middle Archaic. This is thought to be due to the focus of Late Archaic peoples on wetland environments and the lack of extensive wetlands in the interior of the same nature as those in the St. Johns River basin and the Atlantic and Gulf coasts.

In contrast to the interior uplands, the St. Johns Basin and the Atlantic coast saw dramatic increases in the number of sites during the Late Archaic (Milanich 1994:87). While permanent or semi-permanent Middle Archaic sites may have existed on the coast (Russo 1996b), such sites were certainly present by the Late Archaic. Site types of the Late Archaic are essentially much the same as they were in the Middle Archaic, with the exception that there were more of them in coastal locations and they may have been occupied for longer periods of time. According to Milanich (1994:85), Late Archaic sites of considerable size are found in a number of locations: along the northeast coast and inland waterway from Flagler County north, along the southwest coast from Charlotte Harbor south into the Ten Thousand Islands, and the braided river-marsh system of the central St. Johns River below Lake George. In these areas, sites are large, densely clustered and associated with sedentary, or at least semi-sedentary populations.

Large populations, semi-sedentary villages, and the development of regionalization are some of the more important developments during the Late Archaic. During this time regional populations began to take on characters of their own, possibly as a result of adaptations to different ecological zones in which they were located. Several regional Late Archaic cultures have been identified by Milanich (1994) and are distributed along the coasts and in the St. Johns Basin. One regional entity is situated along the Atlantic coast and St. Johns Basin, another along the Gulf coast in Northwest Florida, the Greater Tampa Bay area, and the southwest Gulf coast. In each of these areas preceramic Middle and Late Archaic and Orange period sites have been identified and differences in material culture and subsistence practices have been observed.

Fiber-tempered pottery of the Orange tradition began to be made and used by Late Archaic communities of the study area after about 4200 B.P. According to Milanich (1994:86) there was little change in the basic lifeways of Late Archaic peoples following the introduction of pottery. Material culture from Late Archaic sites is much the same as that of the preceding Middle Archaic. Besides pottery, the only notable changes in material culture are changes in projectile point styles. Point types typically found in Late Archaic sites are the Culbreath, Lafayette, Clay, and Levy types (Milanich 1994; Milanich and Fairbanks 1980), often in association with Orange pottery (Cumbaa and Gouchnour 1970). Preceramic Late Archaic sites containing these same points are also known, the most notable being the Culbreath Bayou site (Warren et al. 1967).

Fiber-tempered pottery is clearly the most diagnostic item in Late Archaic material culture inventories from northeast Florida. Orange pottery is widely distributed and easily recognized. According to Bullen (1972), during the Orange 1 subperiod (4000-3650 B.P.), pottery was manufactured by hand modeling and unadorned with surface decoration. Vessels were flat bottomed and rectangular in shape (Bullen 1972). During Orange 2 (3650-3450 B.P.) incised designs appear on pottery in the Orange Incised and Tick Island types. Vessel forms are thought to be the same as Orange 1. Orange 3 (3450-3250 B.P.) is characterized by the appearance of rounded vessels with flat bottoms. Incised designs persist and rims are thickened and flanged. Sand appears in the pastes during Orange 4 (3250-3000 B.P.) and simple incised motifs are common. By Orange 5 sandy and chalky ware pastes are common and bowl forms predominate. Originally coiling as a method of manufacture was thought to begin during this subperiod (Bullen 1972), but a radiographic analysis of Orange period sherds from the St. Johns Basin has shown that this practice began as early as Orange 2 (Endonino 2000). Many other details of Bullen's (1972) Orange sequence have yet to be verified. One recent project at the Summer Haven site (8SJ46) produced a large assemblage of Orange sherds whose physical and decorative attributes would, according to the Bullen sequence, postdate by several centuries the C14-age of ca. 3840-4000 for associated oyster shell (Janus Research 1995). Likewise, new AMS dates on Orange Incised from site sin the middle St. Johns suggests that attributes of the sequential Orange 1-3 subperiods were actually coeval (Sassaman 2003).

St. Johns Period

Following the Late Archaic/Orange/Transitional period is the long-lived St. Johns period. Beginning no later than 2500 B.P. and ending with European contact, St. Johns chronology is divided into two periods, St. Johns I (2500-1250 B.P.) and St. Johns II

(1250 B.P. to contact). These periods are further divided into St. Johns I (2500-1900 B.P.), Ia (1900-1500 B.P.) and Ib (1500-1250 B.P.); and St. Johns IIa (1250-950 B.P.), IIb (950-487 B.P. [A.D. 1050-1513]), and IIc (A.D. 1513-1565). These divisions are based on internal changes and responses to regional influences in pottery technology, mortuary ritual, and, late in the period, European contact. The appearance of chalky, spiculate ceramics marks the onset of the St. Johns I period; check stamping on chalky, spiculate pottery ushers in the St. Johns II period. The St. Johns IIc people are the various Timucuan-speaking groups described by European chroniclers (Milanich 1994:247).

Environmental conditions during the St. Johns I period were essentially like those of their Late Archaic and Orange ancestors. Archaeological surveys have demonstrated that Orange and St. Johns period components are found in the same locales and often at the same sites (Milanich 1994:254-255; Miller 1998:80). Wetlands in both coastal and riverine settings were still as important as they were during the preceding periods. Additionally, numerous sites are found around the many lakes and wetlands of central and east-central Florida (Milanich 1994:254). Along the coast, lagoons, barrier islands, and marsh environments attracted St. Johns peoples. Inland, the St. Johns River, its tributaries, and marshes also proved to be attractive to St. Johns peoples. According to Milanich (1994:254) the basic life-way of St. Johns peoples "seems to have been little changed from their Late Archaic, Orange period predecessors." Similarly, there is also a significant degree of continuity between the locations of St. Johns I and St. Johns II sites (Miller 1998:80-82). Populations increased through time from Orange to St. Johns II as indicated by an increase in the number of sites for each period per century (Miller 1998).

Continuity of site occupation from one period to the next underscores the importance of wetlands to peoples of the St. Johns region (Milanich 1994:263). The dietary regime and procurement strategies used by St. Johns I peoples were continued by St. Johns II peoples. Maize agriculture, which was important to populations in Northwest and North Central Florida, does not seem to have played an important role in the subsistence strategy of St. Johns II groups. Evidence for maize agriculture is almost nonexistent in the St. Johns region. One cultigen that has been identified as being used by St. Johns II populations, and was probably used by previous populations, is the bottle gourd (*Langeria siceria*). These were probably not a major food source, but were used instead as containers. More than 2000 seeds and rind fragments were recovered from Hontoon Island by Purdy (1991; Newsom 1987).

Populations during the St. Johns II period evidently were larger than those in St. Johns I period (Miller 1998:85) and, with this growth came the development of complex sociopolitical system like those of the Ft. Walton and other Mississippian period societies (Milanich 1994:263). It is not certain whether chiefdom level societies could be supported by the economic system of this region. St. Johns IIb mounds at Shields, Mount Royal, and Thursby—all along the St. Johns River—mirror the mounds of Mississippian chiefdoms in morphology and artifact content, suggesting widespread ideological influences. Conversely, the local St. Johns IIb economies apparently did not involve intensive food production, specifically maize farming.

Material culture during the St. Johns I period differs significantly from that of the Archaic periods. As noted earlier, the appearance of chalky, sponge-spiculate pottery marks the onset of the St. Johns ceramic tradition. St. Johns I village ceramics are plain or otherwise display incising, pinching, or punctations. Some Deptford tradition ceramics, or local copies, also occur. In the St. Johns Ia period, surface decoration disappears as nearly all wares are plain. St. Johns Ib village ceramics are still almost all plain. Nonlocal ceramics are present throughout St. Johns I, I a, and Ib times, but they are often restricted to burial contexts.

The St. Johns II period is marked by the appearance of check-stamped pottery, and this has allowed archaeologists to distinguish between St. Johns I and II sites and/or occupations at the same site. About the same time that check-stamped ceramics first appeared in the St. Johns region, they also appeared in regions of the Weeden Island culture (Milanich 1994:262). Some archaeologists speculate that the appearance of check-stamped ceramics coincides with the spread of maize agriculture, although evidence to substantiate this is lacking at present (Milanich 1994:263). St. Johns IIb ceramic assemblage diversified to include extraregional trade goods and stylistic motifs of Mississippian-influenced cultures found along the Gulf Coast and to the north.

Stone tools in St. Johns sites are similar to those in earlier sites in the St. Johns Basin with the exception of projectile point forms. Overall during this period, points tend to be smaller (Bullen 1975:3) and not as well made as earlier forms. Diminutive representations of Archaic forms are still manufactured, as are new ones. New point types include the Jackson, Florida Copena, Bradford, Columbia, Broward, Taylor, Westo, Florida Adena, Gadsen, Sarasota, and Ocala types (Bullen 1975). According to Purdy (1981:47-48) other stone tool forms from the late ceramic period tend to be nondescript and resemble Archaic specimens. Drills, microtools, blades, hafted end scrapers, and other tool forms were also made.

Similar lithic artifact types are found in both St. Johns I and II. An exception worthy of mention is the transition from the Columbia, Bradford, Duval, Leon, and O'Leno points to the Pinellas, Ichetucknee, and Tampa points types around St. Johns IIa or IIb times (Bullen 1975:6). Tools of shell and other materials were also made during this period. Shell adzes, celts, picks, hammers, and cutting tools have been recovered from numerous sites, as have ornamental shell items, such as beads and gorgets. Wood was also utilized to make a host of items. Purdy (1991) recovered large numbers of wood chips in her Hontoon Island investigations. These chips are thought to be the result of wood-working activities such as making dugout canoes, paddles, bowls, tool handles, and small points, among other things (Milanich 1994:266). Cordage, fabric, and matting were also made as in earlier periods as evidenced by the presence of fabric impressions on the bottom of ceramic vessels (Milanich 1994:259). St. Johns IIc period sites contain European objects such as nails, chisels, glass beads, and ceramics.

Ceremonialism in the St. Johns area appears to combine indigenous elements with extraregional aspects of practices from within and without Florida (Milanich 1994:260).

Generalized Middle Woodland burial mound ceremonialism has been recognized in the St. Johns cultural area. Low truncated cone-shaped burial mounds appear for the first time during St. Johns I (Milanich 1994: 247). Mounds grew in size during the St. Johns II period. Local copies of Deptford and Swift Creek ceramics appear in burial mounds, as do exotic trade items by St. Johns Ia (Milanich 1994:247). These exotic items include copper discs, cymbal shaped ear spools, mica and galena, greenstone celts, quartz plummets, and bird effigy elbow pipes (Milanich 1994:261).

By St. Johns Ib, Swift Creek-Weeden Island ritual and belief spread and are reflected in the types of ceramics found in mounds (Milanich 1994:262). Late varieties of Swift Creek Complicated-Stamped and Weeden Island Incised and Punctated ceramics are present, as are St. Johns Plain and Dunns Creek Red. Smaller truncated cone-shaped burial mounds decline through St. Johns IIa. Exotic trade goods are present and Hopewellian influenced ceremonialism is still present. St. Johns IIb mounds are multi-stage mounds, which is considered to be evidence for intensified ceremonialism. Fort Walton and Safety Harbor Check-Stamp ceramics appear alongside exotic trade goods and Southern Cult motifs in ceremonial burial contexts. Toward the end of St. Johns IIb, Cult motifs and truncated mounds increase. Gold and silver appear in some mounds, such and the Thursby Mound across the St. Johns River from Hontoon Island (Moore 1892-94), and indicate at least indirect contact (i.e., shipwreck scavenging) with Europeans who had expropriated these valuables from Latin American civilizations. Burial and temple mound building continued into St. Johns IIc, but European influences in the form of missionization and disease eventually ended their construction. The archaeology and history of the Spanish in the region and their effects on the Timucua are thoroughly documented in several recent works (Hann 1996; Milanich 1996; Worth 1998a, 1998b).

RECENT LAND-USE HISTORY AT BLUE SPRING

Archival research was conducted by Aidith Flores to provide historical support to the excavations being conducted at Blue Spring State Park. The primary purpose of this research was to identify any type of construction or land use that would have affected the above-ground and subsurface components of site 8VO43.

Much information was found in the archives of the Deland House, a facility of the West Volusia Historical Society. Folk historian Bill Dreggors was extremely helpful in locating relevant information and supplementing the records with his extensive knowledge of local history. An interview with Mrs. Mert Pierson, a former owner of Blue Spring, was especially fruitful. The property appraisal staff for Volusia County provided additional assistance.

Landowners of Blue Spring included two very influential families to this area: the Thursby family and the Pierson family. The Thursby family owned Blue Spring for nearly a century and resided there for most of that time. They were, by far, the most influential people in the area in those times, and they had an enormous effect on the economic development of west Volusia County through the late 19th century. The

Pierson family was the last family to raise their children on this land before it was acquired by the state.

Samuel L. Parsons (1846-1856)

A portion of the land that is now Blue Spring State Park was sold to Samuel L. Parsons in 1846. Records on the seller, Sam Brown, are sketchy, and we have no firm knowledge how long he owned the land and what use he made of it. Parsons was a horticulturist from Flushing, Long Island, New York, and bought the land to collect plants of Florida. He built a log cabin just big enough for his family and brought them there every winter.

The Thursby Family (1856-1946)

Louis P. Thursby from Brooklyn, New York purchased 133 acres of the land from Parsons in 1856. After fighting in the Mexican-American War, his health began to diminish, so he moved to Florida to escape the harsh northern climate. He and his wife, Mary Ann Boyer Thursby (born in the Swiss Alps) lived in Parson's small cabin until they built their larger home. While they were living in the cabin, Louis Thursby planted a large number of orange trees around it. This was the time known as "orange fever" in Florida because so many people established groves for market production, and that was what Thursby originally planned for his main source of income. Thursby eventually diversified by investing in transportation infrastructure. He began to build docks along the river to accommodate the steamboats working there.

The year 1872 marked the completion of the Thursby's home. This large, three-story home was the perfect place to raise their ten children (six girls and four boys). Originally, the house was two stories; the third story was added years later as the family grew. A peculiar aspect of this home was its backyard water tank, which is connected to the rook by a gutter. Rainwater was collected from the roof to the tank and entered the house through an outlet pipe. Indoor running water was quite a major innovation for a house of this era.

The docks actualized much capital in the area and for the people working on the river. During this time they were able to establish the first post office, which was run by Mrs. Thursby from its beginning. Blue Spring Landing proved to be very useful with the coming of the railroads as well. The first railroad, a horse-drawn affair, came in 1880. In about 1890, the first mechanized railroad was established, running from Blue Spring to the Halifax River in New Smyrna. A gazebo was built next to the dock where passengers could sit and await the train's arrival. A turn-about for the train was just ahead (south?) of this spot.

After L.P. Thursby died of consumption in 1890, Mrs. Thursby continued to live there for several years and operate the farm and landing. Their youngest son, John Thursby took over ownership of the family holdings in 1901, and maintained the landing operation into the 1930s. He and his wife, Etta, had a small house in what is now considered the front portion of the park. John Thursby also ran a dairy very close to the big house. By 1933 John was promoting Blue Spring as an outdoor recreational facility, a venture that proved fruitful for him, as well as two successive owners.

Homer Smith (1946-1957)

In 1946, the "park" was sold to Homer Smith, a tax assessor for Volusia County. Smith never resided on the property, however. He lived in De Leon Springs and hired a manager to run the park. Smith continued to operate the land for several years as a park and a fish camp. Throughout this time, Mrs. Thursby maintained her home in the Thursby house, of which she had a lifetime lease. When she became too weak to go up and down the stairs of that large house, she set up a room for herself near the kitchen area.

Gordon and Mert Pierson (1955-1972)

The story behind the purchase of the park by Mr. and Mrs. Pierson is an interesting one. The couple and their two children lived in Waycross, Georgia and came down to Florida to spend the day fishing. Mrs. Pierson had packed a picnic for the whole family and they drove around looking for a place to have their lunch. The came across a sign that read 'Blue Spring Park' and thought this would be the perfect place to stop. A few months later, Mr. Pierson had retired and joined a golf club. While out playing golf one day he overheard someone say that Blue Spring was for sale. He remembered how much he and his family enjoyed themselves there and immediately went back and contacted Homer Smith. For approximately three months he continued to make attempts at a deal with Smith. Finally they agreed to a lease with an option to buy. The Piersons leased the park for two years. The final purchase was made in 1957, during which time Mrs. Thursby was still living there. Eventually Mrs. Thursby was given an amount of money to build a house in Orange City and move there.

The Pierson family operated the park quite successfully. Several changes were made to the park, as well as many new additions. They built ten cottages, a concession stand, several bathhouses, and owned about forty boats that they rented to the public. Each of the cottages had its own septic tank. It was also a popular place for Northerners seeking refuge from the winter. Several families from the north would return each year and rent cottages for months at a time.

After owning the park for a few years, the Piersons decided to refurbish the Thursby house and move in. They patched up holes, repainted the interior and exterior, installed bathtubs and fixtures upstairs, and made the home practically new. They moved in and raised their children there.

Around 1969, the Pierson family ran into some trouble. According to Mrs. Pierson, the county insisted that they install a central treatment plant for the cottages. Because they ran the park more for enjoyment than for profit, they did not have the capital or the incentive to comply with this demand. They had not choice but to sell the property. A development company, Keystone Enterprises, run by Brad Prince, purchased the 300-care parcel form the Piersons.

Under Prince's management, the park underwent substantial transformation. He put in campsites with electrical outlets. He installed an in-ground pool and bathhouses. In time, however, Prince and his company failed to make payments for the purchase, so the Piersons "repossessed" the park from him. At this point, the Piersons still could not afford to keep the land, but they did everything in their power to put the park back into working order.

Despite their hard efforts to restore the park, the Piersons had no choice but to sell it again, this time to the state of Florida in 1972. Along with purchasing this main portion of the park, the State acquired the adjacent land surrounding the "boil" (i.e., spring) and the land north of it. Originally open to visitors, the Thursby House, complete with period furniture and décor, has been closed since 1989 and currently awaits completion of repairs to reopen it to the public. Proposed repairs to the foundation of the house prompted the archaeological investigations of the 2000 University of Florida Field School.

CHAPTER 3
BLUE SPRING MIDDEN B (8VO43)

Field investigations during the 2000 and 2001 field schools centered on Blue Spring Midden B (8VO43). As discussed in Chapter 1, work at this site was initiated at the request of Florida State Parks. The 19th-century Thursby House at Blue Spring, a major park attraction, required foundation repairs that had some potential to adversely impact archaeological deposits beneath the house. Although shell-bearing deposits beneath and around the Thursby House have been known to exist since 1873, when Jeffries Wyman visited the area, systematic archaeological investigations were not conducted prior to 2000. The Florida Master Site File contained only cursory information about the site. Specific information on the extent, age, and integrity of the deposits was lacking. Thus, the initial work at 8VO43 was both exploratory and mitigative.

Two outcomes of the initial investigations of 8VO43 in 2000 prompted additional work in 2001. First, the excavation units opened on the north and south sides of the Thursby House exposed markedly different stratigraphic sequences. Separated by only 16 meters, these distinct profiles raised questions about the internal configuration of the midden that could not be resolved without additional excavation. Second, coring and testing away from the Thursby House showed that 8VO43 was potentially much more extensive than the site files indicated. Wyman (1875:24) observed a large shell mound at the mouth of the run, so it is not surprising that archaeological deposits exist in the area between the house and the river, despite the lack of surface evidence. As we discovered through subsurface testing, a sand mantle accumulated over the lower portion of the site since the late 19th or early 20th century, after the presumed mound was removed. Thus, work in 2001 included limited testing of the buried remnant of midden in the portion of the site downslope from the Thursby House.

The bulk of this chapter is devoted to descriptions of the stratigraphic sequences and features observed in each of six test units excavated in 2000-2001. Also included is a full account of the application of ground penetrating radar to detect clusters of features indicative of household space. The chapter begins, however, with a review of the coring and mapping effort that resulted in a more accurate and refined sense of the vertical and horizontal extent of 8VO43 (Figure 3-1).

SITE MAPPING AND CORING

Surface exposures of the shell-bearing deposits of 8VO43 are limited to the topographic high of the landform, that is, the hill on which the Thursby House sits. The area surrounding the site is generally open and grassy. Small disturbances from burrowing animals routinely bring shell and organically enriched soil to the grassy surface, making it relatively easy to delimit the extent of the near-surface midden. This apparently was the basis for drawing boundaries around 8VO43 for the Florida Master Site File. No prior information on the depth of this near-surface deposit was available at the outset of field work in 2000, nor was the site ever mapped with survey instruments.

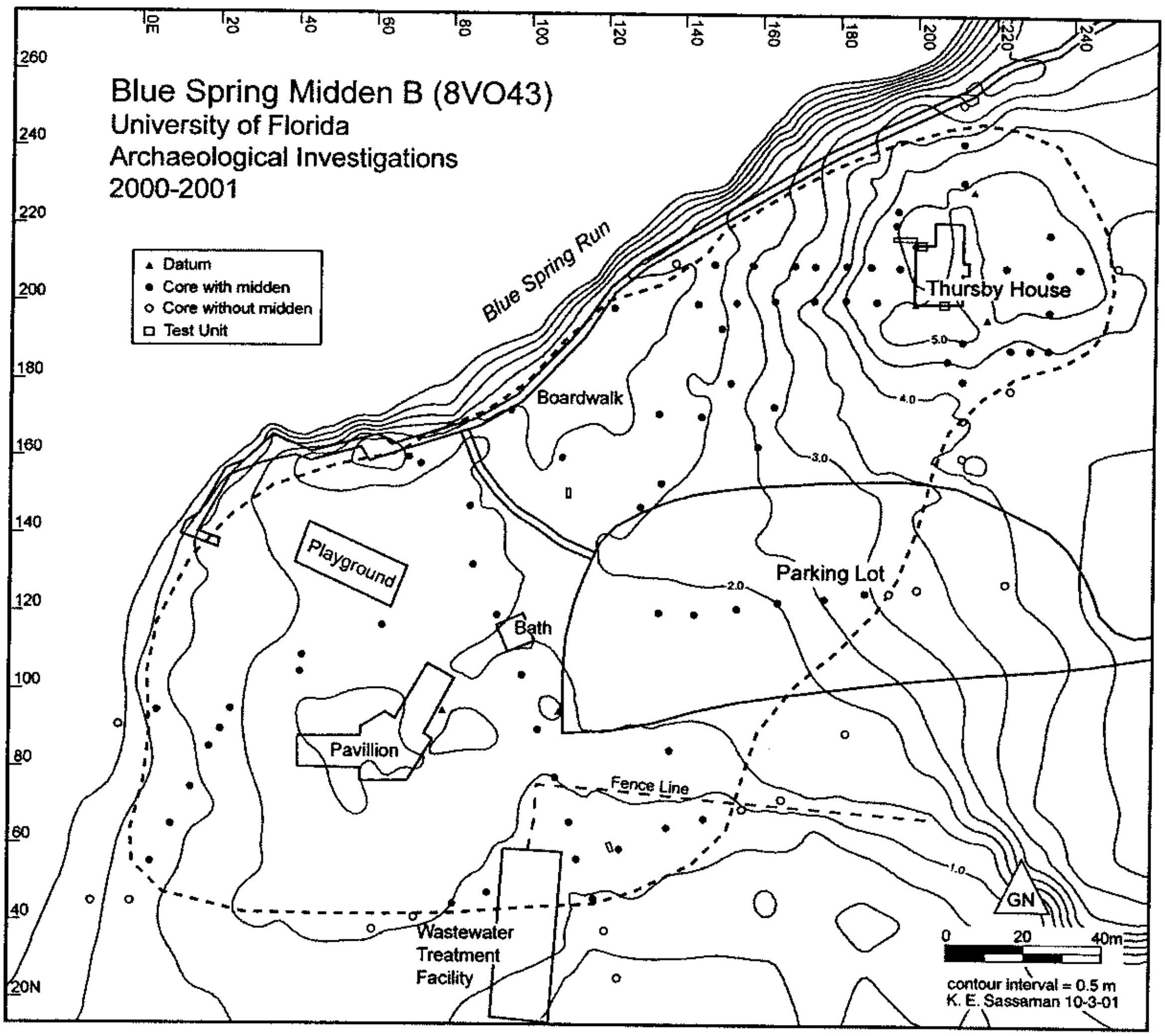

Figure 3-1. Site map, Blue Spring Midden B (8VO43) (dashed line demarcates site boundary).

Thus, two goals of the first season of work at 8VO43 were detailed mapping of the surface and extensive subsurface testing with a bucket auger to determine variations in the depth of midden. To facilitate these efforts, a grid was established over the site with four permanent data arrayed in the vicinity of the Thursby House. Based on existing knowledge of the extent of the site, we assumed that 8VO43 was relatively small (less than 100 x 100 m) and centered on the Thursby House. A north-south base line, roughly 14° west of magnetic north, was established along the west elevation of the house by driving 3-ft-long sections of galvanized conduit into the ground at the southwest (Datum A) and northwest piers (Datum B) of the porch foundation. Two additional data were established with conduit in the nearby area, one several meters off the northeast corner of the house (Datum C), near the woods line, and another several meters off the southeast corner of house (Datum D), at the edge of another wooded patch. Datum A was set at N200 E 200 and given an arbitrary elevation of 5.00 m. Grid coordinates for the other data and all excavation units and cores from the 2000-2001 investigations are provided in Appendix x. The locations of data around the Thursby House are depicted in Figure 3-1 as small solid triangles.

Surface mapping of 8VO43 was accomplished with the use of a Nikon DTM-310 Total Station. All field school students were trained in the use of the equipment and spent at least one week with a crew of three of four shooting points for the map shown in Figure 3-1.

Subsurface testing with a 4-inch bucket auger was conducted alongside topographic mapping with rotating crews of three students. Initially, cores were sunk at a 10-m interval along transects oriented to the grid and emanating out from the Thursby House. Initial results confirmed the existing projection of site size based on surface exposures alone. That is, shell-bearing deposits from the surface to depths as great as 1.5 m were observed in all cores near the house and along the slope to the west, but not much beyond the 3.0-m contour of this western slope, nor more than about 30 m to the north, east, and south of the house. Had State Parks not requested our assistance in testing a location slated for construction near the existing Wastewater Treatment Facility (Figure 3-1), we would have recapitulated the existing map, thereby limiting 8VO43 to the area immediately surrounding the Thursby House. As it turned out, subsurface testing near the Wastewater Treatment Facility resulted in the discovery of shell midden beneath one meter of recent alluvium. Additional coring confirmed that sandy alluvium obscured shell midden over most of the site. It likewise confirmed that buried midden and the exposed, near-surface deposits beneath and around the house were, in fact, contiguous. The resultant plan for 8VO43 is an elongated affair some 300 m long that widens to the southwest to about 140 m, encompassing most of the landform between the lagoon to the south and the run to the north.

The boundaries of 8VO43 shown in Figure 3-1 conform fairly well with the description provided by Wyman (1875:24), insofar as he observed shell deposits extending to the river and lagoon:

> Shell heaps consisting almost exclusively of Paludinas (i.e., *Viviparus*) exist on both sides of the mouth of the creek. That on the left bank is much the largest, and forms an extensive mound. It is a hundred feet (30 m) broad towards the river and about two feet and a half thick. It extends back from the shore about five hundred feet (152 m) and rising for a short distance as it recedes. At one hundred and fifty feet (46 m) from the water its height is from twelve to thirteen feet (ca. 4 m). Still farther back on sand knolls are three or four small shell fields, and south of these, on the low land towards the lagoon and separated from it by a thicket, is another thin deposit in which were found many fragments of human bone mingled with those of animals (*parenthetical notes added*).

The mound Wyman saw has obviously been removed. According to L. P. Thursby, some 30 feet of shell mound had already been eroded by the channel by the time Wyman visited the site (Wyman 1875:24). The mound was completely removed no later than the late 1940s, when the aerial photograph shown in Chapter 2 was taken. It is highly unlikely that this entire mound was removed from river erosion alone, although we note that there are no known records of shell-mining operations at the site.

Whether by stream shovel or river action, the mound observed by Wyman in 1873 was fully obliterated, leaving no surface evidence of its actual location. Wyman's comments about its size, shape, and orientation are not without ambiguity. Clearly the mound was located at the river's edge, near the mouth of Blue Spring Run. It is likewise clear that the mound was elongated, but we cannot be certain about its orientation relative to the river or creek channels. Assuming it was oriented along the spring run, the mound would have extended northeastward from the river's edge to about 20-40 m east of the walkway connecting the parking lot and the boardwalk. This entire expanse today is covered with upwards of one meter of alluvial sands. This sand body, in fact, covers the entire landform of the site below the 2 m contour line in Figure 3-1.

A cross-sectional schematic of 8VO43 shows the depth and extent of the alluvial sands over the lower two-thirds of the site (Figure 3-2). Originating at the Thurbsy House, this 240-m-long cross-section runs roughly grid-southwest down the slope to the river, intercepting the south edge of the playground in Figure 3-1. Vertical exaggeration of the cross-section is x15. Included in this cross-section is a projected outline of the mound described by Wyman, also shown at x15 vertical exaggeration.

Although plausible, it is unlikely that lateral erosion of the river and spring run alone obliterated the mound, for the underlying midden would have been removed as well if the two channels cut as deep as they run today. Scouring from overbank flooding could have removed surface deposits and deposited sands as floodwaters receded, leaving a stratigraphic unconformity between the scoured midden and overlying alluvium. However, buried midden profiles in the two test units excavated through the alluvial sands included A horizons, suggesting that the midden was exposed at the surface for a substantial period of time.

Given the nature of the unconformity between the buried midden and overlying sands, the most likely agent affecting the shell mound Wyman observe was human.

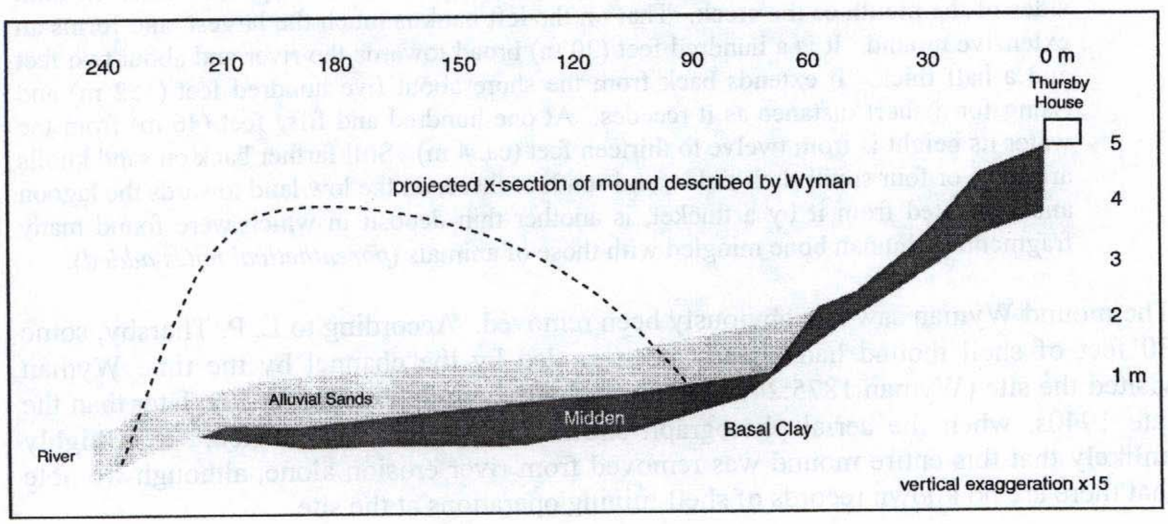

Figure 3-2. Cross-sectional schematic of 8VO43, showing extent of sand body covering midden and the projected outline of shell mound observed by Wyman in 1873 (all at x15 vertical exaggeration).

Improvements to the Thursby property during the late 19th century included construction of a turnabout for the Blue Spring-Orange City Halifax Railroad (see Chapter 2). This construction and additional improvements over the early 20th century may have necessitated removal of shell from the mound and surrounding midden. The cross-section in Figure 3-2 suggests that this may have been a large-scale, systematic operation involving shell removal and land leveling over most of the lower elevations of the site. Subsequent flooding may have then in-filled the effected area with a mantle of alluvial sands, masking to this day the remnant of midden that survived shell-mining operations.

All this remains speculative. Irrespective of the actual agent responsible for mound removal, alluvial sands have long protected from recent disturbances an essentially preceramic shell midden. The near-surface midden beneath the Thursby House consists largely of Orange (ceramic) period deposits. Intact shell-midden deposits postdating the Orange period were not observed in any of the testing conducted in 2000-2001, although sherds of St. Johns age were recovered from alluvial sands in both test units downslope from the house. The mound Wyman observed was most likely the source of these later period sherds.

Finally, the "small shell fields" Wyman mentioned deserve brief consideration. It is frustrating that Wyman does not mention the relationship between the Thursby House and these shell fields. The house was completed the year prior to Wyman's visit, and it no doubt was visible from atop the mound he described. It seems reasonable to suggest that the Orange-period shell deposits uncovered around the Thursby House by the 2000-2001 field schools were among the " three or four small shell fields" Wyman mentioned, although, again, his not mentioning the house is disconcerting. The other small shell field he noted, to the south near the lagoon, is almost certainly the portion of the site we tested for the Wastewater Treatment Facility (Figure 3-1). Like the rest of the low-lying portion of the site, this area was covered by alluvium, so it is impossible to know what the surface condition at the time of Wyman's visit may have been. In any event, midden is preserved well below the surface and is seemingly contiguous with buried midden elsewhere. Wyman observed only the surface components of the site, unaware that midden below the surface was distributed continuously across most of the landform west and south of the house.

To summarize, subsurface coring and topographic mapping of 8VO43 resulted in a revision of the extant site boundaries to include most of the landform bordered by Blue Spring Run, the St. Johns River, and a broad lagoon off the river channel. The shell mound described by Wyman was located at the confluence of the river and run, but has since been completely obliterated. A mantle of alluvial sand now covers the lower two-thirds of the site, obscuring an underlying shell midden of largely preceramic age. Orange period shell midden dominates the deposits beneath and surrounding the Thursby House. All later period components of the site, including those associated with the mound Wyman observed, have been impacted by land alteration since the 19th century. Test units excavated in 2000 and 2001 targeted Orange-period deposits beneath the Thursby House and preceramic deposits beneath the alluvial sands over the lower portion of the site.

TEST UNITS 2000

Test Unit 1

Located along the south elevation of the Thursby House, Test Unit 1 (TU1) was a 2 x 2-m unit positioned to assess the potential impact of repairs to the house foundation. Excavation proceeded with trowel and shovel in 10-cm arbitrary levels and all fill was passed through ¼-inch waterscreens. A 50 x 50-cm column left standing in the northwest corner of the unit was removed in 10-cm levels within defined stratigraphic units and passed through 1/8-inch waterscreens. Bulk samples for flotation were collected from each of the column levels. Two features (Features 1 and 2) consisting of clusters of plain fiber-tempered sherds were recorded in the unit (see feature descriptions elsewhere).

As shown in Figures 3-3 through 3-5, TU1 exposed a relatively uncomplicated profile of shell midden some 120 cm thick overlying sterile sand. Five major stratigraphic units were observed (Table 3-1), representative of at least three ethnostratigraphic units, including the historic era.

Strata I and II are distinguished in the north profile by discontinuous lenses of sand, bivalve shell, and charcoal. They otherwise consist of very dark brown to dark gray silty sand with moderate amounts of *Viviparus* shell and lesser quantities of other freshwater gastropod shell. Dispersed throughout these strata are historic-era artifacts related to construction, maintenance, and occupation of the house and subsequent park use. No historic-era artifacts were recovered below 40 cm BS. Especially noteworthy at the base of Stratum II was a concentration of plain fiber-tempered sherds (Feature 1) in the northwest corner of the unit, many from an oval-shaped, flat-bottomed basin. The lenses of sand, charcoal, and ash in and amongst these sherds dip into Stratum III below but otherwise dissipate along the north wall as undulating, thin lenses. Outside of the Feature 1 area, none of these lenses were observed in the profiles of the walls, nor was the distinction between Strata I and II apparent (Figures 3-4, 3-5). Given the localized nature of these sand/charcoal/ash lenses and the presence of historic-era artifacts to depth of Stratum II, it seems reasonable to conclude that this portion of the profile may have been recently disturbed. Other near-surface disturbances were observed in other profiles of this unit (see, for example, Stratum I of the west profile), as well as in TU2. We thus recommended to State Parks that foundation repairs involving ground disturbances less than 40 cm in depth would not have adverse effects on intact prehistoric-era deposits.

Whether or not recent disturbances penetrated to the base of Stratum II, there is nothing to suggest that Stratum III was affected by house construction or subsequent activities. Stratum III consists of a 40-cm-thick brown to grayish-brown silty sand with moderate density of *Viviparus* shell and traces of plain fiber-tempered pottery. This stratum represents an intact ethnostratum of Orange cultural affiliation. Although radiocarbon assays were not obtained for this stratum, crossdating with Orange period strata from units on the north side of the house gives a *terminus post quem* for this stratum of ca. 3810 rcybp. Note that Stratum III thins slightly on the east profile, where several thin lenses of bivalve shell were observed.

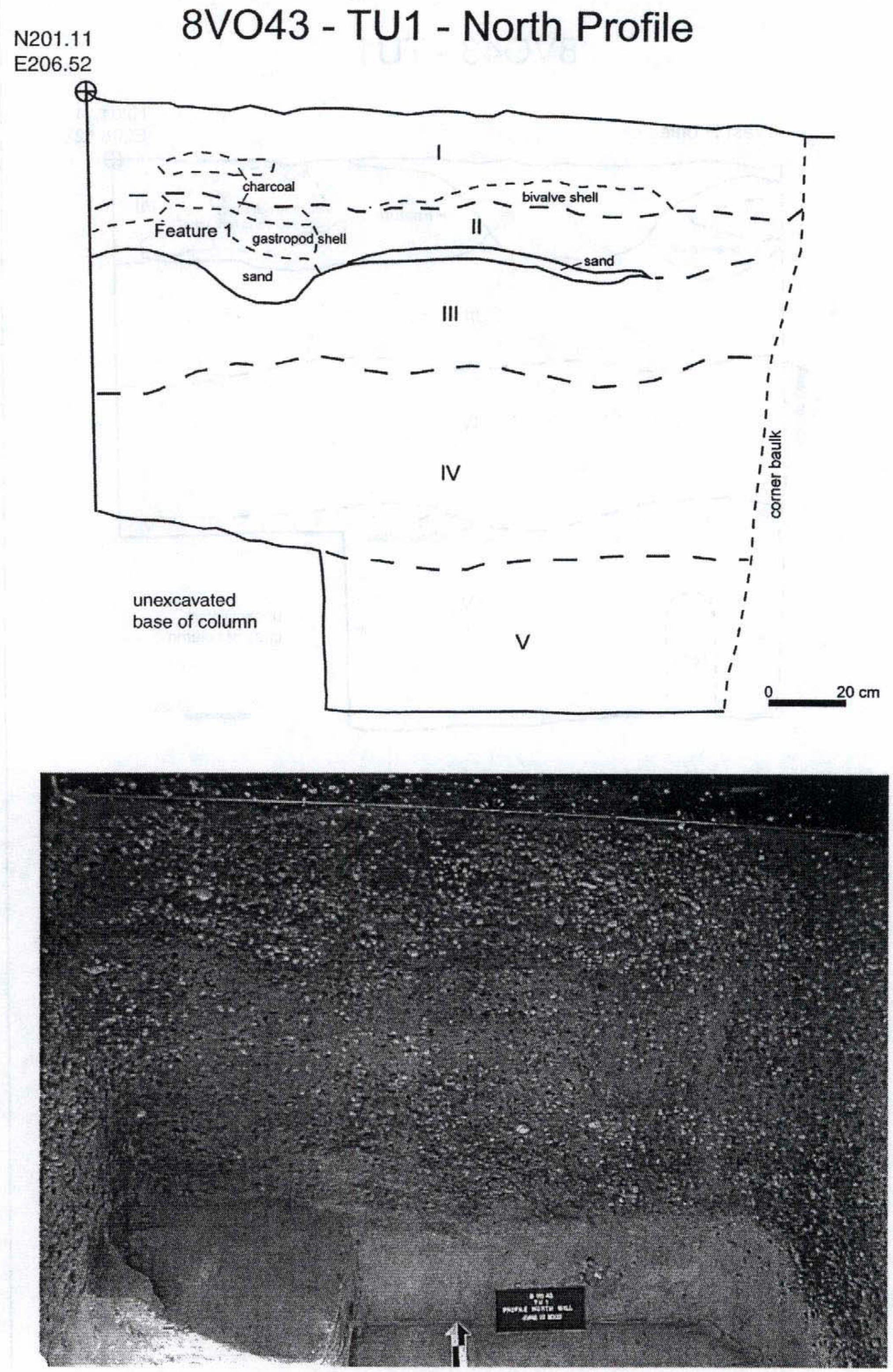

Figure 3-3. Stratigraphic drawing and photograph of north wall of Test Unit 1, 8VO43.

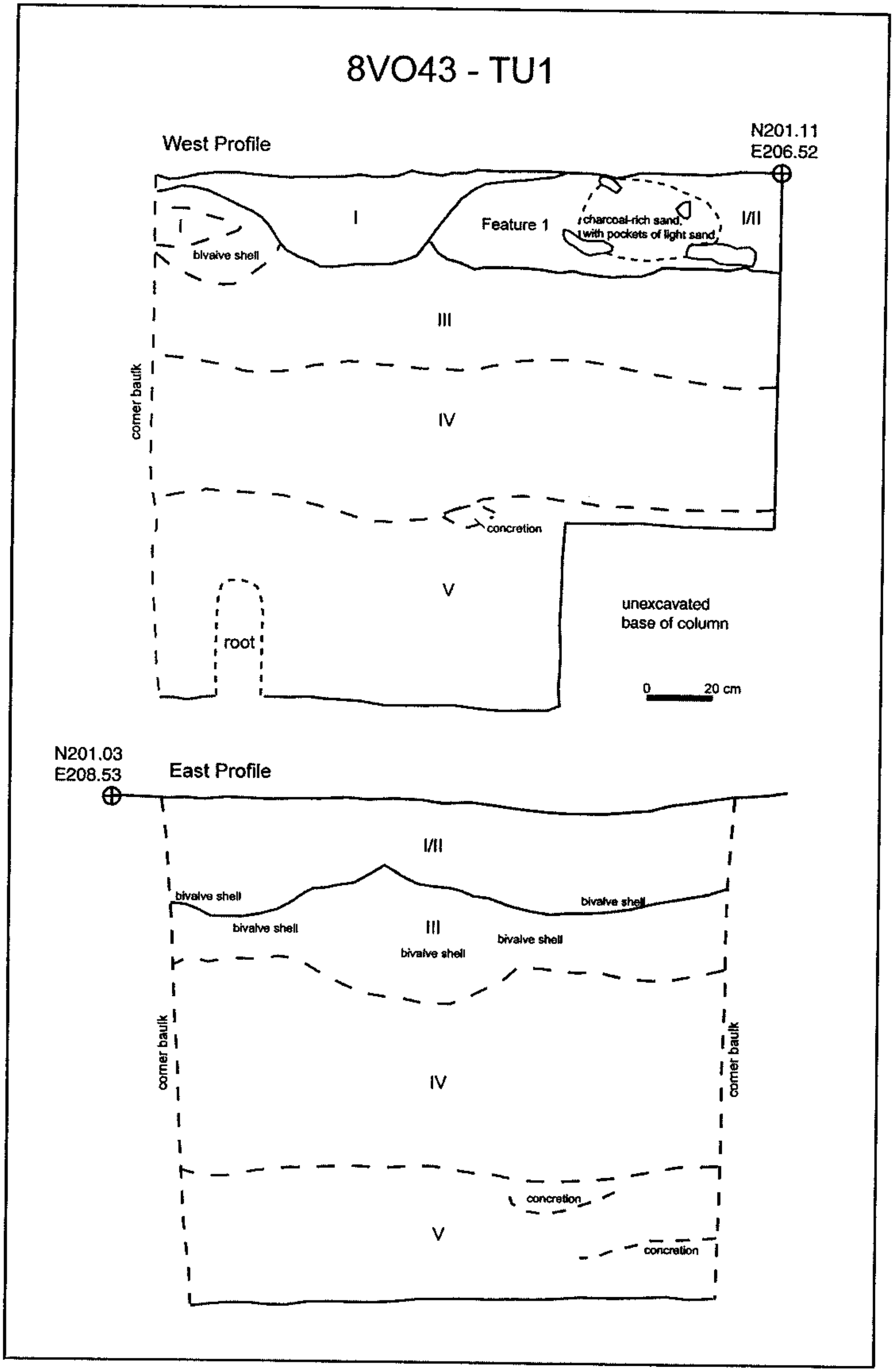

Figure 3-4. Stratigraphic drawings of west and east walls of Test Unit 1, 8VO43.

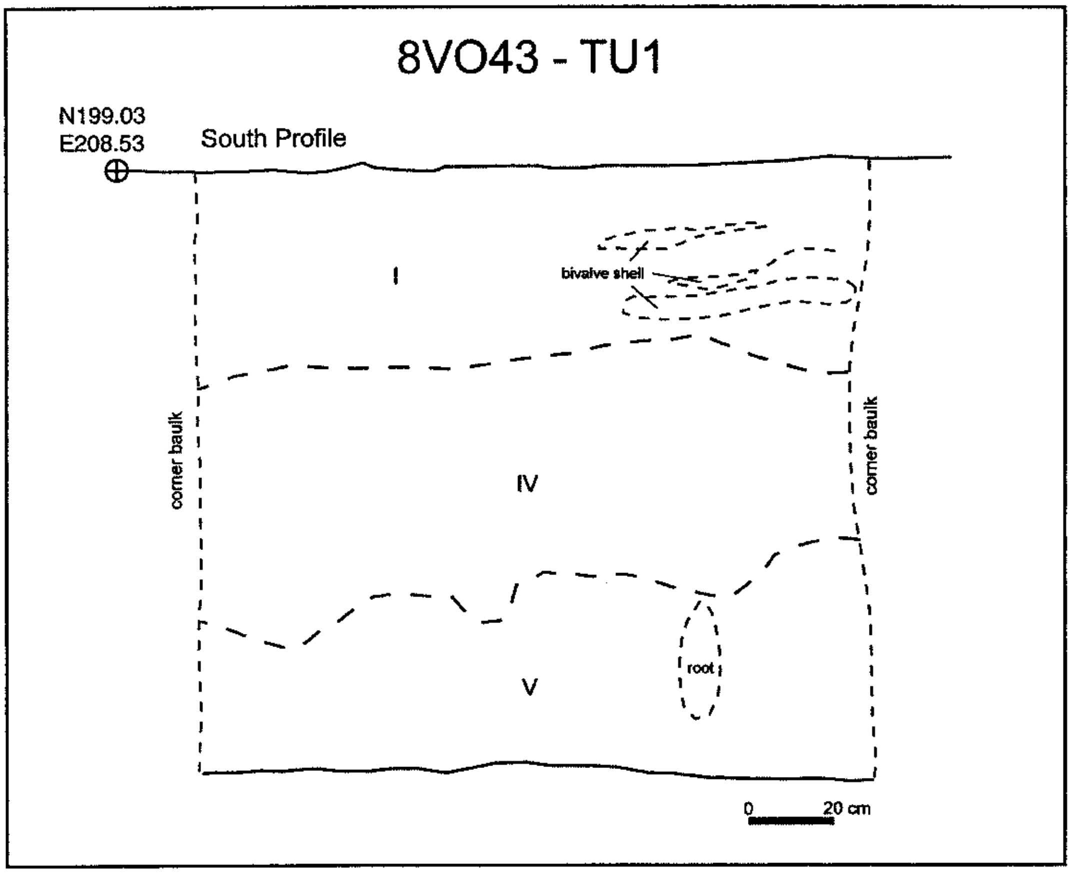

Figure 3-5. Stratigraphic drawing of south wall of Test Unit 1, 8VO43.

Table 3-1. Stratigraphic Units of North Profile of Test Unit 1, 8VO43.

Stratum	Max. Depth (cm BS)	Munsell Color	Description
I	25	10YR2/2-4/1	surface stratum of silty sand midden with whole and crushed gastropod and lenses of bivalve shell; plain fiber-tempered pottery intermixed with historic-era artifacts
II	40	10YR4/1	silty sand with lenses of charcoal and 10YR5/4 silty sand; plain fiber-tempered pottery intermixed with historic-era artifacts; delineated clearly on north profile only
III	80	10YR4/3-5/2	homogeneous midden of silty sand with moderate density of gastropod shell; plain fiber-tempered pottery
IV	125	10YR3/2-4/2	homogeneous midden of fine sand with increased apple snail and charcoal over Stratum III; includes marine shell tools, bone pin fragments, and traces of chert, but no pottery; C14 assay of 4360 ± 120 rcybp
V	165	10YR6/4-7/3	sterile fine sand with flecks of charcoal in upper 10-15 cm; terminated at 165 cm BS

The 45-cm-thick Stratum IV appears to reflect a preceramic component of the site. This dark grayish brown fine sand contains a moderate amount of *Viviparus* shell, but it is distinguished from the overlying stratum by an increase in apple snail and bivalve shell, and, most notably, greater amounts of charcoal. Aside from a single plain fiber-tempered sherd in Level J (90-100 cm BS), pottery was not recovered from Stratum IV. Occasional marine shell tools, chert flakes, and bone pin fragments point to an assemblage that is somewhat distinct from the overlying Orange-period assemblage. A sample of charcoal from the base of Stratum IV returned an assay of 4360 ± 120 rcybp. Although at minus two-sigma (i.e., 4120 rcybp) this assay approaches the beginning of the Orange period as currently dated, given the absence of pottery and rather unique assemblage qualities, this stratum almost certainly formed over the preceramic Late Archaic period. The test unit dug in the Wastewater Treatment Area (WWTA) to the southwest of the Thursby House also revealed an apparent preceramic component. Another unit equidistant between the WWTA and Thursby House duplicated the basal midden component of TU1 and returned a C14 assay of 4210 ± 50 rcybp (see below).

The submidden stratum in TU1, Stratum V, consists of light yellowish brown to very pale brown fine sand with flecks of charcoal and occasional lenses of concreted shell. Despite the presence of charcoal, occasional shell and other faunal remains, as well as trace artifacts, this stratum represents the sterile basal sand on which midden accumulated. Features penetrating Stratum V were not observed despite repeated efforts to locate pit stains or other anomalies. Excavation of Stratum V was terminated at 165 cm BS.

Test Unit 2

Located along the north elevation of the Thursby House, Test Unit 2 (TU2) was a 2 x 2-m unit positioned to assess the potential impact of repairs to the house foundation. Excavation proceeded with trowel and shovel in 10-cm arbitrary levels and all fill was passed through ¼-inch waterscreens. A 50 x 50-cm column left standing in the southeast corner of the unit was intended to be removed for bulk samples, but it began to collapse before excavation was completed and was thus removed and processed by ¼-inch waterscreening. A second column was cut into the south wall after excavation and profiling of TU2 was completed. Matrix from the column was removed in 10-cm levels within defined stratigraphic units and passed through 1/8-inch waterscreens. Bulk samples for flotation were collected from each of the column levels. Although only one feature (Feature 3) was recorded in TU2, a series of basin-shaped lenses are evident in the profiles, some of which were treated as subunits of levels during normal level excavation.

As seen in Figure 3-6 through 3-8 and described in Table 3-2, stratigraphy in TU2 is complex compared to that of TU1. Thirteen discrete stratigraphic units and another four subunits were defined in the south profile of the unit. Including the upper historic-era unit, three ethnostratigraphic units are represented. The chief one, dating to the Orange period, is distinguished as a series of successive occupation/activity surfaces, which resulted in stacked, discontinuous lenses of alternating whole, burned, and crushed shell interspersed with charcoal and ash. Unlike TU1, this unit appears to consist largely of primary and de facto refuse and is perhaps the location of habitual use areas, probably

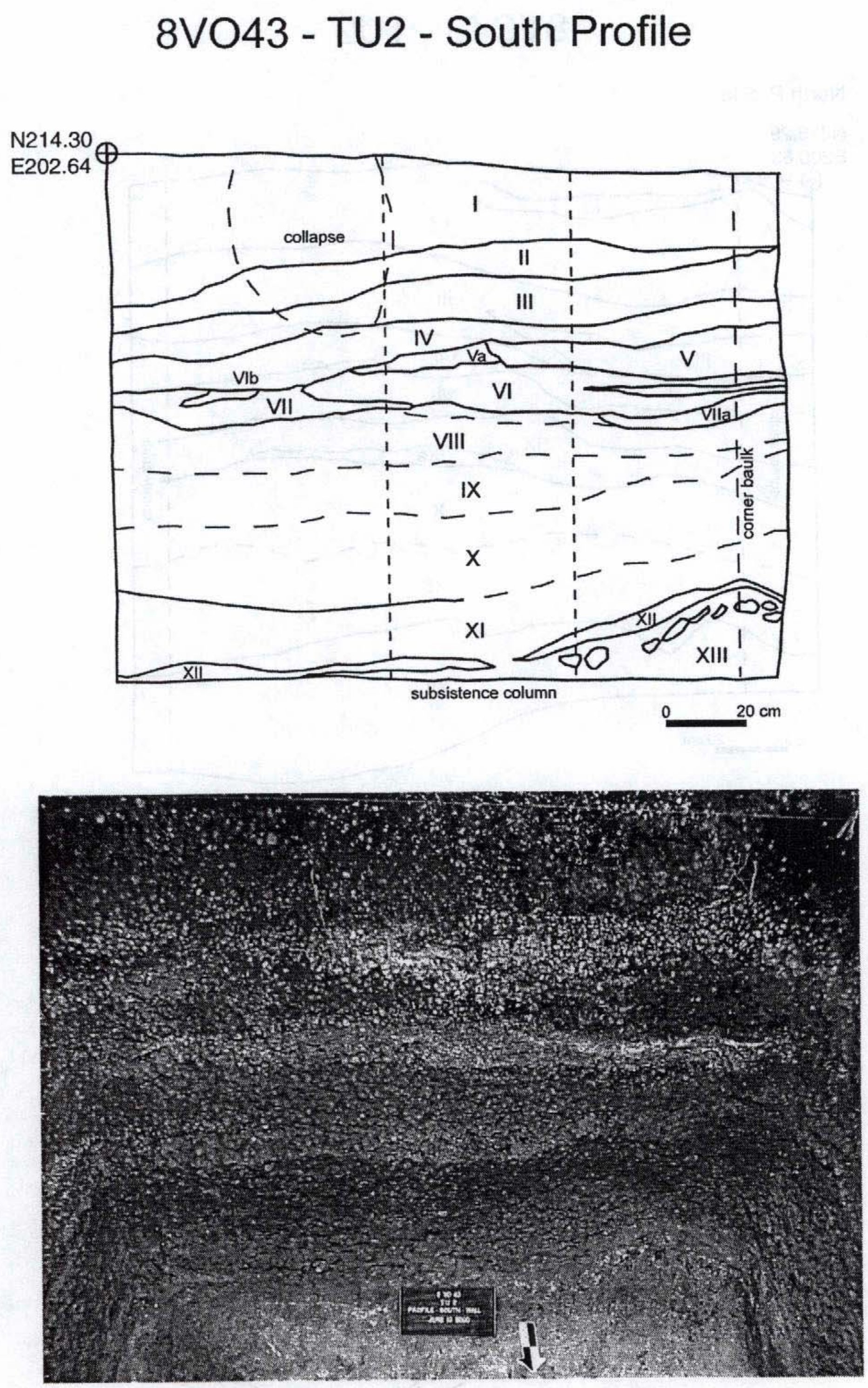

Figure 3-6. Stratigraphic drawing and photograph of south wall of Test Unit 2, 8VO43.

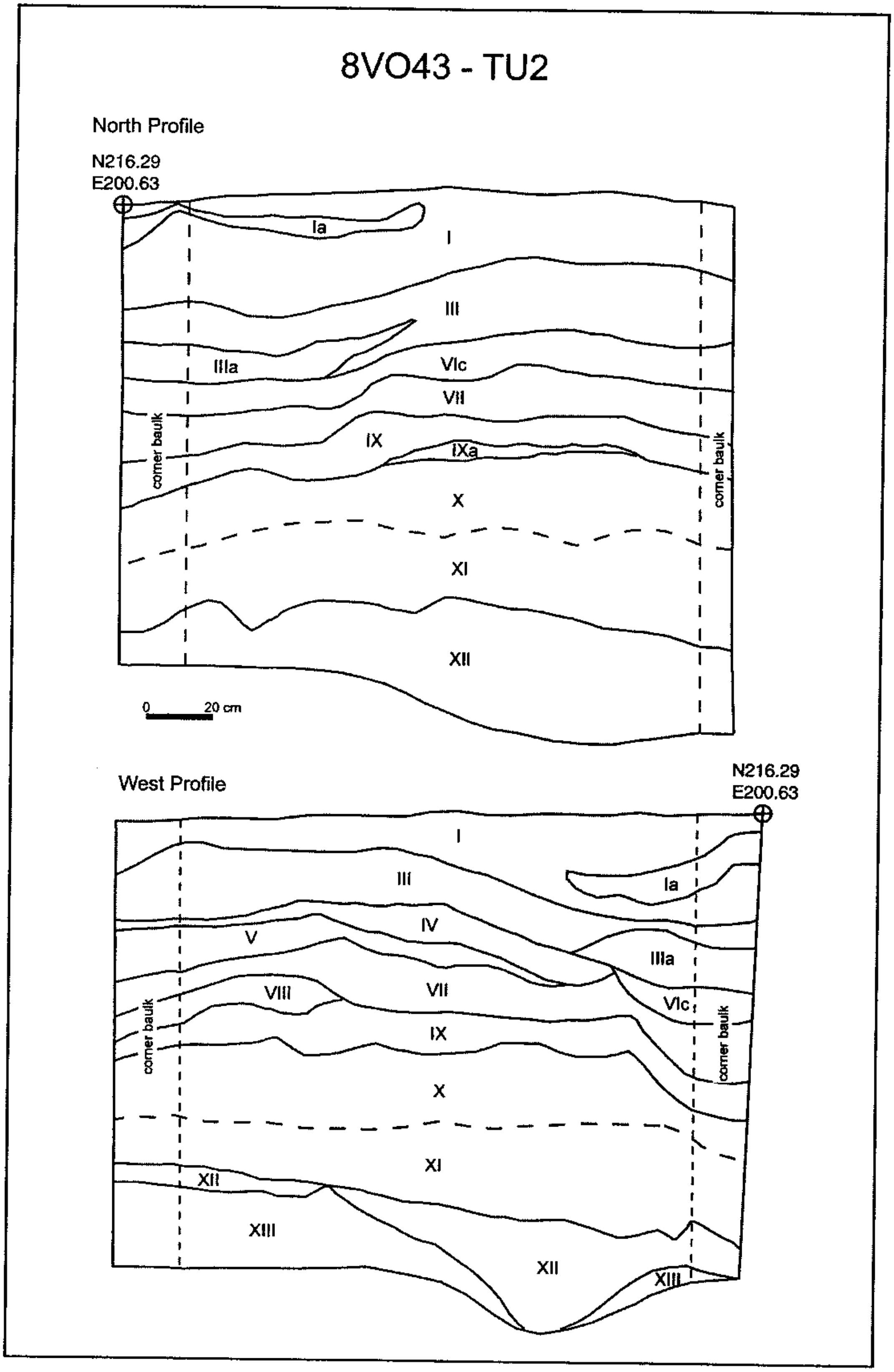

Figure 3-7. Stratigraphic drawings of north and west walls of Test Unit 2, 8VO43.

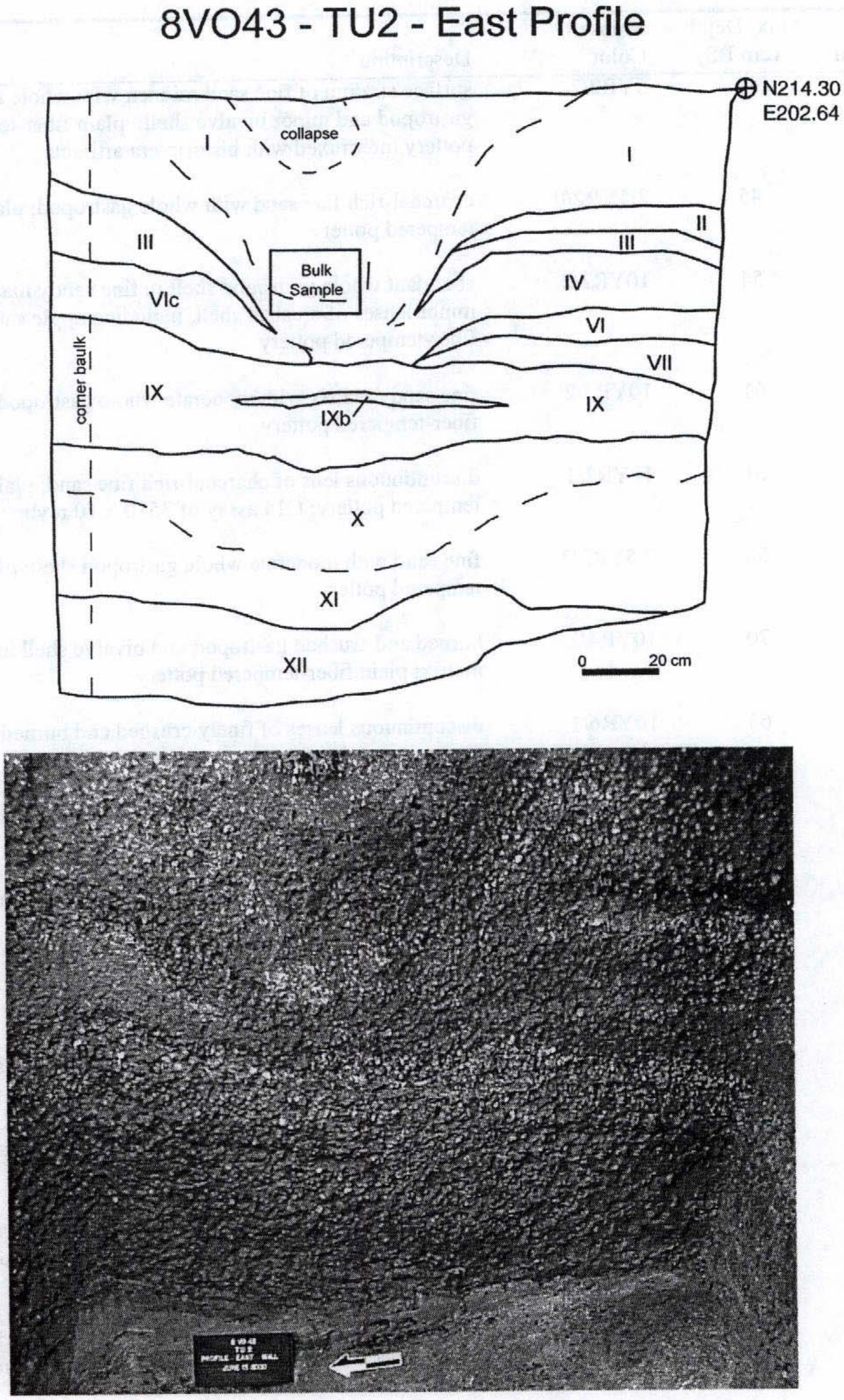

Figure 3-8. Stratigraphic drawing and photograph of east wall of Test Unit 2, 8VO43.

Table 3-2. Stratigraphic Units of North Profile of Test Unit 2, 8VO43.

Stratum	Max. Depth (cm BS)	Munsell Color	Description
I	40	5YR2/2	surface stratum of fine sand midden with whole and crushed gastropod and minor bivalve shell; plain fiber-tempered pottery intermixed with historic-era artifacts
II	45	2.5YR2/0	charcoal-rich fine sand with whole gastropod; plain fiber-tempered pottery
III	54	10YR2/2	abundant whole gastropod shell in fine sandy matrix with minor lenses of crushed shell, including apple snail; plain fiber-tempered pottery
IV	61	10YR3/2	fine sandy matrix with moderate whole gastropod shell; plain fiber-tempered pottery
V	61	10YR2/1	discontinuous lens of charcoal-rich fine sand; plain fiber-tempered pottery; C14 assay of 3510 ± 70 rcybp
Va	58	7.5YR3/2	fine sand with moderate whole gastropod shell; plain fiber-tempered pottery
VI	70	10YR4/2	burned and crushed gastropod and bivalve shell in ashy sand matrix; plain fiber-tempered pottery
VIa	65	10YR6/1	discontinuous lenses of finely crushed and burned shell; plain fiber-tempered pottery
VIb	66	10YR4/1	discontinuous lens of finely crushed and burned shell; plain fiber-tempered pottery
VII	72	10YR3/3	finely crushed shell in fine sand matrix; plain fiber-tempered pottery
VIIa	74	7.5YR4/4	finely crushed shell and charcoal in fine sand matrix; plain fiber-tempered pottery
VIII	84	10YR3/2	fine sandy matrix with moderate whole gastropod shell; plain fiber-tempered pottery
IX	99	10YR4/2	fine sandy and ashy matrix with moderate whole gastropod shell; plain fiber-tempered pottery
X	120	10YR3/4	fine sandy matrix with moderate whole gastropod shell and charcoal; plain fiber-tempered pottery; C14 assay of 3730 ± 40 rcybp
XI	138	10YR3/2	fine sandy matrix with diminished whole gastropod shell but increased apple snail and marine shell fragments and tools; no pottery
XII	140	10YR5/3	sterile fine sand
XIII	140	5YR5/2	sterile basal clay

associated with habitation structures. An underlying preceramic unit is also observed in TU2, although it is much thinner and less well defined than its counterpart in TU1.

Stratum 1 in TU2 is consistent with the surface stratum of TU1 in content and texture, although its hue is redder. Historic-era artifacts associated with the Thursby House are interspersed throughout this 40-cm-thick stratum. In at least one location on the east profile, a historic-era pit penetrated some 65 cm into the midden (Figure 3-8). Otherwise, strata below 40 cm are relatively undisturbed and, as all four profiles show, highly differentiated.

Plain fiber-tempered pottery was not abundant in TU2, but it was distributed much more deeply than in TU1. Small sherds were recovered from all levels through Stratum IX and slightly into Stratum X, or at least 100 cm BS. At least three surfaces are inferred in the 60+ cm of complex layering between Strata I and X. The shallowest is represented by Stratum II, a thin, charcoal-rich layer whose upper aspect was compromised by recent disturbances. The second and most conspicuous is represented by Stratum VI, a thin layer of finely crushed and burned shell. We regard crushed shell as a direct indicator of trampling in habitual use areas. Resting in stratigraphic conformity on this stratum of crushed shell is Stratum V, a lenticular deposit of charcoal that returned a C14 assay of 3510 ± 70 rcybp. The overlying strata of whole shell and sandy midden matrix (Strata III and IV) appear to have been deposited over the second surface, perhaps as secondary refuse. The final detected surface is represented by Stratum X, another charcoal-rich stratum with an overlying ashy matrix (Stratum IX). Charcoal from the upper portion of Stratum X returned a C14 assay of 3730 ± 40 rcybp. The overlying Stratum VIII has the appearance of secondary refuse accumulation.

We experimented with various ways of recording and removing matrix as excavations in TU2 progressed. Zonation of diverse matrices became apparent as early as the base of Level C (30 cm BS), when we began to crosscut stratigraphic units. The situation became more complex in the next few levels as discrete zones of charcoal or whole shell appeared. It became quickly apparent that much of the matrix within strata consisted of shallow, in-filled basins. One such basin was removed as a feature, but we otherwise mapped them and removed them as zones within levels. The one exception, Feature 3, was a 70-80-cm wide, 20-cm-deep basin with whole shell in its upper fill and charcoal in the lower half. It appears to have originated from the second surface of Orange affiliation (Stratum VI). Several features in the profiles of TU2 have similar size and content, although we did not always recognize them for what they were until they were excavated. Stratum V in the south profile is one such example.

Below strata containing fiber-tempered pottery was a thin layer (Stratum XI) that graded from the charcoal-rich Stratum X into a very dark grayish brown fine sandy matrix with diminished *Viviparus* shell, but increased occurrences of bivale shell. Two large marine shell tools (one conch, one whelk) were recovered from the base of Level L (ca. 120 cm BS). Combined with a lack of pottery, these marine shell artifacts are consistent with the assemblage content of Stratum IV in TU1 and suggest the presence of a preceramic component in TU2, albeit a thin one. A clay dome (Stratum XIII) along the western edge of TU2 appears at this same depth (ca. 120 cm BS), where it is intermixed with fine sands (Stratum XII), both of which appear to be sterile. Excavation in TU2 was terminated at 140 cm BS.

Wastewater Treatment Area

As testing under the Thursby House proceeded, Blue Spring staff requested our assistance in assessing potential impacts to a location approximately 140 m southwest of the house. The existing Wastewater Treatment Facility in this area of the park was beginning to fail and State Parks hoped to construct a new facility adjacent to the existing one (Figure 3-1). Cultural resource specialists for State Parks acknowledged the need to assess the potential for significant archaeological deposits in the project area. Wildlife Biologist Richard Harris observed evidence of shell midden in a small surface exposure near the northeast corner of the extant facility. As part of the field school, we agreed to examine this area for subsurface deposits and do what we could to delineate the extent of any such deposits through a program of shovel testing. At the time of our testing, project boundaries were not yet established, although we were made aware of the likely dimensions of the project footprint and its southwest corner.

Subsurface testing began at the location of observed midden. All shovel tests were 30 x 30-cm in size and dug to a minimum depth of 120 cm below surface. All fill was passed through ¼-inch hardware cloth. Testing was implemented as a cruciform pattern centered on the location of observed midden and oriented to intercept the proposed project area. Barring obstructions such as downed trees, tests were placed at 10-m intervals along each leg of the cruciform. A 4-inch bucket auger was used to complete the testing program after deeply buried midden was located. Extensions on the bucket auger enabled testing well below 3 m, which, as it turned out, proved necessary in certain locations.

The initial shovel test showed quickly that surface-exposed midden deposits were simply redeposited, most likely from the construction of the extant wastewater treatment facility decades ago. Only a thin veneer of midden was observed in the first test. Beneath this was a thick mantle of fine, banded sands, generally devoid of cultural material. At a depth of about 110 m below surface, however, sands gave way to an intact A horizon and thick shell midden (largely *Viviparus*). A similar sequence was observed in three subsequent shovel tests on the eastbound transect (70° azimuth); the first two of the subsequent tests yielded St. Johns sherds in the banded sands. One of the tests penetrating into the shell deposit yielded a plain fiber-tempered sherd. The final positive shovel test of this transect revealed a shallower sequence, with overlying sands and midden both tapering in thickness.

Coring below shovel-testing range in these initial tests showed that the shell midden exceeded one meter in thickness near the existing Wastewater Treatment Facility. Thanks to below-average rainfall, the watertable was at least 2 meters below the surface, affording semi-dry access to the upper portion of the midden.

In the interest of collecting sufficient information to characterize the sequence, age, and content of this buried midden, we arranged with Park Manager Danny Paul to open a 1 x 2-m test unit (WWTA-TU1) near one of the positive shovel tests and in close proximity to the southwest corner of the proposed Wastewater Treatment Facility (Figure 3-1). This unit was excavated in 10-cm arbitrary levels within natural stratigraphy. With the exception of a subsistence column, all filled was passed through ¼-inch hardware cloth. A 25 x 100-cm pedestal was left at the south end of the unit starting at the top of the A horizon. Matrix in this pedestal was removed in 10-cm arbitrary levels within natural strata and processed by 1/8-inch waterscreening. Bulk samples of about 10 liters each were taken from all levels. Recovery from this pedestal is comparable, volumetrically, to the columns taken from test units beneath the Thursby House.

Test unit profiles reveal conclusively that the sands overlying shell midden in the WWTA are of recent depositional origin (Figures 3-9, 3-10; Table 3-3). Contact with the underlying A horizon is sharp and abrupt. Root mat of the buried A horizon is very well preserved. Banding in the sands is likewise well preserved. The lack of mixing and leaching of organics within and between the respective stratigraphic units reflects the recent age of the sandy deposits. A couple of historic artifacts of probable 20th-century age in the A horizon suggests that the sands were deposited over the shell midden less than 100 years ago, probably much less.

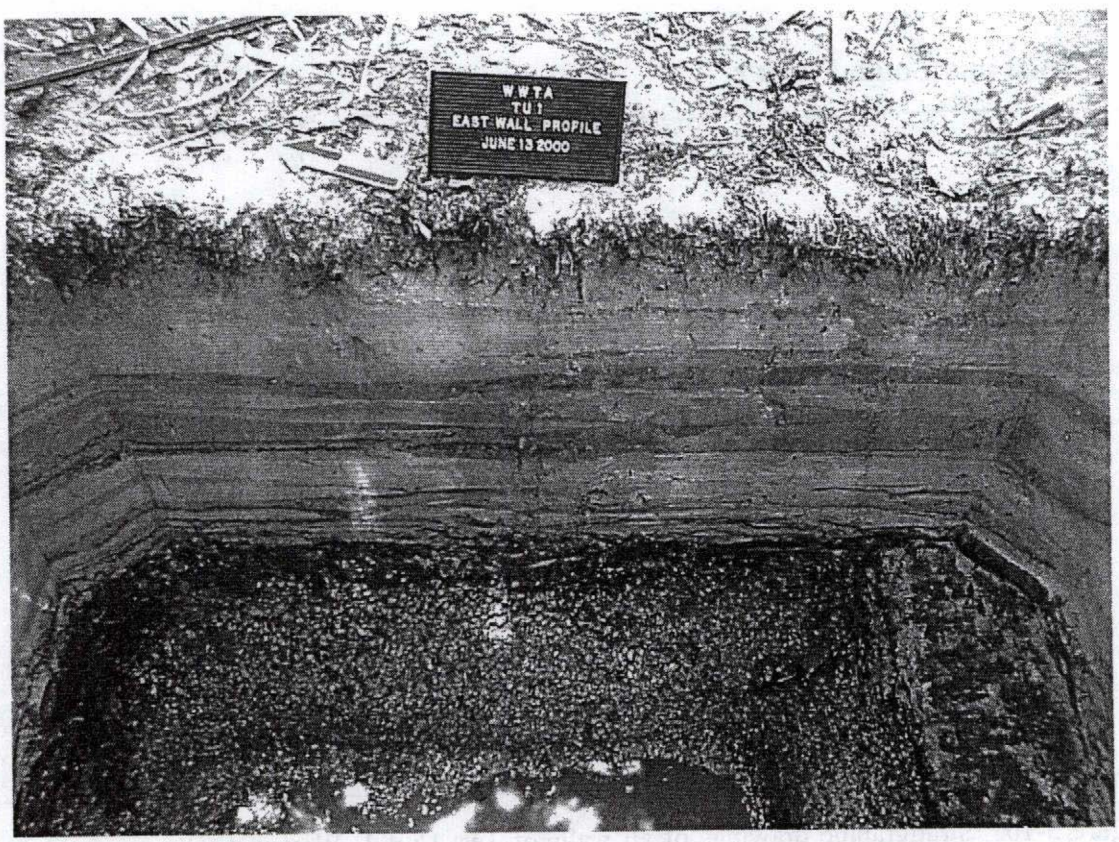

Figure 3-9. Photograph of east wall of Test Unit 1, Wastewater Treatment Area, 8VO43.

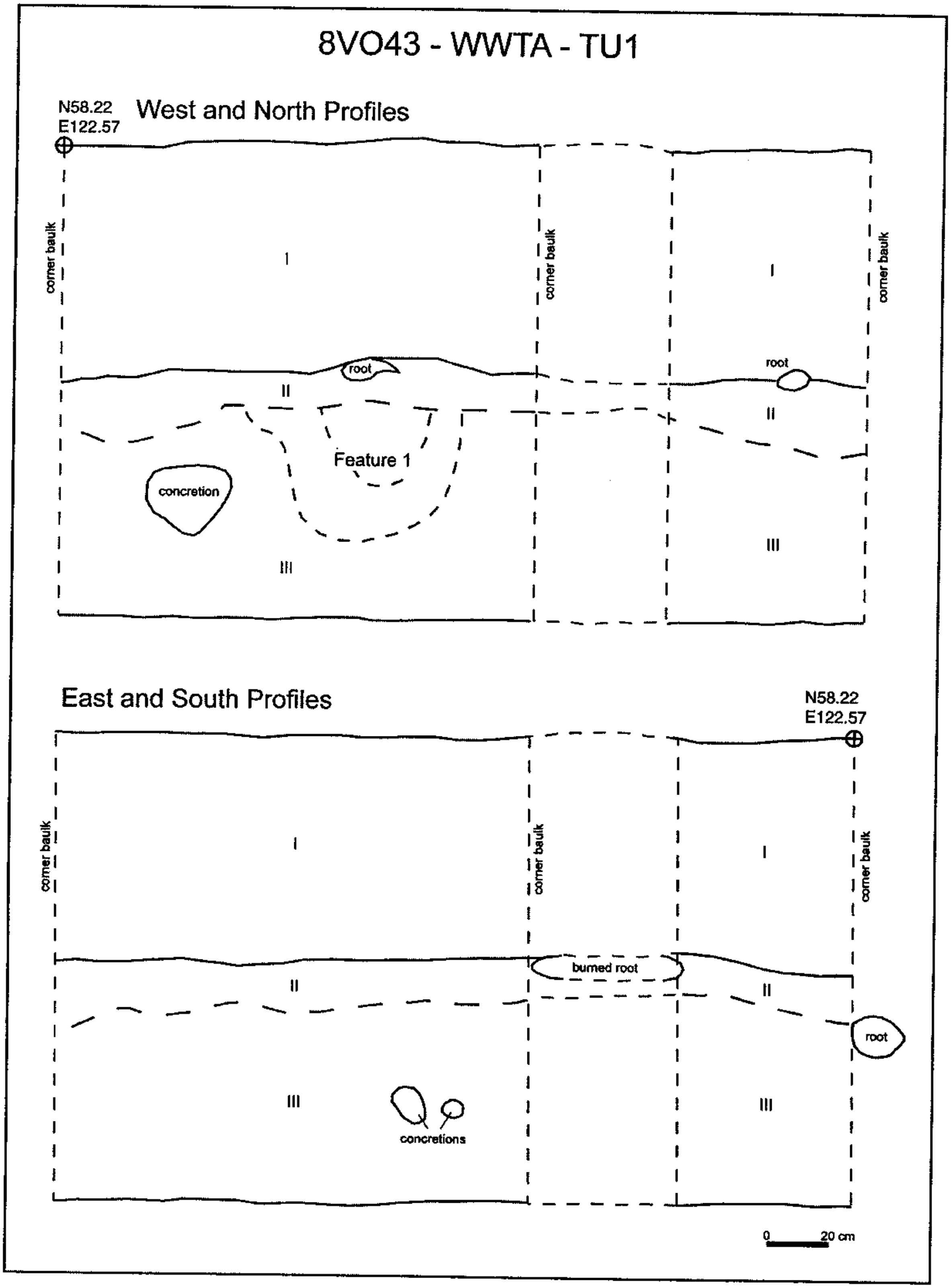

Figure 3-10. Stratigraphic drawings of all walls of Test Unit 1, Wastewater Treatment Area, 8VO43.

Table 3-3. Stratigraphic Units of West Profile of Test Unit 1, Wastewater Treatment Area.

Stratum	Max. Depth (cm BS)	Munsell Color	Description
I	80	10YR7/1 to 5YR2/1	fine sands in bands ranging 0.7-11.0 cm in thickness; St. Johns sherds and occasional vertebrate faunal remains
II	100	2.5YR2/0	buried A horizon with root mat and charcoal; prehistoric artifacts (sherds, flakes) intermixed with historic-era artifacts (stoneware, nails)
III	156	10YR5/1	homogeneous midden of fine sand with moderate density of gastropod shell; minor frequency of crushed gastropod shell and bivalve shell; occasional pockets of concreted shell; terminated at 156 cm BS

The buried A horizon of WWTA-TU1 contained abundant charcoal, a sample of which was submitted for C14 dating, returning an assay of 140 ± 50 rcybp. Apparently the source of this charcoal was a single large tree root. While this date provides a terminus post quem for the overlying sands, it provides no insight on the termination of midden accumulation.

Excavation of the buried shell midden in WWTA-TU1 produced a few plain fiber-tempered sherds similar to those found in the upper portion of the midden beneath the Thursby House. Likewise, the WWTA midden lacked pottery in the lower portion of the sequence and thus mirrored the testing results from upslope. Preservation of vertebrate faunal remains was excellent. Excavation was halted at the water table, although a small shovel test into the saturated deposits revealed 60-80 cm of additional midden overlying peaty muck. These normally wet deposits have the potential to contain the sorts of perishable remains found at the nearby Hontoon Island and Groves' Orange middens by Barbara Purdy and colleagues.

One pit feature (WWTA-Feature 1) was encountered near the top of the shell midden in the WWTA test unit (Figure 3-10). Distinguished from surrounding matrix by a darker fill and higher bone density, this small feature lacked large diagnostic artifacts, although a small fiber-tempered sherd suggests an Orange period age.

Upon completion of field operations in 2000 an interim report of our testing at the WWTA was issued to State Parks. Given the potential of the buried midden to provide well preserved organic remains in stratified context, we recommended that the proposed new facilty be relocated or, if relocation were not possible, that data recovery be conducted to mitigate adverse impact to the buried midden. Happily, State Parks was able to relocate the project and avoid further impact to the site.

TEST UNITS 2001

Testing at 8VO43 in 2000 left us with two major, unresolved issues: (1) the uncertain relationship between the stratigraphic sequences observed on opposite sides of the Thurby House; and (2) the extent of buried midden discovered in the WWTA and its relationship to deposits beneath the Thursby House. A brief research design addressing these two problems was submitted to State Parks and BAR in Tallahassee.

As discussed in detail elsewhere in this chapter, we deployed ground penetrating radar (GPR) to prospect for stratigraphic signatures that would enable us to locate places most likely to provide data relevant to the two questions listed above. Two locations were selected for additional testing: (1) the northwest corner of the Thursby House, directly off of TU2, where two contiguous 1 x 2-m units (TUs 3-4) were dug; and (2) a location equidistant between the Thursby House and the WWTA, just to the north of parking lot, where a 1 x 2-m unit (TU5) was dug. Stratigraphy of these units is described in the sections that follow.

Test Units 3 and 4

The results of GPR survey indicated that the complex stratigraphy observed in TU2 was discontinued some 2 m west of TU2, just off the northwest corner of the Thursby House porch, where it gave way to a deposit whose GPR signal mimicked the simplified stratigraphy of TU1, on the south side of the house. A 4-m-long trench oriented east-west and positioned off the northwest corner of TU2 would not only expose this facies, but likewise provide profiles that would result in, when combined with those of TU2, a 6-m-long section on a north line, and a 3-m-long section on an east line. To enhance horizontal provenience, the 4-m-long trench was actually divided into two 1 x 2-m units, the eastern one designated Test Unit 3 (TU3), the western one Test Unit 4 (TU4).

Excavation of TUs 3 and 4 was conducted simultaneously, with matrix from the respective units processed in separate screens. Excavation proceeded with trowel and shovel in 10-cm arbitrary levels and all fill was passed through ¼-inch waterscreens. A 50 x 50-cm column was removed from the north wall of TU4 upon completion of the unit. As with the other column samples, bulk samples of about 10 liters each were taken from all levels and the remaining matrix was passed through 1/8-inch waterscreens. Several features were observed in TUs 3 and 4, including one large pit (Feature 7) and a smaller pit (Feature 12), both at the base of TU4; a large pit (Feature 8) at the base of TU3; and a set of three postholes (Features 9-11) traversing the base of both units.

For the most past, TU3 yielded a stratigraphic sequence that was consistent with that of TU2, while TU4 more closely resembled the profile from TU1 (Figure 3-11). Despite the conformity between TU3 and TU2, the excavation crew found it difficult to match the stratigraphic units (e.g., Figure 3-12). Lacking visual access to the actual profiles of TU2 (which were backfilled in 2000), the crew had to work from the drawings and descriptions alone. Rather than impose stratigraphic labels from TU2 strata onto TU3 strata, the crew assigned an entirely new sequence of roman numerals to strata mapped in TUs 3 and 4. Needless to say, this posed unnecessary confusion to an already complex stratigraphic sequence.

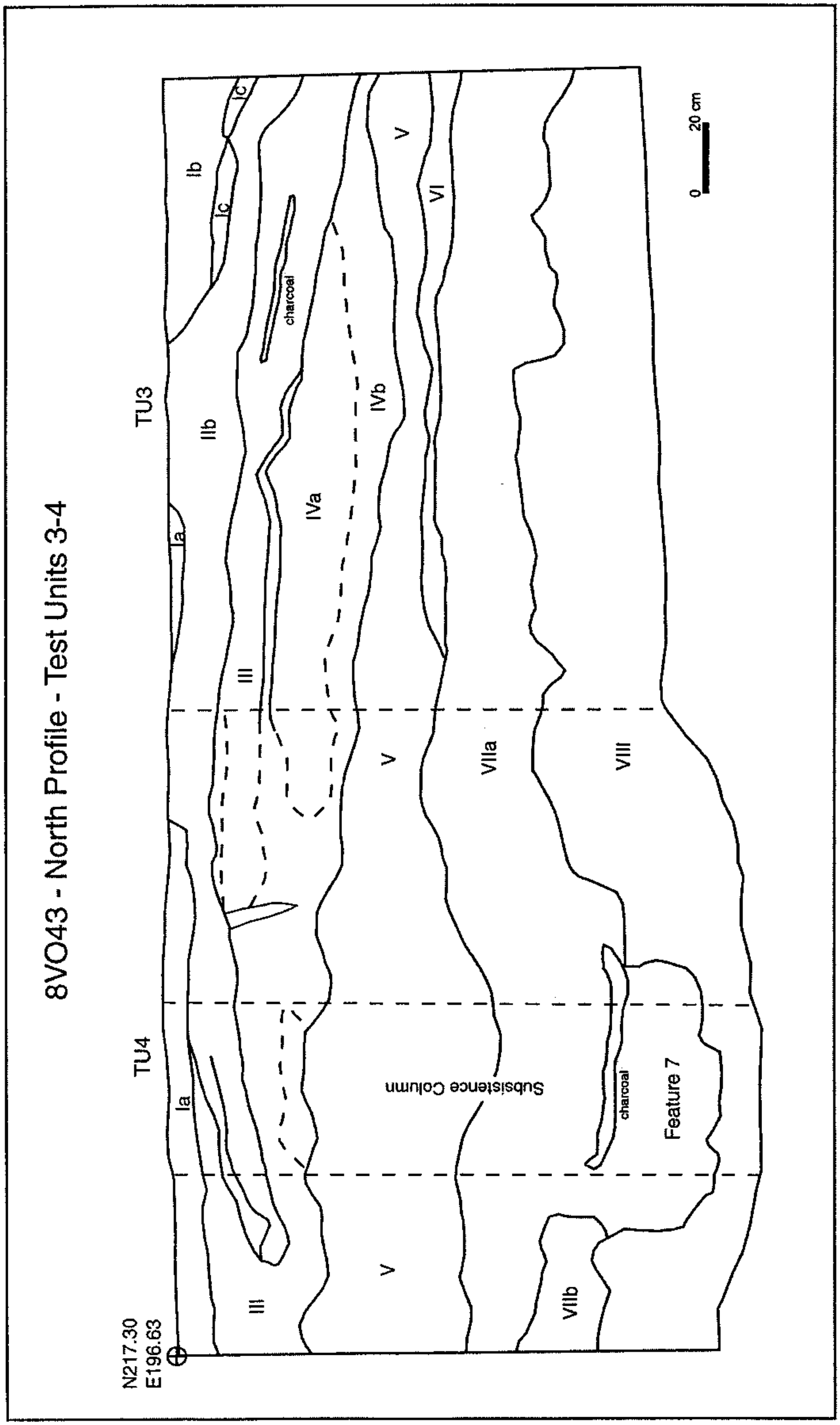

Figure 3-11. Stratigraphic drawing of north wall of Test Units 3 and 4, 8VO43.

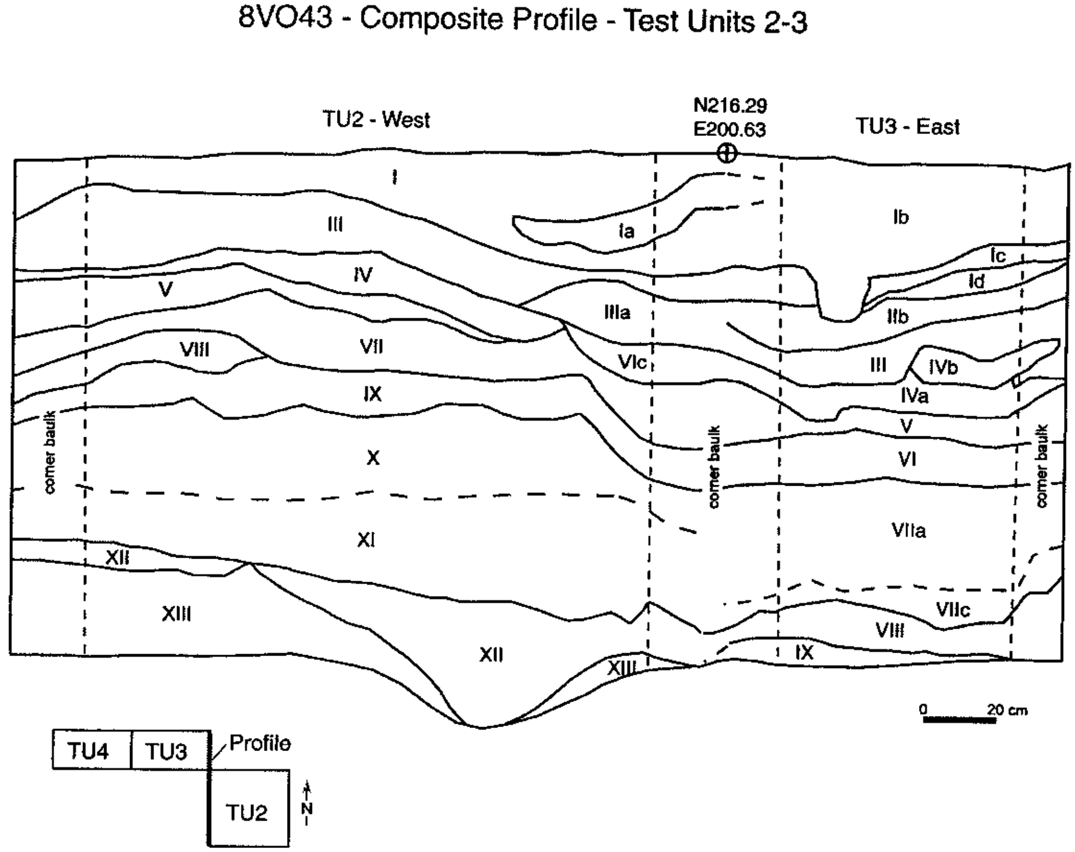

Figure 3-12. Composite stratigraphic drawing of TUs 2 and 3, 8VO43. Note discrepancy in nomenclature between TU 2 and TU3 strata.

The surface strata of TUs 3 and 4, like those dug in 2000, consisted of mixed deposits with historic-era artifacts associated with construction and maintenance of the Thursby House. Historic artifacts were, in fact, found as deep as 59 cm below the surface in the lowest portion of Stratum III. These were generally isolated occurrences, consistent in distribution with historic-era pits emanating from the present-day surface, such as the one seen in the east profile of TU2. Apart from than these few intrusions, midden deposits in excess of 40 cm BS were largely undisturbed across both TUs 3 and 4.

Plain fiber-tempered pottery was recovered throughout the entire stratigraphic sequence of TUs 3 and 4. Occurrences of sherds in the highly differentiated strata of TU3 (i.e., Strata IV, V, and VI) were expected, as these correspond precisely with Orange pottery-bearing strata of TU2. The incidence of sherds in the thicker strata of TU4 was likewise expected, although the lack of a preceramic stratum at the base of the sequence was a bit surprising. Rather, the basal stratum of both units contained pit features that penetrated into sterile basal sands (Stratum VIII). The largest of these pits, Feature 7,

Table 3-4. Stratigraphic Units of North Profile of Test Units 3-4, 8VO43.

Stratum	Max. Depth (cm BS)	Munsell Color	Description
Ia	11	10YR3/1	surface humus of fine sand with minor gastropod; prehistoric and historic-era artifacts interspersed throughout
Ib	21	10YR2/2	surface stratum of fine sand midden with whole and crushed gastropod and minor bivalve shell; prehistoric and historic-era artifacts interspersed throughout; trench for copper gas line
Ic	28	10YR4/3	fine sand midden with burned whole and crushed gastropod shell
II	41	10YR3/2-4/2	fine sand midden with whole and crushed gastropod shell; occasional crushed bivalve lenses; occasional burned and crushed gastropod shell lenses; plain fiber-tempered pottery intermixed with historic-era artifacts
III	59	10YR3/2-4/3	fine sand midden with whole gastropod shell; plain fiber-tempered pottery intermixed with historic-era artifacts
IVa	59	10YR3/2	abundant whole gastropod shell and high density of bone (mostly fish) in fine sandy matrix with charcoal flecks throughout; plain fiber-tempered pottery
IVb	71	10YR3/2	abundant whole, crushed, and burned gastropod shell in fine sandy matrix; occasional concreted shell midden; plain fiber-tempered pottery
V	95	10YR3/2-4/2	abundant whole and crushed gastropod shell in fine sandy matrix; plain fiber-tempered pottery
VI	87	10YR3/2	low density whole and crushed gastropod shell in fine sandy matrix; plain fiber-tempered pottery
VIIa	131	10YR3/2	low density whole gastropod shell in fine sandy matrix; plain fiber-tempered pottery
VIIb	126	10YR4/2	low density whole gastropod shell in fine sandy matrix; intermixed with Stratum VIII below; plain fiber-tempered pottery
VIII	84	10YR6/3	sterile fine sand

contained small fiber-tempered sherds and a fragment of hickory nutshell that returned an AMS assay of 3780 ± 50 rcybp. This age estimate is well within a one-sigma range of overlap with the assay from Stratum X of TU2 (3730 ± 40 rcybp). These contexts are stratigraphically identical inasmuch as Feature 7 emanated from Stratum VII of TU4. Lacking in either TU3 or TU4 was clear evidence of a preceramic stratum, although the recovery of large marine shell tools from the basal stratum of these units is consistent with preceramic assemblages elsewhere on the site. Apparently, pit activity during the Orange period obscured any chance of recognizing a discrete preceramic component in the profiles of TUs 3 and 4.

In short, TUs 3 and 4 bisected the contact between highly differentiated Orange-period midden indicative of primary and de facto refuse accumulation, presumably on or near house floors, and the more homogeneous midden that presumably accumulated as secondary refuse. The stratigraphic break between Orange period and preceramic deposits was not observed in these units, largely due to pit intrusions of the former on the latter.

Test Unit 5

Test Unit 5 was located to examine the buried midden observed in the Wastewater Treatment Area (WWTA) in an area sufficiently elevated to avoid the watertable. With the aid of GPR survey and occasional coring, TU5 was positioned roughly equidistant between the WWTA and Thursby House, at roughly 1.25 m higher than the WWTA. A 1x2-m unit, TU5 was excavated using methods consistent with those used elsewhere at the site. The presence of utility-related features and other historic-era features in the upper stratigraphic unit posed a bit of an unexpected challenge. Fortunately, no such features penetrated into the buried midden. After overlying sands and the features therein were removed, the walls of the unit were shored-up with plywood and cross braces (Figure 3-13). After buried midden was removed in 10-cm levels to a depth of ca. 180 cm BS, a 50 x 50-cm column was extracted from the north wall of the unit.

Figure 3-13. The walls of Test Unit 5 shored up with plywood and braces. Note contact between alluvial sands and underlying midden at base of plywood.

As shown in Figure 3-14, TU5 exposed a thick stratum of a sandy deposits over a buried shell midden, and a basal stratum of midden lacking shell resting on fine, sterile sands. Seven stratigraphic units were observed (Table 3-5), representative of at least three ethnostratigraphic units, including the historic era.

Stratum I is essentially construction fill from various earth-moving projects of the historic era. Conspicuous in this fill are several builder's trenches. One trench with its cast iron pipe in place traversed the southwest corner of the unit. Some 50 cm north of this trench, on the west wall of the unit, was a cluster of disarticulated brick and metal. Possibly the remnants of a house pier (i.e., foundation footing), this feature might simply be a small refuse pit. A larger pit filled with bottles and cans was observed at the base of Stratum I. The undulating contact between Strata I and II attest to the multiple disturbances associated with historic-era use of the park. Recovered throughout Stratum I were brick fragments, mortar, bits of roofing shingle, nails, glass, and tin. Occasional St. Johns sherds and faunal remains were also recovered.

Stratum II consists of recently deposited sands consist in color and texture with those observed in the WWTA. Bands in these sands were not as frequent and continuous as those of the WWTA unit, owing, in part, to the numerous pit disturbances emanating from Stratum I. Dominating the north half of this unit was Feature 3, a 90+ cm wide trash pit with numerous bottles and cans. Aside from the historic-era artifacts of this feature and the surrounding matrix, Stratum II yielded several St. Johns sherds. As with the test unit of the WWTA, the source of these sherds remains a mystery. If the sands are indeed alluvial in origin, the inclusion of St. Johns pottery may attest to some on-site erosional activity prior to deposition, if we assume that a St. Johns component once existed at the site, perhaps in the mound described by Wyman. The intact nature of the A horizons in both TU5 and the WWTA unit indicate that any scouring (or shell mining) of the deposit was followed by an appreciable period (i.e., at least a few years) of stability. Designated Stratum III in TU5, the buried A horizon has an intact root mat and sharp contact with the overlying sands.

Undisturbed shell midden observed in TU5 consists of a ca. 50-cm-thick stratum (Stratum IV) of whole and crushed *Viviparus* shell with occasional bivalve and moderate vertebrate remains in a homogeneous dark gray sandy matrix. Infrequent St. Johns and Orange period sherd were restricted to the upper 10-15 cm of this stratum; deposits in excess of 100 cm BS are almost assuredly preceramic in age (see Stratum V below). Aside from a few reddish-brown stains and lenses of crushed bivalve, evidence for features or subunits of midden deposition was elusive. In short, the midden was relatively homogeneous, consistent with the preceramic midden exposed in TU1 beneath the Thursby House, as well as that observed in the WWTA. The only conspicuous variation in the content or texture of this stratum was an apparent increase in bivalve shell with depth. In addition to an occasional lithic flake, Stratum IV yielded moderate amounts of burned limestone. Several fragments of marine shell were recovered from the lower half of Stratum IV, duplicating the basal assemblages from units beneath the Thursby House.

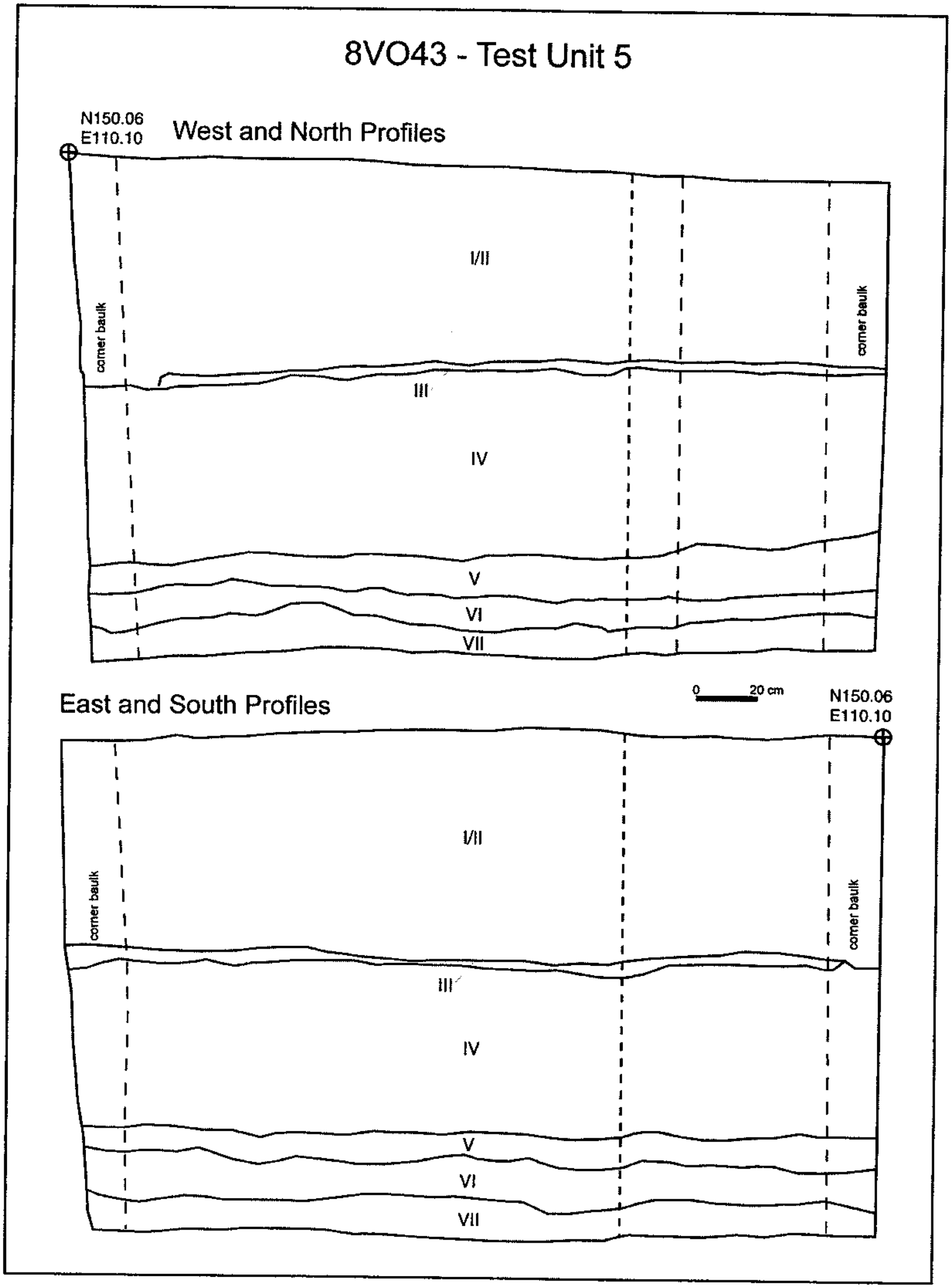

Figure 3-14. Stratigraphic drawings of all walls of Test Unit 5, 8VO43.

Table 3-5. Stratigraphic Units of Test Unit 5, 8VO43.

Stratum	Max. Depth (cm BS)	Munsell Color	Description
I	30	10YR4/2 to 10YR6/2	construction fill; fine sands with thin surface humus, abundant roots, historic- era artifacts, and features associated with park utilities
II	85	10YR7/1 w/ 10YR2/2	fine alluvial sands in dark bands ranging of varied thickness; historic-era artifacts, St. Johns sherds and occasional vertebrate faunal remains
III	88	10YR2/1	buried A horizon/surface
IV	145	10YR4/1	abundant whole and crushed gastropod shell with faunal remains, infrequent pottery (upper 10-15 cm of stratum) and lithic artifacts, burned limestone, and marine shell fargments in fine sandy matrix
V	159	10YR3/1	largely shell-free, organically enriched fine sand with abundant faunal remains, charcoal, and occasional lithic flakes; no pottery; C14 assay of 4210 ± 50 rcybp
VI	170	10YR5/1	shell-free fine sands with organic enrichment from Stratum V above; sparse faunal remains and lithic flakes
VII	180	10YR4/2	relatively sterile fine sand

The most significant result of testing at TU5 was discovery of a shell-free midden beneath Stratum IV. This stratum (Stratum V) first appeared in the north half of the unit at ca. 140 cm BS. Another 10 cm deeper, the entire plan consisted of dark, compacted and organically enriched sand. Occasional bits of shell from the overlying shell midden were confined to the upper half of the stratum. Notable throughout Stratum V was an abundance of vertebrate faunal remains. A chert hammerstone and occasional small flakes were among the only artifacts recovered. One small pit feature (Feature 6) emanating from this stratum penetrated the underlying sands to a depth of 10 cm. It contained no diagnostic artifacts.

A sample of charcoal taken from the subsistence column at a depth of 140-150 cm BS returned an AMS assay of 4210 ± 50 rcybp. This sample's location corresponds with the upper portion of Stratum V. At one-sigma, its range overlaps with that of Stratum IV, TU1 by 70 years, making them radiometrically contemporaneous. Although the midden deposits from which the TU1 charcoal sample was drawn were rife with shell, the lack of shell in a stratigraphic position below a shell midden suggests that TU5 exposed the actual onset of shellfish exploitation by occupations that had spent considerable time previously collecting, eating, and discarding resources other than shellfish. The horizontal extent of this shell-free midden, however, remains unknown. The addition of shell observed in TU5 may thus be a small-scale, relatively insignificant event, or merely a symptom of complex horizontal stratigraphy. Still, the stratigraphic relationship between Strata V and IV in TU5 is suggestive of continuity, as there are no abrupt changes other than the addition of shell and a corresponding drop in vertebrate bone density.

The underlying Stratum VI is a 10-15-cm-thick zone of organic leaching from the overlying midden. Its sandy matrix contained occasional faunal remains, a few lithic flakes, and scattered, fine charcoal. Contact with Stratum V and the underlying sterile sands was very diffuse. Other than the pit feature emanating from Stratum V in the southeast corner, no features were observed in Stratum VI. Essentially sterile basal sands were encountered at ca. 170 cm BS. Excavation was terminated at 180 cm BS.

FEATURES

Sixteen features were identified in the testing of 8VO43 in 200 and 2001. These consisted of seven pits, three postholes, and two clusters of fiber-tempered pottery, as well as three historic-era features and one anomalous stain. The numerical sequence identifying features in 2000 was inadvertently duplicated in 2001, leading to a series of three features with the same number. Also, one pit feature located in the Wastewater Treatment Area in 2000 was given a unique number before this area was deemed part of 8VO43. In the description of features that follows, these duplicate numbers are modified by prefixes that designate the test unit of their locations.

Historic-Era Features

Shallow pits and near-surface disturbances dating to historic-era use of Blue Spring occur across much of the site, but only three such features were recorded as features. Features 1-3 in TU5 (TU5-1, 2, and 3) were located in the alluvial sands overlying shell midden and represent construction and refuse disposal activities associated with recreational use of Blue Spring in the 20th century.

Feature TU5-1. This cluster of brick, mortar, and related construction debris was uncovered near the surface in the west wall of TU5. In profile the cluster was some 35 cm wide and 25 cm below the surface. It was pedestalled and left in situ over the course of the excavation until the underlying shell midden was reached, upon which all debris and surrounding fill was recovered and processed through 1/8-inch waterscreen. The recovered remains consisted of roughly 1.5 kg of mortar, six brick fragments weighing 332.8 g, 73 rusted metal scraps weighing 362.0 g, and one plastic utensil handle. Although the size and shape of this cluster of bricks and mortar resembles the footing (pier) for a structure, its disarticulated nature, coupled with the inclusion of metal scraps and the plastic utensil, suggest instead that it may have been deposited as refuse. TU5 was in the general vicinity of cottages constructed at Blue Spring by the Piersons in the late 1950s (see Chapter 2).

Feature TU5-2. A pipe trench traversing the southern end of TU5 was designated Feature 2. The trench was observed at the base of Level A and its metal pipe exposed in Level C, some 25 cm below the surface. In the fill of the trench were small bits of glass, metal, tile, brick, and mortar, as well as a disarticulated portion of concrete pipe. The intact metal pipe was about two inches in diameter and most likely served to deliver water to one of the cottages, bath houses, or the concession stand built by the Piersons in the late 1950s.

Feature TU5-3. As the alluvial sands overlying shell midden in TU5 were removed, excavators noticed a concentration of historic-era artifacts in the north half of the unit. At about 40 cm BS, the outline of a round pit roughly 100 cm wide became apparent in the northeast corner of the unit. Designated Feature 3, this pit proved to be roughly 50 cm deep and chock full of bottles and cans, glass fragments, metal scraps, bottle caps, and a few prehistoric sherds (Figure 3-15). Additional whole bottles and glass fragments were recovered from the overlying fill and surrounding matrix. Several of the whole bottles are pint-sized liquor containers, one identified as a Fleischman's gin bottle. All but one of these specimens was fitted with a screw cap; the exception was designed to accept a cork. Other bottles appear to be from condiments or other prepared foods. The bottle caps were too rusted to reveal information about product or brand type, although they almost certainly came from soft drinks and/or beer. Occasional vertebrate bone with butcher's cuts was also recovered. Taken together, the assemblage reflects the disposal of refuse expected from a recreational setting like Blue Spring, ca. 1950s through the early 1960s.

Figure 3-15. Test Unit 5, Feature 3 sectioned. Note contact with underlying A horizon at bottom of pit.

Sherd Clusters

Prehistoric pottery was not abundant in the test units dug at 8VO43, so the occurrence of clusters of sherds was assumed to reflect discrete activities, possibly associated with pits. Early in the testing in 2000 two such clusters in TU1 were designated Features 1 and 2. Both were mapped in plan, sectioned, profiled, and removed fro 1/8-inch waterscreening. Neither could be unequivocally associated with pit activity.

Feature TU1-1. A concentration of plain fiber-tempered sherds in the northwest corner of TU1 was designated Feature 1. Sherds began to appear at about 26 cm BS are were associated with a matrix of charcoal-rich, ashy sand in an oval stain about 40 cm in diameter (Figure 3-16). The northern edge of the stain abutted the subsistence column of TU1. This contact provided a convenience line of bisection for profiling. After mapping in place all large sherds, the fill of the stain was scooped out of the south half to reveal an amorphous, dipping outline with an area of disturbed soil, possibly an animal burrow. The maximum depth of matrix associated with this feature was 39 cm BS. All fill from this feature was passed through 1/8-inch waterscreen.

Several dozen sherds of plain fiber-tempered pottery from Feature 1 were conjoined to form the upper portion of a large, oval-shaped basin with an orifice of 27 x 33 cm (Vessel 2, see Chapter 6). It is worth noting that several of the rim sherds were oriented in a fashion that suggests they broke in situ. An additional 83 crumb sherds was recovered from the matrix, as were a variety of gastropod shell (mostly *Viviparus*), bivalve shell, charcoal, and minor bits of vertebrate bone. Given the near-surface context of this feature and apparent disturbance from a burrowing animal, it was not considered a good candidate for radiometric dating. Sufficient charcoal is available for this purpose.

Feature TU1-2. About 60 cm to the south of Feature 1 was a second concentration of plain fiber-tempered sherds in a very dark brown (10YR2/2), charcoal-rich matrix (Figure 3-16). The contact of this matrix with background midden soil was diffuse, but appeared to be situated in an oval pit roughly 25 x 40 cm in plan. After mapping in place the large sherds, excavators sectioned and removed the oval feature to reveal an irregular profile only 4-5 cm deep. A root disturbance at the south end of the pit obscured the contact between pit fill and midden matrix. All fill from this feature was passed through 1/8-inch waterscreen.

The matrix of Feature 2 included four plain fiber-tempered sherds and 34 crumb sherds similar to those of Feature 1. Whole *Viviparus* shell was accompanied by minor occurrences of other aquatic gastropods, bivalve shell, charcoal, a hackberry seed, and a small amount of vertebrate bone. The content of this feature does not deviate from general midden matrix, and, if not for the sherds, would have gone undetected. Its status as a pit feature is uncertain.

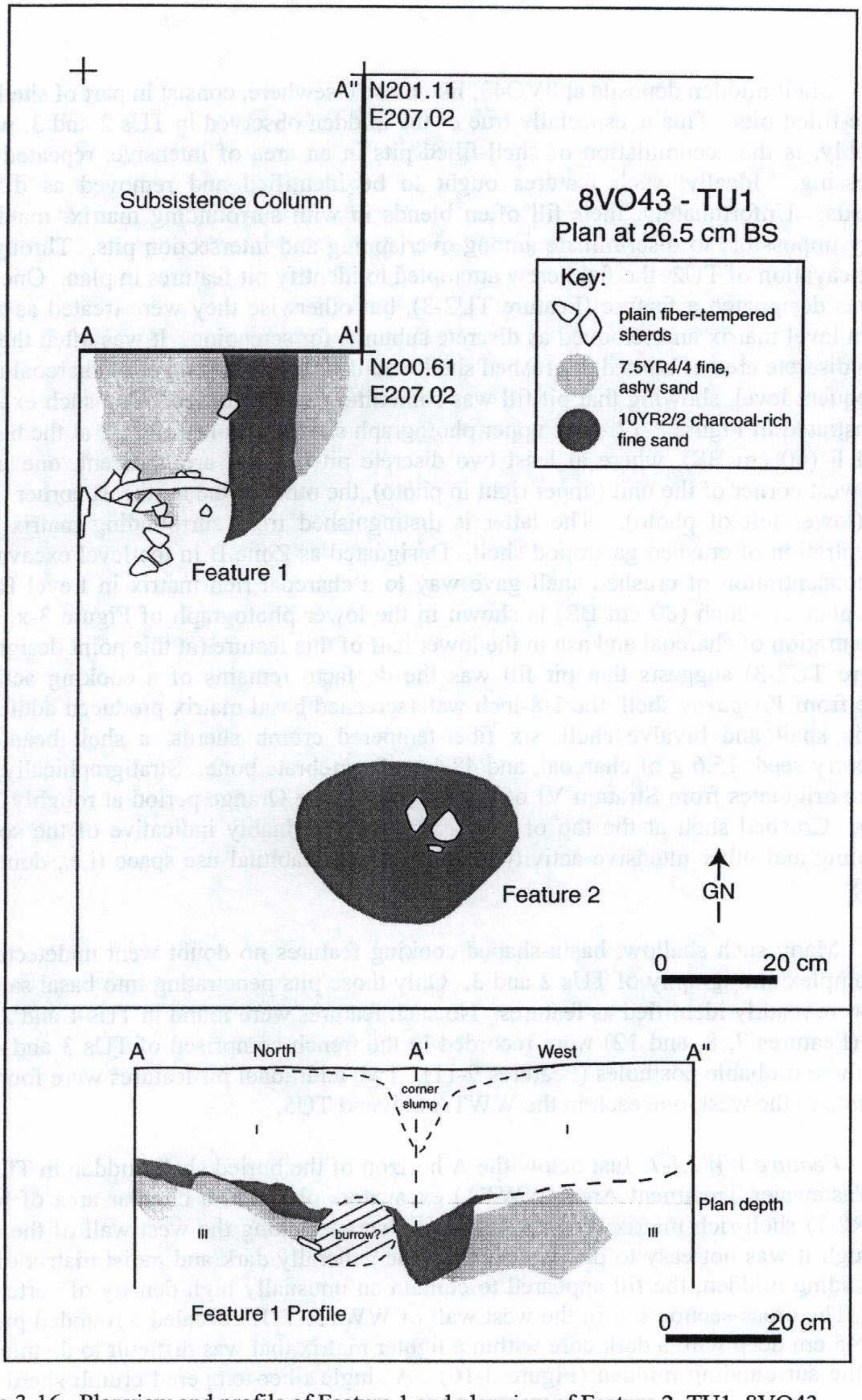

Figure 3-16. Planview and profile of Feature 1 and planview of Feature 2, TU1, 8VO43.

Pits

Shell midden deposits at 8VO43, like those elsewhere, consist in part of shell- and refuse-filled pits. This is especially true of the midden observed in TUs 2 and 3, which, arguably, is the accumulation of shell-filled pits in an area of intensive, repeated food processing. Ideally, such features ought to be identified and removed as discrete contexts. Unfortunately, their fill often blends in with surrounding matrix, making it nearly impossible to discriminate among overlapping and intersection pits. Throughout the excavation of TU2 the field crew attempted to identify pit features in plan. One such pit was designated a feature (Feature TU2-3), but otherwise they were treated as zones within level matrix and removed as discrete subunits for screening. It was often the case that a discrete area of burned or crushed shell would give way to a layer of charcoal in the subsequent level, showing that pit fill was sometimes well stratified. One such example is illustrated in Figure 3-17. The upper photograph shows the plan of TU2 at the base of Level F (60 cm BS), where at least two discrete pit features are apparent, one in the southwest corner of the unit (upper right in photo), the other in the northeast corner of the unit (lower left of photo). The latter is distinguished from surrounding matrix by a concentration of crushed gastropod shell. Designated as Zone B in the level excavation, this concentration of crushed shell gave way to a charcoal rich matrix in Level H, the basal plan of which (80 cm BS) is shown in the lower photograph of Figure 3-x. The concentration of charcoal and ash in the lower half of this feature (at this point designated Feature TU2-3) suggests that pit fill was the de facto remains of a cooking activity. Aside from *Viviparus* shell, the 1/8-inch waterscreened basal matrix produced additional aquatic snail and bivalve shell, six fiber-tempered crumb sherds, a shell bead, one hackberry seed, 15.6 g of charcoal, and 48.6 g of vertebrate bone. Stratigraphically, this feature originates from Stratum VI of TU2, dating to the Orange period at roughly 3500 rcybp. Crushed shell at the top of this feature is presumably indicative of the sort of trampling and other intensive activity associated with habitual use space (i.e., domestic space).

Many such shallow, basin-shaped cooking features no doubt went undetected in the complex stratigraphy of TUs 2 and 3. Only those pits penetrating into basal sand or clay were readily identified as features. No such features were found in TUs 1 and 2, but three (Features 7, 8, and 12) were recorded in the trench comprised of TUs 3 and 4, as were three probable postholes (Features 9-11). Two additional pit features were found in test units to the west, one each in the WWTA unit and TU5.

Feature WWTA-1. Just below the A horizon of the buried shell midden in TU1 of the Wastewater Treatment Area (WWTA) excavators observed a circular area of black (10YR2/1) shell-rich matrix roughly 45 cm in diameter along the west wall of the unit. Although it was not easy to distinguish from the generally dark and moist matrix of the surrounding midden, the fill appeared to contain an unusually high density of vertebrate bone. The cross-section left in the west wall of WWTA-TU1 revealed a rounded profile some 45 cm deep with a dark core within a lighter matrix that was difficult to distinguish from the surrounding midden (Figure 3-10). A single fiber-tempered crumb sherd was

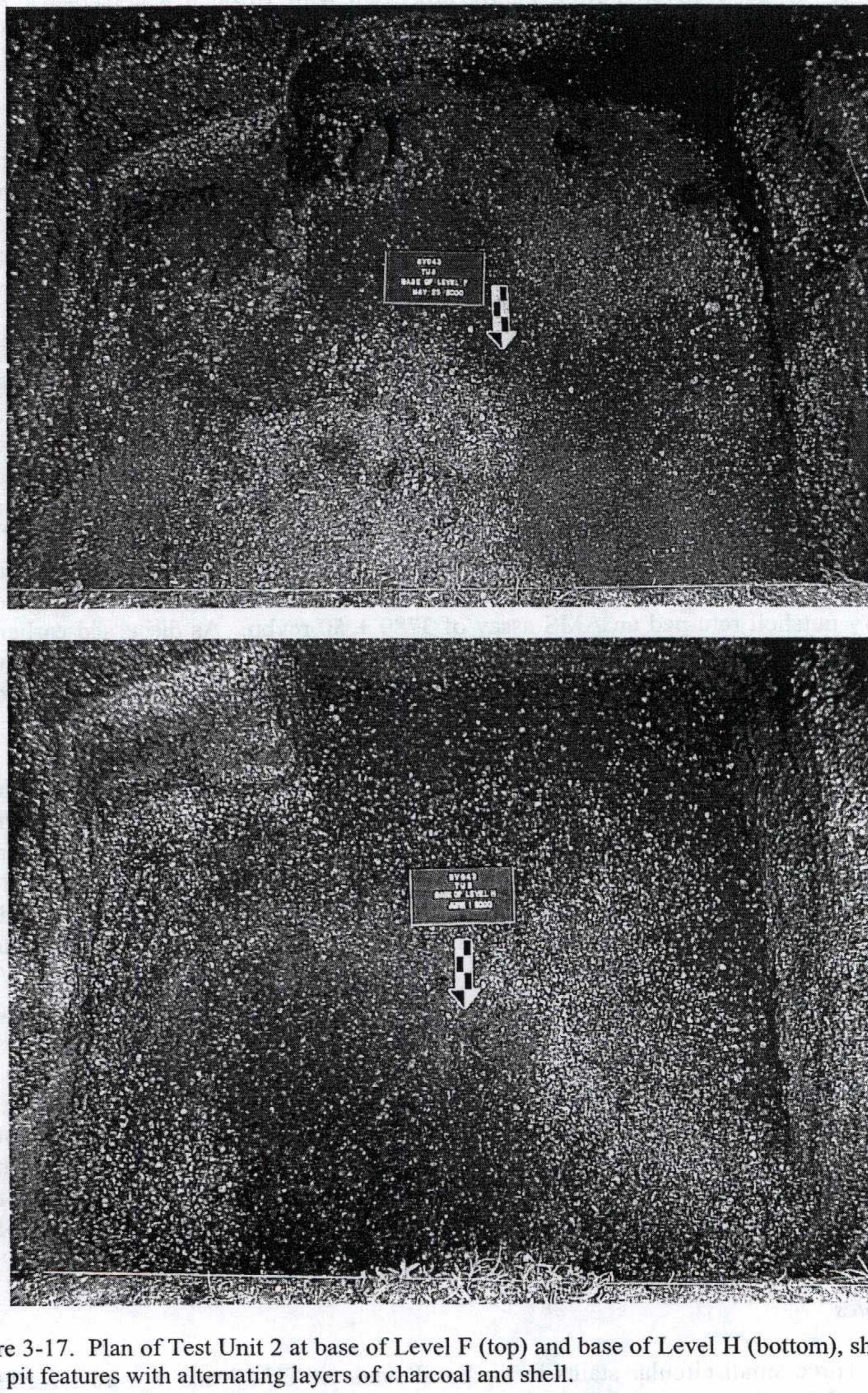

Figure 3-17. Plan of Test Unit 2 at base of Level F (top) and base of Level H (bottom), showing large pit features with alternating layers of charcoal and shell.

the only artifact recovered from matrix processed with 1/8-inch waterscreen. A bulk sample awaits flotation processing.

Feature TU5-6. In the nonshell, basal stratum of TU5, excavators recorded a very dark gray (10YR3/1) circular stain roughly 30 cm in diameter. Designated Feature 6, this pit was sectioned to reveal a shallow, rounded profile only 10 cm deep. Matrix passed through 1/8-inch waterscreen produced a small assemblage of vertebrate bone, charcoal, and concretions. A bulk sample was collected for flotation. The point of origin of this pit is uncertain, but given the lack of shell in its matrix, it likely originated from the basal stratum in which it was first observed in plan.

Feature TU4-7. Near the base of the shell midden in TU4 was observed a circular stain of very dark grayish brown (10YR3/2) matrix that extending into the underlying pale brown (10YR6/3) sands, as well as the north wall of the unit (Figure 3-18). Removal of the adjacent subsistence column enabled nearly complete definition of the plan. Sectioning revealed the profile of a rounded pit some 36 cm deep. Matrix from the pit exposed in TU4 (less the subsistence column) was removed and processed through 1/8-inch waterscreen; two 10-l samples of fill were retained for flotation. The waterscreened matrix contained 33 fiber-tempered crumb sherds, abundant *Viviparus* and other gastropod and bivalve shell, hackberry seeds, and vertebrate bone. A fragment of hickory nutshell returned an AMS assay of 3780 ± 50 rcybp. As discussed earlier, this age estimate is well within a one-sigma range of overlap with the assay from Stratum X of TU2 (3730 ± 40 rcybp), representative of the earliest Orange-period component of the site.

Feature TU3-8. A second large-diameter stain at the contact between midden and underlying sterile sand was observed in the southeast quadrant of TU3 and designated Feature 8 (Figure 3-18). Unlike Feature 7, this pit penetrated into basal sands only a few centimeters. Its dark yellowish brown (10YR3/4) matrix was removed for 1/8-inch waterscreening and flotation processing. The fill contained the usual gastropod and bivalve shell, vertebrate bone, and small bits of charcoal, but no artifacts. Despite the lack of diagnostic artifacts, the feature appears to have originated from Stratum VII of TUs 3-4 (contiguous with Stratum X of TU2), and is thus stratigraphically coeval with Feature 7.

Feature TU4-12. One final pit penetrating into basal sands was located along the south wall of TU4 and designated Feature 12. (Figure 3-18). Like Feature 8 it did not penetrate far into the sand. Its yellowish brown matrix contained small amounts of shell, bone, and charcoal. No artifacts other than a minute shell bead were recovered from the 1/8-inch waterscreened matrix. A bulk sample for flotation awaits processing. In profile and plan, Feature 12 is irregular; its point of origin is uncertain.

Postholes

Three small circular stains in the basal sands of TUs 3 and 4 were recorded as Features 9-11 (Figure 3-18). Against the pale brown (10YR6/3) sands of the submidden

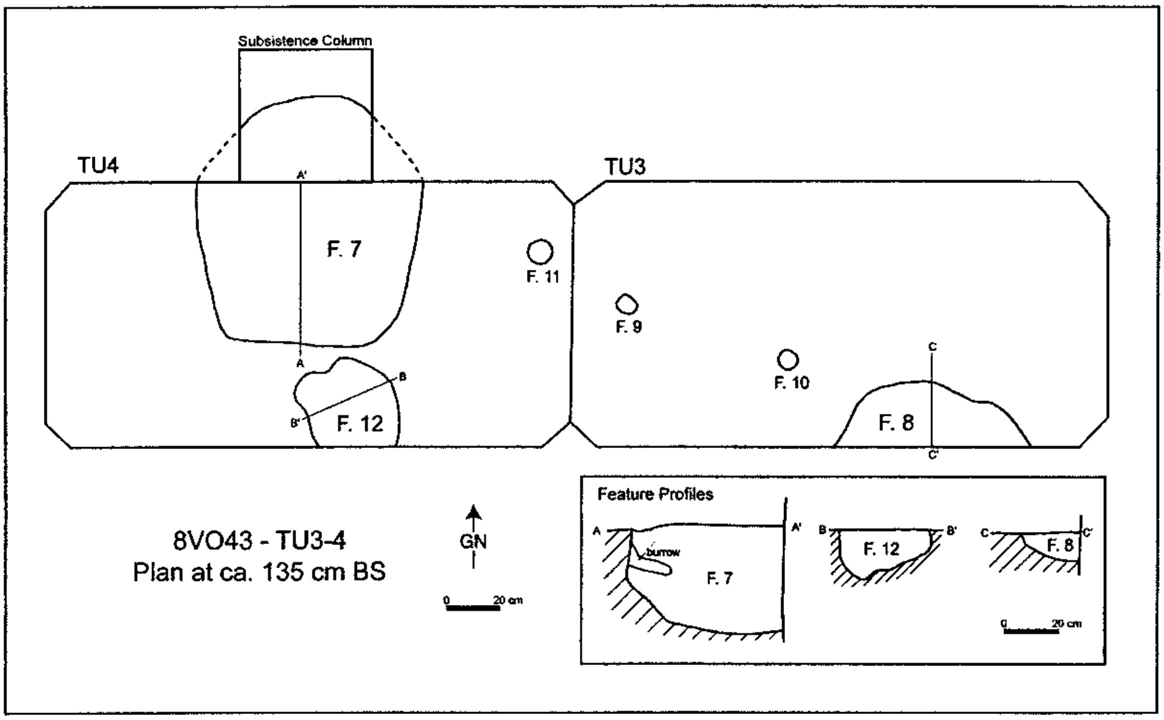

Figure 3-18. Planview and profiles of features at base of midden depsoists, TUs 3-4, 8VO43.

matrix, these dark grayish brown (10YR4/2) to brown (10YR5/3) stains were relatively conspicuous and regular in plan, raging from 7 to 10 cm in diameter. Each of the stains was sectioned to inspect the profile. Features 9 and 10 were merely 3 cm deep, with irregular outlines, but Feature 11 went down some 11 cm and had a symmetrical, conical profile. Given the spacing of these features and their association with pits, it seems reasonable to conclude that all three were holes for posts. The surface origin of these features remains unknown, although they must have emanated from at least the middle of the overlying Stratum VII of TUs 3 and 4, perhaps a good bit higher. If one were to project the arc formed by these posts to the north of TUs 3 and 4, the line would essentially duplicate the stratigraphic break between presumed primary and secondary refuse deposits seen in the north profile of those units. As the discussion of GPR survey below indicates, this stratigraphic facies is arguably a good proxy for the location of domestic structures.

GROUND PENETRATING RADAR SURVEY

One of the more interesting results of testing at 8VO43 in 2000 was the contrast between stratigraphic sequences on either side of the Thursby House. Test Unit 1 (TU1), on the south side of the house, exposed a shell midden roughly 125 cm in thickness overlying fine, sterile sand. Although some stratigraphic differences were observed in TU1 profiles, the midden consisted of a generally homogenous matrix of *Viviparus* shell in a dark brown to grayish brown silty sand with occasional, discontinuous lenses of bivalve shell and brown silty sand. Test Unit 2 (TU2), on the north side, contained a more complicated sequence involving alternating lenses of whole *Viviparus* shell, and crushed and/or burned shell with charcoal in the upper meter, overlying a dark grayish brown fine sand matrix with whole *Viviparus* and bivalve shell, as well as marine gastropod tools, lying on a dome of olive gray sterile clay at 120-140 cm BS. Artifact assemblages and radiocarbon assays for the respective sequences suggested that the basal strata were preceramic in age (i.e., >4000 rcybp), but that the upper 80-100 cm of midden formed during the Orange period, minimally between 3810 and 3370 rcybp. The contrast in stratigraphy on either side of the house is especially marked for these Orange-period deposits.

Assuming that the Orange-period deposits on opposite sides of the Thursby House are fully contemporaneous, we hypothesized that the relatively homogeneous midden observed in TU1 resulted from secondary deposition and that the highly differentiated strata of TU2 consisted of primary and de facto refuse. The deposits observed in TU2 include a series of stacked, shallow basin-like features interspersed between possible living surfaces or "floors," as evidenced by lenses of finely crushed shell. Although direct evidence for architecture was not observed in testing in 2000, we assumed that the array of shallow features and crushed shell reflected the location of domestic structures, or at least locations of repeated food processing, burning, and trampling.

More excavation was needed to test these ideas. Clearly the best way to explore the stratigraphic relationship between sequences observed in TUs 1 and 2 would be trenching between them. With more than 13 meters between the units and the Thursby House inhibiting access, trenching was not feasible. Even if we had unfettered access, such extensive excavation would be ill-advised for a site under protection. Coring under the house was, of course, out of the question.

Given our need to clarify stratigraphy at 8VO43 while minimizing impact to the site, nondestructive, geophysical survey seemed in order. To our knowledge, geophysical techniques of survey have not been previously deployed at shell-bearing deposits in the St. Johns Basin, although they have been used elsewhere to not only delineate the vertical and horizontal extent of shell midden, but also to provide information on the internal structure of deposits. In a case in Washington using electrical resistivity (Dalan et al. 1992), buried shell midden could be distinguished from underlying and surrounding soils because its of coarse texture and porosity. We were hopeful that similar differences would inhere in readings of variable texture and porosity (or density) within the midden, thus enabling us to potentially distinguish between presumptive habitation areas and secondary deposition.

The geophysical resolution required to recognize variations in the internal configuration of a shell midden precluded the use of most techniques. Resistivity, for instance, would be largely ineffective at distinguishing between a homogeneous midden of moderate texture and porosity from a stacked sequence of 10-cm layers of midden with alternating high and low values of texture and porosity. Magnetometry offers limited advantage in this sort of application, and besides, the tin roof covering the Thursby House posed too much magnetic interference for survey in the immediate area of the house, as we learned in a small pilot study with Ryan Williams. Both techniques, resistivity and magnetometry, are effective tools for locating the boundaries of the entire midden—vertical and horizontal—but they are not the best techniques for detecting small-scale stratigraphic variations within the midden.

Ground-penetrating radar (GPR) has the highest resolution of any geophysical technology and is therefore, better suited to both small- and large-scale prospecting at prehistoric sites. The main advantage of this technology is the immediate graphic representation of subsurface features because the data is continuous (real-time). Geophysical prospecting with GPR is not only conducive to mapping site stratigraphy, but is extremely useful for detecting features that are on a much smaller scale.

During a GPR survey, repetitive electromagnetic pulses of short duration are emitted into the ground as the antenna is pulled over the ground surface. As the electromagnetic wave propagates downward into the ground through different materials, the pulse speed changes and some of the energy is reflected back to the surface and received by the antenna, indicating subsurface discontinuities. During field data acquisition the radar transmission process is repeated many times a second. A cross-sectional view of subsurface reflections is generated from the composite of all of the reflected wave traces along a transect creating a two-dimensional profile that is referred to as a reflection.

A series of reflections that are plotted together in a profile create a horizontal or sub-horizontal line on a profile. Physical discontinuities such as a stratigraphic layer, particularly a clay horizon, or water table produce distinctive reflections visible in profile. In addition, disruptions of stratigraphic horizons on profile are also referred to as anomalies. Subsurface discontinuities that generate reflections are typically produced by variations in water content, variations in electrical properties, variations in bulk density, and the presence of voids.

GPR surveys were performed with a 500-MHz antenna using the Subsurface Interface Radar (SIR) 2000 that is manufactured by Geophysical Survey Systems, Inc. (GSSI). This unit is powered by a 12-volt battery and consists of a digital control unit and keypad, a VGA color monitor, and internal hard drive. The hard drive stores the data for either immediate playback in the field or further computer processing in the lab using RADAN, proprietary software of GSSI.

Site 8VO43 provided ideal conditions for GPR prospecting. Although the site was on a slope, the surveyed area was in a grassy, open field with only a few, widely spaced trees. In addition, previous subsurface testing detected a prominent clay horizon less than two meters deep. The presence of this horizon was useful in calibrating the depth of the GPR profiles.

The GPR survey was deployed in two stages: (1) a preliminary survey to establish signatures for alternative stratigraphic sequences; and (2) a "full-coverage" survey to locate all possible habitation loci. GPR was also used to help resolve the stratigraphic relationship between the exposed midden beneath the Thursby House and the deeply buried midden uncovered in 2000 at the Wastewater Treatment Area some 160 m southwest of the house. This latter application is discussed in a later section of this chapter.

Establishing Stratigraphic Signatures

The major goal of stratigraphic testing in 2001 was to expose and document the relationship between sequences observed the previous year in TUs 1 and 2. We aimed to open a test trench that spanned these sequences without superfluous excavation, so we needed to locate the horizontal boundary between the sequences. Inasmuch as we assumed that the complex stratigraphy of TU2 represented habitation space, centering our efforts on this unit offered the added potential of uncovering direct evidence for domestic structures. We therefore began the GPR survey by dragging the unit along a transect at the northern edge of backfilled TU2. After some calibration and other technical adjustments, the GPR returned signals commensurate with the stratigraphic complexity of TU2. Transects directed to the west and north of TU2 suggested lesser stratigraphic complexity only 3-4 m distant. A few judgmental bucket auger tests confirmed the presence of relatively homogenous midden. These preliminary findings suggested that the heterogeneous deposits evident in profiles of TU2 were highly localized. The house precluded GPR survey to south and east of TU2, so we were unable to predict the full extent of these deposits. None of the preliminary GPR transects pulled along the west or south elevations of the house returned signals comparable to those of TU2.

In deciding on a location for additional testing, the clearest indication of a stratigraphic boundary came from the GPR transects running east-west along the north wall of TU2. Here the GPR signals suggested a transition between heterogeneous and homogenous midden at approximately 2-3 m west of TU2. We therefore opted to locate a 4-m-long trench off the northwest corner of TU2 so as maximize profiles along both major axes. The trench was excavated as two contiguous 1 x 2-m units, TUs 3 and 4.

Stratigraphic details of the trench were summarized in an earlier section of this chapter. For the purposes of establishing GPR signatures of the stratigraphy, one of the GPR profiles is displayed in Figure 3-19 along with a composite profile of TUs 2-4. As this figure shows, the GPR reflections match closely the actual stratigraphic sequence of the profile. The east half of the profile consists of alternating layers of whole and burned/crushed shell and charcoal, a pattern we argue is indicative of primary and de facto reuse associated with living floors of domestic structures. The west half of the profile, as the GPR predicted, lacked the complex sequence and was instead relatively homogenous in composition. This contrast in sequence is strongest in the upper half of the profile (i.e., 40-70 cm BS), dating to the Orange period. The lower half of the profile is not so dramatically differentiated.

Having established the efficacy of GPR survey in prospecting for locations of domestic space, we were optimistic that intensive GPR survey of the rest of the

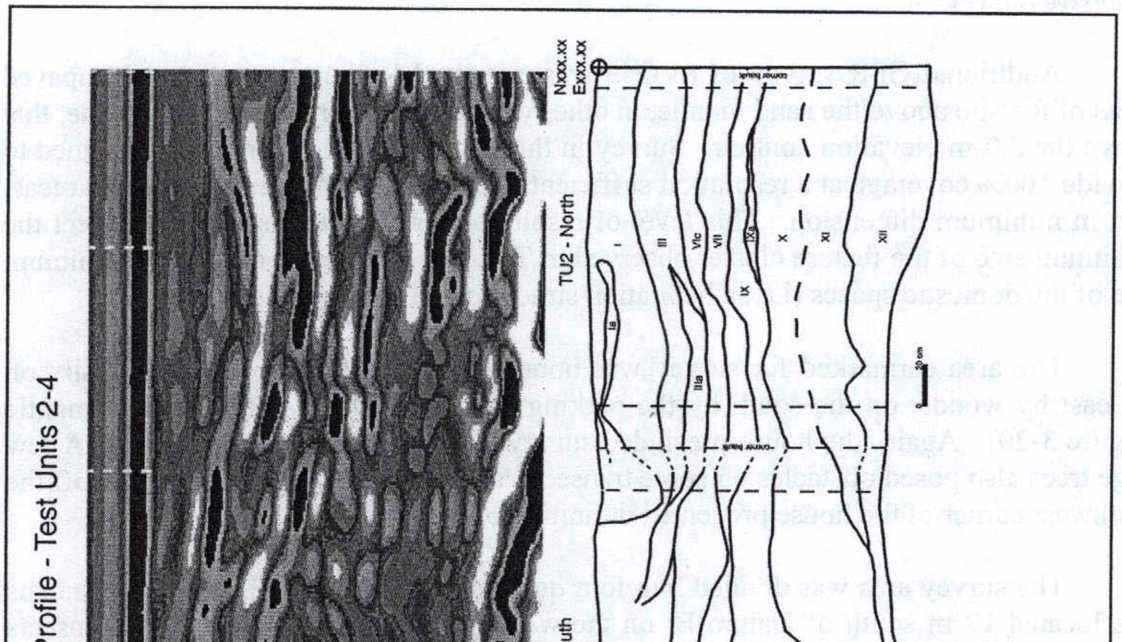

Figure 3-19. Composite profile of Test Units 24 (bottom) and GPR reflectionof transect to the immediate north of the profile.

surrounding area would reveal locations other possible structures and, in turn, enable us to reconstruct community patterning. In late October 2001, long after field school, we returned to Blue Spring for an intensive GPR survey.

Intensive Survey

Additional GPR survey of 8VO43 was restricted to the unwooded and unpaved areas of the site above the sand mantle, in other words, the eastern portion of the site, that above the 2.0-m elevation contour. Survey in this roughly 6400 m^2 area was designed to provide 100% coverage at a resolution sufficient to capture any cluster of features at least 4 m in minimum dimension. This level of resolution was chosen to not only reflect the minimum size of the feature cluster observed in TUs 2-4, but also to reflect the minimum size of the domestic spaces (i.e., a habitation structures) of foragers in general.

The area earmarked for survey was bounded on the north by the boardwalk; on the east by woods; on the south by the parking lot; and to the east by the sand mantle (Figure 3-20). Again, the house precluded survey of a small portion of this area. A few large trees also posed obstacles on some transects, although only the large oak tree off the southwest corner of the house prevented definition of detected anomalies.

The survey area was divided into four quadrants (NW, SW, SE, NE) whose nexus was located 13 m south of Datum B, on the west elevation of the house. All transects except those behind the house (to the east) were set at 4-m interval; additional transects to resolve anomalies resulted in 2-m interval coverage behind the house.

Survey began in the northwest quadrant. After calibrating the equipment with buried targets, the unit was dragged southward along transects emanating from the boardwalk and terminating near the N203 line. The only anomalies mimicking the signature of TU2 stratigraphy were detected on the E160 transect. A bucket auger sunk at ca. N211 E160 revealed homogeneous shell midden from surface to 60 cm BS, underlain by concreted midden, which was impenetrable. A second auger placed 3 m to the north (N214 E160) revealed organically enriched sand to ca. 100 cm BS, underlain by clean, saturated sand to at least 119 cm BS, where augering was terminated. Consistent with the results of coring in 2000, these additional subsurface tests suggest that this portion of the site may have witnessed substantial subsurface disturbance in recent years.

Transects in the southwest quadrant emanated from the N203 line, essentially extending south, to the N160 line, the transects pulled in the northwest quadrant. The paved parking lot and its concrete parking abutments precluded further survey to the south. GPR anomalies at five locations along these transects warranted subsurface testing. The first, located at ca. N185 E172, revealed a 20-cm thick dark loamy sand over at least 72 cm of clayey matrix with sparse, fragmented bivalve shell. A second auger at ca. N180 E 176 lacked midden and consisted of silty to clayey sand to at least 100 cm BS. The other three augers were located on the E184 line. The two southernmost (ca. N176 E176 and N169 E176) consisted of clayey sand over clay, with only a 20-cm surface stratum of shell midden at N176 E176. The third auger on this

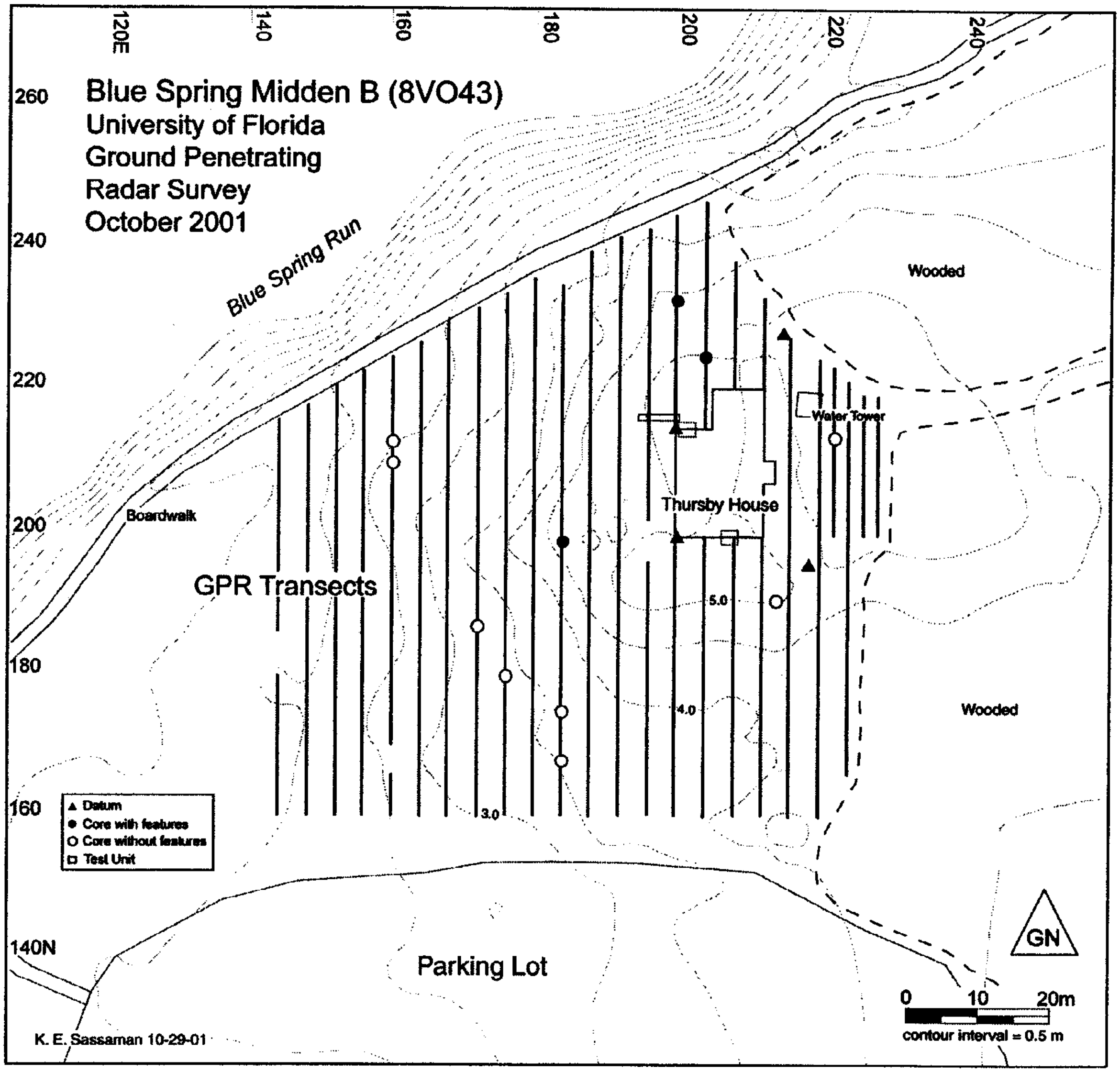

Figure 3-20. Location of GPR transect and anamolies tested with bucket auger.

transect, located off the southwest corner of the house at ca. N201 E176, revealed 125 cm of shell midden over sand, the upper half of which was consistent with TU2 stratigraphy. Tree roots from the large oak at the southwest corner of house made rendering difficult additional GPR in this area.

Transects in the southeast quadrant emanated from the south elevation of the house (N200 line), and extended southward to the N160 line, just north of the parking lot. Only one auger was sunk in this quadrant, located between anomalous readings on adjacent transects (E212 and E216) at ca. N190. The profile consisted of relatively homogeneous midden to 180 cm BS overlying sand. An Orange plain sherd was recovered at 20-30 cm BS. This profile and the depth of the pottery was consistent with that observed in TU1, the excessive depth of midden notwithstanding.

The northeast quadrant was the most complicated because of its unusual configuration and the presence of numerous obstacles. It proved, however, to provide the best evidence for deposits similar to those observed in TU2. Most of the transects in this quadrant emanated from the woods line to the northeast of the house; the final two (E200 and E204) began at the boardwalk to complete the circuit. Two additional transects (E222 and E226) were placed between the regular transects at the back yard of the house (where the water tower sits) to refine unusually inconsistent GPR readings. An auger placed at ca. N213 E222 revealed a profile with 50-60 cm cap of construction fill overlying 15-20 cm of sparse shell midden over sterile sand to at least 115 cm BS. Augers sunk in this area in 2000 likewise revealed the presence of fill and other deposits related to house construction and maintenance.

The final two transects of the northeast quadrant proved the most interesting. Auger tests of anomalies at N234 E200 and N224 E204 each exposed alternating lenses of whole snail shell, crushed shell, and charcoal-rich matrix in the upper 70 cm, over homogeneous shell midden to ca. 150 cm BS. Both profiles mimicked closely the sequence observed in TU2 and provided our best probable indicators of additional domestic areas.

To summarize, only three locations along some 1470 m of GPR transect readings produced anomalies whose testing with a bucket auger confirmed the presence of stratigraphy consistent with TU2. These are hypothesized to be the locations of domestic dwellings and/or areas of intensive, repeated food processing activities. Marked by solid circles in Figure 3-x, these locations were earmarked for additional GPR survey and groundtruthing to delineate their boundaries. Additional GPR survey was likewise used to better define the horizontal extent of deposits observed in TU2.

Defining Horizontal Extent of Domestic Spaces

Methods used to delineate the boundaries of presumed domestic spaces were not much different than cruciform shovel testing to define site boundaries. GPR transects oriented to (grid) cardinal directions were centered over locations of augers revealing complex stratigraphy. Additional transects on a cruciform pattern turned 45 degrees from cardinal lines helped to refine the boundaries of complex stratigraphy. As seen in Figure 3-21, the effect was a radial pattern of transects centered on the original auger holes.

Boundaries between complex and simple strata were projected from continuously read GPR signals. For this purpose the GPR units was pulled several times over transects, in both directions, to obtain the best possible results. Boundaries for the northernmost location (centered on N234 E200) were relatively conspicuous. Three auger tests along the southwesterly transect were sunk to groundtruth the projected boundaries. The first two auger tests (ca. N231 E198 and ca. N230 E197) exposed complex stratigraphy in the upper 40-60 cm underlain by homogenous midden. The third

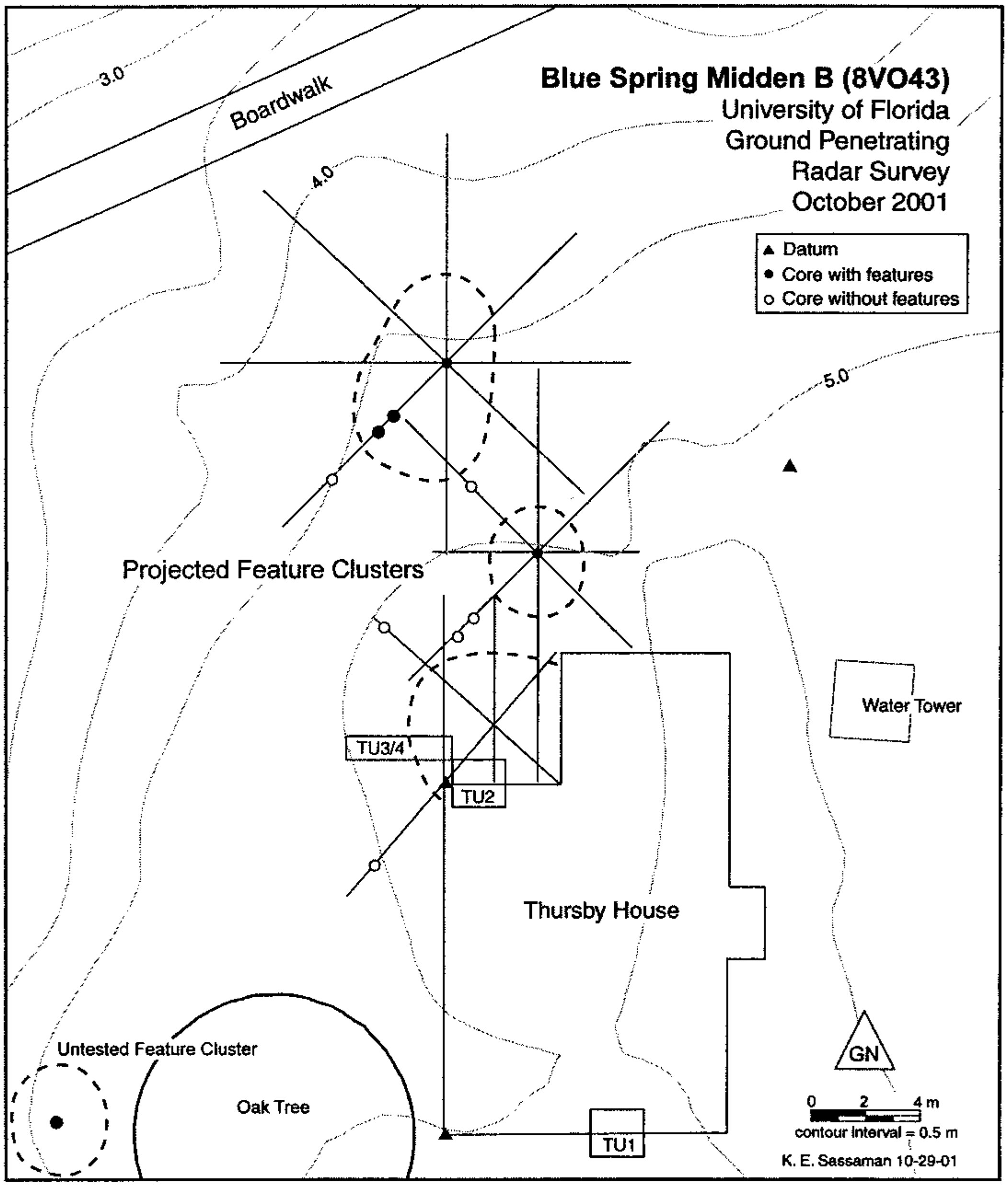

Figure 3-21. Locations of GPR transects to define feature clusters.

test (ca. N228 E195) revealed only homogeneous midden. The projected extent of this presumed domestic space is roughly 5 x 7.5 m in plan.

The second location for refined GPR survey (ca. N224 E204) proved problematical and required many repeated passes of the GPR unit. In the end, a small area some 3.5 x 4 m in plan was delimited by readings and groundtruthed with three auger tests. Similar difficulty was experienced with transects centered on TU2 and the adjoining trench, but in the end a domestic area comparable in size to the northernmost area was defined. Auger tests consisting exclusively of homogeneous midden were observed to the northwest and southwest of this third area.

To summarize, the refined GPR survey enabled the recognition of three probable locations of domestic space. Given the evidence for architectural and pit features in TUs 2-4, we infer that these were the locations of habitation structures. A fourth location of complex stratigraphy off the southwest corner of the Thursby House could not be investigated geophysically because so many roots from the nearby oak tree interfered with the signal. Accepting that this fourth area was indeed the location of a domestic dwelling, the overall pattern of presumed structures assumes an arc with a projected diameter of 34 m. Space for an additional two structures could easily fit along this arc in the area now occupied by the oak tree and the west-facing house porch. This would bring the minimum number of structures to six, with an interstructure spacing of about 8 m on center.

It is noteworthy that the projected arc of domestic structures at 8VO43 mimics the semicircular to circular patterns known for shell rings and related sites of the Atlantic and Gulf coasts. In this regard, we note as well that the surface topography at 8VO43 has subtle contours that conform nicely to the projected arc of structures. Whereas some of this apparent patterning may be a product of recent land-altering activities, we might add that the distribution of food processing features and refuse disposal at shell rings on the South Carolina coast (Trinkley 1980, 1985) provides a fairly good model for the (admittedly limited) patterns of feature placement and refuse accumulation at 8VO43. Specifically, the disposal of refuse to the outer edge of shell rings mirrors the distribution of homogeneous midden at 8VO43, deposits we believe to have accumulated through secondary refuse disposal. What is more, shell rings of the Atlantic coast routinely have interiors free of features and accumulated refuse. The area situated in the center of the projected arc at 8VO43, while possibly the subject of recent land-altering activity, generally lacks appreciable midden. The sorts of pit features uncovered in the trench are likewise consistent with food processing features observed by Trinkley (1980, 1985) on the inside edge of shell rings.

Late in 2002 we received notice from Richard Harris that the front porch of the Thursby House had been removed temporally as part of the restoration project. That October we took advantage of this opportunity to run a GPR transect lengthwise across the front of the house, as well as run additional, close-interval transects in the area of the northernmost feature cluster for purposes of three-dimensional modeling (i.e., z-slicing). Unfortunately, the generally dry condition of the soil prevented us from duplicating the GPR signals we obtained when the soil was moister. Thus, this effort proved fruitless. Additional GPR survey under more favorable conditions is clearly warranted to refine the projections of extant feature clusters and possibly detect additional clusters in front of the house.

Taken together, the GPR survey and limited groundtruthing have enabled us to infer the presence of a semicircular village at 8VO43. Stratigraphic data suggest that this projected village belongs to the upper Orange component, dating between 3650 and 3370 rcybp. The underlying Orange occupation may or may not conform to this projected pattern, but certainly the more widespread preceramic component(s) at the site does not. This village configuration adds to a growing body of evidence for circular village-plaza complexes among early ceramic-making cultures of the Southeast (e.g., Blessing and Sassaman 2001).

GPR Survey of the Sand Mantle

Test Unit 1 in the Wastewater Treatment Area exposed a profile consisting of 80 cm of banded sands overlying a buried A horizon and shell midden. This test provided the first indication that 8VO43 extended all the way to the river. In the absence of prior subsurface testing, the sand mantle obscured surface evidence of midden in this area, resulting in boundaries for 8VO43 that included only the surface exposed midden at the topographic high of the landform, namely, under and around the Thursby House. Bucket auger testing in 2000 enabled us to determine that the buried midden extended well north of the Watsewater Treatment Area, but we were unable to establish its connection to the surface-exposed midden before the season ended.

The GPR unit was deployed in 2001 to characterize the extent of the sand mantle geophysically and help us to determine a good location for additional subsurface testing. This particular application of GPR was opportunistic. The unit was simply dragged along a series of transects traversing the lawn between the surface-exposed midden beneath the house and the walkway connecting the parking with the boardwalk along Blue Spring Run. This effort clearly showed the contact between sand and underlying midden, as well as the substrate below the midden. Auger tests were used to occasionally to groundtruth the GPR readings.

Combining the GPR results with auger testing from 2000, we can safety conclude that the sand mantle observed in the Wasterwater Treatment Area extends over virtually all of the area mapped in Figure 3-1 below the 2.0-m contour. Although the mantle tends to be thickest downslope, and thins upslope, it is generally in the 80-100-cm range across most of its expanse.

CONCLUSION

Although a large shell mound at Blue Spring Midden B was apparently destroyed in the early 20th century as the site was utilized increasingly for travel and recreation, shell midden deposits remain intact beneath and around the Thursby House and under as much as one meter of recent alluvial sands across the lower elevations of the landform. Testing on either side of the house in 2000 revealed markedly different stratigraphic profiles in shell-bearing midden over one meter in depth. Verified with additional excavations in 2001, GPR survey was deployed to detect the stratigraphic contact between differentiated and homogeneous midden and to project the locations of similar facies across the upper portion of the site.

The results allow us to suggest that a circular arrangement of domestic structures existed at the site during the Orange period. Support for this projection in the form of architectural features is wanting, although the weight of circumstantial evidence is appreciable. Among the strongest evidence is the array of stacked basins and related strata observed in TU2. Among these features and strata are lenses of highly fragmented shell. The level of fragmentation at ca. 40 and 65 cm BS is especially marked. Comparing the proportions of shell fragments less than 1/4-inch in maximum dimension, these two levels in TU2 eclipse all others by at least 20 percent (Figure 3-22). In stark contrast is the profile from nearby TU4. With the exception of its surface stratum, this column exhibits consistently low values for fragmentation. This pattern from TU4 is believed to be indicative of largely secondary refuse in locations outside of habitual use areas, in this case, immediately adjacent to a presumed structure.

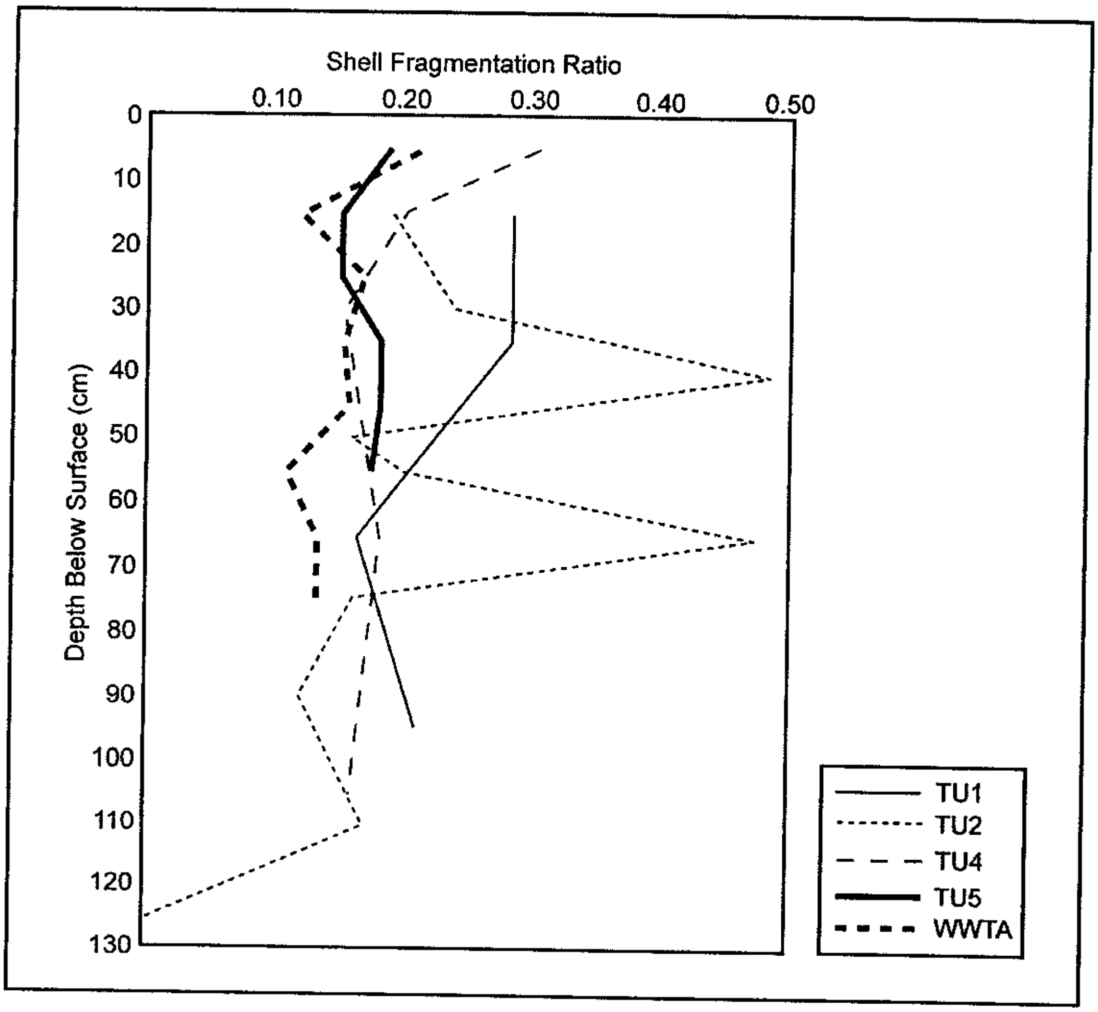

Figure 3-22. Relative percent of shell <1/4-inch by stratigraphic layer of subsistence columns, 8VO43.

The mantle of alluvial sand that covers the lower two-thirds of 8VO43 has effectively sealed off from recent disturbance an extensive preceramic shell-bearing deposit. Testing in the location of the now-defunct Wastewater Treatment Facility showed that the lower half of this buried midden is below the water table as observed in 2000, a dry year. Testing at TU5 upslope penetrated the entire midden before striking water. This effort revealed the presence of a shell-free midden at the base of the deposit. Dating to about 4200-4300 rcybp, this initial use of the site occurred just prior to the onset of pottery manufacture. The incidence of marine shell in this component suggest that preceramic groups may have routinely traveled to coast, perhaps as part of an annual round. However, by the time Orange period residents were constructing and using circular villages, settlement may have been perennial. Of course, the best data to verify this will not come from architectural evidence, but from subsistence data. Such data are reported in Chapter 7 of this report, although we cannot lay claim to any definitive information about site seasonality. Additional information on 8VO43 appears in the artifact analyses reported in Chapter 6.

CHAPTER 4
LIVE OAK MOUND (8VO41)

A large shell mound approximately one kilometer north of Blue Spring is recorded in the Florida Master Site Files as the "Mound/Midden in Woods above Blue Spring," 8VO41. According to the digital record of site locations, this mound is situated within a larger midden site recorded as "Palmetto Shell Midden (8VO40). It is not clear whether these two locations are indeed separate sites that have been erroneously mapped, or if they are nested in the same location, with 8VO41 fully encompassed by the recorded boundaries of 8VO40. Also confusing is the relation of this location to the "Palmetto Shell Mound" described by Wyman (1875:25). As we reason below, this latter location should lie nearly one kilometer north of 8VO41, and may truly be the location of what is currently recorded in the site files as 8VO40. For the purpose of this report, the shell mound we tested in 2001, 8VO41, is renamed "Live Oak Mound," in commemoration of a massive live oak tree observed by Wyman in 1873. Our work at this site was limited to (1) topographic mapping of the mound, including the scores of looters' pits that pock its surface, and (2) stratigraphic profiling in two locations of looting. Although subject to intensive vandalism in the 1970s, Live Oak Mound currently is in reasonably good shape and under the protection of Florida State Parks. Our limited work demonstrates that the site holds considerable potential for additional archaeological investigation.

PREVIOUS INVESTIGATIONS

In his 1873 visit to Blue Spring, Wyman (1875:25) noted two other "considerable" mounds north of the spring. His description of a large mound along the swamp edge to the north matches closely the present-day dimensions and configuration of 8VO41:

> There are two other considerable mounds in the neighborhood of Blue Spring. The larger of these is reached by following the edge of the swamp, which meets the river a quarter of a mile below, in a northerly direction and towards Lake Beresford. Its length is estimated at four hundred feet (122 m), and its breadth measures from one hundred to one hundred and fifty feet (30-46 m). The easterly end is the highest, and rises thirteen to fourteen feet (ca. 4 m) quite abruptly; the southwesterly portion slopes gradually to the general level. It is completely overgrown with forest trees, and is separated from the river by a narrow belt of cypress and a marsh several hundred feet in width. There are many large trees growing upon the mound, but the oldest and the one which gives the most decisive indication of age is a prostrate live oak lying on the crest, from which the bark, outer layers of wood and all the branches except the largest have wholly disappeared. The trunk, eight feet from the roots, measures fifteen feet and four inches in circumference, and is estimated to have been over three hundred years old at the time of its fall. This mound consists almost exclusively of Paludinas, and has on its surface many of the so-called graves. Excavations made in many places, and much searching of materials drawn up by the roots of overturned trees, have resulted in the discovery of pieces of earthen vessels, the bones of edible animals, etc., but only in small numbers. Some of these were obtained from an excavation three feet deep made upon the spot where stood the ancient tree just described (*parenthetical notes added*).

That this mound is the one recorded as 8VO41 is all but certain, although Wyman (1875:25) goes on the describe a second, smaller mound in the general area, one he dubbed "Palmetto Shell Mound":

> Following the borders of the marsh and hammock for a half mile in a northerly direction from the mound just described, a circular grove of palmettoes (sic) is reached, separated from the woods by an open space about one hundred and twenty feet wide. This grove covers a low oval mound of shells, which measures a hundred feet in its long and eighty in its short diameter, and is two feet nine inches high. As is obvious (in 1873) from the marks on the trees, it was covered to the depth of nearly three feet during the high water in 1871.

Wyman (1875:25-26) described briefly his excavations in this second mound, noting that the base consisted of cemented shell. He encountered small amounts of pottery, and deer and turtle bones, a *Busycon* "drinking vessel," and a fragmentary human interment.

Discrepancies between Wyman's description of the locations of these two mounds and the mapped locations of 8VO41 and 8VO40 can be traced to a series of recording efforts beginning with John Goggin and the Florida Archaeological Survey in the 1950s. An undated record attributed to Goggin lists 8VO41 as the "Midden in woods near Blue Springs." A handwritten note on the record reads: "Insuff info in FDAHRM files; not plotted on USGS topo (general area on USGS Orange City, 1/4 mi N of Blue Spring as per Wyman)." However, one copy of this quad map shows 8VO41 listed in its "G.V." (general vicinity) at a location one-quarter mile north of Blue Spring. Clearly this location was an estimation based on Wyman's description, as indicated in the handwritten note. Unfortunately, Wyman was not describing the location of the mound, but where the swamp meets the edge of the river "below". Given this erroneous location for 8VO41, it follows that an estimate for the location of Wyman's Palmetto Shell Mound—one-half mile north of the larger mound—is also incorrect. As it turns out, the estimated placement of Palmetto Shell Mound (8VO40) is the actual location of 8VO41. The result has been a conflation of these two locations into one, with 8VO41 (the large mound) situated within the boundaries of 8VO40.

In March of 1983, Florida Department of Transportation issued a request for archaeological assessment of an area just to the north of the (then) northern boundary of Blue Spring State Park for the construction of a discharge pipe. A survey crew working the route for the discharge line observed a mound that is described in a March 30, 1983 memo from Noel Wamer as a 10-foot-high midden with numerous pot holes and a dense thicket of 5-10-year-old cherry laurel. An attached copy of the USGS Orange City quad map showing the proposed location of the discharge outlet (labled "location of rip-rap energy dissipator," which, as is explained in the memo, is located 70 feet south of the "midden area"), clearly places the mound they observed at the present location of 8VO41. This same map shows the "G.V. of 8VO40" in the same location as 8VO41, thereby resulting in the conflation of these two locations noted above.

Archaeologist William Browning conducted a reconnaissance survey of 8VO41 for FDOT on April 12, 1983. He apparently dug a few shovel tests and made a surface collection of some pottery and animal bone. He seems to have verified that this location was indeed the large mound described by Wyman, but did not address the location of 8VO40, Wyman's Palmetto Shell Mound.

Site 8VO41 was visited again in January 1991 by archaeologists with the state's C.A.R.L. program. No subsurface tests were made at this time, although inspection of the surface revealed a single plain St. Johns sherd at the southern end of the mound. Given the description of the site provided by C.A.R.L. archaeologists Chris Newman and Brent Weisman, the location is clearly the same visited by Browning in 1983. An additional copy of the USGS Orange City quad map shows 8VO41 alone in this location; no mention was made of 8VO40 and its ambiguous location.

Given current information, 8VO41, known heretofore as the "Mound/Midden in Woods above Blue Spring," is not contained within the boundaries of 8VO40, Wyman's Palmetto Shell Mound, but rather is a discrete location some 1.25 km north of the mouth of Blue Spring. The precise location of 8VO40 has not been verified by modern observers. Brief reconnaissance during our summer 2001 investigations failed to reveal any traces of this site in the stretch of swamp edge north of 8VO41. Given the low relief of Palmetto Shell Mound and its susceptibility to flooding, as noted by Wyman, it stands to reason that 8VO40 may be obscured by recent sediments. Subsurface testing is required to locate and delimit this site.

Finally, the decision to rename 8VO41 Live Oak Mound is clearly warranted given the confusion surrounding its relationship to Palmetto Shell Mound. The existing moniker (Mound/Midden in Woods above Blue Spring) is both cumbersome and misleading. Because Wyman was struck by the size of the live oak atop 8VO41, Live Oak Mound seems like an appropriate substitute. A check of the site files for counties in northeast Florida shows no existing mound site with that name.

MAPPING LIVE OAK MOUND

A primary goal of fieldwork at 8VO41 in the summer of 2001 was to generate an accurate topographic map of the mound and its immediate surroundings. A large part of this effort involved mapping the location of all open looters' pits across the site. As others have observed repeatedly since the early 1980s, Live Oak Mound is riddled with pot holes. Given the age of beer cans and other refuse scattered about the surface, most of the illicit digging took place in the 1970s. One visitor to Blue Spring in 2001 recounted that a local individual exhumed and kept many human burials from Live Oak Mound. A high frequency of burials is consistent with Wyman's description, although it seems odd that in all of our mapping work at looters' pits, not a trace of human bone was observed. Still, we have little reason to doubt the account of that park visitor. The scope of the digging alone is testament to substantial rewards for the looters, and, as Wyman noted and our work verified, there is relatively little material culture at the site, so skeletons themselves must have been the target.

To facilitate mapping, a grid was initiated with a short east-west base line at the south end of the mound. Datum A was arbitrarily established at N1000.00 E1000.00 m with a 3-ft-long section of 1/2-inch galvanized conduit. Surface elevation at this datum was set at an arbitrary 10.00 m. A second permanent datum (Datum B) was set 32.00 meters to the east at N1000.00 E 1032.00. A longer baseline would have been desirable, but dense stands of cherry laurel, cabbage palm, and soapberry prevented long lines of sight, and we tried to avoid excessive clearing. Instead, the strategy was to establish temporary data wherever necessary to collect topographic readings. A third permanent datum (Datum H; N1063.61 E1013.79), again set with galvanized conduit, was established at the north end of the mound to enable future work using our grid. All mapping was conducted with a Nikon Total Station DTM-310. The locations of permanent datums were recorded with a Trimble Pathfinder GPS unit.

Mapping proceeded from Datum B northwesterly along the ridge of the mound, and then northeasterly toward the summit, with transects of readings taken at roughly 10-m intervals on either side of this line. In addition, every visible looters' pit was marked with a pin flag and numbered, then recorded for location and elevation at its center and around its upper perimeter (i.e., rim). One-hundred-thirty-five such pits were mapped in this fashion.

The resultant topographic map (Figure 4-1) reveals an interesting configuration, with a 5-m high conical-like mound at the north end and a trailing, ramp-like feature extending south and southeast of the main mound. The overall plan resembles a reverse apostrophe or comma, seen best in the three-dimensional projection in Figure 4-2. The degree to which this configuration has been affected by recent human and natural agents is not altogether clear. Obviously, looters' pits resulted in a pocked surface, with many pits strung together to create trench-like features across the mound summit and slopes. Otherwise, the mound appears to be largely intact, with the possible exception of the eastern flank, which is punctuated by a gully-like feature just to the south of the conical mound. Given the relatively low elevation of the adjacent terrain, it is possible that this feature formed through erosion, perhaps flood related. On the other hand, the position of this feature does not seem to sharply truncate the overall contour of the conical component, suggesting it's location and configuration are by design. In addition to the ramp-like feature extending to the south, a possible causeway linking the conical mound and higher terrain to the east can be seen in a low, linear feature to the northeast.

Data on surface elevation were collected relative to Datum A (10.00 m), then converted to values approximating actual elevation above mean sea level. The basal contour in Figure 4-1 is 1.5 m, coincident with the upper limits of the flat, swampy terrain between 8VO41 and the St. Johns River, and approximating the 5-ft contour line on the Orange City topo map. The mound summit lies at an elevation of 7.0 m, and its base somewhere between 2 and 3 m. Thus the mound is currently some 4-5 m in maximum height. This matches closely the estimate of 13-14 ft high provided by Wyman (1875:25). The southern, ramp-like feature of the mound is roughly 5 m in maximum elevation, or some 2-3 meters in relative height. Slope contours across the

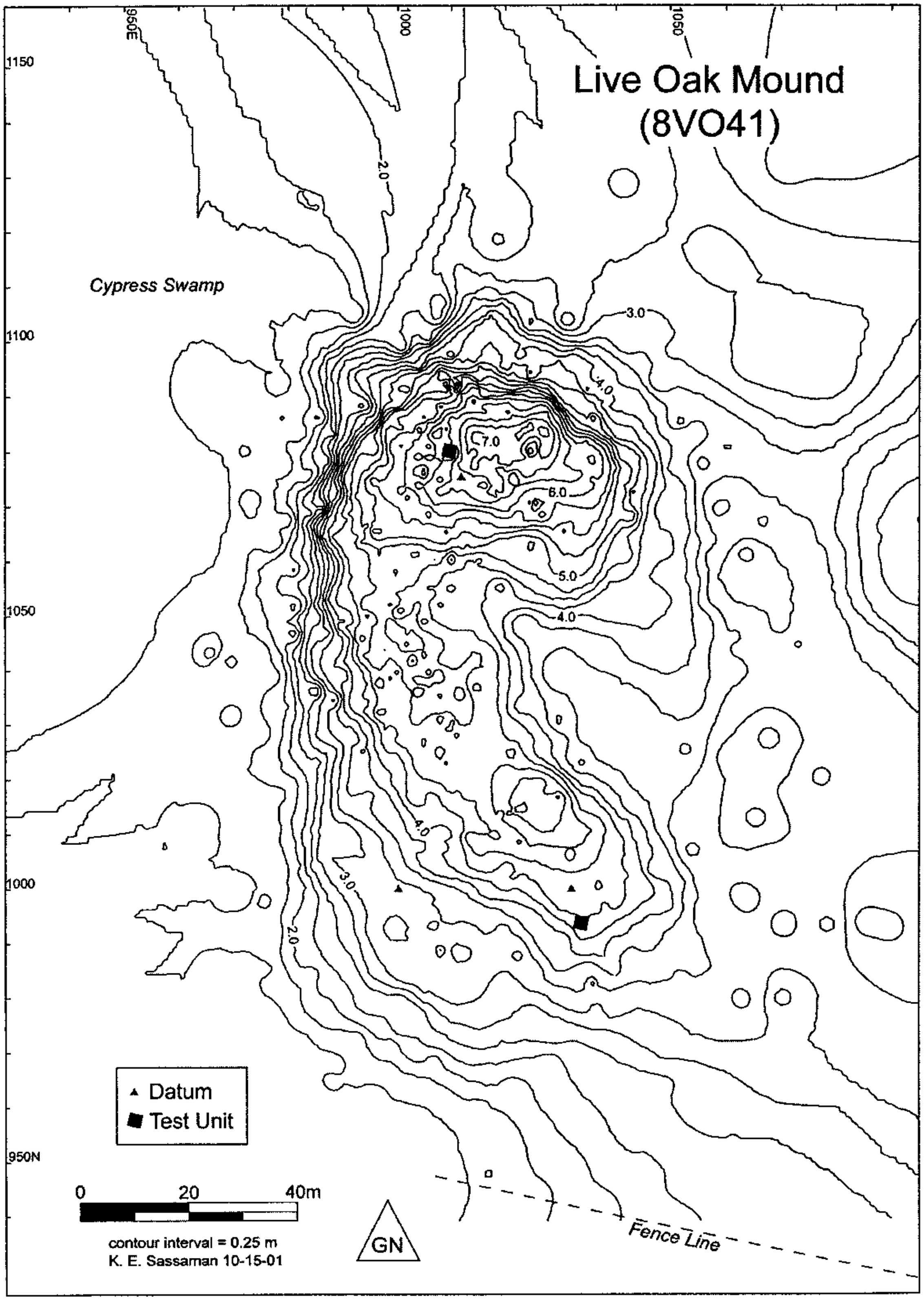

Figure 4-1. Topographic map of Live Oak Mound (8VO41).

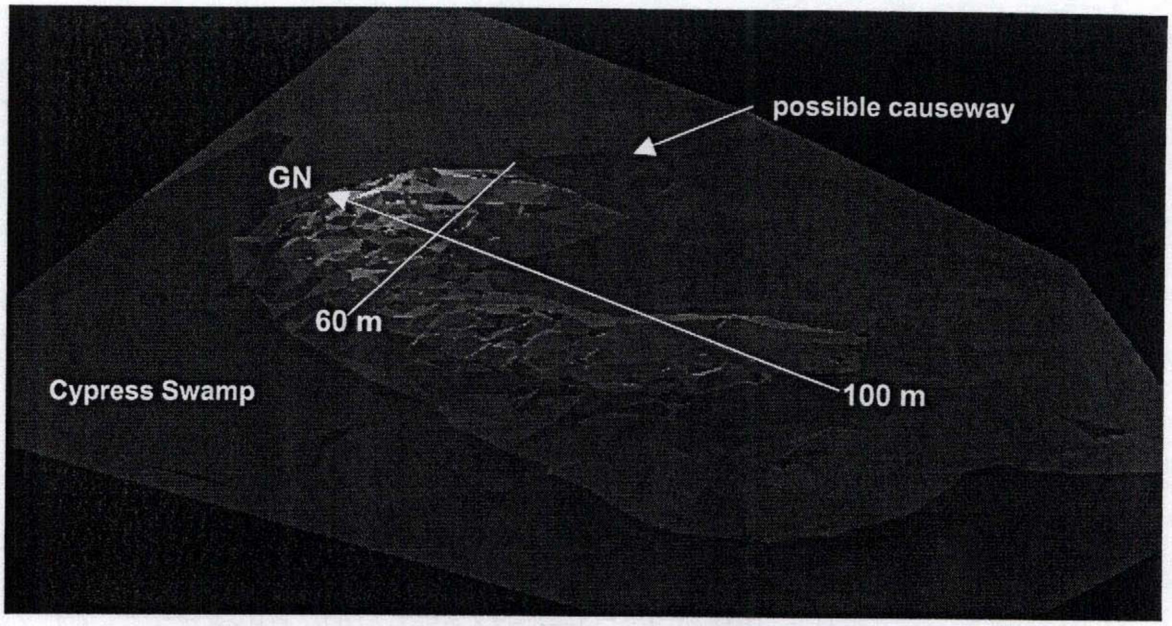

Figure 4-2. Three-dimensional projection of Live Oak Mound (8VO41), facing northeast. Note pocked surface of mound from over 135 looters' pits.

entire mound vary from steep to gentle, with the sharpest gradients along the northwest, north, and northeast margins of the mound. Consistent with Wyman's (1875:25) description, the southwestern portion of the mound slopes gradually to the marsh surface.

The locations of all looters pits mapped in 2001 are depicted in Figure 4-3. Typically, each pit was mapped for basal location and depth, and for a series of points around the upper perimeter ("rim") of the hole. Locations marked by black dots in Figure 4-3 correspond to basal readings and are not intended to accurately represent the size and shape of pits. Two locations of subsurface testing (Looter Pits 1 and 71) are also shown in this figure.

SUBSURFACE TESTING AT LOOTERS' PITS

Subsurface investigations at Live Oak Mound in the summer of 2001 were limited to two locations of looter activity. The strategy was to take advantage of large exposures made by looters by positioning test units to maximum strategic profiles at the edges of pits, in other words, to "face" looter pits. Because looters do not generally dig neat, square holes, this goal was not easy to achieve. In both locations tested, the initial position of our test units relative to the extant edges of looters' pits failed to expose fully intact profiles. Our difficulties centered largely on the consequence of looters digging horizontal shafts into the walls of these pits, resulting in alternating lenses of intact and backfilled midden. Still, our efforts substantiated that Live Oak Mound is indeed entirely anthropogenic (i.e. mounded midden), that it contains components dating from the

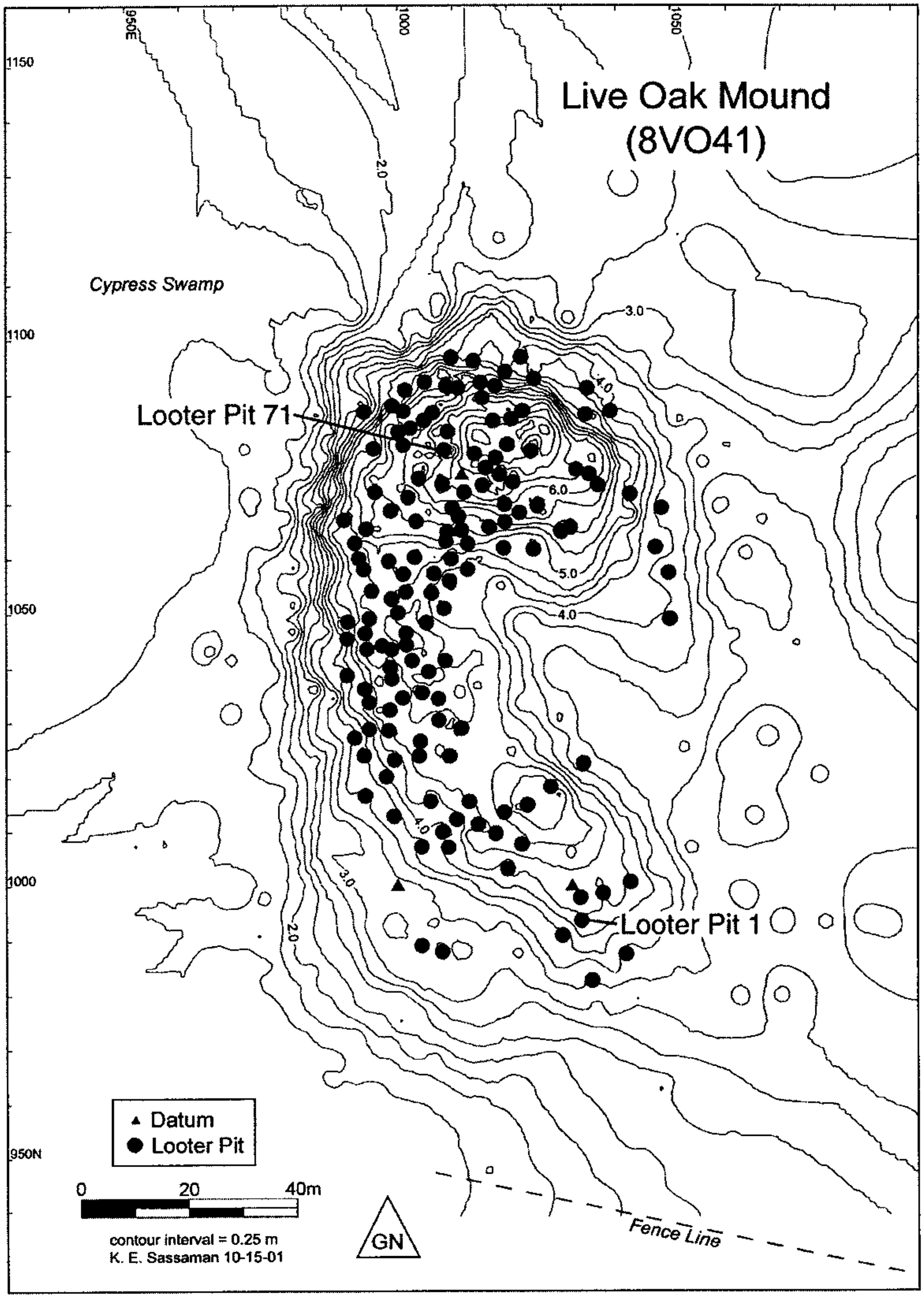

Figure 4-3. Locations of 135 looters' pits on the surface of Live Oak Mound (8VO41), including locations of two pits that were tested for stratigraphic profiles (Looters' Pits 1 and 71).

Middle Archaic to St. Johns II periods (ca. 6300 to 1000 rcybp), and that despite extensive looting, large portions of the mound contain well stratified midden deposits.

The two locations tested in 2001 were Looter Pit 1, at the south end of the mound, and Looter Pit 71, at the north end of the mound, near the summit. The sections that follow describe the methods and results of testing at each of these locations.

Looter Pit 1

One of several looters' pits at the south end of the mound was chosen for stratigraphic testing because it was rather deep (ca. 1.5 m) and provided a good "profile" on the west face. Two pins were set 2.0 m apart along this west face and two others triangulated to establish a 2 x 2-m unit (LP1). The southwest corner of the unit was designated datum for purposes of vertical control with line level and string. Crew members began by stripping the extant west face of soil and roots. All fill from this operation was passed through ¼-inch dry screen. Exposed at the surface was a stratum of whole *Viviparus*, some 20-30 cm thick overlying 20-40 cm of sand generally devoid of shell. We assumed this sand accumulated from the screening operations of looters. Below the sand, and extending well into the apparent base of the looter's pit was a second stratum of *Viviparus* shell midden. The west profile of LP1 provided in Figure 4-4 shows all three of these strata and the outlines of backfilled pits.

Stratigraphic excavation in 10-cm arbitrary levels within "natural" strata commenced at the top of the shell midden beneath the stratum of backfilled sand. Matrix from such levels was passed through 1/8-inch dry screen, and all artifacts and vertebrate faunal remains captured by the screen were bagged. After removing one level, however, it appeared that looter backfill still comprised much of the matrix. Occasional items of modern material culture were recovered along with trace amounts of St. Johns plain and check stamped sherds, and Orange plain and incised sherds.

Our suspicion of continuing looter backfill was confirmed in the excavation of Level B. Recovered from this level were shotgun shells and a Wrangler-brand jean patch. We therefore removed Level C quickly by returning to the use of a ¼-inch screen and collecting only diagnostic items. At the base of Level C we sunk a 30-cm diameter shovel test in the west-central portion of the unit. This test showed that shell midden continued another 80 cm below the base of Level C (roughly 160 cm below datum [BD]), where concreted midden prevented further excavation. No modern refuse was observed in this small test and the matrix appeared compacted and undisturbed, so we decided to clean off the entire 2 x 2-m unit to this level and establish a 1 x 1-m subunit (designated LP1A) in the east half of the 2 x 2 (Figure 4-5).

Level A (59-77 cm BD) of LP1A revealed intact midden in all portions with the possible exception of southwest corner, which consisted of loose, unconsolidated midden (backfill?). A small amount of vertebrate faunal remains was recovered. Neither modern artifacts nor prehistoric sherds were observed. All matrix from LP1A was passed through 1/4-inch screen.

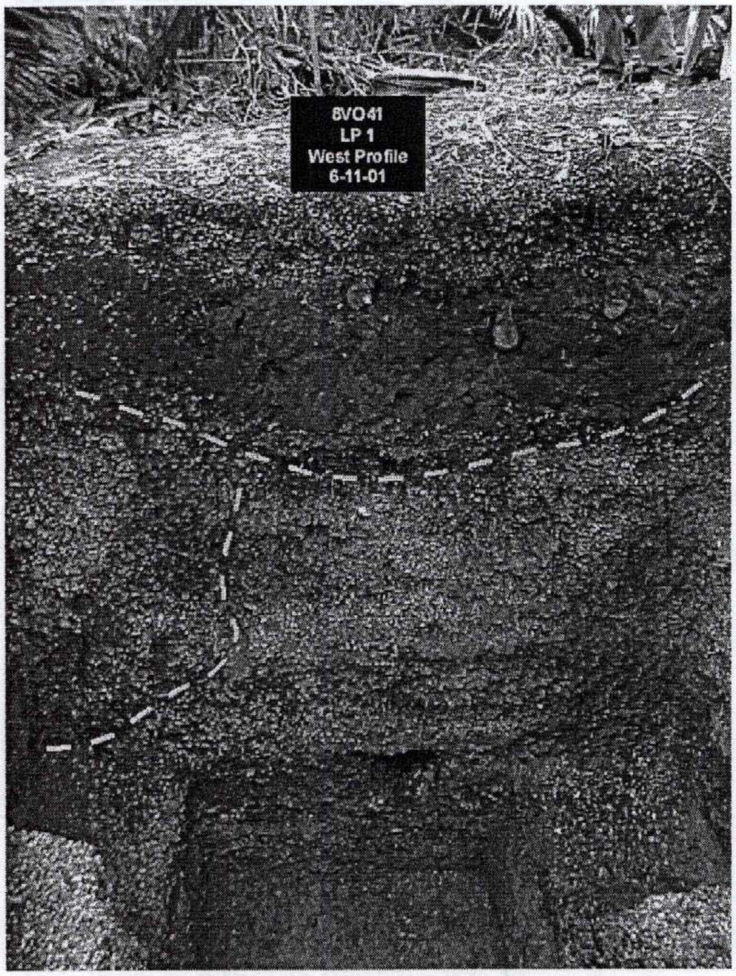

Figure 4-4. West profile of Looter Pit 1 test unit, showing two backfilled looters' pits in the upper third and southwest corner (margins of which are marked by dashed lines); intact stratigraphy in the lower northwest corner; and charcoal-rich concreted shell midden in the stepped unit over basal sand.

Fully intact midden was observed throughout Level B (77-88 cm BD) of LP1A. Along with the usual *Viviparus*, the level contained appreciable amounts of crushed apple snail shell (*Pomacea*). Concreted shell was exposed along the west wall of the unit. No diagnostic artifacts were recovered, but a fragmented bone pin was recovered from the northeast corner of the unit, in the location of crushed shell. A similar mix of concreted and unconsolidated shell midden was observed throughout Level C (88-100 cm BD). Only sparse bone and no pottery was observed. A bulk sample of soil was taken from the northeast corner of the unit in the location of crushed apple snail shell. The area of crushed shell was mapped in plan as a possible pit feature.

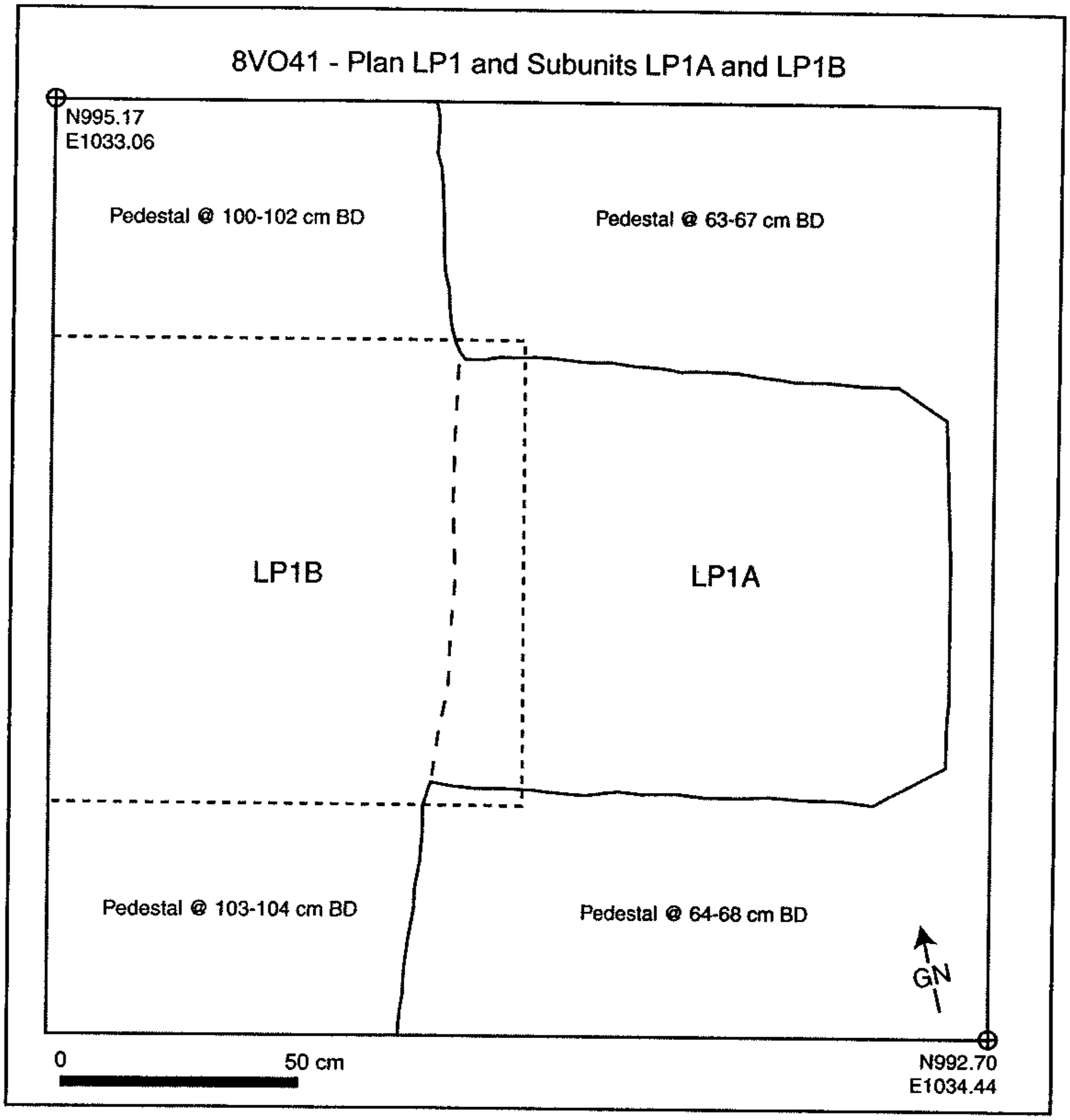

Figure 4-5. Plan schematic of LP1, showing locations of subunits LP1A and LP1B, and pedestals.

Suspecting that we had reached undisturbed midden below ca. 80-85 cm BD, the crew removed the west half of LP1 down to the base of Level C in LP1A to locate and map variations in midden consistency and composition that may potentially be indicative of pit features. All matrix from this operation was passed through 1/4-inch screens. Only a few vertebrate faunal remains were recovered. Concreted midden observed in LP1A proved to be discontinuous. Most of the western portion of LP1 at 100 cm BD consisted of unconsolidated midden.

To continue testing we established a second subunit (LP1B), positioned on the center of and flush with the west wall of LP1 (Figure 4-5). Because this unit was truncated by the bowing west wall of LP1 (necessitated by collapse of unconsolidated midden/looter backfill), its actual dimensions were 1.0 x 0.80 cm.

The floor of LP1B was mapped at 100 cm BD prior to excavation. Immediately into Level A an area of dense crushed shell, dominated by apple snail, was observed in the northwest corner. A bulk sample of this matrix was collected. This matrix expanded out from the corner as level excavation progressed. The concreted midden observed along the western margin of LP1A expanded as well. At base of level A the entire east half of LP1B consisted of concreted midden (and left at higher elevation than surrounding matrix because of its recalcitrant nature). Level B began by taking a pick-ax to concreted midden. Observed in the concreted matrix was a higher than usual density of bivalve shell, along with charcoal, most of which seems to be concentrated at the bottom of the concreted matrix. A chunk of concreted matrix with large charcoal was bagged for radiometric dating. No diagnostic artifacts were found in either the concreted midden or the area of crushed, loose shell.

Excavation in LP1 and its subunits from this point forward was extremely difficult. A the base of Level C in LP1B (ca. 125 cm BD), dark concreted midden in northeast portion of the unit contrasted sharply with lighter-colored and sandier concreted midden along the south and west walls. The latter was not only lighter, but much denser, owing perhaps to higher sand content and its potential for more rapid and more frequent drying. The contact between the two matrices assumes something of a right angle, and observed off the corner of this angle in the lighter, harder matrix was a dark stain ca. 12 cm in diameter, possibly a post hole. A second, similar stain along this seam of contact became increasing difficult to define with repeated scraping. Observed in the northwest corner of the unit was a different sort of feature, this one consisting of an apparent pit some 20-25 cm in diameter, which was intercepted by the west wall of LP1. Its loose fill was dominated by crushed bivalve and apple snail shell, as well as other gastropods.

Given the potential for architectural evidence, we closed LP1B at the base of Level C (125 cm BD) and reopened LP1A, which was temporally terminated at ca. 100 cm BD. A pick axe was used to break through concreted midden, which was generally lighter and clayier than the surrounding matrix and concentrated in the west half of the unit. At about 5 cm above the floor of LP1B, we scraped LP1A clean to observe a complex array of different matrices. Two areas of dark and generally unconsolidated matrix assumed generally circular configurations suggestive of relatively large pits (ca. 50 cm in diameter). Efforts to better define these possible features and their relationship to concreted midden were frustrating. Clearly the concreted midden observed in the two subunits was discontinuous and highly variable in consistency and content, but it was thoroughly unclear whether pit-life features were intrusive to matrix that had become concreted, or if the pit-life features were simply areas invulnerable to concretion.

Level excavation in LP1A and LP1B continued with repeated attempts to delineate features and zones of varying matrix. It became apparent after reaching submidden sands at ca. 160 cm BD that we were, in some cases, crosscutting strata that sloped gently to the south. In hindsight, these strata should have been excavated by natural levels, although this would have been extremely difficult in the absence of prior stratigraphic controls. In any event, testing at LP1 revealed intact, stratified deposits in the lower meter of a roughly 2-m thick sequence. We also learned that concreted midden in this lower portion of the sequence is neither continuous nor restricted to the basal stratum. Rather, in some places concreted midden overlies unconsolidated midden, which in turn overlies additional concreted midden. Consistent with the report of Wyman, the deposit throughout contained few artifacts and vertebrate faunal remains; the only diagnostic artifacts (St. Johns and Orange sherds and modern refuse from looters) were restricted to the upper half of the unit, little of which apparently was undisturbed. The entire stratigraphic profile of the west wall of LP1 is illustrated in Figure 4-6 and described in Table 4-1.

As seen in the west profile (Figure 4-6), the lower 80-100 cm of LP1 is nicely stratified and apparently undisturbed. No pottery was recovered from excavations of Stratum VI and below. The alternating layers of whole, crushed, and concreted shell are reminiscent of the stratigraphy of Test Units 2-4 at Blue Spring Midden B (8VO43), suggesting that LP1 cut into a stacked sequence of living surfaces. However, the limited amount of faunal remains and artifacts from LP1 runs counter to the situation at Blue Spring Midden B. Also, the LP1 sequence lacks the definitive features and thin strata of finely crushed and compacted shell observed at Blue Spring Midden B. Thus, despite the apparent similarity in the overall stratigraphic sequence of the two sites, there is little to recommend that LP1 stratigraphy actually consists of stacked house floors and associated midden accumulation.

Lacking sherds and other diagnostic artifacts, strata from the lower portion for LP1 could not be crossdated. However, sufficient charcoal was present throughout many of the intact strata to enable radiometric dating. At this preliminary stage of testing, only one sample was submitted for dating. Taken from a sample of concreted midden from Stratum XIII of the south profile of LP1A (Figure 4-7), charcoal flecks were submitted to Beta Analytic, Inc. for AMS dating and returned an assay of 6260 ± 50 rcybp. This date is consistent with the basal dates from the Groves' Orange Midden (8VO2601), a submerged shell-midden site with a 2000-year sequence of occupation by populations of Mount Taylor cultural affiliation (McGee and Wheeler 1994). The Grove's Orange Midden dates and this single date from Live Oak Mound are the oldest radiocarbon age estimates for shell middens/mounds along the middle St. Johns River, corresponding roughly with the diminished rate of sea level rise that is presumed to have improved the inhabitability of riverine and coastal zones alike (Miller 1998; Wheeler et al. 2000:143). Although older sites along the river may currently be inundated, shell deposits in the region are not believed to predate the late seventh millennium before present. The basal date from Live Oak Mound is indeed the oldest assay from a freshwater shell midden context in northeast Florida.

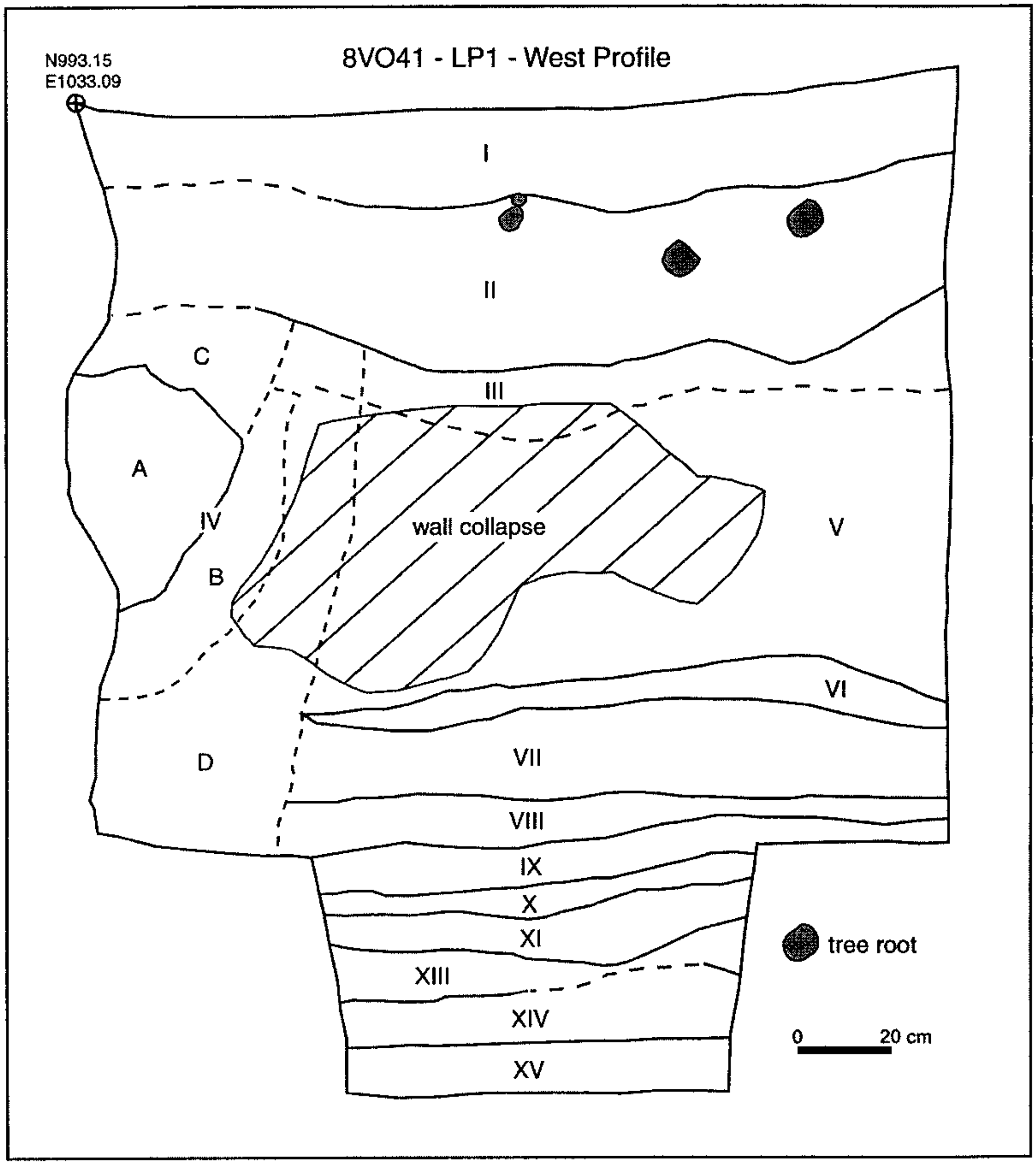

Figure 4-6. Stratigraphic drawing of west wall of Looter Pit 1, 8VO41.

Table 4-1. Stratigraphic Units of West Profile of Looter Pit 1, 8VO41.

Stratum	Max. Depth (cm BS)	Munsell Color	Description
I	26	10YR2/2	loamy, unconsolidated midden with abundant *Viviparus* and heavy root mat; looter backfill
II	62	7.5YR3/2	largely shell-free, fine sandy loam; likely sifted matrix from looter digging
III	77	10YR2/2	loamy, unconsolidated midden with abundant *Viviparus*; basal contact with Stratum V is probable buried surface of looter pit
IV	174+	10YR2/1-3/2	A: loose shell midden matrix lacking bedding (10YR2/2) B: apparent burned tree root (10YR2/1) C: fine sandy loam with abundant shell (10YR3/2) D: fine sandy loam with abundant shell and small roots throughout; apparent looter backfill(10YR3/2)
V	138	10YR3/2	mix of whole *Viviparus* shell and shell-midden matrix in fine sandy loam; no apparent bedding; occasional modern refuse in upper half of unit, along with a few Orange plain and incised sherds and chert flakes
VI	142	10YR2/1	abundant *Viviparus* in fine sandy matrix with abundant charcoal flecks and minor pockets of concreted midden
VII	158	10YR4/4	dense, whole shell (predominately *Viviparus*) in fine sandy matix
VIII	170	10YR2/1	abundant *Viviparus* in fine sandy matrix with abundant charcoal flecks and minor pockets of concreted midden
IX	179	10YR4/4	dense crushed and whole shell (including abundant *Pomacea*) with abundant charcoal flecks in fine sandy matrix
X	184	10YR2/1	whole *Viviparus* in fine sandy matrix with abundant charcoal flecks
XI	195	5YR3/3	finely crushed *Pomacea* with *Viviparus* in sandy matrix with fine manganese/iron oxide scattered throughout
XIII	204	10YR5/4	concreted *Viviparus* and bivalve midden in sandy matrix with abundant charcoal flecks; C14 assay of 6260 ± 50 rcybp
XIV	213	10YR3/2	basal shell stratum with moderate to sparse *Viviparus* in medium sandy matrix
XV	224	10YR5/1-5/6	submidden basal sands with organic leaching (10YR5/1) and pockets of oxidized clayey sand (10YR5/6)

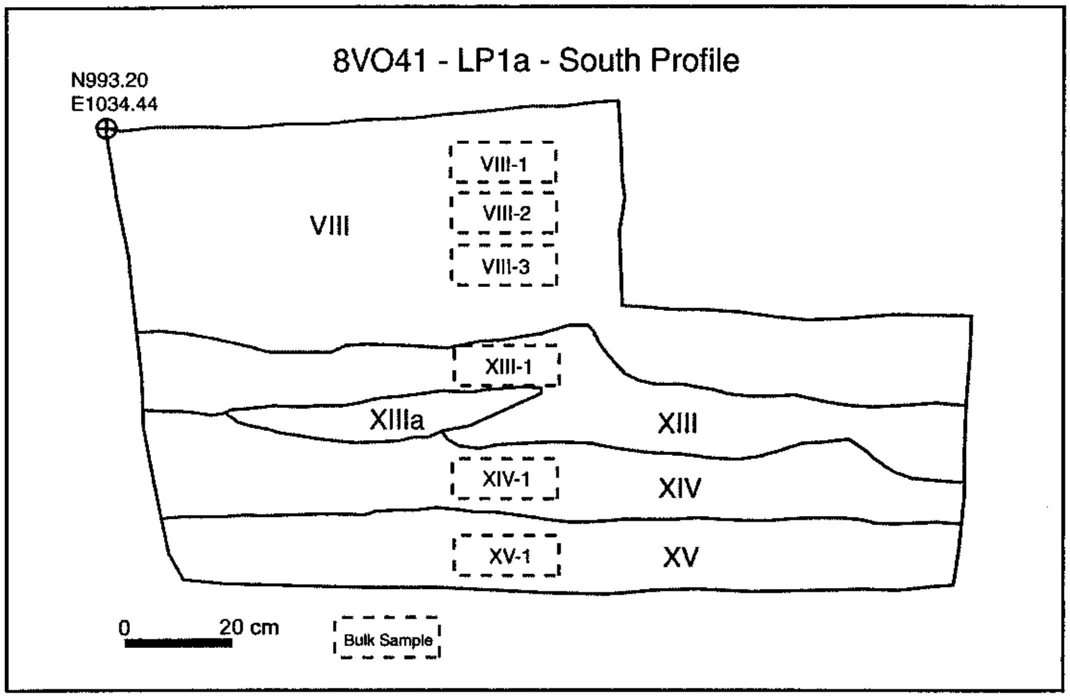

Figure 4-7. Stratigraphic drawing of south wall of Looter Pit 1A, 8VO41, showing locations of bulk samples.

A brief note of the exact context of the dated sample is warranted. As shown in Figure 4-7, bulk samples were taken from the south profile of LP1A, which consists of only the lower 90-cm of the profile exposed on the west wall of LP1. The lower three strata in the south wall profile (Strata XIII-XV) are contiguous with those depicted in Figure 4-5 and conform to the descriptions provided in Table 4-1. The dated charcoal was taken from sample XIII-1, a chunk of concreted midden. The stratigraphic unit labeled XIIIa in Figure 4-7 is coterminus with Stratum XIII but consists of nonconcreted midden with abundant charcoal and whole and crushed shell in a very dark gray (10YR3/1) fine sand matrix. The overlying stratum (Stratum VIII) is not consistent with the startigraphic designations and descriptions provided in Table 4-1. Rather, this thick stratum is a generalized layer of shell midden in a dark yellowish-brown (10YR3/4) fine sand matrix whose internal differentiation is not as clear as that observed in the west profile of LP1. Stratigraphically, it is equivalent to strata VII-XI in the west profile.

Looter Pit 71

The second looter pit investigated was Looter Pit 71, located near Datum H at the north end of the mound. Just west of the summit of the mound, Looter Pit 71 was among the largest openings observed. After establishing a 2-m long line along the western edge of the pit, loose fill was removed without screening to reveal a complex array of backfill and possible intact midden. Several St. Johns sherds and large pieces of deer bone were recovered as loose fill was removed. This backfilled soil also contained a large assemblage of beer cans, which, like those found virtually throughout the site, consisted of pull-tab examples of Old Milwaukee and other low-priced brands. The 1970s looters who left behind this evidence apparently had little money to spend on beer and/or a taste for cheap brew.

The strategy for testing LP71 was the same as that used in LP1 except that the greater potential depth of the profile posed a significant safety risk, and thus, the senior author worked the unit alone. As loose fill was excavated, seemingly intact midden was removed for screening only to be underlain by additional evidence of looting (beer cans, a section of 1/2-inch hardware cloth, and miscellaneous items of modern refuse). Even after removing fill to a depth of 1.5 m BS, seemingly intact midden was interspersed with obvious evidence of looting. Apparently, looters had tunneled into promising strata from vantage points removed from but immediately adjacent to the 2 x 2-m area designated LP71. Tracking the various directions of looters tunnels was simply a matter of watching loose backfill pour from vertical cuts of the walls. As a portion of hardware cloth attests, looting in this portion of the site involved sifting matrix; the resultant layers of clean shell were extremely loose and unstable. Needless to say, this posed a formidable challenge to efforts at keeping profiles neat for stratigraphic mapping (Figure 4-8).

An unfortunate consequence of removing sifted backfill was that it desensitized the senior author to detecting undisturbed strata of largely clean shell. Given the lack of clean shell strata in LP1 and the fact that looters screened matrix, potentially intact strata of clean shell were summarily dismissed as redeposited. Not until the backfill removal operation reached about 1.8 m BS did relatively thin, alternating layers of charcoal-rich midden and whole shell lenses signal unequivocally undisturbed midden. At this point, the excavation was reduced to a 1 x 1-m unit in the northwest corner of LP71 and taken down another meter (Figure 4-8). A bucket auger was used at ca. 2.85 m BS to reach the base of the mound at ca. 4.25 m BS.

None of the matrix from LP71 was screened, as the chief goal was to collect stratigraphic data on the thickest portion of the mound and initial indications were that virtually all of it was compromised by looters. In hindsight, the lack of screening was a mistake and no additional testing at Live Oak Mound should proceed without screening, looters' disturbances notwithstanding. Still, the technique of backfill removal (i.e., hand shoveling) enabled close surveillance of the matrix for artifacts. Consistent with observations in LP1 and those made by Wyman, LP71 contained few artifacts and little bone. Granted, sifting of matrix by looters ensured that all items larger than 1/2 inch were separated from matrix. But even so, high frequencies of pottery and faunal remains would most likely result in more than the occasional find in backdirt, which is precisely what we observed in LP71. Moreover, at depths greater than 1.8 m BS, within presumably intact midden, virtually no artifacts or faunal remains were observed. The only sherds collected came from the upper meter of backfill. One additional, notable find was a triangular marine shell pendant (see Chapter 6), retrieved from the backdirt pile by one of the field school students.

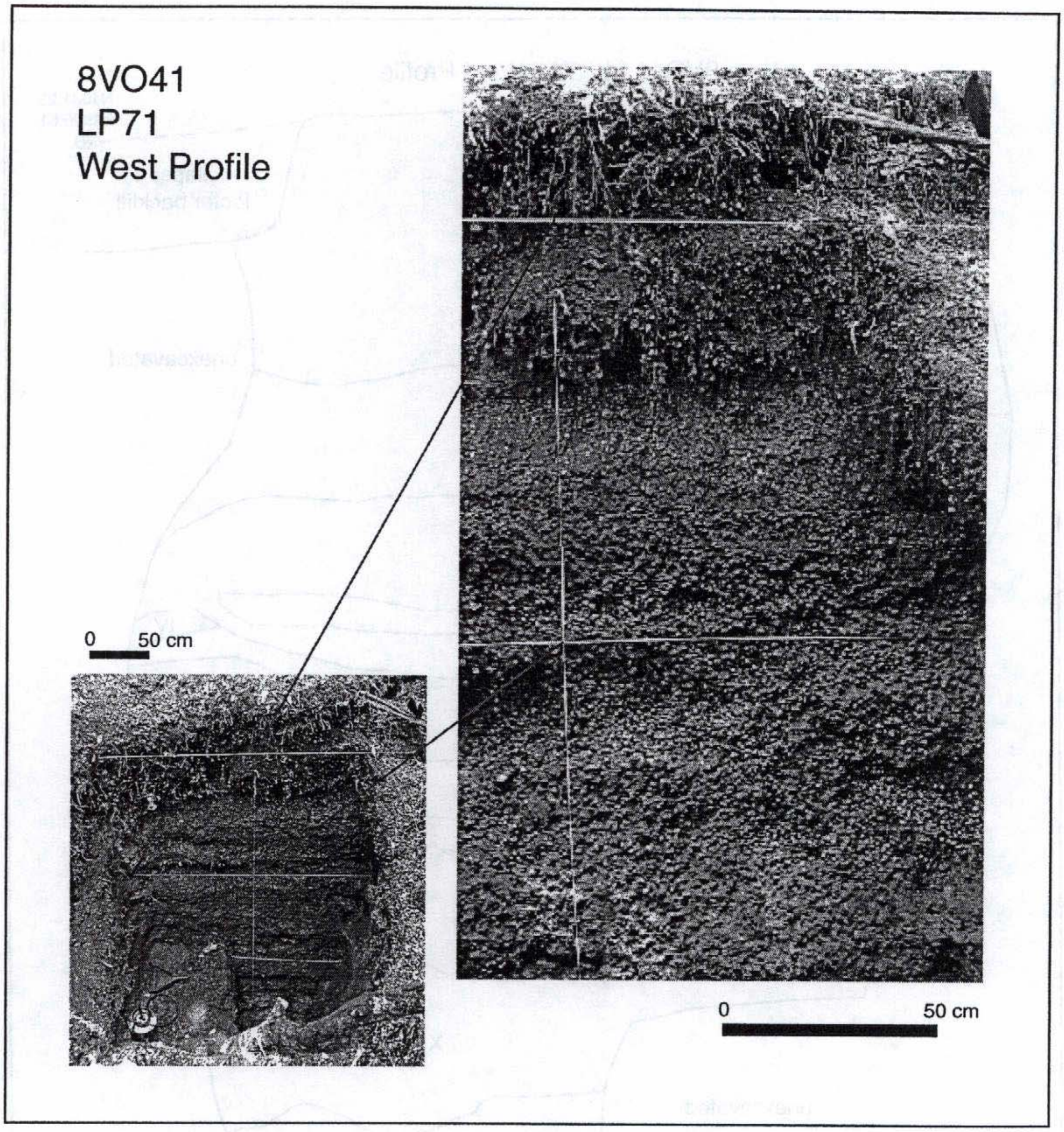

Figure 4-8. Photograph of west profile of Looter Pit 71, with magnified view of upper two meters, which were rife with looters tunnels and backfill.

The complete west profile of LP71 is a complex array of looters' backfill overlaying up to least six successive sequences of organic (charcoal)-rich midden interspersed with loose shell, the last three of which are concreted. Details of the lower 1.4 meters of midden are sketchy as this unit of the mound was penetrated by only a 4-inch-diameter bucket auger. The upper 2.85 meters of the profile are illustrated in Figure 4-9, while descriptions of each of the strata in the profile, as well as the layers penetrated by augering, are given in Table 4-2.

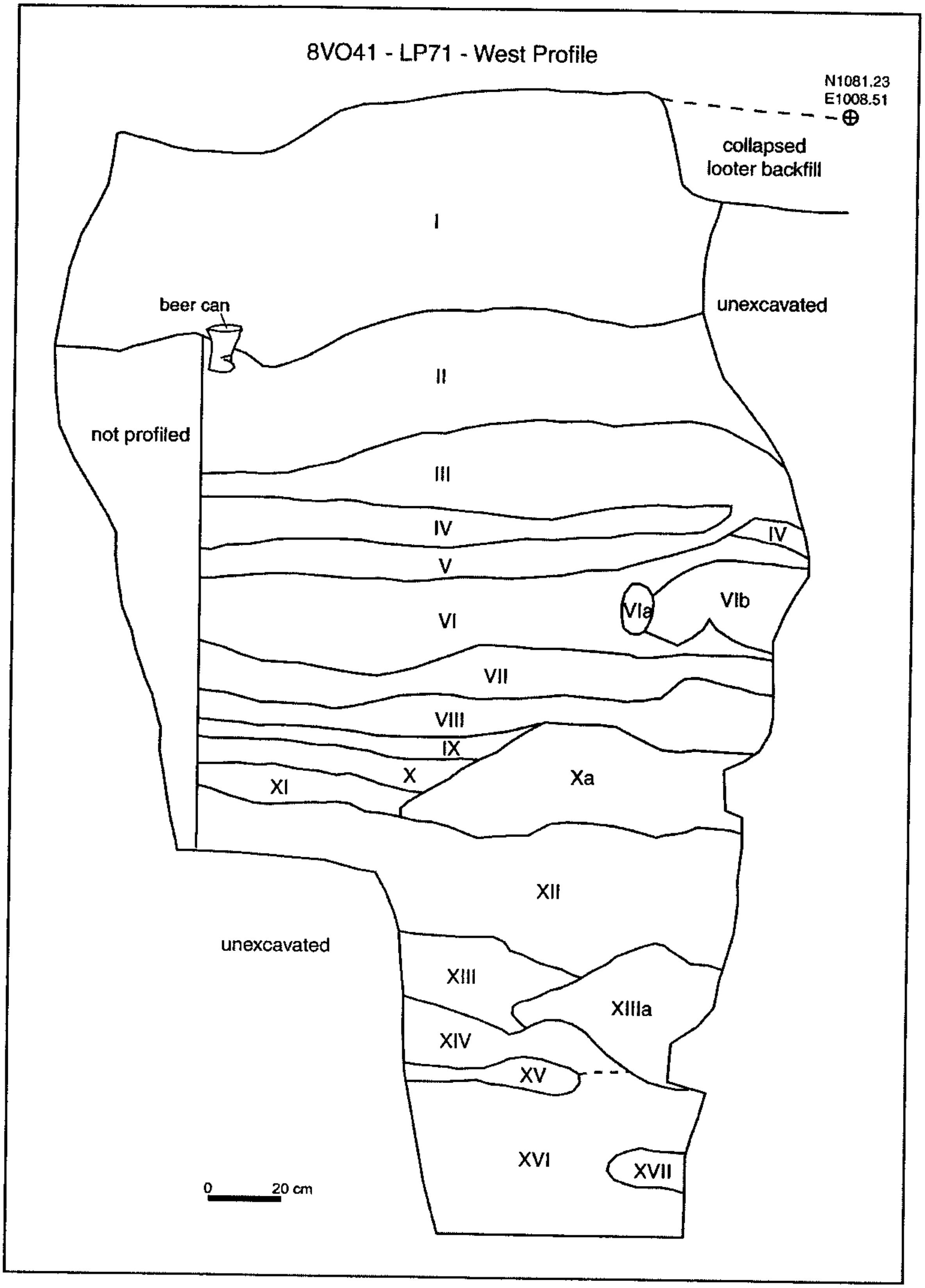

Figure 4-9. Stratigraphic drawing of west wall of Looter Pit 71, 8VO41.

Table 4-2. Stratigraphic Units of West Profile of Looter Pit 71, 8VO41.

Stratum	Max. Depth (cm BS)	Munsell Color	Description
I	44		loamy, unconsolidated midden with abundant *Viviparus* and heavy root mat; beer can at base; looter backfill
II	73		whole, dense shell in sand matrix; primarily small *Viviparus*; minor *Pomacea*; lenses of crushed shell near base
III	85	10YR3/2	abundant *Viviparus* in fine loam matrix with 2-3 cm discontinuous lenses of charcoal
IV	94		whole, dense shell in sand matrix; primarily small *Viviparus*; minor *Pomacea*
V	103	10YR3/2	abundant *Viviparus* in fine loamy matrix with flecks of charcoal throughout
VI	129	10YR5/3	whole, dense shell in sand matrix; primarily small *Viviparus*; minor *Pomacea;* subunit a: charcoal-rich; subunit b: weakly concreted
VII	138	10YR3/3	whole, dense shell in sand matrix with 2-3 cm discontinuous lenses of charcoal
VIII	147	10YR4/2	low-density shell in fine sand matrix, mottled with 10YR6/2, and iron oxides
IX	153	10YR3/3	thin, charcoal-rich sand matrix
X	162	10YR4/3	whole, dense shell in sand matrix
Xa	174	10YR4/3	weakly concreted, low-density shell in sand matrix
XI	168	10YR3/3	thin, charcoal-rich sand matrix
XII	212	10YR3/2	whole, dense shell in sand matrix; primarily small *Viviparus*; minor bivalve and *Pomacea*; minor lenses of crushed shell near base
XIII	228	10YR5/3	low-density shell in fine sand matrix with mottles of iron oxides
XIIIa	243	10YR2/2-5/2	sand matrix with moderate shell and abundant flecks of charcoal throughout; concreted at base; weakly concreted throughout; possible feature
XIV	238	10YR3/2	whole, dense shell in sand matrix; primarily small *Viviparus*; minor bivalve and *Pomacea*; minor lenses of crushed shell near base
XV	245		lens of crushed shell

Table 4-2. continued.

Stratum	Max. Depth (cm BS)	Munsell Color	Description
XVI*	335		whole, clean shell; predominately large *Viviparus*; minor *Pomacea*
XVII	272	10YR5/4	low-density shell in sand matrix
XVIII**	405	10YR3/3	moderate shell in sand matrix with flecks of charcoal throughout
XIX**	425		moderate shell in sand matrix with charcoal and iron oxide concretions throughout; occasional crushed *Pomacea*; pockets of oxidized clayey sand
XX**	<426		oxidized clayey sand, with possible clay substrate

* lower 50 cm observed in bucket auger only
**observed in bucker auger only

Several aspects of the LP71 profile are noteworthy. First, the basal strata of LP71 are comparable to those observed in LP1, and they lie at comparable depths. Considering depth below surface, both sequences terminate at an absolute elevation of roughly 2.0 meters. As shown in a schematic cross-section linking LP1 and LP71 (Figure 4-10), the basal midden stratum in both units lies at the present-day upper-marsh surface. Thus, the entire deposit exceeding 2.0 m in elevation is anthropogenic. The AMS date from the basal cultural stratum of LP1 places the initiation of midden formation at ca. 6260 rcybp. The basal strata in both units include concreted midden rich in charcoal and ash. Such features are not uncommon to shell middens and mounds dating to the Mount Taylor period. As explained by Palmer and Williams (1977:25; cited in Wheeler et al. 2000:145), concreted midden forms when

> water percolating through humus combines with detrital carbon dioxide to form carbonic acid. This in turn dissolves calcium carbonate shell in the upper part of the midden to form calcium bicarbonate solution. As the solution percolates downward, it comes in contact with more alkaline soil and begins to precipitate calcium carbonate, which forms the cementing matrix for the assorted large particles of shell.

Given the abundance of charcoal and ash in concreted midden, it stands to reason that the process of cementation is accelerated in burned shell matrix.

In both Looters Pits, the size of *Viviparus* increased with depth, or, conversely, decreased through time. This is a trend observed at other sites in the region (see Chapter 6), and appears to accelerate after the Orange period (i.e., post 3000 rcybp). *Viviparus* shell in the upper portion of LP71 is clearly among the smallest we have observed at sites in the Blue Spring/Hontoon Island area. Although we do not have a good handle on the

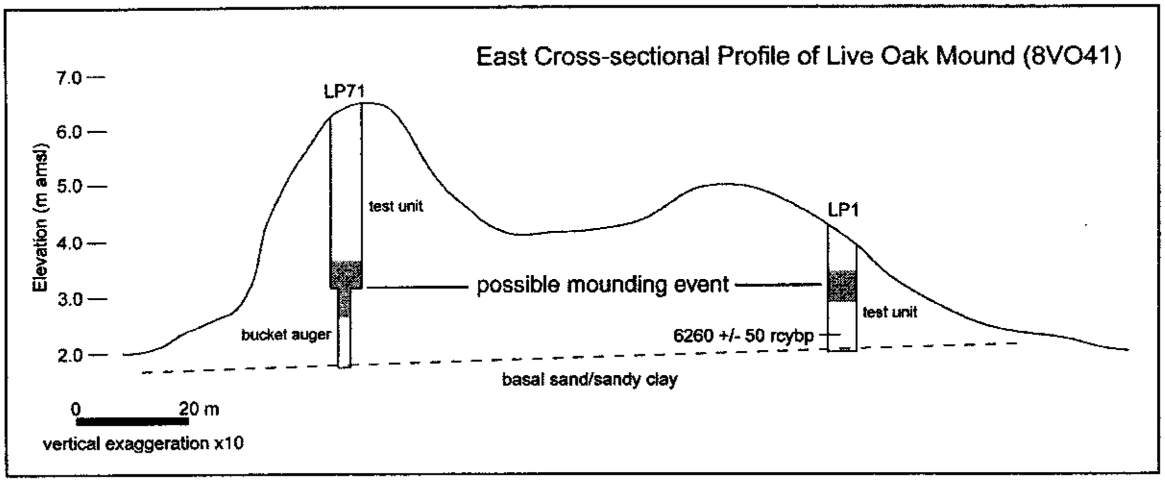

Figure 4-10. East cross-sectional profile of Live Oak Mound (8VO41), showing locations of LP1 and LP71, stratigraphic position of submound sand/sandy clay, and possible mounding event.

age of the upper half of the LP71 profile, a trace of St. Johns check stamped sherds supports a post A.D. 750 estimate.

This leads us to the assertion that Live Oak Mound was occupied and/or constructed intermittently for over 5000 years. Considering the "occupational" aspects of this assertion, it is difficult to argue that Live Oak was the locus of intensive habitation since 4000 rcybp, after which pottery was routinely used. One would expect more occupational debris, including pot sherds, as well as abundant faunal remains besides shell. Of course, refuse disposal patterns may have removed such debris from the mound proper, but that argument rests on negative evidence alone.

As for the "constructed" aspects of this assertion, there is some evidence to suggest that Live Oak was erected as a mound and not simply an accumulation of domestic refuse. The thick stratum of clean shell exposed in the lower portion of the LP71 profile (Stratum XVI) is stratigraphically commensurate with a similar stratum in LP1 (Stratum V), although the latter was apparently compromised by looter activity. This possible "mounding event" (Figure 4-10) is sandwiched by strata that are thinner and consisting of sands, charcoal, and crushed shell—strata typical of gradually accreted midden. Without further testing, we ought not elaborate on this possible mounding event and its relationship to strata above and below. However, its stratigraphic position places it most likely in the Orange period of ca. 4000-3000 rcybp.

Mounding at sites like Live Oak must be considered an incremental, or staged process, involving perhaps a variety of gradual, accretional events or periods of occupation, interspersed with rapid accumulations of shell and refuse. The latter episodes may very well have coincided with major ceremonial events and ritual feasting. Although evidence for such events elude us, the high frequency of human interments reported by Wyman and apparently targeted by looters, attests to a mortuary dimension to rituals that may have involved the intentional mounding of shell.

Finally, we ought to consider seriously that the overall configuration of Live Oak Mound was itself intentional, or at least derivative of the spatial arrangements of groups responsible for its construction. In this regard, it is noteworthy that Live Oak bears a strong affinity to a shell mound at the southwest end of Hontoon Island, 8VO214. Based on a topographic map of the site provided by Ray McGee (personal communication, 2001), 8VO214 is not quite as long and wide as Live Oak, but it has a conical apex 4-5 meters high at its south end and a trailing, ramp-like feature extending to the northwest and north. It thus is an inverted image of Live Oak, and it too fronts a cypress swamp to the west. Concreted midden exposed at the base of 8VO212 suggests it may have a similar stratigraphic sequence as Live Oak. Virtually nothing else is known about 8VO214. Some limited testing is clearly warranted.

CONCLUSION

Our limited work at Live Oak Mound returned some valuable results. A detailed topographic map of the site confirms that Live Oak Mound is indeed the mound Wyman referred to immediately north of Blue Spring Run. The many looters pits we mapped allegedly were dug to exhume human remains, which, as Wyman noted, were rather numerous. Still, not a single trace of human bone was observed in any of the work we conducted. Despite extensive looting, the mound is largely intact and likely retains its original configuration, with a tall conical component and trailing ramp-like feature. Our stratigraphic tests at two locations of looting demonstrate that the entire deposit is anthropogenic, with a basal component dating to the late seventh millennium before present (early Mount Taylor period), and an upper component dating to the St. Johns II period (post A.D. 750). At least one thick stratum of relatively clean, whole shell attests to a large-scale mounding episode, while most other strata consist of thinner, alternating layers of dense whole and crushed shell (primarily *Viviparus*) in sand matrix, with varying amounts of particulate charcoal. Although many such strata may be indicative of living surfaces and gradual, incremental accumulation of midden, the paucity of artifacts and vertebrate faunal remains runs counter to our expectations for mundane, domestic refuse. Clearly more work is needed at Live Oak Mound to explore its internal structure and composition, but in many respects the observations to date support the idea that it was erected during Orange times (ca. 4000-3000 rcybp) as a monument, eventually a mortuary monument, and was not simply an accumulation of everyday refuse.

CHAPTER 5
HONTOON ISLAND RECONNAISSANCE SURVEY

Jon C. Endonino

Phase I reconnaissance survey was conducted throughout the 2000 and 2001 field seasons of the University of Florida's St. Johns Archaeological Field Schools. This effort had three goals: (1) explore the potential for archaeological sites in the interior of Hontoon Island; (2) define the boundaries of extant sites on Hontoon Island; and (3) train students in the practice of Phase I survey so that they are prepared for employment in the most common aspect of Cultural Resource Management (CRM) archaeology. Given that the training of students was a high priority of the survey operation, the pace was slow and deliberate, something that admittedly cannot be said of many CRM projects. Still, with an emphasis on full-coverage survey in locations not likely to contain archaeological deposits, students were indoctrinated to the importance of documenting the absence of cultural resources in locations that have long-been neglected by "academic" archaeologists. Moreover, all students had the opportunity to shovel test extant sites for purposes of site mapping and characterization on Florida Master Site File forms, and some of those in 2001 experienced the use of Global Positioning Systems technology to accurately locate sites. Throughout both seasons, students in teams of 2-3 each spent at least one week on survey.

The combined results of both seasons were (1) completion of six "full-coverage" shovel-test transects, two of which intercepted two new sites (8VO7493, 8VO7494), (2) expanded boundary definition for Hontoon Island's largest site (8VO202); (3) relocation of a small shell-bearing midden site (8VO215); and limited perimeter testing of the extant shell mound at the south end of the island (8VO214). The locations of all these sites and others in the Florida Master Site File are illustrated in Figure 5-1. Following some background on previous work on Hontoon Island, this chapter summarizes the methods and results of all survey work conducted in 2000 and 2001.

BACKGROUND

Hontoon Island has received considerable archaeological attention since the mid-nineteenth century, owing primarily to the presence of large, conspicuous shell mounds. Jeffries Wyman (1875:26-31) visited and dug at all of the major mounds on Hontoon Island and recovered material culture that is useful in determining the cultural affiliation of these sites. In his account are descriptions of the location of each site, their size and shape, as well as their stratigraphy and the presence of burials and other cultural features. Unfortunately, the large mounds described by Wyman at the north end of Hontoon Island have since been completely removed by shell mining in the 1930s (Purdy 1991:104).

Clarence B. Moore (1892-94 [1998]), in his prodigious diggings at mounds throughout northeastern Florida, was unable to gain access to the sites on Hontoon Island, although he completely "demolished" the Thursby Mound at 8VO35, across the St. Johns

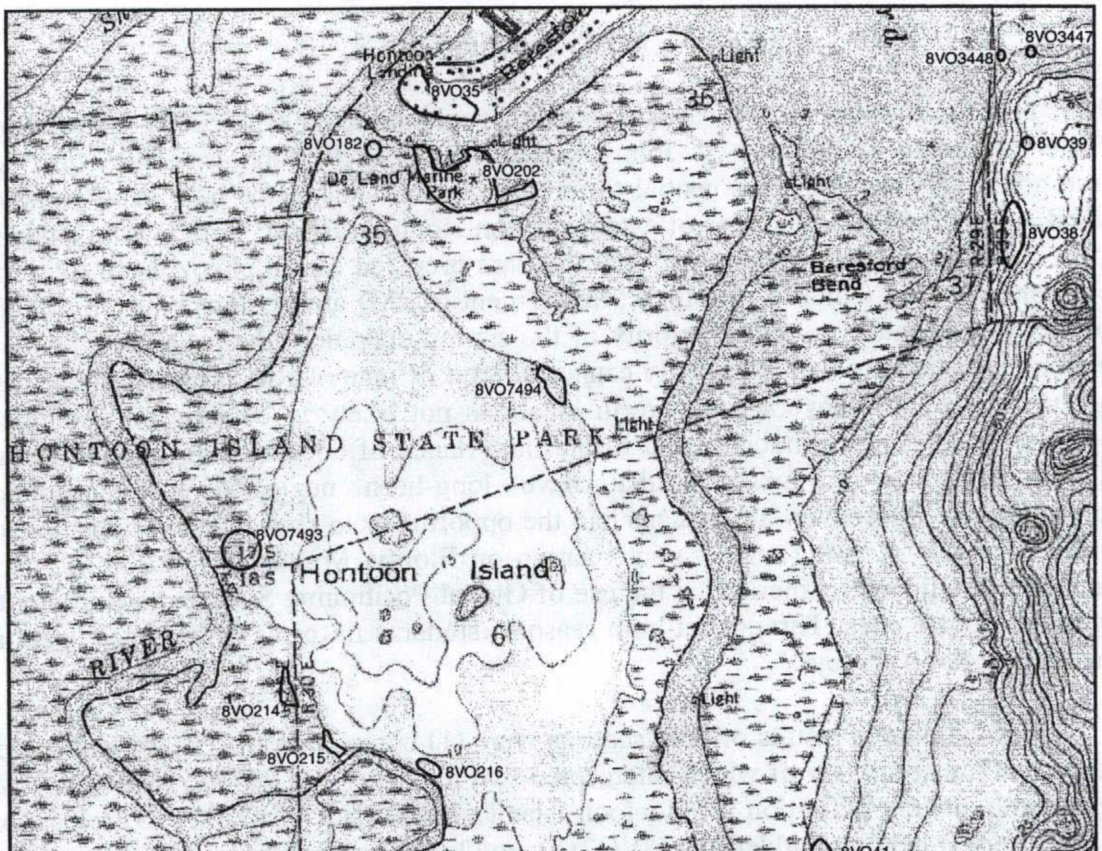

Figure 5-1. Topographic map of Hontoon Island and vicinity, showing locations of previously recorded sites and two new sites (8VO7493 and 8VO7494).

River, directly opposite the massive mounds and ridges Wyman described at the north end of Hontoon Island. Moore describes Hontoon Island as "a place of great shell deposits" and comments on the presence of two sand and shell burial mounds located "a short distance from the riverbank" noting "their nature has not been determined, though a superficial examination was made by Professor Wyman" (Moore 1998:205). Like the larger shell ridge complex Wyman described, the mounds Moore noted no longer exist. Ray McGee's graphical reconstruction of the mound/ridge complex at the north end of Hontoon Island provides some sense of these now-defunct monuments (Purdy 1991:106).

Archaeological interest in Hontoon Island waned during the twentieth century until a dragline operator in 1955 found a 12-foot wood carving of an owl in the river adjacent to the Thursby midden (8VO35) (Bullen 1955), and in 1977 two smaller totems (an otter and a pelican) were recovered near the same location (8VO238, whose specific location in the river is not provided in the Florida Master Site File). Shortly thereafter, cultural resources on Hontoon Island were inventoried by the state of Florida (Dunbar et al. 1978) and a statewide survey of wet sites two years later by George MacDonald and Barbara Purdy identified significant submerged deposits along the northeast margin of the island (Purdy 1991:106). This led to a series of investigations by Purdy (1987) and her students at the University of Florida. This work began in December 1980 with a single 3-m square unit in the shallow lagoon to the east of 8VO202 using a combination of hydraulic excavation and evacuation techniques. Based on the abundance of cultural material and the excellent state of organic preservation of the materials recovered from the marsh environment, Purdy conducted additional testing in February 1982. A second 2-m square was excavated approximately 10 m from the previous one with the purpose of obtaining samples for radiometric dating of the deposits. In addition to the radiometric samples, a volumetric sample was retrieved for dietary analyses. The somewhat unexpected results of this analysis prompted a third round of investigations with a University of Florida Archaeological field school in the spring of 1984. Several research goals were set for the project and a 2 x 26-m trench with a 6-m lateral extension adjacent to the trench were excavated at 8VO202 (Purdy 1987). Abundant perishable materials such as wood and botanical remains were recovered, along with copious amounts of St. Johns pottery, faunal remains, and shell and bone tools. While the majority of the cultural material recovered dates to late prehistoric and historic periods (A.D. 1 to 1770) some evidence of preceramic Archaic occupation was found in a 2-m square 40 m west of the trench and in limited testing of "a large shell midden on the south end of the island" (possibly 8VO214) (Purdy 1987:12).

Previously Recorded Sites

Six archaeological sites have been previously recorded on Hontoon Island. Many of the earliest descriptions of sites on Hontoon Island, and the St. Johns in general, can be credited to Jeffries Wyman (1875). Later, in his book *Space and Time Perspectives in Northern St. Johns Archaeology, Florida,* Goggin (1952) provided additional locational information and cultural affiliation for many of the sites. Originally, all of the sites were thought to be located in Lake County and thus assigned Lake County site numbers. These were corrected to Volusia County site numbers, apparently in the 1970s.

Huntoon Island Mound A, 8VO182, is described as a sand and shell mound located at the northern end of Hontoon Island adjacent to the larger Huntoon Island Midden (8VO202). Florida Master Site File forms for this site do not indicate its cultural affiliation, but suggest that it may be St. Johns I or later in age based on the recovery of a pottery bowl from "mounds on Hontoon Island in Lake Beresford" (The Florida Times Union, April 5, 1884). Additionally, it is indicated in the FMSF form that a collection of artifacts and/or human skeletal material were collected by Clarence B. Moore and donated to the Academy of Natural Sciences and then accessioned to the Wagner Free Institute of Science in 1919. Currently, nothing more is known about the nature, extent, and cultural affiliation of this site. Formerly designated 8LA36, now 8VO183, Huntoon Island Mound B is located in close proximity to Huntoon Island Mound A and is also a mound of unknown type, composition, and temporal affiliation. Also visited and collected by Moore, this site may also have materials in the collection previously described.

What remains today of the large Huntoon Island Midden (8VO202) is but an unassuming portion of what apparently was a massive shell mound and ridge complex with two adjacent conical mounds. The complex described by Wyman (1875:27-29) included two long, parallel shell ridges, the larger of the two, nearest the river, was over 600 ft in length and 12-14 feet high. Erosion from the river had washed away a portion of this ridge, leaving an "abrupt" profile, perhaps the very one photographed by Moore in 1894. The second, landward ridge was even longer and taller than the first. Separated from the smaller ridge by a "deep valley" (Wyman 1875:27), this second ridge was estimated by Wyman to be at least 25 ft high. The two conical mounds Wyman noted, the largest 25 ft high, were landward of the eastern end of the second ridge. Again, McGee's sketch of this mound and ridge complex is a useful illustration of the complex based on Wyman's account.

Purdy's (1987) field research at 8VO202 focused on wet deposits at the eastern end of the site where, after shell-mining operations removed the ridges and mounds, an adjacent and submound midden extended into the large lagoon to the east. This work succeeded in recovering well preserved organic remains, including maize and other cultivated plants, over 30 species of wood, and 82 species of seeds (Newsom 1987), as well as numerous wood, shell, and stone artifacts, and a suite of radiocarbon ages. This work was never intended to sample widely at the site, so we have little knowledge about the extent of subsurface deposits across what originally was acres of shell ridges and mounds. Again, however, Purdy (1987) notes that presumably preceramic deposits were uncovered in a small test unit to the west of the wet-site trench dug in 1984.

The site Goggin (1952) referred to as the "Northernmost Midden, Hontoon Creek," is recorded in the FMSF as 8VO214, formerly 8LA36. Given its plotted location in the FSMF, this presumably is the large shell mound described by Wyman at the southern end of the island, currently along the edge of a swamp forest with cabbage palm and oak hammock some 300 east of Hontoon Dead Creek. Goggin (1952) suggested the site dates to the Mt. Taylor and St. Johns I periods, although nothing in the FMSF record supports this assertion, nor was Wyman successful in locating diagnostic artifacts in his multiple excavations (Wyman 1875:27). He did, however, recover "old fire-places," worked bone and other faunal remains, along with human skeletal remains he believed to be from a "dwarf," given their "diminutive" size. Located at the end of a nature trail, the mound is relatively well preserved and attracts the interest of visitors to the island. Recent efforts to locate subsurface remains adjacent to this shell mound are discussed below.

The "Middle Midden, Huntoon Creek," 8VO215, formerly 8LA37, is described as a “midden” in the FMSF, and as a "small shell field" by Wyman (1875:26). The site is situated close to where Snake Creek and Hontoon Dead Creek meet, but this location is somewhat ambiguous, in spite of Wyman’s description. The FMSF form indicates that the exact site location is unknown and plotted based on a vague verbal description. Pottery, faunal bone, and shell and bone tools were collected by Wyman (1875:26) and suggest that this site likely dates to the St. Johns period but possibly the earlier Orange period, although Wyman does not specify. The ambiguous temporal affiliation of this site, as well as its location, was addressed by the field school and is discussed further below.

The "Southern Midden, Hontoon Creek," 8VO216, formerly designated 8LA38 is quite similar in description to 8VO215. The site is located along Snake Creek several hundred meters southeast of 8VO215. No cultural affiliation is given for this site, and it is simply described as a "midden." Wyman visited the site and recovered a modest assemblage of shell and bone tools, pottery, and faunal material. The exact location of this site in the site file is just as ambiguous as 8VO215. An effort was made to locate this site during the 2001 field season by traversing the high ground on the north side of Snake Creek, southeast of 8VO215. After expending approximately half a day in search of this site, the effort was abandoned.

Environment

As its name implies, Hontoon Island is surrounded by waterways. Its northern and eastern margins consist of the main channel of the St. John River, while its western and southern boundaries are shaped by Hontoon Dead River and Snake Creek, respectively. The island lies within the "offset" segment of the St. Johns basin, essentially a westward rerouting of its relict channel to the east that occurred something during the late Tertiary to early Pleistocene (White 1970; Pirkle 1971 cited in Schmidt 1997:12). The offset includes a number of large lakes linked by the river channel, most notably Lake George to the north, the largest in the drainage, and Lakes Monroe and Jesup to the south. Many lesser lakes, most notably Lake Beresford to the immediate northeast of Hontoon Island, and Lake Woodruff 16 km farther north, are linked together by a broad, braided channel and extensive wetlands. The generally low-lying terrain and broad floodplain of the middle St. Johns is characterized by vast stretches of swamp and marsh whose boundaries with dry terrain shift constantly with fluctuations in rainfall, river discharge, and groundwater.

Hontoon Island itself is rather topographically flat with its prehistoric shell mounds being the most significant features. Elevations on Hontoon Island range between 5 and 15 feet (1.5-4.5 m) above sea level, with the center of the island possessing the areas of highest terrain. So slight is the topography of the island that it is nearly imperceptible and obscured by vegetation. Only at the edges of wetlands along the island's perimeter is a difference in elevation clearly evident, such as were the cypress/bottomland forest west of 8VO214 rises up and grades to hammock and eventually pine flatwoods to the east. Several small seasonal wetlands are present within the interior of Hontoon Island and all were dry during the 2000 and 2001 field seasons. One man-made or enhanced wetland is located in the interior of the island and it is at this location where a historic dump is found.

Two environmental zones dominate the terrestrial portion of Hontoon Island: mixed hammock and pine flatwoods. In addition, cypress swamp is found in association with Hontoon Dead River and Snake Creek along the western and southern margins of the island.

Hammock communities dominate the perimeter of Hontoon Island. Generally, hammocks do not occur as contiguous areas of unbroken forest but rather as "narrow bands of vegetation, often only a few hundred meters wide" found between areas of "uplands," in the case of Hontoon Island, pine flatwoods, and "bottomlands," namely cypress swamp and river marsh (Platt and Schwartz 1990:195). Numerous tree species are found in hammock communities and their composition in any one setting is influenced by factors such as flooding, fire, and tropical storms. On Hontoon Island, much of the hammock community is characterized by cabbage palm, live oak, pines, and palmetto.

Pine flatwoods cover the largest portion of Hontoon Island's interior. According to Abrahamson and Hartnett (1990:103) pine flatwoods are "characterized by low, flat, topography, and relatively poorly drained, acidic, sandy soil often underlain by an organic horizon." Flatwoods communities are strongly influenced by fire, which affects the structure and composition of the community. The density of the overstory depends on several factors and can vary considerably. A number of different pine species make their home in the flatwoods and include longleaf pine, typical slash pine, and pond pine. Minor or infrequent trees include live oak, water oak, sweet gum, and red oak. The central portion of Hontoon Island is covered by widely spaced pines and palmettos of varying density and height due to controlled burns. On the southern and eastern side of the island denser stands of longleaf pine and a more open understory is present.

Cypress Swamp is found primarily along the western and southern margins of the island and extends from the edge of the cabbage palm and oak hammock communities to the edge of the river channel. Generally this community is inundated and supports almost exclusively cypress and some ferns with an admixture of sweetgum and bay. A significant factor affecting the nature and composition of cypress swamps is the hydroperiod or length of time that soils are saturated during the year. Other important factors affecting the structural and functional diversity of swamps are fire frequency, organic matter accumulation, and the source of water (Ewel 1990:283). During the 2000 and 2001 field seasons, the cypress swamps bordering Hontoon Island to the west were dry and traversable to the edge of Hontoon Dead River, a situation which enabled the placement of shovel test pits in this environmental setting.

Two soil associations characterize the areas surveyed on Hontoon Island: Samsula-Terra Ceia-Tomoka and Myakka-Smyrna-Immokalee. Samsula-Terra Ceia-Tomoka association soils are characterized by swamps and marshes dominated by organic soils (USDA 1980). This association is typically found around the edges of Hontoon Island near the St. Johns River and its associated floodplain forests. Generally these areas are flooded and inaccessible to testing. Due to lowered water levels in 2000-2001, shovel testing in this soils was indeed possible. The second association present within the project area is the Myakka-Smyrna-Immokalee, which is characterized by nearly level, poorly drained soils that have a dark, organic stained subsoil underlain by sandy material. Poorly defined drainage ways and swamps are generally interspersed throughout this association. The greatest majority of the area surveyed during the 2000 and 2001 field seasons was characterized by this association and are found in the central portions of the island, supporting pine flatwoods and mixed hammock environments.

Six specific soil types are found on Hontoon Island. The most common, Terra Ceia muck, is found along the eastern side of the island bordering the St. Johns River and characterized by swamp and freshwater marshes, and is generally wet or inundated. Eaugallie fine sand is also found along the perimeter of the island though at slightly higher elevations than soils bordering the St. Johns River directly. Characterized as nearly level and poorly drained, usually with 0-2 percent slopes, EauGallie fine sand is normally found in broad flatwoods and supporting forests of longleaf and slash pine with an understory of saw palmetto, gallberry, and pineland threeawn. On the western and north sides of Hontoon Island, hammock composed of live oak, water oak, and magnolia is present. On the east side of the island mixed oak, pine and cabbage palm hammock are supported by this soil type. All known archaeological sites are found in areas characterized by this soil.

Myakka fine sands are present in the central and southern portions of Hontoon Island and support typical flatwoods communities of pine and palmetto. Myakka fine sand is nearly level and poorly drained. Other vegetation types supported by this soil include gallberry, pineland threeawn, and shiny blueberry. Immokalee sand is found in a small area in the southeast part of the island and currently supports a forest of open longleaf pine and saw palmetto. This soil type is characterized as nearly level, poorly drained sandy soil found in broad areas in flatwoods, in low areas between sand ridges, or slightly elevated areas between ponds and sloughs.

One small area in the center of the island is characterized by the Pompano-Placid complex and corresponds to a low wetland that was dry during the time of survey but appears to hold water during wetter cycles. Soils of this complex are nearly level, poorly drained, and generally found in depressions in the flatwoods supporting a natural vegetation of swamp hardwoods interspersed with slash pine and cabbage palm with an understory of waxmyrtle, gallberry, and fetterbrush. Grasses associated with this soil type and habitat include sawgrass, smooth cord grass, maidencane, chalky bluestem, and broomsedge bluestem.

SURVEY METHODS

Reconnaissance survey in 2000-2001 was designed primarily as an exercise in "full-coverage" survey, that is, as a systematic survey unbiased by prior knowledge about locational tendencies for sites. As is the case for areas of northeast Florida best known archaeologically from the efforts of Wyman and Moore, prior knowledge of site locations is biased toward the large, conspicuous shell and sand mounds and middens, all of which occur at the interface between land and water. The dry, interior "uplands" of Hontoon Island had never before been surveyed for sites. Intuitively, the potential in this area for sites, or, more precisely, "significant" sites, is extremely low. Obviously, this supposition is not satisfying in either scientific or managerial terms. As is the case archaeological surveys mandated by federal or state law, survey efforts must be sufficiently thorough to detect all sorts of sites and to explore the potential for sites in locations previously understudied. In full-coverage survey, then, all portions of project areas must be examined, which, in the case of shovel testing, typically involves transects spaced 30 m apart. At this sampling interval, over 70 transects of shovel tests are required to sufficiently survey Hontoon Island. At a 30-m site interval between shovel tests along transects, some 2300 shovel tests would be required. Given the slow, deliberate pace of field school training, only a small fraction of that sample was executed. In practical terms, the exercise was highly effective in impressing upon the students the need to test in areas were sites are not expected to occur. Even with our limited sample of four transects, we have begun to verify that sites do not occur routinely in the interior of the island.

Figure 5-2 shows the locations of four "site discovery" transects across Hontoon Island, as well as two transects at the north end of the island designed to explore the subsurface extent of 8VO202. As this figure shows, two new sites (8VO7493 and 8VO7494) were intercepted by shovel tests at the ends of two transects. The figure also shows how one of the transects (T15) was placed to intercept one of the interior wetlands on the island. The ends of each of these transects and all positive shovel tests were located using a Trimble Pathfinder Global Positioning Systems (GPS) unit, as were the locations of each of the extant and new sites.

Site discovery transects were oriented east-west and facilitated by lower than normal water levels in the St. Johns River. Because of the low water levels it was possible to place shovel tests in cypress swamp along the western margin of the island, which is normally submerged. All transects were given an alpha-numeric designation (e.g., T 1) and Shovel Test Pits (STPs) were also assigned numbers (e.g., STP 1). These were merged to form a combination Transect/STP designation (T1-24 for Transect 1/STP 24). All transects were so numbered, including those used to define site boundaries, many of which contained fewer than five tests. Transects dug between two existing transects, again most frequently during site delineation, were assigned transect numbers

Figure 5-2. Infrared aerial photo of Hontoon Island, showing locations of site-discovery transects (T1, T2, T4, T15), two site-definitional transects (T3, T10), and locations of all sites.

combining both of the pre-existing transects (ex. T1/4 for a transect dug between Transects 1 and 4). An interval of 30 meters was used for the majority of the survey, but closer intervals of 10 or 20 meters were used to define boundaries of sites. Shovel Test Pits measuring 50 by 50 cm were excavated to a depth of a meter below ground surface or until limestone, clay, or impenetrable hardpan and roots were encountered. All soils were screened though 1/4-inch hardware cloth and all artifacts and faunal material bagged and labeled by transect/STP#. Shovel test pits containing cultural materials, faunal remains or shell were tested in all four cardinal directions until two negative shovel tests were obtained or until sufficient coverage was achieved to determine site boundaries. Shovel Test Pits were plotted on 1:200 scale aerial photographic maps and plotted with the GPS unit.

SURVEY RESULTS

Twenty transects were dug during the 2000 and 2001 field seasons, four to detect sites across the entire expanse of the island, and 16 to define the boundaries of recorded and new sites. A total of 252 shovel tests were dug along these transects, 40 of which contained cultural material. Of the six recorded sites on Hontoon Island, three were tested in order to determine their extent: 8VO202, 8VO214, and 8VO215. Site 8VO216 could not be relocated and the presumed locations of 8VO182 and 8VO183, sites which may be completely destroyed, were not tested. Two new sites were identified, 8VO7493 and 8VO7494.

Huntoon Island Midden (8VO202)

Considering that virtually all of the above-ground components (i.e., mounds and ridges) of 8VO202 were destroyed long before there modern era of shovel-test survey, it stands to reason that an extensive subsurface testing program is required to determine the absolute boundaries of this site. The extant boundaries are based largely on Wyman's account. Purdy's work concentrated on the eastern margin of the site, where subaqueous deposits exist. Little is known about the subsurface extent of the western and southern portions of this site. Accordingly, the field school program targeted these areas for shovel testing.

Two transects (T3, T10) were placed at the southern end of 8VO202 in an effort to establish the southern and western boundaries of subsurface archaeological deposits (Figure 5-2). Both transects spanned the width of the island from east to west. The first (T3) was begun west of Purdy's main trench and the second (T10) 60 m to the south. Each transect consisted of 21 shovel tests, 12 of which yielded cultural material. Table 5-1 provides a tabulation of artifacts recovered by transect/shovel test and depth below surface.

Stratigraphy observed in positive shovel tests at 8VO202 generally consisted of a humus zone from approximately 0-10 cm below surface (cmbs), underlain by dense, dark gray midden deposits to a depth of 60 cm or more before reaching impenetrable concreted midden. Water was encountered at approximately 40 cmbs in shovel tests on the east end of transects. Soils became drier moving west across the island, as midden deposits became diffuse and stratigraphy changed dramatically. A typical profile in this area of the site consists of humus from 0-8 cmbs, gray sand from 8-20 cmbs, brownish gray sand from 20-31 cmbs, dark gray sand and diffuse shell midden from 31-46 cmbs, and light gray sand underlying the midden to 100 cmbs. Cultural material was not recovered from shovel tests in excess of 300 m west of Purdy's trench along Transect 3, nor in excess of 150 m west of Purdy's trench along Transect 10.

Table 5-1. Cultural Material Recovered from Shovel Tests at 8VO202.

Tran-	STP	Depth.	Ceramic Sherds			Vertebrate	Marine	Lithic	
sect	#	(cmbs)	SJ-CS	SJ-Other	Other	Wt. (g)	Shell	Flake	Other
3	1	0-10	11	53	1	21.4			
	2	0-79		1		19.7			
	3	12-60	4	152		101.6	3	1	
	4	0-41		21		63.1	1		1 shark tooth
	5	0-45		6		97.1			
	7	10-21				1.8			
	10	0-20				6.6			
	11	35-50				11.5			
10	2	5-70	3	55		125.6			
	3	10-41		22		8.3			
	4	10-41		32		124.2		1	1 worked bone
	5			4	1	4.4			

Depth: depth of cultural material (cmbs)
Ceramic sherds: SJ-CS: St. Johns Check Stamped; SJ-Other: other varieties of St. Johns; Other: 1 fiber-tempered/sand-tempered plan
Vertebrate Wt. (g): weight (in grams) of all vertebrate faunal remains
Marine shell: fragments of modified marine shell

Positive shovel tests generally produced abundant cultural material, particularly St. Johns Pottery and vertebrate faunal remains. Wood chips (debitage) similar to those recovered from Purdy's wet site testing were also common in tests in saturated soil. Freshwater shell (largely *Viviparus*) was likewise common in tests containing pottery. Occasional lithic waste flakes, a shark tooth, and one piece of worked bone complete the assemblage. Moving west, the frequency of cultural material dropped rapidly. Further details on the pottery and associated artifacts from 8VO202 shovel testing is reserved for discussion in Chapter 6.

Many more shovel tests are required to finalize the absolute subsurface dimensions of 8VO202. Work conducted thus far has effectively expanded the western boundary of the site approximately 75 m. Future efforts should concentrate on delineating the southern boundary with shovel test transect oriented perpendicular to those reported here.

Northernmost Midden, Hontoon Creek (8VO214)

Site 8Vo214 is located in a mixed oak and cabbage palm hammock bordered on the west by river floodplain swamp associated with the Dead River and pine and palmetto flatwoods to the west. One east-west transect, Transect 2, was begun on the western edge of island immediately on the east side of 8VO214 in the hopes of defining the eastern edge of the site. Surprisingly, no shell or cultural material was recovered during shovel testing in spite of the fact that STP T2-1 was placed lass than a meter from the observable easternmost edge of the mound. Such an abrupt drop off in cultural material and shell so close to this large shell midden was unexpected, but perhaps periodic flooding has scoured away any associated, low-lying midden.

During both the 2000 and 2001 field seasons survey teams were deployed to scan the surface of the mound at 8VO214 for evidence of cultural material. The only items recovered were a flake of quartz crystal, a marine shell tool, and several fragments of marine shell. In addition, some faunal bone was observed but not collected. The complete absence of pottery was striking at this site, especially considering its abundance at 8VO202. However, the lack of cultural material is consistent with Wyman's (1875:27) account of his excavations there, as well as the situation at Live Oak Mound (see Chapter 4). It seems likely that a large portion of the shell midden that comprises the 8VO214 mound formed long before pottery was made and used in the area.

Middle Midden, Huntoon Creek (8VO215)

Site 8VO215 is situated on a slight topographic rise in a mixed hardwood hammock bordered to the west by a floodplain forest, Snake Creek immediately to the south, and pine and saw palmetto flatwoods to the north. On the Florida Master Site File form this site is incorrectly mapped and shown as being located at the confluence of Hontoon Dead River and Snake Creek. The site is actually located on the north side of Snake Creek several hundred meters to the east of its FMSF location (Figure 5-3). Seven short, site-definitional transects were dug at 8VO215 to define its boundaries and cultural affiliation. In all a total of 20 STPs were dug, 10 of which contained cultural materials and/or shell and faunal material. This site is defined primarily by accumulations of shell midden although cultural materials were recovered from locations lacking midden deposits. The site measures approximately 50 m east-west and 60 m north-south and has a somewhat crescent-shaped plan, following the curvature of the topography on which it is deposited.

Generally this site consists of rather shallow midden deposits ranging in thickness from 30 to 50 cm. Stratigraphy at the site generally consists of a humus zone and loosely compacted gray or brown sand to a depth of 10-30 cmbs. The midden matrix is composed of loosely compacted sand and shell at the interface of the sand overburden and the midden and dense viviparous shell varying between 20 and 50 cm in thickness. Underlying the midden zone is light gray sand, and in some cases, limestone, mineralized sand, and midden concretion. In the case of the latter this occurred at the bottom of the midden zone before culturally sterile sand was reached.

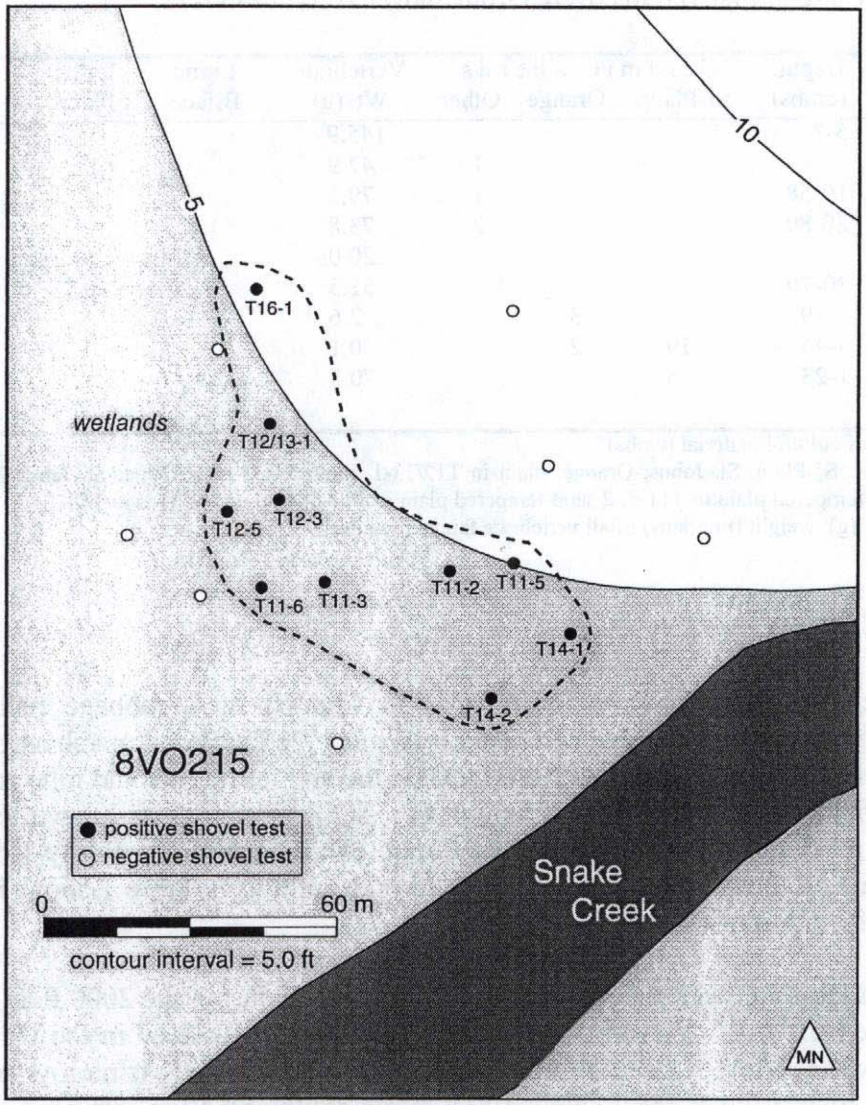

Figure 5-3. Sketch map of 8VO215, showing locations of shovel tests and site boundaries (dashed line) derived from shovel-test results.

Cultural materials recovered from 8VO215 are listed in Table 5-2 Artifacts found at this site include pottery of the St. Johns and Orange series, including St. Johns Plain and Cord-Marked; Orange Incised and Plain; and Sand Tempered Plain. Two possible bone pin fragments were recovered from a single shovel test. Two flaked stone artifacts were also recovered, one bifacial tool and one lithic waste flake. In most shovel tests yielded moderate quantities of vertebrate faunal remains.

Site 8VO215 appears to date to the St. Johns I period, with a minor Orange component. Its limited midden deposits suggest that the site may have functioned as a short-term habitation site or a resource extraction location.

Table 5-2. Cultural Material Recovered from Shovel Tests at 8VO215.

Tran-sect	STP #	Depth. (cmbs)	Ceramic Sherds SJ-Plain	Orange	Other	Vertebrate Wt. (g)	Lithic Biface	Lithic Flake	Other
11	2	5-?				145.9			
	3				1	47.9		1	
	5	10-58			1	79.5			2 worked bone
	6	20-80			2	73.8	1		
12	3					20.0			
	5	30-70				51.3			
12/13	1	5-19		3		2.6			
14	1	5-45	19	2		0.1			
	2	1-23	5			70.8			
16	1								

Depth: depth of cultural material (cmbs)
Ceramic sherds: SJ-Plain: St. Johns; Orange: plain in T12/13-1, incised in T14-1; Other: St. Johns Cord-Marked in T11-5; 1 sand-tempered plain in T11-3, 2 sand-tempered plain in T11-6; 18 crumb sherds in T14-1
Vertebrate Wt. (g): weight (in grams) of all vertebrate faunal remains

East Hontoon (8VO7494)

The East Hontoon site (8VO7494) is situated in a cabbage palm and oak hammock at on the eastern edge of Hontoon Island. Wetlands and marsh associated with the main channel of the St. Johns River bounds the site to the east and pine and palmetto flatwoods border it to the west. Although this site apparently was known to Purdy and colleagues as evidenced by their published map of the island (e.g. Purdy 1991:105), no FMSF form has been filled out for this site and nothing is known about its cultural-historical affiliation or function.

East Hontoon was encountered by shovel testing during the 2000 field season and further tested in 2001. Eleven transects and 30 STPs were placed in the vicinity of the site, 17 of which yielded cultural material (Figure 5-4). This site is narrow and linear in orientation, measuring approximately 100 m north-south and 40 m east-west, conforming closely to the edge of the hammock on which it is situated. A diffuse midden zone and organically stained soils characterize the center of the site and scattered artifactual and faunal remains typify the edges.

Stratigraphy varies but generally consists of a humus zone from the surface to 12 cmbs, gray sand from 12 to 54 cmbs, a brown, organically stained zone with faunal material from 54-60 cmbs, mixed shell with brown or gray organic soils and faunal bone from 61-77 cmbs, and gray-tan mottled sand below 77 cm. On several occasions limestone and clay were encountered at depths of approximately 70-75 cmbs.

Cultural materials recovered from East Hontoon are listed in Table 5-3 and include several St. Johns plain sherds and three Orange fiber-tempered sherds from a single test, as well as a biface of indeterminate type (Figure 6-5), possibly associated with St. Johns period occupation, and a lithic flake. Vertebrate faunal remains were collected form virtually all test pits.

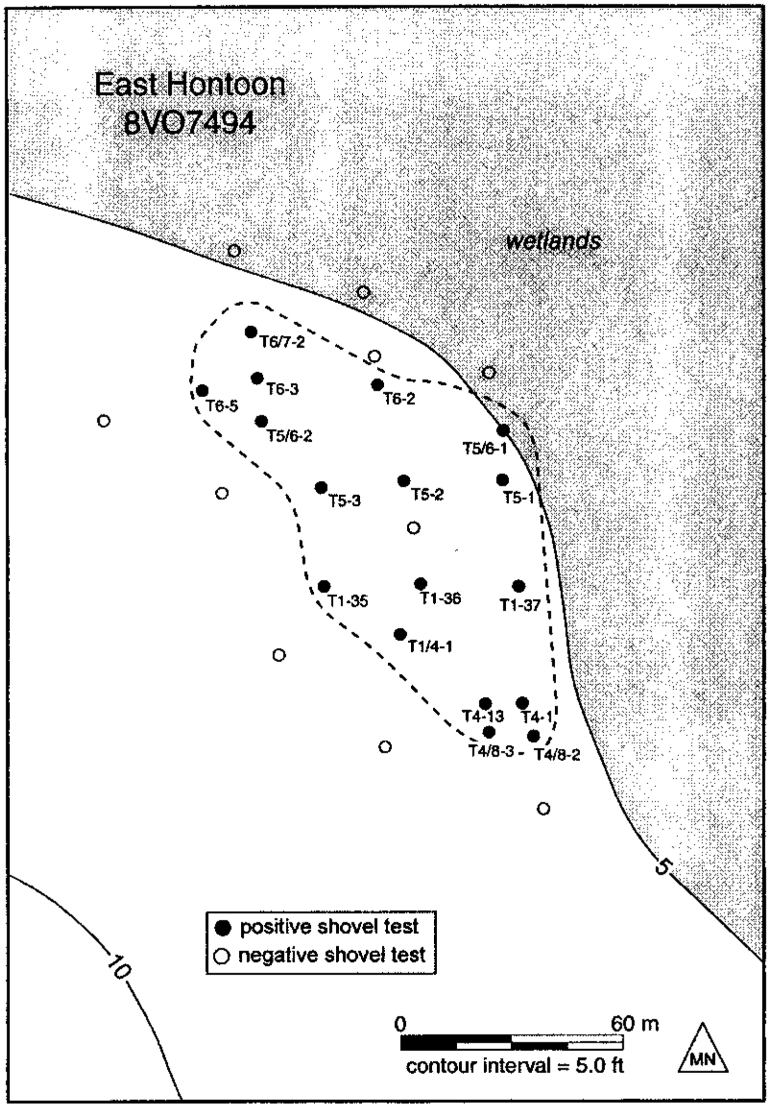

Figure 5-4. Sketch map of 8VO7494, showing locations of shovel tests and site boundaries (dashed line) derived from shovel-test results.

East Hontoon represents a series of small, ephemeral occupations with at least two components; a Late Archaic Orange component and a later St. Johns I or II component. Evidence for the Orange occupation is scant, consisting of only a few sherds of fiber-tempered pottery from a single shovel test. Because of its diffuse nature and restricted extent both the vertical and horizontal distribution of cultural materials it is likely that this site functioned as a small temporary campsite where subsistence related tasks were carried out over a short period of time.

Table 5-3. Cultural Material Recovered from Shovel Tests at 8VO7494.

Tran-sect	STP #	Depth. (cmbs)	Ceramic Sherds		Vertebrate Wt. (g)	Lithic Biface	Lithic Flake	Other
			SJ-Plain	Orange				
1	35		1		1.3			
	36				5.0			
	37	30-65	1		1.1			
1/4	1	33				1		
4	1				23.5			
	13	40-59			19.5		1	
4/8	2	45-70			4.8		1	1 marine shell
	3	50-95			9.4			
5	1	25-75	1		30.7			
	2	30-70			36.1			
	3	64-77		3	8.4			
5/6	1	25-50	3		6.5			
	2	50-75			11.4			
6	2	20-50			3.3			
	3	20-100			2.3			
	5	30-50			2.4			
6/7	2	50-65			2.8			

Depth: depth of cultural material (cmbs)
Ceramic sherds: SJ-Plain: St. Johns Plain
Vertebrate Wt. (g): weight (in grams) of all vertebrate faunal remains

Indian Mound Trail Site (8VO7493)

The Indian Mound Trail site is a previously unknown and unrecorded site located in both a mixed hammock and cypress swamp environments on the western margin of Hontoon Island. The site is bisected by the Indian Mound Trail and situated on a slight topographic rise with Hontoon Dead River located less than 25 m from the western edge of the site (Figure 5-5).

Intercepted by a single transect (T15) during the last day of 2001 survey, the Indian Mound Trail site was subjected to only five shovel tests, three of which yielded cultural material. The exact extent of the site is at present unknown but the east-west extent is approximately 120 m. Its north-south dimension is presently unknown but is likely linear in orientation, following the edge of Hontoon Dead River. This site is characterized by a diffuse artifact scatter in the hammock area and a moderately dense, buried shell midden at the edge of the cypress swamp and the hammock.

Stratigraphy is variable at the Indian Mound Trail site but the hammock area generally consists of a humus zone from 0-20 cmbs, light gray sand from 21-40 cmbs, dark gray or light brown sand from 40 to 70 cmbs and dark brown hardpan below 70 cmbs. Stratigraphy of the shell midden consists of humus from 0-20 cmbs, shell midden and gray sand from 20-50 cmbs, and homogenous, sterile black sediments from 50-70 cmbs. Cultural materials in the hammock area of the site were found between 50 and 60 cmbs and all artifacts found in the midden area were recovered from the midden zone, 20-50 cmbs.

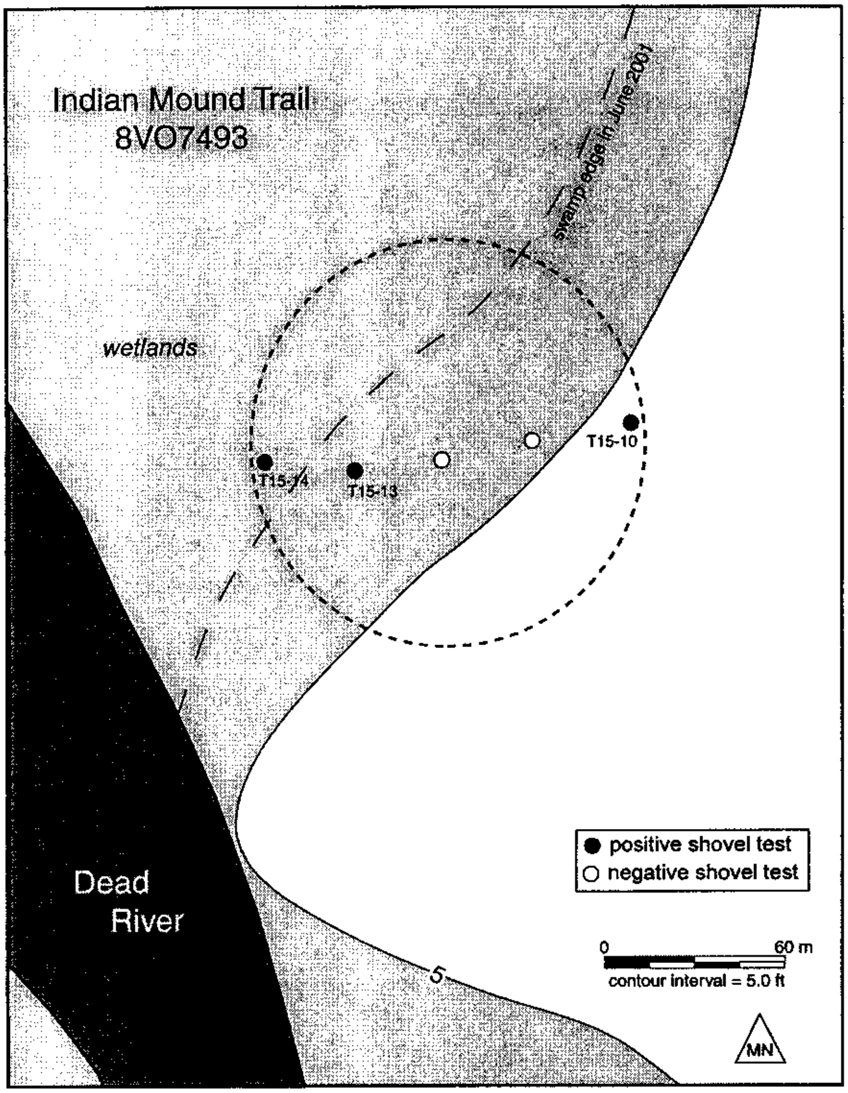

Figure 5-4. Sketch map of 8VO7493, showing locations of shovel tests and provisional site boundaries (dashed line) derived from shovel-test results along a single transect.

Cultural materials recovered from this site are listed in Table 5-4 and include a single lithic waste flake and Stemmed Archaic biface (Figure 6-5), both from the hammock area, as well as small fragments of three different bone pins and other faunal bone recovered from the single test in the midden. Based on the artifacts recovered and the lack of pottery at the site, Indian Mound Trail site may represent a preceramic Archaic habitation site, although sampling thus far is woefully inadequate to make any definitive statements about components at this site. The diffuse nature of the site may also suggest that it functioned as a short-term habitation site oriented toward the exploitation and extraction of resources in the environment immediately surrounding the site. The extent and nature of the site remain to be defined more accurately and additional testing is recommended.

Table 5-2. Cultural Material Recovered from Shovel Tests at 8VO7493.

Tran-sect	STP #	Depth. (cmbs)	Vertebrate Wt. (g)	Lithic Biface	Lithic Flake	Other
15	10	60		1		
	13	50			1	
	14		114.0			4 bone pin frags.

Depth: depth of cultural material (cmbs)
Vertebrate Wt. (g): weight (in grams) of all vertebrate faunal remains

CONCLUSIONS

Hontoon Island supports a suite of large and small shell-bearing sites around much of its perimeter. Two newly discovered sites add to this overall pattern, and the lack of sites in areas surveyed in the interior underscore the importance of wetlands and river channels for sustained human occupation. The lack of even small extractive sites in the interior of the island is not surprising considering the size of the island. Terrestrial resources could easily be procured in the interior of the island and returned to river-edge sites for processing and consumption. Of course, other sorts of activities likely took place at locations in the interior, but any traces of such activity have thus far gone undetected.

The relationship between the smaller midden sites like 8Vo215, East Hontoon, and Indian Mound Trail, and the larger sites such as 8VO202 and 8VO214 are not yet fully understood. However, it seems likely these are components of a larger settlement-subsistence system of the St. Johns region in general, where larger sites of long-term occupation are flanked by smaller resource extraction sites oriented in a linear fashion relative to the St. Johns and smaller relict channels and swamps. The overall location of sites, close to water and wetlands, and the absence of sites in interior areas of the island underscores again the importance of aquatic resources to middle St. Johns subsistence economies.

There yet exists great potential for additional sites along the edges of the island in the mixed hammock environments, particularly on the western and southern edges of the island where some slight, though relatively significant, elevation changes occur between the hydric hammock and swamp forests and the mixed hammock and flatwoods habitats. Further testing of these areas of the island should prove fruitful. Circumferential testing of the interior, seasonal wetlands with close-interval tests may likewise prove fruitful.

CHAPTER 6
ARTIFACT ASSEMBLAGES

The combined subsurface testing operations at Blue Spring Midden B (8VO43), Live Oak Mound (8VO41), and Hontoon Island resulted in the recovery of 5,444 objects of human manufacture or modification. As shown in Table 6-1, the vast majority (88.2%) of the artifacts came from 8VO43, where 1/8-inch waterscreening of some of the deposits resulted in the recovery of many minute items. If we delete from this particular inventory the large assemblage of "crumb" sherds (i.e., sherds <1/2-inch in maximum dimension), the total count of artifacts project-wide drops to 1351. Considering the total volume of excavation, this is a rather meager assemblage. Like many sites in the middle St. Johns region, those investigated by the 2000-2001 field school do not include many objects made from stone, nor is unmodified stone common, owing largely to the great distance between these sites and geological sources of toolstone. Another contributing factor is the prevalence of preceramic deposits at both Blue Spring Midden B and Live Oak Mound. These contexts yielded a small assemblage of marine-shell tools, but are, by definition, devoid of pottery and include only a handful of flaked stone artifacts. Moreover, many contexts demonstrably ceramic period in age have very limited artifact density. The meager inventory of sherds from Live Oak Mound, as noted by Wyman (1875) and verified by us in 2001, is especially curious considering the extremely high density of St. Johns sherds in shovel tests at 8VO202 on Hontoon Island. Cross-cutting all such contexts, high to low in artifact density, preceramic to ceramic, are consistently dense assemblages of food remains. It is thus strikingly obvious that sites in the study area have artifact assemblages that covary independently of subsistence refuse. That is, the accumulation of inedible food remains sometimes occurred apart from the deposition of tools, tool by-products, and other material culture. In other contexts, the two accumulated simultaneously. Detailed interassemblage comparisons are required to understand how such intersite variation relates to regional land-use patterning.

Table 6-1. Absolute Frequency of Artifacts Recovered during the 2000-2002 Field Schools by Artifact Class and Site Context.

	8VO41	8VO43	Hontoon Island	Total
Pottery sherds				
fiber-tempered	16	626	6	648
other	72	24	435	531
crumb	44	4047	2	4093
Flaked stone	38	46	11	95
Shell tool		11		11
Shell ornament	1	11		12
Bone tool/ornament	6	41	7	54
Total	177	4806	461	5444

Toward this goal, the sections that follow provide descriptions of the artifacts recovered during the 2000-2001 field school seasons. Other than the treatment of fiber-tempered pottery from Blue Spring Midden B, little of what follows is analytical. Few of the contexts outside 8VO43 were sampled adequately enough or constitute sufficiently sound contexts to warrant more than descriptive treatment. A complete inventory of all artifacts by context is provided in Appendix A.

POTTERY

The inventory of 1179 sherds (excluding crumb sherds) recovered from subsurface contexts at all field school sites is divided into two major types: Orange and St. Johns. All but a handful of sherds of the former type came from test units at Blue Spring Midden B, while nearly 80 percent of the latter type came from 8VO202 on Hontoon Island.

Orange Fiber-Tempered Pottery

The middle St. Johns region of northeast Florida is home to some of the oldest pottery in North America, Orange fiber-tempered ware, dating to at least 4000 rcybp. A cultural-historical sequence for Orange pottery was established nearly 50 years ago by Ripley Bullen (1954; see also Bullen 1972). In this sequence, Orange pottery was made and used over a period of 1000 years, first in a plain form, then as a decorated ware. In the final centuries of its existence, Orange pottery gave way to the sponge spiculate wares of the St. Johns pottery tradition.

Blue Spring Midden B yielded a sizable assemblage of plain Orange sherds from the upper portions of Test Units 1-4 at the Thursby House and TU1 in the WWTA (see Chapter 3). Sherds were not recovered in the basal strata of these units. Little in the content or internal structure of these lowest strata would suggest a stratigraphic unconformity between preceramic and ceramic-bearing components. Pottery appears to have been "introduced" without any obvious break in occupation or radical change in site function and subsistence activities (see Chapter 7). Blue Spring Midden B therefore offers a good opportunity to investigate the circumstances surrounding the initial use of pottery in the area, as well as contribute to a growing body of data on the technological and functional variation of Orange fiber-tempered pottery.

All but three of the 626 fiber-tempered sherds from Blue Spring Midden B have plain surface treatments. The meager sample of decorated sherds includes incised and punctuated surface treatments. The overwhelming dominance of plain surface treatments suggests the assemblage dates to Bullen's Orange 1 subperiod, which he estimated to date from 4000-3650 rcybp (Bullen 1972:13). Incised and punctated surface treatments in the Bullen sequence appear in the Orange 2 subperiod, estimated at 3650-3450 rcybp. The subsequent subperiod, Orange 3 (3450-3250 rcybp, according to Bullen), witnessed the dominance of incised over plain pottery, as well as significant changes in vessel form.

The radiometric ages reported in Chapter 3 for levels containing Orange sherds at Blue Spring Midden B, ranging from 3780 to 3510 rcybp, fall squarely within the Orange 1 and 2 subperiods. The two age estimates for strata below pottery (4210 ± 50 and 4360 ± 120 rcybp) are likewise consistent with Bullen's chronology

Although the Blue Spring Midden B pottery assemblage fits well within Bullen's sequence for Orange, recent radiocarbon dates for incised Orange pottery from the middle St. Johns region suggest that the sequence is not as unilinear as once believed (Sassaman 2003). In brief, a series of seven AMS dates on soot from incised Orange sherds from Tick Island (8VO24), Mosquito Hammock (8LA28), and Mouth of Silver Glen Run (8LA1), all located within 40 km of Blue Spring, returned assays in the range of 4070 ± 40 to 3610 ± 40 rcybp. Although assemblages from these sites would be classified as Orange 3 (3450-3250 rcybp) based on surface treatment and form alone, they clearly date to Bullen's Orange 1 subperiod. The significance of these new data lies in the recognition that assemblages dominated by plain fiber-tempered pottery are coeval with nearby assemblages dominated by decorated fiber-tempered pottery. These contemporaneous assemblages likewise differ markedly in terms of vessel form and function. Because such variation can no longer be regarded as chronological (i.e., change in surface treatment and form over time), as the Bullen sequence implies, we are encouraged to explore alternative factors, such as functional specialization, or ethnic diversity. In this regard, data on technological and functional variation of Orange pottery is of foremost relevance.

The Orange pottery assemblage from test units at the Thursby House lends itself to a vessel unit of analysis. The sherds taken from these subsurface contexts are supplemented by several dozen Orange sherds collected by Richard Harris from spoil removed from beneath the Thursby House as foundation piers were being replaced in 2000. A total of 610 sherds >1/2-inch in size were available for analysis. To determine minimum number of vessels, 159 rim sherds were sorted into like lots by surface treatment, paste, and lip/rim form; body sherds were added to rim sherd lots whenever similarities in surface treatment and paste allowed. An intensive refitting effort resulted in the assembly of several dozen sherds into sizable portions of two vessels. The resulting sample of vessel lots consists of a minimum of 27 vessels, most represented by only one to four sherds. Figure 6-1 provides examples of sherds from 10 of those lots; Table 6-2 lists all the data collected for each of the 27 vessel lots.

Vessel lots were analyzed for a series of variables, including temper, surface treatment, lip form, lip thickness, rim form, rim thickness, and orifice diameter. Observations of temper were admittedly subjective and simply involved a determination of the relative abundance of fiber (abundant, minor) and presence of sand grains visible to the naked eye. A small, fresh break was made on each sherd to make these determinations. Codes for lip form and rim form are those used by Sassaman (1993) in his analysis of Stallings fiber-tempered pottery from the Savannah River region. Measurements for lip and rim thickness were recorded to the nearest tenth of a millimeter using dial calipers. Rim thickness was taken at a point 3 cm below the lip, and was thus available for measurement on only large rim sherds. Orifice diameter was measured with

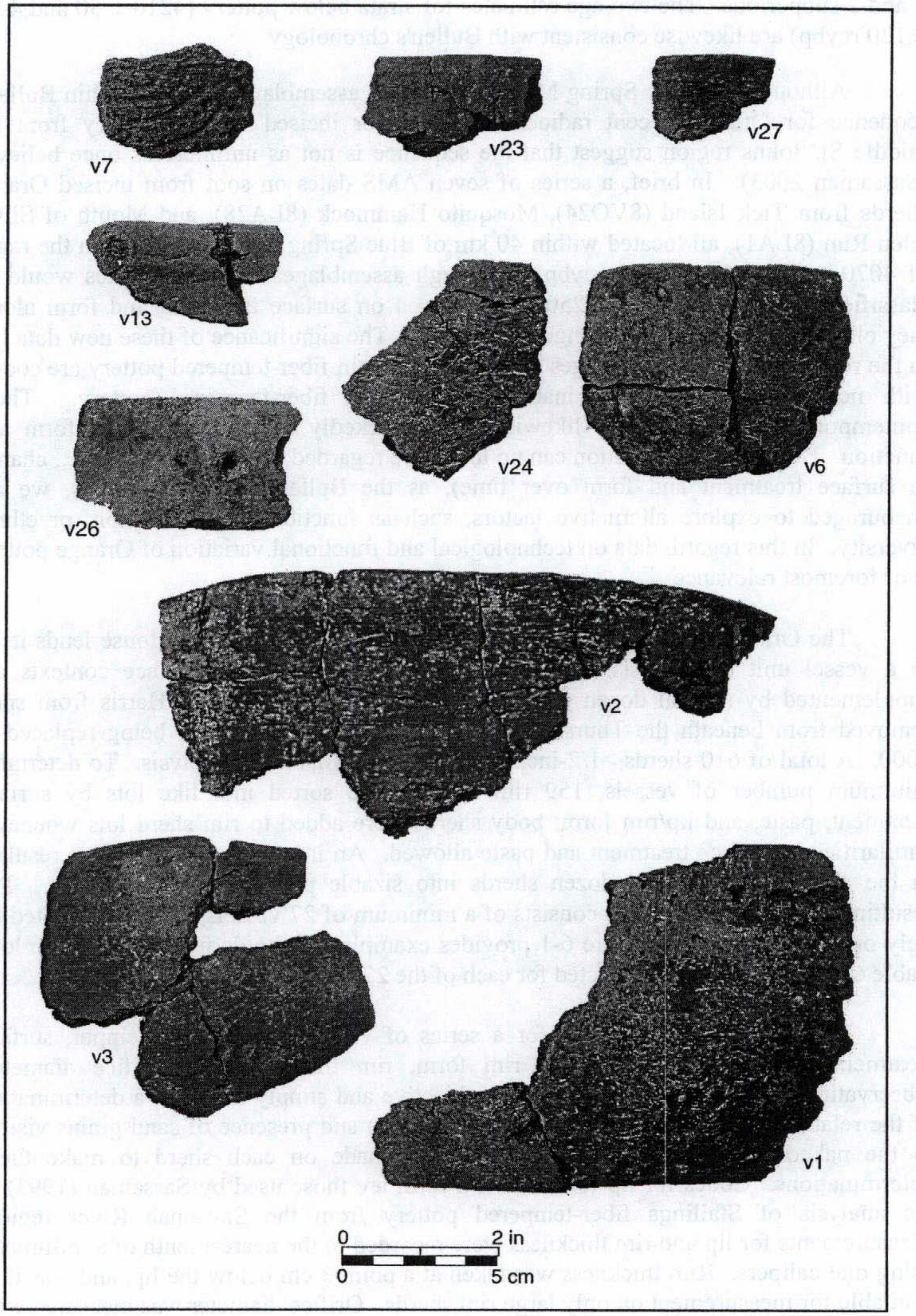

Figure 6-1. Examples of Orange fiber-tempered vessel lots from Blue Spring Midden B (8VO43).

Table 6-2. Data on Orange Fiber-Tempered Vessel Lots from Blue Spring Midden B (8VO43).

V #	# Sherds	Temper	Surface Treatment	Lip Form	Lip Thk. (mm)	Rim Form	Rim Thk. (mm)	Orifice Diam. (cm)
1	9	FAS	PL	IR		ST	11.6	
2	76	FAS	PL	FD/FI	12.7	ST	6.5	27-33
3	4	FAS	PL	PR	5.5	IN	8.3	22
4	3	FAS	PL	PR	8.1			
5	4	FAS	PL	FI	7.2			
6	3	FAS	PL	RD	6.5	IN	7.1	24
7	4	FAS	INP					
8	3	FAS	PL	RD	8.4			
9	3	FAS	PL	BE	7.5	IN	6.8	
10	1	FAS	IN	RI	5.2			
11	10	FAN	PL	RD	4.4	IN	4.8	
12	2	FAS	PL	BI	5.1			
13	6	FAS	PL	IR				
14	2	FAS	PL	RD	5.0			
15	2	FAS	PL	RE	7.5			
16	4	FAN	PL	RD	5.8			
17	1	FAS	PL	FI	6.8			
18	1	FAS	PL	RE	6.2			
19	4	FAS	PL	RD	6.8			
20	1	FAS	PL	RD	7.1			
21	4	FAN	PL	IR/RE	7.7			
22	4	FAS	PL	RD	6.1			
23	2	FAS	PL	XF	6.4			28
24	2	FAS	PL	RD	5.7	IR	10.4	
25	2	FAS	PL	RE	4.4			
26	1	FAS	PL	RE	7.5	IN	9.6	
27	1	FAN	PL	RE	5.5			

V#: vessel lot number
Temper: FAN, fiber abundant, no visible sand; FAS, fiber abundant, sand visible
Surface Treatment: PL, plain; INP, incised and punctuated; IN, incised
Lip Form: XF, flat; RD, rounded; RE, rounded exterior; RI, rounded interior; PR, tapered; FD, double flange; FI, flanged interior; BE, beveled exterior; BI, beveled interior; IR, irregular
Rim Form: ST, straight; IN, incurvate; IR, irregular

a rim chart and was attempted for only those vessel lots with at least 10 percent of the rim present.

The Blue Spring Midden B sample of Orange Plain vessels embodies considerable variation in some respects, but generally these are small, shallow basins or bowls with flat or nearly flat bottoms, thin walls, and abundant fiber vesicles. The largest and most complete example is Vessel 2 (Figures 6-1, 6-2), an oval-shaped basin measuring 33 x 27 cm at the orifice. Its height cannot be determined for lack of a conjoining basal sherd (Figure 6-3), but it is estimated at about 15 cm. Its lip is thickened in places to form an irregular flange, but otherwise the walls are very thin (6.5 mm). Both interior and exterior surfaces were irregularly burnished, resulting in a variegated pattern of oxidation from firing.

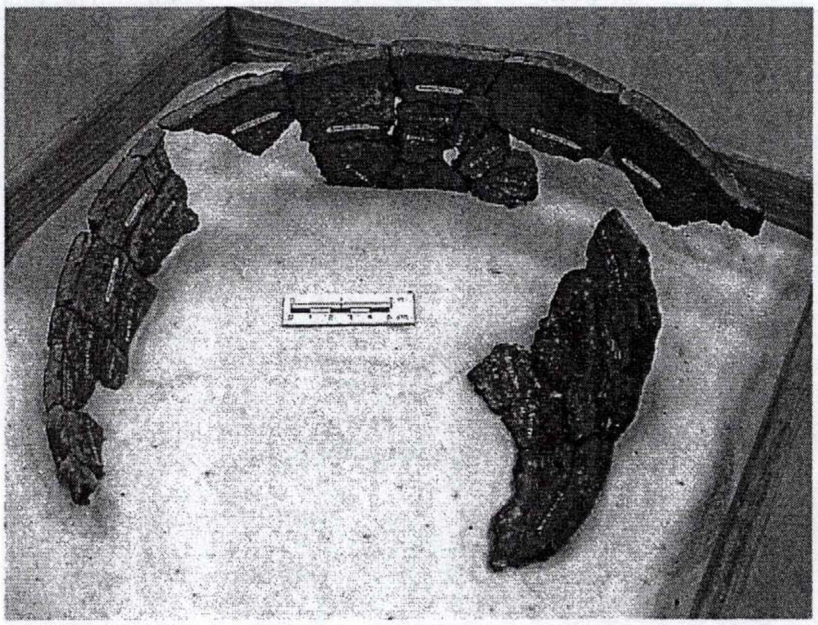

Figure 6-2. Reassembled portions of two Orange Plain vessels (Vessels 1 [bottom right] and 2 [top]) from Blue Spring Midden B (8VO43) (scale is 2.0 inches/5.0 cm)

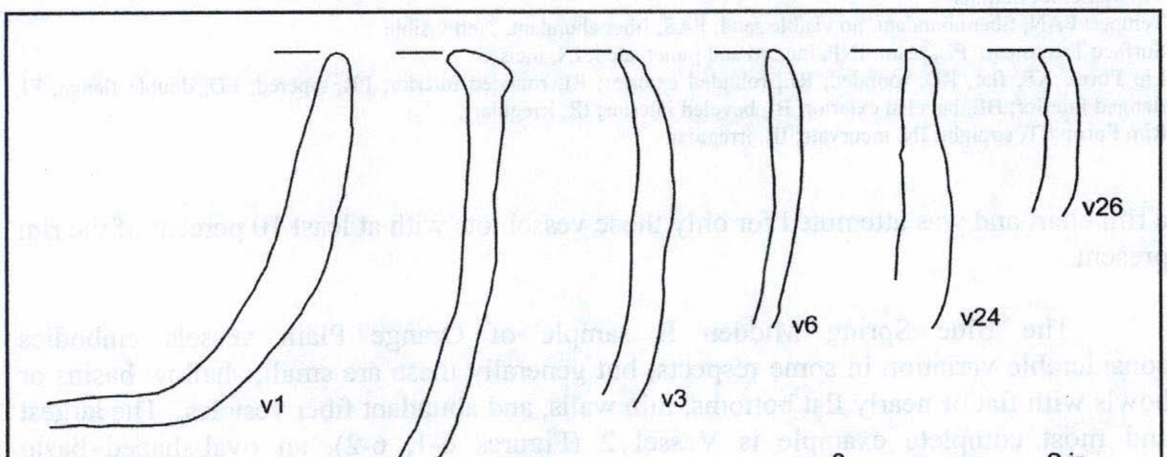

Figure 6-3. Profiles of rim portions of six Orange Plain vessels from Blue Spring Midden B (8VO43).

Another vessel lot with multiple conjoined sherds is Vessel 1, a shallow, flat-bottomed basin with thick walls and a thin base (Figures 6-1, 6-2). Its outflaring walls form a profile that is only about 8 cm tall (Figure 6-3).

Paste among the Orange Plain vessels from Blue Spring does not vary much with respect to fiber content. All were tempered with abundant fiber as is evident in the numerous vesicles and high porosity of the interiors of sherds. They vary somewhat in the abundance of visible aplastics, largely fine to medium sand. An occasional example may likewise include sponge spicules and at least one vessel lot includes minor traces of shell. This later inclusion type was identified by microscopy by Ann Cordell (2001) of the Florida Museum of Natural History (FLMNH). As part of a regionwide study of paste variability in Orange pottery, Cordell examined three sherds from Blue Spring Midden B. None of the Blue Spring sherds examined by Cordell had spiculate paste, although this constituent is not uncommon to incised fiber-tempered sherds in the middle St. Johns (Cordell 2001). Notably, several of the incised fiber-tempered sherds mentioned earlier in our reassessment of the Bullen sequence contain frequent spicules in the paste, underscoring the ambiguity of this inclusion for cultural-historical purposes.

Again, surface treatment in the Blue Spring sample is predominately plain, although several were clearly also lightly or irregularly burnished. Of the two vessel lots with incising, Vessel 7 (Figure 6-1) is noteworthy for its curvilinear motif and background punctations, two of the hallmark features of Bullen's Tick Island Incised type. Contrasted with the general homogeneity of the plain surfaces along the vessel lots is a high degree of variation in color and texture, indicative perhaps of varying firing environments and taphonomic conditions. None of the sherds in these lots bears any trace of soot on exterior walls. An absence of soot on Orange Plain vessels contrasts with abundant soot on many sherds of Orange Incised from Tick Island and other middle St. Johns sites. Once believed to indicative on an increase of direct-heat cooking through time (Sassaman 2002:415), the incidence of soot on Orange Incised vessels points to marked differences in the uses of plain and incised vessels that is fully synchronic (Sassaman 2003).

Lip form varies widely across the Blue Spring vessel lots, reflecting the overall nonstandardization of form in the assemblage. Rim forms are less varied than lips, as all vessel lots with large enough rim sherds express a generally open profile, with either straight or slightly incurvate walls (Figure 6-3). Again, too few of the lots have basal fragments to complete the profile, although all are believed to be flat-bottomed forms with heights no greater than 15 cm.

Comparisons of the Blue Spring Orange Plain assemblage with others in the middle St. Johns are hampered somewhat by lack of comparable data. However, the sizable assemblage of sherds from the Bluffton site (8VO22), 25 km north of Blue Spring, was recently analyzed as part of a class project by Christian Russell. The assemblage from Bluffton housed at the FLMNH was analyzed by Russell using the same protocols employed in this study. This sample consists of 218 vessel lots, 196 of which are Orange Plain, four Orange Incised, and two Tick Island incised.

Table 6-3. Comparison of Vessel Wall Thickness and Orifice Diameter for Orange Plain Vessels from Blue Spring Miden B (8VO43) and Bluffton (8VO22).

	Blue Spring	Bluffton
Vessel Wall Thickness (mm)		
n	8	175
mean	8.1	7.6
st. dev.	2.3	1.5
minimum	4.8	3.9
maximum	11.6	12.5
Orifice Diameter (cm)		
n	4	179
mean	26.0	21.2
st. dev.	3.7	6.3
minimum	22.0	10.0
maximum	30.0	46.0

In most respects, the Bluffton and Blue Spring assemblages are indistinguishable. The range of variation for rim thickness and orifice diameter for the admittedly small Blue Spring assemblage fits comfortably within the ranges of the Bluffton assemblage (Table 6-3). All lip and rim forms observed in the Blue Spring assemblage occur commonly at Bluffton, as does the single example of a rim lug or node seen at Blue Spring (Figure 6-1, Vessel 13). The occasional occurrence of repair holes on sherds from Bluffton also has a counterpart in the Blue Spring sample (Figure 6-1, Vessel 26). Differences between the two assemblages may owe more to sample bias than to any real deviations.

Minor occurrences of Orange pottery from the 2000-2001 field schools are noted from the disturbed strata of LP1 at Live Oak Mound (see Chapter 4), a single shovel test at East Hontoon, and two shovel tests at 8VO215 (see Chapter 5). The Live Oak examples include incised sherds with motifs characteristic of Bullen's Orange 3 subperiod (Figure 6-4). Given the new AMS dates for incised Orange pottery, examples from Live Oak are most likely coeval with the plain sherds from Blue Spring, thus raising the hypothesis that vessels with differing forms and surface treatments were not only functionally distinct, but also spatially segregated at different sites on the landscape. We might add that the decorated ware is from a mound of presumed ritual significance and the plain ware from a location of domestic activity.

St. Johns Pottery

The long-lived St. Johns sponge-spiculate pottery tradition in northeastern Florida began no later than 3000 rcybp and persisted through the protohistoric era. Over these millennia, the tradition evolved such that variations in surface treatment and associations with other regional wares enable Florida archaeologists to divide the period into two

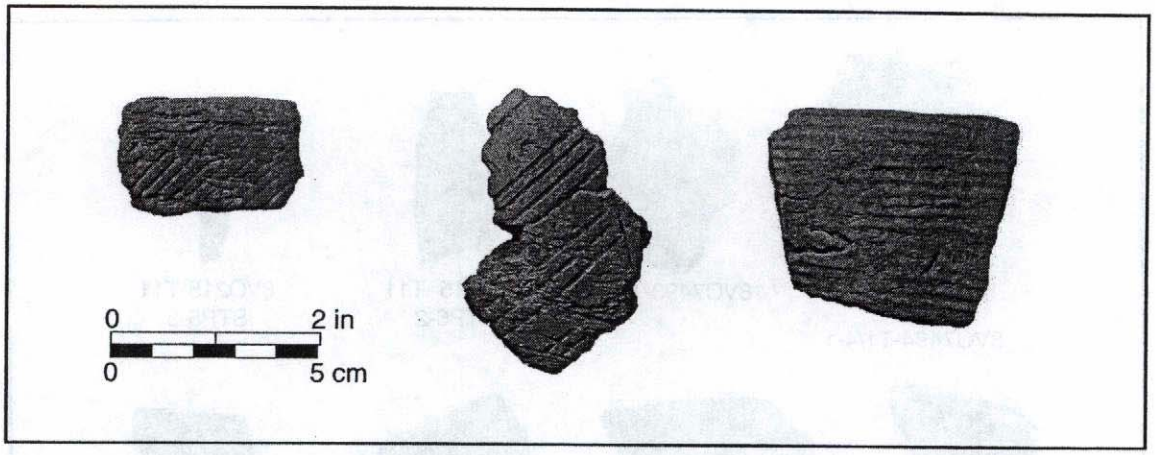

Figure 6-4. Orange Incised sherds (left, middle) and St. Johns Check Stamped sherd (right) from LP1 at Live Oak Mound (8VO41).

major divisions—St. Johns 1 and II—and several subperiods within these divisions (Milanich 1994:247).

St. Johns pottery was recovered from several locations investigated by the 2000-2001 field schools, although four-fifths of this material came from shovel tests at 8VO202 on Hontoon Island (Figure 6-5). A small number of St. Johns sherds came from backfill at Live Oak Mound. No St. Johns sherds were found in secure subsurface context at Blue Spring Midden B, although several were taken from the sand cap over the western half of the site. As discussed in Chapter 3, this cap apparently was deposited over a scoured surface on which stood a large, now-defunct shell mound. The sherds may help to secure a St. Johns affiliation for the mound, although it seems likely that it began to form long before 3000 rcybp.

The presence of check-stamped sherds with spiculate paste marks a post-A.D. 750 age for components at Live Oak Mound (Figure 6-4) and 8VO202 (Figure 6-5), although the later has already been securely dated to as late as the St. Johns IIc subperiod, A.D. 1513-1565 (Purdy 1987, 1991:133). Earlier components of the St. Johns I period are difficult to infer on the basis of plain pottery alone. In the stratified midden tested by Purdy (1991:117) at 8VO202, plain St. Johns wares dominated in the lower levels of Zone IV, a snail midden, and then check stamped and plain pottery co-occurred in the upper part of this zone. In the overlying mussel-shell midden (Zone III), where corn appears, checks became smaller and rim thickness changed. Also noted was the use of a thick slip prior to check stamping. This may very well be evident on some of the sherds illustrated in Figure 6-5, where light-colored exterior surfaces contrast with dark-colored, reduced cores. However, it is not altogether clear whether these examples are truly slipped or instead thin zones of oxidation formed when vessels were pulled from reduction firing while they were still extremely hot. In any event, the occasional "foreign" wares that accompany St. Johns II sherds in large assemblages are absent in all of the assemblages from the field school, owing perhaps to small sample size.

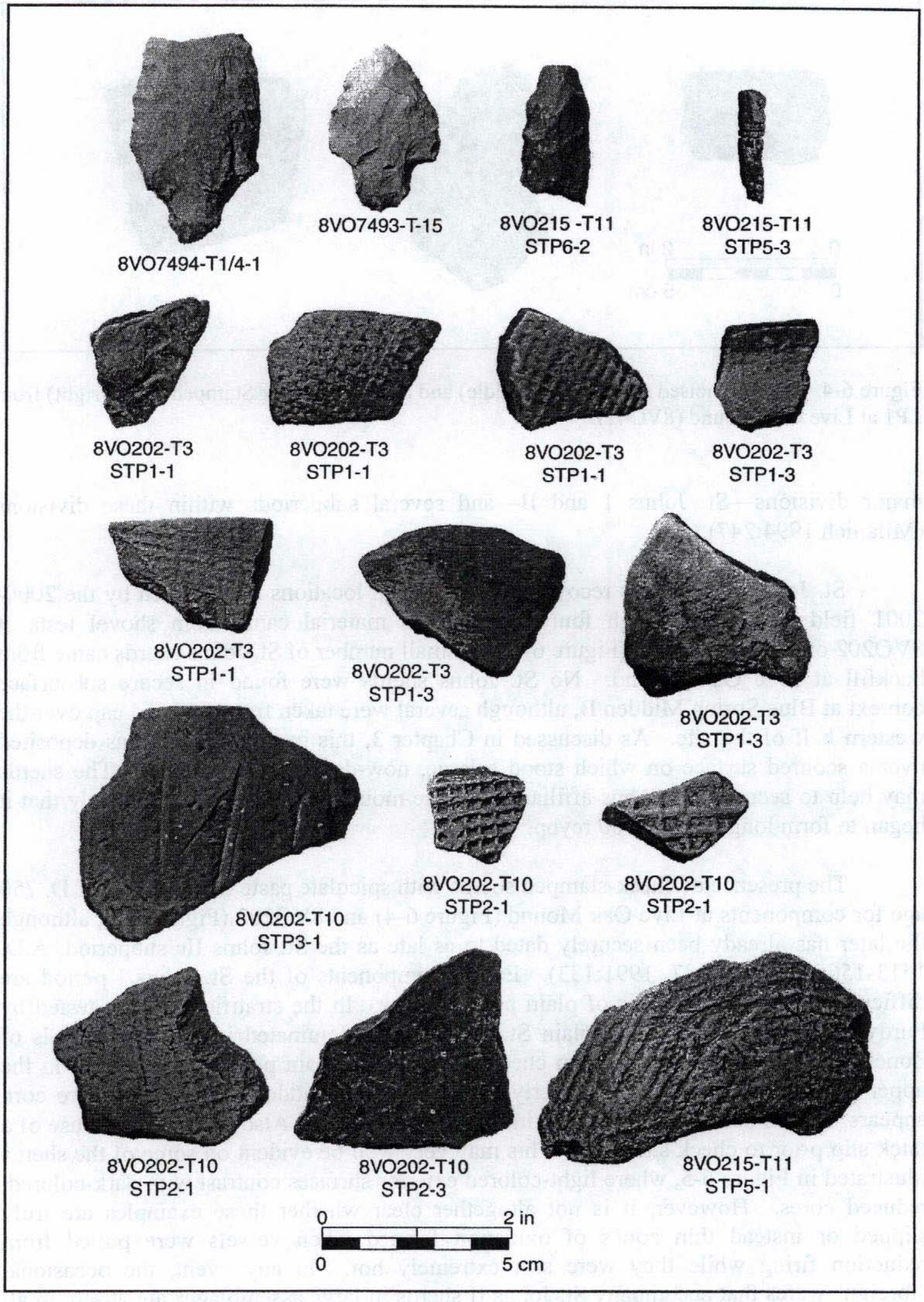

Figure 6-5. St. Johns sherds and other artifacts from various locations on Hontoon Island.

LITHIC ARTIFACTS

Only 95 items of flaked stone were recovered from all contexts examined by the 2000-20001 field schools. Formal tools were limited to a few bifaces. Two stemmed examples from Hontoon Island came from the new sites found on opposite sides of the island. The whole example from 8VO7493 (East Hontoon) is Marion-like in morphology and made from chert that is moderately patinated (Figure 6-5; T15). The other specimen, from 8VO7494, is stemmed chert form whose haft element appears to have been reworked from a broken blade (Figure 6-5: T1/4-1). Neither of these items is terribly diagnostic, but both are most likely affiliated with Mount Taylor or Orange components at these sites.

Transect 15 through 8VO215 yielded a third bifacial tool, this one a caramel-colored chert blade of nondiagnostic morphology (Figure 6-5: T11-STP6-2). The remaining inventory of lithic artifacts from Hontoon Island consist of isolated pieces of debitage in six shovel tests at four sites (see Chapter 5), and a two nondiagnostic bifacial tools from uncertain surface contexts on the island.

The inventory of lithic tools from Blue Spring Midden B is especially sparse considering the presence of a preceramic Mount Taylor component, which, at certain sites in the area (e.g., Groves' Orange Midden [Purdy 1994]), have been known to yield sizeable lithic assemblage despite the vast distance from sources of toolstone. The only "complete" flaked stone tool was a stemmed biface made from a highly porous material (limestone?) (Figure 6-6: TU2-D-4). The large void in the center of this tool caused a lateral fracture at midblade. Its provenience in Level D of TU2 places it squarely in the Orange component. Two other bifacial tools are represented by an apparent stem of a hafted biface (Figure 6-6: TU4-F.7-3), from Feature 7, an Orange-period pit; and the bit of a drill from preceramic context in TU1 (Figure 6-6; TU1-K-6). One retouched flake from the base of TU4 is the only other flaked stone tool from the preceramic levels (Figure 6-6: TU4-VIII-1). A small chert hammerstone (Figure 6-7) was also recovered from preceramic context. All other lithic artifacts recovered from subsurface testing at Blue Spring Midden B were small flakes widely scattered about ceramic and preceramic levels alike.

A small assemblage of 38 lithic artifacts was collected from disturbed contexts at Live Oak Mound. The only formal item was a tapered stemmed biface from the surface near Datum H. A large retouched flake was also collected from the surface of the mound. All other items are unretouched flakes of stone from widely dispersed subsurface contexts in LP1 and LP71.

SHELL ARTIFACTS

In lieu of stone, tool users at Blue Spring drafted marine shell into cutting, chopping, and gouging functions. Large marine gastropods were also used as vessels for cooking. Beads and a pendant were likewise made from shell.

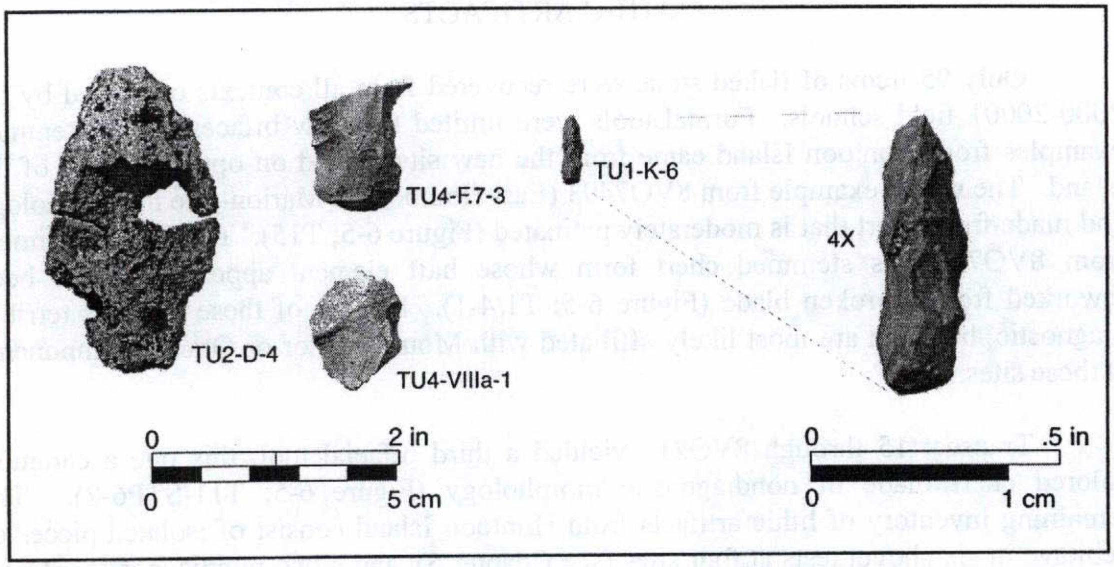

Figure 6-6. Flaked stone tools from test units at Blue Spring Midden B (8VO43).

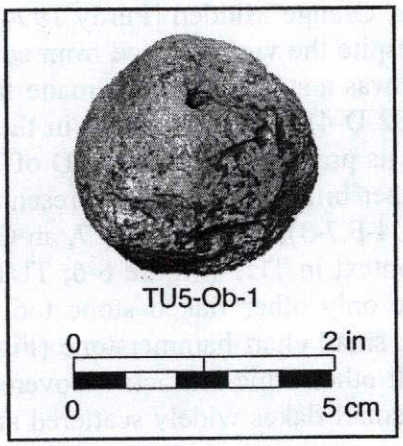

Figure 6-7. Chert hammerstone from Test Unit 5, Level Ob, Blue Spring Midden B (8VO43).

Shell Tools

Eleven specimens of modified marine shell were recovered from secure, subsurface contexts at Blue Spring Midden B (Figures 6-8, 6-9). All but three of these items came from preceramic contexts; two of the remaining three most likely date to the preceramic era, but they were found at the interface of the ceramic and preceramic horizons. Marine shell tools are very common to preceramic, Mount Taylor assemblages form the middle St. Johns region (Wheeler and McGee 1994a; Wheeler et al. 2000).

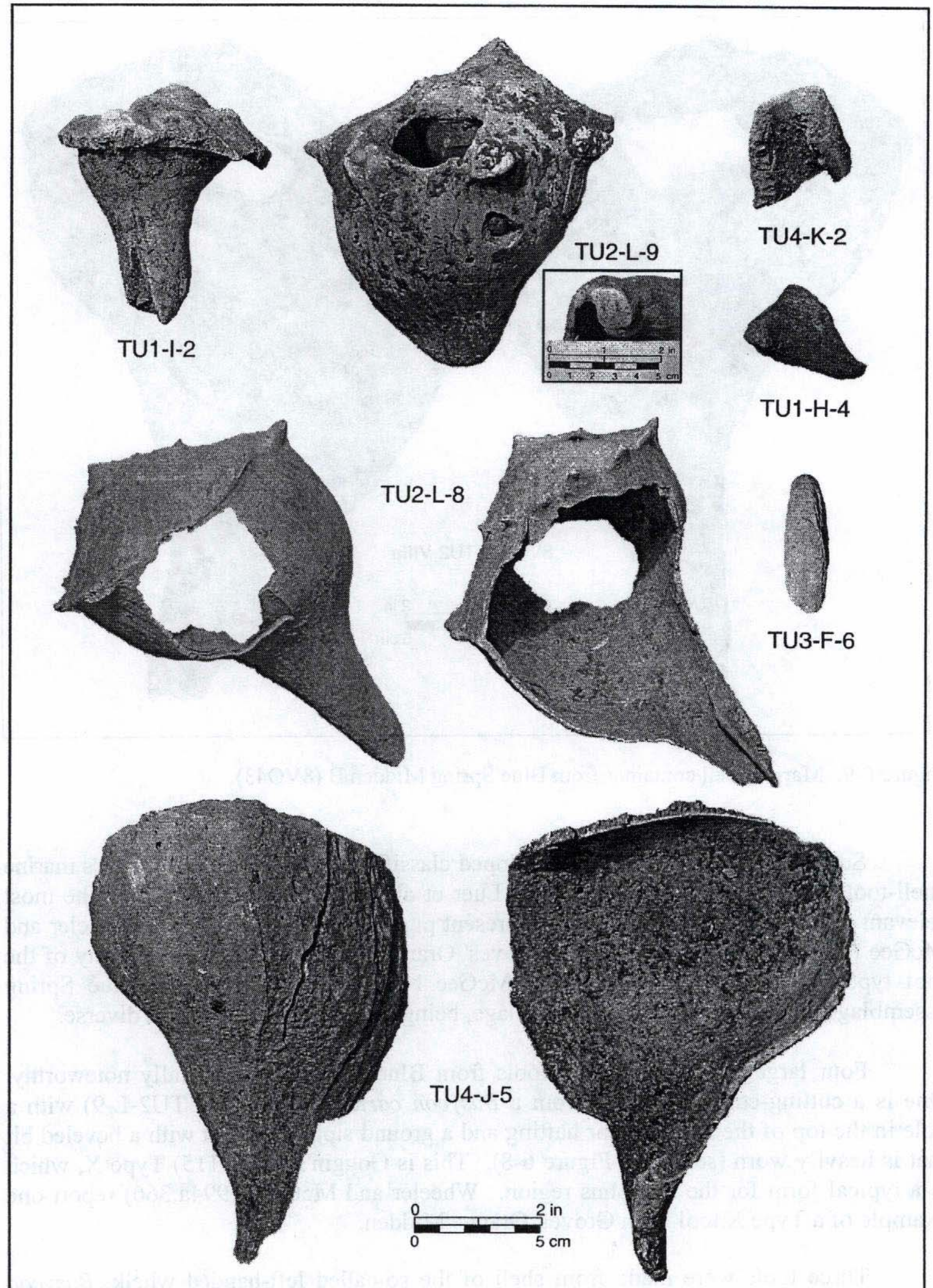

Figure 6-8. Marine shell tools from Blue Spring Midden B (8VO43).

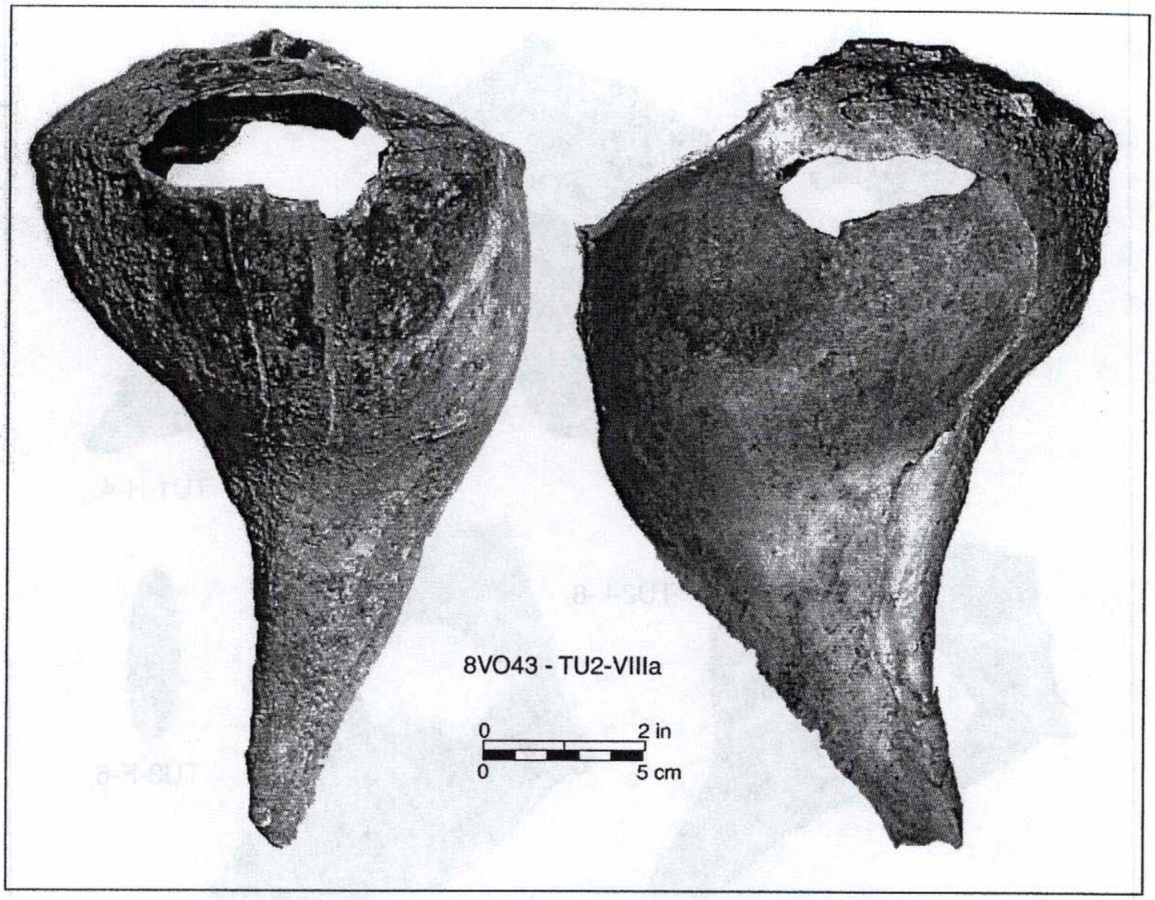

Figure 6-9. Marine shell container from Blue Spring Midden B (8VO43).

Several archaeologists have developed classification schemes for Florida's marine shell-tool industries (e.g., Goggin 1952; Luer et al. 1986; Marquardt 1992). The most relevant treatment of shell tools for the present purpose is that provided by Wheeler and McGee (1994a) in their study of the Groves' Orange Midden assemblage. Many of the tool types described by Wheeler and McGee have counterparts in the Blue Spring assemblage, although the present assemblage, being smaller in size, is not as diverse.

Four large marine gastropod tools from Blue Spring are especially noteworthy. One is a cutting-edge tool made from a *Busycon carica* (Figure 6-8: TU2-L-9) with a hole in the top of the shoulder for hafting and a ground siphonal canal with a beveled bit that is heavily worn (see inset, Figure 6-8). This is Goggin's (1952:115) Type X, which is a typical form for the St. Johns region. Wheeler and McGee (1994a:366) report one example of a Type X tool from Groves' Orange Midden.

Three tools were made from shell of the so-called left-handed whelk, *Busycon contrarium*. One is a large, triangular-shaped section of the outer whorl (Figure 6-8: TU4-J-5). This form often has a beveled edge along the inner margin (Wheeler and McGee 1994a:361, 363-364) to form an adze or gouge, but the example from Blue Spring has fracture margins without macroscopic evidence of modification or wear. Perhaps this was a blank for an adze or gouge.

Two other examples of *B. contrarium* are modified in a manner consistent with use as a container, or what Wheeler and McGee (1994a:365, 368) call a receptacle. The larger of the two (Figure 6-9) was clearly used over a fire, as its outer surface is scorched and blackened with soot, and its interior stained. Holes in the crown and outer whorl of this specimen were made after the carbon accumulated on its outer surface. The other possible container (Figure 6-8: TU2-L-8) is much smaller than the first and lacks evidence of thermal alteration, but in its modification, it fits the morphological criteria of unequivocal containers. Burned *Busycon* containers apparently are found exclusively in preceramic contexts in Florida (Webster 1970).

The remaining specimens of marine shell are mostly fragments. One bit fragment (Figure 6-8:TU4-K-2) appears to be from a Type X cutting-edge tool, most likely from a shell of *B. carica*. A crown and inner whorl portion of another *B. carica* may be the remnant of yet a third Type X tool (Figure 6-8: TU1-I-2). One other fragment illustrated in Figure 6-8 (TU1-H-4) is part of a knob. Finally, the lozenge-shaped piece of weathered shell (Figure 6-8:TU3-F-6) cannot be identified as to tool type, although it may possibly be a remnant of a perforator.

Shell Ornaments

Eleven shell beads were collected form various levels of the Blue Spring test units, mostly from the subsistence columns and feature fill (Figure 6-10). They are divided between preceramic and Orange contexts. A single example of tubular shell bead came from preceramic context in TU5. The other 10 items are disk beads, the exclusive variety found in preceramic contexts at Groves' Orange Midden (Wheeler and McGee 1994a:365, 369). The disk beads from Blue Spring range from small to large, as do the biconical holes drilled through them. The assemblage of nine disk beads from Groves' Orange Midden reflects a similar range in size.

One additional marine shell ornament was recovered from the backfill neat Looter Pit 71 at Live Oak Midden. It is a triangular-shaped pendant measuring 38.9 mm wide, 46.2 mm long, and 4.3 mm thick (Figure 6-11). In profile the pendant has a slight curve lengthwise, suggesting that it came from the outer whorl of a large gastropod. Its edges and surfaces are nicely ground. The two cylindrical holes measure roughly 3.2 mm in diameter, and are "countersunk" by a slightly larger diameter. Although the context of this item is uncertain, it most likely dates to the St. Johns II period because of its placement at the top of the mound, where many burials of this era were allegedly looted in the 1970s.

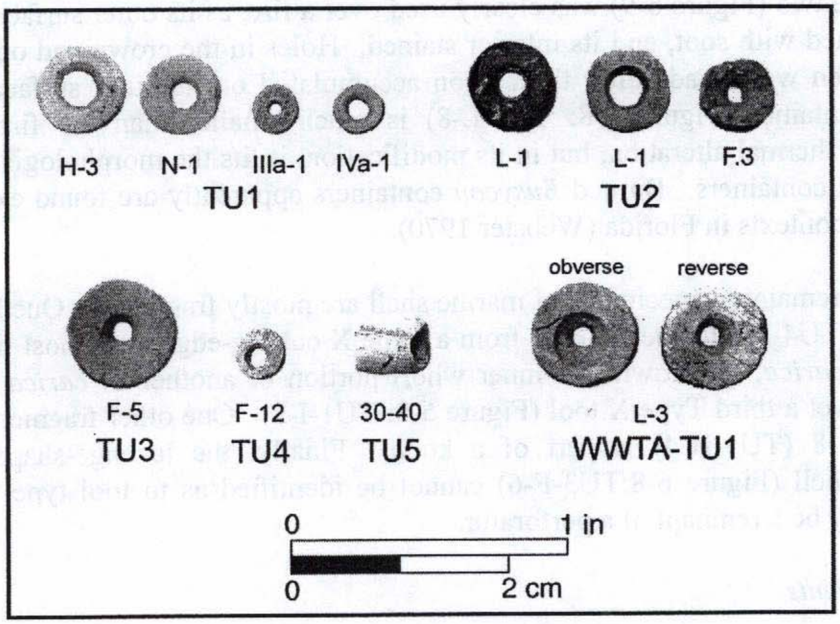

Figure 6-10. Shell beads from Blue Spring Midden B (8VO43).

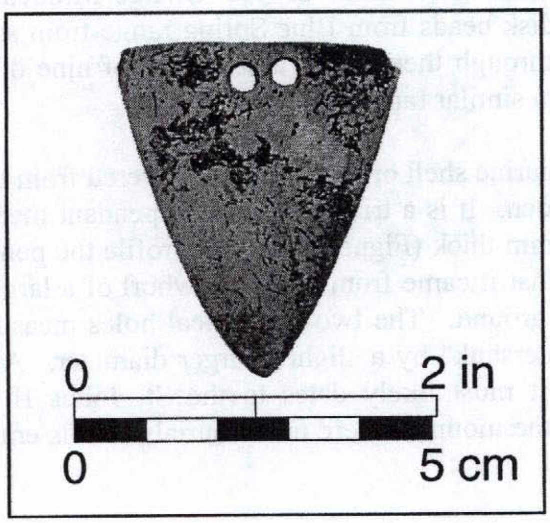

Figure 6-11. Marine shell pendant from backfill of Looter Pit 71, Live Oak Mound (8VO41)

BONE ARTIFACTS

Among the tens of thousands of pieces of vertebrate bone recovered from Blue Spring Midden B were several items of obvious modification, along with many more possible bone artifacts. Figure 6-12 provides examples of the more formal items recovered. These generally consist of fragments of bone pins or awls, two nearly whole. None of these items were incised or engraved, although most were highly polished. One bead made from a bird long bone (Figure 6-12:TU1-D) came from the Orange component in Test Unit 1. The only other unusual find was a pair of turtle bone fragments with cut or drilled holes. Turtle-shell rattles familiar to Archaic contexts in the Midwest and Midsouth often have such holes for purposes of binding the carapace to the plastron. Such items have not routinely been found in contexts in Florida, however.

Aside from the meager assemblage of bone tools from Blue Spring, the field school collected some bone pin fragments from test pits on Hontoon Island. A small fragment of one incised example was recovered from a test pit at 8VO215 (Figure 6-5). Fragments of at least three other pins were found in a single test pit at 8VO7493, a possible preceramic midden site on the western margin of the island (see Chapter 5).

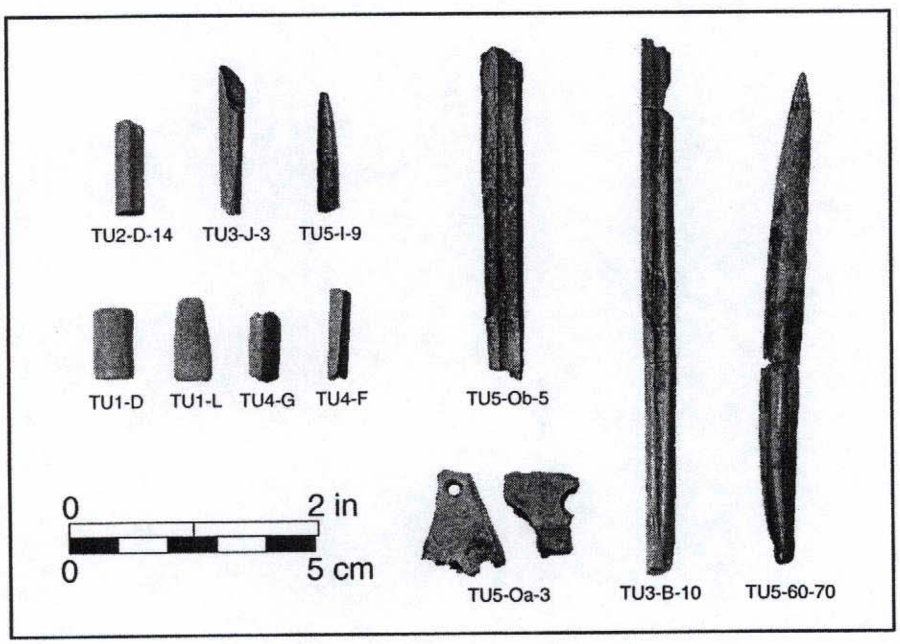

Figure 6-12. Examples of bone artifacts from Blue Spring Midden B (8VO43).

CHAPTER 7
ZOOARCHAEOLOGICAL ASSEMBLAGES

All subsurface contexts examined by the 2000-2001 St. Johns Archaeological Field School contained vertebrate faunal remains, and virtually all contained the inedible remains of various species of freshwater shellfish. Over 41 kg of vertebrate bone and over 387 kg of shell was returned to the lab for identification and analysis. The vast majority of this zooarchaeological material was taken from Blue Spring Midden B. Recovered from this site were five columns of stratified shell-midden matrix, each 50 x 50-cm in plan. Each level within natural strata of each column was sampled for flotation and the remaining matrix passed through 1/8-inch screen with the use of water. All vertebrate and invertebrate remains captured in these screens were collected for analysis. All other matrix from 16 m^2 of stratigraphic excavation totaling roughly 20 m^3 was passed through 1/4-inch waterscreens and all vertebrate remains collected for analysis. Thus, the zooarchaeological assemblage from Blue Spring Midden B consists of vertebrate and invertebrate remains from flotation samples and 1/8-inch waterscreened samples of subsistence columns in five locations across the site (TU1, TU2, TU4, TU5, and WWTA-TU1; see Chapter 3), plus all vertebrate remains greater than 1/4-inch in remaining matrix.

In this chapter we report some preliminary results of the analysis of vertebrate bone from the 1/8-inch waterscreen samples from three subsistence columns at Blue Spring Midden B. Additional data on the shell assemblages from the other two columns are incorporated into the interpretation of site formational processes and changing diet breadth. The three columns of vertebrate faunal data reported here were selected to pursue some general comparisons between preceramic and ceramic-period components at the site, as well as comparisons between areas of primary and secondary midden accumulation. In addition, microstratigraphic comparisons enabled by the recognition of stacked house floors in TU2 is used to address diet change during the Orange (ceramic) period.

Raw data on the volume of aggregated vertebrate remains and shellfish remains by taxa are provided in Appendix A. In the section that follows below, vertebrate faunal identification and calculations for MNI were accomplished by Meggan Blessing. Additional vertebrate data were generated by students in a UF zooarchaeology class taught by Susan deFrance. Blessing's considerable effort to standardize these data for the present purpose ensures comparability between strata and across columns. The results summarized below will be supplemented in the near future in a thesis by Sean Connaughton.

BLUE SPRING VERTEBRATE FAUNA

All vertebrate bone greater than 1/8-inch in size was analyzed from the waterscreened portions of three columns at Blue Spring Midden B in Test Units (TU) 1, 2, and 5. The 1.0-m deep column from TU5 is preceramic in age, as is the basal strata of TUs 1 and 2. The upper 1.2 m of the 1.4-m deep TU2 column arguably consists of primary and de facto refuse, including stacked house floors and related domestic features of Orange age. The upper 80 cm of the 1.25-m deep TU1 column arguably consists of secondary refuse accumulation. Data to support these inferences about context are presented in detail in Chapter 3.

Given the context of these column samples, three broad comparisons of vertebrate fauna are enabled. First, we are afforded the opportunity to compare preceramic and ceramic-age food remains from contexts that are both horizontally and vertically stratified. To anticipate these results, there is little change in overall diet through time at a coarse-grained taxonomic level, but interesting differences are evident at the level of genus and species within general taxa, with certain resources in the preceramic samples either absent or substantially reduced in strata of ceramic age, while the use of other resources in the Orange component expanded.

The second level of comparisons aims to test the idea that test units on the south and north elevations of the Thursby House (TUs 1 and 2) intercepted primary and secondary midden deposits, respectively, of Orange-period occupations. In this respect, the vertebrate faunal data provide some important taphonomic signatures for burning and fragmentation that tend to support this inference about spatial structure. Shell data bolster these taphonomic signatures.

A third level of comparison is enabled by the stacked living floors of TU2. Dating to the Orange period, these surfaces represent successive occupations over several decades, perhaps centuries. Crushed and burned shell and bone attest to primary and de facto accumulations of food remains in a similar (unchanging?) context over time. It follows that this microstratigraphic perspective holds potential to expose variations in the composition and condition of the vertebrate fauna indicative of diet change, environmental change, and possibly resource depression. A significant increase in the variety of species taken is apparent in a comparison of successive layers, and these changes correspond with a slight, but consistent trend for diminished size of *Viviparus* through time.

Finally, a note about the reporting of faunal data in Appendix B is warranted. Typically, reports of zooarchaeological remains from sites such as Blue Spring Midden B aggregate the counts for number of individual specimens (NISP) and minimum number of individuals (MNI) by species so that a single table or series of tables summarizes the assemblage. For instance, one might choose to report all the fauna from a subsistence column in a single table, or combine like-strata for all columns into tables that are sensitive to chronostratigraphic variation. Neither of these solutions is desirable in this case. Combining the counts for NISP and MNI for all strata in a single column collapses at least five centuries of occupation. Similarly, combining the counts for all strata of like age, irrespective of column context, mixes primary and secondary refuse, at least from the Orange period. Arguments that samples need to be combined for purposes of calculating MNI or meat weights may be analytically sound, but they are interpretively flawed. The analytical structure of zooarchaeological data should be no different than that used to organize and interpret artifactual remains. Context is of the utmost importance, and Blue Spring Midden B has contexts whose variation cannot be ignored for analytical ease. Having said that, the data reported in Appendix B, generated and compiled by Blessing, are in effect a series of standard zooarchaeological tables broken down by strata within columns. The authors are happy to provide an electronic version of these data to any interested party.

Methods

Guidelines for the analysis of zooarchaeological material were taken from Reitz and Wing (1999). Samples were rough-sorted according to their major classes (i.e. Mammalia, Aves, Reptilia/Amphibia, and Osteichthyes). Unidentifiable, fragmentary bones were relegated to the order Vertebrata. All samples were subsequently identified using the faunal comparative collection housed at the Florida Museum of Natural History.

All identifications were made on diagnostic elements. Of the material that could be identified, the following data were recorded: taxon, element, portion, side, modification, burning, number present, and weight. The highest taxonomic level recorded was class and the lowest level was species. For classes Mammalia and Aves those non-diagnostic elements that could be discerned were noted, counted, and weighed. This was not the case for class Osteichthyes. These elements, many being of a fragmentary nature, were only counted and weighed.

As the results reported here represent only first-order analyses, further identifications are possible within the genus *Ameiurus/Ictalurus* spp. and within the family Centrarchidae. For the Centrarchids, the sunfish were classified to the level of genus only (i.e. *Lepomis spp.*). This does not include Large-mouth bass (*Micropterus salmoides)*, Black crappie *(Pomoxis nigromaculatus)*, and Redear sunfish *(Lepomis microlophus)*. Due to the distinctiveness of the Redear's pharyngeal grinders, these elements were identified to the species level. As stated above, identifications within this family were made on diagnostic elements. The exceptions include articulars, quadrates, and thoracic and precaudal vertebrae. These elements were kept at the level of family. This was mainly a function of time constraints as the Centrarchids account for a majority of the fish sample.

The number of identified specimens (NISP) and the minimum number of individuals (MNI) were recorded for each strata within each column sample. When formulating NISP, all pieces of bone were counted separately. Those that could be cross-mended were noted. Minimum number of individuals was recorded using diagnostic elements. Size was also taken as discriminatory evidence, as listed in the notes section of Appendix B. Levels within natural strata (e.g., Level B or Stratum III [Stratum IIIb]) were analyzed and enumerated separately and then collapsed into subtotals. Relative frequencies for NISP and MNI were then calculated for strata and their subtotals.

Results

Comparisons of zooarchaeological data from Blue Spring begin with general taxonomic categories. Table 7-1 lists the NISP and MNI by general taxa for each of the three columns. In this table and others that follow, bones from the upper two strata (I-II) of TU1 and TU2 are excluded due to near-surface contamination, primarily activities associated with construction and occupation of the Thursby House. Shell-bearing strata of Test Unit 5 were capped by one meter of recent alluvium and are thus considered uncontaminated.

As these data show, the three columns examined have bone assemblages that are virtually indistinguishable in their relative frequencies across general taxa. Fish are vastly dominate in all three samples, followed by turtle, and lesser proportions of deer, other mammal, bird, and snake. Other reptiles and amphibians occur in trace frequencies. Add to this mix the abundant freshwater shellfish species, particularly *Viviparus*, and it is patently obvious that occupants of Blue Spring Midden B took good advantage of the aquatic biome that surrounded them. That aboriginal peoples in the middle St. Johns focused primarily on aquatic resources has been known since the time of Wyman, and recent zooarchaeological studies substantiate this knowledge with data on the dominance of shellfish and fish in actual meat weights (Russo et al. 1992; Wheeler and McGee 1994c). As discussed in Chapter 2, this is an economy that began no later than the Mount Taylor period, when shell middens and mounds began to form at locations along the river, as well as the coast. And it is an economy that apparently continued virtually unchanged until European contact. A comparison of the preceramic and Orange-period zooarchaeological assemblages from Blue Spring lends further empirical evidence to this general pattern.

Comparisons between Preceramic and Orange Period Assemblages. Table 7-2 lists the NISP and MNI by general taxa for preceramic and Orange-period zooarchaeological assemblages from Blue Spring Midden B. To reiterate findings reported in Chapter 3, the preceramic component is expressed in the basal strata of TUs 1 and 2, and throughout TU5. Because the upper two levels of the buried profile in TU5, a buried A horizon, contained a few small sherds, these are excluded from consideration in Table 7-2 and the discussion that follows.

As seen in Table 7-2, the differences between the two components are insignificant, at least at the level of general taxa. Again, fish eclipse all other taxa by an order of 10 or more. The result is an overall low level of diversity for both assemblages (preceramic = 0.393; Orange = 0.368).[1] As expected, these data reflect overall continuity in subsistence economy over a period of at least five centuries.

[1] Diversity calculated by sum of the squares of proportions of each class subtracted from 1.0

Table 7-1. Absolute and Relative Frequencies of Vertebrate Fauna by General Taxa and Test Unit, Blue Spring Midden B (8VO43).

	Number of Individual Specimens (NISP)		Minimum Number of Individuals (MNI)	
	n	%	n	%
TEST UNIT 1				
Deer	20	0.4	5	2.9
Mammal	107	2.3	9	5.2
Bird	9	0.2	4	2.3
Turtle	132	2.9	18	10.5
Snake	65	1.4	10	5.8
Reptile	9	0.2	1	0.6
Amphibian	9	0.2	4	2.3
Fish	4222	92.3	122	70.9
Total	4573	100.0	173	100.0
TEST UNIT 2				
Deer	42	0.2	10	2.2
Mammal	332	2.0	18	3.9
Bird	29	0.2	7	1.5
Turtle	791	4.7	28	6.1
Snake	150	0.9	14	3.0
Reptile	29	0.2	4	0.9
Amphibian	27	0.2	9	1.9
Fish	15,422	91.7	372	80.5
Total	16,822	100.0	462	100.0
TEST UNIT 5				
Deer	32	0.2	8	1.7
Mammal	281	1.4	18	3.9
Bird	78	0.4	12	2.6
Turtle	1025	5.0	33	7.2
Snake	134	0.7	14	3.1
Reptile	8	<0.1	5	1.1
Amphibian	12	0.1	7	1.5
Fish	18,766	92.3	361	78.8
Total	20,336	100.0	458	100.0
TOTAL	41,731		1093	

Table 7-2. Absolute and Relative Frequencies of Vertebrate Fauna by General Taxa and Component, Blue Spring Midden B (8VO43).

	Number of Individual Specimens (NISP)		Minimum Number of Individuals (MNI)	
	n	%	n	%
ORANGE COMPONENT				
Deer	60	0.3	13	2.6
Mammal	368	2.0	19	3.8
Bird	34	0.2	9	1.8
Turtle	858	4.7	35	6.9
Snake	180	1.0	18	3.6
Reptile	32	0.2	4	0.8
Amphibian	27	0.1	8	1.6
Fish	16,593	91.4	398	79.0
Total	18,152	100.0	504	100.0
PRECERAMIC COMPONENT				
Deer	24	0.1	7	1.4
Mammal	227	1.2	22	4.5
Bird	79	0.4	12	2.5
Turtle	908	4.6	37	7.6
Snake	154	0.8	17	3.5
Reptile	13	0.1	4	0.8
Amphibian	21	0.1	12	2.5
Fish	18,283	92.8	377	77.3
Total	19,709	100.0	488	100.0

Composition of the fish assemblages is likewise very similar between components (Table 7-2). Sunfish comprise roughly half of the MNI of both samples. Other well represented taxa include shiner, sucker, and catfish. Lesser fractions of gar, bowfin, and pike are also consistent between the samples. Overall, a moderate level of diversity characterizes both assemblages (preceramic = 0.710; Orange = 0.727).

Despite the overall similarity in the fish assemblages, two subtle diffrences are observed. First, American eel (*Anguilla rostrata*), a minority species throughout the samples, is concentrated in strata of preceramic age. Out of a total of 25 NISP and 7 MNI for eel, only two elements from a likely single individual were found outside of preceramic context. TU5 accounted for the vast majority of eel elements, but instances were also found in the basal, preceramic components of TU1 and TU2. Thus, the use of eel during preceramic times was widespread, albeit at low frequency. The Lake Monroe Outlet Midden (8VO53), south of Blue Spring, included a few eel in preceramic context (Irvy Quitmyer, personal communication, 2001), but the Groves' Orange Midden, also on Lake Monroe, yielded no eel remains in several columns of preceramic midden (Russo et al. 1992; Wheeler and McGee 1994c).

The second noticeable difference is the increased proportion of suckers in the Orange component. Much of this increase is attributed to a concentration of bones from 37 Lake Chubsuckers (*Erimyzon sucetta*) in one level of the column from TU2, discussed further below. Many species of suckers prefer flowing water, but Lake Chubsuckers prefer quiet, slowly moving water with soft bottoms, and abundant organic debris and aquatic vegetation. Considering that the American eel inhabits streams with strong flow, then the decrease in eels and increase in suckers through time may signal less reliance on harvesting of the main river channel and Blue Spring Run and increased dependence on the nearby lagoon. It is certainly possible that this latter biome emerged as a significant and predictable resource patch only after sea level slowed in its rate of rise after 6000 rcybp, and was thereafter subject to fluctuations in production due to changing water levels. During the dry summer of 2000, after a period of several successive dry years, the swampy terrain surrounding the lagoon on the south margin of Blue Spring Midden B dried considerably and the water's edge receded several meters. Thus, the use of lagoonal resources, like the Lake Chubsucker, likely waxed and waned with fluctuations in precipitation, river flow, and groundwater levels.

Apart from subtle variations in fish taxa, the preceramic and Orange components are virtually identical. Shellfish species in these two components (see below) are likewise very similar, with the exception of marine shell, which is presumably more of a raw material for tools than direct subsistence item, at least in a context far from the ocean. Virtually all the marine shell tools and tool by-products from Blue Spring came from preceramic levels. Marine shell tools are common in Mount Taylor assemblages from the middle St. Johns (Wheeler et al. 2000). The Lake Monroe Outlet Midden yielded not only the usual marine shell tools in its Mount Taylor component, but also an abundance of shark teeth, many nonfossilized (Irvy Quitmyer, personal communication, 2001). In general, Mount Taylor assemblages in the middle St. Johns include sufficient marine shell and other marine resources to argue that groups either moved between the coast and the river on a regular basis, or maintained frequent interpersonal contact with coastal dwellers. If the former, it would be hard to imagine a lack of difference in the zooarchaeological assemblages between seasonal occupants of Mount Taylor times and perennial inhabitants of the Orange period. Indeed, the lack of significant difference argues that a perennial settlement pattern along the middle St. Johns was initiated during Mount Taylor times and was carried forward, virtually unchanged, through subsequent millennia (Russo et al. 1992).

This leads to one final observation on the introduction of pottery. A viable hypothesis for the origins of pottery is that it was stimulated by subsistence stress. Alternatively, pottery may have been introduced for reasons other than alleviating subsistence stress, but its use as subsistence technology would have enabled change in resource selection and/or processing. Either way, subsistence change is expected to attend the introduction of pottery. Insofar as subsistence does not change appreciably, pottery may not have been all that innovative. As discussed in Chapter 6, some of the large marine shells from preceramic contexts show evidence of use of vessels for direct-heat cooking. Burned *Busycon* shells are often recovered from Mount Taylor contexts in the region (e.g., Jahn and Bullen 1978; Webster 1970; Wheeler and McGee 1994a:365), and are generally absent from assemblages with early ceramic vessels. It thus appears that pottery may have simply been a substitute for marine shell, perhaps because of an increased need for larger vessels and/or a diminished supply of marine shell.

Table 7-3. Absolute and Relative Frequencies of Fish by General Taxa and Component, Blue Spring Midden B (8VO43).

	Number of Individual Specimens (NISP)		Minimum Number of Individuals (MNI)	
	n	%	n	%
ORANGE COMPONENT				
Shark	1	<0.1	1	0.3
Skate/ray	0	0.0	0	0.0
Eel	2	<0.1	1	0.3
Gar	279	6.0	18	4.5
Bowfin	141	3.1	18	4.5
Shiner	241	5.2	24	6.0
Shad/herring	69	1.5	15	3.8
Sucker	428	9.3	62	15.6
Catfish	335	7.3	48	12.1
Pike	46	1.0	16	4.0
Sunfish	3054	66.2	188	47.2
Mullet	16	0.3	7	1.8
Total	4612	100.0	398	100.0
PRECERAMIC COMPONENT				
Shark	3	0.1	3	0.8
Skate/ray	2	<0.1	2	0.5
Eel	23	0.5	6	1.6
Gar	957	20.0	18	4.8
Bowfin	231	4.9	17	4.5
Shiner	248	5.2	30	8.0
Shad/herring	68	1.4	11	2.9
Sucker	249	5.2	37	9.9
Catfish	323	6.8	39	10.4
Pike	44	0.9	16	4.3
Sunfish	2591	54.5	189	50.5
Mullet	14	0.3	6	1.6
Total	4753	100.0	374	100.0

Comparison between Primary and Secondary Midden Areas in the Orange Component. As discussed in Chapter 3, the difference in midden structure and composition on either side of the Thursby House, along with GPR survey to locate nonrandom patterning in the distribution of subsurface features, led to the inference that TU2 was placed in a location of habitation space and that TU1 was placed in a location of secondary refuse accumulation. This distinction applies only to the Orange component at the site, and thus only to the upper portions of these test units. The implication of this spatial distinction for the accumulation of midden is that habitation space would be the locus of primary and de facto refuse, and that midden that accumulated elsewhere, such as the location of TU1, consisted of refuse removed from actual locations of processing and consumption. As far as faunal remains are concerned, bony elements from units of consumption (i.e., individual animals or groups of animals), would tend to be scattered more broadly within secondary refuse and more tightly clustered in de facto refuse, and possibly primary refuse as well. Of course, the concept of secondary refuse implies that habitual use areas are periodically cleaned and the refuse removed to dumps. It follows that many, perhaps most, elements of discarded food remains would be removed from primary context. However, the stratigraphy of TU2 consisted of a series of shallow, basin-shaped pits associated with lens of burned and crushed shell. Bone density was especially high in these contexts, suggesting that shallow pits became convenient receptacles for refuse in areas with heavy foot traffic (i.e., in and around habitation structures). Spatially discrete accumulations of elements from the same individuals, especially small creatures, are expected in such contexts.

Table 7-4 shows how differences in context affect MNIs across taxa. Fish comprise only 66.7 percent of the MNI in TU1 and 81.6 percent in TU2, even though they have nearly identical proportions in terms of NISP. The differences are not marked, but they do suggest that more articulated remains and/or tightly clustered remains accumulated in the area of the TU2 column. More dramatic differences are seen in the ratio of MNI to NISP for bird, turtle, and snake. In all three cases, the ratio of MNI to NISP is much greater in TU1 than in TU2. Given the relatively small size of samples of bird and snake, these differences could very well be statistical aberrations. However, the turtle samples are sufficiently large to suggest a real difference in formational processes.

Differences in the relative size of faunal elements in two samples would be instructive, although data to examine this have yet to be developed. Given ethnoarchaeological observations about midden formation, large items are more likely to be removed from primary context than are minute items that can easily be overlooked or lost in substrate. It follows that the average size of elements in secondary midden would be larger than the average size of elements in primary context, all else being equal. The use of pits for refuse disposal in primary use areas is one of several complicating factors.

Another contextual factor is differential burning of bony elements in primary and secondary midden contexts. Repeated episodes of burning in hearths and other thermal features within habitual use areas would, over the long run, thermally affect much of the associated bone, independent of the means by which the food was prepared. A casual inspection of the profile from TU2 reveals a high incidence of in situ burning (Chapter 3). As expected, a high percentage of the bone from the column of this unit was burned. This can be seen in Table 7-5, which includes data on percent burned bone for all strata of all subsistence columns. The rate of burned bone for the entire assemblage of 63,407 elements is 14.5 percent. In Table 7-5, all strata with averages for burned bone greater than 14.5 percent are emboldened. Overall, burning is much more common on samples from Orange context, than from preceramic context. Within Orange contexts, the rate of burning is highest in two strata of TU2, Stratum III and Stratum VI. Both of these levels correspond with shallow pits, crushed and burned shell, charcoal and other evidence of intensive, in situ activity. TU1 also has some above-average values for burned bone, but in either homogeneous midden (Stratum IIIb), or near-surface disturbed contexts (Strata I-IIb).

Table 7-4. Absolute and Relative Frequencies of Vertebrate Fauna by General Taxa and Refuse-Disposal Context, Orange Component, Blue Spring Midden B (8VO43).

	Number of Individual Specimens (NISP)		Minimum Number of Individuals (MNI)		NISP/ MNI
	n	%	n	%	
TU1 - Secondary Midden					
Deer	19	0.8	4	4.3	21.1
Mammal	67	2.9	4	4.3	6.0
Bird	8	0.3	3	3.2	37.5
Turtle	94	4.1	11	11.8	11.7
Snake	35	1.5	6	6.5	17.1
Reptile	3	0.1	1	1.1	33.3
Amphibian	4	0.2	2	2.2	50.0
Fish	2088	90.1	62	66.7	3.0
Total	2318	100.0	93	100.0	4.0
TU2 - Primary Midden					
Deer	41	0.3	9	2.2	22.0
Mammal	301	1.9	15	3.6	5.0
Bird	26	0.2	6	1.5	23.1
Turtle	764	4.8	24	5.8	3.1
Snake	145	0.9	12	2.9	8.3
Reptile	29	0.2	4	1.0	13.8
Amphibian	23	0.1	6	1.5	26.1
Fish	14,505	91.6	336	81.6	2.3
Total	15,834	100.0	412	100.0	2.6

Table 7-5. Relative Frequency of Burned Bone from Columns in TUs 1, 2, and 5, Blue Spring Midden B (8VO43) (values exceeding mean percent burned [14.5%] are emboldened).

TU1	%burned	TU2	%burned	TU5	%burned
I	**17.3**				
IIa	11.9	III	**32.1**		
IIb	**24.1**	IV	12.1		
IIIa	13.9	V	7.5		
IIIb	**18.0**	VI	**53.1**		
IIIc	8.1	VIIIa	10.1		
IIId	8.5	VIIIb	5.1		
		VIIIc	4.9		
		IX	4.4		
		Xa	3.6	0-10	12.6
Orange		Xb	7.2	10-20	7.3
Preceramic					
IVa	6.6	XIa	10.9	20-30	6.9
IVb	5.7	XIb	3.8	30-40	**22.7**
IVc	3.6			40-50	5.3
				50-60	6.3
				60-70	4.2
				70-80	9.3
				80-90	5.9
				90-100	0.0

On balance, the contrasts in vertebrate faunal remains between TU1 and TU2 tend to support the idea that the former consists of primary midden, and the latter secondary midden. The importance of this distinction for sampling purposes should be obvious. Space is likely to be highly structured at locations of prolonged and/or repeated habitation and samples of fauna will vary depending on context. Thus, sites need to be broadly sampled for purposes of dietary and paleoenvironmental reconstruction, and comparisons between sites are most robust when similar contexts are compared.

Subsistence Change during Orange Occupations. The stacked "living floors" of Orange age in Test Unit 2 offer an opportunity to explore potential subsistence changes over the course of decades or a couple of centuries within relatively unchanging cultural and locational contexts. Two strata in TU2 lend themselves to such comparison: Strata III, VI, and Xb. A third possible "living floor," Stratum Xb, provides a deeper (older) context for additional comparison. Each of these strata also embody higher-than-average frequencies for bivalve shell, a point we return to in a later section of this chapter.

Table 7-6 reports the breakdown of general taxa across these three successive "living floors." Most obvious is the overall increase in vertebrate bone from Stratum Xb to Stratum III. Coupled with this is an increase in the proportion of fish, from a low of 76.5 percent by MNI in Stratum Xb to a high of 89.5 percent in Stratum III. This increased focus on fish accounts for an incremental drop in the diversity of fauna through time (Xb = 0.403; VI = 0.308; III = 0.196).

Overshadowed by an overall drop in diversity is an increase in the diversity of fish species taken over time (Xb = 0.595; VI = 0.713; III = 0.734). As shown in Table 7-7 and displayed in Figure 7-1, the dominance of sunfish in Stratum Xb gives way to increased proportions of suckers, doubling each successive stratum until they comprise close to 40 percent of the fish by MNI in Stratum III. The percentage of catfish likewise increase in this upper stratum, although not as dramatically. As indicated earlier, Stratum III contained an unusually large number of suckers. Thirty-seven examples of the supraoccipital of *Erimyzon sucetta* were recovered from less than 0.025 m^3 of matrix. Whereas one might argue that such an elevated number is aberrant, or simply a one-time event, the high relative frequency for suckers in the intervening stratum (VI) may point to a legitimate trend for increased use of lagoonal species of fish through time, perhaps as a result of increased primary production (e.g., increased aquatic vegetation for forage) in this biome.

In sum, the relative distribution of fauna across successive levels in TU2 clearly shows a trend toward increased specialization in subsistence, namely an increased focus on fish and other aquatic resources. However, the comparison of general taxa hides significant change in the array of fish species taken through time. Thus, although increased specialization within the overall economy is borne out in these data, pursuits of aquatic resources apparently diversified with time. Data on invertebrate subsistence corroborate this pattern.

Table 7-6. Absolute and Relative Frequencies of Vertebrate Fauna by General Taxa and Successive "Living Floors," Orange Component, Test Unit 2, Blue Spring Midden B (8VO43).

	Number of Individual Specimens (NISP)		Minimum Number of Individuals (MNI)	
	n	%	n	%
TU2-III				
Deer	28	0.5	1	1.0
Mammal	120	2.1	2	1.9
Bird	8	0.1	1	1.0
Turtle	318	5.5	4	3.8
Snake	68	1.2	3	2.9
Reptile	0	0.0	0	0.0
Amphibian	0	0.0	0	0.0
Fish	5289	90.7	94	89.5
Total	5831	100.0	105	100.0
TU2-VI				
Deer	1	0.0	1	1.6
Mammal	29	1.0	1	1.6
Bird	7	0.2	1	1.6
Turtle	31	1.1	4	6.3
Snake	11	0.4	1	1.6
Reptile	18	0.6	1	1.6
Amphibian	18	0.6	2	3.1
Fish	2811	96.1	53	82.8
Total	2926	100.0	64	100.0
TU2-Xb				
Deer	4	0.4	1	2.9
Mammal	21	2.3	2	5.9
Bird	2	0.2	1	2.9
Turtle	44	4.8	2	5.9
Snake	20	2.2	2	5.9
Reptile	0	0.0	0	0.0
Amphibian	0	0.0	0	0.0
Fish	821	90.0	26	76.5
Total	912	100.0	34	100.0

Table 7-7. Absolute and Relative Frequencies of Fish Taxa across Successive "Living Floors," Orange Component, Test Unit 2, Blue Spring Midden B (8VO43).

	Number of Individual Specimens (NISP)		Minimum Number of Individuals (MNI)	
	n	%	n	%
TU2-III				
Shark	1	0.1	1	1.1
Eel	0	0.0	0	0.0
Gar	26	1.9	1	1.1
Bowfin	22	1.6	5	5.3
Shiner	59	4.4	4	4.3
Shad/Herring	20	1.5	1	1.1
Sucker	250	18.5	37	39.4
Catfish	169	12.5	16	17.0
Pike	19	1.4	2	2.1
Sunfish	775	57.4	26	27.7
Mullet	10	0.7	1	1.1
Total	1351	100.0	94	100.0
TU2-VI				
Shark	0	0.0	0	0.0
Eel	2	0.2	1	1.9
Gar	19	2.1	2	3.8
Bowfin	21	2.4	1	1.9
Shiner	26	2.9	4	7.5
Shad/Herring	3	0.3	1	1.9
Sucker	92	10.3	11	20.8
Catfish	50	5.6	6	11.3
Pike	2	0.2	1	1.9
Sunfish	677	75.8	25	47.2
Mullet	1	0.1	1	1.9
Total	893	100.0	53	100.0
TU2-Xb				
Shark	0	0.0	0	0.0
Eel	0	0.0	0	0.0
Gar	40	16.9	1	3.8
Bowfin	8	3.4	1	3.8
Shiner	2	0.8	1	3.8
Shad/Herring	3	1.3	1	3.8
Sucker	11	4.7	2	7.7
Catfish	14	5.9	3	11.5
Pike	2	0.8	1	3.8
Sunfish	156	66.1	16	61.5
Mullet	0	0.0	0	0.0
Total	236	100.0	26	100.0

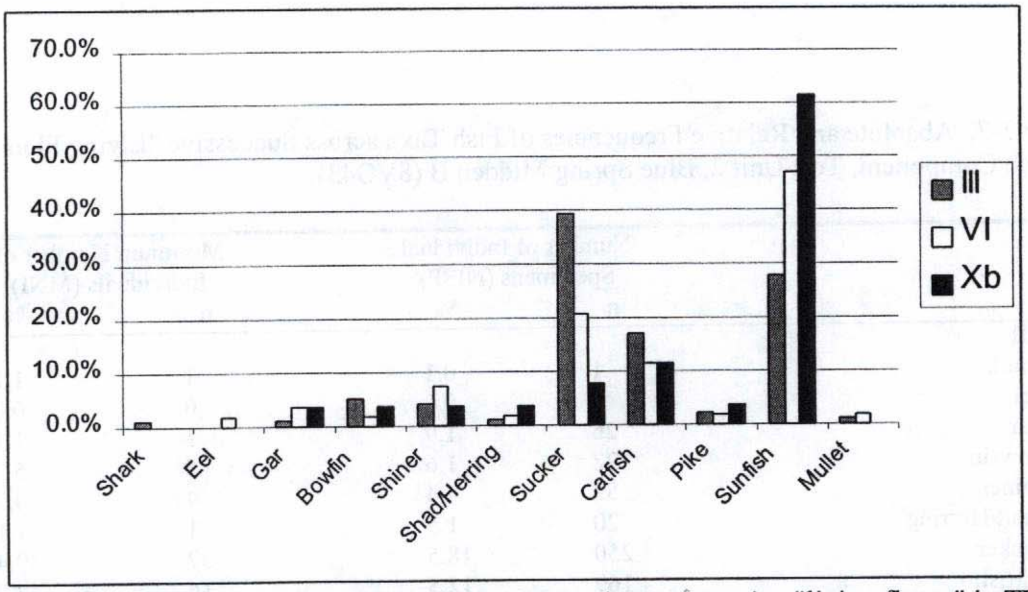

Figure 7-1. Relative frequencies of fish by taxa across three successive "living floors" in TU2, Blue Spring Midden B (8VO43).

BLUE SPRING INVERTEBRATE FAUNA

The 300+ kg of shell recovered from Blue Spring Midden B was taken from the same five subsistence columns reported above. All shell from the 1/8-inch waterscreen portions of columns was fractionated with 1/4-inch screen and everything greater than 1/4 inch was sorted in taxa, counted, and weighed. Shell falling through 1/4-inch screens was weighed only and formed the basis for the fragmentation ratios reported at the close of Chapter 3. Here we present some preliminary data on variations in shellfish composition and taphonomy, as well as summarize research by Sean Connaughton on changes in the size of *Viviparus* through time.

Variations in Shellfish Diversity

Absolute and relative frequencies of shell remains by weight are reported in Tables 7-8 and 7-9. A remarkable level of consistency is apparent in the dominance of *Viviparus georgianus* (Banded Mystery Snail) across test units. Shells of this species comprise no less than 89.5 percent of all shell remains in each of the five columns. The only minority constituents with relative values greater than a few percent are shells of Unionidae, freshwater mussels (bivalves). Lesser fractions of *Pomacea paludosa* (Florida applesnail) and *Elimia floridensis* (Rasp elimia), and traces of two species of *Planorbella* (*P. trivolvis* and *P. duryi* [Mesa rams-horn]) complete the assemblage.

The dominance of *Viviparus* overshadows occasional spikes in the values for bivalves and *Pomacea*. Figure 7-2 displays the relative frequency of these latter taxa by strata for each of the test units. Test Unit 2 shows the greatest variation, with bivalve frequencies 15 percent or more in Strata II and Xb; Stratum IVc in TU1 has a similar spike. Lesser peaks in the range of about 10 percent are found in Stratum III of TU1, Stratum VI of TU2, and Stratum Vg in TU4.

Pomacea exceeds five percent in only one stratum, Stratum III of TU2. Otherwise, *Pomacea* comprises a low background frequency, and is most conspicuous by its absence in certain levels. We should note, however, that the ratio of shell weight to meat weight for *Pomacea* is substantially less than *Viviparus* or bivalves, so these minority numbers do not actually reflect its contribution to diet. Nonetheless, the *relative* values across strata are meaningful.

Diversity in shellfish species across samples is predictably low given the dominance of *Viviparus*. And yet, diversity does increase slightly, albeit irregularly, through successive strata of TUs 1 and 2 (Table 7-9). This is best seen in Figure 7-2, especially for TU2, where bivalves and *Pomacea* exhibit net gains from the bottom to the top of the sequence. The incremental rise in *Pomacea* from Stratum VIIIb to Stratum III is especially striking. This trend corresponds precisely with the increase in fish diversity noted earlier, supporting the notion that aquatic resource extraction expanded through time to include a greater variety of resources. In several other places across columns, both bivalve and *Pomacea* increase in frequency in two successive samples, but are then followed by precipitous drops in frequency. This erratic record could possibly reflect boom and bust cycles in the availability of these species. Alternatively, increased use of bivalve and *Pomacea* may very well reflect diminished access to other, preferred species.

Burned Shell

Many of the strata where bivalves peak in frequency are rich in charcoal and ash, and shell is often discolored and friable from apparent exposure to heat. To test this association across strata, relative frequencies of bivalve were plotted against relative frequencies of burned bone (Figure 7-3). With the exception of handful of outliers, burned bone and percent bivalves covary in a positive fashion. The greatest exceptions are Stratum IVc of TU1 and Stratum Xb of TU2, which have high frequencies of bivalve shell but little burned bone, and Stratum VI of TU2, which has an exceptionally high fraction of burned bone but only a moderate spike in bivalve shell. The two samples from TU2 are among the "living floors" discussed above; the sample from TU1 is at the very base of the preceramic horizon.

Little can be added about this apparent association between bivalves and fire except to speculate that it may be directly related to processing technique. Inasmuch as lenses of bivalve are indeed often burned, and rarely unburned, they may have been routinely roasted over fire, rather than steamed, boiled, or eaten raw. A more detailed taphonomic analysis of shell from Blue Spring is needed to further explore this possibility.

Table 7-8. Absolute Frequencies of Shellfish Remains from Subsistence Columns by Weigh (g) for Identifiable Taxa of Gastropod and Bivalve.

Prov.	Stratum	*Viviparus*	*Pomacea*	*Elimia*	*P. Trivolvis*	*P. duryi*	Bivalve	Total
TU1	I	10,155.0	150.2	173.0	0.3	23.2	845.8	11,347.5
	II a	1075.0	10.2	9.3			41.1	1135.6
	II b	4095.6	77.5	74.9		10.2	422.7	4680.9
	II subtotal	*5170.6*	*87.7*	*84.2*		*10.2*	*463.8*	*5816.5*
	III a	3381.4	24.1	43.9			411.9	3861.3
	III b	2083.2	5.9	18.6		2.4	157.3	2267.4
	III c	6078.0	16.6	45.4	0.8	12.5	104.0	6257.3
	III d	3054.1	14.3	14.2		1.7	44.0	3128.3
	III subtotal	*14,596.7*	*60.9*	*122.1*	*0.8*	*16.6*	*717.2*	*15,514.3*
	IV a	6164.9	7.0	38.9		0.8	257.3	6468.9
	IV b	3155.4	25.9	35.2		6.9	217.9	3441.3
	IV c	1711.1	61.3	7.8		0.8	417.8	2198.8
	IV subtotal	*11,031.4*	*94.2*	*81.9*		*8.5*	*893.0*	*12,109.0*
	Total	60,721.0	541.6	667.5	1.9	85.3	4100.8	66,118.1
TU2	I	12,987.7	215.4	213.5	1.0	34.5	347.4	13,799.5
	II	3198.1	42.4	50.7		6.6	791.9	4089.7
	III	4891.7	432.6	191.7		14.8	622.8	6153.6
	IV	3548.4	212.6	29.3		3.0	79.7	3873.0
	V	4174.6	238.0	77.4		11.1	107.5	4608.6
	VI	3099.0	128.6	236.9	0.2	3.0	341.4	3809.1
	VIII a	2761.7	68.9	50.4	0.3	17.0	18.1	2916.4
	VIII b	5692.2	43.7	179.8		0.3	190.7	6106.7
	VIII subtotal	*8453.9*	*112.6*	*230.2*	*0.3*	*17.3*	*208.8*	*9023.1*
	IXa	987.3	7.2	41.3		13.8	18.3	1067.9
	IXb	4624.3	18.0	152.8		30.3	169.7	4995.1
	IX subtotal	*5611.6*	*25.2*	*194.1*		*44.1*	*188.0*	*6063.0*
	X a	2234.4	21.5	25.8	0.4	12.3	200.3	2494.7
	X b	3289.3	17.4	40.5	0.3	7.0	563.5	3918.0
	X subtotal	*5523.7*	*38.9*	*66.3*	*0.7*	*19.3*	*763.8*	*6412.7*
	XI a	1215.9		13.0		4.6	80.4	1313.9
	XI b	2633.7		24.2	1.2	3.7	32.4	2695.2
	XI subtotal	*3849.6*		*37.2*	*1.2*	*8.3*	*112.8*	*4009.1*
	Total	55,338.3	1446.3	1327.3	3.4	162.0	3564.1	61,841.4
TU4	I a	650.8	17.3	9.6		2.6	36.7	717.0
	I b	169.9		1.5			1.4	172.8
	I subtotal	*820.7*	*17.3*	*11.1*	*0.0*	*2.6*	*38.1*	*889.8*
	II a	4395.7	50.7	57.6		9.7	105.7	4619.4
	II b	3985.2	236.5	65.1		16.0	368.2	4671.0
	II subtotal	*8380.9*	*287.2*	*122.7*	*0.0*	*25.7*	*473.9*	*9290.4*
	III a	3887.1	65.9	62.9		9.5	76.6	4102.0
	III b	3579.1	52.3	59.0		14.0	237.8	3942.2
	III c	4459.4	47.6	71.8	0.2	2.9	92.8	4674.7
	III d	4736.1	75.7	59.9		12.8	102.8	4987.3
	III subtotal	*16,661.7*	*241.5*	*253.6*	*0.2*	*39.2*	*510.0*	*17,706.2*
	V a	3458.5	55.2	80.6		16.9	139.6	3750.8
	V b	5997.5	230.0	129.8		31.3	315.8	6704.4
	V c	2649.7	154.6	42.1	0.1	16.7	123.1	2986.3

Table 7-8. (continued).

Prov.	Stratum	*Viviparus*	*Pomacea*	*Elimia*	*P. Trivolvis*	*P. duryi*	Bivalve	Total
TU4	V d	6260.3	169.3	125.4	0.8	52.8	396.7	7005.3
	V e	8560.4	137.3	119.5	0.4	34.2	370.7	9222.5
	V f	1661.9	7.2	20.6	0.4	7.7	53.3	1751.1
	V g	837.0	37.9	17.8		5.1	116.8	1014.6
	V subtotal	*29,425.3*	*791.5*	*535.8*	*1.7*	*164.7*	*1516.0*	*32,435.0*
	VII a	2233.0	30.6	42.0		12.5	142.7	2460.8
	VII b	4143.9	41.5	53.2		13.4	223.1	4475.1
	VII c	4313.3	72.3	65.9		23.4	254.8	4729.7
	VII d	3587.6	153.1	35.5		14.8	198.5	3989.5
	VII subtotal	*14,277.8*	*297.5*	*196.6*	*0.0*	*64.1*	*819.1*	*15,655.1*
	Total	69,566.4	1635.0	1119.8	1.9	296.3	3357.1	75,976.5
TU5	0-10 cm	4253.8	30.0	45.0		9.2	97.0	4435.0
	10-20 cm	4899.1	48.2	22.7		25.6	252.3	5247.9
	20-30 cm	11,413.9	119.9	199.7	1.0	44.8	1036.2	12,815.5
	30-40 cm	6075.6	42.9	90.3	0.4	27.9	480.7	6717.8
	40-50 cm	1954.7	8.6	34.9		5.2	125.1	2128.5
	50-60 cm	705.0	1.0	6.4		0.1	48.2	760.7
	Total	29,302.1	250.6	399.0	1.4	112.8	2039.5	32,105.4
WWTA	0-10 cm	2650.9	13.6	28.9		5.4	118.2	2817.0
	10-20 cm	3309.7	10.8	31.8			73.5	3425.8
	20-30 cm	3235.2	10.6	35.3		12.2	118.4	3411.7
	30-40 cm	4907.5	5.2	56.5		5.4	198.7	5173.3
	40-50 cm	4331.0	200.2	75.6		9.6	281.1	4897.5
	50-60 cm	4327.4	30.4	75.9	0.2	8.9	154.6	4597.4
	60-70 cm	2988.8	40.3	42.3		13.0	42.9	3127.3
	70-76 cm	1320.9	40.7	34.4		17.1	22.3	1435.4
	Total	27,071.4	351.8	380.7	0.2	71.6	1009.7	28,885.4

Table 7-9. Relative Frequencies and Diversity Indices of Shellfish Remains from Subsistence Columns by Weigh (g) for Identifiable Classes of Gastropod and Bivalve.

Prov.	Stratum	*Viviparus*	*Pomacea*	*Elimia*	*P. Trivolvis*	*P. duryi*	Bivalve	Diversity
TU1	I	89.5	1.3	1.5	<0.1	0.2	7.5	0.19
	II a	94.7	0.9	0.8			3.6	0.10
	II b	87.5	1.7	1.6		0.2	9.0	0.23
	II subtotal	*88.9*	*1.5*	*1.4*		*0.2*	*8.0*	*0.20*
	III a	87.6	0.6	1.1			10.7	0.22
	III b	91.9	0.3	0.8		0.1	6.9	0.15
	III c	97.1	0.3	0.7	<0.1	0.2	1.7	0.06
	III d	97.6	0.5	0.5		0.1	1.4	0.05
	III subtotal	*94.1*	*0.4*	*0.8*	*<0.1*	*0.1*	*4.6*	*0.11*
	IV a	95.3	0.1	0.6		<0.1	4.0	0.09
	IV b	91.7	0.8	1.0		0.2	6.3	0.16
	IV c	77.8	2.8	0.4		<0.1	19.0	0.36
	IV subtotal	*91.1*	*0.8*	*0.7*		*0.1*	*7.4*	*0.16*
	Total	91.8	0.8	1.0	<0.1	0.1	6.2	0.15
TU2	I	94.1	1.6	1.5	<0.1	0.3	2.5	0.11
	II	78.2	1.0	1.2		0.2	19.4	0.35
	III	79.5	7.0	3.1		0.2	10.1	0.35
	IV	91.6	5.5	0.8		0.1	2.1	0.16
	V	90.6	5.2	1.7		0.2	2.3	0.18
	VI	81.4	3.4	6.2	<0.1	0.1	9.0	0.33
	VIII a	94.7	2.4	1.7	<0.1	0.6	0.6	0.10
	VIII b	93.2	0.7	2.9		<0.1	3.1	0.13
	VIII subtotal	*93.7*	*1.2*	*2.6*	*<0.1*	*0.2*	*2.3*	*0.12*
	IX a	92.5	0.7	3.9		1.3	1.7	0.14
	IX b	92.6	0.4	3.1		0.6	3.4	0.14
	IX subtotal	*92.6*	*0.4*	*3.2*		*0.7*	*3.1*	*0.14*
	X a	89.6	0.9	1.0	<0.1	0.5	8.0	0.19
	X b	84.0	0.4	1.0	<0.1	0.2	14.4	0.27
	X subtotal	*86.1*	*0.6*	*1.0*	*<0.1*	*0.3*	*11.9*	*0.24*
	XI a	92.5		1.0		0.4	6.1	0.14
	XI b	97.7		0.9	<0.1	0.1	1.2	0.04
	XI subtotal	*96.0*		*0.9*	*<0.1*	*0.2*	*2.8*	*0.08*
	Total	89.5	2.3	2.1	<0.1	0.3	5.8	0.19
TU4	I a	90.8	2.4	1.3		0.4	5.1	0.17
	I b	98.3		0.9			0.8	0.03
	I subtotal	*92.2*	*1.9*	*1.2*		*0.3*	*4.3*	*0.15*
	II a	95.2	1.1	1.2		0.2	2.3	0.09
	II b	85.3	5.1	1.4		0.3	7.9	0.26
	II subtotal	*90.2*	*3.1*	*1.3*		*0.3*	*5.1*	*0.18*
	III a	94.8	1.6	1.5		0.2	1.9	0.10
	III b	90.8	1.3	1.5		0.4	6.0	0.17
	III c	95.4	1.0	1.5	<0.1	0.1	2.0	0.09
	III d	95.0	1.5	1.2		0.3	2.1	0.10
	III subtotal	*94.1*	*1.4*	*1.4*	*<0.1*	*0.2*	*2.9*	*0.11*
	V a	92.2	1.5	2.1		0.5	3.7	0.15
	V b	89.5	3.4	1.9		0.5	4.7	0.20
	V c	88.7	5.2	1.4	<0.1	0.6	4.1	0.21
	V d	89.4	2.4	1.8	<0.1	0.8	5.7	0.20

Table 7-9. (continued).

Prov.	Stratum	*Viviparus*	*Pomacea*	*Elimia*	*P. Trivolvis*	*P. duryi*	Bivalve	Diversity
TU4	V e	92.8	1.5	1.3	<0.1	0.4	4.0	0.14
	V f	94.9	0.4	1.2	<0.1	0.4	3.0	0.10
	V g	82.5	3.7	1.8		0.5	11.5	0.30
	V subtotal	*90.7*	*2.4*	*1.7*	*<0.1*	*0.5*	*4.7*	*0.17*
	VII a	90.7	1.2	1.7		0.5	5.8	0.17
	VII b	92.6	0.9	1.2		0.3	5.0	0.14
	VII c	91.2	1.5	1.4		0.5	5.4	0.16
	VII d	89.9	3.8	0.9		0.4	5.0	0.19
	VII subtotal	*91.2*	*1.9*	*1.3*		*0.4*	*5.2*	*0.16*
	Total	91.6	2.2	1.5	<0.1	0.4	4.4	0.16
TU5	0-10 cm	95.9	0.7	1.0		0.2	2.2	0.08
	10-20 cm	93.4	0.9	0.4		0.5	4.8	0.13
	20-30 cm	89.1	0.9	1.6	<0.1	0.3	8.1	0.20
	30-40 cm	90.4	0.6	1.3	<0.1	0.4	7.2	0.18
	40-50 cm	91.8	0.4	1.6		0.2	5.9	0.15
	50-60 cm	92.7	0.1	0.8		<0.1	6.3	0.14
	Total	91.3	0.8	1.2	<0.1	0.4	6.4	0.16
WWTA	0-10 cm	94.1	0.5	1.0		0.2	4.2	0.11
	10-20 cm	96.6	0.3	0.9			2.1	0.07
	20-30 cm	94.8	0.3	1.0		0.4	3.5	0.10
	30-40 cm	94.9	0.1	1.1		0.1	3.8	0.10
	40-50 cm	88.4	4.1	1.5		0.2	5.7	0.21
	50-60 cm	94.1	0.7	1.7	<0.1	0.2	3.4	0.11
	60-70 cm	95.6	1.3	1.4		0.4	1.4	0.09
	70-76 cm	92.0	2.8	2.4		1.2	1.6	0.15
	Total	93.7	1.2	1.3	<0.1	0.2	3.5	0.12

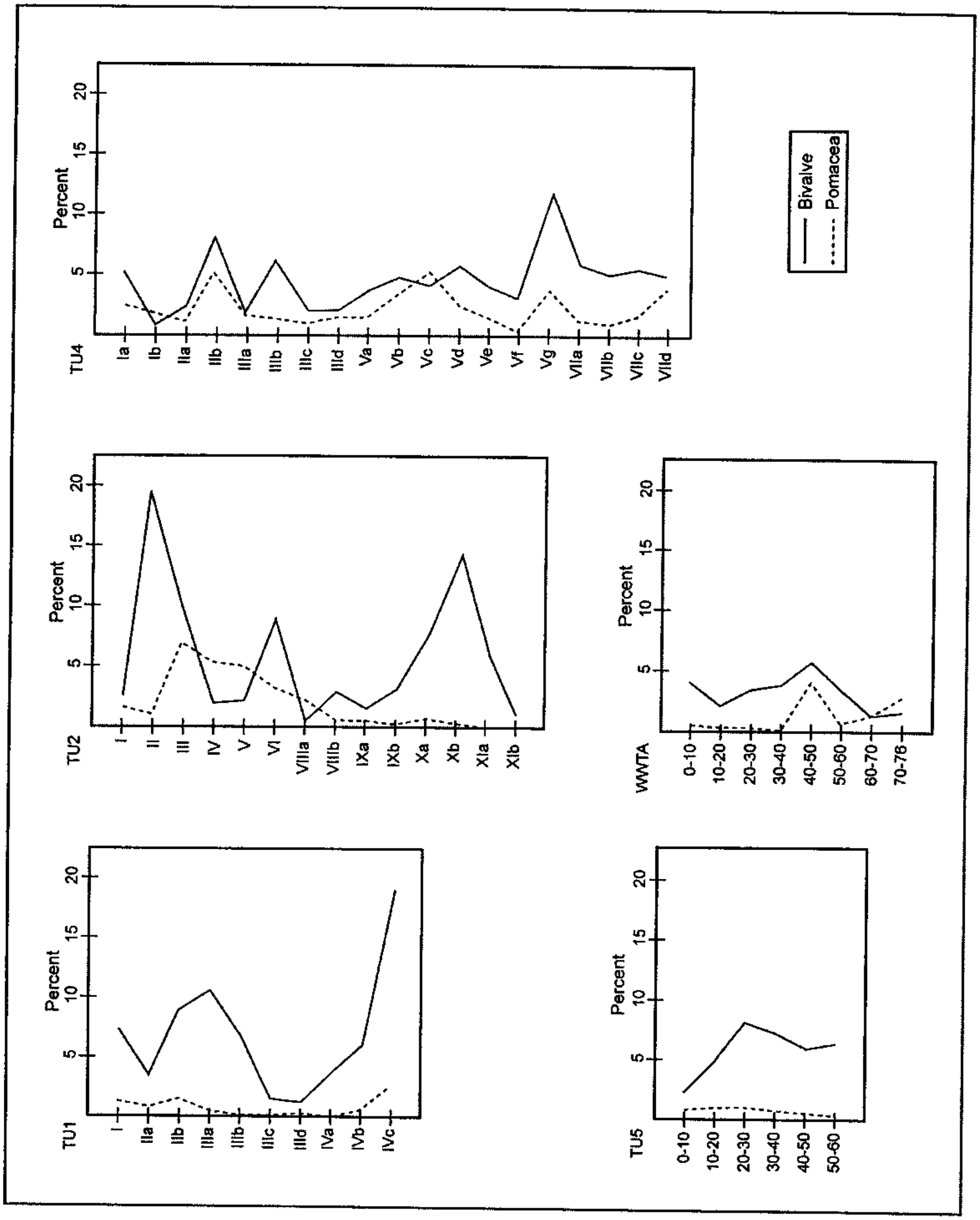

Figure 7-2. Relative frequency of bivalve and Pomacea shell by weight (g) in strata of five columns at Blue Spring Midden B (8VO43).

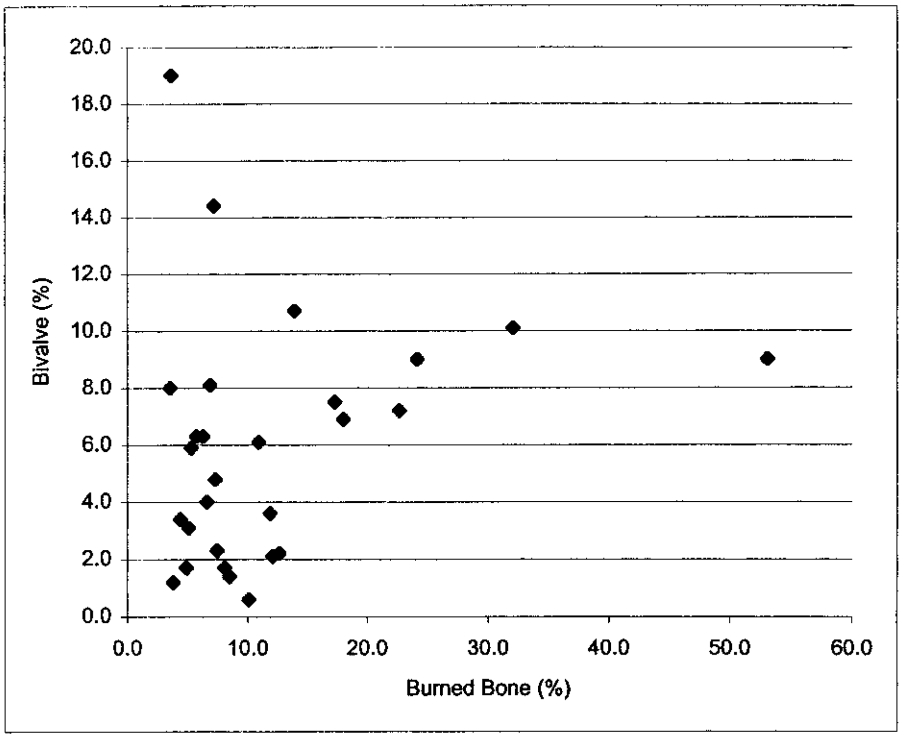

Figure 7-3. Percent burned bone by percent bivalve in all stratigraphic samples from columns in Test Units 1, 2, and 5, Blue Spring Midden B, 8VO43.

Reduction in Size of Viviparus *through Time*

A subject of recurring debate in Florida archaeology is the sustainability of shellfish exploitation over the long term and its relationship to settlement permanence along the St. Johns River. In his report on Kimball Island in Lake County, Florida, Cumbaa (1976) asserted that snail collecting was an ineffective long-term strategy because it required nearly 24,000 snails and an expenditure of 10-20 person hours to feed a small coresident group for one day. Given that such intensive harvesting levels for snails would likely deplete local beds over a relatively short period of time, Cumbaa suggested that groups would have had to relocate regularly. He estimated that aquatic resources comprised less than one-third of the Archaic diet, and that terrestrial species, especially white-tailed deer, were the mainstay of the diet (Cumbaa 1976:53).

More recent research has taken exception to Cumbaa's findings. In their analysis of Groves' Orange Midden fauna, Russo et al. (1992:105) demonstrate that "there is nothing inherently limiting about the environment or peoples during the Middle to Late Archaic periods that prevented year-round occupations of the coasts and river valleys." Using shell weight allometry to estimate actual meat weight, they demonstrate that *Viviparus* and other aquatic resources could indeed support permanent settlement.

Florida archaeologists have long noted that the average size of *Viviparus* diminished over the course of the middle to late Holocene. However, the actual effects of harvesting on snail size have not been adequately investigated. Clearly *Viviparus* was harvested in massive quantities, and Russo et al. (1992) make a strong case for its central dietary importance. But was intensive use of *Viviparus* sustainable without affecting the ability of local snail populations to rebound after periods of intensive predation? Does the evidence for more intensive and permanent settlement along the middle St. Johns imply a fixed relationship between humans and beds of shellfish?

Mobility is key to the economic sustainability of hunter-gatherers worldwide. Mobility allows human populations to extract resources from many different locations without overexploiting local resources (Kelly 1995). Unable to relocate, humans may experience reduced rates of energy return as key species diminish in frequency and/or size, a condition known as "resource depression." Evidence for economic intensification under these conditions may take the form of expanded diet breadth, technological innovation, or new labor arrangements. Documenting resource depression is not so straightforward, however, as changes in the mix of species exploited can be affected by independent environment factors, such as climate change. For many aquatic species, predation (i.e., harvesting) is a key factor in demographic shifts toward accelerated maturity and thus net reduction in the average size of individual organisms. Because age is "correlated with size among species that continue to grow throughout life, such as fishes and molluscs, increasing harvest rates can be indicated by decreases in mean size" (Broughton 1999:16).

Viviparus georgianus are freshwater snails found on all continents except South America (Thompson 1984). They are generally not found in larger rivers but in sloughs along the edge or in smaller creeks, lakes, ponds and springs (Clench and Turner 1956). They usually reside in colonies and each colony may be distanced from the other. *V. georgianus* can thrive where there is a great deal of soft mud and vegetation in quiet water (Clench and Turner 1956). The quiet lagoon that forms the southern margin of Blue Spring Midden B is an ideal habitat for this species.

Not surprisingly, the quantity or quality of food influences the growth rate of *Viviparus* (Vermeij 1981). *V. georgianus* can feed both by grazing on detritus and Aufwuchs (microbiotal scum on hard surfaces) and by filter feeding on phytoplankton and other suspended organic material (Aldridge et al.1985). *V. georgianus* will grow more rapidly and reach a larger size if these food sources are abundant in their habitat; if not, then growth could possibly be stunted (Vermeij 1981).

Females of *V. georgianus* usually live longer and grow faster than males (which allows females to reach larger sizes) (Browne 1978; Aldridge et al. 1985). Females also give birth to fully developed young, which is rare among gastropod species (Browne 1978). Growth of *V. georgianus* is continuous throughout the year and throughout the life cycle, although growth rate decreases slightly each winter (Browne 1978). Fertilization takes place late in the fall and through the winter, decreasing in late summer and early fall. Births begin in mid-winter and continue through mid-summer (Vail 1978).

V.georgianus are capable of producing offspring one year after birth. Browne (1978) charts the growth rate (in shell height) of *V. georgianus* in both male and females from four different lakes in upstate New York. His studies show that after one year of birth, males are on average 16.75 mm and females are on average 19.25 mm in shell height (Browne 1978:744). The average range for shell height of adult snails is 20-45 mm and the total width is 18-36 mm (Thompson 1984)

Browne's (1978) research on fecundity shows how size affects overall reproductive potential of *V. georgianus*:

> In comparison to most other molluscs, the fecundity of *V. georgianus* is uncommonly low. Selection probably drives females toward a larger size than males as a consequence of the cost of viviparity. The reproductive output of smaller females is not only limited bioenergetically, but smaller size places severe physical constraints on the number of embryos that can be maintained in the uterus if discrete embryo size units are to be maintained (Browne 1978:748).

Under these conditions, *V. georgianus* are not able to reproduce quickly. Males, on the other hand, have two options at the end of their first year. They may either divide their available energetic resources between growth and reproduction or they may devote the majority of their resources to the search for females. In *V.georgianus*, the copulation period probably occurs when primary trophic level food resources are optimal (in April and May). This period is also a time of intense competition between males to mate with the greatest number of females (Browne 1978:748).

The ability of females to reproduce and keep the population growing is determined by the number of active males that live and reproduce. Any disturbance to the population, such as predation, could severely affect the growth rate and population dynamics of *Viviparus* populations. Like most species, *V. georgianus* goes through normal demographic cycles. Unfortunately, the literature offers little insight on the "normal" demographic cycles of this species.

Environmental effects must also be examined for possible changes in shell morphology. Katoh and Foltz (1994) selected many samples from the Southeast including the St. John's river within three Florida counties: Marion, Seminole and Volusia. Studies on *V. georgianus* indicated that there was no apparent genetic differentiation among drainage systems. Their statistics show that most of the intraspecific variation was within, and not between, drainage systems (Katoh and Foltz 1994). There were significant site effects on *V. georgianus*, which were represented by multiple collections. "Intraspecific variation in shell weight and shell erosion was observed among collections in this study. This morphological variation suggests that the variation was environmentally induced"(Katoh and Foltz 1994).

The relative effect of environmental and human impact is an important consideration in any study of resource depression. Populations of *V. georgianus* in different locations can have differences in shape, thickness, or size. It is not enough to claim the environment influenced the mean size of these *Viviparus* populations in a given area, especially if being harvested regularly by humans. Independent environmental controls must be established. This is well beyond the scope of this report, as it will require a great deal more research. Nonetheless, patterning evident in preliminary analyses of *Viviparus* shells from Blue Spring strongly suggests that human exploitation of this species indeed contributed to reduced snail size through time.

To document variations in the mean shell size through time, *Viviparus* shells were measured from column samples from the basal and upper strata of three test units at Blue Spring Midden B. The samples consist of Strata III, XIa and XIb from TU2 and two levels (20-30 cm and 70-76 cm) from TU1 of the WWTA. Samples were subdivided into two subsamples using ½-inch and ¼-inch screens. Each sample was then sorted into four basic subsets: whole snails >½-inch, whole snails >¼-inch but <½-inch, fragmented snails >½-inch, and fragmented snails >¼-inch but < ½-inch. After sorting, each category was weighed in grams and hand counted (see Connaughton 2001 for raw data).

A minimum of 100 snails was randomly selected as a subsample from each column. Five different measurements (Figure 7-4) were taken for each snail: shell height, aperture width, aperture height, apex length, and spire height, following protocols outlines by Claassen (1999:101).

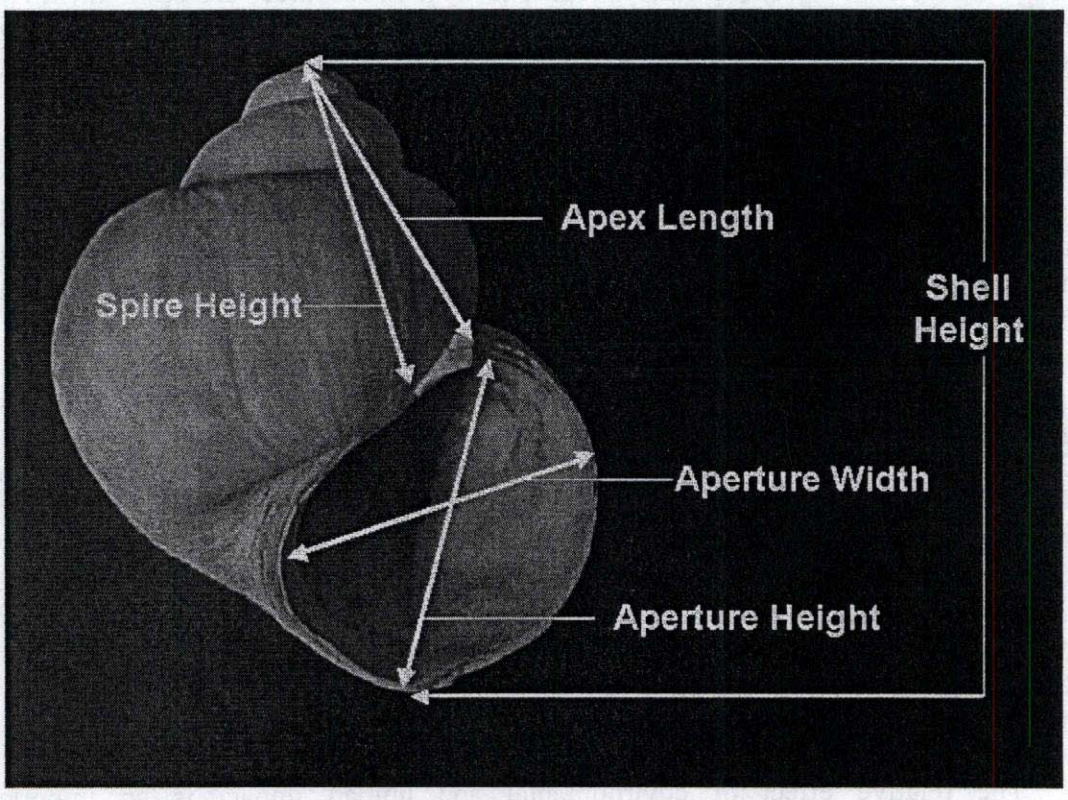

Figure 7-4. Locations of measurements taken from shells of *Viviparus georgianus*.

Table 7-10. Summary Statistics for Measurements (mm) Taken from Shells of *Viviparus georgianus* from Strata III and XIb in Test Unit 2, Blue Spring Midden B (8VO43).

		Shell Height	Aperture Width	Aperture Height	Apex Length	Spire Height
TU2-Str.III	n	100	100	100	100	100
	mean	23.21	12.52	14.00	11.34	10.11
	s.d.	2.48	1.18	1.27	1.49	1.61
	min.	18.37	9.55	11.05	8.58	7.09
	max.	32.41	16.70	18.46	16.16	15.18
TU2-Str.XIb	n	102	102	102	102	102
	mean	23.81	12.42	14.22	11.94	10.68
	s.d.	2.72	1.24	1.31	1.73	1.76
	min.	18.77	9.66	11.89	8.69	7.20
	max.	32.44	16.03	18.01	18.05	16.62

Significant differences in snail size were not observed in all pairwise comparisons of samples in stratigraphic sequence. Nonetheless, samples from TU2 indeed reflect a net decrease in the snail size for certain dimensions (Table 7-10). These are the most relevant samples for comparison and arguably the only ones with sufficient stratigraphic integrity (i.e., primary deposition/living floors) to accurately reflect short-term demographic change in snails.

Pairwise comparisons of mean values for snail shell dimensions were statistically evaluated with Student's *t*-test (Table 7-11). Significant differences are apparent in the mean values of apex length and spire height. The results for apex length show less than a 0.5-percent chance that snails from these two samples are from the same populations; the probability for spire height is less than one percent. Mean differences in the other dimensions are not significant at the 0.5 level, although in each dimension besides aperture width, the later stratum (Stratum III) has mean values less than the older stratum (Stratum XIb).

Table 7-11. Results of Students *t*-test on Pairwise Comparison of Mean Values for Metric Dimensions of *V. georgianus* from Strata III and XIb, Test Unit 2, Blue Spring Midden B (8VO43).

	Shell Height	Aperture Width	Aperture Height	Apex Length	Spire Height
t values unpooled	-1.631	0.584	-1.206	-2.630	-2.391
t values pooled	-1.629	0.584	-1.206	-2.626	-2.391
significance	>0.05	>0.10	>0.10	<0.005	<0.01

A ranked frequency distribution for the two samples of snails shows clearly where the difference in shell size lies (7-5). For aperture length, only about 7 percent of the Stratum XIb sample has values less than 10 mm. In contrast, nearly 20 percent of the Stratum III populations are 10 mm or less in apex length. The complementary trend is seen at the opposite end of the distribution, where only about 10 percent of the snails in Stratum III have apex length greater than 13 mm, compared to some 20 percent in Stratum XIb. This shift in size is reflective of an overall shift in demographic structure, whereby the later population has fewer "older" individuals, hence fewer large snails. Presumably, the population experienced accelerated growth and maturation to compensate for a net loss of older individuals.

These results must be considered tentative and await further testing with larger samples. The relatively minor change in snail size observed in samples from TU2 may be entirely insignificant from the standpoint of human subsistence. Still, we hasten to add that the trend for decreased snail size manifested in these preliminary samples continues well beyond the ca. 3700-3500 rcybp timeframe of the Blue Spring strata. Snails from the upper strata of Live Oak Mound, for example, are markedly smaller than those from the Orange component of Blue Spring. Through time, local populations clearly experienced drops in average size of *Viviparus*, and undoubtedly this affected the relative costs and benefits of the use of this resource.

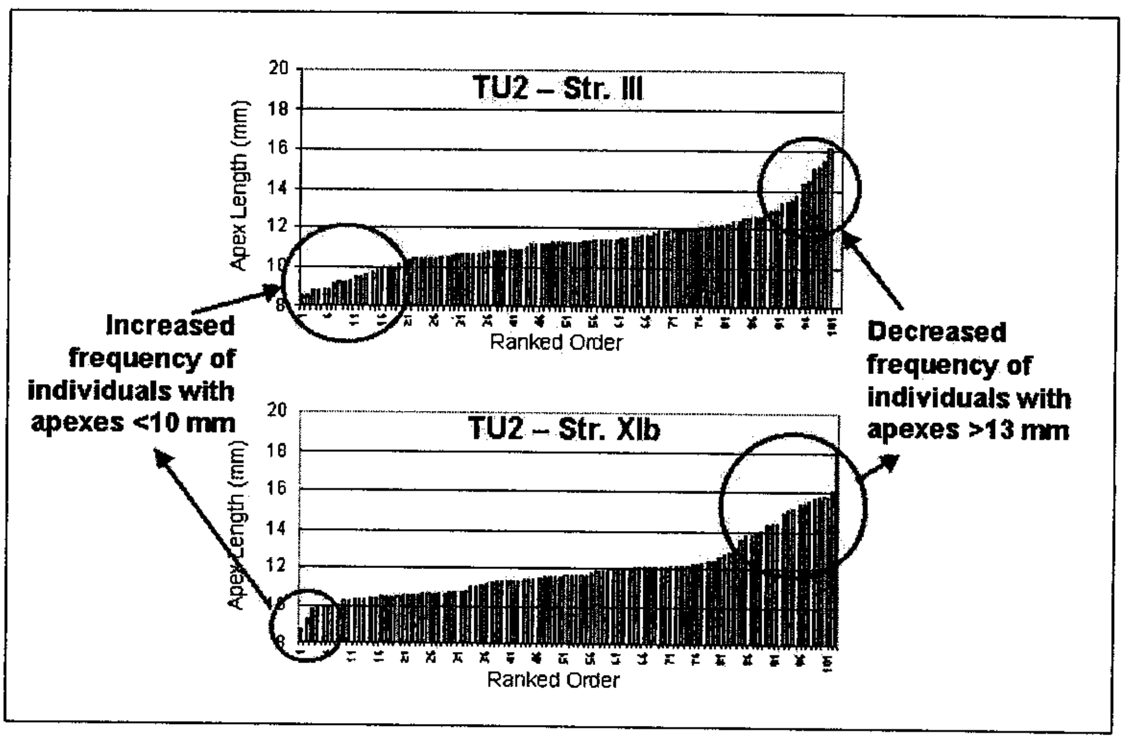

Figure 7-5. Ranked frequency distribution of values for apex length (mm) for snails in Strata III and XIb of Test Unit 2, Blue Spring Midden B (8VO43).

CONCLUSION

The data and analyses reported in this chapter are preliminary. The Blue Spring Midden B faunal assemblage is rich, well preserved, and from contexts that allow for a variety of comparisons through time and across intrasite space. Additional materials from the 1/8-inch waterscreened samples of stratigraphic columns await basic identification, and 67 bulk samples of 10 liters each await processing. These shortcomings notwithstanding, the data at hand reveal some robust patterning in the composition and condition of zooarchaeological remains.

First, the overall picture is one of continuity in subsistence over the five or more centuries of midden formation at Blue Spring. This corroborates what Florida archaeologists have repeatedly observed: once established some 6000 years ago, the riverine economies of the St. Johns were remarkably stable and sustainable, despite apparent increases in population and cultural elaboration. The addition of pottery is a case in point. Its introduction at Blue Spring, at about 4000 rcybp, apparently was uneventful, at least from the standpoint of resource selection. Possibly changes in the ways traditional foods were processed, and/or in the scale of processing, may have taken place, and are currently unobservable, but nothing in the record from Blue Spring or regional sites of similar sequence (e.g., Groves' Orange Midden) reflects any marked change in resource selection at the onset of pottery making.

Beneath the veneer of continuity in subsistence lie some subtle variations that appear to reflect short-term responses to changes in the availability of staple resources. The overall trend for increased diversity in the shellfish and fish species exploited from the earliest to the latest Orange-period occupations exposed in Test Unit 2 coincides with a minor decrease in the average size of *Viviparus*. Thus, diet breadth may have increased in response to diminished returns on shell production, although when we consider some of the specific resources expanded over this time, local environmental changes come to the fore. Specifically, the apparent increased use of Lake chubsucker through time suggests that the productive capacity of the nearby lagoon was on the rise, perhaps as a result of increased precipitation and the local groundwater responses to net gains in sea level. If so, the diminished use of species from the channels of the run and river, such as American eel, may signal less attention to species with greater capture costs.

Finally, the Blue Spring zooarchaeological assemblages lend further support to the inference that deposits on either side of the Thursby House reflect difference contexts of refuse disposal. Zooarchaeological data are generally underutilized for interpretations of site formation, which is unfortunate given their potential in this regard. Moreover, inattention to the contexts from which zooarchaeological materials are collected can lead to erroneous conclusions about resource selection, food processing, and the like. The Blue Spring samples demonstrate the importance of analytical separation of contexts that are too often collapsed in zooarcheological studies for the sake of sample size.

CHAPTER 8
CONCLUSIONS AND RECOMMENDATIONS

Two five-week episodes of field work at Hontoon Island and Blue Spring State Parks in 2000 and 2001 contributes many new findings to archaeological knowledge that has been accumulating since the 1870s. However, this recent work succeeded in raising more questions than it answered, underscoring the complexity of an archaeological record that ranges from small sheet middens to 500-ft-long shell ridges. In the interest of advancing this research further, specifically with regard to archaeology at these state parks and more generally within the middle St. Johns area, we offer in this closing chapter a prospectus for an additional phase of field work. The following recommendations are in keeping with the Unit Management Plan for the parks, which indicates that "further research and survey opportunities should be pursued when possible... [to] support increased interpretation of the two parks' cultural resources as part of the Florida Park Service's ecotourism efforts" (Dept. of Environmental Protection 1999:48). We might also add that additional efforts to identify and characterize cultural resources in the parks is consistent with modern archaeological practice aimed at preserving sites through management of the information potential contained within such resources. To this point, the St. Johns Archaeological Field School has utilized low-impact surveying techniques and small-scale sampling to fulfill these goals, and the work proposed below continues in this spirit. Before delving into the details of future prospects, a review of the results to date is warranted.

SUMMARY OF RESULTS

Students of the 2002 and 2001 field schools conducted archaeological field work at three locations in the parks: Blue Spring Midden B (8VO43), Live Oak Mound (8VO41), and Hontoon Island.

Blue Spring Midden B

Virtually nothing was known about the extent or content of subsurface deposits at Blue Spring Midden B before 2000. Testing beneath the Thursby House, in advance of foundation repairs, revealed a 1.2-m stratified shell midden dating from roughly 4300 to 3500 rcybp. Differences in the composition and structure of the midden on either side of the house led to the hypothesis that both primary and secondary midden deposits were present, the former indicative of habitation space (i.e., domestic structures). Ground penetrating radar was used to develop a signature for primary midden and then predict the locations of a stratigraphic facies between primary and secondary deposits. Additional testing in 2001 confirmed the position of this facies and led to the application of a site-wide GPR survey to locate other such features. An arcuate arrangement of feature clusters spanning the northern and western elevations of the Thursby House represents the first Orange-period "village" ever detected along the middle St. Johns River. Confirmation of this preliminary result will require additional survey and subsurface testing.

In addition to documenting community patterning at the site, excavations beneath the Thursby House yielded a discrete assemblage of Orange Plain pottery. Combined with new radiocarbon assays from Orange Incised pottery from other sites in the middle St. Johns area (Sassaman 2003), dates for the Blue Spring assemblage (ca. 3700-3500 rcybp) provide ample justification for revising the long-lived Orange chronology developed by Bullen (1954, 1972). Assemblages dominated by Orange Plain pottery and others dominated by Orange Incised are now demonstrably coeval, and not sequential, as was the case in Bullen's chronology.

In advance of construction of a new sewage treatment facility at Blue Spring, the 2000 field school tested a location some 200 m southwest of the Thursby House. Observed beneath one meter of recent alluvial deposition was a well preserved shell midden of apparent preceramic age (i.e., >4000 rcybp). Groundwater levels that summer prevented full characterization of this deposit, so the following summer a second test unit was excavated 100 m upslope, where bucker augering revealed the same buried midden. This second test unit (TU5) penetrated over 80 cm of shell midden over another 20 cm of shell-free midden, all preceramic in age. These results confirmed the presence of an extensive early component beneath Orange-age shell midden beneath the Thursby House. Columns of midden deposits from five locations of testing provide abundant subsistence data for exploring possible changes in diet and paleoecology over a long period of more-or-less continuous occupation. Preliminary analysis of these subsistence data show that diet remained remarkably stable from preceramic to ceramic times, although at a microstratigraphic level, diversification in the species of fish and shellfish exploited may point to short-term responses to diminished returns on first-order species.

Live Oak Mound

A large mound 1 km north of Blue Spring was investigated by Jeffries Wyman in the 1870s and looted 100 years later, allegedly for human burials. The mound is recorded in the Florida Master Site Files as 8VO41, and located within a larger midden site known as Palmetto Midden (8VO40), a site whose location was erroneously estimated by John Goggin from the vague description provided by Wyman (1875). The 2001 field school resolved this locational problem and renamed the mound, Live Oak Mound (8VO41). Work at this site was limited to topographic mapping, including the mapping of 135 looters' pits, along with limited testing at two such looters' pits. The results of testing suggest that the entire mound was initiated as an extensive preceramic midden dating from ca. 6300 rcybp. One probable episode of mounded shell overlying the preceramic midden is estimated to date to the Orange period (ca. 4000-3500 rcybp), and attests to the deliberate construction of this monument. The particular configuration of Live Oak Mound—a tall conical mound with a curving, trailing "ramp"—is a form that recurs at 8VO215 on Hontoon Island and is perhaps consistent with the now-destroyed shell mounds Wyman observed at the north end of Hontoon Island. The burials Wyman described from the upper portion of the Live Oak Mound most likely date to the St. Johns II period, although earlier interments are certainly possible. The field school effort encountered no human remains.

Hontoon Island

Reconnaissance survey of Hontoon Island was designed as a "full-coverage" effort to examine areas heretofore overlooked by archaeologists, namely the interior of the island. No interior sites were located in several transects across the island, but two of the transects intercepted two small, buried shell-bearing sites (8VO7493, 8VO7494), heretofore unrecorded. Survey on the island also sought to refine site boundaries for four sites: 8VO202, 8VO214, 8VO215, and 8VO216. Definitive boundaries were established for two of these sites (8VO214, 8VO215), a third was not relocated (8VO216), and the fourth (8VO202) will require more shovel testing. On balance, the survey effort showed that sites long ago impacted by shell mining (e.g., 8VO202) have extensive subsurface middens still intact, and that many small shell-bearing sites along the margins of the island remain to be found.

RECOMMENDATIONS FOR ADDITIONAL WORK

The St. Johns Archaeological Field School hopes to return in 2003 and 2004 to Blue Spring and Hontoon Island State Parks to resolve some of the outstanding issues raised in previous years and to expand its efforts to locate and characterize both new and extant sites. Seven goals are proposed for work in the ensuing two years.

Finalize GPR Survey of Blue Spring Midden B

The GPR survey of Blue Spring Midden B to date has been sufficient to locate feature clusters, but too coarse-grained to characterize house floors and associated features in three dimensions (i.e., to produce z-slices of the strata). Transects at an interval no greater than 50 cm are required to capture these data. Although a large block excavation to expose all or part of a household cluster would be intellectually satisfying, it is not necessary, perhaps not even appropriate for a site that is not threatened with destruction. Instead, limited bucket-augering to groundtruth GPR readings is all that is required to finalize this aspect of the project.

Reconnaissance Survey of East Terrace of St. Johns to Locate Palmetto Mound (8VO40)

The low mound Wyman (1875:25) referred to as Palmetto Shell Mound, north of Live Oak Mound, has never been documented. Casual reconnaissance in 2001 failed to detect any trace of this site. Given its low relief and location proximate to a bend in the St. Johns River, Palmetto Shell Mound may very well have been destroyed by flooding. Alternatively, it may be hidden under a mantle of recent alluvium. Thus, shovel-test transects along the east terrace edge are needed to search for subsurface evidence of this site. If found, the site will be shovel tested and/or augered in a cruciform pattern to define its boundaries.

Survey and Testing for Subsurface Remnants of 8VO202

The large site where massive shell ridges and conical mounds once stood, and where Purdy (1987) located subaqueous midden, is still without definitive boundaries. The potential is great for preceramic midden across much of the area west of Purdy's wet-site excavation. Shovel tests and bucket augering are needed to determine the full extent of buried midden and limited testing is required to collect materials suitable for radiocarbon dating and subsistence characterization, as well as assess the potential for subsurface features indicative of habitation structures, such as those documented at 8VO43. We propose that the excavation of two or three 2 x 2-m units in locations determined by shovel testing to contain intact subsurface midden will be sufficient to make these observations. These tests should be staged over two seasons to maximize the potential for meaningful observations.

Subsurface Characterization of Small Shell-Bearing Sites along East Terrace of the St. Johns

Two small shell-bearing sites fronting Lake Beresford (8VO38, 8VO39) and the shell midden at Starks Landing (8VO42) have never been mapped or characterized. Augering and shovel tests are required to define the horizontal and vertical extent of each of these sites, and limited controlled tests in one or two 1 x 2-m or 2 x 2-m units are needed to adequately characterize the components present. A particular goal of testing these sites and others like them on Hontoon Island (see below) is to collect materials suitable for dating. Given the lack of evidence for intensive habitation use of mounds such as Live Oak and 8VO215, it stands to reason that some of these small shell-bearing sites are the locus of habitation for communities who used the mound for nondomestic purposes.

Subsurface Characterization of Small Shell-Bearing Sites on Hontoon Island

Two new sites (8VO7493, 8VO7494) and one previously recorded site (8VO215) on Hontoon Island require the same manner of testing described above for sites on the east Terrace of the St. Johns.

Mapping and Limited Testing of 8VO214

The intact mound at the south end of Hontoon Island (8VO214) was dug into by Wyman and later mapped by Ray McGee as part of Purdy's expedition. Although McGee's map is superb, it does not capture much of the surrounding terrain. We therefore propose to map the mound again, and its immediate surroundings with a Total Station. We also propose to open up a small excavation at the southern base of the mound were concreted midden is exposed by tree throws and erosion. We suspect that basal component of the mound, like that at Live Oak Mound, dates to the preceramic era. Radiocarbon dating of the concreted midden is needed to substantiate this supposition.

Mapping and Augering of Unrecorded Mound at Blue Spring

The Wildlife Biologist at Blue Spring State Park, Richard Harris, informs us of another mound at the park that is fully intact and never recorded. We propose to map the site in its entirety and auger its perimeter to determine its basal component. Hopefully some charcoal can be collected from the auger to get a radiometric assay. No subsurface testing other than augering is proposed for this site. As long it is remains under the protection of Florida State Parks, excavation is arguably unjustified.

REFERENCES CITED

Abrahamson, Warren G. and David C. Hartnett
1990 Pine Flatwods and Dry Prairies. In *Ecosystems of Florida*, edited by Ronald Myers and John J. Ewel, pp. 103-149. University of Central Florida Press, Orlando.

Aldridge, David W., W. D. Russell-Hunter, and Daniel E. Buckley
1986 Age-related Differential Catabolism in the Snail, *Viviparus georgianus,* and its Significance in the Bioenergetics of Sexual Dimorphism. *Canadian Journal of Zoology* 64(2):340-346.

Archaeological Consultants, Inc (and Janus Research, Inc.)
2000 *Phase III Mitigative Excavations at Lake Monroe Outlet Midden (8VO53), Volusia County, Florida.* Archaeological Consultants, Inc., Sarasota, Florida

Aten, Lawrence E.
1999 Middle Archaic Ceremonialism at Tick Island, Florida: Ripley P. Bullen's 1961 Excavation at the Harris Creek Site. *The Florida Anthropologist* 52:131-200.

Beriault, John, Robert Carr, Jerry Stipp, Richard Johnson, and Jack Meeder
1981 The Archaeological Salvage of the Bay West Site, Collier County, Florida. *The Florida Anthropologist* 34:39-58.

Borremans, Nina
1990 *The Paleoindian Period.* Florida Historical Contexts, Division of Historical Resources, Department of State, Tallahassee.

Broughton, Jack M.
1999 *Resource Depression and Intensification During the Late Holocene, San Francisco Bay: Evidence from the Emeryville Shellmound Vertebrate Fauna.* Anthropological Records Vol. 32. University of California Press, Berkeley.

Browne, Robert A.
1978 Growth, Mortality, Fecundity, Biomass and Productivity of Four Lake Populations of the Prosobranch Snail, *Viviparus georgianus. Ecology* 59:742-750.

Bullen, Ripley P.
1954 Culture Changes during the Fiber-Tempered Period of Florida. *Southern Indian Studies* 6:45-48.

1955 Carved Owl Totem, De Land, Florida. *The Florida Anthropologist* 8:61-74.

1972 The Orange Period of Peninsular Florida. In *Fiber-Tempered Pottery in Southeastern United States and Northern-Columbia: Its Origins, Context, and Significance*, edited by Ripley P. Bullen and James P. Stoltman, pp. 9-33. Florida Anthropological Society Publications 6. Gainesville.

1975 *A Guide to the Identification of Florida Projectile Points.* Kendall Books, Gainesville.

Claassen, Cheryl
1998 *Shells*. Cambridge University Press, Cambridge.

Clausen, Carl J., A. D. Cohen, Cesaress Emiliani, J. A. Holman, and J. J. Stipp
1979 Little Salt Spring, Florida: A Unique Underwater Site. *Science* 203:609-614.

Clench, William J. and Turner, Ruth D.
1956 Freshwater Mollusks of Alabama, Georgia and Florida. *Bulletin of the Florida State Museum, Biological Sciences* 1(3):108-111.

Connaughton, Sean P.
2001 *Resource Depression in the Subsistence Economy of Prehistoric Hunter-Gatherers of the St. Johns River Valley, Florida.* Senior thesis, department of Anthropology, University of Florida, Gainesville.

Cumbaa, Stephen L.
1976 A Reconsideration of Freshwater Shellfish Exploitation in the Florida Archaic. *The Florida Anthropologist* 29:50-59.

Cumbaa, Stephen L., and Thomas H. Gouchnour
1970 The Colby Site, Marion County, Florida. *The Florida Anthropologist* 29:49-59.

Daniel, I. Randolph, and Michael Wisenbaker
1987 *Harney Flats: A Florida Paleoindian Site.* Baywood, Farmingdale, N.Y.

Department of Environmental Protection
1999 *Blue Spring State Park and Hontoon Island State Park Unit Management Plan* (draft). Division of Recreation and Parks, Tallahassee.

Doren, Glen H. (editor)
2002 *Windover: Multidisciplinary Investigations of an Early Archaic Florida Cemetery.* University Press of Florida, Gainesville.

Doren, Glen H., and David N. Dickel
1988 Multidisciplinary Investigations at the Windover Site. In *Wet Site Archaeology*, edited by B Purdy, pp. 263-290. Telford Press, Caldwell, New Jersey.

Dunbar James S., and B. I. Waller
1983 A Distribution Analysis of the Clovis/Suwannee Paleo-Indian Sites of Florida: A Geographic Approach. *The Florida Anthropologist* 36:18-30.

Dunbar, James S., and S. David Webb
1996 Bone and Ivory Tools from Submerged Paleoindian Sites in Florida. In *The Paleoindian and Early Archaic Southeast*, edited by D. G. Anderson and K. E. Sassaman, pp. 331-353. University of Alabama Press, Tuscaloosa.

Dunbar, James S., Mark Russo, Tom Nielson, Star Lockwood
1978 *Huntoon Island State Park Cultural Resource Survey.* Underwater Archaeological research Section, Division of Archives, History and Records Management, Tallahassee.

Dunbar, James S., S. David Webb, and Dan Cring
1989 Culturally and Naturally Modified Bone from a Paleoindian Site in the Aucilla River, North Florida. In *Bone Modification*, edited by R. Bonnichsen and M. Sorg, pp. 473-497. Center for the Study of the First Americans, Orono, Maine.

Endonino, Jon C.
2000 The Determination of Orange Period Pottery Manufacturing Techniques Using Experimental and Radiographic Approaches. Ms. on file, Florida Museum of Natural History, University of Florida, Gainesville.

Ewel, Katherine C.
1990 Swamps. In *Ecosystems of Florida*, edited by Ronald Myers and John J. Ewel, pp. 281-323. University of Central Florida Press, Orlando.

Gagliano, S. W.
1977 *Cultural Resources Evaluation of the Northern Gulf of Mexico Continental Shelf*, vol. 1. Interagency Meeting of the Society for American Archaeology, Atlanta.

Goggin, John M.
1952 *Space and Time Perspectives in Northern St. Johns Archaeology, Florida.* Yale University Publications in Anthropology 47.

Hann, John H.
1996 *A History of the Timucua Indians and Missions*. University Press of Florida, Gainesville.

Jahn, Otto L., and Ripley P. Bullen
1978 *The Tick Island Site, St. Johns River, Florida.* Florida Anthropological Society Publications 10. Gainesville.

Janus Research, Inc.
1995 *Archaeological Investigations at the Summer Haven Site (8SJ46), an Orange Period and St. Johns Period Midden Site in Southeastern St. Johns County, Florida.* Environmental Research: Cultural Resource Management, State of Florida, Department of Transportation, Tallahassee, Florida.

Katoh, Masaya and Foltz, David W.
1994 Genetic Subdivision and Morphological Variation in a Freshwater Snail Species Complex Formerly Referred to as *Viviparus georgianus (Lea). Biological Journal of the Linnean Society* 53:73-90.

Kelly, Robert L.
1995 *The Foraging Spectrum: Diversity in Hunter-Gatherer Lifeways*. Smithsonian Institution Press, Washington D.C.

Luer, George M., David Allerton, Dan Hazeltine, Ron Hatfield, and Darden Hood
1986 Whelk Shell Tool Blanks from Big Mound Key (8CH10), Charlotte County, Florida: with Notes on Certain Whelk Shell Tools. *Florida Anthropological Society Publications* 12:92-124.

McGee, Ray M, and Ryan J. Wheeler
1994 Stratigraphic Excavations at Groves' Orange Midden, Lake Monroe, Volusia County, Florida: Methodology and Results *The Florida Anthropologist* 47:333-349.

Marquardt, William H.
1992 Shell Artifacts from the Caloosahatchee Area. In *Culture and Environment in the Domain of the Calusa*, edited by William H. Marquardt, pp. 191-228. Institute of Archaeology and Paleoenvironmental Studies, University of Florida Gainesville.

Milanich, Jerald T.
1994 *Archaeology of Precolumbian Florida*. University Press of Florida, Gainesville.

1996 *The Timucua*. Blackwell, Oxford.

Milanich, Jerald T., and Charles H. Fairbanks
1980 *Florida Archaeology*. Academic Press, New York.

Miller, James J.
1991 *The Fairest, Fullest, and Pleasentest of all the World: An Environmental History of the Northeast Part of Florida*. Ph.D. dissertation, University of Pennsylvania, Philadelphia.

1998 *An Environmental History of Northeast Florida*. University Press of Florida, Gainesville.

Moore, Clarence B.
1892-94 Certain Shell Heaps of the St. Johns River, Florida, hitherto Unexplored. Reprint. *American Naturalist*, November 1892, pp. 912-922; January 1893, pp. 8-13; February 1893, pp. 113-117; July 1893, pp. 605-624; August 1893, pp. 709-733; January 1894, pp. 15-26.

1998 *The East Florida Expeditions of Clarence Bloomfield Moore*, edited by Jeffrey M. Mitchem. University of Florida Press, Gainesville.

Neill, Wilfred T.
1964 The Association of Suwannee Points with Extinct Mammals in Florida. *The Florida Anthropologist*.

Newsom, Lee A.
1987 Analysis of Botanical Remains from Hontoon Island (8VO202), Florida, 1980-1985 Excavations. *The Florida Anthropologist* 40:47-84.

1994 Archaeobotanical Data from Groves' Orange Midden (8VO2601), Volusia County, Florida. *The Florida Anthropologist* 47:393-403. *The Florida Anthropologist* 47:404-417

Platt, William J. and Mark W. Schwartz
1990 Temperate Hardwood Forests. In *Ecosystems of Florida*, edited by Ronald Myers and John J. Ewel, pp. 194-229. University of Central Florida Press, Orlando.

Purdy, Barbara A.
1981 *Florida's Prehistoric Stone Tool Technology*. University Press of Florida, Gainesville.

1987 Investigations at Hontoon Island (8V0202), An Archaeological Wet Site in Volusia County, Florida: An Overview and Chronology. *The Florida Anthropologist* 40(1):4-12.

1991 *The Art and Archaeology of Florida's Wetlands*. CRC Press, Boca Raton.

1994 Excavations in Water-Saturated Deposits at Lake Monroe, Volusia County, Florida: An Overview. *The Florida Anthropologist* 47:326-332.

Reitz, Elizabeth J., and Elizabeth S. Wing
1999 *Zooarchaeology*. Cambridge University Press, Cambridge.

Rouse, Irving
1951 *A Survey of Indian River Archaeology, Florida*. Yale University Publications in Anthropology 44.

Russo, Michael
1990a *The Archaic Period*. Florida Historical Contexts, Division of Historical Resources, Department of State, Tallahassee.

1990b *East and Central Florida, 3200 B.P.-A.D. 1565*. Florida Historical Contexts, Division of Historical Resources, Department of State, Tallahassee.

1996a Southeastern Archaic Mounds. In *Archaeology of the Mid-Holocene Southeast*, edited by K. E. Sassaman and D. G. Anderson, pp. 259-287. University Press of Florida, Gainesville.

1996b Southeastern Mid-Holocene Coastal Settlements. In *Archaeology of the Mid-Holocene Southeast*, edited by K. E. Sassaman and D. G. Anderson, pp. 177-199. University Press of Florida, Gainesville.

1999 Bigger, Longer, and Uncut: Thresholds of Power at Florida Archaic Shell Rings? Paper presented at the 56th Annual Meeting of the Southeastern Archaeological Conference, Pensacola, Florida.

Russo, Michael, and Gregory Heide
2002 The Joseph Reed Shell Ring. *The Florida Anthropologist* 55(2):67-87.

Russo, Michael, Barbara A. Purdy, Lee A. Newsom, and Ray M. McGee
1992 A Reinterpretation of Late Archaic Adaptations in Central-East Florida: Groves' Orange Midden (8-Vo-2601). *Southeastern Archaeology* 11:95-108.

Ste. Claire, Dana
1987 The Development of Thermal Alteration Technologies in Florida: Implications for the Study of Prehistoric Adaptations. *The Florida Anthropologist* 40(3):203-208.

Sassaman, Kenneth E.
1993 *Early Pottery in the Southeast: Tradition and Innovation in Cooking Technology*. University of Alabama Press, Tuscaloosa.

2003 New AMS Dates on Orange Fiber-Tempered Pottery from the Middle St. Johns Valley and Their Implications for Culture History in Northeast Florida. *The Florida Anthropologist* 56:5-13.

n.d. *Crescent Lake Survey, Putnam and Flagler Counties, Florida*. Technical Report 5, Laboratory of Southeastern Archaeology, Department of Anthropology, University of Florida, Gainesville (in preparation)

Sassaman, Kenneth E., J. Christian Russell, and Jon C. Endonino
2000 *St. Johns Archaeological Project Phase I: A GIS Approach to Regional Preservation Planning in Northeast Florida*. Technical Report 3, Laboratory of Southeastern Archaeology, Department of Anthropology, University of Florida, Gainesville.

Schmidt, Walter
1997 Geomorphology and Physiography of Florida. In *The Geology of Florida*, edited by A. F. Randazzo and D. S. Jones, pp. 1-12. University Press of Florida, Gainesville.

Thompson, Fred G.
1984 *The Freshwater Snails of Florida, A Manual for Identification*. University Presses of Florida, Gainesville.

Trinkley, Michael B.
1980 *Investigations of the Woodland Period along the South Carolina Coast*. Ph.D. dissertation, Department of Anthropology, University of North Carolina, Chapel Hill.

1985 The Form and Function of South Carolina's Early Woodland Shell Rings. In *Structure and Process in Southeastern Archaeology,* edited by R. S. Dickens and H. T. Ward, pp. 102-118. University of Alabama Press, Tuscaloosa.

United States Department of Agriculture Soil Conservation Service
1980 *Soil Survey of Volusia County, Florida*. University of Florida Institute of Food and Agricultural Sciences, Agricultural Experiment Stations, Soil Science Department, Gainesville.

Vail, Virginia A.
1978 Seasonal Reproductive Patterns in 3 Viviparid Gastropods. *Malacologia* 17(1):73-97.

Vermeij, Geerat J.
1981 Gastropod Shell Growth Rate, Allometry, and Adult Size: Environmental Implications. In, *Skeletal Growth of Aquatic Organisms: Biological Records of Environmental Change*, pp. 379-394. Plenum Press, New York.

Warren, Lyman O., William Thompson, and Ripley P. Bullen
1967 The Culbreath Bayou Site, Hillsborough County, Florida. *The Florida Anthropologist* 20:146-163.

Webster, William J.
1970 A New Concept for the Busycon Shell Receptacle. *The Florida Anthropologist* 23:1-7.

Wharton, Barry, George Ballo, and Mitchell Hope
1981 The Republic Groves Site, Hardee County, Florida. *The Florida Anthropologist* 34:59-80.

Wheeler, Ryan J., and Ray M. McGee
1994a Technology of Mount Taylor Period Occupation, Groves' Orange Midden (8VO2601), Volusia County, Florida. *The Florida Anthropologist* 47:350-379.

Wheeler, Ryan J., and Ray M. McGee
1994b Wooden Artifacst from Groves' Orange Midden. *The Florida Anthropologist* 47:380-389

1994c Report of Preliminary Zooarchaeological Analysis: Groves' Orange Midden. *The Florida Anthropologist* 47:393-403. *The Florida Anthropologist* 47:393-403.

Wheeler, Ryan J., Christine L. Newman, and Ray M. McGee
2000 A New Look at the Mount Taylor and Bluffton Sites, Volusia County, with an Outline of the Mount Taylor Culture. *The Florida Anthropologist* 53:132-157.

Worth, John E.
1998a *The Timucuan Chiefdoms of Spanish Florida, vol. 1, Assimialtion.* University Press of Florida, Gainesville.

1998b *The Timucuan Chiefdoms of Spanish Florida, vol. 1, Resistance and Destruction.* University Press of Florida, Gainesville.

Wyman, Jeffries
1875 *Fresh-Water Shell Mounds of the St. Johns River, Florida.* Peabody Academy of Science, Memoirs, No. 4, Salem, Mass.

APPENDIX A
CATALOG

Blue Spring Midden B (8VO43)

Prov.	Lev./Str.	Subunit	Rec.	Pottery fiber-temp. ct	Pottery fiber-temp. wt	Pottery other ct	Pottery other wt	Pottery crumb ct	Pottery crumb wt	Flaked stone ct	Flaked stone wt	Shell tool ct	Shell tool wt	Shell bead ct	Shell bead wt	Bone tool ct	Bone tool wt	Freshwater Gastopods *Vivi.* wt	*Pom.* wt	*Elim.* wt	*P. tri.* wt	*P. dur* wt
TU1	A		1/4	5	14.3			3	2.6							1	0.4					
TU1	B		1/4	38	171.6	1	2.5	102	64.5													
TU1	C		1/4	61	224.0			261	120.8							3	5.4					
TU1	D		1/4	76	299.6			304	133.6													
TU1	E		1/4	44	153.7			207	86.2	1	0.7					2	10.6					
TU1	F		1/4	12	38.0			40	18.6							2	4.8					
TU1	G		1/4	1	1.2			14	3.6	4	1.4	1	0.3			1	1.1					
TU1	H		1/4					1	0.1	2	1.9	1	16.2	1.0	0.2	2	1.7					
TU1	I		1/4							6	1.4	1	155.2			3	9.5					
TU1	J		1/4	1	5.9					4	1.9	1	0.7			4	8.4					
TU1	K		1/4							1	0.2											
TU1	L		1/4							2	0.5											
TU1	M		1/4							1	1.4											
TU1	N		1/4											1.0	0.1							
TU1	O		1/4																			
TU1	wall	cleanup	1/4													1	2.2					
TU2	A		1/4	1	3.2	1	2.0	3	1.4													
TU2	B		1/4	19	71.7			105	43.9	1	8.3					1	0.4					
TU2	C		1/4	7	11.7			57	26.0							1	0.4					
TU2	D		1/4	8	25.1			140	52.9	1	18.6					1	0.4					
TU2	E		1/4	4	17.7			17	9.8													
TU2	E	ZONE A	1/4	3	8.5			65	23.3													
TU2	E	ZONE B	1/4					9	2.0													
TU2	F	ZONE A	1/4	10	22.7			86	33.0	2	0.9											
TU2	F	ZONE B	1/4	2	4.0			7	1.1													
TU2	F	ZONE C	1/4	1	0.1																	
TU2	G	ZONE A	1/4	9	23.3			48	12.5													
TU2	G	ZONE B	1/4					8	1.0							1	0.9					
TU2	G	ZONE D	1/4	1	1.6			19	7.5													
TU2	H	ZONE A	1/4	7	25.6			42	12.7													
TU2	H	ZONE D	1/4	9	19.7			60	24.0													
TU2	I	ZONE A	1/4	6	16.2			69	26.9													
TU2	I	ZONE D	1/4	4	24.3			44	19.5													
TU2	J	ZONE A	1/4	5	8.4			79	28.9	2	0.5											

Blue Spring Midden B (8VO43)

				Pottery						Flaked		Shell		Shell		Bone		Freshwater Gastopods				
				fiber-temp.		other		crumb		stone		tool		bead		tool		*Vivi.*	*Pom.*	*Elim.*	*P. tri.*	*P. dur*
Prov.	Lev./Str.	Subunit	Rec.	ct	wt	ct	wt	ct	wt	ct	wt	ct	wt	ct	wt	ct	wt	wt	wt	wt	wt	wt
TU2	J	ZONE D	1/4					6	1.3													
TU2	K	ZONE A	1/4					17	10.7	2	0.7											
TU2	L		1/4									2	545.9	2.0	0.2							
TU2	M		1/4							1	0.4											
TU2	N		1/4																			
TU2	O		1/4																			
TU2	P	ZONE A	1/4													1	3.4					
TU3	A		1/4	8	19.0	2	4.9	40	12.7							2	0.3					
TU3	B		1/4	9	46.6			54	21.2							2	6.9					
TU3	C		1/4	5	12.2			16	7.4													
TU3	D		1/4	6	17.9			45	16.7													
TU3	E		1/4	4	8.9			34	9.0													
TU3	F		1/4	5	9.9			72	25.3			1	9.2	1.0	0.6	1	0.3					
TU3	G		1/4	7	26.3			53	19.1							1	2.0					
TU3	H		1/4	15	76.6			53	19.1													
TU3	I		1/4	1	1.1			9	5.0			1	0.4									
TU3	J		1/4	1	2.1											1	0.7					
TU3	K		1/4					4	0.5	1	0.2					1	0.3					
TU3	L		1/4							1	2.4											
TU3	L	50X50	1/8																			
TU3	M		1/4							1	9.5											
TU3	N		1/4																			
TU3	east wall	str lvb	1/8	2	31.0																	
TU4	A		1/4	1	1.7			15	8.3	1	1.1											
TU4	B		1/4	5	10.9			13	8.6													
TU4	C		1/4	5	16.1			30	11.4													
TU4	D		1/4	2	8.8			68	21.2													
TU4	E		1/4	6	39.5			68	25.3													
TU4	F		1/4	4	14.0			28	9.8													
TU4	G		1/4					23	8.6													
TU4	H		1/4	4	19.3			29	20.5							1	7.0					
TU4	I/J MIXED		1/4	1	1.9			2	0.7													
TU4	I		1/4					32	11.2													

Blue Spring Midden B (8VO43)

Prov.	Lev./Str.	Subunit	Rec.	Pottery fiber-temp. ct	Pottery fiber-temp. wt	Pottery other ct	Pottery other wt	Pottery crumb ct	Pottery crumb wt	Flaked stone ct	Flaked stone wt	Shell tool ct	Shell tool wt	Shell bead ct	Shell bead wt	Bone tool ct	Bone tool wt	Freshwater Gastopods *Vivi.* wt	*Pom.* wt	*Elim.* wt	*P. tri.* wt	*P. dur* wt
TU4	J		1/4	23	84.7			46	21.2			1	217.8									
TU4	K		1/4	1	2.9			2	0.5													
TU4	K	50X50	1/8									1	25.9									
TU4	L		1/4	1	1.7											1	0.5					
TU4	M		1/4																			
TU4	N		1/4																			
TU4	O		1/4																			
TU5	A		1/4																			
TU5	B		1/4					2	0.8													
TU5	C		1/4	1	3.3			2	0.3													
TU5	D		1/4			2	6.6	7	2.2													
TU5	E		1/4	4	1.0	1	1.2	2	0.6													
TU5	F		1/4	1	1.6																	
TU5	G		1/4					4	1.7													
TU5	H		1/4			2	3.8	2	0.6													
TU5	I		1/4	7	6.7	2	13.1	7	2.6							1	0.5					
TU5	J		1/4																			
TU5	K		1/4	1	0.2																	
TU5	L		1/4																			
TU5	M		1/4																			
TU5	N		1/4																			
TU5	O	a	1/4													2	0.9					
TU5	O	b	1/4							3	6.8					1	4.0					
TU5	P		1/4													1	5.9					
TU5	P	50x50	1/8																			
TU5	Q		1/4							2	0.2					1	0.5					
TU5	R		1/4																			
WWTA	B		1/4dry																			
WWTA	C		1/4dry			4	19.3	1	0.5													
WWTA	D		1/4dry					1	1.5													
WWTA	E		1/4dry			1	1.8	1	0.5													
WWTA	F		1/4dry			1	8.6															
WWTA	G		1/4dry			1	10.8															

Blue Spring Midden B (8VO43)

Prov.	Lev./Str.	Subunit	Rec.	Pottery fiber-temp. ct	Pottery fiber-temp. wt	Pottery other ct	Pottery other wt	Pottery crumb ct	Pottery crumb wt	Flaked stone ct	Flaked stone wt	Shell tool ct	Shell tool wt	Shell bead ct	Shell bead wt	Bone tool ct	Bone tool wt	Freshwater Gastropods *Vivi.* wt	*Pom.* wt	*Elim.* wt	*P. tri.* wt	*P. dur* wt
WWTA	H		1/4dry					2	3.2													
WWTA	I		1/4	25	104.1	1	2.3	134	93.0													
WWTA	J		1/4	15	47.7			71	34.5													
WWTA	K		1/4	2	5.0			17	8.8													
WWTA	L		1/4	13	11.9									1.0	0.4							
WWTA	M	b	1/4																			
WWTA	N		1/4																			
WWTA	O		1/4																			
WWTA	P		1/4																			
TU1	I		1/8	5	14.9			192	26.1									9314.4	52.9	173.0	3.8	23.2
TU1	II a		1/8					3	1.2									487.1		8.7		
TU1	II b		1/8					18	7.6									4089.4	6.7	73.5		10.1
TU1	III a		1/8					15	2.1					1.0	<0.1			3102.3		43.9		
TU1	III b		1/8					8	0.8									2083.2	5.9	18.6		2.4
TU1	III c		1/8					10	1.0									6078.0	16.6	45.4	0.8	12.5
TU1	III d		1/8															3054.1	14.3	14.2		1.7
TU1	IV a		1/8											1.0	<0.1			6164.9	7.0	38.9		0.8
TU1	IV b		1/8							1	<0.1							3155.4	25.9	35.2		6.9
TU1	IV c		1/8															1711.1	61.3	7.8		0.8
TU2	I		1/8	12	40.2			258	46.3									12987.7	215.4	213.5	1.0	34.5
TU2	II		1/8					1	1.1									3198.1	42.4	50.7		6.6
TU2	III col 1		1/4					5	1.7							1	1.2					
TU2	III		1/8	8	14.8			91	12.4									4891.7	432.6	191.7		14.8
TU2	IV col 1		1/4					25	6.7													
TU2	IV		1/8	1	8.9			9	0.8									3548.4	212.6	29.3		3.0
TU2	V col 1		1/4	1	2.6			10	2.0													
TU2	V		1/8	1	9.1			27	3.9									4174.6	238.0	77.4		11.1
TU2	VI col 1		1/4					10	2.7													
TU2	VI		1/8					72	6.9									3099.0	128.6	236.9	0.2	3.0
TU2	VII		1/8	5	23.5			9	4.0													
TU2	VIIIa col 1		1/4					1	0.4	1	0.5	1	460.5									
TU2	VIII a		1/8					25	4.6									2761.7	68.9	50.4	0.3	17.0
TU2	VIII b		1/8					71	5.2									5692.2	43.7	179.8		0.3

Blue Spring Midden B (8VO43)

Prov.	Lev./Str.	Subunit	Rec.	Pottery fiber-temp. ct	Pottery fiber-temp. wt	Pottery other ct	Pottery other wt	Pottery crumb ct	Pottery crumb wt	Flaked stone ct	Flaked stone wt	Shell tool ct	Shell tool wt	Shell bead ct	Shell bead wt	Bone tool ct	Bone tool wt	Freshwater Gastopods *Vivi.* wt	*Pom.* wt	*Elim.* wt	*P. tri.* wt	*P. dur* wt
TU2	VIII c		1/8					2	0.1									987.3	7.2	41.3		13.8
TU2	IX		1/8	2	2.8			16	3.3									4624.3	18.0	152.8		30.3
TU2	X a		1/8					1	<0.1									2234.4	21.5	25.8	0.4	12.3
TU2	X b		1/8															3289.3	17.4	40.5	0.3	7.0
TU2	XI a		1/8															1215.9		13.0		4.6
TU2	XI b		1/8															2633.7		24.2	1.2	3.7
TU4	A/I a		1/8															650.8	17.3	9.6		2.6
TU4	B/ I a		1/8															169.9		1.5		
TU4	B/ II b		1/8	6	0.3													4395.7	50.7	57.6		9.7
TU4	C/ II b		1/8					27	1.1									3985.2	236.5	65.1		16.0
TU4	B/ III		1/8					11	0.5									3887.1	65.9	62.9		9.5
TU4	C/ III		1/8					36	2.0									3579.1	52.3	59.0		14.0
TU4	D/ III		1/8					7	0.4									4459.4	47.6	71.8	0.2	2.9
TU4	E/ III		1/8					3	0.2									4736.1	75.7	59.9		12.8
TU4	E/ V		1/8	1	23.4			3	0.2									3458.5	55.2	80.6		16.9
TU4	F/ V		1/8					6	0.6									5997.5	230.0	129.8		31.3
TU4	G/ V		1/8					3	0.1									2649.7	154.6	42.1	<0.1	16.7
TU4	H/ V		1/8					4	0.1									6260.3	169.3	125.4	0.8	52.8
TU4	I/ V		1/8					2	0.1									8560.4	137.3	119.5	0.4	34.2
TU4	J/ V		1/8					13	1.0									1661.9	7.2	20.6	0.4	7.7
TU4	K/ V		1/8					3	0.5									837.0	37.9	17.8		5.1
TU4	J/ VII a		1/8					8	0.2									2233.0	30.6	42.0		12.5
TU4	K/ VII a		1/8					1	<0.1	1	2.2							4143.9	41.5	53.2		13.4
TU4	L/ VII a		1/8					1	<0.1									4313.3	72.3	65.9		23.4
TU4	M/ VII a		1/8					4	0.2									3587.6	153.1	35.5		14.8
TU5	0-10cm		1/8					6	0.7									4253.8	30.0	45.0		9.2
TU5	10-20cm		1/8															4899.1	48.2	22.7		25.6
TU5	20-30cm		1/8					1	0.2									11413.9	119.9	199.7	1.0	44.8
TU5	30-40cm		1/8					1	0.3					1.0	<0.1			6075.6	42.9	90.3	0.4	27.9
TU5	40-50cm		1/8															1954.7	8.6	34.9		5.2
TU5	50-60cm		1/8															705.0	1.0	6.4		0.1
TU5	60-70cm		1/8																			
TU5	70-80cm		1/8																			

Blue Spring Midden B (8VO43)

				Pottery						Flaked		Shell		Shell		Bone		Freshwater Gastropods				
				fiber-temp.		other		crumb		stone		tool		bead		tool		*Vivi.*	*Pom.*	*Elim.*	*P. tri.*	*P. dur*
Prov.	Lev./Str.	Subunit	Rec.	ct	wt	ct	wt	ct	wt	ct	wt	ct	wt	ct	wt	ct	wt	wt	wt	wt	wt	wt
TU5	80-90cm		1/8							1	0.1											
TU5	90-100cm		1/8																			
WWTA	Ahoriz-10cm		1/8	1	2.6			43	16.7									2650.9	13.6	28.9		5.4
WWTA	10-20cm		1/8					5	1.2									3309.7	10.8	31.8		
WWTA	20-30cm		1/8															3235.2	10.6	35.3		12.2
WWTA	30-40cm		1/8															4907.5	5.2	56.5		5.4
WWTA	40-50cm		1/8															4331.0	200.2	75.6		9.6
WWTA	50-60cm		1/8															4327.4	30.4	75.9	0.2	8.9
WWTA	60-70cm		1/8															2988.8	40.3	42.3		13.0
WWTA	70-76cm		1/8															1320.9	40.7	34.4		17.1
WWTA	Feat. 1	Area A lev M	1/8					1	0.1									11453.8	46.2	92.1	4.3	33.7
TU1	Feat. 1		1/8	60	574.4			83	14.6									1060.2	5.3	12.0		4.3
TU1	Feat. 2		1/8	4	57.5			34	8.3									641.9	8.2	8.0		
TU2	Feat. 3		1/8					6	0.6					1.0	0.1			3945.0	68.7	115.5	0.6	64.4
TU5	Feat. 1		1/8																			
TU5	Feat. 3	South half	1/8			5	2.8											10.4	2.3			
TU 5	Feat.3	North half	1/8					3	1.0	1	<0.1							8.0	230.6			
TU4	Feat. 4	East half	1/8					9	0.6									182.4	4.8	2.5		1.8
TU3/4	Feat. 5	East half	1/8															826.7	34.0	9.3		2.1
TU4/3	Feat. 5	West half	1/8															3072.1	99.3	35.3	1.0	5.6
TU4	Feat. 7	Sub. Col.	1/8					9	1.1									5123.7	109.2	56.4		11.0
TU4	Feat. 7	East half	1/8					2	0.1	1	1.3							24321.1	253.5	136.2	4.3	50.1
TU4	Feat. 7	West half	1/8					31	6.1	1	4.0							15835.1	215.0	159.6	4.6	63.4
TU3	Feat. 8	West half	1/8															954.4	13.4	10.1		4.1
TU3	Feat. 8	Sub. Col.	1/8															1622.9	26.8	14.5		4.5
TU4	Feat. 12		1/8											1.0	<.1			29.0	0.9	0.4		

Blue Spring Midden B (8VO43)

Prov.	Lev./Str.	Subunit	Rec.	Bivalve wt	Terr. snails wt	>1/4 UID Shell wt	<1/4 UID Shell wt	Unmod. MarShell wt	Vert. Fauna wt	Botani-cal wt	Fired clay wt	Concr. wt	Lime-stone wt	Historic ct	Other
TU1	A		1/4					8.0	299.7				8.9	66	
TU1	B		1/4					6.2	858.5		5.1	23.7	157.4	126	
TU1	C		1/4						1321.7	5.6		54.5	198.8	5	
TU1	D		1/4					2.5	707.2	6.4		22.9	22.1		
TU1	E		1/4					7.1	746.9	20.1		205.9	44.9		
TU1	F		1/4					17.5	345.4	4.7		28.6	150.3		
TU1	G		1/4					2.5	746.7	10.5		117.3	164.3		
TU1	H		1/4					9.8	471.5	6.5		62.3	60.8		
TU1	I		1/4					38.0	778.1	12.7		14.0	274.8		1 shark's tooth 0.2 g
TU1	J		1/4						681.5	23.8		40.0	65.9		
TU1	K		1/4					0.7	844.7	42.1		28.6	416.4	1	1coprolite 11.1g
TU1	L		1/4					1.6	573.7	17.5		6.7	117.3		
TU1	M		1/4						141.8	8.5		26.2	3.6		
TU1	N		1/4					0.5	117.3	12.6		5.2			
TU1	O		1/4						13.2	14.3		4.0	8.3		
TU1	wall	cleanup	1/4												
TU2	A		1/4						135.0	0.5		71.5		188	
TU2	B		1/4					15.6	632.3	4.4	0.4	257.6	14.3	164	
TU2	C		1/4					51.8	278.2	2.8		30.0		88	
TU2	D		1/4					1.7	560.6	11.2	23.6	1.8	4.6	63	
TU2	E		1/4						134.9	1.2		131.2	38.8	1	
TU2	E	ZONE A	1/4						265.4	14.6		0.8	7.3	1	
TU2	E	ZONE B	1/4						14.1	6.0					
TU2	F	ZONE A	1/4						190.2	21.3		17.6	43.2	2	
TU2	F	ZONE B	1/4						86.9			6.0			
TU2	F	ZONE C	1/4						31.4	13.6		1.5			
TU2	G	ZONE A	1/4						237.1	7.7		6.2	62.4	1	
TU2	G	ZONE B	1/4						101.6			2.1			
TU2	G	ZONE D	1/4					23.8	26.2	1.3			1.2		
TU2	H	ZONE A	1/4						261.6	26.1		25.2	12.5	1	
TU2	H	ZONE D	1/4					22.0	53.5	1.7		2.7			
TU2	I	ZONE A	1/4					8.9	246.6	3.2		3.3	18.4		1 shark's tooth 0.2 g
TU2	I	ZONE D	1/4						45.2	3.0		2.0			
TU2	J	ZONE A	1/4					8.3	571.7	31.0		326.7	73.2	1	

Blue Spring Midden B (8VO43)

Prov.	Lev./Str.	Subunit	Rec.	Bivalve wt	Terr. snails wt	>1/4 UID Shell wt	<1/4 UID Shell wt	Unmod. MarShell wt	Vert. Fauna wt	Botani-cal wt	Fired clay wt	Concr. wt	Lime-stone wt	Historic ct	Other
TU2	J	ZONE D	1/4						6.4	<0.1					
TU2	K	ZONE A	1/4					50.0	727.4	33.4		1173.0	584.4	1	2 shark's teeth 1.1 g
TU2	L		1/4					14.3	977.7	61.5	24.1	248.5	1730.6		
TU2	M		1/4					10.7	428.0	4.5		49.7	515.9		
TU2	N		1/4						442.3	11.9		37.0			
TU2	O		1/4						107.3	4.5					
TU2	P	ZONE A	1/4						30.0	4.9					
TU3	A		1/4						328.5	0.1				61	
TU3	B		1/4						239.0	2.5				17	
TU3	C		1/4						350.5	3.8				1	
TU3	D		1/4						323.2	6.1					
TU3	E		1/4						189.6	12.8					
TU3	F		1/4						371.3	5.2					
TU3	G		1/4					11.3	218.3	26.2					
TU3	H		1/4					9.8	PULLED	5.5					
TU3	I		1/4						PULLED	2.7					
TU3	J		1/4						303.6	8.1					
TU3	K		1/4						160.2	10.3					
TU3	L		1/4						60.3	5.2					
TU3	L	50X50	1/8						31.4	3.2		5.7	40.8		
TU3	M		1/4						9.8	0.5					
TU3	N		1/4						0.5	0.3					
TU3	east wall	str lvb	1/8												
TU4	A		1/4					2.5	467.9	1.5				130	
TU4	B		1/4						349.5	14.2				6	
TU4	C		1/4						PULLED	18.1				3	
TU4	D		1/4					85.6	265.8	1.2					
TU4	E		1/4						386.5	0.7					
TU4	F		1/4						316.7						
TU4	G		1/4					3.9	303.7	6.2					
TU4	H		1/4						208.7	1.3					
TU4	I/J MIXED		1/4						267.5	30.7					
TU4	I		1/4							0.3					

Blue Spring Midden B (8VO43)

Prov.	Lev./Str.	Subunit	Rec.	Bivalve wt	Terr. snails wt	>1/4 UID Shell wt	<1/4 UID Shell wt	Unmod. MarShell wt	Vert. Fauna wt	Botani-cal wt	Fired clay wt	Concr. wt	Lime-stone wt	Historic ct	Other
TU4	J		1/4						348.8	4.8		158.9	120.4		
TU4	K		1/4						201.8	6.5					
TU4	K	50X50	1/8						99.8	<0.1					
TU4	L		1/4					3.2	159.6	7.6		1.4	109.4		
TU4	M		1/4						119.2	5.6					
TU4	N		1/4						13.6	3.6					
TU4	O		1/4						11.0	0.8					
TU5	A		1/4						0.7					32	
TU5	B		1/4						6.9					23	
TU5	C		1/4						11.6					6	
TU5	D		1/4						21.6			208.4		27	
TU5	E		1/4						23.0					23	
TU5	F		1/4						7.0	<0.1				1	
TU5	G		1/4						14.2						
TU5	H		1/4						28.8	7.2					
TU5	I		1/4					15.8	295.6	9.3				3	
TU5	J		1/4					5.4	450.7	0.9				2	
TU5	K		1/4					2.4	483.6	0.5			152.8		
TU5	L		1/4					23.2	762.1	4.5					
TU5	M		1/4					9.7	426.1	0.2		8.0	102.4		
TU5	N		1/4					0.3	980.9	8.4					
TU5	O	a	1/4						517.9	0.1			8.8		
TU5	O	b	1/4						509.2	0.6					
TU5	P		1/4						483.1						
TU5	P	50x50	1/8						348.2	0.1		54.5			1 coprolite 4.8g
TU5	Q		1/4						217.3						1 coprolite 14.2g
TU5	R		1/4						60.3						
WWTA	B		1/4dry							0.9					
WWTA	C		1/4dry						4.3	0.2					
WWTA	D		1/4dry						3.0	2.4					
WWTA	E		1/4dry						1.4						
WWTA	F		1/4dry												
WWTA	G		1/4dry						1.3						

Blue Spring Midden B (8VO43)

Prov.	Lev./Str.	Subunit	Rec.	Bivalve wt	Terr. snails wt	>1/4 UID Shell wt	<1/4 UID Shell wt	Unmod. MarShell wt	Vert. Fauna wt	Botanical wt	Fired clay wt	Concr. wt	Lime-stone wt	Historic ct	Other
WWTA	H		1/4dry						49.4	4.7					
WWTA	I		1/4						336.6	80.1				1	
WWTA	J		1/4						181.9	0.2					
WWTA	K		1/4						121.1	0.1			105.2		
WWTA	L		1/4						5.3	1.5			110.0		
WWTA	M	b	1/4						82.9	0.1					
WWTA	N		1/4						91.5				69.3		
WWTA	O		1/4						23.7						
WWTA	P		1/4						387.1						
TU1	I		1/8	523.8		1280.8	4338.8	0.2	335.6	9.6			112.3	20	
TU1	II a		1/8	31.3		99.6	206.8		10.4	0.5		7.1			
TU1	II b		1/8	225.6		1173.9	1705.8		56.6	1.5		416.1			
TU1	III a		1/8	260.8	<0.1	908.2	595.4		50.2	0.8		29.2			
TU1	III b		1/8	157.3			760.3		18.2	0.1		9.5			
TU1	III c		1/8	104.0			741.1	0.1	78.7	1.9	0.4	18.6			
TU1	III d		1/8	44.0			477.2		49.2	2.0					
TU1	IV a		1/8	257.3			1428.2		143.9	8.7		126.2			
TU1	IV b		1/8	217.9	0.2		1339.3		34.5	2.7		102.4			1 shark's tooth 0.2g
TU1	IV c		1/8	417.8	<0.1		359.8		39.4	1.6		36.3			
TU2	I		1/8	347.4	<0.1		3226.9	4.9	816.9	22.3		1933.3		21	
TU2	II		1/8	791.9			1271.1	0.4	167.4	13.6		59.4			
TU2	III col 1		1/4						82.7	5.0	1.8	2.3			
TU2	III		1/8	622.8	<0.1		5587.5	0.3	664.3	20.9		48.4			
TU2	IV col 1		1/4						30.3	5.9					
TU2	IV		1/8	79.7			573.9		Pulled	2.2		4.2			
TU2	V col 1		1/4						52.8	5.2					
TU2	V		1/8	107.5			1181.8	4.6	Pulled	7.5		4.6			
TU2	VI col 1		1/4						24.8	3.2	0.6				
TU2	VI		1/8	341.4			3330.9			34.5		5.0			
TU2	VII		1/8												
TU2	VIIIa col 1		1/4						421.3	<0.1					
TU2	VIII a		1/8	18.1			1200.5	0.2	pulled	11.5	5.8	43.8	4.8		
TU2	VIII b		1/8	190.7	<0.1		560.9		pulled	3.9		12.3			

Blue Spring Midden B (8VO43)

Prov.	Lev./Str.	Subunit	Rec.	Bivalve wt	Terr. snails wt	>1/4 UID Shell wt	<1/4 UID Shell wt	Unmod. MarShell wt	Vert. Fauna wt	Botanical wt	Fired clay wt	Concr. wt	Lime-stone wt	Historic ct	Other
TU2	VIII c		1/8	18.3			97.0	21.1	pulled	1.6					
TU2	IX		1/8	169.7			728.2		pulled	4.0		38.9			
TU2	X a		1/8	200.3			383.5		pulled	0.4		114.1			
TU2	X b		1/8	563.5			914.5		pulled	5.0		51.5			
TU2	XI a		1/8	80.4	0.4				pulled	1.2		16.8			
TU2	XI b		1/8	32.4			11.0		pulled	<0.1					
TU4	A/I a		1/8	36.7			287.0		18.4			11.5		5	
TU4	B/ I a		1/8	1.4			86.4		5.9	0.2		5.3		6	
TU4	B/ II b		1/8	105.7			1043.3		138.5	1.7		16.8		19	
TU4	C/ II b		1/8	368.2			1330.5		144.0	28.2		12.8			
TU4	B/ III		1/8	76.6	<0.1		785.5	0.2	69.5	2.6		15.2		23	
TU4	C/ III		1/8	237.8			947.8	<0.1	116.7	3.6		62.8			
TU4	D/ III		1/8	92.8	<0.1		473.5		44.1	2.3		6.3			
TU4	E/ III		1/8	102.8	0.8		910.9		42.7	1.5		5.2			
TU4	E/ V		1/8	139.6	0.2		943.0		42.7	0.5		3.4			
TU4	F/ V		1/8	315.8	0.2		1278.5	0.3	85.1	2.4		30.3			
TU4	G/ V		1/8	123.1	<0.1		749.0		36.0	1.2		308.6			
TU4	H/ V		1/8	396.7	<0.1		1940.9	4.0	114.7	4.6		1616.2			1 Shark's Tooth 0.6g
TU4	I/ V		1/8	370.7	<0.1		1597.3	0.4	107.0	3.4		3302.9			
TU4	J/ V		1/8	53.3			231.1		98.9	1.6		819.6			
TU4	K/ V		1/8	116.8			245.7		42.7	0.9		8.6			
TU4	J/ VII a		1/8	142.7	0.1		628.0		85.1	1.5		43.5			
TU4	K/ VII a		1/8	223.1			955.0		75.5	5.0		121.9			
TU4	L/ VII a		1/8	254.8	0.1		845.6		81.6	4.2		71.5			
TU4	M/ VII a		1/8	198.5			653.1		57.5	2.6		44.4			
TU5	0-10cm		1/8	97.0			1058.8		pulled	7.8	22.8	69.3			
TU5	10-20cm		1/8	252.3			938.3	14.6	pulled	0.5		58.0			
TU5	20-30cm		1/8	1036.2	<0.1		2279.9	0.4	pulled	2.6		81.3			2 coprolites 10.8g
TU5	30-40cm		1/8	480.7			1461.5	8.2	155.1	2.4		73.0			
TU5	40-50cm		1/8	125.1	<.1		2182.7	<.1	pulled	0.6		370.2			
TU5	50-60cm		1/8	48.2			152.7		pulled			986.6			
TU5	60-70cm		1/8				9.1		pulled			440.4			
TU5	70-80cm		1/8						286.7						

Blue Spring Midden B (8VO43)

Prov.	Lev./Str.	Subunit	Rec.	Bivalve wt	Terr. snails wt	>1/4 UID Shell wt	<1/4 UID Shell wt	Unmod. MarShell wt	Vert. Fauna wt	Botanical wt	Fired clay wt	Concr. wt	Lime-stone wt	Historic ct	Other
TU5	80-90cm		1/8				0.1		pulled	0.6		50.3			
TU5	90-100cm		1/8				0.9		pulled			62.0			
WWTA	Ahoriz-10cm		1/8	118.2	0.1		755.1		181.0	93.6		107.9		1	
WWTA	10-20cm		1/8	73.5			483.0	27.3	37.2						
WWTA	20-30cm		1/8	118.4	0.2		707.8	0.2	62.4	<0.1		20.0			
WWTA	30-40cm		1/8	198.7			897.5		32.2	<0.1	53.5	51.3			
WWTA	40-50cm		1/8	281.1			947.2		24.8	<0.1		139.4			
WWTA	50-60cm		1/8	154.6	<0.1		594.2		51.2			18.4			
WWTA	60-70cm		1/8	42.9			454.0	<0.1	19.5	<0.1		15.5			
WWTA	70-76cm		1/8	22.3			223.4		14.3	0.1		43.4			
WWTA	Feat. 1	Area A lev M	1/8	365.6	0.9		1613.7		60.8			439.2			
TU1	Feat. 1		1/8	96.2			199.7	0.9	10.4	0.4		50.9			
TU1	Feat. 2		1/8	84.8	<0.1		339.5		10.0	1.9		6.1			
TU2	Feat. 3		1/8	146.4			1084.3		48.6	16.6		1460.1			
TU5	Feat. 1		1/8						2.5	0.3		4.3		728	
TU5	Feat. 3	South half	1/8						1.7					339	
TU 5	Feat.3	North half	1/8						26.8					1092	
TU4	Feat. 4	East half	1/8	7.3			13.1		3.2	0.4		<.1			
TU3/4	Feat. 5	East half	1/8	63.3			179.4		11.2	0.4		4.5			
TU4/3	Feat. 5	West half	1/8	268.6	<.1	0.3	1035.9	1.0	33.1	10.7		1080.0			
TU4	Feat. 7	Sub. Col.	1/8	208.0		<.1	846.3	5.4	113.5	7.2		163.4			
TU4	Feat. 7	East half	1/8	429.4	0.2	0.3	1735.9	8.0	64.9	17.4		413.8			
TU4	Feat. 7	West half	1/8	328.7	<.1	0.9	1329.4		75.8	15.0		158.0			
TU3	Feat. 8	West half	1/8	79.6		0.8	171.1		8.2	2.2		230.9			
TU3	Feat. 8	Sub. Col.	1/8	100.8	<.1	0.2	344.3		20.8	4.3		27.4			
TU4	Feat. 12		1/8	6.9			10.3		1.4	0.1		1.4			

Live Oak Mound (8VO41)

Prov.	Lev./Str.	Subunit	Rec.	Pottery fiber-temp. ct	Pottery fiber-temp. wt	Pottery other ct	Pottery other wt	Pottery crumb ct	Pottery crumb wt	Flaked stone ct	Flaked stone wt	Shell tool ct	Shell tool wt	Bone tool ct	Bone tool wt	vert bone wt	bot wt	fired clay wt	concr. wt	hist. ct
	surface	A								1	36.5									
	surface	B								1	14.6									
LP1	A		1/4"	2	8.6	8	21.7	7	1.3	3	1.9			1	0.8	132.7	2.7	7.8	1	1
LP1	B		1/4"	2	3.1	5	4.5	1	1.1	6	1.6					194.1	<0.1	1.1	2.1	1
LP1	C		1/4"	3	12	16	57	5	3.1	9	12.4			2	1.7	434	0.3			4
LP1	wall	cut	1/4"	9	67.6	37	145.8	29	15.8	14	6			1	3.4	365.9	0.4			
LP1	SW/NW	wall	1/4"					1	0.8	2	25.2					329.9	0.1			
LP1	west wall		1/4"													17.1			250.6	
LP1 A	A		1/4"													34.5				
LP1 A	B		1/4"											1	6.2	23.3				
LP1 A	D		1/4"													4.1				
LP1 A	E		1/4"													73.6				
LP1 A	F		1/4"													73.7				
LP1 A/B	G		1/4"							1	7.7					85.6				
LP1 A	wall		1/4"													101.9				
LP1 B	A		1/4"													35	0.1			
LP1 B	B		1/4"					1	0.3							7.1			298.5	
LP1 B	C		1/4"													13.6	12.1		111	
LP1 B	D	zone A	1/4"													52				
LP1 B	D	zone B	1/4"											1	0.8	132	4.8			
LP71	backfill		ns			1	4.9									101.1				
LP71	no info		ns							1	1.7					155.3				
LP71	backfill		ns									1	9.7			12				
LP71	wall		ns			5	47.3									175.9				

Hontoon Island Reconnaissance Survey

			Pottery						Flaked		Shell		Bone		Freshwater Gastopods						Unmod.
			fiber-temp.		other		crumb		stone		tool		tool		*Vivi.*	*Pom.*	*Elim.*	*P. tri.*	*P. dur.*	Bivalve	MarShell
Transect	STP	Rec.	ct	wt	ct	wt	ct	wt	ct	wt	ct	wt	ct	wt	wt	wt	wt	wt	wt	wt	wt
Surface		1/4							1	14.6											
Surface	cab. 1	1/4							1	10.3											
Surface	tower	1/4			9	103.6															
T 1/4	1	1/4							1	15.9											
T 1	35	1/4			1	3.3									8						
T 1	36	1/4													15.6	0.3		0.6		0.6	
T 1	37	1/4			1	1.1									16.2						
T 8	1	1/4																			
T 3	1	1/4			65	253.1															
T 3	2	1/4			1	3.4															
T 3	3	1/4			161	505.2			1	0.4											8.2
T 3	4	1/4			21	68.2															25.8
T 3	5	1/4			6	22.6															
T 3	7	1/4																			
T 3	10	1/4																			
T 3	11	1/4																			
T 4/8	2	1/4							1	5.4											3.1
T 4/8	3	1/4																			
T 4	1	1/4													14	1.7		10.1		0.1	
T 4	13	1/4							1	11.6											
T 5/6	1	1/4			4	2.7															
T 5/6	2	1/4																			
T 6	2	1/4																			
T 6	3	1/4																			
T 5	1	1/4			1	16.3															
T 5	2	1/4																			
T 5	3	1/4	1	5.8			2	1.5													
T 6/7	2	1/4																			
T 6	5	1/4																			
T 10	2	1/4			61	286.6															
T 10	3	1/4			22	205.8															
T 10	4	1/4			32	121.4			1	2.8			1	4.1							
T 10	5	1/4			5	10.3															
T 11	2	1/4																			
T 11	3	1/4			1	4.4			1	0.2											
T 11	5	1/4			1	33.6							2	0.6							

Hontoon Island Reconnaissance Survey

Transect	STP	Rec.	Pottery fiber-temp. ct	Pottery fiber-temp. wt	Pottery other ct	Pottery other wt	Pottery crumb ct	Pottery crumb wt	Flaked stone ct	Flaked stone wt	Shell tool ct	Shell tool wt	Bone tool ct	Bone tool wt	Freshwater Gastopods *Vivi.* wt	Freshwater Gastopods *Pom.* wt	Freshwater Gastopods *Elim.* wt	Freshwater Gastopods *P. tri.* wt	Freshwater Gastopods *P. dur.* wt	Bivalve wt	Unmod. MarShell wt
T 11	6	1/4			2	13			1	5.4											
T 12/13	1	1/4	3	8.8																	
T 12	3	1/4																			
T 12	5	1/4																			
T 14	1	1/4	2	7.8	36	126.9															
T 14	2	1/4			5	62.4															
T 15	10	1/4							1	8.5											
T 15	13	1/4							1	0.8											
T 15	14	1/4											4	11.1							

Hontoon Island Reconnaissa

Transect	STP	Rec.	Vert. Fauna wt	Botanical wt	Fired clay wt	Concr. wt	Historic ct	Other
Surface		1/4						
Surface	cab. 1	1/4						
Surface	tower	1/4						
T 1/4	1	1/4						
T 1	35	1/4	1.3					
T 1	36	1/4	5				1	
T 1	37	1/4	1.1					
T 8	1	1/4					1	
T 3	1	1/4	21.4				2	
T 3	2	1/4	19.7			29.6		
T 3	3	1/4	101.6					
T 3	4	1/4	63.1					1 shark's tooth
T 3	5	1/4	97.1					
T 3	7	1/4	1.8					
T 3	10	1/4	6.6	1.3				
T 3	11	1/4	11.5					
T 4/8	2	1/4	4.8					
T 4/8	3	1/4	9.4					
T 4	1	1/4	23.5					
T 4	13	1/4	19.5					
T 5/6	1	1/4	6.5					
T 5/6	2	1/4	11.4					
T 6	2	1/4	3.3					
T 6	3	1/4	2.3					
T 5	1	1/4	30.7					
T 5	2	1/4	36.1					
T 5	3	1/4	8.4					
T 6/7	2	1/4	2.8					
T 6	5	1/4	2.4					
T 10	2	1/4	125.6	1.8	91.5			
T 10	3	1/4	8.3					
T 10	4	1/4	124.2					
T 10	5	1/4	4.4					
T 11	2	1/4	145.9					
T 11	3	1/4	47.9			254.5		
T 11	5	1/4	79.5	<.1	1.5		1	

Hontoon Island Reconnaissa

Transect	STP	Rec.	Vert. Fauna wt	Botanical wt	Fired clay wt	Concr. wt	Historic ct	Other
T 11	6	1/4	73.8					
T 12/13	1	1/4	2.6					
T 12	3	1/4	20					
T 12	5	1/4	51.3					
T 14	1	1/4	0.1	0.1				6.1 g glass
T 14	2	1/4	70.8					
T 15	10	1/4						
T 15	13	1/4						
T 15	14	1/4	114					

APPENDIX B
ZOOARCHAEOLOGICAL DATA

List of Taxonomic and Common Names

Taxonomic Name	Common Name
Sigmodon spp.	Cotton Rats
Sigmodontinae	Rat Subfamily
Muridae	Rat Family
Sciurus carolinensis	Eastern Gray Squirrel
Sylvilagus spp.	Rabbit
Rodentia	Rodents
Didelphis virginiana	Virginia Opossum
Procyon lotor	North American Raccoon
Urocyon cinereoargenteus	Gray Fox
Lutra canadensis	North American Otter
Odocoileus virginianus	White-tailed Deer
Mammalia	Mammals
Nycticorax spp.	Heron
Podilymbus podiceps	Pie-billed Grebe
Anatidae	Ducks
Aves	Birds
Chelydra serpentina	Snapping Turtle
Kinosternidae	Mud/Musk Turtles
Deirochelys reticularia	Chicken Turtle
Pseudemys/Trachemys spp.	Pond Turtles
Terrapene carolina	Box Turtle
Apalone ferox	Soft-shelled Turtle
Gopherus polyphemus	Gopher Tortoise
Testudines	Turtles
Alligator mississippiensis	Alligator
Nerodia spp.	Water Snake
Elaphe spp.	Rat Snake
Colubridae	Non-Poisonous Snakes
Crotalus spp.	Rattlesnakes
Viperidae	Pit Viper Family
Serpentes	Snakes
Anolas spp.	Lizard
Squamata	Lizards and Snakes
Reptilia	Reptiles
Amphiuma means	Two-toed Amphiuma
Caudata	Salamanders
Anura	Frogs and Toads
Amphibia	Amphibians
Odontaspis taurus	Sand Tiger Shark
Carcharhinidae	Requiems
Lamniformes	Sharks
Rajiformes	Skates and Rays
Anguilla rostrata	American Eel
Lepisosteus spp.	Gar
Amia calva	Bowfin
Notemigonus crysoleucas	Golden Shiner
Dorosoma spp.	Shad
Clupeidae	Shad/Herring Family
Erimyzon sucetta	Lake Chubsucker
Ameiurus/Ictalurus spp.	Catfish
Ameiurus catus	White Catfish
Ameriurus natalis	Yellow Bullhead Catfish
Ameiurus nebulosus	Brown Bullhead Catfish
Ictalurus punctatus	Channel Catfish
Esox spp.	Pike
Lepomis spp.	Sunfish
Lepomis auritus	Redbreast Sunfish
Lepomis gulosus	Warmouth
Lepomis macrochirus	Bluegill Sunfish
Lepomis microlophus	Redear Sunfish
Lepomis punctatus	Spotted Sunfish
Micropterus salmoides	Largemouth Bass
Micropterus sp.	Bass
Pomoxis nigromaculatus	Black Crappie
Centrarchidae	Bass/Sunfish Family
Mugil spp.	Mullet
Osteichthyes	Bony Fish
UID Vertebrata	Vertebrates

PROV	STRATUM	FAMILY	*GENUS*	*SPECIES*	NISP	%NISP	MNI	%MNI	NOTES
TU 1	STR. IIIa	Cervidae	*Odocoileus*	*virginianus*	1	0.1	1	3.7	
TU 1	STR. IIIa	Mammalia			14	1.2	1	3.7	
TU 1	STR. IIIa	Testudines			44	3.8	2	7.4	
TU 1	STR. IIIa	Serpentes			4	0.3	2	7.4	
TU 1	STR. IIIa	Sirenidae	*Siren spp.*		1	0.1	1	3.7	
TU 1	STR. IIIa	Lepisosteidae	*Lepisosteus spp.*		45	3.8	1	3.7	
TU 1	STR. IIIa	Amiidae	*Amia*	*calva*	12	1.0	1	3.7	
TU 1	STR. IIIa	Cyprinidae	*Notemigonus*	*crysoleucas*	11	0.9	1	3.7	
TU 1	STR. IIIa	Clupeidae			11	0.9	1	3.7	
TU 1	STR. IIIa	Catostomidae	*Erimyzon*	*sucetta*	9	0.8	1	3.7	
TU 1	STR. IIIa	Ictaluridae	*Ameiurus/Ictalurus spp.*		19	1.6	2	7.4	comparison of cleithrums
TU 1	STR. IIIa	Esocidae	*Esox spp.*		1	0.1	1	3.7	
TU 1	STR. IIIa	Centrarchidae	*Lepomis spp.*		5	0.4	3	11.1	atlases
TU 1	STR. IIIa	Centrarchidae	*Lepomis*	*microlophus*	4	0.3	1	3.7	
TU 1	STR. IIIa	Centrarchidae	*Micropterus*	*salmoides*	3	0.3	3	11.1	comparison of premax to dentary to atlas
TU 1	STR. IIIa	Centrarchidae	*Pomoxis*	*nigromaculatus*	1	0.1	1	3.7	
TU 1	STR. IIIa	Centrarchidae			121	10.3	3	11.1	
TU 1	STR. IIIa	Mugilidae	*Mugil spp.*		1	0.1	1	3.7	
TU 1	STR. IIIa	Osteichthyes			548	46.8		0.0	
TU 1	STR. IIIa	Vertebrata			316	27.0		0.0	
TU 1	STR. IIIa	Total			1171	100.0	27	100.0	
TU 1	STR. IIIb	Cervidae	*Odocoileus*	*virginianus*	2	0.9	1	7.1	probably same as previous level
TU 1	STR. IIIb	Mammalia			9	4.2	1	7.1	
TU 1	STR. IIIb	Aves			1	0.5	1	7.1	
TU 1	STR. IIIb	Testudines			8	3.8	2	14.3	based on thickness
TU 1	STR. IIIb	Serpentes			4	1.9	1	7.1	
TU 1	STR. IIIb	Lepisosteidae	*Lepisosteus spp.*		2	0.9	1	7.1	probably same as previous level
TU 1	STR. IIIb	Amiidae	*Amia*	*calva*	3	1.4	1	7.1	probably same as previous level
TU 1	STR. IIIb	Clupeidae			3	1.4	1	7.1	
TU 1	STR. IIIb	Ictaluridae	*Ameiurus/Ictalurus spp.*		5	2.4	2	14.3	comparison of basios-bigger from previous level
TU 1	STR. IIIb	Esocidae	*Esox spp.*		1	0.5	1	7.1	probably from previous level
TU 1	STR. IIIb	Lepomis spp.			1	0.5		0.0	atlas is probably microlophus
TU 1	STR. IIIb	Centrarchidae	*Lepomis*	*microlophus*	6	2.8	1	7.1	
TU 1	STR. IIIb	Centrarchidae	*Micropterus*	*salmoides*	1	0.5	1	7.1	probably from previous level
TU 1	STR. IIIb	Centrarchidae			31	14.6		0.0	
TU 1	STR. IIIb	Osteichthyes			79	37.3		0.0	
TU 1	STR. IIIb	Vertebrata			56	26.4		0.0	
TU 1	STR. IIIb	Total			212	100.0	14	100.0	

PROV	STRATUM	FAMILY	*GENUS*	*SPECIES*	NISP	%NISP	MNI	%MNI	NOTES
TU 1	STR. IIIc	Cricetidae			1	0.1	1	3.6	
TU 1	STR. IIIc	Leporidae	*Sylvilagus spp.*		1	0.1	1	3.6	
TU 1	STR. IIIc	Cervidae	*Odocoileus*	*virginianus*	11	1.1	1	3.6	probably same as previous levels
TU 1	STR. IIIc	Mammalia			30	2.9		0.0	
TU 1	STR. IIIc	Aves			3	0.3	1	3.6	
TU 1	STR. IIIc	Emydidae	*Deirochelys*	*reticualria*	1	0.1	1	3.6	
TU 1	STR. IIIc	Trionychidae	*Apalone*	*ferox*	4	0.4	1	3.6	
TU 1	STR. IIIc	Testudines			22	2.1	2	7.1	
TU 1	STR. IIIc	Serpentes			12	1.2	1	3.6	
TU 1	STR. IIIc	Sirenidae	*Siren spp.*		1	0.1	1	3.6	
TU 1	STR. IIIc	Caudata			2	0.2		0.0	
TU 1	STR. IIIc	Lepisosteidae	*Lepisosteus spp.*		10	1.0	1	3.6	probably same as previous levels
TU 1	STR. IIIc	Amiidae	*Amia*	*calva*	3	0.3	1	3.6	probably same as previous levels
TU 1	STR. IIIc	Cyprinidae	*Notemigonus*	*crysoleucas*	5	0.5	1	3.6	belongs here
TU 1	STR. IIIc	Clupeidae			5	0.5	2	7.1	atlases
TU 1	STR. IIIc	Catostomidae	*Erimyzon*	*sucetta*	6	0.6	2	7.1	comparison of cleithrums--belong to this level
TU 1	STR. IIIc	Ictaluridae	*Ameiurus/Ictalurus spp.*		9	0.9	2	7.1	based on spine frags.--one belongs to this level
TU 1	STR. IIIc	Esocidae	*Esox spp.*		2	0.2	2	7.1	comparison of verts--one belongs to this level
TU 1	STR. IIIc	Centrarchidae	*Lepomis spp.*		4	0.4	2	7.1	atlases
TU 1	STR. IIIc	Centrarchidae	*Lepomis*	*microlophus*	11	1.1	2	7.1	based on grinder size
TU 1	STR. IIIc	Centrarchidae	*Pomoxis*	*nigromaculatus*	1	0.1	1	3.6	
TU 1	STR. IIIc	Centrarchidae			118	11.4	1	3.6	
TU 1	STR. IIIc	Mugilidae	*Mugil spp.*		1	0.1	1	3.6	
TU 1	STR. IIIc	Osteichthyes			435	41.9		0.0	
TU 1	STR. IIIc	Vertebrata			339	32.7		0.0	
TU 1	STR. IIIc	Total			1037	100.0	28	100.0	
TU 1	STR. IIId	Cervidae	*Odocoileus*	*virginianus*	5	0.5	1	4.3	probably from previous levels
TU 1	STR. IIId	Mammalia			12	1.3		0.0	
TU 1	STR. IIId	Aves			4	0.4	1	4.3	
TU 1	STR. IIId	Kinosternidae			2	0.2	1	4.3	
TU 1	STR. IIId	Trionychidae	*Apalone*	*ferox*	1	0.1	1	4.3	probably from previous level
TU 1	STR. IIId	Testudines			12	1.3	1	4.3	
TU 1	STR. IIId	Serpentes			15	1.6	2	8.7	
TU 1	STR. IIId	Rep/Amphib.			3	0.3		0.0	
TU 1	STR. IIId	Lepisosteidae	*Lepisosteus spp.*		9	1.0	1	4.3	probably from previous levels
TU 1	STR. IIId	Amiidae	*Amia*	*calva*	8	0.9	1	4.3	belongs to this level
TU 1	STR. IIId	Cyprinidae	*Notemigonus*	*crysoleucas*	3	0.3	1	4.3	belongs to this level

PROV	STRATUM	FAMILY	*GENUS*	*SPECIES*	NISP	%NISP	MNI	%MNI	NOTES
TU 1	STR. IIId	Catostomidae	*Erimyzon*	*sucetta*	5	0.5	1	4.3	probably from previous level
TU 1	STR. IIId	Ictaluridae	*Ameiurus/Ictalurus spp.*		3	0.3	1	4.3	belongs to this level
TU 1	STR. IIId	Esocidae	*Esox spp.*		1	0.1	1	4.3	probably from previous level
TU 1	STR. IIId	Centrarchidae	*Lepomis spp.*		8	0.9	5	21.7	atlases
TU 1	STR. IIId	Centrarchidae	*Lepomis*	*microlophus*	6	0.6	2	8.7	based on grinder size
TU 1	STR. IIId	Centrarchidae	*Micropterus*	*salmoides*	2	0.2	1	4.3	maxilla and vomer
TU 1	STR. IIId	Centrarchidae	*Pomoxis*	*nigromaculatus*	1	0.1	1	4.3	
TU 1	STR. IIId	Centrarchidae			114	12.3	1	4.3	atlas
TU 1	STR. IIId	Osteichthyes			395	42.6		0.0	
TU 1	STR. IIId	Vertebrata			319	34.4		0.0	
TU 1	STR. IIId	Total			928	100.0	23	100.0	
TU 1	STR. III	Cricetidae			1	0.0	1	1.7	
TU 1	STR. III	Leporidae	*Sylvilagus spp.*		1	0.0	1	1.7	
TU 1	STR. III	Cervidae	*Odocoileus*	*virginianus*	19	0.6	1	1.7	
TU 1	STR. III	Mammalia			65	1.9	1	1.7	
TU 1	STR. III	Aves			8	0.2	1	1.7	
TU 1	STR. III	Kinosternidae			2	0.1	1	1.7	
TU 1	STR. III	Emydidae	*Deirochelys*	*reticularia*	1	0.0	1	1.7	
TU 1	STR. III	Trionychidae	*Apalone*	*ferox*	5	0.1	1	1.7	
TU 1	STR. III	Testudines			86	2.6	6	10.2	
TU 1	STR. III	Serpentes			35	1.0	4	6.8	
TU 1	STR. III	Sirenidae	*Siren spp.*		2	0.1	1	1.7	
TU 1	STR. III	Caudata			2	0.1		0.0	
TU 1	STR. III	Rep./Amphib.			3	0.1		0.0	
TU 1	STR. III	Lepisosteidae	*Lepisosteus spp.*		66	2.0	1	1.7	
TU 1	STR. III	Amiidae	*Amia*	*calva*	26	0.8	1	1.7	
TU 1	STR. III	Cyprinidae	*Notemigonus*	*crysoleucas*	19	0.6	3	5.1	
TU 1	STR. III	Clupeidae			19	0.6	3	5.1	
TU 1	STR. III	Catostomidae	*Erimyzon*	*sucetta*	20	0.6	3	5.1	
TU 1	STR. III	Ictaluridae	*Ameiurus/Ictalurus spp.*		36	1.1	5	8.5	
TU 1	STR. III	Esocidae	*Esox spp.*		5	0.1	2	3.4	
TU 1	STR. III	Centrarchidae	*Lepomis spp.*		18	0.5	10	16.9	
TU 1	STR. III	Centrarchidae	*Lepomis*	*microlophus*	27	0.8	6	10.2	
TU 1	STR. III	Centrarchidae	*Micropterus*	*salmoides*	7	0.2	4	6.8	
TU 1	STR. III	Centrarchidae	*Pomoxis*	*nigromaculatus*	3	0.1	3	5.1	
TU 1	STR. III	Centrarchidae			384	11.5	2	3.4	
TU 1	STR. III	Mugilidae	*Mugil spp.*		2	0.1	1	1.7	
TU 1	STR. III	Osteichthyes			1457	43.5		0.0	

PROV	STRATUM	FAMILY	GENUS	SPECIES	NISP	%NISP	MNI	%MNI	NOTES
TU 1	STR. III	Vertebrata			1030	30.8		0.0	
TU 1	STR. III	Total			3349	100.0	63	106.8	
TU 1	STR. IVa	Rodentia			1	0.0	1	2.4	
TU 1	STR. IVa	Leporidae	*Sylvilagus spp.*		1	0.0	1	2.4	
TU 1	STR. IVa	Procyonidae	*Procyon*	*lotor*	1	0.0	1	2.4	
TU 1	STR. IVa	Canidae	*Urocyon*	*cinereoargenteus*	1	0.0	1	2.4	
TU 1	STR. IVa	Cervidae	*Odocoileus*	*virginianus*	1	0.0	1	2.4	
TU 1	STR. IVa	Mammalia			23	1.0		0.0	
TU 1	STR. IVa	Testudines			26	1.2	2	4.8	based on size and thick.--cf. one with Kinosternidae
TU 1	STR. IVa	Serpentes			19	0.8	2	4.8	
TU 1	STR. IVa	Sirenidae	*Siren spp.*		2	0.1	1	2.4	
TU 1	STR. IVa	Caudata			2	0.1		0.0	
TU 1	STR. IVa	Rep./Amphib.			5	0.2		0.0	
TU 1	STR. IVa	Lepisosteidae	*Lepisosteus spp.*		41	1.8	1	2.4	
TU 1	STR. IVa	Amiidae	*Amia*	*calva*	3	0.1	1	2.4	
TU 1	STR. IVa	Cyprinidae	*Notemigonus*	*crysoleucas*	11	0.5	1	2.4	
TU 1	STR. IVa	Clupeidae			6	0.3	1	2.4	
TU 1	STR. IVa	Catostomidae	*Erimyzon*	*sucetta*	11	0.5	2	4.8	based on size of quad. Compared to articular
TU 1	STR. IVa	Ictaluridae	*Ameiurus/Ictalurus spp.*		12	0.5	3	7.1	2 left arts. And comparison of one big quadrate
TU 1	STR. IVa	Esocidae	*Esox spp.*		1	0.0	1	2.4	
TU 1	STR. IVa	Centrarchidae	*Lepomis spp.*		13	0.6	8	19.0	atlases
TU 1	STR. IVa	Centrarchidae	*Lepomis*	*microlophus*	11	0.5	4	9.5	
TU 1	STR. IVa	Centrarchidae	*Micropterus*	*salmoides*	6	0.3	3	7.1	
TU 1	STR. IVa	Centrarchidae			227	10.1	6	14.3	atlases
TU 1	STR. IVa	Mugilidae	*Mugil spp.*		1	0.0	1	2.4	
TU 1	STR. IVa	Osteichthyes			923	41.2		0.0	
TU 1	STR. IVa	Vertebrata			893	39.8		0.0	
TU 1	STR. IVa	Total			2241	100.0	42	100.0	
TU 1	STR. IVb	Mammalia			8	1.2		0.0	
TU 1	STR. IVb	Aves			1	0.1	1	5.9	
TU 1	STR. IVb	Testudines			5	0.7	2	11.8	based on carapace thickness
TU 1	STR. IVb	Serpentes			3	0.4	1	5.9	
TU 1	STR. IVb	Rep/Amphib			1	0.1		0.0	
TU 1	STR. IVb	Lamniformes			1	0.1	1	5.9	
TU 1	STR. IVb	Lepisosteidae	*Lepisosteus spp.*		16	2.3	1	5.9	probably from previous level
TU 1	STR. IVb	Amiidae	*Amia*	*calva*	2	0.3	1	5.9	probably from previous level
TU 1	STR. IVb	Cyprinidae	*Notemigonus*	*crysoleucas*	5	0.7	2	11.8	axes--one belongs here

PROV	STRATUM	FAMILY	*GENUS*	*SPECIES*	NISP	%NISP	MNI	%MNI	NOTES
TU 1	STR. IVb	Clupeidae			1	0.1	1	5.9	
TU 1	STR. IVb	Ictaluridae	*Ameiurus/Ictalurus spp.*		2	0.3	1	5.9	belongs here
TU 1	STR. IVb	Esocidae	*Esox spp.*		1	0.1	1	5.9	belongs here
TU 1	STR. IVb	Centrarchidae	*Lepomis*	*microlophus*	1	0.1	1	5.9	probably from previous level
TU 1	STR. IVb	Centrarchidae	*Micropterus*	*salmoides*	1	0.1	1	5.9	probably from previous level
TU 1	STR. IVb	Centrarchidae	*Pomoxis*	*nigromaculatus*	1	0.1	1	5.9	
TU 1	STR. IVb	Centrarchidae			98	14.4	1	5.9	extra vomer
TU 1	STR. IVb	Mugilidae	*Mugil spp.*		1	0.1	1	5.9	
TU 1	STR. IVb	Osteichthyes			321	47.1		0.0	
TU 1	STR. IVb	Vertebrata			212	31.1		0.0	
TU 1	STR. IVb	Total			681	100.0	17	100.0	
TU 1	STR. IVc	Didelphidae	*Didelphis*	*virginiana*	1	0.2	1	4.8	
TU 1	STR. IVc	Mammalia			4	0.7		0.0	
TU 1	STR. IVc	Kinosternidae			2		1	4.8	they articulate
TU 1	STR. IVc	Trionychidae	*Apalone*	*ferox*	1	0.2	1	4.8	
TU 1	STR. IVc	Testudinidae	*Gopherus*	*polyphemus*	1		1	4.8	
TU 1	STR. IVc	Testudines			3	0.5		0.0	
TU 1	STR. IVc	Serpentes			8	1.4	1	4.8	
TU 1	STR. IVc	Sirenidae	*Siren spp.*		1	0.2	1	4.8	
TU 1	STR. IVc	Anguillidae	*Anguilla*	*rostrata*	1	0.2	1	4.8	
TU 1	STR. IVc	Lepisosteidae	*Lepisosteus spp.*		11	1.9	1	4.8	probably from previous level
TU 1	STR. IVc	Amiidae	*Amia*	*calva*	1	0.2	1	4.8	
TU 1	STR. IVc	Cyprinidae	*Notemigonus*	*crysoleucas*	4	0.7	1	4.8	
TU 1	STR. IVc	Clupeidae			1	0.2	1	4.8	
TU 1	STR. IVc	Catostomidae	*Erimyzon*	*sucetta*	1	0.2	1	4.8	probably from previous level
TU 1	STR. IVc	Ictaluridae	*Ameiurus/Ictalurus spp.*		8	1.4	2	9.5	comparison of cleithrum to verts--one belongs here
TU 1	STR. IVc	Esocidae	*Esox spp.*		2	0.3	2	9.5	comparison of verts--belong to this level
TU 1	STR. IVc	Centrarchidae	*Lepomis spp.*		5	0.9	2	9.5	atlases
TU 1	STR. IVc	Centrarchidae	*Lepomis*	*microlophus*	1	0.2	1	4.8	
TU 1	STR. IVc	Centrarchidae			56	9.7	2	9.5	atlases
TU 1	STR. IVc	Osteichthyes			326	56.4		0.0	
TU 1	STR. IVc	Vertebrata			140	24.2		0.0	
TU 1	STR. IVc	Total			578	100.0	21	100.0	
TU 1	STR. IV	Rodentia			1	0.0	1	1.6	
TU 1	STR. IV	Leporidae	*Sylvilagus spp.*		1	0.0	1	1.6	
TU 1	STR. IV	Didelphidae	*Didelphis*	*virginiana*	1	0.0	1	1.6	
TU 1	STR. IV	Procyonidae	*Procyon*	*lotor*	1	0.0	1	1.6	

PROV	STRATUM	FAMILY	GENUS	SPECIES	NISP	%NISP	MNI	%MNI	NOTES
TU 1	STR. IV	Canidae	*Urocyon*	*cinereoargenteus*	1	0.0	1	1.6	
TU 1	STR. IV	Cervidae	*Odocoileus*	*virginianus*	1	0.0	1	1.6	
TU 1	STR. IV	Mammalia			35	1.0		0.0	
TU 1	STR. IV	Aves			2	0.1	1	1.6	
TU 1	STR. IV	Kinosternidae			2	0.1	1	1.6	
TU 1	STR. IV	Trionychidae	*Apalone*	*ferox*	1	0.0	1	1.6	
TU 1	STR. IV	Testudinidae	*Gopherus*	*polyphemus*	1	0.0	1	1.6	
TU 1	STR. IV	Testudines			34	1.0	3	4.8	
TU 1	STR. IV	Serpentes			30	0.9		0.0	
TU 1	STR. IV	Sirenidae	*Siren spp.*		3	0.1	1	1.6	
TU 1	STR. IV	Caudata			2	0.1		0.0	
TU 1	STR. IV	Rep./Amphib.			6	0.2		0.0	
TU 1	STR. IV	Lamniformes			1	0.0	1	1.6	
TU 1	STR. IV	Anguillidae	*Anguilla*	*rostrata*	1	0.0	1	1.6	
TU 1	STR. IV	Lepisosteidae	*Lepisosteus spp.*		68	1.9	1	1.6	
TU 1	STR. IV	Amiidae	*Amia*	*calva*	6	0.2	1	1.6	
TU 1	STR. IV	Cyprinidae	*Notemigonus*	*crysoleucas*	20	0.6	3	4.8	
TU 1	STR. IV	Clupeidae			8	0.2	3	4.8	
TU 1	STR. IV	Catostomidae	*Erimyzon*	*sucetta*	12	0.3	2	3.2	
TU 1	STR. IV	Ictaluridae	*Ameiurus/Ictalurus spp.*		22	0.6	5	8.1	
TU 1	STR. IV	Esocidae	*Esox spp.*		4	0.1	3	4.8	
TU 1	STR. IV	Centrarchidae	*Lepomis spp.*		18	0.5	10	16.1	
TU 1	STR. IV	Centrarchidae	*Lepomis*	*microlophus*	13	0.4	5	8.1	
TU 1	STR. IV	Centrarchidae	*Micropterus*	*salmoides*	7	0.2	3	4.8	
TU 1	STR. IV	Centrarchidae	*Pomoxis*	*nigromaculatus*	1	0.0	1	1.6	
TU 1	STR. IV	Centrarchidae			381	10.9	8	12.9	
TU 1	STR. IV	Mugilidae	*Mugil spp.*		2	0.1	1	1.6	
TU 1	STR. IV	Osteichthyes			1569	44.8		0.0	
TU 1	STR. IV	Vertebrata			1245	35.6		0.0	
TU 1	STR. IV	Total			3500	100.0	62	100.0	
TU 5	0-10	Cricetidae			3	0.1	1	1.5	
TU 5	0-10	Sciuridae	*Sciurus*	*carolinensis*	1	0.0	1	1.5	
TU 5	0-10	Cervidae	*Odocoileus*	*virginianus*	2	0.1	1	1.5	tooth fragments
TU 5	0-10	Carnivora			1	0.0	1	1.5	
TU 5	0-10	Mammalia			86	2.3		0.0	
TU 5	0-10	Aves			1	0.0	1	1.5	not Anatidae
TU 5	0-10	Chelydridae	*Chelydra*	*serpentina*	2	0.1	1	1.5	articulate w/ pieces from 10-20
TU 5	0-10	Emydidae	*Pseudemys/Trachemys spp.*		1	0.0	1	1.5	

PROV	STRATUM	FAMILY	*GENUS*	*SPECIES*	NISP	%NISP	MNI	%MNI	NOTES
TU 5	0-10	Trionychidae	*Apalone*	*ferox*	3	0.1	1	1.5	
TU 5	0-10	Testudinidae	*Gopherus*	*polyphemus*	1	0.0	1	1.5	
TU 5	0-10	Testudines			121	3.2	1	1.5	small turtle--cf. Kionstenidae and Terrapene
TU 5	0-10	Serpentes			12	0.3	2	3.0	
TU 5	0-10	Rep/Amphib			1	0.0	1	1.5	
TU 5	0-10	Anguillidae	*Angilla*	*rostrata*	2	0.1	1	1.5	
TU 5	0-10	Lepisosteidae	*Lepisosteus spp.*		146	3.8	1	1.5	
TU 5	0-10	Amiidae	*Amia*	*calva*	30	0.8	2	3.0	atlases
TU 5	0-10	Cyprinidae	*Notemigonus*	*crysoleucas*	19	0.5	2	3.0	atlases and axes
TU 5	0-10	Clupeidae			24	0.6	2	3.0	basios
TU 5	0-10	Catostomidae	*Erimyzon*	*sucetta*	37	1.0	4	6.1	atlases
TU 5	0-10	Ictaluridae	*Ameiurus/Ictalurus spp.*		42	1.1	6	9.1	basios and one large atlas
TU 5	0-10	Esocidae	*Esox spp.*		1	0.0	1	1.5	small fish
TU 5	0-10	Centrarchidae	*Lepomis spp.*		4	0.1		0.0	
TU 5	0-10	Centrarchidae	*Lepomis*	*microlophus*	25	0.7	2	3.0	
TU 5	0-10	Centrarchidae	*Micropterus*	*salmoides*	3	0.1	2	3.0	based on size of dentary and premaxilla
TU 5	0-10	Centrarchidae	*Pomoxis*	*nigromaculatus*	5	0.1	4	6.1	atlases
TU 5	0-10	Centrarchidae			315	8.3	25	37.9	atlases
TU 5	0-10	Mugilidae	*Mugil spp.*		3	0.1	1	1.5	
TU 5	0-10	Osteichthyes			1554	40.8		0.0	
TU 5	0-10	Vertebrata			1361	35.7		0.0	
TU 5	0-10	Total			3806	100.0	66	100.0	
TU 5	20-Oct	Didelphidae	*Didelphis*	*virginiana*	1	0.1	1	2.9	
TU 5	20-Oct	Cervidae	*Odocoileus*	*virginianus*	8	0.5	2	5.9	1 adult, 1 juvenile-- 2 pieces articulate
TU 5	20-Oct	Mammalia			33	1.9		0.0	
TU 5	20-Oct	Aves			2	0.1	1	2.9	
TU 5	20-Oct	Chelydridae	*Chelydra*	*serpentina*	2	0.1		0.0	articulate w/ pieces from 0-10
TU 5	20-Oct	Trionychidae	*Apalone*	*ferox*	1	0.1	1	2.9	same from previous level
TU 5	20-Oct	Testudines			51	2.9		0.0	
TU 5	20-Oct	Serpentes			3	0.2	1	2.9	
TU 5	20-Oct	Anguillidae	*Anguilla*	*rostrata*	4	0.2	1	2.9	
TU 5	20-Oct	Lepisosteidae	*Lepisosteus spp.*		45	2.5	2	5.9	comparison of dentaries and vert-- the big gar starts
TU 5	20-Oct	Amiidae	*Amia*	*calva*	11	0.6		0.0	
TU 5	20-Oct	Ictaluridae	*Ameiurus/Ictalurus spp.*		41	2.3	4	11.8	atlases
TU 5	20-Oct	Clupeidae			5	0.3	1	2.9	
TU 5	20-Oct	Esocidae	*Esox spp.*		1	0.1	1	2.9	
TU 5	20-Oct	Cyprinidae	*Notemigonus*	*crysoleucas*	26	1.5	3	8.8	based on atlases and 1 penult.--size
TU 5	20-Oct	Catostomidae	*Erimyzon*	*sucetta*	19	1.1	2	5.9	

PROV	STRATUM	FAMILY	*GENUS*	*SPECIES*	NISP	%NISP	MNI	%MNI	NOTES
TU 5	20-Oct	Centrarchidae	*Lepomis spp.*		11	0.6	4	11.8	atlases
TU 5	20-Oct	Centrarchidae	*Lepomis*	*macrochirus*	1	0.1	1	2.9	
TU 5	20-Oct	Centrarchidae	*Lepomis*	*microlophus*	16	0.9	2	5.9	
TU 5	20-Oct	Centrarchidae	*Micropterus*	*salmoides*	2	0.1	2	5.9	based on size of premax and dent.
TU 5	20-Oct	Centrarchidae			186	10.5	3	8.8	atlases; one massive vert to consider
TU 5	20-Oct	Mugilidae	*Mugil spp.*		1	0.1	1	2.9	
TU 5	20-Oct	Osteichthyes			955	54.1		0.0	
TU 5	20-Oct	Vertebrata			340	19.3		0.0	
TU 5	20-Oct	Total			1765	100.0	33	97.1	
TU 5	20-30	Didelphidae	*Didelphus*	*virginiana*	1	0.0	1	1.7	probably from previous level
TU 5	20-30	Procyonidae	*Procyon*	*lotor*	1	0.0	1	1.7	
TU 5	20-30	Cervidae	*Odocoileus*	*virginianus*	9	0.2	1	1.7	3 pieces articulate
TU 5	20-30	Mammalia			24	0.5		0.0	
TU 5	20-30	Aves			10	0.2	1	1.7	
TU 5	20-30	Kinosternidae			1	0.0	1	1.7	
TU 5	20-30	Trionychidae	*Apalone*	*ferox*	2	0.0	1	1.7	
TU 5	20-30	Testudines			89	1.9	1	1.7	poss. Pseud./Trachemys &more Kino. Or Terrapene
TU 5	20-30	Alligatoridae	*Alligator*	*mississippiensis*	1	0.0	1	1.7	
TU 5	20-30	Serpentes			14	0.3	1	1.7	
TU 5	20-30	Sirenidae	*Siren spp.*		1	0.0	1	1.7	
TU 5	20-30	Rep/Amphib.			2	0.0		0.0	
TU 5	20-30	Anguillidae	*Anguilla*	*rostrata*	10	0.2	1	1.7	
TU 5	20-30	Lepisosteidae	*Lepisosteus spp.*		131	2.8	2	3.4	based on vert size
TU 5	20-30	Amiidae	*Amia*	*calva*	30	0.7	1	1.7	
TU 5	20-30	Cyprinidae	*Notemigonus*	*crysoleucas*	39	0.8	2	3.4	
TU 5	20-30	Clupeidae			20	0.4	1	1.7	
TU 5	20-30	Catostomidae	*Erimyzon*	*sucetta*	39	0.8	5	8.5	
TU 5	20-30	Ictaluridae	*Ameiurus/Ictalurus spp.*		41	0.9	4	6.8	
TU 5	20-30	Esocidae	*Esox spp.*		8	0.2	1	1.7	
TU 5	20-30	Centrarchidae	*Lepomis spp.*		30	0.7	12	20.3	atlases
TU 5	20-30	Centrarchidae	*Lepomis*	*microlophus*	23	0.5	3	5.1	
TU 5	20-30	Centrarchidae	*Micropterus*	*salmoides*	10	0.2	3	5.1	
TU 5	20-30	Centrarchidae	*Pomoxis*	*nigromaculatus*	2	0.0	1	1.7	
TU 5	20-30	Centrarchidae			391	8.5	13	22.0	atlases
TU 5	20-30	Mugilidae	*Mugil spp.*		6	0.1	1	1.7	
TU 5	20-30	Osteichthyes			2354	51.1		0.0	
TU 5	20-30	Vertebrata			1319	28.6		0.0	
TU 5	20-30	Total			4608	100.0	60	101.7	

PROV	STRATUM	FAMILY	*GENUS*	*SPECIES*	NISP	%NISP	MNI	%MNI	NOTES
TU 5	30-40	Procyonidae	*Procyon*	*lotor*	1	0.0	1	2.5	
TU 5	30-40	Cervidae	*Odocoileus*	*virginianus*	6	0.2	1	2.5	split toe bone
TU 5	30-40	Mammalia			25	0.9		0.0	
TU 5	30-40	Ardeidae	*Nycticorax spp.*		1	0.0	1	2.5	
TU 5	30-40	Podicipedidae	*Podilymbus*	*podiceps*	1	0.0	1	2.5	
TU 5	30-40	Kinosternidae			21	0.7	1	2.5	
TU 5	30-40	Emydidae	*Deirochelys*	*reticualria*	6	0.2	1	2.5	
TU 5	30-40	Trionychidae	*Apalone*	*ferox*	1	0.0	1	2.5	
TU 5	30-40	Testudines			74	2.6		0.0	
TU 5	30-40	Colubridae	*Elaphe spp.*		5	0.2	1	2.5	
TU 5	30-40	Colubridae			2	0.1		0.0	
TU 5	30-40	Serpentes			1	0.0		0.0	
TU 5	30-40	Amphibia			1	0.0	1	2.5	
TU 5	30-40	Anura			1	0.0	1	2.5	
TU 5	30-40	Anguillidae	*Anguilla*	*rostrata*	9	0.3	1	2.5	
TU 5	30-40	Lepisosteidae	*Lepisosteus spp.*		68	2.4	2	5.0	comparison of atlas to verts
TU 5	30-40	Amiidae	*Amia*	*calva*	15	0.5	1	2.5	
TU 5	30-40	Cyprinidae	*Notemigonus*	*crysoleucas*	19	0.7	2	5.0	atlases
TU 5	30-40	Clupeidae			9	0.3	1	2.5	
TU 5	30-40	Catostomidae	*Erimyzon*	*sucetta*	24	0.8	3	7.5	supraoccipitals
TU 5	30-40	Ictaluridae	*Ameiurus/Ictalurus spp.*		17	0.6		0.0	
TU 5	30-40	Ictaluridae	*Ameiurus*	*natalis*	2	0.1	2	5.0	based on comparison of spine to dentary
TU 5	30-40	Esocidae	*Esox spp.*		1	0.0	1	2.5	
TU 5	30-40	Centrarchidae	*Lepomis spp.*		18	0.6	4	10.0	atlases
TU 5	30-40	Centrarchidae	*Lepomis*	*auritus*	1	0.0	1	2.5	
TU 5	30-40	Centrarchidae	*Lepomis*	*microlophus*	11	0.4	3	7.5	atlases
TU 5	30-40	Centrarchidae	*Lepomis*	*punctatus*	4	0.1	4	10.0	atlases
TU 5	30-40	Centrarchidae	*Micropterus*	*salmoides*	15	0.5	3	7.5	comparison of verts and atlases
TU 5	30-40	Centrarchidae	*Micropterus sp.*		14	0.5		0.0	
TU 5	30-40	Centrarchidae	*Pomoxis*	*nigromaculatus*	1	0.0	1	2.5	
TU 5	30-40	Centrarchidae			207	7.2		0.0	
TU 5	30-40	Mugilidae	*Mugil spp.*		1	0.0	1	2.5	
TU 5	30-40	Osteichthyes			1497	51.9		0.0	
TU 5	30-40	Vertebrata			808	28.0		0.0	
TU 5	30-40	Total			2887	100.0	40	100.0	
TU 5	40-50	Rodentia			1	0.0	1	1.7	
TU 5	40-50	Leporidae	*Sylvilagus spp.*		1	0.0	1	1.7	

PROV	STRATUM	FAMILY	GENUS	SPECIES	NISP	%NISP	MNI	%MNI	NOTES
TU 5	40-50	Procyonidae	*Procyon*	*lotor*	2	0.1	1	1.7	
TU 5	40-50	Cervidae	*Odocoileus*	*virginianus*	3	0.1	1	1.7	
TU 5	40-50	Mammalia			19	0.8		0.0	
TU 5	40-50	Anatidae			1	0.0	1	1.7	
TU 5	40-50	Aves			16	0.6	1	1.7	
TU 5	40-50	Chelydridae	*Chelydra*	*serpentina*	2	0.1	1	1.7	
TU 5	40-50	Trionychidae	*Apalone*	*ferox*	1	0.0	1	1.7	
TU 5	40-50	Testudines			50	2.0	1	1.7	
TU 5	40-50	Serpentes			9	0.4	2	3.4	
TU 5	40-50	Rajiformes			1	0.0	1	1.7	
TU 5	40-50	Anguillidae	*Anguilla*	*rostrata*	1	0.0	1	1.7	
TU 5	40-50	Lepisosteidae	*Lepisosteus spp.*		53	2.1	2	3.4	comparison of atlas to verts
TU 5	40-50	Amiidae	*Amia*	*calva*	36	1.5	2	3.4	comparison of maxilla to dentary
TU 5	40-50	Cyprinidae	*Notemigonus*	*crysoleucas*	23	0.9	4	6.8	
TU 5	40-50	Clupeidae			3	0.1	1	1.7	
TU 5	40-50	Catostomidae	*Erimyzon*	*sucetta*	20	0.8	3	5.1	based on size of basio and cleith with atlases
TU 5	40-50	Ictaluridae	*Ameiurus/Ictalurus spp.*		36	1.5	4	6.8	based on # of elements and one large vert
TU 5	40-50	Esocidae	*Esox spp.*		4	0.2	2	3.4	based on size of dentary and basio
TU 5	40-50	Centrarchidae	*Lepomis spp.*		17	0.7	8	13.6	atlases
TU 5	40-50	Centrarchidae	*Lepomis*	*microlophus*	22	0.9	2	3.4	grinders
TU 5	40-50	Centrarchidae	*Micropterus*	*salmoides*	8	0.3	3	5.1	based on premaxilla size
TU 5	40-50	Centrarchidae	*Pomoxis*	*nigromaculatus*	3	0.1	2	3.4	atlases
TU 5	40-50	Centrarchidae			217	8.8	13	22.0	atlases
TU 5	40-50	Osteichthyes			1084	43.7		0.0	
TU 5	40-50	Vertebrata			844	34.1		0.0	
TU 5	40-50	Total			2477	100.0	59	100.0	
TU 5	50-60	Didelphidae	*Didelphis*	*virginiana*	1	0.0	1	1.8	
TU 5	50-60	Procyonidae	*Procyon*	*lotor*	2	0.1	1	1.8	
TU 5	50-60	Cervidae	*Odocoileus*	*virginianus*	3	0.1	1	1.8	
TU 5	50-60	Mammalia			24	1.2		0.0	
TU 5	50-60	Anatidae			1	0.0	1	1.8	
TU 5	50-60	Aves			1	0.0	1	1.8	
TU 5	50-60	Chelydridae	*Chelydra*	*serpentina*	2	0.1	1	1.8	
TU 5	50-60	Kinosternidae	*Kinosternon spp.*		3	0.1	1	1.8	
TU 5	50-60	Emydidae	*Pseudemys/Trachemys spp.*		2	0.1	1	1.8	
TU 5	50-60	Trionychidae	*Apalone*	*ferox*	2	0.1	1	1.8	
TU 5	50-60	Testudines			66	3.2		0.0	
TU 5	50-60	Alligatoridae	*Alligator*	*mississippiensis*	1	0.0	1	1.8	

PROV	STRATUM	FAMILY	*GENUS*	*SPECIES*	NISP	%NISP	MNI	%MNI	NOTES
TU 5	50-60	Serpentes			15	0.7	2	3.6	
TU 5	50-60	Sirenidae	*Siren spp.*		2	0.1	1	1.8	
TU 5	50-60	Anura			1	0.0	1	1.8	
TU 5	50-60	Odontaspididae	*Odontaspis*	*taurus*	1	0.0	1	1.8	use wear on tip
TU 5	50-60	Lepisosteidae	*Lepisosteus spp.*		47	2.3	2	3.6	based on vert size
TU 5	50-60	Amiidae	*Amia*	*calva*	40	1.9	2	3.6	comparison of maxillas
TU 5	50-60	Cyprinidae	*Notemigonus*	*crysoleucas*	19	0.9	2	3.6	
TU 5	50-60	Clupeidae			8	0.4	1	1.8	
TU 5	50-60	Catostomidae	*Erimyzon*	*sucetta*	28	1.3	3	5.4	
TU 5	50-60	Ictaluridae	*Ameiurus/Ictalurus spp.*		38	1.8	4	7.1	based on dentaries and one large cleithrum
TU 5	50-60	Esocidae	*Esox spp.*		6	0.3	1	1.8	
TU 5	50-60	Centrarchidae	*Lepomis spp.*		16	0.8	8	14.3	atlases
TU 5	50-60	Centrarchidae	*Lepomis*	*microlophus*	18	0.9	4	7.1	based on grinders
TU 5	50-60	Centrarchidae	*Micropterus*	*salmoides*	8	0.4	2	3.6	
TU 5	50-60	Centrarchidae	*Pomoxis*	*nigromaculatus*	2	0.1	1	1.8	
TU 5	50-60	Centrarchidae			207	10.0	10	17.9	atlases
TU 5	50-60	Mugilidae	*Mugil spp.*		2	0.1	1	1.8	
TU 5	50-60	Osteichthyes			932	44.8		0.0	
TU 5	50-60	Vertebrata			581	27.9		0.0	
TU 5	50-60	Total			2079	100.0	56	100.0	
TU 5	60-70	Cervidae	*Odocoileus*	*virginianus*	1	0.0	1	2.2	
TU 5	60-70	Mammalia			13	0.3	1	2.2	
TU 5	60-70	Anatidae			3	0.1	1	2.2	
TU 5	60-70	Aves			19	0.5	1	2.2	
TU 5	60-70	Chelydridae	*Chelydra*	*serpentina*	1	0.0	1	2.2	
TU 5	60-70	Kinosternidae			1	0.0	1	2.2	
TU 5	60-70	Emydidae	*Terrapene*	*carolina*	1	0.0	1	2.2	
TU 5	60-70	Trionychidae	*Apalone*	*ferox*	12	0.3	1	2.2	
TU 5	60-70	Testudines			105	2.7		0.0	
TU 5	60-70	Alligatoridae	*Alligator*	*mississippiensis*	1	0.0	1	2.2	
TU 5	60-70	Serpentes			25	0.7	1	2.2	
TU 5	60-70	Anguillidae	*Anguilla*	*rostrata*	1	0.0	1	2.2	
TU 5	60-70	Lepisosteidae	*Lepisosteus spp.*		206	5.4	2	4.3	based on vert size
TU 5	60-70	Amiidae	*Amia*	*calva*	41	1.1	2	4.3	atlases
TU 5	60-70	Cyprinidae	*Notemigonus*	*crysoleucas*	50	1.3	4	8.7	phryngeals
TU 5	60-70	Clupeidae			5	0.1	1	2.2	
TU 5	60-70	Catostomidae	*Erimyzon*	*sucetta*	53	1.4	7	15.2	supraoccipitals
TU 5	60-70	Ictaluridae	*Ameiurus/Ictalurus spp.*		75	2.0	6	13.0	atlases

PROV	STRATUM	FAMILY	*GENUS*	*SPECIES*	NISP	%NISP	MNI	%MNI	NOTES
TU 5	60-70	Esocidae	*Esox spp.*		7	0.2	1	2.2	
TU 5	60-70	Centrarchidae	*Lepomis spp.*		15	0.4	7	15.2	atlases
TU 5	60-70	Centrarchidae	*Lepomis*	*microlophus*	17	0.4	2	4.3	grinder size
TU 5	60-70	Centrarchidae	*Micropterus*	*salmoides*	12	0.3	3	6.5	atlases
TU 5	60-70	Centrarchidae	*Pomoxis*	*nigromaculatus*	1	0.0	1	2.2	
TU 5	60-70	Centrarchidae			222	5.8		0.0	
TU 5	60-70	Osteichthyes			1805	47.0		0.0	
TU 5	60-70	Vertebrata			1145	29.8		0.0	
TU 5	60-70	Total			3837	100.0	46	100.0	
TU 5	70-80	Sigmodontinae	*Sigmodon spp.*		1	0.0	1	1.4	
TU 5	70-80	Leporidae	*Sylvilagus spp.*		1	0.0	1	1.4	
TU 5	70-80	Rodentia			5	0.1		0.0	
TU 5	70-80	Didelphidae	*Didelphis*	*virginiana*	1	0.0	1	1.4	
TU 5	70-80	Procyonidae	*Procyon*	*lotor*	2	0.0	1	1.4	
TU 5	70-80	Mammalia			24	0.4		0.0	
TU 5	70-80	Anatidae			1	0.0	1	1.4	
TU 5	70-80	Aves			21	0.3	1	1.4	
TU 5	70-80	Chelydridae	*Chelydra*	*serpentina*	4	0.1	1	1.4	
TU 5	70-80	Kinosternidae			25	0.4	1	1.4	
TU 5	70-80	Emydidae	*Pseud/Trachemys spp.*		3	0.0	1	1.4	
TU 5	70-80	Emydidae	*Terrapene*	*carolina*	5	0.1	1	1.4	
TU 5	70-80	Trionychidae	*Apalone*	*ferox*	7	0.1	1	1.4	
TU 5	70-80	Testudinidae	*Gpoherus*	*ployphemus*	3	0.0	1	1.4	
TU 5	70-80	Testudines			312	4.9		0.0	
TU 5	70-80	Colubridae	*Nerodia spp.*		6	0.1	1	1.4	
TU 5	70-80	Colubridae	*Elaphe spp.*		2	0.0	1	1.4	
TU 5	70-80	Colubridae			6	0.1		0.0	
TU 5	70-80	Viperidae	*Crotalus spp.*		2	0.0	1	1.4	
TU 5	70-80	Viperidae			4	0.1		0.0	
TU 5	70-80	Serpentes			16	0.2		0.0	
TU 5	70-80	Polychridae	*Anoles spp.*		2	0.0	1	1.4	
TU 5	70-80	Amphiumidae	*Amphiuma*	*means*	2	0.0	1	1.4	
TU 5	70-80	Anura			4	0.1	1	1.4	
TU 5	70-80	Lamniformes			1	0.0	1	1.4	articulates w/ tooth from 80-90.
TU 5	70-80	Lepisosteidae	*Lepisosteus spp.*		315	4.9	2	2.9	comparison of vert size
TU 5	70-80	Amiidae	*Amia*	*calva*	44	0.7	2	2.9	basios
TU 5	70-80	Cyprinidae	*Notemigonus*	*crysoleucas*	45	0.7	5	7.2	axes
TU 5	70-80	Clupeidae			8	0.1	1	1.4	

PROV	STRATUM	FAMILY	GENUS	SPECIES	NISP	%NISP	MNI	%MNI	NOTES
TU 5	70-80	Catostomidae	*Erimyzon*	*sucetta*	54	0.8	5	7.2	atlases
TU 5	70-80	Ictaluridae	*Ameiurus/Ictalurus spp.*		55	0.9		0.0	
TU 5	70-80	Ictaluridae	*Ameiurus*	*catus*	3	0.0	2	2.9	
TU 5	70-80	Ictaluridae	*Ameiurus*	*natalis*	4	0.1	3	4.3	
TU 5	70-80	Ictaluridae	*Ameiurus*	*nebulosus*	3	0.0	2	2.9	
TU 5	70-80	Ictaluridae	*Ictalurus*	*punctatus*	1	0.0	1	1.4	
TU 5	70-80	Esocidae	*Esox spp.*		9	0.1	3	4.3	based on dentaries
TU 5	70-80	Centrarchidae	*Lepomis spp.*		12	0.2		0.0	
TU 5	70-80	Centrarchidae	*Lepomis*	*auritus*	5	0.1	5	7.2	atlases
TU 5	70-80	Centrarchidae	*Lepomis*	*macrochirus*	1	0.0	1	1.4	maxilla
TU 5	70-80	Centrarchidae	*Lepomis*	*microlophus*	84	1.3	5	7.2	atlases
TU 5	70-80	Centrarchidae	*Lepomis*	*punctatus*	2	0.0	2	2.9	atlases
TU 5	70-80	Centrarchidae	*Micropterus sp.*		3	0.0		0.0	
TU 5	70-80	Centrarchidae	*Micropterus*	*salmoides*	49	0.8	6	8.7	based on premaxillas
TU 5	70-80	Centrarchidae	*Pomoxis*	*nigromaculatus*	5	0.1	2	2.9	based on quadrates
TU 5	70-80	Centrarchidae			218	3.4		0.0	
TU 5	70-80	Mugilidae	*Mugil spp.*		3	0.0	1	1.4	
TU 5	70-80	Fish sp. A			1	0.0	1	1.4	
TU 5	70-80	Fish sp. B			1	0.0	1	1.4	
TU 5	70-80	Osteichthyes			3042	47.4		0.0	
TU 5	70-80	Vertebrata			1986	31.0		0.0	
TU 5	70-80	Total			6413	100.0	69	100.0	
TU 5	80-90	Didelphidae	*Didelphis*	*virginiana*	1	0.1	1	4.2	
TU 5	80-90	Mammalia			6	0.5		0.0	
TU 5	80-90	Trionychidae	*Apalone*	*ferox*	1	0.1	1	4.2	
TU 5	80-90	Testudines			39	3.3	1	4.2	small turtle
TU 5	80-90	Serpentes			12	1.0	1	4.2	
TU 5	80-90	Lamniformes			1	0.1		0.0	Articulates w/ tooth from 70-80.
TU 5	80-90	Rajiformes			1	0.1	1	4.2	
TU 5	80-90	Lepisosteidae	*Lepisosteus spp.*		50	4.2	1	4.2	
TU 5	80-90	Amiidae	*Amia*	*calva*	8	0.7	1	4.2	
TU 5	80-90	Cyprinidae	*Notemigonus*	*crysoleucas*	8	0.7	2	8.3	axes
TU 5	80-90	Clupeidae			1	0.1	1	4.2	
TU 5	80-90	Catostomidae	*Erimyzon*	*sucetta*	5	0.4	3	12.5	atlases
TU 5	80-90	Ictaluridae	*Ameiurus/Ictalurus spp.*		22	1.9	2	8.3	pectoral spines
TU 5	80-90	Esocidae	*Esox spp.*		3	0.3	1	4.2	
TU 5	80-90	Centrarchidae	*Lepomis spp.*		2	0.2		0.0	
TU 5	80-90	Centrarchidae	*Lepomis*	*microlophus*	33	2.8	2	8.3	grinders

PROV	STRATUM	FAMILY	*GENUS*	*SPECIES*	NISP	%NISP	MNI	%MNI	NOTES
TU 5	80-90	Centrarchidae	*Micropterus*	*salmoides*	8	0.7	2	8.3	comparison of maxilla and atlas
TU 5	80-90	Centrarchidae	*Pomoxis*	*nigromaculatus*	3	0.3	3	12.5	atlases
TU 5	80-90	Centrarchidae			95	8.0		0.0	
TU 5	80-90	Osteichthyes			530	44.6		0.0	
TU 5	80-90	Vertebrata			360	30.3		0.0	
TU 5	80-90	Total			1189	100.0	23	95.8	
TU 5	90-100	Testudines			2	8.3	1	25.0	
TU 5	90-100	Cyprinidae	*Notemigonus*	*crysoleucas*	1	4.2	1	25.0	
TU 5	90-100	Ictaluridae	*Ameiurus/Ictalurus spp.*		1	4.2	1	25.0	
TU 5	90-100	Esocidae	*Esox spp.*		1	4.2	1	25.0	
TU 5	90-100	Osteichthyes			14	58.3		0.0	
TU 5	90-100	UID Vertebrata			5	20.8		0.0	
TU 5	90-100	Total			24	100.0	4	100.0	
TU 2	STR. III	Procynidae	*Procyon*	*lotor*	3	0.0	1	1.0	
TU 2	STR. III	Mustelidae	*Lutra*	*canadensis*	2	0.0	1	1.0	
TU 2	STR. III	Cervidae	*Odocoileus*	*virginianus*	28	0.4	1	1.0	
TU 2	STR. III	Mammalia			115	1.5		0.0	
TU 2	STR. III	Ardeidae	*Nycticorax spp.*		1	0.0	1	1.0	
TU 2	STR. III	Aves			7	0.1		0.0	
TU 2	STR. III	Emydidae	*Deirochelys*	*reticularia*	11	0.1	1	1.0	
TU 2	STR. III	Emydidae	*Pseudemys*	*floridiana*	19	0.3	1	1.0	
TU 2	STR. III	Trionychidae	*Apalone*	*ferox*	56	0.8	1	1.0	
TU 2	STR. III	Testudinidae	*Gopherus*	*polyphemus*	19	0.3	1	1.0	
TU 2	STR. III	Testudines			213	2.9		0.0	
TU 2	STR. III	Colubridae	*Elaphe spp.*		5	0.1	1	1.0	
TU 2	STR. III	Colubridae	*Nerodia spp.*		19	0.3	1	1.0	
TU 2	STR. III	Viperidae	*Agkistrodon*	*piscivorous*	1	0.0	1	1.0	
TU 2	STR. III	Serpentes			43	0.6		0.0	2 articulate
TU 2	STR. III	Carcharhinidae			1	0.0	1	1.0	Likely tiger shark
TU 2	STR. III	Lepisosteidae	*Lepisosteus spp.*		26	0.3	1	1.0	
TU 2	STR. III	Amiidae	*Amia*	*calva*	22	0.3	5	4.8	atlases
TU 2	STR. III	Cyprinidae	*Notemigonus*	*crysoleucas*	59	0.8	4	3.8	phryngeals
TU 2	STR. III	Clupeidae			20	0.3	1	1.0	
TU 2	STR. III	Catostomidae	*Erimyzon*	*sucetta*	250	3.4	37	35.2	based on supraoccipitals
TU 2	STR. III	Ictaluridae	*Ameiurus/Ictalurus spp.*		127	1.7		0.0	
TU 2	STR. III	Ictaluridae	*Ameiurus*	*catus*	8	0.1	4	3.8	pectoral spines
TU 2	STR. III	Ictaluridae	*Ameiurus*	*natalis*	31	0.4	9	8.6	dentaries

PROV	STRATUM	FAMILY	*GENUS*	*SPECIES*	NISP	%NISP	MNI	%MNI	NOTES
TU 2	STR. III	Ictaluridae	*Ameiurus*	*nebulosus*	1	0.0	1	1.0	
TU 2	STR. III	Ictaluridae	*Ictalurus*	*punctatus*	2	0.0	2	1.9	dentary
TU 2	STR. III	Esocidae	*Esox spp.*		19	0.3	2	1.9	
TU 2	STR. III	Centrarchidae	*Lepomis spp.*		72	1.0	4	3.8	atlases
TU 2	STR. III	Centrarchidae	*Lepomis*	*gulosus*	3	0.0	3	2.9	atlases
TU 2	STR. III	Centrarchidae	*Lepomis*	*macrochirus*	1	0.0	1	1.0	atlas
TU 2	STR. III	Centrarchidae	*Lepomis*	*microlophus*	31	0.4	5	4.8	UR grinders
TU 2	STR. III	Centrarchidae	*Micropterus*	*salmoides*	38	0.5	5	4.8	dentaries
TU 2	STR. III	Centrarchidae	*Pomoxis*	*nigromaculatus*	20	0.3	8	7.6	atlases
TU 2	STR. III	Centrarchidae			610	8.2		0.0	
TU 2	STR. III	Mugilidae	*Mugil spp.*		10	0.1	1	1.0	
TU 2	STR. III	Osteichthyes			3938	53.0		0.0	
TU 2	STR. III	Vertebrata			1600	21.5		0.0	
TU 2	STR. III	Total			7431	100.0	105	100.0	
TU 2	STR. IV	Procynidae	*Procyon*	*lotor*	1	0.1	1	3.1	
TU 2	STR. IV	Cervidae	*Odocoileus*	*virginianus*	1	0.1	1	3.1	
TU 2	STR. IV	Mammalia			4	0.3		0.0	
TU 2	STR. IV	Aves			1	0.1		0.0	possible cut mark--maybe bead?
TU 2	STR. IV	Trionychidae	*Apalone*	*ferox*	109	9.5	1	3.1	
TU 2	STR. IV	Testudines			6	0.5		0.0	
TU 2	STR. IV	Lepisosteidae	*Lepisosteus spp.*		30	2.6	1	3.1	
TU 2	STR. IV	Amiidae	*Amia*	*calva*	4	0.3	1	3.1	
TU 2	STR. IV	Cyprinidae	*Notemigonus*	*crysoleucas*	18	1.6	2	6.3	atlases
TU 2	STR. IV	Clupeidae	*Dorosoma spp.*		1	0.1	1	3.1	atlas
TU 2	STR. IV	Catostomidae	*Erimyzon*	*sucetta*	3	0.3	1	3.1	
TU 2	STR. IV	Ictaluridae	*Ameiurus/Ictalurus spp.*		14	1.2	1	3.1	
TU 2	STR. IV	Ictaluridae	*Ameiurus*	*natalis*	1	0.1	1	3.1	pectoral spine
TU 2	STR. IV	Ictaluridae	*Ictalurus*	*punctatus*	1	0.1	1	3.1	vert
TU 2	STR. IV	Esocidae	*Esox spp.*		1	0.1	1	3.1	
TU 2	STR. IV	Centrarchidae	*Lepomis spp.*		9	0.8	2	6.3	atlases--not microlophus or gulosus
TU 2	STR. IV	Centrarchidae	*Lepomis*	*gulosus*	2	0.2	1	3.1	
TU 2	STR. IV	Centrarchidae	*Lepomis*	*macrochirus*	8	0.7	7	21.9	atlases
TU 2	STR. IV	Centrarchidae	*Lepomis*	*microlophus*	8	0.7	3	9.4	
TU 2	STR. IV	Esociade	*Esox spp.*		1	0.1	1	3.1	
TU 2	STR. IV	Centrarchidae	*Micropterus*	*salmoides*	2	0.2	1	3.1	
TU 2	STR. IV	Centrarchidae	*Pomoxis*	*nigromaculatus*	9	0.8	2	6.3	atlases
TU 2	STR. IV	Centrarchidae			121	10.5	2	6.3	atlases
TU 2	STR. IV	Osteichthyes			580	50.5		0.0	

PROV	STRATUM	FAMILY	*GENUS*	*SPECIES*	NISP	%NISP	MNI	%MNI	NOTES
TU 2	STR. IV	Vertebrata			215	18.7		0.0	
TU 2	STR. IV	Total			1149	100.0	32	100.0	
TU 2	STR. V	Cricetidae			1	0.1	1	3.0	
TU 2	STR. V	Cervidae	*Odocoileus*	*virginianus*	1	0.1	1	3.0	
TU 2	STR. V	Mammalia			17	1.3		0.0	
TU 2	STR. V	Aves			3	0.2	1	3.0	
TU 2	STR. V	Kinosternidae	*Kinosternon spp.*		2	0.2	1	3.0	they articulate
TU 2	STR. V	Trionychidae	*Apalone*	*ferox*	6	0.5	1	3.0	
TU 2	STR. V	Testudines			22	1.7		0.0	
TU 2	STR. V	Alligatoridae	*Alligator*	*mississippiensis*	1	0.1	1	3.0	
TU 2	STR. V	Amphiumidae	*Amphiuma*	*means*	1	0.1	1	3.0	
TU 2	STR. V	Caudata			1	0.1		0.0	
TU 2	STR. V	Rep./Amphib.			4	0.3		0.0	
TU 2	STR. V	Lepisosteidae	*Lepisosteus spp.*		9	0.7	2	6.1	atlases
TU 2	STR. V	Amiidae	*Amia*	*calva*	7	0.5	1	3.0	
TU 2	STR. V	Cyprinidae	*Notemigonus*	*crysoleucas*	10	0.8	1	3.0	
TU 2	STR. V	Clupeidae			2	0.2	1	3.0	
TU 2	STR. V	Catostomidae	*Erimyzon*	*sucetta*	11	0.8	1	3.0	
TU 2	STR. V	Ictaluridae	*Ameiurus/Ictalurus spp.*		11	0.8	2	6.1	comparison of basio and pectoral spine frag
TU 2	STR. V	Esocidae	*Esox spp.*		3	0.2		0.0	comparison of verts to quadrate
TU 2	STR. V	Centrarchidae	*Lepomis spp.*		12	0.9	7	21.2	atlases
TU 2	STR. V	Centrarchidae	*Lepomis*	*macrochirus*	4	0.3	3	9.1	atlases
TU 2	STR. V	Centrarchidae	*Lepomis*	*microlophus*	5	0.4	2	6.1	
TU 2	STR. V	Centrarchidae	*Micropterus*	*salmoides*	7	0.5	3	9.1	based on comparison of quadrates and atlas/basio
TU 2	STR. V	Centrarchidae	*Pomoxis*	*nigromaculatus*	5	0.4	2	6.1	atlases
TU 2	STR. V	Centrarchidae			137	10.5	1	3.0	atlas
TU 2	STR. V	Osteichthyes			780	60.0		0.0	
TU 2	STR. V	Vertebrata			238	18.3		0.0	
TU 2	STR. V	Total			1300	100.0	33	100.0	
TU 2	STR. VI	Mustelidae	*Lutra*	*canadensis*	1	0.0	1	1.6	
TU 2	STR. VI	Cervidae	*Odocoileus*	*virginianus*	1	0.0	1	1.6	
TU 2	STR. VI	Mammalia			28	0.9		0.0	
TU 2	STR. VI	Aves			7	0.2	1	1.6	2 articulate
TU 2	STR. VI	Chelydridae	*Chelydra*	*serpentina*	1	0.0	1	1.6	
TU 2	STR. VI	Kinosternidae	*Kinosternon spp.*		1	0.0	1	1.6	
TU 2	STR. VI	Emydidae	*Terrapene*	*carolina*	1	0.0	1	1.6	
TU 2	STR. VI	Trionychidae	*Apalone*	*ferox*	1	0.0	1	1.6	one small carapace frag

PROV	STRATUM	FAMILY	*GENUS*	*SPECIES*	NISP	%NISP	MNI	%MNI	NOTES
TU 2	STR. VI	Testudines			27	0.8		0.0	
TU 2	STR. VI	Alligatoridae	*Alligator*	*mississippiensis*	1	0.0	1	1.6	
TU 2	STR. VI	Colubridae			6	0.2	1	1.6	
TU 2	STR. VI	Serpentes			5	0.2		0.0	
TU 2	STR. VI	Sirenidae	*Siren spp.*		5	0.2	1	1.6	
TU 2	STR. VI	Anura			13	0.4	1	1.6	
TU 2	STR. VI	Rep./Amphib.			17	0.5		0.0	
TU 2	STR. VI	Anguillidae	*Anguilla*	*rostrata*	2	0.1	1	1.6	
TU 2	STR. VI	Lepisosteidae	*Lepisosteus spp.*		19	0.6	2	3.1	compariosn of dentaries and atlas
TU 2	STR. VI	Amiidae	*Amia*	*calva*	21	0.6	1	1.6	
TU 2	STR. VI	Cyprinidae	*Notemigonus*	*crysoleucas*	26	0.8	4	6.3	based on ultimates
TU 2	STR. VI	Clupeidae			3	0.1	1	1.6	atlas
TU 2	STR. VI	Catostomidae	*Erimyzon*	*sucetta*	92	2.8	11	17.2	based on supraoccipitals
TU 2	STR. VI	Ictaluridae	*Ameiurus/Ictalurus spp.*		49	1.5	5	7.8	based on quadrates and complex verts
TU 2	STR. VI	Ictaluridae	*Ameiurus*	*natalis*	1	0.0	1	1.6	dentary
TU 2	STR. VI	Esocidae	*Esox spp.*		2	0.1	1	1.6	verts
TU 2	STR. VI	Centrarchidae	*Lepomis spp.*		35	1.1	16	25.0	atlases
TU 2	STR. VI	Centrarchidae	*Lepomis*	*microlophus*	10	0.3	2	3.1	basios
TU 2	STR. VI	Centrarchidae	*Micropterus*	*salmoides*	6	0.2	3	4.7	comparison of vomers to dentary
TU 2	STR. VI	Centrarchidae	*Pomoxis*	*nigromaculatus*	7	0.2	4	6.3	atlases
TU 2	STR. VI	Centrarchidae			619	18.8		0.0	
TU 2	STR. VI	Mugilidae	*Mugil spp.*		1	0.0	1	1.6	
TU 2	STR. VI	Osteichthyes			1918	58.4		0.0	
TU 2	STR. VI	Vertebrata			378	11.5		0.0	
TU 2	STR. VI	Total			3304	100.5	64	100.0	
TU 2	STR. VIIIa	Leporidae	*Sylvilagus spp.*		1	0.1	1	3.6	
TU 2	STR. VIIIa	Cervidae	*Odocoileus*	*virginianus*	1	0.1	1	3.6	
TU 2	STR. VIIIa	Mammalia			9	0.8	1	3.6	
TU 2	STR. VIIIa	Aves			1	0.1	1	3.6	
TU 2	STR. VIIIa	Emydidae	*Pseudemys/Trachemys*		1	0.1	1	3.6	
TU 2	STR. VIIIa	Trionychidae	*Apalone*	*ferox*	4	0.3	1	3.6	
TU 2	STR. VIIIa	Testudines			18	1.5	1	3.6	Cf. Kinosternidae and Terrapene
TU 2	STR. VIIIa	Colubridae			1	0.1	1	3.6	
TU 2	STR. VIIIa	Serpentes			1	0.1		0.0	
TU 2	STR. VIIIa	Sirenidae	*Siren spp.*		1	0.1	1	3.6	
TU 2	STR. VIIIa	Rep./Amphib.			4	0.3		0.0	
TU 2	STR. VIIIa	Lepisosteidae	*Lepisosteus spp.*		17	1.4	2	7.1	based on comparison of verts
TU 2	STR. VIIIa	Amiidae	*Amia*	*calva*	13	1.1	1	3.6	

PROV	STRATUM	FAMILY	GENUS	SPECIES	NISP	%NISP	MNI	%MNI	NOTES
TU 2	STR. VIIIa	Cyprinidae	*Notemigonus*	*crysoleucas*	9	0.8	2	7.1	atlases
TU 2	STR. VIIIa	Clupeidae			3	0.3	1	3.6	
TU 2	STR. VIIIa	Catostomidae	*Erimyzon*	*sucetta*	8	0.7	1	3.6	
TU 2	STR. VIIIa	Ictaluridae	*Ameiurus/Ictalurus spp.*		8	0.7	2	7.1	based on comparison of basio to dentary
TU 2	STR. VIIIa	Esocidae	*Esox spp.*		3	0.3	1	3.6	
TU 2	STR. VIIIa	Centrarchidae	*Lepomis spp.*		8	0.7	5	17.9	atlases
TU 2	STR. VIIIa	Centrarchidae	*Lepomis*	*microlophus*	2	0.2	1	3.6	based on grinders
TU 2	STR. VIIIa	Centrarchidae	*Micropterus*	*salmoides*	1	0.1	1	3.6	atlas
TU 2	STR. VIIIa	Centrarchidae	*Pomoxis*	*nigromaculatus*	1	0.1	1	3.6	
TU 2	STR. VIIIa	Centrarchidae			132	11.1		0.0	
TU 2	STR. VIIIa	Mugilidae	*Mugil spp.*		1	0.1	1	3.6	
TU 2	STR. VIIIa	Osteichthyes			650	54.8		0.0	
TU 2	STR. VIIIa	Vertebrata			289	24.3		0.0	
TU 2	STR. VIIIa	Total			1187	100.0	28	100.0	
TU 2	STR. VIIIb	Rodentia			1	0.1	1	2.7	probably from previous level
TU 2	STR. VIIIb	Cervidae	*Odocoileus*	*virginianus*	1	0.1	1	2.7	
TU 2	STR. VIIIb	Mammalia			16	1.7		0.0	
TU 2	STR. VIIIb	Emydidae	*Terrapene*	*carolina*	2	0.2	1	2.7	they articulate
TU 2	STR. VIIIb	Testudines			16	1.7	1	2.7	cf. Chelydra serpentina
TU 2	STR. VIIIb	Colubridae			1	0.1	1	2.7	
TU 2	STR. VIIIb	Viperidae			1	0.1	1	2.7	
TU 2	STR. VIIIb	Lepisosteidae	*Lepisosteus spp.*		14	1.5	2	5.4	comparison of dentary frag to verts
TU 2	STR. VIIIb	Amiidae	*Amia*	*calva*	9	1.0	1	2.7	
TU 2	STR. VIIIb	Cyprinidae	*Notemigonus*	*crysoleucas*	40	4.3	2	5.4	axes
TU 2	STR. VIIIb	Clupeidae			9	1.0	1	2.7	
TU 2	STR. VIIIb	Catostomidae	*Erimyzon*	*sucetta*	8	0.9	1	2.7	
TU 2	STR. VIIIb	Ictaluridae	*Ameiurus/Ictalurus spp.*		11	1.2	2	5.4	comparison of pectoral spine to dentary
TU 2	STR. VIIIb	Esocidae	*Esox spp.*		3	0.3	1	2.7	atlas
TU 2	STR. VIIIb	Centrarchidae	*Lepomis spp.*		19	2.1	14	37.8	atlases
TU 2	STR. VIIIb	Centrarchidae	*Lepomis*	*microlophus*	5	0.5	1	2.7	
TU 2	STR. VIIIb	Centrarchidae	*Micropterus*	*salmoides*	4	0.4	2	5.4	based on size of premaxilla to dentary
TU 2	STR. VIIIb	Centrarchidae	*Pomoxis*	*nigromaculatus*	2	0.2	2	5.4	atlases
TU 2	STR. VIIIb	Centrarchidae			136	14.8	1	2.7	cf. Pomoxis and Lepomis
TU 2	STR. VIIIb	Mugilidae	*Mugil spp.*		1	0.1	1	2.7	
TU 2	STR. VIIIb	Osteichthyes			513	55.6		0.0	
TU 2	STR. VIIIb	Vertebrata			110	11.9		0.0	
TU 2	STR. VIIIb	Total			922	100.0	37	100.0	

PROV	STRATUM	FAMILY	*GENUS*	*SPECIES*	NISP	%NISP	MNI	%MNI	NOTES
TU 2	STR. VIIIc	Procynidae	*Procyon*	*lotor*	1	0.3	1	5.3	
TU 2	STR. VIIIc	Canidae			1	0.3	1	5.3	
TU 2	STR. VIIIc	Mammalia			5	1.6	1	5.3	Large mammal
TU 2	STR. VIIIc	Trionychidae	*Aplaone*	*ferox*	1	0.3	1	5.3	
TU 2	STR. VIIIc	Testudines			6	2.0	1	5.3	Cf. Terrapene and Kinosternidae
TU 2	STR. VIIIc	Serpentes			2	0.7	1	5.3	probably from previous level
TU 2	STR. VIIIc	Lepisosteidae	*Lepisosteus spp.*		1	0.3	1	5.3	probably from previous level
TU 2	STR. VIIIc	Amiidae	*Amia*	*calva*	3	1.0	1	5.3	
TU 2	STR. VIIIc	Cyprinidae	*Notemigonus*	*crysoleucas*	14	4.6	2	10.5	based on phryngeals but one prob. from prev. level
TU 2	STR. VIIIc	Clupeidae			3	1.0	1	5.3	probably from previous level
TU 2	STR. VIIIc	Catostomidae	*Erimyzon*	*sucetta*	6	2.0	1	5.3	not from previous stratum based on hyomandibular
TU 2	STR. VIIIc	Ictaluridae	*Ameiurus/Ictalurus spp.*		3	1.0	1	5.3	probably one of two from previous level
TU 2	STR. VIIIc	Esocidae	*Esox spp.*		1	0.3	1	5.3	lg. Vert probably not same fish as previous level
TU 2	STR. VIIIc	Centrarchidae	*Lepomis spp.*		1	0.3	1	5.3	atlas
TU 2	STR. VIIIc	Centrarchidae	*Micropterus*	*salmoides*	3	1.0	2	10.5	comp. of vomer to maxilla but lg. One from level VIIIb
TU 2	STR. VIIIc	Centrarchidae	*Pomoxis*	*nigromaculatus*	1	0.3	1	5.3	
TU 2	STR. VIIIc	Centrarchidae			35	11.4	1	5.3	atlas
TU 2	STR. VIIIc	Osteichthyes			159	52.0		0.0	
TU 2	STR. VIIIc	Vertebrata			60	19.6		0.0	
TU 2	STR. VIIIc	Total			306	100.0	19	100.0	
TU 2	STR. VIII	Rodentia			1	0.0	1	1.5	
TU 2	STR. VIII	Leporidae	*Sylvilagus spp.*		1	0.0	1	1.5	
TU 2	STR. VIII	Procyonidae	*Procyon*	*lotor*	1	0.0	1	1.5	
TU 2	STR. VIII	Canidae			1	0.0	1	1.5	
TU 2	STR. VIII	Cervidae	*Odocoileus*	*virginianus*	3	0.1	1	1.5	
TU 2	STR. VIII	Mammalia			30	1.2	1	1.5	
TU 2	STR. VIII	Aves			1	0.0	1	1.5	
TU 2	STR. VIII	Kinosternidae			1	0.0	1	1.5	
TU 2	STR. VIII	Emydidae	*Pseudemys/Trachemys spp.*		1	0.0	1	1.5	
TU 2	STR. VIII	Emydidae	*Terrapene*	*carolina*	2	0.1	1	1.5	
TU 2	STR. VIII	Trionychidae	*Apalone*	*ferox*	5	0.2	1	1.5	
TU 2	STR. VIII	Testudines			39	1.6	2	3.1	
TU 2	STR. VIII	Colubridae			2	0.1	1	1.5	
TU 2	STR. VIII	Viperidae			1	0.0	1	1.5	
TU 2	STR. VIII	Serpentes			3	0.1		0.0	
TU 2	STR. VIII	Sirenidae	*Siren spp.*		1	0.0	1	1.5	
TU 2	STR. VIII	Rep./Amphib.			4	0.2		0.0	
TU 2	STR. VIII	Lepisosteidae	*Lepisosteus spp.*		32	1.3	2	3.1	

PROV	STRATUM	FAMILY	*GENUS*	*SPECIES*	NISP	%NISP	MNI	%MNI	NOTES
TU 2	STR. VIII	Amiidae	*Amia*	*calva*	25	1.0	2	3.1	
TU 2	STR. VIII	Cyprinidae	*Notemigonus*	*crysoleucas*	63	2.6	3	4.6	
TU 2	STR. VIII	Clupeidae			15	0.6	2	3.1	
TU 2	STR. VIII	Catostomidae	*Erimyzon*	*sucetta*	22	0.9	2	3.1	
TU 2	STR. VIII	Ictaluridae	*Ameiurus/Ictalurus spp.*		22	0.9	3	4.6	
TU 2	STR. VIII	Esocidae	*Esox spp.*		7	0.3	3	4.6	
TU 2	STR. VIII	Centrarchidae	*Lepomis spp.*		28	1.2	20	30.8	
TU 2	STR. VIII	Centrarchidae	*Lepomis*	*microlophus*	7	0.3	1	1.5	
TU 2	STR. VIII	Centrarchidae	*Micropterus*	*salmoides*	8	0.3	4	6.2	
TU 2	STR. VIII	Centrarchidae	*Pomoxis*	*nigromaculatus*	4	0.2	4	6.2	
TU 2	STR. VIII	Centrarchidae			303	12.5	2	3.1	
TU 2	STR. VIII	Mugilidae	*Mugil spp.*		2	0.1	1	1.5	
TU 2	STR. VIII	Osteichthyes			1322	54.7		0.0	
TU 2	STR. VIII	UID Vertebrata			459	19.0		0.0	
TU 2	STR. VIII	Total			2416	100.0	65	100.0	
TU 2	STR. IX	Cricetidae			4	0.2	1	3.0	
TU 2	STR. IX	Rodentia			1	0.1		0.0	
TU 2	STR. IX	Cervidae	*Odocoileus*	*virginianus*	3	0.2	1	3.0	
TU 2	STR. IX	Mammalia			31	1.7		0.0	2 pieces articulate
TU 2	STR. IX	Aves			2	0.1		0.0	
TU 2	STR. IX	Chelydridae	*Chelydra*	*serpentina*	3	0.2	1	3.0	
TU 2	STR. IX	Testudines			70	3.8	1	3.0	Cf. vert w/ Chelydra serpentina
TU 2	STR. IX	Viperidae			2	0.1	1	3.0	
TU 2	STR. IX	Serpentes			24	1.3		0.0	
TU 2	STR. IX	Caudata			1	0.1	1	3.0	
TU 2	STR. IX	Anura			1	0.1	1	3.0	
TU 2	STR. IX	Rep./Amphib.			1	0.1	1	3.0	
TU 2	STR. IX	Lepisosteidae	*Lepisosteus spp.*		25	1.3	1	3.0	
TU 2	STR. IX	Amiidae	*Amia*	*calva*	18	1.0	1	3.0	
TU 2	STR. IX	Cyprinidae	*Notemigonus*	*crysoleucas*	30	1.6	2	6.1	axes
TU 2	STR. IX	Clupeidae			6	0.3	3	9.1	atlases
TU 2	STR. IX	Catostomidae	*Erimyzon*	*sucetta*	8	0.4	1	3.0	
TU 2	STR. IX	Ictaluridae	*Ameiurus/Ictalurus spp.*		13	0.7	3	9.1	comparison of quadrates to pectoral spine
TU 2	STR. IX	Esocidae	*Esox spp.*		5	0.3	1	3.0	
TU 2	STR. IX	Centrarchidae	*Lepomis spp.*		12	0.6	3	9.1	atlases
TU 2	STR. IX	Centrarchidae	*Lepomis*	*microlophus*	17	0.9	3	9.1	
TU 2	STR. IX	Centrarchidae	*Micropterus*	*salmoides*	5	0.3	3	9.1	vomers
TU 2	STR. IX	Centrarchidae			147	7.9	3	9.1	vomers

PROV	STRATUM	FAMILY	*GENUS*	*SPECIES*	NISP	%NISP	MNI	%MNI	NOTES
TU 2	STR. IX	Mugilidae	*Mugil spp.*		1	0.1	1	3.0	
TU 2	STR. IX	Osteichthyes			945	50.9		0.0	
TU 2	STR. IX	Vertebrata			482	26.0		0.0	
TU 2	STR. IX	Total			1857	100.0	33	100.0	
TU 2	STR. Xa	Rodentia			2	0.1	1	3.7	
TU 2	STR. Xa	Cervidae	*Odocoileus*	*virginianus*	1	0.1	1	3.7	
TU 2	STR. Xa	Mammalia			36	2.5		0.0	
TU 2	STR. Xa	Aves			2	0.1	1	3.7	
TU 2	STR. Xa	Chelydridae	*Chelydra*	*serpentina*	4	0.3	1	3.7	
TU 2	STR. Xa	Kinosternidae			1	0.1	1	3.7	
TU 2	STR. Xa	Testudines			100	7.0		0.0	
TU 2	STR. Xa	Alligatoridae	*Alligator*	*mississippiensis*	1	0.1	1	3.7	
TU 2	STR. Xa	Serpentes			14	1.0	1	3.7	
TU 2	STR. Xa	Lepisosteidae	*Lepisosteus spp.*		32	2.2	1	3.7	
TU 2	STR. Xa	Amiidae	*Amia*	*calva*	10	0.7	1	3.7	
TU 2	STR. Xa	Cyprinidae	*Notemigonus*	*crysoleucas*	14	1.0	1	3.7	
TU 2	STR. Xa	Catostomidae	*Erimyzon*	*sucetta*	11	0.8	2	7.4	articulars
TU 2	STR. Xa	Ictaluridae	*Ameiurus/Ictalurus spp.*		4	0.3	3	11.1	comparison of atlases to quadrate
TU 2	STR. Xa	Esocidae	*Esox spp.*		1	0.1	1	3.7	
TU 2	STR. Xa	Centrarchidae	*Lepomis spp.*		9	0.6	5	18.5	atlases
TU 2	STR. Xa	Centrarchidae	*Lepomis*	*microlophus*	7	0.5	1	3.7	grinder
TU 2	STR. Xa	Centrarchidae	*Micropterus*	*salmoides*	1	0.1	1	3.7	
TU 2	STR. Xa	Centrarchidae			131	9.1	4	14.8	basios
TU 2	STR. Xa	Osteichthyes			456	31.8		0.0	
TU 2	STR. Xa	Vertebrata			595	41.6		0.0	
TU 2	STR. Xa	Total			1432	100.0	27	100.0	
TU 2	STR. Xb	Leporidae	*Sylvilagus spp.*		1	0.1	1	2.9	
TU 2	STR. Xb	Cervidae	*Odocoileus*	*virginianus*	4	0.3	1	2.9	probably from previous level
TU 2	STR. Xb	Mammalia			20	1.6	1	2.9	tooth fragment from a carnivore
TU 2	STR. Xb	Anatidae			1	0.1	1	2.9	
TU 2	STR. Xb	Aves			1	0.1		0.0	Most likely Anatidae
TU 2	STR. Xb	Kinosternidae			2	0.2	1	2.9	probably same from previous level
TU 2	STR. Xb	Trionychidae	*Apalone*	*ferox*	2	0.2	1	2.9	
TU 2	STR. Xb	Testudines			40	3.2		0.0	
TU 2	STR. Xb	Colubridae			1	0.1	1	2.9	
TU 2	STR. Xb	Viperidae			2	0.2	1	2.9	they articulate
TU 2	STR. Xb	Serpentes			17	1.3		0.0	

PROV	STRATUM	FAMILY	*GENUS*	*SPECIES*	NISP	%NISP	MNI	%MNI	NOTES
TU 2	STR. Xb	Lepisosteidae	*Lepisosteus spp.*		40	3.2	1	2.9	
TU 2	STR. Xb	Amiidae	*Amia*	*calva*	8	0.6	1	2.9	
TU 2	STR. Xb	Cyprinidae	*Notemigonus*	*crysoleucas*	2	0.2	1	2.9	
TU 2	STR. Xb	Clupeidae			3	0.2	1	2.9	
TU 2	STR. Xb	Catostomidae	*Erimyzon*	*sucetta*	11	0.9	2	5.9	right articulars
TU 2	STR. Xb	Ictaluridae	*Ameiurus/Ictalurus spp.*		14	1.1	3	8.8	dentaries and comp. to pectoral spine-- one atlas as well
TU 2	STR. Xb	Esocidae	*Esox spp.*		2	0.2	1	2.9	same as previous level
TU 2	STR. Xb	Centrarchidae	*Lepomis spp.*		12	0.9	5	14.7	atlases
TU 2	STR. Xb	Centrarchidae	*Lepomis*	*microlophus*	10	0.8	2	5.9	comparison of grinders
TU 2	STR. Xb	Centrarchidae	*Micropterus*	*salmoides*	3	0.2	2	5.9	comparison of vomer to atlas
TU 2	STR. Xb	Centrarchidae	*Pomoxis*	*nigromaculatus*	2	0.2	1	2.9	
TU 2	STR. Xb	Centrarchidae			129	10.2	6	17.6	atlases
TU 2	STR. Xb	Osteichthyes			585	46.1		0.0	
TU 2	STR. Xb	Vertebrata			356	28.1		0.0	
TU 2	STR. Xb	Total			1268	100.0	34	100.0	
TU 2	STR. X	Rodentia			2	0.1	1	2.0	
TU 2	STR. X	Leporidae	*Sylvilagus spp.*		1	0.0	1	2.0	
TU 2	STR. X	Cervidae	*Odocoileus*	*virginianus*	5	0.2	1	2.0	
TU 2	STR. X	Mammalia			53	2.0	1	2.0	
TU 2	STR. X	Anatidae			1	0.0	1	2.0	
TU 2	STR. X	Aves			3	0.1		0.0	
TU 2	STR. X	Chelydridae	*Chelydra*	*serpentina*	4	0.2	1	2.0	
TU 2	STR. X	Kinosternidae			3	0.1	1	2.0	
TU 2	STR. X	Trionychidae	*Apalone*	*ferox*	2	0.1	1	2.0	
TU 2	STR. X	Testudines			137	5.2		0.0	
TU 2	STR. X	Colubridae			1	0.0	1	2.0	
TU 2	STR. X	Viperidae			2	0.1	1	2.0	
TU 2	STR. X	Serpentes			31	1.2	1	2.0	
TU 2	STR. X	Lepisosteidae	*Lepisosteus spp.*		72	2.7	2	3.9	
TU 2	STR. X	Amiidae	*Amia*	*calva*	18	0.7	1	2.0	
TU 2	STR. X	Cyprinidae	*Notemigonus*	*crysoleucas*	16	0.6	1	2.0	
TU 2	STR. X	Clupeidae			3	0.1	1	2.0	
TU 2	STR. X	Catostomidae	*Erimyzon*	*sucetta*	22	0.8	4	7.8	
TU 2	STR. X	Ictaluridae	*Ameiurus/Ictalurus spp.*		18	0.7	5	9.8	
TU 2	STR. X	Esocidae	*Esox spp.*		3	0.1	1	2.0	
TU 2	STR. X	Centrarchidae	*Lepomis spp.*		21	0.8	10	19.6	
TU 2	STR. X	Centrarchidae	*Lepomis*	*microlophus*	17	0.6	2	3.9	
TU 2	STR. X	Centrarchidae	*Micropterus*	*salmoides*	4	0.2	2	3.9	

PROV	STRATUM	FAMILY	*GENUS*	*SPECIES*	NISP	%NISP	MNI	%MNI	NOTES
TU 2	STR. X	Centrarchidae	*Pomoxis*	*nigromaculatus*	2	0.1	1	2.0	
TU 2	STR. X	Centrarchidae			257	9.7	10	19.6	
TU 2	STR. X	Osteichthyes			1029	39.0		0.0	
TU 2	STR. X	Vertebrata			914	34.6		0.0	
TU 2	STR. X	Total			2641	100.0	51	100.0	
TU 2	STR. XIa	Canidae	*Urocyon*	*cinereoargenteus*	1	0.2	1	4.5	
TU 2	STR. XIa	Mammalia			8	1.4		0.0	
TU 2	STR. XIa	Anatidae			2	0.3	1	4.5	
TU 2	STR. XIa	Aves			1	0.2		0.0	
TU 2	STR. XIa	Trionychidae	*Apalone*	*ferox*	1	0.2	1	4.5	
TU 2	STR. XIa	Testudines			4	0.7		0.0	cf. vert with Chelydra serpentina
TU 2	STR. XIa	Colubridae			2	0.3	1	4.5	
TU 2	STR. XIa	Serpentes			2	0.3		0.0	
TU 2	STR. XIa	Lepisosteidae	*Lepisosteus spp.*		8	1.4	1	4.5	
TU 2	STR. XIa	Amiidae	*Amia*	*calva*	4	0.7	2	9.1	comparison of atlas to vertebra
TU 2	STR. XIa	Cyprinidae	*Notemigonus*	*crysoleucas*	8	1.4	2	9.1	2 ultimates
TU 2	STR. XIa	Catostomidae	*Erimyzon*	*sucetta*	7	1.2	3	13.6	cleithrums
TU 2	STR. XIa	Ictaluridae	*Ameiurus/Ictalurus spp.*		1	0.2	1	4.5	
TU 2	STR. XIa	Esocidae	*Esox spp.*		1	0.2	1	4.5	
TU 2	STR. XIa	Centrarchidae	*Lepomis spp.*		7	1.2	3	13.6	atlases
TU 2	STR. XIa	Centrarchidae	*Lepomis*	*microlophus*	8	1.4	2	9.1	comparison of grinders
TU 2	STR. XIa	Centrarchidae	*Micropterus*	*salmoides*	2	0.3	1	4.5	
TU 2	STR. XIa	Centrarchidae			41	7.1	2	9.1	atlas--cf. one with P. nigromaculatus and Lepomis
TU 2	STR. XIa	Osteichthyes			288	49.9		0.0	
TU 2	STR. XIa	Vertebrata			181	31.4		0.0	
TU 2	STR. XIa	Total			577	100.0	22	100.0	
TU 2	STR. XIb	Cricetidae			1	0.1	1	3.6	
TU 2	STR. XIb	Rodentia			1	0.1		0.0	
TU 2	STR. XIb	Procyonidae	*Procyon*	*lotor*	1	0.1	1	3.6	
TU 2	STR. XIb	Cervidae	*Odocoileus*	*virginianus*	1	0.1	1	3.6	
TU 2	STR. XIb	Mammalia			19	2.3		0.0	9 of these are worked
TU 2	STR. XIb	Chelydridae	*Chelydra*	*serpentina*	1	0.1	1	3.6	
TU 2	STR. XIb	Testudines			21	2.6	2	7.1	probably Kinosternidae and Chelydra
TU 2	STR. XIb	Serpentes			1	0.1	1	3.6	
TU 2	STR. XIb	Sirenidae	*Siren spp.*		2	0.2	1	3.6	
TU 2	STR. XIb	Amphiumidae	*Amphiuma*	*means*	1	0.1	1	3.6	
TU 2	STR. XIb	Anura			1	0.1	1	3.6	

PROV	STRATUM	FAMILY	*GENUS*	*SPECIES*	NISP	%NISP	MNI	%MNI	NOTES
TU 2	STR. XIb	Anguillidae	*Anguilla*	*rostrata*	1	0.1	1	3.6	
TU 2	STR. XIb	Lepisosteidae	*Lepisosteus spp.*		11	1.4	1	3.6	
TU 2	STR. XIb	Amiidae	*Amia*	*calva*	7	0.9	1	3.6	might belong to the previous level
TU 2	STR. XIb	Cyprinidae	*Notemigonus*	*crysoleucas*	16	2.0	2	7.1	axes
TU 2	STR. XIb	Clupeidae			6	0.7	1	3.6	
TU 2	STR. XIb	Catostomidae	*Erimyzon*	*sucetta*	7	0.9	2	7.1	supraoccipitals
TU 2	STR. XIb	Ictaluridae	*Ameiurus/Ictalurus spp.*		2	0.2	1	3.6	probably from previous level
TU 2	STR. XIb	Centrarchidae	*Lepomis spp.*		7	0.9	2	7.1	atlases
TU 2	STR. XIb	Centrarchidae	*Lepomis*	*microlophus*	1	0.1	1	3.6	probably from previous level
TU 2	STR. XIb	Centrarchidae	*Micropterus*	*salmoides*	5	0.6	3	10.7	comp. of premax to dentary--premax prob. w/prev. lev.
TU 2	STR. XIb	Centrarchidae			68	8.4	3	10.7	atlases
TU 2	STR. XIb	Osteichthyes			411	50.8		0.0	
TU 2	STR. XIb	Vertebrata			217	26.8		0.0	
TU 2	STR. XIb	Total			808	99.9	27	96.4	
TU 2	STR. XI	Cricetidae			1	0.1	1		
TU 2	STR. XI	Rodentia			1	0.1		0.0	
TU 2	STR. XI	Procyonidae	*Procyon*	*lotor*	1	0.1	1	2.5	
TU 2	STR. XI	Canidae	*Urocyon*	*cinereoargenteus*	1	0.1	1	2.5	
TU 2	STR. XI	Cervidae	*Odocoileus*	*virginianus*	1	0.1	1	2.5	
TU 2	STR. XI	Mammalia			27	2.0		0.0	
TU 2	STR. XI	Anatidae			2	0.1	1	2.5	
TU 2	STR. XI	Aves			1	0.1		0.0	
TU 2	STR. XI	Chelydridae	*Chelydra*	*serpentina*	1	0.1	1	2.5	
TU 2	STR. XI	Trionychidae	*Apalone*	*ferox*	1	0.1	1	2.5	
TU 2	STR. XI	Testudines			25	1.8	1	2.5	
TU 2	STR. XI	Colubridae			2	0.1	1	2.5	
TU 2	STR. XI	Serpentes			3	0.2		0.0	
TU 2	STR. XI	Sirenidae	*Siren spp.*		2	0.1	1	2.5	
TU 2	STR. XI	Amphiumidae	*Amphiuma*	*means*	1	0.1	1	2.5	
TU 2	STR. XI	Anura			1	0.1	1	2.5	
TU 2	STR. XI	Anguillidae	*Anguilla*	*rostrata*	1	0.1	1	2.5	
TU 2	STR. XI	Lepisosteidae	*Lepisosteus spp.*		19	1.4	1	2.5	
TU 2	STR. XI	Amiidae	*Amia*	*calva*	11	0.8	2	5.0	
TU 2	STR. XI	Cyprinidae	*Notemigonus*	*crysoleucas*	24	1.7	3	7.5	
TU 2	STR. XI	Clupeidae			6	0.4	1	2.5	
TU 2	STR. XI	Catostomidae	*Erimyzon*	*sucetta*	14	1.0	3	7.5	
TU 2	STR. XI	Ictaluridae	*Ameiurus/Ictalurus spp.*		3	0.2	1	2.5	
TU 2	STR. XI	Esocidae	*Esox spp.*		1	0.1	1	2.5	

PROV	STRATUM	FAMILY	*GENUS*	*SPECIES*	NISP	%NISP	MNI	%MNI	NOTES
TU 2	STR. XI	Centrarchidae	*Lepomis spp.*		14	1.0	5	12.5	
TU 2	STR. XI	Centrarchidae	*Lepomis*	*microlophus*	9	0.7	2	5.0	
TU 2	STR. XI	Centrarchidae	*Micropterus*	*salmoides*	7	0.5	3	7.5	
TU 2	STR. XI	Centrarchidae			109	7.9	5	12.5	
TU 2	STR. XI	Osteichthyes			696	50.3		0.0	
TU 2	STR. XI	Vertebrata			398	28.8		0.0	
TU 2	STR. XI	Total			1382	99.9	39	97.5	

APPENDIX C
RADIOCARBON DATA

Prov.	Material	Beta Lab Number	Measured 14C Age BP	13C/12C Ratio	Conventional 14C Age BP	2-sigma Cal BC	2-sigma Cal BP
8VO43							
TU2-Level E	nutshell	145694	3500 ± 70	-24.9	3510 ± 70	2020-1670	3970-3620
TU2-Level K	charcoal	145695	3720 ± 40	-24.3	3730 ± 40	2265-2260 2220-2020	4215-4210 4170-3970
TU4-Feat. 7	charcoal	164962	3790 ± 50	-25.4	3780 ± 50	2340-2040	4290-3990
TU5 140-150 cm BS	charcoal	164963	4210 ± 50	-25.3	4210 ± 50	2900-2630	4860-4580
TU1-Level M	charcoal	145693	4360 ± 120	-24.9	4360 ± 120	3360-2830 2830-2650	5310-4780 4780-4600
8VO43-WWTA							
TU1-Level I	charcoal	145696	170 ± 50	-27.0	140 ± 50	(Cal AD) 1660-1950	290-0
8VO41							
LP1A- Str. XIII	charcoal	164961	6260 ± 50	-24.9	6260 ± 50	5320-5060	7270-7010