GEOARCHAEOLOGICAL ANALYSIS OF TWO BACK-BARRIER ISLANDS AND THEIR
RELATIONSHIP TO THE CHANGING LANDSCAPE OF COASTAL GEORGIA, U.S.A.

by

JOHN A. TURCK

(Under the Direction of Ervan G. Garrison)

ABSTRACT

This study examines the past human settlement system on the coast of Georgia from 12,000-1,000 B.P. (the Paleoindian through Late Woodland periods) in relation to landscape change. I take a landscape approach to understanding settlement, incorporating geomorphology, formation processes, a distributional approach to archaeological data, and landscape ecology metrics.

Archaeological surveys of two back-barrier islands, Mary Hammock (9MC351) and Patterson Island (9MC493), are combined with non-archaeological paleoenvironmental data, and compared to changes in sea level, and to archaeological surveys from other environmental settings, to understand the change in human occupation in McIntosh County, GA. Numerous environmental datasets, including present-day elevations, former surfaces under the marsh, bathymetric data, soils, and wetlands, were incorporated together. These data were combined with changes in sea level over time, creating a dynamic model of landscape change. This model is used to create predictions about human settlement patterns in relation to the marsh-estuarine system for McIntosh County in general, and the back-barrier area specifically. These predictions
were then tested with prehistoric site distributions of McIntosh County, as well as to prehistoric sherd densities of various surveys.

Analysis revealed that terminal Middle Archaic sites (~5,000 B.P.) with evidence of coastal adaptations should be found within present-day McIntosh County. Because there are no such sites, I suggest that there may have been an abandonment of the coast at this time. The explosion in Late Archaic sites, then, may have been from an influx of people to the Georgia coast. Back-barrier islands were always part of the settlement system. The intensity of back-barrier island utilization may be related to their proximity to larger landmasses (the mainland and major barrier islands), and the different types of settlement systems associated with those landmasses. The intense utilization of back-barrier islands at certain times suggests that they may have been permanently settled. Another explanation for their intense use may be that these are relatively small islands where activities would have been concentrated.

The predictions of the model were not always substantiated, indicating that changes in sea level and marsh-estuarine resources were not the only reason for changes in settlement and subsistence patterns.

INDEX WORDS: Geoarchaeology;Geomorphology;Landscape approach;Settlement patterns;Survey;Landscape change;Sea level;Paleoenvironment;Back-barrier;Marsh;Islands
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DEDICATION

To my family.
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CHAPTER 1
INTRODUCTION

To reconstruct past settlement systems, it is necessary to understand “the full range of variation that once existed” (Nicholas 2001:262). Smaller, specialized sites can provide important insights into patterns of land use change over time because “their function within settlement systems varies over time and across landscapes” (Byrd and Reddy 1999; see also Glassow 1985; Means 1999; Vellanoweth and Erlandson 2006). This includes sites in marginal, or peripheral, areas (Means 1999; see also Attema et al. 1999-2000; Balkansky 2006). Another important aspect in settlement studies is to understand how the environment has changed over time, with specific interest in human-environmental interactions (Dincauze 2000:20; Jochim 1990:75; Reitz et al. 1996:3). These interactions between culture and environment are viewed as non-deterministic, where the environment created conditions that affected the choices people made, while at the same time humans had an impact on their environment (Hardesty and Fowler 2001; see also Redman 1999). Changes in human behavior observed in the archaeological record can be due to: changes in the natural environment, human-induced environmental changes, strictly social reasons, or some combination of the three. This can make it difficult to discern the causes of human behavioral changes using the archaeological record alone. Independent evidence of paleoenvironmental data must be integrated with archaeological data to assist archaeological interpretations (Bailey and Craighead 2003:177; Dickinson et al. 1999:688; Peros
et al. 2006:405). This is especially true for interpreting the archaeology of coastal zones, which undergo environmental changes on a daily basis. Understanding the dynamic coastal landscape is integral to understanding the dynamic evolution of the archaeological record (Wells 2001:149). Factors such as relative sea level (RSL) (which includes eustatic changes in the amount of ocean water, isostatic movement of the earth’s crust, and tectonic movement on the earth’s crust), energy flux (tides, waves, and currents), and sediment flux, all affect the evolution of the coastal zone and the people who inhabited it (Wells 2001:149). Thus, for a more complete understanding of settlement systems, smaller, specialized sites, including sites located in seemingly marginal areas, need to be incorporated into archaeological studies, as does independent, non-archaeological evidence of past environments.

The back-barrier area of the coast of Georgia, McIntosh County, USA, (Figure 1.1) is an ideal place to gather such data on changes in settlement patterns, past environments, and thus human-environmental interactions. Located between the landward boundary of barrier island complexes and the mainland, this area is comprised of salt marsh, tidal streams and creeks, estuaries, and back-barrier islands (areas of higher elevation within the marsh). This area is part of a greater coastal zone, defined here as extending from the eastern coasts of the barrier islands, to about 30 km inland (following Thompson and Turck 2009). Whether or not the back-barrier area is considered a marginal part of the coastal zone is related to who does the considering.

In general, there has been a scholarly debate regarding the productivity of coastal areas to support dense populations (Erlandson 2001:290; see also Thompson and Turck 2010). The view that coastal areas are marginal and unproductive most likely stems from a cultural bias (Erlandson 2001:191). In modern Euro-American economic terms, the coast can be considered marginal. Based on ethnohistoric accounts as well as the properties of coastal soils, Larson
(1980:219) concluded that coastal Georgia was “marginal” in the sense that agriculture was
constrained. Fields would have to be abandoned periodically, which meant that large permanent
villages were not possible (Larson 1980:219). This in turn constrained social development. This
view would be especially true for back-barrier areas, where there is a limited amount of uplands,
and the soil is poorly suited for both agriculture and raising livestock (Byrd et al. 1961). It seems
that such views influenced most archaeologists, giving them preconceived notions that such
areas were not heavily used, and thus these areas have typically not been the main focus of study.

Other factors besides economics can lead to a range of views of these back-barrier areas,
and can be seen as everything from marginal to extremely important. They can be viewed as
marginal in terms of location, being difficult to access, and having many kinds of flying, biting
insects. These same factors relate to researchers considering them marginal places for conducting
research. Owning your own private island in this area can be valued highly, for privacy as well
as for the status it confers. However, different parts of the back-barrier area can be viewed
differently. For example, most land owners are more concerned with the small upland areas than
the well-being of the marsh-estuarine system, as demonstrated by the proliferation of the creation
of recreational docks in recent years (see Alexander and Robinson 2004).

From an ecological standpoint, Georgia salt marshes can be considered abundant and
productive. Georgia has four times the amount of marsh area than the rest of the Atlantic coast
(Hayden and Dolan 1979:1063), and its salt marshes generate very high ecosystem services (the
benefits that humans get from the processes that sustain ecosystems) (Gedan et al. 2009:119).
The salt marsh/ upland ecotone has been shown to have a distinctive plant assemblage and
increased diversity (Traut 2005). Although Larson (1980:20) acknowledged this, noting that the
variety and abundance of resources of the marsh were very important to Native Americans, he
still felt that populations needed to move around seasonally to exploit other resources (see Thomas 1987:60). On the other hand, Jones (1978:189) has suggested that the ethnohistoric accounts of the Jesuits were exaggerated, and that horticulture and other subsistence practices were sufficiently productive for Native Americans to live in permanent residences.

The main point of this discussion is that coastal areas, and the back-barrier area specifically, are viewed differently by different groups of people (land owner, vacationer, environmental activist, researcher, etc.). There can even be differences within these groups, based on individual backgrounds. For archaeologists, the trick is to not let these views bias our interpretation of the archaeological record, and realize that Native American views of these places could have been any and all of these things. On a broader temporal scale, views must have changed over time, not just with different groups, but with the changing environment.

Fluctuations in RSL throughout the late Pleistocene and Holocene (Colquhoun and Brooks 1986; DePratter and Howard 1981; Gayes et al. 1992) led to significant changes in coastal morphology over time, with the lateral migration of coastlines and marshes, and the submergence and emergence of upland areas. Changes in sea level and the extent of the marsh-estuarine system affected the very existence of the back-barrier area, by leaving it as an upland setting some distance from the coast, or by drowning parts of it in water, sediment, or both. Understanding the changes to the marsh-estuarine system over time is an important step in comprehending past human occupations of the area. Marsh sediments can record these environmental changes, as well as evidence of past human occupation in the form of human-deposited shell and non-shell midden deposits (Tveskov and Erlandson 2003:1024).

I propose that to gain a more complete understanding of the prehistoric human settlement system in relation to landscape change on the coast of Georgia, data regarding the broader range
of settlement options must be combined with non-archaeological evidence of the paleoenvironmental record. The key here is to have data from as many areas as possible, without making judgments on their marginality (in terms of past human use and/or views, as well as the views of present-day researchers).

Specifically, this dissertation work describes an archaeological survey performed on two back-barrier islands, Mary Hammock (9MC351) and Patterson Island (9MC493) (Figure 1.2), to understand the change in prehistoric human occupation between the beginning of the Paleoindian period (12,000 B.P., where B.P. is years before A.D. 1950) and the end of the Late Woodland period (1,000 B.P.). Paleoenvironmental data obtained through hand probing and sediment core extraction/analysis in the surrounding back-barrier marsh is also described. This information is used to understand changes in sea level, and the effect those changes had on the geomorphology of these back-barrier islands, as well as the marsh-estuarine system in the county as a whole. These paleoenvironmental data are incorporated into an elevation and bathymetric dataset, and combined with changes in sea level over time, creating a model of landscape change in McIntosh County between 12,000 and 1,000 B.P. This dynamic model is used to create predictions about the human settlement patterns of McIntosh County in general, and the back-barrier area specifically, as related to the marsh-estuarine system. These predictions are tested with the already-known site distributions of McIntosh County, available through the Georgia Archaeological Site File (GASF) database, as well as to the prehistoric sherd densities obtained in this study, and in previous studies performed throughout the county (Elliott 2008; Grover 1996; Grover et al. 1997; Thompson and Turck 2010; Zurel et al. 1975) and on the nearby St. Catherines Island (Thomas 2008f).
Background: Archaeology and Geology of the Georgia Coast

This section details the archaeology of back-barrier islands specifically, as well as both the archaeology and geology of the Georgia coast in general. This will put the present state of back-barrier archaeology into context with the archaeology and the geology of the coast at large. The majority of the cultural chronology is from DePratter (1991:11, Table 1) and DePratter and Howard (1981:1288, Table 1), which is in uncalibrated years, B.P. (Table 1.1). For comparison, the St. Catherines Island chronology is also included (Table 1.2).

Previous Studies on Back-Barrier Islands

Limited archaeological studies have been performed on the back-barrier islands (also known as hammocks, hummocks, or marsh islands) of Georgia. During the 1970s and 1980s, DePratter performed surface surveys and probing on many back-barrier islands as part of an NSF grant. While some of this information is available on site forms at the GASF, most of this work remains unpublished except in the form a so-called “gray literature” report (DePratter 1973).

DePratter (1973) surveyed and excavated on four back-barrier islands in southern McIntosh County (Cow Island, Black Island, and two small islands north of Black Island) located between 0.7 and 2.2 km from the mainland. The survey involved walking the perimeter of the back-barrier islands to find shell eroding out of the edges, walking “criss-crossed” over the interior of the hammocks, and also using probes to find subsurface deposits of shell in certain locations (DePratter 1973:4). Six shell middens were found, none dating earlier than the Middle Woodland period.
In another “gray literature” report, Crook (1975) describes the investigation of two marsh islands south of Skidaway Island. On Green Island, walkover surface surveys were performed around the perimeter, and at 50 m intervals over the interior (Crook 1975:1). On Green Island Hammock, survey was limited to the perimeter (Crook 1975:1). Subsurface testing was performed on seven sites, and only three of the 57 prehistoric sites recorded were assigned to a cultural period based on the presence of diagnostic ceramics: Late Archaic/ Early Woodland, Late Mississippian, and general Mississippian periods (Crook 1975:1).

Colonel’s Island has the most extensive record of publication for any back-barrier island. This is a large marsh island in Glynn County, GA, located close to the present-day mainland. Both survey and excavation have been conducted on this marsh island. The archaeological survey involved walking along the margin of the island, as well as walking the roads, trails, and few open areas of the interior, noting shell and artifacts on the surface (Sheldon 1976:4). The sites selected for excavation were chosen “after a thorough field inspection of the known prehistoric middens” (1987:13) deemed those sites to be “representative of the range of sites on the island” (1984:165). Excavations revealed that they were small, thin, and contained low artifact and faunal densities (Steinen 1984, 1987). In addition, no features were identified (Steinen 1984, 1987). These sites ranged in occupation from the Late Archaic through the Historic periods, excluding the Early Woodland period (Steinen 1984, 1987).

The faunal evidence (raccoon, deer, muskrat, catfish, drum, and turtles) from Colonel’s Island indicate that the occupants exploited multiple environments, including terrestrial, marsh, and tidal creeks (Reitz 1987:68). This subsistence pattern is similar to small middens found on the mainland and barrier islands, and Steinen (1984:170, 1987:26) concluded that all of these
small sites were non-permanent habitations, that represent short-term camps used for the seasonal exploitation of terrestrial and marsh resources.

While no changes in settlement or subsistence are noted for the prehistoric occupations of Colonel’s Island, this can be attributed to method and disturbance. Almost all of the sites had been considerably disturbed by agricultural practices during the Plantation Period (1780s-1860s) (Steinen 1987:26). It is difficult to discern changes in subsistence over time, because the faunal remains at each site were combined for analysis. The large amount of disturbance, and the low frequency of faunal material, may have precluded any other method of analysis.

These studies underscore two important points. The first is the need for more systematic archaeological surveys on back-barrier islands. The unsystematic nature of these walkover surveys, coupled with the lack of subsurface survey and the focus on shell-bearing sites, introduces biases into site distributions, making inferences about settlement patterns problematic. Second, the location of back-barrier islands must be considered when discussing site distributions. Distance to the mainland, major barrier islands, other back-barrier islands, tidal creeks and estuaries are all potential factors influencing the prehistoric utilization of these landforms.

Geology of the Georgia Coast Prior to Human Occupation

The present-day barrier island complexes are composed of Pleistocene islands of beach and dune deposits fronted by Holocene islands with analogous deposits (Hayes et al. 1980:285) (see Figure 1.3). The Pleistocene islands are part of the Silver Bluff shoreline, which formed sometime between 110,000 and 40,000 B.P. (Howard and Frey 1985:78). To the west of these islands are the Pamlico and the Princess Anne shoreline complexes, which formed prior to the
Silver Bluff shoreline, when sea level was higher than at present (Hoyt and Hails 1967:1541). Researchers initially believed that the Silver Bluff shoreline formed during the late Pleistocene (36,000-25,000 B.P.) (Hoyt and Hails 1967). However, it has recently been suggested that radiocarbon (\(^14\)C) dates between 25,000 and 40,000 B.P. are inaccurate due to excess amounts of \(^14\)C in the atmosphere (Dockal 1995). Thus, sea level high stand indicators with those dates might actually date to around 60,000 B.P. (Dockal 1995). In addition, Booth and Rich (1999) found a freshwater peat in a vibracore from St. Catherines Island that seems to have been deposited during a time of lowered sea level, and dates to over 40,000 B.P., indicating that some of the present-day barrier islands may have formed before 40,000 B.P. (Linsley et al. 2008).

Similarly, recent \(^14\)C and optically stimulated luminescence (OSL) dates have put the formation of both Skidaway and Sapelo barrier islands at over 40,000 cal. B.P. (Turck and Alexander 2011). In addition, Garrison et al. (2008:138) have dated shell beds off the coast of Georgia at Gray Reef and J-Reef to between 44,000 and 31,000 B.P. These were originally deposited in a subtidal environment, and subaerially exposed between 31,000 and 8,000 B.P. (Garrison et al. 2008:138).

The assumption, then, is that most of the islands in the present-day back-barrier area represent remnants of barrier islands that formed when sea level was higher then at present (between 125,000 and 40,000 B.P.) (Howard et al. 1973:48). Thus, they formed well over 40,000 B.P., before the formation of the Silver Bluff shoreline, but after the formation of the Princess Anne shoreline. Of course this excludes those marsh islands of recent historical formation, created from ship ballast dumps or piles of dredge spoil (Howard and Frey 1980:119). After the Silver Bluff shoreline formed, eustatic sea level continued to drop until the last glacial maximum occurred around 18,000 B.P., when the advance of the Wisconsin Laurentide ice sheet (LIS)
reached its greatest extent, and sea level fell to around 125 meters below present (mbp) mean sea level (Balsillie and Donoghue 2004; Milliman and Emory 1968; Siddall et al. 2003). This left the present-day back-barrier area as an interior coastal plain, with certain landforms having higher topographic relief than others. After 18,000 B.P., glacial termination proceeded until the complete LIS collapse, and sea level rose, most likely with multiple oscillations (see Siddall et al. 2003).

Geology and Archaeology during the Paleoindian, Early Archaic, and Middle Archaic Periods (12,000-5,000 B.P.)

At the beginning of the Paleoindian period (~12,000 B.P.) sea level was still anywhere from 90 mbp (Fairbanks 1989) to 15 mbp (Lidz and Shin 1991), leaving the present-day back-barrier area some distance from the coast. Sea level continued rising, and it was not until sometime between 6,000-4,500 B.P. (the end of the Middle Archaic period) that it neared its current position, reuniting the former Pleistocene shorelines with the coast. Throughout these early cultural periods, the present-day back-barrier islands were areas of higher topographic relief amid an inland landscape.

Populations from these early periods most likely occupied the coastal zones of earlier coastlines that were subsequently submerged under rising sea levels (Reitz 1988:145), and sites dating to these periods have been found underwater off the coast of North America (Blanton 1996; Faught 2004; Stright 1990; also see Thompson and Worth 2011 for a review). In addition, evidence of human utilization of coastal resources has been found dating to as early as 12,000 B.P. in Louisiana (Russo 1996:185), and around 10,000 B.P. on the Pacific coast of the U.S. and Canada (Cannon 2000; Erlandson 1991, 1997). There is also evidence of long-term continuity in
settlement and subsistence behavior over time for the coastal region of New York and southern New England, suggesting that the broad-spectrum resource use of coastal people was a long-established tradition, possibly beginning during the Paleoindian period (Bernstein 2006:277). Evidence of past marshes and estuaries has been found on the continental shelf of Georgia (Howard and Frey 1980; Littman 2000). There is also the idea that marsh habitats move laterally with changing sea levels. Although marsh accretion rates can be diminished during the initial stages of transgression, (Reed 2002:239-240), with sufficient sedimentation, the marsh can maintain its elevation in the face of continued sea level rise.

The implications are that populations from the Paleoindian, Early Archaic, and Middle Archaic periods utilized coastal resources, and followed the coastline as sea level rose. However, most traces of these early coastal adaptations have been buried under sediment, submerged under water, or destroyed by sea level fluctuations. Therefore, sites that date to these early time periods can be found in the present coastal zone of Georgia, but they will only reveal information about terrestrial adaptations (see Lewis 2000).

*Geology and Archaeology during the Late Archaic Period (4,200-3,100 uncal. B.P.)*

It was during this period that sea level rose near to the present coastline of Georgia (DePratter and Howard 1980; see Figure 1.4). Evidence from a more recent study on past sea levels indicates a high sea-level stand of about 1.2 mbp at 4,200 B.P. (Gayes et al. 1992). It is possible that this rising sea level initially created lagoons that were subsequently filled with salt marshes in the back-barrier area west of the Silver Bluff shoreline (Howard and Frey 1985:78). However, Howard and Frey (1980:119) also point out that “Georgia marshes typically constitute veneers overlying either a Pleistocene ‘basement’ or a channel fill-point bar sequence rather than
a traditional ‘lagoon-fill’ sequence.” Either way, by ~4,200 B.P this area was filled with Holocene marsh sediment (DePratter and Howard 1981:1289), and became a back-barrier area. It was also around this time that Holocene-aged deposits and barrier islands started to form to the east of the late Pleistocene Silver Bluff shoreline (Hayes et al. 1980:286).

Archaeological data reveal intensive settlement of the Georgia coast, beginning around 4,200 B.P., coinciding with marsh formation (DePratter and Howard 1981:1289; Elliot and Sassaman 1995:18). The GASF database confirms this. Only four Paleoindian, nine Early Archaic, and three Middle Archaic sites are found within the present coastal zone of Georgia, which is defined here as extending from the eastern coasts of the barrier islands, to about 30 km inland. In contrast, 243 Late Archaic period sites are found in this same area. There is also some evidence for year-round occupation in Georgia (Thompson and Andrus 2011) and south Florida (Russo 1996; Russo and Quitmyer 1996). That many settlements were along the margins of back-barrier areas is attributed to the marsh and its associated resources. Relatively large settlements consisting of ring-shaped and linear to amorphous shell middens were located along island margins next to tidal creeks, providing access to the back-barrier environments (DePratter and Howard 1980:7). DePratter and Howard (1980) suggest that sites not located near marshes were small, more dispersed, and contained little or no shell, indicating hunting and collecting camps. Subsistence during this period seems to be focused on estuarine mollusks and fishes (Colaninno 2010; DePratter 1977a:11), as well as land/ fresh water turtles, birds, mammals, nuts and seeds (DePratter and Howard 1980:7). Sea level was still lower than at present, and evidence for this is contained in the archaeological record as well. The bottom 40 cm of the midden at the Bilbo site is found below the present water table (Crook 2009:15, Figure 12), and the lower levels of the midden at Cannon’s Point are inundated at high tide (DePratter 1977a:11).
Geology and Archaeology during the Early Woodland Period (3,100-2,400 uncal. B.P.)

During the Early Woodland period changes in the archaeological record indicate that there were changes in the environment. Brackish water shellfish were no longer utilized (DePratter 1977a:11), no large shell middens are found (Reitz 1988:147), and most sites are made up of artifact scatters with no midden accumulation (DePratter and Howard 1980:10). Lithics were more abundant, suggesting an increase in the importance of hunting (DePratter and Howard 1980:10), while whelk-shell hammers and adzes and bone pins were no longer used, indicating a termination of marsh exploitation (DePratter and Howard 1980:11). In addition, sites from the Early Woodland period have been found buried under modern marsh sediment or recent Holocene islands (DePratter 1977a:8). This evidence indicates that changes in sea level and/or marsh habitat occurred, because a rapid change in sea level can lead to the reduction in estuarine productivity by destroying or reducing the nutrient-rich areas behind barrier islands (Ricklis and Blum 1997:301-302). DePratter and Howard (1981) originally estimated a two to three meter drop in sea level (to 3.0 or 4.0 mbp) during the middle of the Early Woodland period, around 2,700 B.P. (see Figure 1.4). This was based on deeply buried archaeological sites, dredged up pottery sherds, and submerged tree stumps (DePratter and Howard 1981:1292). The sea level curve by Gayes et al. (1992:159), based on foraminifera instead of archaeological evidence, indicates that this lowstand occurred earlier, around the middle of the Late Archaic period. These authors also discuss other data that show a cluster of sea level indicators that average about 4.7 mbp sea level at around 2,700 B.P. (Gayes et al. 1992:159, Figure 6). These other data were not used in the construction of the sea level curve, because they were obtained from a different part of the South Carolina coast, and possibly represent local submergence due to sediment loading (Gayes et al. 1992:155). However, the authors note that it is possible that these data represent a
continued regression until 3,000 or 2,700 B.P. (Gayes et al. 1992:159), which is at the same time as the DePratter and Howard (1981) lowstand. Nonetheless, it is important to keep in mind that disagreements between sea level data may be due to local differences in neotectonic activity, including downwarping (Colquhoun and Brooks 1986:278; Hayes 1994:246). This underscores the need for specific regional sea level curves.

One other sea level curve (Colquhoun and Brooks 1986) relevant to the study area was also considered. This curve was constructed using basal and intercalated peat deposits, as well as archaeological data, indicating seven small-scale fluctuations in sea level during the last 5,000 years (Colquhoun and Brooks 1986:276). Colquhoun and Brooks (1986:279) assert that these fluctuations can only be correlated between different estuaries using archaeological data. The construction of this curve has been questioned. As Gayes et al. (1992:159) note, the sea-level indicators are suspect for some intervals. More detailed data are needed to test this idea of small-scale/short-term fluctuations.

Geology and Archaeology during the Middle and Late Woodland Periods (2,400-1,000 uncal. B.P.)

After 2,400 B.P. settlement on the Georgia coast changes, once again indicating a change in environment and RSL. During the Middle and Late Woodland periods it was common for the edges of back-barrier areas, including back-barrier islands, to be used for habitation (DePratter and Howard 1980:12-14), so people could utilize the resources of the marshes, hammocks, and tidal creeks (Milanich 1980:173). Brackish-water shellfish were once again important, and much of the diet was made up of bony fish and turtle (DePratter and Howard 1980:14; Milanich 1980:174). These changes in the archaeological record indicate that sea level was fairly stable,
which enabled marsh productivity to return. The sea level curve of DePratter and Howard (1980) and the extra data of Gayes et al. (1992) support this notion, indicating a quick rise to around 1 mbp. After 1,000 B.P. there was a slow and steady rise in sea level until today, with a negligible change in the marsh-estuarine system. For this reason, the Mississippian and Historic Contact periods are not included in this study.

**Environment and Landscape**

In this section, I will provide a theoretical discussion of various environmental and landscape approaches in archaeology. While not exhaustive, this review will detail my interpretation of the main similarities of these approaches, and lay out the framework of how they will be utilized in this study.

The main goal of this dissertation is to gain a more complete understanding of the prehistoric human settlement system in relation to landscape change on the coast of Georgia. Specifically, the human occupation of Mary Hammock and Patterson Island will be compared to the changing human occupation, sea level, and marsh-estuarine locations of the rest of McIntosh County. The research in this dissertation will be guided by a theoretical framework that relies heavily on ideas from environmental archaeology, which tries to understand human-environmental interactions from a viewpoint that sees these interactions as non-deterministic (Dincauze 2000:20; Jochim 1990:75; Reitz *et al.* 1996:3).

In general, ecological approaches to archaeological studies often have a number of problems. Environmental and behavioral reconstructions are often averaged over space and time,
and can be too coarse-grained (Jochim 1990:84). The archaeological record is biased, especially concerning past environments. Evidence from an archaeological site is just a sample of the resources that were economically important to people from the surrounding region of unknown size (Jochim 1990:84). In addition, agency is often neglected. Human actors are the agent of cultural change (Brumfiel 1992:559), and can also be the agents of environmental change (Balée and Erickson 2006; Rick and Erlandson 2008). Change can happen internally, arising from negotiations among different groups of people, and can lead researchers to overestimate the external causes of cultural change (Brumfiel 1992:551, 553).

The focus on landscape introduces other difficulties into this study. There are very diverse theoretical and methodological approaches to landscape in archaeology (see Kowalewski 2008:251), with sometimes contrasting ideas of what “landscape” is (Hicks and McAtackney 2007:13). In very general terms, most approaches to landscape emphasize either natural or cultural aspects of the environment (Anschuetz et al. 2001:158). Archaeologists realize that past human decision-making did indeed affect the environment (Balée 1998, 2006; Rick and Erlandson 2008; Hardesty and Fowler 2001:85), with landscapes being the dynamic interaction of nature and culture (Anschuetz et al. 2001:185; Bruck and Goodman 1999:13; see also Wobst 2005). Being both natural and cultural, landscapes can be considered as human constructions (Anschuetz et al. 2001:160), at least in part. Thus, integrating the natural and cultural aspects of landscapes under one paradigm should be considered a worthwhile goal in archaeology. The difficulty arises in how this can be implemented and accomplished.

Anschuetz et al. (2001:187) try to give guidance with this, stating that the spatial and temporal occupational histories of each community can be determined through the “tactics and strategies” that those communities used to interact with their environment. Archaeologists can
determine the tactics and strategies by integrating human history and agency into their reconstructions of the past (Anschuetz et al. 2001:187). The main point seems to be that agency should be a part of archaeological studies. This is not very specific or even new (see Trigger 2006:497). Anschuetz et al. (2001:189) then state that the natural and cultural factors that affected how people occupied the landscape over time and space must be defined by the archaeologist. This is achieved by defining the archaeological and physical landscape, identifying the links between the two, establishing where the two intersect, and then defining the landscape through the integration of these intersections (Anschuetz et al. 2001:189). Methodologically speaking, this explanation falls short of how to integrate the disparate views on landscape.

Historical ecology, which studies past ecosystems by charting the change in landscapes over time (Crumley 1994:6), has similar views about landscape. The main ideas of this framework are: human activity affects the environment, but does not necessarily lead to its degradation; different types of socio-political and/or economic systems will have different affects on the landscape; and the interaction between humans and the environment, and the affects they have on each other over time, are “total phenomena,” meaning they are cumulative (Balée 1998:14). Inferring how human attitudes towards, and decisions about, the environment changed over time is another component of historical ecology (Crumley 1994:6; Hardesty and Fowler 2001:78). As such, human decision-making is the key to understanding the development of landscapes over time. This includes trying to understand why individual actors decided to interact with the environment in the way they did (Hardesty and Fowler 2001:78). The problem is that it is difficult to get at such understandings without historic documents (Butzer 1990:95; Hardesty and Fowler 2001:84-85; see also McGovern 1994 as an example using historic
Traditionally, archaeologists that believe this can be achieved work mostly within a post-processual theoretical framework (e.g., Hodder et al. 1995; Tilley 1994), or more recently, incorporate diverse theoretical approaches to view the past in multiple ways (Hegmon 2003; Pauketat 2003). Scale is also a factor in understanding human decision-making in relation to the environment. While it would be difficult to get at such an understanding with synchronic studies, historical ecologists believe that this is possible by linking together multiple scales (local to regional) of analysis (Balée and Erickson 2006:12).

Systems theory is yet another approach to the past, which, like in the previous examples, is related to the idea that humans cannot be separated from their environment. Since humans are integral parts of ecosystems, this approach seeks to incorporate humans into ecological research by viewing ecosystems as human ecosystem, or socio-ecological systems (Butzer 1980, 1996; Delcourt and Delcourt 2004; Redman et al. 2002). The relationship between social and ecological systems is such that they are actually part of one single system. Much of this seems to be based on panarchy theory and its model of adaptive cycles, as adopted for studying human ecosystems (Delcourt and Delcourt 2004; Gunderson and Holling 2002; Redman 2005). With panarchy, the interactions between people and the environment are viewed as responses to changes in the other; meaning both adapt to changes in the other (Delcourt and Delcourt 2004:1). It integrates environmental and archaeological data to understand how human ecosystems changed over time, by determining the spatial and temporal scale at which the two match up (Delcourt and Delcourt 2004:2, 9). This views humans as a keystone species: one that controls the environment and determines which other species can exist with it (O’Neill and Kahn 2000). Human ecosystems change continuously, with levels in the panarchy of human ecosystems getting added continuously over time (Delcourt and Delcourt 2004:18-19). These ideas are
similar to those in historical ecology, which also uses the term “keystone species” in regards to
humans as drivers of ecological change (Balée and Erickson 2006:2). It seems this phrase is
mostly used for the sake of ecologists, to help them understand that ecological and social systems
should not be separated (see O’Neill and Kahn 2000). Although historical ecologists focus on
human agency (Balée and Erikson 2006:4) instead of human adaptations to the environment
(Balée 1998:14), adaptationist approaches can also incorporate human agency (Moran 2008:53; 86-89).

Catchment analysis, while more closely linked to settlement studies, shares some
similarities with landscape approaches as well. It tries to understand the changing relationship
people had with their environment by relating the evidence at a site to the area served by the site,
while also realizing that the catchment (and resources within it), changed over time (Higgs and
Vita-Finzi 1972:27). I view this as a micro-landscape view, taking into account distance, natural
features like topography, etc., (Higgs and Vita-Finzi 1972:27), within close proximity to sites.

Catchment studies differ from other landscape studies in that they have a more specific
focus on nutritional yields of the area, viewing the catchment area as equivalent to an economic
zone (Higgs and Vita-Finzi 1972:27). This view can lead to problems, because the relationship
between humans and the landscape is usually conceptualized in terms of capitalist economics
(e.g., with ideas of environmental or economic exploitation) (Brück and Goodman 1999:8). All
human behavior might not be able to be reduced to maximizing economic gain and minimizing
risk: this may only be the basis of economic practice in capitalist societies (Brück and Goodman
1999:9). More to the point, and as Higgs and Vita-Finzi (1972:29) themselves mention, not all
site locations can be explained by looking at the resources in a territory. Non-economic factors
may very well be involved. Site locations can be due to environmental reasons, such as
protection from cold winds and rain (Suttles 1946:101), and water availability (Griffen 1959:3). Site locations, or the absence of sites, can also be due to social reasons, such as the need to maintain buffer zones between groups (Hally 1994:171), or due to religious reasons (Griffen 1959:16).

Another problem with site catchment analysis is with the uncritical use of the 5 km and 10 km diameter catchment areas (McGovern 1980). Higgs and Via-Finzi (1972:31) state that the distance threshold for exploitation is 5 km for sedentary economies, and 10 km for mobile economies. This has been seen in other studies, for example, Wing and Scudder (1983) found that all resources at sites in the Bahamas could be obtained within a 5 km diameter. It has also been suggested that these thresholds were derived from an ethnographic sample that was too small (Foley 1977:164). Higgs and Via-Finzi (1972:31) note that the actual delineation of territories should be based on time, with sedentary people walking 5 km in one hour, and mobile people walking 10 km in two hours (1972:33). Aspects of the terrain will shape the actual territory (e.g., slope, elevation, water, etc.) (Higgs and Vita-Finzi 1972:33), as will a society’s transportation system (McGovern 1980), and distance between other groups of people.

One last major problem with catchment studies, related to concepts in non-site archaeology (Ebert 1992; Dunnell 1992), is the realization that behaviors occurred continuously across a landscape (Foley 1981:2). This is a problem in all of archaeology, not just site catchment analysis. Archaeologists focus on samples with high artifact density, high artifact visibility, and where the ground is intensely modified, while “sterile” areas are usually not studied, and are assumed to be areas of non-occupation or non-use (Wobst 2005:20). It is difficult to understand the meanings of these areas, to know if they were actually not utilized, or if impacts on the land were avoided on purpose (Wobst 2005:21). While such a problem cannot
be overcome easily, it should be kept in mind that these “sterile” areas articulate with non-sterile areas in some way. Other minor problems with catchment analysis include the difficulty in taking the changing environment into account (Flannery 1976), the over-simplification of the environmental variables, and the accuracy of the data (Hunt 1992).

The Landscape Approach

As Yesner (2008:42) notes, the various methodological and theoretical camps in ecologically-oriented archaeology are not mutually exclusive, and overlap considerably. The following are the main concepts discussed in the previous section that are important to the landscape approach that I will utilize in this study:

1. The interaction between humans and environment are non-deterministic.
2. Humans and the environment are so closely inter-related, they can be viewed as being part of one socio-ecological system.
3. Landscapes are the cumulative affects of both natural and cultural processes over time.
   a. Humans affected the landscape, both intentionally and unintentionally.
   b. Local and global environmental changes affected the landscape.
4. Human activity occurs continuously across the landscape, although it might not leave archaeologically recoverable traces in every area.
5. While the locations of some sites are related to nearby resources, other site locations are related to other features of the environment, as well as to aspects of the society that have nothing to do with environment.

The main idea here is not to be deterministic, either environmentally or culturally speaking. As Reitz et al. (2009) note, humans implement cultural changes that can, intentionally or not, cause environmental changes, environmental changes can cause people to implement cultural changes, and humans can promote environmental change, as well as adapt to changes in the environment that they did not create. The environment, landscape, human activity, and human thought are intertwined, maybe inextricably so. However, to understand past environments, human behavior, and the interaction between the two as one or both changed, they must be separated from each other as much as possible. It is imperative to distinguish between anthropogenic and non-anthropogenic forces, because both past environments and past human populations were affected by them (Reitz et al. 2009:13). After this is done, the degree to which human behavior and environment articulated with each other can be discerned. It is in this way that circular arguments can be avoided concerning environmentally-related changes in behavior, and human impacts on the landscape. Correlations between environmental changes and behavioral changes can be seen, and possible causations between the two can be tested. Only then can archaeologists begin to (re)construct human landscapes.

In my approach to understand changes in both the natural environment and human activities over time, separate from (but ultimately in relation to) each other, I will be using elements of two related approaches. The first is the landscape approach of Rossignol (1992). The main feature of this approach involves incorporating regional geomorphology at the landscape
scale, and formation processes at the site level, into investigations of past land use (Rossignol 1992:8). The incorporation of geomorphology and formation processes helps to understand the influences that non-cultural factors have on the archaeological record (Rossignol 1992:4). This includes ecological factors that influenced the human decisions that went into the creation of the archaeological record, as well as the factors that affected the archaeological record after it was created. Incorporating these factors into studies of past human land-use allows for better differentiation between natural and anthropogenic deposition patterns (Rossignol 1992:8). The other main feature of the landscape approach involves taking a distributional approach to the archaeological record (Rossignol 1992:4), which treats artifacts as observational units (Dunnell 1992:33). The density (or distribution) of artifacts across the landscape, and the timing of the deposition of those artifacts, are most important in understanding past land use (Dunnell 1992:34). Sites are viewed as being constructed by the archaeologist (Dunnell 1992:27), and are usually not relevant to the people being studied. Understanding how multiple processes (geomorphological, formation, and ecological) came together to result in the distribution of artifacts across the landscape results in a better understanding of changing land use patterns (Rossignol 1992:10).

The second approach used in this study is landscape ecology, which is the study of the change in the structure (i.e., the spatial distribution of elements) and function (i.e., the interaction among elements) of landscapes over time (Forman and Godron 1986:25). The landscape is viewed as being heterogeneous over space, and also as having changed over time. Humans have become a main focus in landscape ecology studies, due to the realization that people are linked to the environment intricately (Wagner 2003:127). These studies can incorporate human action, and dynamically link social and environmental processes (Matthews et al. 2007). Models can be
constructed to explain spatial patterns of land-use or settlement, or even test hypotheses of land-use and settlement patterns (Matthews et al. 2007). Landscape ecology can describe, analyze, and model the movement of individuals over landscapes (Hassan 2004:320), because the spatial structure of the landscape is linked to the function (or flows in energy) of the landscape (Forman and Godron 1986:516). So, the movement of people over the landscape (i.e., the function) can be deduced by looking at the change in the spatial distribution of landscape elements over time (i.e., the structure). With the addition of human activity into these studies, it can be argued that landscape ecology and historical ecology are similar.

The approach outlined above to study former landscapes provides a conceptual framework that structures what data are needed (Church et al. 2000:146). It can define site formation processes (sensu Schiffer 1972), geomorphic processes (landscape level), and environmental variables important for human land use (Church et al. 2000; Rossignol 1992; Stafford 1995; Stafford and Hajic 1992). This is important, as Jochim (1990:85) states that the reasons for selecting environmental variables need to be clear. The main advantage of this approach is that it views the environment, the landscape, the resources, and human behavior as dynamic. All of these things need to be taken into account when trying to understand the interaction between past human behavior and the environment.

The utilization of a Geographic Information Systems (GIS) program facilitates this approach (Church et al. 2000) by:

1. Integrating large and detailed environmental and archaeological datasets, of fine spatial and temporal scales.
2. Allowing the study to be multi-scalar, moving easily and quickly between the site and the region.

3. Incorporating geomorphological and site formation processes to help understand changes in the landscape over time.

4. Adding a measure of quantification to the study, calculating certain landscape ecology metrics.

These factors make this study dynamic by putting changes in human land-use in the context of a changing environment (Church et al. 2000).

A Model for Back-Barrier Evolution and Human Settlement

I constructed a model of human-environmental interaction between 12,000 and 1,000 B.P. for McIntosh County, Georgia based on the concepts of the approach detailed in the previous section. While the model is mainly geomorphological, it begins with one main archaeological assumption: the location and extent of the marsh-estuarine system influenced human settlement over time. As seen in the background section, changes in sea level, and its concomitant affect on marsh-estuarine productivity, has been cited as a major influence in settlement patterns on the coast of Georgia. Using this as my starting point, I constructed a model that looks at the detailed changes in sea level over time, and how those changes affected the structure of McIntosh County, with a specific focus on the marsh-estuarine system. To quantify these changes, the landscape ecology metric Class Area Proportion (also called Percentage of
Landscape) was calculated. This is simply the proportions of land cover types in the study area (Leitão et al. 2006:68). This metric is easy to calculate and interpret, and is considered one of the most important landscape descriptors (Leitão et al. 2006:68-69). Five basic land cover types were chosen: subtidal (areas never subaerially exposed), intertidal (areas subaerially exposed only at low tide, sometimes also called tidal), barrier island (upland landforms directly adjacent to oceans), marsh island (upland areas within the marsh), and mainland (upland areas of the conterminous United States).

The model is focused on changes in the location and extent of intertidal (which includes marsh) and subtidal (which includes estuaries) land cover types. This allowed changes in marsh-estuarine productivity to be estimated, and predictions on human settlement and land-use to be created. These predictions were based solely on geomorphological changes, because most archaeological data were not incorporated into the model. The only archaeological data that went into the model were data on human shell deposition, which itself is geomorphological. The act of depositing shellfish remains on land simultaneously buries surfaces while adding extra elevation. These human-made elevations were removed from the model initially, and re-added at the appropriate times. The majority of archaeological data (including site distributions in the county, and artifact density distributions from multiple surveys) were used after the fact, to test the predictions of human settlement.

Following are the individual questions that the model addresses, and the datasets used to answer them:

1. How did changes in sea level affect the coastal habitats of McIntosh County over time, especially the location and extent of the marsh-estuarine system?
a. Detailed present-day elevations for the county

b. Information on the elevations of former surfaces (including those below the present-day marsh, and those underneath human deposits of shell)

c. Bathymetry (underwater elevations)

d. Information on changes in sea level over time, including existing sea level curves (Gayes et al. 1992; DePratter and Howard 1981)

e. County-level soil and wetlands datasets, which contain locational information of subtidal habitats, intertidal habitats, and upland habitats, as well as salinity information of subtidal habitats

2. What expectations/predictions can be made about McIntosh County settlement patterns over time, when taking into account changes in the location and extent of the marsh-estuarine system (i.e., looking at environmental changes to make predictions about human settlement)?

a. Changes in the percent of land cover types over time (using the landscape ecology metric Class Area Proportion, also called Percentage of Landscape)

3. What were the changes in human occupation over time within McIntosh County as a whole, and on the back-barrier islands specifically (using site number and sherd densities as proxies for utilization/intensity of occupation)?

a. GASF database for McIntosh County

b. Mainland survey information (Grover 1996; Grover et al. 1997; Zurel et al. 1975)

c. Sapelo and Blackbeard Islands survey information (DePratter 1977b; Juengst 1980; Marrinan 1980; McMichael 1977; Simpkins and McMichael 1976)
d. Supplemental survey data from the nearby St. Catherines Island (Thomas 2008f)
e. Mary Hammock and Patterson Island survey data (this study)
f. Other back-barrier island survey data (Thompson and Turck 2010; Elliott 2008)

4. How do the predictions about settlement compare to the spatial distribution of known archaeological sites over time? (Test the expectations of the model versus archaeological data.)

Although I am aware that people are not just “passive recipients” that get change imposed on them from outside their culture (Anschuetz et al. 2001:181), as Erlandson (2001) notes, the main problem with studying coastal populations is understanding their relationship to a changing sea level. This study begins with the non-anthropogenic process of sea level change, and works towards understanding human behavior. This method of assessment is similar to an idea noted by Higgs and Vita-Finzi (1972:29), which suggests that the resource potential of a site be analyzed to determine if that is the reason the site was occupied.

In addition, creating predictions of human behavior, and testing them with archaeological data will move this study away from typical correlative studies, which look at the relationship between sites and environmental variables, but only confirm pre-existing statements (Church et al. 2000:136-137). This study will be “explanatory predictive” in that it will try to explain how patterns of human land-use will be reflected in the archaeological record (Church et al. 2000:135). This hypothesis testing can lead to a better understanding of human-environmental
interaction, and hopefully avoid overestimating the external causes of cultural change (Brumfiel 1992).

**Objectives**

The main goal of this study is to understand how the structure of the McIntosh County landscape changed over time in accordance with changes in sea level, and to compare that to changes in human settlement. The questions noted above will be addressed by conducting a geoarchaeological investigation. The various datasets will be obtained utilizing both archaeological and geomorphological methods. The objectives of this investigation are:

*Archaeological Objectives*

1. Determine the human occupational history of Mary Hammock and Patterson Island from the Paleoindian period through the Late Woodland period.
2. Prepare a GIS layer of a recent version of the GASF database for McIntosh County.
3. Create a comparative dataset of prehistoric sherd densities (number of sherds per area surveyed) obtained from previous surveys in McIntosh County.

*Geomorphological Objectives*

1. Determine the stratigraphic depth of back-barrier island surfaces underneath human-deposited shell.
2. Determine the detailed present-day topography of Mary Hammock and Patterson Island.

3. Determine the stratigraphic depth of former upland surfaces underneath the marsh across McIntosh County, as well as around the back-barrier islands.

4. Find evidence for changes in past sea level.

5. Create one continuous GIS layer of present-day elevation and bathymetric data.

6. Incorporate the above geomorphological and site formation data together to construct a model.

**Synthesis**

1. Run the model using data from the sea level curves, and calculate changes in the proportions of landscape types (Class Area Proportion metric).

2. Create predictions about the settlement patterns of McIntosh County in general, and the back-barrier area specifically.

3. Test those predictions with archaeological data obtained in this study, as well as previous studies throughout McIntosh County.

**Summary**

This chapter provided detailed background information on the archaeology and geology of the study area, as well as the landscape approach utilized in this study. It also provided information on the model that was created to examine human-environmental interactions on the
coast of Georgia from 12,000-1,000 B.P. (the Paleoindian through Late Woodland periods). The questions asked, the datasets needed to answer these questions, and the objectives of the dissertation were also laid out. In the next chapter, I describe the methods used to obtain the data, and achieve those objectives.
Table 1.1. Cultural Chronology and Associated Ceramic Sequence of the Georgia Coast (from DePratter 1991:11, Table 1; DePratter and Howard 1981:1288, Table 1).

<table>
<thead>
<tr>
<th>Period</th>
<th>Phase</th>
<th>Ceramic Types</th>
<th>Uncalibrated Years B.P.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Late Woodland Period</td>
<td>Wilmington</td>
<td>Wilmington Cord Marked, Wilmington Brushed, Wilmington Fabric Marked, Wilmington Plain</td>
<td>1,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wilmington Cord Marked, Wilmington Plain</td>
<td>1,400</td>
</tr>
<tr>
<td></td>
<td>Walthour</td>
<td>Walthour Complicated Stamped, Walthour Check Stamped</td>
<td>1,500</td>
</tr>
<tr>
<td>Middle Woodland Period</td>
<td>Deptford II</td>
<td>Deptford Complicated Stamped, Deptford Cord Marked, Deptford Check Stamped, Refuge Simple Stamped, Refuge Plain</td>
<td>1,700</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Deptford Linear Check Stamped, Deptford Cord Marked, Deptford Check Stamped, Refuge Simple Stamped, Refuge Plain</td>
<td>2,400</td>
</tr>
<tr>
<td>Early Woodland Period</td>
<td>Refuge III</td>
<td>Deptford Linear Check Stamped, Deptford Check Stamped, Refuge Simple Stamped, Refuge Plain</td>
<td>2,900</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Refuge Dentate Stamped, Refuge Simple Stamped, Refuge Plain</td>
<td>3,000</td>
</tr>
<tr>
<td></td>
<td>Refuge II</td>
<td>Refuge Simple Stamped, Refuge Incised, Refuge Plain</td>
<td>3,100</td>
</tr>
<tr>
<td>Late Archaic Period</td>
<td>St. Simons II</td>
<td>St. Simons Incised &amp; Punctated, St. Simons Incised, St. Simons Punctated, St. Simons Plain</td>
<td>3,700</td>
</tr>
<tr>
<td></td>
<td>St. Simons I</td>
<td>St. Simons Plain</td>
<td>4,400</td>
</tr>
</tbody>
</table>
Table 1.2. Comparison of the Dates for two Cultural Chronologies on the Georgia Coast (adapted from Thomas 2009:53, Table 2.1).

<table>
<thead>
<tr>
<th></th>
<th>DePratter 1991 (uncal.) B.P.</th>
<th>Thomas 2009 (cal.) B.P.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Late Woodland (Wilmington)</td>
<td>1500 - 1000</td>
<td>1600 - 1150</td>
</tr>
<tr>
<td>Middle Woodland (Deptford)</td>
<td>2400 - 1500</td>
<td>2300 - 1600</td>
</tr>
<tr>
<td>Early Woodland (Refuge)</td>
<td>3100 - 2400</td>
<td>2950 - 2300</td>
</tr>
<tr>
<td>Late Archaic (St. Simons)</td>
<td>4200 - 3100</td>
<td>4950 - 2950</td>
</tr>
</tbody>
</table>
Figure 1.1. Coastal zone of McIntosh County, Georgia.
Figure 1.2. Main study area and places discussed in the text.
Figure 1.3. Relict shorelines on the coast of Georgia.
Figure 1.4. Sea level curves adopted from Colquhoun and Brooks 1986, DePratter and Howard 1981, and Gayes et al. 1992.
CHAPTER 2
METHODS

The methods applied in this study often gathered both archaeological and geomorphological information at the same time. However, to correspond with the order of the objectives, the archaeological and geomorphological methods will be discussed separately (regardless of when chronologically they were performed).

Archaeology

Archaeological Survey

To determine the human occupational history of Mary Hammock and Patterson Island, systematic archaeological shovel test surveys at 20-meter intervals were performed. This is more intense than the typical 30-meter interval used in surveys in Georgia (e.g., a 25 to 50-meter interval was used on the mainland by Zurel et al. 1975). This closely spaced interval increased the number of shovel tests significantly, allowing the marsh islands to be looked at from a “siteless” perspective (i.e., in a distributional manner) (Dunnell 1992:33; see also Ebert 1992). The resultant data can then be used to interpolate artifact densities across the landscape, instead of merely estimating site densities (see Banning 2002:31). Multiple judgmental (or, “special”)
shovel tests were also dug, off of the 20x20 m grid, in areas that were deemed potentially significant due to visible archaeological features (e.g., shell middens).

The shovel test grid was laid out using a Trimble Global Positioning System (GPS), in accordance with the Universal Trans Mercator coordinate system Zone 17 and the North American Datum of 1927 (NAD 27). The typical accuracy was between 1 and 6 meters. When the proper location was reached, the UTM coordinates were recorded with the GPS, and these coordinates were written on a flag that was then placed in the ground. Laying out the shovel test grid was performed exclusively by me, or by me and one other person.

Shovel tests teams consisted of two people: one to dig, and one to screen. They were made up of undergraduate students attending field school, graduate students, myself, and Victor Thompson. Shovel tests were 50x50 cm in area, and dug to the standard 1-meter depth. When obstructions were encountered (e.g., tree roots), shovel test locations were moved and noted. Soil was put through wire hardware cloth with a mesh size of 0.6 cm (1/4 inch). All artifacts and faunal remains except shell were saved in plastic bags, which were labeled with the proper UTM coordinates. Information on the depths of cultural material was recorded on shovel test forms. Different species of shell were noted in the field, and the total amount of shell from each shovel test was weighed using hand scales. This information was also recorded on the forms.

*Archaeological Laboratory Work*

After getting back from the field each day, artifacts were washed with water and toothbrushes, and left out in the sun to dry. They were then moved inside and left out of their bags over night, to dry further. Clean and dry artifacts from the previous day were re-bagged.
Analysis of artifacts occurred in the field, after completion of each survey. DePratter, Thompson, and I classified the prehistoric ceramics from Mary Hammock, and Thompson and I classified ceramics from Patterson Island. The main objective was to determine period of use. Prehistoric ceramics were described with regard to surface treatment/ decoration, temper, rim form, count, and weight, using the typology DePratter (1991) developed for the northern coast of Georgia (see Table 1.1). Sherds that could fit through wire hardware cloth with a mesh size of 1.3 cm (1/2 inch) were recorded as ceramic “residuals,” and not included in the count and weight measurements. Re-classification of some ceramics was performed back at the Laboratory of Archaeology, University of Georgia, Athens. For example, sherds that could be fit back together that were broken during the shovel test process (as determined by edges that were recently broken), were regarded as a single sherd, and counted as such. Also, in addition to the classic sources (DePratter 1991; Williams and Thompson 1999), new sources were consulted when they became available (Deagan and Thomas 2009; Guerrero and Thomas 2008).

The ceramic typology (DePratter 1991:11; also see Table 1.1): permitted sherds to be assigned to the following periods and phases: Late Archaic period- St. Simons phase (4,200-3,100 B.P.), Early Woodland period- Refuge and Deptford phases (3,100-2,400 B.P.), Middle Woodland period- Refuge and Deptford phases (2,400-1,500 B.P.), Late Woodland period- Walthour, Wilmington, and Swift Creek phases (1,500-1,000 B.P.), Early Mississippian period- St. Catherines phase (1,000-800 B.P.), Middle Mississippian period- Savannah phase (800-675 B.P.), Late Mississippian/ Historic Contact periods- Irene and Altamaha phases (675-250 B.P.), Historic Contact period- Altamaha phase (370-250 B.P.), and Unknown (for ceramics that could not be classified due to erosion or lack of diagnostic features.).
Several things must be noted at this point. First, the Late Mississippian and Historic Contact periods were combined because the Late Mississippian ceramic types found on these two marsh islands (Irene plain, Irene burnished plain, and Irene complicated stamped) persisted into the historic period (DePratter 1991:11; DePratter 2009:35 and 40; Thomas 2009:62). When strictly Historic Contact period ceramics (Altamaha/ San Marcos) were identified, they were put into their own category. This scheme may need to be revised in the future, if more of these Historic Contact ceramic types are found to date to before Spanish contact, as on St. Catherines Island (Thomas 2009:79).

Second, some ceramic types span multiple time periods, and similarly, not all sherds could be assigned to a single type with certainty. As DePratter (1979:113) notes, and Thomas (2008c:405-406) concurs, small sherd samples, of the kind recovered in this survey, are difficult to assign to single phases. Thus, ceramics were given time ranges, in years B.P., based on when they possibly were used. This practice, in effect, created *supra*-periods, in addition to the standard periods mentioned above. The Early/ Middle Woodland supra-period (3,100-1,500 B.P.) included ceramics classified as Refuge plain or Refuge simple stamped. The Late Woodland/ Early Mississippian supra-period (1,500-800 B.P.) included Wilmington and St. Catherines plain clay tempered ceramics. Various Mississippian supra-periods were also created, again based on DePratter’s ceramic phase chronology (1991:11). For example, a Middle/ Late Mississippian supra-period (700-575 B.P.) was created for check stamped sherds that could not be identified as the Savannah or Irene types. Also, a Middle/ Late Mississippian/ Historic contact supra-period (800-250 B.P.) was created for burnished plain sherds that could not be identified to the Savannah or Irene phases. Important to note here is that occupation did not extend throughout
these supra-periods, and that these supra-periods do not represent intermediate time periods. They are nothing more than general categories suggesting a possible time of occupation.

Third, DePratter’s (1991) Middle Mississippian time period, (Savannah) was used, even though it was not employed in the recent chronology constructed for St. Catherines Island (Thomas 2008c:431). As DePratter mentions and Thomas (2008c:434, note 17) concurs, the $^{14}C$ record might lack the resolution to detect the short-lived Savannah phase. In addition, this expression of the Savannah phase may be localized to St. Catherines Island (Thomas 2008c:431).

Lithic material, when encountered, was typed, counted, and weighed. Analysis of faunal materials was done to determine species type. Faunal analysis was performed by Carol Colaninno using the comparative collection at the Zooarchaeology Laboratory in the Georgia Museum of Natural History, University of Georgia, Athens.

All of the data recorded on the shovel test forms, as well as the results of the artifact and faunal analysis, were entered into two spreadsheets, one for Mary Hammock, and one for Patterson Island. The main identifiers for all of this information were the UTM coordinates of each shovel test.

**Correction of the GASF Database**

The locations and time period designations of McIntosh County site within the GASF database were checked and corrected. To correct the locational information of sites, multiple steps were taken. First, quad maps were georeferenced to the internal NAD 1927 UTM Zone 17 grid of ArcGIS. These maps were already scanned as .TIFF images for a different project at the GASF, and the images were opened up in ArcMap. Four points along the edges of each quad map were selected where northings and eastings intersected, and these were stretched to the
appropriate points of the internal grid. This process, also known as “rubber-sheeting,” resulted in maps that had positional errors of around +/- 5 m. Next, the GIS point layer of GASF sites was overlayed on top of these maps, and discrepancies between the point layer and the position of sites recorded on the maps were sought. Digital orthophoto quarter quadrangles (DOQQs), which are aerial photographs that have been rectified for the angle of the camera and relief of the topography, were also used to help identify landforms, especially along the edges of upland, marsh, and water bodies. If a discrepancy was noted, the original site form was checked for the original recorded UTM positions and maps. This corrected mistakes of archaeologists (writing the wrong UTM numbers on the site form) as well as mistakes of site file workers (inputting the wrong numbers into the site file database). The selection tool was also used to identify mistakes. All sites within the borders of McIntosh County were selected from the site database (spatial), and those sites were checked to make sure that they were coded as being present in McIntosh County (tabular). Next, all sites coded as being in McIntosh county were selected (tabular), and checked to make sure they fell within the borders of McIntosh County (spatial). Again, when discrepancies were noted between the tabular and spatial information, the original site forms were consulted and corrections were made.

To correct time period designations, the tabular part of the database was used. The database is constructed so that phases must be associated with a period. The attribute table was arranged by period in alphabetical order, to check for discrepancies between periods and phases. Once again, where problems were noted, original site forms were checked to determine correct period and phase designations. It is important to note that this only fixed problems with the recording of site information, and problems of inputting the information into the database.
To check the accuracy of the site designations with artifacts collected, random sites were chosen for which the collections were stored at the Laboratory of Archaeology, University of Georgia. Some discrepancies were noted between sites in the GASF database and those same sites described by Zurel et al. (1975). For example, some diagnostic artifacts found at sites (especially lithic material) were not recorded on the site forms, and thus not part of the GASF database. Since this report was the main source for settlement patterns on the mainland, the entire report (Zurel et al. 1975) was read through looking for diagnostic material related to the Paleoindian through Late Woodland periods, and this information was input into the GASF database. After the database was downloaded and made into a GIS layer, further modifications were made to the Zurel et al. (1975) data. Sites with plain clay tempered sherd (ceramics that could not be classified as either Wilmington or St. Catherines) were put into the Late Woodland/Early Mississippian supra-period, to match the survey data of the present study.

**Sherd Density Dataset**

To compare the distribution of prehistoric sherds of Mary Hammock and Patterson Island obtained in this study to other areas in McIntosh County and St. Catherines Island, a dataset of prehistoric sherd densities was created. Sherd density is the number of sherds within the area surveyed. It was calculated by taking the number of sherds from each period, dividing by the number of hectares (ha) surveyed, and multiplying by 10, resulting in the number of sherds per 10 ha. This was done for eight surveyed areas, from west to east: the Townsend Bombing Range (Grover 1996; Grover et al. 1997), the Big Mortar-Snuff Box watershed (Zurel et al. 1975), the Julianton Plantation (Elliott 2008), Patterson Island and Mary Hammock (this dissertation), Little Sapleo Island and Pumpkin Hammock (Thompson and Turck 2010), and St. Catherines Island.
(Thomas 2008f) (Figure 2.1). This measure of “sherds per area surveyed” standardizes the data, incorporating the size of the survey area into the calculations. It also avoids the problems of how different researchers delineate sites and components. This makes the information in these different surveys more comparable, which can be used as a proxy for land use/intensity of occupation. It is useful to note that the measure “sherds per linear distance” was also calculated for comparative purposes. It was calculated by taking the number of sherds and dividing by the total length (in km) of the survey transects. Although sherds per 1 km is a different measurement than sherds per 10 ha, the results were nearly identical (the only differences are that the Big Mortar-Snuffbox densities were slightly higher, and the St. Catherines Island densities were slightly lower). Since the results were not affected, these calculations were not included in this study.

For the Townsend Bombing Range, the results of the two reports were combined, as were the survey areas of 447.6 ha (Grover 1996) and 1,366 ha (Grover et al. 1997). For the Big Mortar-Snuff Box survey, the survey area was estimated. Zurel et al. (1975:6) concentrated the survey to 30-meter wide strips on the three types of high-ground areas, adjacent to soil conservation service right-of-ways. By scanning the survey coverage maps in the report, georeferencing those images, and heads-up digitizing the areas that were surveyed, the survey area was calculated to around 534.2 ha.

The transect survey of St. Catherines Island was chosen to represent the major barrier island landscape area. This survey divided the island into 31 east-west transects (A6 to P6) of 100 m widths (Thomas 2008b:303). Eleven people walked each transect in 10-m intervals, hand probing for shell (Thomas 2008b:303), and returning later to do test excavations if the shell concentrations were deemed to be a potential archaeological site (Thomas 2008b:304). To
calculate the area surveyed on St. Catherines Island, the length of each transect was determined and multiplied by 100 m (their widths). The areas of each transect were then added up, and converted to hectares. The total area surveyed on St. Catherines Island was around 975.8 ha.

The test excavations were 1x1 m units, not shovel tests (Thomas 2008a:519), so the data is not exactly comparable to the data in the other survey areas (which were obtained mostly through shovel testing). However, this is one of the most comprehensive subsurface surveys of any barrier island, and is very close to the study area, making it invaluable to this study. The 1x1 m test units dug on St. Catherines Island are four times larger than the 50x50 cm shovel tests dug on Mary Hammock and Patterson Island. The St. Catherines sherd counts were divided by four, to make that data more comparable to the shovel test surveys. Despite this, the number of sherds found on St. Catherines Island may still be over-represented. The test units on St. Catherines Island were dug specifically in areas with known archaeological material (shell), while the shovel tests on the back-barrier islands were dug at an arbitrary interval.

Geomorphology

Hammock Stratigraphy

During shovel testing, all stratigraphic information as seen in the shovel test wall profiles were recorded on the forms. This included both archaeological and geomorphological information, such as the presence or absence of any amount of shell, the presence or absence of visible shell middens, the depths of the top and bottom of shell midden deposits, and the color
and texture of the natural and anthropogenic soil layers. This information was also entered into the spreadsheets, again using the UTM coordinates of the shovel tests as the main identifiers.

*Hand Probing for Shell*

Probing was performed on Mary Hammock and its immediate interface with the marsh, to obtain more detailed data on the extent and depths of shell middens that fell outside, and between, shovel tests. A solid metal probe rod was pushed into the ground until hard shell layers were encountered. Then, one hand was used to grip the probe at the ground surface and extract it, and the penetration depth was measured using a tape measure. This indicated the top of the shell layer. The probe was put back into the hole, and pushed until it went through the shell layers. Again, the probe was removed and the depth recorded. This measurement indicates the bottom of the shell layer, (i.e., the top of the former surface prior to shell deposition). This was often done multiple times in a single location to get a more precise measurement. These shell depths were recorded on flags and left in the ground, to be recorded with a total station. Eventually, the bottom depths of the shell layers were subtracted from present-day ground surface elevations (obtained with the total station), to determine the elevation of the ground surface prior to shell deposition. The two main areas of shell probing were along the western and southwestern edges of Mary Hammock (Figure 2.2).

*Topographic Survey*

Data collected with the shovel test survey provided information on both present-day topography, as well as previous topography (i.e., surface elevations prior to, and after, human shell deposition). The beginning and end depths of shell deposits recorded in the shovel test data
was subtracted from the present-day elevation, determining the surface elevations prior to, and after, shell deposition (following Whittaker and Stein 1992:25). Present-day topographic data was only collected on Mary Hammock. Present-day topographic data was estimated on Patterson Island due to recent disturbance (i.e., surfaces graded flat, movement and re-piling of shell middens, creation of an airstrip, creation of a pond and corresponding spoil pile, etc.).

On Mary Hammock, a total station was used to collect fairly accurate location and elevation data in reference to an arbitrary grid system (i.e., beginning with a point of X=1,000 m, Y=1,000 m, and Z=100 m). All shovel test and hand probe locations were recorded with the total station, as well as various random points of topographic relief. For each point that was recorded with the total station, corresponding notes were made concerning the nature of the point (i.e., shovel test coordinates, shell probe depths, random topographic point, stake for repositioning the total station, etc.). The data were then downloaded from the total station data collector (in the form of point number and XYZ information), and opened up in a spreadsheet. The handwritten notes were then manually entered into this spreadsheet.

*Hand Probing for Sand*

To obtain information on former surfaces beneath the marsh, and thus get a better idea on where to extract sediment cores, a hand probe was used to find layers of sand buried under marsh mud. A solid metal probe, with various extensions, was pushed into the marsh mud until a more compact sand layer was felt. As with shell probing, one hand was used to grip the probe at the marsh surface and extract it, and the other hand measured the depth the probe went into the ground. This measurement indicates the top of the sand layer (i.e., the former surface before marsh sedimentation). A GPS was used to record the position of each probe. Afterward, the
locations were downloaded into a spreadsheet, and the measurements were entered in manually. The assumption is that the sand layers represent the former upland surfaces originally deposited during the Pleistocene, and were eventually covered by rising sea levels and marsh sedimentation in the last 5,000 years. However, it is also possible that buried sand layers could represent the former position of tidal streams that have subsequently meandered, leaving a lens of sand in its wake (see Farrell et al. 1993). Chowns et al. (2008) have also proposed that estuaries relocated during times of sea level regressions and transgressions (Chowns et al. 2008). The idea is that as sea level lowered after the Silver Bluff shoreline formed, the Sapelo River was diverted to the south, flowing just to the west of Mary Hammock, and emptying into Doboy Sound (Chowns et al. 2008:153-154). Such a scenario means present-day Mary Hammock would have formed as a levee, with a floodplain of fine-grained alluvium to the east.

Sediment Core Extraction

A vibracore machine was used to extract six sediment cores (MT01 through MT06) from the marsh near Mary Hammock (following Blue 2006; Boomer et al. 2007; Jing and Rapp 2003; Peros et al. 2006) (Figure 2.2). The results of the above sand probing were used to determine where the cores would be extracted. A Real-Time Kinematic (RTK) GPS was used to record the precise locations and elevations of the core extraction sites. RTK GPS systems have centimeter-level accuracy in the horizontal and vertical planes. This is made possible by setting up a base station on a known point, which then transmits corrections to the GPS receivers in real-time. With the help of Christine Hladik and Jacob Shalack of the Georgia Coastal Ecosystems Long Term Ecological Research (GCE-LTER), the horizontal and vertical positions of the six core extraction locations were recorded. A bucket auger with a 12.7 cm (5 in) diameter and 17.8 cm
(7 in.) long was used to remove the first 18-36 cm of marsh in the location to be cored. This was done to get roots out of the way, which could have formed a plug and clogged the pipe. A tripod was set up over the hole, and aluminum core pipe (irrigation tubing), at 3.1 m (10 ft) in length and 7.6 cm (3 in) in diameter, was placed within the tripod. The end of the vibracoring mechanism was clamped near the top of the core pipe. While holding the pipe steady, and pushing down on it, the vibracoring motor was turned on, and the core pipe was eased into the ground.

At refusal, (the point when the core pipe could not be pushed in any further), the vibracore machine was turned off, and the clamp removed. Measurements were taken from the top of the core pipe to the top of the ground surface on the outside of the core, as well as to the inside of the core. The difference in these measurements, and taking into account the amount previously removed with the bucket auger, calculated the amount of compaction that occurred during coring.

The core pipe was extracted using a come-along. One end was attached to the tripod, and the other end was attached to straps tied tightly around the core. Once out, a cap was placed on the bottom of the core, extra pipe at the top was cut off using a hacksaw, and another cap was placed on top of the core. The caps were clearly marked as to the location of the core, as well as which end was top and bottom. Cores were then cut into 1.5-meter sections, for ease of transport. Again, caps labeled top or bottom were placed on the ends, and then a sharpie was used to label the different core sections.
Sediment Core Analysis

Core Preparation. The cores were than transported to the Georgia Southern Coastal Research Lab at the Skidaway Institute of Oceanography (SkIO), in Savannah, GA. Here, the cores were mounted in a specially-made wooden box so they could be cut open with a circular saw without moving around. After one side of the core pipe was cut, the box was opened, the core was turned 180 degrees, the box was closed, and the opposite side was cut. The core was then laid horizontally on a table, and a wire was pulled down the cuts made in the core, splitting the core sediment in half.

Using a standard technique in archaeology, a trowel was used to scrape the exposed surface of the cores perpendicularly, to “clean up” the surface and bring out sedimentary structures. Cores were then visually inspected and described, noting how color, texture, inclusions, etc. change down core. Both halves of each core were then photographed with a digital camera. Since it took several images (between 7 and 9) to capture the whole core, the images were mosaiced together in Photoshop, creating one seamless image for each core. One half of each core was wrapped in plastic wrap, put into a plastic “D-tube” with a damp sponge, and put into refrigerated storage at SKIO. The other core halves, (which will be referred to hereafter as “working halves”), were kept for further analysis.

Each working halve was X-rayed to find discrete layers and sedimentary structures not visible to the naked eye (cf. Butler 1992). A VR 1020 portable X-Ray machine was set up in a trailer about 90 cm from the floor. Film was placed on the floor underneath the X-Ray machine, and the top section of the working half of the core was placed on top of that. From a safe distance, the film for each section of core was exposed to X-Rays between 18 and 22 seconds, at a tube voltage of 60kV and current of 20mA. The film was developed in a dark room using D-19
developer, stop bath, and fixer. Five film sheets were placed in a tray of developer for five minutes, and then they were placed in a stop bath (i.e., a tray of deionized water) for 30 seconds, to stop the chemical reaction. Next, the film was placed in a fixer (UV stabilizer) for five minutes. Last, the film was placed in a rinse bath of constant flowing water for about 30 minutes, and then hung to dry. Once dry, the developed film was then scanned as true color images using a transmissive scanner, at 600 DPI. Again, since it took multiple films to capture the whole core, the images were mosaiced together in Photoshop to create one seamless X-ray image for each core.

Core Sampling. Visual descriptions and X-ray images were used to define where samples would be removed from. Due to the lack of sedimentary structures, it was decided to sample the cores at arbitrary intervals of 10 cm. Three sets of sediment samples were taken at each 10-cm interval, for particle size analysis, organic matter content, and a future pollen study. These things will reveal the depositional history of the marsh as related to changes in sea level (Allen 2004; Goodbred et al. 1998).

Particle size analysis was performed on one set of samples, dry sieving the larger grains, and using the pipette method for smaller grains (after Galehouse 1971; also see Folk 1980; Loveland and Whalley 2001). The pipette method does not determine the actual physical size of the particles, only the sedimentation diameter (Galehouse 1971:79). The sedimentation diameter is a function of particle size, shape, and density (Galehouse 1971:79). For each sample, the large fraction (i.e., sand, or anything bigger or equal to 63 microns) was separated from the small fraction (i.e., silt and clay, or anything smaller than 63 microns). The large fraction was then put through stacked sieves and weighed to the nearest ten-thousandth of a gram, revealing the amount of sand in the sample. The small fraction was put in a graduated cylinder with 1,000 ml
of deionized water, shaken, and then 20 ml were sampled twice using a pipette. The first sample, extracted near the bottom of the cylinder directly after it has been shaken, is used to determine the weight of silt and clay in the entire graduated cylinder. (The weight of the sediment in the 20 ml sample, minus the amount of dispersant contained in a 20-ml sample, and divided by 20, results in the amount of sediment in 1 ml. When multiplied by 1,000, the result is the weight of silt and clay, in grams, contained in the entire 1,000 ml cylinder.) After a specified length of time had passed, the second sample of 20 ml was taken, with the pipette only 5 cm down. This determined the weight of clay. This can then be subtracted from the previous calculation to get the amount of silt.

Along with the visual descriptions and X-Rays of each core, the particle size results were used to define stratigraphic discontinuities, which are abrupt erosional contacts showing breaks in sedimentation (Leigh 2001:274). Employing the concept of sequence stratigraphy, these unconformities are used to determine the boundaries of separate sedimentary units, and therefore to infer the direction and rate of relative sea-level change (after Peros et al. 2006). Within a unit, particle size can indicate the depositional environment. When energy decreases (e.g., when transitioning from subtidal to intertidal), the sediment should be characterized by a “fining-upward” facies (coarse sediments at the base and progressively finer sediments toward the top) (Southard 2007). Fining downward indicates an increase in depositional energy.

While soil formation typically happens on stable (or, non-depositional) landscapes, marshes tend to undergo incipient soil formation, creating horizons that are related to each other (Mendel and Bettis 2001:175). This is due to the accumulation of organic matter, forming organic soils, or Histosols (Mendel and Bettis 2001:175). Soil horizons in marshes can be O (organic) horizons. These are dark in color, and form where marsh vegetation is growing in areas
with no sediment source (Rabenhorst 2001:311). There may also be A (mineral) or C (bedrock/no structure) horizons. These are typically gleyed or gray (they lack a colored coating), and form where mineral sediments accumulate faster compared to organic material (Rabenhorst 2001:311). As conditions change over time, lenses of organic material and mineral layers can be interspersed with each other (Rabenhorst 2001:311). Sometimes B (clay accumulation) horizons are present in the subsoil, and formed during previous soil formation processes, when the area was a well-drained upland (Rabenhorst 2001:311; also see Gardner and Porter 2001:377). Layers high in clay, then, might indicate the buried B horizon of a paleosol: buried soils representing the former ground surface (Birkeland 1999:26). Marsh soils can overlie these former upland soils, with the O horizon of the marsh thinning towards the upland margin (Rabenhorst 2001:302), creating a potentially confusing sequence.

The third set of samples were brought to the Georgia Cooperative Extension, College of Agricultural and Environmental Sciences, at the University of Georgia where testing for organic matter content was performed. Organic matter and total carbon (all the carbon in the sample, including both inorganic and organic carbon) were determined by the Loss on Ignition (LOI) method, and are expressed as percent by weight (Kissel and Sonon 2008:20). Samples were combusted in an oxygen atmosphere at 1350ºC, which converts elemental carbon into CO2. This gas is then passed through infrared cells to determine the carbon content (Kissel and Sonon 2008:20).

Soil organic matter is the non-living organic material in soil (Swift 1996:1011), made up of animal, plant, or microorganisms in some state of decomposition. Total carbon is the sum of inorganic and organic carbon in soil (Nelson and Sommers 1996:961). Thus, total carbon is a part of total organic matter. Inorganic carbon is found mostly in carbonate minerals, and is
derived from non-living sources (may also be referred to as carbonate, bicarbonate, and dissolved carbon dioxide) (Nelson and Sommers 1996:961). Organic carbon is found in the soil organic matter fraction, and comes from decaying cells of animals, plants, and microorganisms, as well as highly carbonized compounds (e.g., charcoal) (Nelson and Sommers 1996:961).

As mentioned above, incipient soil formation can occur within marsh sediment, with the accumulation of organic matter. However, just as with the B horizon of a paleosol, the marsh may overlie the O or A horizon of a paleosol. These layers would be high in carbon content due to past biotic activity (Leigh 2001:275), at least compared to the B horizon of a paleosol.

The last set of samples taken was for a future pollen study. A plastic syringe was used to extract 2 cc of sediment from each interval, which should be of sufficient sample size for pollen studies. The samples are being refrigerated and/ or frozen until needed. While microfossils, especially foraminifera, are used commonly as indicators in sea level and marsh studies (Scott et al. 1995:618), there are various technical aspects that make this type of analysis beyond the scope of this study (e.g., foraminifera do not preserve well on the Georgia coast and thus are difficult to find; an initial baseline study would need to be done of modern taxa and their distributional patterns, relating the modern distributions of taxa to elevation by developing a transfer function, etc.) (Goldstein 2007, personal communication).

Recording of Drowned Tree Stumps

The last piece of evidence to help determine the geomorphology of the area was the recording of drowned tree stumps. These were noticed at low tide, eroding out of the creek banks to the north of Mary Hammock, near where the cores were extracted (Figure 2.2). The general position of one stump (Stump 1) was recorded by measuring the position of a root below the
marsh surface, which was sticking out of the creek bank at low tide. The more precise vertical and horizontal position of a second stump (Stump 2) was also recorded. Stump 2 was found by digging into the side of the creek bank, completely buried under the marsh. The RTK GPS was used to record the marsh above Stump 2, and measurements were taken to determine the position of the stump in relation to that point. Several characteristics of Stump 2 and surrounding stratigraphy were noted at this time. First, the stump was vertical, so there is a good chance that this was the position the tree was in when it died. Second, the roots of Stump 2 were recorded to estimate where the ground surface was when the tree was alive. Third, the positions of sedimentary structures were noted in the creek bank profile, and their depths were recorded in relation to Stump 2. This stump was removed, and brought back to the University of Georgia for further analysis. A section was cut off and brought to the Forestry Department, to determine the species. Another section was cut off, and a sample was removed from one of the inner rings and sent for \(^{14}\)C dating.

**Elevation and Bathymetry of McIntosh County**

Numerous sources exist detailing the elevation and bathymetry of McIntosh County, GA. These were brought together, and turned into digital format for means of analysis. The resulting dataset was in vector format (i.e., ArcGIS polygons), and combined present-day elevation and bathymetric data of McIntosh County. As detailed in a later chapter, the geomorphological data discussed above was eventually used to refine this dataset.
**Elevation**

The National Elevation Dataset (NED), high resolution (i.e., 1 arc-second, or 30 m) elevation data created by the USGS, was obtained for McIntosh County. This raster dataset was converted into vector format using the conversion tool (from raster to polygon) in ArcGIS. The elevations are in meters above mean sea level (ma MSL), which is an arithmetic mean of the hourly heights of the tide recorded between 1983 and 2001 (National Oceanic and Atmospheric Administration 2010). These elevations were converted to meters above mean lower low water (ma MLLW). Like MSL, MLLW is a tidal datum; a base elevation used to measure local water levels (National Oceanic and Atmospheric Administration 2010). MLLW is “the average of the lower low water height of each tidal day” observed between 1983 and 2001 (National Oceanic and Atmospheric Administration 2010). In simple terms, MLLW represents the lowest level of the tide. To convert elevations from MSL to MLLW, 1.118 m were added to the MSL values. This was done because at the nearest benchmark to the study area (tidal station ID # 8675622, Old Tower, Sapelo Island, GA), MSL is 1.118 m above MLLW (see Table 2.1). The soil map for McIntosh County, which is based on 1957 aerial photos, was then used to differentiate high marsh from low marsh. Low marsh is regularly flooded (Odum 1988:156) and defined by geomorphic criteria, specifically elevation, which correlates with salinity and vegetation (Howard and Frey 1985:115). The general value of 2.118 ma MLLW (1 meter above mean sea level) obtained from the NED dataset was retained for low marsh. High marsh areas were traced using the soil map, and were given values of 2.264 ma MLLW. This value corresponds to the mean higher high water (MHHW) mark at the Old Tower benchmark. MHHW is the “average of the higher high water height of each tidal day” (National Oceanic and Atmospheric Administration 2010), and is also considered to be the boundary between low marsh and high...
marsh (Howard and Frey 1980:119). High marsh is irregularly flooded (Odum 1988:156), and is
based mostly on botanical criteria (Howard and Frey 1985:115), although elevation and salinity
are correlated with it as well. Last, the elevations were converted to feet above MLLW by
dividing their values by 0.3048 (i.e., the number of meters in one foot). The final product was a
fairly high resolution elevation dataset, in polygon form, with elevations referenced to feet above
MLLW.

**Bathymetry**

The next step involved creating a bathymetric dataset (underwater elevations). High
resolution nautical chart containing the bathymetry of McIntosh County was downloaded from
the National Oceanic and Atmospheric Administration (NOAA) Office of Coast Survey website:
(http://www.charts.noaa.gov/OnLineViewer/AtlanticCoastViewerTable.shtml). According to the
legend on this map, the coordinate system is NAD 1983, the bathymetric data are in feet below
MLLW, and they were obtained in surveys performed during the 1970s. Since this was a scanned
image of the original chart, it needed to be georeferenced. Roads, major landmarks, and the
internal grid system of NAD 1983 within ArcGIS were used as control points to georeference the
image to real-world coordinates.

Next, the bathymetric lines were “heads-up” (on-screen) digitized. Polygons
corresponding to different bathymetric depths were cut from and appended directly to the
previously made elevation dataset. All of the various physical boundaries (between uplands,
marsh, tidal creeks, rivers, etc.) were digitized in finer detail using DOQQs from 1999, as well as
aerial photos from the 1950s and 1970s.
The bathymetric map also had many soundings (discreet depths in feet below MLLW). A point data set was digitized from these soundings. To integrate this with the elevation/bathymetry polygon data, the polygons were converted to a point dataset. This was accomplished by first converting the polygons to line data, and then those lines to point data. This point dataset was then merged with the soundings point dataset, creating one point dataset with all bathymetric information. In addition, this dataset contained information on the boundaries of all water bodies, also in point form. Next, a surface was interpolated, using the “Topo to Raster” tool, and creating a raster dataset of the bathymetric data. The parameters of this interpolation were: input feature-point dataset, output cell size- 20, no drainage enforcement, and spot (i.e. point) data as the primary input data. The interpolated values were then converted to integers using the “Math/ Int” tool, and the entire dataset was converted into polygons using the “Raster to Polygon” tool, simplifying the polygons in the output. Elevations were then converted from feet to meters below MLLW.

The result was two polygon datasets, one with elevations and bathymetry, and one with only bathymetry, with all data in relation to feet above and below MLLW. The two datasets were then joined together using the “Union” tool. All elevation and bathymetric information were then transformed into meters above (ma) and meters below (mb) MLLW, respectively. In the last step, the data were reprojected to NAD 27. The result was one polygon dataset for McIntosh County, where all elevations and bathymetric values were in meters, and in relation to MLLW of the Old Tower benchmark, Sapelo Island.
Radiocarbon Dating

Samples for $^{14}$C dating were collected from archaeological settings (soot on sherds and shells from middens), within cores (plant/ root material), and the tree stump (wood). These samples were analyzed at the UGA Center for Applied Isotope Studies in Athens, GA. The $^{14}$C ages were calibrated at 2σ using the online version of Calib 6.0. For shell samples, the Delta R value from Thomas (2008d:359) of -134 ± 26.0 was applied, and calibrated using the standard marine calibration curve (Marine09). The author is aware that the act of calibrating and correcting the dates of both terrestrial and marine samples can introduce new problems to the chronology (DePratter 2010:250; Thomas 2010:182), which may even lead to the obscuring or distorting of reality (DePratter 2010:250). As such, both the uncalibrated $^{14}$C age and the calibrated age B.P. are reported here.

Summary

This chapter described the methods used to obtain the necessary datasets for this study. I described the details of the archaeological surveys on the back-barrier islands, laboratory work, and how the time period designations will be determined, which includes $^{14}$C dating. I also described corrections to the GASF data, and the creation of a sherd density dataset for archaeological surveys close to the study area. I described the geomorphological methods used to obtain present-day elevations in the study area, as well as the elevations of former upland surfaces. I also described how elevation and bathymetric datasets were combined, creating the
base of the model. The next chapter will describe the results of the archaeological and geomorphological studies.
Table 2.1. Tidal Datums at three Tidal Stations Pertinent to this Study.

<table>
<thead>
<tr>
<th></th>
<th>Fort Pulaski</th>
<th>Old Tower, Sapelo Island</th>
<th>St. Simons Lighthouse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Higher-High Water</td>
<td>2.287</td>
<td>2.264</td>
<td>2.186</td>
</tr>
<tr>
<td>Mean High Water</td>
<td>2.173</td>
<td>2.143</td>
<td>2.073</td>
</tr>
<tr>
<td>North American Vertical Datum 88</td>
<td>1.235</td>
<td></td>
<td>1.277</td>
</tr>
<tr>
<td>Mean Sea Level</td>
<td>1.164</td>
<td>1.118</td>
<td>1.077</td>
</tr>
<tr>
<td>Mean Tide Level</td>
<td>1.119</td>
<td>1.104</td>
<td>1.067</td>
</tr>
<tr>
<td>Mean Low Water</td>
<td>0.065</td>
<td>0.064</td>
<td>0.061</td>
</tr>
<tr>
<td>Mean Lower-Low Water</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>
Figure 2.1. Locations of archaeological surveys where sherd density data were acquired.
Figure 2.2. Locations of shell probing, sediment core extraction, and drowned tree stumps.
CHAPTER 3

RESULTS

Archaeology

Mary Hammock

Recent and Historic Activity. In 1976, the state of Georgia and the National Oceanic and Atmospheric Administration (NOAA) purchased part of the south end of Sapelo Island, as well as the Duplin River estuary to the west of Sapleo (Sullivan 1992:685). This included the surrounding marsh, and the marsh islands, of which Mary Hammock is one. This became the Sapelo Island National Estuarine Research Reserve (SINERR) administered by NOAA (Sullivan 1992:685), and managed by Georgia DNR. For over 30 years, no significant land-use activities have occurred on Mary Hammock.

No remains of structures, tabby or otherwise, were found on Mary Hammock. Only one shovel test contained evidence of historic material culture (see Figure 3.1). This shovel test was not part of the 20x20 m grid, but one of the judgmental shovel tests added to the survey to assess a particular shell midden. One piece of banded ware (AD 1830-1845) was found in the top 20 cm of a shell midden, in association with three Late Mississippian period sherds.

Despite the lack of historic material culture, numerous, presumably historic, features were identified (Figure 3.1). Present-day aerial photographs show stands of pine trees along the

65
eastern edge of Mary Hammock. It has been demonstrated (Turck and Thompson 2008, 2009) that distinct pine stands can indicate areas that were cleared previously. In fact, further analysis of aerial photographs shows that this pattern can last a relatively long time. Between 1942 and 1953, Little Sapelo Island had two distinct areas of cleared fields. By 1962, those fields were mostly forested with pine. By 1972, they were completely forested with pine, and are still so today. It took nine years or less for pine to move in, and they have remained the dominant species for 42 years. Remains of fence posts and wire fencing encircling the boundaries of these previous fields, along with the remains of a barn on the island, suggest that these areas were cleared for livestock. Aerial photographs of Mary Hammock show a similar progression of open areas between 1942 and 1953, partially forested by pine in 1962, and fully forested by 1972. However, the absence of fencing and the odd shapes of the pine stands suggest that they are not related to former animal pastures or even agricultural plots.

Aerial photographs also indicate that the pond in the center of Mary Hammock was present in 1942. A hand-drawn McIntosh County soil map indicates the pond was present by 1929. It is not known if this pond was formed entirely from historic land-use practices, but a metal pipe from an artesian well was found around 10 m from the present-day pond edge. Water from this well presumably fed the pond when the water table was higher and the well was flowing. There is a ditch running south-east from the pond to the marsh, measuring around 70 m long and 2.5 m wide (Figure 3.1). While it is not filled with water at present, it is most likely an historic construction, made to drain the pond when the water level was higher. The idea of a more recent origin for this ditch is supported by the fact that it cuts through a small shell midden, thereby post-dating that midden. Two depressions were also noted, one about 1.5 m in diameter, and one 4 m in diameter. These may represent areas where holes were dug to find freshwater and
establish wells (Chester DePratter, personal communication 2008), although how and when they were created is uncertain.

**Prehistoric Archaeology.** A wide distribution of prehistoric remains was found over much of Mary Hammock (Figure 3.2). There are a large number of positive shovel tests, with almost 68% containing some evidence for past Native American activity in the form of artifacts and/or human-deposited shell (Table 3.1). These data include the presence of any amount of shell (not just shell midden), with even one shell adequate enough for a positive designation. When considering only Native American pottery, over 36% of the shovel tests were positive.

When shell midden is treated separately from shell occurrences, it reveals that shell midden was found in over 31% of the shovel tests (Table 3.2). In addition, 12 shovel tests had artifacts but no shell, and 29 had artifacts and shell, but no midden (Table 3.2). When just taking into account the 81 shovel tests with artifacts, it is revealed that over 50% had no discernible shell (either on the surface or through probing) (Table 3.3).

In the 41 shovel tests with artifacts and either no shell or no midden, the artifacts were found within the first 70 cm, with an average depth of 43 cmbs. Two of these contained Early Woodland ceramics, which were found at 40 and 60 cmbs. A general rule, then, is that where shell was not added to the surface creating artificial elevations, artifacts will be found within the first 60 cm. The absence of Late Archaic period pottery on Mary Hammock suggests that pottery from this period might be found at depths greater than 60 cmbs. Most shovel tests were dug to between 80 and 100 cmbs, which further suggests that, if present, a Late Archaic period occupation might be buried deeper than that.

The occupational history of Mary Hammock is seen when shovel test data are separated by time period (Table 3.4). Occupation does not begin in the Late Archaic period, but during the
Early Woodland period. Both the count and weight of Native American ceramics remain fairly steady during the Early/ Middle Woodland supra-period, the early Late Woodland period, and Late Woodland/ Early Mississippian supra-period. There seems to be a decrease in ceramics during the Middle Mississippian period. However, if the large number of ceramics from the Middle/ Late Mississippian supra-period is evened out over the two periods, it shows that the occupation may have continued steadily. There is a large increase in Late Mississippian/ Historic Contact period ceramics.

Although one of the objectives of using a closely spaced shovel test interval was to better interpolate artifact densities across the landscape, when artifacts were separated by time period, their counts and weights were small for most periods. Density maps would not represent these data adequately, so simple post maps were made based on raw sherd weights. The classification method chosen to visually represent the post maps is “Natural Breaks” (also known as Jenk’s Optimization) with five classes of sherd weights (excluding zero). This method designates the breaks between classes based on naturally-occurring large gaps in data values, keeping similar values together in the same category, and separating dissimilar values into separate categories (McGrew and Monroe 2000:25). This was performed on the total number of prehistoric ceramics on Mary Hammock, and the resulting classes were then used to classify the sherd weights of each individual time period. This made the data comparable between periods. On Mary Hammock, the lowest sherd weight in one shovel test was 0.1 g, and the highest weight in one shovel test was 121.2 g, resulting in five classes with ranges from: 0.1-6.9, 6.9-15.9, 15.9-31.2, 31.2-64.8, and 64.8-121.2 g. These classes were visually represented with graduated black dots. The smallest dots represent shovel tests with sherd weights in the lowest class, with dots getting progressively bigger with each larger weight class.
The earliest ceramics (Early and Middle Woodland periods) are lightly scattered throughout the western side of the island (Figure 3.3a-c). Sherds with designations definitively in the Late Woodland period are found in the southwestern portion of the island (Figure 3.4a). These concentrations are fairly heavy. Late Woodland/Early Mississippian sherds are more spread out, and found in twice as many locations, but the concentrations are lighter (Figure 3.4b). Strictly Middle Mississippian sherds are found in the southwest portion of the island (Figure 3.5a), with Middle/early Late Mississippian sherds (consisting of the check stamped variety) were found in two distinct areas (Figure 3.5b). The heavier concentration is found in the southwest portion of the island. Late Mississippian/Historic Contact period sherds are found over the entire island, with large concentrations found in multiple areas (Figure 3.5c). Historic Contact period rims are clustered near the center of the island (Figure 3.5d).

Density maps based on both shell midden thickness (Figure 3.6) and shell weight (Figure 3.7) were constructed to provide a better indication of where shell middens occur. The two datasets complement each other, indicating that the heaviest concentrations of shell are on the southwestern portion of the island. The thickest shell midden recorded on Mary Hammock was about 90 cm, and the heaviest amount of shell was 98.7 kg. Of the four marsh islands surveyed by Thompson and Turck (2010), Mary Hammock had the largest shell deposits.

Identifiable faunal remains are: white-tailed deer, raccoon, turtles (including mud turtle), hardhead catfish, and black drum (Table 3.5). That so few shovel tests (12) had faunal remains is most likely due to the large (¼ in) screen size. However, this could also be due, partly, to poor preservation. Of the eight shovel tests that had both bone and pottery, seven had pottery from the Middle or Late Mississippian periods. If faunal material are associated with the ceramics found in the same shovel tests, than only bones from more recent time periods have survived. Although
shell midden may preserve bone better than more acidic soils, Crook (2009) has shown how poor
the preservation of bone is in shell-bearing sites when compared to water-logged sites. Another
pattern is that four of the shovel tests with bone had no other artifacts, suggesting that they were
either not archaeological samples of bone, or that artifacts and bone can get discarded in different
areas.

Patterson Island

Recent and Historic Activity. Being privately owned, Patterson Island is in use today.
There are modern structures, including two houses, a pool, and a shed. At the time of the
archeological survey, a barn was being constructed. In addition, the owners dug a large hole to
use as a garbage dump. The entire southern portion of the island is very open, with no
underbrush. Although there are trees, the openness is maintained by mowing. The area to the
north is not maintained, and has denser vegetation. Just prior to the survey of the island, various
trails had been cut through this area.

The only historic structures found were the remains of tabby structures (Figure 3.8). Along the southeastern edge of the island, only the bases of two or three walls are manifest on
the surface. On the south-central part of the island, all four walls of one tabby structure are still
standing, at heights of about one to two feet. Shortly after the completion of the archaological
survey, a pitched roof structure was constructed to protect this tabby house, similar to what was
done on St. Catharines Island. Records indicate that around AD 1800, Jean Lafong acquired
Patterson Island and managed a small plantation on the island until his death in 1819 (Sullivan
1992:206). His wife remained on Patterson Island, managing the plantation with slaves until they
all died in a hurricane of great magnitude that hit the coast of Georgia in September of 1824
Sullivan (1992:206) believes Lafong was the one that built the tabby structures, based on concepts, and even advice, from Thomas Spaulding of Sapelo Island.

A newspaper article from the Atlanta Journal (Oct. 7, 1928) states that remains of both a Spanish fort and a fort of Oglethorpe were still visible on the island, as well as part of a concrete pilaster, ruins of cellars, and an indication of a horse race track built as part of the estate of a Scotch nobleman who lived there prior to AD 1820. Buddy Sullivan (personal communication 2010) believes this information is unreliable at best, if not an outright fabrication. On a map of Darien, GA from 1921, there is a marker symbol for a building (i.e., a black square) in the north-western area of Patterson. The archaeological survey did not substantiate any of the information from the newspaper article or the 1921 map. Evidence for these structures were neither seen on the surface nor found in the shovel tests. Most historic artifacts found through the survey are non-diagnostic pieces of glass. Three shovel tests did have diagnostic historic sherds: two pieces of blue feather edge pottery (AD 1780-1840), and one piece of brown salt-glazed stoneware (AD 1650-1850) (see Figure 3.8). This is in keeping with the plantation period occupation of the island. Most of the historic artifacts were found near the modern-day structures, which are also near the tabby ruins, indicating that older structures and modern ones were located in the same area.

A pond was constructed on the north-west part of the island, sometime prior to 1942, as it can be seen on aerial photographs dating to that time. A large pile of soil was noted on the north-west side of the pond, with slightly smaller piles around the north and north-east sides (Figure 3.8). These are most likely spoil piles from the construction of the pond. A grass airstrip was constructed down the center of the island in a NW-SE direction sometime after 1953 but before 1972. As indicated by the large berms of shell along the northern edge of the airstrip, it seems
that many shell middens have been disturbed. During the construction of the airstrip, shell middens were pushed out of the way, leveling the land and also creating a barrier to keep out any water during floods. There are also shell berms along the western edge of the island. Again, shell middens in the interior were most likely pushed out to the edge, leveling the main part of the island while also creating berms to protect it from floods. The last berm of interest is made up of soil, and was found near the north-central part of the island in the marsh (Figure 3.8). Such features, along with old fence posts, have been noted in the marsh near other hammocks (Turck and Thompson 2008), which locals on Sapelo Island have suggested were constructed to make hog wallows. This is plausible, as it is known that livestock was allowed to roam in the woods and marsh to get food (Byrd et al. 1961).

There are many ditches around the island, either muddy or filled partially with water. One ditch along the north-west edge of the airstrip leads from the pond to the marsh, and is probably for drainage. The ditches along the north-east side of the island are probably related to plantation period farming. Various other historic features were also noted during the survey, including a wooden post in the marsh, and a rectangular metal object, partially buried in the ground.

Prehistoric Archaeology. Patterson Island has a large number of positive shovel tests, with over 59% containing some evidence for past Native American activity (Table 3.1). This is surprising, considering that there are very few positive shovel tests to the north of the airstrip (Figure 3.9). Over 38% of the shovel tests had some amount of Native American pottery.

When shell midden is treated separately from shell occurrences, it is revealed that shell midden was found in over 23% of the shovel tests (Table 3.2). In addition, 34 shovel tests had artifacts but no shell, and 64 had artifacts and shell, but no midden (Table 3.2). When taking into account only the 151 shovel tests with artifacts, it is revealed that almost 65% had no discernible
shell (either on the surface or through probing) (Table 3.3). In the 98 shovel tests with artifacts and either no shell or no midden, the artifacts were found within the first 88 cm, with an average depth of 32 cmbs. Artifacts from the earliest occupation of the island (Late Archaic pottery) were found within an average of 40 cmbs, and as deep as 88 cmbs. The average shovel test depth was between 80 and 100 cmbs, suggesting that earlier occupations might be found buried deeper.

The initial occupation of Patterson Island began during the Late Archaic period (Table 3.6). As is typical for most of the Georgia coast, there is a decline in occupation during the Early Woodland period. Pottery counts and weights indicate a more substantial occupation by the latter part of the Middle Woodland period. Although there seems to be a decline in the Late Woodland period occupation, this is probably due to the large amount of pottery in the Late Woodland-Early Mississippian category. In fact, this extended category has the second highest percentage of sherd weight. These sherds are all plain, and could not be designated to a more specific period or phase. Spreading these sherds over the two periods suggests that there could have been a similar occupation from the end of the Middle Woodland period through the Early Mississippian period. There is definitive evidence for occupation during the Early, Middle, and Late Mississippian periods, as well as at the time of Historic Contact. Due to the large amount of ceramics in the supra-period categories, it is difficult to surmise the exact nature of the occupations, and how they changed over time. Based on the number of Irene rims (4) vs. Altamaha rims (0), the most intense occupation may have occurred during the Late Mississippian period, with a possible decrease in occupation during the Historic Contact period.

Multiple sherds with soot on the outside were recovered in the shovel testing, and four were chosen for $^{14}$C dating, to help refine the ceramic typology. A $^{14}$C determination (UGAMS # 4501) between 3,688 and 3,450 cal B.P. corroborated the typology on a St. Simons plain sherd
(Table 3.7). A check stamped rim sherd with clay temper (UGAMS # 4502), which was
determined to be from either the Late Woodland or Early Mississippian periods, had a $^{14}$C
determination between 923 and 743 cal. B.P. A check stamped sherd (UGAMS # 4500) which
was determined to be either Savannah or Irene had a $^{14}$C determination between 653 and 542.
One complicated stamped sand and grit tempered sherd, which was thought to be Irene or
Altamaha, was dated twice. A date range of 1,382 to 1,302 cal B.P. (UGAMS # 4499) was
obtained from a piece of charcoal from the inside of the sherd. A more accurate date range of
512-339 cal. B.P. (UGAMS # 4499-redo) was obtained from soot on the outside of the sherd.
This discrepancy is most likely due to the fact that clay can preserve organic material such as
root relicts (e.g., UGAMS sample # 5005). This material gets carbonized when the clay is fired
into pottery, resulting in charcoal inclusions in the pottery that relate to when the plant died, not
to when they pot was made.

As with the Mary Hammock data, density maps were not constructed for Patterson Island
ceramics. Simple post maps were made based on the raw sherd weights. The “Natural Breaks”
classification method was used again, creating five classes of sherd weights (excluding zero) for
all of the prehistoric ceramics on Patterson Island. The lowest sherd weight in one shovel test
was 0.7 g, and the highest weight in one shovel test was 250.7 g, resulting in five classes with
ranges from: 0.7-6.6, 6.6-14.6, 14.6-26.4, 26.4-58.6, and 58.6-250.7 g. These classes were used
to classify the sherd weights of each individual time period, making the data comparable
between periods. Again, these classes were visually represented with graduated black dots, with
the smallest dots representing shovel tests with sherd weights in the lowest class, and
progressively bigger dots representing each of the larger weight classes. It should be noted that
the Patterson Island post maps are not comparable to the Mary Hammock post maps, because
dots represent different ranges of sherd weights.

Most Late Archaic period ceramics are distributed in a curious northwest-southeast
pattern, (Figure 3.10a). There is also one shovel test in the extreme southwest corner, and one to
the northeast that have Late Archaic period sherds. Only one shovel test had definitive Early
Woodland pottery (Figure 3.10b), with Early/ Middle Woodland pottery located in the center of
the island (Figure 3.10c). A few shovel tests had large amounts of definitive Middle Woodland
pottery, but their distribution seems not to be in a regular pattern (Figure 3.10d). For the most
part, Late Woodland, Late Woodland/ Early Mississippian, and Early Mississippian ceramics
(Figure 3.11a-c) are concentrated on the southern portion of the island (below the air strip). The
four shovel tests with definitive Middle Mississippian ceramics do not seem to be in any specific
pattern (Figure 3.12a), while Middle/ early Late Mississippian ceramics are found in the
centralized portion of the island (Figure 3.12b). As mentioned above, a large amount of Late
Mississippian and Historic Contact period ceramics were put into overlapping, supra-period
categories, making it difficult to understand exactly how occupations changed over these time
periods. Suffice to say, Late Mississippian and Historic Contact period occupations covered most
of the island (Figure 3.13a-d).

Density maps of shell thickness (Figure 3.14) and weight (Figure 3.15) reveal that the
densest shell midden on Patterson Island occurs on the southern half of the island. As noted
above, the central portion of the island was most likely covered with extensive shell middens in
the past, but these were pushed north of the airstrip and to the east. These disturbed berms of
shell were avoided purposefully when laying out the shovel test grid, because they would
adversely skew the data collection. In addition, there are only three small shell middens manifest
on the surface in the entire area south of the airstrip. The rest of the area is very flat, with shell middens noted along the south edge of the island, eroding into Atwood Creek. This is in contrast to the extensive shell middens that Buddy Sullivan (personal communication 2010) encountered on the island as a boy. This suggests that much of Patterson Island has been graded flat. These various observations indicate that large amounts of shell have been displaced, which affects the results of the shell density maps. It is possible that the highest shell concentrations were located more towards the center of the island.

Identifiable faunal remains consist of white-tailed deer, turtle (including pond turtle and diamondback terrapin), alligator, and bony fish (Table 3.8). As on Mary Hammock, very few shovel tests (19) had faunal remains. Again, this is due to the large (¼ in) screen size, poor preservation, or a combination of both. Thirteen shovel tests had both bone and artifacts, with the earliest associated artifacts being from the Late Woodland period.

**Sherd Densities**

The prehistoric sherd densities (the number of sherds per 10 ha) for the eight survey areas can be seen in Tables 3.9 to 3.11. Patterson Island has by far the highest sherd density during the Late Archaic period than any other survey area (Table 3.9). It should be noted that for Pumpkin Hammock, only the shovel test data are used in the calculation. If the 42 Late Archaic period sherds found in the shoreline survey are considered (Thompson and Turck 2010), the sherd density would calculate to 133.33 sherds per 10 ha. Mary Hammock has the highest sherd density during the Early Woodland period, and Patterson Island has the highest during the Middle Woodland period (Table 3.10). Patterson Island also has the highest density of sherds that could not be placed into either the Early Woodland or Middle Woodland periods (Refuge/
Deptford phase ceramics) (Table 3.10). Mary Hammock and Pumpkin Hammock have the highest sherd densities during the Late Woodland period. Patterson Island also has the highest density of sherds that could not be placed into either the Late Woodland or Early Mississippian periods (Table 3.11).

**Geomorphology: Mary Hammock**

Hammock stratigraphy, specifically the top and bottom depths of shell midden layers, shell probe data, and all other surface elevations collected in the topographic survey were used to make topographic maps of Mary Hammock. As seen in the present-day elevation map (Figure 3.16) elevations above 3.4 ma MLLW (meters above mean lower low water) are found just north and south of the pond. The two highest recorded elevations are ~3.8 ma MLLW, and are associated with fairly thick (~ 60 cm) shell middens.

The end depths of shell layers were subtracted from the present-day topography, resulting in a topographic map of the ground surface prior to shell deposition. As can be seen in Figure 3.17, a large amount of elevation is lost in the southwestern portion of Mary Hammock. The area north of the pond, as well as part of the area south of the pond, maintained their elevations. In addition, some of the shovel tests in these two areas either have no shell, or did not have enough shell to weigh/ no discernible midden. This suggests that the high elevations in these areas are natural.

Three locations on Mary Hammock, discovered while probing, have two layers of shell separated by a layer of non-shell (see Figure 3.17). To ground truth this, a judgmental shovel test
(Special Shovel Test #2), was dug at one of these locations (E-471953.71, N-3478856.97). Two shell middens, separated by a sand layer, were found. The top shell midden went from the surface to 50 cmbs, and contained four Irene sherds, the one historic banded ware ceramic, a catfish otolith, and UID mammal bone. A $^{14}$C determination on an oyster shell (UGAMS # 5237a) from the bottom of this layer revealed a date of 478-309 cal. B.P. (Table 3.7). A $^{14}$C determination on charcoal (UGAMS # 5237b) in association with this shell revealed a date of 520-335 cal. B.P. The sand layer was between 50 and 75 cmbs. It was sterile, except for a small layer of burned sand between 53 and 58 cmbs in the northwest corner of the shovel test. The second shell layer started around 75 cmbs, and continued to 110 cmbs. No ceramics or faunal materials were found in this layer. A $^{14}$C determination on an oyster shell (UGAMS # 5238) from this layer revealed an age of 538-428 cal. B.P. Both shell layers most likely date to the Late Mississippian period, but the exact timing of their deposition is unknown. They could have been deposited at the same time, or slightly over 200 years apart.

Geomorphology: Marsh

Sand Probes

Extensive. Marshes between the mainland and Sapelo Island were probed (Figure 3.18). The depth of the sand layer, representing the former upland surface, was found to be between 0.4 and >6.1 mb present marsh surface. Probes on either side of Patterson Island (i.e., close to a terrestrial body) revealed that the former sandy layer was fairly shallow (0.4 and 1.8 mb present marsh).
Intensive. Probing around Mary Hammock occurred in all four cardinal directions (Figure 3.19). To the west, south, and east, the general range of sand depths was found to be between 0.3 and >3.7 mb present marsh surface. There were problems with identifying the sand layer in many of the deeper (>1.95 mbs) probes here, with multiple sand layers (or multiple lenses of resistance) detected. More reliable depths for the sandy layer are between 0.3 and 1.7 mbs. Only one sand layer was detected in probes of these depths.

The area to the north of Mary Hammock had a different pattern. The sand layer seemed fairly shallow close to the hammock (between 1.1 and 1.4 mbs), but got progressively deeper further away from the hammock (to 2.2, >3.7, and >4.9 mbs). Knowing the general sea level history of the coast made this the best place to extract sediment cores. Sea level curves show a high-stand at about 4,200 years ago, (see DePratter and Howard 1981; Gayes et al. 1992). This high stand was around 1.2 mbp sea level. Therefore, according to the probe data, the interface where rising sea level (and/or marsh sedimentation) met the former upland surface during the Late Archaic period should be found here.

Sediment Cores

Visual Inspection. Initial inspection of cores MT01 through MT06 (the locations of witch can be seen in Figure 2.2) revealed three main facies in each core (see Table 3.12). Core MT03 will be used as the visual example of these three layers, showing both digital images and X-rays of the core (Figures 3.20-3.22). The first layer is modern marsh, which extends from the marsh surface to between 31 and 105 cmbs. In core MT03, this layer is from 0-81 cmbs (Figure 3.20). The characteristics of this layer include a live root system (mostly of Spartina alterniflora), within a matrix of soft, very dark gray or greenish gray, mud (i.e., clay). The middle layer is
made up of a very dark grayish brown, grayish brown, or gray sandy matrix, mottled with black streaks (probably carbonized material), dark stains, and clay inclusions. In core MT03, this layer extends from 81-171 cmbs (Figure 3.21). In some of the cores, this sandy layer also contains very dark brown, brown, or grayish brown loamy sand concretions. The bottom layer is a dense/highly compact greenish gray clay layer, beginning between 163 and 220 cmbs. In core MT03, this layer begins at 171 cmbs (Figure 3.22). It contains iron-rich dark yellowish brown and/or brownish yellow stains which surround preserved root relicts. In between the sand layer and the bottom greenish gray clay layer, there is a small transitional layer where the sand and clay meet, which can be seen at the bottom of Figure 3.21. This layer is either a dark yellowish brown, iron-rich humic layer, or it is mostly sand but contains humic clasts.

**X-Ray Analysis.** The X-Ray analysis confirmed the findings of the visual inspection: there is a muddy marsh layer, followed by a sandy layer, and then a dense clay layer (Figures 3.20-3.22). Areas with high mineral content are seen as light areas on the X-rays, while darker areas indicate more organic material. X-ray analysis also revealed that there is a fair amount of bioturbation here (see Figure 3.21), with a lot of mud inclusions (dark colored) mixed in with the sandy layer (light colored). Unfortunately, it did not reveal many unseen sedimentary structures. Exceptions were seen in cores MT05 and MT06, which both have two thin (around 1cm each) sand layers within the upper modern marsh facies of the cores. As seen in core MT06 (Figure 3.23), the characteristics of the layers are different above and below the sand layers.

**Particle Size.** Particle size analysis of cores MT01, MT03, and MT06 also confirmed the visual inspection. Samples from the central portions of the cores contain about 70% sand or more (see areas highlighted in gray in Tables 3.13-3.15). Line diagrams visually represent this, indicating how far below the marsh surface these sand layers occur (Figures 3.24-3.26). The
minor differences in sand content within these layers, (e.g., whether they were designated as sand, loamy sand, or sandy loam), are most likely due to bioturbation. It was clear when the samples were removed that roots and animal burrows had brought marsh mud down from the top layer into the sandy layer, making it difficult to extract pure matrix. In the bottom clay layer, sand percentages drop to the teens or even single digits, while clay increases to between 50% and 60%.

More in-depth particle size analysis was performed on the sand fraction of core MT03. The sand samples were put through a set of five nested sieves, ranging from very coarse to very fine (from 0 to 4 Phi). In every modern marsh layer and sand layer sample, the sand fraction is made up of mostly fine sands (between 2 and 3 Phi) (Table 3.16). In the top 3/4 of the greenish gray clay layer, the sand is mostly very fine. In contrast, the very bottom of this clay layer has a small amount of very fine sand, with the sand portion of this layer consisting of mostly fine sand (>16%). Note that the percentages of sand, silt, and clay in the detailed analysis (Table 3.16) are slightly different than those reported in Table 3.14. The more detailed analysis allowed for the removal of non-sand objects (concretions and plant material) from the sand fraction, and adjusted percentages of sand, silt, and clay. Although this is more accurate, the difference is negligible.

**Organic Matter.** In a very general sense, organic matter decreases with depth in cores MT01, MT03, and MT06 (Tables 3.13-3.15). On closer examination, organic matter content fluctuates throughout the cores. In addition, the reported values for the upper two samples in core MT03 are apparently incorrect. Total carbon is a part of organic matter content, meaning a certain percentage of organic matter is made up of carbon. For these two samples, the TOC values were larger than the organic matter values. This discrepancy could be due to the very small volumes of the original samples (Leticia Sonon, personal communication 2009).
sample volumes could also be related to why there does not seem to be any pattern in the organic matter analysis. Once again, bioturbation, mixing the matrix with mud from above, is most likely the largest factor with these results.

Tree Stumps

The general position of one tree stump (Stump 1) on the west side of the creek north of Mary Hammock was recorded. The position of horizontal roots, which were sticking out of the creek bank at low tide, were noted to be around 187 cm below the marsh surface.

On the east side of the creek north of Mary Hammock, a stump completely buried under the marsh was found and extracted (Stump 2). Several things were noted at this time. First, the stump was vertical, so there is a good chance that this was the position the tree was in when it died. Second, the roots of the stump were recorded to estimate where the ground surface was when the tree was alive. Third, the position of the greenish gray clay in the creek bank profile was recorded in relation to the stump. The former ground surface when the tree was alive was calculated to be about 131.7 cm below the present marsh surface, which is equivalent to 0.6 m (59.6 cm) above MLLW. At the site where the stump was removed, this would be about 36 cm above the greenish gray clay layer.

The stump was brought back to the University of Georgia for further analysis. A horizontal section was cut off and brought to the Forestry department, where it was determined that it was most likely a pine (Laurie Schimleck, personal communication 2009). Another section was cut off, and a sample was removed from one of the inner rings and ¹⁴C dated. A date of 4,427-4,247 cal B.P. was reported. This calibrated date range corresponds precisely with the
timing of the sea level high-stand reported by DePratter and Howard (1981) and Gayes et al. (1992).

There is more than one pith (center of tree) at ground level, indicating that when this tree first formed, it had multiple stems. In addition, the pith of the stump is offset, with reaction wood forming along one side. This indicates the tree may have developed on a slope, with reaction wood forming down-slope on conifers (Grissino-Mayer 2003:69). Offset stems and reaction wood are also indicative of wind-induced developmental responses (Telewski 1995:238), especially in young trees growing on slopes (Grissino-Mayer 2003:68). There does not seem to be other indicators that the stump formed at an angle (i.e., the entire stump was found in a vertical position, there are no bends in the trunk or tap roots, etc.), although in trees with small mass, reaction wood can return the stem to a vertical position (Telewski 1995:252). With a diameter of 36 cm (and between 8 and 15 rings), the tree was fairly small when it died.

A sediment sample from the tree stump was also analyzed, obtained from where the tap roots split off from the main trunk. This sample, found within the roots of the stump, was from about 57.6 cm above MLLW (133.7 cmbs). This is close to the estimate of the former surface, and thus is a good representation of the particle size of that surface. This tree originally grew on a surface of sandy loam (> 76% sand) with little clay content (< 19%) (see Table 3.13). As with the sandy layers seen in the cores, the majority of the sand (> 65%) is made up of fine sands.
Summary

This chapter described the results of the archaeological and geomorphological fieldwork, as well as the sherd density analysis of nearby archaeological surveys. The next chapter discusses the geomorphology results, describing the implications this new information has for the geologic history of the area. It will also describe the methods used to incorporate those results, as well as data from sea level curves, into the model.
Table 3.1. Number and Percentage of Shovel Tests on Mary Hammock and Patterson Island that had Pottery, Shell, or were Sterile.

<table>
<thead>
<tr>
<th>Shovel Test Content</th>
<th>Mary Hammock</th>
<th></th>
<th>Patterson Island</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td># STs</td>
<td>% STs</td>
<td># STs</td>
<td>% STs</td>
</tr>
<tr>
<td>Native American pottery and shell</td>
<td>69</td>
<td>31.1%</td>
<td>117</td>
<td>29.8%</td>
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<tr>
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<td>12</td>
<td>5.4%</td>
<td>34</td>
<td>8.7%</td>
</tr>
<tr>
<td>Shell only</td>
<td>69</td>
<td>31.1%</td>
<td>82</td>
<td>20.9%</td>
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<tr>
<td>Sterile</td>
<td>72</td>
<td>32.4%</td>
<td>160</td>
<td>40.7%</td>
</tr>
<tr>
<td>Total</td>
<td>222</td>
<td></td>
<td>393</td>
<td></td>
</tr>
</tbody>
</table>

Table 3.2. Shovel Tests on Mary Hammock and Patterson Island Separated by Midden and Shell.

<table>
<thead>
<tr>
<th>Shovel Test Content</th>
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<th>Patterson Island</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td># STs</td>
<td>% STs</td>
<td># STs</td>
<td>% STs</td>
</tr>
<tr>
<td>Native American pottery and shell midden</td>
<td>40</td>
<td>18.0%</td>
<td>53</td>
<td>13.5%</td>
</tr>
<tr>
<td>Native American pottery and shell (not midden)</td>
<td>29</td>
<td>13.1%</td>
<td>64</td>
<td>16.3%</td>
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<tr>
<td>Native American pottery only</td>
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<td>5.4%</td>
<td>34</td>
<td>8.7%</td>
</tr>
<tr>
<td>Shell midden</td>
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<td>13.1%</td>
<td>38</td>
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<tr>
<td>Shell (but not midden)</td>
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<tr>
<td>Sterile</td>
<td>72</td>
<td>32.4%</td>
<td>160</td>
<td>40.7%</td>
</tr>
<tr>
<td>Total</td>
<td>222</td>
<td></td>
<td>393</td>
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Table 3.3. Number and Percentage of only Pottery-bearing Shovel Tests on Mary Hammock and Patterson Island.

<table>
<thead>
<tr>
<th>Shovel Test Content</th>
<th>Mary Hammock</th>
<th></th>
<th>Patterson Island</th>
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<td>Native American pottery and shell midden</td>
<td>40</td>
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<td>Ceramic Type</td>
<td># of Shovel Tests</td>
<td>Total Sherds</td>
<td>% Sherds</td>
</tr>
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<td>---------------</td>
<td>-------------------------------------------</td>
<td>-------------------</td>
<td>--------------</td>
<td>----------</td>
</tr>
<tr>
<td>4500 - 3100 BP</td>
<td>St. Simons plain</td>
<td>0</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>3100 - 3000 BP</td>
<td>Refuge punctate</td>
<td>1</td>
<td>1</td>
<td>0.4</td>
</tr>
<tr>
<td>3100 - 1500 BP</td>
<td>Refuge plain</td>
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<td>3</td>
<td>1.1</td>
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<tr>
<td>2900 - 1500 BP</td>
<td>Deptford check stamped</td>
<td>3</td>
<td>13</td>
<td>4.9</td>
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<tr>
<td>2400 - 1700 BP</td>
<td>Deptford cord marked</td>
<td>1</td>
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<td>Wilmington or St. Catherines plain</td>
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<td>22</td>
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<td>Savannah burnished</td>
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<td>1</td>
<td>0.4</td>
</tr>
<tr>
<td>700 - 675 BP</td>
<td>Savannah comp. stamped</td>
<td>1</td>
<td>1</td>
<td>0.4</td>
</tr>
<tr>
<td>700 - 575 BP</td>
<td>Savannah/ Irene check stamped</td>
<td>4</td>
<td>39</td>
<td>14.6</td>
</tr>
<tr>
<td>675 - 250 BP</td>
<td>Irene plain, burnished, and comp. stamped</td>
<td>50</td>
<td>115</td>
<td>43.1</td>
</tr>
<tr>
<td>575 - 250 BP</td>
<td>Irene incised</td>
<td>4</td>
<td>14</td>
<td>5.2</td>
</tr>
<tr>
<td>370 - 250 BP</td>
<td>Altamaha stamped</td>
<td>4</td>
<td>6</td>
<td>2.2</td>
</tr>
<tr>
<td>Unknown</td>
<td>Unknown (total)</td>
<td>22</td>
<td>32</td>
<td>12.0</td>
</tr>
</tbody>
</table>

| Unknown Sand                      | 12 | 19 | 50.8 |
| Unknown Sand and Grit             | 9  | 12 | 69.0 |
| Unknown Sand and Coarse Grit      | 0  | 0  | 0.0  |
| Unknown Sand Grit Clay            | 0  | 0  | 0.0  |
| Unknown Coarse Grit               | 1  | 1  | 1.4  |
| Unknown Grit                      | 0  |    |      |
| Unknown Indian (Lost)             | 0  | 0  |      |
| Unknown Temperless                | 0  |    |      |

| Unknown Lithics                   | 2  |    |      |
| TOTALS                            | 267| 1,574.5 |
Table 3.5. Faunal Material from Mary Hammock.

<table>
<thead>
<tr>
<th>Taxa</th>
<th>NISP</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Odocoileus virginianus</em> White tailed deer</td>
<td>2</td>
<td>1 right scapula, fused; 1 distal medipodial, fused</td>
</tr>
<tr>
<td><em>Procyon lotor</em> Racoon</td>
<td>1</td>
<td>1 mandible</td>
</tr>
<tr>
<td>Mammalia</td>
<td>8</td>
<td>8 UID fragments</td>
</tr>
<tr>
<td>Kinosernon sp. Mud turtles</td>
<td>1</td>
<td>1 nuchal fragment</td>
</tr>
<tr>
<td>Testudinidae Turtle family</td>
<td>3</td>
<td>3 UID fragments</td>
</tr>
<tr>
<td><em>Ariopsis felis</em> Hardhead catfish</td>
<td>2</td>
<td>1 left pectoral spine; 1 left otolith</td>
</tr>
<tr>
<td><em>Pogonias cromis</em> Black drum</td>
<td>1</td>
<td>1 right quadrate</td>
</tr>
<tr>
<td>UID Bone</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
Table 3.6. Prehistoric Ceramics found in Shovel Tests on Patterson Island.

<table>
<thead>
<tr>
<th>Dates</th>
<th>Ceramic Type</th>
<th># of Shovel Tests</th>
<th>Total Sherds</th>
<th>% Sherds</th>
<th>Sherd Weight</th>
<th>% Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>4500 - 3100 BP</td>
<td>St. Simons plain</td>
<td>20</td>
<td>48</td>
<td>10.2</td>
<td>605.8</td>
<td>16.4</td>
</tr>
<tr>
<td>3000 - 2900 BP</td>
<td>Refuge dentate</td>
<td>1</td>
<td>1</td>
<td>0.2</td>
<td>1.9</td>
<td>0.1</td>
</tr>
<tr>
<td>3100 - 1500 BP</td>
<td>Refuge plain and simple stamped</td>
<td>4</td>
<td>6</td>
<td>1.3</td>
<td>19.7</td>
<td>0.5</td>
</tr>
<tr>
<td>2900 - 1500 BP</td>
<td>Deptford check stamped</td>
<td>7</td>
<td>11</td>
<td>2.3</td>
<td>73.8</td>
<td>2.0</td>
</tr>
<tr>
<td>2400 - 1700 BP</td>
<td>Deptford cord marked</td>
<td>2</td>
<td>4</td>
<td>0.9</td>
<td>9.0</td>
<td>0.2</td>
</tr>
<tr>
<td>2400 - 1500 BP</td>
<td>Deptford plain</td>
<td>1</td>
<td>1</td>
<td>0.2</td>
<td>10.7</td>
<td>0.3</td>
</tr>
<tr>
<td>2000 - 1500 BP</td>
<td>Swift Creek</td>
<td>3</td>
<td>26</td>
<td>5.5</td>
<td>259.5</td>
<td>7.0</td>
</tr>
<tr>
<td>1500 - 1400 BP</td>
<td>Walthour stamped</td>
<td>5</td>
<td>7</td>
<td>1.5</td>
<td>71.3</td>
<td>1.9</td>
</tr>
<tr>
<td>1500 - 1000 BP</td>
<td>Wilmington net marked</td>
<td>1</td>
<td>4</td>
<td>0.9</td>
<td>19.9</td>
<td>0.5</td>
</tr>
<tr>
<td>1500 - 800 BP</td>
<td>Wilmington or St. Catherines plain</td>
<td>32</td>
<td>65</td>
<td>13.9</td>
<td>693.6</td>
<td>18.8</td>
</tr>
<tr>
<td>1000 - 800 BP</td>
<td>St Cat burnished and chk. stamped (14C date)</td>
<td>2</td>
<td>3</td>
<td>0.6</td>
<td>28.9</td>
<td>0.8</td>
</tr>
<tr>
<td>800 - 675 BP</td>
<td>Savannah burnished</td>
<td>3</td>
<td>7</td>
<td>1.5</td>
<td>67.0</td>
<td>1.8</td>
</tr>
<tr>
<td>700 - 675 BP</td>
<td>Savannah comp. stamped</td>
<td>1</td>
<td>1</td>
<td>0.2</td>
<td>4.1</td>
<td>0.1</td>
</tr>
<tr>
<td>700 - 575 BP</td>
<td>Savannah/ Irene chk. stamped and crd. marked</td>
<td>15</td>
<td>17</td>
<td>3.6</td>
<td>127.8</td>
<td>3.5</td>
</tr>
<tr>
<td>800 - 250 BP</td>
<td>Savannah/ Irene burnished and comp. stamped</td>
<td>4</td>
<td>13</td>
<td>2.8</td>
<td>89.8</td>
<td>2.4</td>
</tr>
<tr>
<td>675 - 575 BP</td>
<td>Irene check stamped (14C date)</td>
<td>1</td>
<td>2</td>
<td>0.4</td>
<td>25.0</td>
<td>0.7</td>
</tr>
<tr>
<td>675 - 250 BP</td>
<td>Irene plain, burnished, and comp stamped</td>
<td>42</td>
<td>92</td>
<td>19.6</td>
<td>877.1</td>
<td>23.8</td>
</tr>
<tr>
<td>370 - 250 BP</td>
<td>Altamaha stamped</td>
<td>4</td>
<td>8</td>
<td>1.7</td>
<td>65.8</td>
<td>1.8</td>
</tr>
<tr>
<td>Unknown</td>
<td>Unknown (total)</td>
<td>80</td>
<td>153</td>
<td>32.6</td>
<td>632.0</td>
<td>17.2</td>
</tr>
<tr>
<td></td>
<td>Unknown Sand</td>
<td>23</td>
<td>37</td>
<td></td>
<td>122.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unknown Sand and Grit</td>
<td>51</td>
<td>110</td>
<td></td>
<td>481.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unknown Sand and Coarse Grit</td>
<td>5</td>
<td>5</td>
<td></td>
<td>24.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unknown Sand Grit Clay</td>
<td>1</td>
<td>1</td>
<td></td>
<td>2.7</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>Unknown Indian (Lithics)</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>TOTALS</strong></td>
<td><strong>228</strong></td>
<td><strong>469</strong></td>
<td></td>
<td><strong>3,682.7</strong></td>
<td></td>
</tr>
</tbody>
</table>
Table 3.7. Radiocarbon Dates from Patterson Island, Mary Hammock, Vibracores, and the Tree Stump.

<table>
<thead>
<tr>
<th>Lab #</th>
<th>Provenience</th>
<th>cmbs</th>
<th>Material</th>
<th>δ13C,‰</th>
<th>14C age (BP)</th>
<th>14C age, cal. B.P. (2σ)</th>
<th>Area Under Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>UGAMS-4499</td>
<td>Patterson Island/ E-467740, N-3480640 0-40 Charcoal, sherd interior</td>
<td>-24.10</td>
<td>1450 ± 25</td>
<td>1,382-1,302</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UGAMS-4499 (Re-do)</td>
<td>Patterson Island/ E-467740, N-3480640 0-40 Soot on sherd</td>
<td>-24.40</td>
<td>410 ± 20</td>
<td>512-457</td>
<td>0.967</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UGAMS-4500</td>
<td>Patterson Island/ E-467980, N-3480520 0-30 Soot on sherd</td>
<td>-24.90</td>
<td>600 ± 30</td>
<td>653-577</td>
<td>0.739</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UGAMS-4501</td>
<td>Patterson Island/ E-467860, N-3480540 0-30 Soot on sherd</td>
<td>-23.80</td>
<td>3330 ± 50</td>
<td>3,688-3,654</td>
<td>0.067</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UGAMS-4502</td>
<td>Patterson Island/ E-467800, N-3480560 0-25 Soot on sherd</td>
<td>-15.60</td>
<td>920 ± 40</td>
<td>923-759</td>
<td>0.970</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UGAMS-5003</td>
<td>Marsh/ Stump 130 Wood</td>
<td>-26.60</td>
<td>3920 ± 30</td>
<td>4,427-4,247</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UGAMS-5004</td>
<td>Marsh/ Core MT02 162 Plant frag.</td>
<td>-27.60</td>
<td>2780 ± 30</td>
<td>2,952-2,792</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UGAMS-5005</td>
<td>Marsh/ Core MT06 223 Plant frag.</td>
<td>-25.90</td>
<td>4270 ± 50</td>
<td>4,972-4,799</td>
<td>0.766</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UGAMS-5237a</td>
<td>Mary Hammock/ Special ST #2 40-50 Shell</td>
<td>-2.11</td>
<td>630 ± 25</td>
<td>478-309</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UGAMS-5237b</td>
<td>Mary Hammock/ Special ST #2 40-50 Charcoal</td>
<td>-22.56</td>
<td>420 ± 25</td>
<td>520-453</td>
<td>0.961</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UGAMS-5238</td>
<td>Mary Hammock/ Special ST #2 75-100 Shell</td>
<td>-1.52</td>
<td>730 ± 25</td>
<td>538-428</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3.8. Faunal Material from Patterson Island.

<table>
<thead>
<tr>
<th>Taxa</th>
<th>NISP</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Odocoileus virginianus</em> White tailed deer</td>
<td>2</td>
<td>1 metapodial, unfused; 1 2nd and 3rd carpal bone</td>
</tr>
<tr>
<td>Mammalia</td>
<td>5</td>
<td>5 UID fragments</td>
</tr>
<tr>
<td>Malaclemys terrapin Diamondback terrapin</td>
<td>1</td>
<td>1 left peripheral, number seven</td>
</tr>
<tr>
<td>Emydidae Pond turtle family</td>
<td>1</td>
<td>1 hyoplastron fragment</td>
</tr>
<tr>
<td>Testudines Turtle order</td>
<td>14</td>
<td>14 UID fragments</td>
</tr>
<tr>
<td>Alligator mississippiensis</td>
<td>3</td>
<td>3 scutes</td>
</tr>
<tr>
<td>Actinopterygii Indeterminate bony fish</td>
<td>4</td>
<td>2 vertebrae; 2 dorsal spines</td>
</tr>
<tr>
<td>Vertebrata Vertebrate</td>
<td>1</td>
<td>1 UID fragment</td>
</tr>
<tr>
<td>UID Bone</td>
<td>1</td>
<td>1 UID fragment</td>
</tr>
</tbody>
</table>

Table 3.9. Late Archaic Period Sherd Counts and Densities from Eight Survey Areas.

<table>
<thead>
<tr>
<th>Survey Area</th>
<th>Hectares</th>
<th>Late Archaic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Sherds</td>
</tr>
<tr>
<td>Townsend Bombing Range</td>
<td>1,813.6</td>
<td>4</td>
</tr>
<tr>
<td>Big Mortar-Snuffbox</td>
<td>534.2</td>
<td>318</td>
</tr>
<tr>
<td>Julianton Plantation</td>
<td>526.1</td>
<td>184</td>
</tr>
<tr>
<td>Patterson Island</td>
<td>18.2</td>
<td>48</td>
</tr>
<tr>
<td>Mary Hammock</td>
<td>10.4</td>
<td>0</td>
</tr>
<tr>
<td>Little Sapelo Island</td>
<td>44.9</td>
<td>19</td>
</tr>
<tr>
<td>Pumpkin Hammock</td>
<td>3.3</td>
<td>2</td>
</tr>
<tr>
<td>St. Catherines Island</td>
<td>975.8</td>
<td>136</td>
</tr>
</tbody>
</table>
Table 3.10. Early and Middle Woodland Period Sherd Counts and Densities from Eight Survey Areas.

<table>
<thead>
<tr>
<th>Survey Area</th>
<th>Hectares</th>
<th>Early Woodland Sherds</th>
<th>Sherds/10 ha</th>
<th>Early/ Middle Wood. Sherds</th>
<th>Sherds/10 ha</th>
<th>Middle Woodland Sherds</th>
<th>Sherds/10 ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Townsend Bombing Range</td>
<td>1,813.6</td>
<td>0</td>
<td>0.00</td>
<td>7</td>
<td>0.04</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Big Mortar-Snuffbox</td>
<td>534.2</td>
<td>12</td>
<td>0.22</td>
<td></td>
<td></td>
<td>365</td>
<td>6.83</td>
</tr>
<tr>
<td>Julianton Plantation</td>
<td>526.1</td>
<td>30</td>
<td>0.57</td>
<td></td>
<td></td>
<td>23</td>
<td>0.44</td>
</tr>
<tr>
<td>Patterson Island</td>
<td>18.2</td>
<td>1</td>
<td>0.55</td>
<td>17</td>
<td>9.33</td>
<td>31</td>
<td>17.02</td>
</tr>
<tr>
<td>Mary Hammock</td>
<td>10.4</td>
<td>4</td>
<td>3.85</td>
<td></td>
<td></td>
<td>14</td>
<td>13.46</td>
</tr>
<tr>
<td>Little Sapelo Island</td>
<td>44.9</td>
<td>5</td>
<td>1.11</td>
<td>23</td>
<td>5.13</td>
<td>21</td>
<td>4.68</td>
</tr>
<tr>
<td>Pumpkin Hammock</td>
<td>3.3</td>
<td>0</td>
<td>0.00</td>
<td></td>
<td></td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>St. Catherines Island</td>
<td>975.8</td>
<td></td>
<td></td>
<td>212</td>
<td>2.18</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3.11. Late Woodland and Late Woodland/ Early Mississippian Period Sherd Counts and Densities from Eight Survey Areas.

<table>
<thead>
<tr>
<th>Survey Area</th>
<th>Hectares</th>
<th>Late Woodland Sherds</th>
<th>Sherds/10 ha</th>
<th>Late Wood./ Early Miss. Sherds</th>
<th>Sherds/10 ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Townsend Bombing Range</td>
<td>1,813.6</td>
<td>0</td>
<td>0.00</td>
<td>33</td>
<td>0.62</td>
</tr>
<tr>
<td>Big Mortar-Snuffbox</td>
<td>534.2</td>
<td>42</td>
<td>0.79</td>
<td>65</td>
<td>35.68</td>
</tr>
<tr>
<td>Julianton Plantation</td>
<td>526.1</td>
<td>18</td>
<td>0.34</td>
<td>22</td>
<td>21.15</td>
</tr>
<tr>
<td>Patterson Island</td>
<td>18.2</td>
<td>11</td>
<td>6.04</td>
<td>14</td>
<td>3.12</td>
</tr>
<tr>
<td>Mary Hammock</td>
<td>10.4</td>
<td>19</td>
<td>18.27</td>
<td>22</td>
<td>21.15</td>
</tr>
<tr>
<td>Little Sapelo Island</td>
<td>44.9</td>
<td>11</td>
<td>2.45</td>
<td>14</td>
<td>3.12</td>
</tr>
<tr>
<td>Pumpkin Hammock</td>
<td>3.3</td>
<td>6</td>
<td>17.97</td>
<td>2</td>
<td>5.99</td>
</tr>
<tr>
<td>St. Catherines Island</td>
<td>975.8</td>
<td>184</td>
<td>1.89</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3.12. Thickness of the three Layers Noted within the Cores and the Distance of Cores from Mary Hammock and .

<table>
<thead>
<tr>
<th>Distance from Hammock (m)</th>
<th>MT01</th>
<th>MT02</th>
<th>MT03</th>
<th>MT04</th>
<th>MT05</th>
<th>MT06</th>
<th>Stump</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>61.5</td>
<td>115.3</td>
<td>178.2</td>
<td>247.8</td>
<td>305.0</td>
<td>349.7</td>
<td></td>
</tr>
<tr>
<td>Modern Marsh Layer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>cm below surface</td>
</tr>
<tr>
<td></td>
<td>0 to 31</td>
<td>0 to 48/63</td>
<td>0 to 68/81</td>
<td>0 to 78/100</td>
<td>0 to 105</td>
<td>0 to 85/102</td>
<td></td>
</tr>
<tr>
<td>Sand Layer</td>
<td>31 to 163</td>
<td>48/63 to 179</td>
<td>68/81 to 171</td>
<td>78/100 to 220</td>
<td>105 to 198</td>
<td>85/102 to 193</td>
<td></td>
</tr>
<tr>
<td>Greenish Gray Clay Layer</td>
<td>163 to &gt;208</td>
<td>179 to &gt;201</td>
<td>171 to &gt;211</td>
<td>220 to &gt;265</td>
<td>198 to &gt;232</td>
<td>193 to &gt;235</td>
<td></td>
</tr>
<tr>
<td>Estimated Start of Sand</td>
<td>110-114</td>
<td>120-158</td>
<td>161-166</td>
<td>181-189</td>
<td>196-219</td>
<td>174-175</td>
<td>cm above MLLW</td>
</tr>
<tr>
<td>Layer Determined by</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elevation</td>
<td>210.9</td>
<td>222.8</td>
<td>232.4</td>
<td>224.8</td>
<td>208.0</td>
<td>191.7</td>
<td>191.6</td>
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<td>223 to 174/159</td>
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<td>174/159 to 43</td>
<td>164/151 to 61</td>
<td>146/124 to 4</td>
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Table 3.13. Core MT01: Particle Size and Organic Matter Analysis with Sandy Layer

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Table 3.14. Core MT03: Particle Size and Organic Matter Analysis with Sandy Layer

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Table 3.15. Core MT06: Particle Size and Organic Matter Analysis with Sandy Layer Highlighted.

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Table 3.16. Detailed Separation of the Sand Fraction from Core MT03 and the Tree Stump.

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<td>0.7</td>
<td>4.5</td>
<td>73.4</td>
<td>7.6</td>
<td>89.7</td>
<td>1.6</td>
<td>8.6</td>
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<td>7.6</td>
<td>89.7</td>
<td>1.6</td>
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<td>89.7</td>
<td>1.6</td>
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<td>5.2</td>
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Core MT03

Stump
Figure 3.1. Historic features on Mary Hammock.
Figure 3.2. Results of archaeological survey on Mary Hammock. Shown are shovel tests with Native American pottery and shell, just pottery, just shell, and with no cultural remains.
Figure 3.3. Mary Hammock shovel tests showing weight (in grams) of ceramics for three periods: (a) Early Woodland; (b) Early/ Middle Woodland; (c) Middle Woodland.
Figure 3.4. Mary Hammock shovel tests showing weight (in grams) of ceramics for two periods: 
(a) Late Woodland; (b) Late Woodland/Early Mississippian.
Figure 3.5. Mary Hammock shovel tests showing weight (in grams) of ceramics for four periods:
(a) Middle Mississippian; (b) Middle/ Late Mississippian; (c) Late Mississippian/ Historic Contact period; (d) Historic Contact period.
Figure 3.6. Density map showing shell thickness (cm) on Mary Hammock.
Figure 3.7. Density map showing shell weight (kg) on Mary Hammock.
Figure 3.8. Historic features on Patterson Island.
Figure 3.9. Results of archaeological survey on Patterson Island. Shown are shovel tests with Native American pottery and shell, just pottery, just shell, and with no cultural remains.
Figure 3.10. Patterson Island shovel tests showing weight (in grams) of ceramics for four periods: (a) Late Archaic; (b) Early Woodland; (c) Early/ Middle Woodland; (d) Middle Woodland.
Figure 3.11. Patterson Island shovel tests showing weight (in grams) of ceramics for three periods: (a) Late Woodland; (b) Late Woodland/ Early Mississippian; (c) Early Mississippian.
Figure 3.12. Patterson Island shovel tests showing weight (in grams) of ceramics for two periods:
(a) Middle Mississippian; (b) Middle/ Late Mississippian.
Figure 3.13. Patterson Island shovel tests showing weight (in grams) of ceramics for four periods: (a) Middle Mississippian/ Late Mississippian/ Historic Contact period; (b) Late Mississippian; (c) Late Mississippian/ Historic Contact period; (d) Historic Contact period.
Figure 3.14. Density map showing shell thickness (cm) on Patterson Island.
Figure 3.15. Density map showing shell weight (kg) on Patterson Island.
Figure 3.16. Present-day topographic map of Mary Hammock. The two highest elevations are also noted.
Figure 3.17. Topographic map of Mary Hammock prior to shell deposition. Locations of three areas with more than one layer of shell midden are also noted.
Figure 3.18. Results of extensive hand-probing of the marsh. Values are in meters below surface.
Figure 3.19. Results of intensive hand-probing around Mary Hammock. Values are in meters below surface.
Figure 3.20. Modern marsh layer: top 50 cm of core MT03, extending from 0-81 cm below the surface. Note the few areas of white in the X-radiographs, indicating low sand content.
Figure 3.21. Sandy layer: middle 90 cm of core MT03, extending from 81–171 cm below the marsh surface. Note the slightly darker X-radiograph towards the top of this section (81-115 cmbs), indicating modern marsh mud inclusions.
Figure 3.22. Greenish gray clay layer: bottom 40 cm of core MT03, extending from 171–211 cm below the marsh surface. Note the dark yellowish brown/ brownish yellow stains in the clay, which is oxidation around root relicts.
Figure 3.23. Digital image and X-radiograph of core MT06, showing two thin sand layers within the modern marsh layer. Note the differences in texture seen in the X-radiograph, with more mud in between the two sand layers, and more sand above the 55.5 cmbs sand layer.
Figure 3.24. Particle size analysis of core MT01. This core is made up mostly of sand, except for the bottom section which is mostly of clay.
Figure 3.25. Particle size analysis of core MT03. Note the large amount of clay in both the upper and lower sections.
Figure 3.26. Particle size analysis of core MT06. In general particle size is mostly sand, except for the bottom section.
CHAPTER 4
REFINING THE MODEL

As discussed in the introduction chapter, a model was constructed to look at how changes in sea level affected the structure of McIntosh County over time. The base of the model is the elevation/bathymetry dataset, which is constructed from modern (within the last 50 years) data. This chapter is a summary and discussion of the geomorphology results of the previous chapter (detailed present-day elevations and former upland surfaces of Mary Hammock and the surrounding marsh). It also describes the methods used to incorporate those results into the elevation/bathymetry dataset, refining the model. At the same time, this chapter describes how the data from sea level curves were incorporated into the dataset for each specific time period, to run the model.

Detailed Present-Day Elevations

The topographic survey data for Mary Hammock and the surrounding marsh were in the arbitrary XYZ grid system of the total station. To transform the horizontal (i.e., the XY) positions of this data to real-world coordinates, a transfer function was applied to them using Desktop Mapping Softcopy 5.1, a program written by Tommy Jordon, Associate Director for
Twenty four points that had both total station coordinates and accurate GPS coordinates were selected, and separated into two text files: one with the total station coordinates, and one with the GPS coordinates. These files were then put into the Desktop Mapping Softcopy program, which created a relationship between the two coordinate systems. The output file created contained the coefficients to be used in the transformation, as well as the RMS error (which was 0.78 m). The coefficients were then applied to the rest of the total station data, performing a first order polynomial affine transformation.

To transform the arbitrary Z coordinates of the total station grid system into the real-world vertical datum, information obtained with the RTK GPS was used. In total, the horizontal and vertical positions of 14 points in the marsh surrounding Mary Hammock were recorded with the RTK GPS. As mentioned in the methods chapter, six of these points were core extraction locations, and one was the location of the stump. Five others were random points in the marsh. The final two points were wooden stakes put in the marsh during the topographic survey. These two stakes were used to tie the real-world RTK GPS data to the arbitrary total station data of the topographic survey.

The RTK GPS recorded vertical elevations in reference to the North American Vertical Datum of 1988 (NAVD 88), with vertical accuracies of 1.4 and 1.7 cm. They needed to be converted to meters above MLLW (mean lower low water), to match with the elevation/bathymetry dataset created previously. Unfortunately, the benchmarks at The Old Tower tidal station are not tied in to the National Geodetic Survey, which defines and manages a national grid system, and there is no NAVD 88 value for this tidal station.
The closest tidal station with an NAVD 88 value is at the St. Simons Island Lighthouse
(ID # 8677344), which has an NAVD 88 value of 1.277 ma MLLW (see Table 2.1). Comparing
the tidal datums of the St. Simons station to those of Fort Pulaski in north Georgia, and the Old
Tower on Sapelo Island (see Table 2.1), revealed that the differences are minimal (~10 cm or
less, see Table 4.1). The tidal datums at Old Tower, on average, have a difference of less than 5
cm. The NAVD 88 value at Fort Pulaski also has a difference of less than 5 cm. By taking the
locations of the tidal stations into account, it seems that the Old Tower tidal station most likely
has an NAVD 88 value that is around +/- 5 cm different than the NAVD 88 value at the St.
Simons tidal station. Thus it is justified to use the NAVD 88 value from the St. Simons tidal
station to translate the RTK GPS data to MLLW, keeping in mind that there may be a slight
difference of 5 cm. The value of 1.277 ma MLLW (which is the NAVD 88 value at the St.
Simons Light House) was added to the elevation of 0.823 ma NAVD 88 recorded by the RTK
GPS at both marsh stakes. This translates to 2.1 ma MLLW.

These RTK GPS positions were used to both corroborate and refine the present-day low
marsh and high marsh elevations. Five points to the west and north of Mary Hammock (two
stakes, core MT 01, and two random points near MT 01) had an average elevation of 2.104 ma
MLLW. This was close to the 2.118 ma MLLW calculation for low marsh. These points were
between 53 and 23 m from the edge of Mary Hammock, so the low marsh/ high marsh border
was moved between these points and the edge of Mary. The nature of the elevation/ bathymetry
dataset is such that any polygon can only be represented by one value. In this case, it was
realized that the elevation represented the leading edge of the polygon. To accommodate the
lowest low marsh elevations gathered with the RTK GPS (1.916 ma MLLW at the site of the
stump extraction, and 1.917 at the site of core MT 06), all low marsh was given an elevation of
1.9 ma MLLW. This better represented the gradual change in elevation over low marsh, with elevations of 1.9 ma MLLW at the tidal creek edge, up to 2.264 ma MLLW at the low marsh-high marsh interface. This is also in keeping with the definition of low marsh, which is found just below mean sea level and continues to MHHW.

Only three RTK GPS positions were collected in the high marsh. All were towards the south of Mary Hammock, and in close proximity to each other. Nevertheless, the average elevation of these points was 2.262 ma MLLW. With a vertical precision of 0.02 m, these elevations are extremely close to the 2.264 elevation estimated for high marsh at the Old Tower benchmark, validating the use of this benchmark to tie together all of the elevation data.

Extrapolating the 2.1 ma MLLW elevations at the two marsh stakes to all other arbitrary total station data involved a simple equation. The arbitrary Z value obtained for the stakes with the total station was 98.337 m. This value should be equal to the 2.1-m value obtained with the RTK GPS. Thus 98.337 m was subtracted from each of the arbitrary Z values, and then 2.1 m was added, resulting in elevations in relation to MLLW. For example: an arbitrary Z value of 198.337 m, which is 100 m higher than 98.337 m, calculates to 102.1 ma MLLW, which is 100 m higher than 2.1 ma MLLW.

A detailed map of the present-day topography was interpolated using these topographic survey data, as well as the 14 RTK GPS positions. All of these points were added to ArcMap using the “Add XY Data” function. The resulting point file was then input into the “Topo to Raster” tool to create a surface map. The parameters were as follows: the input data were spot (i.e., point), the output cell size was 2.5, and drainage was not enforced (i.e., sinks were not filled). The output file was a topographic surface in raster format (named Mary_Present). The elevation/bathymetry dataset, which is in polygon format, was overlaid on top, and the
topographic contours of the raster dataset were traced, cutting the polygons manually at intervals of 0.25 m.

Past Elevations

To incorporate past elevations and geomorphological changes into the elevation/bathymetry database, mathematical calculations were performed applying a slightly modified version of the Gayes et al. (1992) sea level curve. One assumption I make here is that the tidal range was the same in the past as it is today. So, although Gayes et al. (1992) report sea level indicators in depth below mean high water (MHW), the same values apply to depth below MLLW.

Geomorphology: Back-barrier Islands and Marsh

How and when back-barrier islands formed is still in question. Radiocarbon determinations on shell found in one of the cores from Mary Hammock revealed dates of 49,274-46,484 B.P. (474.5 cmbs) and 43,221-41,975 B.P. (515.5 cmbs) (Turck and Alexander 2011). The depositional environment represented in these layers does not seem to be related to the formation of the marsh island (Turck and Alexander 2011). A $^{14}$C date on shell collected from a “core hole” on Pumpkin Hammock revealed an infinite age of >38,500 B.P. (Hoyt et al. 1968:385-386). No provenience information was given for this sample, and it may be related to the same depositional environment as that found in one of the cores from Mary Hammock.
Further complicating our understanding of the formation of back-barrier islands is the fact that all but two cores extracted from these islands (Mary Hammock, Fishing Hammock, and Jack Hammock) contained the same greenish gray clay layer found in the cores extracted from the marsh (see Turck and Alexander 2011). This is problematic, because the greenish gray clay layer is thought to represent the relict Pleistocene marsh, deposited behind Sapelo Island after it first formed between 100 to 40 thousand years ago (see Henry and Lens 1980:288). The greenish grey color clay is attributed to reduction. When soils with organic matter are saturated with water, for example when below the water table, iron content gets reduced (gains electrons) (Buol et al. 2003:94). This reduction is mediated by microbes, where dissolved oxygen is removed by microbial respiration. When reduction occurs, soils have a characteristic green or blue-green color, resulting from partial reduction of iron-bearing clay minerals (Buol et al. 2003:94). When exposed to air, the color will turn brownish, due to oxidation. Localized areas of oxidized iron are typical within such a reduced matrix, taking the form of orange mottled lepidocrocite (Buol et al. 2003:94). This is most likely the orange and yellow stains found in the cores surrounding the root relicts. Of course, oxidizing and reducing conditions fluctuated since this layer was first deposited, due to changes in the water table (Buol et al. 2003:95), especially during the last 4,500 years. Unfortunately, no material was obtained that could directly date this layer. A root relict sample, which almost certainly was from plants that lived above this layer, was obtained from about 30 cm below the top of the greenish gray clay layer. This sample was $^{14}$C dated to 4,972-4,629 cal. B.P. A similar compacted blue-green clay layer was found in the back-barrier area of Virginia (Finkelstein and Ferland 1987:149). Sandy peat underneath the clay layer, at the bottom of one of the cores taken from Mockhorn Island, was radiocarbon-dated to 23,550 and 30,870
years ago (Finkelstein and Ferland 1987:147 and 151). This is a much more reliable date than the Holocene age obtained from the root relict in this study.

If this greenish gray clay layer represents relict Pleistocene marsh, it seems that these back-barrier islands may not represent remnants of former Pleistocene shorelines, because they formed after the Silver Bluff formation (Turck and Alexander 2011). This proposition cannot be confirmed at this time. The cores taken from back-barrier islands are all close to the flanks of the islands. It is possible that the greenish clay layer near the bottom of these cores thins, and eventually disappears altogether, towards the centers of the islands. This would suggest that after the Silver Bluff marsh formed around the back-barrier islands, sand eroded off of the islands, on top of the relict marsh. Thus, the original interface between the marsh and the island edge may be much closer towards the center of the islands than the present-day interface of marsh and island edge.

It is also possible that the greenish gray clay layer is not a relict Pleistocene marsh. Following the idea that Georgia estuaries relocated during times of sea level regressions and transgressions (Chowns et al. 2008), Chowns (personal communication 2010) proposed that this greenish gray layer could represent a former floodplain deposit. It is possible that as sea level lowered after the Silver Bluff shoreline formed, Sapelo River to the north of Sapelo Island may have been diverted to the south, instead of following more direct routes to the ocean as they do today (Chowns et al. 2008:153). If this is the case, the back-barrier islands behind Sapelo Island might be remnants of natural levees, formed as an estuary flowed south (Chowns, personal communication 2010).

One aspect of back-barrier islands that has been confirmed is that former surfaces do continue under the present-day marsh. The sandy layer in the marsh seems to be identical to that
of the sand from the back-barrier islands. They are both made up of fine sands, with a mean sand grain size of 2.75 phi. Tidal energy determines sedimentation and landform development (Wells 2001:150). Thus, back-barrier islands formed in a similar environment as the Pleistocene sections of major barrier islands, as the mean grain size of Pleistocene barrier island facies is between 2.0 to 3.0 phi range (Henry and Lens 1980:289). The particle size analysis also revealed that hand-probing for sand layers can be unreliable. With the hand probe, resistance (which was assumed to be former upland sand layers) was encountered between 50 and 104 cm below the actual sand layers. This was related to bioturbation, mixing marsh mud with sand, and masking the true contact surface between marsh and sand. This is typical of soil evolution in marshes, as they go from sandy forested soils to marsh with sea level rise (Gardner et al. 1992).

Organic matter analysis also supports the idea of former surfaces under the current marsh. In a typical soil, organic matter content is determined by vegetation (typically roots), and thus high in the top 30 cm, while decreasing rapidly with depth (Baize 1993:23). The analysis of organic matter in cores MT01, MT03, and MT06 seemed to follow this rule generally, but there also seemed to be layers of higher organic matter content interspersed thought the cores. In a marsh setting where conditions have changed over time, it is possible to have lenses of organic material interspersed with mineral layers (Rabenhorst 2001:311). These organic horizons that get buried can maintain their high organic matter content (Baize 1993:23). However, the visual inspection and X-ray analysis of the cores indicate that layers with high organic matter were due to modern marsh being brought down-core by bioturbation, not to the presence of buried O horizons.

The sandy layer seems to not have been deposited during the last 4,500 years as part of a Holocene marsh setting. As mentioned in the above discussion, it is not known whether the sand
layer in the marsh was deposited at the same time as the back-barrier island (as part of one formation), or the back-barrier islands formed first, and then its sand was eroded around it. Either way, Holocene marsh on top of, and bioturbated down into, the sandy layer, indicates that the sand was present by at least 4,500 years ago. In addition, Late Archaic occupations on many back-barrier islands (Little Sapelo, Pumpkin, Jack, and Patterson) indicate that the islands formed at least by 4,500 B.P.

The two thin sand layers seen in the upper sections of cores MT05 and MT06 are also worth mentioning (see Figure 3.38). These sand layers were most likely deposited on the former marsh surface during storms. Storms have the necessary energy to move larger particles. As noted with the hurricanes of 1824 and 1898, areas normally above high tide could be drowned in water. In 1824, the tide rose more than 3.1 m (10 ft) above the surface on the mainland (Sullivan 1992:210). In 1898, Sapelo Island was in direct path of the eye of the storm, causing a tidal surge of 3.7 to 5.5 m (12 to 18 ft) higher than normal that submerged most of Sapelo Island and other low areas of McIntosh County (Sullivan 1989:28). On Sapelo Island, Archibald McKinley described the water as being 1.8 m (6 ft) deep, with 3.7-meter (12-foot) high waves (Sullivan 1989:28). There also seems to be some indication of vegetation die-off after the deposition of the sand, as the matrix is different above and below the sand layers. Unfortunately no materials were present to date these layers. If these layers are dated in the future, and specific storms can be attributed to each, they would make excellent stratigraphic markers.

The last piece of information used to assess past elevations is the location and position of the stump. It seems that the sandy layer under the Holocene marsh slopes downward away from Mary Hammock, with the stump near the bottom of this slope. The physical characteristics of the stump (i.e., the reaction wood) corroborate this, indicating the tree developed on sloping
topography. It can be concluded that prior to 4,427-4,247 B.P., the area north of Mary Hammock was a forested upland. There was a gentle slope moving away from the hammock, with a one-meter drop in elevation over a span of 288 m. Distance to back-barrier islands, then, seems to be one main determinant in the elevation of the former upland surface. Depending on their positions in relation to these sandy bodies, former surfaces would have been inundated, and subject to subaqueous sedimentation, at different times. By about 4,427-4,247 B.P., the lower part of this slope was inundated by water with higher salinity values, at least during high tide, due to a rising sea level. Upland vegetation, including the tree, was killed.

Incorporation of Past Elevations into the Elevation/ Bathymetry Database

These data on the former topography underneath the marsh near Mary Hammock were incorporated into the elevation/ bathymetry dataset. This information was also translated to other back-barrier islands in McIntosh County. While the former topography surrounding each marsh island is probably specific to that island, the general idea of distance of former surface to marsh island edge is the best estimation available at present. At the same time, this section also describes the methods for incorporating changes in sea level over time. Incorporating past elevations and changes in sea level involves mathematical calculations, because these data have a third dimension (elevation), and the GIS is basically a two dimensional program.

Baseline Elevation. A baseline elevation was created (column: Elev_Baseline), representing the surface prior to the 4,200 B.P. sea level rise and subsequent marsh formation. All bathymetric values and upland elevations were given the same values as present day. The lowest former surface was that of the stump, at 0.6 m above MLLW. This was used as the baseline for the surface under the marsh prior to 4,200 B.P. Anything designated as low marsh in
the present-day elevation/bathymetry data set (i.e., from 0.0 to <2.264 ma MLLW), was given the value of 0.6 ma MLLW. A value of 30 cm was subtracted from present-day high marsh elevations (2.264, as well as 2.324 and 2.478), since the former upland surface was considered to be about 30 cm below the modern high marsh surface. This was based partially on core MT01, which showed that there was about 30 cm of modern marsh mud on top of the underlying sand layer. This was also based on shell middens along the southwestern edge of Mary Hammock that continued into the marsh. The base of some of these shell middens were found to be up to 30 cm below the modern marsh surface. Thus, during the Mississippian and/or Woodland periods, when those middens were deposited, the former ground surface was 30 cm below the modern marsh. Analysis of the cores revealed that I overestimated the depth of the former surface by between 72 and 114 cm, with an average overestimation of 90 cm. Applying this average overestimation to the probe data results in an estimation of the former surface to be between 0 and 80 cmbs, with an average of 26 cmbs. Although the former surface most likely undulated to some degree, using the median value of 30 cm below the modern high marsh as a fixed value for the former surface is appropriate without more direct evidence (coring).

To translate the gentle slope of the former surface surrounding Mary Hammock to the other back-barrier islands, the data from certain cores were used (Table 4.2). Distances from the edge of present-day Mary Hammock were calculated for cores MT 01, 03, and 06. These distances were used to create three buffers around the other back-barrier islands in the elevation/bathymetry database. The depths of the former sandy surfaces were then estimated for the three cores, and these values were subtracted from the present-day surface elevation, resulting in three elevations, (in MLLW), that corresponded to one of the three buffers. These elevations were then entered into the attribute table of the elevation/bathymetry database for the appropriate buffer.
The final result was gradual slopes around the back-barrier islands (i.e., 2.5 m drops over 350 m distances), instead of abrupt changes in elevation (i.e., going directly from 3.1 to 0.6 ma MLLW). The buffers were created in low marsh only. If areas or high marsh or tidal creeks were encountered, those sections of the buffers were deleted.

The different gradations in the elevations of former surfaces are: 0.6 ma MLLW under most low marsh, 0.979, 1.579, and 1.794 ma MLLW under the low marsh surrounding back-barrier islands (the buffers), and 1.964 ma MLLW under high marsh. High marsh was treated differently, not just because of its higher present-day elevations, but because of many different characteristics. High marsh substrate is different, with the top 30 cm made up mostly of sand, as opposed to low marsh which is mostly clay and silt (Edward and Frey 1997:220-222; Frey and Basan 1981:122; Howard and Frey 1985:115). High marsh is only inundated during spring tides or storm tides, and has fairly low rates of deposition, especially when compared to low marsh (Howard and Frey 1985:118). In addition, the high marsh connecting Mary Hammock, Pumpkin Hammock, Fishing Hammock, Little Sapelo Island, and the hammock south of Mary Hammock is the largest area of contiguous high marsh in McIntosh County, with the fewest tidal creeks dissecting it. This makes sense due to the close proximity of the marsh islands here. Former elevations should lower moving away from the marsh islands, but rise again fairly quickly as the other islands are approached.

**Middle Archaic Period (8,000 B.P.).** At the beginning of the Middle Archaic period, sea level was anywhere from 32 mbp (Milliman and Emery 1968), to around 22 mbp (Fairbanks 1989; Fairbridge 1974; Gornitz and Seeber 1990; Nelson and Bray 1970; Siddall et al 2003), to as high as 10 mbp (Balsillie and Donoghue 2004; Colquhoun and Brooks 1986; Curray 1960; Törnqvist et al. 2004). Along the North Carolina coast, Horton et al. (2009:1731-1732) report
past sea level indicators at 15.5 and 17.9 mbp at this time. Garrison et al. (2008:138) found that Gray’s Reef, which outcrops around the 20 m bathymetric line east of Sapelo Island, was overstepped by sea level rise around 8,000 B.P. The present study uses a conservative value of 15 mbp for the height of sea level at 8,000 B.P., although data from Garrison et al. (2008) suggest that it may have been as low as 20 mbp. To have the elevation/bathymetry dataset represent this mathematically, a new column was made that added 15 m to the baseline elevation.

**Terminal Middle Archaic Period (5,000 B.P.).** Sea level rose rapidly, reaching about 3.0 mbp by the end of the Middle Archaic period (Gayes et al. 1992). A column was added to the database which added 3.0 m to the baseline elevation.

**Late Archaic Period (4,200 B.P.).** Sea level continued rising, reaching a high stand of about 1.2 mbp (Gayes et al. 1992). A column was added to the database which added 1.2 m to the baseline elevation. This layer represents the surface at about 4,200 B.P., showing subtidal, intertidal, and upland areas.

**Late Archaic Period with Marsh Sedimentation (4,200 B.P.).** The numerous shell midden sites dating to the Late Archaic period are clear evidence that marsh had formed at this time. To simulate the affects of marsh sedimentation in the intertidal areas (from 0.0 to 1.9 m above MLLW), I filled them in mathematically with marsh sediment. These elevations were all given values of 1.9 m above MLLW, which seems to be the equivalent of the present-day low marsh (at least surrounding Mary Hammock). Elevations between 1.9 and 2.264 m did not have marsh sediment added to them, even though these elevations probably would have undergone some sedimentation during the highest of the spring tides. Subtidal and upland elevations did not have any marsh sediment added to them. Some shell had been deposited on Patterson Island at this point. Since the exact amount could not be differentiated from later deposits, all shell was added.
(i.e., all Archaic through Mississippian shell). All further calculations will be performed using this marsh sedimentation data.

*Late Archaic Period (3,600 B.P.)* At this time, sea level had dropped to about 3.15 mbp (Gayes et al. 1992). Since this is 1.95 m below the 4,200 BP sea level, a column was added to the database that added 1.95 m to the 4,200 B.P. marsh sedimentation data.

*Late Archaic/Early Woodland Periods (3,100 B.P.)* By the end of the Late Archaic period, sea level either rose to 2.7 mbp (according to the sea level curve of Gayes et al. 1992), or dropped to about 4.0 mbp (according to data from the Santee River delta that Gayes et al. 1992 report, but did not use in the creation of their curve). This 4.0 mbp value was determined by interpolating the depth between the 3.15 mbp data point, and the cluster of data points from the Santee River delta that are around 4.7 mbp at 2,700 B.P. (Gayes et al. 1992). For the present study, I utilize the 3.15 mbp data point at 3,600 B.P. (Gayes et al. 1992), while also taking into account the DePratter and Howard (1981) sea level curve (4.0 mbp at 2,700 B.P.). Thus a value of 3.5 mbp was interpolated for 3,100 B.P. This is 2.3 m below the 4,200 B.P. sea level, so a column was added to the database that added 2.3 m to the 4,200 B.P. marsh sedimentation data.

Marsh may have formed along the northeast shore of Sapelo Island around this time, but the available data is difficult to interpret. Evidence from sediment cores indicates that marsh deposition began sometime after 3,560 but before 2,900 B.P. in this area (Turck and Alexander 2011). This same marsh was found underneath a small marsh island. Using the OSL technique, the marsh island was dated to 6,240-4,440 B.P. (Turck and Alexander 2011). Turck and Alexander (2011) suggest that the older date may have been skewed by storm-derived, heavy mineral concentrates in the core. I interpret this to mean that the marsh island formed after 2,900 B.P. Marsh formation suggests that some sort of protective barrier also formed by 3,100 B.P.
However, it is not certain where, or even when, this barrier formed. The same 3,560-2,900 B.P. marsh was also found on the east side of the marsh island, but the nearest barrier (the western edge of Blackbeard Island) has been dated to between 2,000 and 1,500 B.P. by the $^{14}$C method (Turck and Alexander 2011) as well by the archaeology (DePratter 1977b). An OSL date also puts the formation of the western edge of Blackbeard Island even later, between 1,340 and 1,140 B.P. (Turck and Alexander 2011).

*Early Woodland Period (2,700 B.P.)*. Sea level was around 4.0 mbp (DePratter and Howard 1981), or possibly even lower at this time (according to the extra data of Gayes et al. 1992). The 4.0 mbp value was used, which is 2.8 m below the 4,200 B.P. sea level, so a column was added to the database that added 2.8 m to the 4,200 B.P. marsh sedimentation data.

*Early/ Middle Woodland Periods (2,400 B.P.)*. By the end of the Early Woodland period, sea level rose to 1.0 mbp (DePratter and Howard 1981; Gayes et al. 1992). This is 0.2 m above the 4,200 B.P. sea level, so a column was added to the database that subtracted 0.2 m from the 4,200 B.P. marsh sedimentation data.

*Middle/ Late Woodland Periods (1,500 B.P.)*. By the end of the Middle Woodland period, sea level had risen to around 0.72 mbp (Gayes et al. 1992). This is 0.48 m above the 4,200 BP sea level, so a column was added to the database that subtracted 0.48 m from the 4,200 B.P. marsh sedimentation data. By this time, people had begun depositing shell on Mary Hammock. As with Patterson Island, the exact amount and timing of this deposition could not be differentiated from later periods, so all shell was added (i.e., all Woodland and Mississippian shell). Blackbeard Island also formed around this time, as indicated by Late Woodland period sites, a $^{14}$C date (2,000-1,616 B.P.), and an OSL date (1,340-1,140 B.P.) (Turck and Alexander 2011). The rest of the ridges making up Blackbeard have not been dated or fully surveyed,
archaeologically. However, they most likely formed later in time, and in succession (see DePratter 1977b).

Late Woodland/ Early Mississippian Periods (1,000 B.P.). By the end of the Late Woodland period, sea level had risen to around 0.6 mbp. This is 0.6 m above the 4,200 B.P. sea level, so a column was added to the database that subtracted 0.6 m from the 4,200 B.P. marsh sedimentation data. Frey and Basan (1981) dated relict marsh under Cabretta Beach (off the east shore of Sapelo Islnd) to between 1,000 and 500 B.P. This suggests that a protective barrier like Nanny Goat/ Cabretta Beach was present at this time, but further seaward (Frey and Basan 1981:113).

Summary

This chapter summarized the results of the geomorphological analysis. It also described the methods used to incorporate those results into the elevation/ bathymetry dataset, and thus how the model of landscape change was constructed and refined. It also described how sea level data were incorporated into the dataset for each specific time period, to run the model. The next chapter describes the implementation of this model for each time period, quantifying the effect that sea level changes had on the five land cover types.
Table 4.1. Differences between the Tidal Datums at two Tidal Stations and the St. Simons Light House Tidal Station.

<table>
<thead>
<tr>
<th></th>
<th>Fort Pulaski (cm)</th>
<th>Old Tower, Sapelo Island (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Higher-High Water</td>
<td>10.1</td>
<td>7.8</td>
</tr>
<tr>
<td>Mean High Water</td>
<td>10.0</td>
<td>7.0</td>
</tr>
<tr>
<td>North American Vertical Datum 88</td>
<td>-4.2</td>
<td></td>
</tr>
<tr>
<td>Mean Sea Level</td>
<td>8.7</td>
<td>4.1</td>
</tr>
<tr>
<td>Mean Tide Level</td>
<td>5.2</td>
<td>3.7</td>
</tr>
<tr>
<td>Mean Low Water</td>
<td>0.4</td>
<td>0.3</td>
</tr>
<tr>
<td>Mean Lower-Low Water</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Table 4.2. Pertinent Core Data Detailing the Slope of the Surface of the Sand Layer under the Marsh around Mary Hammock.

<table>
<thead>
<tr>
<th>Core</th>
<th>Easting</th>
<th>Northing</th>
<th>Surface Elev. (ma MLLW)</th>
<th>Avg. Sand Layer (mbs)</th>
<th>Sand Layer (ma MLLW)</th>
<th>Distance from Mary Edge (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT01</td>
<td>472048.94</td>
<td>3479125.11</td>
<td>2.109</td>
<td>0.315</td>
<td>1.794</td>
<td>62</td>
</tr>
<tr>
<td>MT03</td>
<td>472047.34</td>
<td>3479240.76</td>
<td>2.324</td>
<td>0.745</td>
<td>1.579</td>
<td>178</td>
</tr>
<tr>
<td>MT06</td>
<td>472042.89</td>
<td>3479410.08</td>
<td>1.917</td>
<td>0.938</td>
<td>0.979</td>
<td>350</td>
</tr>
</tbody>
</table>
CHAPTER 5
RUNNING THE MODEL AND TESTING PREDICTIONS ON HUMAN SETTLEMENT

This chapter details the implementation of the model for each time period, quantifying the affect that sea level changes had on the five basic land cover types (subtidal, intertidal, barrier island, marsh island, and mainland) of McIntosh County over time. The total area and percent area (Class Area Proportion) of each land cover type is calculated for each specific date mentioned. The main focus is on how the intertidal land cover type changes over time, as this reveals the most information on changes to the marsh-estuarine system. It should be noted that areas designated as intertidal do not necessarily indicate marsh. Without direct evidence of marsh formation, intertidal areas are considered potential areas where marsh sedimentation could have occurred (areas above the water line at low tide, but underwater at high tide). The estuarine portions of the subtidal land cover type are also important. Although changes in the location and extent of estuaries could not be quantified, they are qualitatively discussed. The color scheme of the land cover types in all of the following figures are: subtidal- blues, intertidal- reds, uplands- greens/ yellows/ pinks.

Hypotheses on human settlement and land-use are created based on the changes in land cover types over time. The validity of these hypotheses is then tested with archaeological data, including the site distribution in McIntosh County, and the sherd density distributions from
multiple surveys. With the intensive archaeological surveys of Mary Hammock and Patterson Island, this back-barrier area is considered more closely.

**Present-Day**

The first applications of the model were performed on the present-day data, to quantify present landscape details, and create a basis for comparison. In addition, flooding of the present-day mainland was looked to as a proxy to better understand past sea level rise and the flooding of previous coastal mainlands. The assumption is that a future rise in sea level will affect the present coastline in a similar way that past sea level rise affected previous coastlines.

At present, 40% (658.0 km²) of McIntosh County is made up of mainland (Table 5.1, Figure 5.1). Another 55.5 km² is barrier island (Pleistocene and Holocene), and 12.2 km² is marsh island (back-barrier, inter-barrier, and inlet), for a total of 44% of upland surface. These numbers include permanent and intermittent wetland areas that are found within the upland setting, such as streams, ponds, and areas designated as palustrine in the National Wetlands Inventory data. Subtidal area (mostly marine) makes up 31% of the county, with intertidal area making up about 25%. The intertidal area includes landforms that are above the water line at mean lower low tide, but underwater at mean higher high tide, such as un-vegetated tidal flats, salt marsh (8-16 mmhos/cm), tidal fresh/ wet alluvial marsh (2 mmhos/cm), and freshwater swamp (0 mmhos/cm). These salinity values were obtained from the USDA county soil dataset, which expresses salinity in terms of electrical conductivity, in units of millimhos per centimeter (Richards 1954). This is a measure of how conductive water is, with a high conductivity equal to
high soluble salt content. Values of 4 mmhos/cm and higher are considered saline, with values greater than 16 mmhos/cm considered extremely saline.

To completely drown the mainland, six meters of ocean water were added to the model (Figure 5.2). For the most part, the consequences of drowning the present-day coast are fairly obvious (Table 5.1). Upland surfaces will be drastically reduced (to 2.9%), while subtidal areas will increase by more than twice the amount (to 77%). The total intertidal area will only decrease by 78 km², although these areas do not indicate salt marsh, just potential areas where marsh could form. Whether marsh would be able to keep pace with sea level rise or not depends on marsh accretion, which in turn depends on the sediment load of the area, as well as the rate of sea level rise. In addition, it seems that the average patch size would decrease substantially, at least initially. This change in patch size could have a fairly large adverse affect on diversity, biomass, nutrient storage, and species composition, which are all inter-dependant with patch size (Forman and Godron 1986). This indicates that changes in sea level can have adverse affects on the marsh, especially if marsh sedimentation lags behind sea level rise.

A cross-section of the present-day mainland reveals how much sediment could potentially cover the upland surface with a 6-m rise in sea level (Figure 5.3). The lowest elevations on the mainland, many of which have freshwater streams, and/ or are part of the drainage system at present, would become subtidal (seen as dark blue in Figure 5.3b). The highest elevations would be subaerially exposed at low tide (Figure 5.3b), but inundated at high tide (Figure 5.3c), at least initially. As sediment accumulates and marsh accretion occurs, intertidal and even subtidal areas will get covered with anywhere from 5.1 to 0.1 m of muddy marsh sediment (if sedimentation occurs up to the MHHW mark). The cross-section also shows the elevations within former back-barrier areas are not linear (i.e., not higher in the west, and
sloping down towards the east). Shallow depths can just as easily be found close to the mainland (west) as they can close to the barrier island (east). The main finding of this exercise is that the depth of former upland surfaces under present marsh sediment cannot be predicted easily.

A related finding corroborates the idea that marshes in Georgia did not form by a traditional ‘lagoon-fill’ sequence (a shallow body of saline water in the back-barrier area that eventually fills with sediment) (Howard and Frey 1980:119). The former topography was high enough to allow for a large portion of the area behind the barrier island to be intertidal prior to marsh sedimentation, with some areas remaining as uplands.

### Paleoindian and Early Archaic Periods: 12,000-8,000 B.P.

**Results**

Throughout the Paleoindian and Early Archaic periods, sea level was between 30 and 20 mbp (Horton et al. 2009:1731-1732), which left the eastern edge of Sapelo Island between 80 and 45 km away from the coast (Figure 5.4). The entire 1,647.5 km² study area of McIntosh County was mainland uplands at this time, (but this figure includes any permanent and intermittent areas of freshwater wetlands, like streams and ponds that may have been present) (Table 5.2). The present-day back-barrier area was an upland setting, with the present day marsh islands being areas of slightly higher topographic relief. The Altamaha River, which had transitioned to meandering by 15,000 B.P. (Leigh 2006), was in a similar position as today, with its floodplain at the same level as today (Leigh 2008:99). Its channel was larger, with larger meanders, indicating a higher frequency of larger floods at this time, due to a wetter climate.
(Goman and Leigh 2004). While features indicating the former size of the Altamaha are noticeable in the interior Coastal Plain, they are more difficult to discern closer to the present-day coastline. It is possible that these features have been obscured by floodplain aggradation (and subsequent sedimentation) that has occurred due to the rise in Holocene sea-levels (Leigh 2008:99). For the purposes of this study, it is sufficient to note that the area where the freshwater from the Altamaha River meets the saline waters of the present-day ocean, (Darien, GA), would have been between 100 and 60 km away from the coastline during the Paleoindian and Early Archaic periods. This is beyond the influence of saline waters, marine processes, and related phenomena of sea level rise such as floodplain aggradation.

**Hypotheses**

1. The setting of McIntosh County throughout the Paleoindian and Early Archaic periods was that of interior Coastal Plain, so only evidence of non-coastally adapted populations will be found.

2. The archaeological evidence for these populations has very low visibility, with no middens made up of marine and/or estuarine shell (in addition, there will also be no ceramics, and a dearth of lithic material).

**Discussion**

There are only two Late Paleoindian sites in McIntosh county, on the present-day mainland. One site is represented by a lone Dalton point, in association with a light scatter of historic material (Zurel et al. 1975:88). The other site is a multi-component prehistoric site, with a Hardaway blade (Zurel et al. 1975:52). There are also two Early Archaic sites on the present-
day mainland. One is multi-component, with a Greenbrier point (Zurel et al. 1975:45), and the other is represented by a lone Bolen point. No shellfish remains are associated with the lone artifacts, or with the early components of the multi-component sites. No evidence of human occupation from these periods was found on Mary Hammock, Patterson Island, or the other two nearby back-barrier islands (Thompson and Turck 2010). This confirms the hypotheses.

There are other reasons for the lack of sites dating to these periods besides the low visibility of material remains left behind. It is possible that the low number of sites actually represents low populations during these periods. However, the setting must be considered as a major factor in site location and previous settlement patterns. For example, if groups traveled up and down watersheds during the year, as suggested by Anderson and Hanson (1988) for Early Archaic populations, the study area would be about a 20-hour (100 km) non-stop walk to the coast, and a 50-hour walk (250 km) to the Fall Line. With no sources of lithic material in this area, utilization would be expected to be minimal. Any sites located in the area would probably be small, non-permanent, camps, located near the Altamaha River. This is related to the next reason: the possibility that sites are buried deeply. Sites would have been buried under recent Holocene sediment after floodplain aggradation. Some sites could also be buried under Holocene marsh sediment. As mentioned previously, Paleoindian and Early Archaic (as well as Middle Archaic) sites have been found underwater (Blanton 1996; Faught 2004; Stright 1990). This indicates that the continental shelf, exposed during times of lowered sea level, and possibly containing more attractive settlement options (such as a coastline with marsh-estuarine resources) must also be considered as an area of occupation. Finding landforms underwater that have a high probability for the occurrence of sites, either in the form of former shorelines or former river systems, is the initial step in this process (Garrison 1992, 2010; Pearson et al. 1986).
Middle Archaic Period: 8,000 B.P.

Results

At the beginning of the Middle Archaic period (8,000 B.P.), McIntosh County was still entirely mainland upland (Table 5.2, Figure 5.4). Present-day Sapelo Island would have been over 20 km away from the coastline (with sea level at 15 mbp), or as much as 35-45 km away (with sea level at 20 mbp). The distances of Mary Hammock and Patterson Island to the coast were 30 and 35 km, respectively. Although this is still some distance from the coast, it seems that rivers, if present, were within range of the ocean (50-20 km) to undergo floodplain aggradation due to sea level rise.

Traditionally this period has been associated with climate change, (with the onset of the mid-Holocene Climatic Optimum, or Hypsithermal). Today it is believed that the changes in climate were much more variable and time-transgressive than originally thought (Kidder and Sassaman 2009:670; McElrath and Emerson 2009:846). For the most part, it may have been a time of warmer summer temperatures, but with colder winter temperatures (Kerwin et al. 1999). In Georgia, conditions were wetter than today (Leigh and Feeney 1995). Evidence for this is seen in large paleomeander scars along the nearby middle Ogeechee River, which indicate that river discharge was high (Leigh and Feeney 1995). There is no planimetric distinction between these paleomeander scars and those of the terminal Pleistocene, indicating that the moisture regimes of these time periods were similar (Leigh 2008:101). However, this does not necessarily indicate higher levels of effective precipitation (see Leigh 2008:105 for discussion).
Hypotheses

1. Although it was wetter and warmer than today, as well as warmer than the previous periods, the setting was still that of interior Coastal Plain, once again suggesting that no evidence of coastally adapted populations will be found.

2. The archaeological evidence will have low visibility due to no marine and/or estuarine shell middens.

Discussion

In general, the archaeology for this period indicates that the Coastal Plain of Georgia is less populated when compared to the Piedmont, (Elliott and Sassaman 1995:125; Kowalewski 1995; Williams 1994:40, 44-45; Williams 2000:5), and this observation is statistically significant (Turck et al. 2011). There is also a decrease in site density on the Coastal Plain when compared to the previous Early Archaic period, but this decrease is not statistically significant (Turck et al. 2011). These settlement patterns may have to do with the expansion of southern pine communities on the Coastal Plain, which could have diminished resources and decreased the carrying capacity from the previous period (Sassaman 1995:182-183). Unfortunately, no Middle Archaic sites have been found in McIntosh County, including the present-day back-barrier area.

Once again, there are multiple reasons for the lack of sites from this time period: a low population, the low visibility of material remains, the interior Coastal Plain setting, etc. The coastline was somewhat closer at this time, with a non-stop walk of just over 4-hours (>20 km) to the coast. If populations on the interior Coastal Plain preferred swamp margins on terraces overlooking floodplains, (Anderson et al. 1979:92; Elliott and Sassaman 1995:142-144), any such sites along the Altamaha River would have been buried or destroyed under subsequent
floodplain aggradation, in addition to more recent Holocene marsh sedimentation. At any rate, if seems that if sites from this time period are found in the area, they will only reveal information about terrestrial adaptations (see Lewis 2000 for a detailed discussion on this).

**Terminal Middle Archaic Period: 5,000 B.P.**

*Results*

At 5,000 B.P., present-day Sapelo Island, the back-barrier islands, and the mainland were still part of one contiguous landmass, even though sea level had risen high enough for flooding to occur. The present-day back-barrier was dissected with tidally influenced creeks, with areas of lower elevations getting flooded (Figure 5.5). This mainland landmass was fairly large, making up about 68% of the study area (Table 5.2). This is despite the fact that the model uses a fairly low estimate of the former surface under most low marsh (0.6 meters above mean lower low water, or MLLW). While there seems to be a fairly large intertidal area (9.6%) where marsh could potentially form, most of this is on the ocean-side of Sapelo Island. Marsh could not have formed in this area unless there was another barrier island further to the east. This scenario seems likely, given the numerous sets of Pleistocene shoreline complexes known on the present-day mainland. This process most likely occurred throughout the last glacial period as sea level dropped. Then, much like with present-day Sapelo Island, Holocene sea levels rose and met these former shorelines, with Holocene and Pleistocene sediments getting reworked next to, and on top, of each other. This shoreline of Pleistocene and Holocene barrier islands would have protected the areas behind it from wave action, creating a back-barrier environment with
associated marsh. Relict marsh has been found off of the eastern shore of Sapelo Island (Frey and Basan 1981), although it dates to a much younger time period (1,000 to 500 B.P.).

Modern forest and climatic conditions were established by 5,000 B.P., as indicated by pollen assemblages (Leigh 2008:101). However, warmer temperatures (3.5 degrees C warmer than at present) may have continued from the previous period (Jones et al. 2005). River channels were the same size and shape as modern channels (Leigh 2008:101). Meanders were small and similar to the present, indicating that heavy rainfall decreased, which reduced the magnitude of floods and sediment supply (Leigh and Webb 2006). This may have led to channel incision, because the sediment-starved rivers would have required a supply of sediment (Leigh and Webb 2006). With sea levels nearing present levels, marine processes would have had greater affects within the study area. Rising sea levels and “backfilling” of river valleys led to Holocene sediments burying former surfaces within 80-60 km of the present shoreline (Leigh 2008:103).

It seems that the Sapelo River/ Sound and Doboy Sound were inundated with marine water at this time. While past salinity values are not known, today they are considered marine-dominated estuaries, with low freshwater input (Craft 2007:1221). Doboy Sound, which has lower salinity values than the Sapelo River, receives its freshwater from the Altamaha River (Johnson et al. 1974). Another factor is the idea that freshwater from artesian springs fed rivers such as the Duplin (see Walker and Cotton 2001) prior to the lowering of the water table. Although it is not known when these water bodies first formed, it has been suggested that tidal currents enhance and deepen the drainage pattern of the previous landscape (Oertel 1992:79, Oertel et al. 2008:182). Bathymetry data show that paleo-channels extend offshore from these rivers, on the continental shelf. This suggests that they were present at least before 5,000 B.P. It is safe to assume that these channels were present and filled with some combination of fresh and
ocean water at 5,000 B.P. It is possible that the Sapelo River/ Sound received freshwater from the mainland and/or artesian springs, and that Doboy Sound had freshwater input from the Altamaha River. This depends on the past position of drainages, including the Altamaha River, and whether or not they underwent incision and widening.

Hypotheses

1. Coastally-adapted Middle Archaic populations were in McIntosh County by 5,000 B.P.

2. Since all of the upland area at this time was mainland, evidence will be manifest as mainland populations exploiting coastal resources, (comparable to coastally-adapted populations on the mainland during the Late Archaic period).

3. The most likely areas for finding evidence of populations exploiting marsh-estuarine habitats will be on present-day Sapelo Island, as well as in certain areas in the present-day back-barrier area.

Discussion

There are no sites in the study area, or in the entire coastal zone of Georgia, dating to this time. It is interesting that coastal sites dating to the Middle Archaic period have been found nearby in northeast Florida (see Russo 1996), as well as ringing the Gulf Coast (Mikell and Saunders 2007; Ricklis and Blum 1997; Russo 1996). There is even some evidence for year-round coastal occupation at this time (Marquardt 1996; Russo and Quitmyer 1996). Some of these sites with Middle Archaic coastal adaptations have been found inland, at some distance from the present coast. To account for these coastal inland sites, it has been suggested that some
rivers were deeply incised, which allowed estuaries to develop further up rivers even though sea level was lower (Russo 1996:179). As mentioned above, the present-day locations and depths for the Sapelo River/ Sound and Doboy Sound indicate that they existed, and were probably filled with both fresh and ocean water at this time.

As opposed to the previous periods, the lack of sites at this time cannot be readily explained by the model. Although there is not a lot of direct evidence for the idea that a barrier island and/or marsh existed to the east of Sapelo Island, this is not surprising, as such evidence would have been destroyed by rising sea levels within the last 5,000 years. However, the coastline was in close enough proximity to allow for the formation of estuaries, as well as for some amount of intertidal flooding, and possibly even marsh formation, in small areas behind Sapelo Island.

Although there is the possibility that the rate of sea level rise was too fast for the marsh-estuarine system to maintain itself, I argue this was not the case. The average rate of sea level rise during the Middle Archaic could have been around 36 cm per 90 years (as calculated in this study), or could have been as high as 78 cm per 90 years (if sea level was as low as 32 mbp at 8,000 B.P.). These rates are similar to the Intergovernmental Panel on Climate Change estimates for sea level rise of 30-100 cm by the year A.D. 2100 (Meehl et al. 2007). Using the mean scenario (52 cm by A.D. 2100, which is a rate of 52 per 93 years), Craft et al. (2009) determined that future salt marsh area could decline by 20%, and that tidal freshwater marsh could actually increase by 2%. This suggests that the sea level rise rate of 36 cm per 90 years would have had even less of an affect on the past marsh-estuarine system.

Related to this is how salinity levels change with changes in sea level. This is important because salinity levels play a main role in the differences between freshwater and salt marshes.
(Odum 1988). Freshwater is critical to marsh biomass, promoting the accumulation of organic matter, and lowering decomposition rates (Craft 2007). While some freshwater comes from the mainland, most comes from the Altamaha River. Observations have revealed unexpected results, showing that when sea level is higher (e.g., during upwelling), the Altamaha River is more saline, but the back-barrier area is more fresh. This shows that the accretion of organic matter could increase with initial transgression, which is important for the marsh to maintain its elevation, because it may be the only type of accretion during initial transgressions (Reed 2002).

I agree with DePratter (2010:247) and others who suggest that Middle Archaic sites are probably deeply buried. However, this is probably more likely for earlier in the Middle Archaic period (although, terminal Middle Archaic sites are most likely buried deeply underneath Holocene marsh sediment in the back-barrier area). Terminal Middle Archaic sites, with evidence of coastal adaptations, should be seen on the present-day barrier islands, back-barrier islands, and possibly the coastal mainland. These are all potential areas where people could have occupied and left evidence of material remains without those remains getting deeply buried.

As Russo (1996:178) notes, the absence of coastally adapted populations in the archaeological record should not be used as a proxy for unproductive estuaries. I submit that there were estuaries and even small areas of marsh established in McIntosh County by 5,000 B.P. If it is true that populations occupied both riverine and coastal areas year-round (see Saunders and Russo 2010), then it follows that riverine Middle Archaic populations of the interior Coastal Plain of Georgia were more numerous than their counterparts in the coastal zone. In addition, if populations occupied former coastlines beginning in Paleoindian times, (which, in light of this study, may not be the case in Georgia), then it is possible that there could have been an abandonment of the coastal zone during the Middle Archaic period. If changes in sea level and
marsh-estuarine resources in Georgia were not the reason for population abandonment, it is possible that other areas could have been sinks, drawing populations towards them. In an unpublished macro-regional study comparing Georgia and Florida site file data, I noted an increase in site density between the Early Archaic (Figure 5.6) and Middle Archaic (Figure 5.7) periods above the Fall Line in Georgia, as well as in various parts of Florida (along the northeast coast, within the interior, and along the northwest coast). Whatever the reasons may be, the model indicates that the lack of sites within the coastal zone of Georgia during the terminal Middle Archaic period indicate an actual lack of people.

Of course, it is possible that the model is wrong. A change in one of the many parameters that went into its creation (the timing and rate of sea level rise, the timing of marsh-estuarine system formation, and the location and depths of former surfaces) would change the results dramatically. For example, past sea level indicators of 32 mbp (Milliman and Emery 1968) and 5.5 mbp (Horton et al. 2009:1731) could have been used for 8,000 and 5,000 B.P., respectively, instead of the 15 and 3 mbp used in this study. The rate of sea level rise would have been much greater (80 cm per 90 years), and the coastline would have been much further away at 5,000 B.P. In this case, the prediction for the entire Middle Archaic period would be that no coastally-adapted populations will be found in the study area, due to a possible disruption in the marsh-estuarine system, as well as a more distant coastline. There is a rationale for choosing the Gayes et al. (1992) data: it was collected closer to McIntosh County (South Carolina) then the Horton et al. (2009) data (North Carolina). However, it should not be discounted.

Personally, I have always been of the opinion that previous shorelines were occupied by people. However, using the best available data, this study indicates that distant shorelines, and a lack of marsh-estuarine resources, may not have been factors in the lack of terminal Middle
Archaic sites in McIntosh County. This idea is plausible, and needs to be evaluated further. This underscores the need for highly detailed (both spatially and temporally) paleoenvironmental data. Information on the exact timing of riverine/estuarine formation, as well as their changing size and position over time, is needed. Previous topography and sedimentation rates for marshes are also needed. Most importantly, relative sea level history for each specific coastal area needs to be obtained.

Late Archaic Period: 4,200 B.P.

Results

It was around 4,200 B.P. that sea level rose high enough for McIntosh County to become a coastal setting similar to today (Figure 5.8). Sea level was still over a meter below present levels, but the tidal range was large enough to cover most of the present-day back-barrier area, at least at high tide. Scott et al. (1995:621) suggest that this highstand was a delayed response to the 4 degree C global warming event that occurred prior to 6,000 B.P. (Houghton et al. 1990). However, a recent study by Jones et al. (2005), suggests that summer-autumn temperatures were on average 3.5 degrees Celsius higher than today. There was a large increase in intertidal area during the Late Archaic period, making up almost 24% of the study area (Table 5.3). This is close to the modern-day landscape percentage of about 25%.

The main water bodies of the Altamaha River, Doboy Sound, Sapelo Sound, and the Sapelo River were most likely in similar positions as today. Rising sea level flooded the Altamaha River delta at this time, increasing salinity and causing tidal fresh marsh and
freshwater swamps (if present) to move up the drainage. Most freshwater in Doboy Sound was probably supplied by the Altamaha River at this time (as it does today).

Marsh sediment filled in the areas of lower elevation, creating numerous islands by choking off areas of higher elevations from the mainland. This was the first time that the various marsh islands, and Sapelo Island as well, were separate entities from the mainland since their initial formation. Mary Hammock, Little Sapelo Island, Fishing Hammock, and Pumpkin Hammock were all part of a single back-barrier island (~2.9 km²) at this time. Jack Hammock was only separated from this landmass by about 145 m of high marsh. The upland portion of Patterson Island was 0.6 km², larger than at present (0.2 km²), and probably included Little Patterson Island as well. Present-day Kittles Island, Rotting Vulture Hammock, and April Hammock were all connected to each other, as well as to the mainland, at this time. Marsh islands made up about 1.7% of the total area, which is more than two times larger than their present extent (0.7%). Harris Neck, which is a relict barrier island dating to the Princess Anne formation, and is today considered a marsh island, was actually a peninsula at this time, with the northern section still connected to the mainland.

Blackbeard Island had not formed yet, and no evidence for marsh has been found east of Sapelo Island dating to this time. Sea level was high enough to submerge the whole area in marine water. There is a possibility that Holocene sediment dating to this time was present, in some form, east of Sapelo, as previous barrier islands rolled over and migrated landward. Evidence of this has not yet been found, and could have subsequently been eroded away or re-worked.
Hypotheses

1. Coastally-adapted Late Archaic populations occupied various parts of McIntosh County.

2. Blackbeard Island will have no evidence of human occupation from this time, as it had not developed yet.

3. The human occupation of Mary Hammock was related to Little Sapelo Island, Fishing Hammock, Pumpkin Hammock, and maybe even Jack Hammock, as these were all part of one large landmass.

4. The human occupation of Patterson Island was that of a coastally-adapted island population, with possible ties to people on the mainland.

Discussion

There are 89 Late Archaic sites in McIntosh County. This is commensurate with the rest of the Coastal Plain of Georgia, which was found to have significant increases in density between the Middle and Late Archaic periods in every physiographic district (Turck et al. 2011). This is actually a region-wide phenomenon, with population growth occurring throughout the Southeast (Anderson 1996; Kidder and Sassaman 2009:677), with coastal zones becoming major areas of settlement (Kidder and Sassaman 2009:677).

In Georgia, the intensive settlement of the coastal zone has been linked to the establishment of the marsh-estuarine system (DePRatter 1977a; DePratter and Howard 1981:1289; Thompson and Turck 2009). The present-day marsh-estuarine system is one of the most productive environments in the world (Johnson et al. 1974:82). It has been argued that the establishment of a similarly productive marsh-estuarine system during the Late Archaic period
led to sedentary populations (DePratter and Howard 1980). It is certain that marsh and estuaries formed in McIntosh County at this time, as indicated by the numerous sites (38) on or near the border of the marsh that are associated with shell middens, mounds, rings, and (possible) shell scatters.

These coastal Late Archaic populations were sedentary. Specifically within the study area, isotopic evidence of year-round occupation has been found at the Sapelo Island Shell Ring Complex (Thompson and Andrus, in press). Ring II and Ring III were found to have had year-round occupations, while Ring I (the largest ring) did not (Thompson and Andrus, in press). In addition to this, Thompson (2006, 2007:100) found occupational midden (with high sherd concentrations and low shell density) between high concentrations of shell at Ring III, suggesting this ring formed with the gradual accumulation of domestic debris. While it has been suggested that shell rings formed from ceremonial activities like feasting (Kidder and Sassaman 2009; Marrinan 2010; Russo 2004, 2010), others believe that there is not yet sufficient evidence to indicate whether ceremonialism was a part of shell ring deposition (DePratter 2010; Marquardt 2010). It has also been suggested that shell rings can form due to both habitation and ceremonial activities (Russo 2004; Thompson 2007). Thompson (2007:92) proposes the “developmental model” of ring formation, stating that initial ring formation is within a domestic setting, but can eventually become more ceremonial.

As noted above, the model indicated that marsh and estuaries may have formed earlier, at the end of the Middle Archaic period. Coupled with the absence of sites dating to that period, I suggested that there was an absence of coastally-adapted Middle Archaic people, at least in the study area. The implication for the Late Archaic period, is that the explosion of sites in the coastal zone of Georgia may have been due to a colonizing group of people, who migrated in
from some other area (e.g., the Georgia piedmont, the interior Coastal Plain, along the Savannah River, or even Florida), and then became sedentary, presumably with the utilization of coastal resources. This is not a new idea, as Crook (2009:81-83) and Crusoe and DePratter (1976:13) have suggested that these sites represent a group which moved to (or colonized) the coast from an inland location. Although these results of the model are speculative, they can be tested with future archaeological and geomorphological studies.

Although the entire county is considered to be part of the coastal zone, there does seem to be differences in occupation between the mainland interior and areas that are directly adjacent to marshes and/or estuaries. In the Big Mortar-Snuff Box Swamp Watershed survey, Zurel et al. (1975:107) noted that 160 of the 171 sites found were inland from the coast/salt marsh, in the freshwater swamp-forest. For the most part, artifact density is low, with 80% of the sites having less than 10 artifacts (Zurel et al. 1975:107). Most sites with larger amounts of artifacts are made up of multiple, non-contemporaneous components (Zurel et al. 1975:107, 118). The conclusion is that these sites represent brief occupations by small numbers of people, who came to the area seasonally to exploit specific resources, but resided elsewhere (Zurel et al. 1975:118).

Zurel et al. (1975:6) also find that human occupation in the watershed was restricted to the high areas with better-drained soils (low ridges and knolls) found within the low-lying flatwood plain area. The low, wet areas of swamps and depressed flats seem to have little evidence of past human use (Zurel et al. 1975:5), as confirmed in a surface survey of similar areas in nearby Glynn County (Zurel et al. 1975:134). Grover (1996) and Gover et al. (1997) also confirm this. In a survey of part of the Townsend Bombing Range (447.6 ha), there were only three positive shovel tests out of 2,748, each with one prehistoric artifact. In the rest of the
survey (a 1,366 ha area), there were only 22 positive shovel tests out of 2,794, and only 11 prehistoric sites were designated (Grover et al. 1997:60).

Specific to the Late Archaic period, only one Late Archaic period site, with four fiber tempered sherds, was found in the Townsend Bombing Range survey (Grover et al. 1997:33). This results in a very low sherd-to-survey area density of 0.02 sherds per 10 ha (see Figure 5.9, which is a bar chart of Tables 3.9 to 3.11). Although 37 Late Archaic sites with 318 fiber tempered sherds were found in the Big Mortar-Snuff Box survey (Zurel et al. 1975), the sherd density (5.95) is similar to Pumokin Hammock (Figure 5.9).

This is in stark contrast to the Julianton Plantation survey on the southern portion of Harris Neck. Although part of the mainland during the Late Archaic period, as mentioned above, it was a long peninsula within the marsh. Within a 526.1 ha area, 54 sites were found, two of which were known previously (Elliott 2008:122, 135). Twenty seven sites were designated to the Late Archaic period, with a total of 184 fiber temper sherds found (Elliott 2008:123). This was the most common type (by weight) of prehistoric ceramics found in the survey (Elliott 2008:123), for a sherd density of 3.5 (Figure 5.9).

On the present-day extent of Mary Hammock, no evidence of Late Archaic occupation was found. This is surprising, considering Late Archaic material was found on Little Sapelo Island and Pumpkin Hammock (Thompson and Turck 2010), as well as Jack Hammock. It is possible that a Late Archaic occupation could have focused around the northern or northwestern edge of the landform, which is close to the present-day extent of Mary Hammock. This would be similar to Pumpkin Hammock, where only two Late Archaic sherds were found in two shovel tests on the island, but 42 sherds were found along the eastern edge, eroding into the Duplin River (Thompson and Turck 2010). However, no evidence of human occupation was found
eroding out of the creek banks north of Mary Hammock (where the tree stumps were found), or in the sediment cores. This suggests that during the Late Archaic period, there was something unattractive about Mary Hammock, as far as human settlement is concerned. It is uncertain if the location of resources is a factor in the observed pattern. In a recent study of the Duplin River, oyster beds were found in abundance along the margins of the marsh (Walker and Cotton 2001). Many oyster beds were also noted in the Duplin River, Doboy Sound, Tea Kettle Creek, and New Tea Kettle Creek in the 1890s (Drake 1891) and 1970s (Johnson et al. 1974). No beds were found in Mary Creek, directly north of Mary Hammock. It seems possible that the distance of this part of the landmass (present-day Mary Hammock) to oyster beds made it unsuitable as a home base. As Meehan (1982) notes for Australian hunter-gatherers, distance of the home base to shell beds is a factor in shell gathering. Similarly, this area would not accumulate shell refuse as dinnertime camps (Meehan 1982), due to the lack of shell beds in the area.

On the surface, evidence from Jack Hammock seems to refute this idea. Although there are also no oyster beds nearby, one Late Archaic sherd has been found in the shoreline survey of minimal-coverage (suggesting that more could be found with a shovel test survey). The model does not predict this, showing an even greater distance between Jack Hammock and the closest oyster beds (in the Duplin River) than between the vicinity of Mary Hammock and the closest oyster beds. The model also shows that people on Jack Hammock would not have been able to walk to any oyster beds, because they were separated by marsh. Again, it is possible that the model is incorrect. A map of the area drawn in A.D. 1760 by Yonge and DeBrahm shows that to the north of Pumpkin Hammock, the Duplin River may have forked to the west, running alongside Jack Hammock. This not only would have made access to Duplin River oyster beds easier, but it is also possible that oyster beds were available very close to the hammock.
On Patterson Island, the large number of positive shovel tests and ceramics dating to the Late Archaic period, and covering a large portion of the island, suggests that it was intensively utilized at this time. There was a more intensive utilization of, or a greater number of people on, the island at this time than on any other nearby marsh island (Thompson and Turck 2010). Patterson Island has a higher sherd density (26.35) during the Late Archaic period than any other survey area (Figure 5.9). Although barrier islands are thought to contain large and sedentary populations (Thompson and Turck 2009:269), the fairly large extent of Late Archaic remains here suggests that this island may have had a more intense utilization and/or occupation, relative to the amount of space.

The locations of the back-barrier islands in relation to the mainland and Sapelo Island may be a factor in this pattern. Little Sapelo Island and Pumpkin Hammock, which are close to Sapelo Island, have sherd densities that are only slightly higher than that of the representative barrier island (St. Catherines Island). By extrapolating the sherd density data from St. Catherines Island to Sapelo Island, it seems that the back-barrier islands close to Sapelo Island had only a slightly more dense occupation than Sapelo Island. Coupled with the fact that Sapelo Island had year-round occupation (Thompson and Andrus 2011), this suggests that the nearby back-barrier islands were occupied year-round, possibly by people who were in some way affiliated with the group(s) on Sapelo.

I argue that the population on Patterson Island was affiliated with the people on the mainland. Further, the intense utilization and/or occupation of Patterson Island is in such contrast to the small, dispersed, and possibly seasonal, occupations of the mainland, it is possible that Patterson Island was more-or-less permanently settled at this time by people who also utilized the mainland. I suggest that groups on Patterson Island, the Julianton Plantation, and
other upland landforms in close proximity to the mainland and with access to marsh-estuarine resources, were part of one similarly-adapted social group that spent most of their time on the coast, but ventured into the mainland to utilize freshwater resources.

**Late Archaic Period: 3,600-3,100 B.P.**

*Results*

After 4,200 B.P., the rising sea level reversed course, and dropped to 3.15 mbp by 3,600 B.P. (Gayes et al. 1992), and to 3.50 mbp by 3,100 B.P. (discussed in Chapter 4). This corresponds to data from western North America, which shows that temperatures fell, glaciers advanced, and westerly winds were exceptionally strong between 4,200 and 3,800 B.P. (calibrated) (Mayewski 2004:250). It is not certain if this relates to the study area, because Scandanavian ice remains static at this time, and glaciers in Europe actually retreat (Mayewski 2004:250). In addition, oxygen isotope evidence suggests that the summer-autumn water temperatures were 3.5 degrees C higher than today in Florida between 5,500 and 3,600 B.P. (uncalibrated). The relationship between paleoclimate studies and sea levels will be discussed later.

According to the best available sea level data (Gayes et al. 1992), much of the county (68.5% at 3,600 B.P. and 68.9% at 3,100 B.P.) reverted back to an upland setting (Tables 5.3 and 5.4). Only 10.6% and 10.3% of the county was intertidal at these two times, and most of this was located to the east of Sapelo Island (see Figures 5.10 and 5.11). According to the model, the amount of marsh sedimentation that occurred during the 4,200 B.P. high stand left the marsh
surface at an elevation that was too high for tidal flooding. In addition, this former back-barrier region had considerably less area at the proper elevations (i.e., intertidal area) where new marsh sedimentation could occur.

Another important factor is sediment budget. Thompson and Turck (2009) showed that settlement persisted in the deltaic regions of the Georgia coast during the Early Woodland period. While they suggest that fresh water supplied by major rivers may play a role in this pattern (Thompson and Turck 2009:270), the main factor is actually the sediment that these rivers supply (mentioned briefly by Thompson and Turck 2009:270). Rivers supply suspended sediment to deltaic areas, resulting in high rates of organic and inorganic accumulation, which can lead to marsh progradation during sea level regression (Reed 2002:238). Since the study area is a non-deltaic area, it follows that there was not enough sediment input to the system to allow for much marsh progradation to occur on the elevations that were flooded intertidally. All of these factors combined to cause a disruption in marsh productivity in the back-barrier area.

Former marsh islands retained their upland vegetation, while other vegetation zones shifted east with the falling sea level and changes in soil properties. As salinity levels lowered, the organic soil of the former marsh would have been ideal for the establishment of upland vegetation. Although much of the area was upland, it would have been dissected by old tidal creeks. Some of the larger and deeper creeks remained subtidal, while others became intertidal, only getting inundated at high tide.

On the seaward side of Sapelo Island, the antecedent topography, including any barrier islands that may have formed prior to 4,200 B.P., was smoothed by wave-dominated processes during the 4,200 B.P. high stand (see Oertel et al. 2008:182). Again, the lack of sediment in this non-deltaic area means that no protective barriers to the east of Sapelo Island would have
formed, and that marsh formation could not have occurred. Although the model shows that a large amount of intertidal area was on the east side of Sapelo at both 3,600 and 3,100 B.P., most of this area was not estuarine intertidal, but marine intertidal (beach).

The one exception to this is near the northeast section of Sapelo Island, near the western edge of present-day Blackbeard Island. As mentioned in Chapter 4, marsh began forming here after 3,560 B.P., but before 2,900 B.P. This suggests that a protective barrier had also formed, but when and where is unknown.

Hypotheses

1. Use of marsh-estuarine resources decreased in the last half of the Late Archaic period throughout the coastal zone of McIntosh County.
2. Coastally-adapted populations will not be found on the back-barrier islands or most areas of present-day Sapelo Island.
3. A small population utilizing marsh resources will be found on the northeast coast of Sapelo Island, dating to the very terminal Late Archaic period.

Discussion

As mentioned previously, there are 89 Late Archaic sites in McIntosh County. Unfortunately the dating of most of these sites is by sherd type, so the exact timing of their occupation is not known. If any of these sites were occupied between 3,600 and 3,100 B.P., their setting would have been in an upland-vegetated mainland dissected by some of the deeper tidal creeks.
The transition from the Late Archaic period to the Early Woodland period was variable throughout the southeast, with multiple causes of change (Kidder and Sassaman 2009:682). The change has been described as gradual, with cultural continuity, or punctuated, with Early Woodland people replacing Late Archaic populations (see Kidder and Sassaman 2009:681). The timing of this transition was also variable, as noted in a recent publication devoted to the subject (Thomas and Sanger 2010). In the middle Savannah River valley, Stallings Island and surrounding riverine sites were abandoned around 3,800 B.P., but most likely relocated elsewhere (higher up the Savannah River, and possibly even to the coast) in a more dispersed settlement pattern (Sassaman 2010:230-231). This pattern continued in the Early Woodland period, with few large sites, but many small sites towards the headwaters of tributary streams (Sassaman 2010:230-231). A somewhat similar reorganization was seen in the Middle St. Johns River of northeast Florida. The area was not abandoned, but the construction of shell works was suspended around 3,900-3,800 B.P. (Sassaman 2010:230-233).

On the coast of northeast Florida, shell rings and mounds were no longer built after 3,700 or 3,600 B.P. (Russo 2010:155). In fact, coastal sites of any size are “virtually unknown” north of Canaveral between 3,500 and 2,500 B.P. (the so-called Transitional period) (Russo 2010:167). Russo (2010:155) views this as an “abandonment of the traditions of large-scale monumental construction” due to a reduction in population.

Closer to the study area, Thomas (2010:184) notes a gap in the $^{14}$C record of St. Catherines Island, with only eight of the over 150 marine shell $^{14}$C dates falling between 3,300-2,150 BP. Since most of the $^{14}$C dates are obtained from shell, Thomas (2010:184) makes a good point that the lack of dates indicates a hiatus in shell midden deposition. This is all the more compelling, considering the shell-centric research design on St. Catherenes Island, with a survey
that was aimed at locating shell deposits (Thomas 2008b:304). If there were many shell deposits on the island, they would have been found and dated. Applying a reservoir correction to such marine samples can introduce various problems (DePratter 2010:250), making it unclear how the dates between marine and terrestrial samples correlate with each other. At the very least, the general time frame for the hiatus in shell midden deposition occurred towards the end of the Late Archaic period, and lasted throughout the Early Woodland period.

Sanger (2010) has posed the idea of three waves of southeastern shell ring abandonment based on changes in sea level (4,400-4,090 B.P., 4,070-3,810 B.P., and 3,800-3,550 B.P.). At present, the data are not detailed enough to support this idea, with multiple examples of shell rings that do not meet the expectations for abandonment (Sanger 2010). In addition, there seem to be discrepancies with some of the dates reported (compare the Sapelo Shell Ring 1 and 3 dates to the original dates in Thompson 2006:183, 2007:100). A much more detailed study is needed, where detailed data on the elevation of the base of shell rings and middens are related to the present-day tidal range, and then compared to detailed changes in sea level.

As Marquardt (2010:266) notes, another way of characterizing shell rings is to state when they were no longer in use. Construction ceased at the St. Catherines Shell Ring around 3,950 B.P., and at the McQueen Ring about 3,900 B.P. (Sanger and Thomas 2010:66). Shell construction completely ceased at both shell rings by 3,750 B.P. (Sanger and Thomas 2010:67). The $^{14}$C date range for Ring 1 on Sapelo Island is 4,249-3,826 B.P. (based on two dates), and for Ring 3 is 4,249-3,690 B.P. (based on three dates) (Thompson 2007:100). The $^{14}$C dates from the St. Simons shell rings reported by Marrinan (2010:81) were calibrated using the standard marine calibration curve (Marine09) of Calib 6.0.0, and the delta R value of -134 +/-26.0 from St. Catherines Island was applied (Thomas 2008d:359). The results indicate that the upper midden
of the West Ring was deposited sometime between 3,963 and 3,393 B.P., and Cannon’s Point was between 4,141 and 3,627 B.P.

In Georgia then, the cessation of shell deposition at shell rings (which may or may not include abandonment) could have occurred any time from 3,950 to 3,393 B.P. This supports the results of the model, which show that lowering sea level would have reverted most of the back-barrier marsh to upland vegetation/ mainland by 3,800 B.P., when sea level was 2.5 mbp. That cultural change occurs in various populations of the coastal zone and coastal plain of Georgia and Florida at the same time (3,800-3,300 B.P.) cannot be a coincidence. Sassaman (2010:235) makes a good point that these cultural changes may be due to environmental changes, but can also be due to the links between these societies. While changes in climate can “shape” or “accelerate” cultural changes (see Rodning 2010), when groups are connected regionally, cultural changes in one area could affect interactions over the rest of the region, whether environmental change was occurring in all of these places or not.

The drop in sea level, and concomitant reduction in marsh area proposed by the model, must have been factors in this cultural change, at least in the immediate study area. Thompson (2007:103) found less-dense Late Archaic occupations (based on sherd count) outside of the Shell Rings on Sapelo. Thom’s Creek-like sherds and a $^{14}$C date of 3,391-3,144 ($p = 0.995$), indicate that this occupation occurred after the shell rings were occupied (Thompson 2010:100, 104). The sooted Late Archaic sherd from Patterson Island was dated to 3,688-3,450 B.P. This date range falls directly in between the occupation of the Sapelo Shell Rings and the occupation outside the rings. Less intense Late Archaic occupations also occurred elsewhere on St. Catherines Island, after the shell rings were no longer occupied. At site 9LI137, dates of 3,640-3,470 B.P. and 3,540-3,290 B.P. were obtained on $M. mercenaria$ associated with 16 Refuge
plain and eight St. Simons plain sherds (Thomas 2008f:547). At site 9LI197, a $^{14}$C date of 3,430–3,000 was obtained on *M. mercenaria* associated with two St. Simons plain sherds (Thomas 2008f:567). Shovel testing on St. Catherines Island also located three Late Archaic sites with fiber tempered pottery and no marine shell (Thomas 2010:189). This evidence indicates not a total abandonment of present-day McIntosh County at the end of the Late Archaic period, but probably a depopulation and/or reorganization. That is, there is continued occupation, but in varying forms.

The lack of shell must also be considered. In the Patterson Island shovel test where the sooted sherd was found, only a small amount of shell (1.2 kg) was found in the first 10 cm of this shovel test, (and was too light to be considered a shell midden). A small (3.7 kg) Irene/Altamaha sherd was also found in this test. Coupled with the fact that this shovel test was probably in a disturbed area, I interpret the small amount of shell in the upper 10 cm to be associated with the Irene/Altamaha sherd, and not the Late Archaic sherds. In addition, 15 of the other 19 shovel tests with Late Archaic sherds had no shell midden (for a total of 16 shovel tests, with 42 sherds at 478.5 g). This suggests that most of the Late Archaic occupation on Patterson Island may have been toward the last half of the period, by a non-shell depositing population. This goes against the assumptions of the model, which predicts a more intensive occupation during times when marsh-estuarine resources are plentiful. Of course it could also mean that Late Archaic sherds and shell were deposited differentially. More detailed archaeological data are needed, including the precise timing of the initial settling and abandonment of sites.

While no intensive surveys have been performed on Sapelo Island, two “test units” were studied in the northeast part of the island (McMichael 1977). These test units were 14,400 m² in area, with 10 posthole tests dug along one of the diagonals of the unit (McMichael 1977:187).
Shell middens were found in both of these tests units, but only Late Mississippian and Historic Contact period pottery was discovered (McMichael 1977:188). Unfortunately such a small survey is not sufficient enough to test the hypothesis regarding a possible marsh occupation on the northeast end of Sapelo. A survey in this area would be a productive direction for future work.

One of the main factors in determining when the back-barrier area reverted to uplands is marsh sedimentation. Since no evidence of a former marsh was discernable in the sediment cores, the elevation of 1.9 ma MLLW was used for all low marsh, simulating the height of the marsh surface after sedimentation occurred at 4,200 B.P. This flat value was used across the entire county, even though surface elevations are known to fluctuate within the marsh. In addition, if the tidal range was different at 4,200 B.P. than it is today, or if marsh sedimentation did not accumulate in relation to MHHW as it does today, the results of the model would be different, possibly with more potential area for marsh formation.

On the other hand, if the tidal range stays the same before and after a drop in sea level, it is safe to say that back-barrier areas that have undergone marsh sedimentation will be most adversely affected with sea level lowering. No matter the level of sedimentation, and no matter the drop in sea level, the former marsh would always be at a height that is too high to be intertidal. There would only be very small areas at the proper elevation to become intertidal, mostly in tidal creeks or at the edge of marshes. The probability for marsh formation would be very low, whether in a deltaic area or not. As mentioned previously, whether marsh formed on the seaward side of the barrier island would depend on, among other things, sediment load. For any given coast, there are multiple factors relating to marsh-estuarine formation in multiple settings. Each specific setting in each specific area needs to be looked at separately.
Early Woodland Period: 3,100-2,400 B.P.

Results

As mentioned in Chapter 4, the model assumes that sea level continued dropping in the Early Woodland period, reaching 3.5 mbp at 3,100 B.P. (interpolated), and 4.0 mbp at 2,700 B.P. (DePratter and Howard 1981). As is expected with falling sea level, mainland area increased to 71% by 2,700 B.P (Table 5.4). Unexpectedly, intertidal area increased slightly to almost 14% of the study area. This is due to the fairly gentle slope of the continental shelf. As sea level lowered, more area east of Sapelo Island was exposed that was at the proper level for intertidal flooding (Figure 5.12). As with the previous period, most likely there was no barrier island to protect this intertidal area, making it marine intertidal. Also of interest is the eastern coastline of Sapelo Island, which was between 1.5 and 2.0 km away from its present position. This actually would have been the coastline of the mainland at this time, as most of the back-barrier area reverted to upland.

It is difficult to interpret the salinity levels of Sapelo Sound/ River and Doboy Sound at this time. The channels seem to be deep enough to remain subtidal, but it is unclear how far up these estuaries ocean water would have traveled. The fact that this area was an upland setting with little-to-no marsh suggests that Sapelo Sound/ River and Doboy Sound were probably low-salinity estuaries.

Between 2,700 and 2,400 B.P., (the terminal Early Woodland period) sea level rose rapidly (one meter every 100 years), reaching slightly higher than the former Late Archaic height (about 1.0 mbp at 2,400 B.P.) (Figure 5.13). During the initial stages of transgression, marsh accretion rates are diminished, and this can lead to the deterioration of marshes (Reed 2002:239,
This is especially true in the face of rapid sea level rise. Although the model calculates that intertidal area was present within these 300 years, the potential for marsh accretion would have been greatly reduced. Overall, the model predicts that there was almost no marsh formation in McIntosh County between 3,800 and 2,400 B.P. As during the terminal Late Archaic period, the one exception to this is near the northeast section of Sapelo Island. By 2,900 B.P. both marsh and a protective barrier had formed here (Turck and Alexander 2011).

**Hypotheses**

1. Most populations in McIntosh County did not use marsh-estuarine resources throughout the Early Woodland period.
2. Occupation should be fairly even-spaced across the county, because most of the area was contiguous mainland.
3. Coastally-adapted populations will not be found on the back-barrier islands.
4. A small population utilizing marsh resources will be found on the northeast coast of Sapelo Island.

**Discussion**

Trends noted at the end of the Late Archaic period continued during the Early Woodland period. In general, it is the disruption of marsh and/or estuarine resources that has been cited as the cause for the lack of Early Woodland sites in the coastal zone (DePratter 1977a; Thompson and Turck 2009). Settlement does persist in deltaic areas of the coast (Crook 2009; DePratter 1976; Thompson and Turck 2009:270). As mentioned above, this is related to available sediment load. Some populations continued a coastally adapted lifestyle by following the lowering sea
level (DePratter and Howard 1980, 1981), but only in deltaic areas, where sediment would have contributed to marsh progradation. Thompson and Turck (2009) found that populations in non-deltaic areas decreased, suggesting that they became more mobile and possibly even abandoned those parts of the coast.

This pattern is seen in the non-deltaic McIntosh County, with only 25 sites dating to the Early Woodland period. Most of the county was a mainland setting at this time, so the occupants at these sites should have had a similar pattern of settlement (meaning, sherd densities should be fairly even across all survey areas). This is not the case, with Mary Hammock having the highest Early Woodland sherd density (3.85) (Figure 5.9). This is interesting, because no evidence for a Late Archaic occupation was found on Mary Hammock. The model shows that Mary Hammock went from being part of a fairly large back-barrier island at the beginning of the Late Archaic period, to being part of the mainland as early as 3,800 B.P. (halfway through the Late Archaic period). Since there was no occupation on Mary Hammock (or, this portion of McIntosh County that was to eventually become Mary Hammock) until 3,100 B.P. at the earliest, this suggests that the Early Woodland occupation was not related to changing sea levels.

The high sherd density on Mary Hammock may be related to its close proximity to Doboy Sound. As mentioned above, Doboy Sound may have been a partly-saline estuary at this time. However, the main factor concerning human settlement of the area is marsh. Intertidal marshes provide juvenile fish and macrocrustaceans protection from predators (Hampel et al. 2003:286). In addition, marsh detritus goes into tidal streams, entering the food chain, and eventually leads to fish moving in to feed on marsh invertebrates (Hampel et al. 2003:287). Thus, marsh functions as nurseries for juvenile fish and macrocrustaceans, providing them with better growth conditions (Hampel et al. 2003:286). The model does retrodict a very limited amount of
intertidal area along certain margins of Doboy Sound and nearby tidal channels in the present-day back-barrier area. It is feasible, then, that small areas of marsh could have formed, and that some estuarine species utilized by humans could have also been present (although most likely in low abundance). One shovel test on Mary Hammock and one on Patterson Island have both Early Woodland sherds and shell midden deposits. This indicates that shellfish may have been available in the area of Doboy Sound during the Early Woodland period. More detailed archaeological data (specifically through excavations) are needed, as well as detailed data regarding the position of former Late Archaic marsh surfaces. In contrast to this, the northeast coast of Sapelo Island is in need of an archaeological survey to evaluate the hypothesis that there was an Early Woodland occupation utilizing the marsh resources in this area.

One potential problem with this analysis is the difficulty in recognizing sites that date to the Early Woodland period (DePratter 1976:2). Related to this is that some ceramic types (Refuge plain and simple stamped) are present throughout the Early and Middle Woodland periods (DePratter 1991:9, 11). As seen in Figure 5.9, Patterson Island has the highest Early/Middle Woodland sherd density (9.33). As noted previously, the sherds from these two periods are put into one Early/Middle Woodland category on St. Catherines Island (see Thomas 2008c:412), which can be more accurate, but it also removes more subtle patterns.

Radiocarbon dating can be used to get at the distinction between these two periods. On St. Catherines Island, there are six $^{14}$C dates (four from shell samples and two from charcoal samples) from four sites (9LI26, 46, 47, and 173) with Early and Middle Woodland ceramics that date to between 3,190 and 2,370 B.P. (the Early Woodland period) (Thomas 2008c:408-409). There are nine dates (eight from shell samples and one from a charcoal sample) from four sites (9LI15, 47, 173, and 228) with Early and Middle Woodland ceramics that date to between 2,290
and 1,510 B.P. (the Middle Woodland period) (Thomas 2008c:408-409). Although the pottery types at these sites are sometimes mixed (including with earlier Late Archaic types), there are distinct occupations dating to both the Early and the Middle Woodland periods. Two of these sites (9LI47 and 173) have $^{14}$C dates from both periods, indicating possible continuities or connections between the Early and Middle Woodland periods. More $^{14}$C dating like this is needed to sort out the details of Early and Middle Woodland occupations, if not the ceramic chronology.

Thomas (2010:184) notes that the $^{14}$C dates on St. Catherines Island, or rather, the lack of dates, indicate that at the very least, the population was low between 2,950 and 2,150 B.P. (during the Early Woodland and early Middle Woodland periods). There seems to be a discrepancy with this though, as most marine shells that were found in association with Early/Middle Woodland ceramics had $^{14}$C age estimates that were much younger than the ceramics (Thomas 2010:185). Possible factors involved in this observation include problems with the ceramic chronology, re-use/ incorporation of old ceramics by later people, disturbance/ mixing of older and younger deposits, problems with the delta R correction, etc. While there are both Early and Middle Woodland sites associated with shell, exactly what this association means needs to be investigated.

This is in contrast to the deltaic area of the Savannah River. The Delta site, located on the South Carolina side of the river, dates to about 3,000-2,800 B.P. While over 99% of the sherds in the undisturbed midden were Refuge phase ceramics, there were also four Late Archaic, fiber tempered sherds. Floral and faunal remains indicate that the inhabitants exploited multiple environments, including upland forest, freshwater river, and estuarine habitats (Crook 2009). In fact, estuarine oyster made up around 74 - 79% of the undisturbed shell midden, which was over
three meters thick (Crook 2009:33, 51). The freshwater eastern elliptio made up 21-26 % of the midden (Crook 2009:51). At 2,900 B.P., the distance to the shoreline on the Georgia side of the Savannah River would have been about 20 km (see DePratter and Thompson 2011), while the distance to the shoreline on the South Carolina side was probably shorter (~15km). This shows that either people were traveling fairly long distances to exploit different habitats, or that estuarine resources were available further up the river (probably on the South Carolina side).

An example from a deltaic barrier island closer to the study area has slightly different findings. Marrinan (2010) found a cultural level dating to the Early Woodland period beneath the present-day marsh on the east side of St. Simons Island. A date of 3,080-2,750 B.P. (calibrated using CALIB 6.0.0), was obtained on carbonized material (sample UM-518) found in association with faunal material, fiber tempered pottery, and sand tempered pottery (Marrinan 2010:80-81). A sample (UM-519) from a tree stump that was “paired” with the above charcoal sample was dated to 3,164-2,732 B.P. (calibrated using CALIB 6.0.0) (Marrinan 2010:80-81). Ceramic evidence indicates a transition from the Late Archaic period to the Early Woodland period, with fiber tempered, fiber and sand tempered, and sand tempered pottery (Marrinan 2010:97). There was a very high frequency of fiber tempered sherds that also had sand temper (Marrinan 1975:61), and apparently even one grit tempered sherd with the typical Late Archaic drag-and-jab decoration. Faunal remains include species from multiple environments, including uplands (deer, raccoon, opossum, dog, cottontail rabbit, and rodent), freshwater (bowfin, Lepisosteus spp., chicken turtle, eastern box turtle), freshwater-to-brackish (common snapping turtle, alligator), brackish (diamondback terrapin), and brackish-to-marine species (gafftopsail catfish, black drum, red drum, Atlantic croaker, Archosargus spp., and Paralichthys spp.) (Marrinan 1975:71-73). The only floral remains recovered were hickory nutshells (Marrinan 2010:97). The
$^{14}$C dates indicate a definitive Early Woodland occupation. The ceramics indicate that there was cultural continuity between these occupants and the previous Late Archaic period. The faunal and floral remains indicate that these Early Woodland inhabitants utilized a large range of environments.

The position of the tree stump and the timing of its demise are of critical importance to understand former coastal environments and changes in sea level. According to Marrinan (1975:49) the stump was found at 61 cm below the present marsh surface, with an associated cultural level between 60 and 80 cm (Marrinan 2010:77). The sample of carbonized material (UM-518) was found in a different unit, between 67 and 87 cm below the present marsh surface (Marrinan 1975:49). Even if the former living surface that the tree was on was as low as 87 cm below the modern marsh, sea level was too low at this time to actually have encroached “on the high ground,” killing the tree (Marrinan 2010:80). If the original Gayes et al. (1992) sea level curve is correct, the highest tides would have only possibly begun to reach the roots of the tree by 2,700 B.P.

Sea level data suggest that this area was most likely an upland mainland setting during the Early Woodland period. The tree and the faunal evidence support this idea. The location of the coastline would have been much further to the east at this time, and being a deltaic area, marsh sedimentation would likely have kept pace with the falling sea level, prograding eastward. All of the fauna utilized could have been obtained in close proximity to the site. The lowering sea level in conjunction with daily tidal changes would have made the freshwater, brackish, and marine species all available in close proximity to the site. That no shell remains are found here also supports the idea that shellfish were not nearby to be utilized by humans/ that the occupation of this site did not involve travelling long distances for food resources. However, this site would
have been slightly closer to the coastline than the Delta site (about 11 km from the coastline on the north side of the Altamaha Sound, and possibly 16 km away from the coast south of the Altamaha sound).

There are multiple explanations for why the St. Simons marsh site contained no shellfish remains, but the Delta site had a fairly large oyster midden. It is possible that shellfish were available much closer to the Delta site, even though the actual coastline was further away. It is also possible that there were no shellfish available. The Altamaha River, whose delta meets the ocean at St. Simons Island, may have had a sediment load that was too low to form a protective barrier and/or marsh east of St. Simons Island. If there was a marsh further towards the east, it may have been utilized by a separate population. Similar to what was proposed for the early Late Archaic period, there could have been a fairly permanent coastal population near the coastline on a barrier island that utilized the marsh resources. People at the St. Simons marsh site were part of a different population that used mainland resources as well as the resources of the nearby coastal mainland, which in this case included multiple fish species. Finally, it is also possible that the St. Simons marsh site was used by a single group that traveled between coastal mainland sites like this, and coastal island sites to the east.

Such equifinality, different circumstances producing the same archaeological pattern, underscores the need for more archaeology directly related to understanding the Early Woodland settlement pattern of the coastal zone. The evidence that is available indicates that there was variability in coastal mainland settlement patterns during the Early Woodland period. In non-deltaic areas like McIntosh County, there seems to be a change in the population and/or the organization during the Early Woodland period, but only when compared to the early part of the Late Archaic period (4,200-3,800/3,500 B.P.). When compared to evidence from the terminal
Late Archaic period (depopulation and modification of the settlement system, with some amount of continuation), occupation during the Early Woodland is fairly similar. Occupation in what was then a non-deltaic coastal mainland, continued from the end of the Late Archaic period, by a small, dispersed/mobile population. People could have occupied any of the upland areas along or near Doboy Sound. However, the remnant patches of upland (the present-day marsh islands) are the only easily accessible areas available today to look for evidence of these occupations. So, these back-barrier islands may not be the ultimate places for Early Woodland or even terminal Late Archaic occupations. They are simply the only parts of the landscape that are still available, and relatively easy to study.

As noted in the discussion above, there were marsh and/or estuarine resources available in at least two of the deltaic areas of the Georgia Coast, although in varying degrees. In the non-deltaic McIntosh County, it is not quite clear what the extent of marsh was along estuaries like Doboy Sound, if there was any marsh at all. It is also unclear if any populations utilized the area where there was known marsh (the northeast coast of present-day Sapelo Island). It is unknown if populations on this mainland coast had a diminished coastal resource base, or no marsh-estuarine resources to utilize at all. The idea that certain Early Woodland occupations may not be related to changing sea levels or obtaining food resources (e.g., on Mary Hammock) is also a factor in the settlement pattern.

The main conclusion is that there is evidence for continuity between the terminal Late Archaic and the Early Woodland populations, especially in deltaic areas. The results also show that the archaeology and sea level history of large coastal areas are not always straightforward, with many factors related to how the evidence for both will manifest themselves. Generalizing for an area larger than an individual barrier island/back-barrier area/mainland coast may not be
worthwhile, as each specific barrier island-to-mainland area may have its own unique archaeological and environmental history. There is even variability within such areas. The changing environmental setting must be kept in mind.

**Middle and Late Woodland Periods: 2,400-1,000 B.P.**

*Results*

Throughout the Middle and Late Woodland periods, changes in sea level were negligible. The extremely rapid sea level rise between 2,700 and 2,400 B.P. slowed to a more gradual rate between 2,400 and 1,000 B.P. (about 3.9 cm every 100 years). Sea level was 1.0 mbp at 2,400 B.P., and 0.6 mbp by 1,000 B.P. With such a slow rise, sedimentation would have been sufficient to maintain marsh accretion (Reed 2002:240). Throughout these two periods, changes in land cover types were minimal (see Figures 5.13 to 5.15). Intertidal area had increased to 23% and mainland had decreased to 41% by 2,400 B.P. (see Table 5.5). By 1,000 B.P. the intertidal area increased slightly to 27% and mainland decreased slightly to 40% (Table 5.6).

Turck and Alexander (2011) estimate that the southern end of Sapelo Island was an active margin, possibly related to Doboy Sound, between 2,375 and 2,056 B.P. Around 2,000 B.P., the small island off of the southern end formed, and the area filled with marsh sediment (Turck and Alexander 2011).

Although the model retrodicts that areas of present-day high marsh would have been upland at 1,500 B.P., it is important to note that this is due to the original estimation of the former surface below the present-day marsh. As discussed in Chapter 4, a flat value of 30 cmbs
was chosen for the former surface under present-day high marsh, even though it may have been
deepener in certain areas. The reader should keep in mind that between Mary Hammock and the
other nearby marsh islands (Figure 5.16), there may have been discreet locations of flooding and/
or intertidal marsh formation at 1,500 B.P. that were subsequently buried. It was also around
1,500 B.P. that the western ridge of Blackbeard Island formed, even though marsh probably had
formed by 2,900 B.P. (Turck and Alexander 2011).

By 1,000 B.P., present-day high marsh would have only been about 30 cma MHHW
(2.264 ma MLLW). Although the model indicates that these areas would have been safe from
tidal flooding (see Figure 5.17), any upland vegetation present would have been affected by
changes in the water table and salt water intrusion from the rising sea level. It is likely that
vegetation had already begun to change to those tolerant of higher salinity. Thus it is only by
1,000 B.P. at the earliest that Mary Hammock would have started to become a separate entity
from Little Sapelo Island, Fishing Hammock, and Pumpkin Hammock. It is also by 1,000 B.P.
that Harris Neck separated from the mainland, itself becoming a marsh island.

Hypotheses

1. Throughout the Middle and Late Woodland periods, the McIntosh County landscape
   was similar to that of 4,200 B.P. (as well as of today), and thus the settlement pattern
   will be similar to that of the early Late Archaic period.
2. Back-barrier islands, once again being the only upland areas within the marsh-
estuarine area, were heavily utilized for their access to marsh-estuarine resources.
3. Populations also occupied new areas that formed (Blackbeard Island, and the marsh
   island off of the south end of Sapelo Island).
Discussion

In general, many aspects of Middle and Late Woodland societies on the Georgia coast are similar to the early Late Archaic period. The construction of ringed and arcuate middens occurs again (Thompson and Turck 2009). Middle Woodland period sites were occupied year-round (Quitmyer et al. 1985, 1997). Subsistence was similar to coastal Late Archaic populations, with people relying on oysters, clams, and fish (see Quitmyer and Reitz 2006). All of this agrees with the expectations of the model.

There are also some new cultural features though, such as the construction of burial mounds during the Middle and Late Woodland periods (see Thompson and Turck 2009). Although Thomas (2008e:1011) suggests a brief period of “mortuary activity” between 2,700 and 2,550 B.P., he also notes that those activities may not be directly related to mortuary ritual. There are also no mounds on St. Catherines that date prior to 2,300 B.P. (Thomas 2008e:1011). The people interred in these Middle Woodland burial mounds are most likely from an egalitarian society, and they achieved higher status during their lifetimes (Thomas 2010:193). There is also a high frequency of female interments (Thomas and Larsen 1979). The construction of mortuary sites can indicate sedentism and/ or competition for resources (Charles and Buikstra 1983). Thompson and Turck (2009) suggest that it was the renewed emphasis on coastal resources that led to the construction of burial mounds so people could claim those resources and territories.

The growing population could also have been a factor in this. On both the coastal plain (Turck et al. 2011) and the coastal zone (Thompson and Turck 2009) of Georgia, there are statistically higher densities of Middle and Late Woodland period sites then in previous periods. The findings in this study also corroborate this. In McIntosh County, there are a total of 117 Middle Woodland period sites, and 86 Late Woodland period sites (as well as 15 sites that could
not be designated to either the Late Woodland or Early Mississippian periods) (Tables 5.6 and 5.7). In both periods, although the mainland has the highest number of sites, the marsh islands actually have the highest density of sites (number of sites per area). This supports the idea that marsh island occupations were related to sea level and the re-establishment of marsh-estuarine resources. The sherd density data also support this idea. Similar to the Late Archaic period, mainland sherd density is fairly low during these two periods. Patterson Island and Mary Hammock have extremely high Middle Woodland, Late Woodland, and Late Woodland/Early Mississippian sherd densities (Figure 5.9).

The pattern on Julianton Plantation needs to be discussed. Densities of 0.44 for Middle Woodland sherds, and 0.34 for Late Woodland sherds is extremely low. This goes against the expectations of the model, which proposes marsh formation and intense occupations throughout the coastal zone of McIntosh county. For all practical concerns, Harris Neck can be considered a large island between 2,400-1,000 B.P., (with the survey occurring on the southern end). Although not calculated for this study, the change in sea level/marsh is negligible over the next 500 years, and yet 242 Early Mississippian sherds (for a density of 4.6) was found in the Julianton Survey (Elliott 2008:126). This fairly drastic change in the intensity of occupation, without any change in marsh-estuarine productivity, suggests that these settlement patterns are not related to environmental changes or subsistence.

As soon as coastal landforms developed, they were rapidly utilized by humans (DePratter 1977b; DePratter and Howard 1977; Turck and Alexander 2011). Both Blackbeard Island (DePratter 1977b; Marrinan 1980) and the small marsh island off the southern end of Sapelo Island (Turck and Alexander 2011) have evidence of Late Woodland occupations.
Year-round settlement and the increase in population suggest an intensification of occupation during the Middle Woodland period, and this trend continued through the Late Woodland period. There seems to be an even greater emphasis on marsh island settlement than during the Late Archaic period. This includes all marsh islands, not just the ones in the back-barrier area. I suggest that marsh islands were just as intensively occupied/utilized as main barrier islands, if not more so. There is also variability in settlement within the county, with less intensive occupation on the mainland (including the peninsula of Harris Neck).

**Summary**

This chapter described the implementation of the model of landscape change of McIntosh County over time for each time period. The affect that that sea level changes had on the intertidal land cover type was quantified for each time period, and used to make predictions on human settlement. These predictions were tested with the archaeological record, sometimes were supported, and sometimes were not. The next chapter summarizes and contextualizes the findings, and describes their broader significance. It also suggests directions for future studies.
Table 5.1. Number and Percent of Land Cover Area (in km²) in McIntosh County at Present and with a Six-meter Rise in Sea Level.

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>Present-Day 0 B.P.</th>
<th>Future A.D. 2600</th>
<th>% Area</th>
<th>% Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subtidal Area</td>
<td>513.3</td>
<td>1,268.6</td>
<td>31.2%</td>
<td>77.0%</td>
</tr>
<tr>
<td>Intertidal Area</td>
<td>408.5</td>
<td>331.0</td>
<td>24.8%</td>
<td>20.1%</td>
</tr>
<tr>
<td>Barrier Island</td>
<td>55.5</td>
<td></td>
<td>3.4%</td>
<td></td>
</tr>
<tr>
<td>Marsh Island</td>
<td>12.2</td>
<td></td>
<td>0.7%</td>
<td></td>
</tr>
<tr>
<td>Mainland</td>
<td>658.0</td>
<td>47.9</td>
<td>39.9%</td>
<td>2.9%</td>
</tr>
<tr>
<td>Totals</td>
<td>1,647.5</td>
<td>1,647.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5.2. Number and Percent of Land Cover Area (in km²) during certain Times of the Paleoindian, Early Archaic, and Middle Archaic Periods.

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>Paleoindian and Early/ Middle Arch. 12-8,000 B.P.</th>
<th>Terminal Middle Arch. 5,000 B.P.</th>
<th>% Area</th>
<th>Sites</th>
<th>% Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subtidal Area</td>
<td>0.0</td>
<td>371.3</td>
<td>100.0%</td>
<td>4</td>
<td>22.5%</td>
</tr>
<tr>
<td>Intertidal Area</td>
<td>0.0</td>
<td>157.9</td>
<td></td>
<td></td>
<td>9.6%</td>
</tr>
<tr>
<td>Barrier Island</td>
<td>0.0</td>
<td>0.0</td>
<td></td>
<td>4</td>
<td>0.0%</td>
</tr>
<tr>
<td>Marsh Island</td>
<td>0.0</td>
<td>0.0</td>
<td></td>
<td>4</td>
<td>0.0%</td>
</tr>
<tr>
<td>Mainland</td>
<td>1,647.5</td>
<td>1,118.3</td>
<td>100.0%</td>
<td></td>
<td>67.9%</td>
</tr>
<tr>
<td>Totals</td>
<td>1,647.5</td>
<td>1,647.5</td>
<td></td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>
Table 5.3. Number and Percent of Land Cover Area (in km²) during certain Times of the Late Archaic Period.

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>4,200 B.P.</th>
<th>% Area</th>
<th>Sites</th>
<th>Late Archaic</th>
<th>% Area</th>
<th>Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subtidal Area</td>
<td>519.5</td>
<td>31.5%</td>
<td></td>
<td>344.1</td>
<td>20.9%</td>
<td></td>
</tr>
<tr>
<td>Intertidal Area</td>
<td>385.7</td>
<td>23.4%</td>
<td>3</td>
<td>175.4</td>
<td>10.6%</td>
<td></td>
</tr>
<tr>
<td>Barrier Islands</td>
<td>42.4</td>
<td>2.6%</td>
<td>3</td>
<td>0.0</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>Marsh Islands</td>
<td>27.3</td>
<td>1.7%</td>
<td>8</td>
<td>0.0</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>Mainland</td>
<td>672.6</td>
<td>40.8%</td>
<td>75</td>
<td>1,127.9</td>
<td>68.5%</td>
<td>89</td>
</tr>
<tr>
<td>Totals</td>
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<td></td>
<td>89</td>
<td>1,647.5</td>
<td></td>
<td>89</td>
</tr>
</tbody>
</table>

Table 5.4. Number and Percent of Land Cover Area (in km²) during certain Times of the Early Woodland Period.

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>3,100 B.P.</th>
<th>% Area</th>
<th>Sites</th>
<th>2,700 B.P.</th>
<th>% Area</th>
<th>Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subtidal Area</td>
<td>342.7</td>
<td>20.8%</td>
<td></td>
<td>246.1</td>
<td>14.9%</td>
<td></td>
</tr>
<tr>
<td>Intertidal Area</td>
<td>170.0</td>
<td>10.3%</td>
<td></td>
<td>229.3</td>
<td>13.9%</td>
<td></td>
</tr>
<tr>
<td>Barrier Islands</td>
<td>0.0</td>
<td>0.0%</td>
<td></td>
<td>0.0</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>Marsh Islands</td>
<td>0.0</td>
<td>0.0%</td>
<td></td>
<td>0.0</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>Mainland</td>
<td>1,134.8</td>
<td>68.9%</td>
<td>25</td>
<td>1,172.1</td>
<td>71.1%</td>
<td>25</td>
</tr>
<tr>
<td>Totals</td>
<td>1,647.5</td>
<td></td>
<td>25</td>
<td>1,647.5</td>
<td></td>
<td>25</td>
</tr>
</tbody>
</table>
Table 5.5. Number and Percent of Land Cover Area (in km$^2$) at the beginning of the Middle Woodland Period.

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>Middle Woodland 2,400 B.P.</th>
<th>% Area</th>
<th>Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subtidal Area</td>
<td>519.5</td>
<td>31.5%</td>
<td></td>
</tr>
<tr>
<td>Intertidal Area</td>
<td>385.7</td>
<td>23.4%</td>
<td>5</td>
</tr>
<tr>
<td>Barrier Islands</td>
<td>42.4</td>
<td>2.6%</td>
<td>2</td>
</tr>
<tr>
<td>Marsh Islands</td>
<td>27.3</td>
<td>1.7%</td>
<td>12</td>
</tr>
<tr>
<td>Mainland</td>
<td>672.6</td>
<td>40.8%</td>
<td>98</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>1,647.5</strong></td>
<td></td>
<td><strong>117</strong></td>
</tr>
</tbody>
</table>

Table 5.6. Number and Percent of Land Cover Area (in km$^2$) during certain Times of the Late Woodland Period and the Late Woodland/ Early Mississippian Supra-period.

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>Late Woodland 1500 BP</th>
<th>% Area</th>
<th>Sites</th>
<th>Late Woodland/ Early Mississippian 1000 BP</th>
<th>% Area</th>
<th>Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subtidal Area</td>
<td>508.0</td>
<td>30.8%</td>
<td></td>
<td>462.0</td>
<td>28.0%</td>
<td></td>
</tr>
<tr>
<td>Intertidal Area</td>
<td>395.0</td>
<td>24.0%</td>
<td>2</td>
<td>436.8</td>
<td>26.5%</td>
<td>1</td>
</tr>
<tr>
<td>Barrier Islands</td>
<td>44.0</td>
<td>2.7%</td>
<td>17</td>
<td>61.0</td>
<td>3.7%</td>
<td>1</td>
</tr>
<tr>
<td>Marsh Islands</td>
<td>28.0</td>
<td>1.7%</td>
<td>21</td>
<td>36.4</td>
<td>2.2%</td>
<td>2</td>
</tr>
<tr>
<td>Mainland</td>
<td>672.4</td>
<td>40.8%</td>
<td>46</td>
<td>651.3</td>
<td>39.5%</td>
<td>12</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>1,647.5</strong></td>
<td></td>
<td><strong>86</strong></td>
<td><strong>1,647.5</strong></td>
<td></td>
<td><strong>15</strong></td>
</tr>
</tbody>
</table>
Figure 5.1. Present-day extent of land cover types in McIntosh County.
Figure 5.2. Change in land cover types with a six-meter rise in sea level.
Figure 5.3. Cross-section of the present-day mainland after a six-meter rise in sea level: (a) location of the transect A-A’; (b) profile of transect at low tide; (c) profile of transect at high tide.
Figure 5.4. Land cover of McIntosh County during the Paleoindian and Early Woodland periods (between 12,000 and 8,000 B.P.).
Figure 5.5. Land cover of McIntosh County at the terminal Middle Archaic period (5,000 B.P.), showing that much of the area was upland mainland.
Figure 5.6. Site density in Georgia and Florida during the Early Archaic period.
Figure 5.7. Site density in Georgia and Florida during the Middle Archaic period.
Figure 5.8. Land cover in McIntosh County at the beginning of the Late Archaic period (4,200 B.P.), with proposed marsh accretion.
Figure 5.9. Sherd densities (sherds per 10 ha) at eight survey areas in and near McIntosh County.
Figure 5.10. Land cover in McIntosh County during the middle of the Late Archaic period (3,600 B.P.), as it reverted back to upland mainland.
Figure 5.11. Land cover in McIntosh County at the end of the Late Archaic period (3,100 B.P.), with the continued lowering of sea level.
Figure 5.12. Land cover in McIntosh County during the middle of the Early Woodland period (2,700 B.P.), during a sea level lowstand of 4.0 mbp.
Figure 5.13. Land cover in McIntosh County at the end of the Early Woodland period (2,400 B.P.), showing a large rise in sea level.
Figure 5.14. Land cover in McIntosh County at the end of the Middle Woodland period/beginning of the Late Woodland period (1,500 B.P.). Note the formation of the western edge of Blackbeard Island at this time.
Figure 5.15. Land cover in McIntosh County at the end of the Late Woodland period (1,000 B.P.).
Figure 5.16. 1,500 B.P.: The location of present-day Mary Hammock as part of a larger landmass.
Figure 5.17. 1,000 B.P.: The location of present-day Mary Hammock as part of a larger landmass.
CHAPTER SIX
CONCLUSION

The main purpose of this study was to gain a more complete understanding of the human settlement system from 12,000-1,000 B.P. in relation to landscape change along the coast of Georgia by combining data regarding the broader range of settlement options with non-archaeological evidence of the paleoenvironmental record. Specifically, archaeological surveys of two back-barrier islands, Mary Hammock and Patterson Island, were combined with a paleoenvironmental study of the same area, and compared to changes in sea level, as well as to archaeological surveys of other environmental settings, to understand the change in human occupation in McIntosh County, GA between the beginning of the Paleoindian period and the end of the Late Woodland period.

These paleoenvironmental data were incorporated into an elevation and bathymetric dataset, and combined with changes in sea level over time to create a dynamic model of landscape change. This model was used to create predictions about the human settlement patterns of McIntosh County in general, and the back-barrier area specifically, as related to the marsh-estuarine system. These predictions were then tested with the already-known site distributions of McIntosh County, as well as to the prehistoric sherd densities of various surveys.
The main questions posed for this study were:

1. How did changes in sea level affect the coastal habitats of McIntosh County over time, especially concerning location and extent of the marsh-estuarine system?

2. What expectations/predictions can be made about McIntosh County settlement patterns over time, when taking into account changes in the location and extent of the marsh-estuarine system?

3. What were the changes in human occupation over time within McIntosh County as a whole, and on the back-barrier islands specifically?

4. How do the predictions about settlement compare to the spatial distribution of known archaeological sites over time?

These questions were addressed using a landscape approach which incorporates regional geomorphology at the landscape scale, with formation processes at the site level (Rossignol 1992:8), as well as a distributional approach to the archaeological data (Dunnell 1992). The metric of land cover percentage (Class Areas Proportion) from landscape ecology was utilized to quantify changes in the landscape over time. This approach allowed for a dynamic analysis of the interaction between past human behavior and the environment.
Summary of Findings

During the Paleoindian, Early Archaic, and beginning of the Middle Archaic periods, McIntosh County was part of the mainland, at some distance from the coast. As such, very few sites dating to these periods have been found, and they do not exhibit evidence of coastal adaptations. By the end of the Middle Archaic period (5,000 B.P.), the model indicates that estuaries and small areas of marsh had been established. That some Middle Archaic sites may be buried deeply does not explain the complete lack of sites dating to this time. Similarly, distant shorelines and lack of marsh-estuarine resources also do not explain the lack of terminal Middle Archaic sites in the study area. I suggest that if previous populations occupied former coastal areas, there may have been an abandonment of the coastal zone during the Middle Archaic period, and changes in sea level and marsh-estuarine resources were not the reason for such abandonment.

If the model is correct, and there were no coastally-adapted Middle Archaic occupations in McIntosh County, the intense occupation of early Late Archaic populations represents an influx of people to the coastal zone during a time of marsh-estuarine productivity. Although Mary Hammock has no evidence of Late Archaic occupation, it was just a small part of a larger marsh island at this time, and was not as close to tidal streams as other parts of the landmass. Present-day Little Sapelo Island and Pumpkin Hammock are other parts of this landmass that were adjacent to tidal streams, and that have evidence of Late Archaic occupations. The occupational intensity was slightly larger than the major barrier island, and I argue that the groups on these nearby landmasses may have been related in some way. In comparison, Patterson Island had such a large Late Archaic period occupation I argue that it was most likely

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semi-permanently occupied by people who also utilized the mainland. This would have been true for similar upland landforms, like the Julianton Plantation, in close proximity to the mainland and with access to marsh-estuarine resources. These groups would have spent most of their time on the coast close to the mainland, but also ventured inland to utilize freshwater resources.

During the second half of the Late Archaic period and the Early Woodland period, times of lowered sea levels and little-to-no marsh-estuarine productivity, occupation in McIntosh County continued, but in modified form. Shell rings were no longer constructed, and population lowered, suggesting a reorganization of the settlement/subsistence system. There was a fairly intense occupation on Mary Hammock (at least as far as the sherd density is concerned), even though it was only a small part of the larger mainland at this time. Patterson Island, Little Sapelo Island, and the Julianton Plantation (also parts of the mainland) had less intense Early Woodland occupations. During the Middle and Late Woodland periods, sea level rose, and the positions of both Mary Hammock and Patterson Island within the landscape were very similar to their positions during the early Late Archaic period. Mary Hammock was once again a small part of a larger marsh island (it did not become its own marsh island until 1,000 B.P. at the earliest), and Patterson Island was a marsh island close to the mainland. During these times, Mary Hammock had intense occupations, quite the opposite of the Late Archaic period. Patterson Island also had intense occupations during these periods, with the most intense occupation probably occurring during the Late Woodland period.
Contextualization

While the utilization of back-barrier islands fluctuated over time, they were always part of the greater settlement pattern. This occurred during times of high population density and low, and times of dispersal and concentration. These relatively small islands are areas where activities would be concentrated. They have all the resources of barrier islands (deer, raccoon, turtles, and are in close proximity to the resources in marshes, tidal creeks and larger estuaries), but concentrated in a smaller area. They are a microcosm of the barrier island ecosystem, as well as human settlement.

However, occupation occurred during times when these islands were much larger in size, or not islands at all, indicating they were not always microcosms throughout their life histories. This is why it is important to understand changes in environment over time, because these places were not always islands where activities would be concentrated. Within the 11,000 years that this study encompasses, the present-day back-barrier islands were only separated from the mainland during the first half of the Late Archaic period (4,200-3,800 B.P.), and during the Middle and Late Woodland periods (between 2,400 and 1,000 B.P.). In addition, Mary Hammock, Pumpkin Hammock, Little Sapelo Island, and Fishing Hammock were all part of one larger marsh island until after 1,000 B.P. Thus for these marsh islands, the fluctuations in settlement and occupation of one must be considered in relation to the others.

This brings up the issue of connectivity and isolationism. Fitzpatrick and Anderson (2008) note that various levels of isolation and/or connectivity will be found between island peoples. Elsewhere, colleagues and I (Thompson and Turck 2011) have argued that connectivity and isolationism define island archaeology. Since connectivity cannot be assumed, the initial
question must be related to demonstrating connectivity (Thompson and Turck 2011). At the base of the question of connectivity is the changing nature of landforms and their existence as islands over time. In light of the results of this study, I suggest that incorporating geomorphological and environmental changes should be the first step in studying connectivity among people in coastal environments.

The main data needed to accomplish this are detailed and accurate changes in sea level. This is arguably the most important information for archaeological studies of coastal populations. While the Gayes et al. (1992) sea level curve used in this study might not be as highly nuanced or fine-grained as, other sea level curves (see Marquardt 2010:258, 267 for discussion), proper sea level curves for any area need to be based on data from that specific, local area. As Rull et al. (1999:496) note, most researchers stopped searching for a single sea-level curve that had global relevance by the early 1980s. Such eustatic sea-level curves should only be used as general guides, and not factual data (Kraft 1988:111). While the Gayes et al. (1992) curve averages only one data point every 800 years, the proximity to the study area makes this the most appropriate curve to use. Similarly, it is important that paleoclimate data is also site-specific, and should not be extrapolated to/from other areas (Mayewski 2004:252). This is especially true considering how variable past climates were. Paleoclimate data can be specific to latitudes (Mayewski 2004:249-250), hemispheres (Kerwin et al. 1999), seasons (Kerwin et al. 1999), and even specific to types of environment (e.g., marine vs. terrestrial/air) (Steig 1999; Zhao et al. 2000).

For the Georgia coast, each specific environment/habitat needs to be treated separately, and characterized environmentally and archaeologically (see Turck and Alexander 2011). Deltaic, non-deltaic, barrier, back-barrier, inter-barrier, Pleistocene, Holocene, island, marsh,
etc., are all areas with different environmental processes, and thus affected differently when environmental changes occurred (especially with changes in sea level). For example, in McIntosh County, the area behind Sapelo Island should be characterized as a non-deltaic, back-barrier area, with Pleistocene landforms among Holocene marsh. Only after the present-day areas are characterized, and how they changed over time are understood, can we appreciate any subtle changes in human settlement and subsistence that may be manifest in those areas, and begin to better understand the timing of, and reasons for, those changes.

**Significance**

This research provided a dynamic model for integrating disparate datasets from various fields to get at changes in environment and human behavior, and the relationships between the two. It demonstrated that seemingly marginal areas (in this case, small islands surrounded by marsh) were important parts in past human settlement systems. Although the utilization/intensity of occupation of these areas fluctuated throughout time, they were almost always incorporated into the settlement system. They were important locations for subsistence purposes, but that they were also utilized at times when marsh productivity was low, suggesting they were utilized for other activities as well. Small islands and other “marginal” areas must be incorporated into coastal studies, in Georgia and around the world. Only after archaeologists investigate the full range of settlement options available to past people can the past settlement system be understood more fully.
This study also showed that non-archaeological evidence of a changing environment is essential to aid in archaeological interpretations of past settlement patterns. Integrating archaeological data on human settlement with non-archaeological data on changes in sea level and marsh location, allowed for correlations to be made between the two. This is significant methodologically speaking, exemplifying a way to distinguish behavioral changes from environmental changes.

This is also significant anthropologically, demonstrating that environmental changes do indeed affect human behavior. The focus on a non-anthropogenic environmental change, in this case changes in sea level, revealed that things important to humans, such as subsistence resources and physical living space, were impacted both adversely and favorably by environmental changes. At certain times, humans dealt with these changes by changing their settlement patterns. However, another main result of this study was that the environment does not determine behavior. In other words, the predictions of the model were not always substantiated. For example, occupations were expected on the coast during the terminal Middle Archaic period, and on Mary Hammock during the Late Archaic period, but no evidence of occupations were found. Conversely, occupation was not expected on Mary Hammock during the Early Woodland period, and yet there was evidence for it. There are also examples of changes in settlement when no changes were predicted (within the area of the Julianton Plantation survey on Harris Neck during the Middle and Late Woodland periods). These examples reveal that changes in the environment (in this case changes in sea level and marsh-estuarine resources) are not the only reason for changes in settlement patterns. With no correlation between environmental change and settlement, these certain areas and periods can be examined in greater detail, looking specifically for non-environmental explanations of changes in
settlement and/or subsistence, or for evidence of why settlement did not change in the face of environmental change.

Finally, understanding how past humans interacted with a dynamic coastal setting is relevant to today, because similar processes have occurred throughout time. Disturbance of coastal areas by recent human activity, including the high demand for land to develop along coastlines, and environmental processes, (e.g., erosion, rising sea levels due to global warming, hurricanes, etc.) lends an air of immediacy to this study. These low-lying coastal areas must be studied before cultural and natural factors make it all but impossible to do so.

**Future Research**

There are multiple avenues for productive future research. As mentioned above, each specific habitat needs to be characterized environmentally. Detailed sea level data for each local area is needed. Depths of former upland surfaces under the marsh are needed from more areas, and this needs to be tied in to the present-day tidal range (and eventually past sea level changes). The changing positions, depths, and salinities of estuaries and tidal streams are needed. More detailed paleoclimate indicators are needed, such as isotopic and pollen data.

As far as the archaeology is concerned, more survey data is needed from a wider range of environments. This is especially true for areas that have been overlooked typically, including more marsh islands, underneath the Holocene marsh, and upland surfaces that may have been deeply buried. More effort needs to be given to finding Paleoindian, Early Archaic, and Middle Archaic period sites (DePratter 2010). Finer chronological controls are needed for some key time
frames, most likely obtained with $^{14}$C dating. The timing of multiple types of Late Archaic period sites, not just shell rings, need to be teased out. Earlier Late Archaic sites and terminal Late Archaic sites need to be distinguished from each other, as does the transition to the Early Woodland period (if this is when a transition occurs).

The main task then, not just in Georgia, but in all areas of the world where coastal archaeology is performed, is to get highly detailed data; both archaeological and paleoenvironmental. These data must be specific, not just to a region, but to each particular habitat. Only then will comparisons between different habitats in an area be meaningful, or even possible. From that point, comparisons can be made between different areas in a region, and finally between different regions. The methodical and careful integration of detailed archaeological and paleoenvironmental data at all of these levels will force us to view the past not as a static event (or a series of static events), but as a continually changing, dynamic interaction between people and environments.
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