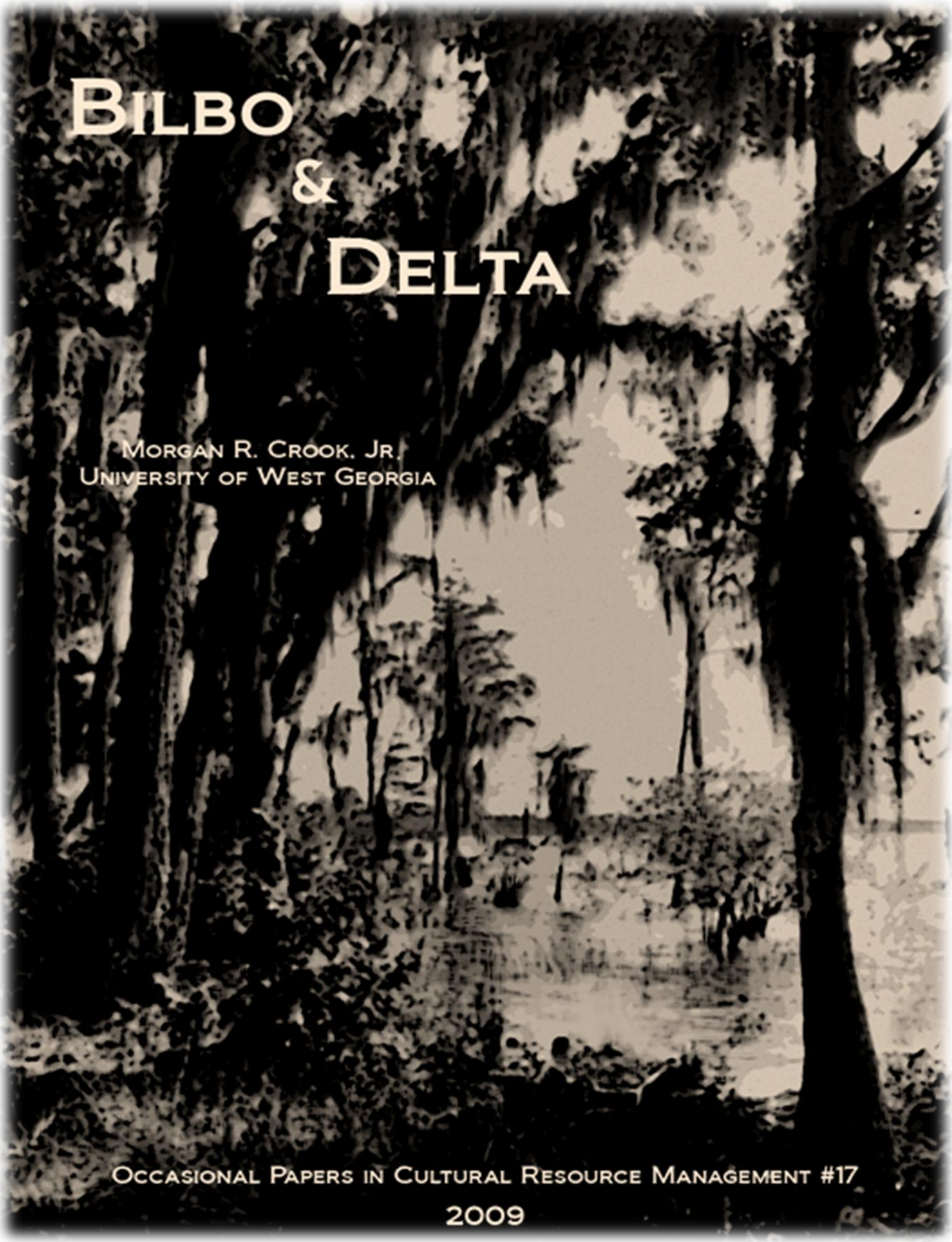

Bilbo & Delta

Morgan R. Crook, Jr.
University of West Georgia

Occasional Papers in Cultural Resource Management #17
2009

BILBO (9CH4) AND DELTA (38JA23):
LATE ARCHAIC AND EARLY WOODLAND SHELL MOUNDS AT THE MOUTH OF THE SAVANNAH RIVER

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June 2009

Georgia Department of Transportation
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Preface

Archaeological investigations at the Bilbo site (9CH4) were undertaken in 2001 by students from the University of West Georgia (UWG) under the direction of Principal Investigator Dr. Morgan R. (Ray) Crook, Jr. to assess the existing archaeological deposits in terms of integrity and impacts from looting and intentional site vandalism. During the work, the Georgia Department of Transportation (GDOT) facilitated Ray's activities with the City of Savannah and provided assistance in any way possible. GDOT's ongoing interest in the Bilbo site dates back to the 1980's, when Bilbo, and the ultimate avoidance of the site, played a large role in the final design and location of the Harry S. Truman Parkway in Chatham County. As part of GDOT's work in the 1980's, steps were taken to curtail ongoing looting that had negatively impacted the archaeological deposits at the Bilbo site. So it was with open arms that GDOT supported UWG's 2001 investigation. The 2001 study results provide a baseline for evaluating the integrity of the Bilbo site's archaeological deposits. But as successful as the study was, it demonstrated a void in archaeological knowledge and models about the Shell Mound Archaic on the Georgia coast.

It is against this backdrop, that the GDOT sponsored two field seasons (2006 and 2007) of archaeological investigation at the Delta site (38JA23) in South Carolina (located on property owned by GDOT), again utilizing students from UWG under the direction of Ray. The goals of the study were two-fold. First, archaeological investigations were to provide an evaluation of the site's integrity in terms of National Register of Historic Places (NRHP) eligibility, heretofore unknown by GDOT, and secondly to provide an examination of the historical ecology associated with the Shell Mound Archaic as it relates to firm archaeological context. The archaeological fieldwork conducted by the UWG team reflected creativity, ingenuity, and persistence in difficult field conditions. The study results equaled the methodology in intellectual vigor and produced data that provide a foundation for understanding cultural lifeways and environmental adaptation during the late Mid-Holocene on the Georgia coast. As with any good academic endeavor, the investigation of this NRHP eligible historic property generated further research avenues that need to be explored for a better understanding of the Shell Mound Archaic.

The study also produced several fulfilling side bars for GDOT that must be addressed. First, the study included extensive coordination with federally recognized tribal governments. While many researchers and academics shy away from this duty, the responsibility for consultation has always been of paramount importance to the GDOT. With consultation comes understanding and new life experiences with our Native American partners, and the following project was no exception. Secondly, GDOT has a long tradition of supporting archaeological education and activities, especially those with a purpose to advance the careers of future archaeologists. All the work presented in this report was completed as part of field school training and education for undergraduate and graduate students from the University of West Georgia. The partnership between the GDOT and UWG in creating training opportunities for aspiring archaeologists has many years behind it, but has never been more satisfying than in the present.

The Georgia Department of Transportation is proud to publish "Bilbo (9CH4) and Delta (38JA23): Late Archaic and Early Woodland Shell Mounds at the Mouth of the Savannah River" as Report Number 17 in its Occasional Papers in Cultural Resource Management series.

Eric Duff
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Introduction

This report* summarizes the results of archaeological investigations, conducted as archaeological field schools through the University of West Georgia, at two prehistoric Native American sites located at the mouth of the Savannah River, 21km from the Atlantic Ocean. These projects were undertaken with two interconnected goals. As part of the undergraduate curriculum for anthropology majors, student training in basic archaeological field methods was seen as an important component. Only through directed fieldwork can students achieve an understanding of the processes involved in the discovery, recovery, and interpretation of new information. The archaeological sites themselves, however, were of paramount importance and the field research was designed to address basic questions about the archaeological record of each site. The training of undergraduate students, both in the field and in the laboratory, was simply one element of the research design.

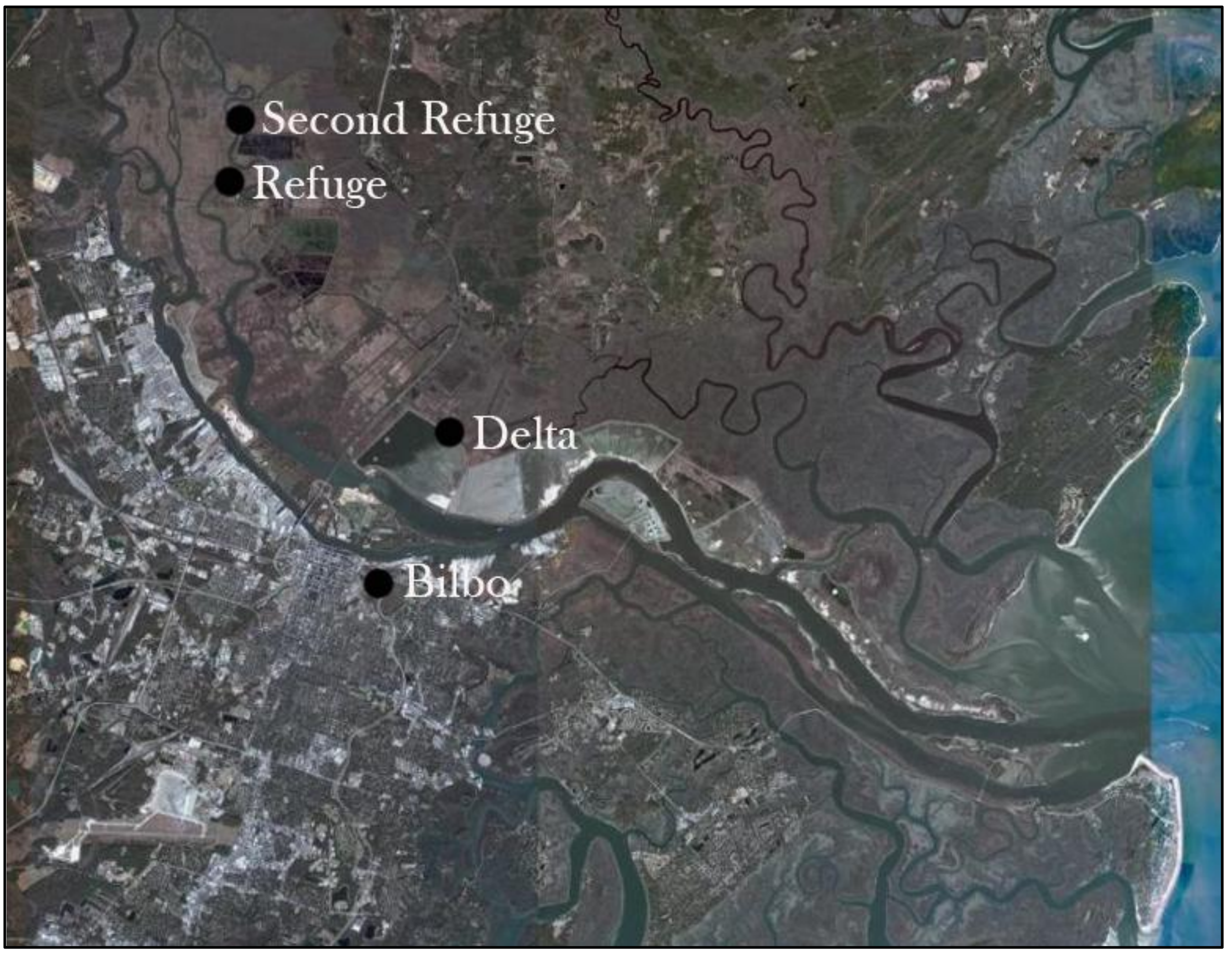

Figure 1. Satellite Image of the Lower Savannah River showing the Locations of the Bilbo, Delta, Refuge, and Second Refuge Archaeological Sites (adapted from GoogleEarth 2005).

*The information contained in this report is taken in part, with corrections and modifications, from previously published material (see Crook 2003 and Crook 2007).

The first project, undertaken with the assistance of eight students for three weeks during the summer of 2001, focused on mapping and testing at the Bilbo site (9CH4) on the Georgia side of the river. The second field school, undertaken with seven students over an eleven-day period during the spring of 2006, concentrated on mapping and limited testing at the Delta site (38JA23) on the South Carolina side of the river some 5km northeast of the Bilbo site. Additional field work was undertaken at the Delta site for ten days during August 2007 with the assistance of three students. The location of each site, along with two others of immediate relevance in the same locality, is shown in Figure 1.

The Savannah is a large river with a watershed which begins in the foothills of the Appalachians. Tidal actions, freshwater flows, and salinity levels combine to create three major environmental zones in the lower Savannah River and its delta, beginning where the river empties into the Atlantic Ocean at Tybee Island and extending more than 45km upstream: tidal salt marsh, tidal freshwater marsh, and tidal freshwater swamp. During tidal cycles sediment loads in the river are alternately eroded, deposited, resuspended, and then sorted by tidal ebbs and flows. Coarser materials are deposited within the lower reaches of the river and into the ocean, while finer sands and clay-sized particles are deposited upstream and in the wetlands. River levels fluctuate in response to tides as well as freshwater inflows. A saltwater wedge enters the river with advancing tides and can increase the river level to heights above the high tide level at the ocean, resulting in upstream flow reversals. Changes in river levels also are a result of seasonally varying freshwater discharges from the watershed, with higher than normal water levels from January through April and lower water levels from May through December (e.g. Duberstein and Kitchens 2007; Levin et al. 2001; Wiegert et al. 1999).

Landscapes all along the course of the Savannah River, including those habitats at the mouth of the river, are very dynamic and have changed substantially over time. Many factors, both anthropogenic and natural, are responsible for these modifications and must be considered when interpreting the archaeological record. The first detailed cartography of the area (Figure 2), produced in 1757 by William de Brahm, shows features of the early city of Savannah and also that a freshwater tidal wetland dominated a large low-lying floodplain north of the river. The character of this wetland appears to be generically indicated by marsh symbols. As Savannah began to develop as a port and market center, additional modifications soon occurred. By 1780 fortifications, roads, dikes, and fields for rice cultivation are shown in and near Savannah. A small road also appears to have been constructed through the freshwater tidal wetland on the north side of the river, an area now depicted with symbols for marsh containing wooded patches or hammocks (Figure 3).

Changes in the local landscape accelerated through the next century as Savannah became a major commercial center and plantations developed along both sides of the river. A minimal amount of dredging also was undertaken and a navigation channel was opened to accommodate increasing harbor traffic as well as river traffic upstream to Augusta at the Fall Line. Rice production became a staple of the plantation economy. Employing slave labor and with high rates of mortality, the tidal freshwater wetlands, both marshes and cypress swamps, were cleared and drained with ditches or canals. Dikes then were constructed to confine rice fields, which were widespread along the mouth of the Savannah River (Figure 4).

Figure 2. 1757 Map showing Landscape and Approximate Locations of the Bilbo and Delta Sites. Adapted from *A Map of South Carolina and a Part of Georgia*, by William de Brahm. The British Library, London.

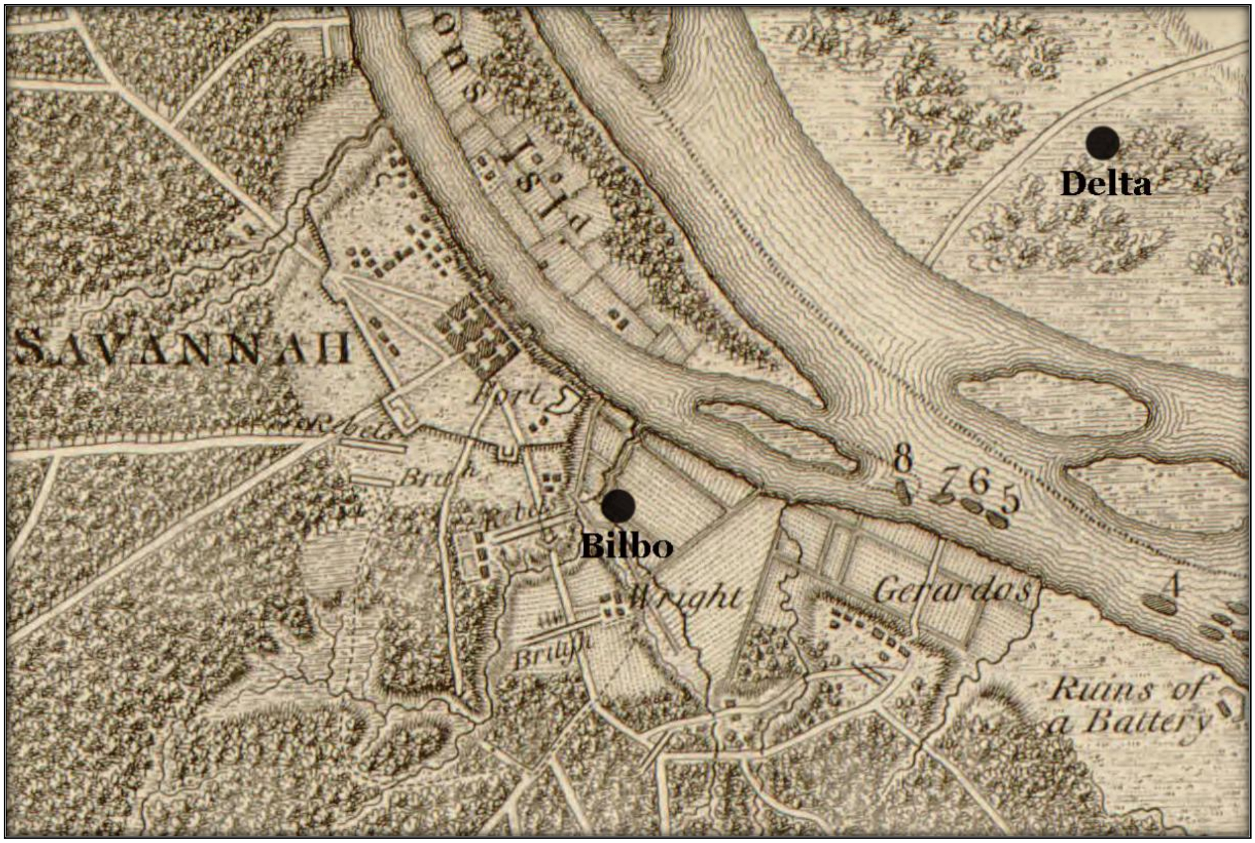

Figure 3. 1780 Map showing Landscape and Approximate Locations of the Bilbo and Delta Sites. Adapted from *Sketch of the northern frontiers of Georgia, extending from the mouth of the River Savannah to the town of Augusta*, by Archibald Campbell. Library of Congress Geography and Map Division, Washington, D.C.

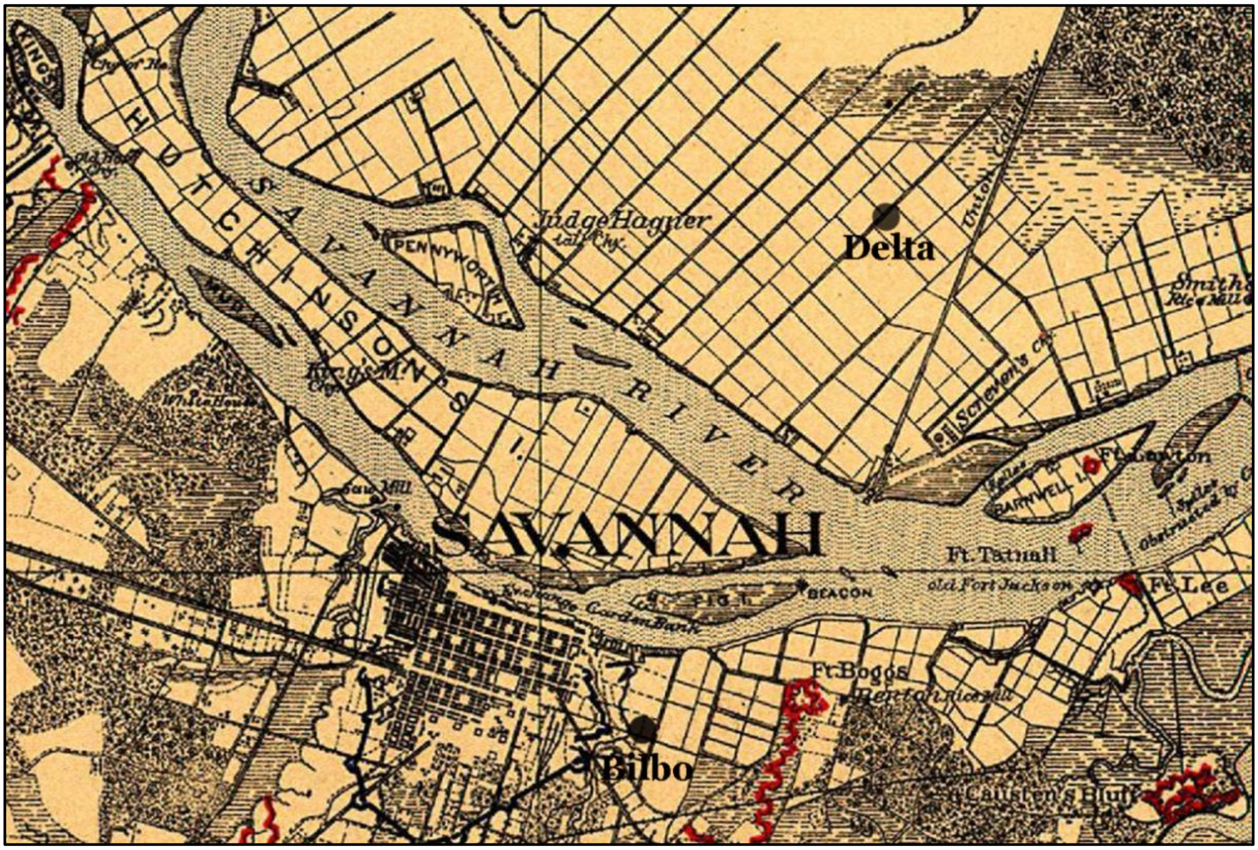

Figure 4. 1864 Map showing Landscape and Approximate Locations of the Bilbo and Delta Sites. Adapted from *Map illustrating the defence* [sic] *of Savannah, Ga. and the operations resulting in its capture by the army commanded by Maj. Genl. W.T. Sherman, Dec. 21st, 1864.* Library of Congress Geography and Map Division, Washington, D.C.

Other dramatic changes can be identified throughout the 20th century. Flow, sediment load, and flood plain were modified in all downstream locations by the construction of three large dams above the Fall Line. Dredging and channelization intensified downstream. As a result of its long history of modifications, the Savannah River now lacks vast vegetated flood plains in its freshwater tidal zone. The alterations also have led to an imbalance of fresh and salt water downstream in the estuarine system, affecting its fish and shellfish populations. Additional changes in the lower Savannah River were initiated around 1960 with dredging operations undertaken to afford unobstructed access to the port by large cargo ships. Since that time, about 300,000,000 cubic yards of dredged material covering 6271 acres have been deposited within the early rice fields and wetlands along the northern side of the river just south of and extending eastward from the Delta site. Today the U. S. Army Corps of Engineers dredges some 7 million cubic yards per year from the river channels, continually adding to the massive area of dredge spoil and creating one of the largest artificial earthen features in North America — imagine a football field piled 34 miles high with fill (John Phillips, Georgia Department of Transportation, 2009 Personal Communication). Refer to Figure 1 for a satellite view of the dredge spoil located south and east of the Delta site.

Millennia of Native American occupations preceded historical settlements at the mouth of the Savannah River, at a time prior to the large-scale anthropogenic landscape modifications noted above. Although certain refinements have been made, the prehistoric cultural chronology of this portion of the coast was basically established over 65 years ago with the pioneering work of Joseph R. Caldwell and Antonio J. Waring, Jr. at archaeological sites around the mouth of the Savannah River (Caldwell and Waring 1939a, 1939b). The early portion of this chronology is particularly important to the research reported here.

The St. Simons phase is associated with occupation of the coast during the Late Archaic period, extending from about 3,100 to 4,200 years ago. The early pottery vessels produced during this time are modeled, fiber-tempered wares, either plain or decorated with incised lines and punctations. Sites of the St. Simons phase include large, dense shell mounds and circular shell rings along with occasional smaller sites (see Waring 1977d; Ford 1966). Very similar assemblages also occur well upstream along the Savannah River, where it is referred to as the Stalling's Island phase (Fairbanks 1942; Sassaman 1993). Connected with complexly organized groups of fishers-hunters-gatherers, the St. Simons phase also defines what is called the Shell Mound Archaic of the Georgia and South Carolina coasts (Crusoe and DePratter 1976; DePratter 1979; Stoltman 1972).

The Refuge phase is less well known and understood but immediately follows the St. Simons phase, separating it from the later Deptford phase of the Woodland period. The few available radiocarbon dates indicate that the Refuge phase spanned a 700-year period between approximately 2,400 and 3,100 years B.P. Originally defined based on Waring's work at the Refuge site on the South Carolina side of the Savannah River (Waring 1977a, 1977b), his observations about the ceramic complex (dominated by coiled sand-tempered wares with simple-stamped surface treatments) were made after he and Caldwell had developed their basic ceramic chronology. In retrospect, Waring recognized that their chronology had lumped Refuge with later pottery of the Deptford complex. More recent research by DePratter (1976), as well as his reanalysis of materials from the W.P.A. (Works Projects Administration) excavations along the coast (DePratter 1991), has attempted to refine its definition and call attention to the importance of the Refuge phase within the chronology. Refuge phase materials are sometimes encountered in the upper or surface levels of St. Simons phase sites and also in dense shell mounds like the Refuge site where river mussels rather than oysters may dominate the shellfish content. A smaller type of site associated with Refuge phase ceramics is humic midden lacking significant shell content. Unrecognized Refuge phase components also likely exist in later Deptford phase sites, where pottery types common to both phases are difficult to segregate.

The importance of the Refuge phase is situated in the evidence it brings to bear on changed cultural adaptations and ecological conditions at the end of St. Simons phase and prior to the Deptford phase.

An understanding of these changes requires an examination of the historical ecology associated with the Shell Mound Archaic and its aftermath. It has become increasingly clear that the coastal environment during the late Mid-Holocene, from roughly 2,400 to 4,200 years ago, was subject to the effects of rising and falling sea levels (DePratter 1977; DePratter and Howard 1981). As more research into sea-level advances and retreats has been undertaken, both complimentary and contradictory evidence has accumulated, leading to an appreciation of inherent complexities and the need for continued research to further refine regional sea-level curves. However, there is little doubt that the period of the Shell Mound Archaic was bracketed by significant changes in sea level. Following a long period of stead rise during the previous 6,000 years, the rate of sea-level rise increased between 4,500 and 5,000 years ago (Scott, Gayes, and Collins 1995: 620), exhibited cycles of fluctuation (Colquhoun, Brooks, and Stone 1995), and began to flood the low, dry land west of the late Pleistocene barrier islands (Hoyt and Hails 1967). As these islands were isolated once again from the mainland (the intervening area had been inundated with developed salt marshes during periods of the Pleistocene), the low lands were flooded with saltwater and sediment loads, the existing vegetation perished, and a tidal marsh and lagoon system began to redevelop (see Delcourt and Delcourt 1991: 75). The earliest Holocene salt marsh in this newly submerged area, discovered at a location along the southwestern edge of St. Catherine's Island, has been radiocarbon dated to 4,060 +/- 50 years B.P. (shell, U.S.G.S. #WW1262) and provides a good indication of when marshlands developed after that island became isolated from the mainland (Booth, Rich, and Bishop 1999: 84). Sea level continued to rise, apparently in an oscillating manner, over the next 1,000 years to within some 1.0 – 1.5 meters below modern levels.

Important related changes occurred when rising sea level met and altered the flow of freshwater rivers. As sea level and tidal influences raised the water level in the rivers, flow velocity was reduced and sediment loads increased. This resulted in increased sedimentation along the flood plains and in the emerging estuarine delta. Meander channels along river courses developed and the deposited sediments created landforms that became tidal freshwater marshes and swamps (Colquhoun, Brooks, and Stone 1995: 194; Delcourt and Delcourt 1991: 75).

Today, estuaries along with tidal freshwater marshes and swamps are the most productive types of high-energy ecosystems (Dame *et al.* 2000; Odum 1969). Those of the late Mid-Holocene may have been even more dynamic and productive. According to ecological theories of succession in newly formed habitats, the development of ecosystems is somewhat predictable (Odum 1969; Odum 1971; see also Whittaker 2000). Species diversity is low and food chains are simple during the initial stages of colonization. Populations grow, more species are added, and the food chain becomes increasingly complex and web-like as the system develops. Gross production is highest during the growth and development stage of an ecosystem, reaching a maximum at its bloom stage. With climax conditions that usually follow the bloom stage, there is a reduction in gross production as the system becomes regulated with various feedback controls.

Progressive enrichment, or eutrophication, is a natural process during the early developmental stages of an ecosystem. There are relatively few species, but with high rates of growth and reproduction, in the early uncrowded stages of development. During the colonization stage, energy increases and entropy is low. Following initial colonization, growing interconnections develop among increasingly more organisms. Constituent species with lower rates of growth and reproduction, and complex relationships with predators and parasites, characterize the more stable climax stage of an ecosystem. Energy increases from early to bloom stages, then is regulated and actually declines with climax conditions.

The estuaries and freshwater tidal marshes/swamps would have been in their high-energy successional stages during much or perhaps all of the Shell Mound Archaic, offering abundant sets of potential subsistence resources. It is likely that these ecosystems never reached climax states during the period, but rather remained at high-energy levels or near their bloom stages because of oscillating sea levels (Morris, Kjerfve, and Dean 1990). This pre-climax phenomenon, known as "pulse stability," can maintain ecosystems such as marshes and swamps in their early fertile stages unless acute perturbations change too severely or suddenly (Odum 1969: 267-268).

As bountiful as the emergent coastal environment may have been, these conditions started to change around 3,100 years B.P., when sea level dropped as much as 4m to a temporary low-stand. The initial rate of this change may have been ecologically rapid, allowing little time for the establishment of new habitats and leading to a severe disruption of pulse stability in the coastal ecosystem. Large areas of tidal freshwater marsh and swamp were left dry and their associated food resources disappeared. Other areas within the saltwater marsh and lagoon system dried up as sea level retreated and rich estuarine fish and shellfish resources also began to vanish. This was evidently the environmental situation associated with end of the St. Simons phase and the beginning of the Refuge phase. Sea levels remained lower but also rebounded some during the Refuge phase, with intermittent fluctuations that would have resulted in a modulating boundary between revived estuarine and freshwater ecosystems. After a suspected second temporary low-stand at 2,400 years B.P. (at the end of the Refuge phase), sea level rebounded once again, beginning a long-term trend of slow and less erratic increase (at the beginning of the Deptford phase). Sea level reached an elevation about 50cm below modern levels by 500 years ago and subsequently continued to rise at an average rate of about 10cm per 100 years (Colquhoun and Brooks 1986; Colquhoun, Brooks, and Stone 1995; DePratter and Howard 1981; Scott, Gayes, and Collins 1995).

The Bilbo Site (9CH4)

The Bilbo site is a Late Archaic period shell mound primarily associated with occupations during the St. Simons phase. The site is located in a low, swampy area near the mouth of the Savannah River (Figures 5 and 6). The shell midden accumulation that defines the mound covers a roughly circular area of approximately 1200 square meters and extends as much as 80cm above the surrounding modern ground surface. The base of the midden deposit at its greatest depth is about 2m below the current ground surface. The midden contains well-preserved cultural remains that include stratigraphic evidence of the early production of plain fiber-tempered pottery followed by the addition of decorated (incised and punctated) fiber-tempered wares.

Figure 5. Central Area of the Bilbo Site (view to the north).

Figure 6. Satellite View of Modern Site Environment (from GoogleEarth, 2005).

Previous Research at the Bilbo Site

The Bilbo site first was investigated during the summer of 1939 as part of the Chatham County Archaeological Project of the W.P.A. under the general supervision of Joseph Caldwell. Antonio J. Waring, Jr. directed excavation at the site with a work-force of African American women from the Savannah area. Waring's research revealed a deep stratigraphic sequence that showed the transition of plain to decorated fiber-tempered pottery and a rich association of lithic and bone artifacts. The remains of a later Deptford occupation, along with a scattering of 19th and 20th century materials, were restricted to the upper levels of the site. The results of his investigation, including a detailed comparison of Bilbo with the Stallings Island site (located near the Fall Line along the Savannah River), were presented in 1940 at the Fifth Southeastern Archaeological Conference held in Baton Rouge, Louisiana and were posthumously published (in part) in 1968 by the Peabody Museum of Harvard University in *The Waring Papers: The Collected Works of Antonio J. Waring, Jr.* (Williams 1977a).

William G. Haag of Louisiana State University conducted additional excavation at the Bilbo site during the summer of 1957 as part of his Atlantic Coastal Survey Project (Figure 7). The focus of his research was to confirm the 1939 data and to also obtain new information for ecological analysis and radiocarbon dating. Haag relocated Waring's test trenches and excavated additional test units within the shell mound (Figure 8). Under Haag's direction, the materials were analyzed by David H. Dye and provided the basis of his M.A. thesis in 1976 (*The Bilbo Site Revisited: Archaeological Investigations from Chatham County, Georgia*). Dye's analysis confirmed many of Waring's observations, plus added new information about the paleoenvironmental context for occupations at the Bilbo site.

Figure 7. Aerial Photo of the Bilbo Site, circa 1957 (from Haag file, LSU Museum).

During the winter of 1991, Bob Entorf and others from the Georgia Department of Transportation relocated the Bilbo site as part of a Section 106 compliance survey along the construction route of the proposed Harry S. Truman Parkway. Their evaluation concluded that the site was eligible for inclusion in the National Register of Historic Places at a state level of significance and the alignment of the proposed parkway was shifted to avoid potential impact. As there was evidence that there had been and continued to be much unauthorized digging by vandals at the site, a preservation plan was developed that included enclosure of the site by a 6-foot chain-link fence topped with razor wire. Chatham County, which was buying the right-of-way for the Harry S. Truman Parkway, also purchased the adjacent parcel containing the Bilbo site and secured federal funding to build the protective fence. Subsequently the parcel was transferred to the City of Savannah, which now assumes management responsibility for the Bilbo site.

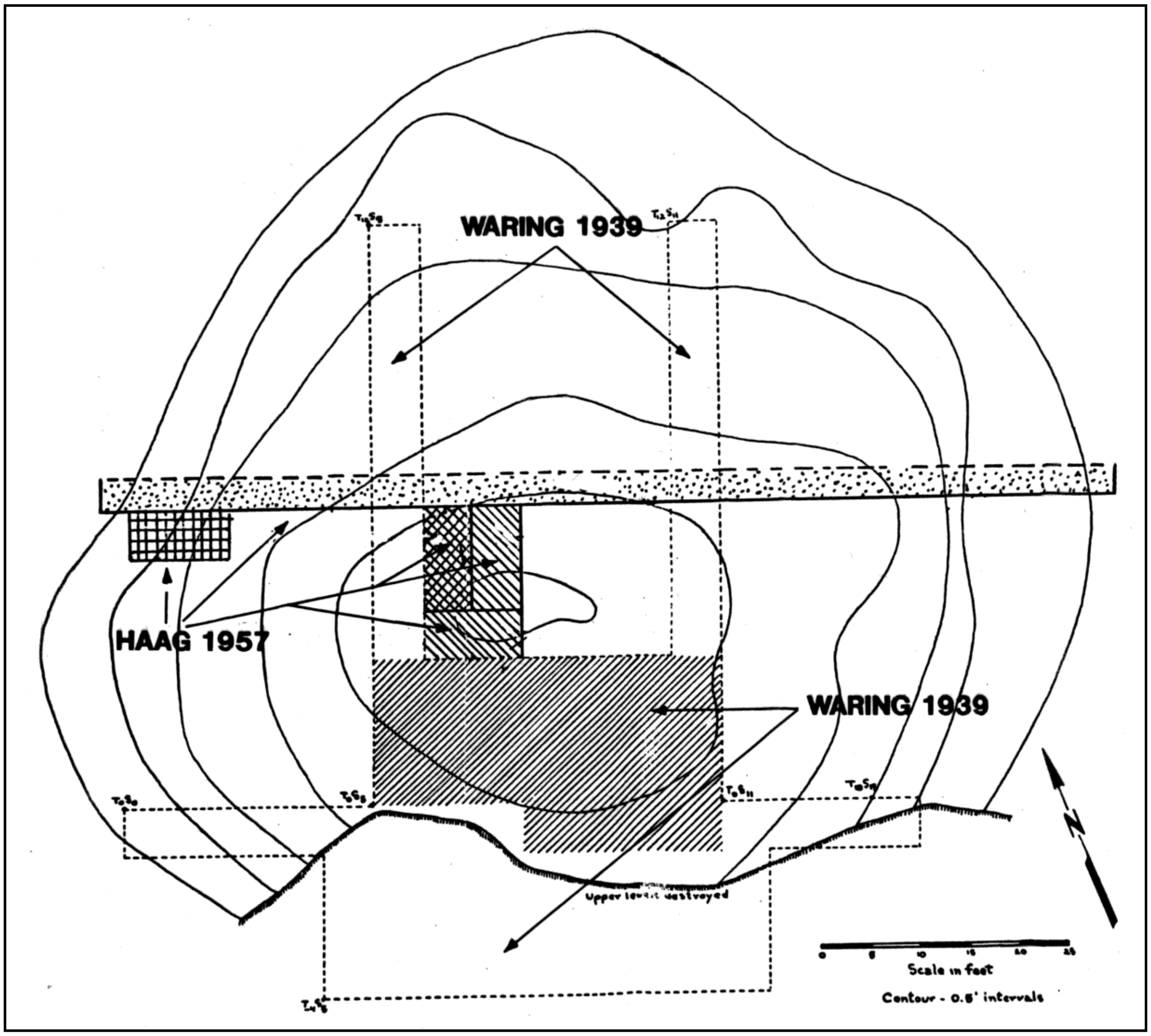

Figure 8. Haag's and Waring's Excavation Units Transposed over Waring's Topographic Map of the Bilbo Site (from Waring 1977c and Dye 1976).

2001 Investigations

Investigations resumed at the Bilbo site during the summer of 2001 for four weeks as part of an archaeological field school under the author's direction. The primary objectives of this fieldwork were to produce a new topographic map of the site, to record the extent of vandal disturbance, to fill existing vandal holes and restore the land surface, and also to conduct limited test excavation to determine if substantial intact subsurface cultural deposits survived at the site.

Topographic mapping was completed using an alidade and plane table. Distances were directly measured with a metric tape and elevations were taken with the alidade and metric stadia rod. A permanent bench mark was established along the southern side of the site and its elevation arbitrarily set at 3.00 meters.

The resulting map generally agrees with Waring's 1939 map in regard to the overall size and height of the shell mound (Figure 9). The drainage ditch and its associated spoil piles may have been constructed after Waring's excavation. Alternatively, however, it may be that Waring's magnetic north is inverted on the published map and that the area he noted as "upper levels destroyed" refers to disturbance from the drainage ditch. The remains of neither Waring's nor Haag's excavation units are evident on the modern landscape.

The 2001 base map also shows the locations of vandal holes and the protective chain-link fence. The 2001 test pits were aligned to Waring's and Haag's test-unit orientation (27 degrees east of magnetic north) and their numbering system was continued. Test Pits #12 and #13 are located off the midden deposit. All 2001 test pits are 1.5m x 1.5m squares except for Test Pit #16, the 1m x 2m unit excavated along the edge of Vandal Hole B.

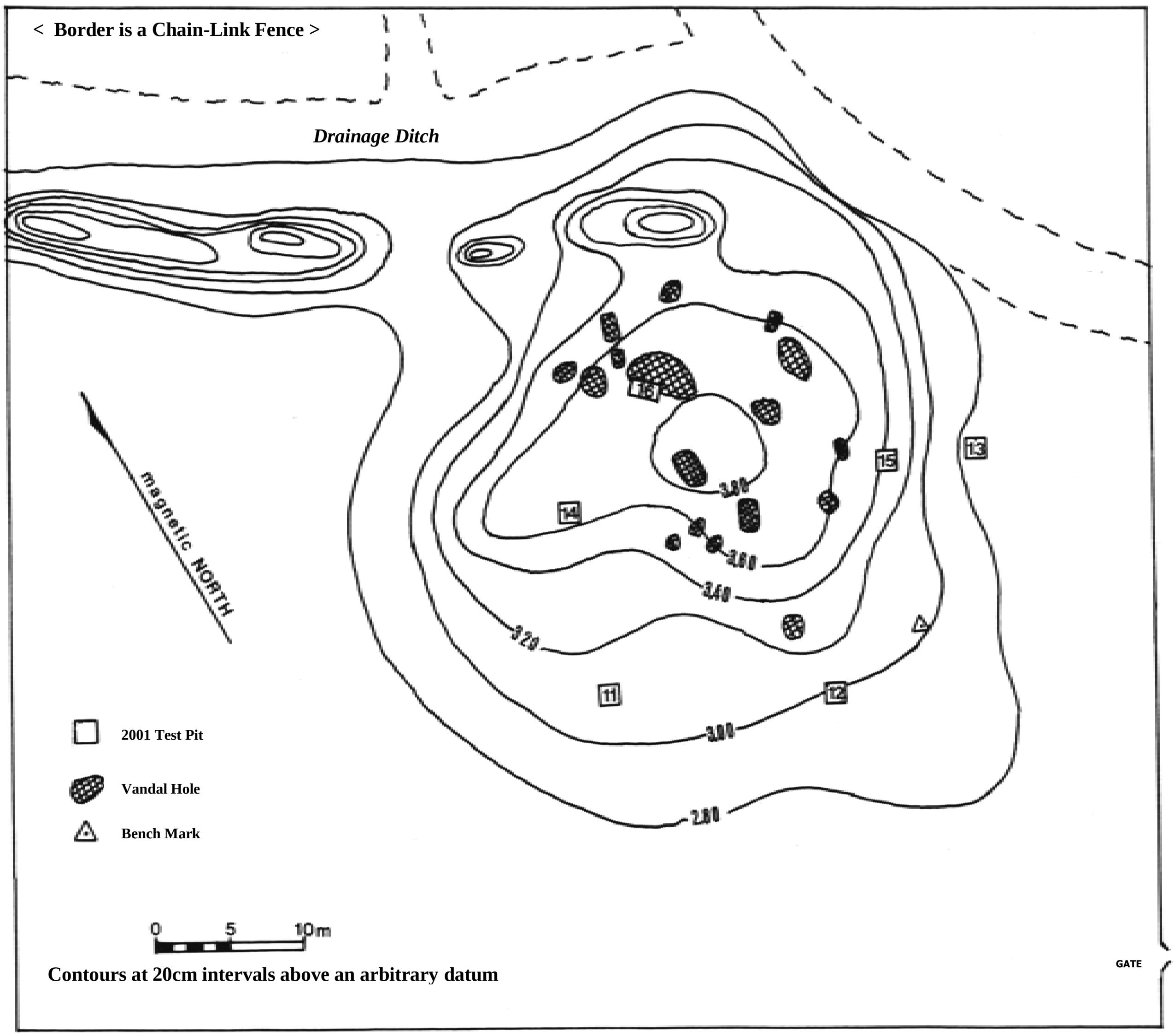

Figure 9. Archaeological Base Map of the Bilbo Site, 2001.

The stratigraphic profiles observed during 2001 generally agree with those recorded by Waring and Haag. However, descriptive nomenclature is not uniform and some variation exists across the site. Figure 10 is Waring's published profile of adjacent 5ft squares along the southeastern end of his stratigraphic block unit.

Zone 1 was below ground water and had been originally deposited on the "tidal silt" of a "low swamp." Waring noted "no sherds" but "numerous animal bones" within this 10-20 inch thick deposit of "untrodden" oyster shell. C-14 dates from charred wood and bone in the lowest part of this zone returned ages of 3,820 and 3,730 radiocarbon years (ca. 1870 B.C. and 1780 B.C.).

Waring described Zone 2 as "black, midden-stained river gravel" that "represented a definite cultural, as well a physical, level." It contained predominately plain fiber-tempered pottery, flint and bone artifacts, and several "clay-lined storage pits." The lower portion of this zone was below ground water. Zone 2 was overlain by a foot or more of lightly stained river gravel with "appreciably less cultural material."

Zone 3 was above ground water and consisted of "hard-packed lenses and layers of mussel and oyster shell" with sand and ash. This zone contained decorated and plain fiber-tempered pottery, animal bones, and chert and bone artifacts. A charred wood sample from a shell layer within this zone, 3.0 – 3.5 feet below the surface, was later dated to 3,700 +/- 125 years old (ca. 1750 B.C.). The dated shell layer is not shown on the published profile.

Waring defined the top 15 inches of the midden as Zone 4. This disturbed layer contained most of the historic artifacts (primarily ceramics and nails) along with Deptford sand-tempered pottery.

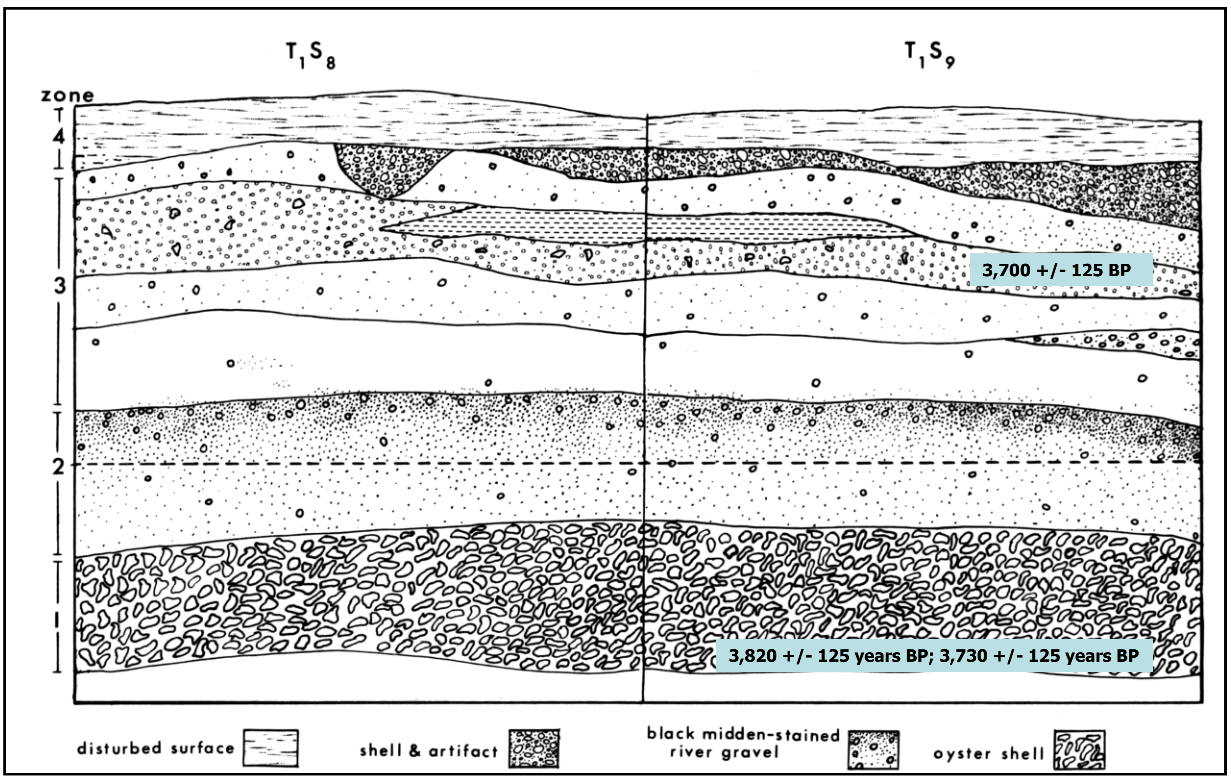

Figure 10. Waring's Stratigraphic Block Profile at the Bilbo Site.

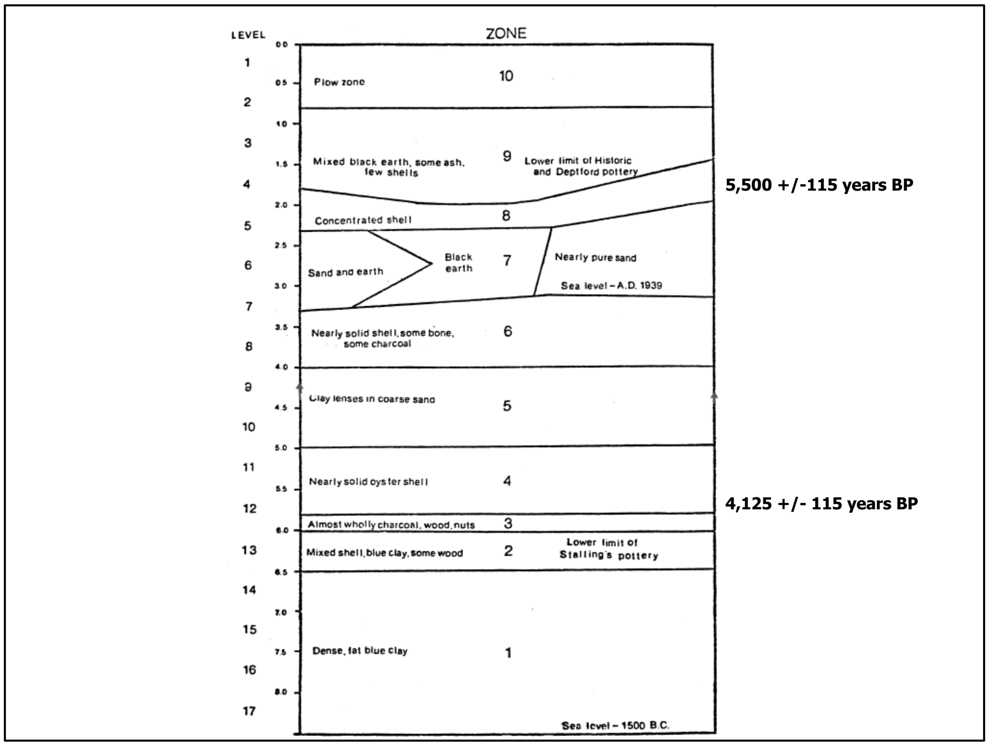

Figure 11. Haag's 1957 Profile of the Bilbo Site.

Haag encountered both similar and distinctive strata during his 1957 investigation (Figure 11). He observed an initial midden accumulation of "nearly solid oyster shell" (Haag's Zone 4 and Waring's Zone 1) underlain by a thin layer of "almost wholly charcoal, wood, nuts" that was deposited on "Dense, fat blue clay." A carbon sample from the base of his Zone 4 provided a C-14 date of 4,125 +/- 115 years B.P. (ca. 2175 B.C.).

This was overlain by Zone 5 – "Clay lenses in coarse sand," which appears to correspond with Waring's Zone 2 of "black midden-stained river gravel," allowing for their unstandardized classification of coarse sand versus gravel.

Waring's layer of lightly stained river gravel that separated his Zones 2 and 3 appears absent in Haag's profile. However, at this level Haag observed a distinctive shell midden deposit, perhaps a substantial shell lense, which he identified as Zone 6.

Haag's Zones 7 and 8 correspond with Waring's Zone 3, all defined by complex layers and lenses of shell midden, organic midden, and alluvial sands. A carbon sample from the shell midden deposit of Zone 8 provided a C-14 date of 5,500 +/- 115 years B.P. (ca. 3550 B.C.), a date noted by Haag to be obviously incorrect (it's some 1,400 years earlier than the other available dates from the base of the midden).

Haag's Zone 9 probably relates to the upper-most level of Waring's Zone 3 and his Zone 10, defined a Plow Zone, is the equivalent of Waring's Zone 4. Like Waring, Haag encountered Deptford phase and historic materials within these levels.

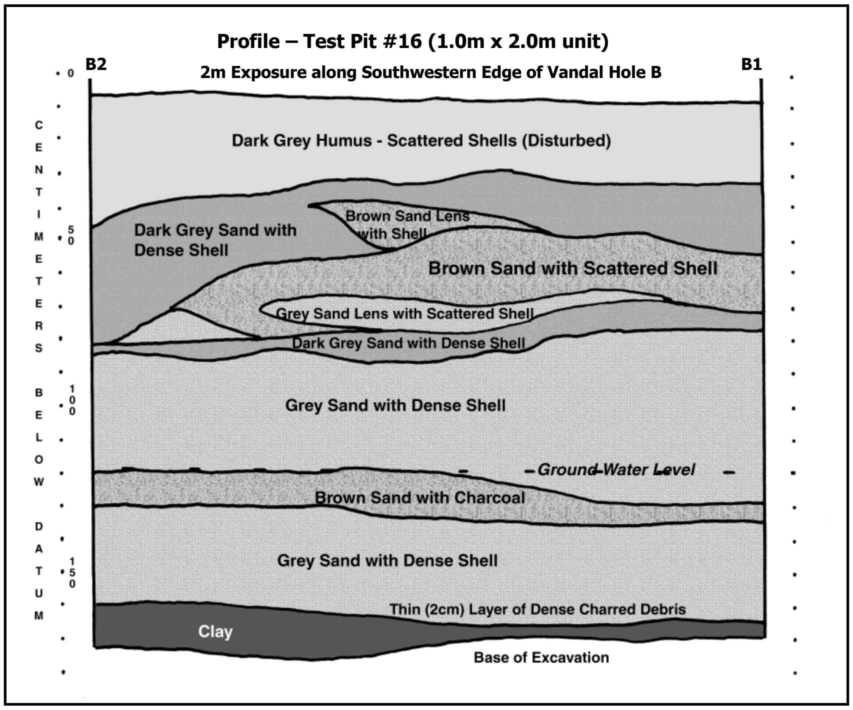

Figure 12. 2001 Profile of Strata in Test Pit #16 at the Bilbo Site.

Strata and deposits equivalent to those recorded by Waring and Haag were encountered during the 2001 excavation at Bilbo. Figure 12 shows the profile of Test Pit #16, excavated along the southwestern edge of the largest vandal hole.

The basal deposit of blue clay was overlain by a thin but dense layer of charcoal, wood, bark, and nutshells. A substantial midden deposit of dense and very compact oyster shells lay directly on top of this debris. A small wooden (pine) post fragment (3.5cm diameter), vertical in orientation and penetrating the underlying clay, was encountered within the base of the shell at 159cm b/d.

The basal shell deposit was overlain by a band of coarse brown sand containing charred wood fragments. Ground water extended to approximately the top of this sand layer. Another dense shell midden lay above the alluvial sand. This uniform deposit was overlain by a complex zone of layers and lenses of shell midden and sand deposits.

The surface stratum exposed in the test pit was defined by a disturbed layer of roots, sand, and scattered shells.

Figure 13 shows the lower portion of the profile exposed in Test Pit #16. The debris layer at the base of the lower dense shell midden is being pointed to by the student. The layer of coarse alluvial sand and second shell midden can be seen above, along with the lower portion of the complex bands and lenses of sand and shell.

Figure 13. Profile of Test Pit #16, Student Pointing to Charred Debris at the Base of the Shell and Top of Blue Clay.

Figure 14 shows the profiles of two walls of Test Pit #14, located about 9 meters west of Test Pit #16. Local depositional variants of the strata are evident. The upper levels in this location were defined by a recent humus layer underlain by an irregular zone of redeposited shell midden, probably from Haag's or Waring's back dirt.

Beginning at a depth of about 70cm b/d, the midden was undisturbed. A small clay-lined pit (Feature #1) was encountered in the upper-most undisturbed levels. Aside from charred-wood fragments, the pit fill was sterile. This feature probably is an example of the "clay-lined storage pits" first noted by Waring. Their function is not well evidenced; however, one possibility is that they were for storage of raw clay brought into to the site for ceramic production (the clay in the base of the pit representing the unused remainder).

Three charred-wood samples were submitted for C-14 dating from the undisturbed levels (Table 1). A sample (UGA #10678) from the organic debris layer underlying the initial dense shell deposit returned an age of 3,720 +/- 90 years B.P. (^{13}C corrected to 3,720 +/- 90 years B.P., ca. 1770 B.C.). A sample (UGA #10677) from the base of the dense shell (170-180cm b/d) returned an age of 3,770 +/- 140 years B.P. (^{13}C corrected to 3,730 +/- 140 years B.P., ca. 1780 B.C.), indicating that the two deposits are essentially contemporaneous. The third sample came from the upper limit of the undisturbed shell midden at 70-80cm b/d. This sample (UGA #10676) returned an age of 3,650 +/-50 years B.P. (^{13}C corrected to 3,630 +/- 50 years B.P., ca. 1680 B.C.), suggesting that the 1.3 meters of midden accumulated over a period of about 100 years. Calibrated calendar ages for the samples are earlier, providing a calibrated range for the shell mound (at one standard deviation) of some 350 years, extending from 1923 B.C. to 2280 B.C.

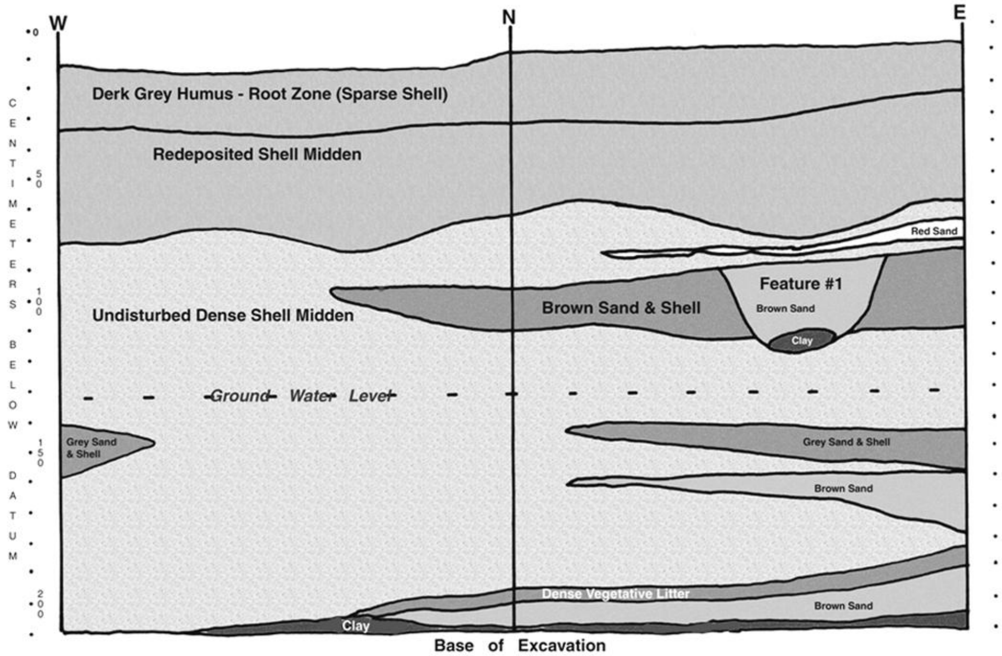

Figure 14. Profile of the North and East Walls of Test Pit #14.

Table 1. Bilbo Site Radiocarbon Analysis Results.
All Samples Charcoal. (A)Conventional and (B)AMS Analysis, Corrected for Isotope Fractionation.
CALIB Radiocarbon Calibration (CALIB REV 5.0.2 © 1986-2005 M. Stuiver and P. J. Reimer).

UGA#	SAMPLE CONTEXT (TEST PIT #14)	DEPTH BELOW DATUM	^{13}C CORRECTED RADIOCARBON AGE (±1σ)	^{13}C CORRECTED CALENDAR AGE RANGE (1σ)	CALIBRATED CALENDAR AGE RANGE (1σ)
(B)10676	Upper Limit of Undisturbed Shell Mound	70-80 cm	3,630 ± 50 B.P.	1630-1730 B.C.	1923-2177 B.C. 1923-2039 B.C.; 2098-2177 B.C.
(A)10677	Base of Shell Mound	170-180 cm	3,730 ± 140 B.P.	1640-1920 B.C.	1942-2341 B.C.
(A)10678	Organic Debris Beneath Shell Mound	190-200 cm	3,720 ± 90 B.P.	1680-1860 B.C.	1978-2280 B.C. 1978-1999 B.C.; 2012-2211 B.C.; 2219-2230 B.C.; 2250-2280 B.C.

Table 2 shows the stratigraphic distribution of pottery and steatite fragments through the excavated levels of Test Pit #14. As noted previously by Waring and Haag, only plain fiber-tempered pottery is associated with the lower levels. Decorated varieties (consisting of incised, punctated, and incised/ punctated designs) are added beginning at 100cm b/d (Figure 15). Amorphous fragments of low-fired clay, most 1cm – 2cm in size, also were noted within the undisturbed excavation levels. Three of the steatite fragments, all portions of perforated steatite disks (Figure 16), are restricted to the 150-160cm level. A fourth was found in the first excavated level below the ground surface. Deptford sand-tempered sherds, as well as scattered historic ceramic and nail fragments, were restricted to the upper disturbed levels.

Table 2. Pottery and Steatite – Test Pit #14.

	Depth Below Datum	Plain Fiber Tempered	Decorated Fiber Tempered	Sand Tempered	Steatite Fragments
DISTURBED	Surface – 20cm	6	0	12	1
	20 – 30 cm	2	2	7	0
	30 – 40 cm	8	2	0	0
	40 – 50 cm	2	6	0	0
	50 – 60 cm	6	3	0	0
	60 – 70 cm	3	3	0	0
	70 – 80 cm	6	13	0	0
	80 – 90 cm	4	8	0	0
	90 – 100 cm	6	2	0	0
	100 – 110 cm	4	0	0	0
	110 – 120 cm	10	0	0	0
	120 – 130 cm	11	0	0	0
	130 – 140 cm	19	0	0	0
	140 – 150 cm	14	0	0	0
	150 – 160 cm	7	0	0	3
	160 – 170 cm	13	0	0	0
	170 – 180 cm	14	0	0	0
	180 – 190 cm	7	0	0	0
	190 – 200 cm	2	0	0	0

Figure 15. Decorated Pottery from the Bilbo Site.

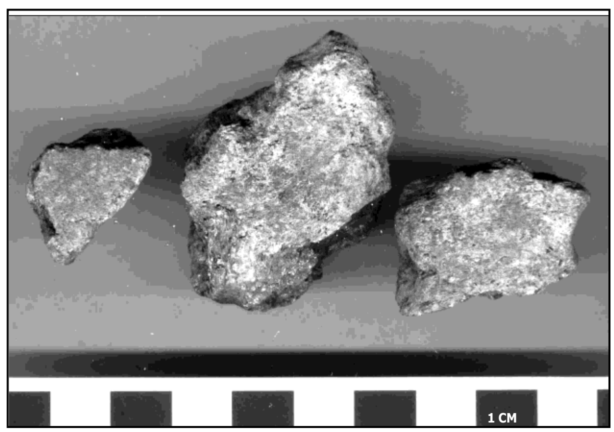

Figure 16. Perforated Steatite Disks from Test Pit #14, 150-160cm b/d.

Figure 17. Examples of Chert Bifaces from various Excavated Contexts at Bilbo. The stemmed points are typical Late Archaic Savannah River forms. A graver is shown on the far left. All are Coastal Plain chert, from sources non-local to the mouth of the Savannah River.

Plant remains were particularly well preserved in the submerged and alkaline midden deposits of the Bilbo site (Table 3 and Figure 18). A preliminary analysis of the 2001 materials was completed with the assistance of Elisabeth Sheldon. This analysis identified of hickory nuts, persimmons, tupelo gum, and sweetgum along with numerous examples of charred and non-charred pieces of wood and bark. The preliminary identification of persimmon seeds now has been revised to squash (*Cucurbita* sp.) following examination of these seeds by Lee Newsom and Logan Kistler (Pennsylvania State University). These are of an early non-domesticated species and probably represent the remains of gourds used as containers. Earlier investigations at the site also reported the remains of walnuts and acorns. While some of the botanical remains are from food items, others represent mast and vegetative litter that naturally accumulated at the site. As a group, the identified plants are native to a swampy riverine environment, or tidal freshwater swamp, and are indicators that this was the habitat near the Bilbo site some 4,000 years ago.

Table 3. Identified Plant Remains from the Bilbo Site.

Test Pit	# Hickory Nut Shells and Husks (*Carya*)	# Wild-Type Gourd-Squash (*Cucurbita*)	# Tupelo Seeds (*Nyssa*)	# Sweetgum Fuiting Head (*Liquidambar*)	Unidentified Seeds, Bark, and Wood
11	129	20	4	0	x
14	588	0	0	8	x
16	10	1	1	0	x

Hickory Nut (*Carya sp.*) also reported from Haag's excavation.
Walnut (*Juglans nigra*) reported from both Waring and Haag's excavation.
Acorn (cf. *Quercus bicolor*) reported from Haag's excavation.

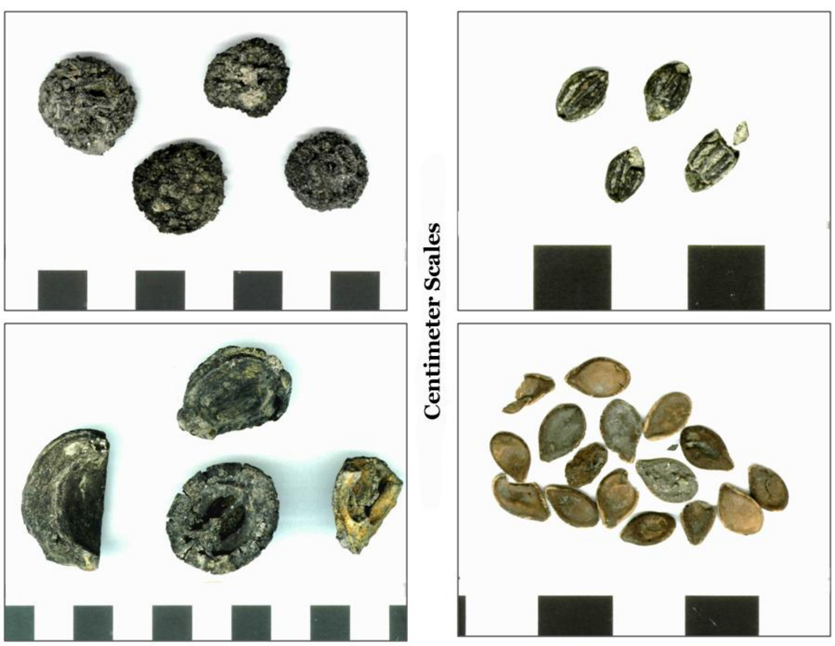

Figure 18. Examples of Identified Seeds from the 2001 Excavation.
Upper Left – Sweetgum fruiting heads. Test Pit #14, organic layer beneath dense shell (190-200cm b/d).
Lower Left – Hickory nut shell and husks. Test Pit #14, organic layer beneath dense shell (190-200cm b/d).
Upper Right – Tupelo Gum seeds. Test Pit #11, base of dense shell (120-130cm b/d).
Lower Right – Wild-Type Gourd/Squash seeds. Test Pit #11, base of dense shell (120-130cm b/d).

Table 4 summarizes the vertebrate species that have been identified from contexts at the Bilbo site, including those analyzed by Dye and Waring. Field identifications from the 2001 investigation indicate that gar is very well represented, along with white-tailed deer, raccoon, opossum, alligator, several species of turtle, and other fish species. Shellfish included American oyster in great abundance and less frequently quahog clams, ribbed mussels, and conch. Waring also noted the occurrence of mussels; presumably, these were freshwater elliptio.

Table 4. Identified Vertebrate Fauna.

Mammals
White-tailed Deer (*Odocoileus virginianus*)
Rabbit (*Sylvilagus sp.*)
Raccoon (*Procycon lotor*)
Opossum (*Didelphis marsupialis*)
Fox or Dog (*Urocyon sp.* or *Canis familiaris*)
Reptiles
American Alligator (*Alligator mississippiensis*)
Box Turtle (*Terrapene carolina*)
Snapping Turtle (*Chelydra serpentina*)
Fish
Gar (*Lepisosteus sp.*)
Sturgeon (*Acipenser sp.*)
Drum (cf. *Pogonias cromis* or *Aplodinotus grunniens*)

In addition to the dietary and ecological information provided by the faunal remains, some of bones were modified and used as tools and ornaments. The most common types of modified bone previously reported were bone pins, some perhaps used as bodkins (Waring 1977c:169; Dye 1976:35-36). A single fragment of a large variety (Waring's Type IV) was encountered; however, small varieties were more common. Four specimens of small pins, round in cross-section and all bearing geometric engraved designs, were found in the undisturbed midden deposits (Figure 19). Three other small pins, these apparently made from small ulnas, also were recovered. One of these was finely engraved and possessed an eye (3mm diameter), indicating its use as a needle. As a group, these small bone pins probably had utilitarian functions associated with stitching hides and perhaps net-making. The small, blunt-end pins also may have had an ancillary use for making the punctated and stab-and-drag designs on fiber-tempered pottery vessels.

Figure 19. Examples of Engraved Bone Pins.

Direct evidence of the use of hides is provided by a well-preserved fragment (~2cm x 4cm x 1.9mm) of leather recovered from the base of the dense shell in Test Pit #16 (Figure 20). The smooth, finished side is marked with two small punched holes spaced slightly more than 2cm apart. An embossed band accompanied by shallow punctations is present beneath the holes. No finished edges are apparent on the fragment and the object of which it was a part remains undetermined. However, it is likely that the fragment is from a leather garment, either clothing or footwear. The sizes of the holes are consistent with the diameters of the small bone pins, supporting the idea that hide or leather working was one of their uses.

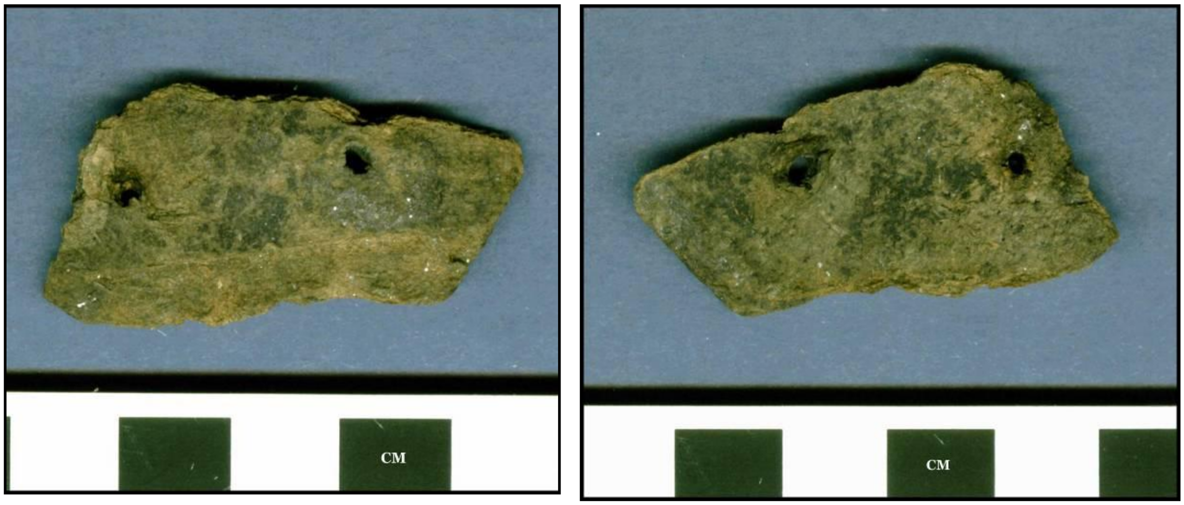

Figure 20. Leather Fragment from the Bilbo Site. Left–Finished Side, Right–Reverse Side.

Summary and Discussion

The 2001 investigation at the Bilbo site achieved its primary objectives of preparing a topographic base map, recording vandal disturbances, and determining that undisturbed archaeological contexts exist at the site. The excavation results confirm many of Waring's, Haag's, and Dye's observations about prehistoric occupation at the site and the nature of its archaeological record. Intact midden deposits at the site survive despite substantial destruction by vandals and major archaeological excavations. It is estimated that as much as 70% of the Bilbo site remains in an undisturbed condition.

The scope and quality of archaeological information available at the Bilbo site are quite remarkable. The well-preserved cultural and natural remains in contexts that maintain their integrity contain a wealth of information about the ecological relationships, adaptive system, and development of the coastal Shell Mound Archaic.

The three excavations at the Bilbo site provide stratigraphic information about the site deposits and their associations at several locations across the site. A complex set of depositional layers is evident; some are persistent and others are discontinuous. These are the products of both cultural and natural processes which resulted in the accumulation of about 2m of shell and sand deposits in the site. The observations and descriptions of Waring and Haag are summarized in Table 5, along with a new identification of the principal contexts represented at the site based upon information from the 2001 excavation. A generalized cross-section of the Bilbo shell mound, showing major stratigraphic and depositional features, is shown in Figure 21.

Table 5. Concordance for Stratigraphic Contexts at the Bilbo Site.

Major Contexts	Waring's 1939 Excavation	Haag's 1957 Excavation
Shell Mound II (~0-75 cm b/s) Top levels (0-25/60 cm b/s) are defined by recent humus, plow zone, and in some areas the spread back dirt of earlier excavations. Historic and Deptford materials are concentrated in the upper levels. Undisturbed strata are dense shell midden with ash, hearths, and pits. Primary associations are plain and decorated fiber-tempered pottery, lithics and debitage, and faunal remains. Base of the shell midden is underlain, in places, by alluvial deposits that may be midden-stained and contain sparse cultural materials.	**Midden Zone No. 4** (~0-15" b/s). Disturbed, upper 15-inches of deposit. European ceramics and nails, sand-tempered pottery, pits (pockets of kitchen debris) and hearths noted.	**Zone 10** (~0-10" b/s). Plowzone containing 19th and 20th century materials, fiber-tempered and sand-tempered pottery, lithics, and animal bones. **Zone 9** (~10-20" b/s). Mixed black earth, ash, and some shells. Fiber-tempered and sand-tempered pottery, lithics, and animal bones.
	Midden Zone No. 3 (~15-24" b/s). Dense, hard-packed lenses and layers of mussel and oyster shell, with sand and ash. Decorated and plain fiber-tempered pottery, animal bone, and lithics. Pits (pockets of kitchen debris) and hearths prevalent.	**Zone 8** (~20-28" b/s). Shell midden, with fiber-tempered and some sand-tempered pottery, lithics, and animal bones. Some mixture with Zones 7 and 9.
	Separates Midden Zone No. 3 and Midden Zone No. 2 (~24-30/36" b/s). Lightly stained river gravel containing sparse cultural material, one foot or more thick.	**Zone 7** (~28-40" b/s). Black earth and alluvial sand, with fiber-tempered and a few sand-tempered pottery sherds, lithics, and animal bones.
Shell Mound I (~75-150/190 cm b/s) Dense shell midden interrupted by numerous discontinuous alluvial deposits, some containing clay lenses. Upper levels may contain hearths and pits that originate in the lower levels of Shell Mound II. Initial, basal shell layer deposited upon marsh-clay sediments.. Primary associations include plain fiber-tempered pottery, lithics and debitage, faunal remains, and botanical materials. Decorated fiber-tempered pottery rarely occurs in the upper-most levels.	**Midden Zone No. 2** (~30/36-48" b/s). 6-12 inches thick; layer of black, midden-stained river gravel. Fiber-tempered pottery and other artifacts, clay-lined storage pits and two hearths. Ground-water level near the middle of this zone.	**Zone 6** (~40-48" b/s). Shell midden, with plain and decorated fiber-tempered pottery, lithics, and animal bones. **Zone 5** (~48-60" b/s). Coarse sand with clay lenses, with sparse cultural materials.
	Midden Zone No. 1 (~48-60" b/s). 10-20 inches thick; uniform layer of oyster shell with animal bones, but few other artifacts. "Fresh, untrodden shell in which no ash or thick midden material was noted."	**Zone 4** (~60-70" b/s). Nearly solid oyster shell, with plain fiber-tempered pottery, lithics, food bone, and nut shells.
Tidal Freshwater Marsh Surface (150/190+ cm b/s) Relic marsh surface littered with vegetative debris and with occasional alluvial sand lenses. Marsh sediment is dense blue clay.	**Tidal silt.** (~60+" b/s)	**Zone 3** (~70-72" b/s). Charcoal, wood, roots, and nuts. **Zone 2** (~72-78" b/s). Mixed blue clay, shell, some wood and nut fragments, with few artifacts. **Zone 1** (~78+" b/s). Fat, blue clay (Georgetown clay).

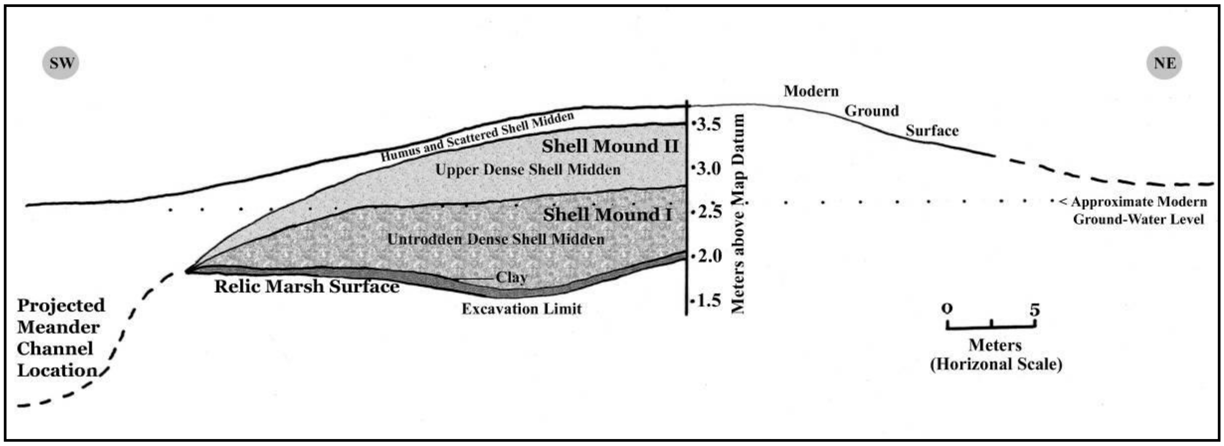

Figure 21. Generalized Cross-Section of the Bilbo Shell Mound.

The natural and cultural strata of the Bilbo site are summarized as follows:

Tidal Freshwater Marsh Surface.

Initial deposition of shell midden was directly upon the surface of a tidal freshwater marsh. The substrate of dense silty clay is defined as "Georgetown Clay" (Latimer and Bucher, 1911) or simply as "Tidal Marsh, Fresh" (Wilkes *et al.*, 1974). It was formed of fine sediments carried by the Savannah River that were deposited when the river overflowed and its currents were severely slowed or halted in response to meeting rising tides. Native vegetation on the regularly flooded marsh surface includes giant cutgrass, maidencane, rushes, and cattails along with stands of cypress and gum. Odum (1988) notes that tidal freshwater marshes exhibit high species diversity relative to tidal saltwater marsh, and also that its plant associations produce large quantities of seeds and other organic litter that accumulate on the marsh surface. The original marsh probably was in close proximity to, and may have at some point developed into, an "Estuarine Swamp" associated with a "Cypress/Tupelo Gum Forest" vegetation community (Buford and Conner, 1998) with bald cypress, water tupelo, swamp tupelo, and Ogeechee tupelo as major constituents. Above-ground primary productivity is exceptionally high in this type of swamp and species diversity increases along its margins, expanding to include oaks, hickories, water locus, American elm, sweet bay, and red bay.

The relic marsh surface is evident about 50cm below the current ground-water level and was encountered in all previous excavations at the site. The stratum was encountered in the 2001 excavation as well, when it received a field description of "dense blue clay." It was sampled to a maximum depth of 30cm beneath its surface, and the remains of a few preserved roots and the bone of an unidentified wading bird were encountered in Test Pit #16. Also within Test Pit #16, a small wooden (pine) post fragment (3.5cm diameter and 12cm long, vertical in orientation) was found which originated in the superimposed midden but penetrated 10cm into the marsh clay.

The marsh surface was littered with a thin (2-5cm) layer of vegetative debris. The debris layer, occurring either directly on the relic marsh surface or on top of localized areas of alluvial sand that overlaid the marsh surface, has a widespread occurrence across the site. The layer appears to be defined primarily by vegetative debris from the surrounding environment that was washed in and trapped on the surface of the marsh, then preserved beneath deposited shell midden. The debris consists of bark and sticks (including *Pinus* sp. and *Quercus* sp.), along with hickory nut shells (*Carya* sp.) and sweetgum balls (*Liquidambar* sp.), and some charred-wood fragments. The charred wood and some of the hickory nuts could represent cultural additions to the otherwise natural debris. Charred wood from the debris layer was radiocarbon dated to 3,720 +/- 90 years B.P. (ca. 1770 B.C.).

Shell Mound I.

Shell Mound I is defined by dense and irregular piles of shell midden with intervening layers of alluvial sand. These accumulated to a level as much as one meter above the marsh surface. Waring referred to the deepest, initial layer of oyster shell as "fresh untrodden shell" and this led him to infer its accretion around an elevated structure.

The cultural associations of Shell Mound I included plain fiber-tempered pottery, fragments of low-fired clay, stone tools and debitage, bone artifacts, faunal remains (estuarine, riverine, and terrestrial), and well-preserved plant materials (food remains and ecofacts). Washed-in vegetative litter like that found on the marsh surface was dispersed within the deposit, indicating that the midden was regularly flooded during its accretion. There was no evidence of direct living surfaces or humus horizons within this first shell mound. Small basin-shaped pits, some perhaps representing clay storage pits, were restricted to the upper-most levels and apparently were intrusive features or associated with the terminal occupation of Shell Mound I. The characteristics of Shell Mound I reflect formation processes that would be expected to occur around and beneath a living surface elevated above a wet and frequently flooded landscape, and offer the best available evidence for the existence of pile dwellings at the Bilbo site. Radiocarbon assays of samples from the base of Shell Mound I indicate that occupation at the Bilbo site began about 3,730 years B.P. (ca. 1780 B.C.).

Shell Mound II.

Unlike Shell Mound I, Shell Mound II served as a direct living surface. As much as 75cm of midden material accumulated on top of the earlier mound. The deposits of the second mound were defined by dense shell midden containing ash lenses, hearths, small pits, and post holes. In some areas a nearly solid layer of sand or sandy humus separated the two shell mounds, perhaps indicating a brief hiatus in occupations at the site. The upper-most level of Shell Mound II was disturbed, but contained both historic artifacts and evidence of a Deptford phase presence at the site. Archaeological materials in Shell Mound II indicate its primary association with the Late Archaic period. Artifacts included both plain and decorated fiber-tempered pottery, but otherwise were similar to those associated with Shell Mound I. Plant remains were less common than in Shell Mound I, probably due in part to differences in the preservation contexts. Nevertheless, there was no evidence of regular flooding and washed-in vegetative litter within the second shell mound.

Radiocarbon dates of samples collected from the base of Shell Mound II indicate that occupation of the living surface began around 3,630 years B.P. (ca. 1680 B.C.), and that the earlier occupation of Shell Mound I had spanned approximately 100 years. Radiocarbon assays of material from contexts that would reflect a terminal date for the Late Archaic occupation of Shell Mound II are not available.

The Bilbo site was located strategically within its late Mid-Holocene environment. It was situated in a tidal freshwater marsh along the inside of a meander channel at the mouth of the Savannah River (Figure 22). This particular place offered immediate access to rich supplies of food available in the river, cypress/tupelo-gum swamplands, upland oak forests, and the nearby estuarine creeks. Plant and animal remains from these areas are well-represented at the Bilbo site and indicate that the residents had a subsistence economy that took advantage of the multiple ecosystems.

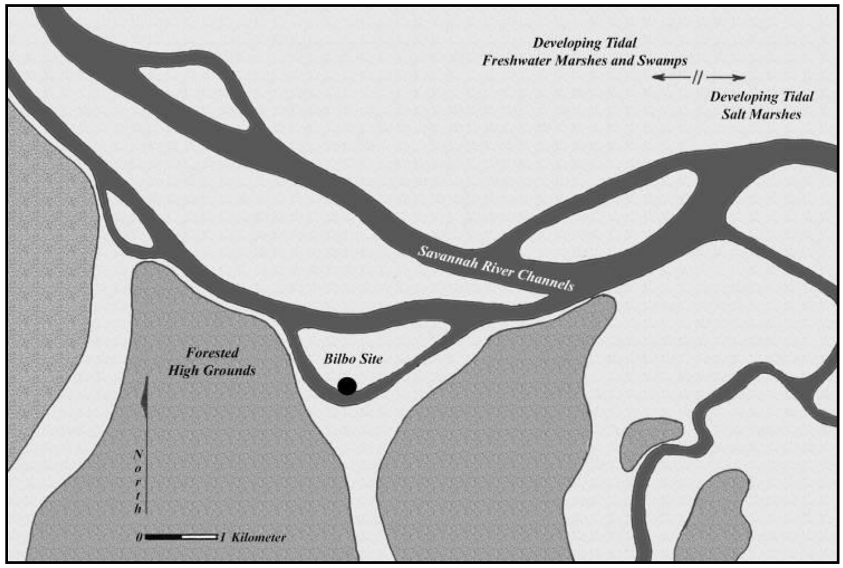

Figure 22. Reconstructed Late Mid-Holocene Environmental Setting of the Bilbo Site.

A principal constituent of the shell mound was American oyster (*Crassostrea virginica*) and their physical remains reflect the type of intertidal oyster community from which they were gathered. The shapes of oyster shells are influenced by the growth constraints and habitat conditions of the natural community the oysters populated. Therefore, it usually is possible to match archaeological samples of oysters with their community type. The technique involves determining the height ÷ length ratios of the left valves of archaeological oysters and comparison of the sample variance (simple analysis of variance employing the F-test, 0.05 significance level) with that represented among the different types of modern oyster communities to determine whether the variances are equal or unequal (see Crook, 1992).

Oyster shells from column samples collected in 2001 from Test Pit #16 were measured and analyzed using this method (Table 6). The results indicate that oysters represented at the Bilbo site initially were harvested from populations in an ecosystem in its early, high-energy stages of

Table 6. Oyster Samples (Left Valves) from Test Pit #16. Descriptive statistics and oyster community types based upon simple analysis of variance and F-Test (p = .05).

Sample	**N**	**Context**	**Height mm**	**Length mm**	**Ratio H ÷ L**	**Single Type**	**Cluster Type**	**Bank Type**	**Reef Type**
#1	48	Shell Mound II (30-40cm b/d)	64.4 ± 19.3	38.5 ± 9.6	1.7 ± 0.4	≠	≠	=	≠
#2	37	Shell Mound II (70-80cm b/d)	70.1 ± 21.3	45.9 ± 10.7	1.5 ± 0.4	=	=	=	≠
#3	136	Shell Mound I (80-100cm b/d)	66.2 ± 18.0	44.2 ± 11.1	1.5 ± 0.3	=	=	≠	≠
#4	127	Shell Mound I (100-120cm b/d)	69.7 ± 17.6	46.4 ± 10.0	1.5 ± 0.3	=	=	≠	≠
#5	97	Shell Mound I (130-150cm b/d)	71.7 ± 18.1	47.6 ± 10.2	1.5 ± 0.2	≠	≠	≠	≠
#6	147	Shell Mound I (150-160cm b/d)	72.9 ± 19.2	45.7 ± 11.5	1.7 ± 0.5	≠	≠	≠	≠

development and then from successively more evolved forms of oyster communities. Samples (#5 and #6) from the lower levels of Shell Mound I do not match any of the modern types of oyster community. These oysters may have been from newly colonized, uncrowded habitats that yielded fast-growing oysters and defined a population unlike that represented among modern oyster communities. Oysters from a community like that represented today appear in the upper levels of Shell Mound I. Samples #3 and #4 matched the variance of single and cluster oyster communities. These communities, whose modern variances are indistinguishable from one another, occur scattered along the banks of tidal creeks and in tidal flats. Their progenitor could have been the unfamiliar community type associated with the lower levels Shell Mound I and their existence simply the result of natural evolutionary processes. Some caution is necessary when interpreting the oyster samples (#1 and #2) from Shell Mound II because of small sample sizes. However, it appears that single and cluster communities continued to be exploited, and that oyster banks began to be harvested. Oyster banks are much larger communities that occupy the same tidal creek edges as single and cluster communities. The bank oysters from Shell Mound II could represent a continuation of the same evolutionary process suggested above – the development of ever-increasing, more dense communities of oysters that are the result of generations of cluster oysters growing in number and spreading along tidal creek banks.

The column samples from the 2001 Bilbo test pits (including Test Pit #16) also were inspected for impressed odostomes (*Boonea impressa*). These tiny parasitic gastropods normally infest intertidal oyster beds and enter the archaeological record attached to the shells of oysters. Identification and analysis of odostomes can provide evidence of the season and duration of prehistoric oyster collection (Russo, 1991) and the column samples were collected with this objective in mind. However, odostomes were absent in all samples (Mistak, 2003). This result, while negative, is consistent with the expected successional processes of a young, pre-climax ecosystem and supports the interpretation about evolving oyster communities presented above. The oyster habitats represented in the Bilbo samples were from immature communities lacking the full ensemble of parasites and other species that are parts of the more complex food-chain that develops with climax conditions.

It is clear the Bilbo site was occupied at a time when the surrounding environment was exceptionally dynamic and naturally productive. The settlement location was ideally situated to provide access to multiple environmental zones, but the freshwater marsh itself was unsuitable for direct habitation. The stratigraphic position of the freshwater marsh surface beneath the current ground-water level indicates that sea level was some 50cm below modern levels at 3,700 years B.P., when the Bilbo site first was occupied. The solution to the problem of residing in such a wet and regularly flooded location was construction of a dry living space. Archaeological evidence from Shell Mound I indicates that this living space was some sort of pile dwelling (Figure 23). Whether this was a single large structure, as portrayed, or a complex of smaller pile dwellings is not indicated in currently available

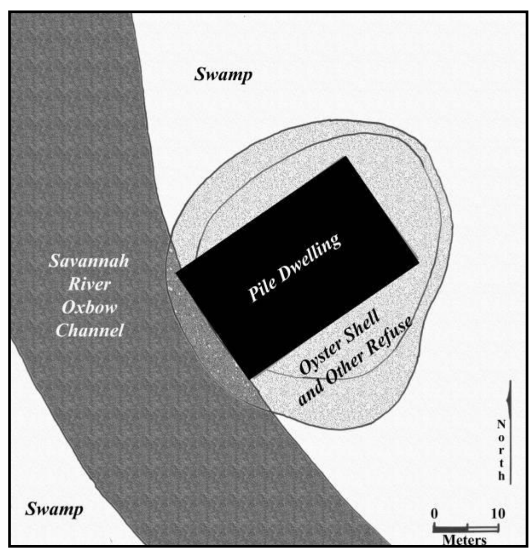

Figure 23. Suggested Structural Form Associated with Shell Mound I.

data. Considering ethnographic examples, the settlement layout could have been quite elaborate – with separate dwellings, work areas, ceremonial areas, and even menstrual huts; all connected by walkways. The nature of the archaeological evidence for some type of pile dwelling at the Bilbo shell mound clearly is derivative and contextual, but nevertheless is considered to be compelling. Primary evidence of structural forms and their layout probably exists in the deeply buried strata of the site; however, all previous excavations were designed to recover stratigraphic information from restricted areas rather than to define architectural details such as post-hole patterns that require extensive excavation and exposure of much larger horizontal areas. These details would be preserved in strata well below the current ground-water level, presenting formidable problems for extensive excavation.

As cultural refuse and flood deposits accumulated around and under the pile dwelling, the shell mound gradually increased in height above normal tide and flood levels, creating a dry living surface. Sea level at this time appears to have been approximately the same as, or perhaps only a little lower than, modern levels. Settlement changed to occupation directly on this ground surface, resulting in the accretion of additional refuse deposits that formed Shell Mound II. Numerous post holes, ash lenses, and pit features mark the direct living surface and make this deposit distinctive from the earlier shell mound. As with Shell Mound I, excavations at the Bilbo site have failed to provide evidence of post-hole patterns that would reflect the house forms and a settlement plan. However, Shell Mound II may have been associated with wall-post houses similar to those found at Late Archaic period sites of interior areas in the region.

The Bilbo shell mound remains one of the most significant archaeological sites on the Georgia coast. Despite extensive vandalism and prior excavations, as much as 70% of the site contexts are intact. While future investigations undoubtedly will contribute to our understanding of Native American life and culture during the late Mid-Holocene, the next research stage should focus on assembly, inventory, and reanalysis of existing collections rather than on additional excavation at the Bilbo site. Although much can be learned from these existing data, every effort should be made to preserve the archaeological information contained within the undisturbed deposits of the site for future advanced study.

The Delta Site (38JA23)

The Delta site is an early Woodland period shell mound associated primarily with the Refuge phase. The site is located within an extensive tidal marsh area on the north side of the Savannah River some 5km northeast of the Bilbo site. This tidally charged brackish to freshwater wetland was modified during the Plantation period with construction of an extensive matrix of canals that serviced and defined rice fields. Those rice fields in the vicinity of the site were part of the Delta Plantation, which operated under a series of different owners beginning in the early 1800s (see Poplin 1990 for additional information). The name Delta is applied here to the shell mound, known previously only by its state site number.

The original form of the Delta shell mound was a roughly circular area about 30m in diameter and covering some 700 square meters. A rice canal was dug through the northeastern part of the site, leaving the shell mound divided into two parts since the early 19th century (probably no later than the 1820s). The larger, southwestern section of the site (that part owned by the State of Georgia) was investigated during 2006 and 2007. The Delta site currently lies at the edge of a massive spoil pile deposited from dredging the Back River to maintain shipping access to the Port of Savannah (Figures 24 – 27).

Figure 24. Delta Site from Top of Dredge Spoil Area, 2006 (view to the southeast).

Figure 25. Delta Site Interior, 2006 (view to the northwest).

Figure 26. Satellite View of the Delta Site (from GoogleEarth, 2005).

Figure 27. 1961 Aerial of Delta Site prior to Deposition of Dredge Spoil (from Ga DOT).

Previous Research at the Delta Site

A site recorded as 38JA23 was identified by Leland Ferguson (University of South Carolina, Institute of Archaeology and Anthropology) during his reconnaissance of an area to be impacted by construction of an additional sediment basin for dredging the Back River for maintenance of the Savannah Harbor (Ferguson 1973). The site was located within the proposed sediment basin and Ferguson recommended excavation prior to it being covered with dredge spoil. To date 38JA23 has not been impacted, although the spoil area now extends to the edge of the site and towers some 5m above it.

The site was described in 1973 as a "shell midden approximately five feet above the water table measuring 80 feet (NE-SW) by 180 feet (NW-SE). The northeastern edge of the midden has been cut by a canal along the dike" (Ferguson 1973: 6). The midden was composed primarily of oyster shell and recovered ceramics were noted as Deptford phase (bold check stamped, linear check stamped, and simple stamped) and Wilmington phase (heavy cord marked) wares. The South Carolina "Site Survey Record" form for 38JA23 also noted that the site was characterized by approximately 3 feet of shell midden and indicated that it had been disturbed by limited vandalism (3 potholes). 38JA23 apparently was not recognized as a Refuge phase shell mound at the time of its discovery.

2006/07 Investigations

Mapping and testing at the Delta site were undertaken during the spring of 2006 as part of an archaeological field school under the author's direction. Support for this project was provided by grants administered through the Georgia Department of Transportation. The limited research goals were to assess the current condition of 38JA23, to determine its content and significance, to develop recommendations for its effective management, and to assess its potential for contributing new information about the prehistory of coastal Georgia and South Carolina. A brief second phase of field work was undertaken during August 2007, when excavation was continued within the deeply buried strata of the shell mound.

Topographic mapping was completed using an alidade and plane table. Distances were measured using a metric tape and elevations were taken with the alidade and metric stadia rod. A temporary bench mark, consisting of an existing 10p nail in a hickory tree, was established in the central area of the site.

The topographic base map of the Delta site shows surface contours at 10cm intervals, the tidal canal, low wet areas along the southern and western sides of the site, and the locations of the excavated test pits (Figure 28). The locations of existing surface disturbances also were recorded. Three of these were the remnants of roughly rectangular pits (5ft squares?) and three others were circular in shape (the three potholes noted by Ferguson?). The map contours show the ground surface extending above the surrounding water level and marsh surfaces, with contours artificially interrupted by the tidal canal along the northeastern side of the site.

Three test pits were partially excavated during the 2006 field season. The test pits were designated numerically (#1, #2, and #3) and each was oriented to magnetic north. Test Pit #1 and Test Pit #2 were 2m squares, the former positioned in the central high area of the site and the latter along the northeastern side of the site near the tidal canal. Test Pit #3 was a 1m square located at a lower elevation at the southeastern side of the site. Excavation during the 2007 field season was restricted to continued work in Test Pit #1. Each test pit was excavated in 10cm levels, as measured below a datum (b/d) set 10cm above the ground surface at the northeast corner of each unit. The arbitrary 10cm excavation levels occasionally were adjusted to 15cm due to difficulty maintaining level control in the deeper, wet midden deposits. The fill of each level was screened through ¼" mesh hardware cloth. Samples, usually 20-liters in volume, also were taken from selected excavation levels for further processing through 1/16" mesh screen or fine sieves. A trash pump was used to remove water in the deeper excavation levels of Test Pit #1 and to temporarily draw down standing water within Test Pit #3. The water discharged from the trash pump also was used to screen the fill of deeper excavation levels in Test Pit #1.

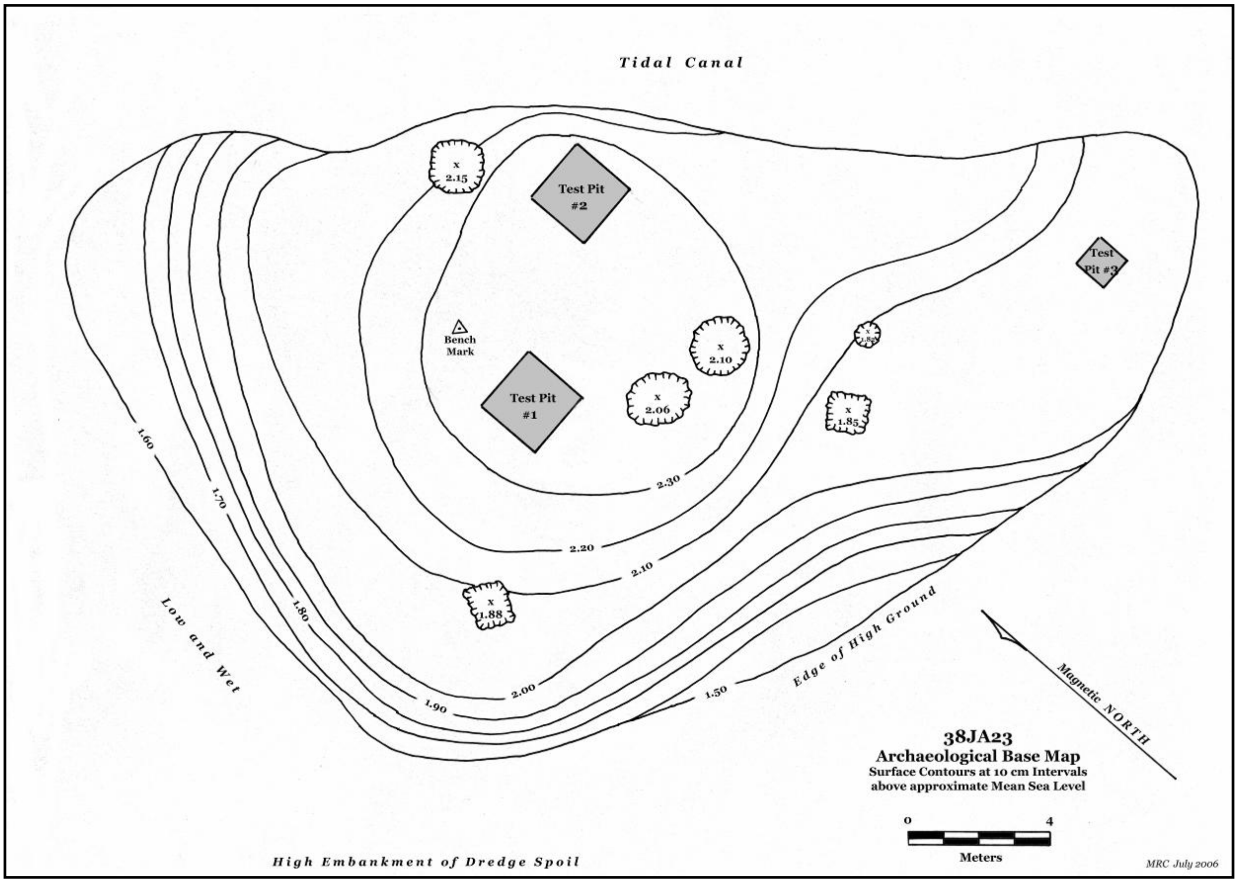

Figure 28. Topographic Base Map of the Delta Site (38JA23).

Test Pit #1.

Much of the field time allotted for this project was devoted to Test Pit #1, with excavation extending to a depth of 200cm b/d at the end of the 2006 field season. A small sondage was excavated an additional 60cm below that depth in the northeast corner of the 2m square, but failed to reach the base of the shell mound. Excavation was continued for a 10-day period in 2007, extending the unit, now reduced to 1m x 2m in size, to 270cm b/d. Three core samples then were extracted from greater depths to detect the base of the cultural midden and underlying strata.

The strata encountered in Test Pit #1 revealed a deep, complex depositional record (Figures 29, 30 and 31). Stratigraphic details were unmistakable in profile, but were only vaguely evident in horizontal view as excavation progressed.

- The surficial layer was composed of a dense zone of roots and root mat that extended, on average, about 25cm b/d.

- An internally complex zone of redeposited shell midden was encountered beneath the root zone, extending to a depth of approximately 95cm b/d and the current ground-water level. The layers within this zone were formed from digging the 19th century rice canal, its construction spoil being deposited on top of the adjacent ground surface, which was the 19th century surface of the shell mound. The cultural remains within this zone represent disturbed and mixed content from that portion of the shell mound bisected by the canal. An abundance of seeds and vegetative debris was observed at the base of the spoil, evidently representing plant materials which were present on the ground surface when the spoil was deposited. Three features were observed in profile within the spoil strata. These irregular pits, one of which intrudes into another, are probably the result of modern pot-hunting activities at the Delta site.
- Undisturbed shell mound strata began approximately at the current ground-water level. The ground-water was at a level equal to that in the adjacent tidal canal. Observed water levels varied several centimeters with changing tidal ranges, the rising and falling water reacting with sand and calcined shell fragments in the midden to form a layer of concreted patches. The upper most stratum of the shell mound was defined by grey and brown silty sand containing dense shell lenses, composed primarily of oyster shell, to a depth of approximately 140cm b/d. This was underlain by a similar stratum of grey silty sand and dense shell, but without extensive lenses, extending to a depth of about 180cm b/d. The third stratum of the shell mound was defined by midden deposits of dark grey silty sand and dense shell with noticeably more mussel shell and charred wood fragments. A single feature, defined by a thin layer or lense of soft red clay, was detected in profile near the top of this stratum. The function of this feature is undetermined. However, it could represent the remnant of a clay supply brought into the site for the production of pottery. Standard excavation failed to reach the base of this stratum at 270cm b/d; however, 3-inch cores excavated below the base of the standard excavation revealed that the dark grey silty-sand midden of the shell mound extended to approximately 390cm b/d.
- The intact basal stratum of the shell mound was underlain by a thick layer of brownish grey silty clay containing shell and other cultural debris that extended to a depth of roughly 430-440cm b/d. This stratum appears to have been formed by shell mound materials and other debris which sank into the soft sediment upon which they were initially deposited.
- Dense brownish grey clay was observed immediately below the mixed shell and silty clay stratum and continued to an indeterminate depth greater than 478cm b/d.

The strata represented in Test Pit #1, in summary, indicate that the Delta shell mound was covered with about one meter of spoil from excavation of the adjacent tidal canal during the early 19th century. The thick spoil zone appears to have protected the underlying shell mound from modern vandalism. The intact shell mound is defined by more than three meters of cultural strata, all now submerged below ground water. Three slightly varying strata were recognized within the shell mound, each defined by midden containing dense shell (oysters and also freshwater mussels) within a matrix of silty sand. Extensive lenses of midden in the upper stratum suggest a series of discrete and possibly intermittent deposition episodes in its formation, while lower strata may have been formed by more or less continuous deposition processes. Initial deposition of the shell mound materials appears to have been on a silty clay ground surface that was underlain by dense clay. After midden materials were deposited on top of this ground surface, the remains sank into the soft sediments, creating a +/- 50cm-thick layer of silt and clay containing intrusive cultural and surficial debris.

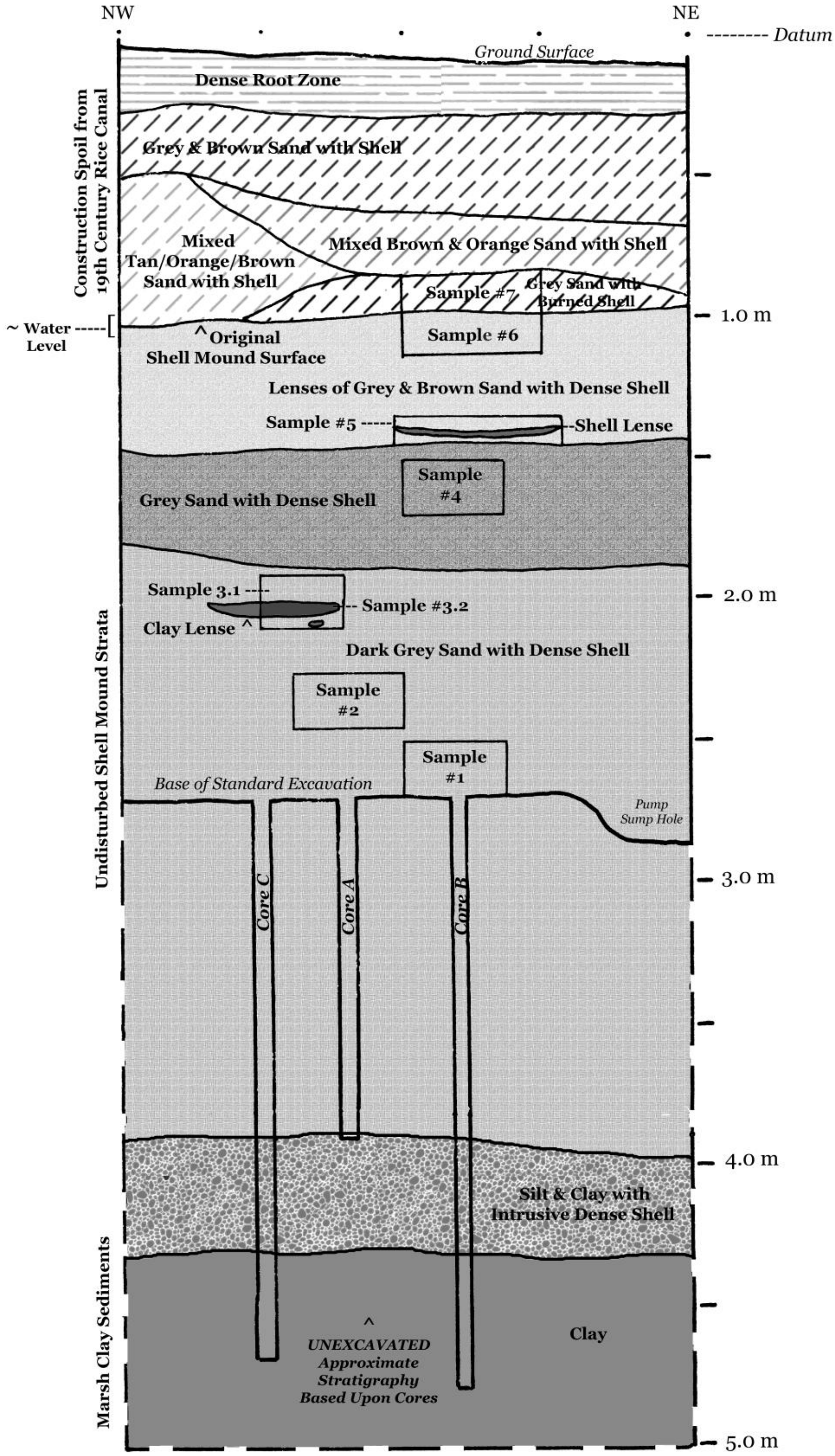

Figure 29. Profile of North Wall of Test Pit #1 showing Spoil and Shell Mound Strata, along with Core (A, B, C) and Bulk Sample (1, 2, 3, 4, 5, 6, 7) Locations.

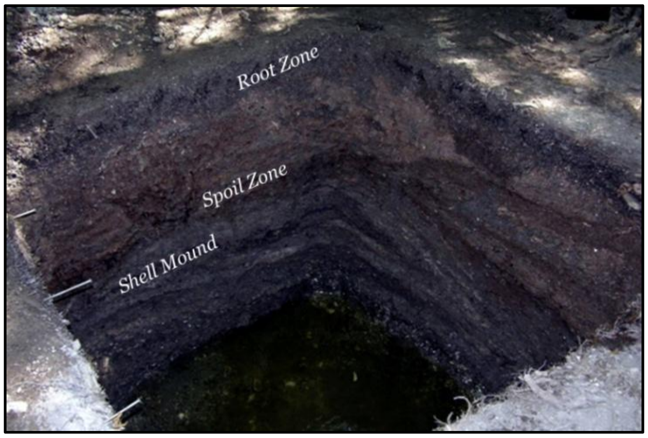

Figure 30. Test Pit #1 (2m x 2m square) showing Faces of the South and West Walls (2006). View to the Southwest Corner.

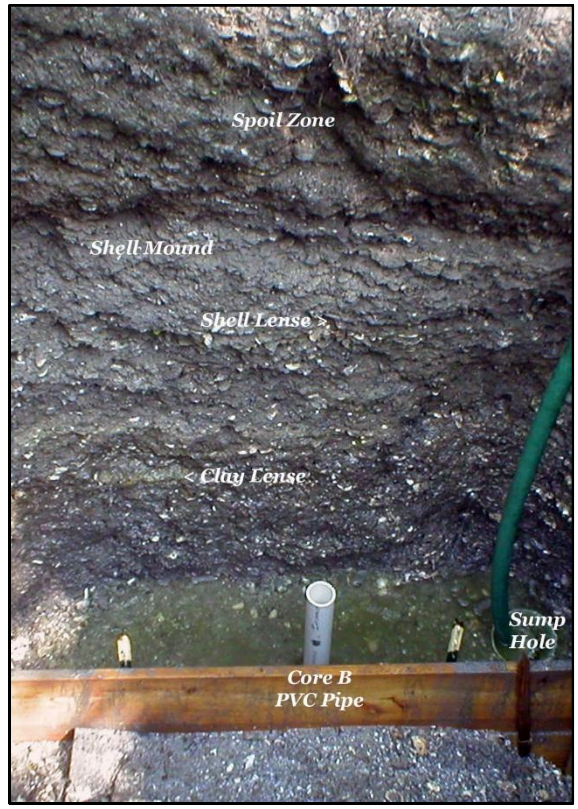

Figure 31. Test Pit #1 showing Portion of North Wall (2007).

Details about the lower strata within Test Pit #1 were obtained by coring below the base of the standard excavation levels. As non-standard methodology was used in retrieving these cores, some discussion is appropriate. The submerged cultural deposits containing dense shell debris presented challenges to conventional coring methods. Solid coring methods, such as driven metal tubes and vibra-cores, were impractical because of obstructions within the dense midden containing large shells. The use of a bucket auger to obtain consecutive samples was stymied because the walls of the core holes would collapse in the wet sediments. The solution employed at the Delta site was a modified bucket auger technique – a 3-inch auger inserted into a 4-inch PVC pipe. The bit of the auger was slightly larger than the 3 inches in diameter bucket, providing a close fit within the 4-inch (OD) PVC pipe. Each core was extracted by inserting the auger into the PVC pipe at the sample point, turning the auger to retrieve a core segment, then carefully pushing or driving the PVC pipe down into the core cavity. The depth (cm b/d) of the base of each core was measured with a tape inserted into the PVC pipe, and then the next core segment was retrieved in the same fashion (auger extensions and PVC sections being added as necessary). A very minor amount of slump was observed from insertion of the PVC pipe into each new core cavity. Each retrieved core sample, minus any slump from the previous core section, was immediately labeled and bagged during the operation. A total of three cores were obtained using this method, beginning at the base of the standard excavation (refer to Figure 29): Core A extending from 270cm b/d to 392cm b/d, Core B from 270cm b/d to 478cm b/d, and Core C from 270cm b/d to 470cm b/d.

Seven radiocarbon dates were obtained from samples collected from undisturbed strata to determine the chronometric age of the Delta shell mound and its Refuge phase association. Carbon samples (charred wood and carbon residue) from several stratigraphic contexts were submitted to the Center for Applied Isotope Studies, University of Georgia, for radiocarbon analysis and stable isotope $^{13}C/^{12}C$ ratio analysis to correct for isotope fractionation (Table 7). The radiocarbon dates indicate that the shell mound was initially formed about 2,900 years B.P., based upon essentially contemporaneous dates from the base of the intact shell mound and the underlying mixed layer of silt/clay/shell. An earlier date of 3,140 years B.P. was obtained on a charred-wood fragment recovered from the underlying stratum of dense clay, perhaps indicating a terminal St. Simons phase presence at the site prior to the Refuge phase. The carbon dates from consecutively higher levels within the shell mound are fairly consistently younger in age and overlap at one standard deviation. A charred-wood sample from the upper portion of the shell mound dates to 2,720 years B.P., providing a terminal date for the Refuge phase shell mound. The entire Refuge phase construction and occupation at the Delta shell mound thus extended over some 180 years, from about 2,720 years B.P. to 2,900 years B.P. (ca. 950 B.C. to 770 B.C.). The calibrated calendar ages for these dates are about 100 years earlier.

Table 7. Delta Site Radiocarbon Analysis Results.
All Samples Charcoal or Carbon Residue. AMS Analysis, Corrected for Isotope Fractionation.
CALIB Radiocarbon Calibration (CALIB REV 5.0.2 © 1986-2005 M. Stuiver and P. J. Reimer).

UGAMS #	SAMPLE CONTEXT (TEST PIT #1)	DEPTH BELOW DATUM	^{13}C CORRECTED RADIOCARBON AGE (±1σ)	^{13}C CORRECTED CALENDAR AGE RANGE (1σ)	CALIBRATED CALENDAR AGE RANGE (1σ)
03906	North Wall Profile	126 cm	2,720 ± 25 B.P.	745-795 B.C.	833-896 B.C. 833-860 B.C.; 864-896 B.C.
R01566	Excavation Level	145-160 cm	2,734 ± 41 B.P.	743-825 B.C.	831-911 B.C.
R01567	Excavation Level	170-185 cm	2,939 ± 44 B.P.	945-1033 B.C.	1056-1255 B.C. 1056-1065 B.C.; 1076-1103 B.C.; 1111-1214 B.C.; 1238-1255 B.C.
R01568	Excavation Level	185-200 cm	2,896 ± 45 B.P.	901-991 B.C.	1107-1189 B.C. 1007-1130 B.C.; 1145-1157 B.C.; 1179-1189 B.C.
03907	Simple Stamped Sherd - Residue	260-270 cm	2,870 ± 25 B.P.	870-920 B.C.	1004-1112 B.C. 1004-1058 B.C.; 1063-1086 B.C.; 1101-1112 B.C.
03908	Core C-8	353-359 cm	2,965 ± 25 B.P.	990-1040 B.C.	1130-1258 B.C. 1130-1146 B.C.; 1155-1181 B.C.; 1188-1218 B.C.; 1232-1258 B.C.
03909	Core C-10	367-382 cm	2,915 ± 25 B.P.	940-990 B.C.	1050-1189 B.C. 1050-1130 B.C.; 1145-1157 B.C.; 1180-1189 B.C.
03910	Core C-14	409-433 cm	2,900 ± 30 B.P.	920-980 B.C.	1024-1126 B.C.
03911	Core C-15	433-457 cm	3140 ± 25 B.P.	1165-1215 B.C.	1399-1440 B.C.

A wide range of artifacts were encountered throughout the levels excavated in Test Pit #1, indicating a primary association with the Refuge phase and secondary associations with the Deptford, Wilmington, and St. Simons phases. Historic artifacts, consisting of 2 badly rusted nails and a 22 caliber shell case, were restricted to the root zone.

Pottery was common in the excavation levels, and especially dense in the strata at or below the water level; a pattern due in part to the use of water screening for artifact recovery in these lower levels. The results of the pottery analysis are shown in Table 8.

Table 8. Ceramic Analysis, Test Pit #1.

Test Pit #1	Total ID	St. S.	Plain	Refuge				Deptford				Wilmington		Total Residual*	Other	
Depth B/D		Fiber Temp	Sand Temp	Simple Stamp	Bold Simple	Fine Incised	Dentate Stamp	Check Stamp	Linear Check	Cord Mark	Comp Stamp	Plain	Cord Mark		Hones Abraders	Fired Clay
2m x 2m Unit																
10-~25 cm (Root Mat)	8	-	2 25%	5 63%	-	-	-	-	-	-	1 13%			10	2	12
~25-30 cm	70	-	15 21%	32 46%	6 9%	1 1%	-	13 19%	-	-	1 1%		2 3%	18	-	1
30-40 cm	27	-	2 6%	-	-	-	-	8 24%	17 50%	-	-	-	-	8	1	2
40-50 cm	39	1 3%	10 26%	15 39%	3 8%	-	-	2 5%	7 18%	1 3%	-	-	-	10	-	-
50-60 cm	38	2 4%	8 21%	21 45%	6 13%	-	-	-	1 2%	-	-	-	-	15	1	-
60-70 cm	44	-	14 37%	-	-	-	1 3%	21 55%	8 21%	-	-	-	-	3	1	1
70-80 cm	53	-	10 19%	32 60%	8 15%	1 3%	-	-	-	-	-	2 4%	-	7	-	4
80-90 cm	28	2 7%	3 11%	17 61%	6 21%	-	-	-	-	-	-	-	-	2	-	-
90-100 cm	29	-	5 17%	14 48%	8 28%	-	1 3%	-	-	1 3%	-	-	-	0	-	2
Subtotal Upper Spoil Zone	336	5 1%	69 21%	136 40%	37 11%	2 <1%	2 <1%	44 13%	33 10%	2 <1%	2 <1%	2 <1%	2 <1%	73	5	22
100-115 cm	83	-	7 8%	62 75%	12 15%	1 1%	-	-	-	1 1%	-	-	-	11	-	4
115-125 cm	111	1 1%	7 6%	69 62%	31 28%	2 2%	-	-	-	1 1%	-	-	-	12	2	30
125-135 cm	118	-	12 11%	63 59%	41 38%	2 2%	-	-	-	-	-	-	-	33	-	40
135-145 cm	107	-	9 8%	32 30%	66 62%	-	-	-	-	-	-	-	-	42	1	40
145-160 cm	193	-	19 10%	60 31%	114 59%	-	-	-	-	-	-	-	-	49	1	14
160-170 cm	171	-	7 4%	31 18%	132 77%	1 1%	-	-	-	-	-	-	-	27	13	2
170-185 cm	224	1 <1%	18 8%	55 25%	146 65%	4 2%	-	-	-	-	-	-	-	64	7	11
185-200 cm	121	-	16 12%	44 34%	60 46%	1 1%	-	-	-	-	-	-	-	36	6	9

Table 8. Ceramic Analysis, Test Pit #1 (Continued).

Test Pit #1	**Total**	**St. S.**	**Plain**	**Refuge**				**Deptford**				**Wilmington**			**Other**	
Depth B/D	**ID**	Fiber Temp	Sand Temp	Simple Stamp	Bold Simple	Fine Incised	Dentate Stamp	Check Stamp	Linear Check	Cord Mark	Comp Stamp	Plain	Cord Mark	**Total Residual***	Hones Abraders	Fired Clay
1m x 2m Unit																
205-220 cm	16	-	3 19%	9 56%	4 25%	-	-	-	-	-	-	-	-	11	-	2
220-230 cm	57	2 4%	6 11%	28 49%	19 33%	1 2%	-	1 2%	-	-	-	-	-	83	9	9
230-240 cm	49	-	2 4%	30 61%	17 35%	-	-	-	-	-	-	-	-	85	7	-
240-250 cm	39	-	3 8%	25 64%	9 23%	-	2 5%	-	-		-	-	-	62	7	5
250-260 cm	43	-	6 14%	26 60%	10 23%	-	1 2%	-	-	-	-	-	-	61	7	11
260-270 cm	38	-	2 5%	19 50%	11 29%	2 5%	3 8%	-	1 3%	-	-	-	-	47	2	21
Subtotal for Undisturbed Shell Mound	1370	4 <1%	117 9%	553 40%	672 49%	14 1%	6 <1%	1 <1%	1 <1%	2 <1%	-	-	-	623	62	198
Total All Levels	1706	9 <1%	186 11%	689 40%	709 42%	16 1%	8 <1%	45 3%	34 2%	4 <1%	2 <1%	2 <1%	2 <1%	696	67	220

* The Residual category refers to very small (< 1cm) and eroded sherds.

The pottery designations shown in Table 8 are somewhat problematic and require discussion (refer to Figures 32 - 35). Pottery of the Refuge series includes simple-stamped, incised, and punctated decorative treatments along with undecorated plain wares and all are sand tempered. However, Refuge pottery types are not restricted to the Refuge phase. They continue into the following Deptford phase when they are accompanied by more distinctive Deptford pottery types (also sand tempered), including check-stamped, linear check-stamped, cord-marked, and complicated- stamped wares. Refuge plain and Deptford plain are virtually indistinguishable. The column labeled "Plain, Sand Temp" could refer to either Refuge or Deptford, or both (see Waring 1977a, 1977b; DePratter 1976, 1991; Lepionka 1983b). An attempt was made to distinguish bold simple- stamped from narrower simple-stamped surface treatments and the results are shown in the table. However, this variation actually was distributed along a continuum and sorting one from another in the middle of the range was rather arbitrary. It is doubtful if these results could be replicated with resorting, but combination of the two columns into a single simple-stamped category would be reliable. The column labeled "St. S. Fiber Temp" refers to a few small fiber-tempered sherds that are conservatively classified as St. Simons phase wares. The few sherds of Wilmington phase wares shown in the table are diagnostic of the type, with heavy-grog tempering. Hones and abraders (Figure 36) in the table are distinctive artifacts commonly associated with other Refuge phase sites. The artifacts classified as abraders have been used as grinding or sanding tools, wearing down the surface on these sand-tempered sherds. Hones are sherds exhibiting narrow grooves worn into their surface as a result of sharpening a pointed tool such as a bone pin, awl, or spear/leister point. Abraders also were commonly used as hones. "Fired Clay" refers to small lumps of low-fired clay (Figure 37). One fragment, smoothed on one side and with a split-vine impression on the reverse, may show the imprint of a mat or basket (and is unlike daub from wattle-and-daub architecture). The other fragments were amorphous, and could be associated with activities around a hearth or from on-site ceramic production (residual scraps of raw clay).

Figure 32. Deptford Linear Check Stamped – a, b, d; Deptford Check Stamped – c; Deptford Cord Marked – j, k; Refuge Fine Incised – e, f, g; Refuge Dentate Stamped – h, i.

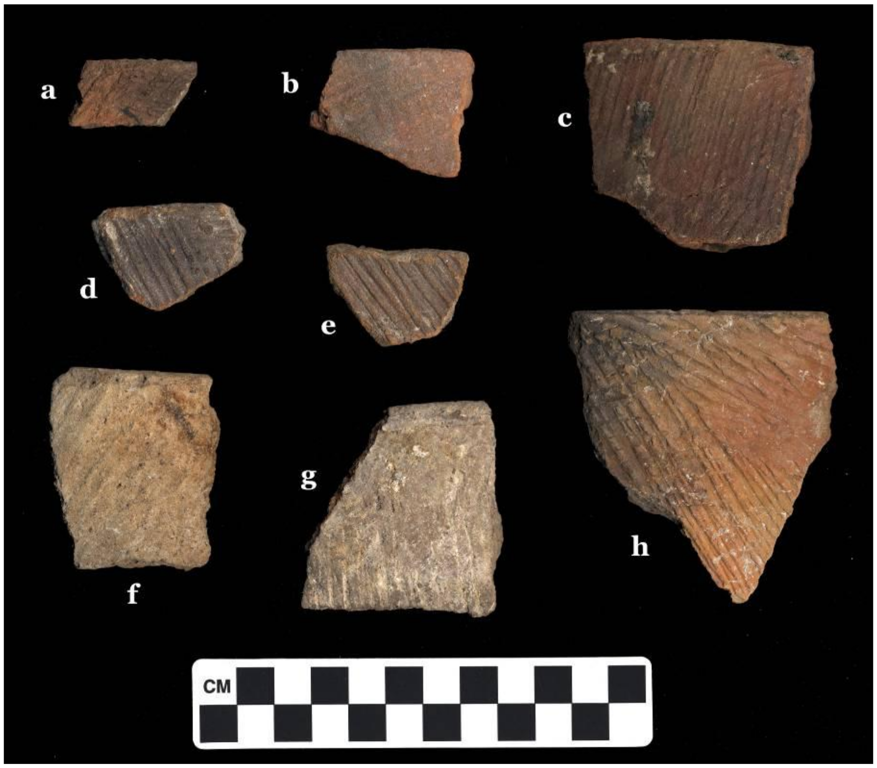

Figure 33. Refuge Simple Stamped.

Figure 34. Refuge Bold Simple Stamped.

Figure 35. St. Simons Fiber Tempered – b, c; Wilmington Heavy Cord Marked – a.

Figure 36. Abrader – a, b; Abrader with Hone – c, d, e.

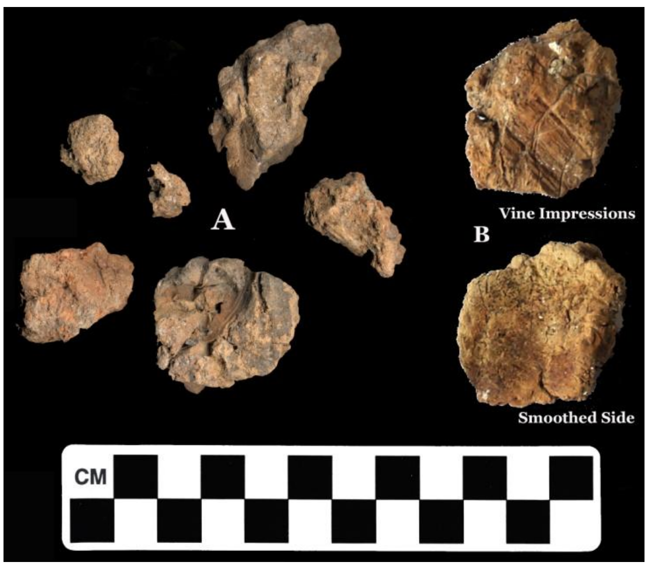

Figure 37. Fired Clay Lumps: Amorphous – a; Smoothed with Split-Vine Impression – b.

Figure 38. Hammer Stones.

Figure 39. Bone Pins – a, b; Clay Bead – c.

Pottery recovered from the spoil zone represent a sample of all cultural materials from that area of the site disturbed by construction of the tidal canal. About 53% of this assemblage is comprised of diagnostic Refuge phase wares, while 24% are diagnostic Deptford phase wares. St. Simons phase and Wilmington phase pottery types each account for only 1% of the pottery. Although from a disturbed context, the pottery recovered from the spoil zone does indicate a significant occupation in the vicinity during the Deptford phase and at least some presence during the St. Simons and Wilmington phases.

Strata associated with the undisturbed shell mound were associated with Refuge phase pottery types to the near exclusion of other diagnostic wares. The assemblage was dominated by Refuge simple-stamped and bold simple-stamped pottery, together comprising about 89% of the analyzed sherds and 99% of the diagnostic wares. The plain sand-tempered sherds within this assemblage almost certainly represent the undecorated portions of simple-stamped vessels. Diagnostic Refuge minority pottery types within the shell mound strata consisted of a few fine-incised (cf. brushed or scratched) and dentate-stamped sherds, and these were encountered even more rarely in the upper levels. Only two Wilmington phase sherds, both plain, were identified in the lower levels and these were from 70–80cm b/d. The other two Wilmington phase sherds, both cord marked, were recovered from an upper level (25–30cm b/d). The few St. Simons phase fiber-tempered sherds in the test pit were found intermittently in both upper and lower excavation levels.

A concentration of Refuge bold simple-stamped sherds from a single pot was encountered in the undisturbed shell mound at a depth of 140cm to 150cm b/d. It was possible to refit several large sherds, allowing restoration of about 20% of the vessel – an open mouth cylindrical jar with a sub-conoidal base and patches of fire clouding (Figure 40). The mouth of the vessel was approximately 30cm in diameter with a flattened, simple-stamped lip, and slight constriction just below the rim. The walls gently curved inward towards the base of the vessel, which appears (based on projected curvatures) to have been a sub-conoidal form. The interior walls were smoothed and coil fractures leave no doubt that the vessel was made using a coiling technique. Stamping was parallel to a little oblique to the rim and rather carefully applied. The slightly irregular grooves of the stamped impressions are shallow and rounded, and are separated by narrow lands. Over-stamping occurs at the overlaps of the application instrument, which appears to have been a roulette that was carved to leave evenly spaced semi-circular raised bands or was tightly wrapped with a smooth and pliable vine or something similar. Use of a roulette tool rather than a paddle is indicated by the extended span of the impressions along the surface of the vessel. This interpretation is supported by the presence of simple stamping commonly seen on the curving interior surfaces of sherds representing the rims of other vessels, a decorative pattern that would be impossible to achieve on the interior of a vessel with a broad, flat paddle. An alternate possibility is that the simple stamping was produced with a scrap of coiled basketry. The reconstructed vessel certainly can be seen as mimicking the appearance of a coiled basket. However, mold impressions of the grooves revealed smooth, even surfaces with no apparent grain. Detailed ceramic technological analysis and experimental archaeology could help resolve questions about the manufacturing technology that was employed in the production of these simple-stamped pots.

Figure 40. Restored Portion of Refuge Bold Simple-Stamped Pot. Above – Simple-Stamped Lip Detail and Reconstructed Vessel Form.

Sherd hones and abraders (Figure 36) were encountered in both the shell mound and spoil strata, but were most common in the excavated levels of the shell mound where fired clay fragments also were more common (Figure 37). The only other ceramic artifact was an oval clay bead measuring 1.5cm in diameter and 2.6cm in length (Figure 39c). The bead was recovered from the 100–115cm b/d excavation level, within the upper-most shell mound stratum.

Stone artifacts were rare and limited to hammer stones (Figure 38) and fragments of Coastal Plain chert (cf. Allendale). Chipped stone tools and significant debitage were notable through their absence in Test Pit #1. These included a few unmodified flakes and, even more rarely, bifacial tool fragments. The only identifiable stone tools were the base of a stemmed drill recovered from the 205-220cm b/d excavation level and a utilized chert flake that may have been used as a cutting implement from the 125-135cm b/d excavation level. One cobble hammer stone fragment was recovered from the spoil zone, while two whole specimens and another fragment were recovered from the intact shell mound. Surface alterations on the ends and body of the cobbles indicate their use as hammering or pecking tools.

Aside from a tip fragment encountered in the spoil zone, the bone pins were recovered from the undisturbed shell mound. One complete and two broken bone pins were found between 115cm and 160cm b/d. One was decorated with finely engraved lines (Figure 39b).

Test Pit #2.

Only the root zone, to the upper surface of the shell midden (presumably the spoil zone) was excavated in this 2m square located adjacent to the tidal canal. Further work was halted at 30cm b/d due to intrusions of large roots in the underlying strata from nearby trees (Figure 41). The limited amount of cultural material recovered from Test Pit #2 included both prehistoric and historic artifacts.

Historic materials consisted of 2 rusted square nails, the cap of a 12 gauge shotgun shell, and 3 pieces of a kaolin pipe stem marked with GERMANY. The nails and pipe stem are probably associated with 19th century use of the high ground offered by the site near rice fields, while the shotgun shell reflects more recent use of the area for hunting.

Figure 41. Test Pit #2 showing Final Excavation (View to the Southeast).

Prehistoric artifacts from a variety of phases were represented in the small sample. Diagnostic Refuge phase pottery accounted 31% of the identified pottery, 38% was Deptford phase, 16% was Wilmington phase, 9% was associated with the late prehistoric Savannah and Irene phases (Table 9). The incurvate base (3.6cm wide) of a chert projectile point and a chert flake also were recovered. The raw material for both was Allendale chert. Amorphous fired-clay lumps, like those in Test Pit #1, also occurred in Test Pit #2. Neither sherd hones nor abraders were encountered.

Table 9. Ceramic Analysis, Test Pit #2.

Test Pit #2	**Total**	**Plain**	**Refuge**				**Deptford**		**Wilmington**		**Savannah**	**Irene**	**Total**	**Other**
Depth B/D	**ID**	Sand Temp	Simple Stamp	Bold Simple	Check Stamp	Dentate Stamp	Linear Check	Cord Mark	Plain	Cord Mark	Cord Mark	Comp Stamp	**Residual**	Fired Clay
10-~20 cm (Root Mat)	2	1 50%	-	-	-	-	-	-	-	-	1 50%	-	5	1
~20-30 cm	30	1 3%	6 20%	-	4 13%	-	11 37%	1 3%	3 10%	2 7%	-	2 7%	12	28
All Levels	32	2 6%	6 19%	-	4 13%	-	11 34%	1 3%	3 9%	2 6%	1 3%	2 6%	17	29

Test Pit #3.

Test Pit #3 (1m square) was excavated to a final depth of 100cm b/d, some 30cm below the ground water level (Figures 42 and 43). As with the previous test pits, a dense root zone covered underlying shell midden in this unit to a depth of 25-30cm b/d. Three strata were exposed beneath the root zone (Figure 44). The upper-most stratum was composed of grey sand containing dense shell (primarily oyster) to a depth ranging from about 60cm to 68cm b/d. The base of that stratum was defined by the top of a hard, cemented layer of sand and shell like that which occurred in patches at the water level in Test Pit #1. Other than being cemented due to fluctuating water levels, this layer was like the overlying grey sand with dense shell. These upper strata apparently represent spoil from the early 19th century excavation of the nearby tidal canal. Beneath the hard shell layer was a different stratum, originating below the water level and probably representing the upper-most part of the undisturbed shell mound, composed of brown sand with dense shell. Excavation was discontinued in this stratum to allow excavation of additional levels in Test Pit #1.

Figure 42. Test Pit #3 showing Southern Wall (View to the South).

Figure 43. Excavation at Test Pit #3 (View to the Northeast).

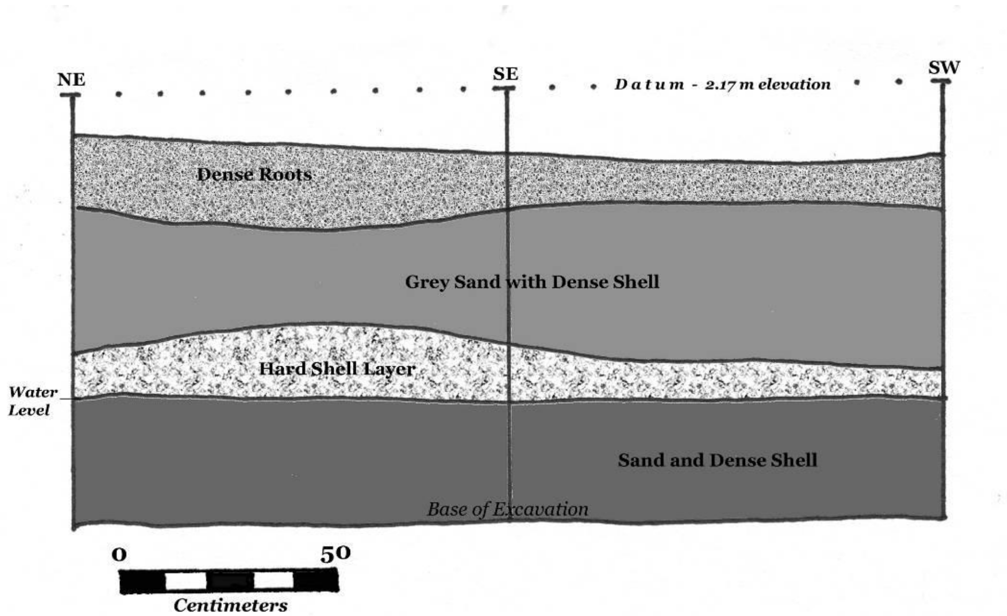

Figure 44. Profile of the East and South Walls of Test Pit #3.

The pottery identified from Test Pit #3 is listed in Table 10. The upper strata in this area was associated primarily with Refuge and Deptford ceramic types in frequencies roughly similar to those shown in the spoil zone of Test Pit #1. However, Refuge bold simple-stamped pottery was uncommon and Irene complicated-stamped sherds were completely absent in Test Pit #3, as was fiber-tempered pottery. Substantially more Wilmington cord-marked pottery was encountered among the 163 identified sherds, and pottery of the Mississippian Savannah phase occurred as minority types. Amorphous fired-clay lumps, like those in Test Pit #1, also occurred in small numbers in Test Pit #3. Neither sherd hones nor abraders were encountered. Non-ceramic artifacts within the assemblage were limited to the head of a small bone pin (85-100cm b/d) and a single chert flake (cf. Allendale) from the root zone. Historic materials also were rare, consisting of unidentified rusted metal fragment and brick fragment from the root zone, along with a rusted square nail from the 40-50cm b/d excavation level.

Table 10. Ceramic Analysis, Test Pit #3.

Test Pit #3	**Total**	**Plain**	**Refuge**			**Deptford**			**Wilmington**		**Savannah**			**Total**	**Other**
Depth B/D	**ID**	Sand Temp	Simple Stamp	Bold Simple	Dentate Stamp	Check Stamp	Linear Check	Cord Mark	Plain	Cord Mark	Burnish Plain	Check Stamp	Cord Mark	**Residual**	Fired Clay
10-~26 cm (Root Mat)	9	2 18%	4 44%	-	-	-	-	-	-	1 11%	1 11%	1 11%	-	8	-
~26-40 cm	27	3 11%	4 15%	1 4%	2 7%	13 48%	-	-	-	4 15%	-	-	-	7	-
40-50 cm	37	2 5%	9 24%	-	-	2 5%	11 30%	-	1 3%	11 30%	-	-	1 3%	1	1
50-60 cm	23	3 13%	2 9%	2 9%	-	6 26%	3 13%	4 17%	-	3 13%	-	-	-	5	1
60-~68 cm	11	2 18%	3 27%	-	-	2 18%	1 9%	-	-	3 27%	-	-	-	3	-
~68-85 cm (hard shell)	33	6 18%	9 27%	-	-	5 15%	7 21%	4 12%	-	2 6%	-	-	-	3	-
~85-100 cm	24	5 21%	5 21%	-	-	-	13 54%	-	-	1 4%	-	-	-	2	-
All Levels	163	23 14%	36 22%	3 2%	2 1%	28 17%	35 21%	8 5%	1 <1%	25 15%	1 <1%	1 <1%	1 <1%	29	2

Human Remains

Human skeletal remains were encountered in Test Pit #1 and #3. These were identified during the analysis of faunal remains by Steven Hale (Zooarchaeologist, Georgia Southern University) and those from Test Pit #3 subsequently were examined by Julie Wieczkowski (Physical Anthropologist, University of West Georgia).

The human remains in Test Pit #1 consisted of two fragments encountered during excavation of the shell mound strata. A burned diaphysis (long-bone) fragment, in two pieces, was recovered from the 230-240cm b/d excavation level. A second burned diaphysis fragment, probably from the same bone, also was recovered from the 240-250cm b/d excavation level. Further analysis of these small fragments is unlikely to yield additional information. However, their association with the undisturbed Refuge phase shell mound is unmistakable.

The human remains in Test Pit #3 consisted of 11 fragments of 8 identifiable skeletal elements that were distributed throughout the levels excavated within the Grey Sand with Dense Shell stratum of spoil, but were concentrated within the 40-50cm b/d level. The identified element fragments were from a tibia, metatarsal, phalange, scapula, rib, cuneiform, talus, and parietal. The remains appear to be from at least two individuals, one an adult and the other a sub adult to young adult (based upon the medial condyle of a right tibia, without the epiphysis). No skeletal abnormalities or modifications were observed and sex determination was not possible given the nature of the remains.

The skeletal remains in Test Pit #3 apparently were not contained within a burial pit, grave, or other interment feature. Rather, the scattered human bone fragments were in common association with other cultural material within the spoil zone represented in the stratum. An original association with shell mound strata that were destroyed by 19^{th} century construction of the nearby tidal canal is strongly suspected. However their connection with slave deaths which occurred during the Plantation period due to the exceptionally harsh labor demands associated with clearing and construction activities cannot be dismissed.

Human skeletal fragments are sometimes found within the general shell midden refuse at other Late Archaic and Early Woodland period sites in the region. Waring reported at least fifteen identifiable human bone fragments from various points within his excavation at the Bilbo site. He concluded (Waring 1977c: 157) that "All of these bones were cracked and several fragments were burned. The fact that no burials were found seemed to indicate that these bones did not come from disturbed burials." Similarly, human bone fragments have been identified from Late Archaic period contexts at the Sapelo Island Shell Ring (Waring and Larson 1977). Disarticulated human remains representing at least four individuals also were encountered at White's Mound, located well inland along the Savannah River near the Fall Line, in a deposit associated with check-stamped, cord-marked and simple-stamped pottery (similar to the Refuge and Deptford ceramic assemblages) of the Early Woodland period. Phelps and Burgess (1964) tentatively concluded that these remains were evidence of cannibalism.

Faunal Analysis

The faunal remains recovered from the Delta site were submitted to Steven Hale (Zooarchaeologist, Georgia Southern University) for analysis. These consisted of faunal remains from standard excavation levels using ¼-inch mesh screen, along with several fine-fraction samples. The identified taxa from all contexts are shown in Table 11.

Table 11. Identified Fauna from the Delta Site.

Scientific Name	Common Name	*Scientific Name*	Common Name
Odocoileus virginianus	White-tailed Deer	Osteichthyes	Bony Fish
Procyon lotor	Raccoon	*Lepisosteus* sp.	Gar
Sylvilagus sp.	Rabbit	*Acipenser brevirostris*	Short-Nosed Sturgeon
Didelphis virginiana	Opossum	*Caranyx* sp.	Ulua or Jack
Mammalia	Mammal	*Amia calva*	Bowfin
Rodentia	Rodent	Siluriformes	Catfish
		Arius (Gaieichthyes) felis	Sea Catfish
Aves	Bird	*Bagre marinus*	Gaftopsail Catfish
Passeriformes	Perching Bird	*Ictalurus*	Freshwater Catfishes
		Pogonias cromis	Black Drum
Alligator mississippiensis	American Alligator	*Cynoscion nebulosus*	Spotted Seatrout
Testudines	Turtles	Centrarchidae	Sunfish
Emydidae	Pond Turtles	*Carcharhinus*	Requiem Shark
Chelydra serpentina	Common Snapping Turtle	*Dasyatis sabina*	Atlantic Stingray
Deirochelys reticularia	Chicken Turtle		
Malaclemys terrapin	Diamondback Terrapin	*Viviparus georgianus*	Banded Mysterysnail
Terrapene carolina	Eastern Box Turtle	*Polygyra* sp.	Snails
Kinosternon	Mud Turtle	*Balanus* sp.	Barnacles
Trachemys sp.	Slider	*Geukensia demissa*	Ribbed Mussel
Apalone ferox	Softshell Turtle	*Tagelus plebeus*	Stout Tagelus
Serpentes	Snakes	*Elliptio* sp.	Freshwater Mussel
Colubridae	Non-venomous Snakes	*Crassostrea virginica*	Eastern Oyster
Viperidae	Venomous Snakes		
		Callinectes sapidus	Blue Crab

Fauna in the Delta shell mound were diverse, reflecting intense utilization of the tidally influenced freshwater and estuarine habitats occurring near the site. Thirty-five vertebrate forms were identified to the lowest reliable taxon. These represent animals from high-ground forest environments, estuarine and riverine wetlands, and brackish to freshwater rivers.

The faunal analysis results for Test Pit #1 are shown in Tables 12 and 13. The mammalian food remains were white-tailed deer, opossum, raccoon, and rabbit. Several unidentified birds also were represented, as well as one alligator. Turtles were all freshwater or estuarine species common to the mouth of the Savannah River and its wetlands. The terrapins and mud turtles were particularly common in the midden, indicating that stream banks and wetlands were important habitats in the subsistence economy. Nearby waters also were home to fish species common in the Refuge phase strata, with estuarine catfishes and the freshwater bowfin being well represented in

Table 12. Identified Vertebrate Fauna by Number of Bone Fragments (FRG), Test Pit #1.

Classification		Upper Spoil Zone 2m x 2m Unit	Undisturbed Shell Mound																
			2m x 2m Unit									1m x 2m Unit [Fine Fraction - (#)]						FRG	
		~25-100 cm Combined Levels	100 115	115 125	125 135	135 145	145 160	160 170	170 185	185 200	Sondage 200-260	205 220	220 230	230 240	240 250	250 260	260 270	#	%
Odocoileus	*virginianus*	9			3	1	3	5	5	10	4		4	3	2(1)	1	4	46	13.4
Procyon	*lotor*	3			1	1	3								2			7	2.0
Sylvilagus	sp.	1										(1)		1	1			3	0.9
Didelphis	*marsupialis*							3	3	2			1	1				10	2.9
Rodentia																	(1)	1	0.3
Passeriformes													(1)			(1)		2	0.6
Aves				1			2		2	2				1		1	1	10	2.9
Colubridae													1		2		3	6	1.7
Viperidae																2		2	0.6
Serpentes															(2)			2	0.6
Alligator	*mississippiensis*		1															1	0.3
Testudines		7										1			16	7(1)		25	7.3
Trachemys	sp.												1	1				2	0.6
Chelydra	*serpentina*					2								2				4	1.2
Deirochelys	*reticularia*						2	3										5	1.5
Malaclemys	*terrapin*			1	2		5		2					1		1		12	3.5
Terrapene	*carolina*	1			1				8	4	2						9	24	7.0
Kinosternon				1	1	6	14						1			1	12	36	10.5
Lepisosteus	sp.						1					(6)	4(17)	7(7)	1(7)	2(3)	4(2)	61	17.8
Caranyx	sp.												1					1	0.3
Amia	*clava*						4		1	1								6	1.7
Siluriformes													(2)		4(1)		(3)	10	2.9
Arius (Galeichthyes)	*felis*				1	1	2							(8)		(7)		19	5.5
Bagre	*marinus*	1			1					3			5	6		9	17	41	12.0
Ictalurus											1							1	0.3
Pogonias	*cromis*													1				1	0.3
Cynoscion	*nebulosus*	1		1														1	0.3
Centrarchidae										1								1	0.3
Carcharhinus						1				1								2	0.6
Dasyatis	*sabina*												1					1	0.3
																Total FRG		343	100.1

Table 13. Identified Vertebrate Fauna by Minimum Number of Individuals (MNI), Test Pit #1.

Classification		Upper Spoil Zone 2m x 2m Unit	Undisturbed Shell Mound																
			2m x 2m Unit									1m x 2m Unit [Fine Fraction = (#)]						MNI	
		~25-100 cm Combined Levels	100 115	115 125	125 135	135 145	145 160	160 170	170 185	185 200	Sondage 200-260	205 220	220 230	230 240	240 250	250 260	260 270	#	%
Odocoileus	*virginianus*	5			1	1	1	1	1	4	1		1	1	1(1)	1	1	15	14.0
Procyon	*lotor*	3			1	1	1								1			4	3.7
Sylvilagus	sp.	1										(1)		1	1			3	2.8
Didelphis	*marsupialis*							2	1	2			1	1				7	6.5
Rodentia																	(1)	1	0.9
Passeriformes													(1)			(1)		2	1.9
Aves				1			1		1	1				1		1	1	7	6.5
Colubridae													1		1		1	3	2.8
Viperidae																1		1	0.9
Serpentes															(1)			1	0.9
Alligator	*mississippiensis*		1															1	0.9
Testudines		2										1			1	(1)		3	2.8
Trachemys	sp.												1	1				2	1.9
Chelydra	*serpentina*					1								1				2	1.9
Deirochelys	*reticularia*						1	1										2	1.9
Malaclemys	*terrapin*			1	1		1		1					1		1		6	5.6
Terrapene	*carolina*	1			1				1	2	1						1	6	5.6
Kinosternon				1	1	1	1						1			1	1	7	6.5
Lepisosteus	*sp.*						1					(1)	1(1)	1(1)	1(1)	1(1)	1(1)	7	6.5
Caranyx	*sp.*												1					1	0.9
Amia	*clava*						1		1	1								3	2.8
Siluriformes													(1)		1(1)		(1)	3	2.8
Arius (Galeichthyes)	*felis*				1	1	1							(1)		(1)		5	4.7
Bagre	*marinus*	1			1					1			1	2		1	2	8	7.5
Ictalurus											1							1	0.9
Pogonias	*cromis*													1				1	0.9
Cynoscion	*nebulosus*	1		1														1	0.9
Centrarchidae										1								1	0.9
Carcharhinus						1				1								2	1.9
Dasyatis	*sabina*												1					1	0.9
																Total MNI		107	99.6

the midden deposits. Gars also are well represented and today are found throughout the year in the lower Savannah River. An unidentified species of requiem shark, a family known to visit inshore waters, as well as Atlantic stingray were represented in small numbers.

The faunal analysis results for Test Pit #3 are shown in Tables 14 and 15. The variety of species is comparable to that found in the larger sample from Test Pit #1, except fish remains were completely absent. White-tailed deer dominated the mammalian assemblage, and raccoon and opossum were also represented. The remains of an unidentified bird occurred, along with one element from an alligator. Other than terrapins, the only turtles identified were a freshwater chicken turtle and a softshell turtle.

Table 14. Vertebrate Fauna by Number of Bone Fragments (FRG), Test Pit #3.

Classification		**Excavation Level, cm b/d**						**FRG**	
Genus	**species**	**~26-40**	**40-50**	**50-60**	**60-~68**	**~68-75**	**75-100**	**#**	**%**
Odocoileus	*virginianus*		2	2		1	5	10	23.8
Procyon	*lotor*		1					1	2.4
Didelphis	*virginiana*		1				2	3	7.1
Mammalia		2					2	4	9.5
Aves		1						1	2.4
Alligator	*mississippiensis*					1		1	2.4
Testudines						1		1	2.4
Emydidae		1		3	1		1	6	14.3
Deirochelys	*reticularia*						3	3	7.1
Malaclemys	*terrapin*	3	2			1	2	8	19.0
Terrapene	*carolina*			1	2			3	7.1
Apalone	*ferox*					1		1	2.4
							Total FRG	42	99.9

Table 15. Vertebrate Fauna by Minimum Number of Individuals (MNI), Test Pit #3.

Classification		**Excavation Level, cm b/d**						**MNI**	
Genus	**species**	**~26-40**	**40-50**	**50-60**	**60-~68**	**~68-75**	**75-100**	**#**	**%**
Odocoileus	*virginianus*		1	1		1	1	4	17.4
Procyon	*lotor*		1					1	4.4
Didelphis	*virginiana*		1				1	2	8.7
Mammalia		1					1	2	8.7
Aves		1						1	4.4
Alligator	*mississippiensis*					1		1	4.4
Testudines						1		1	4.4
Emydidae		1		1	1			3	13.0
Deirochelys	*reticularia*						1	1	4.4
Malaclemys	*terrapin*	1	1			1	1	4	17.4
Terrapene	*carolina*			1	1			2	8.7
Apalone	*ferox*					1		1	4.4
							Total MNI	23	100.3

Shellfish.

The principal constituents, by sheer volume, of the Delta shell mound were oyster (*Crassostrea virginica*), a familiar estuarine shellfish, and eastern elliptio (*Elliptio icterina* complex), a common freshwater mussel. Also known as a freshwater clam or variable spike, modern populations of eastern elliptio are found in patches or beds in a variety of wetland habitats. Their preferred habitat appears to be on a stable substrate of relatively firm silty sand in shallow waters (< 1m deep) that are protected from fast-moving flood waters (Fuller 1971; Patrick, Cairns, and Roback 1967; Strayer 1999). Ribbed mussel (*Geukensia demissa)* and stout tagelous (*Tagelus plebeus*), both estuarine species, were present in much smaller numbers. Quahog clams (*Merceraria mercenaria*), usually well represented in other coastal shell middens, were absent at the Delta site.

The eastern elliptio (Figure 45) was better represented in the midden deposits than was first apparent. Their thin, fragile shells usually survived only as fragments. A sample of shell fragments collected (retained by ¼" mesh screen) from an excavation level (80-90cm b/d) in the spoil zone in Test Pit #1 was sorted to obtain an estimate of the relative frequency of oysters and eastern elliptio. By weight (total of 1256 grams), 77% of the shell fragments were from oysters and 23% from mussels. However, oyster shells are bigger and much heavier than those of eastern elliptio. To roughly estimate the number of whole bivalve shells represented by the fragments for each, measurements were made on small samples (N = 4 of each) of intact oyster shells (averages: height = 84mm; length = 48mm; shell weight = 51.2gm) and elliptio shells (averages: height = 30mm; length = 53mm; shell weight = 12.5gm) from Test Pit #1 and applied to the weights of the shell fragments. Based on these figures, 11.7 oysters and 14.3 elliptio are represented by the fragments in the sample. Expressed another way, these calculations suggest that eastern elliptio account for about 55% of the bivalve shells in the sample, while 45% of the shells are from oysters.

Figure 45. Eastern Elliptio (modern sample).

To determine if a similar pattern was expressed in the undisturbed shell mound, shell samples were analyzed from two excavation levels (250-260cm b/d and 260-270cm b/d). Each sample is defined by the shell debris retained by ¼-inch mesh screen from approximately 20 liters of midden within each excavation level. The analysis results (Tables 16 and 17) indicate that oyster and eastern elliptio also are predominate molluscan species in these levels of the shell mound. The 250-260cm b/d sample contained 2919.8g of oyster shell and 254.1g of elliptio shell. Converting to number of shells as calculated above, this would represent 57.0 oysters and 20.3 eastern elliptio, or about 74% oysters and 26% elliptio. The 260-270cm b/d sample contained 3464.5g of oyster shell and 227.5g of elliptio shell. This would represent 67.7 oysters and 18.2 eastern elliptio, or about 79% oysters and 21% elliptio. These results indicate that estuarine oysters were the primary bivalve mollusk represented in these levels of the undisturbed shell mound, while freshwater eastern elliptio contributed substantially to the midden content. Other estuarine bivalves identified in the samples, in far fewer numbers, were ribbed mussel and stout tagelus.

Table 16. Whole-Screen Shell Sample, Test Pit #1 (250-260cm b/d).

Genus	species	Fragments	Percent	Grams	Percent	MNI	Percent	Element
Viviparus	*georgianus*	8	0.07%	3.9	0.12%	1	3.03%	Gastropod tests
Viviparus	*georgianus*	3	0.02%	0.3	0.01%	0	0.00%	Whorls
Total	Snails	11	0.09%	4.2	0.13%	1	3.03%	
Ellipteo	sp.	5	0.04%	15.3	0.48%	0	0.00%	Valves (Left)
Ellipteo	sp.	8	0.07%	19.0	0.60%	8	24.24%	Valves (Right)
Ellipteo	sp.	509	4.14%	219.8	6.89%	0	0.00%	Valves
Geukensia	*demissus*	37	0.30%	7.6	0.24%	0	0.00%	
Tagelus	*plebeus*	1	0.01%	3.0	0.09%	1	3.03%	Valves (Left)
Crassostrea	*virginica*	11,683	95.03%	2522.0	79.09%	0	0.00%	Valves
Crassostrea	*virginica*	22	0.18%	178.0	5.58%	22	66.67%	Valves (Right)
Crassostrea	*virginica*	17	0.14%	219.8	6.89%	0	0.00%	Valves (Left)
Total	Bivalvia	12,282	99.90%	3184.5	99.86%	31	93.94%	
Balanus	sp.	1	0.01%	0.2	0.01%	1	3.03%	
Total	Commensals	1	0.01%	0.2	0.01%	1	3.03%	
Grand Total	Invertebrates	12,294	100.00%	3,188.9	100.00%	33	100.00%	

Table 17. Whole-Screen Shell Sample, Test Pit #1 (260-270cm b/d).

Genus	species	Fragments	Percent	Grams	Percent	MNI	Percent	Element
Viviparus	*georgianus*	7	0.03%	2.8	0.08%	0	0.00%	Whorls
Total	Snails	7	0.03%	2.8	0.08%	0	0.00%	
Ellipteo	sp.	25	0.12%	48.5	1.30%	25	39.68%	Valves (Left)
Ellipteo	sp.	23	0.11%	46.8	1.26%	0	0.00%	Valves (Right)
Ellipteo	sp.	407	2.03%	132.8	3.57%	0	0.00%	Valves
Geukensia	*demissus*	36	0.18%	11.8	0.32%	1	1.59%	Valves
Tagelus	*plebeus*	3	0.01%	3.0	0.08%	3	4.76%	Valves (Right)
Tagelus	*plebeus*	3	0.01%	4.9	0.13%	0	0.00%	Valves (Left)
Tagelus	*plebeus*	3	0.01%	2.9	0.08%	0	0.00%	Valves
Crassostrea	*virginica*	19,491	97.16%	2,522.0	67.83%	0	0.00%	Valves
Crassostrea	*virginica*	31	0.15%	588.0	15.81%	31	49.21%	Valves (Right)
Crassostrea	*virginica*	29	0.14%	354.5	9.53%	0	0.00%	Valves (Left)
Total	Bivalvia	20,051	99.95%	3,715.2	99.92%	60	95.24%	
Polygyra	sp.	3	0.01%	0.1	0.00%	3	4.76%	
Total	Commensals	3	0.01%	0.1	0.00%	3	4.76%	
Grand Total	Invertebrates	20,061	100.00%	3,718.1	100.00%	63	100.00%	

Gastropods encountered in the shell mound deposits included banded mysterysnails (*Viviparus georgianus*), barnacles (*Balanus* sp.), and small terrestrial snails (*Polygyra* sp.). A single whelk (*Busycon* sp.) also was encountered in the surface level of the spoil zone, however its original association is unclear. The mysterysnails occurred throughout the midden deposits. These freshwater snails (Figure 46) live in a wide range of aquatic habitats, including in shallow waters with the eastern elliptio, and isolated local populations can be quite distinctive (Thompson 2004). The size (typically 1.5cm to 3.0cm in height) and persistence of the banded mysterysnails throughout the excavated levels of the Delta shell mound suggests that may have been collected along with elliptio and have been of limited dietary importance (see also Bobrowsky 1984). The remaining gastropods within the shell mound – the barnacles and small snails – represent non-food fauna. Barnacles were rare in the Delta samples. Their low numbers, occurring unattached and attached to their oyster hosts, may be an indication that the oysters were collected from low-salinity estuarine waters. Small snails (*Polygyra* sp.) were regularly found within the midden deposits. These air-breathing land snails would have been attracted to the organic debris within the shell mound, and indicate that midden accumulation was in a moist, open-air environment.

Figure 46. Banded Mysterysnail (modern).

Impressed odostomes (*Boonea impressa*) were identified in the fine-fraction samples. The absence of this tiny oyster parasite in the shell midden deposits of the Bilbo site was discussed previously. Their presence at the Delta site provides the evidence needed to examine seasons and duration of oyster collection (see later discussion).

Crustacea were represented in the midden deposits of the Delta site by a single species, the blue crab (*Callinectes sapidus*). The claw-finger fragments of this species were recovered from both upper and lower strata in Test Pit #1, but none was observed in Test Pit #3. Blue crabs inhabit a range of habitats in estuarine waters, from salty to brackish, and commonly are found in nearby freshwaters as well.

Faunal Analysis of Core Samples.

The samples from Core C of Test Pit #1 were processed to recover shell fragments and other faunal remains. Although the 3-inch core provided small sample sizes, they do offer evidence about faunal remains represented in the lower levels of the shell mound (Figure 18). The shell fragments were recovered from the core samples with a 4.0mm sieve, while fragments of other fauna were recovered using a 0.5mm sieve.

Shell debris in the cores extended through the lower portion of the shell mound and into the layer mixed with soft silt and clay. These indicate an assemblage essentially like that found in the upper portions of the shell mound. Elliptio and oyster shell again dominated the shell matrix, occurring in varying percentages in Core-C levels of the shell mound. Shell fragments of mysterysnail were represented in all but one of the lower shell mound levels, and in one of the mixed silt and clay levels. Land snails, barnacles, and ribbed mussels were encountered only in the shell mound deposits.

Other fauna represented in the core samples were like those encountered in the upper excavation levels of the shell mound. The remains of gar and saltwater catfishes were well represented in the core samples. Only one additional fish species, the short-nosed sturgeon, was found only in the core samples. This species (now rare and endangered) is semi-anadromous, spawning upstream during the Spring and migrating to the freshwater/saltwater interface during the late Spring and Summer months.

Table 18. Faunal Analysis, Core C of Test Pit #1.

TEST PIT #1 - CORE C		Shell - 4.0mm Sieve						Other Fauna - 0.5mm Sieve											
		Viviparus georgianus	*Polygyra sp.*	*Balanus sp.*	*Geukensia demissa*	*Elliptio sp.*	*Crassostrea virginica*	*Callinectes sapidus*	Osteichthyes	*Bagre marinus*	*Arius (Galeichthyes) felis*	*Lepisosteus sp.*	*Accipenser brevirostris*	Testudines	Kinosternidae	Colubridae	Serpentes	Rodentia	UNID *Vertebrata*
Sample Depth b/d	Strata Description	# (grams)	# (grams)	# (grams)	# (grams)	# (grams)	# (grams)												
#1 270-290cm	Shell Midden	1 (0.6)	1 (0.6)	-	6 (0.2)	170 (29.8)	366 (68.7)		✓					✓					
#2 290-298cm	Shell Midden	4 (1.5)	1 (0.1)	1 (0.1)	11 (0.3)	438 (75.2)	247 (80.4)	✓	✓		✓			✓					✓
#3 298-320cm	Shell Midden	12 (2.8)	1 (0.1)	-	9 (0.9)	780 (108.7)	624 (101.5)		✓		✓				✓				
#4 & #5 320-332cm	Shell Midden	5 (1.1)	1 (0.1)	2 (0.1)	3 (0.1)	746 (105.0)	1399 (198.5)		✓	✓		✓	✓	✓			✓		✓
#6 332-345cm	Shell Midden	2 (0.7)	1 (0.1)	-	-	210 (31.0)	389 (65.8)				✓	✓							✓
#7 345-353cm	Shell Midden	2 (0.1)	-	-	-	212 (37.1)	1068 (186.3)		✓			✓				✓			✓
#8 353-359cm	Shell Midden	-	-	-	-	97 (11.0)	247 (80.4)					✓						✓	✓
#9 359-367cm	Shell Midden	7 (2.8)	-	-	36 (11.8)	25 (48.5)	281 (193.6)					✓							✓
#10 367-382cm	Shell Midden	1 (0.2)	-	-	-	69 (10.9)	517 (139.1)		✓			✓							✓
#11 382-400cm	Base of Shell Midden	12 (0.6)	-	-	-	272 (29.5)	337 (105.6)												✓
#12 400-405cm	Base of Shell Midden & Bank Interface	-	-	-	-	155 (23.3)	208 (63.2)												✓
#13 405-409cm	Silt/Clay w/ Intrusive Shell Midden	-	-	-	-	62 (11.6)	85 (23.0)												✓
#14 409-433cm	Clay/Silt w/ Intrusive Shell Midden	-	-	-	-	21 (4.7)	77 (29.6)		✓										✓
#15 433-457cm	Clay/Silt w/ Intrusive Shell Midden	2 (0.1)	-	-	-	67 (8.0)	179 (33.5)				✓								
#16 357-470cm	Clay	-	-	-	-	-	-												

Odostome Analysis.

Impressed odostomes (*Boonea impressa*) were sorted from the shell matrix recovered from 20-liter fine-screened (1/16" mesh) samples taken from several excavation levels in Test Pit #1 to determine the seasons and duration of oyster collection. Fine-screened material that passed through the 1/16" mesh also was examined in those samples obtained from the lower excavation levels (205cm – 270cm b/d) to determine if even smaller odostomes were present. While fragments were detected, no additional whole odostomes were found. The length of each odostome was measured using a binocular microscope fitted with an ocular scale and the data were summarized using *Minitab 14* statistical software. The statistical results then were compared to the odostome data presented by Russo (1991) to calculate the harvest periods for oysters represented in the midden deposits.

The analysis results are summarized in Table 19. These data indicate that oysters in the shell mound usually were harvested in September and October, with collection activities sometimes occurring as early as July and as late as December. Another pattern shown in the odostome distribution is a general decline in the number of odostomes in the samples obtained from the deeper shell mound levels. This may indicate that exploited oyster communities (and their associated environmental conditions) were becoming more suitable to colonization by odostomes over time, resulting in increasing odostome population numbers. Although the samples were small, it may be significant that odostomes were absent in the basal shell mound deposits represented in Core C.

Table 19. Oyster Harvest Periods from Impressed Odostome Analysis.

Depth b/d	N	Mean Length +/- 1σ	June	July	Aug	Sept	Oct	Nov	Dec
Upper Spoil Zone									
40-50 cm	28	4.17 +/-. 71 mm		○	○		●		
50-60 cm	35	3.99 +/- .65 mm				●	●		
60-70 cm	13	4.20 +/- .48 mm				●			
70-80 cm	52	4.20 +/- .69 mm				●	●		
80-90 cm	17	4.41 +/- .75 mm			○		●	○	
Undisturbed Shell Mound									
145-160 cm	82	4.19 +/- .57 mm				○	●		
160-170 cm	101	4.05 +/- .67 mm				●	●		
205-220 cm	28	3.66 +/- .74 mm			●	●	●		○
220-230 cm	21	4.10 +/- .77 mm				○	●		
230-240 cm	15	3.85 +/- .73 mm			○	●	●	●	
240-270 cm*	14	3.80 +/- .62 mm			○	●			
*Combined excavation levels			● Primary Association ○ Secondary Association						

Analysis of Oyster-Community Sources.

The left valves of whole oysters represented in five excavation levels of Test Pit #1 were measured to assess the type of natural community from which they were harvested, using the analysis of variance methods outlined in Crook (1992). Comparisons of the height-to-length ratios between the archaeological oysters and the modern reference oysters collected from different community types were made using *Minitab 14* statistical software. With significance levels established at 0.05, matches (=) were defined when the null hypothesis of equivalent variances failed to be rejected. Non-equivalent (≠) sample variations were determined when the null hypothesis was rejected (Table 20).

The analysis results indicate that oysters from the entire range of community types were collected during occupations at the Delta site. While tolerant for short periods to influxes of freshwater, *Crassostrea virginica* favors two salinity zones: high salinity (18 ‰ – 30 ‰) polyhaline zones, and lower salinity (5 ‰ – 18 ‰) mesohaline zones (Galtsoff 1964: 404-406). The larger, more densely populated, communities of bank and reef oysters would have been located along polyhaline tidal streams in salt marsh areas downstream from the shell mound. Additional access to rich oyster communities would have been offered in the lower reaches of the Wright River, a tidal stream located just east of the Delta site. However smaller communities, including single and cluster oysters, could have been found along streams and the main river channels in mesohaline areas of lower salinity bordering tidal freshwater marshes located closer to the Delta site. Those oysters associated with the sampled level of the intact shell mound, like most of those from Shell Mound I at Bilbo, were harvested exclusively from single and cluster communities.

Table 20. Oyster-Community Analysis Results.

Test Pit #1 Excavation Level	Number of Valves	Mean Height (mm)	Mean Length (mm)	Ratio H / L	Oyster Community Type			
					Single	Cluster	Bank	Reef
Spoil Zone								
50-60 cm b/d	99	74.3 ± 15.8	45.7 ± 9.0	1.7 ± 0.3	=	=	≠	≠
60-70 cm b/d	111	67.4 ± 13.8	42.7 ± 7.7	1.6 ± 0.3	=	=	≠	≠
70-80 cm b/d	76	84.1 ± 13.8	46.9 ± 8.6	1.8 ± 0.4	≠	=	=	≠
80-90 cm b/d	89	73.3 ± 17.3	45.2 ± 8.8	1.6 ± 0.3	=	=	≠	≠
90-100 cm b/d	40	77.4 ± 15.2	45.0 ± 9.5	1.8 ± 0.5	≠	≠	=	=
Shell Mound								
160-170 cm b/d	127	68.8 ± 11.6	43.7 ± 7.6	1.6 ± 0.5	=	=	≠	≠

Macrobotanical Analysis

Sorted botanical samples and several unprocessed midden and sediment samples were submitted to Lee A. Newsom (Environmental Archaeology Laboratory, The Pennsylvania State University) for macrobotanical analysis. The analysis was completed under her supervision by Logan Kistler. The results presented below are derived from his report (Kistler 2009).

The analyzed botanical materials were from three different recovery contexts (see Figure 29 and Table 21) within Test Pit #1:

- Bulk Samples #1 - #7 were taken directly from the freshly troweled profile of the northern wall of the test pit. These were submitted without sorting for processing and analysis. Sample #1 was located at the base of the standard excavation and Sample #6 at the upper-most part of the undisturbed shell mound. Each of these samples was below the current ground water. Sample #7 was taken from a layer of spoil deposited immediately on top of the shell mound and contains vegetative material that was on the ground surface just prior to construction of the 19th century tidal rice field. Two of the bulk samples contained material from cultural features. Sample #3 includes material from around (#3.1) and within (#3.2) a lense of soft clay. Sample #5 recovered material from a shell lense which may reflect a single episode of refuse deposition within the shell mound.
- Botanical remains were sorted and submitted for analysis from the lower excavation levels (reduced to 1m x 2m) within the test pit, extending from 205cm to 270cm b/d. These consisted of materials recovered by water screening the fill of each excavation level through ¼" screen as well as fine-fraction samples from midden that passed through the ¼" screen for each level. Numerous hackberry (*Celtis* sp.) seeds, naturally occurring in the site environment during excavation, were introduced into the fine-fraction samples as a consequence of water screening with locally pumped water. These obvious contaminates have been omitted from the analysis results.
- Botanical remains from Core C in Test Pit #1 were sorted and submitted for analysis. The samples were collected with a 3" bucket auger from submerged strata below the base of the standard excavation, at depths extending from 270cm to 470 cm b/d. Samples C-1 through C-10 are from dense shell mound deposits. The base of the shell mound, at approximately 4m below datum, is represented in Cores C-11 and C-12; with C-12 defining the interface between the shell mound and the creek bank or tidal mud flat upon which it was originally formed. Samples C-13 through C-15 are defined by silts and clays containing shells and other midden

debris which sank or otherwise intruded into these sediments. Core C-16 is defined by dense, dark brownish grey clay. Each core sample was processed through a 0.05mm mesh sieve prior to sorting.

Presorted samples from Core C and from the excavation levels of Test Pit #1 were scanned for potentially informative plant remains. Bulk Samples #1 through #7 (unsorted) were divided into size fractions (4mm, 2mm, 1mm, and 0.42mm) by gentle washing through a series of nested geological sieves. The size fractions were then processed using standard archaeobotanical procedures to recover potentially identifiable plant remains for analysis.

The sorted plant remains were identified to the lowest possible taxonomic level using published seed manuals (Baxter and Copeland 2008; Delorit 1970; Martin and Barkley 1961), relevant floras (Godfrey and Wooten 1979; Godfrey and Wooten 1981; Radford et al. 1968), and comparative collections housed in the Environmental Archaeology Laboratory. The floras also provided data regarding habit and habitat discussed below. Most taxa were assigned to the level of family, and many were definitively or provisionally identified to the finer rank of genus or species. Four unidentified, yet morphologically distinct, propagules received the designation "UNID seed/fruit" and a UNID number. These taxa have been described and recorded, and taxonomic classifications may be assigned upon further analysis. An example, UNID seed/fruit taxon 1, is shown in Figure 47. Indistinct unidentified materials are lumped in broader UNID categories according to the type of material, and are considered unidentifiable. For the following, all items designated "cf." during analysis (indicating a provisional or tentative identification) are treated as accurate.

Figure 47. UNID Seed/Fruit Taxon 1. Single Specimen from 3 Angles, 22x.

The frequencies and distributions of plant materials recovered from the samples are presented in Table 22. Altogether, 624 botanical items, including 241 seeds and 182 nutshell fragments, were recovered and analyzed. Hickory nut (*Carya* sp.) and acorn (*Quercus* sp.) were fairly abundant throughout the assemblage. Hickory nut was especially prevalent with greater than 76% ubiquity among the samples.

In addition to seeds and nutshell, small amounts of carbonized and uncarbonized wood were recovered, representing at least seven additional taxa. Ash (*Fraxinus* sp., white anatomical group) was the most abundant and most ubiquitous wood taxon, occurring in 60% of samples. Oak (including *Quercus* sp. and *Quercus virginiana*, live oak) occurred in three samples, and the pecan group of hickory was represented in a single sample. Presence of oak and hickory is consistent with the nutshell assemblage. Two taxa were each assignable to two possible genus identifications, but the samples are not further distinguishable. Hackberry or redbud (*Celtis* sp. or *Cercis* sp.) is one of these, and sweetgum or tulip poplar (*Liquidambar* sp. or *Liriodendrom* sp.) is the other. Other wood taxa occurring sporadically include hornbeam (*Carpinus* sp.), holly (*Ilex* sp.), black cherry (*Prunus serotina*), and bald cypress (*Taxodium* sp.). Bald cypress is the only conifer in the assemblage.

Other miscellaneous plant materials also were present in the samples. These consisted of tendrils, scales, stems, thorns, and other tissues, perhaps including tuber remains, some of which were identifiable to various taxonomic levels. Plants with diverse growth habits were represented, including trees, shrubs, vines, lianas (woody vines), and terrestrial and aquatic herbs.

The plant materials represented in Bulk Sample #7 included vegetative materials which were present on the ground surface during the 19^{th} century, immediately prior to deposition of spoil on top of the shell mound from construction of the rice canal. Wax Myrtle is a common coastal wetland taxon, and Pokeweed and Lantana are opportunistic weeds that colonize places (sometimes aggressively) opened by people. The assemblage suggests that the surface of the shell mound was a disturbed wetland habitat when the canal was constructed.

Plant materials in most samples were preserved by carbonization, but several samples from Core C (C-11 through C-16) were subject to organic preservation by the anaerobic nature of the silt and clay strata now subtending the shell mound. The archaeobotanical remains from this zone of organic preservation may coincide with early occupation of the Delta site, representing plant remains and occupation debris that sank down into the soft, wet sediment. In addition, plant materials from these strata provide general habitat information for the corresponding time period. The distorted structure of the uncarbonized wood recovered from these levels confirms that the materials were preserved by anaerobic water-logging. However, the associated structural collapse of this material rendered the specimens unidentifiable. Thus, all wood identifications indicated above and in Table 21 are based on carbonized wood.

Core C-15 and C-16 yielded the most abundant and diverse archaeological seeds of the thirty samples. C-15 contained 93 seeds representing at least 13 distinct taxa, and C-16 contained 29 seeds representing 9 taxa. These high figures demonstrate the disparity in preservation between these deep, anaerobically-preserved samples and those taken from the calcareous shell midden deposits. Core C-15, the richest sample, contained numerous sedges (*Carex* spp., *Cyperus* sp., *Eleocharis* sp., *Scirpus* sp., Cyperaceae family [Figure 48]), wax myrtle (*Morella* sp. [syn. Myrica]), a member of the genus *Rubus*, which includes blackberry and raspberry, wild-type gourd/squash (*Cucurbita* sp.), wild grape or peppervine (*Vitis* sp. or *Ampelopsis* sp., notated *Vitis/Ampelopsis*), and elderberry (*Sambucus canadensis*). Core C-16 also yielded sedges, the same type of *Rubus*, grape or peppervine, and gourd/squash. In addition, C-16 contained spurge (*Euphorbia* sp.), pepperweed (*Lepidium* sp.), knotweed or smartweed (*Polygonum* sp.), and a member of the diverse buttercup genus (*Ranunculus* sp.).

Sedges are not well-represented in the remaining samples, with the exception of a single *Carex* sp. seed in Core C-13 and a single carbonized scale from Core C-1. Grape or peppervine is present in five out of the six samples with organic preservation, and gourd/squash is present in four out of the six, as well as Core C-8 from the shell midden. Other taxa represented in low numbers throughout the assemblage are water-shield (*Brasenia* sp.), flowering dogwood (*Cornus florida*), purslane (*Portulaca* sp.), cabbage palm (*Sabal* sp.), and a member of the mustard family (Brassicaceae). Nutshell is a regular component of the assemblage, as previously noted, and is especially abundant in Bulk Samples #1 and #2.

Top row, left to right: *Carex* sp. Type 1 (32x), *Carex* sp. Type 2 (16x), *Carex* sp. Type 3 (25x), *Carex* sp. Type 4 (40x).
Bottom row, left to right: *Cyperus* sp. (15x), cf. *Eleocharis* sp. (20x), cf. *Scirpus* sp.(20x), sedge scale (16x).

Figure 48. Members of the Sedge Family (Cyperaceae) recovered from the Delta Site Assemblage.

Core C-15 and C-16 provide the most complete habitat data from the assemblage, offering insight into local conditions around the shell mound when it first was occupied. The plant community in both samples is indicative of a moist, marshy habitat. The abundance and diversity of sedges is indicative of wetlands, and wax myrtle is a shrub commonly associated with wetlands or damp-ground habitats. Certain members of genera *Rubus*, *Ranunculus*, and *Polygonum* also thrive in these conditions. Although there is a clear signal for a wetland setting from the deepest strata of Core C, samples lacking organic preservation generally did not yield sufficient materials to track local ecological conditions throughout the formation of the shell mound.

A number of the taxa in the assemblage are potentially useful to humans, and are known archaeologically and ethnohistorically to have been important in southeastern prehistory. Gourd/squash was cultivated extensively in the Midwest and Southeast (Newsom et al. 1993). It was probably initially grown to use the fruits as containers and for other tools, such as fishnet floats, and later was modified through domestication for use as food. Very early prehistoric examples of gourd/squash appear in Florida, but the seeds in the Delta site assemblage represent only the second example to our knowledge elsewhere in the Southeast Coastal Plain – along with the Bilbo site (botanical materials temporarily at the Environmental Archaeology Laboratory). The small, wild-type seeds in these samples (Figure 49) derive from fruits that would have been thin-walled and inedible due to high levels of bitter cucurbitacins. The domesticated form suitable for food, with larger seeds and thicker fruit walls, enters the archaeological record during the Middle Archaic period, and frequently occurs alongside other cultivars from the Late Archaic period into historic times (see Fritz 1995).

Figure 49. Size Comparisons of Wild and Domestic Cucurbits. All Imaged at 7x. Top left: *Cucurbita* sp. Seed from Core C #16. Bottom left: Modern wild *Cucurbita okeechobeensis* seed. Right: Modern domestic *Cucurbita pepo* (pumpkin) seed.

Wild grapes are widely and frequently used for food and as medicinal components (Moerman 2006:598-600). Elderberry fruits are eaten dry, fresh, or cooked, and can be fermented into an alcoholic beverage. The bark, seeds, roots, leaves, and berries have a wide variety of medicinal applications - especially as purgatives, cathartics, and febrifuges (to control fevers) (Moerman 2006:511-512). Grape and elderberry are both known, through human abdominal content analysis, to have been used prehistorically at the Windover site near the Atlantic coast of the Florida peninsula (Newsom 2002). Several members of the genus *Rubus* also produce edible fruits, including raspberry and blackberry. Finally, a wild morphotype of *Polygonum sp.* often appears archaeologically and was probably cultivated, along with domesticated and wild-type seed crops, in the Eastern Woodlands (Fritz 1995). There is no indication that the *Polygonum* in this assemblage, restricted to Core C #16, represents cultivation.

In addition to the seed taxa discussed here, acorn and hickory nut were important foodstuffs throughout the Southeast (Fritz 1995). Both required considerable processing to extract the useful oil ("hickory milk") from hickory nuts and to rid acorns of the astringent tannins that make them naturally unpalatable. The carbonized nutshell remains likely represent use of these mast nuts for food and also the possible use of their remnants for fuel.

Table 21. Delta Site Archaeobotanical Samples.			
General Context	Samples and (Catalog Numbers)	Sample Volume (L)	**Provenience** (centimeters below datum)
Test Pit #1, Bulk Midden Samples	**B1** Sample 7 (60)	3.50	Spoil[1] & 19th century ground surface above undisturbed midden, 80-100 cm b/d
	B2 Sample 6 (59)	3.10	Stratum **I** of shell mound, 100-120 cm b/d
	B3 Sample 5 (58)	0.70	Stratum **I**, shell lense, 135-145 cm b/d
	B4 Sample 4 (57)	0.60	Stratum **II** of shell mound, 150-175 cm b/d
	B5 Sample 3.1 (55)	4.00	Stratum **III** of shell mound, sediment above clay lense, 190-200 cm b/d
	B6 Sample 3.2 (56)	3.00	Stratum **III**, clay lense, 200 cm b/d
	B7 Sample 2 (54)	7.60	Stratum **III**, 225-250 cm b/d
	B8 Sample 1 (53)	2.75	Stratum **III**, 250-270 cm b/d
Test Pit #1, Standard Excavation Levels	**E1** (76, 61)	300, 30.00	205-220 cm b/d
	E2 (77, 62)	200, 30.00	220-230 cm b/d
	E4 (79, 63[2])	200, 30.00	230-240 cm b/d
	E5 (80, 64)	200, 30.00	240-250 cm b/d
	E6 (81, 65)	200, 30.00	250-260 cm b/d
	E7 (82, 66)	200, 30.00	260-270 cm b/d
Test Pit # 1, Core C	**C1** Core C #1 (115)	0.91	270-290 cm b/d
	C2 Core C #2 (116)	0.36	290-298 cm b/d
	C3 Core C #3 (117)	1.00	298-320 cm b/d
	C4&5 Core C #4 & #5 (118, 119)	0.56	320-332 cm b/d
	C6 Core C #6 (120)	0.59	332-345 cm b/d
	C7 Core C #7 (121)	0.55	345-353 cm b/d
	C8 Core C #8 (122)	0.27	353-359 cm b/d
	C9 Core C #9 (123)	0.36	359-367 cm b/d
	C10 Core C #10 (124)	0.68	367-382 cm b/d
	C11 Core C #11 (125)	0.82	382-400 cm b/d[3]
	C12 Core C #12 (126)	0.23	400-405 cm b/d[3]
	C13 Core C #13 (127)	0.18	405-409 cm b/d[3]
	C14 Core C #14 (128)	1.09	409-433 cm b/d[3]
	C15 Core C #15 (129)	1.09	433-457 cm b/d[3]
	C16 Core C #16 (130)	0.59	457-470 cm b/d[3]

[1] Overburden deposited from adjacent construction of a 19th century rice canal.
[2] Samples from a single context that are combined here.
[3] Contains anaerobic-preserved organic material.

Table 22.1. Delta Site Archaeobotanical Data (Raw Counts) from Test Pit #1.											
Sample	Seed Taxa										
	Brasenia sp.	cf. Brassicaceae	*Carex* sp. Type 1	*Carex* sp. Type 2	*Carex* sp. Type 3	*Carex* sp. Type 4	*Celtis* sp.	*Cornus* cf. *florida*	*Cucurbita* sp.	*Cyperus* sp.	Cyperaceae cf. *Eleocharis* sp.
B1	1						3				
B2											
B3		1									
B4											
B5											
B6											
B7											
B8											
E1											
E2											
E4											
E5											
E6											
E7											
C1											
C2											
C3								1			
C4&5											
C6											
C7								1			
C8									1		
C9											
C10											
C11		1									
C12									4		
C13						1					
C14									2		
C15			3	2	2				2	18	1
C16				1					2	1	
Totals:	1	2	3	3	2	1	3	2	11	19	1

Table 22.2 . Delta Site Archaeobotanical Data (Raw Counts) from Test Pit #1 (continued).

	Seed Taxa (continued)										
Sample	Cyperaceae cf. *Scirpus* sp.	Cyperaceae	cf. *Euphorbia* sp.	*Lantana* sp.	cf. *Lepidium* sp.	cf. *Morella* sp.	*Polygonum* sp.	*Portulaca* sp.	*Phytolacca* sp.	cf. *Ranunculus* sp.	*Rubus* sp.
B1				1		12			50		
B2									2		
B3											
B4						1					
B5											
B6											
B7								1			
B8											
E1											
E2											
E4											
E5											
E6											
E7											
C1											
C2											
C3											
C4&5											
C6											
C7						1					
C8											
C9								1			
C10											
C11											
C12											
C13											
C14											1
C15	1	1				1					17
C16			1		1		10			1	4
Totals:	1	1	1	1	1	15	10	2	52	1	22

Table 22.3. Delta Site Archaeobotanical Data (Raw Counts) from Test Pit #1 (continued).											
	Seed Taxa (continued)								Nut Taxa [(#) = cf. ID]		
Sample	cf. *Sabal* sp.	*Sambucus canadensis*	*Vitis/Ampelopsis*	UNID Seed/ Fruit Taxon 1	UNID Seed/ Fruit Taxon 2	UNID Seed/ Fruit Taxon 3	UNID Seed/ Fruit Taxon 4	UNID Seeds/Fruits	*Carya* sp.	*Quercus* sp.	UNID nut
B1								4		1	
B2								1	8	1	
B3			1					1	6	2	
B4									1	1	
B5								3			
B6									1	1	
B7									23	21	10
B8	1								19	1	4
E1				1							
E2					1						
E4									2		
E5								1	(3)		
E6									2		
E7								1	11		
C1								1			
C2									3	2	
C3									9	1	
C4&5									9	(3)	2
C6									2		
C7									6	1	
C8											
C9									4		4
C10					1				2		
C11			1						3(1)	2	1
C12		2	1					1			
C13		1							2		
C14		3	5					1	(3)		
C15		6	30			1		8	1	1	
C16			7				1		2		
Totals:	1	12	45	1	2	1	1	22	123	38	21

Table 22.4. Delta Site Archaeobotanical Data (Raw Counts) from Test Pit #1(continued).

Sample	Wood Taxa: cf. *Carpinus* sp.	*Carya* sp., pecan group	*Celtis* or *Cercis*	cf. *Ilex* sp.	*Fraxinus* sp., white group	*Liquidambar* or *Liriodendron*	cf. *Prunus* (*P. serotina*)	*Quercus virginiana*	*Quercus* sp.	cf. *Taxodium* sp.	UNID Hardwood
B1					3						
B2					2			1			
B3					1						1
B4											
B5					1						
B6					1				1		1
B7					2						1
B8										1	1
E1											
E2											
E4					1						
E5											
E6											
E7	1			1							2
C1											
C2											5
C3					4		1				
C4&5					1						2
C6					1						
C7											3
C8		2			1						
C9			1		2						
C10			4		1						
C11					4				1		
C12					1	2					
C13					1						
C14						1					
C15					3						
C16					1	1					
Totals:	1	2	5	1	31	4	1	1	2	1	16

Table 22.5. Delta Site Archaeobotanical Data (Raw Counts) from Test Pit #1 (continued).

	Miscellaneous								
Sample	Bud scales	cf. *Crataegus* sp. thorn base	Cyperaceae scale	Cyperaceae spikelet	Cyperaceae stem	Monocot stem	Possible Pine Resin	Possible Tuber	cf. Rosaceae thorn
B1									
B2								1	
B3		1						1	
B4									
B5									
B6							1		
B7					1				
B8									
E1									
E2									
E4									
E5								1	
E6									
E7									
C1			1						
C2									
C3				1					
C4&5						3			
C6									
C7									
C8						3			
C9									
C10									
C11									
C12									
C13									
C14									
C15	2		1						
C16				1					2
Totals:	2	1	2	2	1	6	1	3	2

Table 22.6. Delta Site Archaeobotanical Data (Raw Counts) from Test Pit #1 (concluded).											
Miscellaneous (continued)						Assemblage Totals					
Sample	cf. *Rubus* sp. stem	Vitaceae tendrils	UNID parenchyma	UNID Twig or peduncle	UNID plant	Wood	Wood wt. (g)	Nut shell	Seeds	Misc.	All Items
B1					3	3	0.4	1	71	3	78
B2				4		3	0.3	9	4	5	21
B3					3	2	0.2	8	3	5	18
B4					2	0	0.2	2	1	2	5
B5				2		1	0.3	0	3	2	6
B6					7	3	0.1	2	0	8	13
B7				3	36	3	0.4	54	1	40	98
B8	3		1		47	2	0.2	24	1	51	78
E1						0	0	0	1	0	1
E2						0	0	0	1	0	1
E4						1	0.3	2	0	0	3
E5						0	0	3	1	1	5
E6						0	0	2	0	0	2
E7						4	0.5	11	1	0	16
C1						0	0	0	1	1	2
C2						5	<0.1	5	0	0	10
C3						5	0.3	10	1	1	17
C4&5			1			3	0.3	14	0	4	21
C6						1	<0.1	2	0	0	3
C7						3	0.1	7	2	0	12
C8					1	3	0.1	0	1	4	8
C9						3	0.3	8	1	0	12
C10						5	0.9	2	1	0	8
C11						5	0.5	7	2	0	14
C12						3	0.1	0	8	0	11
C13						1	0.1	2	2	0	5
C14						1	0.1	3	12	0	16
C15		3				3	0.1	2	93	6	104
C16						2	<0.1	2	29	3	36
Totals:	3	3	2	9	99	65	6.1	182	241	136	624

Palynological Analysis

Subsets of the samples from Core A of Test Pit #1 (see Figure 29) were submitted to Dr. Fred Rich (Department of Geology and Geography, Georgia Southern University) for palynological analysis. In addition to these core samples, a closed oyster (*Crassostrea virginica*) recovered from a standard excavation level within Test Pit #1 was submitted for analysis of any trapped sediments (i.e. steinkerns, see Rich and Pirkle 1998). The following results are derived from his report (Rich 2009).

#1 (Core A-1) 270-290cm b/d
Olive grey (5Y 4/1) silty clay with shell fragments.

#2 (Core A-2) 290-295cm b/d
Brownish grey (5YR 4/1) silty clay with shell fragments.

#3 (Core A-3) 295-300cm b/d
Same as sample #2.

#4 (Core A-4) 300-313cm b/d
Same as sample #2, but with rare black flecks (charcoal?).

#5 (Core A-5) 313-325cm b/d
Same as sample #2, but with what may be Spanish Moss (*Tillandsia usneoides*) fibers*.

#6 (Core A-6) 325-337cm b/d
Medium dark grey (N4) sandy/silty clay, with shell fragments, a gastropod (*Ellipitio* sp.) with well-preserved color banding, and a small sherd (sand tempered, fine incised).

#7 (Core A-7) 337-344cm b/d
Medium grey (N5) sandy/silty clay with shell fragments.

#8 (Core A-8) 344-372cm b/d
Brownish grey (5YR 4/1) sandy/silty clay with shell fragments and some charcoal (?).

#9 (Core A-9) 372-392cm b/d
Same as sample #8.

\- Closed Oyster (Test Pit #1) 220-230cm b/d
Sample of fecal pellet-bearing sediment from the interior of an articulated and intact *Crassostrea virginica*. Consists of a small quantity of very light grey (N8) silty clay organized into tiny (approximately 2mm long) cylindrical pellets.

* These fibers were submitted to Logan Kistler and Lee Newsom (Department of Anthropology, Pennsylvania State University) for further analysis. A definitive identification of *Tillandsia usneoides* is not possible at this time.

A quantity of each sample was placed in a beaker and covered with distilled water to loosen sediment from the shells. The fecal pellets from the oyster infilling were simply washed from the interior of the shell and collected in a beaker. The sediment from the core samples was repeatedly decanted into 50 ml test tubes and centrifuged until approximately 3cc of sediment had accumulated (except for the fecal pellet sample, which was much less than this at the outset). All samples were then treated as follows:

1. Samples were carefully mixed with 10% HCl to dissolve carbonates. Without exception, this took a great deal of time. All samples contained abundant carbonate from the shells, and

reactions were invariably vigorous. Samples were allowed to react with HCl, and were then centrifuged, decanted, and the HCl applied once again. All samples were thus treated until there was no further reaction to the acid.

2. Samples were washed once with distilled water, and then mixed with 52% HF to remove silicates. Some of them reacted vigorously, others not so. This difference is common, and its cause(s) unknown.
3. All samples were washed free of HF on November 10, and the residues mixed with a 50:50 mixture of glycerin jelly and water. Slides were then prepared for analysis.

At least one slide from each sample was viewed in its entirety (22x22 mm field of view). Not enough palynological material was preserved at any level for a meaningful point count; all samples were dominated by charcoal except for numbers 8 and 9. The analyzed samples had an appreciable amount of microscopic humic debris, but pollen/spore abundances were still very small. In most cases, only one grain of any taxon was seen. If more than one, the number observed is shown below in parentheses.

#1 No pollen, just abundant charcoal flecks

#2 *Osmunda* (Figure 50)

#3 Chenopodiaceae/Amaranthaceae (2; Figure 51), *Osmunda*, *Pinus* (3; Figure 52), *Quercus* (Figure 53), and *Ambrosia* (Figure 54)

#4 *Quercus*, *Osmunda* (2), and *Woodwardia*-type (Figure 55)

#5 *Pinus*, *Osmunda*

#6 *Osmunda* (2), *Pinus*, *Quercus*

#7 No pollen, abundant pyrite framboids

#8 *Osmunda*

#9 *Sphagnum* (Figure 56), Chenopodiaceae (2), *Pinus*, abundant pyrite, both euhedra and framboids

\- Oyster Shell Infilling - no pollen, just charcoal flecks; fecal pellets from an unidentified species.

The quality of preservation improved downward from #7 through #9, though abundances did not. The presence of the pyrite indicates a much more acidic environment at depth, and there was a corresponding change in the color of the material from black to brown. Euhedra are cubic crystals, and framboids are clusters of crystals organized in spheres.

The identified assemblage of taxa indicates a typical freshwater/upland flora associated with temperate and subtropical regions of the southeastern United States. The recurrence of the fern *Osmunda* is interesting because, while the plant is common along the Georgia/South Carolina coastline, one does not expect to encounter its spores in particular abundance. There are three species, cinnamon fern (*O. cinnamomea*), royal fern (*O. regalis*), and interrupted fern (*O. claytoniana*). Their spores cannot be distinguished easily, but this may not be an issue. They live in association with one another wherever the ground is shady and moist, and they might have lived as ground cover in a shady area where the shell mound was being created. If the shell mound had been in the open, one might have expected to find other ferns such as *Pteridium* or *Woodwardia* which prefer open sunny locales.

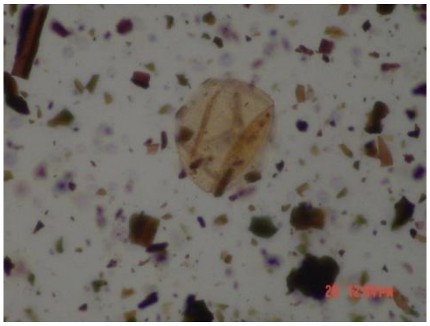

Figure 50. *Osmunda*, Core A-2, 47.5 microns. Note abundant opaque charcoal fragments.

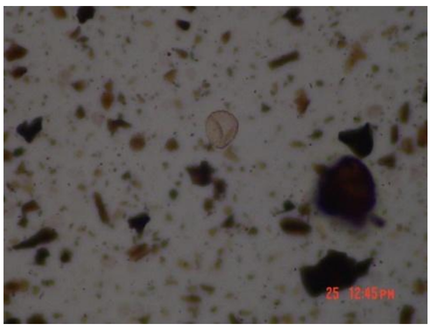

Figure 51. Chenopodiaceae/Amaranthceae, Core A-3, 15 microns.

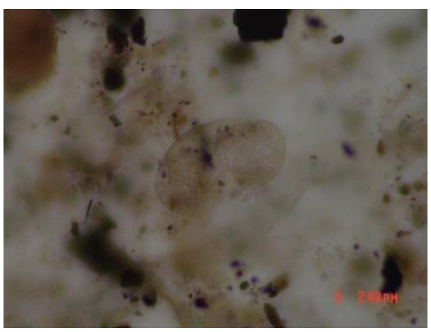

Figure 52. *Pinus*, Core A-6, 65 microns.

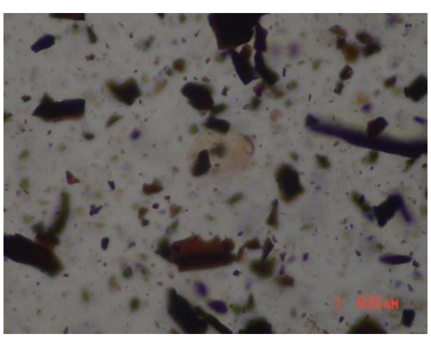

Figure 53. Quercus, Core A-4, 30 microns.

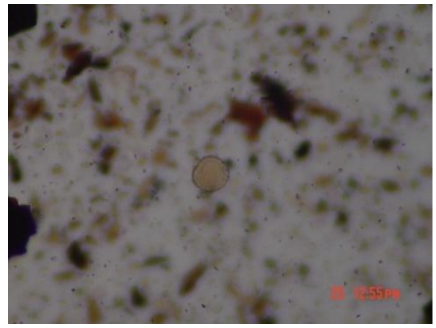

Figure 54. *Ambrosia*, Core A-3, 17.5 microns.

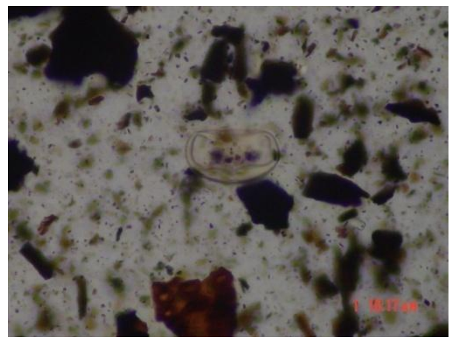

Figure 55. *Woodwardia*-type, Core A-4, 42.5 microns.

Figure 56. *Sphagnum*, Core A-9, 35 microns.

Figure 57. Tarsonemid mite, Core A-4,117.5 microns long. Note clasping hind legs.

Another finding in the search for palynomorphs was the well-preserved exoskeleton of a mite in Core A-4 (Figure 57). Dr. Lance Durden (Institute for Arthropodology and Parasitology, Georgia Southern University) was asked to identify the mite, and he reported that the mite is a male tarsonemid (Family Tarsonemidae). These are sometimes called "Broad mites" and the males have characteristic hind legs for grasping the females. Tarsonemids are native to tropical and subtropical environments, where most are plant feeders with others feeding on fungi. Today they also are common greenhouse-plant pests.

The results of the palynological analysis described above indicate that palynomorphs other than pollen are preserved in the submerged strata of the Delta site. These minute organic structures (generally ranging in size from 5 to 500 micrometers) can provide important paleoenvironmental clues if this information potential is realized and samples collected during archaeological investigations. Palynomorphs typically include dinoflagellates and diatoms, acritarchs, spores, pollen, fungi, worms, arthropod organs and egg casings, and microforams.

To explore the possibility of an extended range of palynomorph types at the Delta site, a small sample (~40 grams) of Core C-10 (367-382cm b/d) was submitted to David M. Jarzen (Paleobotany and Palynology Laboratory, Florida Museum of Natural History) for analysis and characterization. The following results are from his report (Jarzen 2009).

Laboratory processing involved treatment in 25% HCl, followed by three washes in distilled water. The sample then was oxidized with 10% HNO_3, followed by treatment with 5% NH_4OH, and three washes in distilled water. The processing was intentionally without the use of HF in order to recover diatoms if present.

The resultant residue recovered from this processing contained organic material including plant tissue (cuticle, fibers, tracheal elements and amorphous material), diatoms, pollen, spores, algal cysts, fungal elements, and other unknown organic bodies of regular form and structure. Figures 58 and 59 illustrate examples of the palynomorphs recovered from the Core C-10 sample.

Ten slides were prepared using glycerine jelly as the mounting medium, and sealed with clear nail polish: five slides of a sieved fraction > 10µm and five slides of a sieved fraction < 20µm. Sieving of the residue was considered necessary in order to remove most of the organic fine material present. Removal of this material allowed for the photography of specimens without the obstructions caused by the abundant organic debris. Photography was done using a Nikon™ Coolpix 4500 camera mounted on a Leitz Dialux 20™ research microscope. All slides, the unused portion of the submitted sample, and the preparation residue are stored at the Paleobotany and Palynology Laboratory of the Florida Museum of Natural History.

Although the Core C-10 sample was replete with organic remains, the number of palynomorphs observed in the total slides scanned from this sample was insufficient to allow counts or meaningful interpretations. While some of the observed palynomorphs are comparable to taxa of diatoms and pollen, most are fungal, algal or of unknown origin. It is probable that with additional samples, and examination by specialists in the fields of phycology, mycology and plant anatomy, more of the specimens could be identified and their environmental parameters determined. The major forms observed in the Core C-10 sample are identified and discussed below.

DIATOMS

- Coscinodiscus C.G. Ehrenberg 1838 (Figure 58 – 1, 2). Cell discoid, thin or barrel-shaped. The valve face is flat; areolae radiating from central annulus. The species are marine and are abundant in the phytoplankton. According to Round et al. (1990) this genus is a large one and needs extensive study. Some species have been removed and placed with Actinocyclus.
- *Triceratium favus* C.G. Ehrenberg 1839 (Figure 58 – 3, 4). Cells solitary; frustules in valve view, three-sided, heavily sculptured with hexagonal areolae or coarse puncta arranged linearly; girdle sculpture often fine moniliform striae. This is a marine diatom.
- A fragment of a pinnate diatom was also recovered (Figure 58 – 5). It is difficult to place a generic name on this fragment, although species of Navicula are very similar. The cells of Navicula are solitary, with lanceolate valves having blunt or rounded ends; a raphe is present, but sometime difficult to see under normal light microscopy. This form of diatom is extremely common, occurring in both freshwater and marine habitats.

GYMNOSPERM (Figure 58 – 17, 18) and ANGIOSPERM POLLEN (Figure 59 – 1-8)

- Pinus: Several fragmented grains of pine pollen were recovered. One entire grain is illustrated in Figure 58 – 17. Pine pollen is windblown and may have been dispersed from trees on a regional scale. The presence of pine pollen in sediments does not necessarily indicate that pine trees were near the basin of sediment accumulation.
- Cheno-Ams: The pollen of two angiosperm families, the Chenopodiaceae and the Amaranthaceae, produce pollen that is difficult to separate. The pollen grains are spherical and provided with numerous pores distributed more or less evenly spaced over the surface of the grain (periporate).
- Compositae (Figure 59 – 1): The sunflower family produces distinctive pollen grains that bear spines (echinae). Differentiation of the large number of species of composites is nearly impossible using only light microscopy. Only two grains of pollen comparable to the Compositae were recovered from the Delta sample.
- Triporates (Figure 59 – 4, 5): Several forms of unidentified, small pollen grains bearing three apertures were identified. These may be related to several families of angiosperms including the Betulaceae, Myricaceae or several other angiosperm families.
- Tricolpates (Figure 59 – 6): Simple prolate pollen grains with a smooth surface, and bearing three colpi (furrows) were recorded. These pollen forms occur in low numbers, with only four grains observed. Their identity remains unknown as more work is needed to compare these grains with the pollen of plants typical to the southeastern United States.
- Tricolporates (Figure 59 – 7, 8): Three forms of tricolporate grains were identified in the Delta sample. These pollen forms have three colpi (furrows) each bearing a single pore. The colpi are aligned meridionally, with the pore located at the equator of the grain. The wall surface of these small grains is smooth (psilate) to slightly granulate. Many families of flowering plants have pollen similar to the tricolporate pollen forms recovered from the Delta sample.

FERN SPORES (Figure 58 – 14-16)

- Four forms of fern spores were recovered from the Delta sample. Two of these are simple, psilate, trilete spores common to many fern families. Identification of these forms based on the material recovered is not possible. One fragmented fern spore is referable to the modern genus Osmunda (Figure 58 – 16). Three species of Osmunda occur in the area today, and include the cinnamon fern (*O. cinnamomea*), the royal fern (*O. regalis*), and the interrupted fern (*O. claytoniana*). They are often found together in moist, shady areas. One fern spore is reniform in shape, with a smooth wall surface (Figure 58 – 15). This type of fern spore is commonly found in the family Polypodiaceae, a large family with a wide distribution and broad ecological requirements.

FUNGAL SPORES AND FRUCTIFICATIONS (Figure 58 – 8-13)

- Fungal spores and fructifications represent the largest component of the palynomorphs recovered from the Delta site. Identification of the dispersed spores is frequently very difficult, as many spores are only known through proper identification of their associated host organism. The work of Kalgutkar and Jansonius (2000) can be used to identify some of the spores or other fungal structures recovered. Further, more detailed work, by a mycologist, may allow for more identifications and environmental interpretations.

ALGAL CYSTS (Figure 58 – 6, 7)

- Like the fungal elements, the algal cysts are commonly found in the Delta sample. These small to very large cyst stages of algae are sometimes ornate with a reticulate pattern, or adorned with spines or other surface features. Identification of these is difficult, and like the fungal elements, may require a specialist to properly identify and determine the significance, if any, in the sample. Comparative specimens are illustrated in Ward and Whipple (1918) and Zippi (1998).

INSECT EGG CASES (Figure 59 – 9)

- Several quite large structures similar to the egg cases produced by some insects were observed in the Delta sample. Detailed examination by an entomologist will be necessary to properly identify these specimens.

OTHER STRUCTURES (Figure 59 – 10-14)

- The preparation is also replete with several other organic structures including cuticle, stomatal apparatus, plant fibers, tracheal elements, including bordered pit elements, and some unidentified organic structures. Charcoal fragments are common.

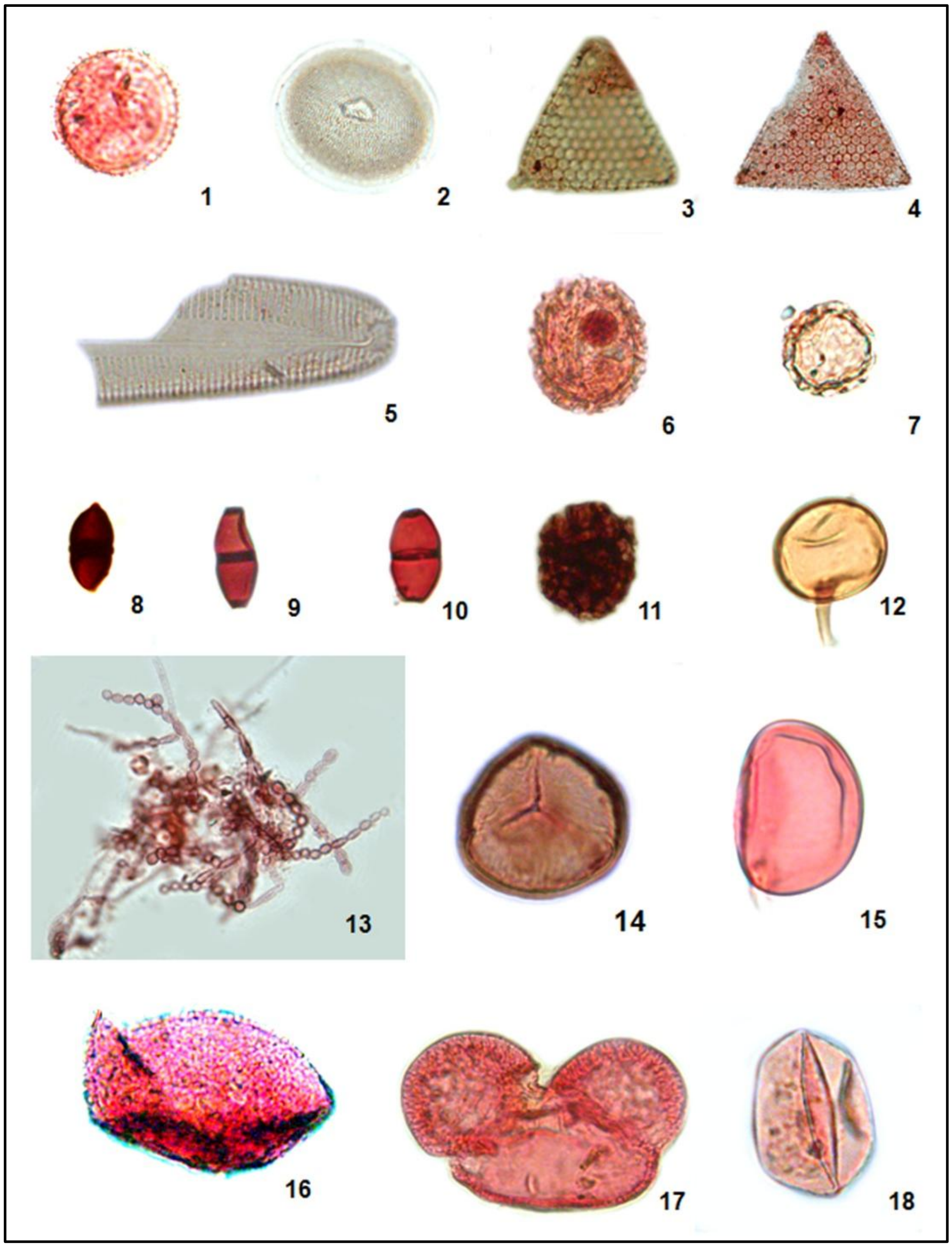

Figure 58. Palynomorphs detected in Core C-10 of Test Pit #1.

1. *Coscinodiscus sp*. a centric diatom. PY05A 30.0 x 109.5; 2. Diatom, centric, showing pattern. PY05A 30.1 x 105.5; 3. *Triceratium favus*. PY01A 26.1 x 108; 4. *Triceratium favus*. PY05A 28.5 x 106.2; 5. Pennate diatom similar to the genus Navicula. PY03A 28.7 x 96.7; 6. Algal cyst (?). PY02A 31.8 x 105.6; 7. Algal cyst (?). PY05A 34.5 x 106.8; 8. Dicellate fungal spore. PY01A 26.0 x 101.2; 9. Dicellate, diporate, fungal spore. PY04A 21.3 x 108.5; 10. Dicellate, diporate fungal spore. PY05 27.2 x 102.1; 11. Palambages sp. a multicellular fungal spore colony. PY01A 26.8 x 97.9; 12. Glomus sp. a mycorrhizal fungus. PY05A34.2 x 96.5; 13. Fungal hyphae with spores in a chain. PY05A 31.1 x 109.3; 14. Trilete spore, with thickened wall. PY03A 37.9 x 107.7; 15. Reniform spore, comparable to the Polypodiaceae. PY05A 36.2 x 109.5; 16. cf. Osmunda fragment. PY02A 23.0 x 101.5; 17. *Pinus* sp. Note the large bladders for wind pollination. PY01A 41.1 x 96.8; 18. Inaperturate pollen grain, cf. Cupressaceae. PY04A 21.6 x 107.5.

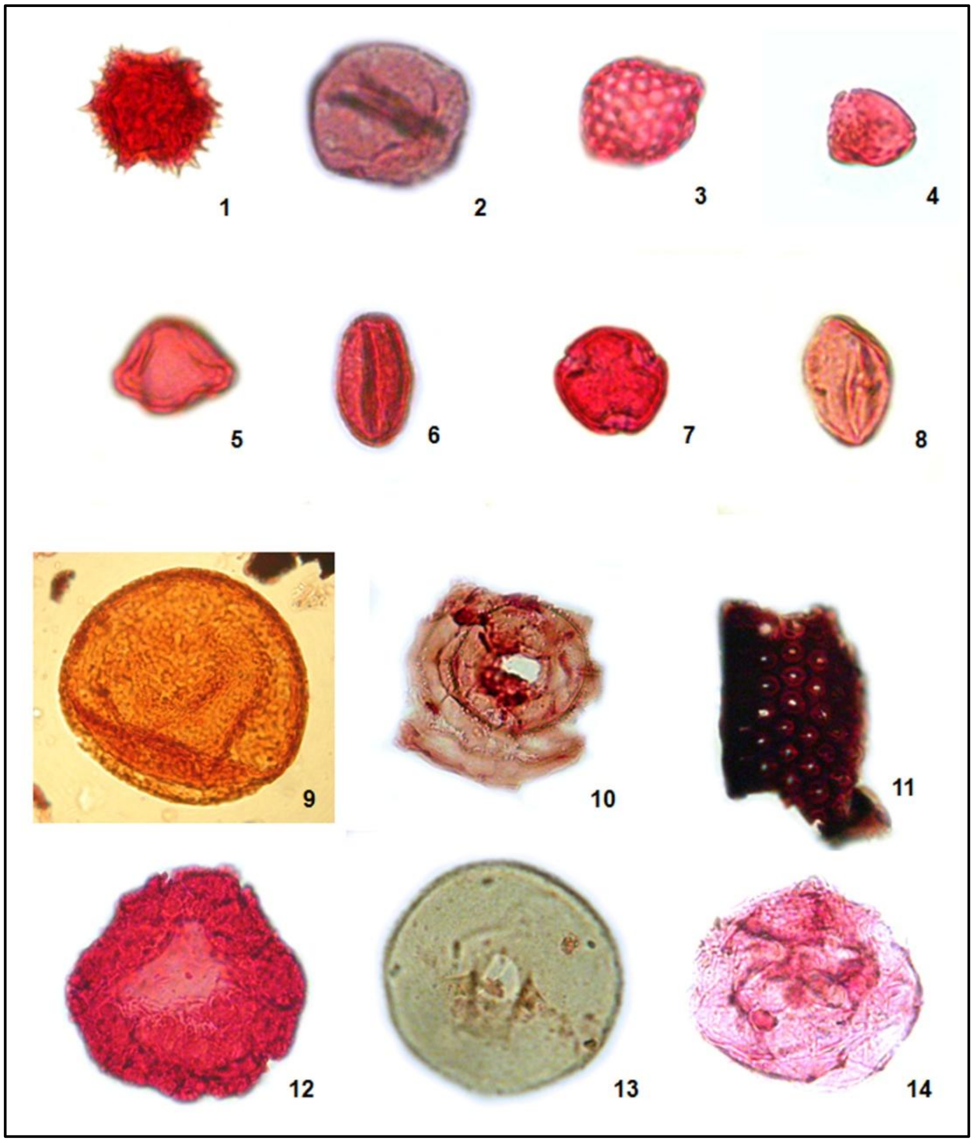

Figure 59. Palynomorphs detected in Core C-10 of Test Pit #1.

1. Compositae pollen grain. PY01A 33.0 x 92.9; 2. Cheno-Am, with several pores over surface of grain. PY02A 22.5 x 103.6; 3. A periporate pollen grain. PY05A 39.7 x 97.2; 4. A Triporate pollen grain, folded. PY05A 38.5 x 101.3; 5. A Triporate pollen grain in lateral view. PY01A 38.8 x 110.5; 6. A prolate pollen grain with three long colpi. PY03A 38.2 x 106.3; 7. A tricolporate pollen grain with thickened exine. PY01A 40.0 x 103; 8. A prolate tricolporate grain. PY02A 21.2 x 96.6; 9. Insect egg case (?). PY02A 25.4 x 107.4; 10. Stomatal apparatus. PY04A 22.1 x 104; 11. Fragment of tracheid with bordered pits. PY05A 40.6 x 99.6; 12. Unknown. PY04A 22.1 x 110.2; 13. Unknown. PY04A 36.0 x 110.5; 14. Unknown. PY03A 27.1 x 111.4.

Summary and Discussion

The 2006/07 investigation of the Delta site shell mound achieved its primary assessment objectives. The site contains significant, deeply stratified archaeological deposits associated primarily with the Refuge phase of coastal prehistory. The upper spoil zone at the site is the result of materials excavated during the 19th century construction of the tidal canal being deposited on top of the shell mound. Cultural materials within this overburden provide evidence of limited earlier and later occupations at the Delta site. The investigated portion of the buried shell mound was associated almost exclusively with occupations during the Refuge phase. The undisturbed shell mound strata begin approximately at the current ground-water level, at about 1 meter below the modern ground surface, and extend some 3.5 meters to its base. The original deposition of the shell mound was on top of a silty clay ground surface, like that which might be observed today as a stream bank or tidal mud flat. However it is likely that this ground surface was relatively firm when first occupied, and then became soft as water levels rose, the initial occupation debris sinking about 50 centimeters into the underlying silty clay.

The Refuge phase occupation of the Delta shell mound began around 2,900 years B.P. (ca. 950 B.C.) and continued for about 150 years. Initial occupation appears to have been on a stream bank or tidal mud flat exposed and temporarily left dry by the low-stand that occurred at +/- 3,100 years B.P. After an indeterminate period of early occupation, sea level rebounded to about 3 meters below modern levels. These estimates are based upon the depth of the bottom of the shell mound below the current ground-water level. However, water levels in the river can be higher than where it empties into the ocean and tidal ranges are much reduced in wetlands back from the main river channels. Mean sea level, and consequently the water level at the shell mound, continued to fluctuate but generally rise throughout the Early Woodland period. The shell mound, as cultural deposits were added and its height increased, provided a relatively dry living surface for its Refuge phase occupants. Environmental habitats near the site would have been redeveloping from earlier conditions associated with dramatically lower sea levels, but nevertheless were different than those present today. River levels would have been lower and the boundary between freshwater and estuarine ecosystems would have been downstream of their modern location, this boundary changing with fluctuating water and salinity levels.

Botanical and palynological evidence from the shell mound indicates that the immediate habitat was moist low-ground, a shady environment with an understory of wax myrtle, varieties of sedges and ferns, woody vines, wild gourd, berries, and weeds. Trees in the vicinity included cypress, ash, oak, hickory, sweetgum or tulip poplar, and hackberry or redbud. The overall impression from these data is an environmental setting like that of a stream bank within a tidal freshwater swamp containing intermittent hammocks of higher ground.

The plant and animal remains associated with the Delta shell mound demonstrate development of an adaptive pattern which included a diverse, wide-ranging subsistence economy. Oak forest and swamp resources were exploited, ranging from white-tailed deer and acorns to turtles and berries, and perhaps also chenopodium or amaranth. While estuarine fishes and oysters were of foremost importance, freshwater mussels also provided a significant food source along with some freshwater and spawning fishes.

It is not clear if the fishers-hunters-gatherers who were responsible for the Refuge phase shell mound lived there on a seasonal or year-round basis, although multi-seasonal settlement and at least some degree of sedentism is indicated. Perhaps operating with the shell mound as a logistical home base, the residential group regularly collected oysters during September and October, and sometimes as early as July and as late as December. The season or duration of freshwater mussel collection is unclear. However, their co-occurrence with oysters in some of the shell lenses indicates these were complementary subsistence resources with concurrent periods of collection and refuse disposal. Mast crops of acorns and hickory nuts were available near the shell mound during the Fall months, and spawning fishes during the Spring. Many other estuarine and freshwater fishes, along with numerous turtles and terrapins, were available throughout most or even all the year.

The importance of the Delta site is situated in its ability to provide critical information about the seldom investigated and poorly understood Refuge phase of the Georgia and South Carolina coasts. This includes information not only about ceramic forms and their chronology, but also regarding the subsistence economy, settlement systems, and paleo-environmental conditions that were associated with the end of the late Mid-Holocene period and prior to more extensive occupation of the coast during the Deptford phase. The current investigation results, based essentially on data obtained from a single test pit, provide substantial clues but few definitive answers.

The only other sites of the Refuge phase that have been excavated at the mouth of the Savannah River are the type site, investigated by Antonio Waring in 1947 (Waring 1977a), and the Second Refuge site, excavated by Larry Lepionka in 1979 (Lepionka 1980, 1983a, 1983b). Both were located adjacent to the Little Back River in the Savannah River National Wildlife Refuge, about 9km northwest of the Delta site. The Refuge site had been destroyed by erosion by 1960. The Second Refuge site was investigated in advance of proposed alternations to the dike-canal system in the refuge and its current status is unknown. Both sites appear to have been very similar in structure and content to the Delta shell mound.

The Refuge site originally was some 30m in diameter with shell midden deposits extending as much as 2.1m to 2.4m deep. Like the Delta site, the Refuge site was located in an area of rice fields separated by tidal canals. Prior to clearing for rice cultivation, the area had been a tidal freshwater cypress swamp. The deep midden deposit (Waring seems to have referred to the site as a shell midden rather than shell mound) was composed principally of freshwater mussels, with noted occurrences of oysters and clams. Waring's site report, published posthumously from his notes, does not mention water levels in his excavation, but the lower excavation levels must have been submerged. The basal stratum was a compact mussel-shell layer associated with fiber-tempered pottery. That was overlain by levels containing Refuge phase ceramics: plain, simple-stamped, dentate-stamped, and punctated wares. Deptford phase ceramics occurred above the Refuge strata, beginning at about 75cm below the surface, where they were accompanied by Refuge pottery types as well as by some pottery from later prehistoric phases. Waring was quite insistent that Refuge simple-stamped pottery could be distinguished from Deptford simple-stamped pottery, the Refuge type being a coarser ware with surface treatments that were "random and quite sloppy" (Waring 1977a: 200). However, later researchers (including this author) have had great difficulty successfully distinguishing Deptford from Refuge simple-stamped pottery. A sample of shell from the upper part of the Refuge phase midden (ca. 90cm below surface) was submitted for C-14 analysis (M-267) and returned an age of 2,929 ± 200 years B.P. (ca. 970 B.C.) (see Williams 1977b).

The Second Refuge site was a deeply stratified midden located on a small (7m x 15m) island remnant that extended 1.3m above the surrounding swamp. The original size and shape of the site are unknown. The midden was 2.4m deep, extending approximately 1m below the water level. Like the situation at the Delta site, the base of the shell deposit was underlain by a "marsh mud deposit." The top 75cm of the midden was disturbed and contained both historic and prehistoric materials. Refuge ceramic types along with some later wares were recovered from the 75cm to 150cm level of soil midden with shell inclusions. Beneath this layer, at the water level, was a thick, black "boundary stratum" which separated the upper, primarily soil, midden from a dense shell midden composed of oyster (*Crassostrea virginica*), freshwater mussels (*Elliptio icterina*), and freshwater snails (*Viviparus georgianus*). Lepionka noted that the proportions of mussels in the midden increased relative to oyster from the basal levels to the top levels, a pattern he suggested may have been related to lowering sea level and a corresponding reduction in the local availability of oysters. Pottery within the shell midden was almost exclusively defined by Refuge phase types - principally simple stamped, plain, and dentate stamped. Lepionka obtained two C-14 dates from the Second Refuge Site. A shell sample (QC-784) from the lower surface of the shell midden (about 2.4m below surface) returned an age of 3,020 ± 115 years B.P. (ca. 1070 B.C.). A second sample (QC-785) from the upper surface of the shell midden (about 1.7m below surface) returned an age of 2,460 ± 100 years B.P. (ca. 510 B.C.).

In recently published research, Thompson and Turck (2009) argue that the Refuge phase reflects a period of adaptive flux and rapid change (following Resilience Theory, an Omega or release phase (Ω); see Redman 2005 and Nelson et al. 2006) in which the cultural system attempted to respond to the dramatic environmental changes associated with lowered sea levels. They go on to argue that this was followed by reorganization (α) and growth (r) phases in the adaptive cycle during the subsequent Middle and Late Woodland periods. Resilience Theory, with its emphasis on reorganization and adaptive cycles, provides a useful framework for examining changes reflected in the archaeological record of hunters and gatherers on the Georgia coast and also nicely complements the perspectives of ecological succession theory developed in this report. However the Refuge phase can hardly be considered representative of an Omega state, which is characteristically a brief phase in adaptive cycles that occurs prior to reorganization and long periods of growth. It seems clear that a successful adaptive strategy actually was achieved, and very doubtful that adaptive flux or an Omega state persisted throughout the 700 years of the Refuge phase. An Omega state would have existed only at the beginning of the Refuge phase, and then would have been followed by reorganization and adoption of an adaptive strategy which responded to the new environmental conditions. It also must be noted that the regional analysis undertaken by Thompson and Turck is based on a dataset of largely unverified records of limited reliability (the Georgia Archaeological Site File), thereby seriously reducing confidence in their identified patterns and resulting arguments. Furthermore, the authors fail to consider evidence from Refuge phase shell mounds located on the South Carolina side of the Savannah River. This may have led them to hypothesize that no major Refuge phase sites will be found below present sea level (p. 268) and that there was a marked reliance on hunting with very limited use of estuarine resources during this period (pp. 270-272). Both contentions are easily dismissed based upon available information from Refuge phase shell mounds. However, the authors do suggest (p. 272) that deltaic regions like that at the mouth of the Savannah River may have remained suitable for long-term settlement during the Early Woodland period.

Preservation and active management of the Delta archaeological site is recommended. Given the extensive and severe landscape modifications that have occurred within the tidal freshwater wetlands at the mouth of the Savannah River, it is certain that the Delta site is one of very few (possibly the only) Refuge shell mounds still in existence. If its destruction is unavoidable, mitigation through data recovery would be possible but methodologically complex and very costly. An impressive range of archaeological and paleo-ecological data is contained within the shell mound, presenting an exceptional opportunity for advanced interdisciplinary research. However, successfully excavating and recovering data from the deeply submerged cultural deposits, and assembling a talented interdisciplinary team for its analysis and interpretation, would be exceptionally challenging.   In the event that the Delta site is threatened by future actions, such as expansion of the adjacent dredge-spoil area, data recovery through intensive excavation and detailed analysis will need to be fully explored.

Conclusions

As temperatures increased and glaciers began to melt some 10,000 to 12,000 years ago, landscapes changed and the moving boundary between sea and land was ecologically dynamic. Sea levels rose on a global scale, the interaction of eustatic and glacio-isostatic factors often leading to complex records of local sea-level change. In areas like that of the Georgia and South Carolina coasts, with broad and shallow off-shore gradients, the configuration of the coastline at times could have changed rapidly and perhaps even noticeably from year to year (Roberts 1989; Trenhaile 1997). Sea levels and coastal landforms began to stabilize, at least temporarily, during the Mid-Holocene. This was a period of intensified human settlement in many coastal regions of the world (e.g. Bailey and Milner 2002; Bailey and Parkington 1988). As Dincauze (2000: 250) has pointed out, "Holocene sea-level rise has affected human cultural adaptations and cultural beliefs at every meeting of land and sea, worldwide."

The Shell Mound Archaic is one example of this global phenomenon of intensified human settlement in the young and vibrant ecosystems of the late Mid-Holocene. Although it is reasonable to suspect that there was low-density human occupation along the coastline of Georgia and South Carolina during earlier Holocene and even late Pleistocene times, their archaeological records would have been destroyed by tidal erosion, now are buried under substantial sediment, or are in a few relatively stable offshore locales awaiting discovery (e.g. Haag 1975; Waters 1992).

Archaeological evidence from the Bilbo shell mound provides needed information about the cultural and ecological relations of hunter-gatherers in a late Mid-Holocene coastal environment, as well as clues about the conditions of colonization and the subsequent demise of a cultural adaptive system. These suggest that traditional models of sociopolitical organization and mobility, constructed largely through analogy with ethnographically observed hunter-gatherers in low-energy environments, do not accurately represent the variability and range of organization and complexity of hunter-gatherers throughout the human past (for examples, see Bailey and Milner 2002; Brown and Price 1985; Ember 1978; Kelly 1995; Nicholas 1998). The adaptive strategies and cultural organization of a colonizing group of hunter-gatherers within an evolving, high-energy ecosystem are without ethnographic analogs and, therefore, will be known only through exploration and interpretation of their archaeological records.

Data from the Bilbo shell mound indicate that a central component of the organizational structure of the culture was construction of pile dwellings in tidal freshwater marsh along water ways at locations providing optimal access to riverine, swamp, estuarine and upland subsistence resources. The architectural form itself indicates the use of communal labor in construction and anticipated residential stability. The use of watercraft, presumably canoes, is implicated and would have expanded the catchment area of the subsistence economy. The size of the exploitive zone, containing patches and strips of distinctive resources accessible through daily round-trip visits, certainly was greater than that of ethnographically recorded, terrestrially based hunter-gatherers, and could have been increased even further with round-trips scheduled to coincide with favorable tidal currents.

Food resources were exceptionally abundant, owing in part to "bloom" conditions in the coastal environment. Based upon evidence of species availability today, most of the potential food resources during the late Mid-Holocene would have been accessible year-round, although the abundance of some species fluctuated seasonally. Nut crops were available during the Fall months in upland environments and, in the Spring, spawning fish such as sturgeon (*Acipenser sp.*) would have increased greatly in the freshwater rivers. Although formal, quantified analysis of the faunal remains recovered from the Bilbo site has not been undertaken, existing information does indicate that subsistence concentrated on high-yield or high-bulk species rather than more evenly on the much larger variety of potentially available food resources. Selection appears to have been biased towards white-tailed deer (*Odocoileus virginianus*) in upland habitats (and probably also hickory nuts, acorns, and walnuts), gar (*Lepisosteus sp.*) in the mouth of the Savannah River (and more seasonally, sturgeon), American alligator (*Alligator mississippiensis*) and turtles in the tidal freshwater swamps (and perhaps tupelo gum fruits from the swamp margins, as well as gourds for use as containers), along with drums (Sciaenidae) and American oysters (*Crassostrea virginica*) from the lower reaches of the river and in estuarine creeks. A much greater and more diverse natural supply of food resources was available than evidently was exploited, suggesting that the human settlers were adapting as a small population within a rich environment and operating at an entry level of carrying capacity.

The size of the resident population at the Bilbo shell mound at any point in time, though impossible to demonstrate with precision, was certainly small rather than large. Given the circumscribed site area of approximately 1200 square meters, roughly a circle with a diameter of 40 meters, it may be reasonable to suggest a local group of about 25 people (the ethnographic average of mobile hunting and gathering local groups; see Kelly 1995: 209-213) organized within an extended family or a few nuclear family social units. Of the suggested resident population only 7 or 8 adults would have been the most active food collectors, while the others would have been minimal economic contributors because of age or health factors. Within this scenario, subsistence needs could have been easily maintained from the settlement location without logistic pressure for movement to new areas because of resource depletion. In other words it is suggested that given a small residential group within a large catchment area containing abundant food resources, the costs of residential movement would not have been offset by increased energy returns.

Whereas residential mobility to meet subsistence needs may have been unnecessary, maintenance of social networks beyond the small and sedentary local group would have been crucial. Among ethnographically observed nomadic hunting and gathering bands, local residential groups are temporary and fluid in composition. Social mixture and information flow occurs with mobility and interpersonal conflicts are resolved through separation. However, the more sedentary residential group at Bilbo would have had to have been integrated into a much larger social network to maintain a viable reproductive and social population. This social dimension of their cultural adaptation would have provided the necessary means for acquiring spouses, resolving disputes, maintaining alliances, building solidarities, prestation, and sharing a wide range of socioeconomic and environmental information. Festive occasions attended by dispersed but socially connected residential groups would have been important vehicles for social integration and information exchange. The shell rings of the Shell Mound Archaic probably were the locations of these periodic feasts, their large size (as much as 100 meters in diameter and 3 meters high) representing the accumulated food waste and other living debris of many small groups temporarily united on such occasions. Their circular form, with further conjecture, could reflect the spatial arrangement of feasts organized by a basically egalitarian society.

The archaeological record of the Shell Mound Archaic presents an opportunity to explore the material conditions and, by inference, the social fabric of a cultural system that developed under particularly dynamic and productive ecological conditions. However, traditional models based on nomadic hunter-gatherers in marginal environments appear to be poor analogs for reconstruction and explanation of how this cultural system was organized. Other models need to be constructed that delineate a more complex organizational structure with components that include sedentism and subsistence economies based upon resource abundance.

Elements of a more fitting model for complex hunter-gatherers within the late Mid-Holocene coastal environment might be found in Sahlins' (1961) classic discussion of tribal organization. He entertained the notion that tribally organized cultures may have first emerged in "exceptionally favorable environments in the food-collecting, Paleolithic era" (Sahlins 1961: 324). More complex than hunting and gathering bands, the social segments may be lineages, nonlineal descent groups, or loosely organized local kindred who collectively exploit local resources and form relatively stable residential groups. Each is economically and politically autonomous, but may combine with others on ceremonial occasions. They are socially integrated (but weakly so) through identity, pan-tribal institutions, systems of intermarrying clans, age-grades, and other mechanisms which cross-cut the primary social segments. Sahlins argues that one tribal form, the Segmentary Lineage, is the social means for temporary consolidation of the fragmented polity for concerted action such as expansion into the territory of another group. Conditions of colonization in a rich new environment, like that along the Georgia and South Carolina coasts, may have presented other pressures for consolidation and a parallel trend in cultural organization to negotiate the new opportunities and challenges of unfamiliar habitats.

Once material adjustments, both economic and social, were made for survival within the new environment, it may be expected that the evolving cultural organization was quite dynamic. Population growth was one likely consequence of a small initial population, divided into relatively autonomous residential groups, selectively exploiting abundant resources from strategically located settlements. As population levels grew, the pressures for social integration would have increased and social linkages would have become more complex.

A better understanding of the cultural form and its adaptive characteristics also will permit a measure of understanding about its demise. As part of a widespread pattern of climate change associated with the transition between the Late Archaic and Early Woodland periods elsewhere in eastern North America (see e.g. Kidder 2006), the disappearance of the Shell Mound Archaic along the southeastern coast appears to have been connected directly with falling sea-levels around 3,100 years ago. This sea-level change would have had far-reaching effects throughout the coastal ecosystem, resulting in profound and possibly rapid loss of habitats and resources. However well-adapted the complex hunter-gatherers may have become after more than 1,000 years on the coast, they apparently were ill equipped to successfully cope with this magnitude of environmental change. Many of the shell mounds and shell rings were abandoned and resident populations presumably dispersed as carrying capacity was approached and their adaptive strategy was challenged, leaving the coast more sparsely occupied for several hundred years. Over the next 1,000 years sea-levels eventually rebounded, similar ecosystems redeveloped, and the coastal environment once again became extensively settled by growing populations. However, unlike those of the Shell Mound Archaic, the earliest Woodland period archaeological sites tended to be smaller, more numerous, and widely dispersed (see Brooks *et al.* 1986: 297).

This period of dramatic ecological and cultural change, between about 3,100 and 2,400 years B.P. (ca. 1150 B.C. to 450 B.C.), was associated with Refuge phase occupations at the mouth of the Savannah River, extending some distance along the coastline (i.e. Marrinan 1975; Espenshade and Brockington 1989) and inland (i.e. Sassaman et al. 1990) as well. The cultural dynamics and adaptive processes that accompanied this change were surely remarkable, but are difficult to reconstruct with archaeological data. Whether the cultural groups of the Refuge phase completely replaced the former hunting and gathering population, emerged from surviving remnants of that group, or perhaps reflect the merging of immigrant and resident groups, is uncertain at this point in our understanding of the archaeological evidence. DePratter (1976: 6) points out some continuity between the earlier St. Simons wares and Refuge pottery, suggesting surviving stylistic or decorative influences from the earlier group or even in-place development. Waring, however, seems to have thought that Refuge ceramics were evidence of an immigrant population and wondered if the Refuge pottery might somehow be connected to the fiber-tempered pottery with similar decorative treatments found in the Wheeler Basin of the Tennessee River in northern Alabama (Waring 1977a: 208).

Regardless of their genesis, it is clear that the Refuge phase cultural groups like that represented at the Delta site were able to develop adaptive strategies to survive within a changed and probably challenging coastal environment. Much more information is needed to sort out the details of the structure and organization of the Refuge phase hunting and gathering culture. Available information suggests, however, that one characteristic feature was an adaptive system based on exploitation of a wider range of subsistence resources from estuarine, freshwater, and upland environments than was characteristic of their predecessors. Those settlements located slightly upstream, such as at the Refuge and Second Refuge sites, appear to have relied more on freshwater resources. Those located further downstream, in locations such as the Delta site, appear to have relied more on estuarine resources. It is likely that some habitats and their resources were maintained in an early seral condition, such as in that nascent zone along the fluctuating boundary between tidal freshwater marshes and swamps. Others may have failed to reach or sustain high-energy bloom states, creating a patchwork of basically rich but variably productive ecosystems at the mouth of the Savannah River. As an adaptive response, the Refuge phase population appears to have been smaller in total numbers, more widely dispersed, and may have been less sedentary and cultural complex than their predecessors.

However, continuity as well as change is evidenced in the available archaeological information, suggesting that intriguing cultural dynamics were active during the Refuge phase. Settlements in tidal freshwater swamp or marsh areas near stream channels continued to form shell mounds similar in size and shape to those of the preceding St. Simons phase. However it is also significant that shell rings were no longer formed during the Refuge phase, suggesting a general reduction in socio-political complexity. No clear evidence of dwelling forms has been discovered at Refuge phase shell mounds. Continued use of pile dwellings cannot be completely dismissed; however, evidence from the Delta shell mound indicates that midden accretion was above water. Some ceramic decorative treatments (e.g. incising and punctuation) persisted, but in greatly reduced frequencies, from the St. Simons phase. Amorphous fragments of low-fired clay also are found in both St. Simons and Refuge shell mounds; however, the common activity reflected by these is unclear. The use of gourds (*Cucurbita* sp.) is indicated during both the St. Simons and Refuge phases, probably reflecting continued use of these as containers. Bone pins also continued to be made and used, but were less common and had only simple engraved designs during the Refuge phase.

Major innovations did occur in ceramic technology, reflecting significant changes in the use of pottery vessels. Vessels of the Refuge phase were coiled rather than modeled and inclusion of fiber in the paste as temper was replaced by sand inclusions or perhaps simply the use of different clay sources with naturally high sand content. Ceramic forms shifted to conoidal or sub-conoidal jars, vessels that may have been used as storage containers as well as for cooking soups or stews (e.g. pepper pot, mixed and varying ingredients) in a hearth. The "simple stamped" decorative treatments of the Refuge pottery, probably executed with a roulette, may have presented the familiar appearance of coiled basketry, a type of container that would not normally be preserved in archaeological deposits.

A dramatic increase also is seen in the sheer quantity of pottery in the midden deposits, indicating intensification in ceramic production and use. The Refuge midden of the Delta site was associated with five times as many potsherds as the St. Simons midden of the Bilbo site (Delta site – 246 sherds per cubic meter; Bilbo site – 48 sherds per cubic meter). The challenges for survival within the transformed coastal environment of the late Mid-Holocene may have been met, in part, through innovations in ceramic technology and use.

As the material infrastructure changed during the Refuge phase, it may be expected that corresponding changes occurred in social and political systems as well. Disruption and realignment of sociopolitical networks and reduction in ceremonial complexity may have been important consequences, along with modification in the composition and size of residential groupings. Extra-local social and economic connections also may have been altered, as indicated by the paucity of chert and steatite artifacts from interior sources during the Refuge phase.

The archaeological record at the mouth of the Savannah River during the late Mid-Holocene offers a rare opportunity to examine evidence of human adaptation and culture change within an environmental setting which also was associated with remarkable change. Culture change, as well as its explanation, is necessarily complex, multivariate, and multiscalar. However, a major factor during the Late Archaic and Early Woodland periods on the Georgia and South Carolina coasts must have been ecosystem changes connected with cycles of rising and falling sea levels. Continued research focusing on reconstruction and explication of the cultural forms which were part of this dynamic ecosystem will not only expand our understanding of coastal prehistory, but also may contribute to a better anthropological understanding of cultural dynamics in general.

Acknowledgements

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Research at each site was undertaken as an archaeological field school with anthropology students from the University of West Georgia. Their hard work and careful attention to detail is appreciated, and their learning experience led to substantial success in both field projects. Field equipment and laboratory facilities were provided by the Waring Archaeological Laboratory. Analytic support for the Bilbo project was provided by a Faculty Research Grant and a Faculty Research Enhancement Award from the University of West Georgia. Research and analysis at the Delta site was supported by grants from the Federal Highway Administration, administered through the Georgia Department of Transportation.

Both undergraduate students and volunteers participated in research at the Bilbo site. Susan Fishman-Armstrong served as field assistant and laboratory coordinator. The undergraduate students enrolled in the 2001 field class were Douglas Mabry, Sarah Mistak, Matthew Tidmore, Jennifer Warhop, Rachel Whetstone, William Willey, Siska Williams, and Drew Wise. Several volunteers also gave their time and talents to field work at the Bilbo site. Special thanks are extended to Amy Tannus, Carolyn Rock, Bob Mistak, Myrna Crook, Sarah Crook, Morgan Crook, Max Crook, and Susan Crook for their contributions. Some anthropology students continued work in the laboratory with special analysis projects: Sarah Mistak on the mollusk remains, Jennifer Warhop on the ceramics, and Rachel Whetstone on the bone pins, and Siska Williams on the botanical materials.

A somewhat smaller, but no less conscientious, group of students participated in research at the Delta site. Lucy Cloudsdale served as field assistant and laboratory supervisor as a graduate student. The undergraduate students enrolled in the 2006 field class were Ryan Body, Courtney Calvo, Francis Colon, Brandon McLaren, Dana Russell, and Armando Tovar. Those participating in the 2007 field project were Armando Tovar, Andrew Carter, Bradley Peacock, and seasoned volunteer Max Crook. Courtney Calvo and Dana Russell also assisted with sorting and analysis of odostomes and other fine-fraction materials in the laboratory.

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The Bilbo Site 2001 collection (Accession Number 59) and the Delta Site 2006/07 collection (Accession Number 2081) are curated as held-in-trust collections at the Antonio J. Waring, Jr. Archaeological Laboratory of the University of West Georgia.

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