Revisiting the Resilience of Late Archaic Hunter-gatherers along the Georgia Coast

By

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Abstract

This paper addresses fisher-hunter-gatherer settlement and subsistence variability of the Georgia Coast during the Archaic-Woodland transition, framed within ideas derived from Resilience Theory, and focusing on systemic shifts, or "collapse." A critical examination of these shifts is needed to understand how communities experience change differentially, which in turn can lead to differential community resilience. Analysis of site file and radiocarbon date databases, as well as Bayesian modeling on a subset of dates, was performed at multiple scales and within distinct micro-environmental habitats. Results indicate that as sea levels dropped, there was continuity in Late Archaic occupation within deltaic areas of the coast, with intensive shellfishing occurring earlier (~5000 cal. BP) and lasting longer (~3500 cal. BP). In certain habitats, occupation may have continued into the following Early Woodland period. In non-deltaic areas, shellfishing occurs between 4500 and 3800 cal. BP, followed by subsistence changes and population movement. However, some of the post-3800 cal. BP occupations were fairly substantial. This differential experience of change between deltaic and non-deltaic areas was not accompanied by collapse: both areas had resilient communities. We conclude that inter-village relationships developed during the early Late Archaic period continued into the terminal portion, leading to resilience in the face of change.

Keywords: Resilience Theory, Spatial Analysis, Radiocarbon, Island and Coastal, American Southeast, Archaic

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1. Introduction

This paper addresses the social and environmental variability of the fisher-hunter-gatherers of the Georgia Coast (Figure 1) during the Archaic-Woodland transition. The study is framed within ideas derived from Resilience Theory, focusing on systemic shifts, or "collapse," noted for this time frame (Sanger 2010; Thomas 2010; Thompson 2010; Thompson and Turck 2009). While many recent studies of collapse employ Resilience Theory (e.g., Iannone 2016; Pool and Laughlin 2016; Sedig 2016; Torvinen et al. 2016), critique of its explanatory power (e.g., Emerson and Hedman 2016), suggests that the underlying causes and consequences of shifts in the adaptive cycles of past societies must be explored more fully. While we have addressed these issues previously (Thompson and Turck 2009), the analysis of newly synthesized data sets in this paper suggests that our earlier work glossed over some of the important variability now recognized in the archaeological record.

In this paper, a multi-scalar approach is utilized, synthesizing and analyzing state site file data, as well as a recently created radiocarbon date database (Turck and Thompson 2014). The results are contextualized within an ecological framework of dynamic, micro-environmental habitat change over time, to elucidate the variably changing lifeways of coastal Late Archaic-to-Early Woodland peoples. These results are considered in the context of Resilience Theory, understanding the collapse and continuity of hunter-gatherer economies in regards to differential responses to environmental change.

2. Collapse, Continuity, and Differential Resilience

Examining the nature of collapse is a perennial topic in archaeology, particularly for researchers who concentrate on politically complex societies such as states and chiefdoms (Anderson 1994; Marcus 1998; Tainter 1990, 2006). Fauseit (2016) offers a cogent summary of recent trends in this body of literature. He notes that there are a wide variety of ways that archaeologists define societal collapse, including group fragmentation, abandonment of sites or places, the cessation of large scale construction, and the breakdown of class systems, among others (Fauseit 2016:4-5). Scholars are beginning to take a more critical look at the notion of collapse, suggesting a further consideration of post-collapse events (e.g., Schwartz and Nichols 2006), and critiquing the notion of societal collapse altogether (see McAnany and Yoffee 2009). What has emerged from these studies is a call for a more critical examination of the underlying causes and consequences of systemic shifts noted in the archaeological record.

By exploring such shifts in detail, and at multiple scales, it becomes possible to understand how communities experience change differentially. This differential experience of change, which includes the understanding and acknowledgement of, as well as the response to, various events, can occur on local levels, in turn creating differential resilience to those events. This is particularly true when the event involves environmental change. A modern example of this can be seen in the different responses of communities to climate change and sea-level rise. New York state has commissioned studies and task forces to assess the threat and impact of sea level rise, and has recently signed into law a bill that requires certain state programs to take into consideration future climate risks, including adopting science-based sea-level rise estimates (see the Community Risk and Resiliency Act, SB 6617-B). At the other end of the spectrum, in a state equally susceptible to sea level rise, government officials in Florida have supposedly (unofficially) banned the terms "climate change" and "global warming." This example provides insight into the differential acknowledgement and response to, and therefore resilience of, various communities to environmental change.

This idea, which we are calling differential community resilience, can be applied to the analysis of past human-environmental interactions, due to the different ways that past communities experienced change. For the current study, we define community as operating on at least two scales, although we recognize that this is not an all-encompassing framework (e.g., imagined communities of Anderson 2006). At the smallest scale, we define community as operating at the level of the co-resident population tied to specific places on the landscape. Archaeologically consistent practices related to group interactions at this level leave materially recognizable traces that suggest that such interactions took place (see Yeager and Canuto 2000:10-11). This study views village sites as a dimension of community, containing co-resident, year-round populations organized according to a spatial layout (in this case, circular shell ring village sites with a central plaza). We recognize, however, that site and community are not isomorphic (see Yeager and Canuto 2000:3-4). Thus, at the largest scale, we define community as interactions between non-resident or semi-resident groups. Such interactions can occur as individuals or groups enter each other's territories, or during ritually integrative ceremonies. Both of these scales are important for the present study. They relate to how people organize themselves on the landscape with respect to resources and relations of production and mobility (Whitelaw 1994), as well the development of integrative social institutions, such as those observed among so-called tribal societies (Anderson 2002; Parkinson 2002).

This study focuses on the details of systemic shifts at multiple scales, to consider the variability that is observable at smaller, intra-regional scales, and to better interpret the responses of past societies to external environmental influences. This includes the variable responses of micro-environmental habitats to environmental change, the multiple ways in which people responded to external stimuli, and the recursive nature between these two factors. By considering this variability in terms of coupled socio-ecological systems that varied in both space and time, the nature of long-term changes in the distant past, as well as the multifaceted paths that such trajectories might have taken, can be better understood. This will lead to a better interpretation of the systemic changes seen in the archaeological record.

3. Environmental Change and Late Archaic Coastal Settlement

Intensive settlement on the Georgia coast initially occurred during the Late Archaic period (Thompson and Turck 2009; Turck et al. 2011). This period spans from around 5000-3000 cal. BP (DePratter 1991; Thomas 2008a:423), with sites identified largely on the presence of diagnostic fiber-tempered pottery, some of the earliest in North America (Sassaman 1993).

This intense Late Archaic occupation seems to coincide with marsh formation (DePratter and Howard 1981:1289; Elliot and Sassaman 1995:18), as sea levels rose to about 1.2 meters below present (mbp) by 4200 cal. BP (Gayes et al. 1992; Turck and Alexander 2013). However, Turck (2012) argues that marsh resources may have predated intensive settlement, and were in place at the end of the Middle Archaic period, when sea levels started reaching the 3.0 mbp mark, just before 5000 cal. BP (see Gayes et al. 1992). This raises the possibility that there were no substantial coastally-adapted Middle Archaic populations in Georgia, and that later populations migrated in from other areas (see Turck 2012).

Sea levels lowered to 2.5 mbp by 3800 cal. BP, and to 3.5 mbp by 3100 cal. BP (Gayes et al. 1992), which is near the transition from the Late Archaic period, to the Early Woodland period (ca. 3000-2300 cal. BP). In previous analysis, we (Thompson and Turck 2009) found evidence for a general collapse of the socio-political and settlement systems by the Early Woodland period, in association with a drop in sea level. This was likely due to a reduction in

marsh-estuarine resources that occurred at the same time, as much of the area reverted back to an upland setting (Turck 2011:171-172). It also appears that Early Woodland populations persisted in deltaic areas, which again was likely due to differences in marsh-estuarine productivity. That is, the sediment supplied by rivers allowed the marsh to endure in deltaic areas, so these areas remained attractive for settlement (Turck 2011:164). When sea level fluctuates up or down, the marsh can maintain itself if there is enough sediment in the system (Reed 2002). Non-deltaic areas did not have this influx of sediment, making it difficult for the marsh to keep up with the changing coastline, adversely affecting the resources important for human subsistence and settlement (Turck 2011). In Resilience Theory parlance, the transition from the Late Archaic to the Early Woodland period represents the exploitation/ growth (r) and the conservation (K) phases of the adaptive cycle (the Late Archaic period), and the collapse/ release (Ω) phase of the adaptive cycle (the Early Woodland period) (Thompson and Turck 2009:268-269). In the archaeological record, this is seen as the initial settlement of early villages at shell ring sites during the Late Archaic period, with the subsequent abandonment of these sites, and a supposed shift towards a more mobile, terrestrial-based economy during the Early Woodland period (Thompson and Turck 2009).

There is evidence to suggest that the reorganization observed for Early Woodland peoples actually began earlier, at the end of the Late Archaic period. On St. Catherines Island on the Georgia coast, Sanger and Thomas (2010:66-67; see also Sanger 2010) note that construction ceased at the St. Catherines Shell Ring around 3950 BP, and the McQueen Shell Ring around 3900 BP, with shell construction completely ceasing at both shell rings by 3750 BP. Furthermore, there appears to be a gap in the radiocarbon record, with only eight of the over 150 marine shell radiocarbon dates falling between 3300-2150 BP (Thomas 2010:184). Since most of the radiocarbon dates are obtained from shell, Thomas (2010:184) makes the point that the lack of dates indicates a hiatus in shell deposition. This is all the more compelling, considering the shell-centric research design on St. Catherines Island, with a survey that was aimed at locating shell deposits (see Thomas 2008b:304). This indicates that the general time frame for the hiatus in shell midden deposition, at least on St. Catherines Island, occurred towards the end of the Late Archaic period, and lasted throughout the Early Woodland period.

These studies indicate that disruptions in settlement and/ or subsistence noted for the Early Woodland period actually began during the Late Archaic period. Such a systemic shift includes the disruption or abandonment of certain subsistence practices, the cessation of shell deposition, whole or partial abandonment of sites, and whole or partial abandonment of entire coastal areas.

4. A Critical Review of Late Archaic Site Types

One of the principle keys to understanding the nature of such a systemic shift in the past, and whether or not a collapse occurred, is to understand the variety among, and relationship between, site types (e.g., Nicholas 2001). A number of studies have attempted to clarify the relationship between the three main coastal Late Archaic site types in Georgia: shell rings, shell middens, and non-shell sites (Michie 1979; Waring 1968). The best studied of the three are shell rings: large arcuate-to-circular shaped middens comprised predominantly of shell, usually surrounding a mostly shell-free plaza. There has been a long-standing discussion on the functions of these site types, with ideas concerning mobility and monument construction at its core (Thompson and Andrus 2011). Some researchers explain the formation of the rings as a result of the intentional mounding of feasting debris (e.g., Saunders 2014:61). Saunders (2014:44, 50)

cites ethnographic examples of people disposing of refuse at some distance from the living area when habitation is to last several months or more, as well as the seemingly octagonal shape of one shell ring indicating "some kind of societal division." Another less empirical line of reasoning is logistics and ring-wall integrity, where researchers find it "difficult to envision" (Saunders 2014:50; Russo 2014:37) people living on top or within shell rings, as this would be laborious, and destructive to the shell walls. There is empirical evidence that some portion of the population occupied shell rings year-round (Colaninno-Meeks 2012; Russo 1998; Thomas 2010:190-191; Thompson and Andrus 2011; Trinkley 1980). For example, Thompson and Andrus (2011: 335 and 337) used both growth band analysis and isotope analysis to find all four seasons of occupation at Sapelo Island Rings II and III. Some suggest that shell ring deposits are the result of both habitation and ceremonial activities, with the mounding of possible feasting deposits (Russo 2004, 2014; Sanger 2015; Thompson 2007; Thompson and Andrus 2011). Since ritual feasting occurs at the same location as daily meals, shell rings "followed a prescribed architectural plan that was adhered to as episodic deposition continued" (Russo 2014:33). Thus the only way to distinguish between ritual and quotidian food are by the context and quantities of food remains (Russo 2014:29). Thompson (2007:92; see also Thompson and Andrus 2011) also suggests a "developmental model" of ring formation, stating that the function of some shell rings might change over time, with initial formation through domestic habitation, but eventually becoming more ceremonial as places of ritual mounding. This can manifest either through the hosting of periodic feasts by the village, or the wholesale shift in use of a previously domestic shell ring to a ceremonial space (Thompson and Moore 2015; see also Sanger 2015).

In contrast to shell rings, other Late Archaic sites are generally viewed as either simple midden accumulations and/ or extraction sites (Elliot and Sassaman 1995:144-147). Shell-bearing sites, consisting of linear middens, amorphous shapes, as well as crescents, and rings, are relatively large, and located near tidal creeks which provide access to marsh-estuarine environments (DePratter and Howard 1980:7). Sites with fiber-tempered pottery, but little-to-no shell midden, are usually smaller and more dispersed, and not located near marshes, possibly indicating their use as hunting and/ or collecting camps (DePratter 1976; DePratter and Howard 1980). Based on these observations, DePratter (1976) surmised that non-shell sites were of "limited occupation in marginal areas," meaning away from marsh-estuarine resources. Milanich (1971) believed that these different site types could be used to differentiate between two Late Archaic phases within the coastal zone. The earlier phase (Sapelo) was associated with shell rings, and the later phase (St. Simons) was shell midden-related, but also overlapped the earlier phase partially (Milanich 1971:119-128). Elliott, Ledbetter, and Gordon (1994) also parsed out Late Archaic settlement into a five-phase system, but this evidence comes from the upper coastal plain. While this indicates behavioral changes with nearby Late Archaic populations, the phases are not directly translatable to the coastal zone.

DesJean, Walker, and Saunders (1985:166) state that sites with small amounts of pottery, but little or no shell, might not be as limited as once thought. There may be a large number of non-shell Late Archaic sites in marsh-estuarine areas, as well as at more inland locations (DesJean, Walker, and Saunders 1985:166). However, since shell-bearing sites are easier to locate during surveys, there may be a bias towards these types of sites (DesJean, Walker, and Saunders 1985:166). The reality is that the absence of non-shell sites from coastal marsh areas may not be a past cultural phenomenon, but a weakness in archaeological practice.

In sum, there is variation in Late Archaic site sizes and types, and these correspond with differences in settlement and subsistence within the Late Archaic period. However, with the

focus of previous studies mostly occurring on shell rings, and without a proper understanding of the relationship and chronology of the other site types, the full spectrum of Late Archaic settlement and subsistence at any given time is largely unknown.

5. Evaluating Change and Continuity in the Late Archaic

To address the various ways that different communities may have responded to large-scale environmental change as the Late Archaic period progressed, we must understand the timing of the occupation of the different site types. Thus two main datasets are examined for shell rings, shell middens, and non-shell sites: the most recent Georgia Archaeological Site File (GASF) locational data, and our recently created Georgia Coast radiocarbon database (Turck and Thompson 2014) in which we re-correct, re-calibrate, and re-evaluate the radiocarbon record. These data are contextualized within their unique, dynamic environments. One of our initial environmental criteria separates sites based on their position in deltaic or non-deltaic areas, following the results of Thompson and Turck (2009). Deltaic areas occur where freshwater rivers meet the ocean, influencing landform development and ecosystem processes. This includes an increased sediment influx, which can make these areas less susceptible to perturbations (see Turck 2011). On the Georgia coast, there are three such areas: the Savannah and Ogeechee Rivers, the Altamaha River, and the Satilla River. Non-deltaic areas lack freshwater rivers and associated sediment influx, leaving the marsh-estuarine system more susceptible to sea level change (see Turck 2011). These areas occur between the aforementioned rivers. Analysis also focuses on the more specific, micro-environmental habitats at each site, and how they changed over time (following Turck and Alexander 2013). Such an intra-regional approach advocated here utilizes archaeological and environmental data with finer resolution, and separates this study from others that have addressed similar questions at different scales (e.g., Russo 2010; Sanger 2010; Sassaman 2010; Thompson 2010).

6. Methods

6.1 Site Locational Data

State site file data from the coastal zone of Georgia was employed as a first step in evaluating site type distributions. We attempted to separate all Late Archaic components into three classes: shell rings and crescents, shell middens, and non-shell-bearing sites. Unfortunately, this proved to be problematic. The ambiguity of a specific site type in the site file database called “Prehistoric Indian Artifact or Shell Scatter” makes it impossible to know if the site has shell or not without obtaining more detailed information from other sources. This is especially important to this study, because small scatters of lithics, ceramics, or shell have the potential to reveal information about landscape use, and the larger settlement pattern. In addition, site type information is not specific to any individual component. At multicomponent sites, this makes it difficult to know which component(s) are associated with shell midden. This speaks to a larger issue in archaeological methodology, focusing on constructing arbitrary entities called “sites,” instead of focusing on more meaningful designations such as components (see Ebert 1992).

Despite the above issues, we were still able to obtain some general patterns using these data. Single component Late Archaic sites, with definitive shell or non-shell site types, were assigned. At multi-component sites, if the site type data indicated no shell was present at the entire site, then we designated the Late Archaic components as non-shell, obviously because each individual component must lack shell. At multi-component sites where shell was definitely present, we were only able to designate the Late Archaic component as possibly having shell.

We also designated single component and multi-component sites with “Prehistoric Indian Artifact or Shell Scatter” as possibly having shell.

6.2 Radiocarbon Date Database

To understand the timing of these various Late Archaic site types, we turned to the radiocarbon record for the coastal zone of Georgia. This was part of a larger project, compiling all known radiocarbon dates from the coastal plain of Georgia into a database (Turck and Thompson 2014). This database included all published and unpublished dates from the study area. The information in this database includes raw (measured) dates, corrected (or adjusted) dates, the material radiocarbon dated, site information, provenience information, and associated cultural material. One issue encountered was that many early dates were not corrected for isotopic fractionation. Organisms that live in different environments have different carbon isotope ratios in their chemical makeup. At present, laboratories automatically calculate the carbon 13 isotope ($\delta^{13}\text{C}$) in the sample, and then use that to normalize, or correct, the carbon 14 date. This was not common practice until the late 1970s or early 1980s, thus many older radiocarbon dates do not have a $\delta^{13}\text{C}$ value. However, this $\delta^{13}\text{C}$ value can be estimated for a sample, if it is from a known material (i.e., if the environment where that organism lived is known). These estimates are based on thousands of $\delta^{13}\text{C}$ measurements, and were obtained from the CALIB website. The estimates that were used were: -25 for wood and charcoal (e.g., nutshells and charred material); -12 for freshwater shell; -10 for corn; and 0 for marine shell. Uncertainty values of plus or minus two were used with these estimates, as suggested by CALIB.

In addition, CALIB provides a downloadable spreadsheet with formulas to correct raw radiocarbon dates by applying $\delta^{13}\text{C}$ values (<http://calib.qub.ac.uk/calib/fractionation.html>). Using Equation 1 for $^{14}\text{C}/^{12}\text{C}$ measurements (see Reimer, Brown, and Reimer 2004), raw radiocarbon dates with previously uncalculated $\delta^{13}\text{C}$ values were corrected. The raw dates with associated errors were entered into the spreadsheet, along with the corresponding estimated $\delta^{13}\text{C}$ values and a plus or minus two uncertainty value. The resulting corrected dates and new plus or minus values were then copied to our database.

For this study, these corrected dates were then calibrated using the online program CALIB, version 7.0.0. For terrestrial dates, the northern hemisphere calibration curve (intcal13.14c) was used. For marine dates, the global marine calibration curve was used (marine13.14c), along with an estimated marine carbon percentage of 100%, and applying the delta R value of -119 +/- 16 calculated recently for the Georgia coast (see Thomas, Sanger, and Hayes 2013:33). For human bone, the mixed (northern hemisphere and marine) calibration curve was used (Marine/INTCAL), along with an estimated marine carbon percentage of 50%, and the Thomas, Sanger, and Hayes (2013:33) delta R. Calibration was at two sigmas, and the resulting calibrated date ranges were downloaded as a spreadsheet. These date ranges were then copied to our database. Around 85% of the dates had sufficient information for correction and calibration.¹

The database was sub-sampled, choosing samples where any part of the calibrated date range fell within the Late Archaic or Early Woodland periods (5000 to 2300 cal BP), or that were associated with Late Archaic and Early Woodland cultural materials. A “radiometric hygiene” (following Fitzpatrick 2006) was then performed, removing numerous problem samples, such as those that were not compatible with the stratigraphy or ceramics. Samples with date ranges that were greater than 1,000 years (after calibration, and at two standard deviations) were also removed. Finally, terrestrial and marine samples were sometimes analyzed separately, as there can still be discrepancies between dates of these materials, even with the new delta R correction.

Two exceptions to this radiometric hygiene need to be noted. One sample with a date range of greater than 1,000 years (UGA-SC3), and one sample from a possible non-archaeological context (NOSAMS-71166) were kept in the database for this analysis. The reasoning behind this was that these samples had Early Woodland period dates, and were associated with Early Woodland period ceramics and/ or in close proximity to archaeological sites: contexts that are lacking in dates on the Georgia coast.

6.3 Bayesian Statistical Modeling

To better understand trends in the radiocarbon record, we applied a Bayesian approach to our dataset. As Bayliss et al. (2007:18) note, simple examinations of radiocarbon dates will almost always end in an overestimation of the time elapsed for a given set of dates, as well as an earlier estimated start date. Bayesian analysis is dependent upon existing knowledge (i.e., a priori beliefs) regarding the nature of the dates from the archaeological record (Bayliss et al. 2007:19). In this study, the prior information is site types, as well as the various environments along the coast.

Although, this approach is more common in Europe, specifically the United Kingdom, it is gaining traction in research in the Americas (see Jew et al. 2015; Kennet and Culleton 2012; Krus et al. 2013; Schilling 2013). The basic tenets of Bayesian modeling and Bayes' Theorem, and their use of Markov Chain Monte-Carlo statistics to provide a set of solutions in regards to radiocarbon dates, are outlined in numerous publications (see Bayliss et al. 2007; Bronk Ramsey 2014; and Steier and Rom 2000).

Bayesian modeling was performed only on radiocarbon dates from clear Late Archaic-Early Woodland shellfishing contexts, to better understand the span of time shellfishing takes place on the coast. A stricter radiometric hygiene procedure than outlined above was followed in selecting dates for the model. Dates with a sigma of 100 years or more were excluded, to create more precise models. Both terrestrial and marine dates were included, using the same calibration conventions as outlined above. In addition, OxCal 4.2© was used to create the Bayesian models for the dates (Bronk Ramsey 2009).

Simple phase models for both the deltaic and non-deltaic areas of the coast were employed. In each of these models, radiocarbon dates are grouped together as a series of unordered events, with a boundary start and end. To calculate the duration that shellfishing was practiced in each of these environmental habitats, the span function was used in OxCal. Solutions for each model were evaluated based on convergence (i.e., values greater than 95), as well as agreement for individual dates (A), the model, (A_{model}), and the overall agreement, (A_{overall}), with values over 60.0 indicating significant agreement (see Bayliss et al. 2011:34-35).

7. Initial Results

7.1 Site Locational Data and Site Types

There are 276 sites with Late Archaic components in the coastal zone of Georgia (Table 1, Figure 2). Around eight percent ($n=23$) definitely have shell, with 13 of those being shell rings or crescents. Around 17% ($n=46$) definitely do not have shell. While most of the non-shell sites are on the mainland, there are also some non-shell sites on the barrier islands and in the back-barrier areas. This includes the Late Archaic components on Patterson Island (Turck and Thompson 2011), outside of the Sapelo Shell Ring complex (Thompson 2006), and at Kenan Field (Ritchison and Thompson, *in prep.*). For about 45% of the sites ($n=125$), it is unknown whether there is shell present or not (i.e., they are designated as "Artifact or Shell scatters").

Site file data was also used to address potential articulation between the 13 shell ring sites and other nearby site types. Although we surmise that these Late Archaic coastal populations were able to move across the landscape with relative ease, we use Higgs and Vita-Finzi's (1972:31) estimate for less mobile populations of five kilometers in two hours for territory delineation. That is to say, we use a conservative 5-km radius as a unit of study around the 13 shell ring sites. Results show that within these estimated shell ring territories, there are eight single-component Late Archaic sites that definitely have shell, five sites that do not have shell, and 44 sites with both a Late Archaic component and shell (where it is unknown if the two attributes are associated). There are an additional 16 Late Archaic sites, or components within sites, where it is unknown whether or not shell is present, again, due to sites designated as "Artifact or Shell scatters." Without knowing the exact timing of these 73 Late Archaic sites surrounding shell rings, it is difficult to understand how they articulate with each other. However, the relatively short distance between shell rings, shell middens, and non-shell sites shows the potential for a wide range of settlement and subsistence patterns at any given time. For a coastal, canoe-faring people like those of the Late Archaic, this could easily include activities at all three site types. This analysis, and others like it (even when relegated to a footnote, such as Saunders 2014:55, footnote 10) also reveal that more data (i.e., radiocarbon dates) is needed before shell ring sites can be labeled as "isolated" (Saunders 2014:52) from possible contemporaneous shell midden and non-shell sites.

7.2 Radiocarbon Database

In the coastal zone of Georgia, there are 92 corrected and calibrated radiocarbon dates dating to the Late Archaic and Early Woodland periods (Table 2 and Table 3). Five Middle Woodland (2300-1500 cal. BP) dates were left in the table as well (UGA-1688, 1007, 1560, 1684, and 1256), as they were associated with Early Woodland artifacts, and were from sites that contained other Early Woodland period dates. Almost 60% of these dates (58 out of 97) are from St. Catherine's Island. Thirteen are from Sapelo Island, with all but one of those coming from the Sapelo Shell Ring complex. Thus 73% of the radiocarbon dates come from two adjacent islands, in a similar non-deltaic section of the coast, introducing potential bias into the analysis.

Radiocarbon data were plotted in simple graph form (Figure 3), with dates grouped by environmental region and material. A summed probability distribution of the data was not created due to the small sample size (i.e., less than 500 dates), which would lead to a statistically unreliable plot (see Williams 2012:587). The majority of the two sigma date ranges fall within the Late Archaic period, with very few falling entirely within the Early Woodland period. In fact, most of the date ranges are between 5000 and 3800 BP, the early part of the Late Archaic period. As a side note, our initial investigation into the radiocarbon record analyzed differences between shell samples and organic matter samples. Results showed an identical pattern of date ranges falling between 5000 and 3800 BP. Although there can be problems with trying to interpret the past based solely on radiocarbon dates (see Anderson 2010; Williams 2012), a similar pattern is mirrored in regional site data (Thompson and Turck 2009). Taken together, the lack of radiocarbon dates and the lack of sites suggest a reduced population on the coast during the terminal Late Archaic and Early Woodland periods.

7.3 Bayesian Modeling of Intensive Shellfishing

Bayesian modeling was performed to further analyze this pattern in relation to shellfishing. Based on the criteria of inclusion outlined in the methods section, we identified a

total of 36 dates for the non-deltaic model (Table 4), and 11 for the deltaic model (Table 5). One date (UGA-226) for the non-deltaic model was included, but identified as an outlier. This was due to the fact that this date was obtained on an unidentified species of whelk. Four whelk species have been observed on the Georgia coast: *Busycon carica* (knobbed whelk), *Busycon contrarium* (lightning whelk), *Busycon spriatum* (pear whelk), and *Busycotypus canaliculatus* (channeled whelk). The delta R calculated by Thomas, Sanger, and Hayes (2013) might not be applicable to these species. In addition, researchers are beginning to find problems with the radiocarbon dates of whelk species (Hadden and Cherkinsky 2014). As an aside, when we ran the model with this date included, the A_{model} dropped below 60%, indicating poor agreement. We note this here for future consideration of dates on whelk species, and their incorporation into Bayesian modeling.

For the deltaic regions of the coast, the model shows good agreement between the radiocarbon dates and phase modeling of shellfishing in the area ($A_{\text{model}} = 87.8$; $A_{\text{overall}} = 87.1$). Similarly, the non-deltaic region of the coast also shows agreement between the dates and phase modeling for the region ($A_{\text{model}} = 79.6$; $A_{\text{overall}} = 70.8$). The lower agreement for the non-deltaic model is likely due to the inclusion of one date (Beta 238328), which shows poor agreement with the overall model ($A = 17.6\%$). This is the oldest date in the sample. In fact, when the model is run with this date as an outlier, it increases the agreement significantly ($A_{\text{model}} = 100$; $A_{\text{overall}} = 85.4$). This date might be an outlier. It is a piece of burnt wood from the interior plaza of the St. Catherines Island Shell Ring (Sanger and Thomas 2010:62), calibrating to 4820-4526 cal. BP, with 72% of the probability curve represented by the 4729-4526 cal. BP date range. It does not agree with an associated bulk soil sample (Beta-238329) from the same feature (Sanger and Thomas 2010:62), which dates to 4075-3733 cal. BP, with 94% of the probability curve represented by the 3993-3826 cal. BP date range. This is a 500-700 year difference. At the very least, this indicates a mobilization of carbon particles, which in turn could indicate disturbance. In addition, the location of these samples within the plaza of a shell ring suggests that it could be associated with “pre-ring” activities, and not with the deposition of shellfish during the construction of the ring itself. Kennett and Culleton (2012:46) note this in their Bayesian modeling of the St. Catherines shell ring, finding considerable overlap in the dates from the plaza area with “pre-ring” dates. Even with these caveats, there is not a definitive reason to exclude Beta 238328 from the model.

For the deltaic regions of the coast, the model estimates with a 95% probability that intensive shellfishing began 5320-4540 cal. BP (start), with a duration of 750-1870 years (span), ceasing around 3,910-3,310 cal. BP (end) (Figure 4). At a 68% probability, intensive shellfishing could have begun around 5090-4690 cal. BP, for a span of 980-1520 years, ceasing around 3820-3550 cal. BP.

For the non-deltaic regions of the coast, the model estimates with a 95% probability that intensive shellfishing began 4570-4420 cal. BP (start), with a duration of 480-740 years (span), ceasing around 3970-3780 cal. BP (end) (Figure 5). At a 68% probability, intensive shellfishing began 4490-4440 cal. BP, for a span of 530-630 years, ceasing around 3930-3830 cal. BP. We offer one caveat for the non-deltaic model. If sample Beta 238328 (the oldest date in the model) indeed represents the “pre-ring,” pre-intensive shellfishing occupation of the St. Catherines Shell Ring, and is treated as an outlier, the span of intensive shellfishing is greatly reduced. This new model estimates intensive shellfishing to have lasted for 280-570 years (95% probability), or even 340-490 years (at a 68% probability).

8. The Evolution of Late Archaic Settlement

The combined locational and radiocarbon information from coastal sites, in relation to the results of the Bayesian analysis, allows for a clearer understanding of Late Archaic society on the Georgia coast. Given our previous discussion regarding the variability in both coastal ecosystems and human interactions with them, we find variable settlement-subsistence patterns within specific micro-environmental settings (following Turck and Alexander 2013).

8.1 Deltaic Areas

In deltaic areas, where we have posited that the marsh-estuarine system was less susceptible to perturbations due to the sediment influx from rivers, there appears to have been continuity from the beginning of the Late Archaic period, through the terminal portion of the period, and even into the Early Woodland period. Such continuity can be seen in subsistence practices, the locations of activities, or both. Our idea that the marsh-estuarine system persisted in deltaic areas as sea levels dropped is also substantiated. In general, the evidence for continued occupation in deltaic areas is found in the inter-barrier areas. These areas are located to the east, closer to the present-day ocean, in the more expansive marsh between Pleistocene barrier islands and more recent Holocene islands.

Bayesian analysis confirms this, indicating that intensive shellfishing started relatively early (between 5320 and 4540 *cal. BP*), and lasted longer (to between 3910 and 3310 *cal. BP*), in deltaic areas. Site locational data reveal high concentrations of both Late Archaic and Early Woodland sites in deltaic areas. On the northern Georgia coast, around the Savannah and Ogeechee Rivers, large shell-bearing Late Archaic sites (rings, crescents, and middens) are found in all micro-environmental habitats. This includes the mainland (e.g., the two-meter thick shell midden Bilbo site), the Pleistocene barrier island of Skidaway, and the inter-barrier marsh just east of this island (with 16 shell-bearing sites, four of which are shell rings or crescents). Radiocarbon dates indicate that initial shell deposition occurred during the early Late Archaic period. This includes a charcoal sample (UGAMS-16980) that we ran for this publication from a shell midden in the marsh (site 9CH306). The two-sigma date range for this sample is 4407-4155 *cal. BP*, and falls squarely within the early portion of the Late Archaic period.

Continuity on the northern Georgia coast can be seen in the form of Late Archaic shell deposition after 3800 *cal. BP* in the inter-barrier area. The two sites with dates from good archaeological contexts are both shell middens completely or partially buried in the marsh, on former beach ridges. Oyster shell from the base of one of these shell middens (site 9CH377, sample ID 16- Lot 2) dates between 3846 and 3474 *cal. BP*. Using collections materials, we dated charred nutshell (sample ID UGAMS-16981) from the base of another buried shell midden (Marsh Midden D, at site 9CH482) associated with Late Archaic ceramics. The date range of 3978-3838 *cal. BP* indicates that shell deposition began fairly late in this environmental setting. Evidence for a continued Early Woodland occupation also occurs in the inter-barrier area, with six inter-barrier sites containing Early Woodland components. Evidence also indicates that shellfish were available in a similar environmental context during the following Early Woodland period. This comes from a radiocarbon date on a non-archaeological sample of marine shell (2,698-2,496 *cal. BP*, NOSAMS-71166), found over 3 meters below the marsh surface (from Turck and Alexander 2013).

Along the central portion of the Georgia coast, where the Altamaha River meets the ocean, definitive shell-bearing Late Archaic sites are found on the Pleistocene barrier island St. Simons. This includes the oldest date for shell ring construction on the Georgia coast (5276-4731

cal. BP, UM-520) at the Cannon's Point Marsh Ring. With the upper levels of both the Cannon's Point Ring and the nearby West Ring dating to before 3800 cal. BP, it is clear that occupation had ceased at both rings by the terminal Late Archaic.

Evidence for continuity once again comes from the inter-barrier area to the east. Close to the Cannon's Point and West Ring shell ring sites, a transitional Late Archaic-Early Woodland site was found beneath the present-day marsh, dating from 3141-2750 cal. BP (sample UM-518, from Marrinan 1975; 2010). The date, and the mix of associated ceramics (i.e., fiber tempered, fiber and sand tempered, and sand tempered pottery, see Marrinan 2010:97), indicate that there was some kind of cultural continuity between the Late Archaic and Early Woodland people. The faunal and floral remains also indicate that the inhabitants utilized a large range of environments, including uplands, freshwater, freshwater-to-brackish, brackish, and brackish-to-marine species (see Marrinan 1975), although no shellfish were recovered. This is most likely due to the area reverting back to an upland mainland setting as sea level fell (see Turck 2011:176-180). This supports our idea that the marsh-estuarine system remained productive in deltaic areas, while also suggesting that shellfish species may have had a more limited range during sea level lowering. Other evidence for continuity includes a shell midden with both Late Archaic and Early Woodland components (9GN58) on a buried landform within the inter-barrier marsh. This mirrors the inter-barrier occupations of the northern Georgia coast, however as of yet there are no radiocarbon dates to confirm this idea. This is another area integral to understanding the Archaic-Woodland transition on the Georgia coast, with the possibility of terminal Late Archaic and Early Woodland shellfish utilization.

The southernmost deltaic area of the Georgia coast, where the Satilla and St. Marys Rivers flow, has the least data. On the mainland, the non-shell Kings Bay site (9CM171) has an early Late Archaic date obtained from a wood sample (5258-4446 cal. BP, UM-1433). However, Middle Archaic and Late Woodland period dates were also obtained on samples found in the same level of the same feature, indicating contextual problems such as disturbance. Devils Walking Stick (9CM177), another non-shellfish site on the mainland (DesJean, Walker, and Saunders 1985), has a date of 4229-3634 cal. BP (Beta-3499) that falls in the middle of the Late Archaic. The large plus/ minus of this date makes this site difficult to assess, but if the site dates towards the latter portion of that range, the lowering sea level would have positioned marsh-estuarine resources roughly 7-15km away. In the back-barrier area, there is one possible Late Archaic-aged shell ring site. Unfortunately, the timing of its occupation is unknown, as no known diagnostic artifacts or radiocarbon dates are associated with it. As opposed to the northern and central portions of the coast, evidence for continuity on the southern portion of the coast comes from the mainland, with one contextually-accurate sample dating to the terminal Late Archaic (3843-3409 cal. BP, Beta-4430). The date was obtained on charcoal from a feature at the Big Cedar Area of the Kings Bay site (Saunders, DesJean, and Walker 1985:201). Although no ceramics were associated directly with this feature, the Late Archaic component of the site was not a shellfish-bearing deposit.

8.2 Non-Deltaic Areas

In non-deltaic areas, where we have surmised that the lack of sediment influx from rivers made the marsh-estuarine system more susceptible to fluctuating sea levels, we find that communities experienced the event of sea level lowering in differing ways. This is only based on the northern-most non-deltaic area, as the southern area has no definitively-identified shell-bearing sites from the Late Archaic period with radiocarbon dates. Shellfishing occurred mainly

during the early part of the Late Archaic, centering around the high point of sea level rise around 4200 cal. BP, with little-to-no shellfishing after 3800 cal. BP (in both the terminal Late Archaic and Early Woodland periods). Occupation does continue after 3800 cal. BP, but this is at non-shell-bearing sites. In non-deltaic areas then, the Late Archaic population transitioned from coastal adaptations, to lifeways where shellfish-exploitation was limited or non-existent.

Once again, the Bayesian analysis confirms this idea. Intensive shellfishing started later (between 4570 and 4420 cal. BP), and ended around 3800 cal. BP (between 3970 and 3780 cal. BP) in non-deltaic areas. As discussed in the background section, intensive shell-fishing of the early Late Archaic on the non-deltaic Pleistocene barrier islands of St. Catherines and Sapelo, have been well-documented. This includes the cessation of shell construction at both shell rings on St Catherines Island by 3750 cal. BP (Sanger and Thomas 2010:67), and all three shell rings on Sapelo Island by 3800 cal. BP (Thompson 2007; Thompson and Andrus 2011).

Although occupation continues on St. Catherines Island, there does not seem to be continuity in location or subsistence practices. There are multiple sites on St. Catherines Island that have been dated to terminal Late Archaic and/ or Early Woodland period contexts, that are not associated with shell rings or large shell middens. Among these are Sites 9Li197 and 9Li137, which contain artifacts and radiocarbon dates from both the terminal Late Archaic and Early Woodland periods (Thomas 2008c:547 and 567). Taken together with the other Late Archaic sites without marine shell located on St. Catherines (Thomas 2010:189), their presence indicates a population transitioning at the end of the Late Archaic period.

A similar pattern is seen on the barrier island of Sapelo as well. A “less-dense” Late Archaic occupation (based on sherd count), not associated with any shell deposition, was found outside of the three shell rings (Thompson 2007:103). This dates to the very end of the Late Archaic period (3388-3084 cal. BP, sample UGA-15087). Continuity also occurs with more substantial occupations. South of the Sapelo shell rings, at the Kenan Field site, the Late Archaic component has been dated to between 3571 and 3409 cal. BP (sample UGAMS-15933). Of all the components present at the site, the Late Archaic has the largest number of positive shovel tests, covering the widest area (Ritchison and Thompson, *in prep.*). A substantial terminal Late Archaic occupation was also found on the back-barrier Patterson Island, especially when compared to other back-barrier islands (see Thompson and Turck 2010). With the majority (75%) of Late Archaic shovel tests not associated with shell, and the rest (25%) associated with shell and other components, we argue that this was a non-shellfish using population dating to the terminal Late Archaic (3690-3451 cal. BP, sample UGAMS-15933).

There are two sites that do not meet our expectations for a non-deltaic area. The A. Busch Krick shell ring (or crescent), located on the back-barrier Creighton Island has been dated to 3900-3450 cal. BP; the only shell ring in Georgia that dates to the terminal Late Archaic period. However, this date may be discounted, as it was obtained from a conch or whelk, a species prone to dating problems (Hadden and Cherkinsky 2014). Buried within the marsh just southwest of Creighton Island, DePratter (1984: unpublished notes) found Early Woodland ceramics in the same level as a 5-10 cm thick shell layer. If this site is dated definitively to the Early Woodland period, the presence of shell, and the location in a non-deltaic, back-barrier area close to the mainland, is an anomaly for the coast of Georgia.

8.3 Summary

Taken together, evidence indicates that there was a differential experience of change within the coastal zone of Georgia during the Late Archaic period. In deltaic areas, shell rings,

crescents, and middens date from around 5000 to 3500 cal. BP. Occupation, including shellfishing practices, continues during the latter part of the period within the inter-barrier portions of deltaic areas. Here, Late Archaic shell middens are buried partially or wholly under the marsh, in association with former surfaces, when sea level was lower, and the habitat was more upland than marsh. It is clear from our analysis that coastal Late Archaic peoples living in deltaic areas followed the migrating coast, and continued utilizing marsh-estuarine resources where available. This is similar to the premise discussed by DePratter and Howard (1977, 1981) for the following Early Woodland period. The co-occurrence of Late Archaic shell middens and Early Woodland components in inter-barrier areas reveals that this micro-environment is integral to studying the Archaic-Woodland transition on the Georgia coast. These areas must be tested more thoroughly for potential archaeological information regarding shellfishing during the terminal Late Archaic and Early Woodland periods. By necessity, such testing will follow geoarchaeological methods (see Schuldenrein et al. 2014), as the deep nature of these sites will prohibit more typical archaeological methods (i.e., shovel testing and excavation) from being used.

In non-deltaic areas, shell-bearing sites date from 4500 to 3800 cal. BP. Occupation continues into the terminal Late Archaic (3800-3000 cal. BP), but with a lack of shellfishing. Through paleo-landscape modeling, Turck (2011:163-165) found that non-deltaic areas reverted back to an upland setting as sea levels lowered during the terminal Late Archaic period. Combined with our Bayesian modeling, this indicates that shellfish bed productivity was much reduced, especially compared to deltaic areas. This, in turn, influenced the nature of settlement and subsistence, resulting in population movements and a departure from intensive shellfishing earlier than in other areas. This is seen in non-shell midden sites with less intensive occupations, away from previous shell-bearing sites. However, some non-shell sites had fairly substantial occupations, indicating that fluctuating sea levels did not necessarily lead to wholesale societal transformation (e.g., abandonment or collapse) in non-deltaic areas.

9. Resilience Revisited: Settlement, Subsistence, and Organizational Complexity

With a better understanding of the chronology and relationships among different Late Archaic site types, we can speak to 1) the founding of shell ring populations and their role as early villages; 2) the variability of shifts in settlement from shell rings to other types of settlements during the terminal Late Archaic; and 3) the nature of transformation or "collapse" along the Georgia Coast during this time frame. This new understanding provides insight not just into the study region, but also into the dynamics of settlement systems based on foraging economies and their interactions with dynamic environments.

Our analysis reveals that initial occupations of shell rings and large shell middens on the Georgia coast first occurred around 5000 cal. BP within deltaic areas. It was only around 4500 cal. BP that people moved into non-deltaic habitats, again at shell rings and large shell midden sites. Since this is the only evidence of occupation dating to the early Late Archaic period (i.e., there are no other site types), this lends support to the idea that shell rings were settled villages, essentially functioning as co-resident communities. Intensive zooarchaeological analyses at Georgia shell rings (Colaninno 2010; 2012; Colaninno and Reitz 2015), reveal that shell rings signify a fidelity to place, where the people at each ring probably had authority to specific fishing rights, at fisheries that were common-pool resources (see Reitz 2014). We suggest that deltaic areas were prime regions for the establishment of new villages, with the rest of the landscape filling in shortly after, due to rapid population growth and village fissioning that often

accompany shifts from mobile foragers to settled villages (see Bandy 2004 and Bandy and Fox 2010 for a discussion of early village dynamics).

At the regional level, if shell ring communities of the early Late Archaic represent an influx of people from other areas, as modeled by Turck (2012), such regional communities may have required greater collective governance and cooperation among contemporaneous villages. This is particularly so if populations grew exponentially, with a rapid infilling of the landscape. Evidence from the Sapelo Shell Ring complex indicates that shellfish came from as much as 20km away (Andrus and Thompson 2012), suggesting that populations from adjacent villages likely would have encountered one another, particularly in the estuaries where the vast majority of resources are located. With a high degree of encounters from groups in adjacent villages, we suggest that certain structural elements would have been necessary to facilitate cooperation among these groups. Specifically, one of the ways in which such cooperation was facilitated was through inter-village feasts and ceremonies (see Reitz 2014; Sanger 2015; Thompson and Andrus 2011; Thompson and Moore 2015).

The rapid infilling of the landscape at these new villages, combined with the close contact and high rates of encounter during the collection of resources, likely necessitated such frequent inter-village interactions. While the central focus of shell rings was domestic life, the recurrent hosting of ceremonies and rituals would have helped suppress conflict over resources, as well as reaffirm rules concerning the use of resource areas (i.e., which were exclusively controlled by a single group as opposed to which were held in common). In this sense, we agree with Saunders (2014:50) that shell rings sites were integrative, but not because their main functions were as ceremonial sites. Late Archaic organization at ring sites may have been related, at least initially, to determining property and use rights of fisheries and other resources. This permeated into other aspects of daily life, including the very structure of village society. The circular layout of villages as seen at shell ring sites was a mechanism that facilitated organization: orderly village life allowed people to keep track of each other among a growing population, particularly where everyone lived.

These were the systems in place when sea level began lowering, and Late Archaic populations were faced with decisions about settlement and subsistence. Initially, we claimed that there was a shift to a more mobile hunter-gatherer lifestyle by the Early Woodland period (Thompson and Turck 2009). The refined temporal analysis of this study indicates that certain changes began earlier, but differentially in deltaic and non-deltaic areas. Shellfishing at Late Archaic villages persists for a longer duration in deltaic areas. There is also the possibility that it continued throughout the terminal Late Archaic, and even into the following Early Woodland period. In non-deltaic areas, shell ring villages and shellfishing as a whole cease by 3800 cal. BP. However, intensive occupation continues at new locals, as seen with large in area, and relatively dense pottery deposits at non-shell sites, although it is unknown if these sites represent settled, year-round villages. The movement of these terminal Late Archaic populations, coupled with subsistence changes, indicates a restructuring of the organizational aspects of society and community at the scale of the co-resident group. However, this restructuring seems to also have occurred in deltaic areas as well, represented by the cessation in construction of shell rings in both areas. So, although there was a differential experience of change, such transformations were not accompanied by societal collapse, but rather a restructuring of how community practices were expressed. Communities at the regional level were resilient in both deltaic and non-deltaic areas of the coast. We speculate that the inter-village relationships reinforcing communal activities that were developed during the early part of the Late Archaic period, continued into the

terminal Late Archaic, but in an altered form, to account for new residential patterns and the reduction of a key resource (i.e., shellfish). These relationships ameliorated any adverse affects that may have occurred, leading to resilience in regional community patterns in the face of change. This is slightly different than the conclusion by Reitz (2014) who suggests people's relationship with a resilient ecosystem contributes to the observed continuity in the archaeological record. This idea may be true, but only for the early Late Archaic period, as that study does not contain data from sites that post date 3800 cal. BP. As our present study demonstrates, the terminal Late Archaic is a critical time for both environmental and social changes that is not uniformly experienced along the Georgia Coast.

Although these ideas need further testing, this new understanding of the timing of Late Archaic site types on the Georgia coast lends insight into the nature of "collapse." While certain parts of social systems may be affected by environmental change (e.g., settlement, subsistence, organization, or group inter-relationships), even if reorganization occurs, it will not necessarily lead to a wholesale collapse of societies.

10. Conclusions

We conclude there was a general regional continuity between the early Late Archaic and the terminal Late Archaic period on the Georgia coast as a whole. This continuity was in the face of environmental change, with a lowering sea level reverting much of the coastal zone to an upland mainland setting. New locales were settled, the resource base was modified, or sometimes both occurred. In deltaic areas, there was a continuation of established settlement and subsistence traditions. In non-deltaic areas, there were changes to the resource base, which in turn affected subsistence patterns. However, this did not inhibit people from aggregating in large numbers, perhaps still in settled villages, albeit with likely new spatial layouts (i.e., at non-circular sites). We agree with Bernstein (2006:277) who notes that when variations in subsistence are seen in the archaeological record, they can be related to environment (i.e., different or changing ecological settings), and not necessarily related to changes in the structure of human behavior. In this sense, the changes that occurred at the end of the Late Archaic period do not equate to a collapse.

The proposed model for change and continuity throughout the Late Archaic coastal landscape of Georgia is a significant refinement of earlier research. This was only discerned with the detailed analysis of large datasets over multiple scales, where the unique environmental, as well as archaeological, histories were considered for each specific habitat or landform (see Turk and Alexander 2013). In addition, the results also underscore the importance in understanding the relationship between site types. As others have noted (e.g., Nicholas 2001), it is necessary to know about the total variety of site types that once existed, to fully reconstruct past settlement systems.

Most archaeological studies dealing with so-called "collapse" transformations tend to focus on large-scale agricultural communities, with some exceptions (e.g., Rodning and Mehta 2016; Thompson 2016). This study illustrates the nature of societal transformations that are usually associated with collapse among foraging societies. The broader implication is that transformations and resilience vary temporally, and at relatively small spatial scales. More studies are needed that address issues of transformation and resilience among foraging economies, focusing on multiple scales in relation to heterogeneous and dynamic ecosystems. Given the dynamics of coastal environments, such studies will lend insight into how humans initially came to, left, and returned successively to coastlines throughout time, starting as early as

195,000-125,000 BP (Marean 2011:422). Studies such as the one outlined here have the potential to speak to these larger issues regarding the changing nature that human societies have with their environments.

¹ For the current study, we then refined the database by location and time period. First, only those dates from the coastal zone of Georgia (i.e., within the coastal counties) were copied to a separate table. Dates that had no detailed locational information (i.e., no known site association, and no coordinates) were excluded. This dataset was further refined, putting all calibrated dates that fell partially or entirely between 5000 and 2300 cal BP into a new table. Samples that were associated with fiber tempered, St. Simons, Stallings, Thom's Creek, Orange, Refuge, or Refuge-Deptford materials were also added to the table (regardless of calibrated date), as were samples from known Late Archaic shell rings. Due to the difficulty in discerning Early Woodland (Refuge phase) and Middle Woodland (Deptford phase) ceramics on the Georgia coast, especially on St. Catherines Island, where Early and Middle Woodland period ceramics are combined into a single Refuge-Deptford phase (Thomas 2008a:410), some Middle Woodland dates were included in the above sampling. To further refine the dataset for analysis, if the entire two sigma date range was within the Middle Woodland period or younger (i.e., younger than 2300 cal. BP), it was removed from the table if there were no other dates from the same site with older ranges (i.e., older than 2300 BP).

Table 1

Number and percent of site types for the Late Archaic and Early Woodland periods.

	Shell-bearing		Shell at Site (Unknown at Component)		Artifact or Shell Scatter		Non-Shell		Total Components
	#	%	#	%	#	%	#	%	
Early Woodland			60	46.5%	50	38.8%	19	14.7%	129
Late Archaic	23	8.3%	82	29.7%	125	45.3%	46	16.7%	276

Table 2

Contextual information for radiocarbon samples with raw radiocarbon dates.

Lab Code/ ID	Site	Site Type	Material	Environmental Habitat	Raw ¹⁴ C age BP
O-1046	Bilbo	Shell midden	Charcoal	Deltaic Pleistocene Mainland	5550 +/-115
UM-520	Marsh Ring- Cannon Pt.	Shell ring	Crassostrea	Deltaic Holocene Inter-barrier	4190 +/-90
O-1047	Bilbo	Shell midden	Charcoal	Deltaic Pleistocene Mainland	4125 +/-115
UM-522	West Ring- Cannon Pt.	Shell ring	Crassostrea	Deltaic Pleistocene Barrier Island	3860 +/-90
UM-521	Marsh Ring- Cannon Pt.	Shell ring	Crassostrea	Deltaic Holocene Inter-barrier	3765 +/-90
Beta-MM4	Marsh Midden 4	Shell midden	Crassostrea	Deltaic Pleistocene Mainland	3700 +/-70
UGAMS-16980	(none)	Shell midden	Charcoal	Deltaic Pleistocene Mainland	
Beta-MMbase	Marsh Midden: base	Shell midden	Crassostrea	Deltaic Pleistocene Mainland	3650 +/-60
M-1111	Bilbo	Shell midden	Charred wood	Deltaic Pleistocene Mainland	3820 +/-125
UM-523	West Ring- Cannon Pt.	Shell ring	Crassostrea	Deltaic Pleistocene Barrier Island	3605 +/-110
Beta-MM5	Marsh Midden 5	Shell midden	Crassostrea	Deltaic Pleistocene Mainland	3540 +/-70
UGA-10677	Bilbo	Shell midden	Charcoal	Deltaic Pleistocene Mainland	3770 +/-140
UGA-10678	Bilbo	Shell midden	Charcoal	Deltaic Pleistocene Mainland	3720 +/-90
M-1109	Bilbo	Shell midden	Charred wood	Deltaic Pleistocene Mainland	3700 +/-125
UGA-10676	Bilbo	Shell midden	Charcoal	Deltaic Pleistocene Mainland	3650 +/-50
UGAMS-16981	Lazaretto Creek	Shell midden	Charcoal	Deltaic Holocene Inter-barrier	
Beta-MMs	Marsh Middens	Shell midden	Crassostrea	Deltaic Holocene Inter-barrier	3210 +/-60
NOSAMS-71166	N/A	N/A	Unknown Shell	Deltaic Holocene Inter-barrier	
UM-1432	Kings Bay	Non-shell	Carbonized wood	Deltaic Pleistocene Mainland	5000 +/-180
UM-1433	Kings Bay	Non-shell	Carbonized Wood	Deltaic Pleistocene Mainland	4260 +/-100

Beta-3499	Devil's Walkingstick (fiber)	Non-shell	Charcoal flecks	Deltaic Pleistocene Mainland	3600 +/-100
Beta-4430	Kings Bay (Big Cedar)	Non-shell	Charcoal	Deltaic Pleistocene Mainland	3380 +/-80
UM-518	Marsh Culture	Non-shell	Carbonized material	Deltaic Holocene Inter-barrier	2785 +/-80
UM-1429	Kings Bay	Non-shell	Carbonized wood	Deltaic Pleistocene Mainland	2330 +/-180
Beta-238336	St. Catherines Ring	Pre-ring	Unknown Shell	Non-deltaic Pleistocene Barrier Island	3990 +/-60
Beta-231335	St. Catherines Ring	Pre-ring	Unknown Shell	Non-deltaic Pleistocene Barrier Island	3800 +/-40
Beta-215821	St. Catherines Ring	Pre-ring	Crassostrea	Non-deltaic Pleistocene Barrier Island	3780 +/-50
Beta-215824	St. Catherines Ring	Pre-ring	Crassostrea	Non-deltaic Pleistocene Barrier Island	3770 +/-50
Beta-231334	St. Catherines Ring	Pre-ring	Unknown Shell	Non-deltaic Pleistocene Barrier Island	3670 +/-50
Beta-238328	St. Catherines Ring	Shell ring	Burnt wood	Non-deltaic Pleistocene Barrier Island	4110 +/-40
Beta-239276	St. Catherines Ring	Shell ring	Charred material	Non-deltaic Pleistocene Barrier Island	3930 +/-40
UGA-01425	Sapelo Ring II	Shell ring	Sooted Sherd	Non-deltaic Pleistocene Barrier Island	3900 +/-60
Beta-238332	St. Catherines Ring	Shell ring	Burnt wood	Non-deltaic Pleistocene Barrier Island	3900 +/-40
Beta-238324	McQueen Ring	Shell ring	Unknown Shell	Non-deltaic Pleistocene Barrier Island	3710 +/-50
Beta-238322	St. Catherines Ring	Shell ring	Hickory nut	Non-deltaic Pleistocene Barrier Island	3880 +/-40
Beta-238337	St. Catherines Ring	Shell ring	Burnt wood	Non-deltaic Pleistocene Barrier Island	3890 +/-40
Beta-238327	St. Catherines Ring	Shell ring	Hickory nut	Non-deltaic Pleistocene Barrier Island	3810 +/-40
Beta-238331	St. Catherines Ring	Shell ring	Burnt wood	Non-deltaic Pleistocene Barrier Island	3830 +/-40
Beta-233130	St. Catherines Ring	Shell ring	Unknown Shell	Non-deltaic Pleistocene Barrier Island	3620 +/-60
Beta-251766	McQueen Ring	Shell ring	Charred material	Non-deltaic Pleistocene Barrier Island	3840 +/-40
Beta-244620	McQueen Ring	Shell ring	Charred material	Non-deltaic Pleistocene Barrier Island	3800 +/-40
Beta-238326	McQueen Ring	Shell ring	Unknown Shell	Non-deltaic Pleistocene Barrier Island	3600 +/-50
Beta-251765	McQueen Ring	Shell ring	Unknown Shell	Non-deltaic Pleistocene Barrier Island	3590 +/-50
Beta-229423	St. Catherines Ring	Shell ring	Unknown Shell	Non-deltaic Pleistocene Barrier Island	3630 +/-50
Beta-229424	St. Catherines Ring	Shell ring	Unknown Shell	Non-deltaic Pleistocene Barrier Island	3600 +/-50
UGA-75	Sapelo Shell Rings	Shell ring	Crassostrea	Non-deltaic Pleistocene Barrier Island	3545 +/-65
UGA-01424	Sapelo Ring II	Shell ring	Charcoal	Non-deltaic Pleistocene Barrier Island	3750 +/-70
UGA-15083	Sapelo Ring III	Shell ring	Charcoal	Non-deltaic Pleistocene Barrier Island	3740 +/-60
UGA-15085	Sapelo Ring I	Shell ring	Sooted Sherd	Non-deltaic Pleistocene Barrier Island	3630 +/-60
UGA-15086	Sapelo Ring III	Shell ring	Charcoal	Non-deltaic Pleistocene Barrier Island	3740 +/-50
Beta-251761	McQueen Ring	Shell ring	Charred material	Non-deltaic Pleistocene Barrier Island	3700 +/-40
Beta-251764	McQueen Ring	Shell ring	Charred material	Non-deltaic Pleistocene Barrier Island	3710 +/-40
Beta-251768	McQueen Ring	Shell ring	Unknown Shell	Non-deltaic Pleistocene Barrier Island	3540 +/-40

Beta-251767	McQueen Ring	Shell ring	Charred material	Non-deltaic Pleistocene Barrier Island	3680 +/-40
Beta-215823	St. Catherines Ring	Shell ring	Crassostrea	Non-deltaic Pleistocene Barrier Island	3510 +/-50
Beta-21408	St. Catherines Ring	Shell ring	Mercenaria	Non-deltaic Pleistocene Barrier Island	3470 +/-80
UGA-74	Sapelo Shell Rings	Shell ring	Crassostrea	Non-deltaic Pleistocene Barrier Island	3430 +/-70
UGA-73	Sapelo Shell Rings	Shell ring	Crassostrea	Non-deltaic Pleistocene Barrier Island	3430 +/-65
Beta-251769	McQueen Ring	Shell ring	Unknown Shell	Non-deltaic Pleistocene Barrier Island	3490 +/-40
Beta-251762	McQueen Ring	Shell ring	Unknown Shell	Non-deltaic Pleistocene Barrier Island	3420 +/-50
UGA-15084	Sapelo Ring I	Shell ring	Sooted Sherd	Non-deltaic Pleistocene Barrier Island	3480 +/-50
Beta-215822	St. Catherines Ring	Shell ring	Crassostrea	Non-deltaic Pleistocene Barrier Island	3430 +/-50
Beta-238325	McQueen Ring	Shell ring	Unknown Shell	Non-deltaic Pleistocene Barrier Island	3420 +/-50
UGA-15082	Sapelo Ring III	Shell ring	Charcoal	Non-deltaic Pleistocene Barrier Island	3600 +/-50
UGA-226	A. Busch Krick	Shell ring	Conch or Whelk	Non-deltaic Pleistocene Back-barrier	3215 +/-80
UGA-1553	Seaside Mound II	Shell midden	Unknown Shell	Non-deltaic Pleistocene Barrier Island	2650 +/-70
UGA-1552	Seaside Mound II	Shell midden	Crassostrea	Non-deltaic Pleistocene Barrier Island	2340 +/-65
UGA-SC3	Seaside Mound I	Oyster pit	Crassostrea	Non-deltaic Pleistocene Barrier Island	2350 +/-220
UGA-104	Seaside Mound I	Oyster pit	Crassostrea	Non-deltaic Pleistocene Barrier Island	2220 +/-100
Beta-21406	Refuge-Deptford	Shell midden	Mercenaria	Non-deltaic Pleistocene Barrier Island	2470 +/-80
UGA-15081	Southeast of Sapelo Ring I	Non-shell	Charcoal	Non-deltaic Pleistocene Barrier Island	4080 +/-50
Beta-217217	9Li 137 (Fiber temp.)	Non-shell	Mercenaria	Non-deltaic Holocene Beach	3560 +/-70
UGA-1562	Cunningham Mound A	Non-shell	Charcoal	Non-deltaic Pleistocene Barrier Island	3405 +/-80
UGAMS-4501	Patterson Island	Non-shell	Soot on sherd	Non-deltaic Pleistocene Back-barrier	
UGAMS-15933	Kenan Field	Non-shell	Sooted Sherd	Non-deltaic Pleistocene Barrier Island	
UCLA-1997E	McLeod Mound	Non-shell	Charcoal	Non-deltaic Pleistocene Barrier Island	3250 +/-60
Beta-217219	9Li 137 (Fiber temp.)	Non-shell	Mercenaria	Non-deltaic Holocene Beach	3020 +/-70
Beta-217218	9Li 137 (Fiber temp.)	Non-shell	Mercenaria	Non-deltaic Holocene Beach	2970 +/-40
UGA-15087	Southeast of Sapelo Ring I	Non-shell	Charcoal	Non-deltaic Pleistocene Barrier Island	3070 +/-50
Beta-20822	9Li 197 (Fiber temp.)	Non-shell	Mercenaria	Non-deltaic Pleistocene Barrier Island	2850 +/-80
UGA-1686	Cunningham Mound C	Non-shell	Charcoal	Non-deltaic Pleistocene Barrier Island	3010 +/-60
UGA-1254	Cunningham Mound A	Non-shell	Charcoal	Non-deltaic Pleistocene Barrier Island	2965 +/-75
UGA-1255	Cunningham Mound D	Non-shell	Charcoal	Non-deltaic Pleistocene Barrier Island	2805 +/-60
UGA-1557	McLeod Mound	Non-shell	Charcoal	Non-deltaic Pleistocene Barrier Island	2660 +/-60
UGA-1554	McLeod Mound	Non-shell	Mercenaria	Non-deltaic Pleistocene Barrier Island	2370 +/-65
UCLA-1978	Cunningham Mound B	Non-shell	Charcoal	Non-deltaic Pleistocene Barrier Island	2500 +/-60

UGA-1555	McLeod Mound	Non-shell	Mercenaria	Non-deltaic Pleistocene Barrier Island	2285 +/-80
UGA-1253	Cunningham Mound C	Non-shell	Charcoal	Non-deltaic Pleistocene Barrier Island	2375 +/-80
UGA-1689	South New Ground Mound	Non-shell	Charcoal	Non-deltaic Pleistocene Barrier Island	2155 +/-60
UGA-1008	Cunningham Mound B	Non-shell	Charcoal	Non-deltaic Pleistocene Barrier Island	2155 +/-65
UCLA-1997C	Cunningham Mound A	Non-shell	Charcoal	Non-deltaic Pleistocene Barrier Island	2150 +/-60
UGA-3460	South End Mound II	Non-shell	Charcoal	Non-deltaic Pleistocene Barrier Island	2140 +/-170
UGA-1688	South New Ground Mound	Non-shell	Charcoal	Non-deltaic Pleistocene Barrier Island	1890 +/-55
UGA-1007	Cunningham Mound B	Non-shell	Charcoal	Non-deltaic Pleistocene Barrier Island	1865 +/-60
UGA-1560	Cunningham Mound A	Non-shell	Charcoal	Non-deltaic Pleistocene Barrier Island	1855 +/-65
UGA-1684	Cunningham Mound B	Non-shell	Charcoal	Non-deltaic Pleistocene Barrier Island	1845 +/-60
UGA-1256	McLeod Mound	Non-shell	Charcoal	Non-deltaic Pleistocene Barrier Island	1840 +/-65

Table 3
Corrected and calibrated radiocarbon dates.

Lab Code/ ID	$\delta^{13}\text{C}$	Corrected/ Adjusted age BP	2 Sigma Calibrated Date Ranges, BP (with Relative Probabilities)				
			1st Range	2nd Range	3rd Range	4th Range	5th Range
O-1046	-25 +/-2	5550 +/-119	6635-6172 (93.5%)	6156-6108 (3.2%)	6080-6019 (3.3%)		
UM-520	0 +/-2	4597 +/-96	5276-4770 (99.4%)	4746-4731 (0.6%)			
O-1047	-25 +/-2	4125 +/-119	4958-4930 (0.8%)	4887-4291 (99.2%)			
UM-522	0 +/-2	4267 +/-96	4808-4288 (100%)				
UM-521	0 +/-2	4172 +/-96	4711-4126 (100%)				
Beta-MM4	0 +/-2	4107 +/-77	4523-4085 (100%)				
UGAMS-16980	-27 +/-0	3850 +/-30	4407-4363 (13.7%)	4360-4219 (65.5%)	4208-4155 (20.8%)		
Beta-MMbase	0 +/-2	4057 +/-68	4445-4048 (100%)				
M-1111	-25 +/-2	3820 +/-129	4568-4555 (0.4%)	4549-4541 (0.2%)	4537-3844 (99.4%)		
UM-523	0 +/-2	4012 +/-115	4502-3873 (100%)				
Beta-MM5	0 +/-2	3947 +/-77	4343-3879 (100%)				
UGA-10677	-25 +/-2	3730 +/-140	4506-4502 (0.1%)	4500-4485 (0.5%)	4440-3700 (99.4%)		
UGA-10678	-25 +/-2	3720 +/-90	4403-4367 (2%)	4356-4325 (1.9%)	4300-3839 (96%)		
M-1109	-25 +/-2	3700 +/-129	4415-3714 (100%)				
UGA-10676	-25 +/-2	3630 +/-50	4090-3831 (100%)				
UGAMS-16981	-27 +/-0	3600 +/-30	3978-3838 (100%)				
Beta-MMs	0 +/-2	3617 +/-68	3846-3474 (100%)				
NOSAMS-71166	-0.5 +/-0	2720 +/-15	2698-2496 (100%)				
UM-1432	-28.0 +/-0	4951 +/-180	6178-6147 (1%)	6121-5308 (99%)			
UM-1433	-25.5 +/-0	4251 +/-100	5258-5247 (0.3%)	5232-5225 (0.2%)	5214-5189 (0.9%)	5054-4516 (97.7%)	4471-4446 (0.9%)
Beta-3499	-25 +/-2	3600 +/-105	4229-4198 (1.4%)	4180-4168 (0.5%)	4162-3634 (98.1%)		
Beta-4430	-25 +/-2	3380 +/-86	3843-3445 (99.2%)	3424-3409 (0.8%)			
UM-518	-25 +/-2	2785 +/-86	3141-3123 (1.4%)	3113-3093 (1.6%)	3080-2750 (97%)		
UM-1429	-26.9 +/-0	2299 +/-180	2751-1923 (99.7%)	1910-1902 (0.3%)			
Beta-238336	-0.9 +/-0	4390 +/-60	4835-4522 (100%)				
Beta-231335	-2.7 +/-0	4170 +/-40	4528-4263 (100%)				
Beta-215821	-3 +/-0	4140 +/-50	4517-4209 (100%)				
Beta-215824	-3.8 +/-0	4120 +/-60	4506-4152 (100%)				
Beta-231334	-2.2 +/-0	4040 +/-50	4393-4081 (100%)				

Beta-238328	-24.5 +/-0	4120 +/-40	4820-4747 (26.3%)	4743-4734 (1.4%)	4729-4526 (72.3%)		
Beta-239276	-25 +/-0	3930 +/-40	4514-4481 (6.8%)	4445-4242 (93.2%)			
UGA-01425	-25.9 +/-0	3890 +/-60	4512-4482 (2.7%)	4443-4148 (97.1%)	4107-4103 (0.3%)		
Beta-238332	-26 +/-0	3880 +/-40	4419-4225 (92.7%)	4202-4177 (5%)	4172-4159 (2.3%)		
Beta-238324	-0.9 +/-0	4100 +/-60	4492-4136 (100%)				
Beta-238322	-25.7 +/-0	3870 +/-40	4416-4222 (88.6%)	4205-4157 (11.4%)			
Beta-238337	-26.8 +/-0	3860 +/-40	4413-4217 (83.7%)	4209-4155 (16.3%)			
Beta-238327	-24.2 +/-0	3820 +/-40	4405-4367 (5.9%)	4357-4322 (6.5%)	4318-4140 (78.9%)	4129-4091 (8.7%)	
Beta-238331	-25.4 +/-0	3820 +/-40	4405-4367 (5.9%)	4357-4322 (6.5%)	4318-4140 (78.9%)	4129-4091 (8.7%)	
Beta-233130	-0.6 +/-0	4020 +/-60	4396-4027 (99.6%)	4023-4017 (0.4%)			
Beta-251766	-27.5 +/-0	3800 +/-40	4400-4392 (0.6%)	4387-4369 (1.4%)	4354-4327 (2.7%)	4299-4081 (93.5%)	4031-4008 (1.9%)
Beta-244620	-25.3 +/-0	3800 +/-40	4400-4392 (0.6%)	4387-4369 (1.4%)	4354-4327 (2.7%)	4299-4081 (93.5%)	4031-4008 (1.9%)
Beta-238326	-1.3 +/-0	3990 +/-50	4337-3988 (100%)				
Beta-251765	-1 +/-0	3990 +/-50	4337-3988 (100%)				
Beta-229423	-4.1 +/-0	3970 +/-50	4305-3963 (100%)				
Beta-229424	-3.3 +/-0	3960 +/-50	4290-3952 (100%)				
UGA-75	0 +/-2	3952 +/-73	4340-3893 (100%)				
UGA-01424	-26.2 +/-0	3730 +/-70	4345-4334 (0.4%)	4295-3880 (99.6%)			
UGA-15083	-25.5 +/--7	3730 +/-60	4281-4275 (0.3%)	4248-3897 (99.7%)			
UGA-15085	-18.9 +/-98	3730 +/-60	4281-4275 (0.3%)	4248-3897 (99.7%)			
UGA-15086	-25.6 +/--9	3730 +/-50	4237-3962 (97.6%)	3948-3928 (2.4%)			
Beta-251761	-23.9 +/-0	3720 +/-40	4225-4203 (2.4%)	4176-4174 (0.2%)	4158-3964 (95.6%)	3946-3929 (1.9%)	
Beta-251764	-25 +/-0	3710 +/-40	4218-4209 (0.7%)	4155-3958 (95.6%)	3951-3926 (3.7%)		
Beta-251768	-2.4 +/-0	3910 +/-40	4187-3902 (100%)				
Beta-251767	-24.8 +/-0	3680 +/-40	4145-4118 (5.2%)	4096-3897 (94.8%)			
Beta-215823	-2.5 +/-0	3880 +/-50	4156-3844 (100%)				
Beta-21408	-1.7 +/-0	3849 +/-80	4208-3734 (100%)				
UGA-74	0 +/-2	3837 +/-77	4172-3716 (100%)				
UGA-73	0 +/-2	3837 +/-73	4157-3722 (100%)				
Beta-251769	-4.2 +/-0	3830 +/-40	4075-3822 (100%)				
Beta-251762	-0.8 +/-0	3820 +/-50	4085-3772 (100%)				
UGA-15084	-17.0 +/-129	3610 +/-50	4084-3826 (97.3%)	3790-3772 (1.7%)	3744-3731 (1%)		
Beta-215822	-2.6 +/-0	3800 +/-60	4078-3714 (100%)				

Beta-238325	-3.2 +/-0	3780 +/-50	4041-3711 (100%)			
UGA-15082	-27.5 +/-40	3560 +/-50	3978-3703 (100%)			
UGA-226	0 +/-2	3622 +/-86	3894-3444 (100%)			
UGA-1553	0 +/-2	3057 +/-77	3178-2771 (100%)			
UGA-1552	0 +/-2	2747 +/-73	2769-2380 (100%)			
UGA-SC3	0 +/-2	2757 +/-222	3173-2064 (100%)			
UGA-104	0 +/-2	2627 +/-105	2731-2240 (99.8%)	2215-2209 (0.2%)		
Beta-21406	-1.5 +/-0	2850 +/-80	2937-2500 (100%)			
UGA-15081	-26.2 +/-19	4060 +/-50	4809-4757 (12.7%)	4705-4668 (5.4%)	4653-4421 (81.9%)	
Beta-217217	-2 +/-0	3930 +/-80	4325-3849 (100%)			
UGA-1562	-25 +/-2	3405 +/-86	3868-3453 (100%)			
UGAMS-4501	-23.8 +/-0	3330 +/-50	3690-3660 (5.9%)	3648-3451 (94.1%)		
UGAMS-15933	-24.7 +/-0	3270 +/-30	3571-3445 (97.4%)	3424-3409 (2.6%)		
UCLA-1997E	-25 +/-2	3250 +/-68	3638-3350 (100%)			
Beta-217219	-1.1 +/-0	3410 +/-80	3615-3209 (100%)			
Beta-217218	-0.1 +/-0	3380 +/-40	3494-3253 (100%)			
UGA-15087	-25.0 +/-0	3070 +/-50	3388-3156 (99.2%)	3151-3145 (0.5%)	3087-3084 (0.3%)	
Beta-20822	-1.4 +/-0	3240 +/-80	3406-2980 (100%)			
UGA-1686	-25 +/-2	3010 +/-68	3366-2998 (100%)			
UGA-1254	-25 +/-2	2965 +/-82	3357-2924 (99.4%)	2902-2893 (0.6%)		
UGA-1255	-25 +/-2	2805 +/-68	3136-3132 (0.3%)	3104-3097 (0.5%)	3077-2762 (99.2%)	
UGA-1557	-25 +/-2	2660 +/-68	2948-2699 (95.7%)	2632-2617 (1.1%)	2587-2539 (2.9%)	2525-2519 (0.3%)
UGA-1554	0 +/-2	2777 +/-73	2827-2425 (100%)			
UCLA-1978	-25 +/-2	2500 +/-68	2743-2377 (100%)			
UGA-1555	0 +/-2	2692 +/-86	2735-2335 (100%)			
UGA-1253	-25 +/-2	2375 +/-86	2723-2301 (93.8%)	2244-2178 (5.8%)	2168-2162 (0.4%)	
UGA-1689	-25 +/-2	2155 +/-68	2328-1993 (100%)			
UGA-1008	-25 +/-2	2155 +/-73	2336-1988 (99.8%)	1956-1954 (0.2%)		
UCLA-1997C	-25 +/-2	2150 +/-68	2330-1989 (100%)			
UGA-3460	-25 +/-2	2140 +/-173	2698-2633 (2.3%)	2616-2588 (0.9%)	2538-2526 (0.3%)	2517-1711 (96.5%)
UGA-1688	-25 +/-2	1890 +/-64	1988-1696 (98.8%)	1649-1634 (1.2%)		
UGA-1007	-25 +/-2	1865 +/-68	1948-1684 (92.3%)	1679-1618 (7.7%)		
UGA-1560	-25 +/-2	1855 +/-73	1965-1964 (0.1%)	1950-1605 (99.9%)		
UGA-1684	-25 +/-2	1845 +/-68	1928-1608 (100%)			
UGA-1256	-25 +/-2	1840 +/-73	1928-1598 (99.2%)	1583-1571 (0.8%)		

Table 4
Results of the Bayesian analysis of non-deltaic radiocarbon dates.

	Unmodeled (BP)						Modeled (BP)						Indices					
													A _{model} =79.6		A _{overall} =70.8			
	from	to	%	from	to	%	from	to	%	from	to	%	A _{comb}	A	L	P	C	
Non-deltaic																		
Boundary Start							4490	4440	68.2	4570	4420	95.4						99.7
Curve: IntCal13																		
Beta-238328	4810	4560	68.2	4830	4520	95.4	4470	4440	68.2	4560	4410	95.4		17.6				99.9
Beta-239276	4430	4290	68.2	4520	4240	95.4	4430	4290	68.2	4450	4240	95.4		104.5				99.7
Beta-238332	4410	4240	68.2	4420	4150	95.4	4410	4250	68.2	4420	4150	95.4		100.2				99.7
Beta-238322	4410	4240	68.2	4420	4150	95.4	4410	4240	68.2	4420	4150	95.4		100.0				99.7
Beta-238337	4410	4180	68.2	4420	4150	95.4	4410	4180	68.3	4420	4150	95.4		99.8				99.7
Beta-238327	4290	4140	68.2	4410	4090	95.5	4290	4140	68.2	4410	4090	95.4		99.8				99.7
Beta-238331	4290	4140	68.2	4410	4090	95.5	4290	4140	68.2	4410	4090	95.4		100.0				99.6
Beta-251766	4250	4090	68.2	4410	4000	95.3	4250	4090	68.2	4410	4000	95.4		99.9				99.7
Beta-244620	4250	4090	68.2	4410	4000	95.3	4250	4090	68.2	4400	4000	95.4		99.7				99.6
Beta-251761	4150	3980	68.2	4230	3920	95.4	4150	3980	68.2	4230	3930	95.4		100.3				99.7
Beta-251764	4140	3980	68.2	4220	3920	95.4	4140	3980	68.2	4220	3920	95.4		100.4				99.6
Beta-251767	4090	3930	68.2	4150	3890	95.4	4090	3970	68.2	4150	3900	95.4		101.7				99.7
UGA-15085	4220	3980	68.2	4290	3890	95.4	4160	3980	68.2	4280	3900	95.4		101.1				99.7
UGA-15084	3980	3850	68.2	4090	3730	95.5	4070	3880	68.2	4090	3850	95.4		102.5				99.6
UGA-01425	4420	4240	68.2	4520	4100	95.4	4420	4240	68.2	4450	4150	95.4		102.7				99.6
UGA-01424	4230	3970	68.2	4350	3880	95.4	4230	3970	68.2	4350	3890	95.4		101.7				99.7
UGA-15083	4220	3980	68.2	4290	3890	95.4	4160	3980	68.2	4290	3900	95.4		101.2				99.6
UGA-15086	4150	3980	68.2	4240	3920	95.4	4150	3980	68.2	4240	3930	95.4		100.5				99.5
UGA-15082	3960	3730	68.1	3980	3700	95.4	3980	3870	68.2	4080	3830	95.4		83.0				99.5
Curve: Marine13																		
Delta R	-137	-101	68.2	-151	-87	95.4	-149.5	-117	68.2	-165	-100.5	95.4		83.4				99.8
Beta-233130	4300	4090	68.2	4400	4010	95.4	4340	4130	68.2	4410	4050	95.4		99.9				99.6
Beta-229423	4230	4050	68.2	4310	3960	95.4	4240	4070	68.2	4330	3980	95.4		98.8				99.5
Beta-229424	4220	4040	68.2	4300	3950	95.4	4230	4060	68.2	4310	3960	95.4		98.9				99.6
Beta-215823	4090	3920	68.2	4160	3840	95.4	4120	3950	68.2	4190	3880	95.4		100.6				99.7

Beta-21408	4080	3850	68.2	4220	3730	95.4	4100	3900	68.2	4230	3850	95.4	104.4	99.6
Beta-215822	4000	3810	68.2	4080	3710	95.4	4040	3890	68.2	4120	3840	95.4	96.5	99.7
Beta-238324	4410	4220	68.2	4500	4130	95.4	4410	4250	68.2	4470	4150	95.4	104.0	99.7
Beta-238326	4250	4070	68.2	4340	3980	95.4	4270	4090	68.2	4360	4000	95.4	98.7	99.6
Beta-251765	4250	4070	68.2	4340	3980	95.4	4260	4090	68.2	4360	4000	95.4	98.6	99.5
Beta-251768	4120	3970	68.2	4190	3900	95.4	4140	3990	68.2	4220	3930	95.4	97.6	99.6
Beta-251769	4000	3860	68.2	4080	3820	95.4	4050	3910	68.2	4090	3860	95.4	97.8	99.7
Beta-251762	4000	3830	68.2	4090	3770	95.4	4040	3900	68.2	4110	3850	95.4	98.4	99.6
Beta-238325	3970	3800	68.2	4050	3710	95.4	3990	3870	68.2	4070	3840	95.4	87.5	99.6
UGA-75	4220	3990	68.2	4350	3890	95.4	4240	4000	68.2	4360	3920	95.4	100.1	99.7
UGA-74	4070	3840	68.2	4180	3710	95.4	4080	3900	68.2	4210	3850	95.4	103.9	99.6
UGA-73	4070	3850	68.2	4160	3720	95.4	4080	3900	68.2	4190	3850	95.4	103.5	99.6
UGA-226	3800	3560	68.2	3900	3440	95.4	3810	3580	68.2	3920	3460	95.4	6.1	99.2
Boundary End							3930	3830	68.2	3970	3780	95.4		96.9
Span End							530	650	68.2	480	740	95.4		99.1

Table 5
Results of the Bayesian analysis of deltaic radiocarbon dates.

	Unmodeled (BP)						Modeled (BP)						Indices					
	from	to	%	from	to	%	from	to	%	from	to	%	A _{model} =87.8	A _{overall} =87.1				
													A _{comb}	A	L	P	C	
Deltaic																		
Boundary Start							5090	4690	68.2	5320	4540	95.4						95.7
Curve: IntCal13																		
UGA-10678	4230	3920	68.2	4410	3840	95.3	4230	3920	68.3	4410	3840	95.4			100.4			99.4
UGA-10676	4070	3870	68.2	4090	3830	95.4	4070	3870	68.2	4090	3830	95.4			100.6			99.6
UGAMS-16980	4390	4150	68.2	4410	4150	95.4	4390	4160	68.2	4410	4150	95.4			99.4			99.7
UGAMS-16981	3970	3860	68.2	3980	3830	95.4	3970	3860	68.2	3980	3830	95.4			100.3			99.8
Curve: Marine13																		
Delta R	-137	-101	68.2	-151	-87	95.4	-135.5	-102	68.2	-151.5	-86	95.4			100.0			99.8
Beta-MM4	4430	4200	68.2	4530	4080	95.4	4430	4200	68.2	4530	4080	95.4			100.1			99.4
Beta-MMbase	4370	4150	68.2	4450	4050	95.4	4370	4150	68.2	4450	4050	95.4			100.0			99.4
Beta-MM5	4220	3980	68.2	4350	3880	95.4	4220	3970	68.2	4350	3880	95.4			100.1			99.5
Beta-MMs	3770	3560	68.2	3850	3470	95.4	3850	3650	68.2	3930	3550	95.4			81.9			99
UM-520	5120	4820	68.2	5280	4730	95.4	4970	4620	68.2	5080	4510	95.4			73.2			98.6
UM-521	4550	4260	68.2	4720	4130	95.4	4550	4260	68.2	4700	4120	95.4			100.8			99.4
UM-522	4690	4400	68.2	4810	4280	95.4	4680	4400	68.2	4800	4280	95.4			101.5			99.3
Boundary End							3820	3550	68.2	3910	3310	95.4						96.9
Span							980	1520	68.2	750	1870	95.4						96.4

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Figure Captions

Fig. 1. Georgia coastal zone study area, with environmental habitats.

Fig. 2. Late Archaic site types.

Fig. 3. Radiocarbon date ranges for the Late Archaic and Early Woodland periods.

Fig. 4. Bayesian modeled start and end dates for deltaic areas.

Fig. 5. Bayesian modeled start and end dates for non-deltaic areas.

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5