DEBORAH ANN KEENE
Archaeological and Geophysical Investigations of Grove's Creek Site (09CH71), Skidaway Island, Georgia.
(Under the direction of ERVAN G. GARRISON)

Magnetometry and conductivity surveys were conducted on Grove's Creek Site (09CH71), Skidaway Island, Georgia in order to detect subsurface archaeological features. The data from these surveys were processed in a geographic information system (GIS) to evaluate GIS as a geophysical processing tool for archaeologists. While the GIS constructed for this project was found to be adequate, a system with analytical capabilities more suited to geophysical data would have been preferable. Several anomalies detected by the geophysical surveys were excavated, and one proved to be an Irene phase (AD 1300-1450) structure (Structure 5).

Data gathered from the excavation of Structure 5 coupled with data from four structures previously excavated at the site, structures from other sites, and ethnohistoric accounts from early European chroniclers were compared in order to characterize Irene phase architecture on the Georgia coast. The majority of archaeological structures were square or rectangular and constructed of wattle and daub; however, they varied in size and several aspects of construction. The ethnohistoric accounts indicate that the majority of structures were round and built using a variety of construction techniques. The difference in shape between archaeological and ethnohistoric accounts may be the consequence of social changes following European contact or change over time.

Data from Structure 5 and a midden unit were used to determine the subsistence strategies and season of occupation of Grove's Creek Site. Faunal, botanical, *Boonea impressa* (an oyster parasite) measurement data and stable isotope analysis of oyster shells were used to determine that the site was occupied year round, and that crops provided a significant component of the diet. A revised model of coastal subsistence strategies is proposed, in which the late prehistoric inhabitants of the coastal plain resided in dispersed, sedentary hamlets and relied on a mix of agriculture, gathering wild plants, fishing and hunting.

INDEX WORDS: Magnetometry, Conductivity, Prehistoric Architecture, Irene Phase, Coastal archaeology, Coastal subsistence, Coastal settlement patterns, Grove's Creek Site, Prehistoric agriculture, Geographic Information Systems, GIS

ARCHAEOLOGICAL AND GEOPHYSICAL INVESTIGATIONS OF GROVE'S CREEK SITE (09CH71), SKIDAWAY ISLAND, GEORGIA.

by

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DEDICATION

This work is dedicated to my parents:

Edward Keene and Dorothy Young Keene

They encouraged me to follow my dreams, impractical as they seemed, and helped me in every conceivable way.

and

my grandparents

William Keene and Francis Tratar Keene

Albert Young and Pauline Krysik Young

My grandmothers taught me that women can and should break the rules whenever necessary, and that even if you like to get your hands dirty, you can still wear lipstick and smell nice.

My grandfathers taught me that a little indulgence never hurt anyone, and that you should save everything, because you'll never know when you might need it.

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I would never have made it this far without the help of my parents. They did everything humanly possible to help me succeed. They visited me every time I was in the field and helped me do everything from excavate to patch my roof. They brought me too many boxes of food to count and gave more words of encouragement than I knew existed. I want to thank the rest of my family as well. My brother, Doug, and sister, Diana, and their spouses, Janet and Rodney, were there for me. I want to thank my nieces and nephews, Tarah, Portia, Logan, Trevor and Sierra, for insisting that I wasn't a grownup and refusing to let me act like one.

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CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

The investigations at Grove's Creek Site focus on two hypotheses, one methodological and one theoretical. 1) Gradiometer and conductivity data can be processed in a geographic information system (GIS) in order to locate and characterize archaeological features. 2) The hypothesis that Grove's Creek Site was occupied year round will be tested against several published models of coastal subsistence.

The use of geophysical methods on archaeological sites has increased over the years, and the nature of their use has changed as the instruments and processing programs have evolved (c.f. Beavis and Barker 1995; e.g. Arnold *et al.* 1997; Bevan 1991; Brizzolari *et al.* 1992; Burns *et al.* 1981; Clark 1986; Frohlich and Lancaster 1986; Keay *et al.* 1991; Martin *et al.* 1991; Paterson and Reeves 1985; Weymouth 1986a, 1986b, Wynn 1990). They are no longer used to simply find an archaeological feature or delineate the edges of the site, but to determine what kinds of features are present and their relation to each other. As this geophysical evolution continues, more archaeologists are eager to participate. Two major obstacles in their path can be cost and information. Geophysical instruments and processing software are relatively expensive. Geophysical methods, both in the field and the lab, cannot be used to their best advantage without some background knowledge. To further complicate matters, the archaeologist starting out with geophysical methods is confronted by a methodological gap between geophysicists and archaeologists. Geophysicists are often not satisfied by data processing programs, and prefer to write their own code, building filters and applying them by hand. Archaeologists commonly don't have the time, money or background to follow that example and resort to mapping programs to display their data, and do whatever processing is available with the program. There are now geophysical processing programs that are more user-friendly than their predecessors, but the issue of cost is still present. Geophysical information systems (GIS) should be considered a compromise. Most archaeologists already own one, so no new costs are incurred. Some GIS software contains various filtering capabilities, and the user can either process data with pre-programmed filters or construct their own.

Ladefoged et al. (1995) pioneered the use of GIS for data enhancement of geophysical data from archaeological sites. The current project was designed to further their work by evaluating the use of GIS as a geophysical processing tool for archaeologists. There were four basic steps in that process: collecting conductivity and gradiometer data from an archaeological site, processing the data in a geographic information system (GIS), determining the general archaeological feature type represented by the geophysical anomaly, and conducting an archaeological investigation to ground-truth the data.

Data from the geophysical processing procedure were used to locate and excavate an Irene phase (AD 1300-1450) structure (Structure 5). Only five other Irene phase sites on the Georgia coast have been recorded as containing structures. These sites include Irene (Caldwell and McCann 1941), Seven-Mile Bend (Cook 1971), 9CH112 (Goad 1975), Harris Neck (Braley *et al*. 1986) and Red Bird Creek (Pearson 1984). The archaeological information gathered from these sites was compared with written information from early European explorers in order to characterize Irene phase architecture on the Georgia coast. The characteristics of shape, size, construction technique and associated features are compared.

Faunal and botanical data from Structure 5 and a midden unit were analyzed to determine subsistence strategies of the inhabitants of Grove's Creek Site. These data, coupled with measurement of *Boonea impressa* and stable isotope analysis of oyster shells, were used to determine the seasons of the year in which the site was occupied. This was done in order to test existing models of late prehistoric coastal subsistence and settlements patterns.

Larson (1980) sparked the coastal subsistence strategy debate by proposing a testable model of subsistence strategy for the Southeastern U.S. Atlantic coastal plain. His seasonal round model was constructed on the premise that coastal soils could not support the level of agriculture found at interior Mississippian sites. Larson (1980) suggested that coastal people moved every time they abandoned their fields and lived in different locations throughout the year. They collected nuts in the autumn, shellfish in the winter and other plant foods in the spring. After coming to these conclusions, he stressed the lack of subsistence data in archaeological reports, especially the absence of botanical data, and expressed the need for much more work to be done before the subsistence of coastal peoples could be truly understood.

The Guale Annual Model proposed by Crook (1986) adds more detail to Larson's (1980) model. Crook (1986) suggests that coastal Mississippian people lived in towns or villages while they were harvesting crops nearby. In the autumn, after harvest, the town was abandoned except for the chief and his immediate family. The rest of the population foraged for nuts and other plant foods in surrounding forests while hunting in small parties. In the winter, these same small groups moved near the estuaries to fish, collect shellfish, and continue hunting for deer. In spring, they moved back to their farming plots to begin planting. Here, they would subsist on stored foods, anadromous fish, and shellfish during what Crook (1986) suggests would be a time of subsistence stress.

Building on the preceding models, Steinen (1984) put forth the idea that marsh islands were occupied by some of the small seasonal groups described by Larson (1980) and Crook (1986). The bulk of the population lived either on the barrier islands or the mainland and only visit the marsh islands to gather resources. After European colonization, there may have been a shift in subsistence patterns resulting in more utilization of marsh islands.

Jones (1978) takes issue with Larson's (1980) model. In an ethnohistoric study of the Guale, he concludes that coastal resources could support permanent settlements. He argues for permanent village sites supported by a mix of maize horticulture and wild food. He argues that a chiefdom level political structure supported long-distance trade for exotic items. Reitz (1988) also suggests that people at estuarine sites were basically sedentary, although they may have taken short trips to gather specific resources not locally available. As their reliance on cultivated foods increased, these trips may have become fewer and shorter.

Pearson (1977, 1978) surveyed Ossabaw Island, recording the location and size of all Irene phase sites. He divided the sites into a size hierarchy using cluster analysis. The largest sites defined by Pearson were large social/political centers, the next two size classes were settlements that may have been occupied seasonally, and the last size class contains resource procurement areas. Pearson (1977, 1978) suggested that Ossabaw formed a discrete socio-economic unit from which people interacted with villages on other islands to form a larger society. In a sense, the settlement pattern seen on Ossabaw was mirrored in the larger Irene settlement system.

DePratter (1978) surveyed Skidaway Island, mapping the distribution of sites from all time periods. He recorded a shift in site location during the Irene phase to areas that were previously uninhabited. This information, combined with the survey from Ossabaw, led him to suggest that site distribution might be the result of larger populations dispersing into smaller groups, which relied on a combination of agriculture, hunting and gathering.

The data from Grove's Creek Site are used to revise these existing Late Mississippian Southeastern U.S. Atlantic coastal subsistence and settlement models. Rather than a seasonal round, the inhabitants likely resided in permanent, dispersed settlements. These settlements would be located near major resources, eliminating the need to travel in order to procure resources.

CHAPTER 2

EVALUATING THE USE OF GEOGRAPHIC INFORMATION SYSTEMS AS A GEOPHYSICAL PROCESSING TOOL FOR ARCHAEOLOGISTS[1]

[1] Keene, D.A. To be submitted to *American Antiquity*.

ABSTRACT

Geographic information systems (GIS) are evaluated for use as a geophysical data processing tool. Conductivity and magnetic data were collected at Grove's Creek Site (09CH71), Skidaway Island, Georgia. The data were processed in a GIS consisting of Arcview™ and Imagine™ software. Processing resulted in the identification of six geophysical anomalies. The probable archaeological feature type of each anomaly was determined based on geophysical characteristics and anomaly size, and four of the anomalies were ground-truthed during an archaeological excavation. Two of the four archaeological feature types were correctly predicted based on geophysical anomaly characteristics. The mapping and filtering process conducted with the GIS was evaluated, and while found to have advantages over mapping programs, was not recommended over programs designed specifically for geophysical processing. Useful applications of the GIS included extensive gridding and filtering options. Drawbacks of the procedure included the inability to apply specialized equations. The project resulted in the discovery of an Irene phase (AD 1325-1425) structure.

INTRODUCTION

The use of geophysical methods on archaeological sites has increased over the years, and the nature of their use has changed as the instruments and processing programs have evolved (c.f. Beavis and Barker 1995; e.g. Arnold *et al.* 1997; Bevan 1991; Brizzolari *et al.* 1992; Burns *et al.* 1981; Clark 1986; Frohlich and Lancaster 1986; Keay *et al.* 1991; Martin *et al.* 1991; Paterson and Reeves 1985; Weymouth 1986a, 1986b, Wynn 1990). They are no longer used to simply find an archaeological feature or delineate the edges of the site, but to determine what kinds of features are present and their relation to each other. As this geophysical evolution continues, more archaeologists want to participate. Two major obstacles to their path can be cost and information. Geophysical instruments and processing software are relatively expensive. Geophysical methods, both in the field and the lab, cannot be used to their best advantage without some knowledge of theory. To further complicate matters, the archaeologist starting out with geophysical methods is confronted by a methodological gap between geophysicists and archaeologists. Geophysicists are often not satisfied with packaged data processing programs, and prefer to write their own code, building filters and applying them by hand. Archaeologists commonly don't have the time, money or background to follow that example and resort to mapping programs to display their data and do whatever processing is available with the mapping program. New geophysical processing programs are more user-friendly than their predecessors, but the issue of cost is still present. Geographic information systems (GIS) should be considered as a compromise. Most archaeologists already own one, so no new costs are incurred. Some GIS software contains various filtering capabilities, and users can either process data with pre-programmed filters or construct their own filters.

Ladefoged *et al*. (1995) pioneered the use of GIS for enhancement of geophysical data from archaeological sites. The current project was designed to further their work by evaluating the use of GIS as a geophysical processing tool for archaeologists. The project entailed four basic steps: collecting conductivity and gradiometer data from an archaeological site, processing the data in a GIS, determining the general archaeological feature type represented by the geophysical anomaly and conducting an archaeological investigation to ground-truth the data.

SITE BACKGROUND

Grove's Creek Site is a Native American village site located on Skidaway Island, Georgia (Figure 2-1). Radiocarbon dates (Keene 2002) and ceramic chronologies (Braley 1990) indicate that was occupied during the Irene phase (AD 1300-1450). Excavations conducted from 1985-1991 by Larry Babits and 1993-2001 by Ervan Garrison identified at least four structures as well as numerous archaeological features. The structures were constructed of wooden supports with clay plastered walls, had subsequently burned and were well preserved. Finding multiple structures on one site and having structures with good preservation are both very rare on the Georgia coast. Unfortunately, the site is also typical of coastal sites in that it is disturbed. There are old archaeological excavation units and some looter pits throughout the site area. There is no record of who dug the old pits and no artifacts surviving from them. With several structures in such good condition, it seemed probable that there were more. This offered an excellent opportunity to study coastal architecture and settlement pattern before European contact. However, it did not seem that excavating even more test pits was the correct way to find more structures. A geophysical survey was the best way to learn more about the site without disturbing it further.

GEOPHYSICAL DATA COLLECTION

Many different geophysical methods are available for archaeological analysis. I chose magnetometry and conductivity above the others for three reasons. First, both magnetometry and electrical resistivity, the inverse of conductivity, have been successfully employed on St. Catherine's Island, another barrier island on the Georgia coast (Garrison *et al*. 1985; Thomas and Pendleton 1987).

The second reason is how well these two techniques complement each other. The gradiometer will detect subsurface features that oppose or amplify the earth's magnetic field, such as burned clay (e.g., concentrations of daub or ceramics). It will also detect disturbed soil (Breiner 1973). The conductivity data will record concentrations of clay, and because it is measuring the conductivity of the sediment, areas with especially moist soil will appear as anomalies (Milsom 1996; Tite 1972). This would include trash pits and other heavily organic archaeological features.

The third reason these two geophysical methods were chosen is the type of data they produce. A GIS uses either raster or vector data. Both of these consist of an x,y,z coordinate system, in which x and y are the grid coordinates and z is a value assigned to them. The magnetic and electromagnetic data are collected in the same format; thereby ensuring that they will be well suited to any commercial GIS software.

Using the existing archaeological site grid, we established 5,216 stations at one-meter intervals. Magnetic and electromagnetic data were collected at each station. Magnetic data were collected with a GSM-19 Overhauser gradiometer, manufactured by Gem Systems and supplied by the UGA Department of Geology. As the area around the site has been used for dumping, the lower sensor was raised to eliminate the high frequency noise that such trash creates. The GSM-19 is constructed with only two options for lower sensor height, 50 cm or 94 cm, and so 94 cm was used. The upper sensor was at 1.88 m. The GSM-19 was used to measure vertical gradient in nanoteslas/meter (nT/m). Three readings were taken at each station to ensure precision before recording the data. Diurnal variation does not affect gradient magnetic data; therefore, only one magnetometer was needed for the project (Weymouth 1986a).

We collected electromagnetic data with a GEM-300 electromagnetic profiler, manufactured by GSSI, Inc., and supplied by the United States Forest Service. The coil spacing was 1.67 m. The electromagnetic profiler collected conductivity data, measured in milliSiemens/meter (mS/m), at sixteen frequencies. Multiple frequencies give the data a third dimension because as the frequency decreases, the signal penetrates to greater depth. Three successive readings were stacked to ensure precision. The data were downloaded into a laptop at the end of each day, when the memory was full. When memory is cleared, the zero point is also cleared; therefore, the instrument had to be re-zeroed every morning. Re-zeroing was conducted at the exact same location, facing due north and by the person who would be using the instrument for the remainder of the day. During the survey, detailed notes were taken of all surface disturbances that could affect both data types.

DATA PROCESSING IN THE GEOGRAPHIC INFORMATION SYSTEM

Magnetic data were manually entered into Excel™ and double-checked for accuracy. Conductivity data were downloaded directly into Excel™ from the GEM-300. Both datasets were imported into Arcview,™ in which the maps were created. Digitizing, contouring, and basic visual enhancement was completed in Arcview.™ Filtering was done with Imagine™ software.

All data processing and digital map production was conducted in the Cartographic Visualization Laboratory in the Department of Geography at UGA.

Map Construction

In this dataset, as with most, some map coordinates had no associated geophysical data. At Grove's Creek Site, this was generally due to a tree growing on or near a particular station. The usual solution is to interpolate the data into a grid; the computer program creates a value based on the values surrounding the missing data point (DeMers 1997). Arcview™ does not require interpolation, so grid coordinates that did not have geophysical data were left blank. Maps for all data sets were created in this manner.

Because the GEM-300 had to be re-zeroed at the start of each day, each day's baseline was slightly different. In addition to this, rain during the latter half of fieldwork caused heightened conductivity readings in subsequent days. It was therefore impossible to filter the entire site's conductivity data together, and the data were divided into individual workdays to counteract this problem. Each workday corresponds to the numbered sections in Figure 2-1. The gradiometer data were split into the same sections as the conductivity data for ease in comparison.

When all sixteen frequencies of conductivity were mapped for several of the sections, it became apparent that not all were needed. The water table interfered with the lower frequencies, and the higher frequencies overlapped considerably; therefore, six frequencies were chosen for processing, including two lower frequencies to be sure that any deeper cultural deposits were not missed. The chosen frequencies were 19,950 Hz, 11,490 Hz, 6,630 Hz, 2,910 Hz, 990 Hz and 330 Hz. After all maps were made, it was apparent that 990 Hz and 330 Hz were always affected by the water table. The water table caused highly erratic readings and so these frequencies were not processed further. All described procedures were carried out on the remaining frequencies.

Color-shaded density maps with overlain contour lines were created. All maps had blue contours for negative values and red for positive to enhance dipole recognition and differences between positive and negative conductivities. All contour lines and shading were done in

Arcview.™ Contour intervals for each map are different. Contour intervals were started with the lowest negative number in the dataset and continued to the highest positive. It was not possible to isolate zero as the starting point and have the contours set accordingly; therefore, the interval was changed until zero became a natural break. This problem complicated later interpretation.

Removing Interference

The old archaeological excavation units scattered throughout the survey area affected the data, because the soil had been completely disturbed. The soil in the units was less compact than surrounding soil, so would contain more water, which could affect conductivity. Magnetic minerals in the disturbed soil would likely be re-oriented, causing magnetic anomalies. The gradiometer had detected dipoles caused by all the old excavation units across the site, and their gradients were so high that they might mask any potential archaeological anomalies.

The location of all old excavation units had been recorded during the geophysical survey. This information was made into maps of each section, scanned, digitized on screen, geocorrected to match the coordinates of the existing maps and overlain on the gradiometer plots. The coordinates of the affected areas could then be easily found and recorded. The data could not be deleted directly from the maps, so were deleted from the Excel™ files. New maps were constructed, in which the readings taken near old excavation units were entirely absent. The new gradiometer maps showed several promising anomalies.

The conductivity dataset did not show evidence of the archaeological excavation units, and it also contained only one possible anomaly. This suggested that either the soil wasn't conducive to this type of geophysical technique, or differences in conductivity were extremely subtle and hard to detect. In order to eliminate the interference caused by subtle differences between excavation units, archaeological features and the background soil, new maps with excavation units removed were created for the conductivity data as well. These maps did not isolate any additional conductivity anomalies.

De-spiking

Many of the conductivity maps showed spikes in the data (a spike is an isolated data point with extremely high value surrounded by average values). The most reliable way to determine whether a datapoint is a spike is to look at the dataset in profile. As Arcview™ cannot make profiles appropriate to this type of dataset, profiles were made in Excel.™ The first de-spiking was conservative (Figure 2-2). Only the most extreme values were removed (Figure 2-2b). After the datasets were de-spiked, new maps were created. These maps did not show any additional anomalies. The data were de-spiked again, more aggressively than the first time (Figure 2-2c). The resulting maps showed only one anomaly (Anomaly 3), and so the data were de-spiked a third time, removing all data spikes (Figure 2-2d). No new anomalies were detected.

To determine if the number of spikes at Grove's Creek Site was typical, I contacted the United States Forest Service representative. It was discovered that the electromagnetic profiler had been serviced during a project that was conducted directly after the Grove's Creek Project. The instrument had been randomly generating unusually high readings. Although the manufacturer did not think the Grove's Creek Site dataset had been affected by the same problem, it should be mentioned that some of the above spikes might have been caused by an instrument malfunction. Alternatively, the spikes may be the usual number of spurious readings that are found in any dataset. They were found on all days and when found in one frequency, appeared in all. It is unlikely that they were caused by sunspot activity, as that would have resulted in erratic behavior over longer periods. It is also unlikely that trash or cultural remains would cause spikes, as both should have caused broader anomalies. The spikes were most likely generated randomly by the instrument, but it cannot be determined whether this was a malfunction or was typical of the instrument's usual operating procedures.

Filtering

A trend was visible in some of the conductivity maps. It was generally seen in the sections next to the marsh as a dip in the marsh direction (east) (Figure 2-1). Near the drainage, it dipped in the direction of the drainage and the marsh (northeast) (Figure 2-1). Trends in a dataset can obscure smaller features. One method to lessen the effect of the trend and enhance the small features is by applying a high-pass filter. Imagine™ has many options for all filter types, so tests needed to be conducted to determine the most appropriate filter parameters.

Several test datasets were created to mimic the conductivity data (Figure 2-3). Both 3x3 and 5x5 pixel (3 and 5 m on the ground) high-pass, edge enhancement and edge detect filters were applied. The 3x3 pixel filter size created less of an edge-effect than the 5x5 pixel. The color contrast had to be adjusted after each filter was applied, otherwise the map contained only a few colors and no features could be seen. All filter types proved equally suitable for isolating the small anomalies in the test datasets. When the filters were applied to the actual conductivity datasets, no new anomalies were detected (Figure 2-4).

Correction for Magnetic Latitude

Magnetic anomalies must be interpreted relative to the magnetic latitude of the survey area. Depending on the geographic position of the survey site, the anomaly will be offset a certain distance and cardinal direction from the object that created it (Burger 1992; Dobrin and Savit 1988; Weymouth 1986a). My original intention was to enter the equation for reduction to the pole (Baranov and Naudy 1964) into the software package and apply it to the data. However, neither software package had the capabilities to work with such a multi-variable equation. As a result, an adequate, though less precise method was employed. As stated, all excavation unit positions were overlain on each map. Eight of the thirteen survey sections had at least one excavation unit. The distance and direction of each anomaly from its corresponding excavation unit was determined, resulting in a typical pattern for the entire site. The anomaly was offset slightly to the north and east of the excavation unit that generated it. This pattern was used to determine the positions of the unknown features in relation to their anomalies.

Correction for magnetic latitude was one instance in which the old excavation units were useful. However, if there are no such surface features available on a project, an alternative method for determining the correction is needed. By using an appropriate modeling equation, such as the equation for magnetic effect of a sphere, the horizontal offset between the subsurface feature's position in the earth and the anomaly peak can be determined. This was done at Grove's Creek Site using the equation for magnetic effect of a sphere and IGRF2000 data for magnetic intensity and inclination (Figure 2-5). The graph indicates that the subsurface feature should be found directly under the highest peak of the anomaly, although the base of the anomaly was shifted slightly.

DETERMINING FEATURE TYPE

After all the maps had been created and processed, six anomalies were identified: four gradiometer anomalies, one conductivity anomaly, and one anomaly that had both gradient and conductivity components. The anomalies were numbered in the order that they were to be ground-truthed.

Anomaly 1

Anomaly 1 was located in Section 2 of the geophysical survey grid (Figure 2-1). It was a large, magnetic dipole anomaly. The entire anomaly, including both negative and positive components, measured approximately 10 m north-south and 6 m east-west (Figure 2-6). Such a large anomaly could be produced either by a deep feature or a large feature. If it were a large feature, it could be the remains of a structure. This hypothesis was supported by the fact that this area was on a bluff overlooking the marsh area and perhaps the old creek bed, a common building location in prehistoric times (DePratter 1978; McMichael 1980).

Anomaly 2

This conductivity anomaly was located in Section 7 (Figure 2-1). It measured 1 m north-south and 2 m east-west (Figure 2-7). The values were extremely positive, showing that its conductivity was lower than the surrounding soil. It was hypothesized that the anomaly could represent a buried discreet shell midden. Porous limestones, analogous to shell middens in composition, are not as conductive as sand and soil (Tite 1972). Small household shell middens are common at this time period on the Georgia Coast (Pearson 1977) and could possibly identify the position of a wooden structure.

Anomaly 3

This anomaly was the only one found by both instruments. It was located in Section 16 (Figure 2-1). The magnetic component was a dipole that measured at least 4 m north-south and 3 m east-west (Figure 2-8a). The conductivity component was at least 2 m^2 (Figure 2-8b). The exact size cannot be determined as the anomaly was in the corner of the survey area. Because the subsurface feature created both strong gradient and negative conductivity readings, it was hypothesized that it was a metal object.

Anomaly 4

Anomaly 4 was the only one of two gradient anomalies found in the field south of the drainage (Figure 2-1). It was a weak dipole that measured approximately 3 meters on each side (Figure 2-9). Although some old excavation units were in that field, they belonged to an unknown investigator, so nothing was known of the cultural remains in this area. Even a small excavation unit, such as the one to test this anomaly, might help determine if the village site extended over the drainage. The anomaly could have represented a burned clay feature, such as a hearth, due to its small dimensions. However, it could also have represented modern trash given all the modern building debris nearby.

Anomaly 5

This anomaly was found in Section 9 (Figure 2-1). It was a dipole anomaly with values only slightly above background, but appeared to be rather large (Figure 2-10). A looter pit to the west of the anomaly and a drainage to the north affected the reading and made the size hard to determine. It resembled a weaker version of Anomaly 1. This area was also well situated for a structure, as it was on a slight bluff next to a fresh water drainage.

Anomaly 6

Anomaly 6 was located in Section 1 (Figure 2-1). Quite a bit of modern trash was in the area as well as several large excavation units from unknown excavators. This anomaly had the highest magnetic gradient values. It measured approximately 7 m north-south and 5 m east-west. It was close in size to Anomaly 1, but with higher readings (Figure 2-11). With all the trash around, it was suspected that the anomaly was caused by metal; however, there was no associated conductivity anomaly. Excavations on Anomaly 3 would show whether this was significant. If Anomaly 3 was caused by metal, this would suggest that Anomaly 6 was not, and would help determine if this anomaly represented a structure.

GROUND-TRUTHING METHODS AND RESULTS

After the coordinates of each anomaly were determined, a 1 m^2 excavation unit was dug in the corresponding grid square. Each excavation unit was screened through both 6.35 mm (1/4 inch) and 1.58 mm (1/16 inch) mesh to recover artifacts. All units were excavated in 10 centimeter levels and maps were made at each level. All standard archaeological excavation techniques were employed. Results for all anomaly testing are seen in Table 1.

Anomaly 1

The unit was excavated until it reached a very dark, organic-rich lens. As this appeared to be a living surface, several units were expanded to the north and west. When a 2 m^2 unit had been excavated, the organic layer covered the bottom of the entire unit and the excavation was expanded to the north and east. Large quantities of daub (burned clay) were uncovered to the east. Subsequent units produced more daub, and eventually an intact wall fragment (Figure 2-12). Anomaly 1 had represented all the daub wall and roof debris of a structure, totaling approximately 477 kg of daub to date. The remainder of the field season concentrated on learning as much about this structure as possible.

Anomaly 2

The unit was dug to sterile soil. Although a few artifacts were recovered, neither features, nor any shell were found in the unit. A very large root system was found in the northwest corner of the unit. The anomaly may have been caused by air-space between the roots, as air pockets in soil generally cause a low conductivity reading (Dobrin and Savit 1988; Frohlich and Lancaster 1986).

Anomaly 3

The first shovel scrape in the excavation unit hit a large, metal spike that had been pounded into the ground. No further excavations were conducted.

Anomaly 4

This unit hit subsoil at shallow depth, at which point a large, burned tree stump was discovered. The anomaly could have been caused when the stump burned; heating and oxidizing the soil around it (Weymouth 1986a). The excavation unit would have been opened further to confirm this hypothesis, but the area had clearly been severely disturbed. The surrounding area had been timbered and there were push piles along the east side of the field, directly above the marsh. This unit helped establish that most of the soil, and therefore most of the cultural material, were in the dirt piles beside the marsh. This was tested by digging the back dirt out of one of the old excavation units across the field. Its profile confirmed that most of the cultural strata were absent.

Anomalies 5 and 6

Although Anomaly 1 was excavated first, it took some time to determine that it was indeed a structure. A second crew excavated the other three units in the meantime. When the wall associated with Anomaly 1 was discovered, it was decided that it would be better to concentrate on the known structure rather than disturbing two other potential structures that could not be excavated at that time. It seemed unethical to further disturb a site that had had so much damage done to it.

DISCUSSION - DETERMINING FEATURE TYPE

Two of the four feature types were predicted correctly. A greater number of anomalies to choose from may have resulted in a higher rate, because a range of anomaly types that could have been compared and contrasted may have enabled finer distinctions to be recognized. The lack of archaeological anomalies can be explained by the extent to which the site has been disturbed, and the fact the electromagnetic profiler was ineffective at this particular site. The old excavations at the site affected the geophysical survey in two ways. The first is that the areas closer to the largest fresh water drainage, the area most likely to have cultural remains, had been excavated so intensively that no room was left for a geophysical survey. The survey had to be pushed farther out, away from the probable heart of the village. The second was that the strong geophysical signatures of the old excavation units in over half of the surveyed sections very possibly masked any smaller cultural features nearby.

The fact that the electromagnetic profiler was either not working properly or the soil was not well suited to it, decreased the variety; and therefore, the number of features that could be found. Issues concerning the instrument have already been discussed. It is possible that the soil type, Lakeland Sand (USDA 1974), is not conducive to this geophysical technique. Lakeland Sand is a well-drained soil, and the lack of water in the soil may have contributed to the lack of conductivity differences between cultural and non-cultural features. It was hypothesized that high water content in organic features, such as trash pits, would have been detected by the electromagnetic profiler. If the water content was equally low across the site, there would have been no differences for the instrument to detect.

In the future, the number and variety of features can be increased by conducting a large-grid geophysical survey, then tightening the spacing over "hotspots" to look at them more closely. A large-scale geophysical survey, along with the associated visual surface survey, made me fairly confident that sections 6, 11, 12 and 13 were not likely to have intact cultural remains and were therefore not beneficial areas in which to continue working. Areas such as 9 and 1 that contained Anomalies 5 and 6, respectively, have interesting anomalies that should be surveyed with a tighter gradiometer grid spacing and a ground penetrating radar system.

EVALUATING GIS AS A GEOPHYSICAL PROCESSING TOOL

It should be clearly stated that each GIS is different. They are each constructed using different software packages and different data, and there are different intentions for building each one. I used specific software and data to construct the GIS used for this project. Not all GIS software are the same, and different results can be achieved with different systems. This paper is not intended to be conclusive with respect to GIS and geophysical processing in general, but hopefully provides the impetus for continuing a much broader study of the multiple benefits of GIS to all branches of archaeology.

Map Construction

The fact that the data did not have to be interpolated into a grid was one of the best features of the GIS. Removing all the old excavation units while leaving their associated grid coordinates blank would not have been possible if the data had to be interpolated. When small areas or points need to be removed, such as during de-spiking, interpolation may not be a problem. However, when larger areas have to be removed, as with the excavation units, large blocks of the map have inferred values inserted. The result can be misleading and difficult to interpret. If the survey area is slightly irregular, the interpolated map may be stretched in certain places to normalize the shape. This will not only distort the shape of any anomaly present, and possible make it appear larger, it will diminish the excavator's chance of being able to find a feature with a 1 m^2 excavation unit.

The problem of setting contour intervals to radiate from zero was a small problem, but one that made it difficult to compare different maps. Depending on the software, however, this may not be a universal problem in using GIS as a geophysical processing tool.

Removing Interference

Removing interference was a time-consuming, difficult process. Each time datapoints needed to be removed, it had to be done in Excel™ and imported back into Arcview™ before being viewed. If any datapoints were overlooked, the process had to be repeated. This was one of the major drawbacks of this processing technique.

De-spiking

The inability to view each individual transect in profile was perhaps the biggest drawback of using a GIS for geophysical processing. Profiles are integral to geophysical processing, not only to help determine whether a datapoint is a spike, but also to calculate depth and size of the feature causing the anomaly (Burger 1992; Dobrin and Savit 1988). Although the data could be profiled in Excel,™ this was a cumbersome process because the program is simply not designed for this type of work.

Filtering

Some GIS software contains comprehensive filtering abilities. There are set filters for novices, and experts can write their own. Most filtering is performed in the spatial domain, although there are capabilities in the frequency domain as well. The purpose of the high-pass filters used during this project was to isolate small anomalies. No new anomalies were detected, but this may be because there were none to be found.

Correction for Magnetic Latitude

Although the reduction to the pole equations could not be programmed into the software, alternative solutions were found. The process of determining magnetic latitude adjustments based on known disturbances has drawbacks, however. It was much easier to find the location of small anomalies (the metal spike) than of the larger ones (the structure). Modeling anomalies for the study area is an accurate method for determining magnetic correction, but may be difficult for someone without a background in geophysical theory. In trying to map a village site, and locate the center of each structure, it would be advantageous to have a software package with the appropriate capabilities.

RECOMMENDATIONS AND CONCLUSIONS

The Grove's Creek Project was successful in finding a prehistoric structure with a geophysical survey. The GIS used for this project was useful in that process. Archaeologists who use a mapping program to interpret their geophysical data should consider using a GIS instead. A GIS shares the same mapping options, such as contouring, shade maps, etc., and in most respects, are just as easy to use. One of the most useful procedures available in a GIS is gridding without interpolation. Although high-pass and low-pass filters are included in mapping programs, they cannot be as easily altered as in a GIS, where they can be constructed manually. There are also more types of filters to choose from in a GIS. I would recommend using a GIS instead of a mapping program for interpreting geophysical data.

It should be kept in mind, however, that there is no substitute for a program designed specifically for geophysical processing. Important options, such as applying specialized equations, will make data processing easier and more accurate. Many of these programs are less-expensive than a GIS and would pay for themselves in a very short time. If an archaeologist has a choice between a GIS and a mapping program, the GIS is preferable, but only a true geophysical processing program can give the most accurate results.

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Table 2-1: Results of Anomaly Testing

Anomaly Number	Location	Anomaly Type	Suggested Archaeological Feature Type	Feature Type Uncovered
1	Section 2	gradient	structure	wall and roof debris
2	Section 7	positive conductivity	discreet shell midden	root system
3	Section 16	gradient – negative conductivity	metal	metal spike
4	Section 17	gradient	hearth	burned stump
5	Section 9	gradient	structure	not excavated
6	Section 1	gradient	structure or trash	not excavated

Figure 2-1: The Grove's Creek Site. Numbered areas correspond to geophysical survey sections.

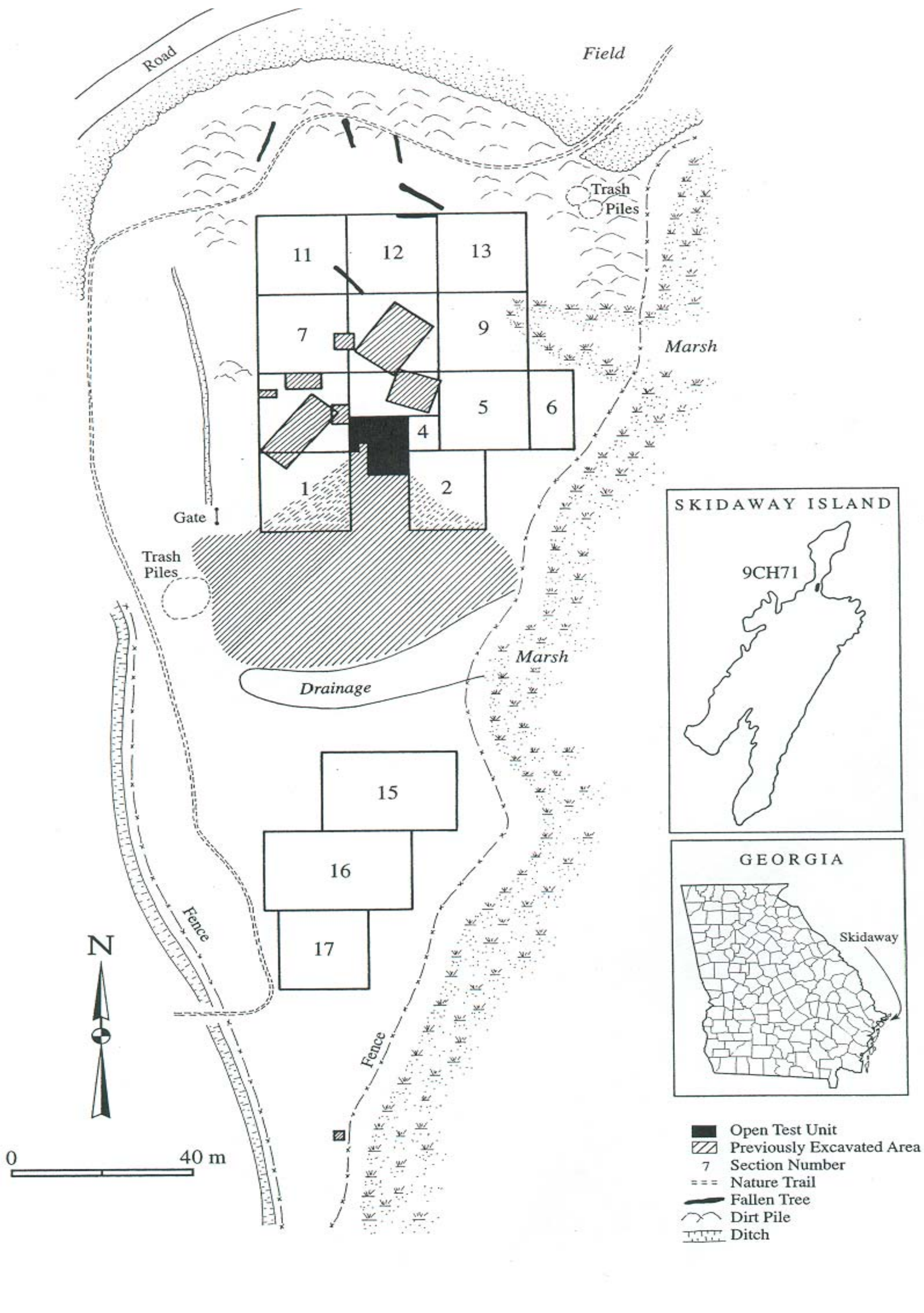

Road
Field
Trash Piles
11
12
13
7
9
5
6
4
1
2
Marsh
Gate
Trash Piles
Marsh
Drainage
15
16
17
Fence
Fence
N
0
40 m
SKIDAWAY ISLAND
9CH71
GEORGIA
Skidaway
Open Test Unit
Previously Excavated Area
7 Section Number
Nature Trail
Fallen Tree
Dirt Pile
Ditch

Figure 2-2a: Profile of Section 2 11,490 Hz conductivity dataset before de-spiking.

Figure 2-2b: Profile of Section 2 11,490 Hz conductivity dataset after first de-spiking.

Figure 2-2c: Profile of Section 2 11,490 Hz conductivity dataset after second de-spiking.

Figure 2-2d: Profile of Section 2 11,490 Hz conductivity dataset after third de-spiking.

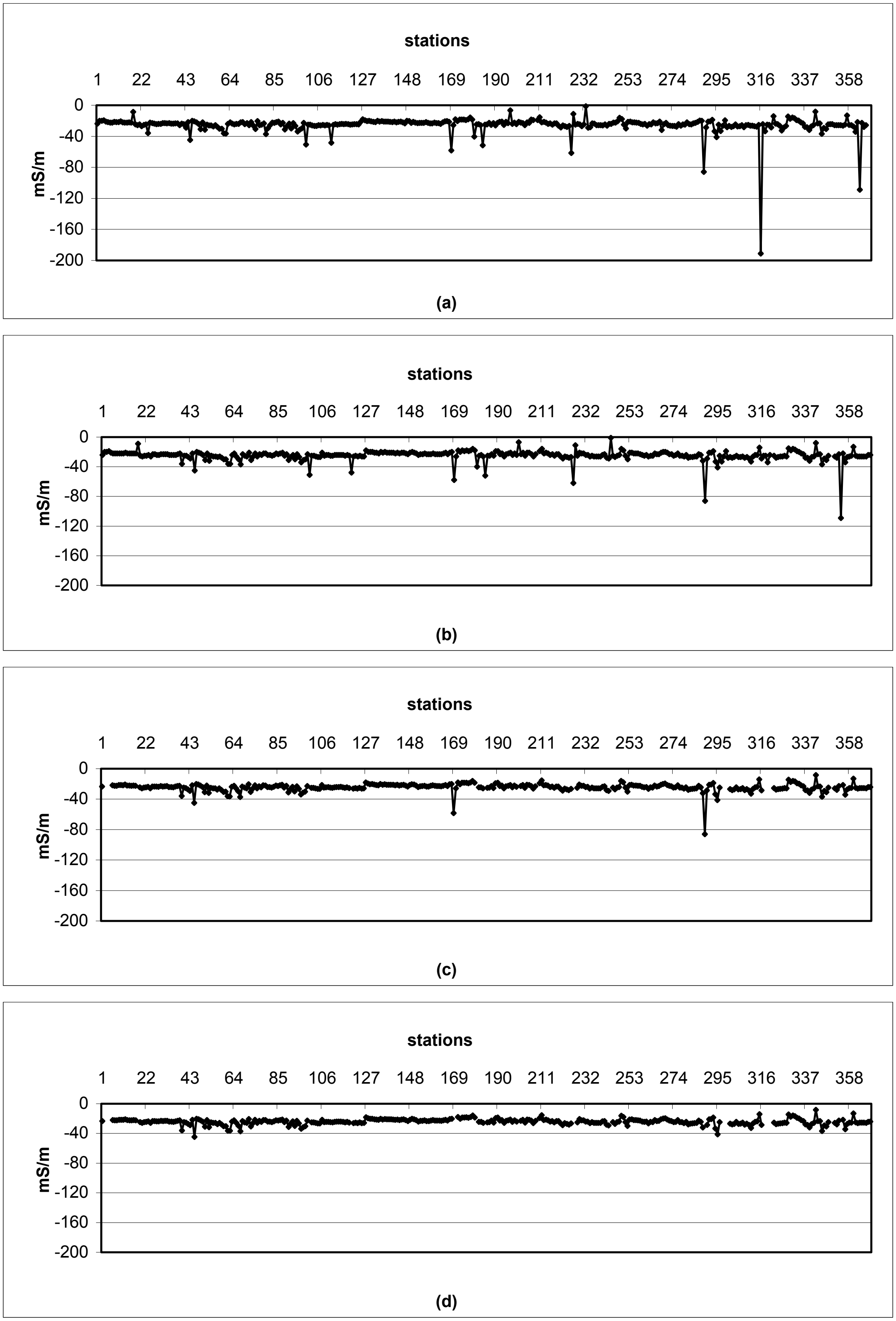
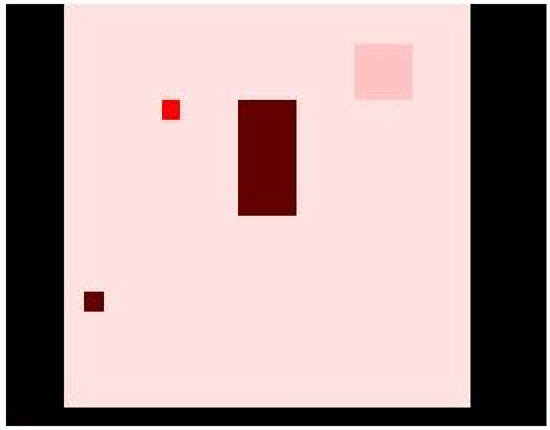
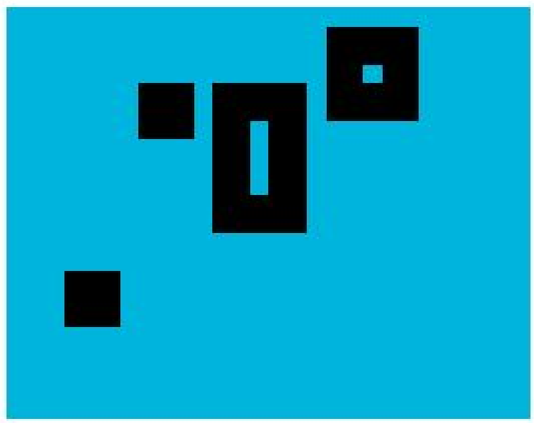

stations
1 22 43 64 85 106 127 148 169 190 211 232 253 274 295 316 337 358
0 -40 -80 -120 -160 -200
mS/m
(a)
stations
1 22 43 64 85 106 127 148 169 190 211 232 253 274 295 316 337 358
0 -40 -80 -120 -160 -200
mS/m
(b)
stations
1 22 43 64 85 106 127 148 169 190 211 232 253 274 295 316 337 358
0 -40 -80 -120 -160 -200
mS/m
(c)
stations
1 22 43 64 85 106 127 148 169 190 211 232 253 274 295 316 337 358
0 -40 -80 -120 -160 -200
mS/m
(d)

Figure 2-3: Test dataset number six. (a) Original dataset with four visible anomalies. (b) Edge detect filter applied (c) edge enhancement filter applied (d) high pass filter applied

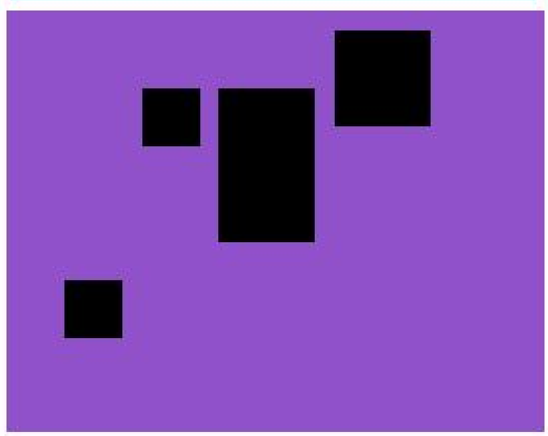
(a)



(b)



(c)



(d)

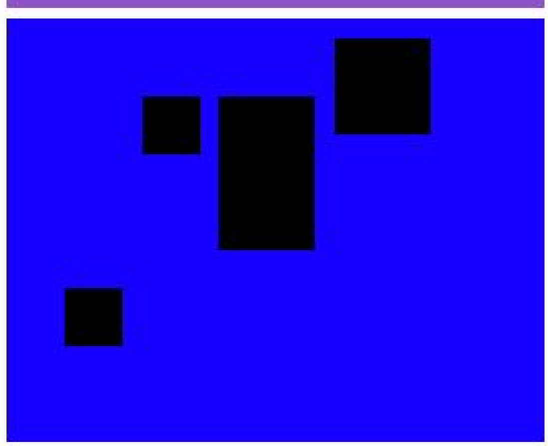
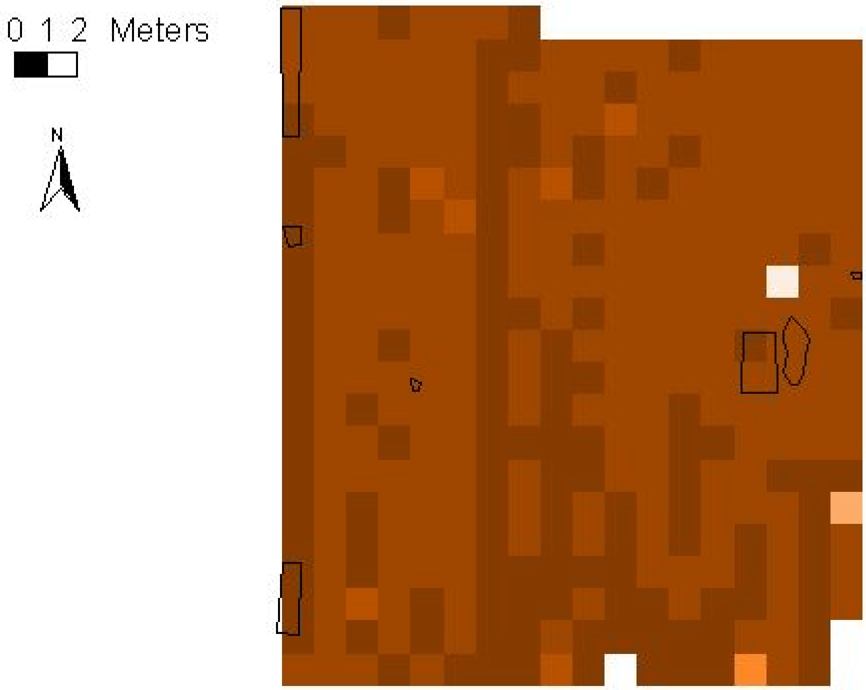
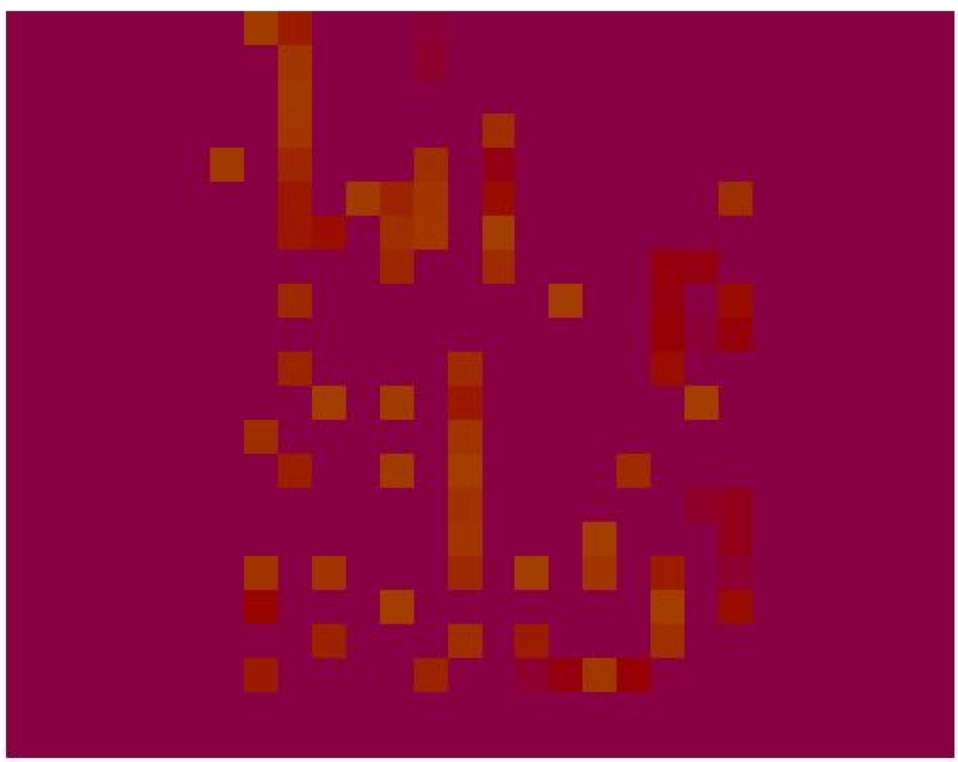


Figure 2-4: Result of high-pass filter applied to conductivity data from Section 2 (Figure 2-1). (a) Map of conductivity data from Section 2. Black outlines represent old excavation units, one with associated backdirt pile. (b) Section 2 conductivity dataset with high pass filter applied. No anomalies detected.

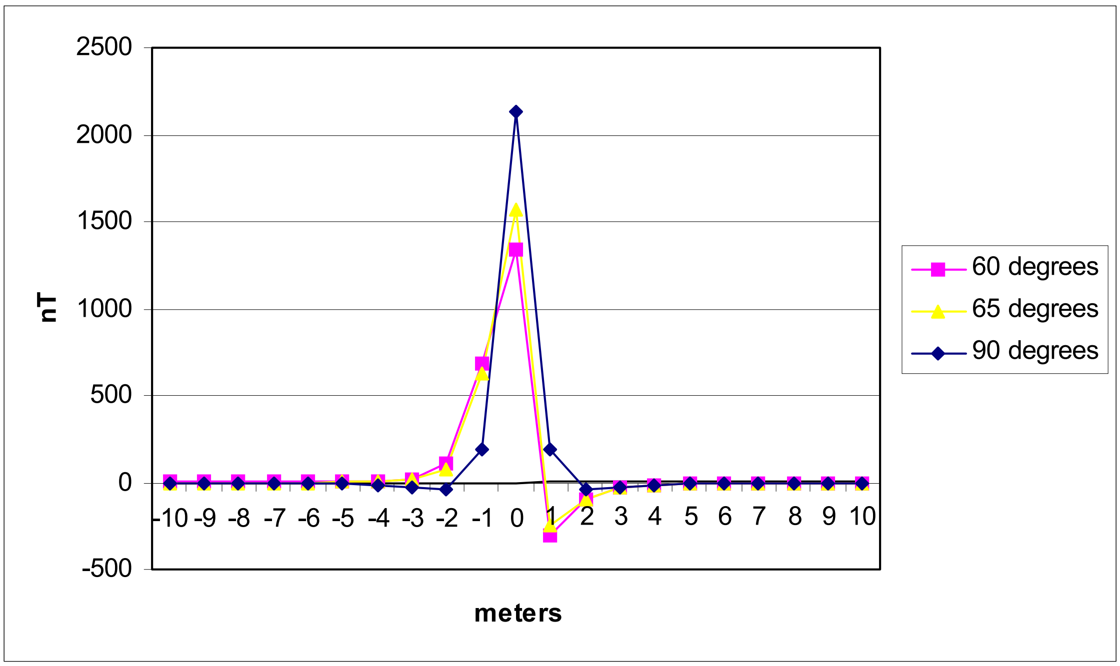


(a)



(b)

Figure 2-5: Total field magnetic anomalies over a uniformly magnetized sphere for 60, 65 and 90 degrees magnetic inclination. Graph indicates that subsurface feature will be directly under highest peak of the anomaly at all inclinations, however, at 60 and 65 degrees, anomaly becomes asymmetric, with both positive and negative components.



2500
2000
1500
1000
500
0
-500
nT
-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10
meters
60 degrees
65 degrees
90 degrees

Figure 2-6: Anomaly 1 (in Section 2 on Figure 2-1) is a large magnetic gradient anomaly on the east side of the map. Red contour lines represent positive gradient values, and blue contour lines represent negative gradient values. Contour interval is 0.15 nT/m. The black outlines represent an old excavation unit with associated backdirt pile. Stations at which readings could not be taken are shown in white.

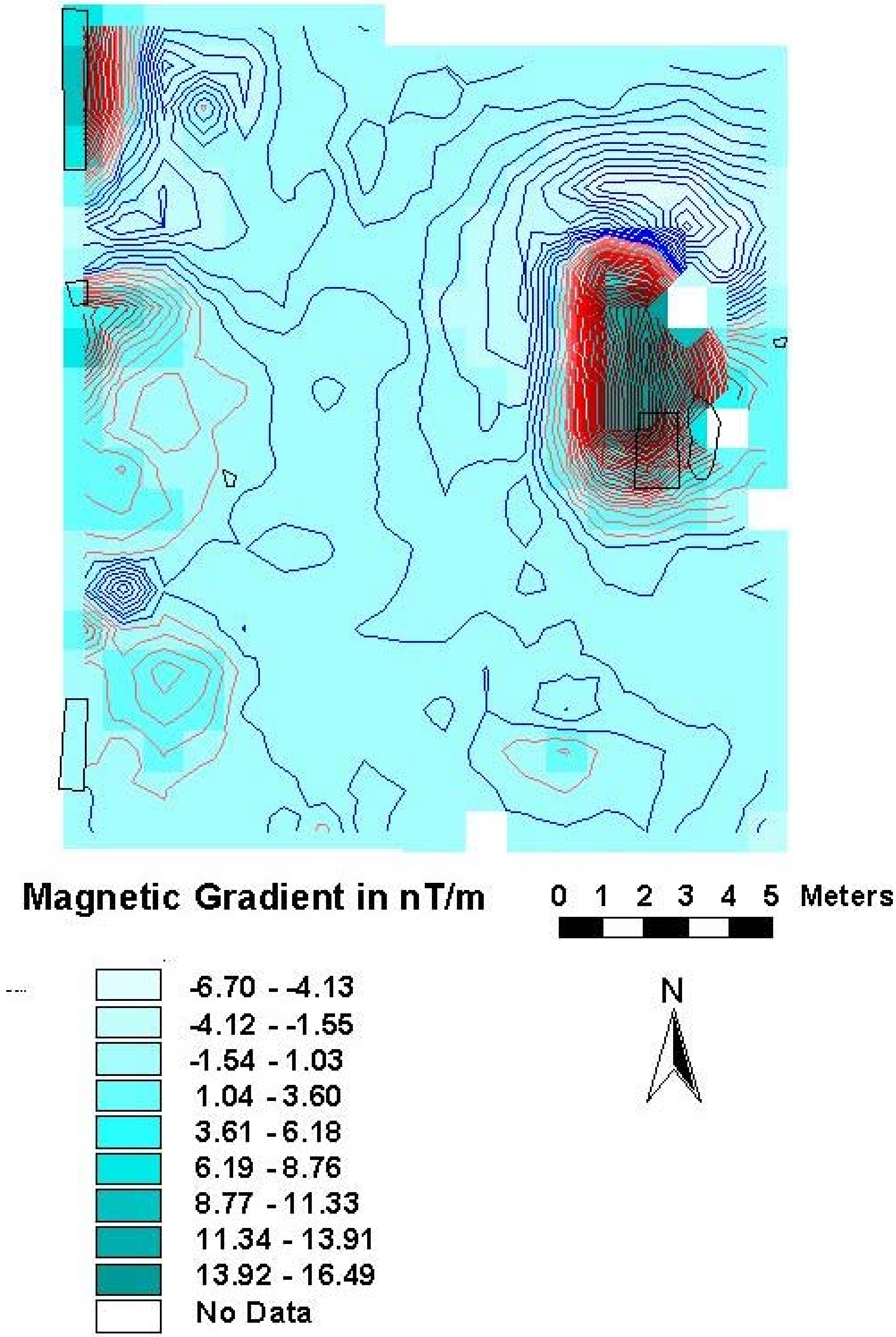

Magnetic Gradient in nT/m
0 1 2 3 4 5 Meters
-6.70 - -4.13
-4.12 - -1.55
-1.54 - 1.03
1.04 - 3.60
3.61 - 6.18
6.19 - 8.76
8.77 - 11.33
11.34 - 13.91
13.92 - 16.49
No Data
N

Figure 2-7: Anomaly 2 (in Section 7 on Figure 2-1) is a positive 11,490 Hz conductivity anomaly in the northeast quadrant of the map. Red contour lines represent positive conductivity values, and blue contour lines represent negative conductivity values. Contour interval is 9 mS/m. The black outlines represent old excavation units. Stations at which readings could not be taken are shown in white.

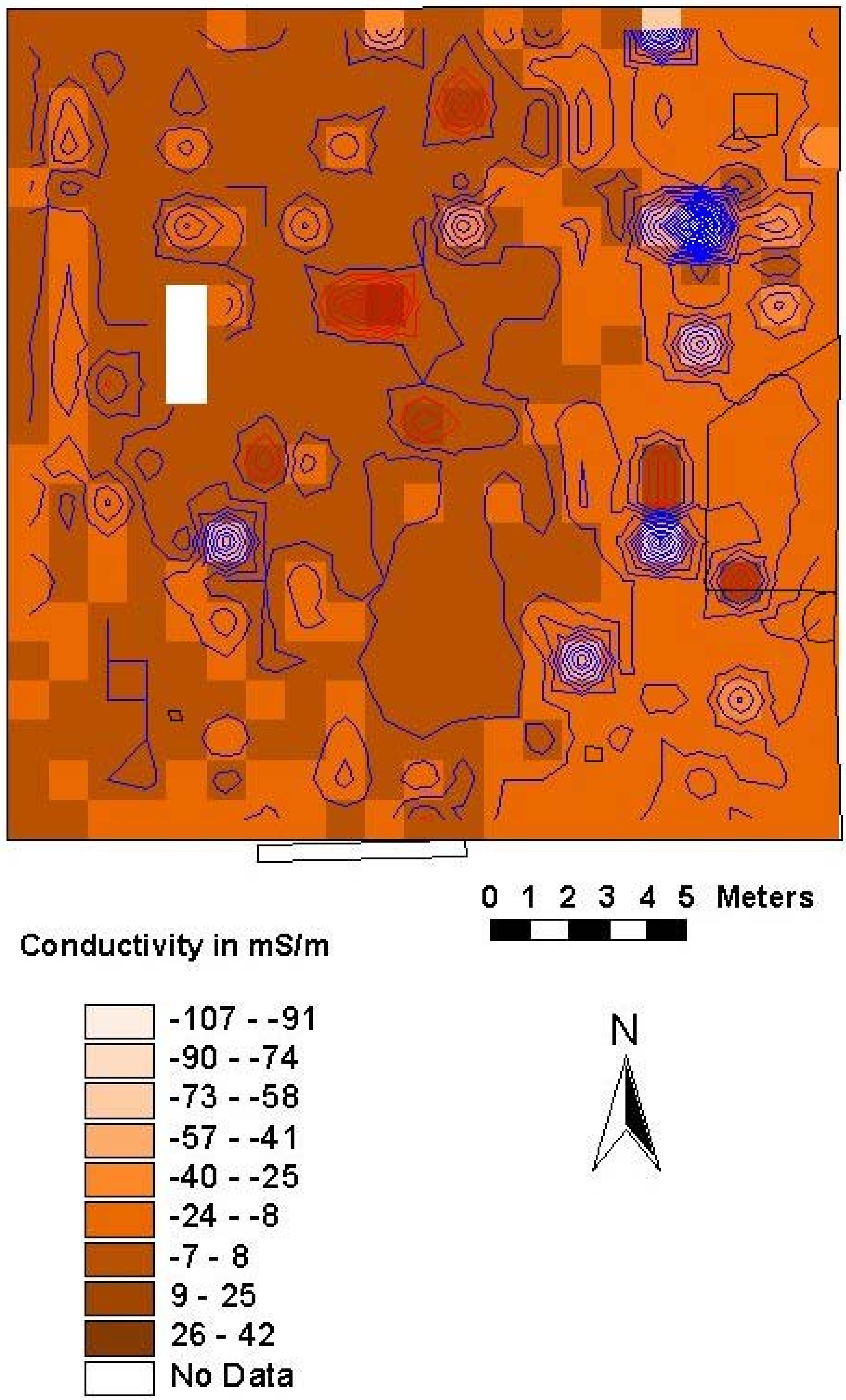

0 1 2 3 4 5 Meters
Conductivity in mS/m
-107 - -91
-90 - -74
-73 - -58
-57 - -41
-40 - -25
-24 - -8
-7 - 8
9 - 25
26 - 42
No Data
N

Figure 2-8a: Anomaly 3 (in Section 16 on Figure 2-1) is a magnetic gradient anomaly in the southeast corner of the map. Red contour lines represent positive conductivity values, and blue contour lines represent negative conductivity values. Contour interval is 0.25 nT/m. The black outlines represent old excavation units. Stations at which readings could not be taken, or were removed, are shown in white.

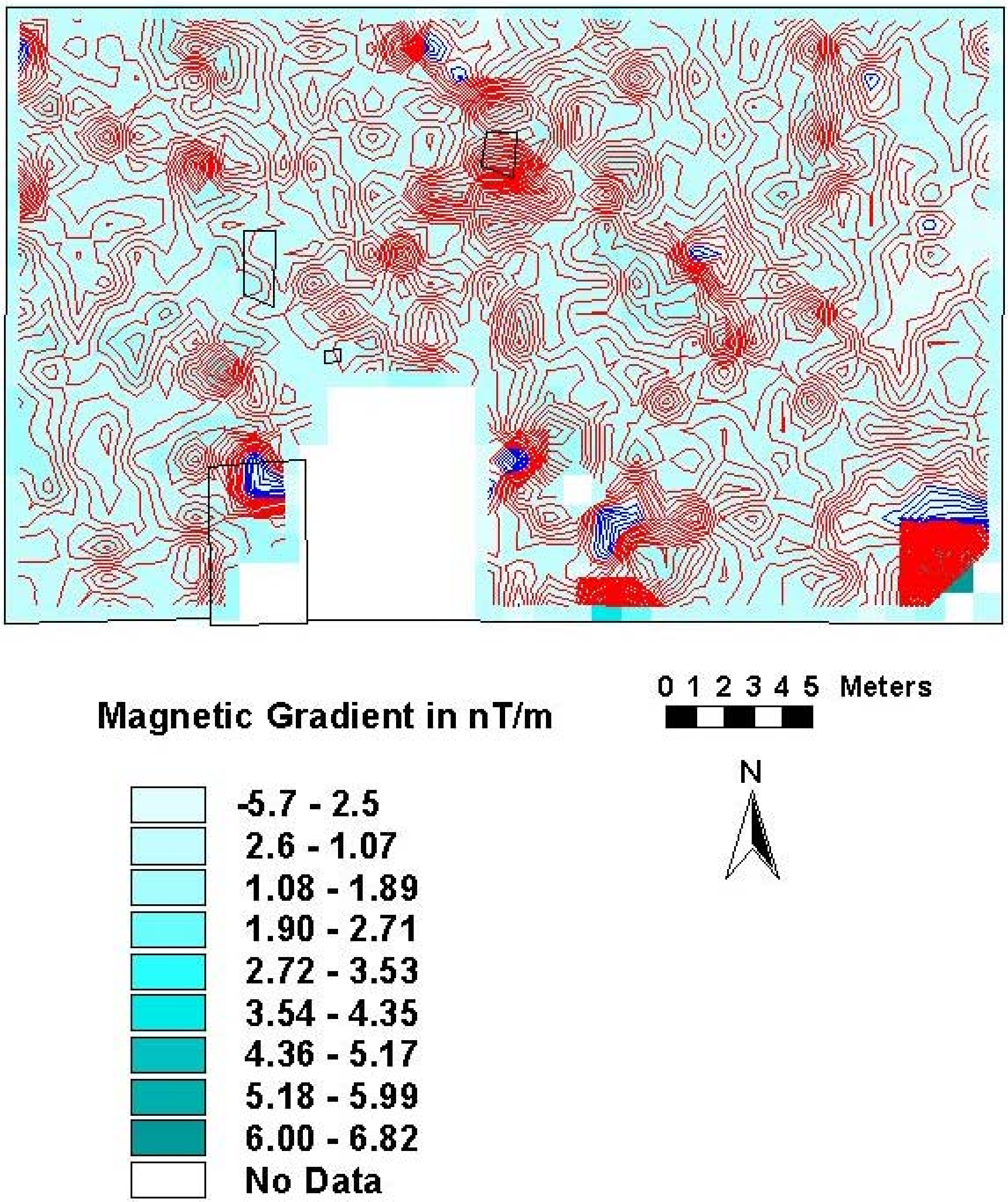

Magnetic Gradient in nT/m
0 1 2 3 4 5 Meters
N
-5.7 - 2.5
2.6 - 1.07
1.08 - 1.89
1.90 - 2.71
2.72 - 3.53
3.54 - 4.35
4.36 - 5.17
5.18 - 5.99
6.00 - 6.82
No Data

Figure 2-8b: Anomaly 3 (in Section 16 on Figure 2-1) is a negative 11,490 Hz conductivity anomaly in the southeast corner of the map. It was identified after de-spiking twice. Red contour lines represent positive conductivity values, and blue contour lines represent negative conductivity values. Contour interval is 3 mS/m. Stations at which readings could not be taken, or were removed, are shown in white.

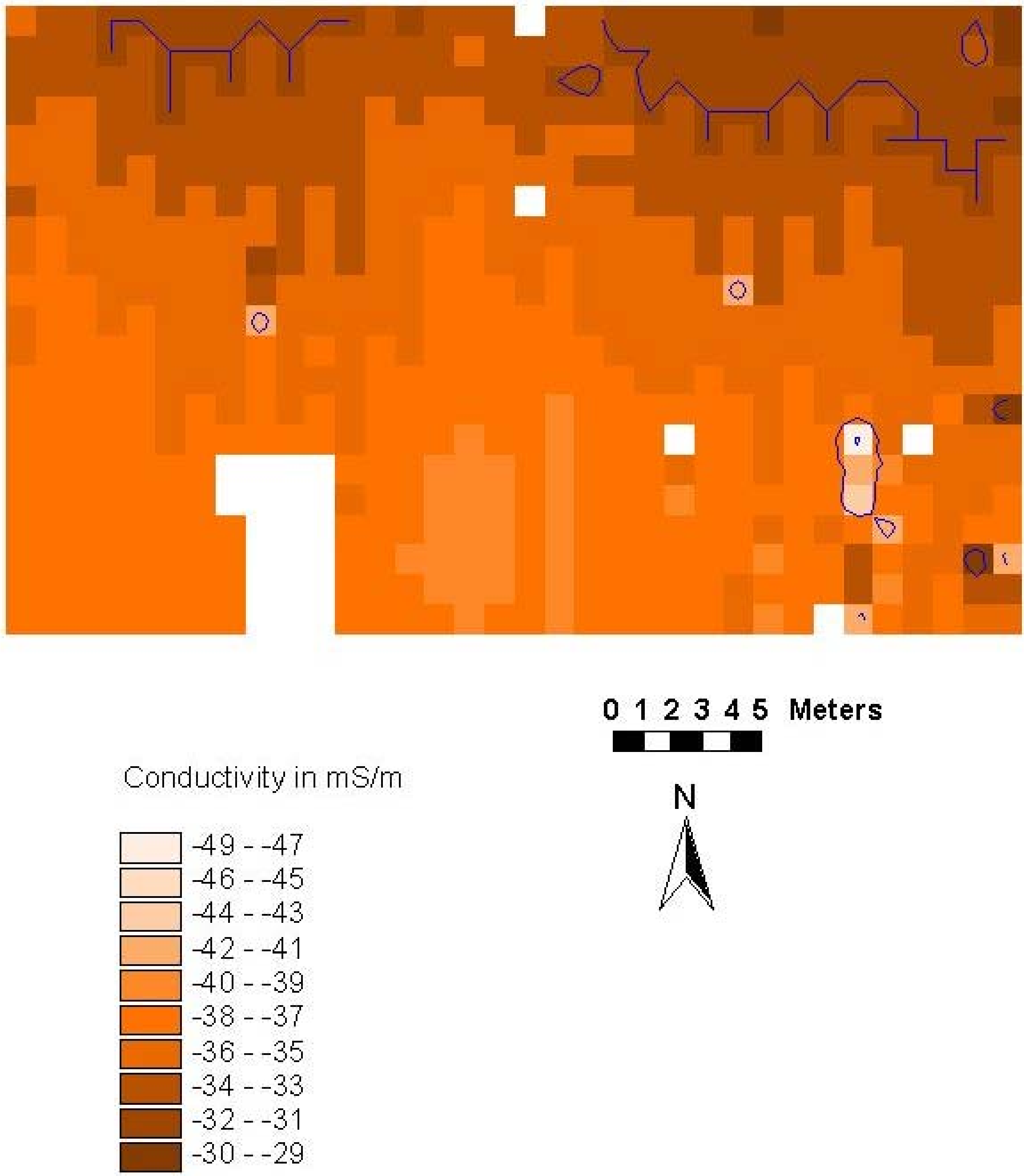
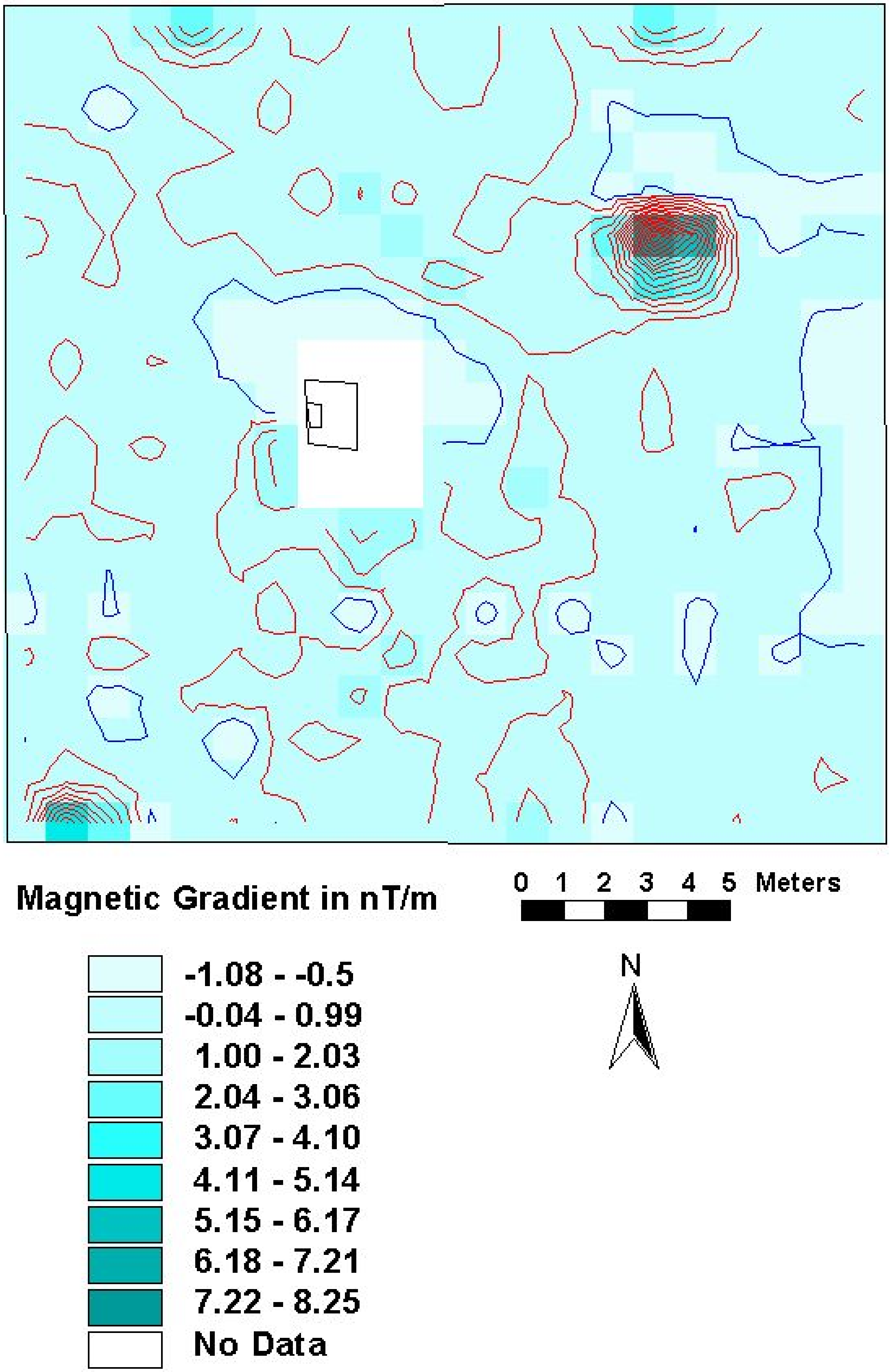
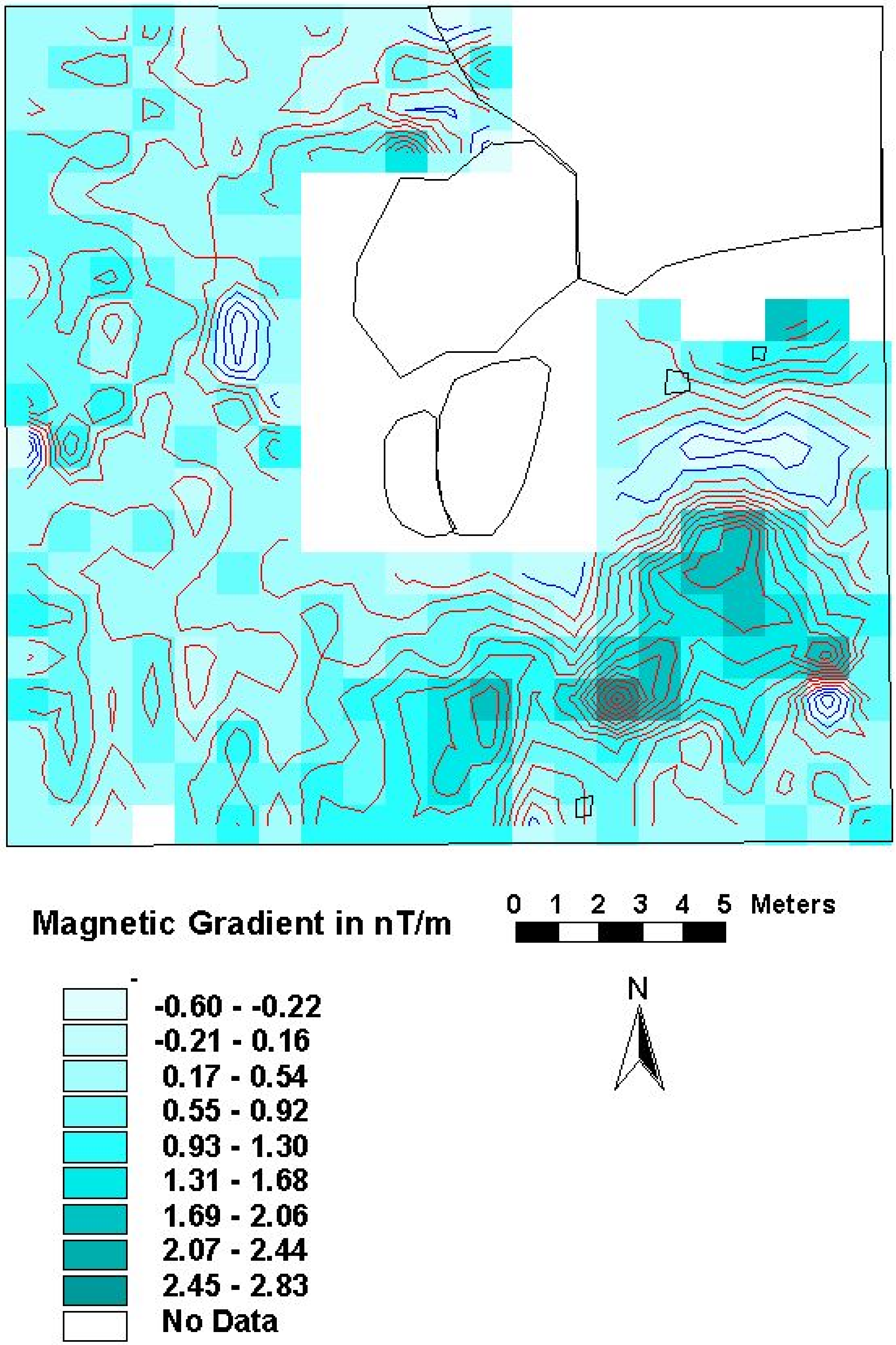

0 1 2 3 4 5 Meters
N
Conductivity in mS/m
-49 - -47
-46 - -45
-44 - -43
-42 - -41
-40 - -39
-38 - -37
-36 - -35
-34 - -33
-32 - -31
-30 - -29

Figure 2-9: Anomaly 4 (in Section 17 on Figure 2-1) is a magnetic gradient anomaly in the northeast quadrant of the map. Red contour lines represent positive conductivity values, and blue contour lines represent negative conductivity values. Contour interval is 1 nT/m. The black outlines represent old excavation units. Stations at which readings could not be taken, or were removed, are shown in white.



Magnetic Gradient in nT/m
0 1 2 3 4 5 Meters
-1.08 - -0.5
-0.04 - 0.99
1.00 - 2.03
2.04 - 3.06
3.07 - 4.10
4.11 - 5.14
5.15 - 6.17
6.18 - 7.21
7.22 - 8.25
No Data
N

Figure 2-10: Anomaly 5 (in Section 9 on Figure 2-1) is a magnetic gradient anomaly in the southeast quadrant of the map. Red contour lines represent positive conductivity values, and blue contour lines represent negative conductivity values. Contour interval is 0.2 nT/m. The black outlines represent old excavation units and a looter pit with associated backdirt pile. Stations at which readings could not be taken, or were removed, are shown in white.



Magnetic Gradient in nT/m
0 1 2 3 4 5 Meters
-0.60 - -0.22
-0.21 - 0.16
0.17 - 0.54
0.55 - 0.92
0.93 - 1.30
1.31 - 1.68
1.69 - 2.06
2.07 - 2.44
2.45 - 2.83
No Data
N

Figure 2-11: Anomaly 6 (in Section 1 on Figure 2-1) is a magnetic gradient anomaly in the center of the map. Red contour lines represent positive conductivity values, and blue contour lines represent negative conductivity values. Contour intervals are 0.50 nT/m. The black outlines represent old excavation units. Stations at which readings could not be taken, or were removed, are shown in white.

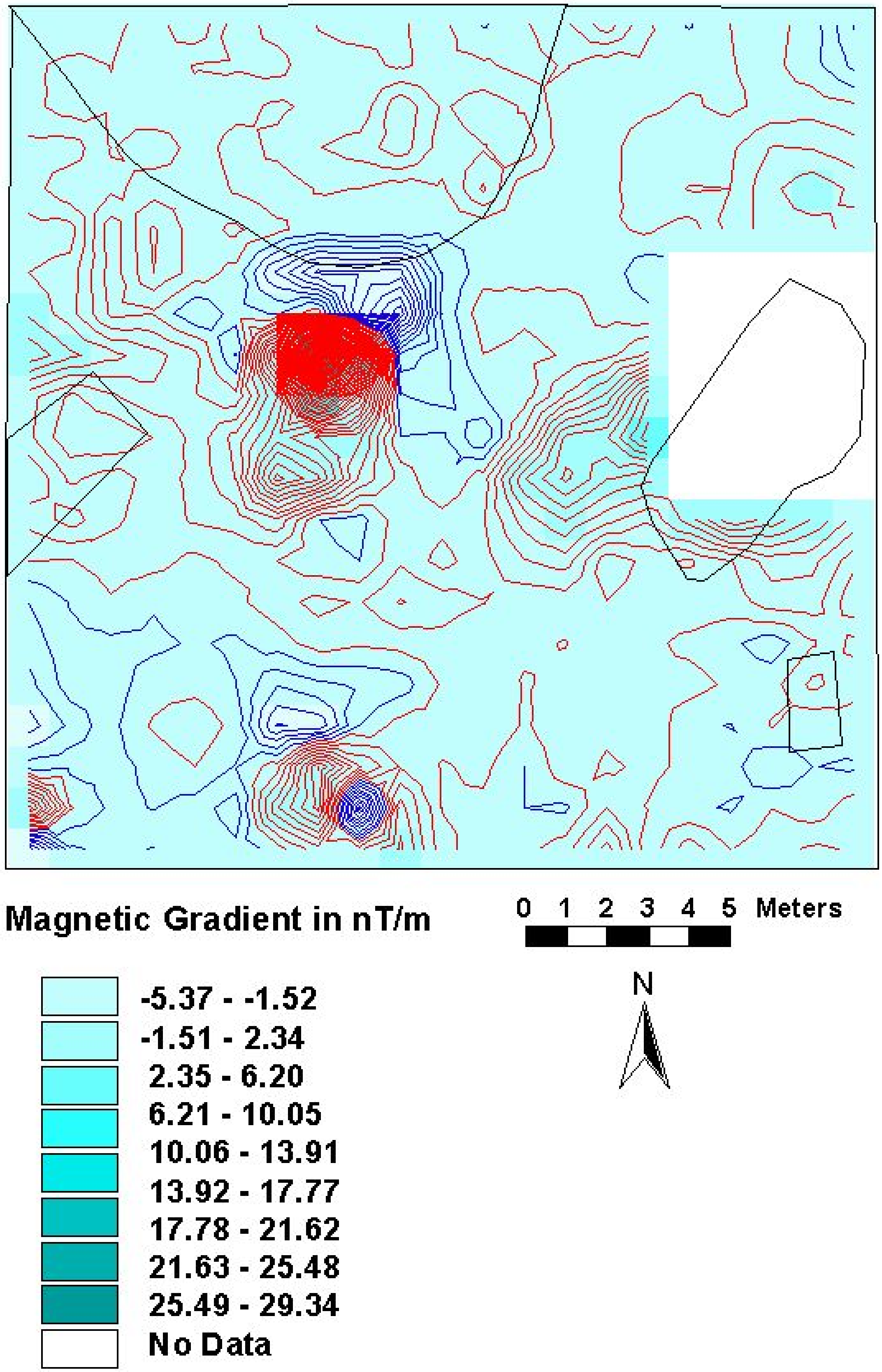

Magnetic Gradient in nT/m
-5.37 - -1.52
-1.51 - 2.34
2.35 - 6.20
6.21 - 10.05
10.06 - 13.91
13.92 - 17.77
17.78 - 21.62
21.63 - 25.48
25.49 - 29.34
No Data
0 1 2 3 4 5 Meters
N

Figure 2-12: Daub wall associated with Anomaly 1.

CHAPTER 3

IRENE PHASE ARCHITECTURE ON THE GEORGIA COAST[2]

[2] Keene, D.A. To be submitted to *Southeastern Archaeology*.

ABSTRACT

The remains of prehistoric architecture on the coastal plain are rarely found in the archaeological record, and therefore, poorly understood. A comparison is made between architectural characteristics found in the archaeological record and those described in ethnohistoric accounts, in order to characterize Irene phase (AD 1300-1450) structures on the Georgia Coast. The architectural characteristics of shape, size and construction are found to vary considerably among all archaeological examples as well as between archaeological and ethnohistoric accounts. There appears to be no universal model of an Irene phase structure, rather variation is the norm.

INTRODUCTION

Few Irene phase (AD 1300-1450) structures have been recovered on the Georgia Coast. Only six structures have been described in the literature. These include the Irene site (Caldwell and McCann 1941), Seven-Mile Bend (Cook 1971), 9CH112 (Goad 1975), Harris Neck (Braley *et al*. 1986) and Red Bird Creek (Pearson 1984) (Figure 3-1). In each of these sites, the preservation was either poor or they were part of a salvage project, which limited the amount of work that could be done. Excavations at Grove's Creek Site uncovered five structures, almost doubling the number of Irene structures known from the Georgia Coast. With these new data, there is enough information to examine the attributes of Irene coastal architecture, compare these to ethnohistoric accounts and characterize Irene phase structures. This paper examines five characteristics of each structure. The first is the date of the structure and the methods by which they were obtained. Other attributes are shape, size, construction and characterization of associated features.

Although the record of Late Mississippian coastal architecture is scant, there are numerous examples of Mississippian architecture elsewhere in Georgia. These structures have many characteristics in common. They are either round, square or rectangular, range in size from

5 m per side to over 10 m per side, were constructed of wattle overlain by either daub or mats, were often semi-subterranean, usually contained a centrally located hearth and often included other features such as storage pits and burials (Anderson and Schuldenrein 1985; Hally 1970, 1979, 2002; Hally and Kelly 1998; Hatch 1995; Kelly *et al.* 1965; Kowalewski and Williams 1989; Poplin 1990; Smith 1994). Many of these architectural characteristics can also be seen across the greater Southeast U.S. (c.f. Hally 2002; Lewis *et al.* 1995; Walling 1993). This information was drawn upon while interpreting the architectural descriptions from the Georgia coast.

STRUCTURES AT GROVE'S CREEK SITE

Site Background

Multiple excavations have been conducted at Grove's Creek Site (Figure 3-2). The first were conducted from 1985 to 1991 by Larry Babits, in association with Armstrong College and the Elderhostel Program. Ervan Garrison has headed the Elderhostel Program from 1993 through 2001. The author directed the third excavation in the summer of 2001 with volunteers and students from the University of Georgia. In addition, there have been numerous unknown excavators working at the site. Excavation units have been found throughout the site area. Some are so large it is probable that they are borrow pits for construction. Others appear to be archaeological excavations, but no documentation from these excavations exists. The data in this paper are from the Elderhostel 1985-1991 and 2001 excavations.

The site is a village associated with a large shell midden. The Elderhostel excavations uncovered four structures. The structures are oriented approximately north-south, and the midden is to their west (Figure 3-2). Unfortunately, however, some of the notes and maps from the Elderhostel excavations were lost. As a result, there are no complete maps of any of the structures. The 2001 excavation uncovered a portion of a well-preserved structure, located to the east of the other structures, and nearer to the marsh (Figure 3-2). The information gathered from the 2001 excavation, coupled with information from the remaining notes and maps, were used to determine the characteristics of the Elderhostel structures. Therefore, the data from the 2001 structure (Structure 5) is given first, as a reference for the discussion concerning the remaining structures (Structures 1-4).

Structure 5

Structure 5 consisted of two perpendicular rows of *in situ* charred posts, many charred timbers, a yellow clay floor, a wattle and daub interior wall, and a large quantity of daub. The high level of preservation suggests that it was burned during or shortly after occupation.

Date

Both absolute and relative dates were determined for the structure. Absolute dates were obtained through accelerator mass spectrometry. The uncalibrated and calibrated dates are seen in Table 3-1. All the post dates were from upright, exterior wall posts found *in situ*. The wall date is from a post found in an interior daub wall. The dates of the posts and wall range from ~AD 1300 to AD 1500, however, as the youngest date is from ~AD 1450, this is likely the date of the structure. Ceramic chronology provided the relative dates for Structure 5. The majority of sherds were Irene Filfot Stamped, with a small percentage of Irene Incised, placing the site near the beginning of the Late Irene phase (AD 1350-1450) (Braley 1990; Saunders 2000:42). Thus, the radiocarbon and ceramic chronology dates correlate.

Shape

The house appears to be square or rectangular with rounded corners (Figure 3-3). A dark stain was associated with the entire northernmost row of posts. While the northern edge of the stain was distinct, the southern border of the stain could not be isolated due to debris. A similar wall stain was found on the west side of the structure in conjunction with a north-south trending line of postholes and posts (Figure 3-3). The only area in which the wall stain was not visible was the northwest corner of the structure. The exterior wall posts of the structure were approximately 25 cm apart except in the northwest corner, where the posts were 60 cm apart. The larger gap in posts and the lack of a wall stain suggests that there may have been a doorway in this corner.

Size

Portions of only two walls have been uncovered, thus it is difficult to give exact dimensions of the structure. As hearths are often found in the center of structures (Anderson and Schuldenrein 1985; Hally 1970, 1979, 2002; Hally and Kelly, 1998; Kelly *et al.* 1965; Kowalewski and Williams 1989; Poplin 1990; Smith 1994), the distance from the hearth to the nearest wall could be used to determine size. However, no hearth has been uncovered in Structure 5 to date. Assuming that a hearth is in one of the unopened units immediately to the southeast of the excavation (Figure 3-3), the structure would be at least 6 by 6 m wide. If there is no hearth in the structure, and the remaining walls are in the next unexcavated unit, the structure would be at least 3 by 4 m wide.

Construction

Figure 3-4 is a composite map of all excavation levels, showing the full extent of the daub debris. The interior portion of the structure contained large quantities of daub, but the area around the exterior walls contains very little, indicating that the exterior walls were not daubed (Hally 2002; Poplin 1990:146). Pieces of burned cane were found in the dark stains surrounding the exterior wall, suggesting that the outside walls were constructed of cane matting that fell around the posts as it burned or rotted, staining the surrounding soil. The stain is not representative of wall trench construction, as it begins well above the floor level, does not extend below the floor level, and the postmolds associated with the charred posts extend up to 33 cm below both the floor and dark stain. Therefore, the method of construction was single-set post. Some exterior wall posts were split in half or in quarters. Some could be identified as pine (Henri Grission Mayee, personal communication 2001), the wood type for most is not known.

One intact, upright interior wall was excavated. It was constructed of daub with cane wattle (Figure 3-5). The daub was most likely tempered with Spanish moss as it was porous and contained a large quantity of organic material. The wall was removed and transported to the laboratory in three sections, where it was carefully excavated from one side to the other. The interior of the wall was filled entirely with soil, suggesting that it was hollow at some time. It is likely that only the exterior of the wall was hardened during the fire and that the interior clay eroded downward once the structure had been abandoned. The evidence for this is a large quantity of charred cane remains at the base of the wall. These were likely the remains of the wattle, which had rotted and fallen, or been pushed, to the base. Although the actual cane had been displaced, the impressions remained intact, as did three of the interior posts. Figure 3-6 is a reconstruction of the interior wall. There were posts on each end and one in the middle. One of the end posts also acted as an exterior wall support. The other end post had daub molded around it to create a smooth, rounded edge. The posts were approximately 50 cm apart. The horizontal cane impressions always appeared as pairs and were approximately 5 cm apart. One knot impression was found, suggesting that the cane pairs were tied with cordage to the vertical posts rather than woven between them.

All of the daub fragments from the site were also inspected for impressions. Cane impressions were most often found as pairs, although rarely as triplets and once with four together. These groupings of cane were 5 to 7 cm apart. It could not be determined whether the cane bunches were originally oriented horizontally or vertically; however, the intact wall contained only horizontal cane, so this is believed to be the pattern throughout the structure.

The most likely explanation for why the interior walls were wattle and daub while the exterior walls were not is that they were plastered to make the structure more fire retardant. This technique has been noted elsewhere in Georgia (Hally 2002; Poplin 1990:146). Another explanation is that the interior walls supported some of the weight from the roof. No central support posts have been found in any of the archaeological structures, and perhaps the daubed interior walls would be needed to hold up the weight of a plastered ceiling.

The unit with the upright wall section contained 31 kg of daub. However, the 1 m by 50 cm unit seen in Figure 3-4 contained 56 kg and all four units in the southeastern section of the excavation block contained between 24 and 36 kg of daub. This amount of daub could be due to the debris from more interior walls; however, these walls would need to be very close together to produce this distribution. A daubed roof interior, above the fire pit or hearth, could produce the distribution pattern seen in the excavation and would help explain why there are larger amounts of daub in the interior of the structure than at the edges (Hally 2002; Poplin 1990:146).

The structure floor was a very thin, yellow clay layer. In most areas, the daub was lying directly above it and many of the sherds were found lying horizontal either on or in it. This layer abutted the interior wall, and scalloped around the postholes of the exterior wall. It terminated at the exterior wall; however, it was discovered again in the north profile of the excavation block, suggesting that it extended beyond the exterior walls of the structure. This discovery led to several hypotheses. First, that the yellow clay layer was not a floor, but rather a natural layer upon which the inhabitants of the structure just happened to build. Secondly, that the structure was bigger in the past and had been rebuilt smaller or shifted laterally, as seen so often elsewhere in the Southeast (Hally 1970, 1979, 2002; Kelly *et al.* 1965; Lewis *et al.* 1995; Polhemus 1987; Smith 1994; Walling 1993). Lastly, there was a prepared floor outside the structure. Unfortunately, these hypotheses cannot be tested until further excavations are completed.

Semi-subterranean construction is widespread throughout the Late Mississippian Southeast (Anderson and Schuldenrein 1985; Hally 1970, 1979, 2002; Hally and Kelly 1998; Hatch 1995; Kelly *et al.* 1965; Kowalewski and Williams 1989; Lewis *et al.* 1995; Poplin 1990; Schroedl 1998; Smith 1994; Walling 1993). There is no conclusive evidence that Structure 5 was semi-subterranean, because the difference in elevation between the prehistoric ground surface and the structure floor was difficult to determine. The yellow clay floor layer, as mentioned above, was found outside the structure on the north and north-west sides. If this does indicate that the structure was re-built and shifted laterally, then the original prehistoric ground surface in this area has already been destroyed. Therefore, the difference in structure floor and prehistoric ground surface elevation on these sides of the structure cannot be resolved until further excavations are completed. The south and east sides of the excavation block did not extend outside the structure (Figure 3-3). Due to a palm tree disturbing the soil, the elevation difference between the structure floor and the prehistoric ground surface on the west side of the excavation could only be measured in one unit, and was between 3-6 cm, with the prehistoric ground surface being slightly higher. This difference could be due to the floor being naturally compacted during use or to the structure being built in a shallow pit.

An argument can be made that Structure 5 was semi-subterranean based on the preservation characteristics. The intact interior wall section was approximately 50 cm high when discovered. This level of preservation suggests that the structure was buried fairly quickly after burning. If Structure 5 was built in a pit, soil could have washed in rapidly after abandonment, burying it quickly. This would explain the height of the wall and the presence of well-preserved beams in all levels of the excavation. However, without conclusive evidence, this aspect of construction cannot be determined until further excavations are conducted.

Associated Features

No features were uncovered in the vicinity of Structure 5. Neither a prepared hearth nor a fire-pit was found. There was no evidence of storage pits either inside or outside the structure.

Other Structures at Grove's Creek Site

The center of Structure 5 has a great quantity of daub associated with it, and by extension, other large concentrations are also likely to be the remains of structures. To help determine the location of the Elderhostel structures, the daub weights for all units were tallied and mapped. Figure 3-7 displays the frequency distribution of daub in the Elderhostel excavations. The smallest amount of daub recovered was 1000 g per 2 m^2 unit and the largest was 50,791 g per 2 m^2 unit. Several of the units have no data, and it is acknowledged that with the loss of some notes, several of the units may have their daub weights underrepresented. However, this method appeared to be reliable as the four daub clusters seen on Figure 3-7 coincided with remaining field note descriptions of walls, postholes, hearths and housefloors. The frequency distribution map, coupled with the surviving excavation notes and ceramics, provided all the information concerning the following structures.

All four structures date to the Irene phase based on ceramic chronology. Ceramic types were identified using Caldwell and Waring (1968), DePratter (1991) and Williams and Thompson (1999). Irene ceramics accounted for 96 percent of all sherds found at the site (Keene 2002). Frequency distribution maps were made for the Irene, Savannah and Deptford sherds (Figures 3-8, 3-9, 3-10) and indicate that all the ceramic types were evenly distributed. As none of the non-Irene ceramic types were clustered near the structures, the structures were probably all constructed during the Irene phase.

Structure 1

Structure 1 was the first structure found during the Elderhostel excavations and is presently the structure closest to the drainage (Figure 3-7). It is not possible to determine its shape or size with existing information. The notes indicate that postholes and postmolds were found, suggesting single-set post construction rather than wall trenches. Very large pieces of daub with impressions were found in some units, but there is no indication of whether these are from walls or a plastered ceiling. Although a floor was mentioned, it is not possible to determine if it is semi-subterranean. There were several small trash pits, and the notes indicate that they may be filled postholes. A clay hearth was found, but the size and shape were not given.

Structure 2

Structure 2 was north of Structure 1 (Figure 3-7). A daub wall, interpreted by Elderhostel to be an exterior wall, was excavated. Several postmolds and postholes were found as well. This suggests a single-set post construction with daubed walls. It is not possible to determine the orientation of the daub wall or whether it was straight or curved. A line of postholes is described as an "arc," but as there is no map, the shape of the structure is unclear. The size of the structure cannot be calculated, because no other walls were found. It is not possible to determine if the structure was semi-subterranean. The floor was identified as a clay layer, and there may have been two superimposed floors. As floors were described in eight contiguous north-south 2 m^2 excavation units, there are either multiple floors, or a natural clay layer. This is reminiscent of Structure 5, where a stratum similar to the structure floor is found outside the structure. The fact that this situation has been identified throughout the site suggests either that these clay layers are natural or that there were prepared living areas outside the structures. The only features associated with Structure 2 were several trash pits in or near the structure, along with a feature described as a midden.

Structure 3

Structure 3 is directly north of Structure 2 (Figure 3-7). It is not possible to determine the shape or size of Structure 3. At least one posthole was mentioned, which suggested single-set post construction. One fallen wall appeared to be constructed of single-set posts and plastered in daub. The house floor was gray and sandy and in some areas had a reddish layer directly above it. No associated features were mentioned.

Structure 4

Structure 4 is located directly north of Structure 3. This structure is currently being excavated by Ervan Garrison of the University of Georgia (Garrison 2000).

OTHER SITES WITH IRENE STRUCTURES

Only five other Irene phase sites on the Georgia coast have been reported to contain structures. These sites include Irene (Caldwell and McCann 1941), Seven-Mile Bend (Cook 1971), 9CH112 (Goad 1975), Harris Neck (Braley *et al*. 1986) and Red Bird Creek (Pearson 1984). The structures found on each site are discussed below. The original reports did not always explicitly describe all structure characteristics. In these cases, interpretations were made using maps, photographs or by piecing together information in the reports.

Irene Site

The Irene site is located in Savannah, Georgia (Figure 3-1) and was excavated as part of the Works Progress Administration (WPA) (Caldwell and McCann 1941). It is a multi-component ceremonial center with one large mound, several ceremonial structures and five domestic structures. Although the mortuary building is Irene phase, it will not be discussed here as it is clearly a special use structure. Of the five structures found at the site, one was Irene phase and one was transitional Savannah/Irene. Dates were determined through ceramic chronology. The Irene phase structure (Feature 55) was rectangular with squared corners, made of wattle and daub, single-set post construction and not semi-subterranean. Exact dimensions were not given, other than to say it was "considerably larger than the Savannah period structure" (Caldwell and McCann 1941:35) below it, which was 10 by 9 m and was semi-subterranean. The only interior feature it contained was a prepared clay hearth (Caldwell and McCann 1941:35).

The transitional phase structure (Feature 61) was rectangular, and in the photograph it appears as though the corners may be rounded. It measured 3 by 3 m. It was made of wattle and daub, but the daub was plastered only on the interior of the exterior walls. The construction was single-set post, although the photograph suggests wall trench entryways. It was not semi-subterranean. The only interior feature mentioned was a "shallow fire basin." The report does not state if the hearth was clay lined (Caldwell and McCann 1941:36).

Seven-Mile Bend

Seven-Mile Bend is on the Ogeechee River near Richmond Hill (Figure 3-1) (Cook 1971). The site had at least one burial mound and one Irene phase structure. The structure date was determined by ceramic chronology. The dimensions of the structure are not known because it was not completely exposed by the excavation. The report describes an east-west trending wall intersecting with a north-south trending wall, suggesting that the structure was rectangular or square. Both walls were constructed of daub tempered with Spanish moss or palmetto fiber, and in some cases, the daub was incised. One wall contained remains of marsh grass wattle. On the map, there appear to be lines of postmolds under the daub debris. The postmolds did not all align with the daub walls, but were very straight, and suggestive of a rectangular or square structure. The postholes suggest single-set post construction. It is not known whether the structure was semi-subterranean. A pit of burned corncobs was found under one of the walls. Based on the description, it is difficult to determine whether this is a smudge pit, trash pit or storage pit. A feature containing burned human bone and a shell pit were found, but it is not clear whether they were inside or outside the structure. A round shell midden was found south of the structure.

9CH112

Site 9CH112 is on Skidaway Island (Figure 3-1) and was comprised of a single structure with several discrete middens (Goad 1975). The date was determined with two ceramic bowls found near the hearth. The structure consisted of several postholes. It was rectangular and measured 10 m by at least 7 m. The description suggested single-set post construction. No mention was made of daub nor what material the walls may have been constructed of. The floor was gray sand and described as "depressed slightly (4cm)," (Goad 1975:42) suggesting that it was not truly semi-subterranean. There were two interior features, a hearth and fire pit turned trash pit. The hearth was an oval-shaped basin made of clay (Goad 1975).

Harris Neck

Harris Neck is located in McIntosh County, Georgia (Figure 3-1). It is a large, multi-component site represented by an extensive number of features and postmolds (Braley *et al.* 1986). Seven postmolds were dated to the Irene phase with a rim sherd found in an associated daub pit. The postmolds were filled with daub, suggesting to the excavators that the structure was constructed of wattle and daub, which fell into the postholes as the structure rotted (Braley *et al.* 1986:47). Due to the number of other temporal components at the site, using this as an example of an Irene structure should be done with caution.

Red Bird Creek

The Red Bird Creek site is found near the Ogeechee River (Figure 3-1), and contains a very well preserved Irene phase structure, two burial mounds and a number of discrete shell middens (Pearson 1984). A roof beam was radiocarbon dated to AD 1145±60; however, the author considered this too early based on a ceramic chronology that indicated Irene phase. The structure is most likely rectangular, although this is not certain. It is estimated to be 5.2 m across, based on the position of the hearth and two intersecting wall fragments. The walls were constructed of pine posts set approximately 45 cm apart, with bunches of cane in between as added vertical supports. Single pieces of cane were tied horizontally to the upright crossbeams. Daub tempered with Spanish moss was applied to both sides of the wall. The floor was not prepared but recognized by the amount of ceramics. As excavations did not continue under the floor, it could not be determined whether the structure was single-set post or wall trench construction. No mention was made of whether the structure was semi-subterranean. A prepared clay hearth with a raised rim is in the center of the structure. No other features are mentioned, although there may some under the unexcavated floor.

Ethnohistoric Descriptions of Architecture

Few ethnohistoric accounts provide details concerning prehistoric architecture of the Georgia Coast. Some accounts describe the Guale and the Cusabo, whose ancestors were the likely inhabitants of Irene phase sites in South Carolina and Georgia, and the Timucua, who lived south of the Guale in present-day Florida. The earliest descriptions come from Jean Ribaut, who came to the New World in 1562 (Ribaut 1927[1563]). In the vicinity of St. Mary's River, he encountered a village in which houses were made of wood and covered with reeds. He describes many of them as similar to pavilions, suggesting that not all had walls. One larger structure in the center of the village was described as "verry great, long and broode" (Ribaut 1927[1563]:84). This could have been a townhouse. In that building only, he describes benches along the walls.

In 1564, Réné Goulaine de Laudonnière led an expedition from present-day Florida to South Carolina. He was accompanied by the artist Jacques Le Moyne de Morgues, who made drawings throughout the journey (Le Moyne 1875). Le Moyne's Engraving 2 depicts an area near St. John's River, Florida. The houses are all round and appear to have thatched roofs. Engraving 3 represents a village seen north of St. John's River, perhaps in southern Georgia. Two round and one rectangular structure is shown. Engravings 5, 6, 22, 31 and 40 are scenes from Port Royal, South Carolina, and each depicts round, thatched roof structures. Engraving 7 depicts the French asking Ouade (Guale) for supplies. It is difficult to determine the shape of one of the structures, but it appears to be rectangular, while the other is round. A sentinel cottage or alligator blind is also depicted. The sentinel cottages and alligator blinds both appear throughout the engravings as small, thatched roof structures, constructed with solid walls (of unknown material) having holes cut out in regular intervals (Engraving 26 and 30). Engraving 30 depicts a fortified town. It consists of a mix of square and circular structures. One large, rectangular structure in the center of the village is referred to as the chief's house but is probably a townhouse. Engraving 33 and several of the unnumbered engravings depict very long, thin rectangular structures. It is unclear what these structures represent or where they were seen.

Le Moyne (1875) describes some aspects of architecture as well, such as roofs made of dried palm branches. He writes that the chief's house was partly underground because of the heat (Le Moyne 1875:12). He does not suggest that common houses were built partly underground, but the engraving does not depict the chief's house as any different from the other houses. He notes that houses were burned down both by enemies and when a chief or priest died (Le Moyne 1875).

Fray Andrés de San Miguel was a Spanish monk who visited the town of Asao, near present-day St. Simon's Island in 1595. He noted that the houses were small, made of unfinished wood and covered in palmetto. The chief's house was made of several small rooms, suggesting that the structure had interior walls acting as partitions, however, it was no larger than any other house. San Miguel and his companions were housed in a large, circular structure made of "entire pine trees." (San Miguel 2001:65). All of the trees came together in a point at the apex of the roof. Beds lined the walls, and San Miguel estimated that 300 men could sleep there (San Miguel 2001:65).

In the seventeenth century, Bishop Gabriel Diaz Vara Calderón wrote of several Native American groups, including the Guale. He described their houses as round and made of straw, and indicates that at least one structure contained a bed made of reeds. He mentions a characteristic that is not described elsewhere: a granary on the side of the structure. It is not clear whether it is attached to the main structure or not, only that it is "supported by 12 beams" (Wenhold 1936:13).

Swanton writes that "Most of the houses of the common people were undoubtedly circular" (Swanton 1977[1946]:407). He speculates that the houses north of the St. John's River were thatched with reeds, while those south were thatched with palmetto; and that the reedthatched roofs were daubed, while the palmetto ones were not. He writes that the roofs were wattle and daub “like the walls.” This suggests that all the walls were wattle and daub construction, although he cites no explicit ethnohistoric source for that description (Swanton 1977[1946]:408)

The general consensus among the ethnohistoric descriptions is that the houses were round, fairly small and thatched with palmetto or reeds; however, LeMoyne’s (1975) drawings depict structures that were rectangular and square. The majority of structures were described as either wattle and daub construction or covered with palmetto. There is only one reference to a structure being semi-subterranean and one for partitions within structures. The only features mentioned were beds or benches along the outer walls of larger buildings.

COMPARISON

Archaeological and ethnohistoric evidence will be compared in order to define some characteristics of Irene phase architecture. Ethnohistoric evidence must always be used with caution for a number of reasons. The chronicler's bias due to lack of understanding of new cultures and their new surroundings can make descriptions less than accurate. Their motives in writing must be taken into account as well. For example, if they are trying to impress a superior, they may embellish or downright lie. Archaeological evidence has its own bias as well, as can be seen in this study. Most of the archaeological structures have not been excavated fully, and so it is difficult to determine which characteristics are present but either have not or cannot be found. The issue of preservation must be considered. Because daub is more durable than plant material, wattle and daub structures are much more likely to be found archaeologically than structures made entirely of palmetto thatch or cane matting. The following discussion is a comparison of all the size, shape, construction and associated features from both sources of information.

Shape

All of the archaeological structures appear to be square or rectangular. The difference in structure shape focuses on the corners, as some are rounded and others are squared. This trait may or may not be of geographical or temporal significance. Swanton (1977[1946]:407) notes that there may be a difference in construction techniques between groups above and below the St. John's River. It is possible that minor attributes, such as corners, may vary over a smaller geographic area. More structures will have to be compared before this can be determined.

The ethnographic accounts indicate circular structures. The discrepancy between these descriptions and archaeological discoveries of square or rectangular structures could be due to a number of factors. The rounded corner found on Structure 5 at Grove's Creek Site was very broad (Figure 3-3). It may be that Europeans perceived any building without perfectly straight walls as rounded, therefore described structures such as Structure 5 as round rather than square. Alternatively, the shape of the houses may have changed between the Irene phase and the Contact period. As ~100 - 200 years passed between the Irene phase and the first chronicler, it is likely that building styles evolved. Lastly, LeMoyne's (1875) drawings depict both rectangular or square and circular structures. If the two types were used at the same time, the rectangular and square structures may be vestiges of earlier construction techniques, have different functions, or be constructed of different materials. For example, it may be possible that round structures were always thatched while rectangular structures were daubed, leading to a bias in the archaeological record. These questions may not be answerable without excavations of villages rather than isolated hamlets.

Size

The archaeological structures that could be measured have a wide size range. With only five structures, and most measurements being minimum estimates, only two structures could be compared. These two structures are at the Irene site, and are the only two excavated in their entirety. The smallest is 9 square meters, and the largest is 90 square meters (Caldwell and McCann 1941). This great size range suggests that the structures had different functions. The ethnohistoric descriptions depict alligator blinds and sentinel cottages as smaller than the other structures of the village (LeMoyne 1875). The chief's house or townhouse was often larger than other structures (LeMoyne 1875; Ribaut 1927[1563]:84; Swanton 1977[1946]). Most written ethnohistoric accounts only describe the common houses as 'small.' These descriptions cannot add any insight into structure size, as it cannot be determined what 'small' meant to a sixteenth-century European.

Construction

The most noticeable difference in construction is wattle and daub versus wattle and thatch construction. Archaeological and ethnohistoric accounts indicate that both construction techniques were employed. However, the archaeological record indicates much greater use of daub than is indicated in the ethnohistoric record. San Miguel (Swanton 1977[1946]) states that the houses were covered with palmetto, suggesting wattle and thatch construction. However, only the interior walls and roof of Grove's Creek Site Structure 5 is covered with daub; the exterior wall is cane matting. The Irene site has one structure that was daubed on the interior of the exterior walls only (Caldwell and McCann 1941:36). If the Europeans did not enter the structure, they may have described it as thatched although it was daubed on the interior. Swanton (1977[1946]:408) does indicate that structures north of the St. John's River were thatched with reeds and constructed of wattle and daub. However, he does not indicate the source of this description. It appears that there were likely several construction types, including wattle and daub, wattle and thatched and stages between the two.

Other variations in construction technique are more difficult to determine. Grove's Creek Structure 5 is the only archaeological structure with interior partition walls, and only one ethnohistoric account mentions interior partition walls (Swanton 1977[1946]: 405). There is no concrete archaeological evidence to suggest semi-subterranean construction. Only one of the archaeological structures was conclusively described as not semi-subterranean. The other site descriptions do not contain enough data to assess. One of the ethnohistoric accounts describes a semi-subterranean structure, which was a chief's house in the Timucuan region (Le Moyne 1875:12). With scant archaeological and ethnohistoric data, it is not possible to determine if this building technique was widely used.

There may be several explanations for the different construction techniques found in both the archaeological and ethnohistoric accounts. As with the size of the structures, variability in construction may be due to function. Swanton (1977[1946]:408) suggests that different temperature zones or geographical areas may account for the contrasting construction techniques. Status of the individual who built the structure might also be a factor.

Several functional differences have already been mentioned. Alligator blinds and sentinel cottages were fairly small in size, and at least alligator blinds appear to have been constructed differently from other types of structures (LeMoyne 1875). In the interior southeast, the use of summer and winter houses during the Mississippian period is well documented (Hally and Kelly 1998; Hatch 1995; McConaughy *et al*. 1985; Pauketat 1989; Smith 1995; Sullivan 1995). The two structure types are often found next to each other, used by the same household at different times of the year. Winter houses are usually identified by their substantial wattle and daub construction and prepared hearths. Summer houses are lighter construction and may or may not contain a hearth or fire pit. In some cases, interior storage pits were identified with winter structures (Smith 1995).

The Red Bird Creek and Seven-Mile Bend structures are both wattle and daub construction. It is possible that corn was stored under the floor at Seven-Mile Bend (Cook 1971:6) and a hearth was in the center of the Red Bird Creek structure (Pearson 1984:8). The presence of daub and, in one case each, of possible stored food and a hearth, fits the definitions of winter structures as given above. The structure at 9CH112 had a fire pit on one side (Goad 1975:44). Neither daub nor the presence of large amounts of clay in the surrounding soil was mentioned in the 9CH112 report, so this structure may fit the definition of a summer type structure.

This particular functional difference may be difficult to prove. There are no ethnohistoric records of summer and winter houses north of the Timucuan area. Furthermore, the Timucuan summer structures are described as little more than arbors, which suggests that they would be difficult to find in the archaeological record (Swanton 1977[1946]:408). Summer and winter structures are often found together in the interior (Smith 1995:231), and most of the archaeological structures discussed in this study were the only ones found at their site. As a consequence, it will be difficult to determine whether the architectural differences observed in the archaeological structures are due to differing summer and winter construction techniques until more multi-structure villages are excavated.

Swanton (1977[1946]:408) suggests that the change in construction materials he noticed above and below the St. John's River was due to latitude. The structures to the south were more open. He also suggests that the change from palmetto mats in the south to reeds in the north was due to the abundance of those materials in each region. It is unlikely that the changes in construction seen in the archaeological record were due to available building materials, because all of the structures were found in a 55 km radius of one another (Figure 3-1).

Several of the ethnohistoric accounts describe the chief's house or a townhouse as different from common houses. The only account of a semi-subterranean structure (Le Moyne 1875:12) or of partition walls (Swanton 1977[1946]:405) are for a chief's house. The chief's house is also often described as larger than the other structures (LeMoyne 1875; Ribaut 1927[1563]:84; Swanton 1977[1946]). It is possible that some of the differences seen in the archaeological record, such as the incised daub on the Seven-Mile Bend Structure (Cook 1971:6), are due to either special use or elite structures.

The trend found in both archaeological and ethnohistoric accounts is one of variability. A variety of construction materials were used to make structures that were round, square or rectangular and of numerous sizes. There are several possible explanations for these differences. However, the most likely explanation is one of function, such as different construction materials for summer and winter structures or size differences between single-family and community structures. It is not likely that these differences are due to dissimilar temperature zones or geographical areas.

Associated Features

The types of features associated with the structures varied as well. Hearths were found in three of the archaeological structures. Seven-Mile Bend and 9CH112 both contained pit features. The feature at 9CH112 appeared to be a cooking pit turned into a trash pit (Goad 1975:44). Seven-Mile Bend had a pit containing burned corncobs (Cook 1971:6), which could also be a trash pit, or a storage or smudge pit. The other feature at Seven-Mile Bend was a shell feature that wasn’t excavated (Cook 1971:7). Given that many of the structures were only partially excavated, and some not below the floor, it is difficult to determine which features were actually present and which were simply never found. Therefore, no archaeological trends could be established for this category. The ethnohistoric data cannot add much more. Beds or benches were described along the walls of large structures, which were likely townhouses, but there is only one such description for common houses.

CONCLUSION

A comparison of the Irene phase structures found on the Georgia coast with ethnohistoric accounts, revealed several interesting similarities and differences. One of the characteristics that all the archaeological structures have in common is that they are single-set post construction and either rectangular or square in shape. Ethnohistoric accounts, however, most often describe circular structures. Wattle and daub and wattle and thatched construction are both found archaeologically and ethnohistorically. It is not possible to determine how widespread the use of semi-subterranean construction was, or what types of features are common in Irene structures. There appears to be no typical Irene phase structure. Rather, there is considerable variation in all aspects from size and shape to construction techniques. The differences noted between archaeological structures and ethnohistoric accounts could be due to either Eurocentric views on the part of the chroniclers or changes over time. The various size, shape and construction differences noted overall are likely due to the different functions of the various structures.

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Table 3-1: Radiocarbon Dates for Grove's Creek Site Structure 5. Calibrated dates calculated with OxCal v.3.5 Bronk Ramsey (2000) [Atmospheric data from Stuiver *et al.* (1998)].

Sample ID	Lab number	material	uncalibrated date B.P.	corrected date	$^{13}C‰$	cal A.D. 2 sigma
Wall #1	UGA-10116	wood charcoal	430 +/- 50	420	-25.42	1410-1530 (p=71.3) 1550-1640 (p=24.1)
Post #8	UGA-10117	wood charcoal	560 +/- 70	540	-26.04	1290-1480 (p=95.4)
Post #15	UGA-10118	wood charcoal	640 +/- 50	600	-27.62	1290-1420 (p=95.4)
Post #19	UGA-10119	wood charcoal	830 +/- 50	830	-25.03	1110-1290 (p=85.3) 1040-1100 (p=10.1)
Post #27	UGA-10120	wood charcoal	620 +/- 60	610	-25.62	1280-1430 (p=95.4)

Figure 3-1: Map of the Georgia coast indicating approximate location of all archaeological sites discussed in the text.

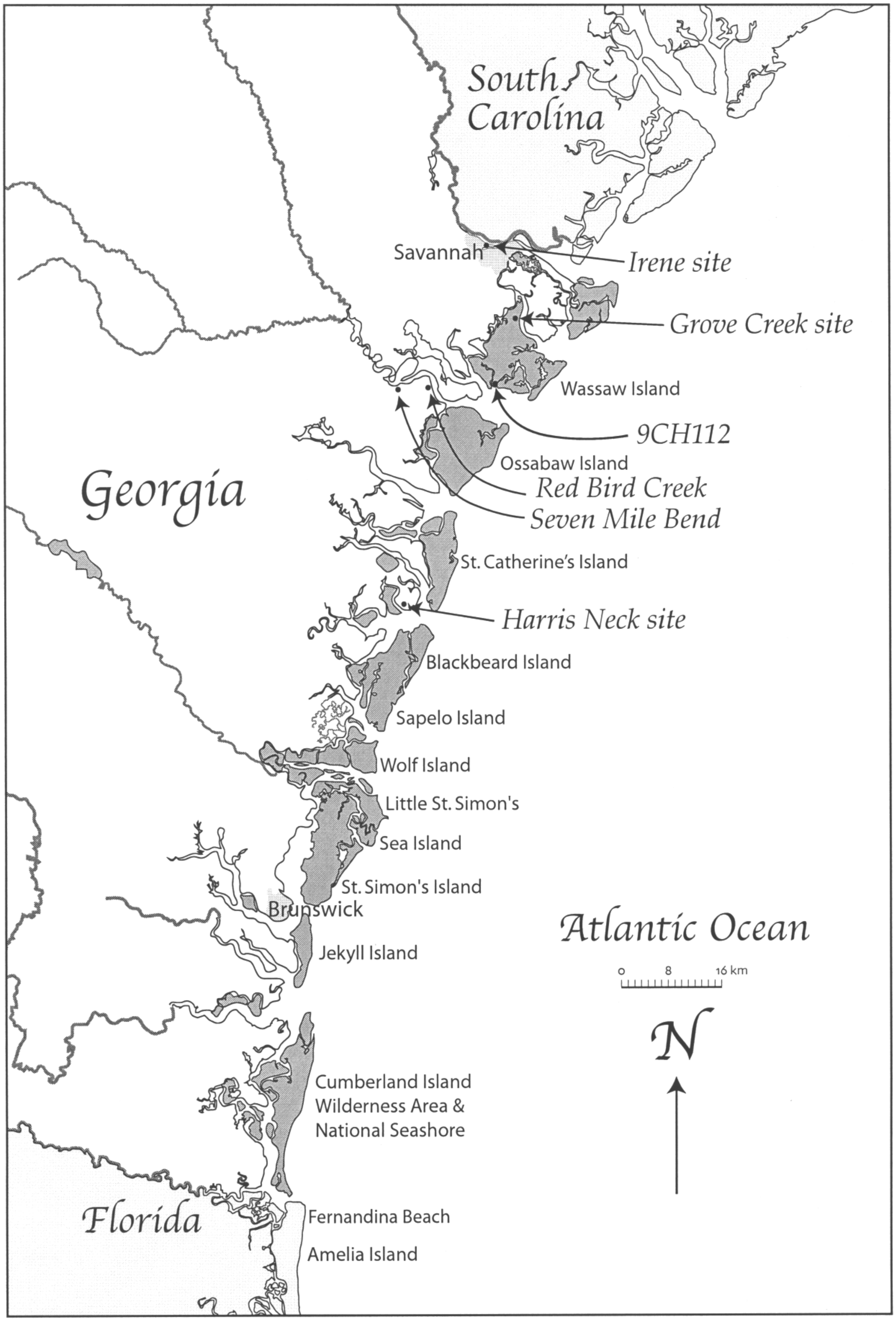
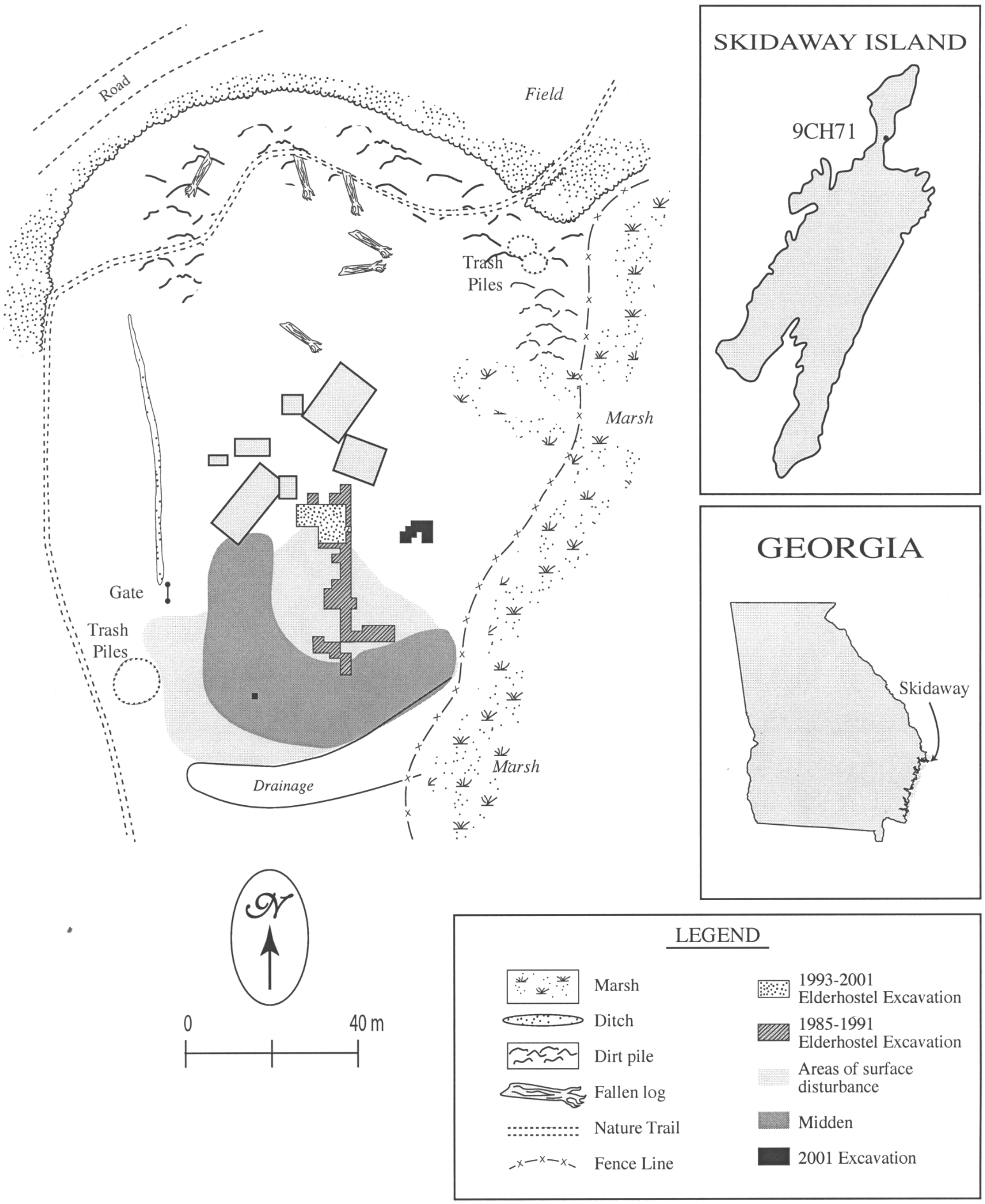

South Carolina
Savannah
Irene site
Grove Creek site
Wassaw Island
9CH112
Ossabaw Island
Red Bird Creek
Seven Mile Bend
Georgia
St. Catherine's Island
Harris Neck site
Blackbeard Island
Sapelo Island
Wolf Island
Little St. Simon's
Sea Island
St. Simon's Island
Brunswick
Jekyll Island
Atlantic Ocean
0 8 16 km
N
Cumberland Island
Wilderness Area &
National Seashore
Florida
Fernandina Beach
Amelia Island

Figure 3-2: Map of Grove's Creek Site depicting all Elderhostel excavations and 2001 excavations.



Road
Field
Trash
Piles
Marsh
Gate
Trash
Piles
Marsh
Drainage
SKIDAWAY ISLAND
9CH71
GEORGIA
Skidaway
N
0
40 m
LEGEND
Marsh
Ditch
Dirt pile
Fallen log
Nature Trail
Fence Line
1993-2001
Elderhostel Excavation
1985-1991
Elderhostel Excavation
Areas of surface
disturbance
Midden
2001 Excavation

Figure 3-3: Plan map of Structure 5, Grove's Creek Site.

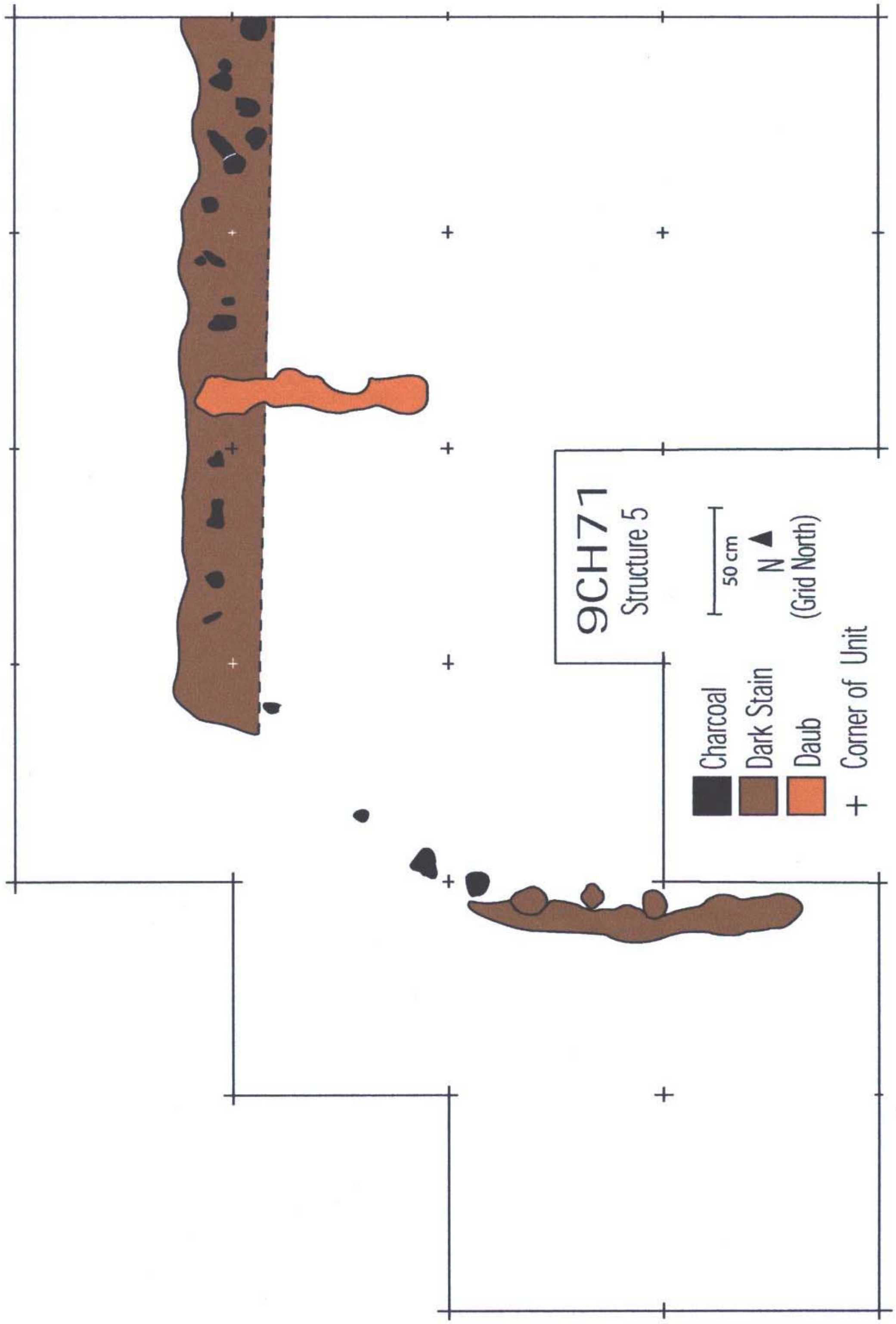
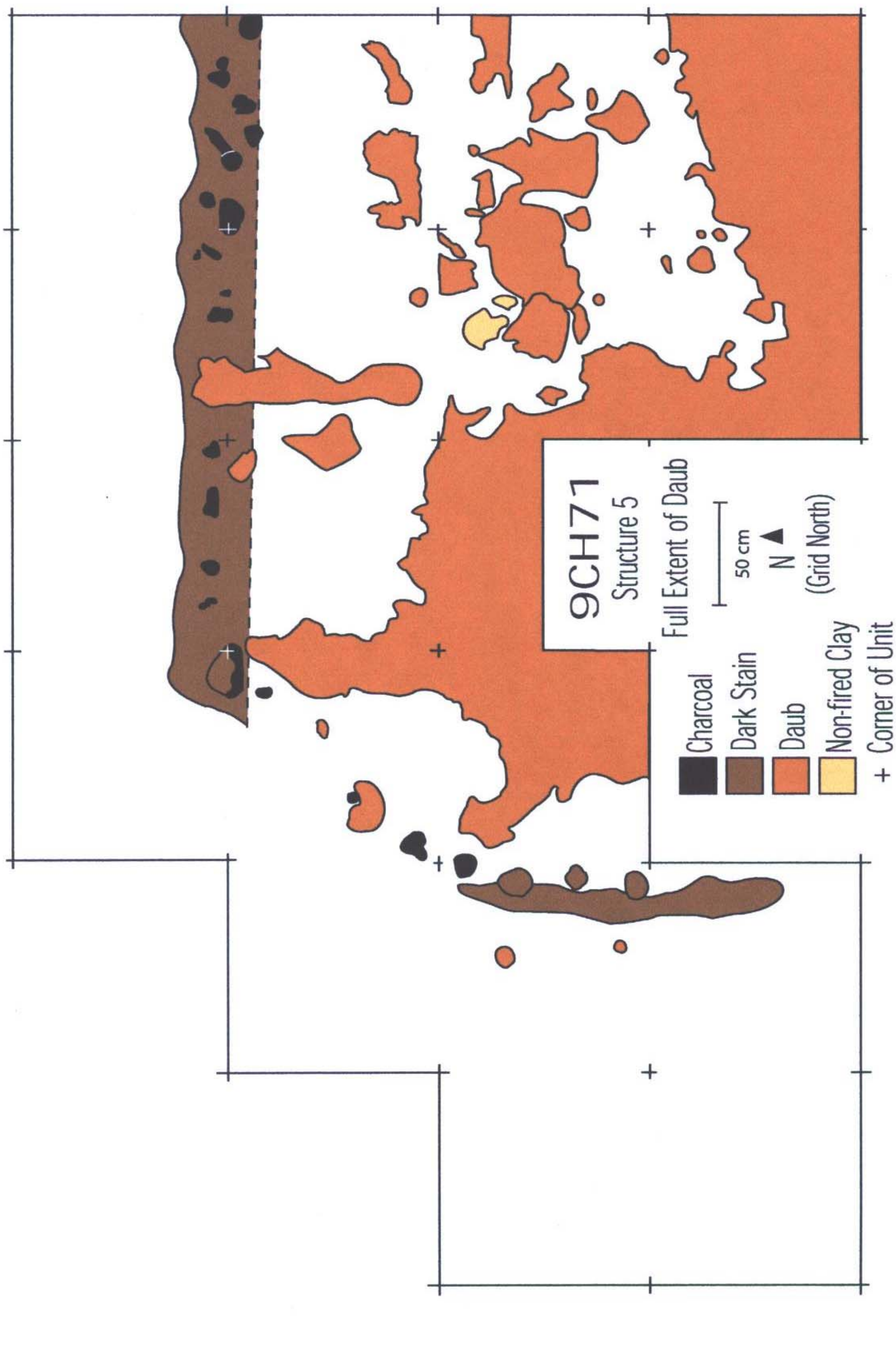

9CH71
Structure 5
50 cm
N
(Grid North)
Charcoal
Dark Stain
Daub
+ Corner of Unit

Figure 3-4: Composite plan map of Grove's Creek Site depicting the daub recovered from all levels.



9CH71
Structure 5
Full Extent of Daub
50 cm
N
(Grid North)
Charcoal
Dark Stain
Daub
Non-fired Clay
+ Corner of Unit

Figure 3-5: The interior wall of Structure 5.


9CH71
N530
W485
6/6/01

Figure 3-6: Reconstruction of the interior wall of Structure 5 (Courtesy of Darla Huffman).

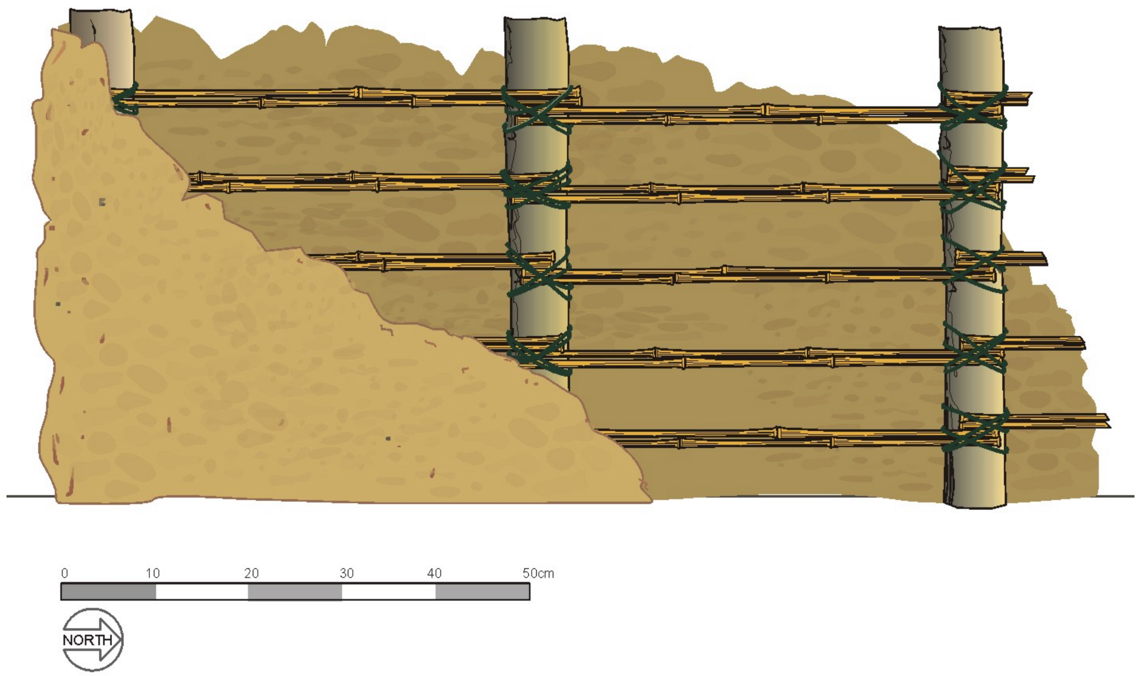

0
10
20
30
40
50cm
NORTH

Figure 3-7: Frequency distribution map of daub from the Elderhostel excavations.

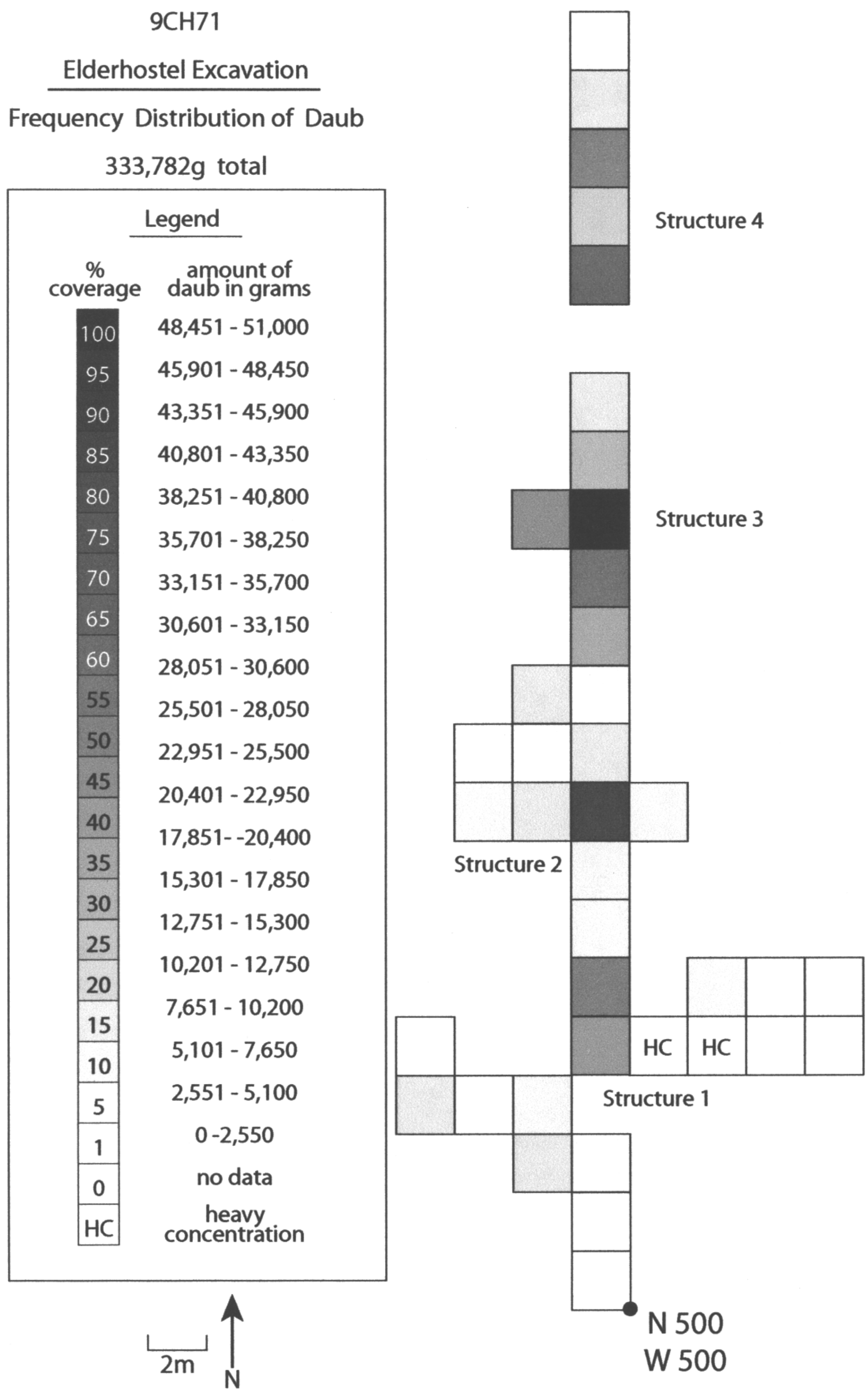

9CH71
Elderhostel Excavation
Frequency Distribution of Daub
333,782g total
Legend
% coverage
amount of daub in grams
100 48,451 - 51,000
95 45,901 - 48,450
90 43,351 - 45,900
85 40,801 - 43,350
80 38,251 - 40,800
75 35,701 - 38,250
70 33,151 - 35,700
65 30,601 - 33,150
60 28,051 - 30,600
55 25,501 - 28,050
50 22,951 - 25,500
45 20,401 - 22,950
40 17,851- -20,400
35 15,301 - 17,850
30 12,751 - 15,300
25 10,201 - 12,750
20 7,651 - 10,200
15 5,101 - 7,650
10 2,551 - 5,100
5 0 -2,550
1 no data
0 heavy concentration
HC
2m
N
Structure 4
Structure 3
Structure 2
HC
HC
Structure 1
N 500
W 500

Figure 3-8: Frequency distribution map of Irene sherds from the Elderhostel excavations.

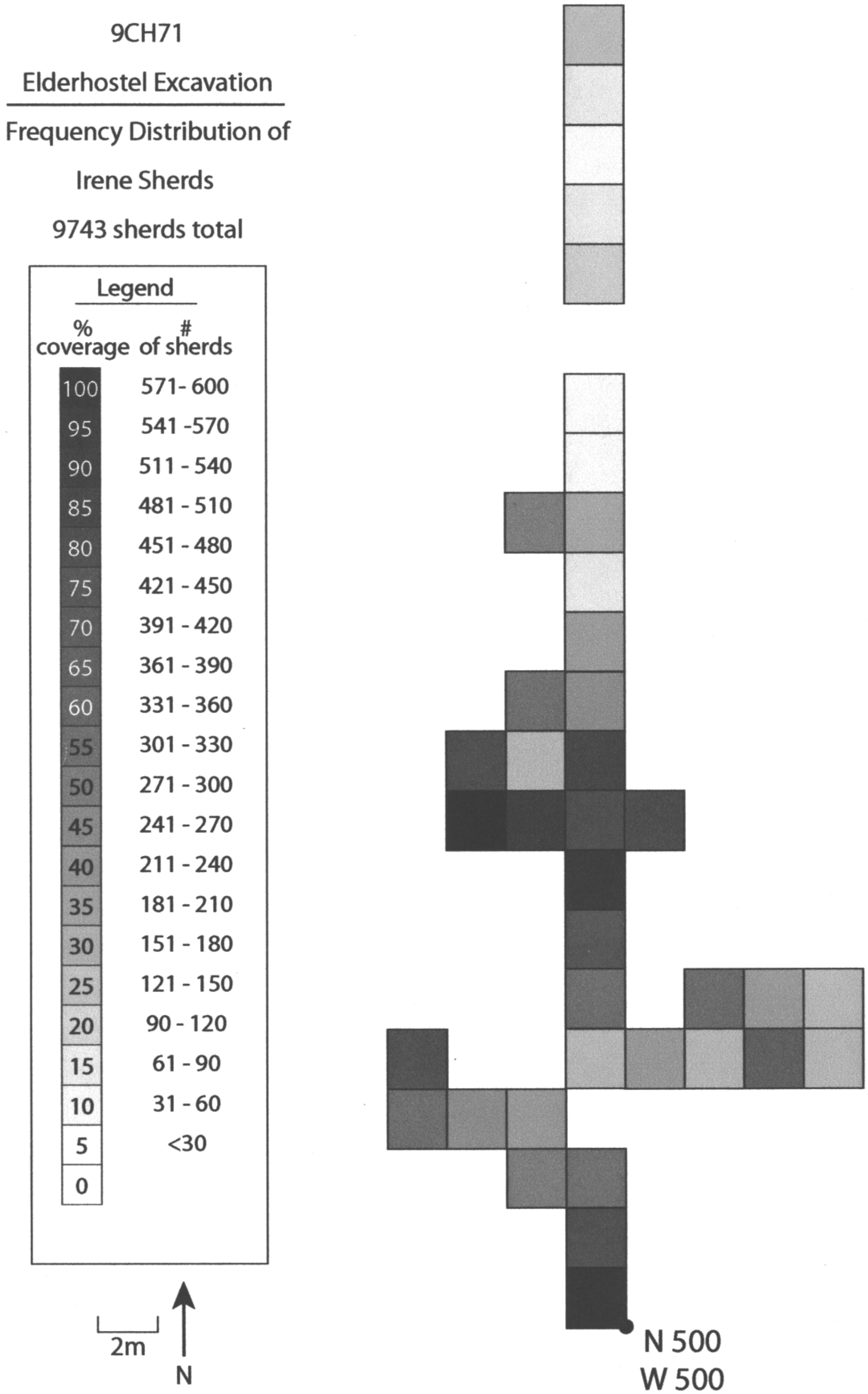

9CH71
Elderhostel Excavation
Frequency Distribution of
Irene Sherds
9743 sherds total
Legend
% coverage
# of sherds
100 571- 600
95 541 -570
90 511 - 540
85 481 - 510
80 451 - 480
75 421 - 450
70 391 - 420
65 361 - 390
60 331 - 360
55 301 - 330
50 271 - 300
45 241 - 270
40 211 - 240
35 181 - 210
30 151 - 180
25 121 - 150
20 90 - 120
15 61 - 90
10 31 - 60
5 <30
0
2m
N
N 500
W 500

Figure 3-9: Frequency distribution map of Savannah sherds from the Elderhostel excavations.

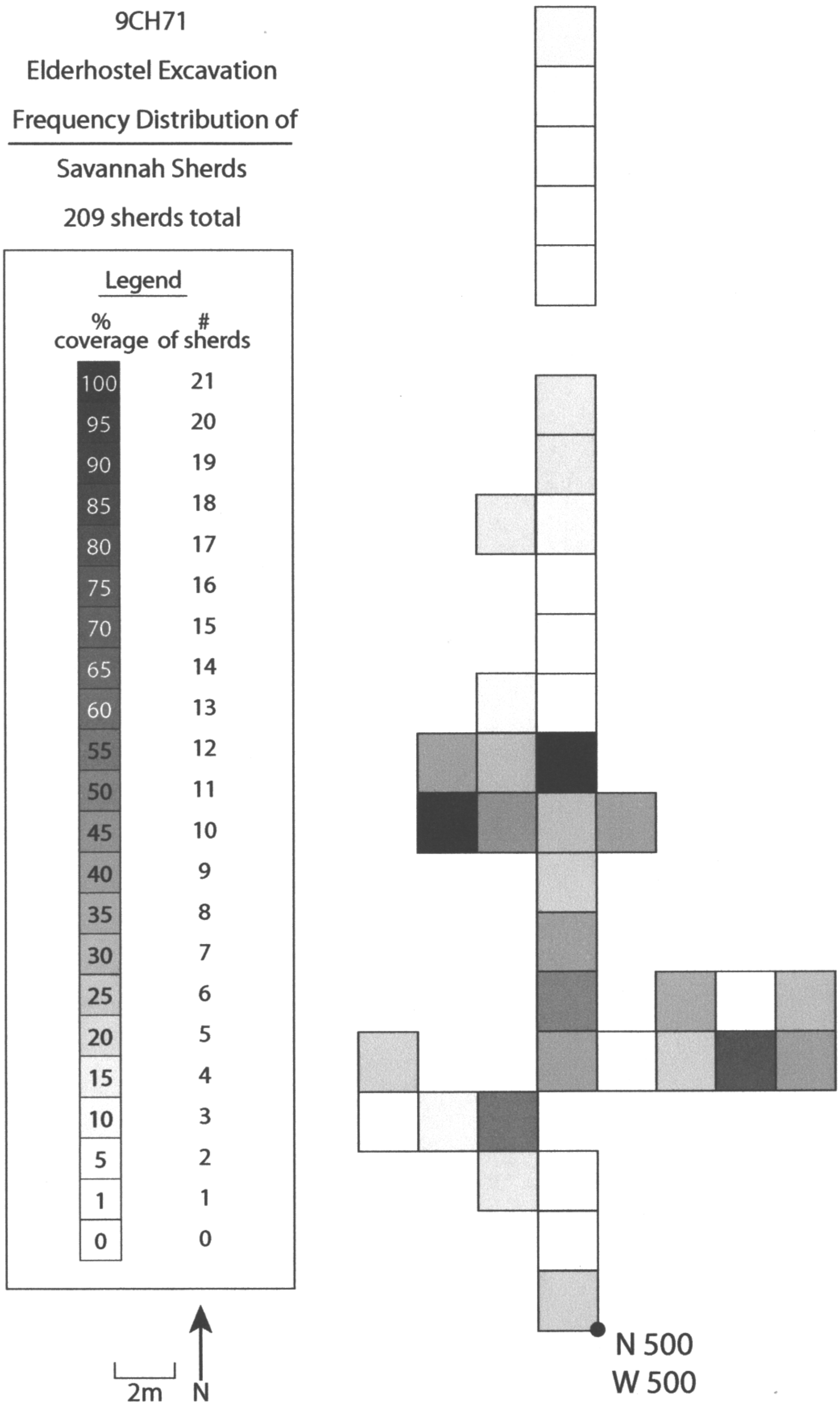
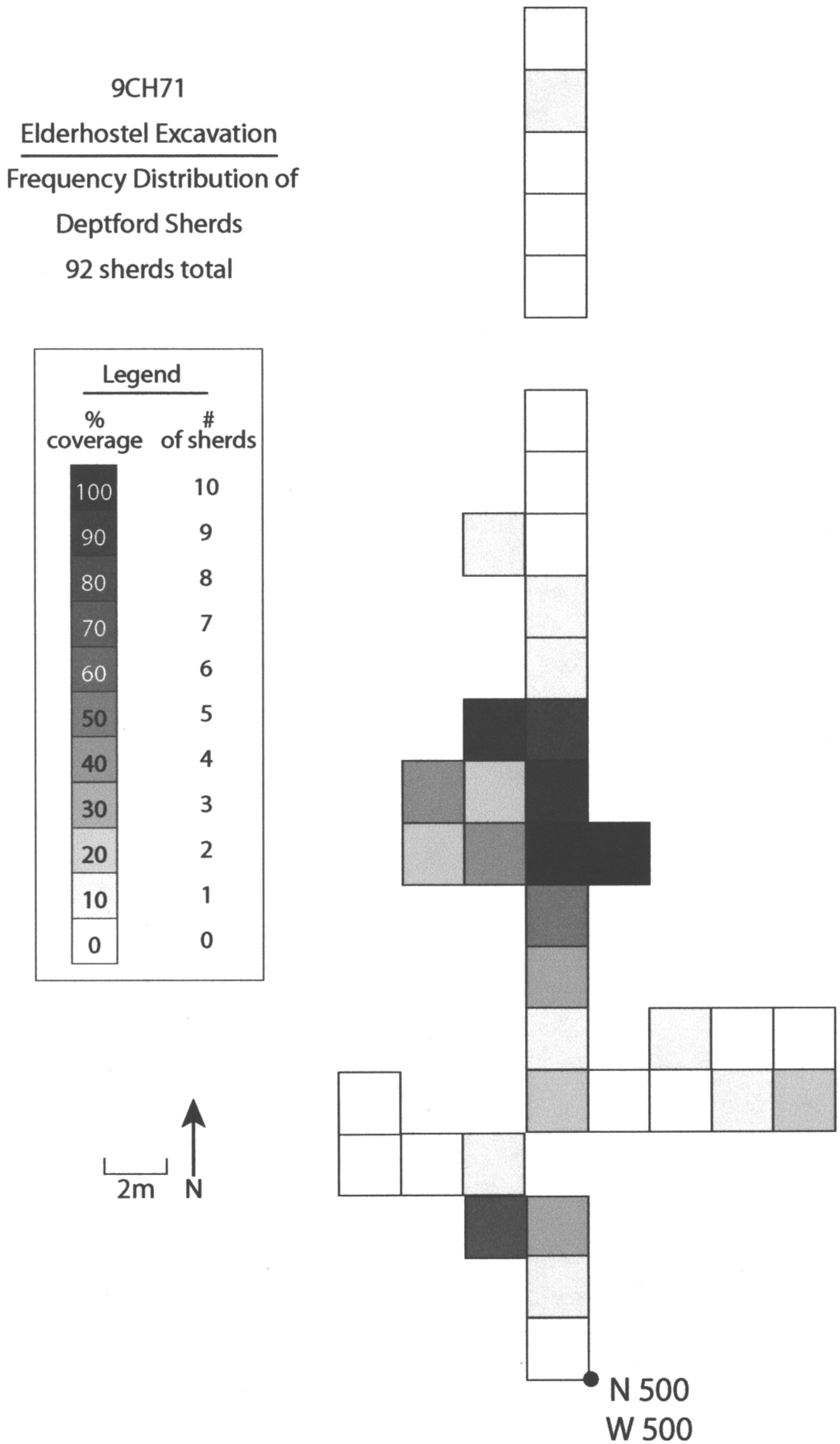

9CH71
Elderhostel Excavation
Frequency Distribution of
Savannah Sherds
209 sherds total
Legend
% coverage
# of sherds
100 21
95 20
90 19
85 18
80 17
75 16
70 15
65 14
60 13
55 12
50 11
45 10
40 9
35 8
30 7
25 6
20 5
15 4
10 3
5 2
1 1
0 0
2m
N
N 500
W 500

Figure 3-10: Frequency distribution map of Deptford sherds from the Elderhostel excavations.


9CH71
Elderhostel Excavation
Frequency Distribution of
Deptford Sherds
92 sherds total
Legend
% coverage
# of sherds
100 10
90 9
80 8
70 7
60 6
50 5
40 4
30 3
20 2
10 1
0 0
2m
N
N 500
W 500

CHAPTER 4

REEVALUATING LATE PREHISTORIC COASTAL SUBSISTENCE AND SETTLEMENT STRATEGIES: NEW DATA FROM GROVE'S CREEK SITE[3]

[3] Keene, D.A. To be submitted to *American Antiquity*.

ABSTRACT

This paper tests existing models of coastal subsistence strategies and settlement patterns of the late prehistoric inhabitants of the Southeastern U.S. Atlantic coastal plain. Excavations at Grove's Creek Site, Skidaway Island, Georgia were conducted to determine the season of occupation of the site. Paleoethnobotanical and zooarchaeological data were used to determine the subsistence strategies of the inhabitants. *Boonea impressa* measurements and stable isotope analysis of oyster shells are combined with the faunal and botanical data to determine the seasons of occupation of the site. The most notable discovery was the diversity of agricultural plants. Paleoethnobotanical data indicate a spring through summer occupation, and the stable isotope data indicate winter through summer. Faunal data suggest occupation during the summer and autumn. *Boonea impressa* data does not offer any additional information. The site was occupied year-round. This information, coupled with other data from the Southeastern U.S. Atlantic Coast, suggests a revision to existing subsistence and settlement pattern models. Coastal peoples lived in permanent villages and relied on a mix of agriculture, hunting, fishing and gathering. Short trips were likely made to procure some resources, but there was not an extensive seasonal round.

INTRODUCTION

Late Mississippian subsistence strategies and settlement patterns of the Southeastern U.S. Atlantic coastal plain have been debated for many years. Larson (1969, 1980) began the debate by proposing that the Native Americans on the Southeastern U.S. Atlantic coastal plain were semi-nomadic. He hypothesized that agriculture could not be a significant source of food due to the poor agricultural potential of the soil. Therefore, the coastal inhabitants moved throughout the seasons to secure all of their resources (Larson 1980). His seasonal round hypothesis was soon both expanded upon (Crook 1986; Steinen 1984) and challenged (Jones 1978; Reitz 1988). Unfortunately, however, the debate has never been resolved. Preservation issues, cost of analyses and the limited amount of coastal archaeology all contribute to the debate remaining unresolved.

This paper will both add to the bank of coastal subsistence data and address the question of coastal Mississippian subsistence and settlements patterns of the prehistoric Southeastern U.S. Atlantic coast, using evidence from Grove's Creek Site. Several lines of evidence are used to determine subsistence and settlement patterns at the site. Zooarchaeological and paleoethnobotanical data provide evidence of the basic subsistence activities at the site. These data, along with isotopic evidence from oyster shells and measurement of *Boonea impressa* shells, indicate patterns of seasonal occupation at the site and enable the issue of permanent residence versus seasonal movement to be addressed. Finally, a revision to the Late Mississippian Southeastern U.S. Atlantic coastal subsistence models is proposed.

THEORETICAL BACKGROUND

Larson (1980) sparked the coastal subsistence strategy debate by proposing a testable model of subsistence strategy for the Southeastern U.S. Atlantic coastal plain. His seasonal round model was constructed on the premise that coastal soils could not support the level of agriculture found at interior Mississippian sites. Larson (1980) suggested that coastal people moved every time they abandoned their fields and lived in different locations throughout the year. They collected nuts in the autumn, shellfish in the winter and other plant foods in the spring. After coming to these conclusions, he stressed the lack of subsistence data in archaeological reports, especially the absence of botanical data, and expressed the need for much more work to be done before the subsistence of coastal peoples could be truly understood.

The Guale Annual Model proposed by Crook (1986) adds more detail to Larson's (1980) model. Crook (1986) suggests that coastal Mississippian people lived in towns or villages while they were harvesting crops nearby. In the autumn, after harvest, the town was abandoned except for the chief and his immediate family. The rest of the population foraged for nuts and other plant foods in surrounding forests while hunting in small parties. In the winter, these same small groups moved near the estuaries to fish, collect shellfish, and continue hunting for deer. In spring, they moved back to their farming plots to begin planting. Here, they would subsist on stored foods, anadromous fish, and shellfish during what Crook (1986) suggests would be a time of subsistence stress.

Building on the preceding models, Steinen (1984) put forth the idea that marsh islands were occupied by some of the small seasonal groups described by Larson (1980) and Crook (1986). The bulk of the population lived either on the barrier islands or the mainland and only visit the marsh islands to gather resources. After European colonization, there may have been a shift in subsistence patterns resulting in more utilization of marsh islands.

Jones (1978) takes issue with Larson's (1980) model. In an ethnohistoric study of the Guale, he concludes that coastal resources could support permanent settlements. He argues for permanent village sites supported by a mix of maize horticulture and wild food. He argues that a chiefdom level political structure supported long-distance trade for exotic items. Reitz (1988) also suggests that people at estuarine sites were basically sedentary, although they may have taken short trips to gather specific resources not locally available. As their reliance on cultivated foods increased, these trips may have become fewer and shorter.

Pearson (1977, 1978) surveyed Ossabaw Island, recording the location and size of all Irene phase sites. He divided the sites into a size hierarchy using cluster analysis. The largest sites defined by Pearson were large social/political centers, the next two size classes were settlements that may have been occupied seasonally, and the last size class contains resource procurement areas. Pearson (1977, 1978) suggested that Ossabaw formed a discrete socio-economic unit from which people interacted with villages on other islands to form a larger society. In a sense, the settlement pattern seen on Ossabaw was mirrored in the larger Irene settlement system.

DePratter (1978) surveyed Skidaway Island, mapping the distribution of sites from all time periods. He recorded a shift in site location during the Irene phase to areas that were previously uninhabited. This information, combined with the survey from Ossabaw, led him to suggest that site distribution might be the result of larger populations dispersing into smaller groups, which relied on a combination of agriculture, hunting and gathering.

Each of these models relies on different kinds of data to support their claims. As this paper incorporates all these differing theories and ideas, several terms and assumptions must be clarified. Throughout this paper, the term “season of occupation” is used. This term refers to the minimum amount of time that the site was occupied based on the data at hand. For example, if faunal evidence indicate the presence of a migrating fish that is only available in winter, the site is said to be occupied during winter months. This indicates only that the site was occupied during some portion of winter. As negative evidence cannot be used as proof, it cannot be assumed that the site was unoccupied at other times of the year. The term “season of capture” is used in reference to shellfish. It assumed that any shell remains found at the site were consumed by the inhabitants shortly after capture. Therefore, the season of capture equates with season of use, and consequently, season of occupation.

SITE BACKGROUND

Grove’s Creek Site is a Native American village associated with a large shell midden (Figure 4-1). The data in this paper come from two excavations at the site. The first was conducted from 1985 to 1991 by Larry Babits, in association with Armstrong College and the Elderhostel Program. This excavation will hereafter be referred to as the Elderhostel excavation. The second excavation was conducted by the author in the summer of 2001 with volunteers and students from the University of Georgia. The 2001 excavations centered on areas containing magnetic geophysical anomalies, one of which was produced by a structure (Keene 2002). A portion of this structure, Structure 5, was excavated. In addition, a 1 m^2 unit, 2001 Midden Unit, was dug through the large midden on the southwest side of the site.

The Elderhostel excavations uncovered at least four structures. The structures are all aligned north-south in relation to one another, and the midden is to their west (Figure 4-1). Most of the ceramics date to the Irene phase (AD 1300-1450; Braley 1990), although there is some evidence of small, earlier occupations. There are no radiocarbon dates from the Elderhostel excavation (Keene 2002).

Several radiocarbon dates were obtained from the posts of Structure 5 and indicate that the structure was likely occupied ~AD 1450 (Table 4-1). The majority of ceramics associated with Structure 5 are Irene, although there are some Savannah sherds. No evidence of a discrete midden associated with Structure 5 was found. The site is extremely disturbed, and the midden sample, designated the 2001 Midden Unit, location was chosen because it was in an area that had no indication of disturbance in the vicinity. Radiocarbon dates from two maize cupules recovered from the midden indicate an occupation ~AD 1450 (Table 4-1). Only Irene ceramics were recovered from the midden (Keene 2002).

The spatial relationship of the structures found during the Elderhostel excavation, and the fact that Irene ceramics dominate all assemblages, suggest that the site was occupied most intensively during the Irene phase. The radiocarbon dates from Structure 5 and the 2001 Midden Unit indicate that the midden was deposited at that time. Therefore, the site is considered to be a single village, and it is the purpose of this paper to determine the subsistence strategies of the inhabitants and season of occupation of that village.

PALEOETHNOBOTANY

Methods

All paleoethnobotanical analyses were conducted at the University of North Carolina at Chapel Hill, using the comparative paleoethnobotany collection and Martin and Barkley's (1961) *Seed Identification Manual*. The majority of identifications were made by Kandace Detwiler (2002), assisted by Amber VanDerwarker, Kimberly Schaefer and Amanda Tickner, under the supervision of C. Margaret Scarry. All paleoethnobotanical remains are from the 2001 excavations. Soil samples were taken from each level of the 2001 Midden Unit. The entire Structure 5 floor as well as 5 cm above (prefloor) and below (subfloor) the floor were collected by unit. All samples were processed by flotation. The majority of the light-fraction flotation samples were screened through 0.25 mm mesh, although several were screened through 1.58 mm (1/16 inch) mesh. Most of the heavy-fraction samples were screened through 0.50 mm mesh, but some were screened through 1.58 mm (1/16) inch mesh. After flotation, the samples were further screened by the paleoethnobotanists. All plant remains in size fractions above 2 mm were identified. Subsamples were taken from the fraction under 2 mm.

Results and Discussion

Subsistence

A large variety of taxa are present in the Grove's Creek Site paleoethnobotanical samples, with thirty being from edible plants (Table 4-2). Two of the most numerous remains were acorn (*Quercus* sp.) and hickory (*Carya* sp.) nut shells. Acorns were important for the flour-like meal that was made from the meat, and hickory was processed for its oil (Swanton (1977 [1946]:273). Fruits were the most diverse group of food plants recovered, represented by 12 taxa. Small quantities of edible seeds were recovered from amaranth (*Amaranthus* sp.), chenopod (*Chenopodium* sp.), maygrass (*Phalaris carolinana*), purslane (*Portulaca* sp.) and wild bean (*Strophostyles* sp.). A few seeds from four plants that could be used for their greens, pokeweed (*Phytolacca americana*), amaranth, chenopod and purslane, were recovered. It is not possible to determine if the leaves of these plants were consumed.

The miscellaneous crop category contains four taxa. Morninglory (*Ipomoea/Convolvulus* sp.) roots can be eaten (Fernald and Kinsey 1943:187); however, only seeds were found at Grove's Creek Site, and these are considered commensal. Pokeweed berries are not edible, although their flesh could be used to make a dye (Fernald and Kinsey 1943:187). There is no evidence, however, that Native Americans used them for this purpose (Hally 1981:731). Wax myrtle berries (*Myrica* sp.) could be used as a spice (Medsger 1966:147). Yaupon holly (*Ilex* cf. v*omitoria*) seeds were recovered, but it is the leaves that are used to make the tea (black drink) (Medsger 1966:215). Given the prevalence of yaupon holly in the site area today, the seeds may be a commensal taxon archaeologically.

A notable discovery at Grove's Creek Site was the amount and variety of cultivated foods. The sample contains maize (*Zea mays*) kernels, cupules and cob fragments. Maize is the second most numerous plant taxon found at the site. In addition, beans (*Phaseolus vulgaris*), squash seeds (*Cucurbita pepo*), squash/gourd rind (Cucurbitaceae) and sunflower (*Helianthus annuus*) were recovered. The low numbers of bean and squash are likely due to the fact that the entire harvested portion of the plant is edible, whereas maize has both cobs and cupules as by-products (Larson 1980:206).

While maize is found at several coastal Georgia sites, the other agricultural foods are rare or non-existent (Larsen 1982; Larson 1980). Several possible beans were recovered at the Pine Harbor Site (Larson 1980), but there is no record of squash or sunflower in other coastal Georgia sites. This is probably due, in part, to screen size and number of samples per site, in combination with a general paucity of ethnobotanical studies at coastal sites. This lack of data has lead to the perception that agriculture was a minor component in the overall subsistence base of late prehistoric coastal peoples. However, the information from Grove's Creek Site shows that agriculture may have played a larger role.

Several researches suggest that agriculture has benefits beyond supplying people with crop foods. Fallow agricultural fields make good environments for plants typically considered weeds, but that are edible or useful for dyes, medicine, cordage or construction (Hammett 1997:197; Ruhl, 1990:561; Yarnell 1982:5). This is corroborated by research from the United Nations, demonstrating that modern swidden agriculturists derive many of their resources from managed fallow fields (Heywood 1999). In New Guinea studies, 40 species of fallow field plants were utilized, while hundreds were used in Thailand and the Philippines. In a study in Veracruz, Mexico, 400 plants were collected from fallow fields by indigenous people. Eighty-one of these were used for food, the rest were used for other purposes from construction to medicine (Heywood 1999:10).

Some ethnohistoric evidence for fallow field management can be found in the Southeast U.S. Cowan (1985:219) and Larson (1980:214) point out that plum (*Prunus* sp.) or persimmon (*Diospyros virginiana*) trees were seen growing in Florida agricultural fields by Spanish explorers. This suggests that the trees established themselves in fallow fields, and when the Native Americans re-cleared the fields, the trees were left in place and possibly even tended. Several additional plants that may indicate agricultural fields were found at Grove's Creek Site. Blackberry/raspberry (*Rubus* sp.) and sumac (*Rhus* sp.) are often found growing around the edges of active and fallow fields (Medsger 1966). Chenopod and poke are common garden weeds (Larson 1980:206). Puslane is a weed often found in abandoned fields (Medsger 1966) and amaranth is common in cultivated gardens (Fernald and Kinsey 1943). Cherry (*Prunus* sp.), grape (*Vitis* sp.), hackberry (*Celtis* sp.), blueberry (*Vaccinium* sp.) and maypop (*Passiflora incarnata*) are other possible indicators of fallow agricultural fields (Yarnell 1982:5). If the Native Americans were managing their fields, then cultivation may account directly and indirectly for 72 percent of the edible plant remains found at Grove's Creek Site.

Season of Occupation

Many seasonality studies have been conducted on archaeological sites (c.f. Monks 1981). However, caution must be used when determining season of occupation with plant remains, as season of harvest does not always equate with season of occupation, absence of a taxon in the archaeological record cannot be used as evidence, and few plants grow during some seasons, such as winter. Many of the taxa found at Grove's Creek Site could be stored for use during other seasons. Table 4-3 lists the season of harvest for each of the taxa found at Grove's Creek Site. It also shows only the season of harvest for the portion of the plant recovered. For example, amaranth seeds are available in the early summer/autumn although their leaves are edible in spring. The season of harvest given in Table 4-3 does not necessarily equate to specific months of the year, but rather to general climactic changes. Depending on annual variations in temperature and rainfall, spring may arrive in early March one year but not until late April in another.

Both acorns and hickory nuts ripen in autumn but can be stored for use throughout the year. Hickory nut shells can be used for fire fuel at any time as well, further hampering their use as a seasonal indicator. The seed foods could all be stored for later use. Four are ready for harvest in autumn, while maygrass is available in spring and early summer.

The season of harvest for fruits lasts almost all year, and most of the fruits found at Grove's Creek Site can be dried and used in any season. Sumac berries were used to make a beverage and were probably used fresh (Medsger 1972:213). Sumac are harvested in late summer or autumn. Persimmons are harvested in the late autumn, when they are very ripe. Swanton (1977[1946]:363) states that Native Americans made a loaf from the fruit by removing all the seeds and skin and drying the pulp out. Given that mostly seed fragments were found at Grove's Creek Site, it is likely that the fruit was either eaten fresh or made into loaves for storage (Hally 1981:731). In either case, this indicates that Grove's Creek Site was occupied at some time in the autumn.

No taxa in the miscellaneous crop category indicates a season of occupation. Wax myrtle berries can be harvested from autumn until early summer, too long a span to be useful for determining season of occupation. Yaupon holly and morninglory are likely commensal and pokeweed may be.

Both Larson (1980:207) and Crook (1986:19) suggest that Native Americans harvested their crops in June or July, and possibly ate most of the crops before the autumn nut-collecting season (Larson 1980:207). Thomas (1993:9) suggests a late summer harvest and mentions the possibility of a second harvest. Swanton (1977[1946]:308) cites Laudonnière describing two maize-planting seasons by the Timucua, one in March and one in June. Each crop took approximately three months to ripen. As a consequence, the presence of maize could mean either a summer or autumn harvest and possibly both. However, as maize is storable, this does not automatically denote a summer or autumn occupation. Beans, squash seeds and sunflower seeds are also storable, so cannot be used as season of occupation indicators.

Wild maygrass produces seeds that ripen in spring or early summer. However, maygrass has been suggested as a cultigen in some parts of the Southeastern U.S. (Cowen 1978). When recovered from Kentucky rockshelters, it is always found with autumn-harvest foods, raising the question of whether it was planted late to coincide with the harvest of other autumn foods. As Kentucky is out of the natural range of the species, it is likely that maygrass was a domesticate in that area (Cowen 1985:213). However, as Grove's Creek Site is within the natural range of maygrass, and there is no evidence of its domestication in this area, it is considered a native wild seed here. Although maygrass is gathered in the spring/early summer, it is a storable food that could be eaten any time of the year. However, the presence of maygrass may bolster the argument for two plantings of maize. Maygrass could have been harvested while either clearing or tending fields during an early spring planting.

Persimmon is the only season of occupation indicator, and it denotes an autumn occupation at Grove's Creek Site. However, if the inhabitants planted their maize crop in the spring, as described in ethnohistoric accounts, they would have harvested it in summer. They could have collected maygrass during this first planting cycle. They would have had time to plant a second crop that would ripen in autumn, just as the persimmons came ripe. While tending their gardens, they could collect all of the summer-harvest wild plants. It is highly unlikely that the inhabitants would abandon their fields while the crops were growing, which suggests that Grove's Creek Site was occupied from at least spring, when the fields were planted, through the autumn harvest. It could be suggested that the inhabitants moved to Grove's Creek Site after the harvest to process persimmons and collect nuts. Although this is possible, it is not plausible. They would have had to carry all their stored foods with them. That would mean transporting at least 19 taxa from one place to the other, which would probably have included a rather large amount of maize.

Indirect paleoethnobotanical evidence suggests that Grove's Creek Site could have been inhabited through the winter season as well. Hackberries and wax myrtle berries can be picked throughout the winter (Fernald and Kinsey 1943:162, 147). The bud of the cabbage palm can be eaten all year, although harvest will kill the tree (Medsger 1972:136). Morninglory roots can be eaten throughout the winter as well (Fernald and Kinsey 1943:326). The great quantity of storable foods at Grove's Creek Site could also be used to argue that the site was occupied all year.

Summary

The paleoethnobotanical data demonstrate that the inhabitants of Grove's Creek Site relied on a mix of wild and cultivated foods. The variety of crops, and taxa commonly associated with gardens and fields, indicates that agriculture was a significant source of food. The season of harvest for the plants indicates that the site was likely occupied at least from spring through autumn.

ZOOARCHAEOLOGY

Methods

Identifications were made by the author, with the assistance of Barnet Pavao-Zuckerman. All identifications were made, using standard zooarchaeological methods, to the lowest taxonomic order possible using the Zooarchaeology Laboratory's comparative collection housed at the Georgia Museum of Natural History. Due to different recovery techniques, the faunal remains were divided into three analytical units for interpretation; Elderhostel, Structure 5 floor and 2001 Midden Unit. All Elderhostel materials were screened through 6.35 mm (1/4 inch) mesh. The Structure 5 materials were obtained through piece plotting during excavation and 0.50 mm flotation of the entire floor. The 2001 Midden Unit materials were screened using 6.35 mm (1/4 inch) and 1.58 mm (1/16 inch) mesh.

Results

Remains of 49 vertebrate taxa and 13 invertebrate taxa were recovered from Grove's Creek Site (Table 4-4).

Elderhostel Results

Deer contributed the greatest amount of biomass to the assemblage, and the smaller mammals contributed very little (Table 4-5). The smaller mammals may be underrepresented due to the 1/4 inch screen size. The screen size probably accounts for the low percentage of fish. Birds contribute the least amount of biomass, which appears to be typical of prehistoric assemblages (Reitz and Scarry 1985:45).

2001 Midden Unit Results

The midden sample gives the most accurate depiction of subsistence at Grove's Creek Site as it includes the invertebrates and was obtained from 1.58 mm (1/16 inch) screen (Table 4-6). Bivalves contribute the greatest biomass by far at 96.3 percent. This is followed by fish and turtle. Deer, other mammals, birds, and gastropods contribute very little. The large numbers of commensal taxa are due to large numbers of inedible invertebrates, such as land snails. No biomass formula is available for the crustaceans.

Structure 5 Floor Results

The sample from Structure 5 was very small (Table 4-7). Large bones would likely have been removed from the vicinity of the structure, leaving behind the smaller elements (Meadow 1978:19). Of those smaller bones, it is likely that only thicker, more durable elements survived the traffic of the structure floor. This is seen in the Structure 5 floor species list, which consists of turtle shell fragments, a white-tailed deer patella, several squirrel teeth and mandible, an eastern wood rat astragalus and various invertebrates. Mammals are the greatest contributor to biomass, followed by turtles and invertebrates. The low numbers of invertebrates are probably due to their being prepared outdoors. Oyster shells are extremely sharp and were likely cleaned up to prevent injury. Overall, the low recovery makes it impossible to accurately determine the subsistence strategies or season of occupation of the inhabitants.

Discussion

Subsistence

Gar (*Lepisoteus* sp.) and bowfin (*Amia calva*) are freshwater fish, although longnose gar can be found in marine water (Lee *et al.* 1980). The marine fishes found at Grove's Creek Site are all commonly found in estuaries and could be caught using hook and line, traps, weirs or nets (Larson 1980).

All of the turtles in the assemblage can be found in estuarine environments although the box turtle (*Terrapene carolina*) and river cooter (*Pseudemys concinna*) are commonly found in wooded areas and freshwater rivers, respectively (Ernst and Barbour 1972). Turtle was originally considered an ancillary food, probably captured in the course of gathering other foodstuffs (Larson 1980). As a result, they were not incorporated into subsistence models (Crook 1986). Since that time, however, evidence from Grove's Creek Site and other sites (Dukes 1993; Weinand *et al.* 2000) has shown that turtle was heavily exploited. Traps may have been employed solely for the purpose of catching turtle, as it seems unlikely that such great quantities would be caught accidentally in fish traps.

Birds could have been trapped or hunted with weapons. The blue heron (*Ardea herodias*), osprey (*Pandion haliaetus*) and rail (*Rallus* sp.) are common marsh birds. The turkey (*Meleagris gallopavo*) is found in wooded areas and swamps (Shanholtzer 1974). Both the hawk and the turkey are considered garden taxa (Neusius 1996:281) and may have been captured in both fallow and active agricultural fields.

Deer were probably actively hunted or killed while raiding agricultural fields. Most of the small mammals could have been captured by garden hunting as well. The mink was likely trapped for fur and the mole is probably commensal.

The invertebrates found at Grove's Creek Site are underrepresented, as they were not collected during the Elderhostel excavation. However, thirteen taxa were recovered from the 2001 Midden Unit and Structure 5. Crabs were represented by a large number of claws but were not identified below class level. Several species of bivalves were recovered at Grove's Creek Site. Mussels (*Geukensia demissus*), tagelus (*Tagelus* sp.) oyster (*Crassostrea virginica*) and the quahog clam (*Mercenaria* sp.) are found in intertidal environments (Abbott 1974). Oysters were the most numerous bivalve taxon recovered.

Gastropods are not as common at Grove's Creek Site as bivalves. The marsh periwinkle (*Littorina irrorata*) is found on *Spartina* grass stems throughout the year and was likely consumed (Fierstien and Rollins 1987:2). Whelk (*Busycon* sp.) is commonly found feeding in tagelus beds (Purchon 1977:64).

Season of occupation

The seasonal availability of the fishes found at Grove's Creek Site were determined with data gathered by an intensive biological survey in the Ossabaw and Wassaw estuaries in 1972 and 1973 (Mahood *et al.* 1974). Fish were collected in sounds, creeks and outside waters using trawls, gill nets and seines. Samples were taken on all sides of Skidaway Island as well as several creeks that run from the island. Both gill netting and trawling samples were taken very close to Grove's Creek Site. Samples were taken once each month. Both the hardhead (*Arius felis*) and gafftopsail (*Bagre marinus*) catfish belong in the family Ariidae. The hardhead catfish were collected from April to November and the gafftopsail from May through October. Killifish (*Fundulus* sp.) were not recorded during the biological survey. Seatrout (*Cynoscion* sp.), silver perch (*Bairdella chrysoura*) and Atlantic croaker (*Micropogonias undulatus*) can be found near Grove's Creek year-round. Red drum (*Sciaenops ocellatus*) were collected from July through January (Mahood *et al.* 1974); however, red drum have been found in estuarine areas year-round (Davy 1994). Two species of mullet (*Mugil* sp.) were collected from May to December during the biological survey. Flounder (*Paralichthys* sp.) are available year-round. Porcupine fish (Diodontidae) were recovered April through December by the biological survey.

The mullet, porcupine fish, and several catfish species are available in the estuarine environment from spring through late autumn, indicating that Grove's Creek Site was occupied during that time of the year. As all other fish species are available year-round, it is possible that the site was occupied in other seasons as well.

The turtles do not offer many clues to season of occupation at Grove's Creek Site. The mud turtle (*Kinosternon* sp.) may seek shelter when it is cold but can probably be found during the winter (Ernst and Barbour 1972). Diamondback terrapin are available all year on the Georgia coast (Johnson and Hillestad 1974:79). River cooter spend most of their time in the water, but come on land during nesting season, where they are slow, and clumsy and easier to catch (Ernst and Barbour 1972). One possible eastern box turtle was found at Grove's Creek Site. Eastern box turtles avoid the heat of summer and are most active during the spring and autumn. They may hibernate in winter but can be seen throughout the year (Ernst and Barbour 1972:89). All of the turtles found at Grove's Creek Site can be caught year-round.

Birds are often an excellent source of season of occupation data as many species migrate (Smith 1978). The family Ciconiiformes, which includes hawks and ospreys, and the subfamily Buteoninae, which encompasses several species of hawks, cannot be used for seasonal data as they contain species with different migration patterns as well as year-round habitation in the area around Grove's Creek Site (Shanholtzer 1974). Rails also encompass several species that have differing migration patterns and year-round residence (Denton *et al.* 1977:15). The great blue heron, osprey and wild turkey are all year-round inhabitants of the Georgia coastal zone (Shanholtzer 1974). As none of the taxa identified to species level are migrating birds, no season of occupation data can be garnered.

The mammals found at Grove's Creek Site provide no additional season of occupation data. White-tailed deer antlers (Smith 1978) and juvenile tooth eruption have been used with good results at other sites (Wagner 1996). Unfortunately, no antlers were recovered at Grove's Creek Site and the breeding season for coastal deer is fairly long (four months) and varies between years (Miller 1989; Nelson and Ford 1986; Osborne 1976; Warren *et al.* 1990). The other mammals cannot contribute information concerning season of occupation.

The invertebrates can offer little help with season of occupation. The bivalves are all sessile, and while the gastropods are motile, they do not migrate long distances (Abbott 1974; Fierstien and Rollins 1987; Purchon 1977).

Summary

The inhabitants of Grove's Creek Site relied on a variety of estuarine resources. Several of the fishes are available only from spring through late autumn, indicating that the site was occupied at least during the warmer months. However, the availability of the other fishes, mammals and birds throughout the year leaves open the possibility that the site was occupied at other times as well.

STABLE ISOTOPE ANALYSIS OF OYSTERS

Methods

Oysters grow in increments that can be seen as light and dark bands in cross-section and as ridges on the surface of the shell. Several researchers have used the visual analysis of these increments to determine season of capture in *Crassostrea virginica* oysters (e.g. Herbert and Steponatis 1998; Kent 1988). However, they noted a margin of error when using this system. Kirby *et al*. (1998) tested the use of visual analysis by comparing increment growth with oxygen isotope data from *Crassostrea virginica* shells from Maryland and the Mississippi Delta. Oyster shells grow throughout the year in oxygen isotope equilibrium with the surrounding water. High resolution isotopic analysis of a shell, in which measurements of the ratio of ^{18}O with ^{16}O (reported as $\delta^{18}O$) of each sample can be converted to relative temperature, gives an accurate indication of the season in which the animal was captured. Kirby *et al*. (1998) found that the isotopic values correlated with growth increments, concluding that visual analysis would be accurate. However, there were differences in growth patterns of shells between Maryland and Mississippi. Growth started earlier in the year in the Mississippi samples and growth breaks occurred in winter in Maryland and summer in Mississippi.

Subsequent studies have shown that the relationship between increment growth and temperature is not reliable. Andrus and Crowe (2000:37) found that, although dark bands generally indicated winter temperatures, they also formed during the height of summer, perhaps due to heat stress. Surge *et al*. (2001:295) found that the type of increment had no relation to water temperature at formation. As Surge *et al*. (2001) were testing oysters from south Florida and Andrus and Crowe (2000) were testing oysters from mid-Georgia, the extent to which increment color and water temperature relate may be influenced by latitude. Surge *et al.* (2001) and Andrus and Crowe (2000) both recommend the use of oxygen isotopes rather than visual increment analysis. Isotopic analysis, in which measurements of the $\delta^{18}O$ of each increment can be converted to temperature, gives a more accurate indication of the season in which the animal died. This method has been successfully completed on modern specimens of *Crassostrea virginica* oysters from Georgia (Andrus and Crowe 2000) and was used on *Crassostrea virginica* oysters from Grove's Creek Site.

The oyster shells for the study were collected from the 2001 Midden Unit. The shells from Structure 5 were too decayed to be used. All the shells from the 2001 Midden Unit were collected, counted and weighed. The oysters for isotopic analysis were selected from each level of the midden unit. The selected shells did not show any signs of epibiont growth in the interior of the shells, indicating that they were collected live. Several different sizes were selected in order to obtain a range of ages, and hopefully, seasons. The shells were all scrubbed in distilled water, then cut in half along the chondrophore. Contiguous samples were milled in ~500 micron transects from the most recently precipitated shell until eight samples were obtained, or until at least one seasonal $\delta^{18}O$ oscillation was measured. CO_2 was extracted from these samples following Craig (1957) and analyzed with a Finnigan MAT 252 isotope ratio mass spectrometer. Precision was ± 0.1‰ (1σ). All stages of the analysis were conducted at the Stable Isotope Lab in the Geology Department of the University of Georgia.

Results and Discussion

Eight shells were analyzed. Figure 4-2 depicts the $\delta^{18}O$ values of the shells. Positive $\delta^{18}O$ values from the area of last growth are indicative of colder temperatures, negative $\delta^{18}O$ as warmer temperatures, and intermediate values indicate either spring or autumn depending on their position on the sine curve. Five shells indicate winter (shells 1-2, 1-4, 2-2, 2-3 and 3-1), two indicate spring (shells 1-3 and 2-1) and one represents summer collection (shell 1-1). These data demonstrate that oysters were collected during a large portion of the year.

Summary

The stable isotope data indicate that oysters were collected from winter through summer. This suggests that Grove's Creek Site was occupied throughout this time.

Boonea impressa **Measurement**

Methods

The use of *Boonea impressa* as a seasonal indicator was first published by Russo (1991). *Boonea impressa* are parasitic gastropods that feed on oysters and are found along the Atlantic and Gulf Coasts. The majority of *Boonea impressa* are spawned in late spring/early summer. They grow larger throughout the year and die after approximately one year. Russo (1991) hypothesized that by collecting and measuring samples every month throughout the year, he could develop a model of growth that could be used to determine season of capture for oysters in archaeological samples. Season of death for *Boonea impressa* would indirectly record the season of death for the oysters to which they were attached. After collecting modern specimens off the northeast coast of Florida for 14 months, he developed six size classes representing spring, summer, autumn, late autumn, winter and late winter. His system was applied to *Boonea* *impressa* from Grove's Creek Site to determine season of oyster collection, and by extension, season of occupation.

The *Boonea impressa* shells were sorted from flotation samples taken from the 2001 Midden Unit and passed through 0.50 mm mesh. All shells were examined under a low power microscope to confirm that they were unbroken. The length of each shell was measured with a pair of digital calipers. The measurements were taken from the apex to the abapical end and were divided into the modal length size classes outlined in Russo (1991).

Results and Discussion

The *Boonea impressa* measurement data are divided into their modal length size classes in Figure 4-3a. Autumn has the highest collection rate, followed by late autumn, summer, spring and winter. Late winter is the only season that doesn't show any oyster collection.

Similar distributions are found with all *Boonea impressa* measurement studies. Russo (1991) found a preponderance of the autumn and late autumn modal length size classes in all the sites he tested, with smaller incidence of spring, summer and winter. The *Boonea impressa* method was also used by Crook (2000) on the North End Site, Little St. Simons, Georgia. He used materials from a 1.58 mm (1/16 inch) screen, which would have lowered the recovery of the small spring size class, but not the others. He also found a preponderance of autumn and late autumn shells, with one instance of increased summer sizes. *Boonea impressa* recovered from 1.58 mm (1/16 inch) screens materials from the Grove's Creek Site 2001 Midden Unit were also measured (Figure 4-3b). From a total of 1300 shells, the majority were from summer, autumn and late autumn. Only 13 percent were from the winter size class and 2 percent from the late winter size class. Less than 1 percent were greater in size than the late winter size class range. All of these *Boonea impressa* studies indicate the same pattern, which is a standard distribution.

There could be several reasons why *Boonea impressa* measurement data always favor the median size ranges. The first is that juvenile *Boonea impressa* (< 0.75 mm width) are often found feeding on invertebrates other than oysters (Powell *et al.* 1987). This could artificially inflate the percentage of larger size classes. While this may explain the small number of spring components found with the *Boonea impressa* method, it does not explain the scarcity of winter components. In Wells' (1959) 1955-1956 study of *Boonea impressa* from North Carolina, he found that the mean shell length stayed between 4 mm and 5 mm from November, 1955 through May, 1956. This may mean that the late autumn size classes in the *Boonea impressa* method are also including winter and late winter, thereby inflating the late autumn percentage. Additionally, the issue of taphonomy must also be considered. It is possible that younger shells are more fragile and break more easily or that the largest shells are more likely to have their tips broken off while still appearing to be whole.

Summary

These issues must be dealt with before the *Boonea impressa* measurement method is applied to other archaeological sites. Therefore, the *Boonea impressa* measurement data from Grove's Creek Site will not be applied to the final consideration of season of occupation at this time.

DISCUSSION

The data from Grove's Creek Site indicate that the village was occupied year-round. The paleoethnobotanical data indicate a spring through autumn occupation. Habits of several species of migrating fish recovered form the site indicate spring through fall occupation. Stable isotope analysis of oyster shells indicate oyster collection in winter, spring and summer.

The seasonal round models proposed for the Late Mississippian coastal area (Crook 1986; Larson 1980) suggest that the villages were occupied year-round by a chief, his/her immediate family and possibly other members of the matrilineage. The other inhabitants of the village would move to different locations throughout the year to acquire various resources. This theory is difficult to test as evidence for year-round occupation would be found in every village site even if the majority of the population moved seasonally. However, new information found at Grove's Creek Site and elsewhere makes it possible to propose a revised model.

When considering all the data from Grove's Creek Site, it is clear that the inhabitants relied on estuarine vertebrate and invertebrate resources and a variety of wild plants. What is less clear is the extent to which agricultural plants contributed to the diet. A greater variety of crop foods were found at Grove's Creek Site than at other coastal archaeological sites; however, as ethnohistoric accounts refer to the presence of these foods, this in and of itself is not new information. Isotopic analysis on human remains from the Georgia coastal area by Hutchinson *et al.* (1998) indicate that maize consumption increased steadily from AD 1000 to contact, although reliance on marine resources remained heavy. In addition, the earliest ethnohistoric accounts from the region indicate that there was a large enough surplus of maize for the Native Americans to share with the French explorers while still retaining large enough stores for themselves (Jones 1978). This growing use of maize would likely be accompanied by a proliferation of other agricultural foods, as seen by the diversity at Grove's Creek Site. Moreover, there is indirect evidence of fallow field management at Grove's Creek Site, and in ethnohistoric accounts, suggesting that even a large portion of the wild plants may have been related to agriculture.

Settlement patterns along the coastal plain were likely affected by this increased use of agriculture. Based on his survey of Skidaway Island, DePratter (1978:77) suggests that there was a shift in site location during the Irene phase, possibly to be near areas with soils better suited to agriculture. In a survey of Ossabaw Island, Pearson (1977, 1978) created a site hierarchy including large villages that were probably social and political centers, smaller settlements and resource procurement areas. While acknowledging the biases of survey data, he suggested that some of the smaller settlements were seasonal, occupied by some portion of the population of the larger villages at various times of the year. As cultivation was not thought to be important in coastal areas at this time, he suggested that a large portion of the smaller sites were for seasonal resource procurement rather than as agricultural hamlets. The greater numbers of sites in general were attributed in some part to population growth. DePratter (1978:77) suggested that the larger numbers of Irene phase sites on Ossabaw may be due to the breakup of larger Savannah phase settlements into smaller settlements relying on cultivation and estuarine resources. It is likely that a combination of these theories reflect settlement patterns during the Irene phase.

Ethnohistoric evidence has been used to bolster seasonal round subsistence and settlement models (Crook 1986; Larson 1969, 1980). However, as Jones (1978) points out, many of the examples come from the missionary period. By that time the Native Americans had been subject to a variety of outside forces, including disease and forced re-settlement, that had disrupted their traditional way of life. When the earlier ethnohistoric texts are examined, it appears that not only was there plenty of food throughout the year, but also enough to share with the French explorers (Jones 1978:189). The Spanish explorers were given supplies even in the year 1566, which was a year of drought (Jones 1978:190). The evidence at earliest contact indicates that the Native Americans on the coastal plain had sufficient food to sustain them throughout the year.

The settlement and subsistence model proposed herein is that the majority of sites found on the Georgia Coast were permanently occupied by people who subsisted on a mix of crops, wild plant foods, estuarine resources and hunting. Multiple plantings of maize each year would allow for plenty to store and use in times of subsistence stress. As good soil would be critical for multiple plantings, people would likely spread out across an area, settling wherever good agricultural soil could be found. Surveys conducted on Skidaway Island found that most Irene phase sites were on soils with good agricultural potential and near the marsh (DePratter 1978; Pluckhahn 1995). Surveys of Green (Crook 1975), Black, Cow, Mayhall (DePratter 1973), Sapelo, and Cumberland Islands, which include sites on both marsh and sea islands from all time periods, point to the same pattern (McMichael 1980:58). Many of these sites are in oak and hickory forests as well. The different sizes of the hamlets that Pearson (1977, 1978) noted may simply be due to the amount and quality of resources in the immediate area. An oak/hickory forest with nearby soils that are well suited for agriculture would be able to support more people than a small patch of decent soil without nut trees nearby. Regardless of how well one was positioned in respect to resources, there would still be no need for a seasonal round. All of the islands are small enough for a person to walk from one end to the other in a single day. Many of the small shell scatters observed are likely daily trips such as those seen by Meehan (1982) in her study of Aboriginal gatherers. This dispersed settlement pattern, in addition to being supported by archaeological survey data, is described in ethnohistoric accounts (Jones 1978:193).

There are several ways to test the above model. Several of the smaller sites found in the archaeological surveys of the islands need to be excavated. If the above model is correct, all but the very smallest sites will have structures associated with them. These sites should also contain evidence of crops and a variety of wild plant foods. Estuarine resources, such as shell, will be found even if the site is in the center of an island. If the inhabitants are taking trips to the marsh or creeks, there should be fish and turtle to indicate this. Lastly, the site should be occupied year-round.

CONCLUSIONS

The data from Grove's Creek Site indicate that it was occupied year-round. The inhabitants relied on a mix of crops, wild plant foods and estuarine faunal resources. The data from Grove's Creek Site, combined with other recent data, previous settlement and subsistence models and ethnohistoric accounts indicate an agricultural, sedentary society on the Southeastern U.S. Atlantic coast. Rather than a seasonal round, it appears that coastal peoples were likely settled in dispersed hamlets. Each of these hamlets would be permanently occupied and rely on a mix of cultivation, hunting, fishing and gathering.

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Figure 4-1: Map of Grove's Creek Site showing Elderhostel Excavations, 2001 Excavations and disturbed areas.

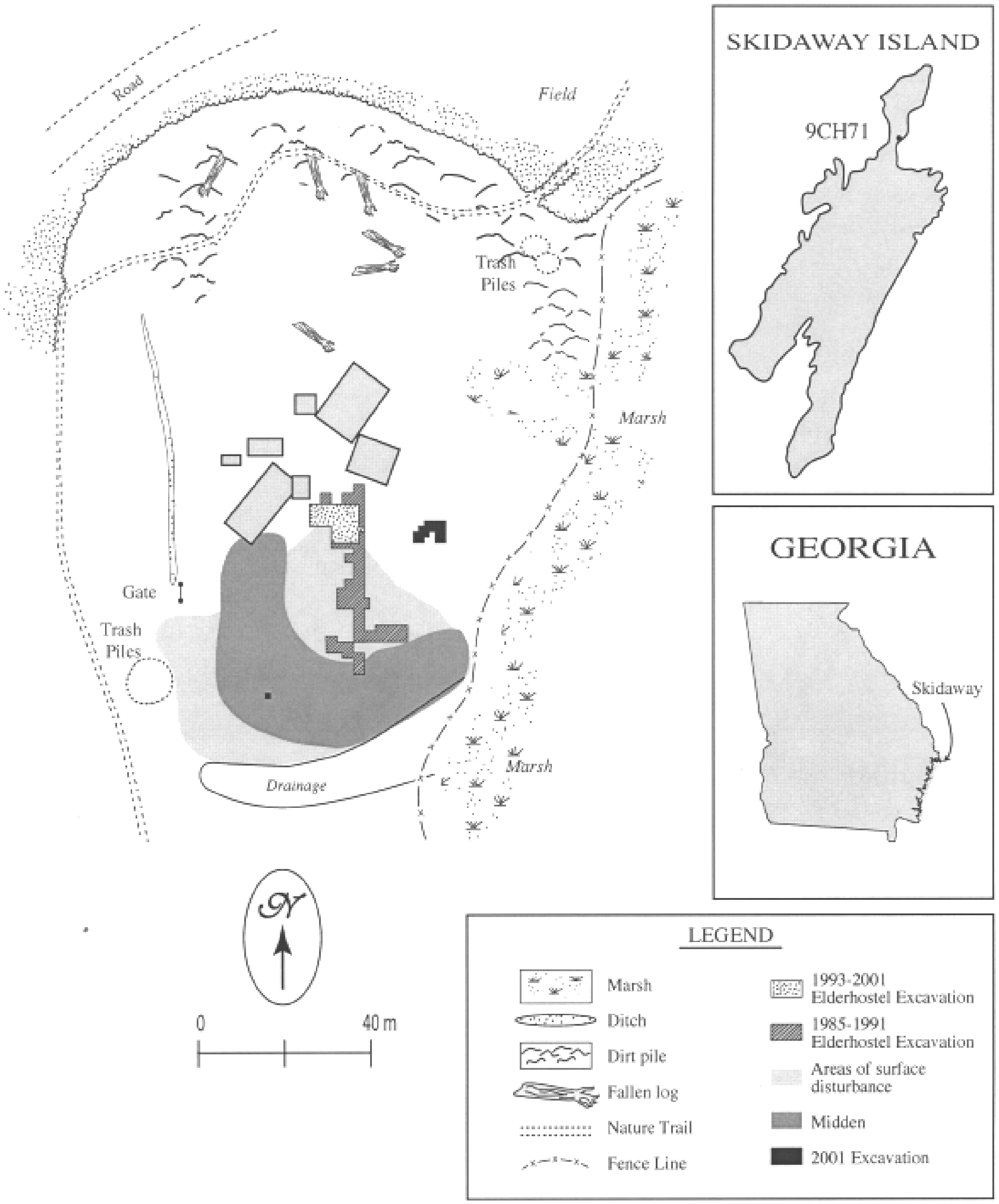
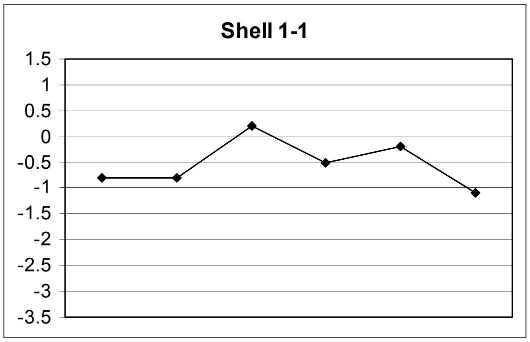

Road
Field
Trash Piles
Marsh
Gate
Trash Piles
Marsh
Drainage
SKIDAWAY ISLAND
9CH71
GEORGIA
Skidaway
0
40 m
LEGEND
Marsh
Ditch
Dirt pile
Fallen log
Nature Trail
Fence Line
1993-2001 Elderhostel Excavation
1985-1991 Elderhostel Excavation
Areas of surface disturbance
Midden
2001 Excavation

Figure 4-2: Oxygen isotope profiles from margins of oysters collected from the Grove's Creek Site 2001 Midden Unit. Y-axis: δ vs. PDB ‰. X-axis: samples taken from the edge of the shell (time of capture/death) are on the left side of the graph. Shells 1-2, 1-4, 2-2, 2-3 and 3-1 indicate winter. Shells 1-3 and 2-1 indicate spring. Shell 1-1 indicates summer.


Shell 1-1
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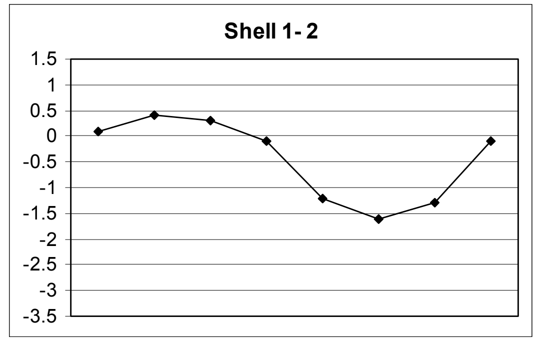
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5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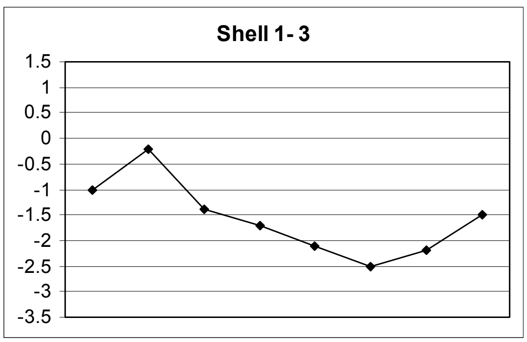
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5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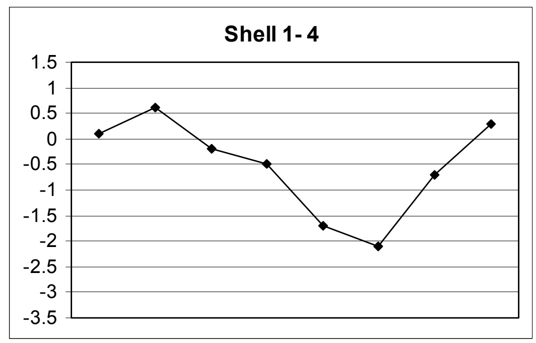
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5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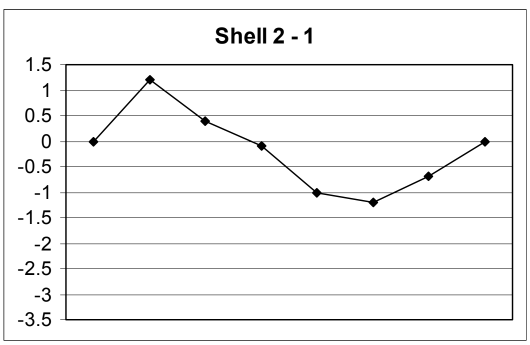
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5


Shell 2 - 1
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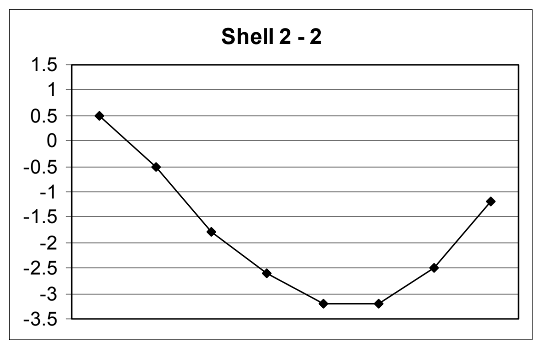
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5


Shell 2 - 2
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1
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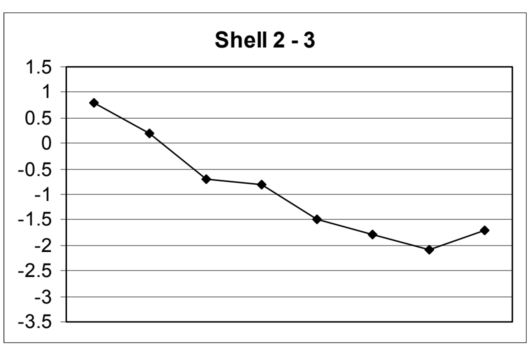
-0.5
-1
-1.5
-2
-2.5
-3
-3.5


Shell 2 - 3
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5

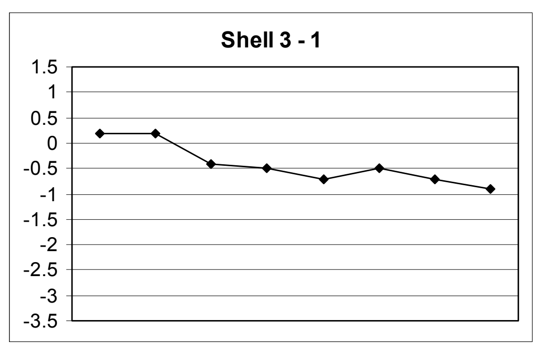
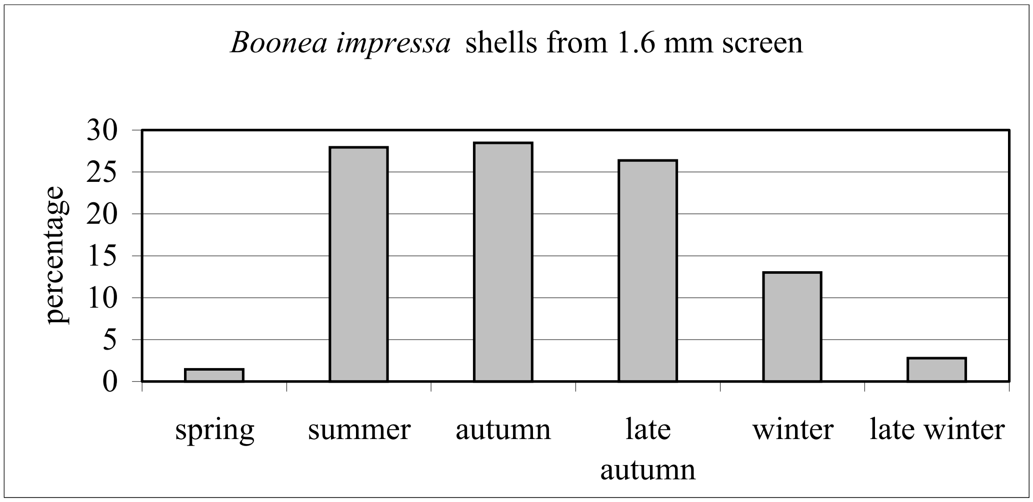
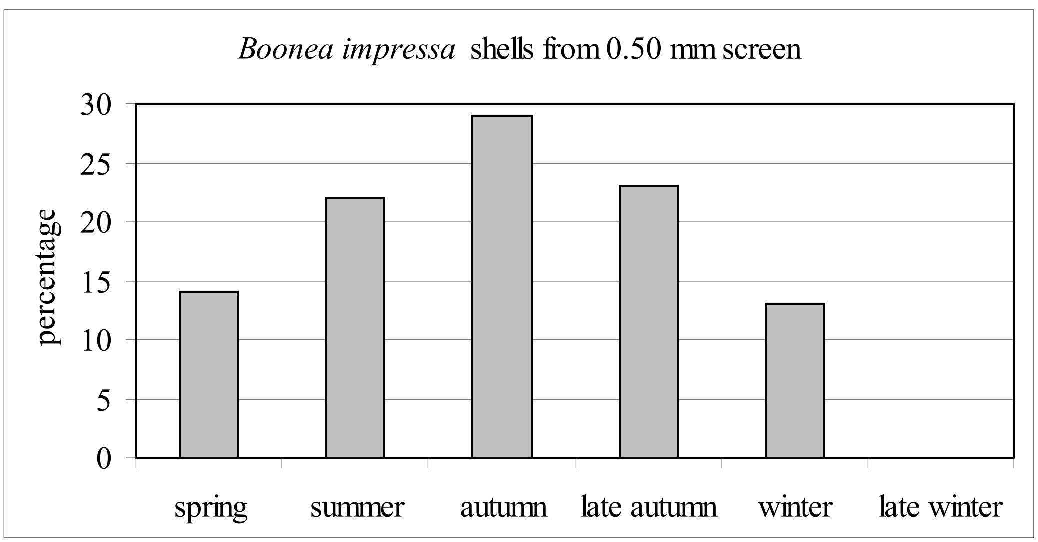

Shell 3 - 1
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5

Figure 4-3: Graphs depicting the seasons represented by *Boonea impressa*. X-axis: Each season corresponds to modal size ranges as outlined in Russo (1991). Y-axis: Percentage of the total assemblage. (a) *Boonea impressa* collected from 0.50 mm screen. N = 79. (b) *Boonea impressa* collected from 1.6 mm screen. N = 1300.


Boonea impressa shells from 1.6 mm screen
percentage
30
25
20
15
10
5
0
spring
summer
autumn
late autumn
winter
late winter

(a)


Boonea impressa shells from 0.50 mm screen
percentage
30
25
20
15
10
5
0
spring
summer
autumn
late autumn
winter
late winter

(b)

Table 4-1: Radiocarbon dates for the Groves Creek Site. Wall and Post dates are from Structure 5, Midden dates are from the 2001 Midden Unit. Calibrated dates calculated with OxCal v.3.5 Bronk Ramsey (2000) [Atmospheric data from Stuiver *et al.* (1998)].

Sample ID	Lab number	material	uncalibrated date B.P.	corrected date	^{13}C‰	cal A.D. 2 sigma
Wall #1	UGA-10116	wood charcoal	430 +/- 50	420	-25.42	1410-1530 (p=71.3) 1550-1640 (p=24.1)
Post #8	UGA-10117	wood charcoal	560 +/- 70	540	-26.04	1290-1480 (p=95.4)
Post #15	UGA-10118	wood charcoal	640 +/- 50	600	-27.62	1290-1420 (p=95.4)
Post #19	UGA-10119	wood charcoal	830 +/- 50	830	-25.03	1110-1290 (p=85.3) 1040-1100 (p=10.1)
Post #27	UGA-10120	wood charcoal	620 +/- 60	610	-25.62	1280-1430 (p=95.4)
Midden-1	Beta-169034	maize cupule	390 +/- 40		-10.90	1430-1530 (p=61.0) 1540-1640 (p=34.4)
Midden-2	Beta-169035	maize cupule	390 +/- 40		-10.90	1430-1530 (p=61.0) 1540-1640 (p=34.4)

Table 4-2: Edible plant remains from Grove's Creek Site, including counts for each taxa.

Common Name	Taxonomic Name	Structure 5 prefloor and floor	Structure 5 subfloor	Structure 5 exterior	2001 Midden Unit	Total
Nuts						
Acorn	*Quercus* sp.	1578	150	122	65	1915
Hickory	*Carya* sp.	235	76	104	58	473
Seeds						
Amaranth	*Amaranthus* sp.	1				1
Chenopod (wild)	*Chenopodium* sp. (wild)	13		1	2	16
Chenopod (wild) cf.	*Chenopodium sp.* (wild) cf.				1	1
Maygrass	*Phalaris caroliniana*	4	1	2		7
Purslane	*Portulaca* sp.	6				6
Wild bean	*Strophostyles* sp.	2				2
Fruits						
Blackberry/raspberry	*Rubus* sp.	4				4
Black gum	*Nyssa sylvatica*	7		36		43
Black gum cf.	*Nyssa sylvatica* cf.	1		4		5
Blueberry	*Vaccinium* sp.	9		2		11
Cabbage palm	*Sabal palmetto*	7	13	1	1	22
Grape	*Vitis* sp.	4	2			6
Hackberry	*Celtis* sp.				2	2
Maypop	*Passiflora incarnata*	24	4	1	1	30
Mulberry	*Morus* sp.	42	6			48
Persimmon	*Diospyros virginiana*	40	15	6		61
Persimmon fruit	*Diospyros virginiana*	1				1
Plum/cherry	*Prunus* sp.	3				3
Saw palmetto	*Serenoa repens*	341				341
Saw palmetto cf.	*Serenoa repens* cf.	2				2
Sumac	*Rhus* sp.	3				3
Miscellaneous						
Morninglory	*Ipomoea/Convolvulus* sp.	7	1		1	9
Pokeweed	*Phytolacca americana*	4	1	1		6
Pokeweed cf.	*Phytolacca americana* cf.	1				1
Wax myrtle	*Myrica* sp.	92	56	85		233
Wax myrtle cf.	*Myrica* sp. cf.	5				5
Yaupon holly	*Ilex* cf. *vomitoria*	9				9
Crops						
Bean	*Phaseolus vulgaris*	3	1			4
Bean cf.	*Phaseolus vulgaris* cf.	1				1
Maize cob	*Zea mays*	2				2
Maize cupule	*Zea mays*	527	131	11	4	673
Maize kernel	*Zea mays*	215	52	10	3	280
Maize kernel cf.	*Zea mays*	1				1
Cucurbit rind cf.	Cucurbitaceae	1				1
Squash seeds	*Cucurbita pepo*			2		2
Squash or gourd rind	*Cucurbita* sp.	2				
Sunflower	*Helianthus annuus*	1				1
Sunflower cf.	*Helianthus annuus* cf.	2				2

Table 4-3: Plant remains from Grove's Creek Site. Chart indicates season when recovered portion of plant is suitable for harvest. Seasons are based on general climactic changes rather than specific months.

	spring	early summer	summer	late summer	autumn	winter
NUTS						
Acorn					■	
Hickory					■	
SEEDS						
Amaranth				■	■	
Chenopod				■	■	
Maygrass	■	■				
Purslane			■	■	■	
Wild bean				■	■	
FRUITS						
Black/raspberry			■	■		
Black gum					■	
Blueberry			■	■		
Cabbage palm		■	■			
Grape			■	■		
Hackberry					■	■
Maypop			■	■	■	
Mulberry		■	■	■		
Persimmon					■	
Plum/cherry			■	■		
Saw palmetto					■	
Sumac				■	■	
MISCELLANEOUS						
Morninglory			■	■	■	
Pokeweed				■	■	
Wax myrtle	■	■			■	■
Yaupon holly					■	
CROPS						
Bean				■	■	
Maize			■	■	■	
Squash seeds			■	■	■	
Squash or gourd rind			■	■	■	
Sunflower				■	■	

Table 4-4: All faunal taxa recovered from Grove's Creek Site

VERTEBRATES

Chondrichthyes	Cartilaginous fish
Osteichthyes	Bony fish
Lepisosteus sp.	Gar
Amia calva	Bowfin
Siluriformes	Catfish
Ariidae	Sea catfish
Arius felis	Hardhead catfish
Bagre marinus	Gafftopsail catfish
Fundulus sp.	Killifish
Sciaenidae	Drum
Cynoscion sp.	Seatrout
Bairdiella chrysoura	Silver perch
Micropogonias undulatus	Atlantic croaker
Sciaenops ocellatus	Red drum
Mugil sp.	Mullet
Paralichthys sp.	Flounder
Diodontidae	Porcupine fish
Anura	Frog or toad
Testudines	Turtle
Kinosternon sp.	Mud turtle
Emydidae	Pond, marsh and box turtle
Malaclemys terrapin	Diamondback terrapin
Pseudemys concinna	River cooter
c.f. *Terrapene carolina*	Possible eastern box turtle
Lacertilia	Lizard
Serpentes	Snake
Viperidae	Venomous snake
Aves	Bird
Ardea herodias	Blue heron
Ciconiiformes	Hawk or osprey
Buteoninae	Hawk
Pandion haliaetus	Osprey
Meleagris gallopavo	Turkey
Rallus sp.	Rail

Mammalia	UID mammal
Large Mammalia	UID large mammal
Small Mammalia	UID small mammal
Didelphis virginiana	Opossum
Talpidae	Mole
Sylvilagus sp.	Rabbit
Sciurus sp.	Squirrel
Sciurus carolinensis	Gray squirrel
Neotoma floridana	Eastern wood rat
Rodentia	Rodent
Muridae	Mice and rat
c.f. *Sigmodon hispidus*	Cotton rat
Procyon lotor	Raccoon
c.f. *Mustela vison*	Mink
Odocoileus virginianus	White-tailed deer
Vertebrata	UID bone

INVERTEBRATES

Decapoda	Crab
Maxillapoda	Barnacle
Anadara brasiliana	Incongruous ark
Geukensia demissus	Mussel
Crassostrea virginica	Eastern oyster
Tagelus sp.	Tagelus
Mercenaria sp.	Clam
UID Marine Gastropod	Marine snails
Littorina irrorata	Marsh periwinkle
Urosalpinx cinerea	Oyster drill
Busycon sp.	Whelk
Ilyanassa obsoleta	Eastern mud snail
Terrestrial gastropod	Land snail
Invertebrata	UID Shell

Table 4-5: Elderhostel Faunal Summary Table.

Taxa	MNI		Biomass	
	#	%	kg	%
Deer	2	3.57	5.61	56.7
Other Wild Mammals	8	14.29	0.24	2.4
Wild Birds	6	10.71	0.43	4.3
Turtles	27	48.21	2.89	29.2
Fishes	12	21.43	0.72	7.3
Commensal Taxa	1	1.79	0.00	0.0
Total	56		9.89	

Table 4-6: 2001 Midden Unit Faunal Summary Table.

Taxa	MNI		Biomass	
	#	%	kg	%
Deer	1	0.02	0.05	0.3
Other Wild Mammals	4	0.07	0.02	0.1
Wild Birds	1	0.02	0.07	0.4
Turtles	2	0.03	0.21	1.1
Snakes	1	0.02	0.00	0.0
Fishes	30	0.51	0.42	2.3
Crabs	12	0.20		
Bivalves	3586	61.05	17.47	95.2
Gastropods	77	1.31	0.11	0.6
Commensal Taxa	2160	36.77	0.00	0.0
Total	5874		18.35	

Table 4-7: Structure 5 Floor Faunal Summary Table.

Taxa	MNI		Biomass	
	#	%	kg	%
Deer	1	14.29	0.13	65.0
Other Wild Mammals	2	28.57	0.01	5.0
Turtles	1	14.29	0.05	25.0
Bivalves	3	42.86	0.01	5.0
Total	7		0.20	

CHAPTER 5

CONCLUSIONS

The Grove's Creek Project was successful in finding a prehistoric structure with a geophysical survey. The GIS used for this project was useful in that process. Archaeologists who use a mapping program to interpret their geophysical data should consider using a GIS instead. A GIS shares the same mapping options, such as contouring, shade maps, etc., and in most respects, are just as easy to use. One of the most useful procedures available in a GIS is gridding without interpolation. Although there are high-pass and low-pass filters included in mapping programs, they cannot be as easily altered as in a GIS, where they can be constructed manually. There are also more types of filters to choose from in a GIS. I would recommend using a GIS instead of a mapping program for interpreting geophysical data.

It should be kept in mind, however, there is no substitute for a program designed specifically for geophysical processing. Important options such as creating data profiles and applying specialized equations will make data processing easier and more accurate. Many of these programs are less expensive than a GIS and would pay for themselves in a very short time. If an archaeologist has a choice between a GIS and a mapping program, the GIS is preferable, but the most accurate results are only available with a true geophysical processing program.

A comparison of the Irene phase structures found on the Georgia coast with ethnohistoric accounts, revealed several interesting similarities and differences. One of the characteristics that all the archaeological structures have in common is that they are single-set post construction and either rectangular or square in shape. Ethnohistoric accounts, however, most often describe circular structures. Wattle and daub and wattle and thatched construction are both found archaeologically and ethnohistorically. It is not possible to determine how widespread the use of semi-subterranean construction was, nor what types of features are common in Irene structures.

There appears to be no typical Irene phase structure. Rather, there is considerable variation in all aspects from size and shape to construction techniques. The differences noted between archaeological structures and ethnohistoric accounts could be due to either Eurocentric views on the part of the chroniclers or changes over time. The various size, shape and construction differences noted overall are likely due to the different functions of the various structures.

The data from Grove's Creek Site indicate that it was occupied year-round. The inhabitants relied on a mix of crops, wild plant foods and estuarine faunal resources. The data from Grove's Creek Site, combined with other recent data, previous settlement and subsistence models and ethnohistoric accounts indicate an agricultural, sedentary society on the Southeastern U.S. Atlantic coast. Rather than a seasonal round, it appears that coastal peoples were likely settled in dispersed hamlets. Each of these hamlets would be permanently occupied and rely on a mix of agriculture, hunting, fishing and gathering.

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APPENDICES

APPENDIX A

GEOPHYSICAL DATA

The entire conductivity dataset can be downloaded with the following link:

conductivity.xls

The entire magnetic dataset can be downloaded with the following link:

magdata.xls

APPENDIX B

ARTIFACT INVENTORY

The entire ceramic inventory from the Elderhostel excavations can be downloaded with the following link:

Elderhostel ceramic.xls

The entire ceramic inventory from the 2001 excavations can be downloaded with the following link:

2001 ceramics.xls

The entire shell and bone artifact inventory from the Elderhostel and 2001 excavations can be downloaded with the following link:

shell and bone tools.xls

A drawing of the shell gorget can be downloaded with the following link:

gorget-final.tif

Daub weight per unit for from the Elderhostel and 2001 excavations can be downloaded with the following link:

daub.xls

The entire lithic inventory from the Elderhostel and 2001 excavations can be downloaded with the following link:

Lithics.xls

Upper row left to right: N510W500 N528W488 N544W500

Bottom row left to right: N542W500 N518W500 N510W506

Follow the Lithics.xls link on the previous page for descriptions and measurements.

APPENDIX C

BOTANICAL REMAINS

All botanical remains recovered from the 2001 excavations can be downloaded with the following link:

botanical.xls

APPENDIX D

ZOOARCHAEOLOGICAL REMAINS FROM GROVE'S CREEK SITE (09CH71)

ABSTRACT

Grove's Creek Site (09CH71) is an Irene phase (AD 1300-1450) village located on Skidaway Island, Georgia. Faunal materials were excavated from three contexts to determine the subsistence strategies and season of occupation of the site. The data indicate that estuarine resources were used more heavily than terrestrial ones, with marine invertebrates contributing over 95 percent of the biomass. Remains of mullet, porcupine fish and several species of catfish indicate that the site was occupied at least during the warmer months of the year. As the remaining taxa are available year-round, it is likely that the site was occupied during other seasons as well.

INTRODUCTION

Grove's Creek Site is located on Skidaway, Island, Georgia. It is a Native American village occupied during the Irene phase (AD 1300-1450), based on radiocarbon dating and ceramic chronology. The site consists of at least five structures and extensive midden deposits. It was excavated over many years by both professional and amateur archaeologists; however, the collections have only recently been studied. The purpose of the current study is to determine the subsistence strategies and seasons of occupation at Grove's Creek Site.

Literature Review

Larson (1980) was one of the first people to propose a testable model concerning Late Mississippian subsistence strategies for the Southeastern U.S. Atlantic coastal plain. His seasonal round model was constructed on the premise that coastal soils could not support the level of agriculture found at other Mississippian sites. Larson (1980) suggested that coastal people moved every time they abandoned their fields and lived at different locations throughout the year. They collected nuts in the fall, shellfish in the winter, and other plant foods in the spring. After drawing these conclusions, he stressed the lack of subsistence data in archaeological reports, especially the absence of botanical data, and called for more work to be done before the subsistence of coastal peoples could be truly understood.

The Guale Annual Model proposed by Crook (1986) adds more detail to Larson's (1980) model. Crook (1986) suggests that coastal Mississippian people lived in towns or villages while they harvested crops nearby. After the fall harvest, the towns were abandoned except for the chief and his immediate family. The rest of the population foraged for nuts and other plant foods in surrounding forests while hunting in small parties. In the winter, these same small groups moved near the estuaries to fish, collect shellfish, and continue hunting for deer. In spring, they moved back to their farming plots to begin planting. Here, they would subsist on stored foods, anadromous fish, and shellfish during what Crook (1986) suggests would be a time of subsistence stress.

Building on the preceding models, Steinen (1984) put forth the idea that marsh islands were occupied by some of the small seasonal groups described by Larson (1980) and Crook (1986). The bulk of the population would live either on the barrier islands or the mainland and only visit the marsh islands to gather resources. During the historic period, there may have been a shift in subsistence patterns resulting in more use of marsh islands.

Jones (1978) takes issue with Larson's (1980) model. In an ethnohistoric study of the Guale, he concludes that coastal resources could support permanent settlements. He argues for permanent villages supported by a mix of maize horticulture and wild foods. He argues that a chiefdom level political structure supported long-distance trade for exotic items. Reitz (1988) also suggests that people at estuarine sites were basically sedentary, although they may have taken short trips to gather specific resources not locally available. As their reliance on cultivated foods increased, these trips may have become fewer and shorter.

MATERIALS

Grove's Creek Site is on the northern side of Skidaway Island, at the edge of a marsh (Figure D-1). Grove's Creek is 15 m northeast of the site. The original size of the site cannot be determined, because much of the area has been graded, and the soil containing cultural material has been removed. Three drainages are found on and adjacent to the site, giving the inhabitants access to many estuarine resources. The bulk of the site is on Lakeland Sand soil, which is suitable for corn agriculture (USDA 1974). The studied portion of the site is currently in mixed hardwood/palmetto forest.

Several excavations have been conducted at Grove's Creek Site. Armstrong State College sponsored a field school there in the early 1980s. In 1985, the site was reopened by Larry Babits and another crew from Armstrong State College. Excavations were conducted intermittently throughout 1985. In 1986, Babits began working with the Elderhostel Program, under whose auspices the site was excavated for one week of each year from 1986-1991 under Babits' supervision. No papers or reports were written on these excavations; however, the artifacts and field notes are available for the present study. In 1993, the Elderhostel Program was reestablished at Grove's Creek Site under the leadership of Ervan Garrison of the University of Georgia (UGA). This program continues today with excavations carried out for one week per year. In the summer of 2001, Deborah Keene excavated a structure and several test units, including one in the midden, as part of her dissertation research.

The site is an Irene phase (AD 1300-1450) village. At least five structures have been identified at the site. Four of the structures are in a north-south orientation with a large midden to the west of them. The fifth structure is to the east, closer to the marsh. There were no discreet middens associated with any of the structures. The majority of the ceramics are from the Irene phase, although there is evidence for smaller, earlier occupations (Keene 2002).

METHODS

Three analytical units are used in this report. The Elderhostel analytical unit includes all of Larry Babits' excavations from 1985 through 1991. Although there appear to be at least four structures associated with the 1985-1991 Elderhostel excavations, as well as numerous features, incomplete notes and maps make it impossible to accurately define them. Therefore, the 1985-1991 Elderhostel materials were analyzed as a whole, and hereafter the entire assemblage is referred to as the Elderhostel analytical unit. Ervan Garrison's 1993-2002 Elderhostel excavations are not included in this study.

The other two analytical units are from Deborah Keene's excavations in 2001. These include a portion of a structure and a midden test unit. The structure is designated as Structure 5. The midden test unit was a single 1x1 m test unit. The 2001 Midden Unit sample includes only faunal materials from that 1x1 m unit. In addition to Structure 5 and the 2001 Midden Unit, two other units were excavated by Keene. One of these (N567 W523) produced a single unidentifiable bone fragment that was added to the Elderhostel analytical unit. The other unit (N411 W515) produced no faunal material.

Field Recovery Methods

The Elderhostel materials were screened through 1/4 inch mesh. The invertebrate materials were inconsistently collected and have not been studied. Structure 5 was excavated by Keene. The fill and exterior soil from Structure 5 was screened through both 1/4 and 1/16 inch mesh. So few remains were recovered from the 1/4 inch fraction that the 1/16 inch fraction was not sorted. Therefore, only the 1/4 inch screen data are reported in the Structure 5 fill and Structure 5 exterior species lists. The soil from the entire structure floor was collected for flotation. The taxa found in the Structure 5 interior species list were collected from flotation samples or piece plotted and collected directly from the structure floor.

The 2001 Midden Unit sample was taken from a 1 x 1 m unit screened through both 1/4 and 1/16 inch mesh. The midden was unstratified and excavated in arbitrary ten centimeter levels. All vertebrate and invertebrate materials were systematically collected. Preservation in the 2001 Midden Unit sample was excellent and all vertebrate faunal materials from both fractions were identified. Only *Boonea impressa* shells and crab (Decapoda) remains were sorted from the 1/16 inch invertebrate materials. The remainder is reported as UID invertebrates, although some identifiable specimens may remain. Flotation samples were collected from each level of the midden unit but were only sorted for botanical remains.

Laboratory Methods

Identifications were made using standard zooarchaeological methods. All identifications were made to the lowest taxonomic order possible using the Zooarchaeology Laboratory's comparative collection housed at the Georgia Museum of Natural History. Most identifications were made by Deborah Keene, with contributions from Barnet Pavao-Zuckerman. The 1/4 inch invertebrate materials were sorted to the lowest taxonomic classification possible, using the Georgia Museum of Natural History's Invertebrate Collection. Deborah Keene made all invertebrate identifications. The element, or portion thereof, was sided, weighed and recorded. Notes were made of all natural and human modifications as well as epiphyseal fusion.

The Number of Identified Specimens (NISP) was determined for each taxon. All elements that could be mended were counted as one regardless of the number of fragments. Specimens from the UID Vertebrata category and many of the invertebrates were not counted. In both instances, the fragmentary nature of the remains made weight a better indicator of their overall contribution to the assemblage. Weights for all taxa were recorded.

Minimum Number of Individuals (MNI) was estimated for vertebrate specimens using symmetry, portion, and age. Bivalve MNI was estimated using paired valves, and univalved MNI was based on apical and abapical ends. MNI was estimated for the lowest taxa or taxon in each class, except UID Vertebrata and UID Invertebrata. An exception to this rule occurred when the assemblage MNI would be lowered using this method. For example, in the Elderhostel assemblage, two squirrel individuals are identified to genus and one to species. The two squirrels identified to genus are included in the overall MNI count while the squirrel identified to species is not.

Biomass formulas are used to calculate the meat weight contributed by certain taxa (Reitz *et al.* 1987; Reitz and Wing 1999:72). The vertebrate and invertebrate formulae used in this study are from Reitz and Quitmyer (1988:97). Some taxa in this study do not have biomass estimates, as no formulae exist for them. Biomass for every taxon for which formulae are available appear in the species lists; however, biomass in the summary tables only represent those taxa for which MNI was estimated.

Natural and human modifications and epiphyseal fusion were recorded for each specimen. The modification categories are burned, calcined, cut, worked, rodent gnawed and carnivore gnawed. Burned bones are black and could have been burned while roasting the meat or after being discarded in a fire. Calcined bones are white and soft. They have been burned at high temperatures, heavily weathered, or exposed to leaching in a shell midden. Cut marks are signs of butchering. Rodent gnawed and carnivore gnawed show that the specimen was not buried immediately after use and that it may have been transported from it's original location.

Worked specimens are those modified by humans for use as tools, ornaments, or similar objects. Epiphyseal fusion can be used to estimate age at death. Epiphyseal fusion data for white-tailed deer are from Purdue (1983).

Species listed as commensal are assumed to be living in the same area as humans, but not exploited by them for food or other resources. Many of the commensal taxa are parasitic invertebrates, which live in the same environment as, or attach to invertebrates commonly used for food. These include barnacles (Maxillapoda), incongruous ark (*Anadara brasiliana*), oyster drills (*Urosalpinx cinerea*), eastern mud snail (*Ilyanassa obsoleta*), and impressed odostomes (*Boonea impressa*). The land snails (terrestrial gastropods) are also likely commensal, as they live in the soil around the site. The other commensal taxa are frog or toad (Anura), lizard (Lacertilia), mole (Talpidae), rodents (Rodentia), mice and rats (Muridae), and cotton rat (cf. *Sigmodon hispidus*). Although these vertebrates are labeled commensal, it is possible that some were eaten by the inhabitants of Grove's Creek Site.

RESULTS

Elderhostel

Faunal remains from the Elderhostel excavations were recovered from a variety of features. At least four structures were found during the Elderhostel excavations, but they are recognizable only by large daub concentrations recorded in the field notes and cannot be clearly defined (Keene 2002). As a result, the materials from the Elderhostel excavations are analyzed as a single analytical unit, even though they include part of a midden, several structures, many features, and at least one burial.

There are 35 taxa in the Elderhostel assemblage, with 4,739 specimens identified from 57 individuals (Table D-1). Ariidae, containing both the hardhead (*Arius felis*) and gafftopsail (*Bagre marinus*) catfish, have the greatest MNI, NISP and biomass of the fishes. Turtles have the greatest NISP and MNI in the Elderhostel assemblage. White-tailed deer (*Odocoileus virginianus*) is the most common mammal recovered from the Elderhostel assemblage.

Although deer are only represented by three individuals, they contribute the largest percentage of biomass in the Elderhostel assemblage (Table D-2). Turtles have the greatest MNI and contribute the second largest quantity of biomass. Fishes are represented by 12 individuals and contribute over seven percent of the total biomass. Wild mammals and wild birds together account for 14 of the individuals and less than seven percent to the Elderhostel assemblage biomass. The mink (*Mustela vison*) is the only commensal taxon.

Elements represented and age estimated indicate that deer cranial specimens are rare (Figure D-2; Table D-3) and that most of the white-tailed deer died after their second year (Table D-4). The epiphyseal fusion data in Table D-4 indicate that at least three deer are present in the Elderhostel assemblage. One deer individual was less than 20 months old, and two individuals were greater than 20 months in age at death.

Burning is the most common modification in the Elderhostel assemblage (Table D-5). Calcined bone is the second most common, followed by carnivore gnawing, working, and rodent gnawing. Seven specimens are worked. The three fish specimens are polished dorsal or pectoral spines. All other worked specimens are awls. The cut mark was observed on a deer humerus.

Structure 5

The tables are divided into the Structure 5 interior, exterior, and fill to distinguish the structure floor specimens from the ground surface outside the structure and from the fill, which may have washed into Structure 5 at a later date. There were fewer taxa found in Structure 5 than in the other two assemblages. The interior of Structure 5 contained small amounts of turtle, mammal, and invertebrate remains (Table D-6). The exterior of Structure 5 yielded only a few UID mammal specimens and several invertebrates. The Structure 5 fill yielded turtle, mammal and invertebrates. There is no summary table for the Structure 5 assemblage, because it is so small. Too few white-tailed deer specimens were recovered to gain any information from their anatomical distribution (Table D-7). No deer specimens with epiphyseal ends were recovered, therefore, no estimates of age at death can be made.

Structure 5 contained very few modified specimens (Table D-8). The Structure 5 interior contained two burned and 41 calcined specimens. The Structure 5 fill contained three burned specimens and eight calcined specimens.

2001 Midden Unit

The 2001 Midden Unit sample is from a single 1x1 meter unit. The 2001 Midden Unit was unstratified and excavated in arbitrary ten centimeter levels. The samples contain both 1/4 inch mesh and 1/16 inch mesh fractions.

The 2001 Midden Unit sample contains a variety of vertebrate and invertebrate specimens (Table D-9). A total of 4,931 vertebrate specimens were recovered, accounting for 43 individuals and representing 36 taxa. Mullet (*Mugil* sp.) constitutes the greatest number (NISP) of specimens; however, the largest amount of biomass is contributed by the sea catfishes (Ariidae, *Arius felis*, and *Bagre marinus*), and the largest MNI is from killifish (*Fundulus* sp.). Fish (Osteichthyes) are the most numerous vertebrates overall, as measured by NISP. At least 4,268 invertebrate specimens were recovered, including 5,831 individuals (NISP was not calculated for all taxa) and 15 taxa. Oysters (*Crassostrea virginica*) are the most abundant invertebrate species. Large weights of both mussels (*Geukensis demissus*) and tagelus (*Tagelus* sp.) were recovered.

The 2001 Midden Unit sample summary (Table D-10) shows that invertebrates contribute over 96 percent of the biomass. Fishes contribute the third largest MNI and second greatest amount of biomass. Turtles account for the third largest MNI and over one percent of the biomass. Wild birds are represented by only one individual but account for a larger percentage of the total biomass than deer and other wild mammals. The large numbers of commensal taxa are due to the presence of land snails, impressed odostomes (*Boonea impressa*), and other small invertebrates

Only three white-tailed deer specimens were recovered from the 2001 Midden Unit deposit. Two specimens were from the foot and one from the axial region (Table D-11). Only one deer specimen was suitable for age determination (Table D-12) and indicates an individual less than 20 months old at death.

There are 378 modified specimens in the 2001 Midden Unit assemblage (Table D-13). Eight are calcined and 370 are burned.

DISCUSSION

Habits of Selected Taxa

Some of the fishes present in the collection are freshwater organisms, however, all but one of these can be found in brackish water. The gar (*Lepisosteus* sp.) could be either a longnose gar or Florida gar (Lee *et al.* 1980). Longnose gar can be found in marine waters (Lee *et al.* 1980:49). The bowfin (*Amia calva*) is also a freshwater fish (Lee *et al.*). Both these fish can be found in the area throughout the year. Siluriformes includes the freshwater white catfish (*Ictalurus catus*) that may also be found in brackish waters along the Georgia coast (Dahlberg 1975:42). Freshwater catfish are found in estuarine creeks from January through July (Mahood *et al.* 1975:26).

Although sharks and rays (Chondrichthyes) are not common in the Grove's Creek Site assemblage, they can be good seasonal markers. There are 18 species of sharks and 13 species of rays found along the Georgia coast. All but one of the sharks and three of the rays migrate offshore during cold weather (Dahlberg 1975). Their presence in the assemblage suggests a warm season deposit.

Biological survey data in and around Skidaway Island gives excellent information concerning migration patterns of local fish species. An intensive biological survey was conducted in the area surrounding the Ossabaw and Wassaw estuaries during 1972-1973 (Mahood *et al.* 1974). Fish were collected in sounds, creeks, and outside waters using trawls, gill nets, and seines. Samples were taken on all sides of Skidaway Island as well as several creeks that run from the island. Both gill net and trawl samples were taken very close to Grove's Creek Site. Samples were taken monthly, so caution must be used when interpreting the data, as one day of fishing determined the presence or absence of a species for an entire month. Both the hardhead (*Arius felis*) and gafftopsail (*Bagre marinus*) catfish were collected in all geographical areas during the biological survey. The hardhead catfish were collected from April to November and the gafftopsail from May through October. Five species of killifish (*Fundulus* sp.) are found in shallow waters off the coast of Georgia (Dahlberg 1975:49); however, none were collected during the biological survey. Two species of mullets (*Mugil* sp.), striped mullet (*M. cephalus*) and white mullet (*M. curema*), may be found along the Georgia Coast (Dahlberg 1975:76). It cannot be determined which is present in the Grove's Creek Site assemblage. Both species were collected in all areas from May to December by the biological survey. Two species of flounder (*Paralichthys* sp.) are commonly found in-shore in the area. These are summer flounder (*P. dentatus*) and southern flounder (*P. lethostigma*). Both species are caught year-round, although they are more abundant in the late summer (Mahood *et al.* 1975:38). One species of porcupine fish (Diodontidae) is commonly found in-shore on the Georgia Coast (Dahlberg 1975:101). This species, spiny boxfish (*Chilomycterus schoepfi*), is found from April through December. Seatrout (*Cynoscion* sp.), silver perch (*Bairdiella chrysoura*), Atlantic croaker (*Micropogonias undulatus*), and red drum (*Sciaenops ocellatus*) belong to the family Sciaenidae. Three species of seatrout are found in the area, spotted (*C. nebulosus*), silver (*C. nothus*), and weakfish (*C. regalis*) (Dahlberg 1975:70), but it is not possible to determine species in the sample from Grove's Creek Site. All three species were collected in all areas throughout the year. Silver perch and Atlantic croaker can be found near Grove's Creek Site all year (Mahood *et al*. 1975).

Red drum were collected in all areas from July through January (Mahood *et al.* 1974). Red drum live year-round in estuarine areas and only juvenile fish are thought to travel long distances; however, tagging data from South Carolina indicate that 90% of juvenile red drum are caught from July to October and 74% of adult red drum are caught from August to December (Davy 1994). Although red drum are present year-round, it appears that they may be more easily captured in the summer and fall. However, these captures were made by sportfishers using hook and line. Native Americans likely used different technologies, such as traps, which may be more efficient at catching red drum throughout the year.

The habits of several of these fishes contribute information towards determining the seasons in which Grove's Creek Site was occupied. Freshwater catfishes (*Ictalurus* sp.) were caught between January and July, the hardhead catfish between April and November and the gafftopsail catfish between May and October. The mullet were caught between May and December and the porcupine fish between April and December. The majority of these species are available from early spring through fall, indicating that Grove's Creek was likely occupied during that time of the year. As all other fish species are available year-round, it is possible that the site was occupied in other seasons as well.

The turtles, although abundant at Grove's Creek Site, do not offer clues to season of occupation. The mud turtle (*Kinosternon* sp.) could be either mud turtle (*Kinosternon subrubrum*) or striped mud turtle (*Kinosternon baurii*). Both of these species are found in swamps and brackish water. They may seek shelter when it is cold but can probably be found during the winter (Ernst and Barbour 1972). Diamondback terrapin (*Malaclemys terrapin*) are found in coastal marshes. Although they are often found in saltwater, they need freshwater to survive (Ernst and Barbour 1972:105). They are available throughout the year along the Georgia coast (Johnson and Hillestad 1974:79). River cooter (*Pseudemys concinna*) are usually found in rivers, but can also be seen in swamps and brackish tidal marshes. They spend most of their time in the water, but come on land during nesting season. River cooter are slow and clumsy when on land, making them easy prey. They may hibernate in winter in the northernmost area of their range (Ernst and Barbour 1972). One possible eastern box turtle (*Terrapene carolina*) was recovered at Grove's Creek Site. They are generally found on land, but have been seen in saltwater. Eastern box turtles avoid the heat of summer and are most active during the spring and fall. They may hibernate in winter but can be seen throughout the year (Ernst and Barbour 1972:89). All of the turtles recovered at Grove's Creek Site can be found year-round.

Birds have been used as a source of seasonality data as many species migrate (Smith 1978). However, none of the birds recovered from Grove's Creek Site that could be identified to the species level migrate. The family Ciconiiformes, which includes hawks and ospreys, and the subfamily Buteoninae, which encompasses several species of hawks, cannot be used for seasonal data as they contain species with different migration patterns as well as year-round habitation in the area around Grove's Creek Site (Shanholtzer 1974:176). Rails (*Rallus* sp.) also encompass several species that have differing migration patterns. The Virginia (*R. limicola*) and king rails (*R.elegans*) are commonly found in fresh and brackish marshes and spend the winter in salt marshes. The clapper rail (*R. longirostris*) is found in salt marshes year-round (Shanholtzer 1974:177). The great blue heron (*Ardea herodias*) and wild turkey (*Meleagris gallopavo*) are both year-round inhabitants of the Georgia coastal zone (Shanholtzer 1974). The ospery is found year-round but is more common in the summer (Shanholtzer 1974:176). The great blue heron is commonly found in marshes and swamps and the osprey is found all along the coastal zone. Wild turkeys prefer wooded environments, including wooded swamps (Shanholtzer 1974). There were no migratory species identified at Grove's Creek Site, and no medullary bone was identified. Therefore, no seasonality data could be provided by the bird remains.

The mammals found at Grove's Creek Site provide no additional seasonality data. White-tailed deer (*Odocoileus virginianus*) are found throughout the coastal zone (Golley 1962), and are often an excellent source of seasonality data for archaeologists. They shed antlers at predictable times of the year (Smith 1978), and juvenile tooth eruption has been used to great effect (e.g. Wagner 1996). Unfortunately, these methods cannot be used on coastal deer as their breeding season is fairly long (four months) and varies between years (Miller 1989; Nelson and Ford 1986; Osborne 1976; Warren *et al.* 1990). Both raccoon (*Procyon lotor*) and opossum (*Didelphis virginiana*) are nocturnal omnivores (Golley 1962), although raccoons living in salt marsh areas are active at low tide, even in daylight (Golley 1962:183). Raccoons are very common in archaeological deposits, although opossums are less so (Larson 1980). Raccoons may be easier to trap because they follow predictable trails when searching for food (Golley 1962:183). The rabbits (*Sylvilagus* sp.) found at Grove's Creek Site may be one of two species. The cottontail rabbit (*S. floridanus*) prefers drier habitats while the marsh rabbit (*S. palustris*) is always found in wetland areas and frequents brackish marshes. One gray squirrel (*Sciurus carolinensis*) was recovered at Grove's Creek Site. They are common in woodland areas. One other species of squirrel is common to the area, the fox squirrel (*S. niger*). It is larger than the gray squirrel and can tolerate more open woodland conditions (Golley 1962). The eastern wood rat (*Neotoma floridana*) frequents marshes and is large enough to be used for food (Golley 1962:141). The mink (cf. *Mustela vison*) is a semi-aquatic animal often found in salt water marshes (Golley 1962:186). Their diet is heavy in fish, so they may have been caught accidentally in nets or basket traps as well as purposely hunted. They may have been used for their fur rather than their meat. The mole (Talpidae) found at Grove's Creek Site is probably commensal.

Several crab (Decapoda) and barnacle (Maxillapoda) specimens were recovered. Numerous species of crab are found near Skidaway Island (Meinkoth 1981), however, the remains recovered at Grove's Creek Site were only identified to the class level. A small number of barnacles were recovered. They are most likely from the bay barnacle (*Balanus improvisus*), as they are often attached to oysters (Meinkoth 1981:596). The barnacles are likely commensal.

There were several species of bivalves recovered at Grove's Creek Site. The incongruous ark (*Anadara brasiliana*) is found on gravelly bottoms in relatively shallow water (Abbott and Morris 1995:9). Mussels (*Geukensia demissus*) are found in salt marsh intertidal environments (Abbott 1974:437). Tagelus (*Tagelus* sp.) found at Grove's Creek Site could either represent the stout tagelus (*T. plebeius*) or purplish tagelus (*T. divisus*), both of which are found in shallow waters (Abbott 1974:516). The clams (*Mercenaria* sp.) could be either the northern quahog (*M. mercenaria*) or southern quahog (*M. campechiensis*). The southern quahog lives on sandy, intertidal waters, the northern in shallow waters (Abbott 1974:523). Unfortunately, the presence of these bivalves does not offer any clues to the season of occupation of Grove's Creek Site, as they are all sessile.

Oyster (*Crassostrea virginica*) is the most common invertebrate at Grove's Creek Site and one that may contribute to distinguishing season of occupation of the site. Winter has been proposed by some archaeologists as the best time to harvest oysters, while summer should be avoided as the oysters are small and not as healthy as in winter (Crook 1986:25). However, data from *Mercenaria* sp. clams from multiple archaeological components at King's Bay indicate that Native Americans collected clams throughout the year (Quitmyer *et al*. 1985). Claassen's survey (1986) of shellfishing seasons in the southeast found that shellfish from most sites were collected from fall through early spring. Several oysters from Grove's Creek Site have been selected for δ^{18}O stable isotope analysis to determine their season of capture. Winter, summer and spring collection were indicated by the isotopic ratios (Keene 2002).

Gastropods are not as common at Grove's Creek Site as bivalves. Marsh periwinkles (*Littorina irrorata*) are found on *Spartina* grass stems throughout the year. On Sapelo Island, they can be found on the tops of the grass in summer months and clustered at the base in winter (Fierstien and Rollins 1987:2). They would be easily collectible any time of the year and were likely consumed. Oyster drills (*Urosalpinx cinerea*) are common in intertidal waters and move inshore to spawn (Abbott 1974:179). They feed on both oysters and mussels (Purchon 1977:64). Four species of whelk (*Busycon* sp.) are common in the shallow waters near Skidaway Island (Abbott and Morris 1995). The low MNI of this genus may be misleading. A rattlesnake gorget and 41 beads found during the 1985-1991 Elderhostel excavations were made of whelk. A digging tool and an ear pin made of whelk were found on the surface during the Keene 2001 excavations. Many of the whelk remains may have been re-used for other purposes. Whelks prefer to feed on *Tagelus*, but will also prey on oysters (Purchon 1977:64). They were likely captured during the collection of these bivalves. The eastern mud snail (*Ilyanassa obsoleta*) is found in the same habitats as marsh periwinkles (Fierstien and Rollins 1987:2) and is likely a commensal species at Grove's Creek Site. The impressed odostome (*Boonea impressa*) is a common shallow water dweller that feeds on other mollusks (Abbott 1974:294). Although it is found in large numbers, it is classified as a commensal species due to it's small size and it's habit of attaching to oysters. The land snails (terrestrial gastropods) probably entered the 2001 Midden Unit after it was deposited.

Elderhostel

The Elderhostel excavations produced a wide variety of taxa (Table D-1). The assemblage indicates a dependence on estuarine resources. Turtle was very important to the diet; only deer were a greater contribution to biomass (Table D-2). The fact that there were few small mammals and fish is likely due to screen size, and so it is hard to interpret their overall importance to the site. Shellfish were probably a very important source of calories as well. Although their remains were not saved during the excavation, the notes indicate that they were very abundant throughout the excavation area. Turtles have not been considered an important source of food for Native Americans (Larson 1980) and are not mentioned as a significant food source in the Guale Annual Model (Crook 1986). However, data from Grove's Creek Site and other site (Dukes 1993; Weinand *et* al, 2000) indicate that they may be more important to the overall subsistence patterns than previously assumed.

Several taxa found in the Elderhostel faunal assemblage can assist in determining seasonality. The assemblage contains both mullet and two species of sea catfishes. These species are all available only in the spring through fall. The other taxa are available year-round.

Structure 5

The sample from Structure 5 was very small (Table D-6). Large bones would likely have been removed from the vicinity of the structure, leaving behind the smaller elements (Meadow 1978:19). The dense bone, such as turtle shell and the patella, as well as teeth would probably have survived, although the more fragile bones, such as fish, would have succumbed to trampling. This is seen in the Structure 5 interior species list, which consists of turtle shell fragments, a white-tailed deer patella, several squirrel teeth with a mandible, and an eastern wood rat astragelus along with various invertebrates. The exterior of Structure 5 produced only a few unidentifiable mammal remains. The Structure 5 fill yielded turtle shells, unidentified mammals, a fragment of a white-tailed deer metapodial and various invertebrates. The low numbers of invertebrates found in all assemblages are probably due to their being prepared outdoors. Oyster shells are extremely sharp and would likely have been cleaned up to prevent injury. Overall, the low recovery make it impossible to accurately determine the subsistence strategies or seasonality of the inhabitants.

2001 Midden Unit

The 2001 Midden Unit sample gives the most accurate depiction of subsistence at the Groves' Creek Site as it includes both 1/4 and 1/16 inch screen sizes and invertebrates (Table D-9). Invertebrates contribute the greatest biomass by far, at over 95 percent (Table D-10). Fish and turtles are the largest vertebrate contributors. Deer, other wild mammals, and birds, as a whole, contribute less than one percent to the total biomass. This indicates a much heavier reliance on marine than terrestrial resources. The fish contribute some data to the seasonality issue. Mullet, porcupine fish, and several species of catfish are available from the spring through fall only, indicating that the site was occupied during this time at least. The other animals could not contribute any season of occupation information.

CONCLUSIONS

The data indicate that the inhabitants of Grove's Creek Site relied heavily on marine resources, supplemented by some terrestrial animals. Invertebrates contributed the greatest amount of biomass, with significant contributions by fish, turtle, and deer. The presence of several migrating fish, including mullet, porcupine fish, and several species of freshwater and sea catfishes indicate that the site was occupied during the spring through fall seasons. This is only a minimum estimate as most of the species found at the site are available throughout the year.

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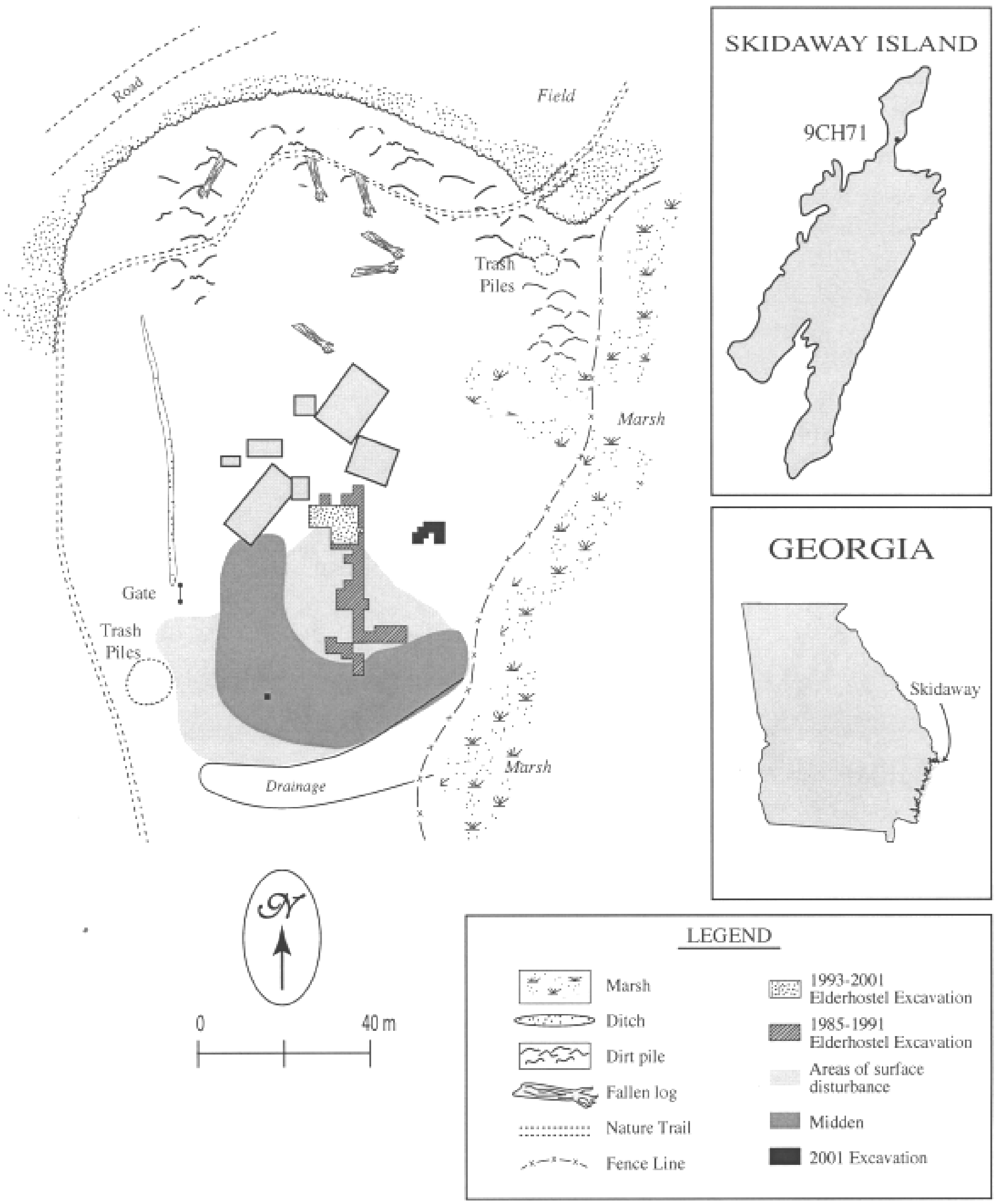
Figure D-1: Map of Grove's Creek Site showing Elderhostel Excavations, Structure 5 (2001 Excavation), and 2001 Midden Unit.



Road
Field
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Piles
Marsh
Gate
Trash
Piles
Marsh
Drainage
0
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SKIDAWAY ISLAND
9CH71
GEORGIA
Skidaway
LEGEND
Marsh
Ditch
Dirt pile
Fallen log
Nature Trail
Fence Line
1993-2001
Elderhostel Excavation
1985-1991
Elderhostel Excavation
Areas of surface
disturbance
Midden
2001 Excavation

Figure D-2. Elderhostel Assemblage: Deer Elements Identified. Not illustrated are 7 teeth fragments. NISP=92.

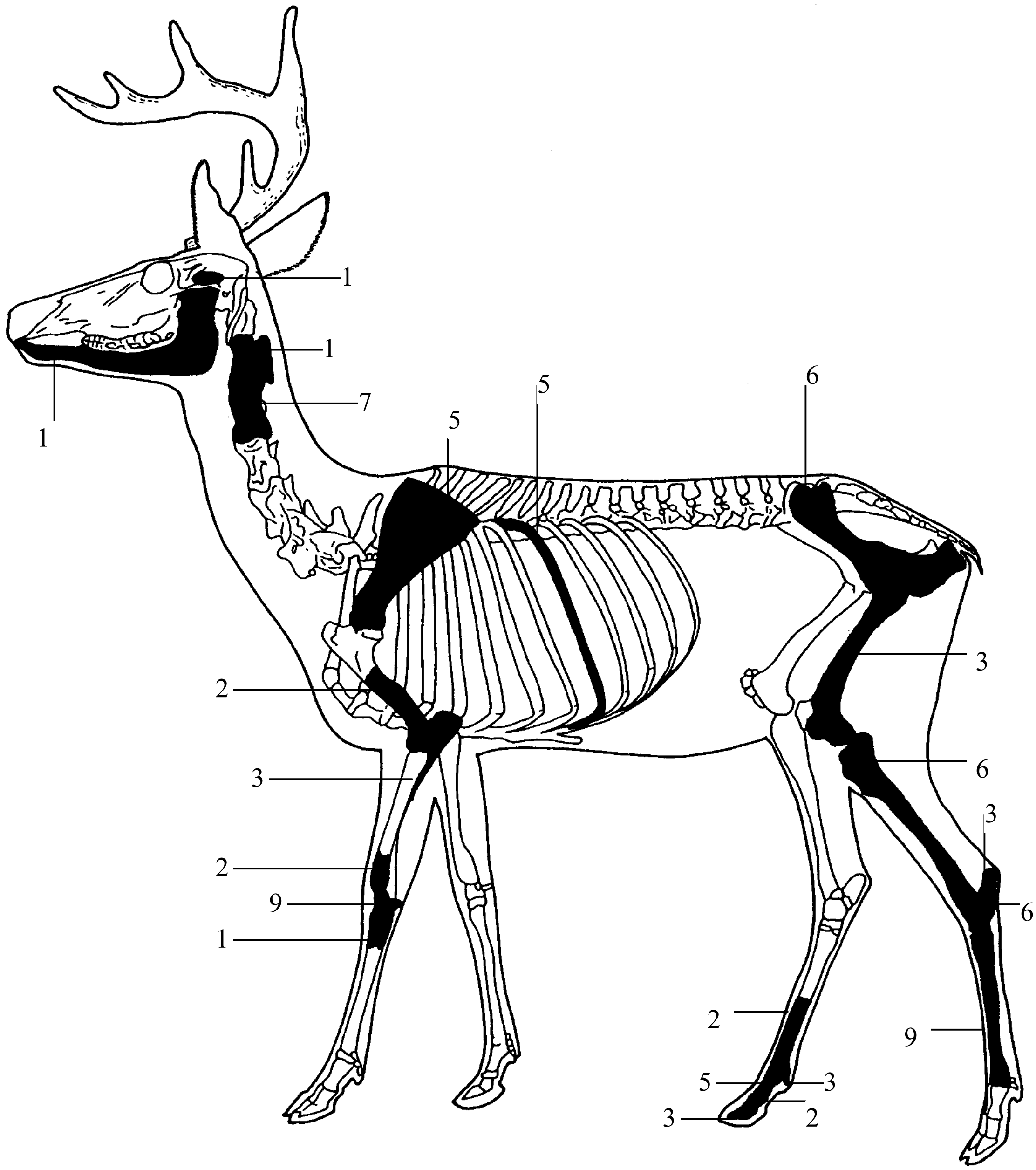
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Table D-1. Elderhostel: Species List

Scientific Name	Common Name	NISP	MNI #	MNI %	Weight (g)	Biomass kg	Biomass %
Osteichthyes	Bony fish	24			4.51	0.10	0.5
Lepisoteus sp.	Gar	1	1	1.8	0.84	0.03	0.1
Amia calva	Bowfin	1	1	1.8	0.17	0.00	0.0
Ariidae	Sea catfish	51			13.77	0.24	1.2
Arius felis	Hardhead catfish	86	7	12.3	30.62	0.51	2.6
Bagre marinus	Gafftopsail catfish	18	1	1.8	7.53	0.14	0.7
Sciaenidae	Drum family	2			0.79	0.03	0.2
Cynoscion sp.	Seatrout	4	1	1.8	0.70	0.03	0.2
Mugil sp.	Mullet	5	1	1.8	0.24	0.01	0.0
Testudines	Turtle	2648			1043.13	3.33	16.9
Kinosternon sp.	Mud turtle	3	1	1.8	0.93	0.03	0.2
Emydidae	Pond, marsh and box turtle	683			348.17	1.60	8.1
Malaclemys terrapin	Diamondback terrapin	668	24	42.1	806.28	2.80	14.2
Pseudemys concinna	River cooter	3	1	1.8	1.14	0.03	0.2
c.f. Terrapene carolina	Possible eastern box turtle	1	1	1.8	0.91	0.03	0.2
Aves	Bird	41			18.25	0.29	1.5
Ardea herodias	Blue heron	5	1	1.8	2.48	0.05	0.2
Ciconiiformes	Hawk or osprey	1			0.14	0.00	0.0
Buteoninae	Hawk subfamily	11	1	1.8	5.49	0.10	0.5
Pandion haliaetus	Osprey	1	1	1.8	1.22	0.02	0.1
Meleagris gallopavo	Turkey	7	2	3.5	15.89	0.25	1.3
Rallus sp.	Rail	3	1	1.8	0.66	0.01	0.1
Mammalia	UID mammal	129			56.57	0.99	5.0
Large Mammalia	UID large mammal	221			208.81	3.22	16.3
Small Mammalia	UID small mammal	2			0.90	0.02	0.1
Didelphis virginiana	Opossum	1	1	1.8	0.42	0.01	0.1
Talpidae	Mole family	1	1	1.8	0.03	0.00	0.0
Sylvilagus sp.	Rabbit	9	2	3.5	4.94	0.11	0.6
Sciurus sp.	Squirrel	13	2	3.5	3.14	0.07	0.4
Sciurus carolinensis	Gray squirrel	1	(1)		0.13	0.00	0.0

Table D-1. Elderhostel: Species List (Continued)

Scientific Name	Common Name	NISP	MNI		Weight	Biomass	
			#	%	(g)	kg	%
Neotoma floridana	Eastern wood rat	1	1	1.8	0.61	0.02	0.1
Procyon lotor	Raccoon	1	1	1.8	0.26	0.01	0.0
c.f. Mustela vison	Mink	1	1	1.8	0.71	0.02	0.1
Odocoileus virginianus	White-tailed deer	92	3	5.3	387.16	5.61	28.4
Vertebrata	UID bone				37.19		
Total		4739	57		3004.73	19.73	

Table D-2. Elderhostel: Summary Table

Taxa	MNI		Biomass	
	#	%	kg	%
Deer	3	3.5	5.61	56.7
Other Wild Mammals	8	14.2	0.24	2.4
Wild Birds	6	10.7	0.43	4.3
Turtles	27	48.2	2.89	29.2
Fishes	12	21.4	0.72	7.3
Commensal Taxa	1	1.7	0.00	0.0
Total	57		9.89	

Table D-3. Elderhostel: Summary of White-tailed Deer Specimens by Anatomical Regions

Anatomical Region	NISP
Head	9
Axial	13
Forequarter	12
Forefoot	10
Foot	15
Hindfoot	18
Hindquarter	15
Total	92

Table D-4. Elderhostel: Epiphyseal Fusion for White-tailed Deer

	Unfused	Fused	Total
Early Fusing:			
Metapodials, proximal		4	4
1st Phalanx, proximal	1	1	2
2nd Phalanx, proximal		2	2
Middle fusing:			
Tibia, distal	1	2	3
Calcaneus, proximal		1	1
Late Fusing:			
Radius, distal	2		2
Ulna, proximal		1	1
Femur, proximal		1	1
Femur, distal		1	1
Total	4	13	17

Table D-5. Elderhostel: Number of Specimens with Modifications

Common Name	Rodent Gnawed	Carnivore Gnawed	Burned	Calcined	Worked	Cut Mark
Bony fish			2		3	
Turtle			157	13		
Pond, marsh and box turtle			14			
Diamondback terrapin			6	2		
Bird			5			
Turkey					1	
Mammal		10	10	10		
Large mammal	5	5	3	34	2	
Small mammal				1		
Rabbit				1		
Raccoon				1		
White-tailed deer			3	4	1	1
UID vertebrate		1	16	5		
Total	5	16	219	71	7	1

Table D-6. Structure 5: Species List

Scientific Name	Common Name	NISP	MNI #	MNI %	Weight (g)	Biomass kg	Biomass %
Structure Floor							
Testudines	Turtle	11	1	14.3	2.11	0.05	22.7
Mammalia	Mammal	4			0.83	0.02	9.1
Small Mammalia	Small Mammal	1			0.02	0.00	0.0
Sciurus sp.	Squirrel	5	1	14.3	0.25	0.01	4.5
Neotoma floridana	Eastern wood rat	1	1	14.3	0.05	0.00	0.0
Odocoileus virginianus	White-tailed deer	2	1	14.3	5.66	0.13	59.1
Vertebrata	UID vertebrate				0.49		
Geukensia demissus	Mussel		1	14.3	0.42	0.00	0.0
Crassostrea virginica	Eastern oyster		1	14.3	31.89	0.01	4.5
Mercenaria sp.	Clam		1	14.3	49.20		
Invertebrata	UID shell				8.90		
Total		24	7		99.82	0.22	
Structure 5 Exterior							
Mammalia	Mammal	10	1	12.5	0.70	0.02	40.0
Vertebrata	UID vertebrate				0.56		
Geukensia demissus	Mussel		1	12.5	2.33	0.01	20.0
Crassostrea virginica	Eastern oyster		6	75.0	119.20	0.02	40.0
Invertebrata	UID shell				20.04		
Total		10	8		142.83	0.05	
Structure 5 Fill							
Emydidae	Pond, marsh, box turtles	1			0.26	0.01	3.3
Malaclemys terrapin	Diamondback terrapin	1	1	2.6	0.84	0.03	10.0
Mammalia	Mammal	9			1.60	0.04	13.3
Large Mammalia	Large Mammal	1			0.65	0.02	6.7
Odocoileus virginianus	White-tailed deer	1	1	2.6	1.18	0.03	10.0
Vertebrata	UID vertebrate				0.58		
Geukensia demissus	Mussel		1	2.6	1.84	0.00	0.0
Crassostrea virginica	Eastern oyster		32	82.1	477.60	0.08	26.7
Busycon sp.	Whelk		3	7.7	82.17	0.09	30.0
Terrestrial gastropod	Land snail		1	2.6	0.07		
Invertebrata	UID shell				534.23		
Total		13	39		1101.02	0.30	

Table D-7. Structure 5 Interior: Summary of White-tailed Deer Specimens by Anatomical Region

Anatomical Region	NISP
Hindfoot	1
Hindquarter	1
Total	2

Table D-8. Structure 5: Number of Specimens with Modifications

Common Name	Burned	Calcined
Structure 5 Interior		
Mammal		3
Eastern wood rat		1
UID vertebrate	2	37
Total	2	41
Structure 5 Fill		
Pond, marsh and box turtle		1
Diamondback terrapin		1
Mammal	3	1
Large mammal		1
White-tailed deer		1
UID vertebrate		3
Total	3	8

Table D-9. 2001 Midden Unit: Species List

Scientific Name	Common Name	NISP	MNI #	MNI %	Weight (g)	Biomass kg	Biomass %
Chondrichthyes	Cartilaginous fish	14	1	0.02	0.09	0.02	0.1
Osteichthyes	Bony fish	2913			22.16	0.36	1.8
Amia calva	Bowfin	1	1	0.02	0.01	0.00	0.0
Siluriformes	Catfish	41			1.50	0.03	0.1
Ariidae	Sea catfish	33			8.00	0.14	0.7
Arius felis	Hardhead catfish	64	2	0.03	8.04	0.14	0.7
Bagre marinus	Gafftopsail catfish	69	2	0.03	5.59	0.10	0.5
Fundulus sp.	Killifish	252	12	0.22	1.03	0.03	0.1
Sciaenidae	Drum family	5			0.03	0.00	0.0
Cynoscion sp.	Seatrout	7	1	0.02	0.09	0.01	0.0
Bairdiella chrysoura	Silver perch	2	1	0.02	0.01	0.00	0.0
Micropogonias undulatus	Atlantic croaker	1	1	0.02	0.09	0.01	0.0
Sciaenops ocellatus	Red drum	3	2	0.03	0.88	0.04	0.2
Mugil sp.	Mullet	272	5	0.09	2.85	0.07	0.3
Paralichthys sp.	Flounder	2	1	0.02	0.01	0.00	0.0
Diodontidae	Porcupine fish	3	1	0.02	0.00	0.00	0.0
Anura	Frog or Toad	15	2	0.03	0.19		
Testudines	Turtle	929			127.68	0.81	4.0
Emydidae	Pond, marsh, box turtles	81			18.59	0.22	1.1
Malaclemys terrapin	Diamondback terrapin	26	2	0.03	16.46	0.21	1.0
Lacertilia	Lizard	2	1	0.02	0.01		
Serpentes	Snake	6			0.11	0.00	0.0
Viperidae	Venomous Snake	1	1	0.02	0.02	0.00	0.0
Aves	Bird	41	1	0.02	4.13	0.07	0.4
Mammalia	Mammal	96			15.61	0.31	1.5
Large Mammalia	Large mammal	8			11.42	0.24	1.1
Small Mammalia	Small mammal	26			1.16	0.03	0.1
Didelphis virginianus	Opossum	1	1	0.02	0.08	0.00	0.0
Sylvilagus sp.	Rabbit	1	1	0.02	0.09	0.00	0.0

Table D-9: 2001 Midden Unit Species List (Continued)							
Scientific Name	Common Name	NISP	MNI #	MNI %	Weight (g)	Biomass kg	Biomass %
Sciurus sp.	Squirrel	7	1	0.02	0.71	0.02	0.1
Neotoma floridana	Eastern wood rat	2	1	0.02	0.08	0.00	0.0
Rodentia	Rodent	1			0.04	0.00	0.0
Muridae	Mice and rat family	2			0.04	0.00	0.0
c.f. *Sigmodon hispidus*	Cotton rat	1	1	0.02	0.03	0.00	0.0
Odocoileus virginianus	White-tailed deer	3	1	0.02	1.98	0.05	0.2
Vertebrata	UID vertebrate						
Invertebrates							
Decapoda	Crab	1498	12	0.20	37.04		
Maxillapoda	Barnacle	55	11	0.19	8.11		
Anadara brasiliana	Incongruous ark	3	1	0.02	8.18		
Geukensia demissus	Mussel		12	0.20	1905.79	1.01	4.9
Crassostrea virginica	Eastern oyster		2935	49.97	71750.00	10.72	52.2
Tagelus sp.	Tagelus		628	10.69	2976.90	5.74	28.0
Mercenaria sp.	Clam	146	11	0.19	561.08		0.0
UID Marine Gastropod		56			11.02	0.01	0.0
Littorina irrorata	Marsh periwinkle	123	74	1.26	76.39	0.04	0.2
Urosalpinx cinerea	Oyster drill	1	1	0.02	2.36		
Busycon sp.	Whelk	7	3	0.05	60.25	0.07	0.3
Ilyanassa obsoleta	Eastern mud snail	5	5	0.09	2.41	0.00	0.0
Boonea impressa	Impressed odostome	1686	1686	28.70	8.86		
Terrestrial gastropod	Land snail	688	452	7.69	39.69		
UID shell					589.83		
Total		9199	5874		78286.72	20.52	

Table D-10. 2001 Midden Unit: Summary Table

Taxa	MNI #	MNI %	Biomass kg	Biomass %
Deer	1	0.02	0.05	0.3
Other Wild Mammals	4	0.07	0.02	0.1
Wild Birds	1	0.02	0.07	0.4
Turtles	2	0.03	0.21	1.1
Snakes	1	0.02	0.00	0.0
Fishes	30	0.51	0.42	2.3
Crabs	12	0.20		
Bivalves	3586	61.05	17.47	95.2
Gastropods	77	1.31	0.11	0.6
Commensal Taxa	2160	36.77	0.00	0.0
Total	5874		18.35	

Table D-11. 2001 Midden Unit: Summary of White-tailed Deer Specimens by Anatomical Region

Anatomical Region	NISP
Axial	1
Foot	2
Total	3

Table D-12. 2001 Midden Unit: Epiphyseal Fusion for White-tailed Deer

	Unfused	Fused	Total
Early Fusing:			
1st/2nd Phalanx, proximal	1		1
Total	1		1

Table D-13. 2001 Midden Unit: Number of Specimens with Modifications

Common Name	Burned	Calcined
Bony fish	42	5
Catfish	1	
Sea catfish	1	
Hardhead catfish	1	
Gafftopsail catfish	1	
Drum family	1	
Turtle	51	1
Pond, marsh and box turtle	5	
Mammal	8	1
Large mammal		1
White-tailed deer	2	
UID vertebrate	20	
Decapoda	237	
Total	370	8

APPENDIX D-A

MEASUREMENT OF SELECTED SPECIMENS

Elderhostel

Taxa	Element	Dimension	Measurement, mm
Odocoileus virginianus	Mandible	M7	84.10
		M8	51.36
		M9	32.40
		M15A	28.75
		M15B	21.32
		M15C	19.35
	Third molar	B	9.63
		L	20.24
	Ulna	BPC	17.76
	Metacarpal	Bp	30.03
	Radial carpal	GB	21.62
	Intermediate carpal	GB	19.07
	2nd and 3rd carpal	GB	18.18
	4th carpal	GB	18.80
	1st phalanx	Bd	12.58, 13.22
	2nd phalanx	GL	33.93
		Bp	13.43, 13.54
		SD	9.88
		Bd	9.64
	3rd phalanx	DLS	36.48
		Ld	19.25
		MBS	9.61, 9.73
	Astragalus	GLl	36.49
		GLm	33.23, 35.09
		Dl	20.22
		Bd	23.05
	Cubo-navicular	GB	29.73
	Malleolaire	GD	16.23
Ariidae	Otolith	Length	11.89, 11.97, 11.97, 13.03, 11.20, 11.27, 9.31, 18.93
		Width	9.77, 10.30, 10.20, 11.96, 10.50, 9.58, 7.91, 16.44
		Thickness	5.19, 5.06, 5.23, 6.02, 5.62, 4.59, 3.73, 8.49

Structure 5

Taxa	Element	Dimension	Measurement, mm
Odocoileus virginianus	Patella	GB	25.01

2001 Midden Unit

Taxa	Element	Dimension	Measurement, mm
Ariidae	Otolith	Length	16.05, 13.82, 11.88, 11.82, 17.70
		Width	14.63, 12.05, 10.34, 10.18, 15.02
		Thickness	6.85, 6.11, 5.51, 5.64, 7.61
Micropogonias undulatus	Otolith	Length	7.13
Sciaenops ocellatus	Otolith	Length	12.59
Fundulus sp.	Atlas	Width	1.46, 1.29, 1.63, 1.83, 1.45, 1.91, 1.51, 1.71, 1.48, 1.29, 0.98, 2.05
Bairdiella chrysoura	Atlas	Width	1.86
Mugil sp.	Atlas	Width	2.21, 1.61, 2.13, 2.47, 3.00

Ariidae measurements are greatest length, width is perpendicular to length, and greatest thickness. Fish atlas measurements are greatest width of anterior centrum. All other measurements follow Driesch (1976).

APPENDIX D-B

PROVENIENCES FROM WHICH FAUNAL REMIANS WERE ANALYZED

Test Unit Coordinates	Test Unit Number	Level	Locus	Feature	Piece Plot
N502W500	1	1 (pz)			
N502W500	1	2			
N510W498	10	2			
N510W498	10	4		D	
N510W498	10	5		C	
N510W498	10	5		D2	
N510W498	10	6			
N510W498	10	6		D2	
N510W498	10	6		D3	
N510W498	10	7		D2	
N522W500	101	3			
N522W502	102	6			
N524W500	106	5			
N510W506	11	duff			
N510W506	11	1			
N510W506	11	2			
N510W506	11	3			
N510W506	11	4			
N510W506	11	5			
N510W506	11	6			
N528W500	116	2			
N528W500	116	3/4			
N510W496	12	2			
N510W496	12	3			
N510W496	12	4			
N510W496	12	4		A	
N510W496	12	4		B	
N510W496	12	6			
N510W496	12	5		D	
N510W496	12	5		F	
N510W496	12	5		H	
N510W496	12	5		I	
N510W496	12	5		J	
N510W496	12			D	
N510W496	12	6		B	
N510W496	12	6		D	
N510W496	12	6		I	
N510W496	12	6		J	
N510W496	12	7		J	
N510W494	13	2			
N510W494	13	2		trash pit	
N510W494	13	3			
N510W494	13	4			
N510W494	13	5			

Test Unit Coordinates	Test Unit Number	Level	Locus	Feature	Piece Plot
N510W494	13	6			
N510W494	13	7			
N510W494	13	8			
N536W500	136	4			
N510W492	14	4			
N510W492	14	5			
N510W492	14	5		A	
N510W492	14	6		A	
N534W500	131	2			
N538W500	141	4			
N540W500	146	3			
N542W500	151	1			
N542W500	151	3			
N542W500	151	4			
N542W500	151	4	3		
N542W500	151	4	4		
N542W500	151	5			
N544W500	156	1			
N544W500	156	2			
N544W500	156	3			
N544W500	156	4			
N544W500	156	5			
N544W500	156	6			
N544W500	156	6	1		
N544W500	156	3-6	2		
N504W500	2	duff			
N504W500	2	2 (pz)			
N504W500	2	3			
N504W500	2	5			
N504W500	2	6			
N504W500	2	7			
N504W500	2	8			
N506W500	3	duff			
N506W500	3	2			
N506W500	3				
N506W500	3	4			
N510W500	5		1 east		
N510W500	5	3		1	
N510W500	5 southwest quad				
N510W500	5	6			
N512W492	52				
N512W492	52	2			
N512W492	52	3			
N512W492	52	4			
N512W494	53	3			
N512W494	53	4			
N512W494	53	3	1		
N512W494	53	3	6		
N512W496	54	4			

Test Unit Coordinates	Test Unit Number	Level	Locus	Feature	Piece Plot
N512W496	54	5			
N512W496	54	6			
N512W496	54	5/6			
N508W502	6	2			
N508W502	6	3			
N508W502	6	4			
N508W502	6	5		postmold 2	
N508W504	7	1			
N508W504	7	2			
N508W504	7	3			
N518W498	70	4			
N512W500	76	2			
N512W500	76	3			
N512W500	76	3	9		
N512W500	76	4	7		
N512W500	76	4	9		
N512W500	76	6			
N508W506	8	1			
N508W506	8	2			
N508W506	8	3			
N508W506	8	4			
N514W500	81	7			
N514W500	81	7	3		
N514W500	81	7	4		
N514W500	81	8			
N514W500	81	8	7		
N514W500	81	9			
N514W500	81	10			
N516W500	86	4			
N516W500	86	5			
N516W500	86	5 west			
N516W500	86	5	2A southwest		
N516W500	86	5	2 east		
N516W500	86	5	2 southwest		
N516W500	86	5	4 east		
N516W500	86	5	4 west		
N516W500	86	5		11	
N516W500	86	6			
N516W500	86	6 east			
N516W500	86	6	2		
N516W500	86	6	5		
N516W500	86	6	4		
N516W500	86	6		11	
N516W500	86	clean-up			
N506W502	9	1			
N506W502	9	2			
N506W502	9	3			
N506W502	9	4			

Test Unit Coordinates	Test Unit Number	Level	Locus	Feature	Piece Plot
N506W502	9	5			
N506W502	9	6			
N518W500	91	3			
N518W500	91	4			
N518W500	91	4 northwest			
N518W500	91	5			
N518W500	91	6			
N518W500	91	6	4		
N518W500	91	6	5		
N518W502	92	2			
N518W502	92	1-4	1 west		
N518W502	92	3			
N518W502	92	3southwest			
N518W502	92	3	1		
N518W502	92	3	22		
N518W502	92	4			
N518W502	92	4	1		
N518W502	92	4		23	
N518W502	92			23 posthole1	
N518W502	92	5			
N518W502	92	5		22	
N518W502	92	5		23	
N518W504	93	2			
N518W504	93	2		22	
N518W504	93	2		22 southeast	
N518W504	93	2/3			
N518W504	93	2/3		22	
N518W504	93	2	1		
N518W504	93			22	
N518W504	93	3		22	
N518W504	93	3		postmold 1	
N518W504	93	3		postmold 2	
N518W504	93	4			
N518W504	93	5 north			
N518W504	93	5 south			
N520W500	96	4			
N520W500	96	4/5		postmold 5	
N520W500	96	5			
N520W500	96			postmold 5 southwest corner	
N520W502	97	3			
N520W502	97	2			
N520W502	97	4			
N520W504	98	2 south wall			
N520W504	98	2-4		posthole	
N520W504	98	3			
N520W504	98	clean-up			
N496W522		1			

Test Unit Coordinates	Test Unit Number	Level	Locus	Feature	Piece Plot
N496W522		2			
N496W522		3			
N528W487		2			
N528W488		4			
N528W487		5			
N528W487		6			
N530W483		7			20
N530W484		4			
N530W485		4			
N530W485		5			
N530W486		8			
N530W486		7			
N567W523		2			
N528W483	7 pre-floor				
N528W483	8 house floor				
N528W484	8 house floor				
N529W483	7 pre-floor				
N529W485	8 house floor				
N530W483	6 pre-floor				
N530W483	6 house wall				
N530W483	7 house floor				
N530W484	pedestal pre-floor				
N530W484	pedestal house floor				
N530W485	pre-floor				
N530W485	7 house floor				
N530W486	8 pre-floor				
N530W486	9 house floor				
N531W483	7 house floor				
N531W483	7 house wall				
N531W484	6 house wall/floor				
N531W485	5 house wall				
N531W485	6 house wall/floor				
N531W485	7 house floor				
N530W484	pedestal house floor				30
N531W485	6 house floor				120
N531W483	3				
N529W484	5				
N529W486	4				
N530W485	8				
N530W487	2				
N530W485	southwest quad just above house floor				

APPENDIX E

BOONEA IMPREEA MEASUREMENTS

All *Boonea impressa* measurement data for Grove's Creek 2001 Midden Unit is available through the following link:

Boonea measurements.xls